Board of Building Standards

ELECTRICAL SAFETY INSPECTOR ADVISORY COMMITTEE
REQUEST FOR RECOMMENDATIONS

DATE: NOVEMBER 09, 2023
TIME: 10:00 AM
LOCATION: NO MEETING THIS MONTH

Personnel Certification Applications

P-1 Camuso, Daniel - ESI
Certification ID: 9231
Current certifications: none
Staff notes- Holds OCILB Electrical Contractor's license, appears to meet requirements. Recommend approval.
ESIAC Recommendations:
Committee Recommendation:

P-2 Greve, Lucas - ESI
Certification ID: 9230
Current certifications: None
Staff notes- Holds OCILB Electrical Contractor's license, appears to meet requirements. Recommend approval.
ESIAC Recommendations:
Committee Recommendation:

P-3 Landoll, Patrick - ESI
Certification ID: 9242
Current certifications: None
Staff notes- Holds OCILB Electrical Contractor's license, appears to meet requirements. Recommend approval.
ESIAC Recommendations:
Committee Recommendation:

P-4 Noble, Nels - ESI, EPE, RBI
Certification ID: 9229
Current certifications: None
Staff notes-IBEW Hall since 2014. Appears to meet requirements, recommend approval for ESI, RBI.
ESIAC Recommendations:
Committee Recommendation:

P-5 Rudyak, Andriy - ESI
Certification ID: 9196
Current certifications: None
Staff notes- Holds OCILB Electrical Contractor's license, appears to meet requirements. Recommend approval.
ESIAC Recommendations:
Committee Recommendation:

Continuing Education Applications for Review

ER-1 2023 NEC Updates (IAEI Northwest)
All certifications (24 hours in twelve sessions)
Staff Notes: Slide sets 1 and 2 are 2020 NEC Analysis of changes, 3 and 4 are 2023.
ESIAC Recommendation:
Committee Recommendation:

ER-2 Electrical Safety Inspector Training and Updated 2023 NEC (Sonnenstein Training Agency)
All certifications (25 hours in five sessions)
Staff Notes: There is no slide presentation, only the book. "Students are required to bring their own code book and follow along our screen presentation. It is a lecture presentation with plenty of open discussion and questions."
ESIAC Recommendation:
Committee Recommendation:

ER-3 Significant Changes to the 2023 NEC Part A (Electrical Trades Center)
All certifications (10 hours in three sessions: 3.5 + 3.5 + 3)
Staff Notes: Recommend approval.
ESIAC Recommendation:
Committee Recommendation:

ER-4 Significant Changes to the 2023 NEC Part B (Electrical Trades Center)
All certifications (10 hours in three sessions: 3.5 + 3.5 + 3)
Staff Notes:
ESIAC Recommendation:
Committee Recommendation:

ER-5 Transformers 2023 NEC Article 450 (Ohio Certificate Renewal)
All certifications (4 hours)
Staff Notes: Recommend approval.
ESIAC Recommendation:
Committee Recommendation:

ER-6 Analysis of 2023 NEC Code Changes Part 1 (Central Electric Inspection Bureau)
All certifications (5 hours)
Staff Notes: For 2023 and 2024 presentation. Recommend approval.
ESIAC Recommendation:
Committee Recommendation:

ER-7 Analysis of 2023 NEC Code Changes Part 2 (Central Electric Inspection Bureau)
All certifications (5 hours)
Staff Notes: For 2023 and 2024 presentation. Recommend approval.
ESIAC Recommendation:
Committee Recommendation:

Old Business

New Business

NB-1 City of Columbus ESI Trainee Alternative Program Proposal
The City of Columbus has been working to develop trainee programs to build their code administration team from the ground up.
The plan submitted is a structured trainee program incorporating observation, classroom instruction, and supervised practical learning.
ESIAC Comments:
Committee Recommendation:

File Attachments for Item:

P-1 Camuso, Daniel - ESI

Certification ID: 9231

Current certifications: none

Staff notes- OCILB Electrical Contractor, appears to meet requirements. Recommend approval.

ESIAC Recommendations:

Committee Recommendation:

Camuso | Daniel | _____

Last Name | *First Name* | *BBS Certification ID*

SECTION 1: CHECK INTERIM CERTIFICATION(S) BEING REQUESTED

☐ Building Official	☐ Master Plans Examiner	☐ Building Inspector	■ Electrical Safety Inspector	☐ Fire Protection Inspector
☐ Building Plans Examiner	☐ Plumbing Plans Examiner	☐ Mechanical Plans Examiner	☐ Electrical Plans Examiner	☐ Fire Protection Plans Examiner
	☐ Plumbing Inspector	☐ Mechanical Inspector	☐ Non-Residential Industrial Unit Inspector	

SECTION 2: LIST ANY OHIO LICENSE, CERTIFICATE, OR REGISTRATION HELD

(Mark "T" If Trainee)

Description			Certificate Number	Date Received
Architectural Registration				
P.E. Registration				
Res	Non-Res			
☐	☐	Building Official Certification		
☐	☐	Plans Examiner Certification		
☐	☐	Building Inspector Certification		
☐	☐	Mechanical Inspector Certification		
Building Plans Examiner Certification				
Mechanical Plans Examiner Certification				
Fire Protection Plans Examiner Certification				
Electrical Plans Examiner Certification				
Plumbing Plans Examiner Certification				
Fire Protection Inspector Certification				
Electrical Safety Inspector Certification				
Plumbing Inspector Certification				
Fire Safety Inspector Certification				
Fire Protection System Designer Certification				
Medical Gas Piping Inspector Certification				

Camuso	Daniel	
Last Name	*First Name*	*BBS Certification ID*

SECTION 3: EMPLOYMENT/EDUCATION

Formal Education	Date Graduated
Hubbard High School	1977
Hubbard, OH	
Related Vocational or Technical Training	Years' Experience
U.S. Military construction experience (MOS or other designation):	Years' Experience
Place of Employment:	Years' Employed
SMAJ Inc dba Camuso Electric	27
F.O. Electric, LLC	3

SECTION 4: APPLICANTS REQUESTING MEDICAL GAS INSPECTOR CERTIFICATION

Attach proof *of certification by an ASSE recognized third-party certifier in accordance with ASSE standard 6020.*

SECTION 5: OBC BUILDING INSPECTION EXPERIENCE PERFORMED FOR A BBS CERTIFIED BUILDING DEPARTMENT

BBS Certified Building Department	BBS Certified Position/Title	Duties	Date of Service, Length of Time (MM/DD/YY)

Camuso	Daniel	
Last Name	*First Name*	*BBS Certification ID*

SECTION 6: ELECTRICAL SAFETY INSPECTOR (ESI) - SPECIFIC EXPERIENCE QUALIFICATIONS

Applicants for Electrical Safety Inspector Only Must Complete This Item

Section 3783 of the Ohio Revised Code specifies that an applicant for a Certificate of Competency as an Electrical Safety Inspector must meet on of the following to qualify to take required examination. Please check the qualification that applies:

1. ☐ Have been a journeyman electrician or equivalent for four years, two of which were as an electrician foreman, and have had two years' experience as a building department electrical inspector trainee;
2. ☐ Have been a journeyman electrician or equivalent for four years and have had three years' experience as a building department electrical inspector trainee;
3. ☐ Have had for four years' experience as a building department electrical inspector trainee;
4. ■ Have been a journeyman electrician or equivalent for six years;
5. ☐ Am a graduate electrical engineer and registered in the State of Ohio. Registration number: _____
6. ☐ Applicant authorizes all testing organizations including ICC to provide test results to the BBS.

SECTION 7: EXPERIENCE *(DO NOT SUBSTITUTE WITH OTHER RESUMES).*

Refer to Experience Requirements Listed in O.A.C. 4101:7-3-01 and O.R.C. 3783

Below, list the specific projects you worked on, and the specific work you performed, your typical duties for each project, and dates of this work. You **must** demonstrate that you have the required number of months (years) of actual, practical experience for the certification requested (see matrix).

Provide letters from certified inspectors, employers, or contractors verifying your experience. Submit copies of any certificates, diplomas, or licenses. Remove all personal information.

SECTION 7 CONT.: EXPERIENCE

List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
Example: *Children's Hospital, Toledo* *Structural steel work on addition*	*Homer Steel and Trade* *125 Anytown Street* *My City, OH, 45454* *(419)555-1212*	*July 2013-May 2014* *(10 months)*
Total Experience on This Page (In Months):		

Camuso *Last Name* | Daniel *First Name* | *BBS Certification ID*

List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
Wiring of new homes and additions	Dibo Construction 7110 Garden Place, Poland, Ohio 44514 Antoin (330) 565-5857	02/12 - 10/23
Wiring of new homes and additions	Greenheart Companies 6001 Southern Blvd STE 105, Youngstown, OH 44512 Brian Angellili (412) 973-0117	06/15 - 10/23
Wiring of new homes and additions	Great Improvements 218 S High St, Cortland, OH 44410 Lee Mellot (330) 503-6705	11/16 - 10/23
Rewiring of Norton Manor, Youngstown, OH 109 room high rise senior apartments	Vendrick Construction 367 Collar Price Rd, Brookfield Center, OH 44403 Rick Dickson (330) 509-3222	10/15 - 06/16
Wiring of various Family Dollar stores	Metro Remodellers 772 Squirrel Hill Cr., Boardman, OH 44505 Jack Zaku (330) 207-4911	04/10 - 07/17
	Total Experience on This Page (In Months):	406

Camuso | Daniel | _____
Last Name | *First Name* | *BBS Certification ID*

SECTION 8: PERSONAL HISTORY

1. Have you ever been convicted of any felony, or any crime involving moral turpitude? ☐ Yes ☐ No

   If you answered "Yes" please explain below:
2. Have you served in the U.S. armed services? (If No, skip question 3) ☐ Yes ■ No
3. If YES, were you discharged under honorable conditions? ☐ Yes ☐ No

   If you answered "No" please explain below:

SECTION 9: CERTIFICATION

I certify the information contained in this application is true and complete, and I understand that providing false information may be grounds for not granting certification or for immediate termination of certification at any point in the future, if granted. I authorize the investigation of all statements contained herein and release all parties from all liability for any damage that may result from furnishing the same to Ohio Board of Building Standards. Falsification is a violation of section 2921.13 of the Ohio Revised Code and is punishable as a misdemeanor of the first degree.

Signature of Applicant: _____

Subscribed and duly sworn before me according to law, by the above named applicant this day 17th of October in the year 2023 at Girard, County of Trumbull and State of OH

Notary Public: _____

SHALYN KAY - NOTARY PUBLIC STATE OF OHIO COMM EXP: JUN 23, 2025

SHALYN KAY - NOTARY PUBLIC STATE OF OHIO COMM EXP: JUN 23, 2025

Department of Commerce

Division of Industrial Compliance
Ohio Constructions Industry
Licensing Board O.C.I.L.B

Mike DeWine
Sheryl Maxfield

CAMUSO, DANIEL A

[redacted]

Mike DeWine
Governor

Sheryl Maxfield
Director

Electrical
CONTRACTOR'S LICENSE

Ohio License # 23960 Expiration Date: 12/31/2025

DANIEL A CAMUSO
FO ELECTRIC LLC
EMPLOYEE

Carol A. Ross
Board Secretary

William Koester
Administrative Chairperson

This is YOUR license. Plan Approvals obtained with YOUR license and posting of YOUR license indicates that YOU and YOUR liability insurance are assuming all responsibility for any projects performed under this license.

Mike DeWine
Governor

Sheryl Maxfield
Director

LICENSE MUST BE POSTED ON JOB SITE

LICENSE MUST BE POSTED ON JOB SITE

OHIO CONSTRUCTION INDUSTRY LICENSING BOARD

STATE OF OHIO

Electrical

CONTRACTOR'S LICENSE

DANIEL A CAMUSO

FO ELECTRIC LLC

EMPLOYEE

Ohio License# 23960

Expiration Date: December 31, 2025

Carol A. Ross
Board Secretary

William Koester
Administrative Chairperson

File Attachments for Item:

P-2 Greve, Lucas - ESI

Certification ID: 9230

Current certifications: None

Staff notes- Holds OCILB Electrical contractor license, appears to meet requirements. Recommend approval.

ESIAC Recommendations:

Committee Recommendation:

Board of Building Standards Application for Interim Certification, Building Department Personnel

Greve — Last Name
Lucas — First Name
BBS Certification ID

SECTION 1: CHECK INTERIM CERTIFICATION(S) BEING REQUESTED

☐ Building Official	☐ Master Plans Examiner	☐ Building Inspector	☒ Electrical Safety Inspector	☐ Fire Protection Inspector
☐ Building Plans Examiner	☐ Plumbing Plans Examiner	☐ Mechanical Plans Examiner	☐ Electrical Plans Examiner	☐ Fire Protection Plans Examiner
	☐ Plumbing Inspector	☐ Mechanical Inspector	☐ Non-Residential Industrial Unit Inspector	

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Description			Certificate Number	Date Received
Architectural Registration				
P.E. Registration				
Res	Non-Res			
☐	☐	Building Official Certification		
☐	☐	Plans Examiner Certification		
☐	☐	Building Inspector Certification		
☐	☐	Mechanical Inspector Certification		
Building Plans Examiner Certification				
Mechanical Plans Examiner Certification				
Fire Protection Plans Examiner Certification				
Electrical Plans Examiner Certification				
Plumbing Plans Examiner Certification				
Fire Protection Inspector Certification				
Electrical Safety Inspector Certification				
Plumbing Inspector Certification				
Fire Safety Inspector Certification				
Fire Protection System Designer Certification				
Medical Gas Piping Inspector Certification				

Greve	Lucas	
Last Name	*First Name*	*BBS Certification ID*

SECTION 3: EMPLOYMENT/EDUCATION

Formal Education	Date Graduated
Botkins High School	5/1999
Related Vocational or Technical Training	**Years' Experience**
Appollo / ABC Apprentice	4 years
U.S. Military construction experience (MOS or other designation):	**Years' Experience**
Place of Employment:	**Years' Employed**
Greve Electric	13
Lucas J Greve Electric (owner)	13

SECTION 4: APPLICANTS REQUESTING MEDICAL GAS INSPECTOR CERTIFICATION

Attach proof *of certification by an ASSE recognized third-party certifier in accordance with ASSE standard 6020.*

SECTION 5: OBC BUILDING INSPECTION EXPERIENCE PERFORMED FOR A BBS CERTIFIED BUILDING DEPARTMENT

BBS Certified Building Department	BBS Certified Position/Title	Duties	Date of Service, Length of Time (MM/DD/YY)

Greene | Lucas S | _____
Last Name | First Name | BBS Certification ID

SECTION 6: ELECTRICAL SAFETY INSPECTOR (ESI) - SPECIFIC EXPERIENCE QUALIFICATIONS
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Section 3783 of the Ohio Revised Code specifies that an applicant for a Certificate of Competency as an Electrical Safety Inspector must meet on of the following to qualify to take required examination. Please check the qualification that applies:

1. ☐ Have been a journeyman electrician or equivalent for four years, two of which were as an electrician foreman, and have had two years' experience as a building department electrical inspector trainee;
2. ☐ Have been a journeyman electrician or equivalent for four years and have had three years' experience as a building department electrical inspector trainee;
3. ☐ Have had for four years' experience as a building department electrical inspector trainee;
4. ☒ Have been a journeyman electrician or equivalent for six years;
5. ☐ Am a graduate electrical engineer and registered in the State of Ohio. Registration number: _____
6. ☐ Applicant authorizes all testing organizations including ICC to provide test results to the BBS.

SECTION 7: EXPERIENCE *(DO NOT SUBSTITUTE WITH OTHER RESUMES)*.
Refer to Experience Requirements Listed in O.A.C. 4101:7-3-01 and O.R.C. 3783
Below, list the specific projects you worked on, and the specific work you performed, your typical duties for each project, and dates of this work. You **must** demonstrate that you have the required number of months (years) of actual, practical experience for the certification requested (see matrix).
Provide letters from certified inspectors, employers, or contractors verifying your experience. Submit copies of any certificates, diplomas, or licenses. Remove all personal information.

SECTION 7 CONT.: EXPERIENCE

List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
Example: *Children's Hospital, Toledo* *Structural steel work on addition*	*Homer Steel and Trade* *125 Anytown Street* *My City, OH, 45454* *(419)555-1212*	*July 2013-May 2014* *(10 months)*
Boat warehouse, Russells Point OH Electric foreman, owner	Lucas J Greene Electric+Plumbing Botkins OH 45306 937-693-6638	June 2014 to Sept 2014 3 months
Precison Detail Machine - Jackson Center OH - Electric Foreman, Design, owner 2000 Amp Service Install -	Lucas J Greene Electric+Plumbing Botkins OH 45306 937-693-6638	April 2017 to July 2017 4 Months
Total Experience on This Page (In Months):		7 Months

Board of Building Standards Application for Interim Certification, Building Department Personnel

Grace | Lucas |
Last Name | *First Name* | *BBS Certification ID*

List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
Hickory Medical center Electric Forman - Bellefountaine OH	Lucas S Graven Electric + Plumbing 103 E walnut St. Botkins OH 937-693-6838	Sept 2015 - April 2016 - 8 Months
The Poppy Seed Store - Bellefountaine OH Electric Forman -	" "	March - 2016 - July - 2016 - 6 months
city Sweets + Creamery - Bel. OH. Electric Forman -	" "	Sept 2013 - Dec 2013 - 4 months
Landing Tavern Russells Point OH Electric, Forman -	" "	Feb 2018 June 2018 5 months
Sign Solutions Lima OH Elect, Forman	"	April 2019 Sept 2019 6 months
Arrowhead campground Exp - Wapak OH - Services, Forman, underground	" "	March 2021 - July 2021 - 5 months
Briarwood Hunting Lodge Bel OH - Electric, Forman	"	10-2022 - 3-2023 - 7 months
HoyPT Botkins OH Electric, Forman.	" "	6-2023 to Present 4 months and counting
Several Speedway's Remodels		No info
	Total Experience on This Page (In Months):	45 months

15

Greene | Lucas | _____
Last Name | First Name | BBS Certification ID

SECTION 8: PERSONAL HISTORY

1. Have you ever been convicted of any felony, or any crime involving moral turpitude? ☐ Yes ☒ No

   If you answered "Yes" please explain below:
2. Have you served in the U.S. armed services? (If No, skip question 3) ☐ Yes ☒ No
3. If YES, were you discharged under honorable conditions? ☐ Yes ☐ No

   If you answered "No" please explain below:

SECTION 9: CERTIFICATION

I certify the information contained in this application is true and complete, and I understand that providing false information may be grounds for not granting certification or for immediate termination of certification at any point in the future, if granted. I authorize the investigation of all statements contained herein and release all parties from all liability for any damage that may result from furnishing the same to Ohio Board of Building Standards. Falsification is a violation of section 2921.13 of the Ohio Revised Code and is punishable as a misdemeanor of the first degree.

Signature of Applicant: [signature]

Subscribed and duly sworn before me according to law, by the above named applicant this day 12 of October in the year 2023 at U.S. Bank, County of Shelby and State of Ohio

Notary Public: [signature]

AMANDA GILLEM - NOTARY PUBLIC
COMM EXP: MAR 13, 2027
STATE OF OHIO

Any changes in information must be submitted within 30 days to:

Bureau of Testing & Registration
PO BOX 529
Reynoldsburg, Ohio 43068
614-752-7126
614-995-4206 (fax)
webfmtr@com.state.oh.us

This license shall be carried on your person while performing the listed activities.

State of Ohio
Department of Commerce
Division of State Fire Marshal

FIRE PROTECTION LICENSE
LUCAS GREVE
54.75.1127
Expiration Date: 01/03/2025

Signature _____
This card shall be on your person while performing listed activities.

Ohio Department of Commerce
Division of State Fire Marshal
Bureau of Testing & Registration
8895 E Main Street, PO Box 529
Reynoldsburg, Ohio 43068

LUCAS GREVE
PO BOX 166
BOTKINS, OH 453060166

Any changes in information must be submitted within 30 days to:

Bureau of Testing & Registration
PO BOX 529
Reynoldsburg, Ohio 43068
614-752-7126
614-995-4206 (fax)
webfmtr@com.state.oh.us

Mike DeWine
Governor

State of Ohio
Department of Commerce
Division of State Fire Marshal

Sheryl Maxfield
Director

2023 Fire Protection Company Annual Certificate

This is to certify that the company listed below meets the requirements of Ohio Revised Code 3737.65 for servicing, testing, repairing, or installing fire protection or firefighting equipment in the State of Ohio.

53.75.1008
GREVE ELECTRICAL & PLUMBING
PO BOX 420
103 E WALNUT
BOTKINS, OH 453060420

Expiration Date: 07/01/2024

Ohio Department of Commerce
Division of State Fire Marshal
Bureau of Testing & Registration
8895 E Main Street, PO Box 529
Reynoldsburg, Ohio 43068

GREVE ELECTRICAL & PLUMBING
PO BOX 420
103 E WALNUT
BOTKINS, OH 453060420

Department of Commerce

Division of Industrial Compliance
Ohio Constructions Industry
Licensing Board O.C.I.L.B.

Mike DeWine
Sheryl Maxfield

GREVE, LUCAS J.
103 E Walnut St
Botkins, OH 45306-8008

Mike DeWine
Governor

Sheryl Maxfield
Director

Electrical
CONTRACTOR'S LICENSE

Ohio License #: 38294 Expiration Date: 09/13/2024

LUCAS J. GREVE

LUCAS J GREVE ELECTRICAL & PLUMBING LLC.

OWNER

Carol A. Ross
Board Secretary

William Koester
Administrative Chairperson

This is YOUR license. Plan Approvals obtained with YOUR license and posting of YOUR license indicates that YOU and YOUR liability insurance are assuming all responsibility for any projects performed under this license.

Mike DeWine
Governor

Sheryl Maxfield
Director

LICENSE MUST BE POSTED ON JOB SITE

OHIO CONSTRUCTION INDUSTRY LICENSING BOARD

Electrical

CONTRACTOR'S LICENSE

LUCAS J. GREVE

LUCAS J GREVE ELECTRICAL & PLUMBING LLC.

OWNER

Ohio License#: 38294

Expiration Date: September 13, 2024

STATE OF OHIO

LICENSE MUST BE POSTED ON JOB SITE

Carol A. Ross
Board Secretary

William Koester
Administrative Chairperson

DIC 3530 Rev 3/2020

THE CITY OF LIMA OHIO
STATE OF OHIO

$0.00 NUMBER: 00981E

In consideration of the sum of $0.00 Dollars

The receipt whereof is hereby acknowledged, grants this

ELECTRICAL JOURNEYMAN LICENSE

To continue in effect until : 12/31/2023 (UNLESS SOONER REVOKED FOR CAUSE BY GRANTING OFFICIAL)

Unto: LUCAS J GREVE 415 E SOUTH ST PO BOX 166 BOTKINS, OH 45306-0166

RENEW AS AN ELECTRICAL CONTRACTOR & JOURNEYMAN FOR 2023

In the City of Lima, subject to all Ordinances, Rules, Regulations pertaining to this subject, nor or hereafter passed by the City Council of Lima or by any official empowered to issue such regulations

IN WITNESS WHEREOF the Mayor and License Clerk of the City of Lima, in accordance with the Charter and Ordinances of the City of Lima, Have hereunto subscribed their name and seal of said city this: 11/22/2022

LIMA OHIO 1831

Chris Pailette, License Clerk

, Mayor

(This license must be framed and kept in view when possible)

This to Certify
That the Bearer

LUCAS J GREVE 00981E

Has passed the necessary examinations and requirements entitling him to be employed in the City of Lima, Ohio as an Electrical Journeyman subject to the conditions as specified in Chapter 1468 of the Codified Ordinances of the City of Lima, Ohio.

Auth. By: Chris Pailette

Expires: 12/31/2023

The Lima / Allen County Building Department
50 Town Square, Lima, OH 45801

NUMBER: 21419

Be it known that: LUCAS J. GREVE ELECTRICAL & PLUMBING LLC

PO BOX 420, 103 E WALNUT ST

BOTKINS, OH 45306

Having qualified as required by law is dully registered and hereby authorized by the Lima / Allen County Building Department as:

REGISTERED ELECTRICAL CONTRACTOR

LIMA OHIO

under the condition of continued compliance in all respects with the regulations and procedures which have been or may hereafter be adopted by the Lima / Allen County Building Department, Lima, Ohio.

Registration Issued this date: 11/22/2022

Registration Expires this date: 12/31/2023

Chief Building Official / Building Commissioner

This Registration is not transferable and is subject to revocation.

LIMA ALLEN COUNTY

Lima / Allen County
Building Department
Contractor Registration

LUCAS J. GREVE ELECTRICAL & PLUMBING LLC

No: 21419 Expires: 12/31/2023

Chief Building Official / Building Commissioner

Ohio Board of Building Standards

To whom it Concerns

I Lucas J Greve am submitting a application for the ESI exam. Along with the application I have attached copies of my Licenses. The Sec 7 Experience sec. I was able to list the projects since I Purchased the Company back in 2011. But there were many other projects I ran before I became owner. I have had My state Electric License #38294 since 2005, and My City of Lima Electric License since 2001, along with fire alarm lic through the state

Reference – Joe Kipp Logan county Elect. Inspector 937-489-7759

I would Like to thank You for your Time, and Reviewing my application

Lucas J. Greve

File Attachments for Item:

P-3 Landoll, Patrick - ESI

Certification ID: 9242

Current certifications: None

Staff notes- Holds OCILB Electrical Contractor's license, appears to meet requirements. Recommend approval.

ESIAC Recommendations:

Committee Recommendation:

Board of Building Standards Application for Interim Certification, Building Department Personnel

Landoll	Patrick	EL45995
Last Name	*First Name*	*BBS Certification ID*

SECTION 1: CHECK INTERIM CERTIFICATION(S) BEING REQUESTED

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☐ Building Plans Examiner	☐ Plumbing Plans Examiner	☐ Mechanical Plans Examiner	☐ Electrical Plans Examiner	☐ Fire Protection Plans Examiner
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(Mark "T" If Trainee)

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☐	☐	Building Inspector Certification		
☐	☐	Mechanical Inspector Certification		
Building Plans Examiner Certification				
Mechanical Plans Examiner Certification				
Fire Protection Plans Examiner Certification				
Electrical Plans Examiner Certification				
Plumbing Plans Examiner Certification				
Fire Protection Inspector Certification				
Electrical Safety Inspector Certification				
Plumbing Inspector Certification				
Fire Safety Inspector Certification				
Fire Protection System Designer Certification				
Medical Gas Piping Inspector Certification				

Landoll	Patrick	EL45995
Last Name	*First Name*	*BBS Certification ID*

SECTION 3: EMPLOYMENT/EDUCATION

Formal Education	Date Graduated
Milan Edison Schools	1984
University of Cincinnati	2000
Related Vocational or Technical Training	**Years' Experience**
Lincoln Electric Welding School	2003
RSES HVAV/Refrigeration School	2016
U.S. Military construction experience (MOS or other designation):	Years' Experience
Place of Employment:	Years' Employed
Landoll Restoration Inc. (self employed)	30

SECTION 4: APPLICANTS REQUESTING MEDICAL GAS INSPECTOR CERTIFICATION

Attach proof *of certification by an ASSE recognized third-party certifier in accordance with ASSE standard 6020.*

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BBS Certified Building Department	BBS Certified Position/Title	Duties	Date of Service, Length of Time (MM/DD/YY)

Landoll	Patrick	EL45995
Last Name	*First Name*	*BBS Certification ID*

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3. ☐ Have had for four years' experience as a building department electrical inspector trainee;
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SECTION 7: EXPERIENCE ***(DO NOT SUBSTITUTE WITH OTHER RESUMES).***
Refer to Experience Requirements Listed in O.A.C 4101:7-3-01 and O.R.C. 3783
Below, list the specific projects you worked on, and the specific work you performed, your typical duties for each project, and dates of this work. You **must** demonstrate that you have the required number of months (years) of actual practical experience for the certification requested (see matrix).
Provide letters from certified inspectors, employers, or contractors verifying your experience. Submit copies of any certificates, diplomas, or licenses. Remove all personal information.

SECTION 7 CONT.: EXPERIENCE

List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
Example: *Children's Hospital, Toledo* *Structural steel work on addition*	*Horner Steel and Trade* *125 Anytown Street* *My City, OH, 45454* *(419)555-1212*	*July 2013-May 2014* *(10 months)*
Too Many to list: I have been a self employed licensed electrician in the state since 2006. I have done hundreds of projects both residential and commercial. I have a job offer in Perkins Township in northern Ohio once my requirements are met. I have another job opportunity in for Huron Township in Northern Ohio as well.	Landoll Restoration, Inc 834 Van Dyke Ave. Cincinnati, OH 45226 513-205-5191 12515 RIVER ROAD MILAN, OH 44846 (513) 205-5191 (CURRENT)	
Total Experience on This Page (In Months):		2006-2023

Landoll	Patrick	EL45995
Last Name	*First Name*	*BBS Certification ID*

List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
See previous page		
	Total Experience on This Page (In Months):	

Landoll	Patrick	EL45995
Last Name	*First Name*	*BBS Certification ID*

SECTION 8: PERSONAL HISTORY

1. Have you ever been convicted of any felony, or any crime involving moral turpitude? ☐ Yes ■ No

   If you answered "Yes" please explain below:
2. Have you served in the U.S. armed services? (If No, skip question 3) ☐ Yes ■ No
3. If YES, were you discharged under honorable conditions? ☐ Yes ☐ No

   If you answered "No" please explain below:

SECTION 9: CERTIFICATION

I certify the information contained in this application is true and complete, and I understand that providing false information may be grounds for not granting certification or for immediate termination of certification at any point in the future. if granted. I authorize the investigation of all statements contained herein and release all parties from all liability for any damage that may result from furnishing the same to Ohio Board of Building Standards. Falsification is a violation of section 2921.13 of the Ohio Revised Code and is punishable as a misdemeanor of the first degree.

Signature of Applicant: Patrick G. Landoll

Subscribed and duly sworn before me according to law, by the above named applicant this day 30th of October in the year 2023 at Cryogen Colonial Bank County of Erie and State of Ohio.

Notary Public: Danielle Jolene Sengstock

SEAL

NOTARY PUBLIC STATE OF OHIO

DANIELLE JOLENE SENGSTOCK
Notary Public, State of Ohio
My Commission Expires 2/3/27

Ohio Department Commerce - OCILB OCILB - Ohio Construction Industry Licensing Board

Lookup Detail View

Name and Address

Name	Mail Address	Public Address
PATRICK A LANDOLL	834 Van Dyke Ave Cincinnati, OH 45226-1215	834 Van Dyke Ave Cincinnati, OH 45226-1215

Registration Information

Credential	License Type	Issue Date	Expiration Date	Status	Reason	Company
EL.45995	Electrical	03/31/2023	03/30/2024	ACTIVE	ACTIVE	LANDOLL RESTORATION INC

Renewal Requirements

Formatted Credential	CE Requirements Completed	Estimated Amount Due
EL.45995	No	$0.00

Generated on: 11/2/2023 12:48:12 PM

File Attachments for Item:

P-4 Noble, Nels - ESI, EPE, RBI

Certification ID: 9229

Current certifications: None

Staff notes-IBEW Hall since 2014. Appears to meet requirements, recommend approval for ESI, RBI.

ESIAC Recommendations:

Committee Recommendation:

Board of Building Standards Application for Interim Certification, Building Department Personnel

Noble	Nels	
Last Name	*First Name*	*BBS Certification ID*

SECTION 1: CHECK INTERIM CERTIFICATION(S) BEING REQUESTED

☐ Building Official	☐ Master Plans Examiner	☐ Building Inspector	☑ Electrical Safety Inspector	☐ Fire Protection Inspector
☐ Building Plans Examiner	☐ Plumbing Plans Examiner	☐ Mechanical Plans Examiner	☑ Electrical Plans Examiner	☐ Fire Protection Plans Examiner
	☐ Plumbing Inspector	☐ Mechanical Inspector	☐ Non-Residential Industrial Unit Inspector	

SECTION 2: LIST ANY OHIO LICENSE, CERTIFICATE, OR REGISTRATION HELD
(Mark "T" If Trainee)

Description			Certificate Number	Date Received
Architectural Registration				
P.E. Registration				
Res	Non-Res			
☐	☐	Building Official Certification		
☐	☐	Plans Examiner Certification		
☐	☐	Building Inspector Certification		
☐	☐	Mechanical Inspector Certification		
Building Plans Examiner Certification				
Mechanical Plans Examiner Certification				
Fire Protection Plans Examiner Certification				
Electrical Plans Examiner Certification				
Plumbing Plans Examiner Certification				
Fire Protection Inspector Certification				
Electrical Safety Inspector Certification				
Plumbing Inspector Certification				
Fire Safety Inspector Certification				
Fire Protection System Designer Certification				
Medical Gas Piping Inspector Certification				

Nobe — *Last Name*

Nels — *First Name*

BBS Certification ID

SECTION 3: EMPLOYMENT/EDUCATION

Formal Education	Date Graduated
Tonawanda High School	2007
Art Institute (Cincinnati)	2011
Related Vocational or Technical Training	**Years' Experience**
NJATC / IBEW	8
U.S. Military construction experience (MOS or other designation):	**Years' Experience**
Place of Employment:	**Years' Employed**
IBEW	8

SECTION 4: APPLICANTS REQUESTING MEDICAL GAS INSPECTOR CERTIFICATION

Attach proof *of certification by an ASSE recognized third-party certifier in accordance with ASSE standard 6020.*

SECTION 5: OBC BUILDING INSPECTION EXPERIENCE PERFORMED FOR A BBS CERTIFIED BUILDING DEPARTMENT

BBS Certified Building Department	BBS Certified Position/Title	Duties	Date of Service, Length of Time (MM/DD/YY)

Noble | Nely | _____
Last Name | First Name | BBS Certification ID

SECTION 6: ELECTRICAL SAFETY INSPECTOR (ESI) - SPECIFIC EXPERIENCE QUALIFICATIONS
Applicants for Electrical Safety Inspector Only Must Complete This Item
Section 3783 of the Ohio Revised Code specifies that an applicant for a Certificate of Competency as an Electrical Safety Inspector must meet on of the following to qualify to take required examination. Please check the qualification that applies:

1. ☑ Have been a journeyman electrician or equivalent for four years, two of which were as an electrician foreman, and have had two years' experience as a building department electrical inspector trainee;
2. ☑ Have been a journeyman electrician or equivalent for four years and have had three years' experience as a building department electrical inspector trainee;
3. ☐ Have had for four years' experience as a building department electrical inspector trainee;
4. ☐ Have been a journeyman electrician or equivalent for six years;
5. ☐ Am a graduate electrical engineer and registered in the State of Ohio. Registration number: _____
6. ☐ Applicant authorizes all testing organizations including ICC to provide test results to the BBS.

SECTION 7: EXPERIENCE *(DO NOT SUBSTITUTE WITH OTHER RESUMES).*
Refer to Experience Requirements Listed in O.A.C. 4101:7-3-01 and O.R.C. 3783
Below, list the specific projects you worked on, and the specific work you performed, your typical duties for each project, and dates of this work. You **must** demonstrate that you have the required number of months (years) of actual, practical experience for the certification requested (see matrix).
Provide letters from certified inspectors, employers, or contractors verifying your experience. Submit copies of any certificates, diplomas, or licenses. Remove all personal information.

SECTION 7 CONT.: EXPERIENCE

List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
Example: *Children's Hospital, Toledo* *Structural steel work on addition* Hahn Hall - electrician Tennis Court Dorm-electrician Waste Water Plants electrician Werner Hospital Tennis Court Fresh Air project	*Homer Steel and Trade* *125 Anytown Street* *My City, OH, 45454* *(419)555-1212* Lake Erie Electric 360 Industrial Way Franklin, Oh	*July 2013-May 2014* *(10 months)* Aug 2014-Oct 2023
Total Experience on This Page (In Months):		

Board of Building Standards Application for Interim Certification, Building Department Personnel

Noble — *Last Name*

Nels — *First Name*

BBS Certification ID

List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
Clermont County Waste Water Cincinnati Waste Water Miami Waste Water Miami Health Science Miami Hamilton Health Science Indoor Sports Complex FCC Cincinnati Stadium Spooky Nook • Conduit • Wire • PLC • Adhering to Code Standards • Safety • Installation • Blue prints • Trouble Shooting	Lake Erie Electric 360 Industrial Wy Franklin Ohio	Aug 2014 Oct 2023
	Total Experience on This Page (In Months):	111 months

Noble | Nels | _____
Last Name | *First Name* | *BBS Certification ID*

SECTION 8: PERSONAL HISTORY

1. Have you ever been convicted of any felony, or any crime involving moral turpitude? ☐ Yes ☒ No

   If you answered "Yes" please explain below:
2. Have you served in the U.S. armed services? (If No, skip question 3) ☐ Yes ☒ No
3. If YES, were you discharged under honorable conditions? ☐ Yes ☐ No

   If you answered "No" please explain below:

SECTION 9: CERTIFICATION

I certify the information contained in this application is true and complete, and I understand that providing false information may be grounds for not granting certification or for immediate termination of certification at any point in the future, if granted. I authorize the investigation of all statements contained herein and release all parties from all liability for any damage that may result from furnishing the same to Ohio Board of Building Standards. Falsification is a violation of section 2921.13 of the Ohio Revised Code and is punishable as a misdemeanor of the first degree.

Signature of Applicant: [signature]

Subscribed and duly sworn before me according to law, by the above named applicant this day 25 of October in the year 2023 at Columbus, County of Franklin and State of Ohio.

Notary Public: [signature]

SEAL

NOTARIAL SEAL STATE OF OHIO

MEGAN DEVOE FOLEY, Attorney-At-Law
Notary Public, State of Ohio
My Commission has no expiration date.
Section 147.03 R.C.

Board of Building Standards

Application for Interim Certification, Building Department Personnel

Noble	Nels	
Last Name	*First Name*	*BBS Certification ID*

SECTION 1: CHECK INTERIM CERTIFICATION(S) BEING REQUESTED

☐ Res. Building Official	☐ Res. Plans Examiner	☑ Res. Building Inspector
	☑ Res. Industrial Unit Inspector	☐ Res. Mechanical Inspector

SECTION 2: LIST ANY OHIO LICENSE, CERTIFICATE, OR REGISTRATION HELD

(Mark "T" If Trainee)

Description			Certificate Number	Date Received
Architectural Registration				
P.E. Registration				
Res	Non-Res			
☐	☐	Building Official Certification		
☐	☐	Plans Examiner Certification		
☐	☐	Building Inspector Certification		
☐	☐	Mechanical Inspector Certification		
Building Plans Examiner Certification				
Mechanical Plans Examiner Certification				
Fire Protection Plans Examiner Certification				
Electrical Plans Examiner Certification				
Plumbing Plans Examiner Certification				
Fire Protection Inspector Certification				
Electrical Safety Inspector Certification				
Plumbing Inspector Certification				
Fire Safety Inspector Certification				
Fire Protection System Designer Certification				
Medical Gas Piping Inspector Certification				

Section 3: Employment/Education

a. Formal Education	Date Graduated
Talawanda High School	2007
NJATC / IBEW	2020
b. Related Vocational or Technical Training	Years' Experience
c. U.S. Military construction experience (MOS or other designation):	Years' Experience
d. Place of Employment:	Years' Employed
IBEW	8

Noble | Neg | _____

Last Name | *First Name* | *BBS Certification ID*

SECTION 4: OBC/RCO BUILDING INSPECTION EXPERIENCE PERFORMED FOR A BBS CERTIFIED BUILDING DEPARTMENT

BBS Certified Building Department	BBS Certified Position/Title	Duties	Date of Service, Length of Time (MM/DD/YY)

SECTION 5: EXPERIENCE *(DO NOT SUBSTITUTE WITH OTHER RESUMES)*.

Refer to Experience Requirements Listed in O.A.C. 4101:7-3-01 and O.R.C. 3783

Below, list the specific projects you worked on, and the specific work you performed, your typical duties for each project, and dates of this work. You **must** demonstrate that you have the required number of months (years) of actual, practical experience for the certification requested (see matrix).

Provide letters from certified inspectors, employers, or contractors verifying your experience. Submit copies of any certificates, diplomas, or licenses. Remove all personal information.

List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
Example: *Children's Hospital, Toledo* *Structural steel work on addition* Hahn Hall Tennis Court Dorm Waste Water Plants Wexner Hospital Tennis Court Fresh Air Project	*Homer Steel and Trade* *125 Anytown Street* *My City, OH, 45454* *(419)555-1212* Lake Erie Elective 560 Industrial Way Franklin Ohio	*July 2013-May 2014* *(10 months)* Aug 2014-Oct 2023
Total Experience on This Page (In Months):		

Noble | Ney |
Last Name | First Name | BBS Certification ID

SECTION 5 CONT.: EXPERIENCE

List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
Clearmont County Waste Water Cincinnati Waste Water Miami Waste Water Miami Health Science Miami Hamilton Health Science Indoor Sports Complex FCC Cincinnati Stadium Spooky Nook • Conduit • Wire • PLC • Code • Safety • Installation • Blue Prints • Trouble shooting	Lake Erie Electric 360 Industrial Way Franklin Ohio	Aug 2014- Oct 2023
	Total Experience on This Page (In Months):	111 months

Last Name	First Name	BBS Certification ID
None	Nely	

SECTION 6: PERSONAL HISTORY

1. Have you ever been convicted of any felony, or any crime involving moral turpitude? ☐ Yes ☑ No
2. If you answered "Yes" please explain below:
3. Have you served in the U.S. armed services? (If No, skip question 3) ☐ Yes ☑ No
4. If YES, were you discharged under honorable conditions? ☐ Yes ☐ No
   If you answered "No" please explain below:

SECTION 7: CERTIFICATION

I certify the information contained in this application is true and complete, and I understand that providing false information may be grounds for not granting certification or for immediate termination of certification at any point in the future, if granted. I authorize the investigation of all statements contained herein and release all parties from all liability for any damage that may result from furnishing the same to Ohio Board of Building Standards. Falsification is a violation of section 2921.13 of the Ohio Revised Code and is punishable as a misdemeanor of the first degree.

Signature of Applicant: _____

Subscribed and duly sworn before me according to law, by the above named applicant this day 25 of October in the year 2023 at Columbus, County of Franklin and State of Ohio.

Notary Public: _____

SEAL

NOTARIAL SEAL STATE OF OHIO

MEGAN DEYOE FOLEY, Attorney At Law
Notary Public, State of Ohio
My Commission has no expiration date.
Section 147.03 R.C.

File Attachments for Item:

P-5 Rudyak, Andriy - ESI

Certification ID: 9196

Current certifications: None

Staff notes- Holds OCILB Electrical Contractor's license, appears to meet requirements. Recommend approval.

ESIAC Recommendations:

Committee Recommendation:

Board of Building Standards Application for Interim Certification, Building Department Personnel

Rudyak — *Last Name*

Andriy — *First Name*

BBS Certification ID

SECTION 1: CHECK INTERIM CERTIFICATION(S) BEING REQUESTED

☐ Building Official	☐ Master Plans Examiner	☐ Building Inspector	☒ Electrical Safety Inspector	☐ Fire Protection Inspector
☐ Building Plans Examiner	☐ Plumbing Plans Examiner	☐ Mechanical Plans Examiner	☐ Electrical Plans Examiner	☐ Fire Protection Plans Examiner
	☐ Plumbing Inspector	☐ Mechanical Inspector	☐ Non-Residential Industrial Unit Inspector	

SECTION 2: LIST ANY OHIO LICENSE, CERTIFICATE, OR REGISTRATION HELD
(Mark "T" If Trainee)

Description			Certificate Number	Date Received
Architectural Registration				
P.E. Registration				
Res	Non-Res			
☐	☐	Building Official Certification		
☐	☐	Plans Examiner Certification		
☐	☐	Building Inspector Certification		
☐	☐	Mechanical Inspector Certification		
Building Plans Examiner Certification				
Mechanical Plans Examiner Certification				
Fire Protection Plans Examiner Certification				
Electrical Plans Examiner Certification				
Plumbing Plans Examiner Certification				
Fire Protection Inspector Certification				
Electrical Safety Inspector Certification				
Plumbing Inspector Certification				
Fire Safety Inspector Certification				
Fire Protection System Designer Certification				
Medical Gas Piping Inspector Certification				

Last Name	First Name	BBS Certification ID
Rudyak	Andriy	

SECTION 3: EMPLOYMENT/EDUCATION

Formal Education	Date Graduated
Valley Forge HS	02
Related Vocational or Technical Training	**Years' Experience**
Valley Forge HS (electrical 2 years)	
U.S. Military construction experience (MOS or other designation):	**Years' Experience**
Place of Employment:	**Years' Employed**
Felton electric inc	9
Rudyak electrical	2015 —

SECTION 4: APPLICANTS REQUESTING MEDICAL GAS INSPECTOR CERTIFICATION

***Attach proof** of certification by an ASSE recognized third-party certifier in accordance with ASSE standard 6020.*

SECTION 5: OBC BUILDING INSPECTION EXPERIENCE PERFORMED FOR A BBS CERTIFIED BUILDING DEPARTMENT

BBS Certified Building Department	BBS Certified Position/Title	Duties	Date of Service, Length of Time (MM/DD/YY)

Department of Commerce

Division of Industrial Compliance
Ohio Constructions Industry
Licensing Board O.C.I.L.B.

Mike DeWine
Sheryl Maxfield

ANDRIY RUDYAK
[redacted]

Mike DeWine
Governor

Sheryl Maxfield
Director

Electrical
CONTRACTOR'S LICENSE

Ohio License # 48098 Expiration Date: 10/20/2024

ANDRIY RUDYAK
RUDYAK ELECTRICAL SERVICES LLC
OWNER

Carol A. Ross
Board Secretary

William Koester
Administrative Chairperson

This is YOUR license. Plan Approvals obtained with YOUR license and posting of YOUR license indicates that YOU and YOUR liability insurance are assuming all responsibility for any projects performed under this license.

Mike DeWine
Governor

Sheryl Maxfield
Director

LICENSE MUST BE POSTED ON JOB SITE

Electrical

CONTRACTOR'S LICENSE

ANDRIY RUDYAK

RUDYAK ELECTRICAL SERVICES LLC

OWNER

Ohio License# 48098

Expiration Date: October 20, 2024

LICENSE MUST BE POSTED ON JOB SITE

Carol A. Ross
Board Secretary

William Koester
Administrative Chairperson

DIC 3530 Rev 3/2020

Any changes in information must be submitted within 30 days to:

Bureau of Testing & Registration
PO BOX 529
Reynoldsburg, Ohio 43068
614-752-7126
614-995-4206 (fax)
webfmtr@com.state.oh.us

This license shall be carried on your person while performing the listed activities.

State of Ohio
Department of Commerce
Division of State Fire Marshal

FIRE PROTECTION LICENSE
ANDRAY RUDYAK

54.18.6156

Expiration Date: 07/01/2024

Signature _____

This card shall be on your person while performing listed activities.

Ohio Department of Commerce
Division of State Fire Marshal
Bureau of Testing & Registration
8895 E Main Street, PO Box 529
Reynoldsburg, Ohio 43068

ANDRAY RUDYAK

[redacted]

RUDYAK Andriy

Last Name *First Name* *BBS Certification ID*

SECTION 6: ELECTRICAL SAFETY INSPECTOR (ESI) - SPECIFIC EXPERIENCE QUALIFICATIONS

Applicants for Electrical Safety Inspector Only Must Complete This Item

Section 3783 of the Ohio Revised Code specifies that an applicant for a Certificate of Competency as an Electrical Safety Inspector must meet on of the following to qualify to take required examination. Please check the qualification that applies:

1. ☐ Have been a journeyman electrician or equivalent for four years, two of which were as an electrician foreman, and have had two years' experience as a building department electrical inspector trainee;
2. ☐ Have been a journeyman electrician or equivalent for four years and have had three years' experience as a building department electrical inspector trainee;
3. ☐ Have had for four years' experience as a building department electrical inspector trainee;
4. ☒ Have been a journeyman electrician or equivalent for six years;
5. ☐ Am a graduate electrical engineer and registered in the State of Ohio. Registration number: _____
6. ☒ Applicant authorizes all testing organizations including ICC to provide test results to the BBS.

SECTION 7: EXPERIENCE *(DO NOT SUBSTITUTE WITH OTHER RESUMES).*

Refer to Experience Requirements Listed in O.A.C. 4101:7-3-01 and O.R.C. 3783

Below, list the specific projects you worked on, and the specific work you performed, your typical duties for each project, and dates of this work. You **must** demonstrate that you have the required number of months (years) of actual, practical experience for the certification requested (see matrix).

Provide letters from certified inspectors, employers, or contractors verifying your experience. Submit copies of any certificates, diplomas, or licenses. Remove all personal information.

List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
Example: *Children's Hospital, Toledo* *Structural steel work on addition*	*Homer Steel and Trade* *125 Anytown Street* *My City, OH, 45454* *(419)555-1212*	*July 2013-May 2014* *(10 months)*
Total Experience on This Page (In Months):		

Rudy Ak
Last Name

Andrew
First Name

BBS Certification ID

SECTION 7 CONT.: EXPERIENCE

List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
	Total Experience on This Page (In Months):	

Rudyak ____ Last Name | Andriy ____ First Name | ____ BBS Certification ID

SECTION 8: PERSONAL HISTORY

1. Have you ever been convicted of any felony, or any crime involving moral turpitude?
   ☐ Yes ☒ No
   If you answered "Yes" please explain below:
2. Have you served in the U.S. armed services? (If No, skip question 3) ☐
   Yes ☒ No
3. If YES, were you discharged under honorable conditions? ☐ Yes ☐
   No

If you answered "No" please explain below:

SECTION 9: CERTIFICATION

I certify the information contained in this application is true and complete, and I understand that providing false information may be grounds for not granting certification or for immediate termination of certification at any point in the future, if granted. I authorize the investigation of all statements contained herein and release all parties from all liability for any damage that may result from furnishing the same to Ohio Board of Building Standards. Falsification is a violation of section 2921.13 of the Ohio Revised Code and is punishable as a misdemeanor of the first degree.

Signature of Applicant: [signature]

Subscribed and duly sworn before me according to law, by the above named applicant this day 5th of September in the year 2023 at Cuyahoga Cleveland, OH, County of Cuyahoga and State of OHIO.

Notary Public: [signature]

LANEDA F REED - NOTARY PUBLIC
COMM EXP MAY 3, 2028
STATE OF OHIO

47

File Attachments for Item:

ER-1 2023 NEC Updates (IAEI Northwest)

All certifications (24 hours in twelve sessions)

Staff Notes: Slide sets 1 and 2 are 2020 NEC Analysis of changes, 3 and 4 are 2023.

ESIAC Recommendation:

Committee Recommendation:

APPLICATION FOR CONTINUING EDUCATION APPROVAL
COURSE CONDITIONS AND GUIDELINES

The Ohio Board of Building Standards is committed to the ongoing education and professional development of board-certified personnel through the delivery of high-quality, accurate and engaging professional continuing education content. To this end, the Board reviews and approves Continuing Education Courses for building department personnel.

Board approval is granted for course instruction on current codes and standards, including the OBC, OMC, OPC, and RCO, and any other content areas directly related to the responsibilities of the certification for which credit is being requested.

Promotion: Any person or organization promoting an approved course is required to make full and accurate disclosure regarding course title, course approval number, number of credit hours, categories for which the BBS has approved the class, and fees in promotion materials and advertising. ***The Board does not grant retroactive approval. It is recommended that courses be submitted for approval well in advance of any scheduling of classes and advertising***. Advertising may not falsely state BBS approval before approval is granted. Course providers may state that BBS approval is pending.

Application Submission: All Applications and associated materials shall be submitted by email in .pdf format. Instructions for completing the application are attached.

Certificate of Completion: Course providers shall provide participants a certificate of completion containing the following information:

- Name of participant
- Title of approved courses
- BBS approval #
- BBS approved certifications
- Date of the continuing education program
- Number of approved credit hours awarded, and
- Signature of authorized sponsor or instructor.

Any person or organization administering an approved course shall return a completed BBS Course Attendance form by email.

Participants: Participants must attend the complete course as presented by the instructor to receive credit hours approved by the Board. The organization or instructor of online courses shall plan and execute methods to verify the individual's attendance and completion of the course. No partial credit will be given to any participant who failed to complete the entire course as approved.

Board approval: All courses are approved for the calendar year in which application is made. Courses may be renewed so long as the referenced code is in effect, and the CEUs, certification and content remain unchanged. When the referenced code is updated, courses must be updated, and new approvals obtained.

Facility/training area: BBS Course may be delivered in person or online, or both, at the sponsor's option.
Course facilities shall include the following:

In Person Classes:
Sufficient seating capacity
ADA accessible facilities
Appropriate Audio/Visual devices for delivery
Writing surfaces for participants

Online Classes:
Web-accessible
ADA accessible delivery
Tech support available
Live and recorded courses permitted

In-person facilities shall comfortably and safely seat at least the number of attendees present in the room and shall be climate controlled, non-smoking, and sound controlled so that outside noise will not interfere with the training.

Ohio | Department of Commerce

Mike DeWine, Governor
Jon Husted, Lt. Governor

Sheryl Maxfield, Director

Board of Building Standards

Application for Continuing Education Course Approval

Provider Information:

Name: Greg Capucini

Organization: IAEI Northwest Div. Ohio Chapter

Address: P.O. Box 167667, Oregon. Ohio 43616

E-mail: gcapucini@gmail.com & gcapucini@cityofsandusky.com Telephone: 419-656-3108

Website: nwohioiaei@yahoo.com

Conference Sponsor (if applicable)_____ Conference Email:_____

Check here if Course Renewal:_____ Prior course number _____ (*i.e. BBS2018-429*)

Renewals will only be granted for identical content and certifications, within the current code cycle.
Attach a copy of prior course approval letter for confirmation. No further information is required.

New Course Information:

Course title: Electrical code review

Course instructor: Greg Capucini

Course description: 2020 & 2023 NEC updates @ 803 Lime City Rd. Rossford Ohio 43460 on the second Tuesday each month of 2024

1-9-24 / 2-13-24 / 3-12-24 / 4-9-24 / 5-14-24 / 6-11-24 / 7-9-24 / 8-13-24 / 9-10-24 / 10-8-24 / 11-12-24 / 12-10-24

Instructional hours per session: 2 Number of Sessions: 12

Course Date(s) and Location: See Above dates

Special Content:

Code Administration: ☑ Conference Course: _____

Existing Buildings: ☐ Conference Name: _____

Electrical Instruction: ☑ Conference location: _____

Plumbing Instruction: ☐

Course to be offered online? ☐ **On Demand** ☐ **Webinar** ☐

Course Website: _____

Detail online course participation confirmation method *(i.e. test, quizlets, participant activity confirmation)*:

_____

Course applicable for the following certifications

Residential Certifications Only: ☐ Commercial Certifications: ☐

Administrative Course, All Certifications: ☑

Application materials included:

☑ Course Outline or Course Learning Objectives

☑ Presentation Materials/Slides (not required for roundtable courses)

☐ Assessment Materials (for online courses)

☑ Presenter Bio

Please submit application and materials in .pdf format to: michael.lane@com.ohio.gov or BBS@com.ohio.gov

Instructions for new Continuing Education Approval form

Provider Information

1. Please include all contact information.
2. If course is not part of a conference, leave conference sponsor and email blank.

Course Renewal

1. Indicate if the course is being submitted for renewal. Include prior approval letter and write in prior course number.
2. Certification approval for courses has now changed: all existing courses being renewed will be approved within the new classification system.
    a. Courses previously approved for only residential certifications will be approved for all residential certifications.
    b. Courses previously approved for at least on commercial certification will now be approved for all commercial certifications and all residential certifications.
    c. Courses on required instruction topics, Ohio Ethics, Code Administration and Existing Buildings, will be noted as Administrative Courses and be approved for all certifications.
3. Courses being renewed should skip the New Course information section and are not required to submit outline, agenda, slides or other instructional materials for review. Skip to Special Content, and mark any item that applies to the course.

New Course Information

1. Enter course title, name of instructor, and a brief description of the course content. Learning objectives may be substituted for course description, if desired.
2. Number of instructional hours per session is the length of instructional time.
3. Number of sessions: can be 1 or the number of sessions planned.
4. Course date(s) and location: not necessary at this time, enter if known.

Special Content

1. Indicate if the course will meet instructional time in Code Administration or Existing Buildings.
2. Indicate if the course is a plumbing or electrical course, for ESIAC review and trainee course tracking.
3. If the course is associated with a conference, indicate the conference name and location, as this will allow BBS to coordinate approvals with the conference provider.
4. If the course will be offered online, specify whether it will be on demand or offered as a virtual webinar, or both. Include website where the course will be provided.

Course applicable for the following certifications

This section represents a major change from previous BBS course approval forms.

1. If the course is only for residential certifications, check 'Residential Certifications Only'. The course, if approved, will be approved for all residential certifications.
2. If the course is appropriate for any commercial certifications, check Commercial Certifications. The course, if approved, will be approved for all commercial certification **AND** all residential certifications.
3. If the course is intended to meet required instruction in Code Administration (Chapter 1) or Existing Buildings (commercial or residential) check 'Administrative Course, All Certifications'.

Application Materials Included

This is a checklist for the course submitter's use, to be sure all materials necessary for review are included with the application. All materials should be submitted in .pdf format, along with the application, via email to Michael.Lane@com.ohio.gov or BBS@com.ohio.gov

Greg Capucini

BIO/Profile

I received my ESI license in 2000.

I have been employed by the City of Sandusky as a backup ESI since 2002. I became a full time ESI for them in 2016 to present.

In 2003 I joined the IAEI. I have been President and am currently the education chairperson of the Northwest Division Ohio Chapter.

In 1986 I joined the IBEW and went through the apprenticeship program.

Class Outline Northwest Division Ohio IAEI -Training Agency
2024 OBBS classes held at:
Toledo Electrical JATC 803 Lime City Rd. Rossford, Ohio 43460 on the 2nd Tuesday of each month from 9:30 to 11:30 am. (2 hrs.)

All classes will be based on and utilize the 2020 & 2023 National Electrical Code

January 9th 2024 — Introduction to the 2017 NEC, review code wide changes and the editorial changes made to the NEC based on the NEC Style Manual. Cover Chapter 1 changes to Article 100 Definitions.

February 13th 2024 — Cover changes to Chapter 1, Article 110 . Requirements for Electrical Installations. Review effect of increasing voltage thresholds from 600v or less to 1000v or less, addition of reconditioned equipment to Article 110.3(A), addition of new torqueing requirements for electrical equipment installations in Article 110.14(D), changes to working space clearances in Table 110.26(A)(1).

March 12th, 2024— cover changes to Chapter 2, Article 200 and 210. Review labeling requirements of Article 210.5, expansion of GFCI requirements in Article 210.8(A) and (B), new requirements in Article 210.12(C) for guest rooms and suites of motel/hotels, branch circuit requirements of Article 210.19 thru 210.24, outlet requirements of 210.52 and 210.70.

April 9th, 2024 — Cover changes to Chapter 3, Article 300 and 310. Review requirements for Protection against Physical Damage found in Article 300.4, Burial and cover requirements of Article 300.5 for

Underground Installations, Firestopping requirements of article 300.21, requirements for Installations over 1000 volts in Article 110 Part II, Conductor Requirements of Article 310 for parallel installations and derating of conductors.

May 14th 2024 — Cover changes to Chapter 2, Article 220 and 290. Review requirements of Article 220 Calculations for branch circuits, lighting and service load calculations, Article 230 Services Part I General and Part III and IV for Overhead and Underground Installations.

June 11th 2024 — Cover changes to Chapter 2, Article 240 and 250. Review requirements of Article 240 Overcurrent Protection, Part I I Tap Rules, new Arc Energy Reduction of Article 240.67, and Article 250 Grounding and Bonding and the grounding electrode system.

July 9th, 2024 — Cover changes to Chapter 4, Articles 404 thru 424. Review requirements for Switches per Article 404, Receptacles in Article 406 including the expansion of tamper-resistant receptacles in 406.12, labeling requirements in Article 408.4, Luminaires (fixtures) in Article 410, arid Appliance requirements in Article 422 with a link from Article •422.5 to Article 210.8 GFCI Protection.

August 13th, 2024 — Cover changes to Chapter 4, Articles 430 thru 490, and Chapter 5. Review requirements for Article 430 Motors and their disconnects per 430 Part Generators Article 445 and their markings per 445.11, Storage Batteries- Article 480 and Article 706 Energy Storage Systems, Article 490 Equipment over 1000 volts, Chapter 5,
Articles 500 thru 506 for Hazardous locations, Article 517 Health Care Facilities and their Essential Electrical Systems, Article 590 Temporary Wiring Installations.

September 10th , 2024— Cover changes to Chapter 6, Articles 600 thru 680, Review requirements for Article 600 Signs, article 625 Electric Vehicle Charging, Article 680 Part I, II and I I I Swimming Pools, Part IV Hot Tubs and Spas, Part V Fountains.

October 8th, 2024 —Cover changes to Chapter 6, Articles 685 thru 694, Review requirements for Article 685 Integrated Electrical Systems, Article 690 Solar Photovoltaic (PV) Systems, Article 694 Wind Electric Systems, new Article 691 Large-Scale Photovoltaic (PV) Electric Power Production Facility, new Article 712 Direct Current Micro-grids, Review tie-in to Article 685 for alternative energy systems.

November 12th, 2024 — Cover changes to Article 695 Fire Pumps and Chapter 7 Articles 700 thru 760. Review requirements for Article 700 Emergency Systems, Article 701 and 702 for Standby Systems, Article 708 Critical Operations Power Systems (COPS), Article 760 Fire Alarm Systems and Article 728 Fire-Resistive Cable Systems.

December 10th 2024 — Cover changes to Chapter 8 Communications Systems Articles 800 thru 840, Chapter 7, Article 725 Class 1, 2, and 3 Wiring and Power Limited Cables and Article 750 Energy Management Systems.

All classes will include a round table.

2024 Course List

Jan. 9th. 2024 Article 100 intro to code & Building code amendments

Feb. 13th. 2024 Article 110 NEC changes

March 12th. 2024 Chapter 2 NEC changes

April 9th. 2024 Chapter 3 NEC Changes

May 14th. 2024 Article 2 Services & Grounding Changes

June 11th. 2024 overcurrent protection

July 9th. 2024 Article 4 Changes

Aug. 13th. Article 4 Continued

Sept. 10th. 2024 Article 6

Oct 8th. 2024 Article 690 and its Changes

Nov 12th. 2024 Article 695 Fire Pumps

Dec. 10th. 2024 Chapter 8 Changes

All classes will include a round table

Analysis of Changes – 2020 *NEC*

Part 1 – NEC Chapters 1 through 4

Training Presentation By:
International Association of Electrical Inspectors

1

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Analysis of Changes – 2020 *NEC*

4

5

Code-Wide Changes

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

6

Code-Wide Changes *(cont.)*

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

7

Code-Wide Changes *(cont.)*

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

8

Code-Wide Changes

Available Fault Current References

Reconditioned Equipment (Yes or No)

XXX.2 Definitions

"The definitions in this section shall apply only within this article."

"The definitions in this section shall apply within this article and throughout the *Code*."

Definition Statements


Alignment of GFCI Requirements


Allowable Ampacity vs Ampacity


Term "Grounding Conductor" Deleted

9

New Articles for the 2020 *NEC*

Article 242 Overvoltage Protection (CMP-10) This article provides the general requirements, installation requirements, and connection requirements for overvoltage protection and overvoltage protective devices. Part II covers surge-protective devices (SPDs) permanently installed on premises wiring systems of not more than 1000 volts, nominal, while Part III covers surge arresters permanently installed on premises wiring systems over 1000 volts, nominal.

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

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

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

10

11

90.2(A) Scope

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

Not for Distribution

12

13

90.2(A) Scope

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

14

15

16

Article 100: Definitions - Scope

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

17

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

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

18

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

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

19

Article 100: Definitions - Accessible

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

20

ARTICLE 100 DEFINITIONS
ACCESSIBLE (AS APPLIED TO EQUIPMENT)

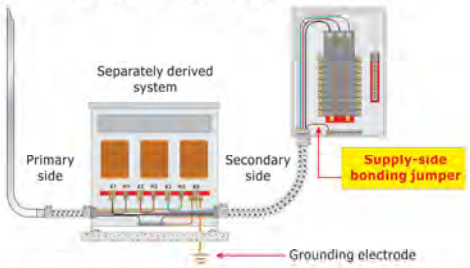
21

Article 100: Definitions - SSBJ

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

22

Article 100 - Supply-Side Bonding Jumper



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

23

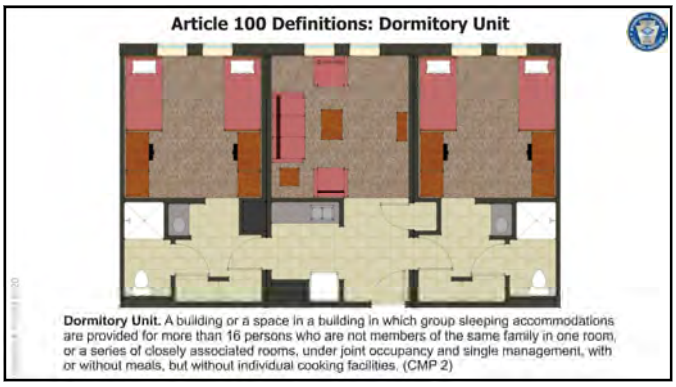
Article 100: Definitions – Dormitory Unit

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

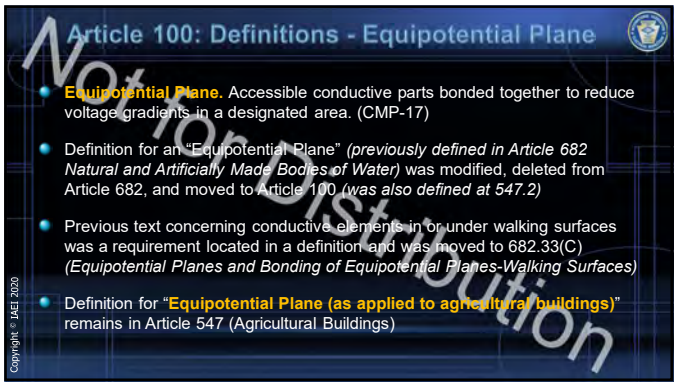
24


Not f
Article 100 Definitions
Dormitory Unit

25


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

26


Article 100: Definitions - Equipotential Plane
Equipotential Plane. Accessible conductive parts bonded together to reduce voltage gradients in a designated area. (CMP-17)
Definition for an "Equipotential Plane" (previously defined in Article 682 Natural and Artificially Made Bodies of Water) was modified, deleted from Article 682, and moved to Article 100 (was also defined at 547.2)
Previous text concerning conductive elements in or under walking surfaces was a requirement located in a definition and was moved to 682.33(C) (Equipotential Planes and Bonding of Equipotential Planes-Walking Surfaces)
Definition for "Equipotential Plane (as applied to agricultural buildings)" remains in Article 547 (Agricultural Buildings)
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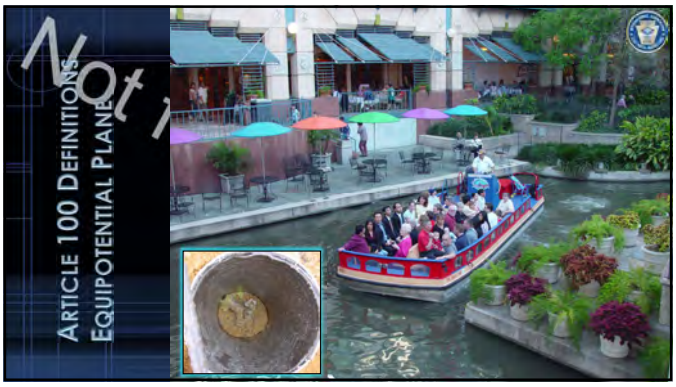
27


Not f
Article 100 Definitions
Equipotential Plane

28

Article 100: Fault Current and Fault Current, Available

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

29

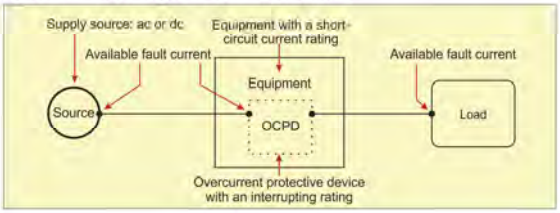
Article 100: Definitions

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

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

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

Figure Informational Note Figure 100.1 Available Fault Current.



30

Article 100: Definitions – Free Air

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

31

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

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

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

32

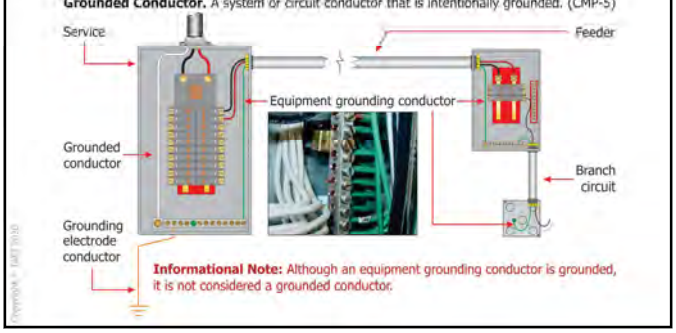
Article 100: Definitions – Grounded Conductor, Informational Note

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

33

Article 100 Definitions: Grounded Conductor (I-Note)

Grounded Conductor. A system or circuit conductor that is intentionally grounded. (CMP-5)

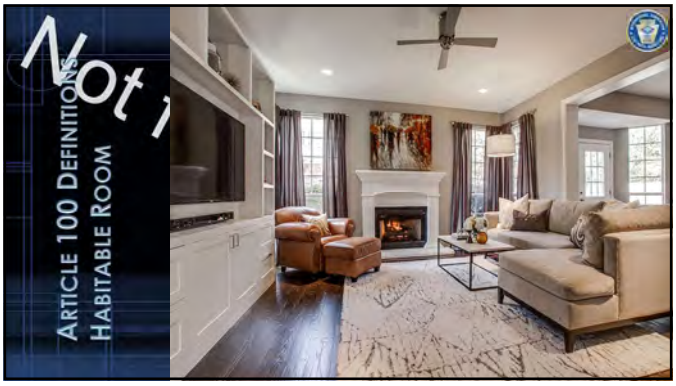


34

Article 100: Definitions – Habitable Room

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

35



36

Article 100: Definitions – Island Mode

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

37

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

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

38

39

Article 100 Labeled

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

40

41

Article 100: Definitions – Reconditioned

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

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Article 100 Definitions: Reconditioned

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

*See also 110.21(A)(2)

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

43

110.3(B) Installation and Use of Listed Equipment

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

44

110.3(B) Installation and Use of Listed Equipment

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

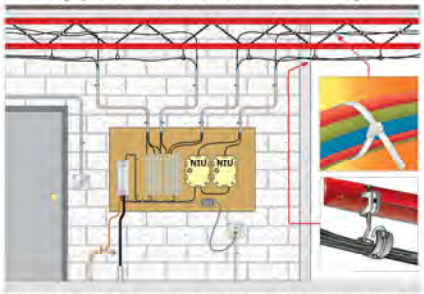
45

110.12(C) Cables and Conductors

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

46

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



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

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

Installation to comply with 300.4 and 300.11

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

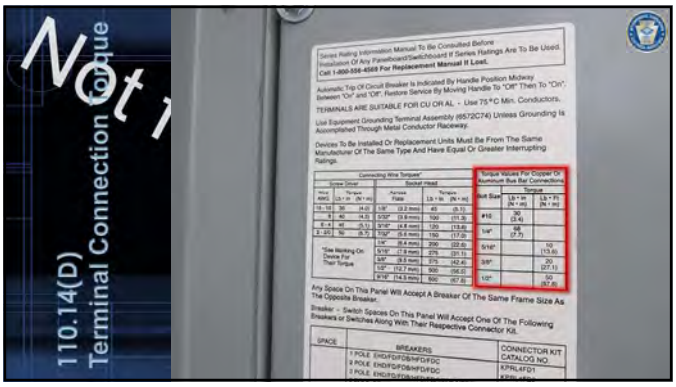
47

48

110.14(D) Terminal Connection Torque

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

49

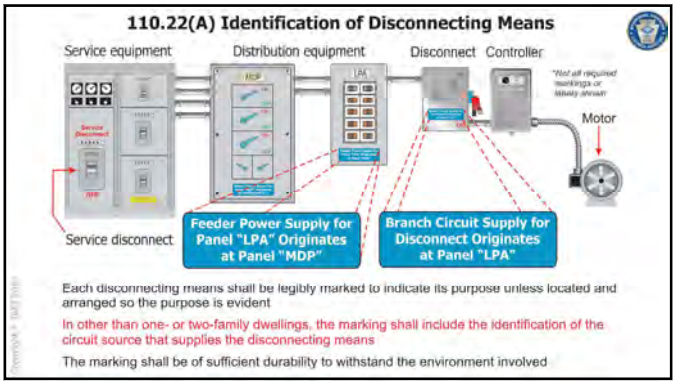


50

110.22(A) Identification of Disconnecting Means

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

51



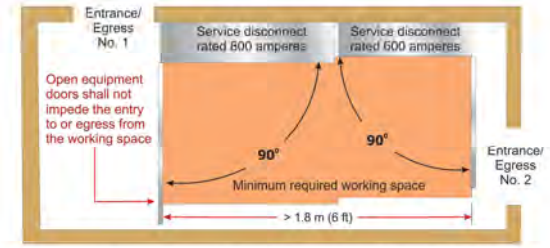
52

110.26(C)(2) Large Equipment

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

53

110.26(C)(2) Large Equipment



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

54

110.26(C)(3) Personnel Doors

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

55

110.26(C)(3) Personnel Doors

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

56

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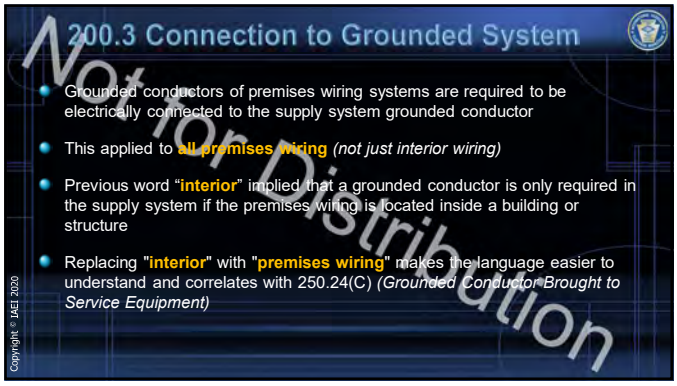
Chapter Two
Wiring and
Protection
Not for Distribution

58


200.3 Connection to Grounded System
Grounded conductors of premises wiring systems are required to be electrically connected to the supply system grounded conductor
This applied to all premises wiring (not just interior wiring)
Previous word "interior" implied that a grounded conductor is only required in the supply system if the premises wiring is located inside a building or structure
Replacing "interior" with "premises wiring" makes the language easier to understand and correlates with 250.24(C) (Grounded Conductor Brought to Service Equipment)
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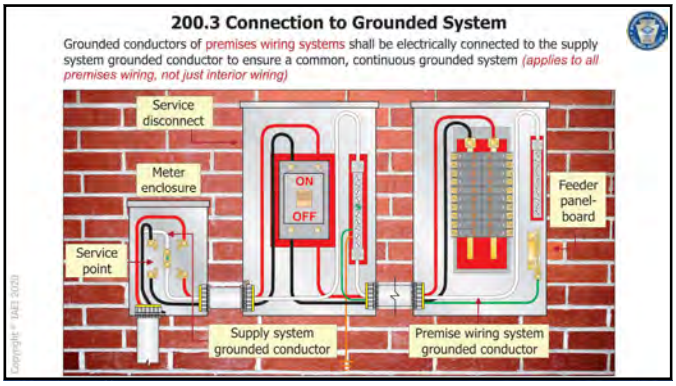
59


200.3 Connection to Grounded System
Grounded conductors of premises wiring systems shall be electrically connected to the supply system grounded conductor to ensure a common, continuous grounded system (applies to all premises wiring, not just interior wiring)
Service disconnect
Meter enclosure
ON
OFF
Feeder panel-board
Service point
Supply system grounded conductor
Premise wiring system grounded conductor

60

200.10(B) Identification of Terminals

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

61

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

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

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

Photo courtesy of Leviton

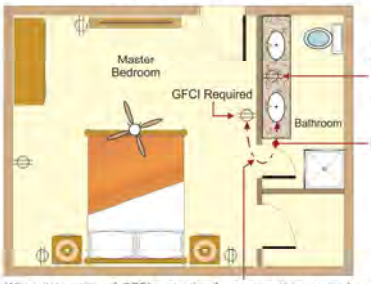
62

210.8 Measurements for GFCI Protection

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

63

210.8 Measurements for GFCI Protection



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

64

210.8(A) GFCI Protection for Personnel

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

65

66

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

67

210.8(A)(5) GFCI Protection for Basements

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

Unfinished Basement | Finished Basement

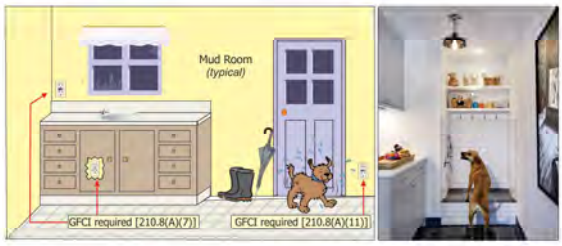
68

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

69

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



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

70

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)*

71

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

72

210.8(B) GFCI Protection for Other Than Dwelling Units

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

Indoor Damp and Wet Locations

Garages, accessory buildings, and service bays

Laundry areas

Bathtubs and shower stalls

73

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

74

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

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

Coffee Shop
(no permanent provisions for cooking)

Ice Cream Parlor
(no permanent provisions for cooking)

75

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

76

210.8(D) GFCI Protection for Specific Appliances

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

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

Vending machine GFCI protection cannot be factory installed within the appliance

77

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)*

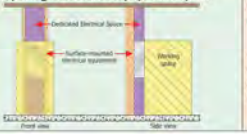
78

210.8(E) GFCI for Equipment Requiring Servicing

210.63(A) HVAC and Refrigeration Equipment

210.63(B)(1) Indoor Service Equipment

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



GFCI protection shall be provided for the receptacles required by 210.63

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

79

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

80

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

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

82

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

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

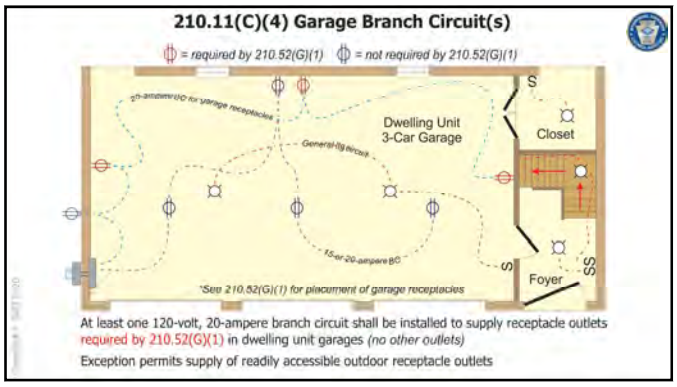
210.52(D): Receptacle outlet must be located within 900 mm (3 ft) of the outside edge of the basin (sink)

83

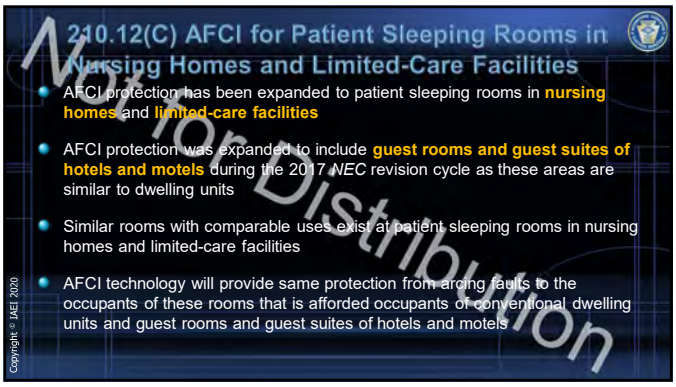
210.11(C)(4) Garage Branch Circuit(s)

- 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)*

84


210.11(C)(4) Garage Branch Circuit(s)
= required by 210.52(G)(1)
= not required by 210.52(G)(1)
Dwelling Unit
3-Car Garage
Closet
Foyer
S
*See 210.52(G)(1) for placement of garage receptacles
At least one 120-volt, 20-ampere branch circuit shall be installed to supply receptacle outlets required by 210.52(G)(1) in dwelling unit garages (no other outlets)
Exception permits supply of readily accessible outdoor receptacle outlets

85


210.12(C) AFCI for Patient Sleeping Rooms in Nursing Homes and Limited-Care Facilities
AFCI protection has been expanded to patient sleeping rooms in nursing homes and limited-care facilities
AFCI protection was expanded to include guest rooms and guest suites of hotels and motels during the 2017 NEC revision cycle as these areas are similar to dwelling units
Similar rooms with comparable uses exist at patient sleeping rooms in nursing homes and limited-care facilities
AFCI technology will provide same protection from arcing faults to the occupants of these rooms that is afforded occupants of conventional dwelling units and guest rooms and guest suites of hotels and motels
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210.12(C) AFCI Protection for Nursing Homes and Limited-Care Facilities
All 120-volt, single-phase, 15- and 20-ampere branch circuits supplying outlets and devices installed in guest rooms and guest suites of hotels and motels and patient sleeping rooms in nursing homes and limited-care facilities are required to AFCI protected

87

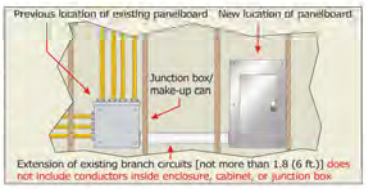
88

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

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

89

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



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

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

90

210.15 Reconditioned Equipment

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

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210.15 Reconditioned Equipment

GFCI GFCI/AFCI GFPE

The following shall not be reconditioned:

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

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

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

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Reconditioned Equipment Sections for the 2020 *NEC*

Code Section	CMP	Equipment	Yes/No	SR/PC
210.15	CMP-2	GFCI devices, AFCI devices, and GFP equipment	No	SR 7657
240.62	CMP-10	Low-voltage fuseholders and low-voltage nonrenewable fuses	No	SR 7974, PC 981
240.88(A)(1)	CMP-10	Molded-case circuit breakers	No	DSR 8011, PC 980
240.88(A)(2)	CMP-10	Low- and medium-voltage power circuit breakers	Yes	DSR 8011, PC 980
240.88(A)(3)	CMP-10	High-voltage circuit breakers	Yes	DSR 8011, PC 980
240.88(B)(1)	CMP-10	Low-voltage power circuit breaker electronic trip units	No	DSR 8011, PC 980
240.88(B)(2)	CMP-10	Electromechanical protective relays and current transformers	Yes	DSR 8011, PC 980
240.102	CMP-10	Medium-voltage fuseholders and medium-voltage nonrenewable fuses	No	SR 8048, PC 982
406.3(A)	CMP-18	Receptacles	No	SR 8187
406.7	CMP-18	Attachment plugs, cord connectors, and flanged surface devices	No	SR 8189

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Reconditioned Equipment Sections for the 2020 *NEC*

Code Section	CMP	Equipment	Yes/No	SR/PC
408.8(A)	CMP-9	Panelboards	No	SR 8172, PC 987
408.8(D)	CMP-9	Switchboards and switchgear, or sections of switchboards or switchgear	Yes	SR 8172, PC 987
410.7	CMP-18	Luminaires, lampholders, and retrofit kits	No	SR 8162
411.4	CMP-18	Listed low-voltage lighting systems or a lighting system assembled from listed parts	No	SR 8164
490.49	CMP-9	Switchgear, or sections of switchgear	Yes	SR 8222
695.10	CMP-13	Fire pump controllers and transfer switches	No	SR 7522, PC 983
700.5(C)	CMP-13	Automatic transfer switches (Emergency Systems)	No	SR7584, PC 984
701.5(C)	CMP-13	Automatic transfer switches (Legally Required Standby Systems)	No	SR 7586, PC 985
702.5	CMP-13	Transfer switches (Optional Standby Systems)	No	SR 7588, PC 986
708.24	CMP-13	Transfer equipment (Critical Operations Power Systems)	No	Sr 7517
800.3(G)	CMP-16	Communication equipment [*must comply with 110.21(A)(2)]	Yes*	SR 7509

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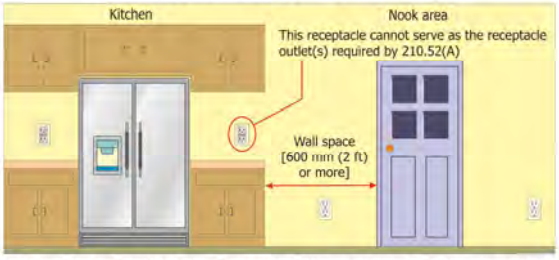
210.52(C) Receptacles at Countertops and Work Surfaces

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

95

210.52(C) Countertops and Work Surfaces



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

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

96

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

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

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

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

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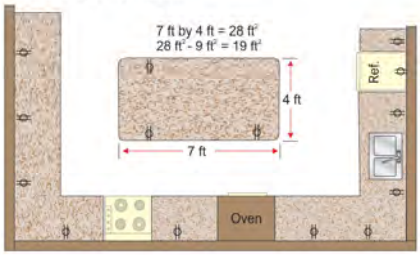
210.52(C)(2) Island and Peninsulars

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

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



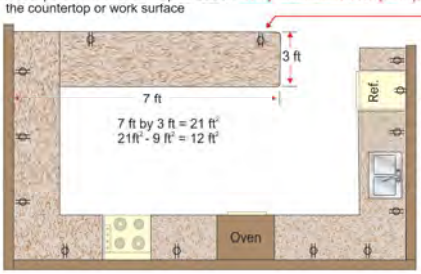
At least one receptacle outlet shall be located within 600 mm (2 ft) of the outer end of a peninsular countertop or work surface

99

210.52(C)(2) Island and Peninsulars

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

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



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

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

100

210.52(C)(2) Island and Peninsulas

Examples of Minimum Number of Receptacle Outlets Required

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

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

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

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

101

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

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

102

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

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

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

103

210.65 Receptacles for Meeting Rooms

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

104

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

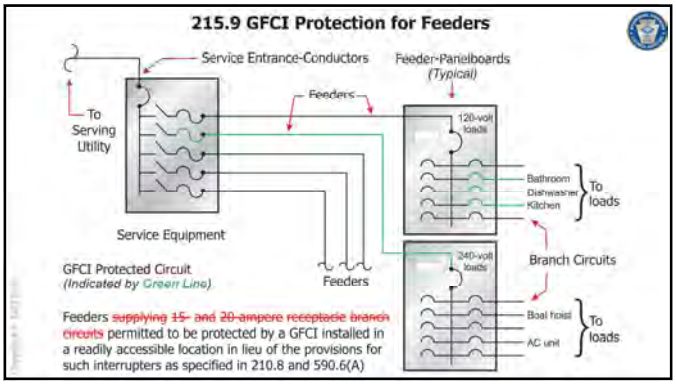
105

106

215.9 GFCI Protection for Feeders

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

107



108

215.10, Ex. No. 3 GFP for Feeders

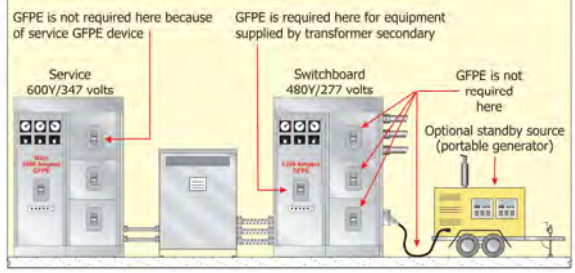
- New exception added to permit **temporary feeders** to be used during repair, maintenance or emergencies **without GFP of equipment**
- Time period permitted for these temporary feeders **not to exceed 90 days**
- GFP of equipment is required for each feeder disconnect rated 1000 amperes or more and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

109

215.10 Ex. No. 3 GFP for Feeders

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

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



110

220.12 Lighting Load for Specified Non-Dwelling Occupancies

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

111

Table 220.12 General Lighting Loads by Non-Dwelling Occupancy

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

112

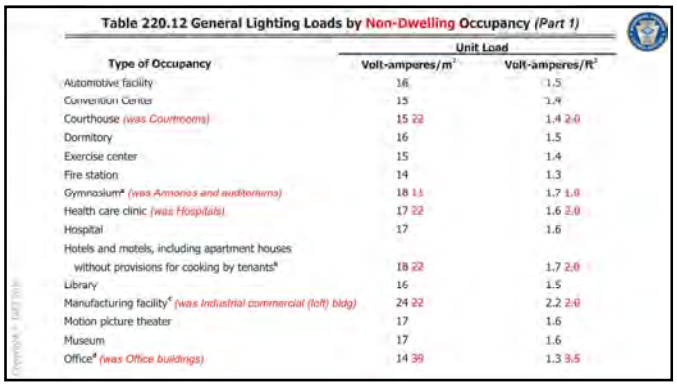


Table 220.12 General Lighting Loads by Non-Dwelling Occupancy *(Part 1)*

Type of Occupancy	Unit Load Volt-amperes/m^2	Unit Load Volt-amperes/ft^2
Automotive facility	16	1.5
Convention Center	15	1.4
Courthouse *(was Courtrooms)*	15 ~~22~~	1.4 ~~2.0~~
Dormitory	16	1.5
Exercise center	15	1.4
Fire station	14	1.3
Gymnasium[a] *(was Armories and auditoriums)*	18 ~~11~~	1.7 ~~1.0~~
Health care clinic *(was Hospitals)*	17 ~~22~~	1.6 ~~2.0~~
Hospital	17	1.6
Hotels and motels, including apartment houses without provisions for cooking by tenants[b]	18 ~~22~~	1.7 ~~2.0~~
Library	16	1.5
Manufacturing facility[c] *(was Industrial commercial (loft) bldg)*	24 ~~22~~	2.2 ~~2.0~~
Motion picture theater	17	1.6
Museum	17	1.6
Office[d] *(was Office buildings)*	14 ~~39~~	1.3 ~~3.5~~

113

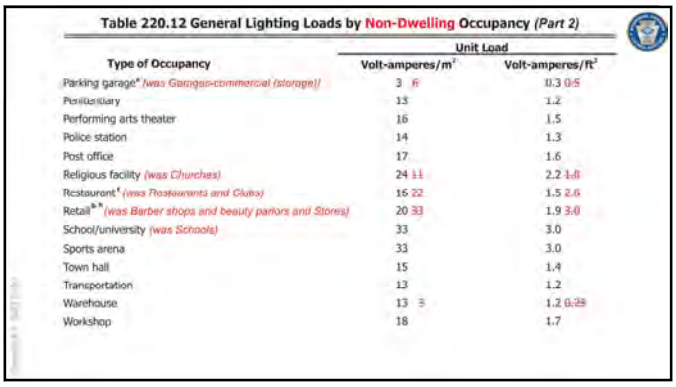


Table 220.12 General Lighting Loads by Non-Dwelling Occupancy *(Part 2)*

Type of Occupancy	Unit Load Volt-amperes/m^2	Unit Load Volt-amperes/ft^2
Parking garage[e] *(was Garages-commercial (storage))*	3 ~~6~~	0.3 ~~0.5~~
Penitentiary	13	1.2
Performing arts theater	16	1.5
Police station	14	1.3
Post office	17	1.6
Religious facility *(was Churches)*	24 ~~11~~	2.2 ~~1.0~~
Restaurant[f] *(was Restaurants and Clubs)*	16 ~~22~~	1.5 ~~2.0~~
Retail[g,h] *(was Barber shops and beauty parlors and Stores)*	20 ~~33~~	1.9 ~~3.0~~
School/university *(was Schools)*	33	3.0
Sports arena	33	3.0
Town hall	15	1.4
Transportation	13	1.2
Warehouse	13 ~~3~~	1.2 ~~0.25~~
Workshop	18	1.7

114

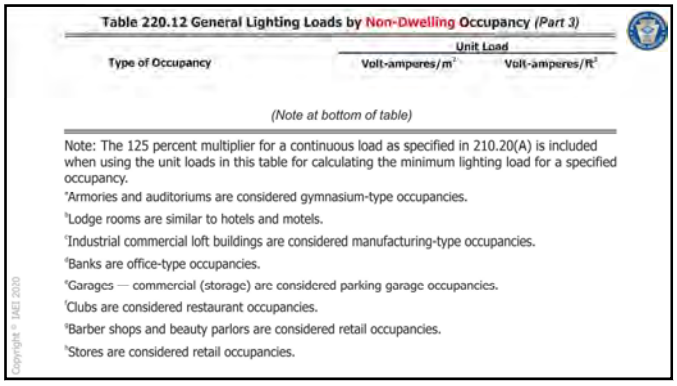


Table 220.12 General Lighting Loads by Non-Dwelling Occupancy *(Part 3)*

Type of Occupancy	Unit Load Volt-amperes/m^2	Unit Load Volt-amperes/ft^2
(Note at bottom of table)		

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

[a]Armories and auditoriums are considered gymnasium-type occupancies.

[b]Lodge rooms are similar to hotels and motels.

[c]Industrial commercial loft buildings are considered manufacturing-type occupancies.

[d]Banks are office-type occupancies.

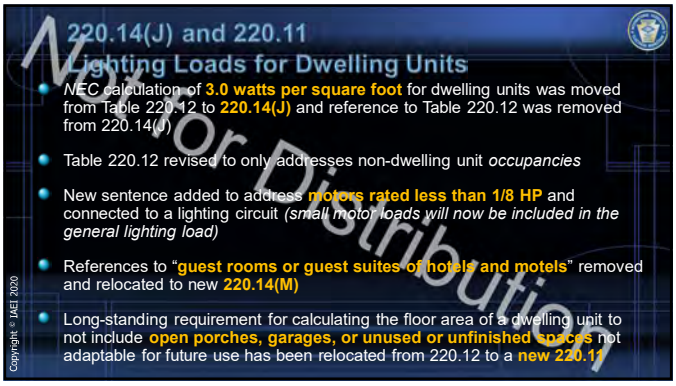
[e]Garages — commercial (storage) are considered parking garage occupancies.

[f]Clubs are considered restaurant occupancies.

[g]Barber shops and beauty parlors are considered retail occupancies.

[h]Stores are considered retail occupancies.

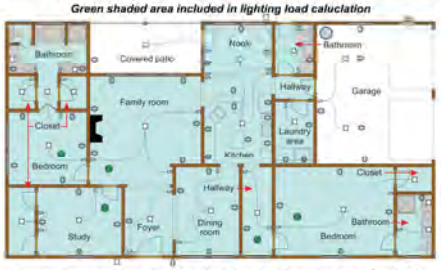
115



116

220.14(J) and 220.11 Lighting Loads for Dwellings

Green shaded area included in lighting load caluclation



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

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

117

220.14(J) and 220.11 Lighting Loads for Dwellings

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

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

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

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

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

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

118

220.42 General Lighting

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

119

Table 220.42 Lighting Load Demand Factors

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

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

120

220.53 Appliance Load - Dwelling Unit(s)

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

121

220.53 Appliance Load - Dwelling Unit(s)

STANDARD LOAD CALCULATION

Appliances	Quantity	VA Ungrnd	VA Neutral
Dishwasher	1	1,500	1,500
Disposal (½ hp motor)	1	1,176	1,176
Compactor	1	600	600
~~Exhaust Fans (120 VA each)~~	~~2~~	~~240~~	~~240~~
Water Heaters (4,500 VA each)	2	9,000	
Totals	**5**	**12,276**	**3,276**
4 or more Appliances Total at 75%		**9,207**	**2,457**

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

This demand factor cannot be apply to:

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

122

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

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

123

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

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

124

225.30(B) Common Supply Equipment (Feeders)

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

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

Each disconnect to be marked to indicate the load served

125

230.46 Splices and Tapped Conductors

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

126

230.46 Spliced and Tapped Conductors

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

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

127

230.62(C) Barriers

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

128

230.62(C) Service Equipment - Barriers

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

Service Panelboard | Transfer switches marked suitable for use as service equipment | Motor control center marked suitable for use as service equipment

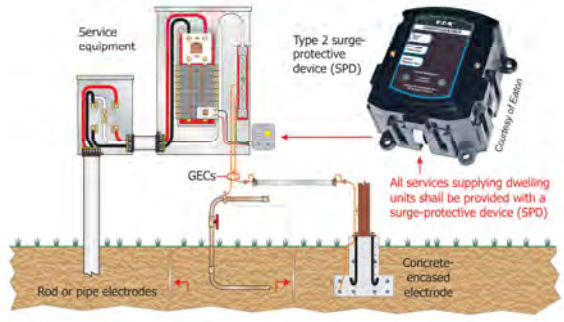
129

230.67 Surge Protection

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

130

230.67 Surge Protection for Dwelling Units



131

230.71 Maximum Number of Disconnects

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

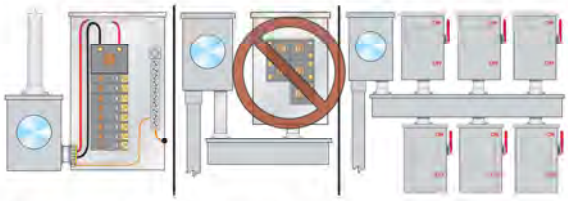
132

230.71 Maximum Number of Disconnects (cont.)

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

133

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



Service disconnecting means can be any of the following:

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

134

230.85 Emergency Disconnects

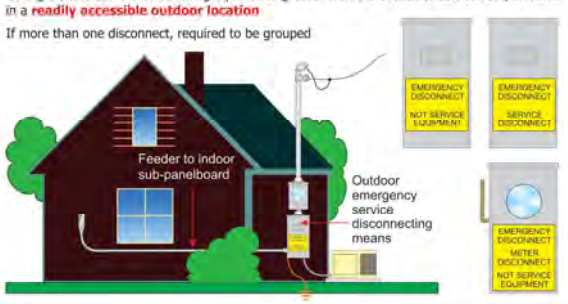
- New requirement added requiring an **emergency disconnect** at a **readily accessible outdoor location** for dwelling units
- New outdoor emergency disconnecting requirement primarily based upon providing **first responders** an outdoor accessible emergency or service disconnecting means during an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

135

230.85 Exterior Emergency Disconnect(s) for Dwelling Units

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

If more than one disconnect, required to be grouped



136

230.85 Exterior Emergency Disconnect(s) for Dwelling Units

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

Each disconnect shall be one of the following:

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

137

240.6(C) Restricted Access Adjustable-Trip Circuit Breakers

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

138

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

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

139

240.6(C) Restricted Access Adjustable-Trip Circuit Breakers

Courtesy of Eaton

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

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

(2) Located behind bolted equipment enclosure doors

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

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

140

240.87 Arc Energy Reduction

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

141

240.87 Arc Energy Reduction *(cont.)*

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

142

240.87 Arc Energy Reduction

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

Courtesy of Eaton Corporation

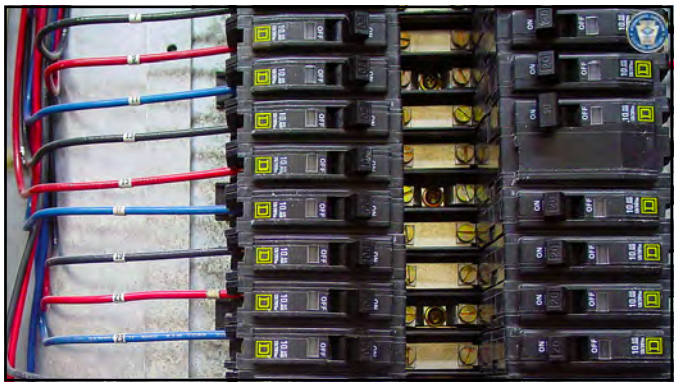
Temporary adjustment of the instantaneous trip setting to achieve arc energy reduction does not satisfy this requirement

143

240.88 Reconditioned Equipment

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

144



145

Article 242 Overvoltage Protection (New)

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

146

Article 242 Overvoltage Protection

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

Relocates previous Articles 280 and 285 into a new Article 242

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

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

147

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

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

148

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

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

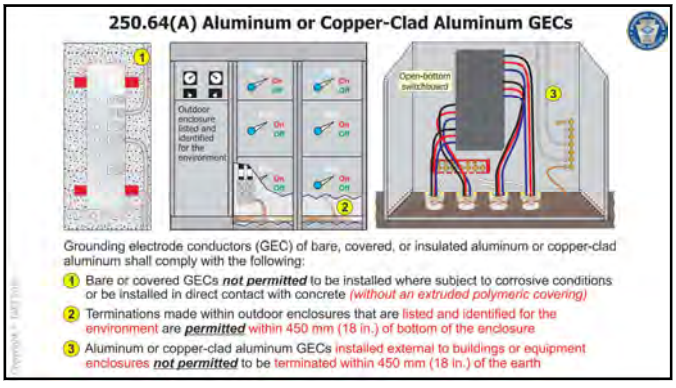
149

150

250.64(A) Aluminum or Copper-Clad Aluminum GECs

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

151

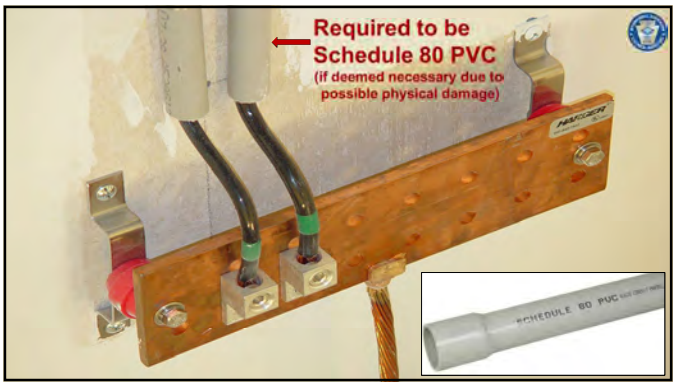


152

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

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

153



154

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

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

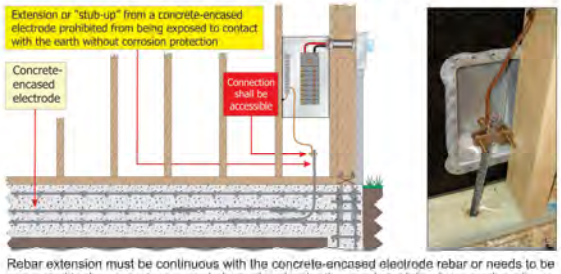
155

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

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

156

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



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

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

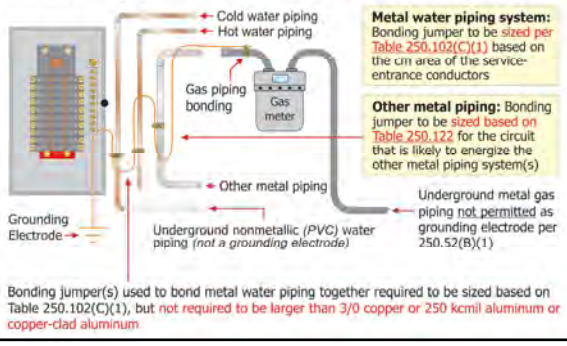
157

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

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

158

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



Metal water piping system: Bonding jumper to be sized per Table 250.102(C)(1) based on the cm area of the service-entrance conductors

Other metal piping: Bonding jumper to be sized based on Table 250.122 for the circuit that is likely to energize the other metal piping system(s)

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

159

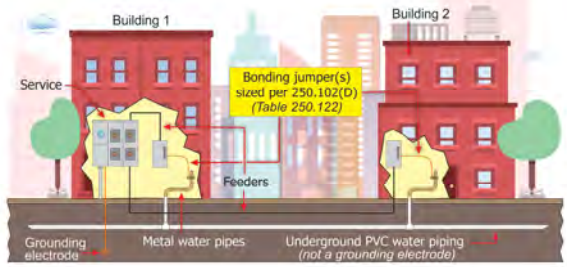
250.104(A)(3) Buildings or Structures Supplied by Feeder(s) or Branch Circuit(s)

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

160

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

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



161

250.109 Metal Enclosures

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

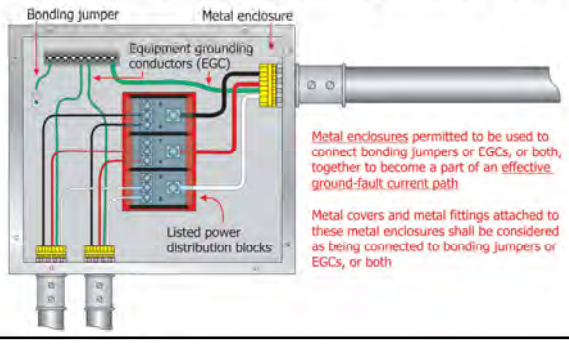
162

250.109 Metal Enclosures *(cont.)*

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

163

250.109 Metal Enclosures as an Effective Ground-Fault Path



164

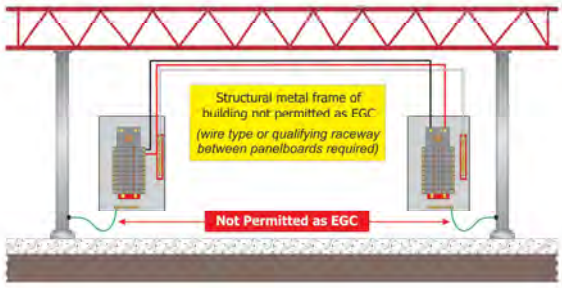
250.121(B) Restricted Use of Metal Frame of Building or Structure as EGC

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

165

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

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



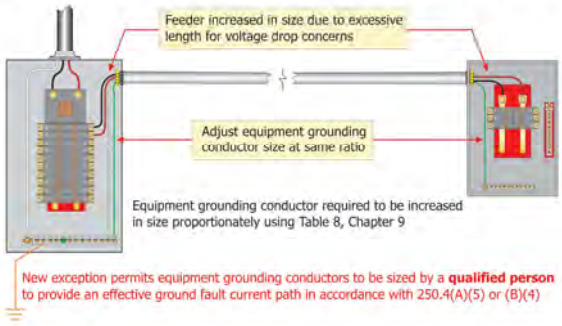
166

250.122(B) Adjustment of EGC Sizing

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

167

250.122(B) Adjusting Equipment Grounding Conductor Size



168

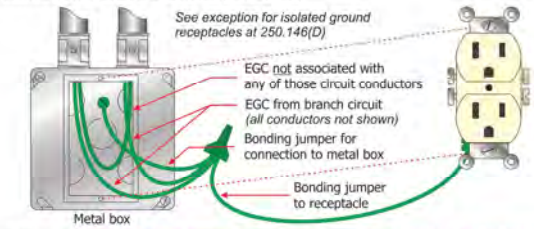
250.148 Continuity of EGCs and Attachment in Boxes

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

169

250.148 Continuity of EGCs and Attachment *In* Boxes

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



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

170

250.184(C), Exception – Multigrounded Neutral Systems

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

171

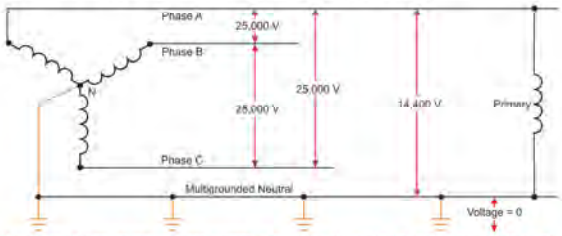
250.184(C), Exception – Multigrounded Neutral Systems *(cont.)*

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

172

250.184(C) Multigrounded Neutral Systems

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



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

173

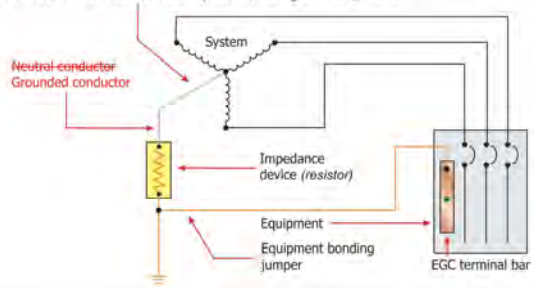
250.187 Impedance Grounded Neutral Systems

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

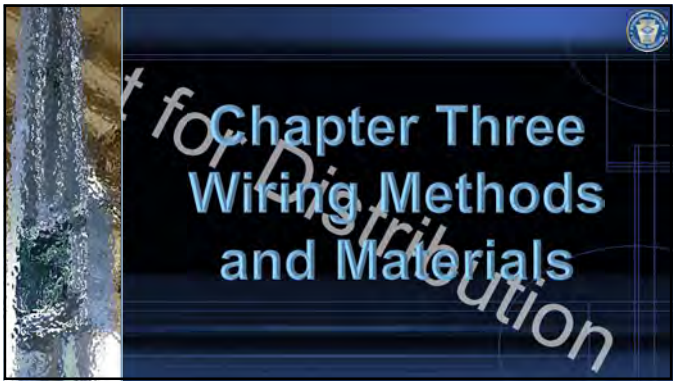
174

250.187 Impedance Grounded ~~Neutral~~ Systems

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



175



176

300.4(G) Protection Against Physical Damage - Insulated Fittings

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

177

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

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

(1) Identified fitting providing a smoothly rounded insulating surface

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

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

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

178

300.4(G) Protection Against Physical Damage - Fittings

179

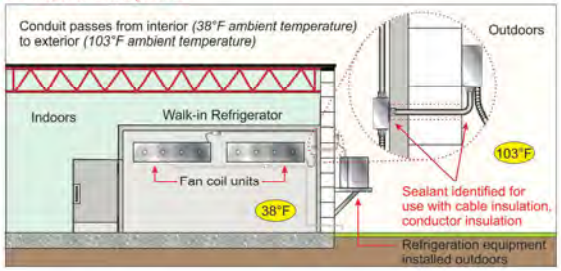
300.7(A) Raceways Exposed to Different Temperatures - Sealing

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

180

300.7(A) Raceways Exposed to Different Temperatures - Sealing

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



181

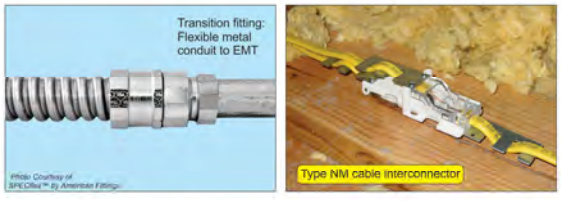
300.15(F) Boxes, Conduit Bodies, or Fittings - Where Required: Fitting

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

182

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

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



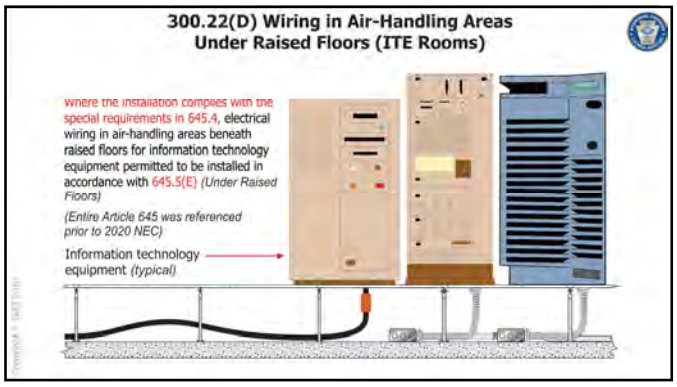
unless the fitting is listed for concealed installation

183

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

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

184



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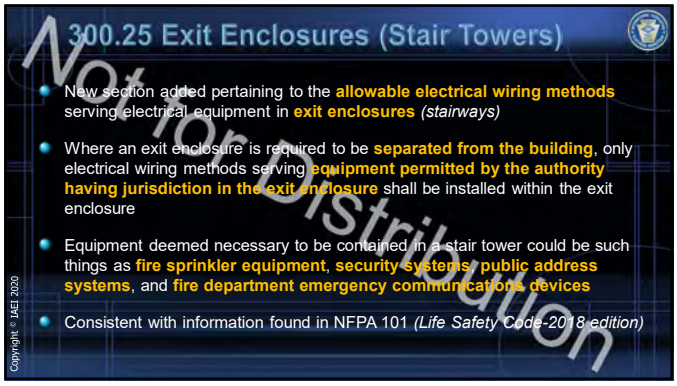
186



187

188

300.45 Warning Danger Signs

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

189

300.45 Warning Danger Signs

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

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

DANGER—HIGH VOLTAGE—KEEP OUT

190

300.45 WARNING DANGER SIGNS

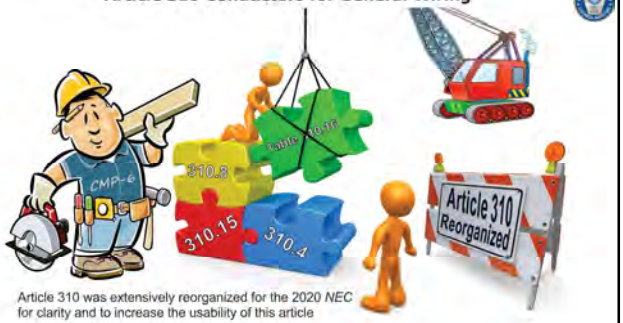
191

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)

192

Article 310 Conductors for General Wiring



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

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

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

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

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

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

2020 *NEC*	Topic	2017 *NEC*
310.10(F)	Corrosive Conditions	310.10(G
310.10(G)	Conductors in Parallel	310.10(H)
310.10(G)(1)	General	310.10(H)(1)
310.10(G)(2)	Conductor and Installation Characteristics	310.10(H)(2)
310.10(G)(3)	Separate Cables or Raceways	310.10(H)(3)
310.10(G)(4)	Ampacity Adjustment	310.10(H)(4)
310.10(G)(5)	Equipment Grounding Conductors	310.10(H)(5)
310.10(G)(6)	Bonding Jumpers	310.10(H)(6)
310.12	Single-Phase Dwelling Services and Feeders	310.15(B)(7)
310.12(A)	Services	310.15(B)(7)(1)
310.12(B)	Feeders	310.15(B)(7)(2)
310.12(C)	Feeder Ampacities	310.15(B)(7)(3)
310.12(D)	Grounded Conductors	310.15(B)(7)(4)
Table 310.12	Single-Phase Dwelling Services and Feeders	Table 310.15(B)(7) *(2011 NEC)*
310.14	Ampacities for Conductors Rated 0-2000 Volts	310.15
310.14(A)	General	310.15(A)

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

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

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

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

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

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

199

Article 310 Ampacity Tables

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

200

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

~~Table 310.16 310.15(B)(16) Allowable Ampacities of Insulated Conductors Rated Up to and Including 2000 Volts, 60°C Through 90°C (140°F Through 194°F), Not More Than Three Current-Carrying Conductors in Raceway, Cable, or Earth (Directly Buried), Based on Ambient Temperature of 30°C (86°F)~~

Size AWG or kcmil	Temperature Rating of Conductor [See Table 310.104(A).]						Size AWG or kcmil
	60°C (140°F)	75°C (167°F)	90°C (194°F)	60°C (140°F)	75°C (167°F)	90°C (194°F)	
	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, USE, ZW	Types TBS, SA, SIS, FEP, FEPB, MI, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, ZW-2	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, USE	Types TBS, SA, SIS, THHN, THHW, THW-2, THWN-2, RHH, RHW-2, USE-2, XHH, XHHW, XHHW-2, ZW-2	
	COPPER			ALUMINUM OR COPPER-CLAD ALUMINUM			
18*	—	—	14	—	—	—	—
16*	—	—	18	—	—	—	—
14*	15	20	25	—	—	—	—
12*	20	25	30	15	20	25	12*
10*	30	35	40	25	30	35	10*
8	40	50	55	35	40	45	8
6	55	65	75	40	50	55	6
4	70	85	95	55	65	75	4
3	85	100	115	65	75	85	3
2	95	115	130	75	90	100	2
1	110	130	145	85	100	115	1
1/0	125	150	170	100	120	135	1/0
2/0	145	175	195	115	135	150	2/0
3/0	165	200	225	130	155	175	3/0
4/0	195	230	260	150	180	205	4/0

1. Section 310.10 shall be referenced for conditions of use.
2. Section Refer to 310.15(B)(2) shall be referenced for the ampacity correction factors where the ambient temperature is other than 30°C (86°F).
3. Section 310.15(C)(1) Refer to 310.15(B)(3)(a) shall be referenced for more than three current-carrying conductors.

*Refer to Section 240.4(D) shall be referenced for conductor overcurrent protection limitations, except as modified elsewhere in the Code.

(Reproduction of NEC Table 310.16 (in part))

201

Article 310 Allowable Ampacity for Conductors

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

202

Article 310 ~~Allowable~~ Ampacity for Conductors

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

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

203

310.10 and Ampacity Tables – Conductor Types Added

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

204

310.10 and Ampacity Tables - Conductor Types Added

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

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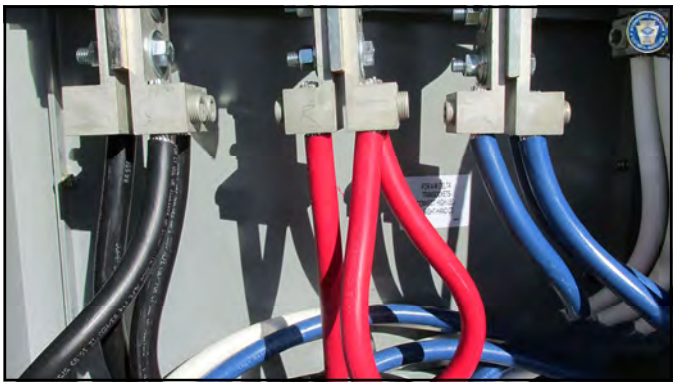


206

310.12 Single-Phase Dwelling Services and Feeders

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

207

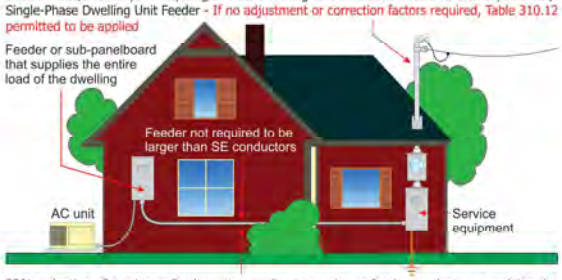
310.12 Single-Phase Dwelling Services and Feeders *(cont.)*

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

208

310.12 Permitted to be Used

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



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

209

Table 310.12 Single-Phase Dwelling Services and Feeders

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

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

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

210

Article 311 Medium Voltage Cable (New)

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

211

Article 311 Medium Voltage Cable

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

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

212

312.8(B) Power Monitoring or Energy Management Equipment

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

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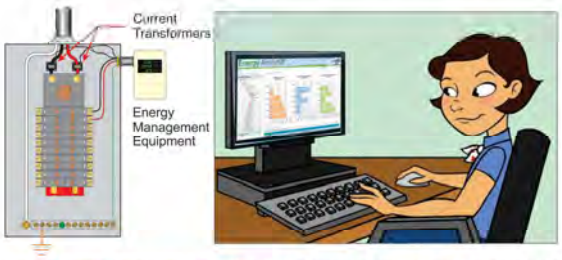
312.8(B) Power Monitoring or Energy Management Equipment



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

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

214

314.16(B)(5) EGC Box Fill Calculations

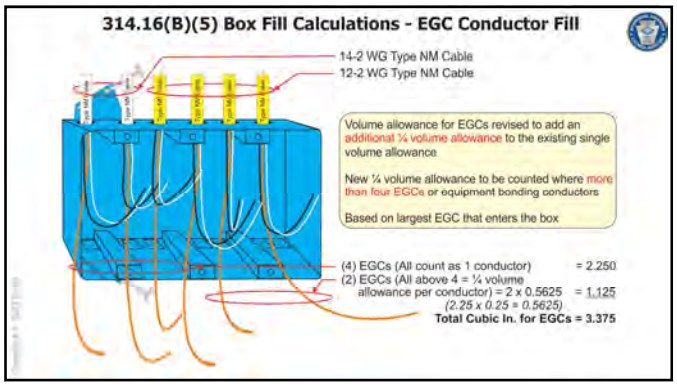
- Volume allowance for equipment grounding conductors (EGC) and equipment bonding jumpers was revised to add an **additional ¼ volume allowance** to the existing single volume allowance
- New ¼ volume allowance to be counted in installations with **more than four EGCs** or equipment bonding conductors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

215

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

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

216



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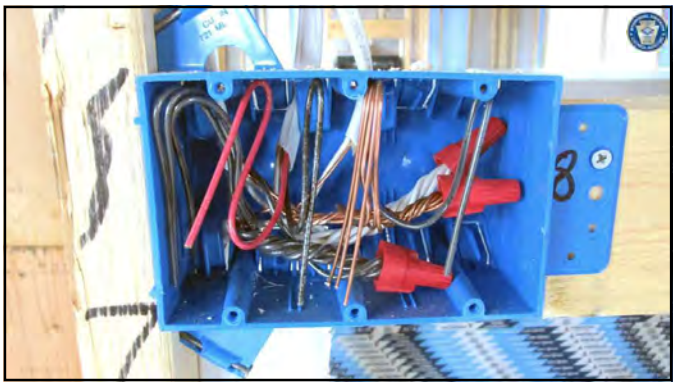

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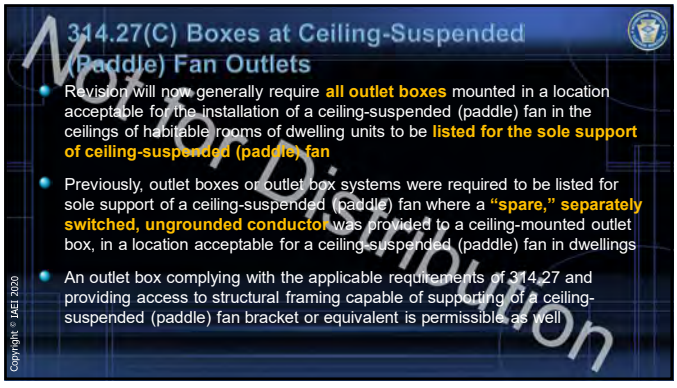

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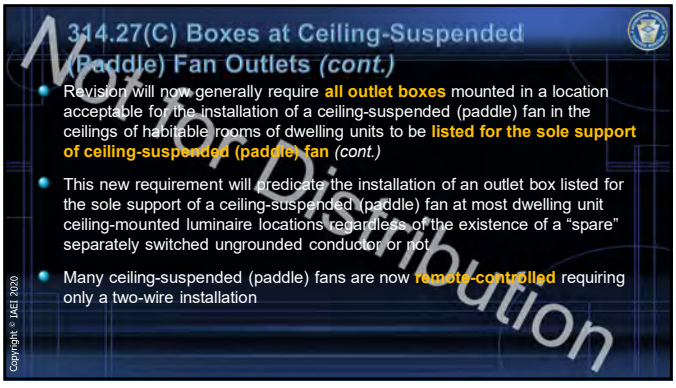

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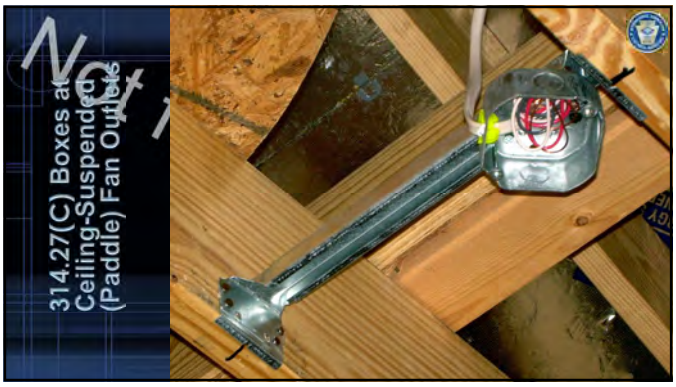

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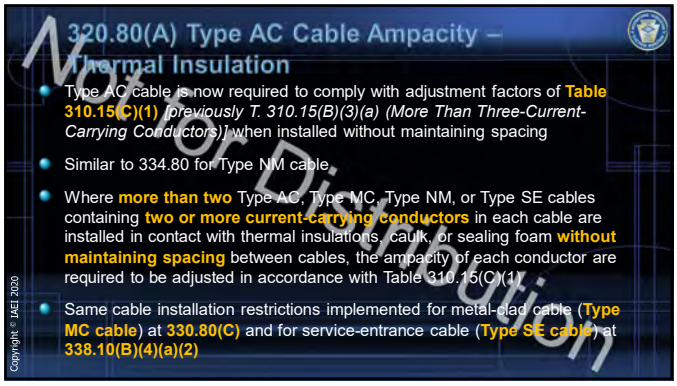

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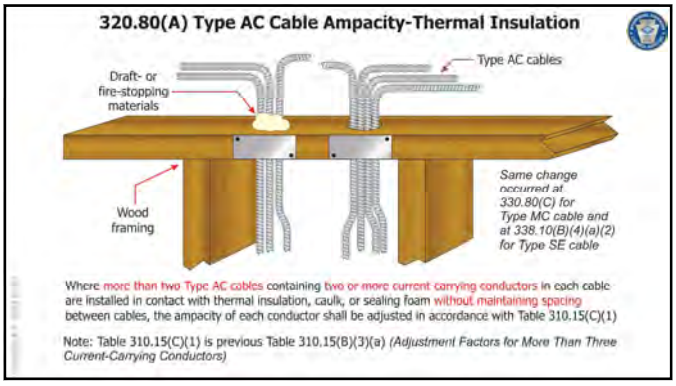

224

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

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

225

330.130 Type MC-HL in Hazardous (Classified) Locations

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

226

334.2 Nonmetallic-Sheathed Cable – Type NMS Deleted

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

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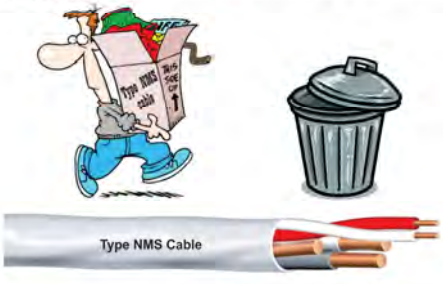
334.2 Nonmetallic-Sheathed Cable - Type NMS Deleted

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



228

334.30 Securing and Supporting of Type NM Cable

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

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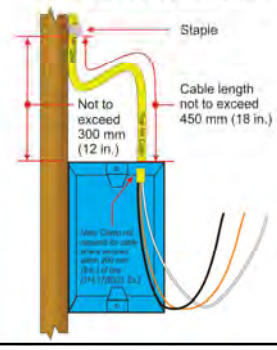
334.30 Securing and Supporting of Type NM Cable



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

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

230

Article 337 Type P Cable (New)

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

231

Article 337 - Type P Cable

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

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

232

338.2 Definitions - Service-Entrance Cables

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

233

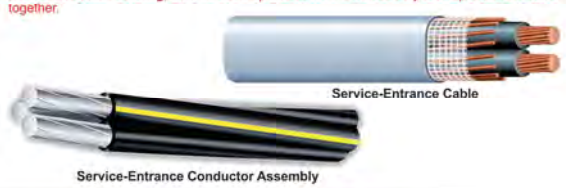
338.2 Definitions - Service-Entrance Cables

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

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

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

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



234

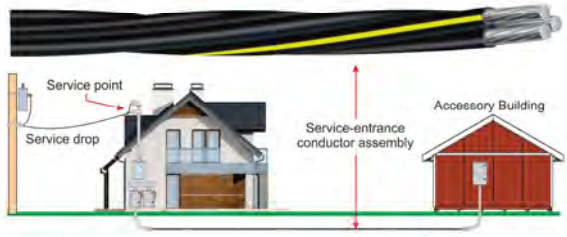
338.100 Construction of Service-Entrance Cables

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

235

338.100 Construction of Service-Entrance Cables

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



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

236

342.10(E) IMC Subject to Severe Physical Damage

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

237

342.10(E) IMC Subject to Severe Physical Damage

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

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

Intermediate Metal Conduit

238

342.14 Dissimilar Metals – Type IMC

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

239

342.14 Dissimilar Metals: Type IMC

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

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

Stainless steel IMC shall only be used with the following:

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

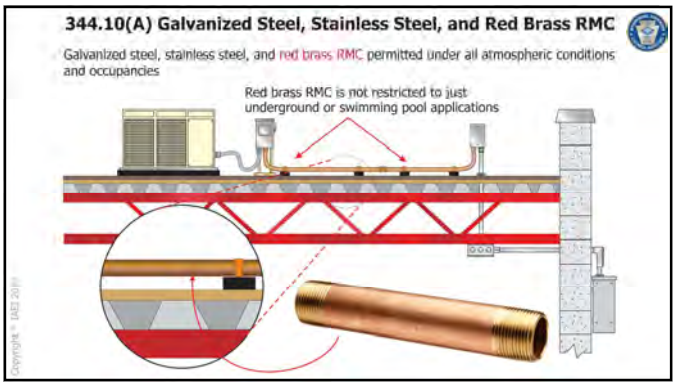
Note: *Same requirements added at 344.14 for RMC and 358.14 for EMT*

240

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

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

241



242

350.10(4) Uses Permitted for Type LFMC

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

243

244

370.20 Conductor Size and Termination (Cablebus)

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

245

370.20 I-Notes Added Cablebus Conductor Sizing and Terminations

Photo Courtesy of Power Bus Way

246

374.6 Listing Requirements - (Cellular Metal Floor Raceways)

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

247

374.6 Listing Requirements for Cellular Metal Floor Raceways

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

Cellular Metal Floor Raceway

248

380.12(7) Uses Not Permitted – Multioutlet Assemblies

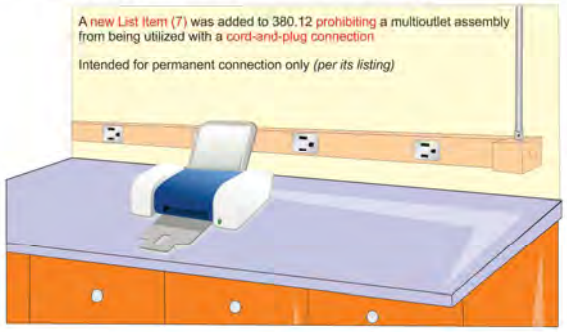
- New text added **prohibiting** a **multioutlet assembly** from being **cord and plug connected**
- Multioutlet assemblies intended for **permanent connection only** with a branch circuits *(prohibited from employing a cord and plug connection)*
- A multioutlet assembly is "a type of surface, flush,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

249

380.12(7) Multioutlet Assembly - Uses Not Permitted

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

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



250

380.12(7) Multioutlet Assembly – Uses Not Permitted

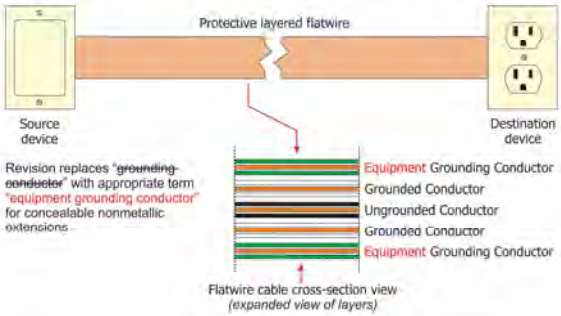
251

382.104(C) Flat Conductor EGC for Nonmetallic Extensions

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

252

382.104(C) Flat Conductor EGC for Nonmetallic Extensions



253

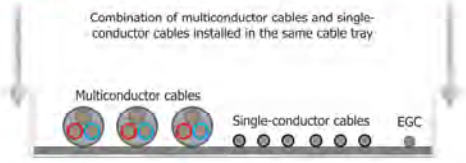
392.10 Single Conductor Cables in Cable Trays

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

254

392.10 Single-Conductor Cables in Cable Trays

Single insulated conductors shall be permitted in cable tray only when installed in accordance with 392.10(B)(1)



Single-conductor cables are required to be:
- sized at 1/0 AWG or larger
- of a type listed and marked on the surface for use in cable trays

Where 1/0 AWG through 4/0 AWG single-conductor cables are installed in ladder cable tray, the maximum allowable rung spacing not more than 225 mm (9 in.)

Single conductors equipment grounding conductors required to be insulated, covered, or bare, and sized at 4 AWG or larger

255

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

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

256

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

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

257

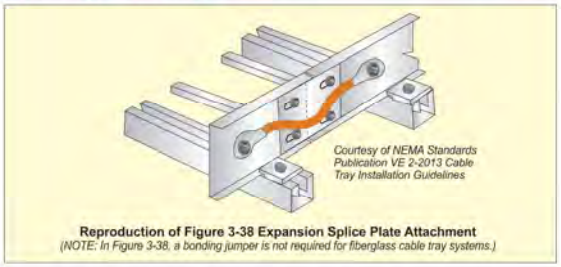
392.44 Expansion Splice Plates for Cable Trays

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

258

392.44 Expansion Splice Plates For Cable Trays

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



Reproduction of Figure 3-38 Expansion Splice Plate Attachment
(NOTE: In Figure 3-38, a bonding jumper is not required for fiberglass cable tray systems.)

259

392.46 Bushed Conduit and Tubing at Cable Trays

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

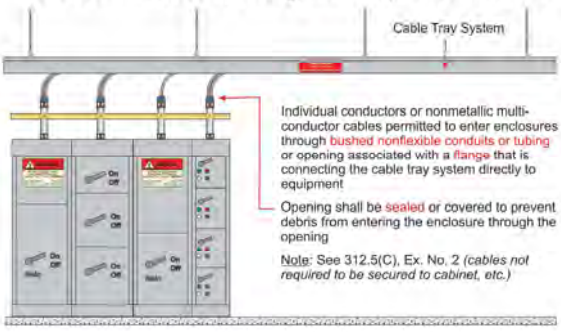
260

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

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

261

392.46 Bushed Conduit, Tubing, and Flanges at Cable Trays

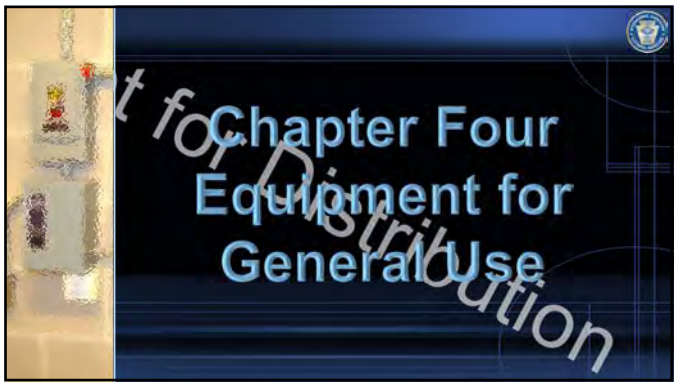


262

392.46 Bushed Conduit and Tubing for Cable Trays

263

264



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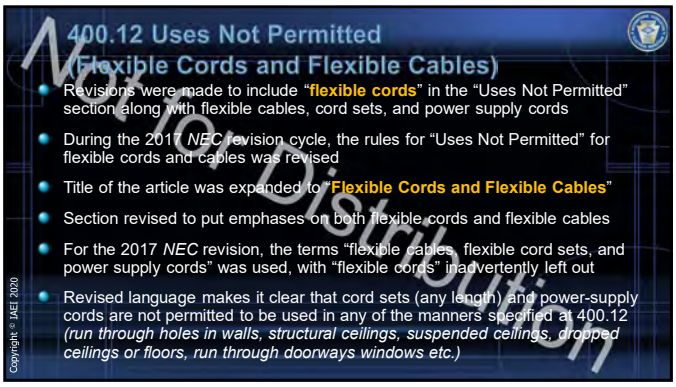

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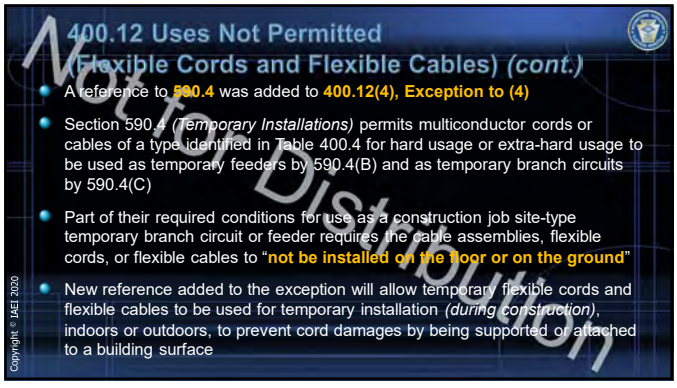

267

268

Table 402.3 Fixture Wires

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

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Table 402.3 Fixture Wires *(in part)*

Name	Type Letter	Insulation	AWG	Thickness of Insulation mm	Thickness of Insulation mils	Outer Covering	Max. Operating Temperature	Application Provisions
Heat-resistant rubber-covered fixture wire - flexible stranding	FFH-2	Heat-resistant rubber or	18-16	0.78	30	Nonmetallic covering	75°C (167°F)	Fixture wiring
	~~FFHH-2~~	~~Cross~~ (2016) linked synthetic polymer	~~18-16~~	~~0.76~~	~~30~~		~~90°C (194°F)~~	
ECTFE-solid or 7-strand	HF	Ethylene chloro-trifluoroethylene	18-14	0.38	15	None	150°C (302°F)	Fixture wiring
ECTFE-flexible stranding	HFF	Ethylene chlorotrifluo-roethylene	18-14	0.38	15	None	150°C (302°F)	Fixture wiring
Tape insulated fixture wire - solid or 7-strand	KF-1	Aromatic polyimide tape	18-10	0.14	5.5	None	200°C (392°F)	Fixture wiring -limited to 300 volts
	KF-2	Aromatic polyimide tape	18-10	0.21	8.4	None	200°C (392°F)	Fixture wiring
Tape insulated fixture wire-flexible stranding	KFF-1	Aromatic polyimide tape	18-10	0.14	5.5	None	200°C (392°F)	Fixture wiring -limited to 300 volts
	KFF-2	Aromatic polyimide tape	18-10	0.21	8.4	None	200°C (392°F)	Fixture wiring

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

Reproduction of NEC Table 402.3 (in part)

270

404.7 Indicating Requirements for Switches

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

271

404.7 Indicating Requirements for Switches

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

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

272

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

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

273

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

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

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

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

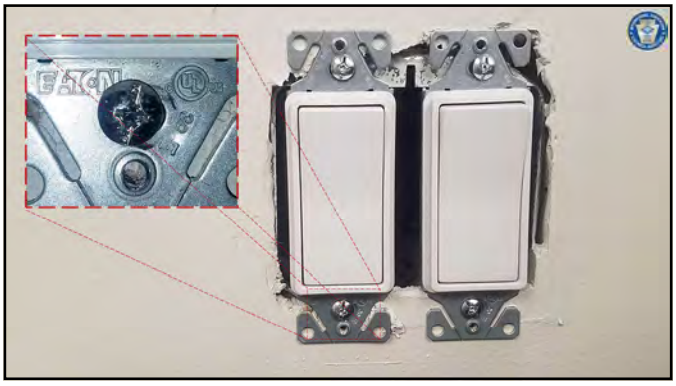
Snap Switches | Dimmers | Control Switches

274

404.14 Rating and Use of Switches

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

275



276

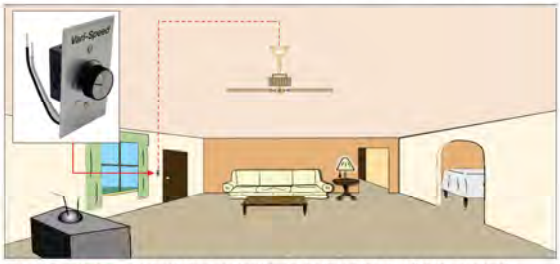
404.22 Electronic Lighting Control Switches

- 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"

277

404.22 Electronic ~~Lighting~~ Control Switches

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



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

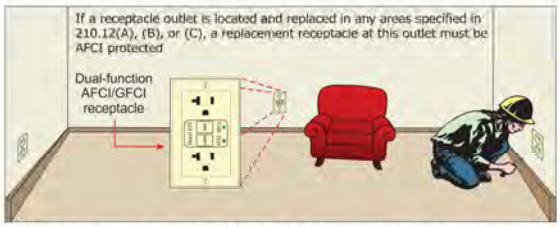
278

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

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

279

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



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

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

280

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

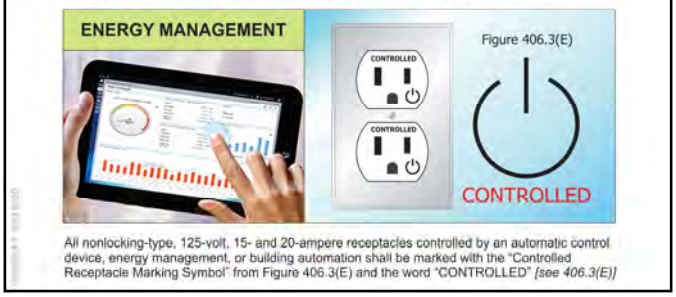
- Automatically controlled receptacles are now required to be replaced with **equivalently controlled receptacles**
- Section **406.3(E)** provides **identification marking requirements** of controlled receptacle *(marked with the word "Controlled" on the controlled receptacle along with a controlled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

281

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

Automatically controlled receptacles to be replaced with equivalently controlled receptacles

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



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

282

406.5(G)(2) Receptacle Mounting Under Sinks

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

283

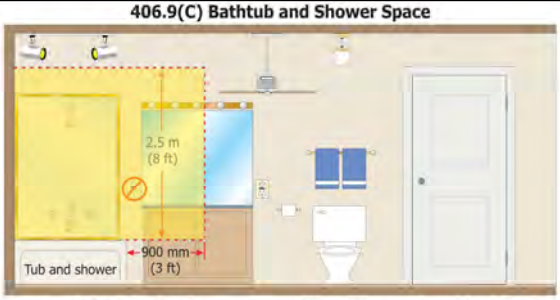
284

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

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

285

406.9(C) Bathtub and Shower Space

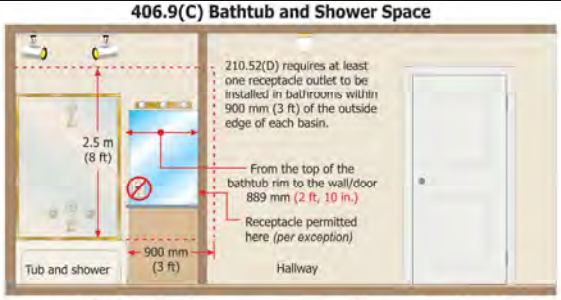


Receptacles shall not be installed within a zone measured 900 mm (3 ft) horizontally and 2.5 m (8 ft) vertically from the top of the bathtub rim or shower stall threshold.

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

286

406.9(C) Bathtub and Shower Space



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

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

287

406.12 Tamper-Resistant Receptacles

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

288

406.12 Tamper-Resistant Receptacles *(cont.)*

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

289

406.12 Tamper-Resistant Receptacles

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

Attached and detached garages and accessory buildings to dwelling units

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

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

290

406.12 Tamper-Resistant Receptacles

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

Attached and detached garages and accessory buildings to dwelling units

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

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

291

406.13 Single-Pole Separable-Connector Type

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

292

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

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

293

406.13 Single-Pole Separable-Connectors

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

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

294

408.4(A) Circuit Directory or Circuit Identification

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

295

408.4(A) Circuit Directory or Circuit Identification

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

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

296

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

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

297

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

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

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

298

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

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

299

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

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

300

408.8 Reconditioning of Equipment for Switchboards, Switchgear, and Panelboards

Panelboards NOT Permitted to be Reconditioned

Switchboards and Switchgear Permitted to be Reconditioned

*See also 110.21(A)(2)

Panelboards shall not be permitted to be reconditioned

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

301

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

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

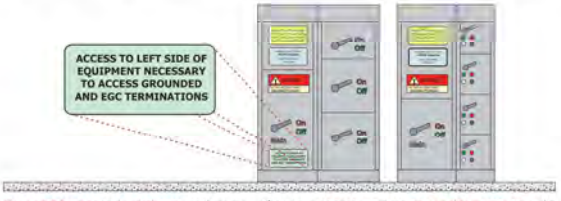
302

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

303

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



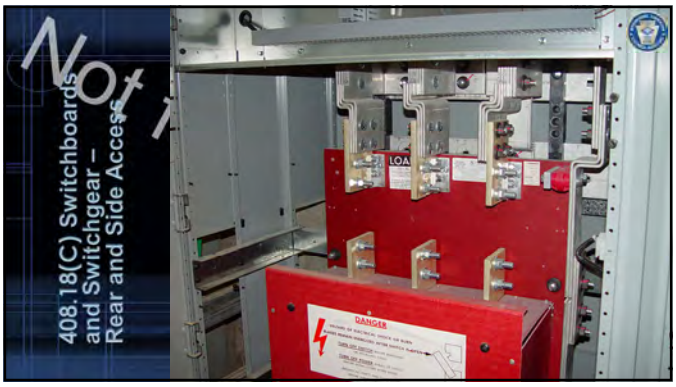
For switchboards and switchgear, each section of equipment that requires rear or side access to make field connections shall be so marked by the manufacturer on the front of said equipment

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

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

304

305



306

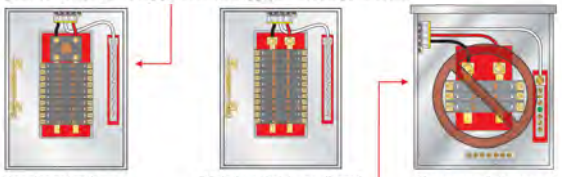
408.36 Overcurrent Protection for Panelboards

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

307

408.36 Overcurrent Protection for Panelboards

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



Panelboard with main in same cabinet

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

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

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

308

408.43 Panelboard Orientation

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

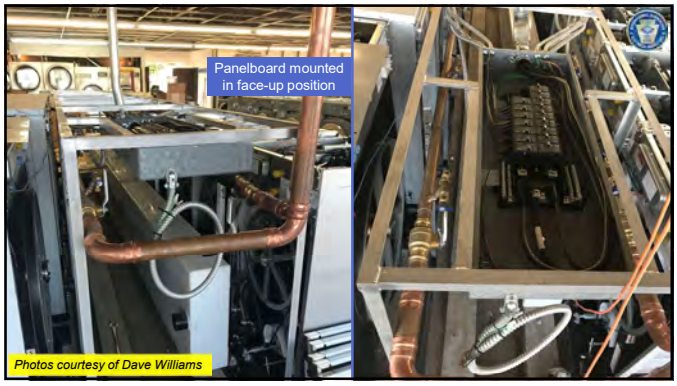
309

408.43 Panelboard Orientation

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

310

408.43 Panelboard Orientation



Photos courtesy of Dave Williams

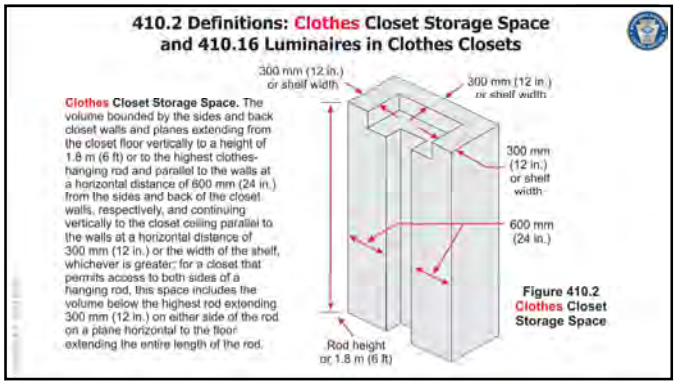
311

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

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

312

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

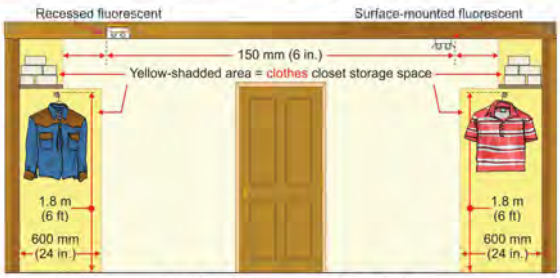


Clothes Closet Storage Space. The volume bounded by the sides and back closet walls and planes extending from the closet floor vertically to a height of 1.8 m (6 ft) or to the highest clothes-hanging rod and parallel to the walls at a horizontal distance of 600 mm (24 in.) from the sides and back of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

Figure 410.2 Clothes Closet Storage Space

313

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



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

314

410.36(A) Luminaires Supported By Outlet Boxes

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

315

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

- Revision illustrates that luminaires can be supported in accordance with **separable attachment fittings** and these outlet boxes are considered lighting outlets *(cont.)*
- **Separable attachment fittings** incorporate listed power supply devices and listed locking support and mounting receptacles and supporting means as an option for mounting and supporting luminaires, lampholders, and ceiling suspended (paddle) fans
- Same basic change at **new 422.22** for appliances and installing a ceiling suspended (paddle) fan

316

410.36(A) Luminaires Supported By Outlet Boxes

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

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

317

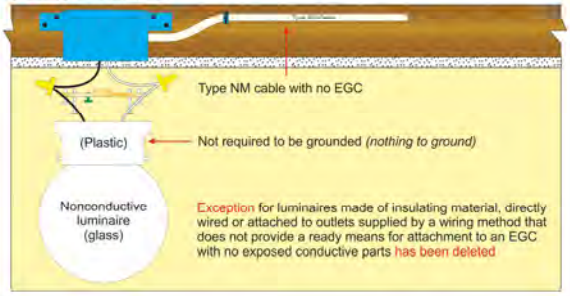
410.44 Methods of Grounding Luminaires

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

318

410.44 Methods of Grounding Luminaires

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



319

410.69 Identification of Control Conductors

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

320

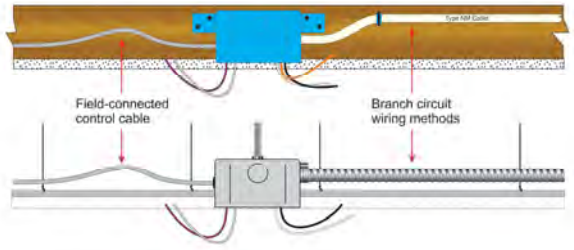
410.69 Identification of Control Conductors (cont.)

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

321

410.69 Identification of Control Conductor

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



322

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

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

323

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

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

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

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

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

324

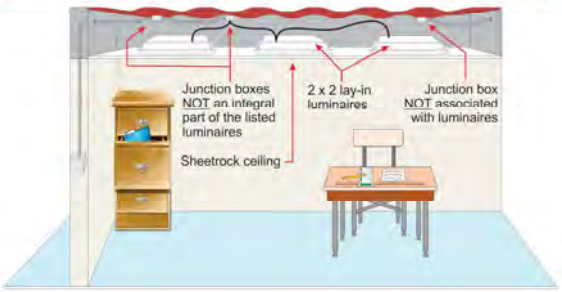
410.118 Access to Other Boxes

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

325

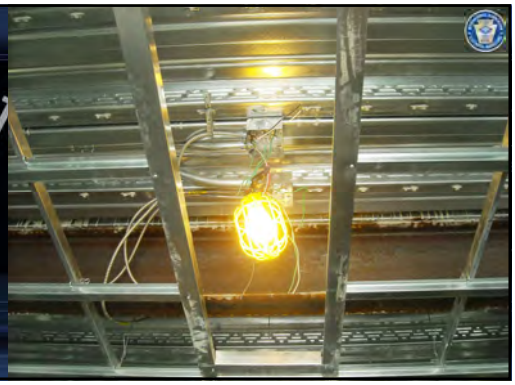
410.118 Access to Other Boxes

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



326

410.118 Access to Other Boxes (thru Luminaires)



327

Article 410, Part XVI Special Provisions for Horticultural Lighting Equipment

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

328

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

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

329

Article 410, Part XVI
Special Provisions for Horticultural Lighting Equipment

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

330

422.5(A) GFCI Protection for Appliances

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

331

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)
  - Article 210 is dedicated to the requirements for branch circuits *(better served by having the all the GFCI requirements for appliances located in Article 422)*
  - 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. ***(previously limited to dwelling unit dishwashers)***

332

422.5(A) GFCI Protection for Appliances

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

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

333

422.5(A) GFCI Protection for Appliances

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

Automotive vacuum machines | Tire inflation machines

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

334

422.5(A) GFCI Protection for Appliances

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

Drinking water coolers | Bottle fill stations

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

335

422.5(A) GFCI Protection for Appliances

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

Sump pumps | Sump pumps

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

336

422.5(A) GFCI Protection for Appliances

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

Dishwashers (Dwelling units)

Dishwashers (Non-dwelling unit)

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

337

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

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

338

422.16(B)(2) Built-In Dishwashers

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

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

339

340

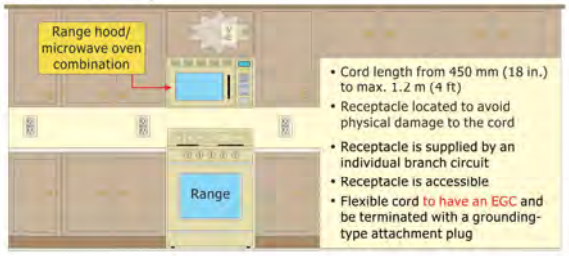
422.16(B)(4) Range Hoods and Microwave Oven/Range Hood Combinations

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

341

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

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



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

342

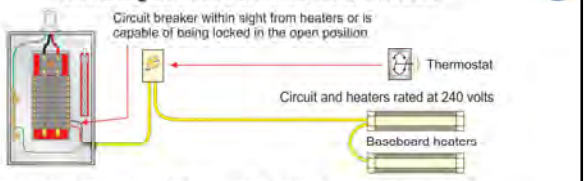
343

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

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

344

424.20(A) Thermostatically Controlled Switching Devices Permitted as Disconnect



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

(1) It has a marked "OFF" position

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

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

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

(5) Located in an accessible location

345

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

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

346

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

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

347

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

348

430.2 Electronically Protected Motor

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

349

350

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

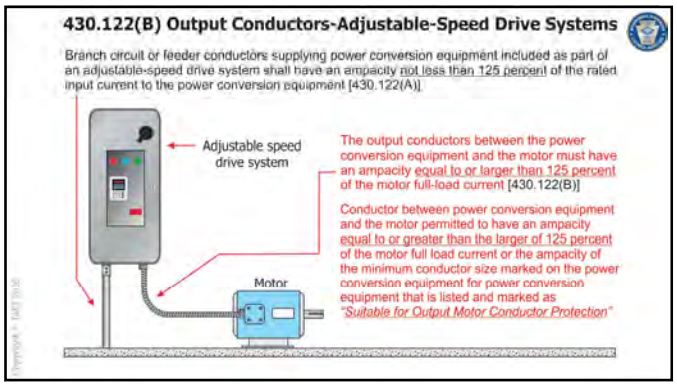
- New provisions added requiring **output conductors** between power conversion equipment and a motor to generally have an ampacity **equal to or larger than 125 percent** of the motor full-load current *(with one exception)*
- **Supply conductors** supplying power conversion equipment included as part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

351

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

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

352



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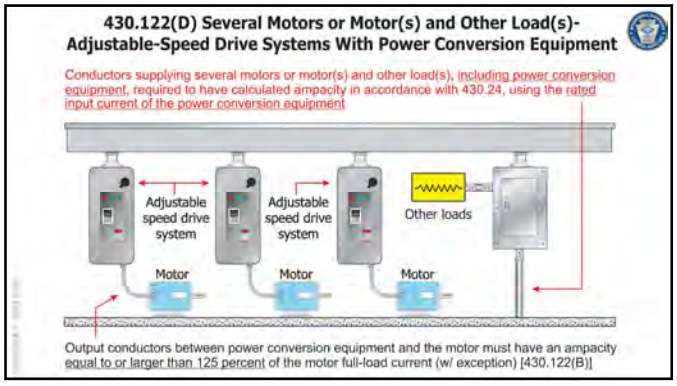

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356

440.9 Grounding and Bonding – Rooftop HACR Equipment

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

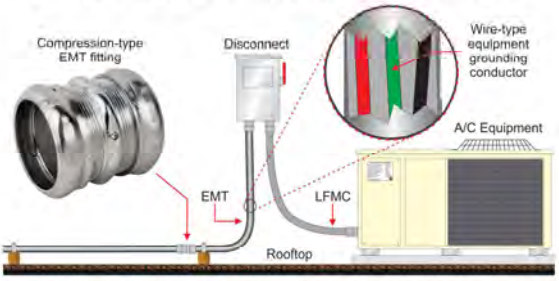
357

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

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

358

440.9 Grounding and Bonding-Rooftop HACR Equipment



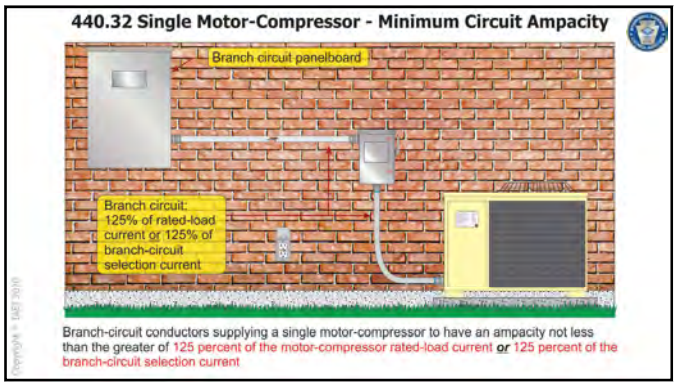
Where ~~multimotor and combination-load~~ equipment is installed outdoors on a roof, a wire type equipment grounding conductor is required to be installed in outdoor portions of metallic raceway systems that utilize ~~non-threaded~~ compression-type fittings

359

440.32 Single Motor-Compressor – Minimum Circuit Ampacity

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

360



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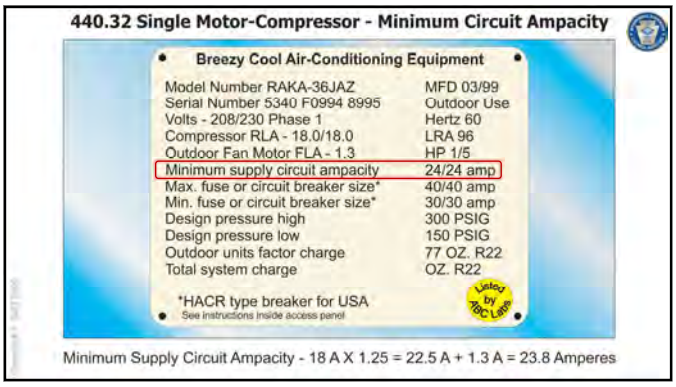

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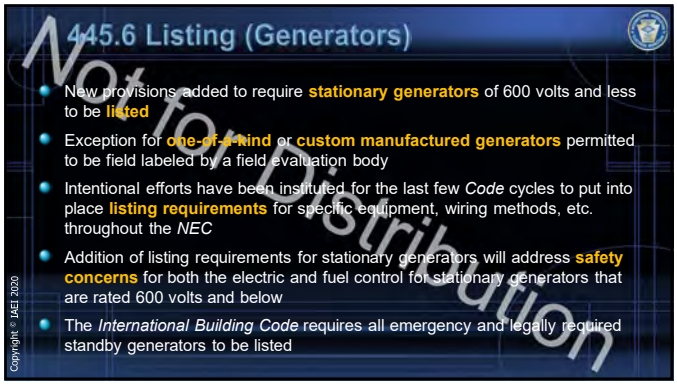


363

364

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

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

365

445.18(D) Emergency Shutdown Device at Dwelling Units

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

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

366

450.9 Horizontal Transformer Top Prohibited as Storage

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

367

450.9 Horizontal Transformer Tops Prohibited as Storage

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

368

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

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

369

480.7(G) Identification of Power Sources

CAUTION: MULTIPLE SOURCES OF POWER

BATTERY STORAGE DISCONNECT LOCATED AT NE CORNER OF BUILDING

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

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

370

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

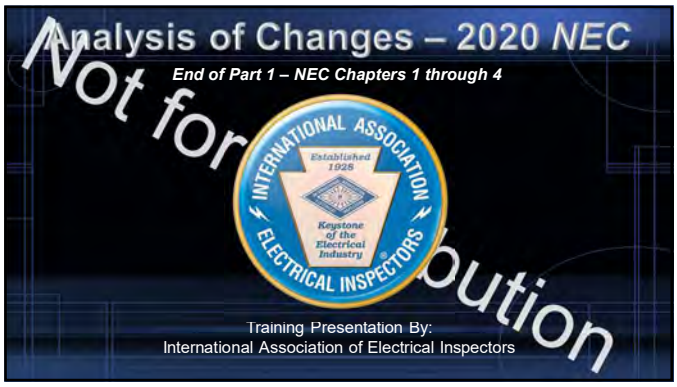
- **Retrofit trip units** are now required to be **listed for use** with the specific circuit breaker with which it is installed
- For circuit breakers and equipment rated over 1000 volts, nominal, retrofit trip units have become more commonplace over the past decade
- Retrofit trip units are designed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

371

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

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

372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Analysis of Changes – 2020 *NEC*

Part 2 – NEC Chapters 5 through 9

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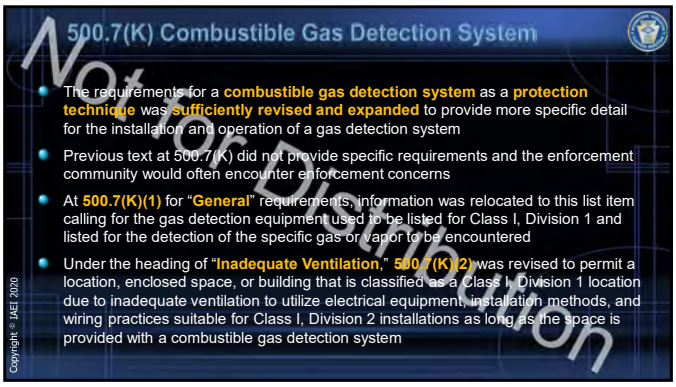
4


Chapter Five
Special
Occupancies
Not for Distribution

5


500.7(K) Combustible Gas Detection System
Not for Distribution
The requirements for a combustible gas detection system as a protection technique was sufficiently revised and expanded to provide more specific detail for the installation and operation of a gas detection system
Previous text at 500.7(K) did not provide specific requirements and the enforcement community would often encounter enforcement concerns
At 500.7(K)(1) for "General" requirements, information was relocated to this list item calling for the gas detection equipment used to be listed for Class I, Division 1 and listed for the detection of the specific gas or vapor to be encountered
Under the heading of "Inadequate Ventilation," 500.7(K)(2) was revised to permit a location, enclosed space, or building that is classified as a Class I, Division 1 location due to inadequate ventilation to utilize electrical equipment, installation methods, and wiring practices suitable for Class I, Division 2 installations as long as the space is provided with a combustible gas detection system
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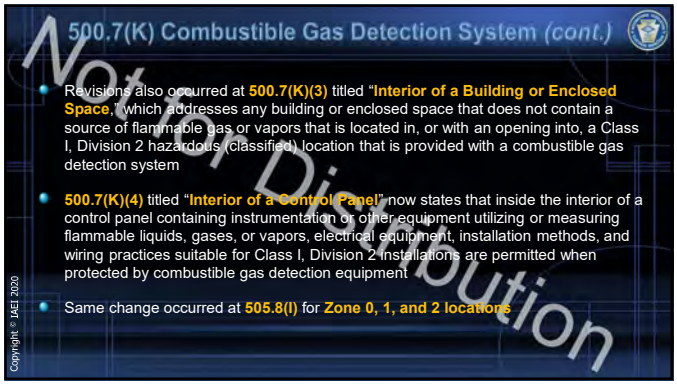
500.7(K) Combustible Gas Detection System (cont.)
Not for Distribution
Revisions also occurred at 500.7(K)(3) titled "Interior of a Building or Enclosed Space," which addresses any building or enclosed space that does not contain a source of flammable gas or vapors that is located in, or with an opening into, a Class I, Division 2 hazardous (classified) location that is provided with a combustible gas detection system
500.7(K)(4) titled "Interior of a Control Panel" now states that inside the interior of a control panel containing instrumentation or other equipment utilizing or measuring flammable liquids, gases, or vapors, electrical equipment, installation methods, and wiring practices suitable for Class I, Division 2 installations are permitted when protected by combustible gas detection equipment
Same change occurred at 505.8(I) for Zone 0, 1, and 2 locations
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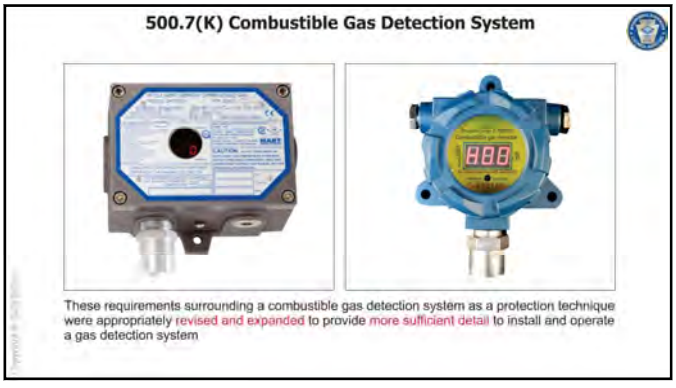
500.7(K) Combustible Gas Detection System
These requirements surrounding a combustible gas detection system as a protection technique were appropriately revised and expanded to provide more sufficient detail to install and operate a gas detection system

8

500.7 Protections Techniques for Hazardous (Classified) Locations

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

9

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

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

10

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

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

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500.7 Protections Techniques for Hazardous (Classified) Locations

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

12

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

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

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

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

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

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

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

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

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

15

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

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

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

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

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511.12 GFCI Protection at Commercial Garages, Repair and Storage

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

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

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

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511.12 GFCI Protection at Commercial Repair and Storage Garages

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

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

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

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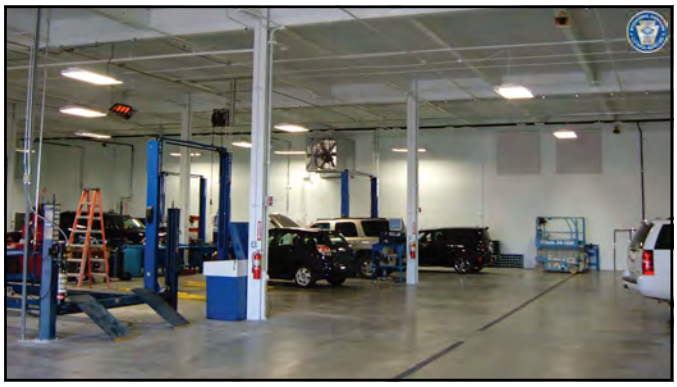

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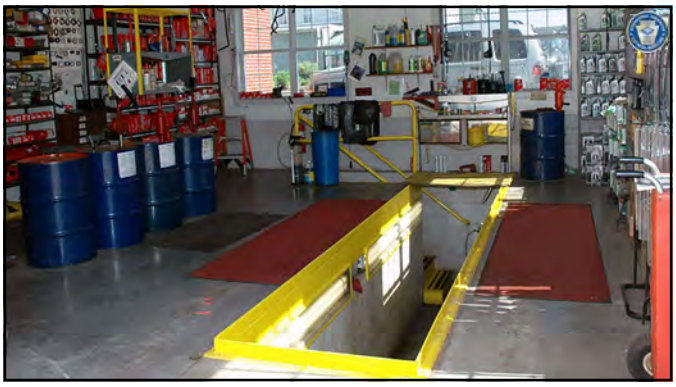

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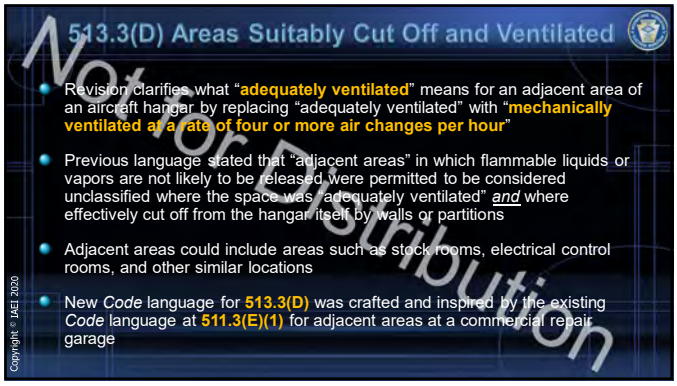
513.3(D) Areas Suitably Cut Off and Ventilated
Revision clarifies what "adequately ventilated" means for an adjacent area of an aircraft hangar by replacing "adequately ventilated" with "mechanically ventilated at a rate of four or more air changes per hour"
Previous language stated that "adjacent areas" in which flammable liquids or vapors are not likely to be released were permitted to be considered unclassified where the space was "adequately ventilated" and where effectively cut off from the hangar itself by walls or partitions
Adjacent areas could include areas such as stock rooms, electrical control rooms, and other similar locations
New Code language for 513.3(D) was crafted and inspired by the existing Code language at 511.3(E)(1) for adjacent areas at a commercial repair garage
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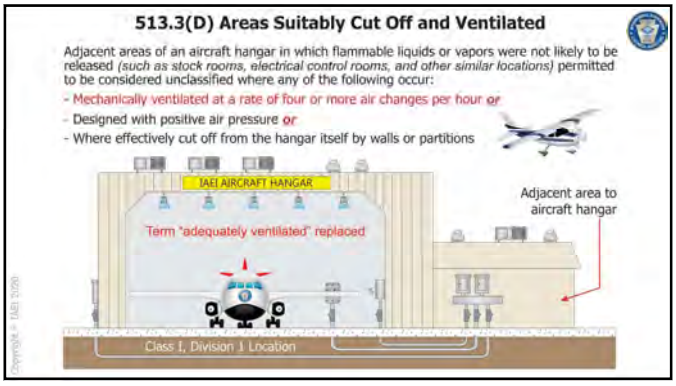
513.3(D) Areas Suitably Cut Off and Ventilated
Adjacent areas of an aircraft hangar in which flammable liquids or vapors were not likely to be released (such as stock rooms, electrical control rooms, and other similar locations) permitted to be considered unclassified where any of the following occur:
- Mechanically ventilated at a rate of four or more air changes per hour or
- Designed with positive air pressure or
- Where effectively cut off from the hangar itself by walls or partitions
IAEI AIRCRAFT HANGAR
Term "adequately ventilated" replaced
Adjacent area to aircraft hangar
Class I, Division 1 Location

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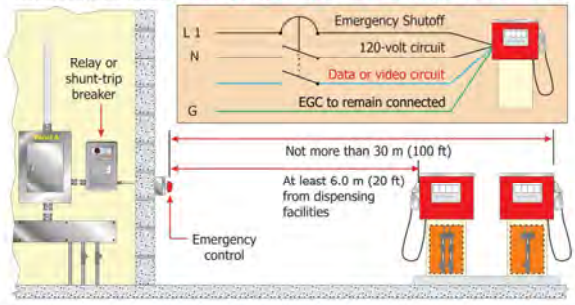
514.11(A) Emergency Electrical Disconnects for Motor Fuel Dispensing Facilities

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

25

514.11(A) Emergency Controls for Fuel Dispensers

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



26

517.10(B) Applicability (Health Care Facilities)

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

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517.16 Use of Isolated Ground Receptacles for Health Care Facilities

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

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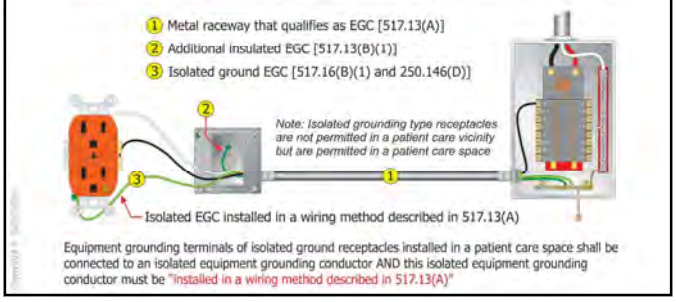
517.16 Use of Isolated Ground Receptacles

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



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

30

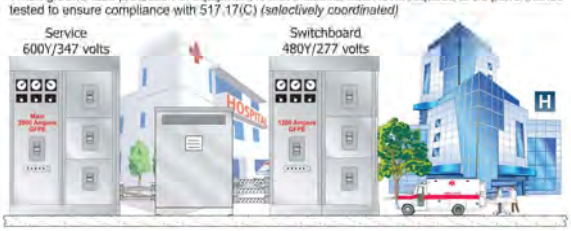
517.17(D) Performance Testing of GFP Equipment at Health Care Facilities

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

31

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

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



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

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

32

517.26 Application of Other Articles (Health Care Facilities)

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

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

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

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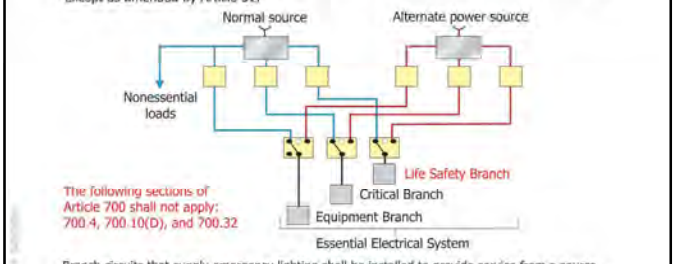
517.26 Application of Other Articles (Health Care Facilities)

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



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

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

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

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

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

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

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

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

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

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

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518.6 Outdoor Illumination (Assembly Occupancies)

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

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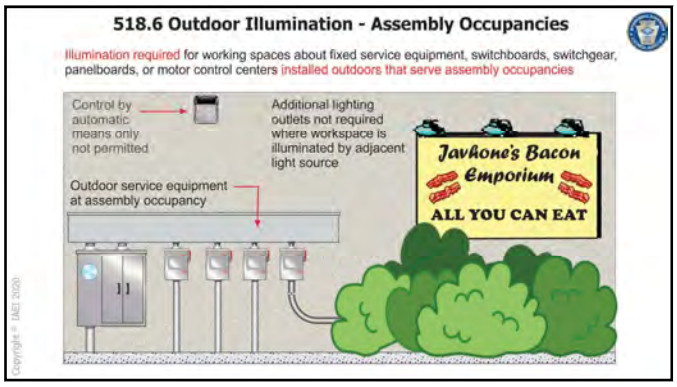
518.6 Outdoor Illumination - Assembly Occupancies
Illumination required for working spaces about fixed service equipment, switchboards, switchgear, panelboards, or motor control centers installed outdoors that serve assembly occupancies
Control by automatic means only not permitted
Additional lighting outlets not required where workspace is illuminated by adjacent light source
Outdoor service equipment at assembly occupancy
JavAone's Bacon Emporium
ALL YOU CAN EAT

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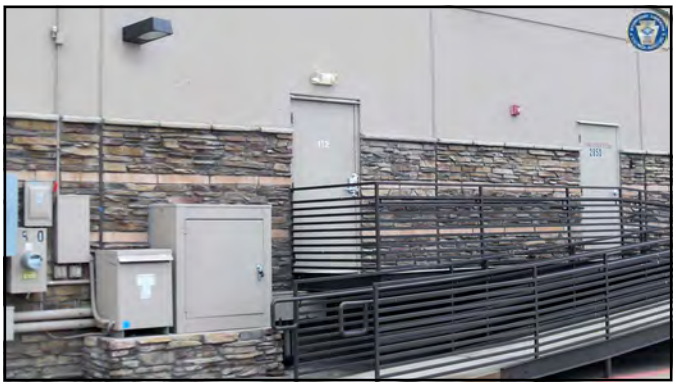

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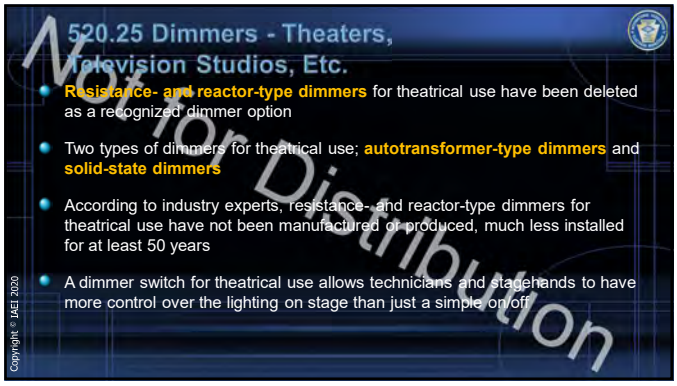
520.25 Dimmers - Theaters, Television Studios, Etc.
Resistance- and reactor-type dimmers for theatrical use have been deleted as a recognized dimmer option
Two types of dimmers for theatrical use; autotransformer-type dimmers and solid-state dimmers
According to industry experts, resistance- and reactor-type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

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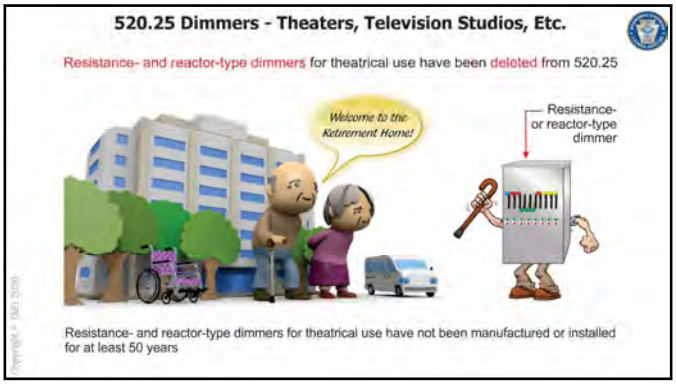
520.25 Dimmers - Theaters, Television Studios, Etc.
Resistance- and reactor-type dimmers for theatrical use have been deleted from 520.25
Welcome to the Retirement Home!
Resistance- or reactor-type dimmer
Resistance- and reactor-type dimmers for theatrical use have not been manufactured or installed for at least 50 years

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

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

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

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

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

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

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

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525.20(G) Protection of Flexible Cords or Cables

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

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

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

48

Article 545 Manufactured Buildings and Relocatable Structures

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

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

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

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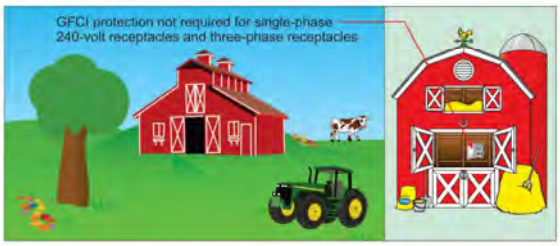
547.5(G) GFCI Protection at Agricultural Buildings

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

53

547.5(G) GFCI Protection at Agricultural Buildings

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



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

54

547.9 Electrical Supply from a Distribution Point (Agricultural Buildings)

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

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

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

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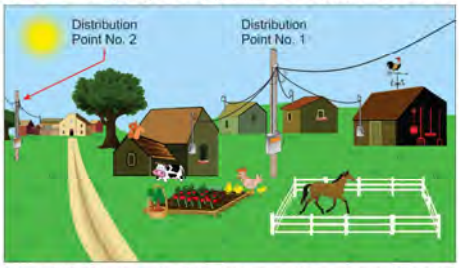
547.9 Electrical Supply from a Distribution Point

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



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

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550.13(B) GFCI Protection for Mobile and Manufactured Homes

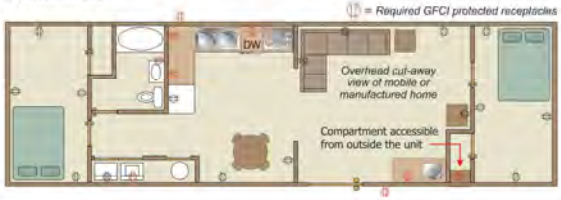
- Language was revised to include **210.8(A)**, which will provide GFCI protection to those additional locations at a dwelling covered in 210.8(A) for a mobile or manufactured home such as a **detached garage**
- **210.8(A)** revelation will allow CMP-7 *(purview over Article 550)* to stop "**chasing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

58

550.13(B) GFCI Required for Mobile and Manufactured Homes

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

GFCI protection not required for other than 125-volt, 15- and 20-ampere receptacles installed within a mobile or manufactured home in the following areas:
(1) Compartments accessible from outside the unit
(2) Bathrooms (including receptacles in luminaires)
(3) Kitchens, where receptacles are installed to serve countertop surfaces
(4) Sinks, where receptacle(s) are installed within 1.8 m (6 ft) of the outer edge of a sink
(5) Dishwashers



59

550.32(E) Supply Receptacles for Mobile or Manufactured Homes

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

60

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

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

61

550.32(E) Supply Receptacles for Mobile or Manufactured Homes

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

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

62

551.40(D) Reverse Polarity Devices for RVs

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

63

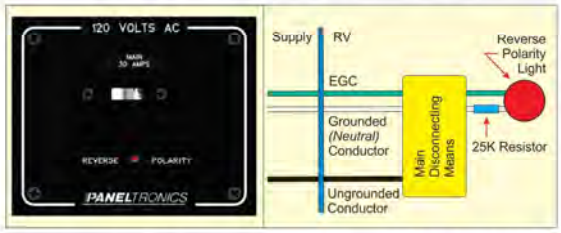
551.40(D) Reverse Polarity Devices for RVs *(cont.)*

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

64

551.40(D) Reverse Polarity Device for RVs

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



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

65

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

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

66

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

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

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

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

67

555.2 Definitions - Marinas, Boatyards, Etc.

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

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

68

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

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

69

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

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

70

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

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

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

71

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

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

72

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

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

73

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

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

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

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

74

75

76

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

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

Photo courtesy of Marina Electrical Equipment (MEE)

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

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

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

77

Article 555 Part III – Floating Buildings

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

78

79

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

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

80

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

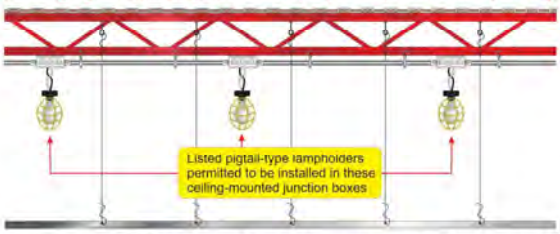
- On construction sites, a **new exception** to 590.4(G) permits branch-circuits that are **permanently installed** in framed walls and ceilings to be used for **temporary power or lighting** *(with GFCI protection) (cont.)*
- Viable solution is to **temporarily energize** one or more of the **permanently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

81

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

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

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



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

82

590.8 Overcurrent Protective Devices (Temporary Installations)

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

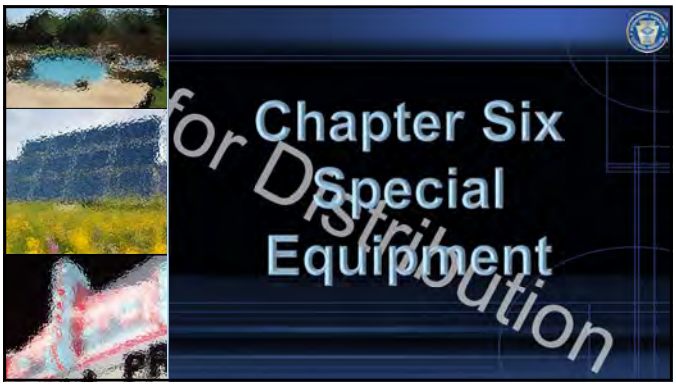
83

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

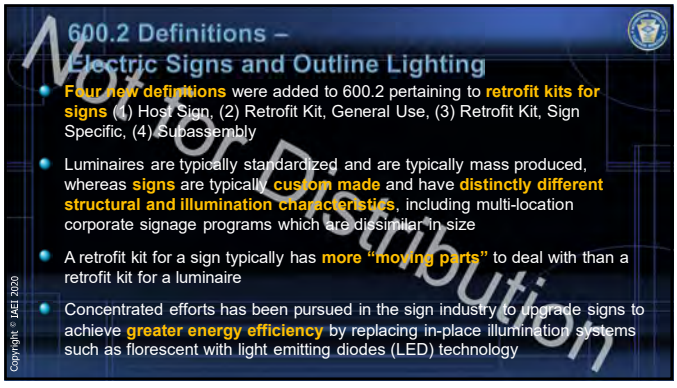
- New **590.8(A)** mandates that overcurrent protective devices be examined to ensure that these devices have been "**properly installed**," "**properly maintained**," and there is "**no evidence of impending failure**" whenever these overcurrent protective devices have been previously used are installed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

84

85


Chapter Six
Special
Equipment
for Distribution

86


600.2 Definitions –
Electric Signs and Outline Lighting
Four new definitions were added to 600.2 pertaining to retrofit kits for signs (1) Host Sign, (2) Retrofit Kit, General Use, (3) Retrofit Kit, Sign Specific, (4) Subassembly
Luminaires are typically standardized and are typically mass produced, whereas signs are typically custom made and have distinctly different structural and illumination characteristics, including multi-location corporate signage programs which are dissimilar in size
A retrofit kit for a sign typically has more "moving parts" to deal than a retrofit kit for a luminaire
Concentrated efforts has been pursued in the sign industry to upgrade signs to achieve greater energy efficiency by replacing in-place illumination systems such as florescent with light emitting diodes (LED) technology
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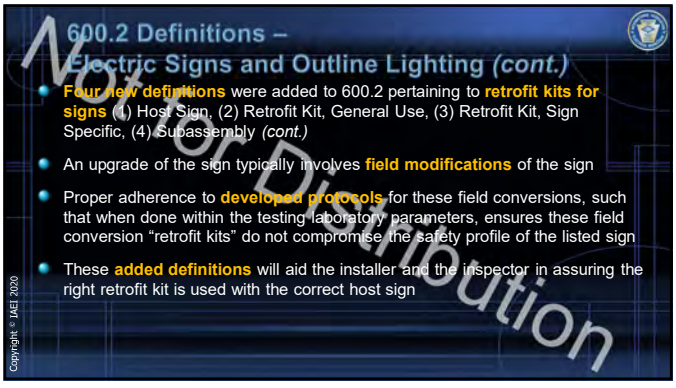
600.2 Definitions –
Electric Signs and Outline Lighting (cont.)
Four new definitions were added to 600.2 pertaining to retrofit kits for signs (1) Host Sign, (2) Retrofit Kit, General Use, (3) Retrofit Kit, Sign Specific, (4) Subassembly (cont.)
An upgrade of the sign typically involves field modifications of the sign
Proper adherence to developed protocols for these field conversions, such that when done within the testing laboratory parameters, ensures these field conversion "retrofit kits" do not compromise the safety profile of the listed sign
These added definitions will aid the installer and the inspector in assuring the right retrofit kit is used with the correct host sign
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88

600.2 Definitions. (Electric Signs and Outline Lighting)

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

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

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

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

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

89

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

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

90

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

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

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

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

91

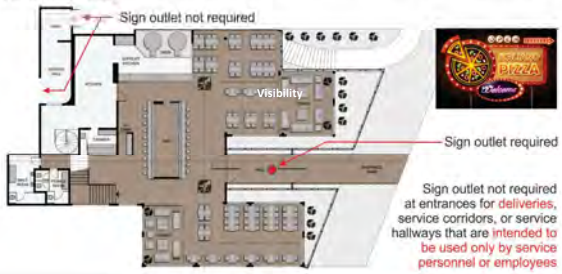
600.5(A) Required Branch Circuit for Electric Signs and Outline Lighting

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

92

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

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



93

600.5(B) Marking Requirements at Sign Disconnects

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

94

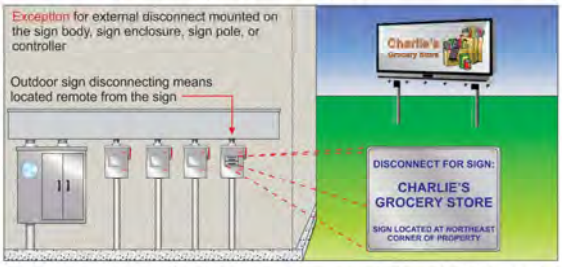
600.5(B) Marking Requirements at Sign Disconnects *(cont.)*

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

95

600.5(B) Marking Requirements at Disconnect

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



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

96

600.35 Retrofit Kits for Electric Signs and Outline Lighting

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

97

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

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

98

600.35 Retrofit Kits

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

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

Retrofit kits shall be listed and labeled

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

99

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

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

100

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

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

COVERED

NOT COVERED

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

101

620.6 GFCI Protection in Elevator Pits, Etc.

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

102

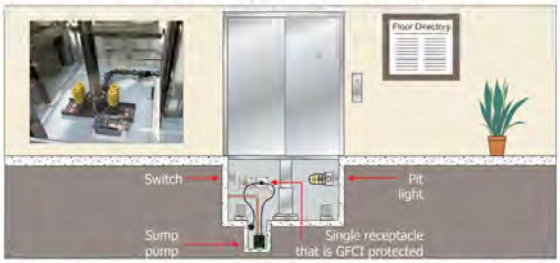
620.6 GFCI Protection in Elevator Pits, Etc. *(cont.)*

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

103

620.6 GFCI Protection in Elevator Pits, Etc.

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



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

104

620.65 Signage for Selective Coordination

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

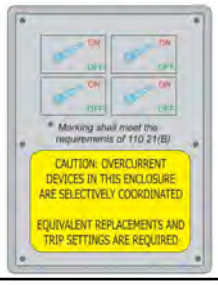
- New section added to require **equipment enclosures** for elevators, etc. containing **selectively coordinated** overcurrent devices to **be legibly marked in the field**
- More than one driving machine disconnecting means for elevators, escalators, etc. were **required to be selectively coordinated**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

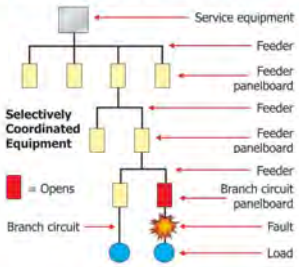
105

620.65 Signage for Selective Coordination

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

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





106

Article 625 and 625.1 Electric Vehicle Charging Power Transfer Systems

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

107

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

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

108

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

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

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110

Article 625, Part II – EV Equipment Construction

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

111

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

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

112

Article 625 - Part II EV Equipment Construction

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

Standard for Safety UL 2202	Standard for Safety UL 2594
Electric Vehicle (EV) Charging System Equipment	Electric Vehicle Supply Equipment
Standard	Standard

113

625.17(B) Output Cable to Electric Vehicles

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

114

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

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

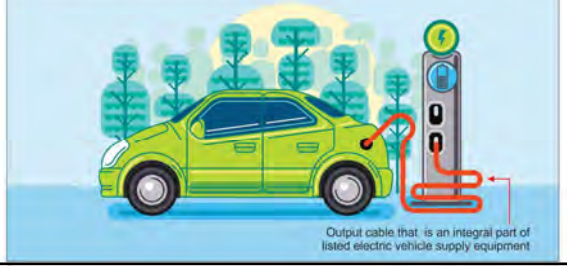
115

625.17(B) Output Cable to an Electric Vehicle

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

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

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



116

625.44 EV Portable Equipment Connection

- The connection methods for connection of **portable EV charging equipment** to the premises wiring system has been **expanded** to include certain **250-volt rated receptacle outlets**
- Previously, **portable EV charging equipment** for connection to the premises wiring system was limited to **(1)** a nonlocking, 2-pole, 3-wire grounding-type receptacle outlet rated at 125 volt, single phase, 15 or 20 amperes or **(2)** a nonlocking, 2-pole, 3-wire grounding-type receptacle outlet rated 60 volt dc maximum, 15 or 20 amperes
- Expanded to the use of a nonlocking, 2-pole, 3-wire, **240-volt, single phase, 15 or 20 amperes** grounding-type receptacle outlet or a nonlocking, 2-pole, 3-wire or 3-pole, 4-wire grounding-type receptacle outlet rated at **250 volts, single phase, 30 or 50 amperes**

117

625.44 EV Portable Equipment Connection *(cont.)*

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

118

119

625.54 GFCI Protection for EV Charging Equipment

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

120

625.54 GFCI Protection for EV Charging Equipment

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

121

625.56 Weatherproof Enclosure for EV Charging Receptacle Outlets

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

122

625.56 WP Enclosure for EV Charging Receptacle Outlets

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

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

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

123

625.60 AC Receptacle Outlets Used for EVPE

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

124

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126

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

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

127

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

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

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129

680.2 and 680.14 Corrosive Environment

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

130

680.2 and 680.14 Corrosive Environments

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

131

680.2, 680.35, and 680.45 Immersion Pools

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

132

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

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

133

134

680.2 and 680.50 Splash Pads

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

135

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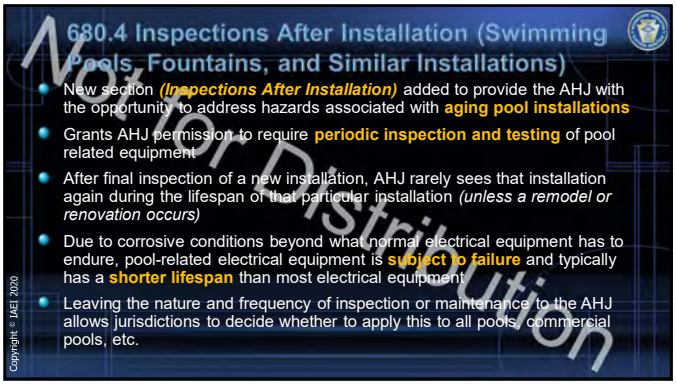


140

680.4 Inspections After Installation

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

141

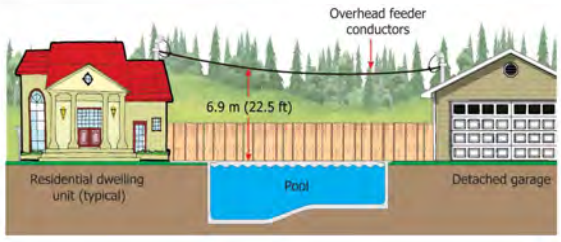
680.9(A) Overhead Power Conductor Clearances

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

142

680.9(A) Overhead Power Conductor Clearances

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

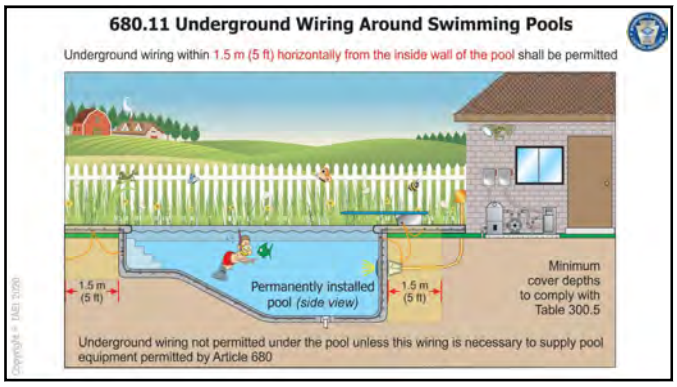


143

680.11 Underground Wiring Around Swimming Pools

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

144



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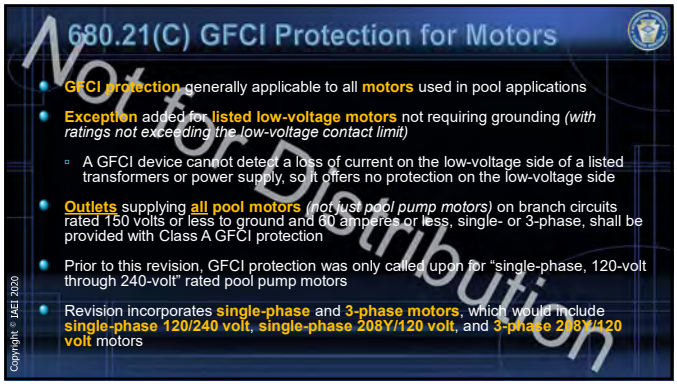


147

148

680.21(D) Pool Pump Motor Replacement

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

149

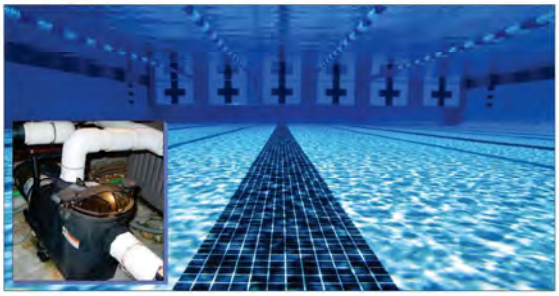
680.21(D) Pool Pump Motor Replacement

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

150

680.21(D) Pool Pump Motor Replacement

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



151

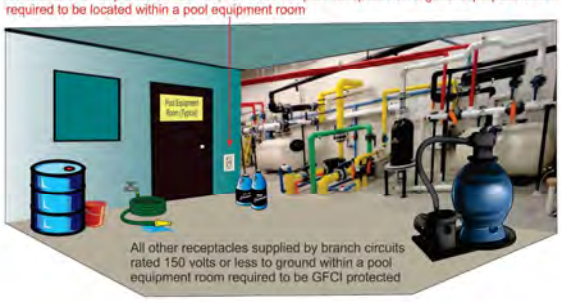
680.22(A)(5) Pool Equipment Room Receptacle

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

152

680.22(A)(5) Pool Equipment Room Receptacle

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



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

153

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

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

154

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

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

155

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

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

156

157

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

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

158

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

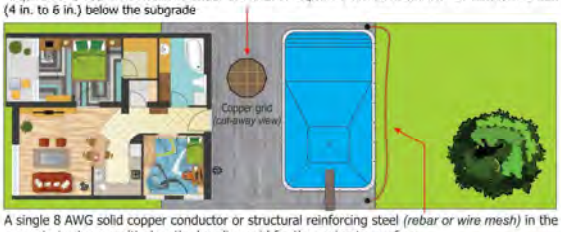
- Copper grid system is an **extremely effective means of bonding** when the structural reinforcing steel is encapsulated in a nonconductive compound or where unencapsulated structural reinforcing steel is not available or utilized
- Previous **copper ring system** of at least one minimum **8 AWG bare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

159

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

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

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



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

160

680.26(B)(5) Metallic Pool Cover Anchors

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

161

680.26(B)(5) Metallic Pool Cover Anchors

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

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

162

680.59 GFCI Protection for Permanently Installed Nonsubmersible Pumps

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

163

680.59 GFCI Protection for Nonsubmersible Fountain Pumps

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

164

680.80 Electrically Powered Pool Lifts

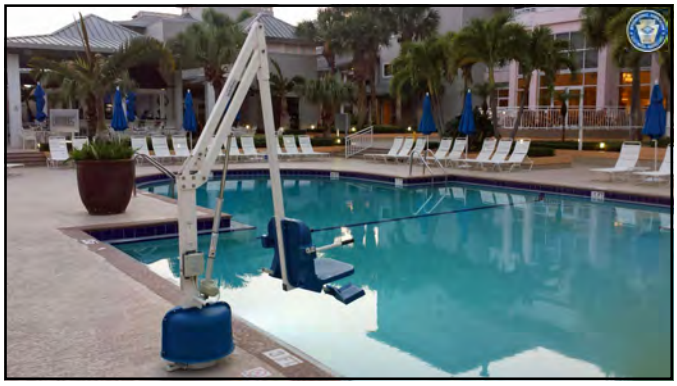
- Revision removes text indicating that **electrically powered pool lifts** do not have to comply with **other parts of Article 680**
- Previously, electrically powered pool lifts were to comply with **Part VIII of Article 680** but did not have to comply with other parts of Article 680
- Electrically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

165

680.84 Receptacles for Electrically Powered Pool Lifts

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

166



167

682.15 GFP for Natural and Artificially Made Bodies of Water

- Revision incorporates **ground-fault protection (GFP)** of equipment and **ground-fault circuit-interrupter (GFCI)** protection for personnel to **one location** in Article 682
- Previously, there were no ground-fault protection (GFP) of equipment requirements in Article 682
- New provisions added for GFP ***(not exceeding 30 mA)*** for feeder and branch circuit conductors installed on piers
- Similar to the revised provisions at **555.35(A)(2)** for marinas, boatyards, floating buildings, and commercial and noncommercial docking facilities
- The revised provisions of **555.35(A)(3)** calls for GFP of equipment set to open at currents **not exceeding 100 mA** for feeder and branch-circuit conductors that are installed on docking facilities

168

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

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

169

682.15 GFP for Natural and Artificially Made Bodies of Water

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

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

170

682.33(C) Bonding of Equipotential Planes

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

171

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

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

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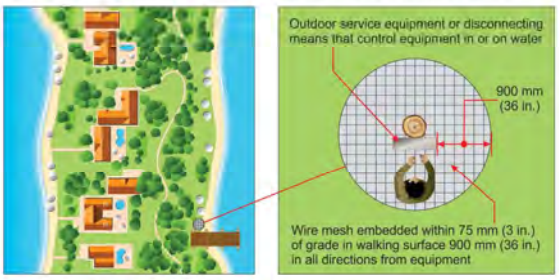
682.33(C) Bonding of Equipotential Planes

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



173

690.2 Definitions: Functional Grounded, Functionally PV System

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

174

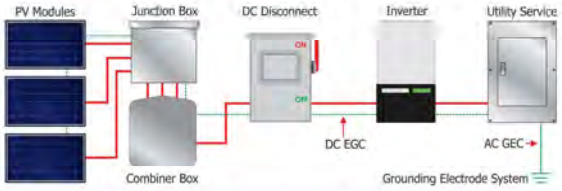
690.2 Definitions: Functional Grounded, Functionally PV System *(cont.)*

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

175

690.2 Definition: Grounded, Functionally

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



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

176

690.4(B) PV Equipment Listing and Evaluation

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

177

690.4(B) PV Equipment Listing and Evaluation

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

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

178

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

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

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180

690.9(A) Overcurrent Protection for PV Circuits and Equipment

- Revision reorganizes **690.9(A)** for **overcurrent protection** to eliminate previous exception with three List Items created for unique and different protection scenarios
- The previous exception was written in positive *Code* language and transformed into **new 690.9(A)(1)** *(Circuits Where Overcurrent Protection Not Required)* with two conditions that must be meet in order to not have to provide overcurrent protection
- New **690.9(A)(2)** addresses circuits connected to current limited sources
- New **690.9(A)(3)** titled "**Other Circuits**" captures all remaining options covered under this section with four protection options

181

690.9(A) Overcurrent Protection for PV Systems

182

690.12 Rapid Shutdown of PV Systems on Buildings

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

183

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

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

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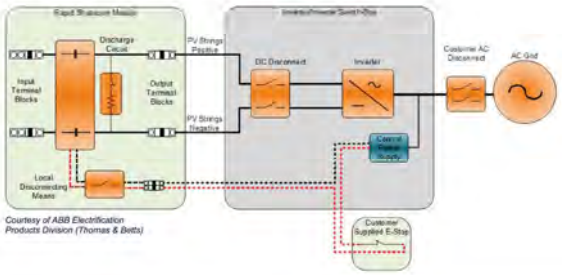
690.12 Rapid Shutdown of PV Systems on Buildings *(cont.)*

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

185

690.12 Rapid Shutdown of PV Systems on Buildings

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



Courtesy of ABB Electrification Products Division (Thomas & Betts)

186

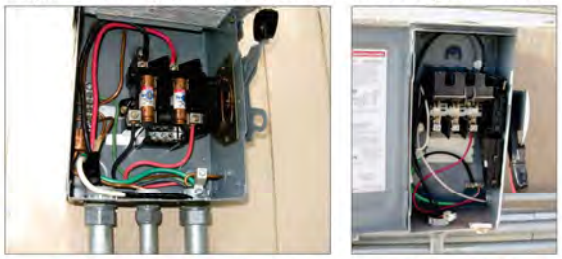
690.13(A) PV System Disconnecting Means

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

187

690.13(A) Photovoltaic System Disconnecting Means

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



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

188

690.13(E) Type of PV System Disconnecting Means

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

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190

690.15 Disconnecting Means for Photovoltaic Equipment

- Requirements for **disconnecting means** for **isolating PV equipment** of PV systems received **extensive revision** to emphasis isolation of equipment from energized conductors
- The original 1984 *NEC* title was changed from "**Disconnection of Photovoltaic Equipment**" to "**Disconnecting Means for Photovoltaic Equipment**"
  - Previous title was misleading and could be interpreted to refer to disconnecting means that is discussed at **690.13**
  - Section is intended to address isolation of equipment from energized conductors (isolated)
  - Does not necessarily have to be accomplished by an equipment disconnecting means

191

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

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

192

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

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

193

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

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

194

690.15 Disconnecting Means for Photovoltaic Equipment

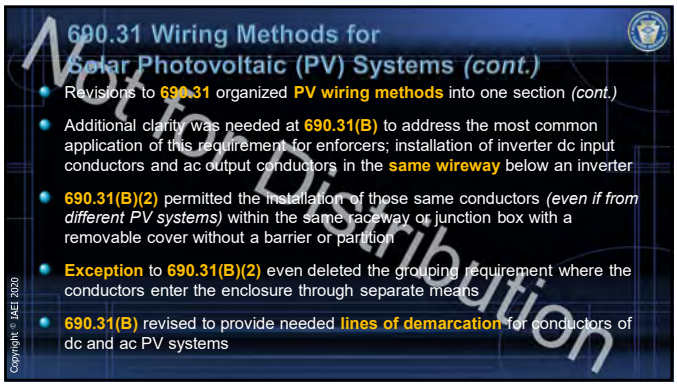
Requirements for disconnecting means for isolating PV equipment of PV systems received extensive revision to emphasis isolation of equipment from energized conductors

195

690.31 Wiring Methods for Solar Photovoltaic (PV) Systems

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

196



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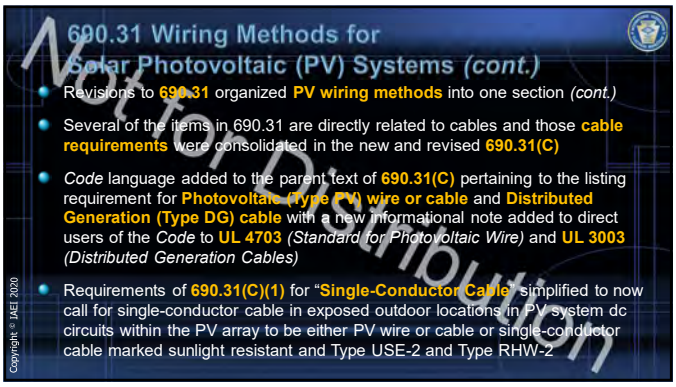

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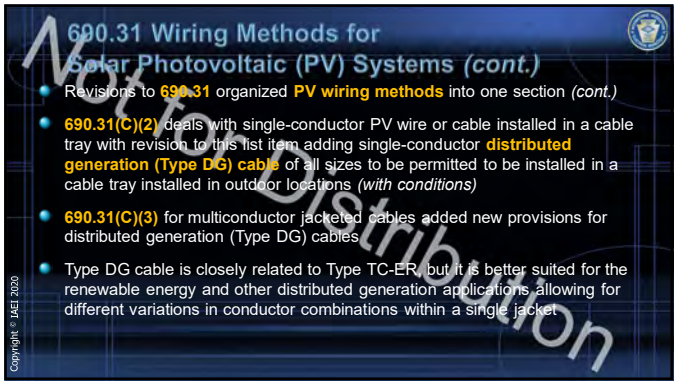

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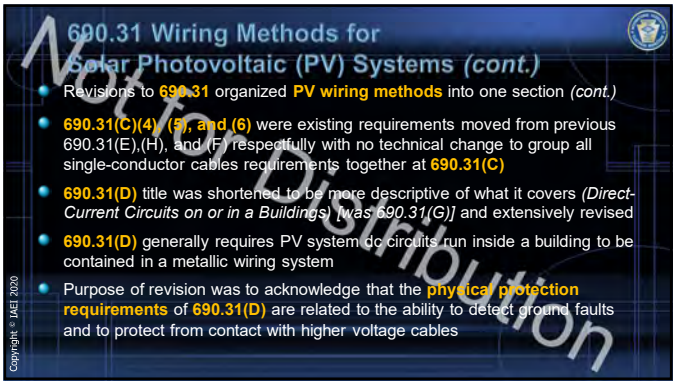


200

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

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

201

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

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

202

690.31 Wiring Methods for Solar Photovoltaic (PV) Systems

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

(A) Wiring Systems
(B) Identification and Grouping
  (1) Identification
  (2) Grouping
(C) Cables
  (1) Single-Conductor Cables
  (2) Cable Tray
  (3) Multiconductor Jacketed Cables
  (4) Flexible Cords and Cables Connected to Tracking PV Arrays
  (5) Flexible, Fine Stranded Cables
  (6) Small-Conductor Cables
(D) Direct-Current on or in Buildings
  (1) Flexible Wiring Methods
  (2) Marking and labeling Required
(E) Bipolar Photovoltaic Systems

203

690.33 Mating Connectors Types for PV Systems

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

204

690.33(C) Mating Connector Types for PV Systems

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

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

205

690.41(B) Ground-Fault Protection for PV Systems

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

206

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

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

207

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

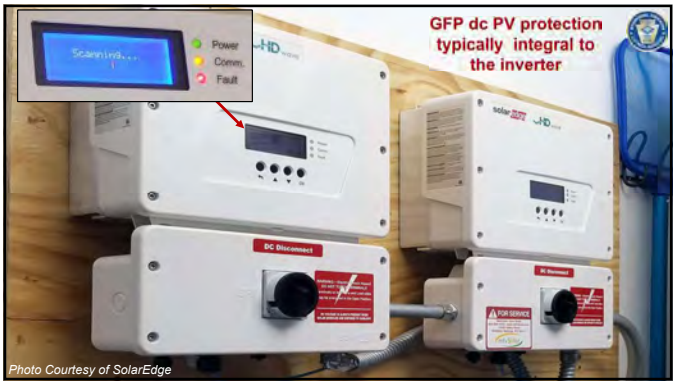
- PV system dc circuits *(not just the arrays)* that exceed **30 volts** or **8 amperes** are now required to be provided with dc ground-fault protection (GFP) *(cont.)*
- Provisions for ground-fault detection at **690.41(B)(1)** have been revised to better align with the definitions in 690.2 and in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

208

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

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

209



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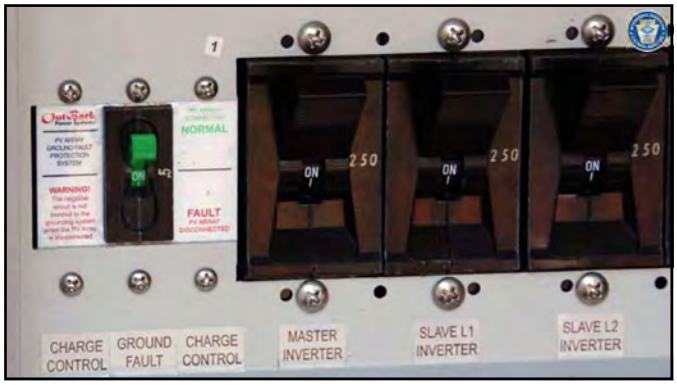


211

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

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

212

Marking Requirements for PV Modules and DC PV Circuits

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

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

213

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

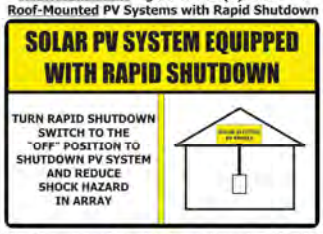
- Several changes were made to **690.56(C)** to address the updated requirements in **690.12** *(Rapid Shutdown of PV Systems on Buildings)*
- Previous 690.56(C) contained **two figures** at 690.56(C)(1) illustrating labels required for the then two different types of rapid shutdown systems for a PV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

214

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

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

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



Label required by 690.56(C)(2)

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

215

691.1 Scope and I-Note Figure 691.1

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

216

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

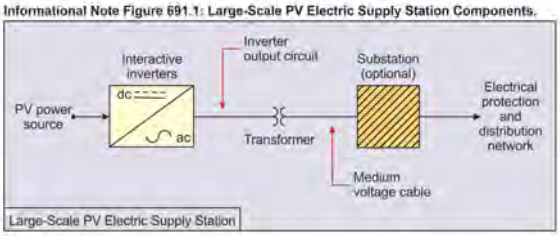
- New **Informational Note No. 3** and **Informational Note Figure 691.1** were added to Article 691 as an aid in interpretation *(cont.)*
- Scope of Article 691 was **updated** to align with the definition of "**Generating Capacity, Inverter**" located in Article 100
- This definitions states that Inverter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

217

691.1 Scope and Informational Note Figure 691.1

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

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



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

218

691.9 Disconnection Means for Isolating PV Equipment

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

219

691.9 Disconnection Means for Isolating Photovoltaic Equipment

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

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

220

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

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

221

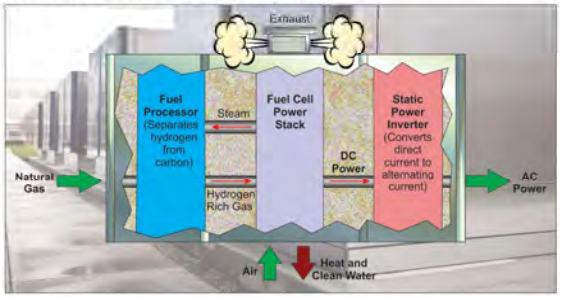
692.4(B) Identification of Power Sources (Fuel Cell System) *(cont.)*

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

222

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

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



223

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

224

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

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

225

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

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

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

226

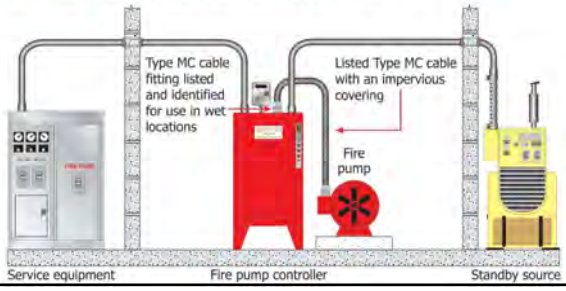
695.6(J) Raceway Terminations (Fire Pumps)

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

227

695.6(J) Raceway Terminations

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



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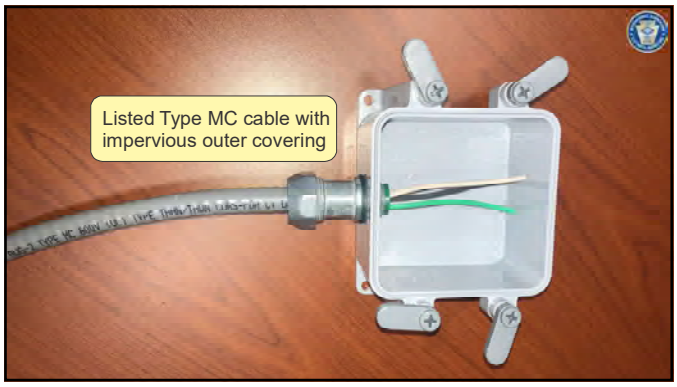

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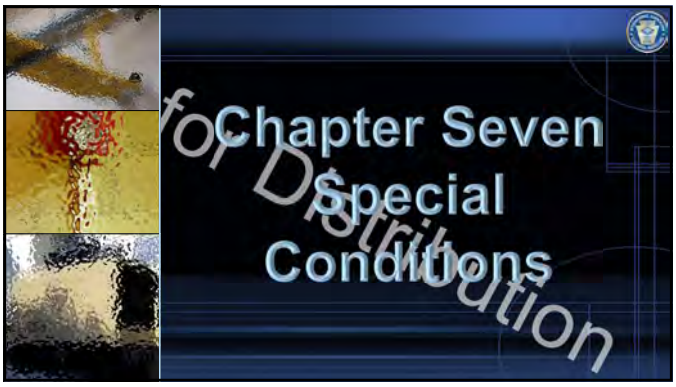

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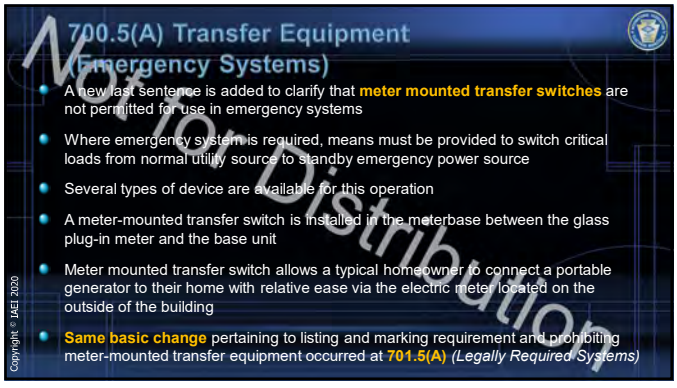

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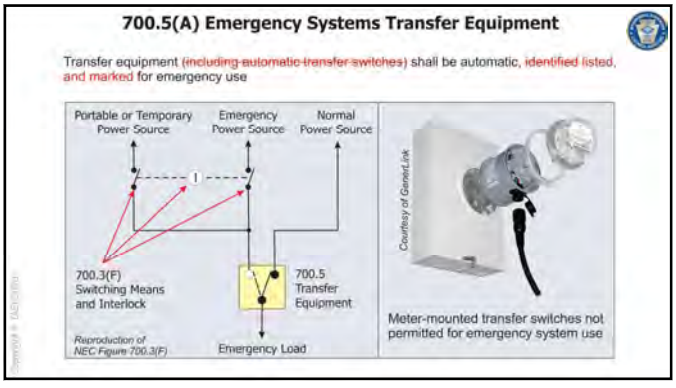


232

700.12(B) Emergency Systems Equipment Design and Location

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

233

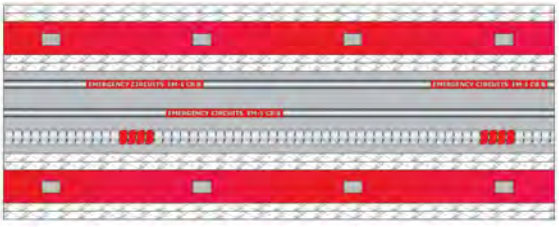
700.12(B) Emergency Systems Equipment Design and Location *(cont.)*

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

234

700.12(B) Emergency System Equipment Design and Location

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



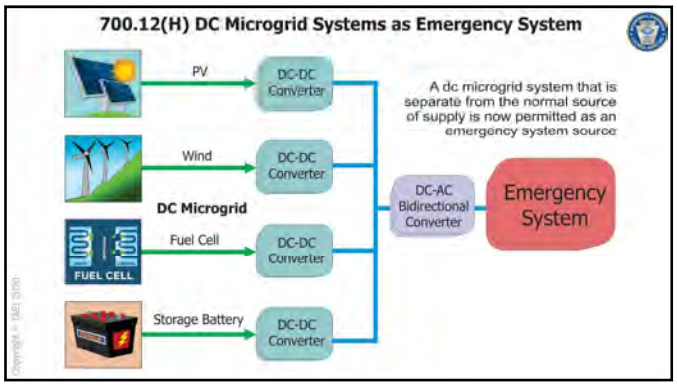
(1) Assembly occupancies for more than 1000 persons, (2) Buildings above 23 m (75 ft) in height with any of the following occupancy classes; assembly, educational, residential, detention and correctional, business, and mercantile, ~~(3) Health care occupancies where persons are not capable of self-preservation;~~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

235

700.12(H) DC Microgrid Systems as Emergency System

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

236



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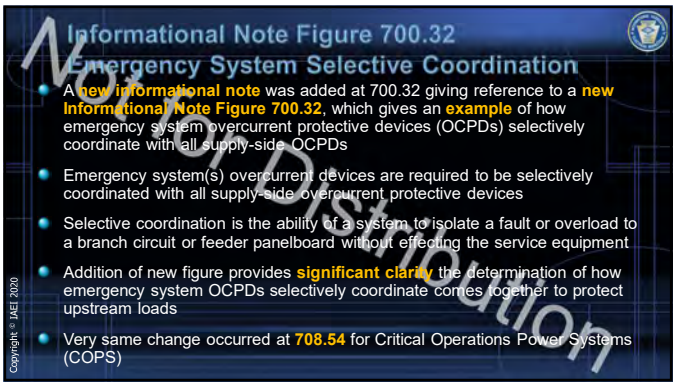

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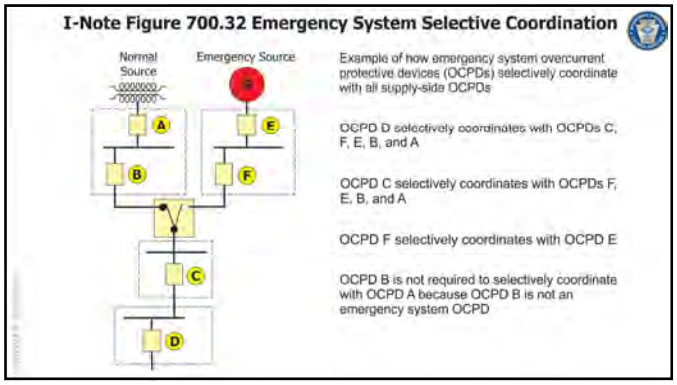

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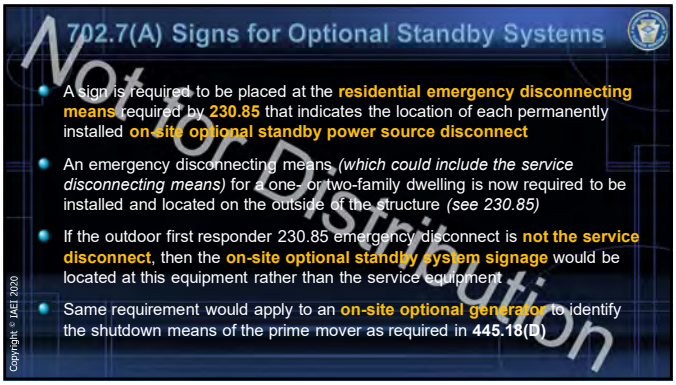
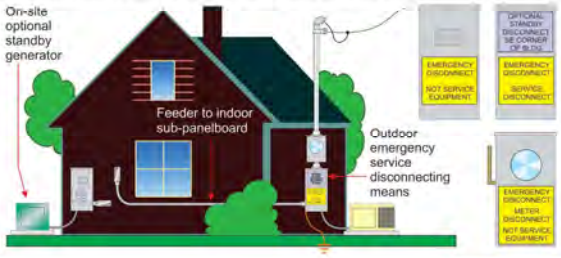


240

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

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

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



241

Article 705 Interconnected Electric Power Production Sources

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

242

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

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

243

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

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

244

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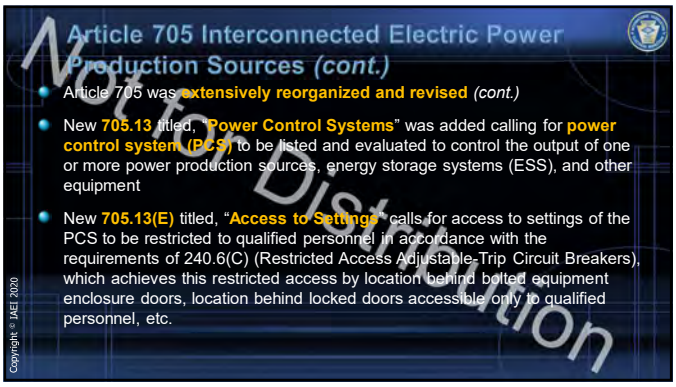

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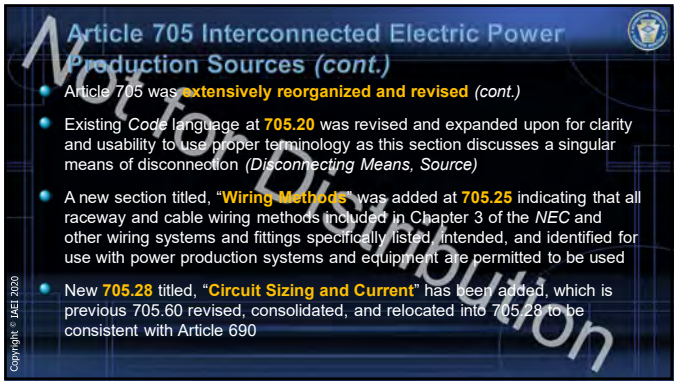

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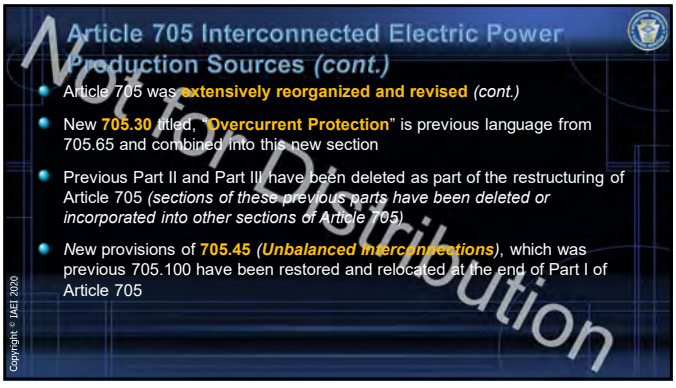
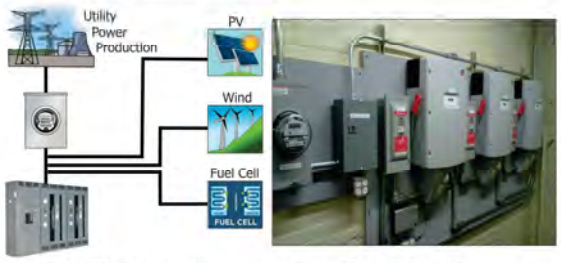


248

Article 705 Interconnected Electric Power Production Sources

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



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

249

706.1 Scope (Energy Storage Systems)

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

250

706.1 Scope of Article 706 (Energy Storage Systems)

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

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

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

251

706.2 Definitions: Energy Storage System (ESS)

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

252

706.2 Definition: Energy Storage System (ESS)

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

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

253

706.4 System Requirements (Energy Storage Systems)

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

254

706.4 System Requirements (Energy Storage System)

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

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

255

706.7 Maintenance of Energy Storage Systems (ESS)

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

256

706.7 Maintenance of Energy Storage Systems (ESS)

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

Maintenance Personnel

Energy Storage System (ESS)

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

257

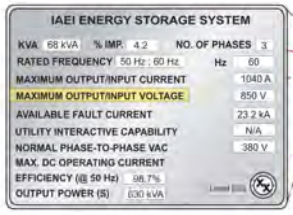
706.9 Maximum Voltage (Energy Storage Systems)

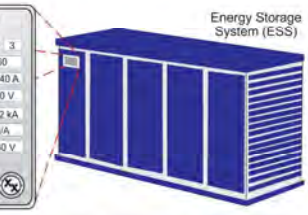
- New section added to provide prescriptive requirements for the determination of **maximum voltage** of an energy storage system (ESS)
- Maximum voltage of an ESS is determined by the rated ESS input and output voltage(s) indicated on the **ESS nameplate(s)** or system listing
- This requirement is in alignment with the new requirements of **706.4**, which calls for an ESS to be provided with a nameplate plainly visible after installation and marked with (8) specific pieces of information provided on the nameplate
- One of the pieces of information now required on the **ESS nameplate** is the "maximum output and input voltage of the ESS at the output terminals"
- New requirements of 706.9 provides clear guidance on how to determine maximum voltage of an ESS

258

706.9 Maximum Voltage (Energy Storage Systems)

The maximum voltage of an ESS shall be the rated ESS input and output voltage(s) indicated on the ESS nameplate(s) or system listing





Energy Storage System (ESS)

New section added to provide prescriptive requirements for the determination of maximum voltage of an ESS

259

706.30(A)(1) Nameplate-Rated Circuit Current for ESS

- Revision occurred to clarify that an energy storage system (ESS) may have **two nameplates**, each respectively indicating input or output circuit rating, or one nameplate showing input and output circuit ratings
- Previous *Code* text at 706.20(A)(1) [now **706.30(A)(1)**] stated that the nameplate(s) rated circuit current was to be the rated current indicated on the ESS nameplate(s) or system listing for pre-engineered or self-contained systems of "**matched components**" intended for field assembly as a system
- Neither the *NEC* or **UL 9540** *(Standard for Energy Storage Systems and Equipment)* contain a definition for "**matched components**"
- The term "**matched components**" was removed from 706.30(A)(1) to align with revised definitions used in conjunction with Article 706

260

706.30(A)(1) Nameplate-Rated Circuit Current for ESS *(cont.)*

- Not uncommon to see an ESS with **two separate nameplates**, each respectively indicating input or output circuit rating, or one nameplate showing input and output circuit ratings
- **706.30(A)(1)** was revised for clarity and to recognize the fact that an ESS can indeed have **two separate nameplates**
- Where an ESS has separate input (charge) and output (discharge) circuits or ratings, these ratings are to be considered individually
- Where the same terminals on the ESS are used for charging and discharging, the rated current would be considered the greater of the two

261

706.30(A)(1) Nameplate-Rated Circuit Current (ESS)

Circuit current is the rated current indicated on an energy storage systems (ESS) nameplate(s) or system listing ~~for pre-engineered or self-contained systems of matched components intended for field assembly as a system~~

Courtesy of ABB Electrification Products Division (Thomas & Betts)

Where an ESS has separate input (charge) and output (discharge) circuits or ratings, these ratings are to be *considered individually (possibly two nameplates)*

Where the same terminals on the ESS are used for charging and discharging, the rated current would be considered the *greater of the two*

262

708.24(D) Bypass Isolation Automatic Transfer Switches (COPS)

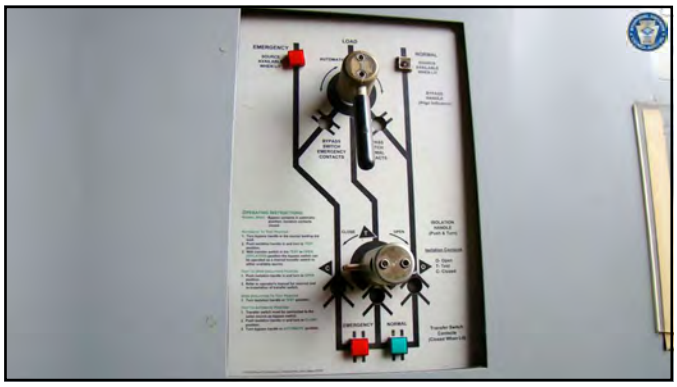
- New List item (D) added to address **bypass isolation automatic transfer switches** where necessary for a designated **Critical Operations Power Systems (COPS)** buildings
- Transfer equipment *(including automatic transfer switches (ATS))* used in conjunction with a COPS system is required to be automatic and identified for emergency use
- COPS transfer equipment is required to be designed and installed to prevent the inadvertent interconnection of normal and critical operations sources of supply in any operation of the transfer equipment
- In some cases, design criteria call for a means to put an **automatic transfer switch** in an **electrically safe work condition** so that **maintenance** can be performed safely on the automatic transfer switch without losing power to the critical loads associated with a COPS designated building

263

708.24(D) Bypass Isolation Automatic Transfer Switches (COPS) *(cont.)*

- New List item (D) added to address **bypass isolation automatic transfer switches** where necessary for a designated **Critical Operations Power Systems (COPS)** buildings *(cont.)*
- If a COPS design has loads that can only be supplied via one automatic transfer switch, the **maintenance may not get done** or if it is done, it is performed in an **unsafe non-compliant NFPA 70E** *(Electrical Safety in the Workplace)* **manner**
- **Bypass isolation switches** provide redundancy and **continuous powering of the loads** while the automatic transfer switch is de-energized so that proper maintenance can be performed under safe compliant NFPA 70E work conditions
- However, while in the bypass mode, if the connected power source fails, it would be necessary to quickly transfer between power sources (this can be achieved by an **automatic bypass isolation switch**)

264



265

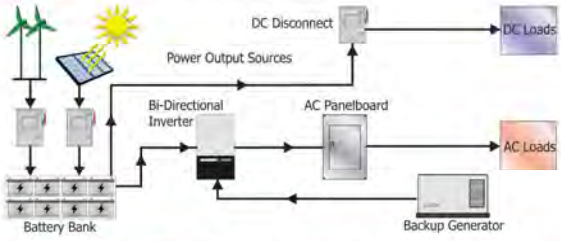
710.15 General Requirements for Stand-Alone Systems

- New Code language has been added at 710.15 to recognize that stand-alone systems can deliver power to **three-phase applications** as well as single-phase systems
- 2017 *NEC* seemed to have indicated that a stand-alone system was reserved for a single-phase system only
- Several manufacturers design and sell products such as inverters, dc disconnects, battery banks, and generators that are capable of delivering and receiving a **three-phase application** as well and a single-phase system
- Existing systems can meet the definition of a stand-alone or islanded system that deliver power to **three-phase applications** such as mid-size server rooms, networks, telecommunication systems, and industrial processes

266

710.15 General Requirements for Stand-Alone Systems

New provisions added to 710.15 to recognize that stand-alone systems can deliver power to three-phase applications as well as single-phase systems



710.15(D): Three-phase Supply. Stand-alone and microgrid systems are permitted to supply three-phase, 3-wire or 4-wire systems

267

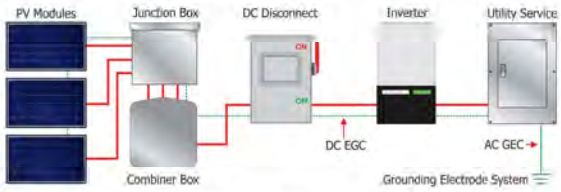
712.2 Definitions: Resistively Grounded, Functionally

- The term "Resistively Grounded" in Article 712 was revised to "**Grounded, Functionally**" to correlate with the same definition in Article 690
- The term "**Grounded, Functionally**" is defined at both 712.2 and 690.2 as "a system that has an electrical ground reference for operational purposes that is not solidly grounded"
- Some users of the *Code* would argue that only one definition is need and that definition needs to be located in Article 100, especially since these definitions mirror each other
- That is a battle for another day and perhaps that is the direction this issue will be heading toward in the 2023 *NEC* revision cycle

268

712.2 Definition: Grounded, Functionally

The term "Resistively Grounded" in Article 712 was revised to "Grounded, Functionally" to correlate with the same definition in Article 690



Grounded, Functionally. A system that has an electrical ground reference for operational purposes that is not solidly grounded.

Informational Note: Examples of operational reasons for functionally grounded systems include ground-fault detection and performance-related issues for some power sources.

269

712.10(B) Building Directory (Direct Current Microgrids)

- New **outdoor plaque or directory** requirement added to denote **all sources of dc power** to a building installed at each outside service equipment location or at an **approved readily visible location**
- This outdoor plaque or directory must denote the location of each power source disconnecting means on or in the building or be grouped with other plaques or directories for other on-site sources
- This provision brought on by ongoing concern expressed by the **fire service** and other **first responders** concerning the need to secure all on-site power sources during emergencies and awareness of where those sources are installed and utilized
- Provide warnings to first responders about the **presence and location of on-site power sources** prior to entering a building
- This new outdoor plaque or directory requirement for dc microgrids aligns with similar *Code* language at **705.10** *(Interconnected Electric Power Production Sources)* and **710.10** *(Stand-Alone Systems)*, with the goal to harmonize these similar requirements

270

712.10(B) Building Directory (DC Microgrids)

A building supplied by a dc microgrid system shall have a permanent plaque or directory installed outside the building at each service equipment location or at an approved readily visible location

271

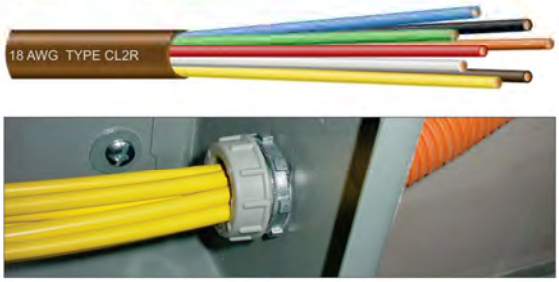
725.3(O) Temperature Limitation of Class 2 and Class 3 Cables

- New text clarifies that the **temperature limitations for conductors** of 310.14(A)(3) apply to Class 2 and Class 3 cables as well *(not just conductors)*
- New **725.3(O)** ***(Temperature Limitation of Class 2 and Class 3 Cables)*** states that requirements of **310.14(A)(3)** *[previous 310.15(A)(3)] (temperature limitation of conductors)* shall apply to Class 2 and Class 3 cables
- Because Class 2 and Class 3 circuits are typically installed in a cable rather than individual conductors, some argued that the temperature limitations of conductors of **310.14(A)(3)** did not apply to Class 2 and Class 3 cables
- To put this argument to rest, a new subsection was added to Article 725 at 725.3(O)
- Same change occurred at **760.3(N)** for **fire alarm system Class 2 and Class 3 cables**

272

725.3(O) Temperature Limitation of Class 2 and Class 3 Cables

The requirements of 310.14(A)(3) on the temperature limitation of conductors shall apply to Class 2 and Class 3 cables *(not just conductors)*



273

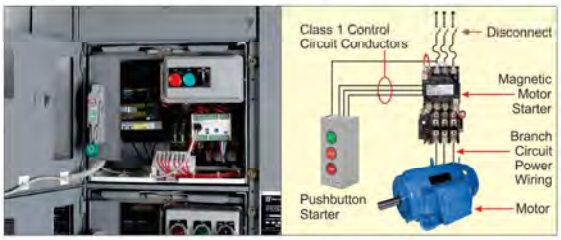
725.48(B)(1) Class 1 Circuits with Power-Supply Circuits

- Revision permits **Class 1 circuits** to share enclosure space with conductors of electric light, power, non–power-limited fire alarm and medium power network-powered broadband communications circuits as long as separated by a **barrier**
- Previously, Class 1 circuits and power-supply circuits were only permitted to occupy the same cable, enclosure, or raceway ***without a barrier*** only where the equipment powered was ***functionally associated*** *(still applies)*
- The "barrier" requirement for Class 1, Class 2, and Class 3 circuits is not specific as to the type of material required

274

725.48(B)(1) Class 1 Circuits with Power-Supply Circuits

Class 1 circuits and power-supply circuits permitted to occupy the same cable, enclosure, or raceway without a barrier only where the equipment powered is functionally associated



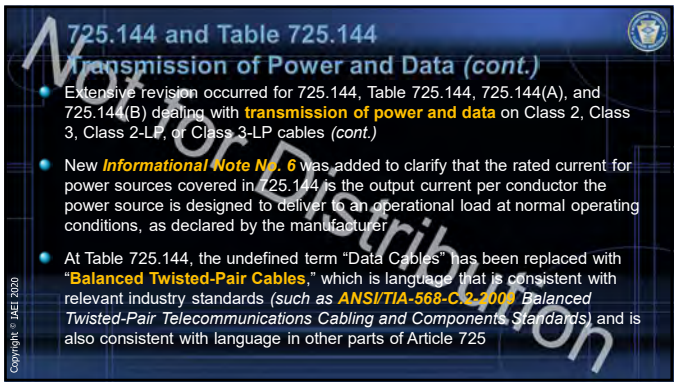
Class 1 circuits permitted to be installed with conductors of electric light, power, non-power-limited fire alarm, etc. *where separated by a barrier*

275

725.144 and Table 725.144 Transmission of Power and Data

- Extensive revision occurred for 725.144, Table 725.144, 725.144(A), and 725.144(B) dealing with **transmission of power and data** on Class 2, Class 3, Class 2-LP, or Class 3-LP cables
- Requirements of parent text of 725.144 did not change, just revised for clarity
- New ***Informational Note No. 3 and No. 4*** were added to identify the unique nature of the type of conductors and cables specified at Table 725.144 and to provide the appropriate reference standards that address the cables covered in the Table
- New ***Informational Note No. 5*** was added since Power over Ethernet (PoE) lighting is a very important application covered by 725.144

276



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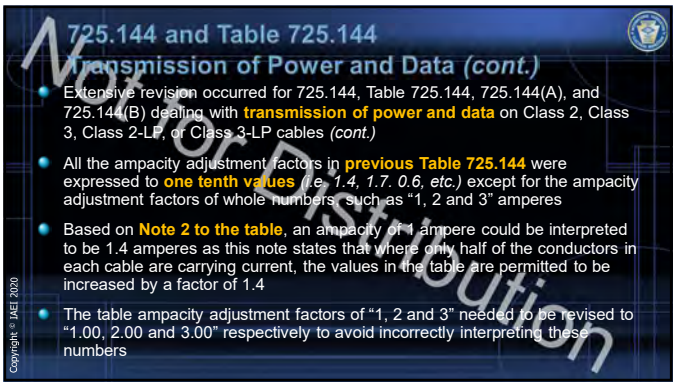

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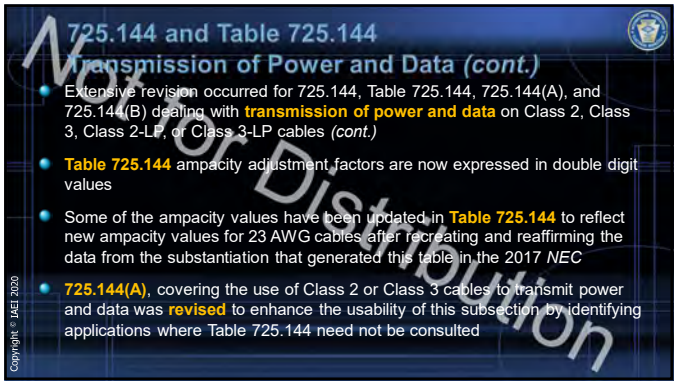

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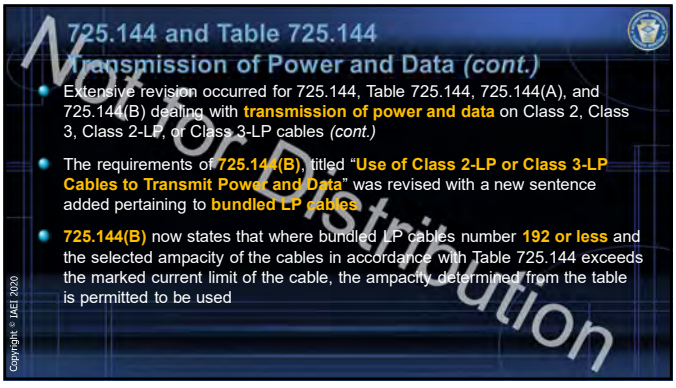


280

Table 725.144

Table 725.144 Ampacities of Each Conductor in Amperes in 4-Pair Class 2 or Class 3 Data Balanced Twisted-Pair Cables Based on Copper Conductors at an Ambient Temperature of 30°C (86° F) with All Conductors in All Cables Carrying Current, 60°C (140°F), 75°C (167°F), and 90°C (194°F) Rated Cables

	Number of 4-Pair Cables in a Bundle											
	1-7			8-19			20-37			38-61			62-91			92-192		
	Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating		
AWG	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C
26	1.00	1.23	1.42	0.71	0.87	1.02	0.55	0.68	0.78	0.46	0.57	0.67	0.45	0.55	0.64	N/A	N/A	N/A
24	1.19	1.46	1.69	0.81	1.01	1.17	0.63	0.78	0.91	0.55	0.67	0.78	0.46	0.56	0.65	0.40	0.48	0.55
23	1.24	1.53	1.78	0.89	1.11	1.28	0.77	0.95	1.10	0.66	0.80	0.93	0.58	0.71	0.82	0.45	0.55	0.63
22	1.50	1.86	2.16	1.04	1.28	1.49	0.77	0.95	1.11	0.66	0.82	0.96	0.62	0.77	0.89	0.53	0.63	0.72

Note 1: For bundle sizes over 192 cables, or for conductor sizes smaller than 26 AWG, ampacities shall be permitted to be determined by qualified personnel under engineering supervision.

Note 2: Where only half of the conductors in each cable are carrying current, the values in the table shall be permitted to be increased by a factor of 1.4.

Informational Note No. 1: Elevated cable temperatures can reduce a cable's data transmission performance. For information on practices for 4-pair balanced twisted pair cabling, see TIA-TSB-184-A and 6.4.7, 6.6.3, and Annex G of ANSI/TIA-568-C.2, which provide guidance on adjustments for operating temperatures between 20°C and 60°C.

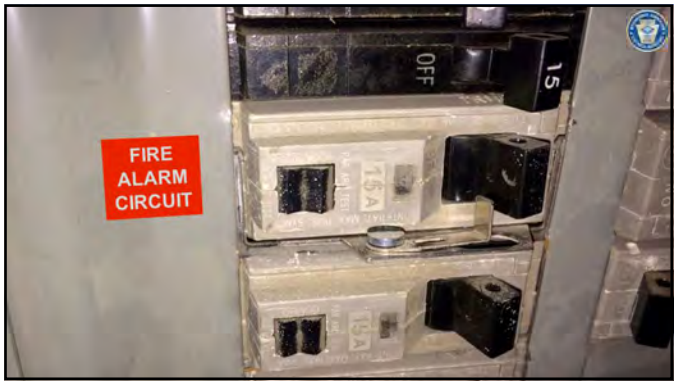
Informational Note No. 2: The per-contact current rating of connectors can limit the maximum allowable current below the ampacity shown in Table 725.144.

281

760.121(B) Power Sources for PLFA Circuits *(Fire Alarm Systems)*

- New sentence added to permit the fire alarm branch-circuit disconnecting means for power limited fire alarm (PLFA) circuits to be **secured in the "on" position**
- The fire alarm circuit disconnect for non-power-limited fire alarm (NPLFA) circuits was already permitted to be secured in the "on" position *[see 760.41(A)]*
- Change provides consistency with NPLFA circuits and PLFA circuits
- While this practice was not prohibited by **760.121**, it was not specifically permitted either
- Installing **breaker locks** is already a common industry practice on fire alarm circuits

282



283

284

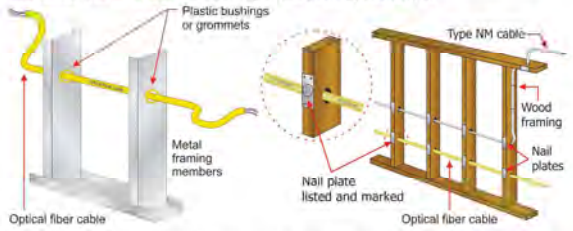
770.24 Mechanical Execution of Work (Optical Fiber Cable)

- Revision will require optical fiber cable to conform to **all of 300.4 and 300.11** *[not just 300.4(D) through (G)]*
- Previously, optical fiber cables were to be installed and protected from physical damage in accordance with 300.4(D) through (G) and 300.11
- Optical fiber cables not limited to communications installations and need protection against physical damage regardless if they can be a shock hazard or not
- Even if optical fiber cable is not carrying any current, the equipment being supplied by this cable in several situations are critical to **life and safety**
- The installation of these optical fiber cables should conform to **all of 300.4**

285

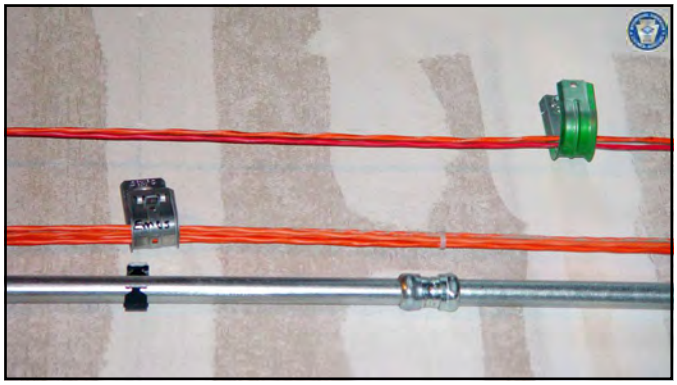
770.24 Mechanical Execution of Work for Optical Fiber Cable

Optical fiber cables are now required to be installed and protected from physical damage in accordance with all of 300.4 and 300.11 *[not just 300.4(D) through (G)]*



Where driven nails or screws can penetrate optical fiber cable installed through wood or metal studs, a steel sleeve, steel nail plate or steel clip not less than 1.6 mm (1/16 in.) in thickness is required to be installed *(Thinner steel plates permitted if listed and marked)*

286



287

770.110(D) Cable Trays for Optical Fiber Cables

- New section added permitting **optical fiber cables** to be installed in metal or listed nonmetallic **cable tray systems**
- Previously, permission to install optical fiber cable in a cable tray was given in several locations across Article 770
- This revision will make it easier to find this cable tray rule with it located in the same section that permits optical fiber cables to be installed in raceways and cable routing assemblies
- New requirement limits the allowance for optical fiber cables to be installed in a cable tray to **metal and listed nonmetallic cable trays** in order to address flame spread concerns
- Same change occurred for **communications cables and raceways** at **800.110(D)**

288

289

290

770.133 Installation of Optical Fibers and Electrical Conductors

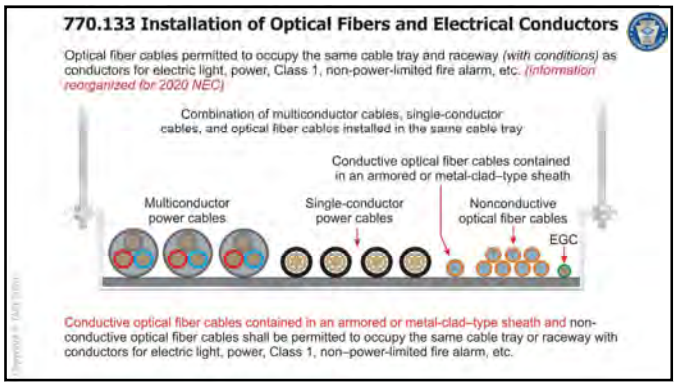
- Previous requirements of **770.133(A)** has been reorganized and relocated throughout **770.133(A)** and new **770.133(B)**
- Previous exceptions rewritten into positive *Code* language
- Previous 770.133(A) permitted optical fiber cables to occupy the same cable tray and raceway as conductors for electric light, power, Class 1, non-power-limited fire alarm, etc. *(with five exceptions)*
- Almost all of the 2017 *NEC* requirements of 770.133 are still there for the 2020 *NEC* but **relocated for a better flow of the information**
- Permission to allow nonconductive optical fiber cables to occupy the same cable tray as conductors for electric light, power, Class 1, non-power-limited fire alarm, etc. operating at 1000 volts or less was moved to the second paragraph of new 770.133(B)

291

770.133 Installation of Optical Fibers and Electrical Conductors *(cont.)*

- Previous requirements of **770.133(A)** has been reorganized and relocated throughout **770.133(A)** and new **770.133(B)** *(cont.)*
- First paragraph of **770.133(A)** was updated to permit **conductive optical fiber cables** contained in an armored or metal-clad-type sheath and **nonconductive optical fiber cables** to occupy the same cable tray with conductors for electric light, power, Class 1, non-power-limited fire alarm, etc. operating at 1000 volts or less
- **Conductive optical fiber cables without an armored or metal-clad-type sheath** not permitted to occupy the same cable tray as power conductors, etc. unless separated by a **permanent barrier** or listed divider

292



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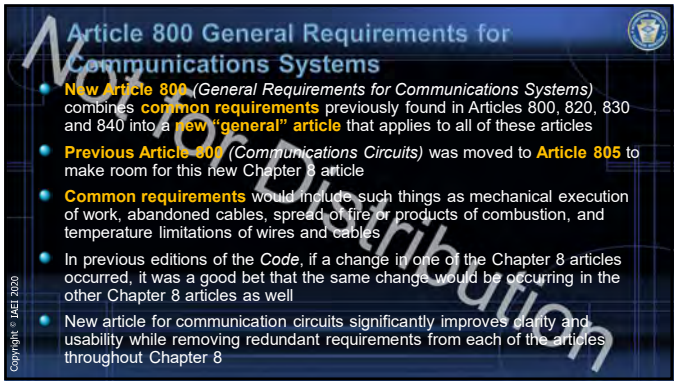

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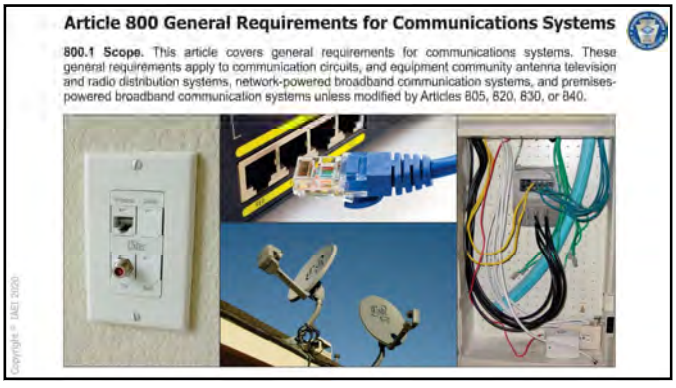
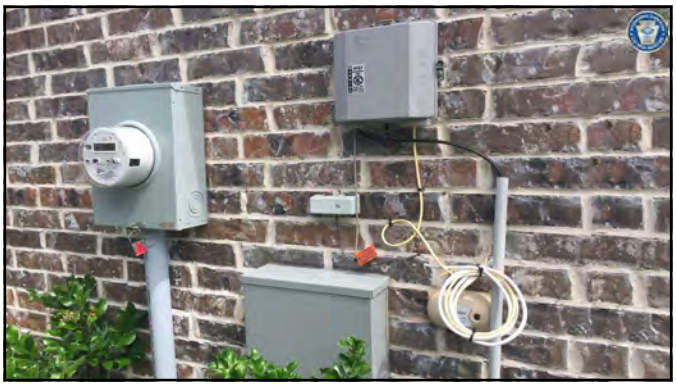


296

800.2 Definitions: Communications Circuit

- **Communications Circuit.** The circuit that extends service from the communications utility or service provider to and including the customer's communications equipment.
- The definition of a "**Communications Circuit**" was revised to remove the "list" of service types offered by a communications circuit
- List was problematic as it did not allow for new technologies to be included in this definition without a *Code* change, which only happens every three years

297

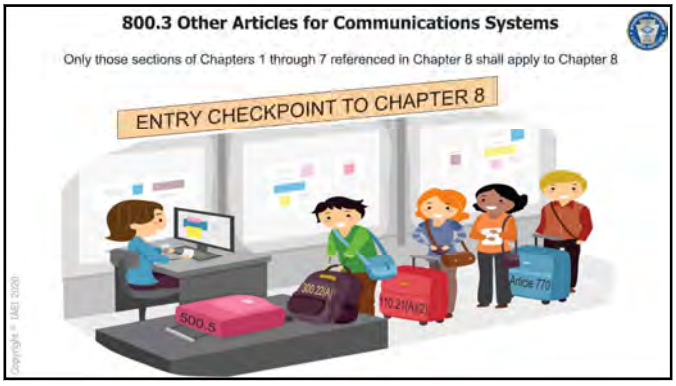


298

800.3 Other Articles for Communications Systems

- New text was added to reinforce the **independence of Article 800 and Chapter 8** which stipulates that only those sections of Chapters 1 through 7 referenced in Article 800 shall apply to communications systems
- Opening sentence of 800.3 now reads, "**Only those sections of Chapters 1 through 7 referenced in Chapter 8 shall apply to Chapter 8.**"
- Requirements of **90.3** state that Chapter 8 of the *NEC* is a **"stand-alone" article** and "is not subject to the requirements of Chapters 1 through 7 except where the requirements are specifically referenced in Chapter 8"
- In order for a requirement from Chapters 1 through 7 to apply to Chapter 8, there must be a clear reference or "**road map**" in Chapter 8 to a specific requirement in Chapters 1 through 7

299



300

800.27 Temperature Limitation of Wire and Cables (Communications Systems)

- New section added to specify that no communication wire or cable be used in such a manner that its **operating temperature** exceeds that of its rating
- When the previous requirements of 800.3 were moved to new Article 800, it was felt that this **temperature limitation requirement** deserved its own section in Article 800
- Previous temperature limitations of 800.3(H) were moved to a **new 800.27** and titled "**Temperature Limitation of Wires and Cables**"
- New text at 800.27 makes it clear that this temperature limitations in Chapter 8 **apply to cables** *(not just conductors)*
- New text simplifies the *Code* by including the temperature limitation requirement **directly in Article 800**, rather than have a cross-reference in Article 800 to the temperature limitation requirements of **Article 210**

301

800.27 Temperature Limitation of Wire and Cables (Communications Systems)

No communications wire or cable is permitted to be used in such a manner that its operating temperature exceeds that of its rating

Plenum, riser, general-purpose, and limited-use communications cables required to have a temperature rating of not less than 60°C (140°F) *(see 800.179)*

302

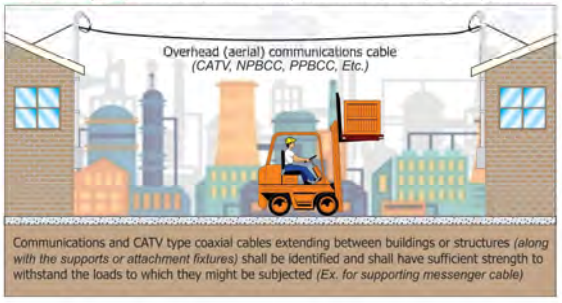
800.44 Overhead (Aerial) Communications Wires and Cables

- Requirements were added for ***all*** communications circuits pertaining attachment to **above-the-roof raceway mast** and cables extending between buildings or structures
- Previously, **Article 820** contained provisions for attaching coaxial cables to an **above-the-roof raceway mast** that did not enclose or support conductors of electric light or power circuits *(none of the other Chapter 8 article contained this mast rule)*
- Previously, **Articles 820 and 830** contained requirements pertaining to coaxial cables and network-powered broadband communications **cables extending between buildings** or structures *(other Chapter 8 articles did not have such rules)*
- These two rules were perfect candidates to be placed in **new Article 800** to prevent repeating these rules in four different articles *(needed consistency)*

303

800.44 Overhead (Aerial) Communications Wires and Cables

Overhead (aerial) communications and CATV type coaxial cables permitted to be attached to above-the-roof raceway mast that does not enclose or support conductors of electric light or power circuits



Communications and CATV type coaxial cables extending between buildings or structures *(along with the supports or attachment fixtures)* shall be identified and shall have sufficient strength to withstand the loads to which they might be subjected *(Ex. for supporting messenger cable)*

304

805.179(D) Limited Power (LP) Cables

- Provisions were added to permit **limited power (LP) cables** to act as a **substitute** for Class 2 and Class 3 cables
- Previously, communications cables were permitted as substitutes for Class 2 and Class 3 cables, but the *Code* **did not specifically address** limited power (LP) cables as a substitute for Class 2 and Class 3 cables
- **725.144** and **Table 725.144** gives designers, installers and AHJs the assurance that 4-pair data cables can safely carry power, as well as data when bundled together in cable trays or cable routing assemblies
- This revision recognizes the fact that an **LP cable** is a specific type of Class 2, Class 3, and communications cable and explicitly permits these cable types as **substitutes** for Class 2 and Class 3 LP cables *(vast majority of LP cables are listed as communications cables)*
- LP cables are listed under the UL product categories of Communications Cable **(DUZX)** and Power Limited Circuit Cable **(QPTZ)**

305

805.179(D) Limited Power (LP) Cables

Provisions added at to permit limited power (LP) cables to act as a substitute for Class 2 and Class 3 cables as well as the previous provisions allowing communications cables as substitutes for Class 2 and Class 3 cables

306

307

840.2 Definitions for Premises-Powered Broadband Communications Systems

- Two new definitions were added to 840.2 to define the terms "**Broadband**" and "**Premises-Powered**"
- **Broadband:** Wide bandwidth data transmission that transports multiple signals, protocols, and traffic types over various media types.
- **Premises-Powered.** Using power provided locally from the premises.
- Previously, neither "**Broadband**" or "**Premises-Powered**" were defined in Article 840 *(Premises-powered Broadband Communications Systems)* or the *NEC*
- Definition for "**Broadband**" was added to provide an appropriate description of the circuits covered under Article 840
- Term "**Premises-Powered**" had to be defined as it now applies to more than one type of system

308

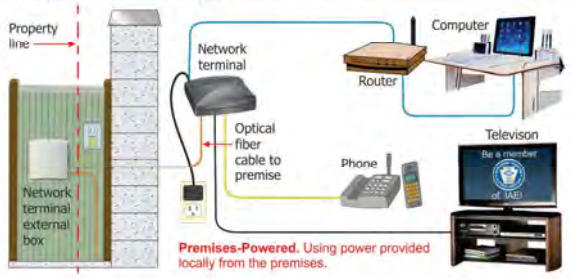
840.2 Definitions for Premises-Powered Broadband Communications Systems *(cont.)*

- Two new definitions were added to 840.2 to define the terms "**Broadband**" and "**Premises-Powered**" *(cont.)*
- Premises powered basically means that the power used by the communications system is **derived from the local premises power**, and this power source has **no limits on the power crossing a premises property line** or boundary
- **Example:** Network terminal being powered from a 125-volt, 15- or 20-ampere ac wall receptacle outlet or an uninterruptible power supply (UPS)/battery backup unit where the network terminal is a few feet from a structure
- This location is not necessarily "**on the premises**" based on prescribed property lines, legal boundaries, and/or utility definitions
- New definition of "**Premises-Powered**" would cover such an installation even though the network terminal might not be technically on the premise and keep this type of installation under the scope of Article 840

309

Article 840 Definitions: Premises-Powered Broadband Communications Systems

Broadband. Wide bandwidth data transmission that transports multiple signals, protocols, and traffic types over various media types.



Premises-Powered. Using power provided locally from the premises.

310

840.94 and 840.102 Premises Circuits Leaving the Building

- Two new sections (840.94 and 840.102) added to provide requirements for **premises-powered broadband communication system (PPBCS) circuits** when they **leave the building** to power equipment **remote to that building**
- Previously, 840.101 contained provisions for PPBCS circuits where they **did not leave the building**, but no provisions existed for when PPBCS circuits **did leave the building**
- PPBCS circuits are being installed by utilities or service providers that provide power to exterior equipment such as an asymmetric digital subscriber line (ADSL), which is a type of digital subscriber line (DSL) technology
- The circuits are equipment on the network being powered from the premises which ultimately would power circuits going to **other premises**

311

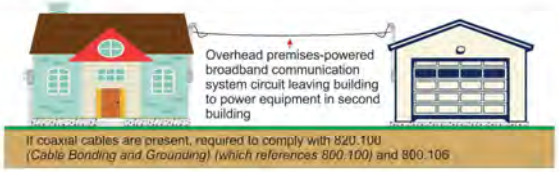
840.94 and 840.102 Premises Circuits Leaving the Building *(cont.)*

- Two new sections (840.94 and 840.102) added to provide requirements for **premises-powered broadband communication system (PPBCS) circuits** when they **leave the building** to power equipment **remote to that building**
- These circuits are derived from the premises power to avoid having to run copper cable to the exterior location, avoid establishing a meter point, and/or avoid providing backup batteries *[sometimes referred to as "**reverse powering (RP)**"]*
- These added circuits are potentially exposed to lightning events and/or electric power ground faults
- They deserve and require the same protection and grounding and bonding means as other aerial, buried, or underground communications cables entering a building

312

840.94 and 840.102 Premises Circuits Leaving the Building

840.94: Requires circuits leaving a building to power equipment remote to that building or outside the exterior zone of protection defined by a 46 m (150 ft) radius rolling sphere, to comply with 805.90 *(Protective Devices)* and 805.93 *(Grounding, Bonding, or Interruption of Non-Current-Carrying Metallic Sheath Members of Communications Cables)*



840.102: Requires communications wires and cables circuits leaving the building to power equipment remote to the building or outside the exterior zone of protection defined by a 46 m (150 ft) radius rolling sphere to comply with 800.100 *(Cable and Primary Protector Bonding and Grounding)* and 800.106 *(Primary Protector Grounding and Bonding at Mobile Homes)*

313

840.160 Powering Circuits (Premises-Powered Broadband Communication Systems)

- Revised text identifies **listing provisions** for communications cables, powered communications equipment, and the power source
- Communications cables that are listed in accordance with **805.179** are permitted to carry circuits for powering communications equipment *(in addition to carrying the communications circuit)*
- Communications equipment has to be listed in accordance with **805.170**
- Power source required to be listed in accordance with **840.170(G)**
- Installation of listed 4-pair communications cables for a communications circuit or installation where 4-pair communications cables are substituted for Class 2 and Class 3 cables in accordance with **725.154(A)** is required to comply with **725.144** with an exception *where the rated current of the power source does not exceed 0.3 amperes in any conductor 24 AWG or larger*

314

Communications cables listed in accordance with 805.179

315

316

Chapter 9, Notes to Tables, Note (2)

- Revision to Note (2) now indicates that **Table 1** does not apply to exposed wiring ***and cable*** when used in incomplete sections of conduit or tubing to protect from physical damage
- Previously, Note (2) to the Chapter 9 tables only referenced "**exposed wiring**" *(and not cable)*
- Revision to make it clear that protection from physical damage is for "**exposed wiring**" **includes cables** as well
- Should have been fairly evident with the title of Table 1 of Chapter 9 being "Percent of Cross Section of Conduit and Tubing for Conductors ***and Cables***" with a subheading of "Number of Conductors and/***or Cables***"
- Proper conductor fill will avoid conductor overheating and possible insulation damage due to excessive heat

317

Chapter 9, Notes to Tables, Note (2)

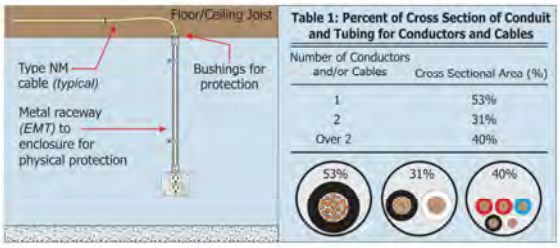
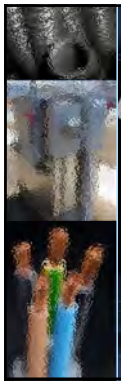


Table 1: Percent of Cross Section of Conduit and Tubing for Conductors and Cables

Number of Conductors and/or Cables	Cross Sectional Area (%)
1	53%
2	31%
Over 2	40%

Note (2): Table 1 applies only to complete conduit or tubing systems and is not intended to apply to sections of conduit or tubing used to protect exposed wiring and cable from physical damage.

318



Informative Annexes

319

Informative Annex A- Product Safety Standards

- Informative Annex A was reformatted to provide and add ***NEC*** **article numbers** and **appropriate product standards were added and updated**
- Previously, Informative Annex A had **two columns** of information; **(1)** the name of the product standard and **(2)** the product standard number
- Informative Annex A now has **three columns** of information; **(1)** the *NEC* article number where the referenced product standard can be found, **(2)** the product standard number, and **(3)** the name of the product standard
- **2017 *NEC*:** Informative Annex A referenced **236 product standards**
- **2020 *NEC*:** Informative Annex A references **352 product standards**
- Previous tabular format of Informative Annex A did not provide **correlation with various *Code* Articles** (*where can these product standard references be found throughout the NEC?*)

320

Informative Annex A - Product Safety Standards

Informative Annex A was reformatted to provide *NEC* article numbers and appropriate product standards were added

2017 *NEC* Informative Annex A *(in part)*		2020 *NEC* Informative Annex A *(in part)*		
Product Standard Name	Product Standard Number	Article	Standard Number	Standard Title
Antenna-Discharge Units	UL 452	110	UL 943	Ground-Fault Circuit-Interrupters
Arc-Fault Circuit-Interrupters	UL 1699	210	UL 1699	Arc-Fault Circuit-Interrupters
Armored Cable	UL 4	230	UL 1053	Ground-Fault Sensing and Relaying Equipment
Attachment Plugs and Receptacles	UL 498			
Audio, Video and Similar Electronic Apparatus — Safety Requirements	UL 60065	240	UL 2735	Electric Utility Meters
			UL 198M	Mine-Duty Fuses
Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements	UL 62368-1		UL 248-1	Low-Voltage Fuses — Part 1: General Requirements
			UL 248-2	Low-Voltage Fuses — Part 2: Class C Fuses
Automatic Electrical Controls	UL 60730-1	250	UL 467	Grounding and Bonding Equipment

321

Informative Annex C - Conduit, Tubing, and Cable Tray Fill Tables for Conductors and Fixture Wires of the Same Size

- Informative Annex C revised to include conductor fill tables for **cable trays** as well and for conduits and tubing
- Previous Informative Annex C contained **26 tables** for determining the maximum number of conductors or fixture wires permitted in various conduits and tubings
- New Informative Annex C is now contains **33 tables** for determining the maximum number of conductors or fixture wires permitted in various conduits, tubings **and cable trays**
- Rules and tables provided in Article 392 *(Cable Trays)* for determining the sizing of various cable tray types and sizes can be intimidating and complicated to some users of the *Code*
- **New tables** in Informative Annex C allows for **simplified determination** of the maximum number of cables or conductors allowed in a particular cable tray width and serve to **enhance safety** due to reductions of errors pertaining to incorrect cable selection and erroneous cable tray sizing calculations

322

Informative Annex C - Conduit, Tubing, and Cable Tray Fill Tables for Conductors and Fixture Wires of the Same Size

C.1 - Electrical Metallic Tubing (EMT)
C.1(A)* - Electrical Metallic Tubing (EMT)
C.2 - Electrical Nonmetallic Tubing (ENT)
C.2(A)* - Electrical Nonmetallic Tubing (ENT)
C.3 - Flexible Metal Conduit (FMC)
C.3(A)* - Flexible Metal Conduit (FMC)
C.4 - Intermediate Metal Conduit (IMC)
C.4(A)* - Intermediate Metal Conduit (IMC)
C.5 - Liquidtight Flexible Nonmetallic Conduit (Type LFNC-A)
C.5(A)* - Liquidtight Flexible Nonmetallic Conduit (Type LFNC-A)
C.6 - Liquidtight Flexible Nonmetallic Conduit (Type LFNC-B)
C.6(A)* - Liquidtight Flexible Nonmetallic Conduit (Type LFNC-B)
C.7 - Liquidtight Flexible Nonmetallic Conduit (Type LFNC-C)
C.7(A) - Liquidtight Flexible Nonmetallic Conduit (Type LFNC-C)
C.8 - Liquidtight Flexible Metal Conduit (LFMC)
C.8(A)* - Liquidtight Flexible Metal Conduit (LFMC)
C.9 - Rigid Metal Conduit (RMC)
C.9(A)* - Rigid Metal Conduit (RMC)
C.10 - Rigid PVC Conduit, Schedule 80
C.10(A)* - Rigid PVC Conduit, Schedule 80
C.11 - Rigid PVC Conduit, Schedule 40 and HDPE Conduit
C.11(A)* - Rigid PVC Conduit, Schedule 40 and HDPE Conduit
C.12 - Type A, Rigid PVC Conduit
C.12(A)* - Type A, Rigid PVC Conduit
C.13 - Type EB, PVC Conduit
C.13(A)* - Type EB, PVC Conduit
C.14- Type MC Cables Allowed in Cable Tray
C.15- Type MC Cables *(4C Multiconductor)*
C.16- Type TC Cables *(3C Multiconductor)*
C.17- Type TC Cables *(4C Multiconductor)*
C.18- Single Conductor Cables Allowed in Cable Tray
C.19- Single Conductor Cables Allowed in Cable Tray
C.20- Single Conductor Cables Allowed in Cable Tray

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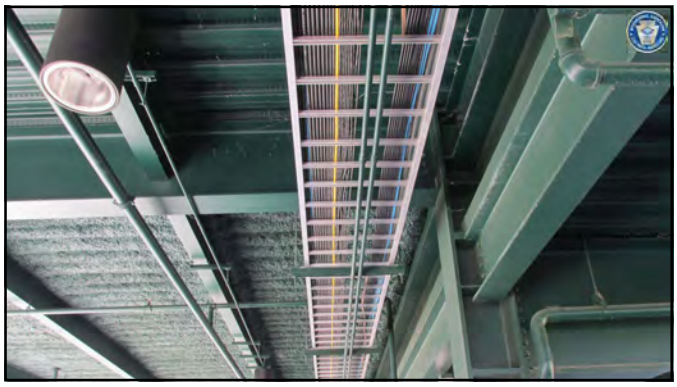
324

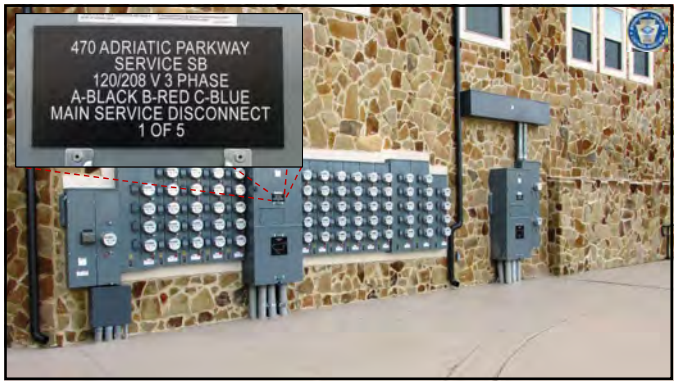


325

Informative Annex D Example D5(b) Optional Calculation for Multifamily Dwelling Served at 208Y/120 Volts, Three Phase

- Example D5(b) has been revised to accurately reflect the **neutral load calculation** for a three-phase system
- Previously, the **neutral load calculation** was based on a **single-phase system**
- The neutral load used in Example D5(b) was extracted from Example D4(a)
- The problem is that **Example D4(b)** is a **single-phase example** and calculations and **Example D5(b)** is a **three-phase example**

326



327

Informative Annex D Example D8 Motor Circuit Conductors, Overload Protection, and Short-Circuit and Ground Fault Protection

- Example D8 was revised to include the **30 hp motor as the largest motor** and the **example was expanded**
- Previous example was based on a 25 hp motor, which was not the largest motor in the circuit
- This mishap has been corrected and the calculations are now based on one of the 30 hp motors for the largest motor
- Text was also added to distinguish between the type motors considered in the calculations *(squirrel-cage vs. wound-rotor)*
- There is a difference in calculations between squirrel cage and wound rotor motors

328

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Informative Annex H – Administration and Enforcement

- Revision to the opening paragraph of **Article 80** informs users of the Code that **Informative Annex H** is intended to provide a **template and sample language** for local jurisdictions adopting the *NEC*
- The opening paragraph of Article 80 now states that "Informative Annex H is not a part of the requirements of this NFPA document and is included for informational purposes only. **Informative Annex H is intended to provide a template and sample language for local jurisdictions adopting the *National Electrical Code*®.**"
- This revision provides **additional clarity** and **removes redundant language** and is intended to help in the process of local jurisdictions adopting the latest edition of the *NEC* in a timely manner

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Informative Annex H - Administration and Enforcement

Informative Annex H is not a part of the requirements of the *NEC* (informational purposes only) and is intended to provide a template and sample language for local jurisdictions adopting the *NEC*

331

Analysis of Changes – 2020 *NEC*

End of Part 2 – NEC Chapters 5 through 9

Training Presentation By:
International Association of Electrical Inspectors

332

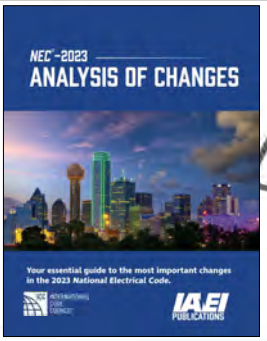
IAEI's Analysis of Changes- 2023 *NEC*

Your essential guide to the most important changes in the 2023 National Electrical Code

IAEI The Electrical Safety Leader

ICC INTERNATIONAL CODE COUNCIL

1



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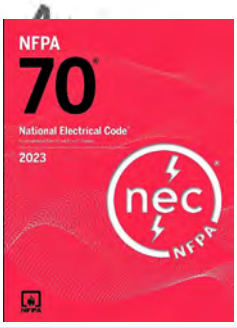
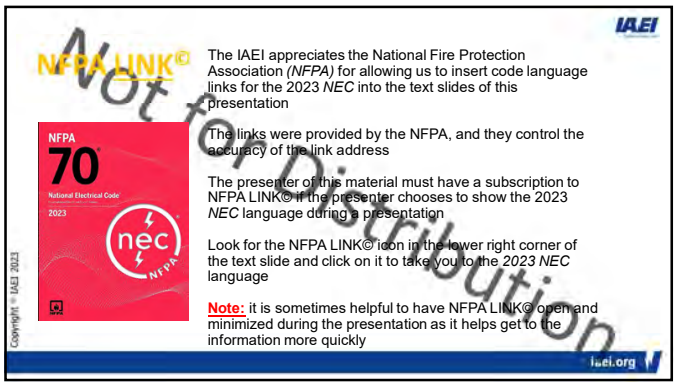


NFPA 70®

National Electrical Code®

This presentation is based on the requirements of the 2023 edition of the *National Electrical Code (NEC)*

4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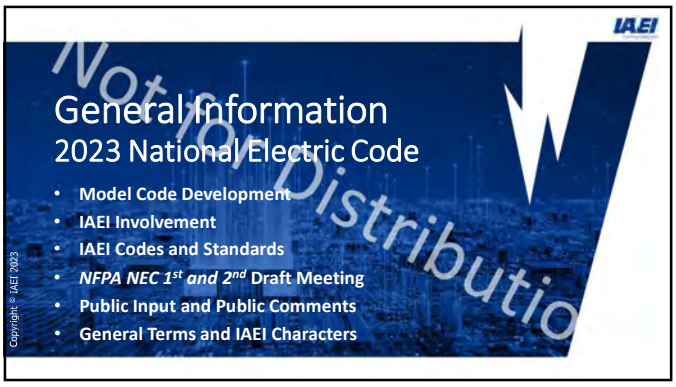
General Information
2023 National Electric Code
Model Code Development
IAEI Involvement
IAEI Codes and Standards
NFPA NEC 1st and 2nd Draft Meeting
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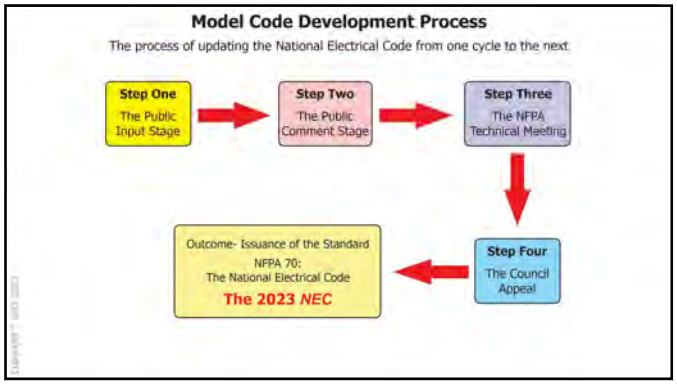
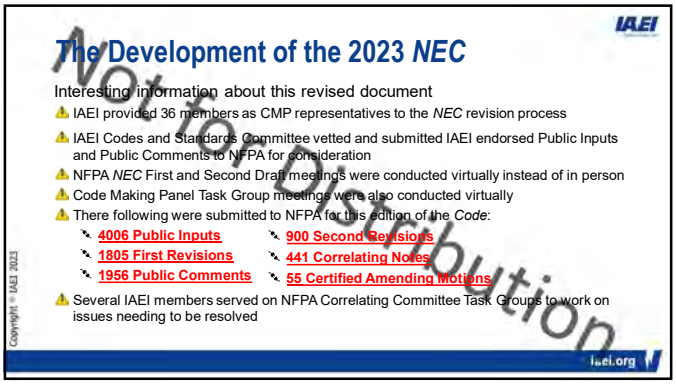
6


Model Code Development Process
The process of updating the National Electrical Code from one cycle to the next
Step One
The Public Input Stage
Step Two
The Public Comment Stage
Step Three
The NFPA Technical Meeting
Step Four
The Council Appeal
Outcome- Issuance of the Standard
NFPA 70:
The National Electrical Code
The 2023 NEC

7


The Development of the 2023 NEC
Interesting information about this revised document
IAEI provided 36 members as CMP representatives to the NEC revision process
IAEI Codes and Standards Committee vetted and submitted IAEI endorsed Public Inputs and Public Comments to NFPA for consideration
NFPA NEC First and Second Draft meetings were conducted virtually instead of in person
Code Making Panel Task Group meetings were also conducted virtually
There following were submitted to NFPA for this edition of the Code:
4006 Public Inputs
1805 First Revisions
1956 Public Comments
900 Second Revisions
441 Correlating Notes
55 Certified Amending Motions
Several IAEI members served on NFPA Correlating Committee Task Groups to work on issues needing to be resolved
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8

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- Rhonda Parkhurst

CMP-4
- **Jim Rogers***
- Pete Jackson

CMP-5
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CMP-6
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NEC Correlating Committee
- David Williams
- Donny Cook

** Denotes Chair Position of CMP*

10

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  - Donny Cook
  - Thomas Domitrovich
  - Pete Jackson
  - Tim McClintock
  - Jim Rogers
  - Mike Savage
  - Joseph Wages, Jr.
  - David Williams

11

IAEI Subject Matter Experts

A special thank you to electrical industry experts who provided input or conducted reviews of this material

- Paul Dobrowsky
- Fred Hartwell
- Mark Hilbert
- Christel Hunter
- Chad Kennedy
- Chuck Mello
- Thomas Lichtenstein
- Bryan Holland
- Don Iverson
- Peter Graser
- Tim McClintock
- Dean Hunter
- David Williams
- Thomas Domitrovich
- David Humphrey
- Cliff Norton
- Chris Faucette
- Donny Cook
- Jim Rogers
- Pete Jackson
- Rob Bowman
- Scott Humphrey
- Steve Thomas

12

Terms Used During the Presentation

AHJ- Authority Having Jurisdiction
CMP- Code Making Panel
CPSC- Consumer Products Safety Commission
IAEI- International Association of Electrical Inspectors
ICSC- IAEI Codes and Standards Committee
NEC- National Electrical Code
NECA- National Electrical Contractors Association
NEMA- National Equipment Manufacturers Association
NFPA- National Fire Protection Association
UL- Underwriters Laboratories

13

IAEI Industry Partnerships

THANK YOU for your continued partnership with the IAEI in the promotion of electrical safety

14

Code-Wide Changes

- *NEC* Style Manual Changes
- Definition Location
- Reconditioned Equipment
- Medium Voltage Requirements
- Copper Clad Aluminum
- New Articles for 2023 *NEC*

15

The *NEC* Style Manual

Revised in 2020 and used for the 2023 *NEC* and 2024 version of *NFPA 70E*

- Purpose of the Style Manual is to make the code usable and clear and to provide formatting provisions
- Deletion of redundant language *(prohibits repeating language from Chapters 1-4 in other chapters of the NEC)*
- Significant Changes for the 2020 edition include actions involving:
  - Parts
  - Definitions
  - Searchability
  - Article Numbers
  - CMP References
  - Multiple Definitions
  - Similar and Alternate Terms
  - Informational Notes
  - Acronyms

David Williams, *NEC* Correlating Committee

16

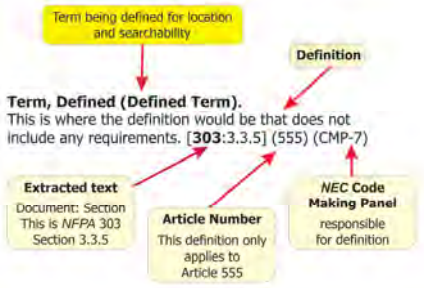
Definitions

Definitions were relocated to Article 100 and arranged in alphabetical order with no parts

- Article 100 now contains approximately 800 definitions
- Additional definition structure requirements were also added to this *Code* cycle
- This allows the *NEC* to follow the same layout as other *NFPA* documents that have all definitions in one chapter
- Similar terms and acronyms may be used along with provisions for electronic searching
- Relocation revealed multiple terms defined differently in the code, which were also addressed with the *NEC Style Manual* revision
- All definitions apply throughout the *Code* (*An article number appearing after the defined term indicates the definition only applies to that article)*

17

Article 100- Definitions



18

Reconditioned Equipment

The xxx.2 sections in many chapters have become "placeholders" for requirements for reconditioned equipment

- This placeholder location *(xxx.2)* was made possible by the movement of all definitions that used to reside in these sections to Article 100
- This will allow code-making panels the opportunity to place requirements for reconditioned equipment in sections of the *NEC* that they have purview over
- These changes will make the *NEC* a more user-friendly document

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Reconditioned Equipment

110.20 Reconditioned
110.21 Marking

210.2 Reconditioned Equipment
240.2 Reconditioned Equipment
242.2 Reconditioned Equipment
245.2 Reconditioned Equipment

362.2 Reconditioned Equipment
348.2 Reconditioned Equipment
350.2 Reconditioned Equipment
369.2 Reconditioned Equipment

404.16 Reconditioned Equipment
406.2 Reconditioned Equipment
408.2 Reconditioned Equipment
410.2 Reconditioned Equipment
411.2 Reconditioned Equipment
430.2 Reconditioned Motors
470.2 Reconditioned Equipment
495.2 Reconditioned Equipment
495.49 Reconditioned Switchgear

517.6 Patient Care-Related Electrical Equipment

660.10 Equipment Installations
695.2 Reconditioned Equipment

700.2 Reconditioned Equipment
701.2 Reconditioned Equipment
702.2 Reconditioned Equipment
708.2 Reconditioned Equipment
800.2 Reconditioned Equipment

Note: Not all Code Making Panels *(CMPs)* used xxx.2 for reconditioned equipment

20

Medium Voltage Requirements

Several new articles appeared in the 2023 *NEC* regarding the inspection and installation requirements for medium voltage conductors and equipment

- **Article 235** Branch Circuits, Feeders and Services Over 1000 Volts ac, 1500 Volts dc, Nominal
- **Article 245** Overcurrent Protection for Systems Rated Over 1000 Volts AC, 1500 Volts DC
- **Article 305** Wiring Methods and Materials for Systems Rated Over 1000 Volts ac, 1500 Volts dc, Nominal
- **Article 315** Medium Voltage Conductors, Cable, Cable Joints, and Cable Terminations
- **Article 495** Equipment Over 1000 Volts AC, 1500 Volts DC, Nominal

21

Copper-Clad Aluminum *(CCA)*

- Copper-clad aluminum *(CCA)* underwent extensive review and testing overseen by the NFPA Bimetallics Task Group formed at the direction of the Standard's Council after the 2020 *NEC* cycle
- The Task Group represented industry stakeholders, and the testing data provided a direct comparison of the performance of 14 AWG CCA to 14 AWG copper at their respective 60 degree C ampacities, demonstrating the safety of CCA
- A new table was added to 210.24, identified as 210.24(2), which summarizes the branch circuit applications for aluminum and CCA as had been permitted for over 50 years, where only copper conductors had this summary information provided in previous code editions

22

Copper-Clad Aluminum *(CCA)(cont.)*

- In addition to the listings for finished insulated conductors and cable assemblies, **conductors made with CCA must carry a listing for the bimetal itself [310.3(B)(4)]**
- The core of the CCA must be AA-8000 series aluminum **[310.3(B)(3)]**
- The copper of CCA must be a minimum of 10 percent of the cross-sectional area of a solid conductor or each strand of a stranded conductor **[310.3(B)(3)]**
- The marriage between copper and aluminum in CCA is such that a metallurgical bond exists between the aluminum core and the copper outer layer

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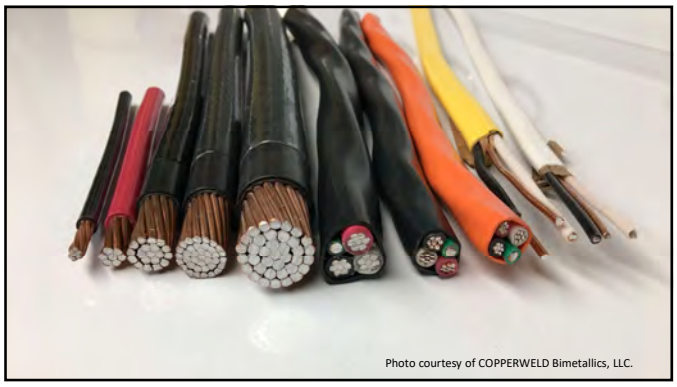
Copper-Clad Aluminum *(CCA)(cont.)*

- Listing will prove that it meets ASTM product design requirements
- The smallest standard size of overcurrent protection is 10 amperes due to more energy- efficient products such as LED lighting and in anticipation of 14 AWG CCA being added to the ampacity tables in Article 310
- Code-Making Panel 1 reconfirmed in Section 110.14, Electrical Connections, that CCA and copper are only dissimilar to single metal aluminum when intermixed but not to each other for the application of the requirement
- Parenthetical text "such as copper and aluminum, copper and copper-clad aluminum, or aluminum and copper-clad aluminum" was removed

24



25

New Articles for the 2023 *NEC*

Thirteen (13) new articles have been added to the 2023 *NEC*:

- **Article 235**
  - Branch Circuits, Feeders and Services Over 1000 Volts ac, 1500 Volts dc, Nominal
- **Article 245**
  - Overcurrent Protection for Systems Rated Over 1000 Volts ac, 1500 Volts dc
- **Article 305**
  - Wiring Methods and Materials for Systems Rated Over 1000 Volts ac, 1500 Volts dc, Nominal

IAEI Code Making Panel Members

26

New Articles for the 2023 *NEC (cont.)*

Thirteen (13) new articles have been added to the 2023 *NEC*:

- **Article 315**
  - Medium Voltage Conductors, Cable, Cable Joints, and Cable Terminations
- **Article 335**
  - Instrumentation Tray Cable
- **Article 369**
  - Insulated Bus Pipe/Tubular Covered Conductors
- **Article 371**
  - Flexible Bus Systems

IAEI Code Making Panel Members

27

New Articles for the 2023 *NEC (cont.)*

Thirteen (13) new articles have been added to the 2023 *NEC*:

- **Article 395**
  - Outdoor Overhead Conductors Over 1000 Volts
- **Article 495**
  - Equipment Over 1000 Volts AC, 1500 Volts DC, Nominal
- **Article 512**
  - Cannabis Oil Equipment

IAEI Code Making Panel Members

28

New Articles for the 2023 *NEC (cont.)*

Thirteen (13) new articles have been added to the 2023 *NEC*:

- **Article 722**
  - Cables for Power-Limited Circuits, Fault-Managed Power *(Class 4)* Circuits
- **Article 724**
  - Class 1 Power-Limited Circuits and Class 1 Power-Limited Remote-Control and Signaling Circuits
- **Article 726**
  - Class 4 *(CL4)* Power Systems

29

Deleted Articles for the 2023 *NEC*

- **Article 311** Medium Voltage Conductors and Cables
  - *(contents moved to new Article 315)*
- **Article 510** Hazardous *(Classified)* Locations - Specific
- **Article 490** Equipment Over 1000 Volts, Nominal
  - *(contents moved to new Article 495)*
- **Article 712** Direct Current Microgrids
- **Article 720** Circuits and Equipment Operating at Less Than 50 Volts

30

Article 90
Introduction

- **Use and application, arrangement, and enforcement of this *Code***
- **Mandatory, permissive, and nonmandatory text**

31

90.5 Mandatory Rules, Permissive Rules, and Explanatory Material

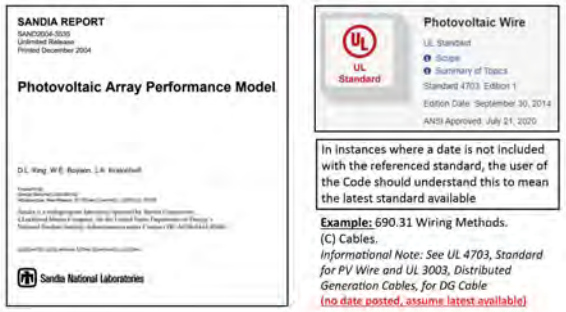
(C) Explanatory Material

Revised to state that unless a standard referenced in the *NEC* contains a date, that reference is to be considered the latest edition of the standard

- CMP members spend a lot of time and effort making date changes to referenced standards that appear in the *NEC*
- In instances where a date is not included with the referenced standard, the user of the *Code* should understand this to mean the latest standard available
- Will reduce the number of public inputs and public comments submitted to modify a date for a standard referenced in the *NEC*

32

90.5(C) Explanatory Material


SANDIA REPORT

Photovoltaic Array Performance Model

Sandia National Laboratories

Photovoltaic Wire

UL Standard

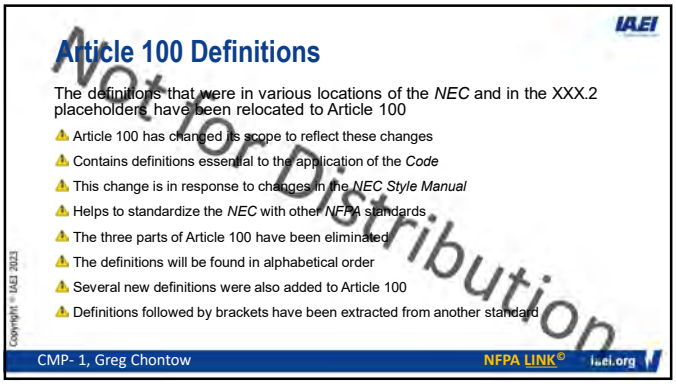
In instances where a date is not included with the referenced standard, the user of the Code should understand this to mean the latest standard available

Example: 690.31 Wiring Methods.
(C) Cables.
Informational Note: See UL 4703, Standard for PV Wire and UL 3003, Distributed Generation Cables, for DG Cable
(no date posted, assume latest available)

33

34

35



36

Article 100- Definitions

Term being defined for location and searchability

Definition

Term, Defined (Defined Term).
This is where the definition would be that does not include any requirements. [**303**:3.3.5] (555) (CMP-7)

Extracted text
Document: Section
This is *NFPA* 303 Section 3.3.5

Article Number
This definition only applies to Article 555

***NEC* Code Making Panel**
responsible for definition

37

Article xxx.2 Sections to Article 100

All definitions will now be found in Article 100 of the National Electrical Code

This change is in response to changes with the *NEC Style Manual*

Helps to standardized the *NEC* with other NFPA standards

38

Reconditioned Equipment

110.20 Reconditioned	404.16 Reconditioned Equipment	517.6 Patient Care-Related Electrical Equipment
110.21 Marking	406.2 Reconditioned Equipment	
	408.2 Reconditioned Equipment	
210.2 Reconditioned Equipment	410.2 Reconditioned Equipment	660.10 Equipment Installations
240.2 Reconditioned Equipment	411.2 Reconditioned Equipment	695.2 Reconditioned Equipment
242.2 Reconditioned Equipment	430.2 Reconditioned Motors	
245.2 Reconditioned Equipment	470.2 Reconditioned Equipment	700.2 Reconditioned Equipment
	495.2 Reconditioned Equipment	701.2 Reconditioned Equipment
362.2 Reconditioned Equipment	495.49 Reconditioned Switchgear	702.2 Reconditioned Equipment
348.2 Reconditioned Equipment		708.2 Reconditioned Equipment
350.2 Reconditioned Equipment		800.2 Reconditioned Equipment
369.2 Reconditioned Equipment		

Note: **Not all Code Making Panels *(CMPs)* used xxx.2 for reconditioned equipment**

39

Article 100 Definitions- Searchability

Revised these definition titles to aid in electronic searches

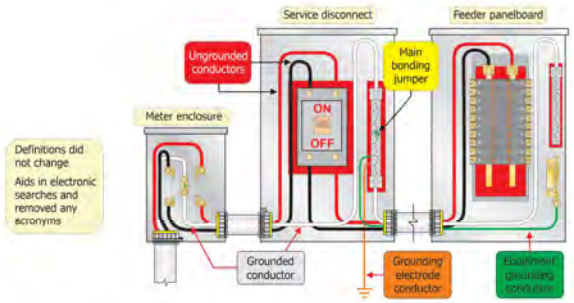
- Bonding Conductor. *(Bonding Jumper)*
- Bonding Jumper, Equipment. *(Equipment Bonding Jumper)*
- Bonding Jumper, Main. *(Main Bonding Jumper)*
- Bonding Jumper, Supply-Side. *(Supply-Side Bonding Jumper)*
- Bonding Jumper, System. *(System Bonding Jumper)*
- Grounded, Solidly. *(Solidly Grounded)*
- Grounding Conductor, Equipment *(EGC)*. *(Equipment Grounding Conductor)*

Note: Language for the above definitions has not changed

CMP- 5, Bill Pancake

40

Article 100- Definitions *(Multiple Definitions)*



41

Article 100- Accessible *(applied to wiring methods)*

Revision clarifies that wiring and electrical equipment made inaccessible by piping, ductwork, drains, raceways, or other mechanical systems **is not considered as accessible** as applied to wiring methods

- Access to the wiring contained within this equipment is sometimes made very difficult
- This can require removal or disassembling of piping, raceways, or other equipment, which, where present, tended to defeat the purpose of using the term "accessible" in *Code* requirements that use the term
- Building-related items such as electrical raceways, plumbing pipes, and mechanical systems were considered accessible because they are not part of the structure or finish of the building, and the definition did not cover anything else

42

Article 100- Accessible *(applied to wiring methods)*

Modifications were made to the definition of "Accessible" as it applies to wiring methods

Clarifies that wiring and electrical equipment **cannot be made inaccessible** by piping, ductwork, drains, raceways, or other mechanical systems

Photos courtesy of IAEI Archives

43

Article 100- Accessible *(applied to wiring methods)*

This helps to clarify that wiring and electrical equipment **cannot be made inaccessible** by piping, ductwork, drains, raceways, or other mechanical systems

Water piping in front of electrical equipment making it **inaccessible for maintenance**

44

Article 100- Class 4 Circuit

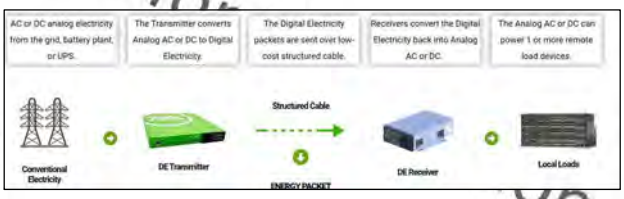
A new definition for a Class 4 Circuit has been added as it applies to equipment and installations located in Article 726

- This was the result of the **Packet Energy Transfer** *(PET)* Systems Task Group tasked to provide guidance towards this new technology
- This emerging technology has been referred to in the past as Packet Energy Transfer *(PET)*, Digital Electricity *(DE)*, Pulsed Power, Smart Transfer Systems and Fault Managed Power (FMP)
- Involves a fault-managed system that verifies the powered device is present and operating correctly prior to a greater than Class 2 power being applied *(a fault would cause a termination of the output power)*
- Must ensure safety in the design, implementation, installation, and use of this technology
- There are now a total of six (6) definitions associated with this Class 4 technology

45

Article 100- Class 4 Circuit *(cont.)*

Flowchart describing how this process works *(courtesy of Voltserver)*



46

Article 100- Class 4 Circuit *(cont.)*

Equipment associated with Class 4 Circuit distribution *(courtesy of Voltserver)*

47

Article 100 Definitions- Counter *(Countertop)*

A new definition was added to help users of the *Code* understand what constitutes a **"Counter *(Countertop)*"** location

- There appears to be installer and enforcement **confusion,** as well as **frequent product misapplications** resulting from electrical equipment being installed incorrectly on these surfaces
- The key distinction between a work surface and a countertop is the **quantity of spillage** that the surfaces may be subjected *(Generally, a counter application assumes a greater volume of spillage)*
- The electrical professional will be directed to the industry standards that aid in the proper application of receptacles in these locations
- See **Informational Note No. 1** for a reference to *UL 498, Receptacles and Attachment Plugs*, and *UL 943, Ground-Fault Circuit-Interrupters*
- See **Informational Note No. 2** for information on receptacles for counters and countertops distinguished from receptacles for work surfaces

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Article 100 Definitions- Counter *(Countertop)*

The key distinction between a **work surface or a countertop** is the quantity of spillage that the surfaces may be subjected *(see Work Surface definition in upcoming slide)*

Features:
- listed for application
- flange raised above surface to prevent liquid from entering
- sealed when in the closed position to prevent liquid from entering
- only energized in the upright position
- GFCI protected

Courtesy of ABB, Thomas and Betts

49

Article 100 Definitions- Work Surface

Work Surface	Countertop
• A container with **8 oz of saline solution**, with 8 g of table salt per liter of distilled water	• A container with **1/2 gallon of saline solution** with 0.28 ounce of table salt per liter of distilled water
• Container is placed on the counter surface 12 inches from the sample	• Container is placed on the counter surface 12 inches from the sample
• Container is tipped over all at once with an effort to direct the spill toward the most disadvantageous area of the assembly	• Container is tipped over all at once with an effort to direct the spill toward the most disadvantageous area of the assembly

50

Article 100 Definitions- Work Surface

- Reference 406.5(E), 406.5(G)(1), and 406.5(H) for information on receptacles for counters and countertops distinguished from receptacles for work surfaces
- 2020 *NEC* introduced work surface and countertop recognizing the differences are important but there were no definitions for these terms *(210.11 & 210.52)*

51

Article 100 Definitions- Energy Management System

A new definition for Energy Management System has been created and added to the 2023 *NEC*

- The Energy Management Task group was asked to review all current and proposed definitions and requirements
- Items reviewed were load management, load management system, power control system, energy management system, and related terms
- Need to promote a coordinated approach and understanding throughout the *Code*
- An energy management system will contain a monitor, a form of communication equipment, some type of controller and timer, and other devices responsible for monitoring or controlling an electrical load, a form of power production, or a type of storage source

52

Article 100 Definitions- Energy Management System

A new definition for **Energy Management System** has been created and added to the 2023 *NEC*

An energy management system will contain a monitor, a form of communication equipment, some type of controller and timer, and other devices responsible for monitoring or controlling an electrical load, form of power production, or a type of storage source

Photos courtesy of Schneider Electric

53

Article 100 Definitions- Feeder Assembly

This new definition will provide consistency when referencing the factory cord or cable assembly between the electrical equipment and the mobile home, recreational vehicle, or park trailer panelboard

- In previous editions of the *Code*, there were different definitions in the *NEC* articles under CMP-7 purview that basically covered the power cord assembly
- Adding the term "feeder assembly" consistently throughout Articles 550, 551, and 552 clarifies that these conductors, although connected to a receptacle, are considered feeders in order to forgo the GFCI protection
- This alleviates concerns about "unwanted tripping" that could be caused by the accumulation *(multiple portable appliances)* of leakage current at the source

CMP- 7, Dean Hunter NFPA LINK© iaei.org

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Article 100 Definitions- Feeder Assembly

Photo's courtesy of RV Upgrades, and IAEI Archives iaei.org

55

Article 100 Definitions- Fibers/Flyings, Combustible

A new definition for "Fibers/Flyings, Combustible" includes 3 informational notes that identify particle size and types of fibers/flyings

- Part of a Standards Council directive to CMP committees to resolve conflicts among the documents
- This change is a result of members from several technical committees as part of a Task Group on Combustible Dusts
- Informational notes following the new definition to include specific information pertaining to combustible metal fibers/flyings

CMP- 14, Haywood Kines NFPA LINK© iaei.org

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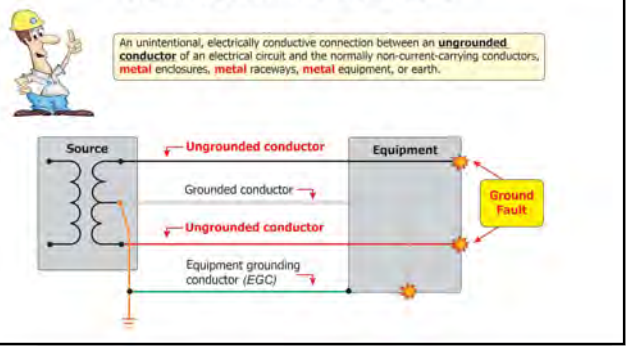
Article 100 Definitions- Ground Fault

Changed the words from "metallic" to "metal" in the definition of *Ground Fault* in Article 100

- Change was made from "metallic" to "metal" to comply with the *NEC Style Manual*
- Helps to add clarity and useability by updating the words of the definition
- This received considerable debate at the NEC Correlating Committee meeting

57

Article 100 Definitions- Ground Fault



58

Article 100- Impedance Grounding Conductor

A new term was added for *Grounding Conductor, Impedance*

- There was no definition until the 2023 *NEC* for a conductor that made a connection between the neutral point for an impedance grounded system and the grounding impedance device
- The impedance grounding conductor will carry fault current that has been reduced by a designated impedance
- This conductor did not meet the definition of a neutral conductor as it is not intended to carry current under normal conditions
- It also did not meet the definition of a *grounding electrode conductor*

59

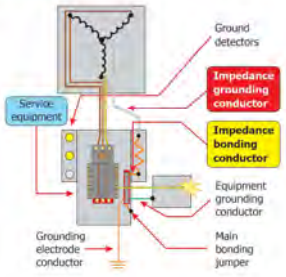
Article 100- Impedance Grounding Conductor

New definition for "Impedance grounding conductor" was created to replace the phrase "grounded system conductor"

There was no definition until the 2023 *NEC*

This conductor makes a connection between the neutral point for an impedance grounded system and the grounding impedance device

The impedance grounding conductor will carry fault current that has been reduced by a designated impedance



60

Article 100- Grounded System, Impedance *(Impedance Grounded System)*

A new term was added for *Grounded System, Impedance*

- There was no definition for an *impedance grounded system* before the 2023 *NEC* code cycle
- An electrical system that is grounded by intentionally connecting the system neutral point to ground through an impedance device (*CMP-5*)
- This resulted in an inconsistent use and understanding of these systems as they applied with high impedance grounded neutral systems and impedance grounded neutral systems
- Electrical professionals will have a new definition that is accurate and consistently defines elements that make up this system

IAEI Contributor- Paul Dobrowsky NFPA LINK© iaei.org

61

Article 100- Impedance Grounded System

Substantiation was submitted for the creation of a new definition for Grounded System, Impedance

No definition for an impedance grounded system before the 2023 *NEC*

This resulted in an **inconsistent use** and understanding of these systems as it applied with high impedance grounded neutral systems and impedance grounded neutral systems

Photos courtesy of Rob Bowman

62

Article 100- Impedance Grounded System

Photo shows the typical ground detection and alarm system associated with an impedance grounded system

Has visual as well as audible alarm features

These systems help maintain continuity of power, and are recognized in NFPA 70E as a method of reducing arc flash severity

Manufactured by Post Grover

Photo courtesy of Rob Bowman

IAEI Contributor- Paul Dobrowsky iaei.org

63

Article 100 Definitions- In Sight From

The definition of *"In Sight From (Within Sight From), (Within Sight)"* has been modified per requirements of the *NEC Style Manual*

- The *NEC Style Manual* states that definitions shall not contain requirements or recommendations
- See the new section for *"In Sight From (Within Sight From), (Within Sight)"* in 110.29 for requirements
- Definition revised for clarity and uniform enforcement
- Equipment that is visible and not more than 15 m *(50 ft)* distant from other equipment is considered to be in sight from that other equipment

CMP- 1, Paul Sood NFPA LINK© iaei.org

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Article 100- In Sight From *(Within Sight From, Within Sight)*

Distance is to be **visible** and not more than 15 m *(50 ft)* from the other equipment
[Note: see 110.29 for requirements for In Sight From (Within Sight From, Within Sight)]

Transformer disconnecting means is located in the electrical panel and is labeled

Transformer is labeled as to the panel and branch circuit it is controlled from

Always test for the presence of electricity before beginning the troubleshooting of electrical issues

65

Article 100- Likely to Become Energized

A new term is now defined explaining the phrase *Energized, Likely to Become*

- There was no definition of this phrase that appears 25 times within the *NEC*
- Annex B of the *NEC Style Manual* defines "likely to become energized" as a "failure of insulation on" *(Annex B is units of measure)*
- There is a very important distinction between what can become energized compared to what is likely to become energized
- Likely to become energized was up to interpretation with opinions that differed from jurisdiction to jurisdiction
- This caused frustration among electrical professionals when applying requirements from the *NEC*

IAEI Contributor- Paul Dobrowsky NFPA LINK© iaei.org

66

Article 100- Energized, Likely to Become

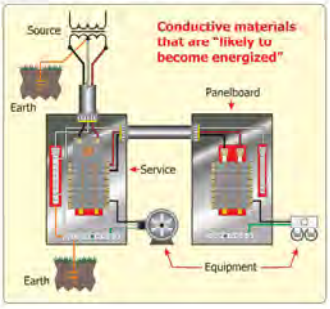
Likely to become energized was up to interpretation with opinions that differ between jurisdictions

Annex B of the *NEC Style Manual* defines "likely to become energized" as a "failure of insulation on"

Many people have never heard of an NEC Style Manual

Definition factors:

- a conductive material
- this conductive material could become energized
- could be due to failure of electrical insulation or electrical spacing



67

Article 100- Load Management

A new term is now defined for *Load Management*

- The result of the Energy Management Task Group who was asked to review current as well as proposed definitions and requirements
- Review topics included load management, load management system, power control system, energy management system, and related terms
- This will result in a coordinated approach and understanding throughout the *NEC*
- Task group proposed several public comments for energy management items located throughout the *NEC*
- Load management is considered a function of a listed energy management system
- The definition will now correlate with Article 750, *Energy Management Systems*

IAEI Codes and Standards Committee NFPA LINK© iaei.org

68

Article 100- Load Management

A new definition for Load Management has been added to the *NEC*

Review topics included load management, load management system, power control system, energy management system and related terms

This will result in a coordinated approach and understanding throughout the *NEC*

The definition will now correlate with Article 750 *Energy Management Systems*

Square D Load Management Systems

Photo from IAEI Archives

69

Article 100 Definitions- Normal High-Water Level

This new definition will help the authority having jurisdiction *(AHJ)* determine the elevation for the electrical datum plane distances used in Articles 551, 555, and 682

- Previously, there was no consistent way to determine the elevation next to a body of water to validate or confirm where electrical equipment could be placed and where the electrical datum plane is located
- This will provide an easier and more consistent way to determine the elevation for the electrical datum planes
- See this definition for further definitions of the following:
  - Natural or Artificially Made Shorelines
  - Rivers and Streams
  - Flood Control Bodies of Water
  - Nonflood Control Bodies of Water

70

What is an Electrical Datum Plane?

- The electrical datum plane is a horizontal plane, a specified distance above the normal high-water level
- It governs, by applicable *Code* rules, the lowest level that specified electrical equipment can be installed, and the electrical connections can be made
- One good example is 555.3(A) for floating piers
- The electrical datum plane for floating piers and landing stages is installed to permit located to accommodate the rise and fall of the pier or stage in response to water level, without lateral movement
- In these cases, the datum plane above the floating pier or landing stage is specified as being 30 inches above the water level at the floating pier or landing stage and a minimum of 12 inches above the level of the deck

71

Photo courtesy of IAEI Archives

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Article 100 Definitions- PV DC Circuit

New terms and revised definitions for PV System DC elements

- PV System Source Circuit and PV String Circuit subsets of a PV System DC Circuit
- **PV Source Circuit** is inclusive of the series and/or parallel dc circuit conductors between the modules and combiners, inverters or PV system dc disconnect
- **PV String Circuit** is inclusive of the series dc circuit conductors between the modules
- Previous terms and definitions were difficult to apply to current designs
- Decided to clarify these definitions as well as relocate all definitions to Article 100
- The definitions relocated to comply with the *NEC* Style manual requirements

CMP- 4, Pete Jackson

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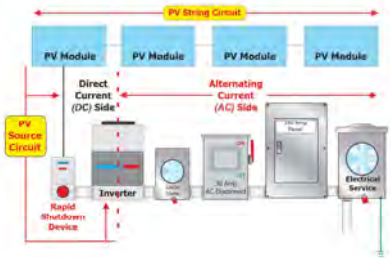
Article 100- PV DC Circuit

PV System Source Circuit and PV String Circuit are subsets of a PV System DC Circuit

PV String Circuit is the series dc circuit conductors between the modules

PV Source Circuit is the series and/or parallel dc circuit conductors between the modules and combiners, inverters or PV system dc disconnect



75

Article 100 Definitions- Restricted Industrial Establishment

New definition in Article 100 created to align with requirements for installations specifically found within hazardous *(classified)* locations

- Resulted in more concise wording in the definition and deleted unnecessary/redundant text for defining an industrial facility
- Removed the phrase *"In industrial establishments with restricted public access, where the conditions of maintenance and supervision ensure that only qualified persons service the installation"*
- Now states it is **an establishment** with restricted public access where there are conditions of maintenance where supervision ensures only qualified persons service the installation
- The above text was repeated in over 40 subdivisions for wiring methods permitted in hazardous *(classified)* locations
- This addressed an NFPA Correlating Committee request for all *code* panels to reduce redundant text that would not impact the *Code* requirements

CMP- 14, Haywood Kines

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Article 100- Definitions- Restricted Industrial Establishment

New definition in Article 100 created to **align with requirements** for installations specifically found within hazardous *(classified)* locations

Resulted in more concise wording in the definition and deleted unnecessary/redundant text for defining an industrial facility

Addressed NFPA Correlating Committee request to reduce redundant text but not impact code language

Photo courtesy of Brian Rock- Hubbie

77

Article 100 Definitions- Servicing

A new definition for servicing of electrical equipment to assist in maintenance and repair activities

- There has been confusion between what is considered reconditioning versus normal servicing, maintenance, and repair of electrical equipment
- This definition distinguishes the act of servicing and maintenance of electrical equipment from reconditioning of electrical equipment
- It will help assure the operational performance of the electrical equipment during the life of the equipment
- See *NEMA CS 100-2020, NEMA Technical Position on Reconditioned Electrical Equipment*, for additional information on the proper application of rules related to reconditioning

CMP- 1, Paul Sood

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Article 100- Servicing

Reconditioning and servicing of equipment is not the same

Switchboards and Switchgear Permitted to be reconditioned

Definition of "Servicing" helps to explain difference

To service equipment means to perform maintenance and repair of electrical equipment

Label shown that has been applied to the switchgear denoting it has also been reconditioned

79

Article 100 Definitions- Short Circuit

A new definition for "short circuit" has been added to the *Code* by CMP-10

- Short circuit is used several times throughout the *NEC*
- The definition is added to improve the usability of the code
- Previously, the user of the *Code* had to rely on other industry standards to determine the definition of this term, such as the *IEEE 100-1992, The New IEEE Standard Dictionary of Electrical and Electronic Terms, 5th Edition*

CMP- 10, David Williams

NFPA LINK© iaei.org

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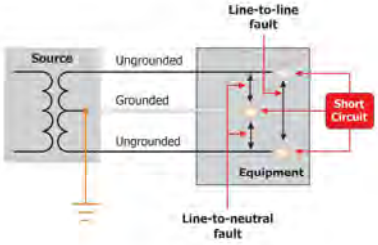
Definition: Short Circuit

Characteristics of a Short Circuit:

- It is a conducting connection
- can exists between any of the conductors of an electrical system
- either from line-to-line or from line to the grounded conductor
- can be accidental or intentional



81

Article 100 Definitions- Storable Swimming, Wading, or Immersion Pools and Storable/Portable Spas and Hot Tubs

The definition was modified **removing the 42 in. depth language** thus aligning with current product manufacturing standards

- This new definition covers:
  - Storable Swimming, Wading, or Immersion Pools and
  - Storable/Portable Spa and Hot Tub
- The previous water depth limitations were based on typical storable pool construction at that time and not related to any electrical hazard associated with water depth
- AHJs were placed in a position of identifying a code violation when the 42-in depth was in the previous definitions *(even though there was not an electrical hazard)*
- This should eliminate the confusion and unnecessary requirements that an equipotential bonding system be installed

82

Article 100 Definitions- Storable Swimming, Wading, or Immersion Pools and Storable/Portable Spas and Hot Tubs

The **42 in. depth** language has been removed

This now aligns with product manufacturing standards

83

Article 100 Definitions- Transformer

A new definition for a transformer has been created and added to the 2023 *NEC*

- The word "transformer" occurs approximately 1500 times in the *NEC*
- This new definition covers both single and polyphase equipment operating by electromagnetic induction
- The definition was careful not to state "changing voltage or current" because isolating transformers filter noise without changing nominal voltages

84

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Article 100 Definitions- Work Surface

A new definition was added to help users of the *Code* understand what constitutes a **"Work Surface"** location

- There appears to be installer and enforcement **confusion** as well as **frequent product misapplications** resulting from electrical equipment being installed incorrectly on these surfaces *(Work surfaces involve lower volumes of spillage than countertops)*
- The key distinction between a work surface and a countertop is the **quantity of spillage** that the surfaces may be subjected
- The electrical professional will be directed to the industry standards that aid in the proper application of receptacles in these locations
- See **Informational Note No. 1** for UL 111, *Outline of Investigation for Multioutlet Assemblies*, and *UL 962A, Furniture Power Distribution Units*
- See **Informational Note No. 2** for information on receptacles for work surfaces distinguished from receptacles for counters and countertops

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Article 100 Definitions- Work Surface

Work Surface	Countertop
• A container with **8 oz of saline solution**, with 8 g of table salt per liter of distilled water	• A container with **1/2 gallon of saline solution** with 0.28 ounce of table salt per liter of distilled water
• Container is placed on the counter surface 12 inches from the sample	• Container is placed on the counter surface 12 inches from the sample
• Container is tipped over all at once with an effort to direct the spill toward the most disadvantageous area of the assembly	• Container is tipped over all at once with an effort to direct the spill toward the most disadvantageous area of the assembly

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Article 100 Definitions- Work Surface

- Reference 406.5(E), 406.5(G)(1), and 406.5(H) for information on receptacles for counters and countertops distinguished from receptacles for work surfaces
- 2020 NEC Introduced work surface and countertop recognizing the differences are important but there were no definitions for these terms *(210.11 & 210.52)*

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Work Surface Locations

Listing of **receptacle assemblies for work surfaces** is based on the amount of liquid spillage verses that of a counter top location

Work surface photos courtesy of IAEI Archives

Note: Need to know what type surface you are dealing with in order to install the correct receptacle assembly

See UL 111, Outline of Investigation for Multioutlet Assemblies, and UL 962A, Furniture Power Distribution Units

89

Article 110
General Requirements for Electrical Installations

90

110.3 Examination, Identification, Installation, Use, and Listing *(Product Certification)* of Equipment.

(A) Examination

List Item 8: Changes addresses cybersecurity for network-connected life safety equipment

- Cybersecurity is a technology hazard that can cause many disturbances to electronic equipment
- Cybersecurity must be considered when evaluating equipment for safety
- Does not mandate that the electrical professional conduct a cybersecurity evaluation but to remember and recognize that it is a hazard

91

110.3 Examination, Identification, Installation, Use, and Listing *(Product Certification)* of Equipment.

(A) Examination

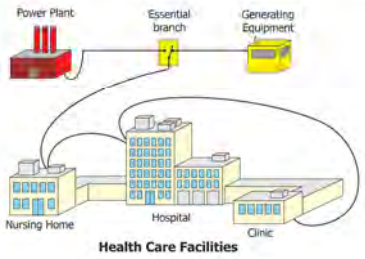
- **Informational Note No. 3** introduces the following valuable standards for consideration towards cybersecurity concerns for electrical equipment:
  - IEC 62443 series of standards for Industrial Automation and Control Systems
  - UL 2900 series of standards for Software Cybersecurity for Network-Connectable Products
  - UL 5500, the Standard for Remote Software Updates

92

110.3 Examination, Identification, Installation, Use, and Listing *(Product Certification)* of Equipment

Addresses cybersecurity for network-connected life safety equipment in (A) Examination *(list item 8)*

Does not mandate the electrical professional to conduct a cybersecurity evaluation but remember and recognize that it is a hazard



Health Care Facilities

93

110.3 Examination, Identification, Installation, Use, and Listing *(Product Certification)* of Equipment.

(B) Installation and Use

A new informational note was added allowing the use of a QR code to access installation instructions

- QR codes are appearing on many different items
- These allow the user to access vast amounts of information about a product
  - **An example:** Arc-Fault Circuit-Interrupters *(AFCIs)* allow the use of printed materials, **QR codes**, and internet addresses as avenues to find product information
- New Informational Note assures the electrical professional that a QR code *(if available)* is allowable for use in finding this important information

94

110.3 Examination, Identification, Installation, Use, and Listing *(Product Certification)* of Equipment

Use of QR codes are now addressed in the New I-Note following (B) Installation of Use

Assures the electrical professional that a QR code *(if available)* is allowable for use in finding this important information

In case you are wondering, QR stands for "quick response"

Photos courtesy of Eaton

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110.14 Electrical Connections

- Parent text removed parenthetical content: "(*such as copper and aluminum or aluminum and copper-clad aluminum*)"
- Copper and copper-clad aluminum are considered similar metals and not dissimilar metals as a CCA conductor
- Terminals are suitable for use with copper-clad aluminum conductors when evaluated for both copper and aluminum

96

110.14 Electrical Connections

(A) Terminals

"*Thoroughly good*" was replaced with "***mechanically secured***" for clarity and the word "*electrical*" was added for accuracy

- Adds clarity as to what kind of connection *(mechanically secure electrical connection)* is being discussed as it applies to terminations found with various types of electrical equipment
- The listing of the product will also determine the acceptability of the connection

97

110.16 Arc-Flash Hazard Warning

(B) Service Equipment/Feeder Supplied Equipment

This adds "Feeder Supplied Equipment" to the title, adds the phrase "arc flash" for the type of permanent label required, and reduces 1200 to 1000 amperes for equipment rating amperes

- Clarifies that the requirements apply to both service equipment and feeder-supplied equipment
- It was necessary to add the phrase "arc flash" to clarify the type of permanent label required for this equipment
- The revision from 1200 to 1000 amperes will protect worker safety
- The four previous list items and exception were deleted, and now references label to meet applicable industry practice

98

110.16(B) Service Equipment/Feeder Supplied Equipment

"Feeder Supplied Equipment" added to the title, "arc flash" added for the type of permanent label required, and reduced 1200 to 1000 amperes

Clarifies that the requirements apply to both service equipment and feeder-supplied equipment

Made sure that the electrical professional understood the label was for an "arc flash"

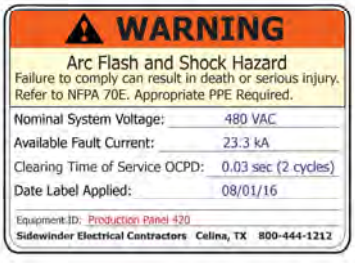
Revised **1200 amperes down to 1000 amperes** to provide greater safety to the worker

99

110.16(B) Service Equipment/Feeder Supplied Equipment

"Feeder Supplied Equipment" added to the title, "arc flash" added for the type of permanent label required, and reduced 1200 to 1000 amperes

Arc flash label is required to contain the following information



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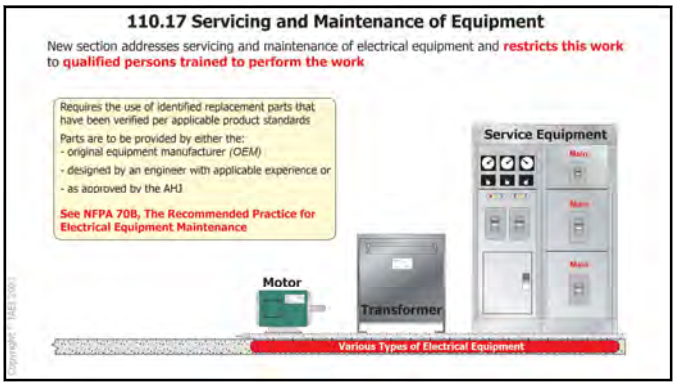

102

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110.20 Reconditioned Equipment

A new section for the establishment of general requirements that will apply to all equipment that is reconditioned

- Requires the use of identified replacement parts verified under applicable standards, provided by the original equipment manufacturer *(OEM)* or designed by an engineer with applicable experience
- **When equipment is to be listed**, reconditioned equipment must be listed, or a field label applied stating it has been reconditioned using information from the OEM
- **When equipment is not required to be listed**, two options exist:
  - The first states that the equipment can be listed or field labeled as reconditioned
  - The second states that the equipment can be reconditioned per the instructions provided by the OEM

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110.20 Reconditioned Equipment *(cont.)*

A new section for the establishment of general requirements that will apply to all equipment that is reconditioned

- A third option (C) is permitted when either option (A) or (B) will not work:
  - The authority having jurisdiction (AHJ) is permitted to approve reconditioned equipment when listing, field labeling, and OEM guidance are not available
- This grants the AHJ the ability to review the documentation regarding the changes that have been made to the equipment
- Based on this review, the AHJ may be able to approve the equipment

106

110.20 Reconditioned Equipment

New section for the establishment of general requirements that will apply to all equipment that is reconditioned

When equipment is not required to be listed, three options exist:

Option A
- it can be listed, or field labeled as reconditioned

Option B
- the equipment can be reconditioned per the instructions provided by the OEM

Option C is permitted when either option (A) or (B) will not work:
- The AHJ is **permitted to approve** reconditioned equipment when listing, field labeling, and OEM guidance is not available

When equipment is to be listed:
- reconditioned equipment must be listed or
- a field label applied stating it has been reconditioned using information from the OEM

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Major flooding resulted in damage to these circuit breakers.

Not all circuit breakers can be reconditioned.

(P.S.- the use of WD-40 is not the solution either!)

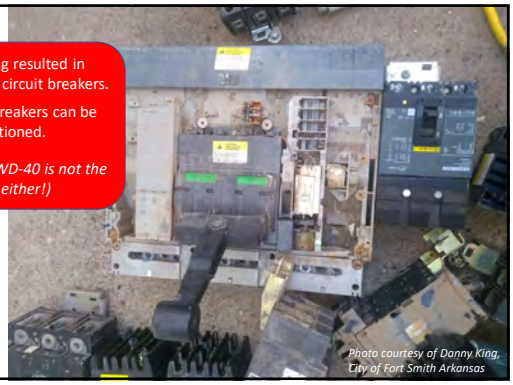

Photo courtesy of Danny King, City of Fort Smith Arkansas

108

The harsh reality:

Sometimes, things just cannot be reconditioned and must be replaced

Large hail event- Plano, Texas

Photos courtesy of Bill McGovern

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110.21 Marking

(A) Marking- (1) General

Changes to requirements for equipment marking to clarify how to apply or affix labels on all electrical equipment

- Clarifies how to apply labels on electrical equipment for the safety of the equipment
- There is a need to apply or affix labels onto the equipment instead of using the term "placed on the equipment"
- This will make sure the label stays there permanently and does not fall off with the passage of time
- Must be evaluated as to the longevity of these labels in the various environment in which the equipment is placed into service

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110.21(A)(1) General *(Equipment Labels)*

Clarified requirements for equipment marking for affixing labels on all electrical equipment

Labels need to be **affixed** to electrical equipment

Label needs to remain with the equipment for the life of the installation

The **environment of the equipment** *(rain, ice, snow, corrosion, etc)* must be considered

Items such as rivets or bolts with nuts may be needed

111

110.21 Marking

(A) Marking- (2) Reconditioned Equipment

Has reorganized information into a list format and clarifies that the original listing mark is to be removed or made permanently illegible

- The information previously found in a sentence format has been placed into a list format making it easier to follow and understand
- Clarification that the original listing mark is to be removed or made permanently illegible
- Clarifies the misunderstanding by some that the nameplate should be removed
- This assures that important information stays with the equipment for future use
- Further clarifies that the approval of this equipment should not be based on the original listing mark

IAEI Codes and Standards Committee

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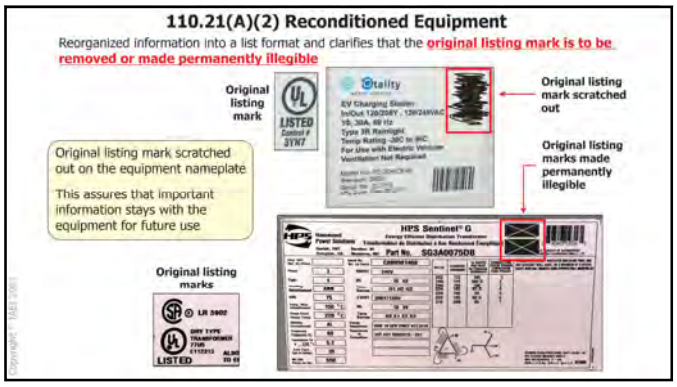

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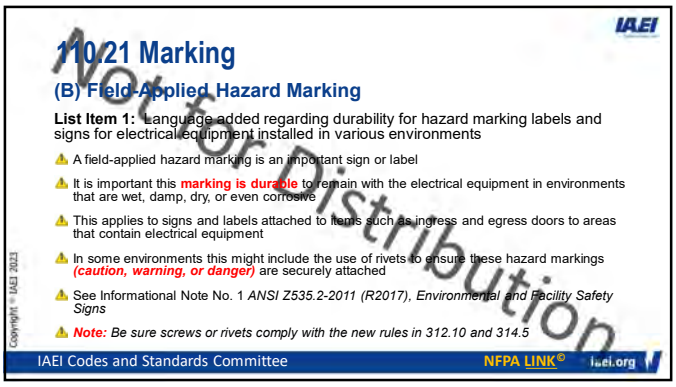

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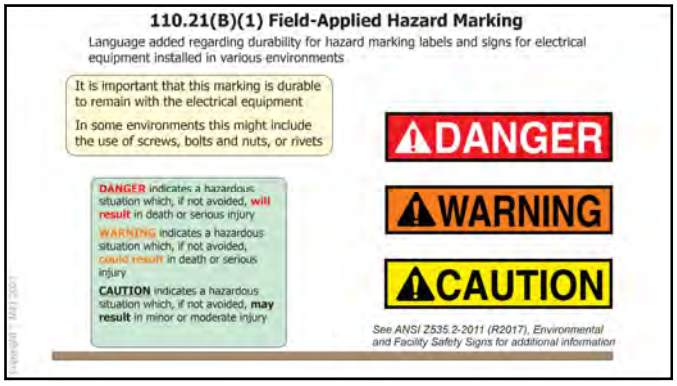

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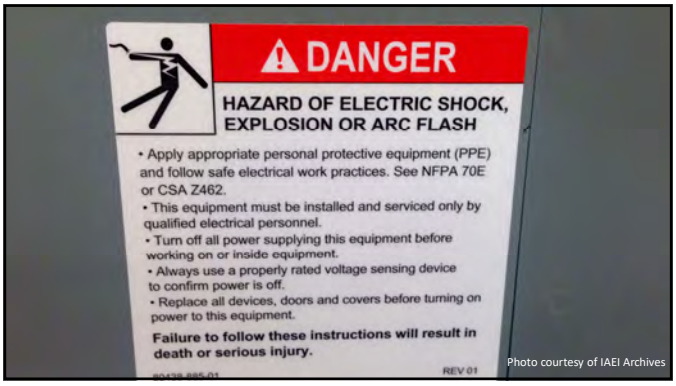

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110.22 Identification of Disconnecting Means

(A) General

This change helps determine when the identification of a disconnecting means is required or not required

- Clarifies that identification of disconnecting is not required when the location of the circuit source is evident
- Marking is to include the identification and location of the circuit source that supplies the disconnecting means
  - **unless** the equipment is located and arranged so that the identification and location of the circuit source is evident
- An example could be the disconnecting means for a water heater or furnace installed close to an electrical panel enclosing the disconnecting means

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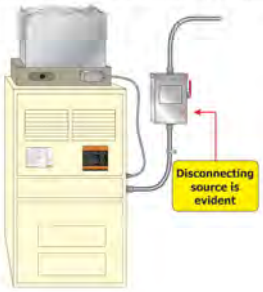
110.22(A) General *(Disconnecting Means)*

This helps determine when the identification of a disconnecting means is required or not required

At a single family dwelling the disconnect source is evident from the unit being serviced

Testing for the absence of electricity before troubleshooting the unit

In other than one- and two-family dwelling, marking shall include the identification and location of the **source circuit supplying** the disconnecting means



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110.26 Spaces About Electrical Equipment

This change concerns equipment doors and their interference with egress and access from the working space moved from 110.26(C)(2)

- Many instances of electrical equipment installations violate the previous *Code* language involving this working space *(entrapment when doors are open)*
- Worker entrapment by equipment doors can cause serious injury or death
- This change recognizes open equipment doors can impede egress from electrical equipment when dangerous situations arise *(arc blast, etc.)*
- Access and egress **are impeded** if an equipment door(s) is opened and **restricts** the working space access to less than 610 mm ***(24 in.)*** **wide** and 2.0 m ***(6 ½ ft)*** **high**
- This rule also applies to the space between two simultaneously opened doors on opposite sides of the aisleway

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110.26 Spaces About Electrical Equipment

This change recognizes open equipment doors can impede egress from electrical equipment when dangerous situations arise *(arc blast, etc.)*

Open equipment doors **not to impede** the access or egress from the working space

Access and egress **is impeded if** an equipment door(s) is opened and restricts the working space access to **less than 610 mm (24 in.) wide and 2.0 m (6 ½ ft) high**

124

110.26 Spaces About Electrical Equipment

(A) Working Space- (6) Grade, Floor, or Working Platform

Addresses the working space conditions of the floor at electrical equipment locations

- Floor conditions were not addressed by the previous editions of the *Code*
- This could be slope of grade or other impediments
- These conditions are safety issues for workers that must perform work on electrical equipment
- AHJ needed this guidance so that the initial installation is installed in a compliant manner

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110.26(A)(6) Grade, Floor, or Working Platform

Floor conditions can present safety issues for workers that must perform work on electrical equipment

This photo is a parking garage

Notice wheel stop in front of electrical equipment

Could pose a tripping hazard injuring the worker

Photo courtesy of IAEI Archives

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110.26(A)(6) Grade, Floor, or Working Platform

Floor conditions can present safety issues for workers that must perform work on electrical equipment

Exterior location with electrical service equipment

Surface grade appears to be in good shape to assure worker safety

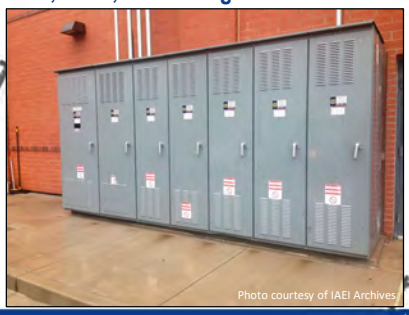

Photo courtesy of IAEI Archives

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110.29 In Sight From *(Within Sight From, Within Sight)*

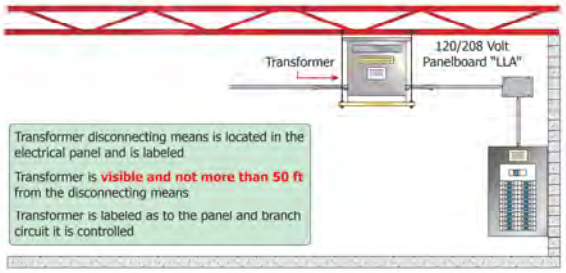
New Section 110.29 has been added to address electrical equipment and the term "In Sight From"

- "In sight from," "Within Sight From," and "Within Sight" appears several times throughout the *NEC*
- This sections adds applicability and useability of these phrases
- Addresses *NEC Style Manual* issues that state definitions shall not contain requirements or recommendations
- Distance is to be **visible** and **not more than 15 m (50 ft)** from the other equipment
- Reference defined term in Article 100: "In Sight From *(Within Sight From) (Within Sight)*"

128

110.29 In Sight From *(Within Sight From, Within Sight)*

Distance is to be visible and not more than 15 m (50 ft) from the other equipment



Transformer disconnecting means is located in the electrical panel and is labeled

Transformer is **visible and not more than 50 ft** from the disconnecting means

Transformer is labeled as to the panel and branch circuit it is controlled

129

110.33 Entrance to Enclosures and Access to Working Space

(A) Entrance

Access to and egress from working space for equipment over 1000 volts, nominal, have been revised and clarified

- Very similar to changes discussed for 110.26 concerning arc blast scenarios
- It has been substantiated that access or egress is impeded by opened equipment doors in some situations
- Conditions that restrict working space access or egress to less than 610 mm (24 in.) wide and 2.0 m *(6 ½ ft)* high make it a safety concern for the worker due to entrapment
- The entrapment is between equipment doors opened simultaneously with the worker trapped within, leaving no egress path

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Photo courtesy of Scott Humphrey

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110.34 Working Space and Guarding

(A) Working Space

Addresses the condition of the work surface making up the floor, grade, or platform area within the working space of electrical equipment 1000 volts, nominal, and above

- Very similar to 110.26(A)(6) for 1000 volts or less conditions
- Clarifies that the working clearance space shall be kept clear, level, and flat as practical for the entire required depth and width of the working space
- This will help ensure the safety of the worker
- This needs to be addressed by the installer and authority having jurisdiction (AHJ) at the time of installation and inspection to assure safety during the life of the electrical installation

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Chapter 2
Wiring and Protection

- Article 210
- Article 215
- Article 220
- Article 225
- Article 230
- Article 235
- Article 240
- Article 242
- Article 245
- Article 250

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Article 210
Branch Circuits Not Over 1000 Volts ac, 1500 Volts dc, Nominal

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210.2 Reconditioned Equipment

The information concerning reconditioned equipment *(as it applies to branch circuits)* has been relocated from 210.15 to 210.2

- Reconditioned equipment text has been reviewed and modified to remove redundant language in accordance with *NEC* Style Manual Section 4.1.1
- The *NEC* Correlating Committee recommended for CMP-2 to move reconditioned equipment information to a standardized placeholder found within the various articles that mentioned this topic to improve the useability of the *Code*
- See information at 110.20 entitled *Reconditioned Equipment* for additional information
- **Note:** The xxx.2 sections within various chapters have become placeholders for information concerning reconditioned equipment

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210.2 Reconditioned Equipment

The information concerning reconditioned equipment has been relocated from 210.15 to 210.2

GFCI

GFCI/AFCI

The following **shall not be reconditioned**:

(1) Equipment that provides ground-fault circuit-interrupter *(GFCI)* protection for personnel

(2) Equipment that provides arc-fault circuit-interrupter *(AFCI)* protection

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210.8 Ground-Fault Circuit-Interruption Protection for Personnel

The GFCI is now required to be listed

- Measurements clarified the cord is a power supply cord
- *NEC Style Manual* influenced: Informational notes pointing to 422.5(A), 555.35(F) and the additional GFCI requirements found in Chapters 4, 5, and 6
- Informational note pointing to 215.9 GFCI permissions for locating GFCI in the feeder remained

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210.8 Ground-Fault Circuit-Interruption Protection for Personnel

(A) Dwelling Units

(3) Outdoors

- Exception to (3) was moved to the end of (A) expanding the exception beyond just those receptacles found outdoors.
- It doesn't matter if the receptacle is located outside or not, if they are not readily accessible and on a branch circuit dedicated for electric snow-melting, deicing, or pipeline and vessel heating equipment
- The reference to 426.28 or 427.22 are still included as a permission

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210.8 Ground-Fault Circuit-Interruption Protection for Personnel

(A) Dwelling Units

(5) Basements

- Exception to (5) was moved to the end of 210.8(A) as Exception No. 2
- This move recognizes that a receptacle supplying only a permanently installed premises security system is not required to be protected by GFCI regardless of its location
- The reference to the fire alarm system and the informational notes were removed to align with the *NEC Style Manual* as 760.41(B) and 760.121(B) prohibit the branch circuit supplying this receptacle and equipment from being supplied through a GFCI or AFCI

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210.8 Ground-Fault Circuit-Interruption Protection for Personnel

(A) Dwelling Units- (6) Kitchens

Ground-fault circuit-interrupter *(GFCI)* protection has been expanded to include any cord-and-plug equipment in the kitchen, regardless of whether the outlet serves the countertop.

- There have been 104 electrocutions that have taken place from 2011 to 2022 based on the Consumer Products Safety Commission *(CPSC)* database
- Eighty-one percent of these accidents were from working on an appliance or other equipment
- GFCI protection is required within a kitchen for receptacles that are
  - 125-volt through 250-volt and
  - supplied by single-phase branch circuits rated 150 volts or less

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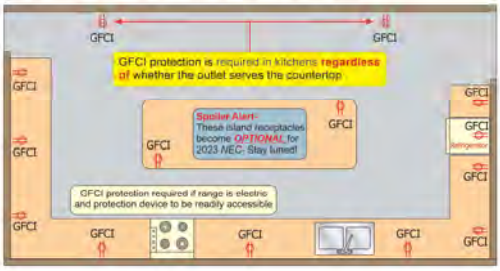
210.8(A)(6) Dwelling Unit Kitchens

Ground-fault circuit-interrupter *(GFCI)* protection required for receptacles in a kitchen
- All 125-volt through 250-volt receptacles
- single-phase branch circuits rated 150 volts or less to ground



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210.8 Ground-Fault Circuit-Interruption Protection for Personnel

(A) Dwelling Units

(7) Areas with sinks and permanent provisions for food preparation, beverage preparation, or cooking

- Added as an alignment with similar requirement found in 210.8(B)
- **Example of impact:** A dry bar in the living room or dining room would require that area to have all receptacles be protected by GFCI

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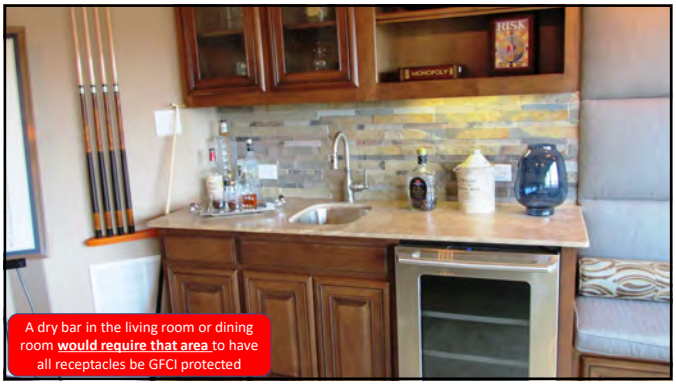

144

210.8 Ground-Fault Circuit-Interruption Protection for Personnel *(cont.)*

(A) Dwelling Units *(cont.)*

Exception 4: A new Exception No. 4 will help the electrical professional address ground-fault circuit-interrupter *(GFCI)* protection requirements for factory-installed exhaust fans and their receptacles

- There was confusion as to if a receptacle found within an exhaust fan installed in the bathroom required GFCI protection
- This receptacle is typically installed within a fan unit and is not accessible or interactable with people
- This will help reduce arguments and misunderstandings in the field
- Language specifies that exhaust fans are not readily accessible and that the receptacles be installed integral to the fan assembly

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210.8(A) Ex. No. 4- GFCI Protection of Bathroom Receptacles

A receptacle outlet internal to a bathroom exhaust fan that is not readily accessible does not require GFCI protection *(unless required by the manufacturer or listing)*

Inspector Knowledge: See Article 100 for the definition of readily accessible

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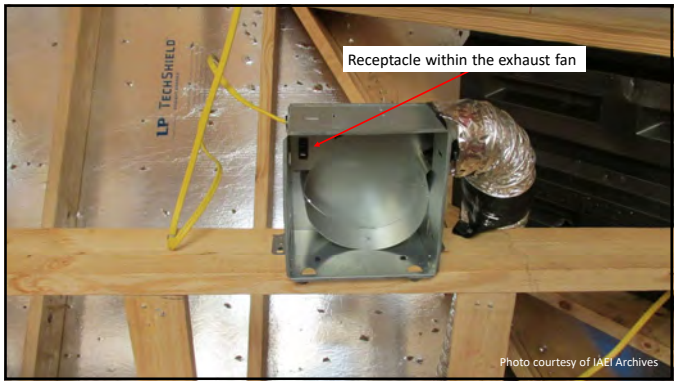

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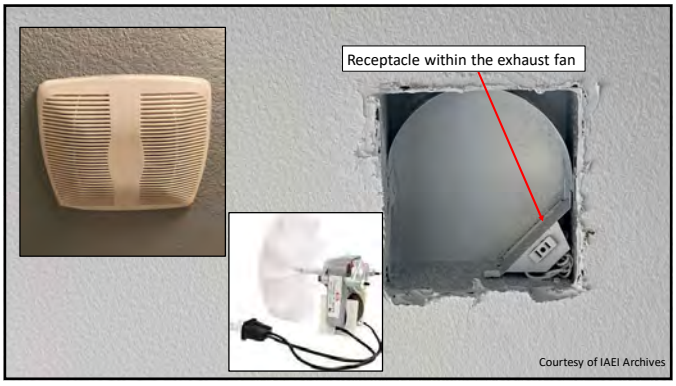

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210.8 Ground-Fault Circuit-Interruption Protection for Personnel

(A) Dwelling Units. Exception No. 3
(B) Other Than Dwelling Units. Exception No. 6

New terms and acronyms introduced for **"Weight Supporting Ceiling Receptacle (WSCR)"** and **"Weight Supporting Attachment Fitting (WSAF)"** - Consistency throughout the *Code*

- These two exceptions were relocated to the end of 210.8(A) and 210.8(B) as part of the reorganization of 210.8
- Exception text was revised to apply the new defined terms "Weight Supporting Ceiling Receptacle (WSCR)" and "Weight Supporting Attachment Fitting (WSAF)"
- WSCR has a new definition in Article 100, and the WSAF had its term and definition modified with the acronym added
- Similar nomenclature changes were made in 314.27 for *Outlet Boxes* and 422.18 for *Ceiling-Suspended (Paddle) Fans*

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210.8(A) Ex. 3 and 210.8(B) Ex. 6 *(GFCI Protection)*

Weight Supporting Ceiling Receptacle *(WSCR)* and Weight Supporting Attachment Fitting *(WSAF)* have been introduced as terms and acronyms for consistency throughout the code

These exceptions **permit for the omittion of GFCI protection** when supporting a ceiling luminaire or ceiling-suspended fan

Similar changes were made at:
- 314.27 for Outlet Boxes and
- 422.18 for Ceiling-Suspended *(Paddle)* Fans

Photos courtesy of Chuck Mello

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Ceiling fan installation with the Weight Supporting Ceiling Receptacle and Weight Supporting Attachment Fitting

Photos courtesy of IAEI Archives

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210.8 Ground-Fault Circuit-Interruption Protection for Personnel- (B) Other Than Dwelling Units

A new list item (4) has been added for the addition of buffet serving areas to the list of locations requiring ground-fault circuit-interrupter *(GFCI)* protection

- All receptacles are to be GFCI protected if they are:
  - Single-phase branch circuits rated 150 volts or less to ground, 50 amperes or less, 125-volt through 250-volt
  - Three-phase branch circuits rated 150 volts or less to ground, 100 amperes or less
- The buffet serving area typically contains various food wells which hold hot water
- Customers or staff members touching the stainless steel are subject to electric shock in the event of an accident
- It was demonstrated that these locations are similar in safety concerns to those surfaces which are in kitchens

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210.8 Ground-Fault Circuit-Interruption Protection for Personnel- (B) Other Than Dwelling Units

IAEI

List item (7): Modified to address cord-and-plug-connected fixed and stationary appliances within 6 feet of a sink.

- The electrical hazard is typically not with the 125-volt through 250-volt receptacle supplying a fixed or stationary piece of equipment but from the equipment itself
- Equipment such as a refrigerator or range is typically constructed of metal and located within 6 feet of a sink
- A person at the sink making contact with these metal appliances has been injured or killed as a result
- This action was necessary to prevent needless electrocutions or shocks to people from occurring

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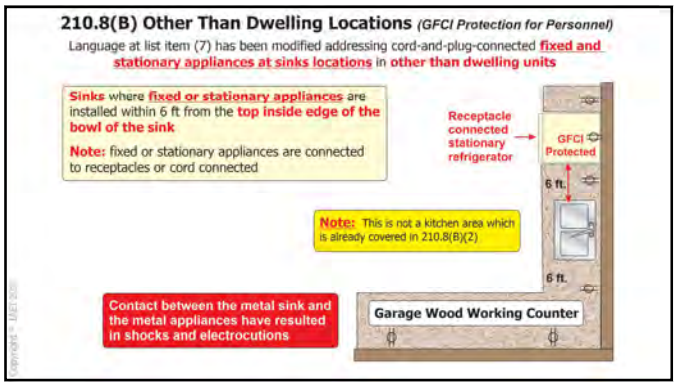

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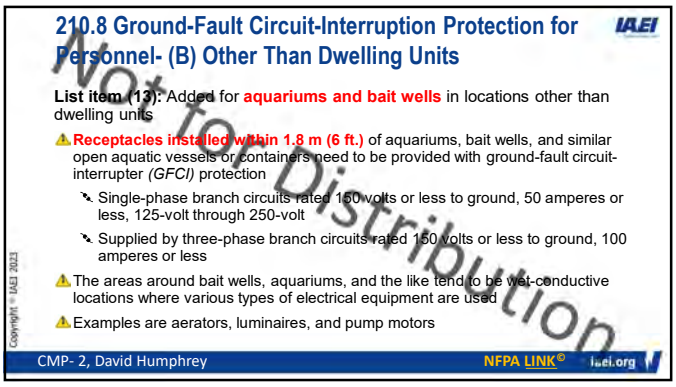

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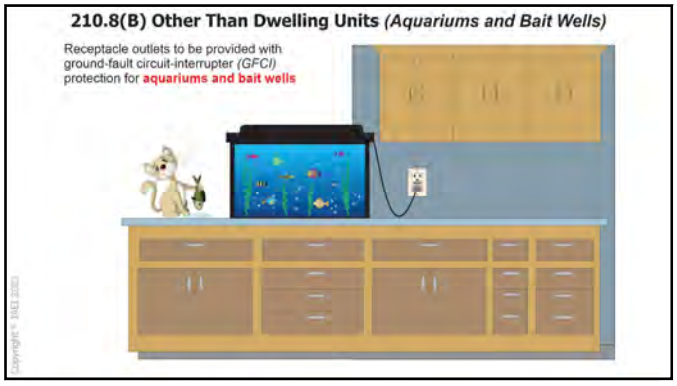

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210.8(B) Other Than Dwelling Units *(Aquariums and Bait Wells)*

Examples:
Receptacle outlets to be provided with *GFCI* protection for **live minnow wells** used by fishing anglers

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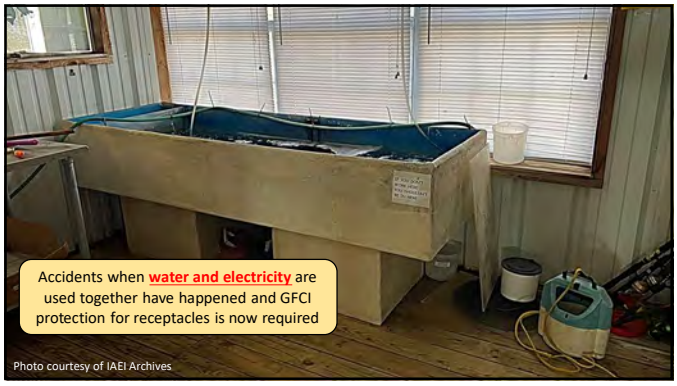

163

210.8 Ground-Fault Circuit-Interruption Protection for Personnel- (D) Specific Appliances

IAEI

The appliances *(cord-and-plug and hard-wired)* requiring ground-fault circuit-interrupter *(GFCI)* protection were placed into a list format for easier use

- GFCI protection will apply to **outlets** supplied by a branch circuit of 150 volts or less to ground and 60 amperes or less in a single-phase system
- **New appliances** appear in **red text**:

- Automotive vacuum machines
- Drinking water coolers and bottle fill stations
- High-pressure spray washing machines
- Tire inflation machines
- Vending machines
- Sump pumps
- Dishwashers
- **Electric ranges**
- **Wall-mounted ovens**
- **Counter-mounted cooking units**
- **Clothes dryers**
- **Microwave ovens**

CMP- 2, Joseph Wages, Jr.

NFPA LINK© iaei.org

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210.8(D) Specific Appliances *(GFCI Protection)*

The appliances *(cord-and-plug and hard-wired)* requiring ground-fault circuit-interrupter *(GFCI)* protection were placed into a list format for easier use *(dwelling and other than dwelling unit locations)*

GFCI protection applies to **outlets supplied by a branch circuit** of **150 volts or less to ground** and **60 amperes or less** in a **single-phase system**

New list items include:
- electric ranges
- wall-mounted ovens
- counter-mounted cooking units
- clothes dryers
- microwave ovens

165

New appliances include:
- electric ranges
- wall-mounted ovens
- counter-mounted cooking units
- clothes dryers
- microwave ovens

166

210.8 Ground-Fault Circuit-Interruption Protection for Personnel- (F) Outdoor Outlets

Ground-fault circuit-interrupter *(GFCI)* protection is to be installed when the equipment supplied by an outlet covered under the requirements of this section is **replaced**

- This addresses issues of **older existing outlets** that are **not GFCI protected**
- Will require GFCI protection for dwelling outdoor outlets when the electrical equipment is replaced that receives power from that older existing outlet
- This change will increase the overall level of safety by providing the same level of protection

Notice: TIA 23-3 *(TIA Log #1664)* created **Exception No. 2** stating that GFCI protection not required for listed HVAC equipment

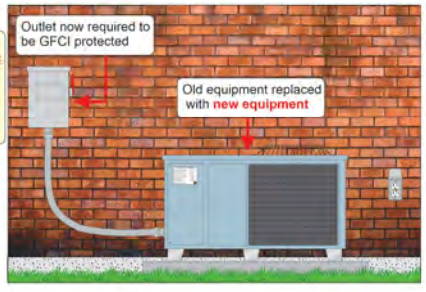
This exception will expire **September 1, 2026**

167

210.8(F) Outdoor Outlets *(GFCI)*

When **new electrical equipment** is installed, ground-fault circuit-interrupter *(GFCI)* protection method is required for the outlet serving the new equipment

Note from the Electrical Inspector:
NFPA has assigned a task group to look at interoperability issues between equipment and GFCI protection



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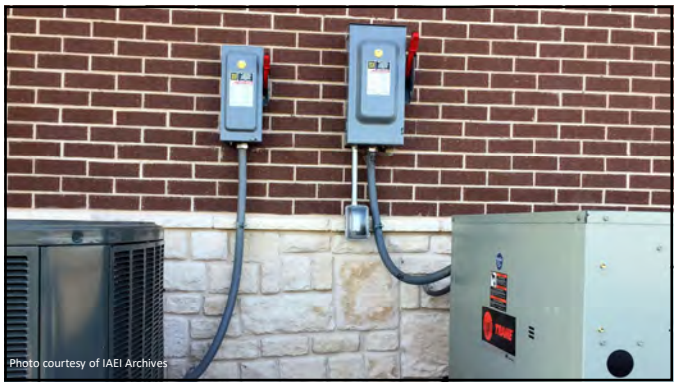

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210.11 Branch Circuits Required

(C) Dwelling Units- (4) Garage Branch Circuits

The text was clarified so that 15-ampere branch circuits are permitted to serve receptacle outlets installed in a dwelling unit garage

- If a 15-ampere branch circuit(s) is installed, it would be in addition to the 20-ampere circuit supplying the required garage receptacles
- This would not diminish the required 20-ampere circuit requirement found at 210.52(G)(1)
- Applies to garages of any size *(1,2,3,4, etc., vehicle bays)*
- Equipment such as a central vacuum unit or garage door opener is allowed to be supplied by a branch circuit that limits ampacity to 15 amperes
- This change will alleviate any confusion about garage branch circuit requirements

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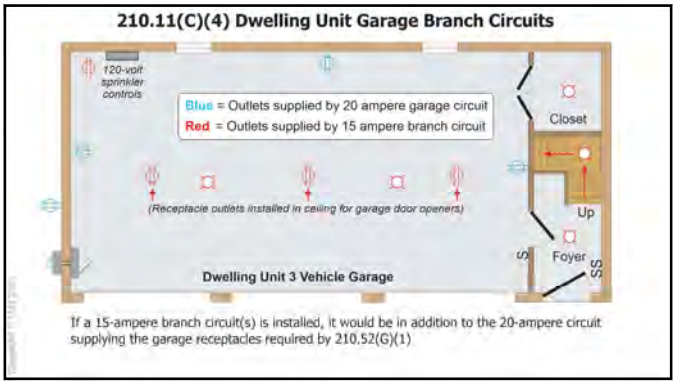

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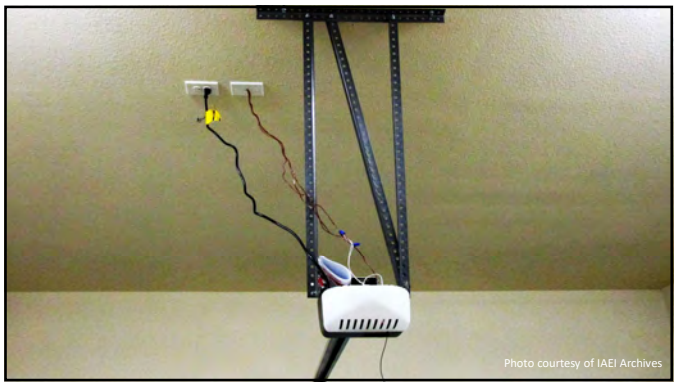

173

210.11 Branch Circuits Required

(C) Dwelling Units- (4) Garage Branch Circuits

New Exception No. (2): Added to permit the 20-ampere branch circuit supplying a single vehicle bay garage to supply other equipment in accordance with requirements in 210.23(A)(1) and (A)(2)

- A single-bay garage is only mandated to be provided with one receptacle outlet on the 20-ampere branch circuit
- The branch circuit will provide adequate circuit capacity to supply other loads
- These loads are likely to be limited in number due to the reduced space availability in the garage

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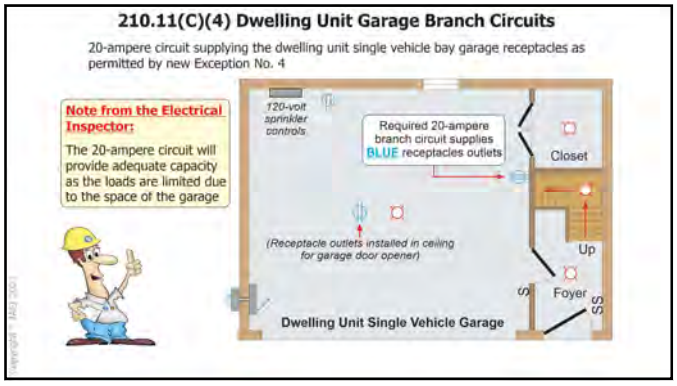

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210.12 Arc-Fault Circuit-Interrupter Protection *(AFCI)*

Reformatted for clarity making it easier to understand requirements

- The 10-ampere branch circuit was added to the branch circuit sizes allowed for these locations, and subdivisions were renamed
  - **(A) Means of Protection:** Now lists the protection methods available
  - **(B) Dwelling Units:** Includes the list of areas of the dwelling unit
  - **(C) Dormitory Units:** Specific requirements for dormitory units
  - **(D) Other Occupancies:** Includes expanded areas for AFCI protection
  - **(E) Branch Circuit Wiring Extensions, Modifications, or Replacements:** Clarity changes included this cycle

177

210.12 Arc-Fault Circuit-Interrupter Protection *(AFCI)*

This section was **reformatted** making it easier to reference and utilize the requirements and a **10-ampere branch circuit added** to allowable branch circuit sizes

Section was reformatted for easier use:

- **Subdivision (A)**, Means of Protection
- **Subdivision (B)**, Dwelling Units
- **Subdivision (C)**, Dormitory Units
- **Subdivision (D)**, Other Occupancies
- **Subdivision (E)**, Branch Circuit Wiring Extensions/Modifications/Replacements

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210.12 Arc-Fault Circuit-Interrupter Protection *(AFCI)*

(D) Other Occupancies

New List Item (3): Rooms designed exclusively as sleeping rooms in places such as firehouses, rescue squads, police departments, and similar locations are to be protected by one of the methods in 210.12(A)(1) through (A)(6)

- All 120-volt single-phase, 10, 15, and 20-ampere branch circuits supplying devices or outlets for these rooms are now required to be provided with arc-fault circuit-interrupter *(AFCI)* protection
- These rooms are occupied in much the same way as bedrooms of dwellings or as guest rooms of hotels and motels and should be provided with the same level of safety
- **Note:** Two new subsections were added in 210.12, and many existing subsections were modified for clarity and useability
  - In some cases, list items replaced long lines of text that detailed locations requiring AFCI protection

179

210.12(D)(3) Other Occupancies *(AFCI Protection)*

All 120-volt single-phase, 10, 15, and 20-ampere branch circuits supplying devices or outlets for the following locations required to be provided with arc-fault circuit-interrupter *(AFCI)* protection

In **sleeping quarters** in places such as:

- firehouses
- ambulance stations
- rescue squads
- police departments
- ranger stations
- and similar locations

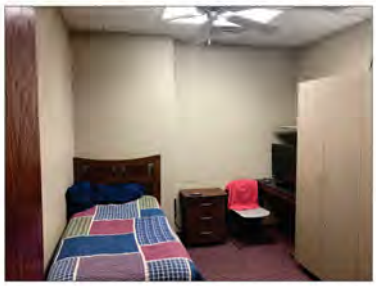


Photo courtesy of Bentonville Arkansas Fire Department

180

210.17 Guest Rooms and Guest Suites

Assisted living facilities were added to the existing list of locations requiring their branch circuits to be installed per the requirements for dwelling units if a permanent means for cooking exists

- Assisted living facilities were seen as having the same characteristics as a guest room and guest suite, which were addressed in the 2020 *NEC*
- If was felt that they should observe the same branch circuit requirements as dwelling units
- The previous locations in this section were placed into a list format for added clarity
- Informational notes were also included for guidance with:
  - laundry branch circuits and
  - direction towards the ***Life Safety Code*** for the definition of an assisted living facility

181

210.17 Guest Rooms and Guest Suites

Assisted living facilities were added to the existing list of locations requiring their branch circuits to be installed per the requirements for dwelling units **if a permanent means for cooking exists**

Assisted living facilities were seen as having the same characteristics as a guest room and guest suite which were addressed in the 2020 *NEC*

These locations should observe the **same branch circuit requirements as dwelling units**

Guest Room or Guest Suite *(added in 2020 NEC)*

Assisted Living Center *(added in 2023 NEC)*

182

210.17 Guest Rooms and Guest Suites

Some assisted living facilities are very similar to a dwelling unit

When provided with permanent means for cooking, **the branch circuits at these locations are required to be installed** the same as for dwelling units

183

210.19 Conductors- Minimum Ampacity and Size

Revised to clarify that the voltage limitation should apply to the circuit, not the conductor insulation rating, and to specify this section applies to branch circuits not exceeding 1000 volts ac or 1500 volts dc

- There was confusion as to if the voltage limitation applied to the circuit or if it applied to the insulation rating of the conductor
- This has been clarified by the action of the code making panel
- Due to the creation of new Article 235, language was added at 210.19 stating that this section applies to **"not more than 1000 volts ac or 1500 volts dc"**
- Article 235 entitled ***Branch Circuits, Feeders and Services Over 1000 Volts ac, 1500 Volts dc, Nominal*** is intended to apply to **voltages over 1000 volts ac and 1500-volt dc**

184

210.19 Conductors- Minimum Ampacity and Size

Clarifies that **the voltage limitation should apply to the circuit**, not the conductor insulation rating and specifies this applies to branch circuits "not exceeding 1000 volts ac or 1500 volts dc"

Photos courtesy of IAEI Archives

These conductors in the photos are rated not over 1000 volts ac and would be covered by Article 210

Article 235 will cover voltages that exceed 1000 volts ac or 1500 volts dc

Article 235 is entitled Branch Circuits, Feeders and Services Over 1000 Volts ac, 1500 Volts dc, Nominal

185

210.23 Permissible Loads

Permissible Loads, Multiple-Outlet Branch Circuits **10 Ampere Branch Circuits**

- This change covers permitted and non-permitted use of a 10-ampere branch circuit
- Installation requirements were necessary for the use of a 10-ampere branch circuit if the installer chose to do so
- Advantages include lower cost due to smaller conductors with loads such as increased LED lighting installations
- A **10-ampere branch circuit can supply loads for** lighting outlets, lighting circuits for bathroom and laundry area exhaust fans within dwelling units, and a gas fireplace unit served by an individual branch circuit
- A **10-ampere branch circuit cannot supply loads for** receptacle outlets, fixed appliances *(except as permitted for individual branch circuits)*, garage door openers, or laundry equipment

186

210.23 Permissible Loads

10 ampere branch circuits are now addressed in the *NEC*

A 10-ampere branch circuit can supply loads for:

- lighting outlets
- lighting circuits for bathroom and laundry area exhaust fans within dwelling units
- gas fireplace unit served by an individual branch circuit

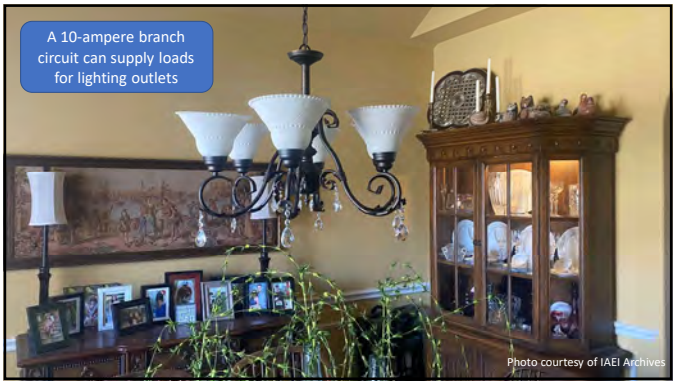
A 10-ampere branch circuit cannot supply loads for:

- receptacle outlets
- fixed appliances (except as permitted for individual branch circuits)
- garage door openers
- laundry equipment

Installation requirements were necessary for the use of 10-ampere branch circuits if the installer chose to do so

Note: A 10-ampere receptacle configuration does not currently exist

187



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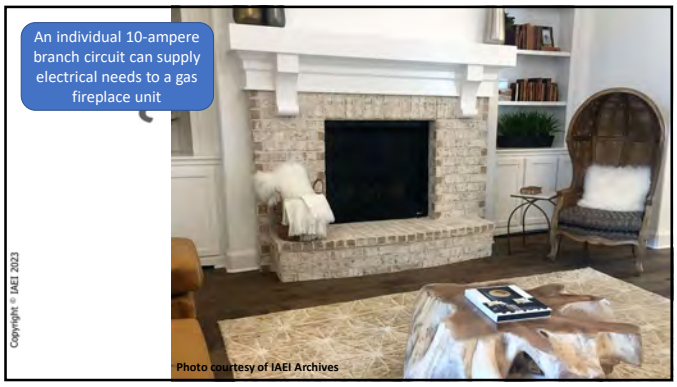

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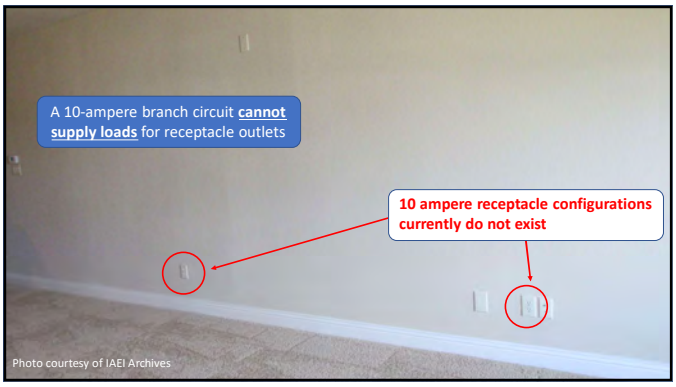

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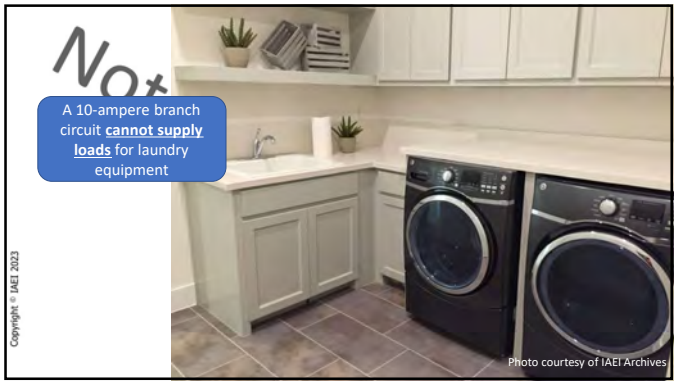

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192

210.52 Dwelling Unit Receptacle Outlets

(C) Countertops and Work Surfaces

(2) Island and Peninsular Countertops and Work Surfaces

The requirement for receptacles serving the countertop or work surface of an island or peninsula has been **made optional**, but guidance for their location has been maintained when they are provided

- Data compiled by the Consumer Products Safety Commission *(CPSC)* document 45 reports of burns or other injuries between January 1991 and 2020
- An estimated 9,700 burns or other injuries were treated in U.S. hospital emergency rooms
- Most injuries were the result of hot contents being spilled from countertop cooking appliances on children who pulled the appliance cord

193

210.52 Dwelling Unit Receptacle Outlets

(C) Countertops and Work Surfaces

(2) Island and Peninsular Countertops and Work Surfaces

- In the event a receptacle outlet is not provided, the electrical contractor must provide a method to the island or peninsula for the future addition of a receptacle outlet
- Some examples may include:
  - NM or UF cable in a box with cover
  - Unfinished basement access to below the island or peninsula

194

210.52(C) Islands and Peninsular Receptacles- Dwelling Units

Receptacle outlets shall be installed **on or above** the countertops

Not permitted face-up in work surface or countertop [406.5(G)(1)]

Receptacle outlet assemblies **listed for the application** shall be permitted to be installed in countertops and work surface

Receptacle outlet **no longer allowed** to be installed below the countertop

195

NEC History of Countertop Receptacle Placement

Before 1990 there was **no guidance or requirement** for receptacle placement for kitchen island and peninsular locations

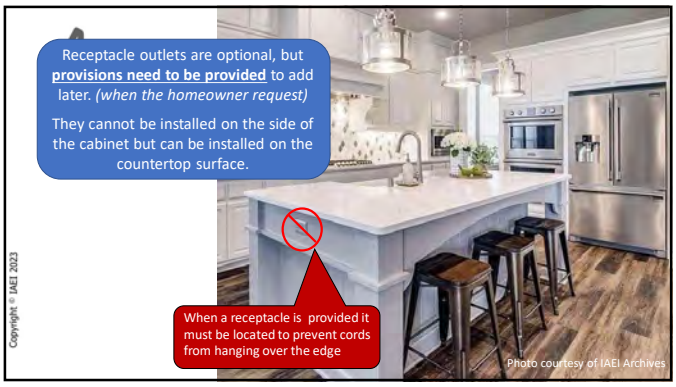
This proposal to NFPA shows **IAEI was opposed to the receptacles being installed below countertops** due to possible accidents that are now well documented

Note: Jim Carpenter was a previous IAEI International Office CEO serving on CMP-2

2-222- (210-52(c)): Reject
SUBMITTER: Marleen Avigliano, IAEI
RECOMMENDATION: (Add) Receptacles required to service peninsular and island countertops shall not be located below the level of the countertop.
SUBSTANTIATION: Electrical cords from kitchen appliances extending over the end of a countertop expose children to a hazardous condition. Children pulling on a cord can pull hot coffee pots, skillets, etc., over the counter edge and onto themselves.
PANEL ACTION: Reject.
PANEL STATEMENT: Too restrictive. Incomplete technical substantiation to support the proposed change.
VOTE ON PANEL ACTION:
AFFIRMATIVE: 11
NEGATIVE: Carpenter
EXPLANATION OF VOTE:
CARPENTER: Many manufacturers of kitchen appliances have included warnings on their products or in their literature concerning the hazards of placing an appliance too close to the counter edge letting the cord extend over the counter edge because of the hazard described in this proposal. Permitting receptacles below the level of the countertop promotes the misuse of these appliances.

196

197



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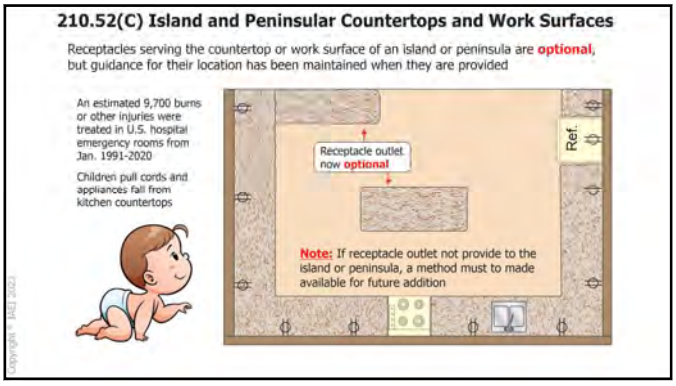

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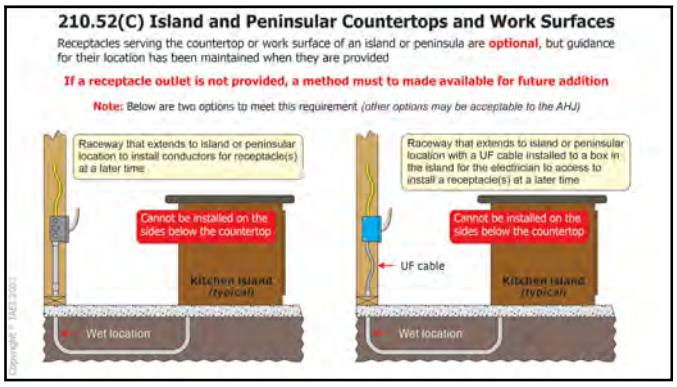

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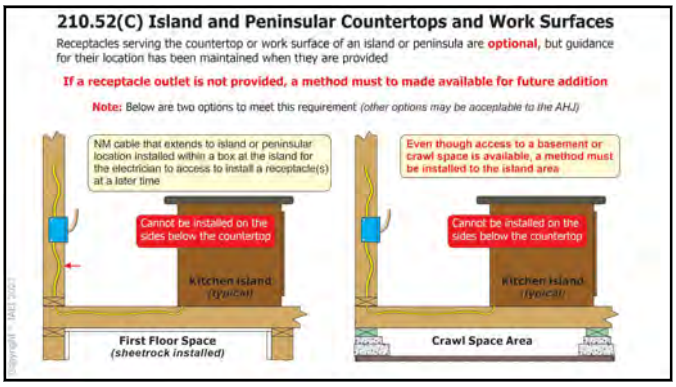

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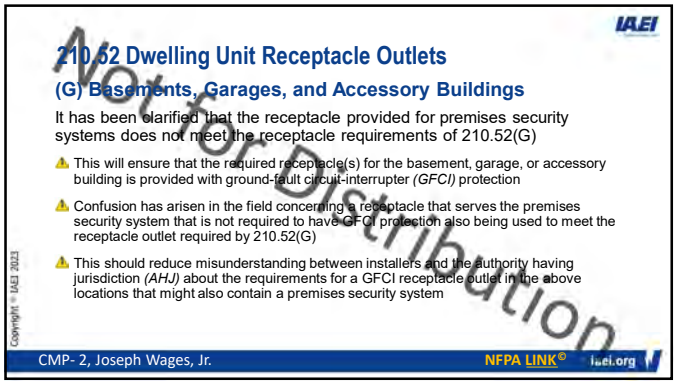

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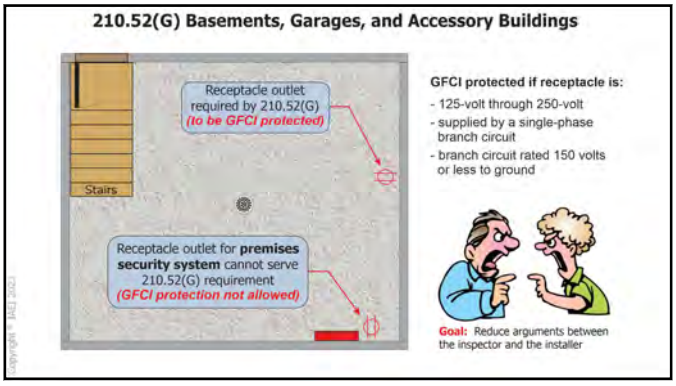


204

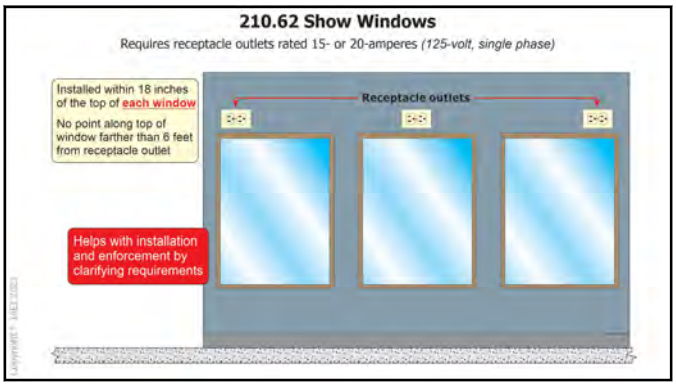
210.62 Show Windows

This change clarified the intent of the receptacle outlets is for **each show window location**

- There had been confusion by electrical professionals as to how the previous *Code* language was to be applied during electrical installations
- New language makes this requirement easier to understand for both the installer and the inspection authority *(AHJ)*

This change **was not included** in the IAEI Analysis of Changes book

205



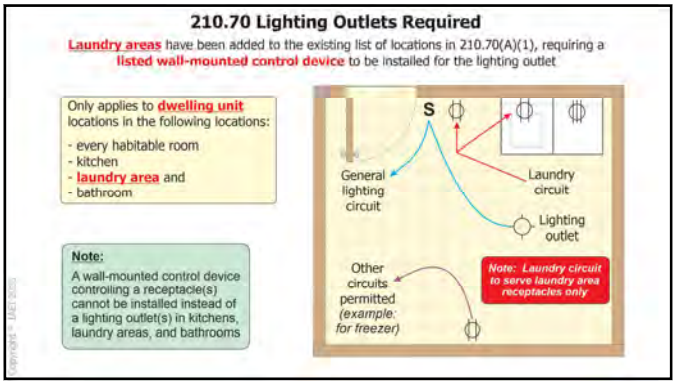
206

210.70 Lighting Outlets Required

Laundry areas have been added to the existing list of locations in 210.70(A)(1), requiring a listed wall-mounted control device to be installed for the lighting outlet

- Prohibits the switch or wall-mounted control device from **relying solely on a battery** unless provided with a **means to energize lighting outlets upon failure**
- This requirement only applies to dwelling unit locations in the following locations:
  - every habitable room
  - kitchen
  - laundry area and
  - bathroom
- It should be noted that a wall-mounted control device controlling a receptacle(s) cannot be installed instead of a lighting outlet(s) in kitchens, laundry areas, and bathrooms

207



208

Not for Distribution

Wall mounted control device installed at the entrance of the laundry area

209

Not for Distribution

Article 215
Feeders

210

Not for Distribution

215.15 Barriers

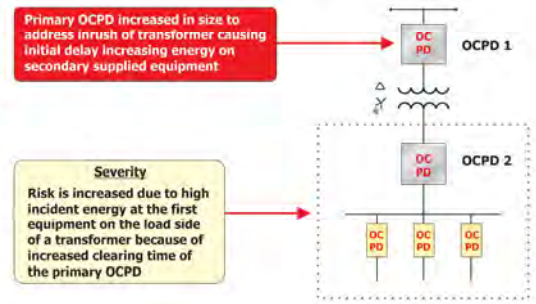
When feeder taps or transformer secondary conductors supply panelboards, switchboards, switchgear, or motor control centers, there must be barriers installed at load terminations when such terminations remain energized when the disconnect for the taps *(or transformer secondary conductors)* is in the off *(open)* position

- When feeder taps or transformer secondary wiring feed a panelboard, for example, the line terminal lugs to a main breaker for the panelboard would remain energized even when the main breaker is turned off
- Would add safety to the installation by requiring covers or barriers over the line terminals to the main breaker
- Will provide additional safety for electrical workers

211

215.15 Barriers

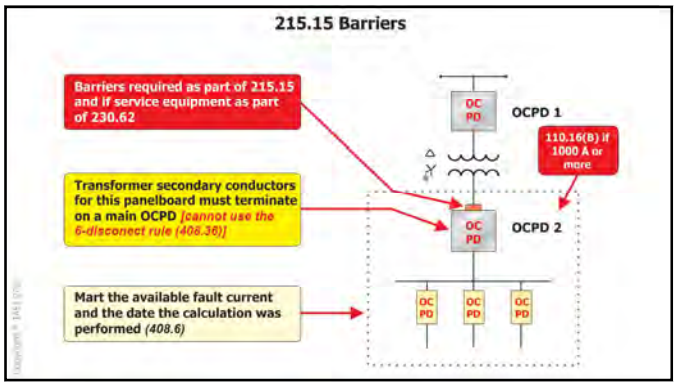
Primary OCPD increased in size to address inrush of transformer causing initial delay increasing energy on secondary supplied equipment



Severity

Risk is increased due to high incident energy at the first equipment on the load side of a transformer because of increased clearing time of the primary OCPD

212



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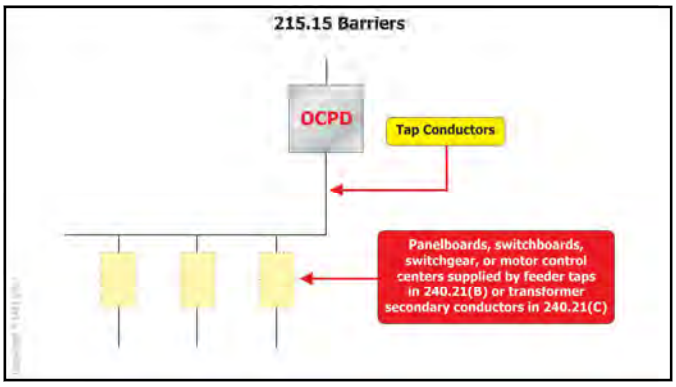

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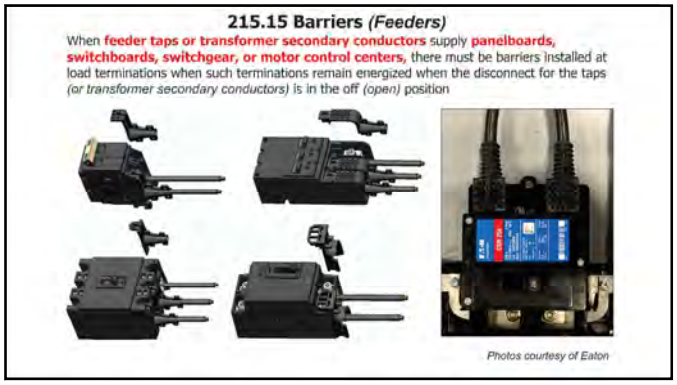

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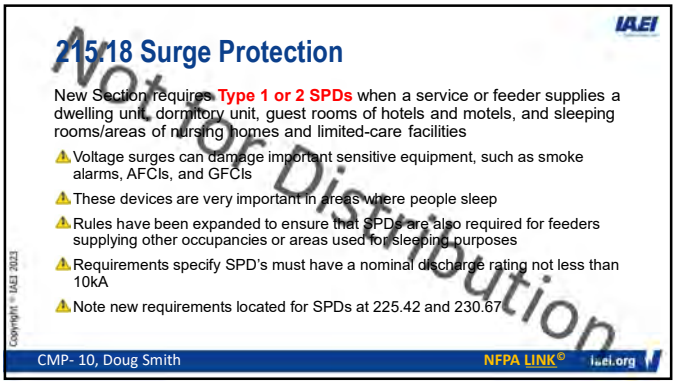

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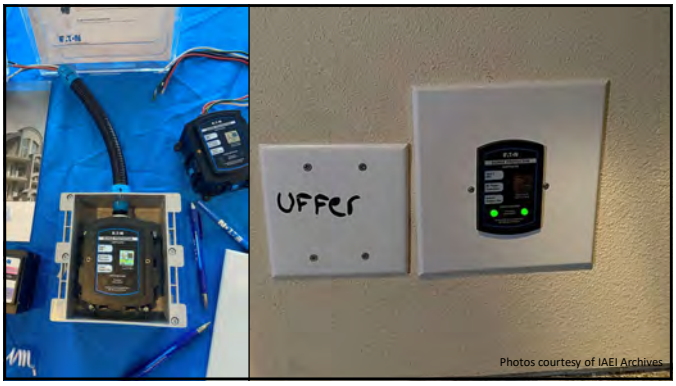


220

Article 220
Branch-Circuit, Feeder, and Service Load Calculations

221

Article 220 Restructuring

It was recognized that a few sections were not in the correct places within this Article. The following changes shifted the requirements into the correct buckets:

- Section and Table 220.12 in part II for branch circuits is not used for calculating loads on branch circuits *(This section was appropriately relocated to Part III)*
- Section 220.14 is titled "Other Loads – All Occupancies" yet this section included first level subdivisions dedicated to "Occupancy types"
- The following were moved into their own sections found in part III
  - 220.14(J) Dwelling Units moved to 220.41 "Dwelling Units, Minimum Unit Load"
  - 220.14(K) Office Buildings moved to 220.43 with same name
  - 220.14(M) Hotel and Motel Occupancies moved to 220.44 with same name

222

220.1 Scope

Information was added to the scope of Article 220 concerning calculation methods for health care facilities and marinas, boatyards, floating buildings, and commercial and noncommercial docking facilities

- Two new parts were added to Article 220 and referenced in the scope
  - Part VI addresses calculation methods for **health care facilities**
  - Part VII addresses calculation methods for **marinas, boatyards, floating buildings, and commercial and noncommercial docking facilities**
- The existing Figure Informational Note 220.1 was also revised

223

220.1 Scope *(Branch-Circuit, Feeder, and Service Load Calculations)*

Information added to the scope for calculation methods for **health care facilities** and **marinas, boatyards, floating buildings, and commercial and noncommercial docking facilities**

Two new parts were added to **Article 220** and referenced in the scope *(Article 220 was restructured)*

- **Part VI** addresses calculation methods for health care facilities
- **Part VII** addresses calculation methods for marinas, boatyards, floating buildings, and commercial and noncommercial docking facilities

Photos courtesy of IAEI Archives

224

220.5 Calculations

(C) Floor Areas

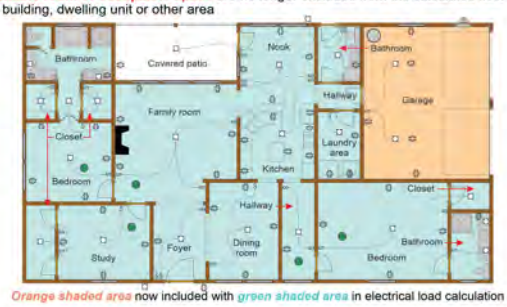
Areas such as **garages, or unfinished areas that can be adaptable for future use as a habitable room or occupiable space** are no longer excluded from the calculated floor area of the building, dwelling unit or other area

- A new subsection (C) was added to Section 220.5(C) entitled "Floor Areas"
- The previous text **"not adaptable for future use"** was considered subjective and reworded for clarity
- Garages and other spaces often are used as ancillary space to the habitable portions of the dwelling
- These spaces will now be included in dwelling, building, or other space square foot calculation

225

220.5(C) Floor Areas *(Calculations)*

Areas such as **garages, or unused or unfinished areas that can be adaptable for use as a habitable room or occupiable space** are no longer excluded from the calculated floor area of the building, dwelling unit or other area



Orange shaded area now included with *green shaded area* in electrical load calculation

226

Photos courtesy of IAEI Archives

227

220.57 Electric Vehicle Supply Equipment *(EVSE)* Load

New Section 220.57 has been added to specify load calculations for Electric Vehicle Supply Equipment *(EVSE)*

- Electric Vehicle Supply Equipment *(EVSE)* is becoming more and more prevalent
- Charging infrastructure is necessary and there was a need for the *NEC* to offer some direction as to load calculation requirements
- This language specifies the use of **7200 volt-amperes or the VA rating from the nameplate of the equipment**, whichever is the larger of the two
- A 7200 volt-ampere *(VA)* minimum requirement was chosen and is based on a 30 ampere, 240-volt, single-phase circuit

228

220.57 Electric Vehicle Supply Equipment *(EVSE)* Load

Section has been added to specify load calculations for Electric Vehicle Supply Equipment *(EVSE)*

This language specifies the use of **7200 volt-amperes or the VA rating from the nameplate** of the equipment, whichever is the larger of the two

Photo courtesy of IAEI Archives

229

220.70 Energy Management Systems *(EMSs)*

A new section has been added to specify load calculations for Energy Management Systems *(EMSs)*

- Resulted from a correlating committee task group focused on alternative energy requirements
- Seeks to build upon specific allowances providing a **new option** for any load connected to a feeder or service conductor where these loads are controlled to a maximum limit that effectively restricts the total loads operated at one time
- If an EMS is used in accordance with 750.30, requirements are provided concerning the maximum value setpoint
- The option allows electric distribution systems to be utilized in a safe and effective manner
- This will help property owners to pursue the use of EMS equipment without requiring extensive electrical system upgrades

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230

220.70 Energy Management Systems *(Communication Circuits)*

A new section has been added to specify load calculations for Energy Management Systems *(EMSs)*

Option allows electric distribution systems to be utilized in a safe and effective manner

Seeks to build upon specific allowances **providing a new option** for any load connected to a feeder or service conductor where these loads are controlled to a **maximum limit** that **effectively restricts the total loads operated at one time**

231

220.70 Emergency Management Systems *(EMSs)*

An example of a product that is available to assist in load management for EV Charging

The DCC-12 has a NEMA 3R enclosure approved for indoor and outdoor installations

DCC allows the connection of any EV charger to a fully loaded panel by managing the energy available at any given time, whether in a home or in a condo

Ideal for the installation of EV chargers in single-family homes with a full electrical panel

Photo courtesy of DCC Electric

232

220.110 Receptacle Loads

New demand factors for receptacles added to Part VI, Health Care Facilities, for Category 1, 2, 3, and 4 patient care spaces

- **Table 220.110(1)** Demand Factors for Receptacles Supplied by General-Purpose Branch Circuits in **Category 1 and Category 2** Patient Care Spaces
- **Table 220.110(2)** Demand Factors for Receptacles Supplied by General-Purpose Branch Circuits in **Category 3 and Category 4** Patient Care Spaces
- The Correlating Committee and the Standards Council determined that CMP-2 has responsibility for occupancy-based load calculations and demand factors ***(Note: CC gave purview of this requirement to CMP-15 at CC Meeting)***
- The focus was concerning the large number of receptacles required in Category 1 and Category 2 patient care spaces
- New tables were developed, which included demand factor values to apply to receptacles used in a health care facility

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220.120 Receptacle Loads

Marinas, Boatyards, Floating Buildings, and Commercial and Noncommercial Docking Facilities

- Requirements of Section 555.6 have been **relocated** to Part VII 220.120
- This will not change the requirements for load calculations or demand factors
- Article 220 entitled *Branch Circuit, Feeder, and Service Load Calculations*, is the logical place for users of the *Code* to find information concerning these calculations

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Article 225
Outside Branch-Circuits and Feeders

240

Sections 225.5 and 225.7

Sections 225.5, *Size of Conductors 1000 Volts, Nominal, or Less*, and 225.7, *Lighting Equipment Installed Outdoors*, **were deleted**

- Section 225.5 was redundant since such requirements can be found in Articles 215 and 220
- Section 225.7 was also redundant since such requirements can be found in Articles 210 and 220

241

225.41 Emergency Disconnects

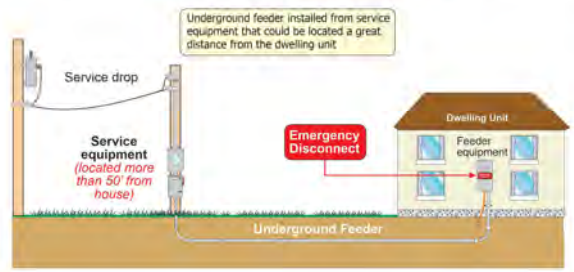
New requirements for an emergency disconnect at a readily accessible outdoor location for one-and two-family dwelling units that are served by feeders

- One-and two-family dwelling unit are not always fed by a service but instead by an outdoor feeder
- This ensures that all new one-and two-family dwelling units are provided with an emergency disconnect located at a **readily accessible outdoor location** on or **within sight of the dwelling unit** *(see definition of Within Sight in Article 100)*
- This disconnect to be marked as **"EMERGENCY DISCONNECT"**
- Plaque, or directory must also be provided adjacent to the emergency disconnect identifying the location(s) of any other energy source disconnect on the premises
- The disconnect must be on or within sight of the dwelling unit

242

225.41 Emergency Disconnects

Requires an **emergency disconnect** at a readily accessible outdoor location for one-and two-family dwelling units that are **served by feeders**



243

244

230.62 Service Equipment- Enclosed or Guarded

(C) Barriers

Clarifies the requirements for barrier installation in service equipment **when the service disconnect is in the open position**

- Installed in such a way that no uninsulated, ungrounded busbars or terminals are exposed to inadvertent contact while load terminations are being serviced when the service disconnect is in the open position
- Main point of the barrier requirement is to provide insulation to busbars or terminals while load terminations are being serviced
- Barriers have proven to increase safety for electrical professionals working on service equipment

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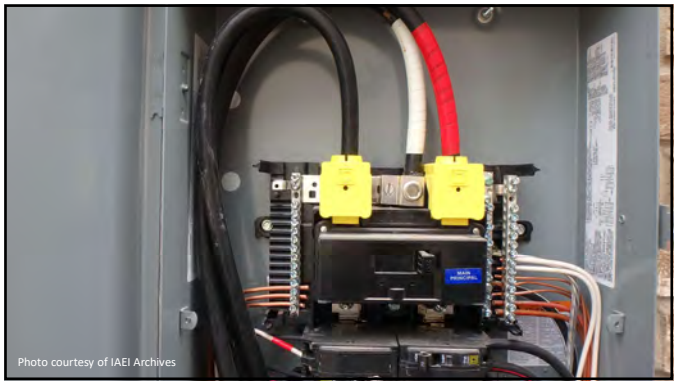
230.62(C) Barriers

Clarifies the requirements for barrier installation in service equipment

Ensure no uninsulated, ungrounded busbars or terminals are exposed to **inadvertent contact** while load terminations are being serviced when the service disconnect is in the open position

Barrier requirement is to provide insulation to busbars or terminals while load terminations are being serviced

246



247

230.67 Surge Protection

(A) Surge-Protective Device

Existing term "dwelling units" changed to "the following occupancies" and added a list of additional locations that now require protection by a surge-protective device *(SPD)*

- Service equipment can, at times, be subjected to surges that inflict damage on systems designed to provide life safety
- Recognized industry authorities such as NEMA, IEEE, and UL, have collected data showing surges cause significant damage
- Electronic life-saving equipment, such as fire alarm systems, GFCIs, AFCIs, and smoke alarms, could be rendered inoperable when a surge occurs *(Many times, this damage is undetected by the owner)*

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230.67 Surge Protection *(cont.)*

(A) Surge-Protective Device *(cont.)*

Existing term "dwelling units" changed to "the following occupancies" and added a list of additional locations that now require protection by a surge-protective device *(SPD)*

- Additional occupancies added include:
  - dormitory units,
  - guest rooms and guest suites of hotels and motels, and
  - areas of nursing homes and limited-care facilities used exclusively as patient sleeping rooms

249

230.67(A) Surge-Protective Devices

Changed the existing term "dwelling units" to "the following occupancies" and added a list of additional locations that now require protection by a surge-protective device (SPD)

Additional occupancies now include:
- dormitory units
- guest rooms and guest suites of hotels and motels
- areas of nursing homes and limited-care facilities used exclusively as patient sleeping rooms

Photo courtesy of Eaton

Electronic life-saving equipment such as fire alarm systems, GFCIs, AFCIs, and smoke alarms, could be rendered inoperable when a surge occurs

(Many times, this damage is undetected by the owner)

Photo courtesy of Siemens

250

230.71 Maximum Number of Disconnects

(B) Two to Six Service Disconnecting Means

Transfer switches were added to clarify that they must be listed for and used as service equipment

- Sections 230.71(B)(4) and (6) increase the ease of usability for the *Code* by adding these requirements to the existing list items
- Motor control centers used as service equipment were also added with requirements limiting a maximum of two service disconnects per single motor control center and barriers required between each unit or compartment containing a service disconnect
- Barrier provisions were added for additional types of service equipment to improve safety by reducing the likelihood of a person or maintenance equipment coming in contact with energized parts while servicing load terminations
- Each service disconnect is to be provided in a separate compartment

251

230.71(B) Two to Six Service Disconnecting Means

Transfer switches were added to clarify that they must be listed for and used as service equipment

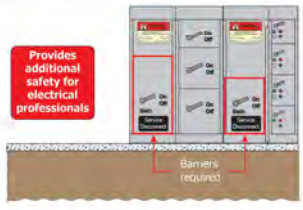
Transfer switch where each disconnect located in a seperate compartment

Photo courtesy of Eaton

Motor control centers used as service equipment limiting to a maximum of two service disconnects per single motor control center

Barriers required between each unit or compartment containing a service disconnect

Provides additional safety for electrical professionals



252

230.71 Maximum Number of Disconnects

(B) Two to Six Service Disconnecting Means

An exception was added to clarify that existing service equipment is not required to comply with the provisions of 230.71(B) when existing equipment was installed in compliance with previous editions of the *NEC*, allowing for up to six service disconnects in a single enclosure or compartment

- Will aid in the enforcement of service equipment disconnecting means installed before this edition of the *Code*
- Concern was expressed when an installer wanted to add a disconnect to existing service equipment that allowed for more than one disconnect means
- Could be interpreted that the entire service equipment was required to be replaced
- New exception clarifies that existing service equipment in compliance with previous editions of the *NEC* is not required to be upgraded

253

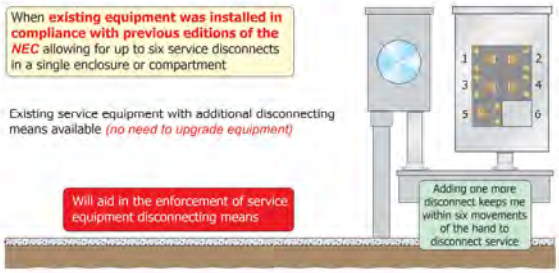
230.71(B) Two to Six Service Disconnecting Means

Existing service equipment is **not required to comply** with the provisions of 230.71(B)

When **existing equipment was installed in compliance with previous editions of the** *NEC* allowing for up to six service disconnects in a single enclosure or compartment

Existing service equipment with additional disconnecting means available *(no need to upgrade equipment)*

Will aid in the enforcement of service equipment disconnecting means



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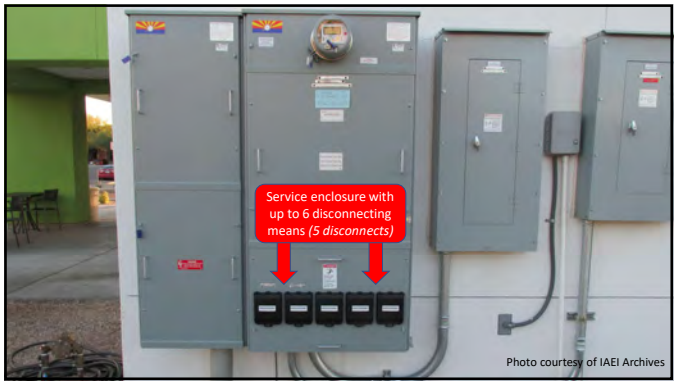


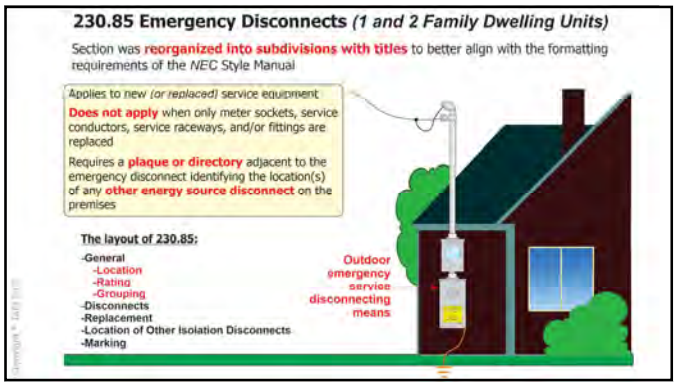
255

230.85 Emergency Disconnects

Section 230.85 was reorganized into sub-sections with titles to better align with the formatting requirements of the *NEC Style Manual*

- Clarifies that meter disconnects integral to meter mounting equipment or other listed disconnects used as the emergency disconnect cannot be marked as "suitable ONLY for use as service equipment"
- This requirement does not apply to the regular service disconnect(s) for the one- and two-family dwelling *[see 230.85(B)]*
- Section 230.85(C) was added to clarify that all of 230.85 applies to new *(or replaced)* service equipment
- An exception was added to clarify that when only meter sockets, service conductors, service raceways, and/or fittings are replaced, 230.85 does not apply
- Section 230.85(D) specifies that a plaque or directory be provided adjacent to the emergency disconnect identifying the location(s) of any other energy source disconnect on the premises

256



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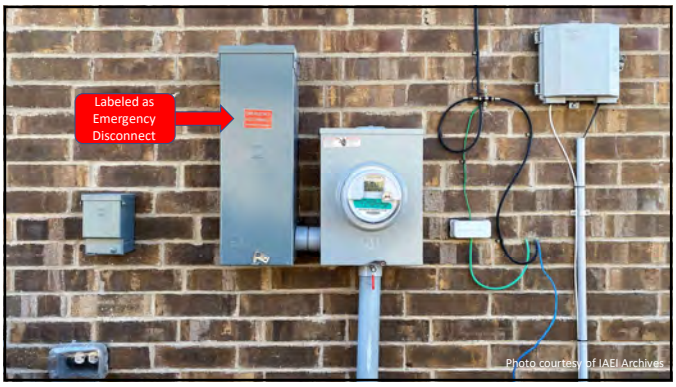

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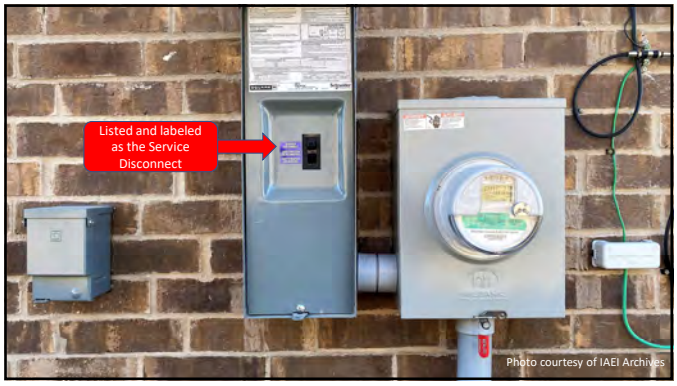

259

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Article 235 Branch Circuits, Feeders and Services Over 1000 Volts ac, 1500 Volts dc, Nominal

New Article 235, entitled *Branch Circuits, Feeders and Services Over 1000 Volts ac, 1500 Volts dc, Nominal* has been created to govern **medium voltage branch circuits**

- This new article will become the **placeholder** for information pertaining to medium voltage branch circuits, feeders and services
- Previously, information for medium voltage branch circuits was located throughout the *NEC*
- Requirements from Article 210 were reviewed for applicability to medium voltage branch circuits
- Information from Article 210 that was applicable to these circuits have been copied and moved to this article
- Some requirements were modified as necessary without making technical changes or modifying the existing requirement
- **Note:** This was originally under the purview of CMP-2 but may be assigned to CMP-10 at the August 2022 Correlating Committee meeting

CMP- 2, Joseph Wages, Jr.

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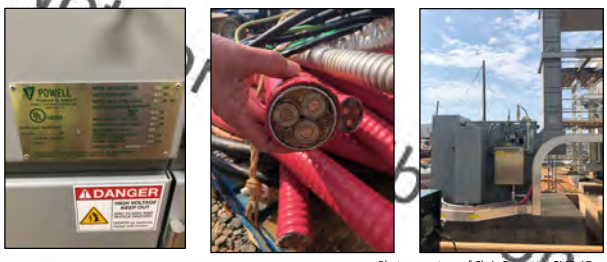
Article 235 Branch Circuits Over 1000 Volts ac, 1500 Volts dc



Photos courtesy of Chris Faucette, CMP-17

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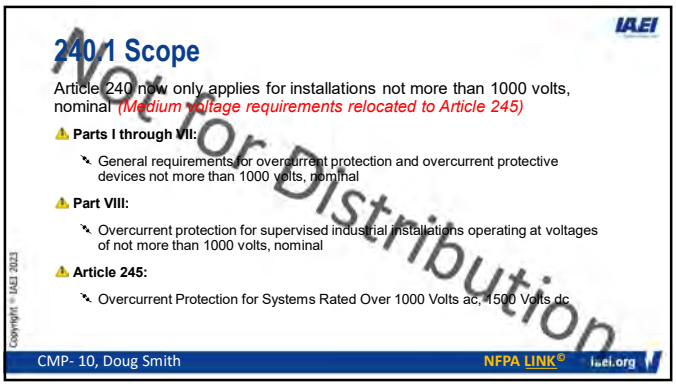

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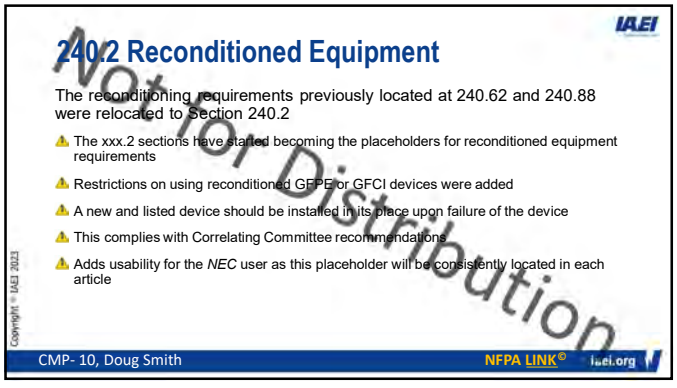

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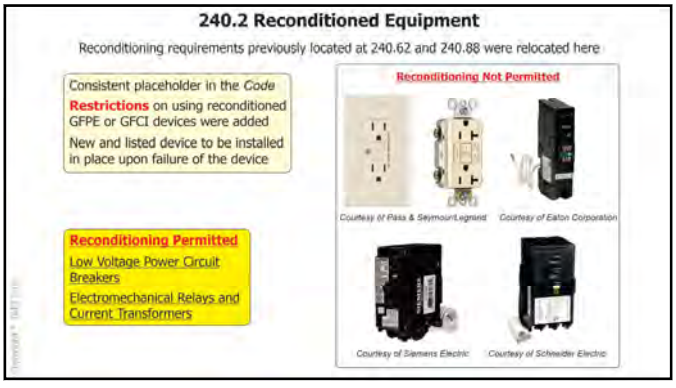

268

240.4 Protection of Conductors

(B) Overcurrent Devices Rated 800 Amperes or Less

Adjustable trip overcurrent protective devices are permitted to have an ampacity value set that does not exceed the next higher standard overcurrent protection device ampacity value *[per Table 240.6(A)]* above the ampacity of the conductors being protected

- Adjustable trip overcurrent devices are being used increasingly throughout the country
- Requirements of 240.4(B)(1), 240.4(B)(2), and 240.4(B)(3) still apply
- Adjustable trip overcurrent protective device must be provided with restricted access per 240.6(C)
- Adds flexibility for designers and electrical professionals when choosing overcurrent protection devices for electrical systems

CMP- 10, Doug Smith

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240.4(B) Overcurrent Devices Rated 800 Amperes or Less

Adjustable trip overcurrent protective devices *(OCPD)* are **permitted to have an ampacity value** set that **does not exceed** the next higher standard OCPD device ampacity value [per Table 240.6(A)] above the ampacity of the conductors being protected

Devices are **permitted to be adjusted** according to **240.4(B)**

Adjustable trip overcurrent protective device must be provided with **restricted access** per **240.6(C)**

Circuit breaker photos courtesy of Chad Kennedy, Schneider Electric

Photo courtesy of Jim Lefevre, Multi Craft Contracting

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240.4 Protection of Conductors

(D) Small Conductors

(3) 14 AWG Copper-Clad Aluminum

New added list item to the list of permitted small conductors

- Has been added to align with other small conductors permitted per 240.4(D)
- **Overcurrent protection** device rating for the conductors **cannot exceed 10 amperes**, and the **maximum continuous load** on the circuit **cannot exceed 8 amperes**
- Branch-circuit-rated breakers or fuses that the conductors connect to **must be listed and marked for use** with such conductors
- Offers the electrical industry more flexibility when choosing types of conductors to install for certain circuits

CMP- 10, David Williams

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240.4(D)(3) 14 AWG Copper-Clad Aluminum

14 AWG copper-clad aluminum was added to the list of permitted small conductors

Branch-circuit-rated breakers or fuses that the conductors connect to **must be listed and marked** for use with such conductors

Photos courtesy of COPPERWELD Bimetallics, LLC.

Overcurrent protection device rating for the conductors **cannot exceed 10 amperes**, and the maximum continuous load on the circuit **cannot exceed 8 amperes**

272

240.6 Standard Ampere Ratings

(A) Fuses and Fixed-Trip Circuit Breakers

Table 240.6(A) Standard Ampere Ratings, **10 ampere was added** to the list of standard ratings of overcurrent protection devices

- 10 ampere rated fuses and circuit breakers are available and being used in the field
- Clarifies that such devices are permitted to be used
- Table listing of ampere ratings is more user friendly that the lines of text that appeared in previous editions of the *NEC*
- Offers more flexibility to the electrical industry when choosing overcurrent protection devices for certain circuits

273

Table 240.6(A) Standard Ampere Rating

10 ampere was added to the list of standard ratings of overcurrent protection devices

These 10- ampere fuses and circuit breakers are available and being used in the field

Table listing is more user friendly

Table type format showing the ampere ratings for fuses and circuit breakers *(10 ampere has been added)*

10	15	20	25	30
35	40	45	50	70
60	80	90	100	125
110	150	175	200	250
225	300	350	400	500
450	600	700	800	1200
1000	1600	2000	2500	4000
3000	5000	6000		

274

240.6 Standard Ampere Ratings

(D) Remotely Accessible Adjustable-Trip Circuit Breakers

Allows for remote access to adjustable-trip circuit breakers through a direct local nonnetworked interface or a networked interface connection

- Due to SMART devices, provisions were needed to reduce likelihood of impact from cybersecurity attached for safety concerns
- When the connection is through a networked interface:
  - the circuit breaker and associated software must be evaluated for cybersecurity
  - **OR** a cybersecurity assessment of the network is required to be completed, and documentation of such assessment must be provided to those authorized to inspect, operate, and maintain the system

275

240.6(D) Remotely Accessible Adjustable-Trip Circuit Breakers

Allows for remote access to adjustable-trip circuit breakers through a direct local nonnetworked interface or a networked interface connection

Enhances protection of remotely accessible adjustable-trip circuit breakers **from cyberattacks**

Can **remotely access** circuit breakers via wifi allowing user to access valuable information without making a trip to the electrical room or panelboard loacation

Photos courtesy of Eaton

276

240.7 Listing Requirements

New listing requirement requires branch-circuit overcurrent protective devices, relays, and circuit breakers that provide ground-fault protection of equipment *(GFPE)* and ground-fault circuit interrupter *(GFCI)* devices must be listed

- Added to eliminate any confusion about whether or not such devices need to be listed
- Provides jurisdictions a tool to require the listing of equipment as a basis to approve such devices
- Only applies to overcurrent protective devices no more than 1000 Volts

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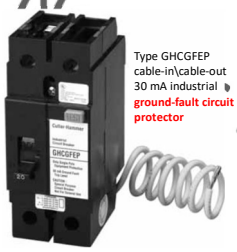
Branch-circuit **overcurrent protective devices, relays, and circuit breakers** that provide ground-fault protection of equipment *(GFPE)* and ground-fault circuit interrupter *(GFCI)* devices **must be listed**



Type GHCGFEP cable-in\cable-out 30 mA industrial **ground-fault circuit protector**

Photos courtesy of Eaton

278

240.11 Selective Coordination

Clarifies that whenever the *NEC* requires a feeder overcurrent protective device to be selectively coordinated with a service overcurrent protective device, then **ALL feeder overcurrent devices** connected to such service **must be selectively coordinated** with the service overcurrent device

- Closes any loopholes or gaps in the *Code*
- Previously it could be interpreted that only certain feeder overcurrent protective devices needed to be included in the coordination study
- All feeder overcurrent protective devices need to be included when such devices are fed by the same service overcurrent protective device in order to obtain proper selectivity
- Ensures the service overcurrent protective device is less likely to open since all feeder overcurrent protective devices are included in the coordination study

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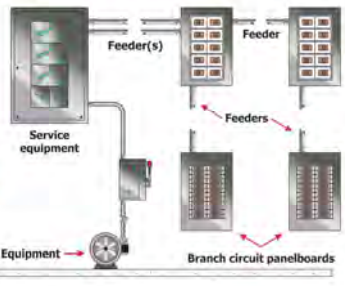
240.11 Selective Coordination

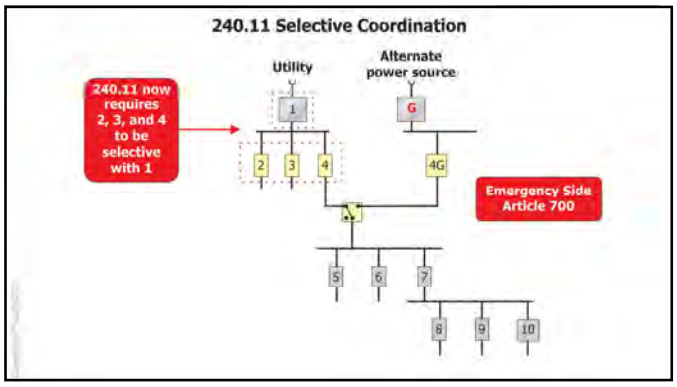
When a feeder overcurrent protective device to be selectively coordinated with a service overcurrent protective device, **ALL feeder overcurrent devices connected to the service** must be selectively coordinated with the service overcurrent device

All feeder overcurrent protective devices need to be included when such devices are fed by the same service overcurrent protective device in order to obtain **proper selectivity**



Localization of overcurrent conditions to restrict outages to the equipment affected

280



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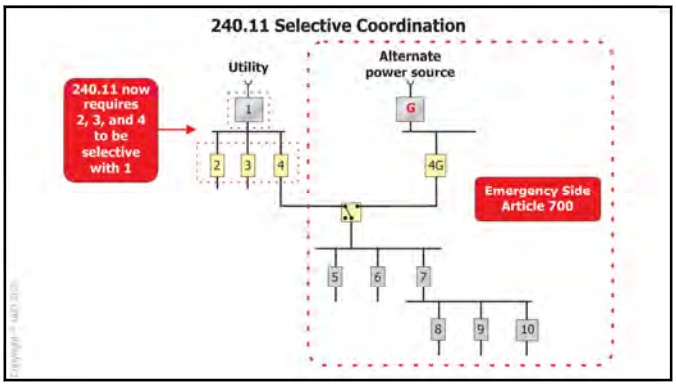

282

240.11 Selective Coordination *(cont.)*

Whenever the *NEC* requires a feeder overcurrent protective device to be selectively coordinated with a service overcurrent protective device, the following sections apply:

NEC Section	System
620.62	Elevators *(multiple elevators on single feeder)*
645.27	Critical operations data systems
695.3(C)(3)	Multi-building campus-style complexes *(fire pumps)*
700.32	Emergency systems
701.27	Legally required standby systems
708.54	Critical operations power systems

Thomas Domitrovich, Contributor

283

240.16 Interrupting Ratings

Now specifies that the minimum interrupting rating of a branch-circuit overcurrent protective device is 5,000 amperes

- Previously found in the definition of Overcurrent Protective Device *(Branch-Circuit Overcurrent Protective Device)*
- *NEC Style Manual* specifies that definitions are not permitted to contain requirements or recommendations
- The 5,000-ampere interrupting rating requirement was moved from the definition to this section

CMP- 10, David Williams

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240.16 Interrupting Rating

Specifies that the **minimum interrupting rating** of a branch-circuit overcurrent protective device is **5,000 amperes**

Square D circuit breaker rated at 10,000 amperes

Note:
Always review the manufacturers instructions!

Overcurrent devices not marked with and interrupting rating have a minimum interrupting rating of 5000 amperes

285

240.24 Location in or on Premises

(A) Accessibility

Revision replaces the words "similar enclosures" in the existing exception due to it being vague and not addressing many legitimate applications

- Addresses a couple of issues that have caused enforcement problems due to the words "similar enclosures"
- Consider the NEMA 4X stainless steel panel with bolted covers are designed with a series of bolts around the perimeter
- This is not an industrial control panel, nor is it a "similar enclosure"
- Revised exception clarifies that any readily accessible requirements that would normally apply to the overcurrent devices must still be applied to the enclosure itself
- This includes any enclosed device(s) with the door or cover in the open position

Fred Hartwell, IAEI Contributor NFPA LINK© iaei.org

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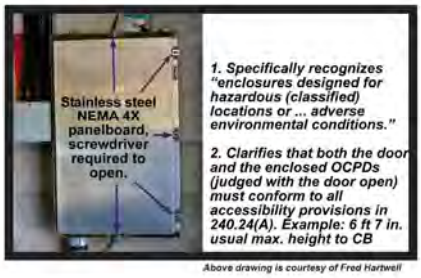
240.24(A) Accessibility- Exception

Replaced the words "similar enclosures" in the existing exception due to the words being vague and in some cases causing issues for the enforcement community

This includes any enclosed device(s) with the door or cover in the open position



1. Specifically recognizes "enclosures designed for hazardous (classified) locations or ... adverse environmental conditions."

2. Clarifies that both the door and the enclosed OCPDs (judged with the door open) must conform to all accessibility provisions in 240.24(A). Example: 6 ft 7 in. usual max. height to CB

Above drawing is courtesy of Fred Hartwell

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240.24 Location in or on Premises

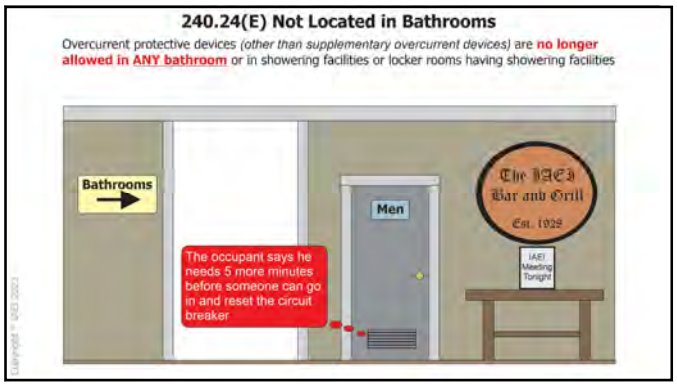
(E) Not Located in Bathrooms

Overcurrent protective devices *(other than supplementary overcurrent devices)* are no longer allowed in **ANY** bathroom or in showering facilities or locker rooms having showering facilities

- Addresses the difficulty of accessing a bathroom when such bathroom is occupied
- No practical reason to continue with the permissive requirement of having overcurrent protective devices in bathrooms of any occupancy
- Overcurrent protective devices are also no longer allowed in showering facilities or locker rooms having showering facilities since such areas present similar hazards as a bathroom
- This will likely have the largest effect on facilities or occupancies having limited square footage
- Office buildings are occupancies where electrical panels can be found in bathrooms

CMP- 10, David Williams NFPA LINK© iaei.org

288



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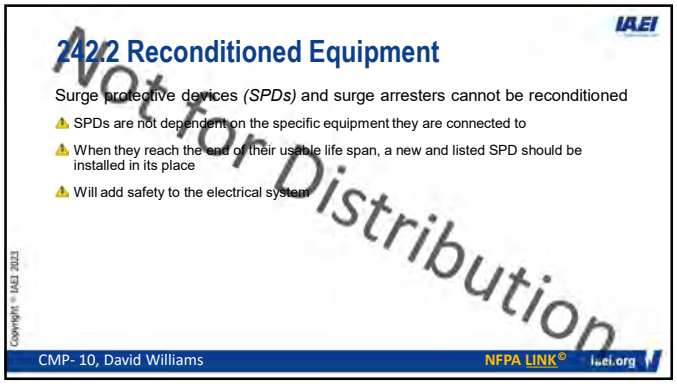


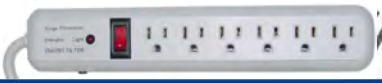
291

292

242.9 Indicating

New requirement added requiring all **surge-protective devices *(SPD)*** to be provided with an **indication notification** to the occupant that the SPD is in working order

- Occupants of offices and other occupancies spend a lot of time trying to figure out why equipment is not working that is plugged into an SPD
- An indication of some type is needed for the end user to determine if the SPD is working properly
- Now addressed by the *Code* so that building occupants can identify whether an SPD is functioning properly or if such device needs to be replaced



293

242.9 Indicating

Surge protective devices *(SPDs)* to have an indication that the **device is functioning properly**
(Replace when they have reached the end of their life)

Photo courtesy of Eaton *Photo courtesy of Siemens*

294

Article 245

Overcurrent Protection for Systems Rated Over 1000 Volts ac, 1500 Volts dc

295

Article 245 Overcurrent Protection

Portions of Articles 215, 225, 230, and 240 dealing with conductors or systems operating at over 1,000 volts relocated to Article 245, Overcurrent Protection for Systems Rated Over 1000 Volts AC, 1500 Volts DC

- Help to increase the usability of the *NEC* by having requirements for systems operating over 1,000 volts be located in their own articles
- Enforcement community has expressed concerns regarding the lack of needed requirements in the *Code*
- Industry is experiencing an increasing installation of medium voltage systems by designers and installers

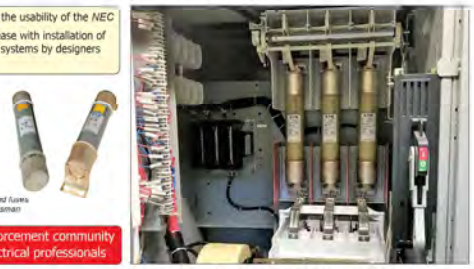
296

Article 245- Overcurrent Protection for Systems Rated Over 1000 Volts AC, 1500 Volts DC

Portions of Articles 215, 225, 230, and 240 dealing with conductors or systems operating at over 1,000 volts relocated to this article

Help to increase the usability of the *NEC*

There is an increase with installation of medium voltage systems by designers and installers



Medium voltage E rated fuses courtesy of Eaton Bussman

Helps the enforcement community and other electrical professionals

Photo courtesy of Rob Bowman, Denver Wastewater

297

298

250.24 Grounding of Service-Supplied AC Systems

The panel added the word "shall" where necessary to clarify electrical professionals' understanding of installing conductors connected in parallel

- Several changes were made to meet the requirements of the *NEC Style Manual*
- In the Exception to 250.24(2), "**The system**" was replaced with "**Impedance grounded system**" to clarify the exception helping to correlate with 250.36 and the changes made for that section
- Section 250.24(D)(2), *Connected in Parallel*, was relocated after "Conductors" and has been revised to a list format for additional clarity and useability

299

250.24 Grounding of Service-Supplied AC Systems

Photo courtesy of Scott Humphrey

300

250.24 Grounding of Service-Supplied AC Systems

(D) Grounded Conductor Brought to Service Equipment

(2) Conductors in Two or More Raceways or Cables Connected in Parallel

- Clarifies the requirements concerning grounded parallel conductors for service equipment found at:
  - 250.24 Grounding of Service-Supplied AC Systems
  - (D) Grounded Conductor Brought to Service Equipment
- When **paralleled grounded service conductors** in raceways and cables are connected in parallel, the size of the grounded conductor should be based upon the size of the ungrounded conductor in the raceway or cable
- Previous language used the word "installed," which was grammatically incorrect
- The word "connected" has replaced the word "installed" adding clarity and usability to the *Code*

IAEI Contributor- Paul Dobrowsky NFPA LINK© iaei.org

301

250.24 Grounding of Service-Supplied AC Systems

Clarifies the requirements concerning grounded parallel conductors for service equipment found at:
- (D) Grounded Conductor Brought to Service Equipment
- (2) Conductors in Two or More Raceways or Cables Connected in Parallel

When paralleled grounded service conductors in both raceways and cables are **connected in parallel**, the size of the grounded conductor should be based upon the size of the ungrounded conductor in the raceway or cable

The word **"connected"** has replaced the word **"installed"** adding clarity and usability to the *Code*

Note: *parallel conductors should be the same length*

302

250.30 Outdoor Source

(C) Outdoor Source

Remove the word "neutral" from 250.30(C) to be consistent with other locations within the *NEC* and be consistent with language found at 250.36 and 250.187

- "Neutral" was removed from impedance grounded ~~neutral~~ systems because it was removed elsewhere in the code to comply with the *NEC Style Manual*
- Correlates with the new definition found in Article 100 for **Impedance Grounded System**
- When consistency in terminology can be achieved, the *Code* becomes more user-friendly

CMP- 5, Bill Pancake NFPA LINK© iaei.org

303

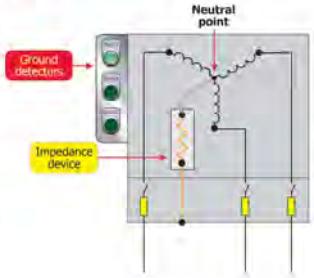
250.30(C) Outdoor Source, Exception *(Impedance Grounded System)*

"Neutral" was removed from **impedance grounded ~~neutral~~ systems** and elsewhere in the *Code* to comply with the *NEC Style Manual*

Correlates with the new definition found in Article 100 for Impedance Grounded System

Grounded **intentionally** from the neutral point **through an impedance device**

Is now **consistent with language** found at 250.36 and 250.187



304

250.36 Impedance Grounded Systems - 480 Volts to 1000 Volts

Removed the words "High" and "Neutral" from the title of Section 250.36, renaming the section to be **Impedance Grounded Systems** - 480 Volts to 1000 Volts

- New definition for **"impedance grounding conductor"** was also created to replace the phrase "grounded system conductor"
- Clarifies that the conductor that connects the neutral point to the impedance of an impedance grounded system does not meet the definition of a "grounded conductor" in Article 100
- Another change was made by deleting the word "Equipment" and replacing it with "Impedance" for the definition of "Impedance Bonding Jumper"

305

250.36 Impedance Grounded System

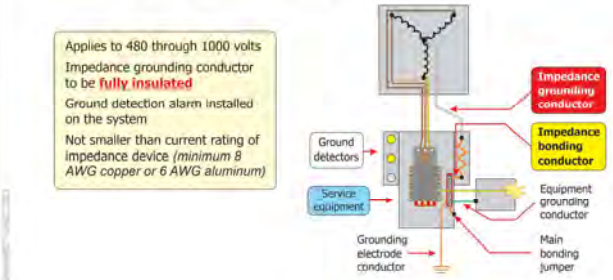
New definition for "impedance grounding conductor" was created to replace the phrase "grounded system conductor"

Applies to 480 through 1000 volts

Impedance grounding conductor to be **fully insulated**

Ground detection alarm installed on the system

Not smaller than current rating of impedance device *(minimum 8 AWG copper or 6 AWG aluminum)*



306

250.36 Impedance Grounded Systems- 480 Volts to 1000 Volts

Photo shows the typical ground detection and alarm system associated with an impedance grounded system

Has visual as well as audible alarm features

Manufactured by Post Grover

Photo courtesy of Rob Bowman

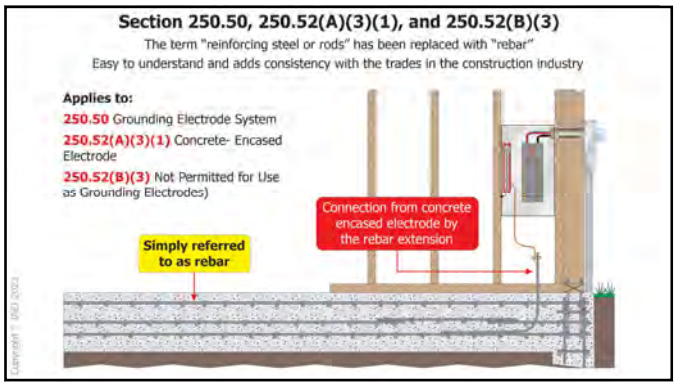
307

250.50 Grounding Electrode System, 250.52(A)(3)(1) Concrete- Encased Electrode, 250.52(B)(3) Not Permitted for Use as Grounding Electrodes

The term "reinforcing steel or rods" was replaced with "rebar"

- Revision was done in all three sections of the *Code* for consistency
  - 250.50 Grounding Electrode System
  - 250.52(A)(3)(1) Concrete- Encased Electrode
  - 250.52(B)(3) Not Permitted for Use as Grounding Electrodes
- Makes it easy to understand and adds consistency in the field and the construction industry *(many use the term "rebar")*
- Harmonizes the term to be consistent with the language preferred in 250.68(C)

308



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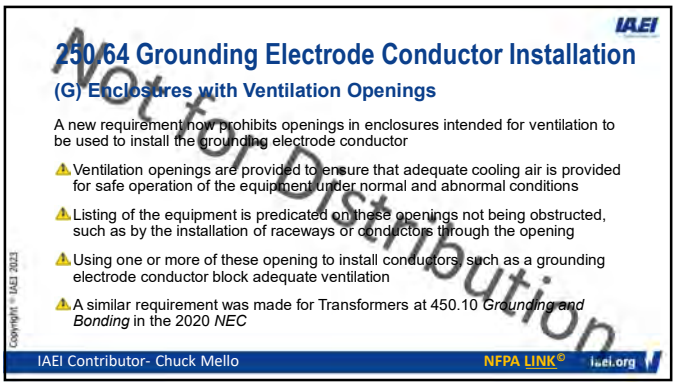

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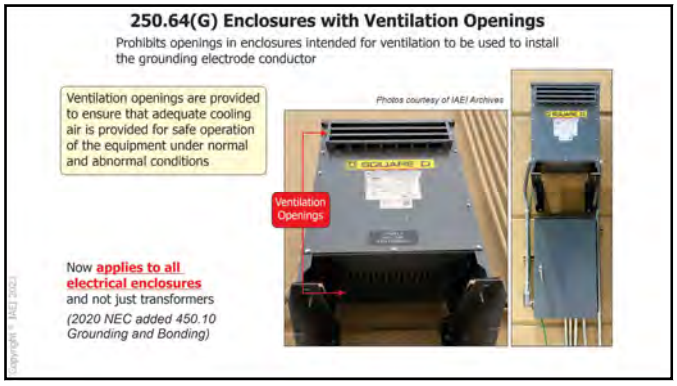

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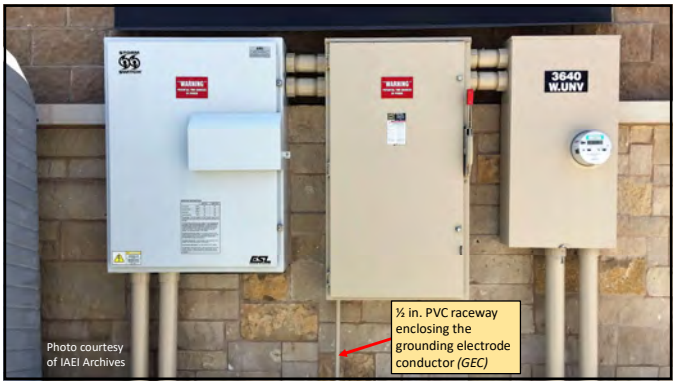


312

250.70 Methods of Grounding and Bonding Conductor Connection to Electrodes

The section has been divided into two new first level subdivisions (A) and (B)

- The list of methods for connection to grounding electrodes has been eliminated
  - **(A) General**
  - **(B) Indoor Communications Systems**

313

250.70 Methods of Grounding and Bonding Conductor Connection to Electrodes

- It was identified that there are no pipe fittings, pipe plugs or other device that screws into pipe that are suitable or identified for attaching a grounding electrode conductor and the list item has been removed
- The list item for communications system has been moved to the new list item (B) as a permitted method
- A new informational note was added to clarify to users that a connector or fitting that is listed as suitable for direct burial is also listed and suitable for concrete encasement
- See UL 467, *Standard for Safety Grounding and Bonding Equipment*, for additional information

314

250.70 Methods of Grounding and Bonding Conductor Connection to Electrodes

The section has been divided into new subparts (A) and (B) and the **list of methods for connection to grounding electrodes has been eliminated**

New informational note was added to clarify that a connector or fitting that is listed as suitable for direct burial is also listed and suitable for concrete encasement

Photos courtesy of IAEI Archives

315

250.94 Bonding for Communications Systems

(A) Intersystem Bonding Termination Device

This now recognizes the Intersystem Bonding Termination Device *(IBT)* as the location "for" the grounding electrode conductor

- The words "or to" were removed and replaced with "for" which clarifies that the IBT is the location "for" the grounding electrode conductor
- Updated language at 250.94(A)(4) a and b helps to clarify this section for the electrical professional
- Informational Note 1 was returned to the panel by the Correlating Committee to be addressed so it would comply with *NEC Style Manual*
- The Informational Note was removed as the panel could not find a way to meet the requirements of the *NEC Style Manual*

316

250.94(A) Intersystem Bonding Termination Device

Recognizes the Intersystem Bonding Termination Device *(IBT)* is **to be securely mounted** and acts as a location "for" the grounding electrode conductor to terminate

Clarifies this section for the electrical professional

Informational Note was removed due to *NEC Style Manual* issues

317

250.106 Lightning Protection Systems

The edition date of the NFPA 780 standard was removed for Informational Note No.1 and updated for Informational Note No. 2

- Revisions to 90.5(C) states that the reference is to be the **latest edition of the standard** unless the standard reference includes a date
- Edits to the Informational Notes were made for clarity and compliance with the *NEC Style Manual*

318

319

250.118 Types of Equipment Grounding Conductors

This section was reorganized into two first level subdivisions

- **(A) Permitted:**
  - 250.118(A)(5)(f) and 250.118(A)(6)(f) were added to **require a wire-type equipment grounding conductor or a bonding jumper** in accordance 250.102(E)(2) when flexible metal conduit or liquidtight flexible metal conduit with a stainless-steel core
- **(B) Not Permitted:**
  - Relocated from 250.121 which prohibits the use of grounding electrode conductors or structural metal frames of building or structures as an equipment grounding conductors

320

250.118 Types of Equipment Grounding Conductors *(cont.)*

(A) Permitted

Recognition of stainless-steel flexible and liquidtight metal conduit and requires a wire-type equipment grounding conductor *(EGC)*

- Acceptable wiring method for locations where high resistance to corrosion is encountered
- The stainless-steel core provides higher resistivity than other metal types used with flexible conduits
- A separate internal EGC or external bonding jumper is required to be installed to provide an effective ground-fault current path
- Provides the electrical professional additional options where high resistance to a corrosive environment is required

321

250.118(A) Types of Equipment Grounding Conductors

Stainless-steel flexible conduit and **liquidtight metal conduit** is a recognized wiring method but require for a wire-type equipment grounding conductor *(EGC)*

Acceptable wiring method for locations where high resistance to **corrosion** is required

An **internal EGC** or **external bonding jumper** is required to be installed to provide an effective ground-fault current path

Photo courtesy of FlexGlory

322

250.130 Equipment Grounding Conductor Connections

Replacement of snap switches without an equipment grounding terminal with snap switches with an equipment grounding terminal when the branch circuit does not have an equipment grounding conductor

- See 250.130(C) for the allowable locations for a snap switch or receptacle to be connected to for their EGC requirements
- An added informational note provides a link to the 404.9(B) requirements regarding the grounding of snap switches

323

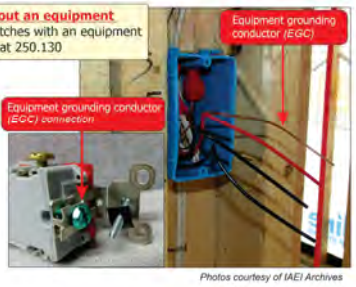
250.130 Equipment Grounding Conductor Connections

Snap switches were added to the item *(previously only receptacle)* that must conform with requirements found at 250.130(C) for their equipment grounding conductor *(EGC)* connection

Replacement of snap switches **without an equipment grounding terminal** with snap switches with an equipment grounding terminal has been added at 250.130

Single-pole, nongrounding switch

Photo courtesy of Leviton



Photos courtesy of IAEI Archives

324

250.140 Frames of Ranges and Clothes Dryers

Section 250.140 was revised to include two first level subdivision

- 250.140(A) is existing text that was relocated from the parent text
- 250.140(B) was the existing exception that was written into positive text
- 250.140(B)(5) adds a new list item to address the hazard of having neutral current on the metal normally non-current carrying parts *(objectional current)*
- Adds copper-clad aluminum as a permitted conductor type

325

250.140(B)(5) Frames of Ranges and Clothes Dryers

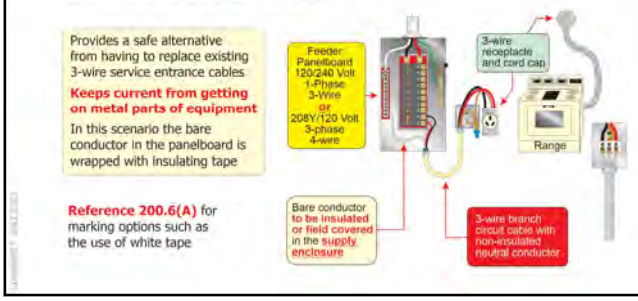
Grounded connector is to be **insulated or field covered** within the **supply enclosure** with a listed insulating material to prevent contact of an uninsulated conductor with any normally non-current carrying metal part of the equipment

Provides a safe alternative from having to replace existing 3-wire service entrance cables

Keeps current from getting on metal parts of equipment

In this scenario the bare conductor in the panelboard is wrapped with insulating tape

Reference 200.6(A) for marking options such as the use of white tape



326

250.148 Continuity of EGCs and Attachment in Boxes

Modified subdivision (A) to specify that all equipment grounding conductors that are spliced or terminated within a box are required to be connected together regardless if they are for different circuits

- Clarification was needed regarding wire-type equipment grounding conductors *(EGCs)* within boxes
- There was spirited debate between installers and inspectors as to if all the EGCs within an electrical box were required to be connected together
- Also, list item (C) was revised providing the sizing requirements for the bonding connection to the metal box by the EGC or the equipment bonding jumper
- Size is based on Table 250.122 for the largest overcurrent device for any of the circuits entering the box

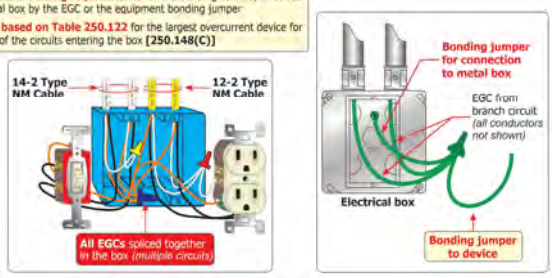
327

250.148 Continuity of EGCs and Attachment in Boxes

Modified subdivision (A) to specify that **ALL** equipment grounding conductors *(EGCs)* spliced or terminated within a box to be connected together **REGARDLESS** if they are for different circuits

Revised the **sizing requirements** for the bonding connection to the metal box by the EGC or the equipment bonding jumper

Size **based on Table 250.122** for the largest overcurrent device for any of the circuits entering the box **[250.148(C)]**



328

Chapter 3
Wiring Methods and Material

- Article 300
- Article 305
- Article 310
- Article 312
- Article 314
- Article 315
- Article 320
- Article 322
- Article 330
- Article 337
- Article 342
- Article 344
- Article 352
- Article 353
- Article 358
- Article 369
- Article 371
- Article 398

329

Various Chapter 3 Raceway Titles

Revised Articles 342, 344, 348, 350, 352, 353, 354, 355, 356, 358, 360, and 362 by removing the word "Types" from their titles

- The word "Type" has been removed from the new definitions found in Article 100 for conduit and tubings
- This editorial deletion correlates with the definition and clarifies the acronym for usability
- This change was related to multiple public inputs that relocated all the xxx.2 definitions in the *NEC* to Article 100 to comply with the 2020 *NEC* Style Manual
- The Correlating Committee established a Task Group to review the format of the wiring method articles regarding the use of acronyms and the use of the word "type" used with some acronyms

CMP- 8, Tom Moore

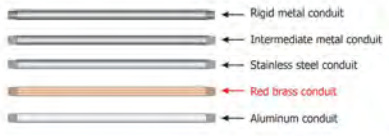
330

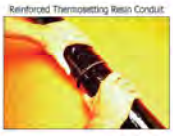
Chapter 3 Raceway Titles- Multiple Articles

Articles 342, 344, 348, 350, 352, 353, 354, 355, 356, 358, 360, and 362 were revised by **removing the word "Types"** from their titles

Raceway types involved in this change include:

- **Article 342-** Intermediate Metal Conduit
- **Article 344-** Rigid Metal Conduit
- **Article 348-** Flexible Metal Conduit
- **Article 350-** Liquidtight Flexible Metal Conduit
- **Article 352-** Rigid Polyvinyl Chloride Conduit
- **Article 353-** High Density Polyethylene Conduit
- **Article 354-** Nonmetallic Underground Conduit
- **Article 355-** Reinforced Thermosetting Resin Conduit
- **Article 356-** Liquidtight Flexible Nonmetallic Conduit
- **Article 358-** Electrical Metallic Tubing
- **Article 360-** Flexible Metallic Tubing
- **Article 362-** Electrical Nonmetallic Tubing





331

Article 300
General Requirements for Wiring Methods and Materials

332

300.2 Limitations

(A) Voltage

Section was modified to add 1500 volts dc requirements in 2 locations

- This allows for wiring methods located within Chapter 3 to be used for 1000 volts ac, 1500 volts dc, nominal, or less installations if not limited in other locations of the *NEC*
- Medium voltage *(MV)* requirements have been relocated to new Article 305 to enhance usability

333

300.2 Voltage

This allows for wiring methods found within in Chapter 3 to be used for **1000 volts ac, 1500 volts dc, nominal,** or less installations *(if not limited in other locations of the NEC)*

Medium voltage *(MV)* requirements are being **reorganized**

MV is being installed by more and more electrical contractors

Installation of a motor control for over 1000 volts at the Denver Wastewater Facility

Photo courtesy of Rob Bowerman

334

300.4 Protection Against Physical Damage

(E) Cables, Raceways, or Boxes Installed in or Under Metal-Corrugated Roof Decking

A new **Exception No. 2** has been added which **recognizes poured concrete** on top of the metal roof decking as a means of physical protection for cables, raceways, or boxes installed in or under metal-corrugated roof decking

335

300.4 Protection Against Physical Damage *(cont.)*

(E) Cables, Raceways, or Boxes Installed in or Under Metal-Corrugated Roof Decking *(cont.)*

- Concrete limits screws from penetrating into the raceway system causing damage to the raceway and wiring
- When the metal-corrugated sheet roof decking is covered with a **minimum thickness 50 mm *(2 in.)* concrete slab**, the 38 mm *(1 ½ in.)* spacing is not necessary
- The concrete slab is measured from the top portion of the corrugated roofing
- This also recognizes the addition of **"listed steel or malleable iron fittings and boxes"** for Exception No. 1 which are used with rigid metal conduit *(RMC)* and intermediate metal conduit *(IMC)*

336

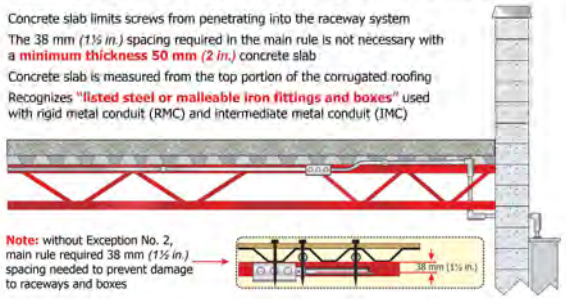
300.4(E) Cables, Raceways, or Boxes Installed in or Under Metal-Corrugated Roof Decking- Ex. No. 1 and 2

Concrete slab limits screws from penetrating into the raceway system

The 38 mm *(1½ in.)* spacing required in the main rule is not necessary with a **minimum thickness 50 mm** *(2 in.)* concrete slab

Concrete slab is measured from the top portion of the corrugated roofing

Recognizes **"listed steel or malleable iron fittings and boxes"** used with rigid metal conduit (RMC) and intermediate metal conduit (IMC)



Note: without Exception No. 2, main rule required 38 mm *(1½ in.)* spacing needed to prevent damage to raceways and boxes

337

300.4 Protection Against Physical Damage

(G) Fittings

New language has been added requiring that protective fittings be installed to fittings "prior to the installation of conductors"

- The protective fitting needs to be in place before the installation of the conductors in order to provide protections to these conductors.
- Installing this fitting after the conductors have been installed allows possible damage to occur to conductors being pulled into the raceway
- Determining if this fitting was installed before the installation of conductors may be hard for an AHJ to determine during an inspection *(sometimes there is no visible conductor damage)*
- There are fittings available on the market that are designed to be installed after the conductors have been installed

338

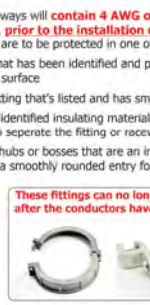
300.4(G) Fittings

Protective fittings to be installed to raceways **"prior to the installation of conductors"**

Where raceways will **contain 4 AWG or larger** insulated circuit conductors, **prior to the installation of conductors**, the conductors are to be protected in one of the following ways:

- a fitting that has been identified and provides a smooth rounded insulating surface
- a metal fitting that's listed and has smoothly rounded edges
- use of an identified insulating material that is securely fastened in place to seperate the fitting or raceway
- threaded hubs or bosses that are an integral part of a raceway providing a smoothly rounded entry for conductors

These fittings can no longer be installed after the conductors have been installed



339

300.5 Underground Installations

(A) Minimum Cover Requirements

Table 300.5(A) Minimum Cover Requirements

Electrical Metallic Tubing *(EMT)* has been added to Column 3 of the table to clearly indicate that it can be installed in an underground location

- EMT is permitted to be used in underground locations
- Supplementary corrosion protection is generally required for EMT in direct contact with earth, but not required in all cases *(Example: Stainless tubing)*
- *UL 797, Standard for Safety Electrical Metallic Tubing- Steel*, also indicates that EMT is permitted in underground installations
- A new note #6 was added to the bottom of the table to direct the *Code* user to 358.10 for additional information requirements for directly buried EMT

340

Table 300.5(A) Column 3 *(EMT)*

Electrical metallic tubing *(EMT)* has been added to Table 300.5(A), Column 3 to indicate it can be installed in underground locations

Not a new change for the use of EMT

It has always been allowed with the use of supplementary corrosion protection

Some EMT such as stainless does not require the use of supplementary corrosion protection

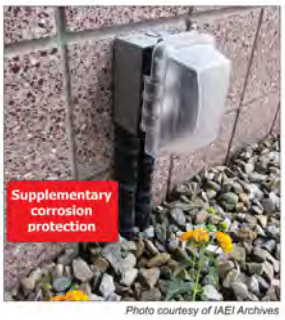


Photo courtesy of IAEI Archives

341

300.5 Underground Installations

(D) Protection from Damage

The words "direct buried" were removed from the heading leaving behind "conductors and cables"

- The text reading as "direct buried conductors and cables," did not apply to buried raceways containing conductors
- Only conductors that were directly buried were included in the 2020 *NEC* edition
- This revision will provide both the installers and inspectors clarity as to requirements for underground conductor and cable installations

342

300.5 (D) Protection From Damage

The words "direct buried" were removed from the heading leaving behind "conductors and cables"

Buried raceways containing electrical conductors require the same protection as buried cables

Utilize **Table 300.5** for the correct burial depths in order to pass an electrical inspection

Photo courtesy of Scott Humphrey

343

344

300.6 Protection Against Corrosion and Deterioration

(A) Ferrous Metal Equipment

The informational note referencing field-cut threads has been removed and added into positive language

- Adding "anywhere other than at the factory where the product is listed" adds clarity
- Threads cut in the field are to be coated with an electrically conductive, corrosion-resistant compound that has been approved for that purpose
- If the threads are cut at the factory, the field installation of this protective coating does not apply
- Informational notes are not enforceable *(these are informative to the user of the Code)*
- Moving the requirements into the section language allows for enforcement

345

300.6(A) Ferrous Metal Equipment

Electrical pipe **threads cut in the field** are to be coated with an electrically conductive, corrosion-resistant compound that has been approved for that purpose

If threads are **cut at the factory**, the field installation of a protective coating does not apply

Photos courtesy of Milwaukee Tools

346

300.11 Securing and Supporting

(C) Raceways Used as Means of Support

Class 3 circuit conductors are permitted to be supported by the raceway containing power supply conductors that supplies the equipment

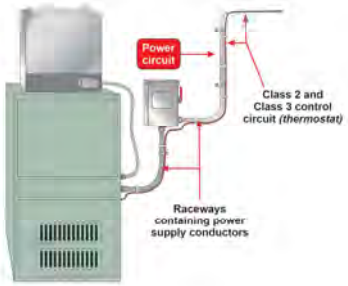
- Class 2 and Class 3 cables are now able to be supported by raceway
- Support to be provided by the raceway containing power supply conductors that supplies the equipment
- These cables are typically the same in size and weight so there should not be an issue
- This also aligns with 725.143, which recognizes Class 2 and Class 3 circuit conductors and points back to 310.11(C) for their installation

347

300.11(C) Raceways Used as Means of Support

Only raceways containing power supply conductors for electrically controlled equipment are allowed to support Class 2 and Class 3 circuit conductors or cables

Class 2 and 3 wiring must be used to control equipment powered by conductors running within the supporting raceway



348

300.14 Length of Free Conductors at Outlets, Junctions, and Switch Points

Language has been added permitting free conductors to be spliced at outlet, junction, and switch point locations

- This clarifies that the conductor is permitted to be spliced with a shorter conductor to add length to it and meet the 6 inches required by this section
- Previously left up to interpretation as to if the free conductor had to be continuous or was permitted to be spliced and extended at the box
- When the drywall installer router damages the conductors within the box, some inspectors would not allow for the conductor to be spliced *(In some cases, the installer would be required to replace the NM cable to the box)*
- This caused misunderstanding and confusion between the installer and the inspector
- Additional issues could also arise where wall surfacing has been installed leaving the length of the free conductor less than the 6-inch requirement

349

300.14 Length of Free Conductors at Outlets, Junctions, and Switch Points

Clarifies that the conductor **is permitted to be spliced** with a shorter conductor to add length to it and meet the 6 inches required by this section

Photo below shows a router being used to expose the device box that was covered with drywall

Photo on right shows a device box with numerous conductors that could be damaged by a careless router

Careless router operator could cause alot of damage to these conductors

Photo courtesy of IAEI Archives

350

300.17 Number and Size of Conductors and Cables in Raceway

Conductors are installed ***(as well as cables)*** in raceways and requirements were needed so they are not damaged during and after their installation

- The number and size of conductors **and cables** in a raceway is limited
- Limited due to a need to dissipate heat generated by conductors
- Conductors **and cables** are not to be damaged due to installation or removal
- Insulation integrity of conductors **and cables** must be protected
- The updated Informational Note offers direction to the location of the various wiring methods and their requirements

351

300.17 Number and Size of Conductors and Cables in Raceways

Conductors are installed ***(as well as cables)*** in raceways and requirements were needed so they are not damaged during and after their installation

Conductors and cables are limited in raceways

Must be able to dissipate heat

Must not damage conductors or cables during installation or removal

Insulation integrity to be protected

352

300.25 Exit Enclosures *(Stair Towers)*

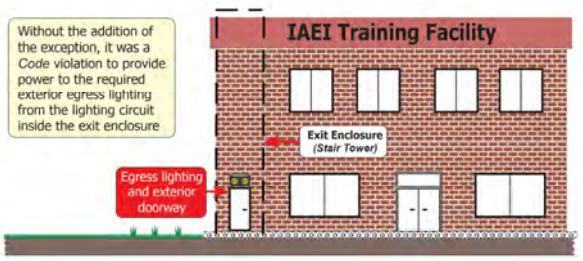
An exception was added addressing egress lighting on outside exterior doorways

- Eliminated the term "be separated from the building" and added the words "have a fire resistance rating"
- "Fire resistance rating" is a defined term in the building code and, therefore, will clarify this requirement
- Outside exterior doorways are part of the means of egress and frequently require egress lighting to extend to the public way
- Without the addition of the exception, it was a *Code* violation to provide power to the required exterior egress lighting from the lighting circuit inside the exit enclosure

353

300.25 Exit Enclosures *(Stair Towers)*

Exception added addressing egress lighting on outside exterior doorways for stair towers



354

300.26 Remote-Control and Signaling Circuits Classification

A new Section 300.26 has been created for remote-control and signaling circuits

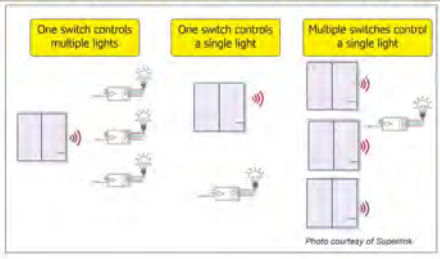
- This should help to clarify that remote-control and signaling circuits can be either power-limited or non-power-limited
- Class 1 circuits have been relocated from Art 725 to a new Article 724
- Class 2 and 3 circuitry shall comply with Article 725
- Power-limited Class 2, and Class 3 circuitry to comply with Section 725.3(E)
- Sections 300.2 through 300.25 to govern remote-control and signaling circuits that are non-power-limited

355

300.26 Remote-Control and Signaling Circuits Classification

Section 300.26 was created by CMP-3 for remote-control and signaling circuits

- Class 1 circuitry has been relocated from Article 725 to Article 724
- Power-limited Class 2, and Class 3 circuitry to comply with Article 725
- Sections 300.2 through 300.25 for non-power-limited remote-control and signaling circuits



356

Article 305
Methods and Materials for Systems Rated Over 1000 Volts ac, 1500 Volts dc, Nominal

357

Article 305 General Requirements for Wiring Methods and Materials

Article 305 was created for general wiring methods and installations applying to Wiring Methods and Materials for Systems Rated Over 1000 Volts ac, 1500 Volts dc, Nominal

- This content was formerly located as Part II of Art. 300
- Increases safety by including more information on medium voltage *(MV)* installations
- Greater likelihood for the electrical professional to apply all the wiring methods and installations requirements correctly if located in this new article
- Medium voltage *(MV)* information will provide the electrical industry, including installers and inspectors, with more guidance toward installation requirements

358

Article 305 General Requirements for Wiring Methods and Materials

Article 305 was created for **general wiring methods and installations** applying to Wiring Methods and Materials for Systems Rated Over 1000 Volts ac, 1500 Volts dc, Nominal

Greater likelihood for electrical professionals to apply all the wiring methods and installations requirements for medium voltage *(MV)* correctly if located in this new article

Systems like these if not correctly installed can result in possible damage to the equipment and facility as wells as injury and death to people

Photo courtesy of Rob Bowerman

359

Article 310
Conductors for General Wiring

360

Tables 310.16, 310.17, and 310.20

Deleted "XHWN" from the 90-degree Celsius columns of Tables 310.16, 310.17, and 310.20

- Due to action from the correlating committee requesting CMP-6 to determine if Type XHWN is allowable for use at 90 degrees Celsius
- CMP-6 decided that Type XHWN insulation was not rated for this temperature and deleted it from the above table columns
- "XHWN" is an insulation that can be used in dry and wet locations and is of a flame-retardant, moisture-resistant thermoset type
- It is listed at Table 310.4(1) as being rated for 75 degrees Celsius

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361

Tables 310.16, 310.17, and 310.20

Deleted "XHWN" from the 90-degree Celsius columns

Type XHWN insulation is not rated for this temperature and was deleted from the above table columns

It is also not longer available on the market for purchase and installation

XHWN is listed in Table 310.4(1) as being rated for 75 degrees Celsius

XHWN can be used in dry and wet locations and is of a flame-retardant, moisture-resistant thermoset type

362

Article 312
Cabinets, Cutout Boxes, and Meter Socket Enclosures

363

312.10 Screws and Other Fasteners

New section added to address **field installed screws or other fasteners** entering a cabinet, cutout box, or meter socket

- Damage to the conductors has been an issue for some time creating a shock or fire hazard
- Injuries to electrical professionals have been reported due to accidental insulation or conductor damage as the result of inappropriate screw use
- Greater attention will be required by the installer as to the type of fastener they use and how far it protrudes into the wiring space
- The AHJ will need to be mindful and examine these enclosures to make sure this new requirement is being adhered to be the installer

CMP- 9, Dean Fortney NFPA LINK© iaei.org

364

312.10 Screws and Other Fasteners *(cont.)*

New section added to address **field installed screws or other fasteners** entering a cabinet, cutout box, or meter socket *(cont.)*

- Screws are to be of a machine type with blunt ends
- Other fasteners being installed are to be of the type with blunt ends
- Screws or other fasteners **cannot extend** into the enclosure further than **6 mm (1/4 in.) unless the end** is protected with an approved means
  - **Exception to above requirement**: Screws or other fasteners are permitted to extend into the enclosure not more than **11 mm (7/16 in.)** if located within 10 mm (3/8 in.) of an enclosure wall
- **Note:** The 7/16-in. dimension accounts for the customary ½-in. screw passing through a 1/16-in. thick enclosure wall along the edges and at the corners of enclosures *(The natural curves in conductors at these locations allow for greater screw lengths)*

365

312.10 Screws and Other Fasteners

Example of a conductor damaged by a screw

Installer and inspector should verify conductors are installed away of locations where screws will fasten covers to cabinet

Photo courtesy of IAEI Archives

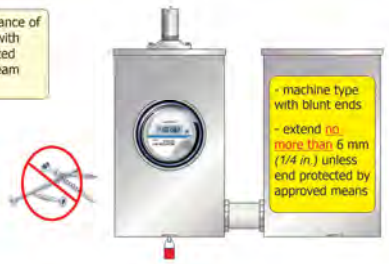
366

312.10 Screws and Fasteners

Damage to the conductors has been an issue for some time creating a shock or fire hazard

The possibilities of an abundance of arcs and sparks are greater with meter enclosures due to limited overcurrent protection upstream by the utility

Greater attention will be required by the installer and the AHJ as to the type of fastener they use and how far it intrudes into the wiring space



- machine type with blunt ends
- extend no more than 6 mm *(1/4 in.)* unless end protected by approved means

367

Article 314

Outlet, Device, Pull, and Junction Boxes, Conduit Bodies, Fittings, and Handhole Enclosures

368

314.5 Screws and Other Fasteners

New section added to address **screws and fasteners** entering the wiring space of boxes and conduit bodies

- This addresses the installation of fasteners which are field installed into the wiring space of these boxes/conduit bodies
- These fasteners and screws have been responsible for **damage to the conductor(s)** causing electrical shock and fire hazards
- A new set of list items include 7 requirements concerning screw and fastener use
- These fastener requirements apply during installation of boxes and conduit bodies
- Fasteners such as drywall screws will not be acceptable for these installations

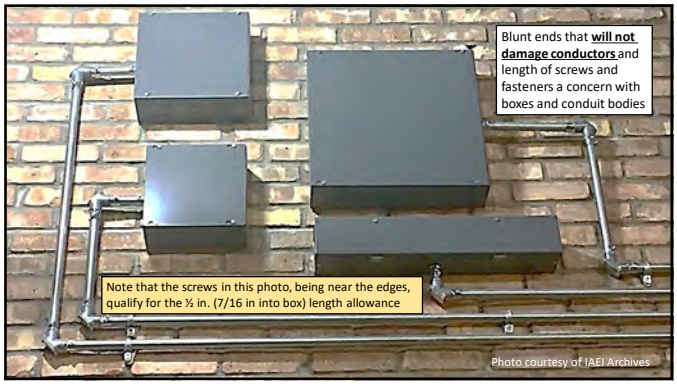
369

314.5 Screws and Other Fasteners *(cont.)*

Review of the Notes:

- Applies to field wiring exclusively, not to screws provided by the manufacturer *(An example would be screws for ganging multiple outlet boxes)*
- Outlet boxes are treated more conservatively due to greater congestion, which makes damage from screw or fastener wall penetrations very difficult to avoid
- The 5/16-in. screw dimension refers to the common 3/8-in. screws that attach device yokes to raised covers, and wall plates to device yokes
- The 7/16-in. screw dimension refers to the common ½-in. screw inserted into a 1/16-in. thick enclosure wall along the edges and at the corners of enclosures *(This is the standard length and positioning for pull box cover screws)*
- Natural curves in conductors at these locations allow for greater screw lengths

370



371

314.16 Number of Conductors in Outlet, Device, and Junction Boxes, and Conduit Bodies

(B) Box Fill Calculations

(6)Terminal Block Fill: A new section added to address volume allowance concerns when terminal blocks are installed in boxes

- A single volume allowance based on the largest conductor size terminated on the assembly will be required based on Table 314.16(B)(1)
- This **does not apply** to every conductor terminated to a pole of a terminal block assembly

372

314.16(B)(6) Terminal Block Fill

Utilize **Table 314.16(B)(1)** to find single volume allowance for the **largest conductor terminated** on the terminal block assembly

This will not be encountered by many electrical installers

See 680.23(F)(2)(b) where requirements **disallow normal twist-on wire connectors** in the equipment grounding return path for in-pool line-voltage lights, but permits grounding terminals

Terminal Block Assembly

Photo courtesy of Steel City

373

314.24 Dimensions of Boxes

Substantiation was presented to CMP-9 to adjust the existing language by broadening the reach of this section to address side entries for outlet and device boxes

- These changes will help to ensure that conductor damage is not caused by the installation of devices into outlet and device boxes
- Adjusted the wording to ensure that the depth of boxes accommodates wiring method entries where those entry points line up with the backs of installed devices or equipment
- CMP became aware of damage to conductors from installed devices or other equipment of sufficient size to create a conflict with conductors entering these boxes
- A fire investigation concerning a GFCI receptacle installed on the outside of a house was also considered as substantiation for this change

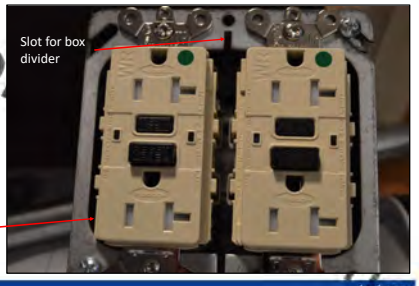
374

314.24 Dimensions of Boxes *(cont.)*

Note two NEMA device envelopes in full use (next slide), with 1/16-in. slot allowance for box divider in center, and radius (7/16-in.) corners; device corners are beveled to fit perfectly.

These two GFCI devices project 1-in. into the box below the ring.

Device depths vary and must be measured in the field.

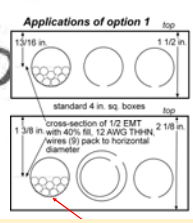


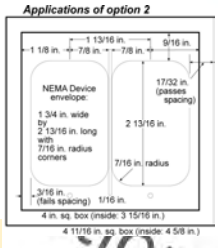
375

314.24 Dimensions of Boxes *(cont.)*

The GFCI receptacles *(prior slide)* would require a plaster ring or a raised cover to fit in this box safely, or wiring entries from top or bottom, or a 4 11/16-inch box, or the deeper box *(below)*.

Many devices do not use the full NEMA envelope, such as snap switches.





This graphic informed the CMP 9 action setting the horizontal knock-out diameter as the fill limit for a side entry within ½ in. of a device body.

376

Article 315
Medium Voltage Conductors, Cable, Cable Joints, and Cable Terminations

377

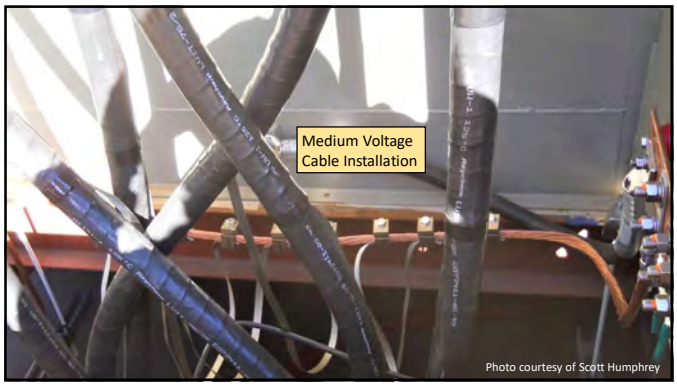
Article 315 Medium Voltage Conductors, Cable, Cable Joints, and Cable Terminations

Clarifications were made as to the voltages associated with conductors, cable, cable joints, and cable terminations

- New article containing these requirements as well as new requirements for cable joints and terminations
- These requirements were previously found in Article 311 in the 2020 *NEC (Article 311 has been deleted)*
- Specification of the voltage requirements was needed to improve usability of the *Code*
- Article includes voltages as follows:
  - from 2001 volts to 35,000 volts ac, nominal
  - from 2001 volts to 2500 volts dc, nominal
- Adds clarity for the user of the *Code* at 315.16 on how to identify Type MV, Medium Voltage Cable

CMP- 6, Susan Newman Scearce

378



379

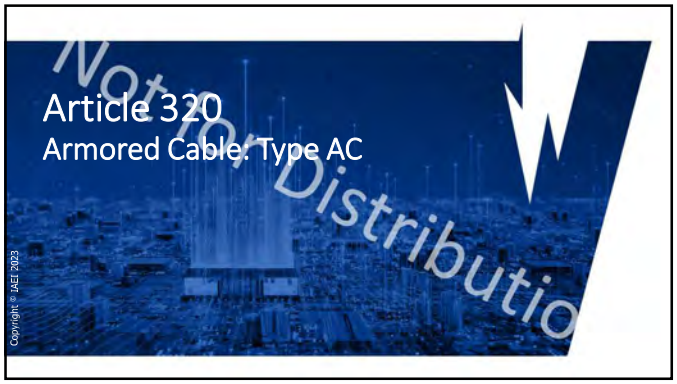
Article 315- Medium Voltage Conductors, Cables, Cable Joints, and Cable Terminations

Wire wheel information tag for medium voltage cable

380

381

382



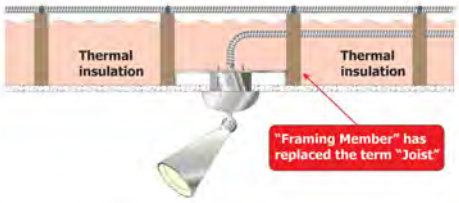
383

384

320.23(A) Cables Run Across the Top of Framing Members

For accessible attics, the term **"Framing Members"** has replaced "Joists" as it pertains to the installation of Armored Cable *(Type AC)*

When AC cables are installed **across the face** of framing members, the reference to joists has been changed to the term **"~~equivalent~~ horizontal surface"** to be more inclusive of any walking or crawling surface



385

Article 322
Flat Cable Assemblies: Type FC

386

322.56 Splices and Taps

(B) Taps

Changes were made to flat cable assembly requirements by removing "color-coded" and replacing it with "marked"

- The term "color-coded" was changed to "marked" to correlate with the terminology found at 322.120 entitled "Marking"
- Does not change the meanings of the requirements found at this location
- Will provide clarity and unison with other code sections

387

Article 330
Metal-Clad Cable: Type MC

388

330.112 Insulation

(A) 1000 Volts or Less

Editorial changes made to correlate with the addition of 16 AWG copper conductors for general use wiring methods

- The recognition of 16 AWG copper conductors for use as ungrounded, grounded and equipment grounding conductors in 330.104 was necessary for useability of the *Code*
- Conductors to be of a type that is listed at Table 310.4(1) for conductor applications and installations rated for 600 volts

389

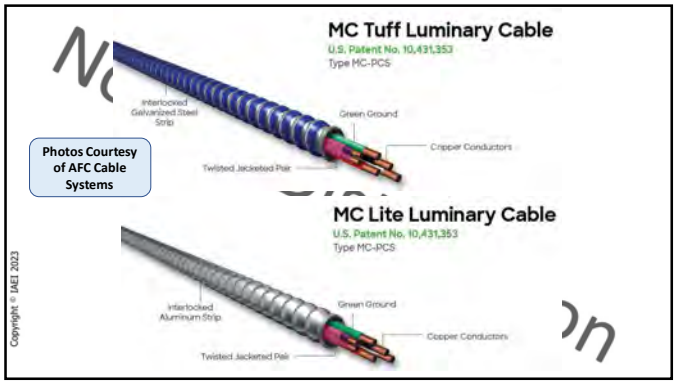
330.112 Insulation *(cont.)*

(A) 1000 Volts or Less

Editorial changes made to correlate with the addition of 16 AWG copper conductors for general use wiring methods *(cont.)*

- There was some confusion with the use of 16 AWG conductors for control and signal applications
- Identification of the conductor types in 330.112(A) was necessary to identify the requirements for each conductor type
- These conductors are to be of the type listed at Table 402.3 for fixture wires

390



391

392

Article 337 ~~Type IM~~ Type P Cable

Changes all references of the former Type P cable to Type IM cable

- The purpose for including Type IM cable was to recognize a suitable wiring method for oil field drilling rig locations that are land-based
- Installation requirements in this article include:
  - Bending radius
  - Ampacity
  - Listing and
  - Uses permitted or not permitted
- Off-shore marine-type installations would not be found in the scope of the *NEC*
- Type P cables used for offshore drilling rigs are not under the purview of the *NEC*

Note: No Change
This reverted back to Type P Cable during a vote at the NFPA Meeting

393

Article 337 Type P ~~Industrial Mobile Cable (Type IM)~~

~~Will change all references of Type P cable to Type IM cable~~ (no change)

Installation requirements for this product include:
- Bending radius
- Ampacity
- Listing
- Uses permitted
- Uses not permitted

Recognize as a suitable wiring method for oil field drilling rig locations that are land-based

Photo courtesy of ICC Cable Corporation

394

Article 342
Intermediate Metal Conduit *(IMC)*

395

342.20 Size
(B) Maximum

A change was made for Intermediate Metal Conduit *(IMC)* by specifying that 6-inch trade size is the largest that can be installed

- Now to include trade sizes 5 and 6-inch IMC
- Maintains consistency in the rigid metal raceway articles
- *UL Standard 1242, Electrical Intermediate Metal Conduit – Steel,* does not currently include IMC trade sizes 5 and 6
- Could be a concern for AHJs, installers, and designers regarding listing requirements
- **Note: 342.30 (also 344.30) Securing and Supporting** Exception: For concealed work in finished buildings or prefinished wall panels where securing is impracticable, unbroken lengths *(without coupling)* of **IMC are permitted to be fished**
- New exception extends provisions for this practice now in place *(since the 1996 edition)* for EMT to IMC *(Same change occurs in 344.30 for RMC)*

396

342.20(B) Maximum *(Intermediate Metal Conduit)*

A change was made for Intermediate Metal Conduit *(IMC)* by specifying that **6-inch trade size is the largest** that can be installed

Note:
Installing 6 in. IMC is not for the faint of heart

397

Article 344
Rigid Metal Conduit *(RMC)*

398

344.28 Reaming and Threading *(Rigid Metal Conduit)*

Clarifies that manufacturer's requirements for reaming and threading of PVC-coated rigid metal conduit *(RMC)* should be followed

- This change was brought about by NEMA due to the installer accidentally damaging PVC rigid metal conduit when they were reaming and adding threads to the conduit
- The use of proper threading and clamping tools specifically designed for PVC-coated conduit should be used so that the exterior PVC coating is not damaged
- Standard threading and clamping tools that are used with non-PVC coated RMC will damage the outside PVC coating and should not be used
- A new informational note was added to assist installers with this procedure
- Reference NECA 101-2013, *Standard for Installing Steel Conduits (Rigid, IMC, EMT)*

399

344.28 Reaming and Threading *(Rigid Metal Conduit)*

Clarifies that **manufacturer's requirements** for reaming and threading of PVC-coated rigid metal conduit *(RMC)* **should be followed**

Proper threading and clamping tools specifically designed for PVC-coated conduit should be used so that the exterior PVC coating is not damaged when being field cut, reamed, or threaded

Photos courtesy of Plastibond

See NECA 101-2013, Standard for Installing Steel Conduits (Rigid, IMC, EMT)

PVC Rigid Metal Conduit vise for cutting, reaming, and threading

400

Article 352
Rigid Polyvinyl Chloride Conduit *(PVC)*

401

352.44 Expansion Fittings

- Requirements were added for an expansion fitting to be installed for underground runs of direct buried PVC conduit that emerge from the ground
- Separated into two first level subdivisions
  - **(A) Thermal Expansion and Contraction** – Existing language of 352.44 including Table 352.44(A) addresses the thermal expansion and contraction of a PVC conduit system
  - **(B) Earth Movement** – New content added to address earth movement events

402

352.44(B) Earth Movement *(Expansion Fittings)*

(B) Earth Movement

Requirements were added for an expansion fitting to be installed for underground runs of direct buried PVC conduit that emerge from the ground

- PVC raceways and associated fitting are sometimes pulled away from the bottom of electrical enclosures due to earth movement
- In some cases, the raceway and fitting are pushed into the electrical enclosure or equipment
- This typically results from the settling of the soil because it was not compacted properly when the raceway was covered or from frost heave events during cold weather

403

352.44(B) Earth Movement *(Expansion Fittings)*

Requirements were added for an expansion fitting to be installed for underground runs of direct buried PVC conduit that emerge from the ground

Photos courtesy of IAEI Archives

404

Article 353
High Density Polyethylene Conduit *(HDPE Conduit)*

405

353.48 Joints

Revised to specify that the joining methods of High-Density Polyethylene Conduit *(HDPE)* are to be made by a method identified by the manufacturer

- Heat fusion or butt fusion joints are not to be permitted
- Heat and butt fusion may "burn" or damage the cabling when it is subsequently pulled over the lip
- The lip will also reduce the potential wire pull surface area and conduit fill calculations
- *UL Standard 651A, Schedule 40 and 80 High Density Polyethylene (HDPE) Conduit* is performance-based
- Including a list format may inadvertently omit a joining method that could meet the performance requirements of the standard

406

353.48 Joints *[High Density Polyethylene Conduit (HDPE)]*

Joining methods of High Density Polyethylene Conduit *(HDPE)* **for electrical installations** are to be made by a method **identified by the manufacturer**

Heat fusion or butt fusion joints **not permitted** for High Density Polyethylene Conduit *(HDPE)*

May damage the cabling or conductors when it is pulled over the lip

The lip will also reduce the potential wire pull surface area and conduit fill calculations

Photos courtesy of HDPE Supply

407

Article 358
Electrical Metallic Tubing *(EMT)*

408

358.20 Size
(B) Maximum

This change increases the maximum size of Electrical Metallic Conduit *(EMT)* to metric designator 155 *(trade size 6)*

- 5- and 6-inch EMT is not addressed in previous editions of the *Code*
- Both are similar to materials used to create 5- and 6-inch rigid metal conduit *(RMC)*, which have a proven result in the industry
- The outer diameter will be the same as 5- and 6-inch RMC but will have a thinner wall
- Both EMT sizes conform to the minimum bend radii shown in Chapter 9, Table 2 of the *NEC*
- Chapter 9 Table 4 and Appendix C.1 and C.1(A) have been updated to include these new trade sizes

CMP- 8, Scott Higgins NFPA LINK© iaei.org

409

358.20(B) Maximum *(EMT Raceways)*

Increases the **maximum size** of Electrical Metallic Conduit (EMT) to **6 inches**

Better be young and in good shape to install 5 and 6 inch EMT all day

5 and 6 in. EMT sizes conform to the minimum bend radii shown in Chapter 9 Table 2

Chapter 9 Table 4 and Appendix C.1 and C.1(A) have been updated to include these new trade sizes

410

Article 369
Insulated Bus Pipe *(IBP)*/Tubular Covered Conductors *(TCC)* Systems

411

Article 369 Insulated Bus Pipe/Tubular Covered Conductors

New Article 369 covers the use, installation, and construction specifications for insulated bus pipe *(IBP)* systems

- Insulated bus pipe *(IBP)*, also known as Tubular Covered Conductor *(TCC)*, has been used for many years in shipboard and utility applications in Europe and utility applications in the United States
- The system incorporates cable systems, bus bars, metal-enclosed bus, resin-impregnated bushings, and tap boxes
- These systems are lighter, consume less volume, and take less time to install than a traditional system
- Has been proven as a practical alternative to using medium voltage cables, bare busbars, or bare conductors
- See the new definition in Article 100 for Insulated Bus Pipe *(IBP)*

CMP- 8, Tom Moore NFPA LINK© iaei.org

412

Article 369 Insulated Bus Pipe/Tubular Covered Conductors

Cover the use, installation, and construction specifications for insulated bus pipe *(IBP)* systems

Used for many years in **shipboard and utility** applications in Europe and utility applications in the United States

Has been proven as a practical alternative to using medium voltage cables, bare busbars, or bare conductors

See the new definition in Article 100 for Insulated Bus Pipe (IBP)

Photos courtesy of NSRP National Shipbuilding Research Program

413

Article 371
Flexible Bus Systems

414

Article 371 Flexible Bus Systems

This new article covers the use and installation requirements of flexible bus systems and their associated fittings

- Addresses a new product *(Flexible Bus Systems)* that provides many of the benefits of both bus duct and cable
- Its flexibility reduces installation time by making it easier to make connections in the field without the need for special tools
- It is light in weight compared to an equivalent bus duct or conductors in a conduit

415

Article 371 Flexible Bus Systems *(cont.)*

This new article covers the use and installation requirements of flexible bus systems and their associated fittings *(cont.)*

- Inspectors, installers, and designers need to be aware that flexible bus systems should be listed
- Currently, there is not a specific standard available for listing this product, but two outlines of investigations have been developed
- See the new definition in Article 100 for *Flexible Bus Systems*

416

Article 371 Flexible Bus Systems

Covers the use and installation requirements of flexible bus systems and their associated fittings

Flexibility reduces installation time by making it easier to make connections in the field without the need for special tools

It is light in weight compared to an equivalent bus duct or conductors in a conduit

Inspectors, installers, and designers need to be aware that **flexible bus systems should be listed**

Photos courtesy of nVent

417

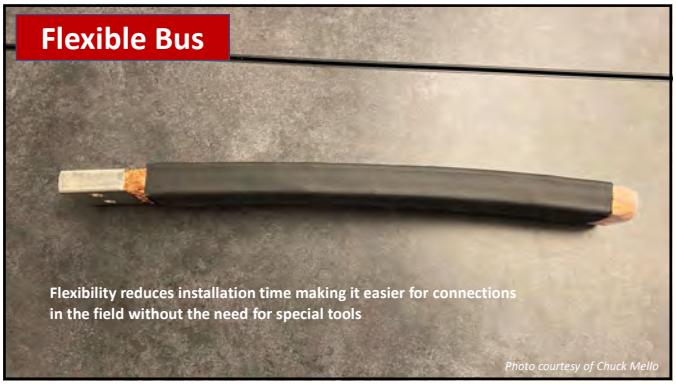
Flexible Bus

Flexibility reduces installation time making it easier for connections in the field without the need for special tools

Photo courtesy of Chuck Mello

418

Flexible Bus



Flexibility reduces installation time making it easier for connections in the field without the need for special tools

Photo courtesy of Chuck Mello

419

Article 371 Flexible Bus Systems *(cont.)*

- Flexible
- Rectangular
- Overall insulation

1

UL 1387

Outline of Investigation for Flexible Insulated Bus

Issue Number: 1

August 9, 2022

420

Flexible Bus Systems

- An assembly
- Flexible insulated bus
- Associated fittings used to secure, support, and terminate the bus
- Engineered systems for specific site location
- Assembled at the point of installation

UL 1386

Outline of Investigation for Flexible Bus Systems

Issue Number: 1

August 30, 2022

421

Flexible Bus System

422

Flexible Bus System

423

Article 371 Flexible Bus Systems *(cont.)*

Part I General

- 371.1 General
- 371.6 Listing Requirements

424

Article 371 Flexible Bus Systems *(cont.)*

Part II Installation

- 371.10 Uses Permitted
- 371.12 Uses Not Permitted
- 371.14 Installation Design
- 371.17 Overcurrent Protection
- 371.18 Flexible Bus Systems Installation
- 371.20 Terminations
- 371.30 Securing and Supporting
- 371.40 Short Circuit Current Rating
- 371.60 Grounding

425

Article 371 Flexible Bus Systems *(cont.)*

Part III Construction Specifications

- 371.120 Marking
  - (A) System Nameplate
  - (B) Associated Fittings
  - (C) Flexible Insulated Bus

426

Article 371 Flexible Bus Systems *(cont.)*

371.6 Listing Requirements

Flexible bus systems are **required to be listed**

- Must be included in a list published by an organization that is acceptable to the authority having jurisdiction
- UL 1387, Outline of Investigation for Flexible Insulated Bus *(August 9, 2022)*
- UL 1386, Outline of Investigation for Flexible Bus Systems *(August 30, 2022)*

427

Article 371 Flexible Bus Systems *(cont.)*

371.17 Overcurrent Protection

Flexible bus systems are **required to be listed**

- (A) When used for services ***(NEC 230.90)***
- (B) When used as feeders ***(NEC 215.3)***
- (C) When used as a branch circuits ***(NEC 210.20)***
- (D) Protection of flexible bus systems used on transformer secondary ***[NEC 240.21(C)]***
- (E) Flexible bus systems connected to generator terminals ***[NEC 445.12 and 445.13)***
- (F) Flexible bus systems connected to battery terminals ***[NEC 240.21(H)]***
- (G) Addresses when flexible bus systems are reduced in size requiring OCPD

428

Article 398
Open Wiring on Insulators

429

398.15 Exposed Work

(C) Exposed to Physical Damage

Removed high-density polyethylene conduit *(HDPE)* as a permitted means to provide physical protection for open wiring on insulators

- Article 353 is entitled *High Density Polyethylene Conduit (HDPE Conduit)*
- It was discovered that 353.12(1), **Uses Not Permitted,** prohibits its use for exposed installations
- HDPE is also not permitted within a building per 353.12(2)
- Because of its inherent properties to spread fire, a technical report would be needed to support the use of this combustible material in locations of a building

430

Not

Photo shows high density polyethylene conduit *(HDPE)* that was used within a building in violation of 353.12(2)

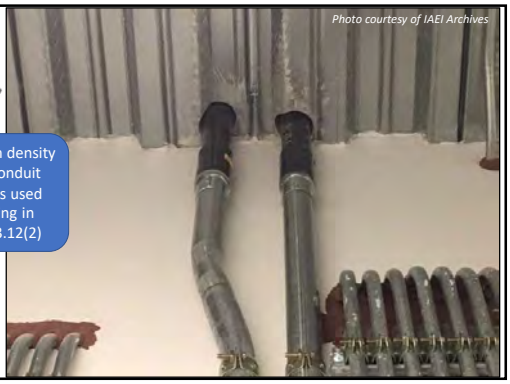


Photo courtesy of IAEI Archives

431

Chapter 4
Equipment for General Use

- Article 404
- Article 406
- Article 408
- Article 409
- Article 410
- Article 422
- Article 424
- Article 425
- Article 426
- Article 427
- Article 430
- Article 440
- Article 450
- Article 470
- Article 495

432

Article 404
Switches

433

404.1 Scope *(Switches)*

New informational note to Section 404.1 addresses wall-mounted control devices

- Battery-powered wireless lighting wall control devices are a new technology, and guidance was needed as to how they should be installed
- Article 404 does not cover equipment such as wireless control switches that do not connect to electrical branch circuit conductors
- Informational note directs the user of the *Code* to Section 210.70, *Lighting Outlets Required*, for additional details

434

404.1 Scope *(Switches)*

New informational note to Section 404.1 addressing wall-mounted control devices

This is a relatively new technology and guidance was needed

This article **does not cover** equipment such as **wireless control switches** that do not connect to electrical branch circuit conductors

Informational note directs the user of the *Code* to **Section 210.70, Lighting Outlets Required,** for additional details

Example of a battery-powered wireless device

Photos courtesy of Apex Lighting

435

404.14(D) Snap Switch Terminations

New language regarding 14 AWG solid coppers conductors used with snap switches resulted in section entitled **Snap Switch Terminations**

- Highlights this limitation for switches provided with push-in terminals
- New text provides for a future allowance for other conductors *(such as 14 AWG copper-clad aluminum)* to be installed using push-in type terminals where the additional evaluation to the applicable UL standards has been completed, and the listing and device markings permit the application
- 14 AWG copper-clad aluminum needs this limitation to ensure push-in terminals on wiring devices are installed according to their listing
- UL standard and associated guide information under category code *WJQR for Snap Switches with Push-In Terminals* permits only 14 AWG solid copper conductors to be used at this time
- This change does not mandate that the push-in terminals must be used *(optional)*

436

404.14(D) Snap Switch Terminations

New requirements for 14 AWG solid coppers conductors used with snap switches

UL standard and associated guide information under category code **WJQR for Snap Switches with Push-In Terminals** permits only **14 AWG solid copper conductors** to be used at this time

Highlights this limitation for switches provided with push-in terminals

Does not mandate that the push-in terminals must be used ***(optional)***

Photos courtesy of Legrand

437

404.16 Reconditioned Equipment

New section was added to address reconditioned electrical equipment

- Addresses control devices that can and can not be reconditioned after being damaged
- This damage might occur to this equipment after being subjected to water, fire, or products of combustion
- Safety, reliability or function of this equipment may be compromised if reconditioning of the items is attempted
- An inspector will have to be keen and alert to determine if the electrical equipment was damaged and if the affected items can be reconditioned

CMP- 9, Dean Fortney NFPA LINK© iaei.org

438

404.16 Reconditioned Equipment

Switches covered in Article 404 **cannot be reconditioned** and must be replaced

Photos courtesy of Pass and Seymour/Legrand

Photo courtesy of IAEI Achieve

CMP- 9, Dean Fortney iaei.org

439

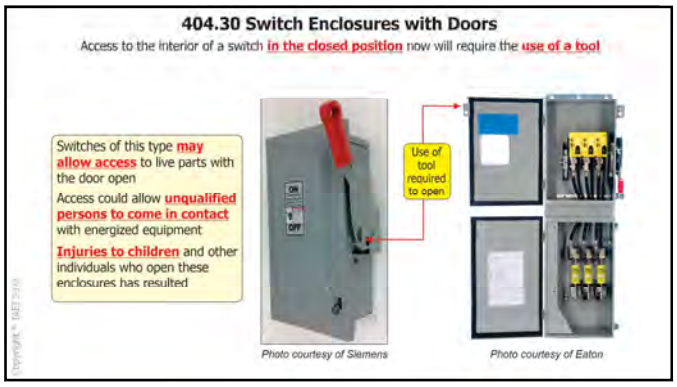
404.30 Switch Enclosures with Doors

Clarifies the requirement for doors with switch mechanisms

- Switches of this type may allow access to live parts with the door open
- Access could allow unqualified persons to come in contact with energized equipment
- Injuries to children and other individuals who open these enclosures hve resulted
- Access to the interior of a switch in the closed position now **will require the use of a tool**
- An **approved design providing equivalent protection** is also allowed
- Approval is issued by the authority having jurisdiction *(AHJ)* per Article 100
- ***Note: An example of a product that might be approved:*** An Eaton brand switch that requires the simultaneous movement of two hands placed in different positions and acting against resistance in order to open *(Fred Hartwell comment)*

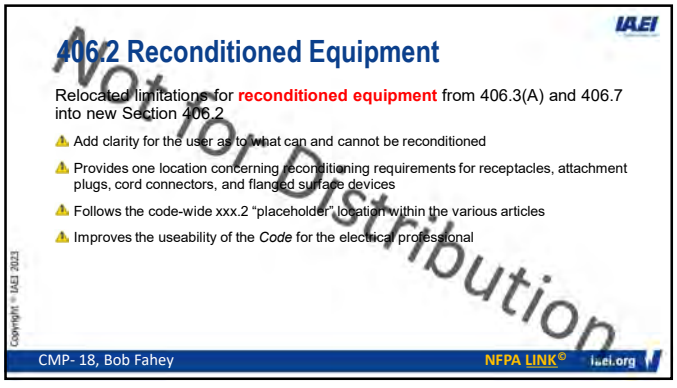
CMP- 9, Rick Hollander NFPA LINK© iaei.org

440



441

442



443

444

406.3(D) Receptacle Terminations

Is intended to emphasize the limitations for receptacles installed on 15-ampere branch circuits

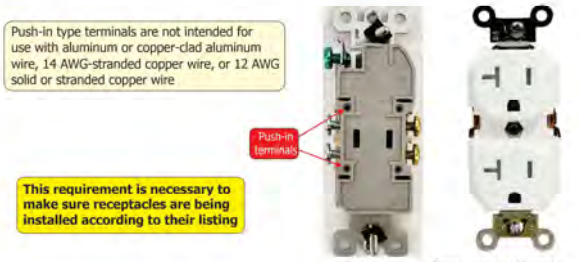
- Task Group was formed with the direction of the NFPA Standards Council to review new requirements covering the use of copper-clad aluminum conductors
- Only **14 AWG copper conductors** used with **"push-in" type terminals** for receptacles are permitted
- Push-in type terminals are **not intended for use with** aluminum or copper-clad aluminum wire, 14 AWG-stranded copper wire, or 12 AWG solid or stranded copper wire
- This requirement is necessary to make sure receptacles are being installed according to their listing

445

406.3(D) Receptacle Terminations

Only 14 AWG copper conductors used with "push-in" type terminals for receptacles are permitted

Push-in type terminals are not intended for use with aluminum or copper-clad aluminum wire, 14 AWG-stranded copper wire, or 12 AWG solid or stranded copper wire



This requirement is necessary to make sure receptacles are being installed according to their listing

Photos courtesy of Leviton

446

406.4(D)(3) Ground-Fault Circuit-Interrupter Protection

Ground-fault circuit-interrupter *(GFCI)* receptacles are now required to be listed

- There was no such requirement in the *NEC* for GFCI devices to be listed
- Assures GFCI devices are listed and manufactured according to the minimum standards set forth in *UL 943, Ground-Fault Circuit-Interrupters*
- Removed the term "outlet," which improves and clarifies the intent of the current *Code* language

447

406.4(D)(3) Ground-Fault Circuit Interrupter Protection

New requirement the ground-fault circuit-interrupter *(GFCI)* receptacles to be listed

Assures GFCI devices are listed and manufactured according to the minimum standards set forth in **UL 943, Ground-Fault Circuit-Interrupters**

Remember..... test monthly

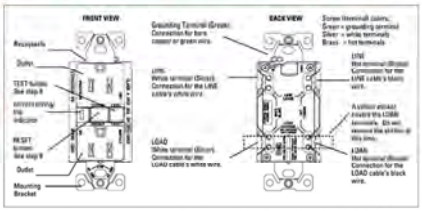


Photo courtesy of Eaton article on Ground Fault Circuit-Interrupter Protection Installation Tips and NEC 2020 Updates

448

406.4(D)(8) Ground-Fault Protection of Equipment

Requires ground-fault protection of equipment *(GFPE)* to be provided for replacement receptacles that require GFPE protection by requirements found elsewhere in the *NEC*

- Needed to provide the ground-fault protection of equipment *(GFPE)* protection when modifications are made in areas such as marinas
- Will protect the people who use this electrical equipment and provide a safer electrical system
- Similar to existing requirements for receptacles being replaced such as tamper-resistant type receptacles, ground-fault circuit-interrupter (GFCI) protected receptacles, AFCI protection, and other similar safety improvements

449

406.4(D)(8) Ground-Fault Protection of Equipment

Requires **ground-fault protection of equipment** *(GFPE)* to be provided **for replacement receptacles** that require GFPE protection by requirements found elsewhere in the *NEC*

(Photo shows **GFPE** and ground-fault circuit-interrupter *(GFCI)* protection at marina)

Photo courtesy of IAEI Achives

450

Photo courtesy of IAEI Archives

451

406.6(D) Receptacle Faceplate with Integral Night Light /USB Charger

Limits the faceplates load to **one watt or less** and specifically requires the screws on the receptacles to be made only of brass or copper alloy

- No substantiation has been received reporting instances where these faceplates have caused any issues
- Spring-tensioned contacts have an excellent safety record based upon over 4 million of these installed in the field
- The screws are to be constructed of brass or copper alloy
- Concerns with steel screws and the uncertainty of their reliability over the long term
- An exception was added to have an effective date of January 1, 2026, allowing spring tension contacts if the receptacle faceplate is specifically listed and identified for connecting to steel screws on receptacles

452

406.6(D) Receptacle Faceplates with Integral Night Light/USB Charger

Limits the faceplate's load to **one watt or less** and specifically requires the **screws on the receptacles** to be made only of **brass or copper alloy**

Photos courtesy of SnapPower

453

406.9(C) Bathtub and Shower Space

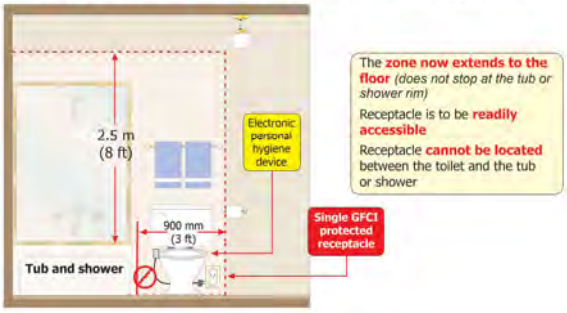
This clarifies receptacle restrictions in and around bathtubs and showers

- The area below the bathtub rim was not included in the previous *Code* language
- Exception No. 4 was added to allow single receptacles within 36 inches of the tub or shower with limitations ***(for dwelling units)***
- Allows toilets with electronic seats or personal hygiene devices for people with physical limitations, which require 120-volt receptacles installed within the 36-inch zone
- Receptacle is required to be a single receptacle and not be located in the space between the bathtub or shower and the toilet or bidet
- The single receptacle in this location would need to be ground-fault circuit-interrupter *(GFCI)* protected

454

406.9(C) Bathtub and Shower Space

A **single, GFCI protected, receptacle** is allowed for electric presonal hygiene devices



The **zone now extends to the floor** *(does not stop at the tub or shower rim)*

Receptacle is to be **readily accessible**

Receptacle **cannot be located** between the toilet and the tub or shower

455

406.9(C) Bathtub and Shower Space

The single receptacle in this location would need to be ground-fault circuit-interrupter *(GFCI)* protected

Photo courtesy of Washlet Plus- Toto

456

406.12 Tamper-Resistant Receptacles

Allows for an easier understanding of where tamper-resistant receptacles are required

- Additional areas and occupancies were added where tamper-resistant receptacles will now be required to help protect children
- Required for public transportation facilities such as bus stations, airports, and other areas such as gymnasiums, skating rinks, and fitness centers
- Required for agricultural buildings **accessible to the general public**, such as pumpkin patches, petting farms, Christmas tree farms, and similar venues
- Text for **clinics, medical, dental offices, and outpatient facilities** was revised to clarify the areas where these receptacles are to be installed

CMP- 18, Bob Fahey

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457

406.12 Tamper-Resistant Receptacles

Additional areas and occupancies were added where tamper-resistant receptacles will now be required to help **protect children**

Required for public transportation facilities
- bus stations
- airports

Required for agricultural buildings *(accessible to the general public)*
- pumpkin patches
- petting farms
- Christmas tree farms
- similar venues

Other areas
- gymnasiums
- skating rinks
- fitness centers

Tamper-resistant (TR) receptacle courtesy of Legrand Pass and Seymour

Clinics, medical, dental offices, and outpatient facilities was revised to clarify the areas where these receptacles are to be installed

458

Article 408
Switchboards, Switchgear, and Panelboards

459

408.4 Descriptions Required

Requirements for circuit directories and descriptions were placed into a list format for clarity

- There was confusion with the previous text as written in paragraph form
- Information in a list format is easier to reference and understand
- Location of where power originates is critical information for inspectors, service persons, and other individuals that may need to locate the supply source
- It is not always readily apparent where the source is located
- Will clarify labeling and description for panelboards and panels for the electrical professional as well as the end user

CMP- 9, Rick Hollander

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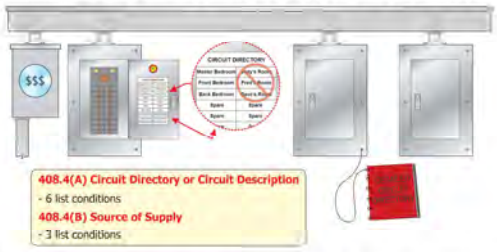
460

408.4 Descriptions Required

Requirements for circuit directories and descriptions were placed into a list format for clarity



408.4(A) Circuit Directory or Circuit Description
- 6 list conditions

408.4(B) Source of Supply
- 3 list conditions

Circuit and circuit modification required to be legibly identified as to its specific purpose or use

Identification should appear in a circuit directory

461

408.9 Replacement Panelboards

Clarifies the replacement requirements for panelboards

- There are now two list items for the replacement of existing panelboards in an enclosure or cabinet
- (A)- If a panelboard is listed for the specific enclosure type, the replacement panelboard shall be allowed to retain it's short-circuit current rating
  - This can be determined by the catalog number or other dimensional information
- (B)- If the replacement panelboard is not listed for the enclosure and the available fault current is greater than 10,000 amperes, the installation is to be field labeled
  - The replacement panelboard is to be identified for the application if the available fault current is 10,000 amperes or less
  - If the cabinet has any previous listing mark pertaining to the previous panelboard, the listing marks are to be removed

462

408.9 Replacement Panelboards

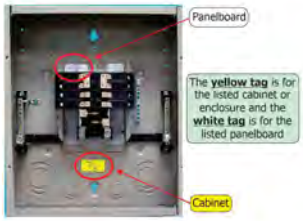
Two new list items clarify the replacement requirements for panelboards

If a panelboard is listed for the specific enclosure type, the replacement panelboard shall be allowed to retain its short-circuit current rating **[408.9(A)]**

If the replacement panelboard is not listed for the enclosure and the available fault current is greater than 10,000 amperes, the installation is to be field labeled **[408.9(B)]**

The panelboard is to be identified for the application if the available fault current is 10,000 amperes or less

If the cabinet has any **previous listing mark** pertaining to the previous panelboard, the listing marks **is to be removed**



463

408.38 Enclosure *(Panelboards)*

The panelboard and enclosure combination shall be evaluated for the application when a panelboard is installed in a cabinet, cutout box, or identified enclosure and has an available fault current greater than 10,000 amperes

- Cabinets are the common enclosure for panelboards, but they are being installed in other types of enclosures
- When an existing panelboard needs to be replaced and the cabinet or other enclosure is installed in a block wall, this can be problematic
- The new requirement for the application to be evaluated where the available fault current is greater than 10,000 amperes will provide guidance and a workable solution for these instances
- An exception exists for equipment without a deadfront and maintained by a qualified person

464

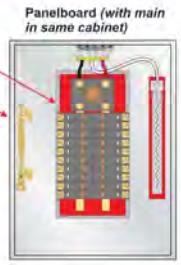
408.38 Enclosure *(Panelboards)*

These shall be evaluated for the application when a panelboard is installed in a cabinet, cutout box, or identified enclosure and having an available fault current greater than 10,000 amperes

Cabinets are the common enclosure for panelboards, but they are being installed in other types of enclosures

When an existing panelboard needs to be replaced and the cabinet or other enclosure is installed in a block wall, this can be problematic

The new requirement for the application to be evaluated where the available fault current is greater than 10,000 amperes will provide guidance and a workable solution for these instances



465

408.43 Panelboard Orientation

Panelboards cannot be installed in the face-down position

- Added due to working space concerns
- Even with acceptable working space, it would be very difficult for a qualified worker to safely work due to the installer lying, kneeling, or standing on a floor surface looking up
- Movement from an arc blast or arc-fault event might only be to the left or right from the equipment
- In some cases, the panelboard overcurrent protective devices would only be accessible utilizing a step ladder
- Some *NEC* articles, such as Article 518, may allow for face-up applications as it has been deemed necessary to comply with the manufacturer's installation requirements

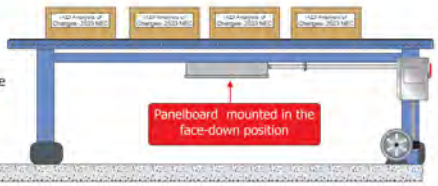
466

408.43 Panelboard Orientation

Panelboards cannot be installed in the face-down position

It would be very difficult for a qualified worker to safely work when lying, kneeling, or standing on a floor surface looking up at the components of the panelboard

Make sure to abide by NFPA 70E requirements



467

408.43 Panelboard Orientation *(cont.)*

Panelboards cannot be installed in the face-down position

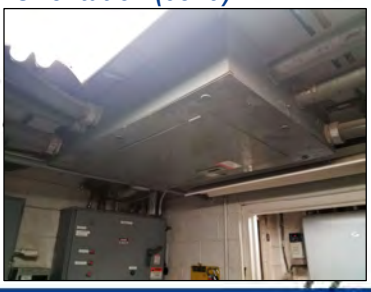


 Photo courtesy of Lowell Reith

468

Article 409
Industrial Control Panels

469

409.60 Bonding

This section for industrial control panels was restructured, creating (A) Grounding and (B) Bonding

- Further clarification was needed to identify that industrial control panels require grounding and multiple sections would be required to be bonded together
- The CMP created (A) and (B) to clarify where grounding and bonding would occur and revised language to comply with the section title
- Further clarification was added to indicate applicable sections for sizing these grounding and bonding conductors
- This addressed any *NEC Style Manual* conflicts that may have existed

470

409.60 Bonding *(Industrial Control Panels)*

Clarification was needed to identify that industrial control panels require grounding and that multiple sections would be required to be bonded together

Inspection of industrial control panels

409.60(A) Grounding Requirements

409.60(B) Bonding Requirements

Photos courtesy of Steve Douglas

471

409.70 Surge Protection

New section has been added requiring surge protection for industrial control panels

- Added these safety features for the protection of the personnel and the equipment
- Added language because not all industrial control panels are made in a factory setting
- Both enforcement and labor are witnessing these types of panels assembled from listed materials in the field
- Provides a needed level of protection for personnel servicing these panels

472

409.70 Surge Protection *(Industrial Control Panel)*

New section has been added requiring **surge protection** for industrial control panel

Added for the protection of personnel and equipment

Example of surge protective device

Photos courtesy of IAEI Archives

473

Article 410
Luminaires, Lampholders, and Lamps

474

410.2 Reconditioned Equipment

Ballasts, LED drivers, and lamps added to the list of items not allowed to be reconditioned

- This information was relocated from 410.7 where it previously prohibited luminaires, lampholders, and retrofit kits from being reconditioned
- Placed into 410.2 as the xxx.2 location is becoming the placeholder location throughout the *NEC* for reconditioned equipment requirements
- Electrical components within luminaries contain specialized materials, parts, and techniques specified by the original equipment manufacturer
- If these items are not properly reconditioned, important safety features may not function properly with safety and reliability being compromised

475

410.2 Reconditioned Equipment

Ballasts, LED drivers, and lamps added to list of **items not allowed** to be reconditioned

Electrical components within luminaries contain specialized materials, parts, and techniques specified by the original equipment manufacturer

Improper reconditioning may result in important safety features not functioning properly leaving safety and reliability compromised

Photos courtesy of IAEI Archives

476

410.10(F) Luminaires Installed in or Under Roof Decking

Requires a minimum of 38 mm (1 ½ in.) to luminaires under any roof system where physical damage can occur to the luminaire

- Roofers installing screws and other fasteners occasionally miss trusses or rafters and could inadvertently damage luminaires
- This previously only applied to metal corrugated style roof systems
- An exception was added where installations of 50 mm (2 in.) of concrete covering metal-corrugated sheet roof decking
- This exception utilizing concrete does not require 38 mm (1½ in.) spacing between the deck and the luminaire

CMP- 18, Bob Fahey NFPA LINK© i-ei.org

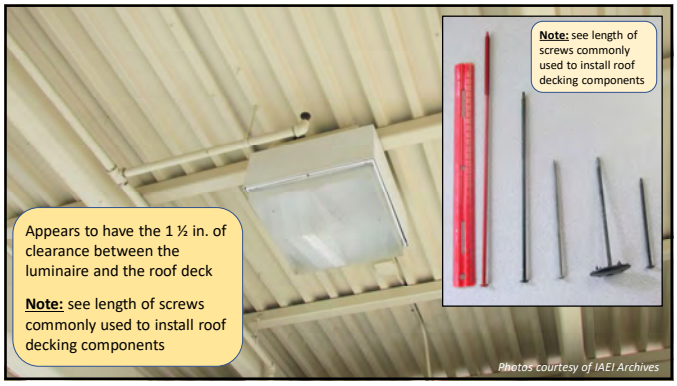
477

Requires a minimum of 1 ½ in. of distance to luminaires under any roof system when physical damage can occur to the luminaire

Note: luminaire appears to be fastened to roof decking

Photo courtesy of IAEI Archives

478



Appears to have the 1 ½ in. of clearance between the luminaire and the roof deck

Note: see length of screws commonly used to install roof decking components

Note: see length of screws commonly used to install roof decking components

Photos courtesy of IAEI Archives

479

410.71 Disconnecting Means for Fluorescent or LED Luminaires

Relocated the requirement for disconnects for luminaires to this location because LED drivers were added to this section

- Originally added to the *Code* in response to an accident involving a double-ended lamp fluorescent ballast replacement
- Many fluorescent lamps are being discontinued and replaced with LED lamps
- Many are being upgraded to incorporate LED lamps to meet energy conservation requirements
- Addresses a hazard that would exist with either style of luminaire
- Only addresses LED-type luminaires that are the equivalent to fluorescent luminaires that utilize double-ended lamps

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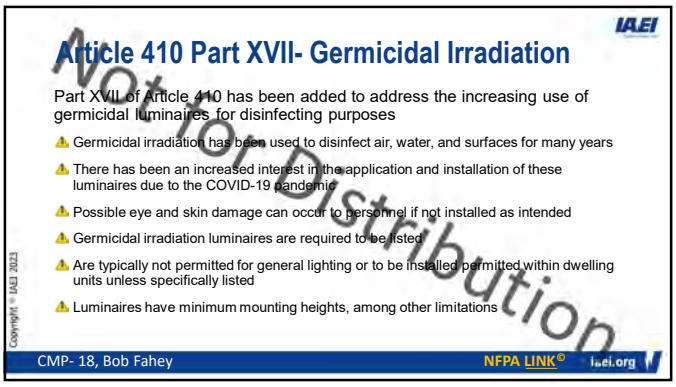
480

481



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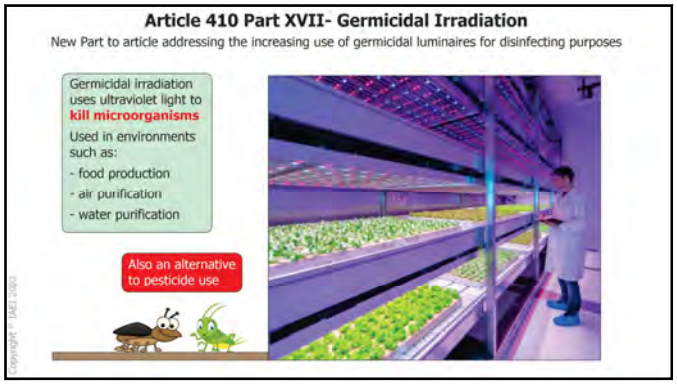

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Article 422
Appliances

489

Article 422 Appliances

Sections 422.3, 422.4, 422.15, 422.23, 422.46, and 422.50 for appliances were deleted from the 2023 edition of the *NEC*

- These sections were identified as redundant or unnecessary
- Section 422.6 already reqdires appliances to be listed
- Many of the removed sections are covered by this listing requirement
- Deletion of this material **does not reduce safety** as the material is covered in product standards or in other general requirements within the *NEC*

490

Article 422 Appliances

These sections were identified as **redundant or unnecessary** and have been deleted

The following sections have been deleted:

422.3 Other Articles
422.4 Live Parts
422.15 Central Vacuum Outlet Assemblies
422.23 Other Installation Methods
422.46 Flatirons
422.50 Cord-and-Plug Connected Pipe Heating Assemblies

Deletion of this material **does not reduce safety** as the material is covered in product standards or in other requirements within the *NEC*

Photo courtesy of IAEI Archives

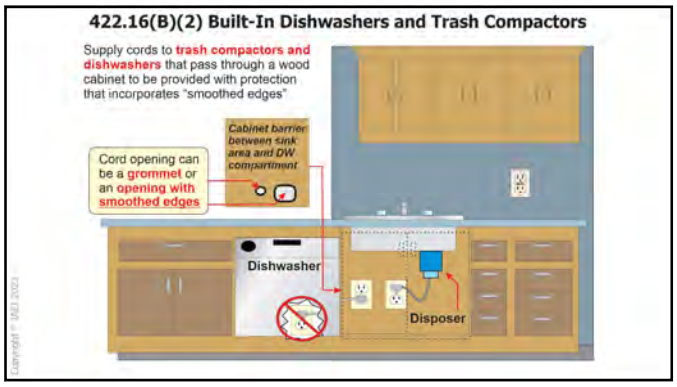
491

422.16(B)(2) Built-in Dishwashers and Trash Compactors

Provisions were added for supply cords to trash compactors and dishwashers that pass through a wood cabinet to be provided with protection that incorporates "smoothed edges"

- In many installations, cords passed through holes in wood cabinet separations
- While grommets and bushings are practical solutions in metal cabinet separations, those fittings were not practical with wood cabinets
- Eliminates the need for a judgment call in the field between the AHJ and the installer when a solution exists *(install protection with "smoothed edges")*

492



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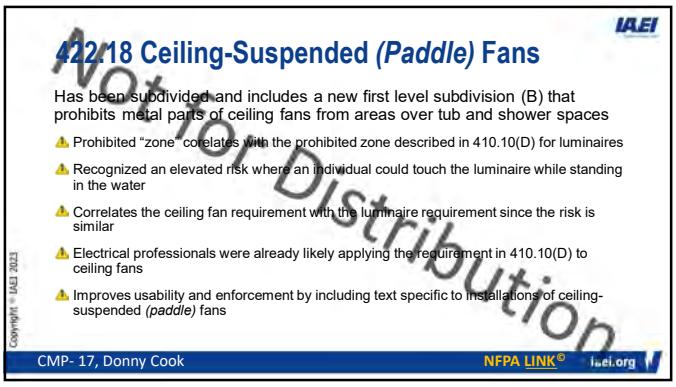

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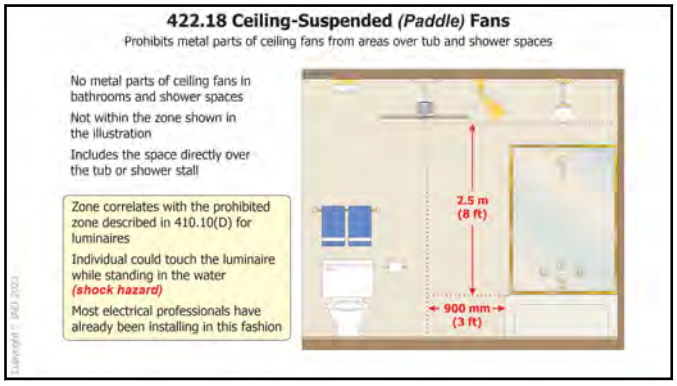


495

496

424.10 Special Permission

Special Permission was deleted, and requirements previously found at 424.9 were relocated to 424.10 for Fixed Electric Space-Heating Equipment

- 2020 *NEC* included a provision in 424.10 to permit the installation of heating equipment by methods other than those included in Article 424 with special permission
- 424.10 is now entitled "General" and is in Part II of Article 424
- This provision was determined to be redundant as 90.4(C) permits the use of special permission
- AHJs can utilize 90.4(C) where an equivalent installation is provided and the option for special permission is needed for approval
- Removes redundancy and adds clarity and usability to the *Code*

497

424.10 General *(Special Permission)*

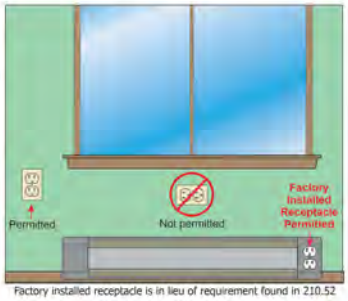
Special permission has been deleted, and requirements found at 424.9 were relocated to 424.10

424.10 is entitled "General" and is in Part II of Article 424

This provision was redundant as 90.4(C) permits the use of special permission

Removed redundant text at this location

The AHJ, can allow special permission for installations involving this equipment



Factory installed receptacle is in lieu of requirement found in 210.52

498

424.48 Installation of Cables in Walls

New section will allow heating cables to be installed in walls with specific protection and limitations

- Concerns existed for heating cable installed in walls, and the need for installation with proper protection was evident
- Provision includes a **January 1, 2026, future effective date**
- This change allows equipment manufacturers, standards developers, and certification agencies an opportunity to develop products and address interoperability issues before the future effective date

499

424.48 Installation of Cables in Walls

Will allow heating cable to be installed **in walls** with specific protection and limitations

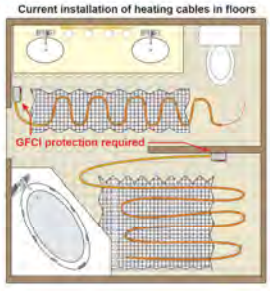
Allows for the installation of heating cables in walls

The need for installation information with proper protection was evident

Includes a **January 1, 2026,** future effective date

Allows the equipment manufacturers, standards developers, and certification agencies opportunities to develop products and address interoperability issues ***before the future effective date***

Current installation of heating cables in floors



500

424.93(C) Installation of Heating Panels in Walls

New first level subdivision was created, allowing heating panels and heating panel sets to be installed in walls with specific protection and limitations

- Concerns existed for heating cable installed in walls, and the need for installation with proper protection was evident
- Provision includes a **January 1, 2026 future effective date**
- This change allows equipment manufacturers, standards developers, and certification agencies an opportunity to develop products and address interoperability issues before the future effective date
- This revision correlates with requirements in 424.48 for heating cables

CMP- 17, Donny Cook NFPA LINK© iaei.org

501

424.93(C) Installation of Heating Panels in Walls

Requirements for **heating cable installed in walls** and the need for proper installation also correlates with requirements in 424.48 for heating cables

Photos courtesy of Dreamstime

Provision has a **future effective date of January 1, 2026** allows equipment manufacturers, standards developers, and certification agencies an opportunity to develop products and address interoperability issues

502

Article 425
Fixed Resistance and Electrode Industrial Process Heating Equipment

503

425.10 Special Permission

Special Permission was deleted, and requirements previously found at 425.8 were relocated to 425.10

- 2020 *NEC* included a provision in 425.10 to permit the installation of industrial process heating equipment by methods other than those included in Article 425 with special permission
- 425.10 is now entitled "General" and is in Part II of Article 424
- This provision was determined to be redundant as 90.4(C) permits the use of special permission
- AHJs can utilize 90.4(C) where an equivalent installation is provided and the option for special permission is needed for approval
- Removes redundancy and adds clarity and usability to the *Code*

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504

425.10 Industrial Process Heating Equipment *(Special Permission)*

Deleted special permission language as it was redundant with 90.4(C) which permits the use of special permission within the *Code* and requirements found at 425.8 were relocated to 425.10

The authority having jurisdiction *(AHJ)* **grants special permission** and it is advisable to get this permission in writing

Photo courtesy of Donny Cook and IAEI Archives

505

Article 426
Fixed Outdoor Electric Deicing and Snow-Melting Equipment

506

426.14 Special Permission

Section 426.14 pertaining to special permission for Fixed Outdoor Electric Deicing and Snow-Melting Equipment was deleted

- 2020 *NEC* included a provision in 426.14 to permit the installation of fixed outdoor electric deicing and snow melting equipment by methods other than those included in Article 426 with special permission
- This provision was determined to be redundant as 90.4(C) permits the use of special permission
- AHJs can utilize 90.4(C) where an equivalent installation is provided and the option for special permission is needed for approval
- Removes redundancy and adds clarity and usability to the *Code*

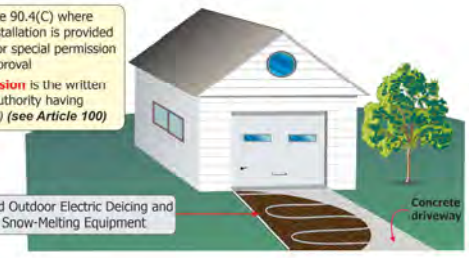
507

426.14 Special Permission *(Fixed Outdoor Electric Deicing/Snow-Melting Equipment)*

Special permission for Fixed Outdoor Electric Deicing and Snow-Melting Equipment has been deleted

An AHJ can utilize 90.4(C) where an equivalent installation is provided and the option for special permission is needed for approval

Special permission is the written consent of the authority having jurisdiction *(AHJ)* ***(see Article 100)***



508

426.28 Ground-Fault Protection

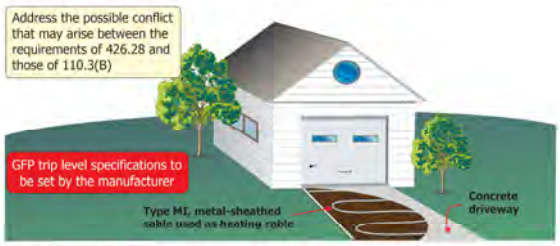
Recognizes that manufacturers of **fixed outdoor electric deicing and snow melting equipment** have an option to require ground-fault protection with reduced current and time threshold values providing a higher degree of protection than previously required

- Helps address the possible conflict that may arise between the requirements of 426.28 and the requirements of 110.3(B)
- This conflict may arise when a higher degree of protection is included in the manufacturer instructions of the fixed outdoor electric deicing and snow melting equipment than that required by 426.28
- This emphasizes the importance of following the manufacturers' installation instructions provided with the equipment, especially when they exceed what the *NEC* requires
- Designers, installers, and AHJs must review installation instructions prior to installation to ensure compliance

509

426.28 Ground-Fault Protection

Fixed Outdoor Electric Deicing and Snow Melting Equipment



Manufacturers of **fixed outdoor electric deicing and snow melting equipment** have an option to require ground-fault protection with reduced current and time threshold values providing a higher degree of protection than previously required

510

Article 427
Fixed Electric Heating Equipment for Pipelines and Vessels

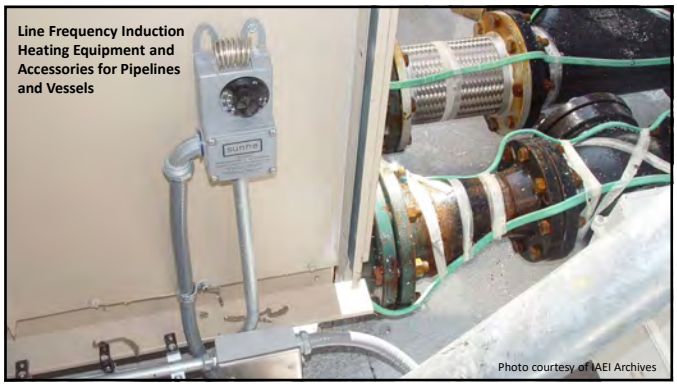
511

427.35 Scope

This section, which covered the installation of **line frequency induction heating equipment** and accessories for pipelines and vessels, has been deleted

- This section was determined to be redundant as 427.1 already covers the scope of the article
- This specialized heating equipment will continue to be covered in this article
- The removal of the scope requirements at 427.35 will increase usability and reduce confusion for the electrical professional

512



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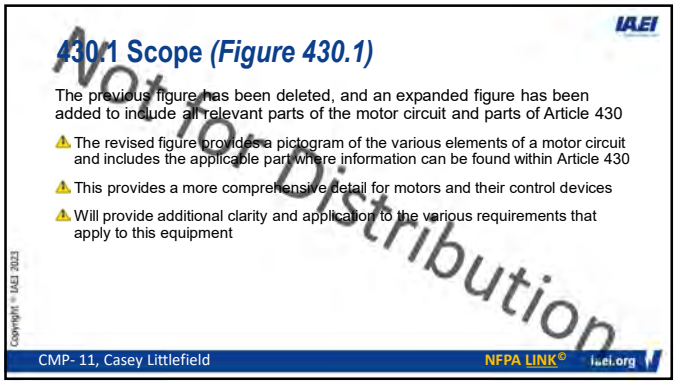

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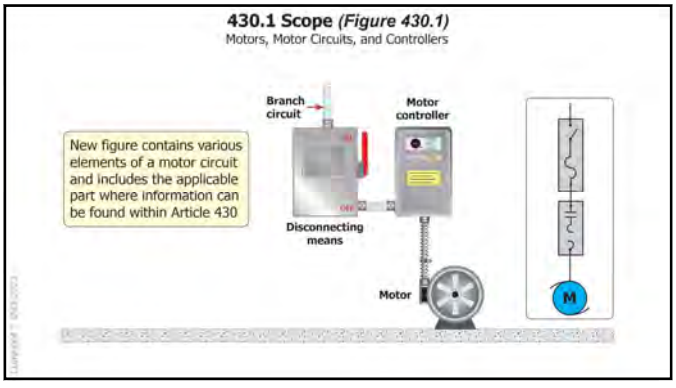


516

430.2 Reconditioned Motors

New guidance along with a new informational note has been added towards the reconditioning of electric motors

- Reconditioning of motors has been successfully occurring for many years
- This procedure has ensured that facilities are able to operate without experiencing downtimes
- Nameplate information supplied on a motor is critical to the process of reconditioning and should never be removed unless the original ratings or characteristics of the motor are altered
- Motors used in hazardous *(classified)* locations can be reconditioned and should be listed as reconditioned when installed in a Class I, Division 1 *(or Zone 0 or 1)* location(s)
- ***ANSI/EASA AR100-2020, Recommended Practice for the Repair of Rotating Electrical Apparatus,*** contains valuable information about the rewinding and repair of electrical motors

517

430.2 Reconditioned Motors

New guidance along with a new informational note has been added towards the reconditioning of electric motors

Reconditioning of motors have been successfully occurring for many years

This procedure has assured that facilities are able to operate without experiencing downtimes

See ANSI/EASA AR100-2020, Recommended Practice for the Repair of Rotating Electrical Apparatus

Photo courtesy of IAEI Archives

Photo courtesy of Rob Bowman, Denver Wastewater

518

Article 440
Air-Conditioning and Refrigerating Equipment

519

440.8 Single Machine and Location

New language has been added indicating that **air-conditioning and refrigeration equipment such as** mini-split unit heating and cooling systems are not to be installed in a tub or shower zone

- This equipment is being installed in bathtub and shower spaces due to a lack of wall space
- Occurring in older homes with smaller bathrooms
- Creates a clear danger to the occupants
- Now **prohibits the installation** of these units in the zone around bathtub and shower spaces
- The dimensions of the zone are consistent with *Code* requirements for other electrical equipment or devices *(3 feet horizontally and 8 feet vertically from the top of a bathtub rim or shower stall threshold)*

520

440.8 Single Machine and Location

Mini-split heating and cooling systems are **not to be installed** in a tub or shower zone

If you don't have room for this item to be installed, the *NEC* does not allow it and the inspector will not accept it

521

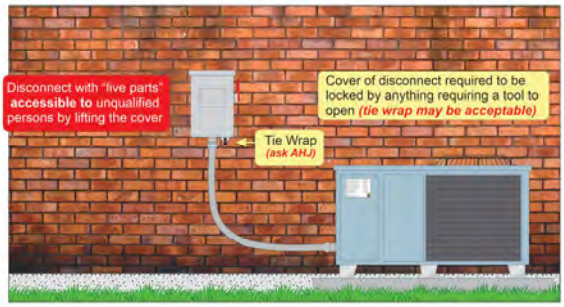
440.11 General

Added additional language requiring disconnects with covers exposing live parts to **require a tool to open or be capable of being locked** *(if readily accessible to unqualified persons)*

- Requires air-conditioning and refrigerating equipment disconnects that have hinged covers, and, when open, have exposed live parts, be locked to prevent children and unqualified people from accidental contact
- CMP generally agreed that knife blade type disconnects pose the biggest hazard even if properly maintained
- CMP also made it clear that a lock would be anything that required a tool to open
- "Zip-ties" would require the use of a tool to remove the cover
- This practice *(zip-ties) is* already used by many electrical and mechanical contractors
- Talk to the local AHJ and make sure he/she is on board with the use of zip ties for this purpose

522

440.11 General *(Air-Conditioning and Refrigerating Equipment)*



523

440.14 Location

Adds a reference to 110.26(A), which makes it clear that working space clearances are required for air-conditioning and refrigerating equipment

- HVAC contractors install their equipment per the manufacturer's specifications
- Some are not aware of the minimum required clearances in 110.26 for disconnects that require servicing
- Adds clarity for the inspector and installer that minimum clearances must be maintained at air-conditioning and refrigerating disconnects

524

525

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528

445.18(A) Disconnecting Means

New guidance has been added permitting the disconnecting means to be located **within the generator** behind a hinged cover, door, or enclosure panel

- When the generator disconnecting means is located in the generator enclosure, **a field-applied label to be provided** indicating the location of the disconnecting means
- Field labeling requirements provide clarity for the purpose of the disconnecting means **to aid first responders**
- Field-applied labels are to meet requirements found at 110.21(B) *(Field-Applied Hazard Markings)*

529

445.18(A) Disconnecting Means

New guidance has been added permitting the disconnecting means to be located within the generator behind a hinged cover, door, or enclosure panel

When the **generator disconnecting means** is located in the generator enclosure, a **field-applied label** to be provided indicating the location of the disconnecting means

Field-applied labels are to meet requirements found at 110.21(B) *(Field-Applied Hazard Markings)*

Note: Generator disconnecting means located inside generator enclosure

530

445.19 Emergency Shutdown of Prime Mover

A new Section 445.19 will separate the generator emergency shutdown requirements from the generator disconnect requirements

- Generators with **greater than 15 kW rating** located at other than one- and two-family dwelling units are to be equipped with a remote emergency stop switch that will shut down the prime mover
- Switch is to be located outside the equipment room or generator enclosure at a readily accessible location and meet the requirements found at 445.19(A)(1) and (A)(2)
- New language at (C) clarifies that the emergency shutdown device located at one- and two-family dwelling units installed on the exterior of the generator enclosure meets the requirements of this section
- This emergency shutdown device is to be marked as the **"Generator Emergency Shutdown"** and meet the requirements of 110.21(B) *(Field-Applied Hazard Markings)*

531

445.19 Emergency Shutdown of Prime Mover

Separates the generator **emergency shutdown requirements** from the generator **disconnect requirements**

Switch is to be located outside equipment room or generator enclosure at a readily accessible location and meet requirements at 445.19(A)(1) and (A)(2)

The emergency shutdown device located at one- and two-family dwelling units installed on the exterior of the generator enclosure meets the requirements of this section ***[445.19(C)]***

At **other than one- and two-family dwelling units**, generators with greater than 15 kW rating are to be equipped with a remote emergency stop switch that will shut down the prime move

This emergency shutdown device is to be marked as the **"Generator Emergency Shutdown"** and meet the requirements of 110.21(B) *(Field-Applied Hazard Markings)*

532

Article 450
Transformers and Transformer Vaults *(Including Secondary Ties)*

533

450.2 Interconnection of Transformers

New guidance has been added for transformer interconnection and operation requirements within Article 450

- Much of this addressed *NEC Style Manual* concerns and corrected some issues that occurred in the 1987 *NEC* code cycle
- This addresses how the provisions in Article 450 are to be applied to transformers either individually or interconnected as a single unit
  - An individual transformer is to comply with the requirements of Article 450
  - Other articles or requirements might be applicable under specific provisions where transformers can be interconnected to operate as a single unit

534

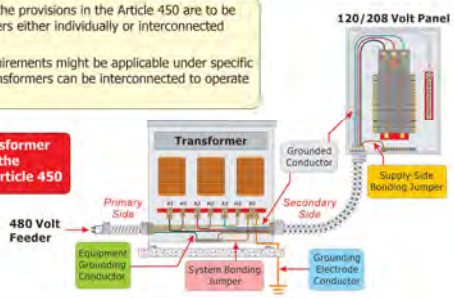
450.2 Interconnection of Transformers

New guidance for transformer interconnection and operation requirements within Article 450

This addresses how the provisions in the Article 450 are to be applied to transformers either individually or interconnected as a single unit

Other articles or requirements might be applicable under specific provisions where transformers can be interconnected to operate as a single unit

An individual transformer is to comply with the requirements of Article 450



535

Article 470
Resistors and Reactors

536

470.2 Reconditioned Equipment

Is now the placeholder for reconditioned equipment and indicating that reconditioning of a resistor is not permitted and that reactors follow manufacturers' guidelines

- *NEC* did not provide clear directions for the reconditioning of both resistors and reactors
- Resistor manufacturers have made it clear that resistors are not to be reconditioned
- Reactor manufacturers provide guidelines in their installation instructions and also provide standards for their reconditioning
- Should now be clear to all electrical professionals regarding the reconditioning allowances for resistors and reactors

CMP- 11, Casey Littlefield

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537

470.2 Reconditioned Equipment

The placeholder in Article 470 for reconditioned equipment permissions for resistors and reactors

Resistor manufacturers state that resistors are **not to be reconditioned**

Reactor manufacturers provide guidelines in their installation instructions and provide standards for their reconditioning

Previously the *NEC* had no clear requirements

Example of a Reactor

Example of Various Resistors

Photo courtesy of Casey Littlefield

538

Article 495

Equipment Over 1000 Volts ac, 1500 Volts dc, Nominal

539

Article 495 Equipment Over 1000 Volts AC, 1500 Volts DC, Nominal

All the requirements previously found in Article 490 *(Equipment Over 1000 Volts, Nominal)* have been **moved to Article 495**

- This action will provide an article that, in future additions, will contain all installation requirements pertaining to equipment over 1000 volts AC and 1500 volts DC
- The creation of a "starting point" for other code-making panels to consider relocating their requirements that pertain to equipment of this nature
- This new article will result in easier use of the *Code* when searching for requirements on this topic

CMP- 9, Dean Fortney

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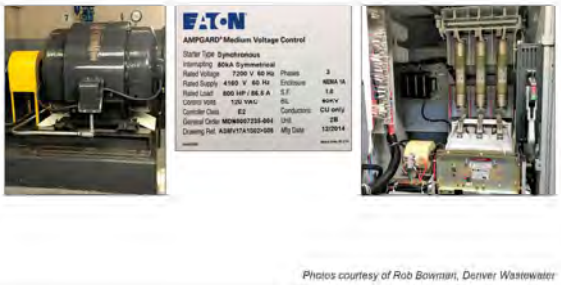
540

Article 495- Equipment Over 1000 Volts AC, 1500 Volts DC- Nominal

Equipment over 1000 Volts AC installed in water treatment facility



Photos courtesy of Rob Bowman, Denver Wastewater

541

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- We are known throughout the electrical trade as "The Electrical Safety Leaders" for a reason
- Thousands of past IAEI members are depending on you to carry on their legacy and move forward the daunting task of ensuring electrical safety
- The IAEI is the **electrical line of defense** keeping families electrically safe
- You, **the electrical professional**, make a difference in the electrical safety of the world
- If you are not a member of the IAEI, please consider joining us in our endeavor of **"Keeping You and Your Families Electrically Safe"**

From the IAEI Board of Directors

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IAEI's Analysis of Changes- 2023 *NEC*

Your essential guide to the most important changes in the 2023 National Electrical Code

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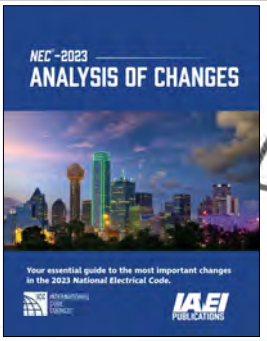

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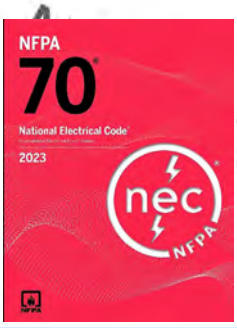

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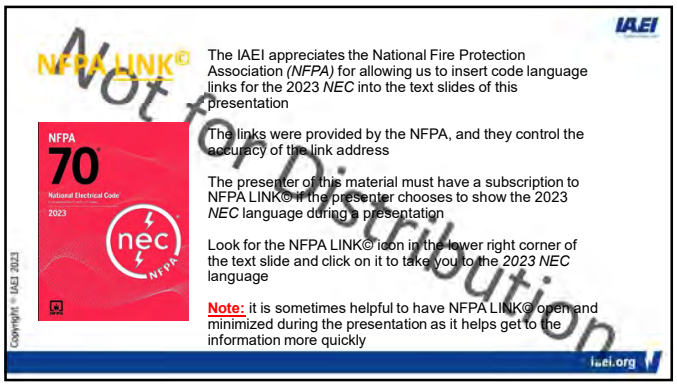
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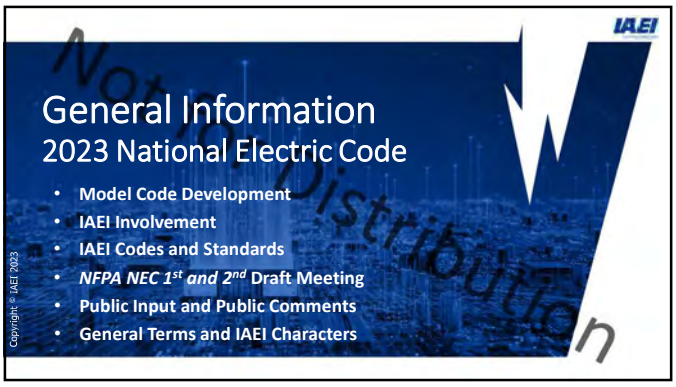
General Information
2023 National Electric Code
Model Code Development
IAEI Involvement
IAEI Codes and Standards
NFPA NEC 1st and 2nd Draft Meeting
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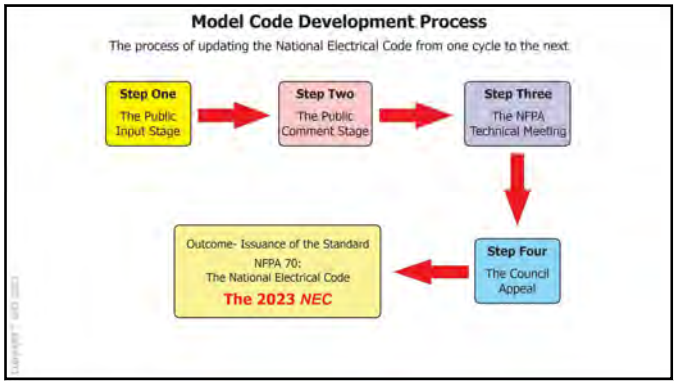
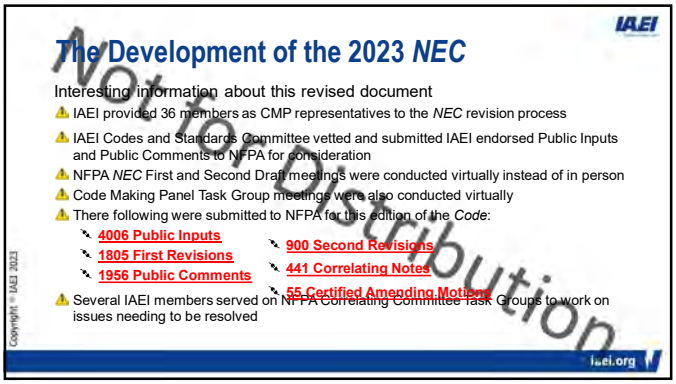

Model Code Development Process
The process of updating the National Electrical Code from one cycle to the next
Step One
The Public Input Stage
Step Two
The Public Comment Stage
Step Three
The NFPA Technical Meeting
Step Four
The Council Appeal
Outcome- Issuance of the Standard
NFPA 70:
The National Electrical Code
The 2023 NEC

7


The Development of the 2023 NEC
Interesting information about this revised document
IAEI provided 36 members as CMP representatives to the NEC revision process
IAEI Codes and Standards Committee vetted and submitted IAEI endorsed Public Inputs and Public Comments to NFPA for consideration
NFPA NEC First and Second Draft meetings were conducted virtually instead of in person
Code Making Panel Task Group meetings were also conducted virtually
There following were submitted to NFPA for this edition of the Code:
4006 Public Inputs
1805 First Revisions
1956 Public Comments
900 Second Revisions
441 Correlating Notes
55 Certified Amending Motions
Several IAEI members served on NFPA Correlating Committee Task Groups to work on issues needing to be resolved
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8

IAEI Code Making Panel Representatives

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- Paul Sood
- Greg Chontow

CMP-2
- **David Humphrey***
- Joseph Wages, Jr.

CMP-3
- Timothy Mikloiche
- Rhonda Parkhurst

CMP-4
- **Jim Rogers***
- Pete Jackson

CMP-5
- William Pancake
- Richard O'Brien

CMP-6
- **Susan Scearce***
- Borgia Noel

CMP-7
- **L. Keith Lofland***
- Dean Hunter

CMP-8
- **Tom Moore***
- Scott Higgins

CMP-9
- Rick Hollander
- Dean Fortney

CMP-10
- David Williams
- Doug Smith

CMP-11
- Charles Littlefield
- Jack Jamison, Jr.

CMP-12
- Phil Clark
- Thomas Couch

** Denotes Chair Position of CMP*

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- Steve Froemming
- Larry Wildermuth

CMP-14
- Haywood C Kines
- Mark Chrysler

CMP-15
- Mark Hilbert
- Bret Stoddard

CMP-16
- Jeff Fitzloff
- Gerald O'Connor

CMP-17
- Donny Cook
- Chris Faucette

CMP-18
- **Robert Fahey***
- James Hathorn

NEC Correlating Committee
- David Williams
- Donny Cook

** Denotes Chair Position of CMP*

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  - Donny Cook
  - Thomas Domitrovich
  - Pete Jackson
  - Tim McClintock
  - Jim Rogers
  - Mike Savage
  - Joseph Wages, Jr.
  - David Williams

11

IAEI Subject Matter Experts

A special thank you to electrical industry experts who provided input or conducted reviews of this material

- Paul Dobrowsky
- Fred Hartwell
- Mark Hilbert
- Christel Hunter
- Chad Kennedy
- Chuck Mello
- Thomas Lichtenstein
- Bryan Holland
- Don Iverson
- Peter Graser
- Tim McClintock
- Dean Hunter
- David Williams
- Thomas Domitrovich
- David Humphrey
- Cliff Norton
- Chris Faucette
- Donny Cook
- Jim Rogers
- Pete Jackson
- Rob Bowman
- Scott Humphrey
- Steve Thomas

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Terms Used During the Presentation

AHJ- Authority Having Jurisdiction
CMP- Code Making Panel
CPSC- Consumer Products Safety Commission
IAEI- International Association of Electrical Inspectors
ICSC- IAEI Codes and Standards Committee
NEC- National Electrical Code
NECA- National Electrical Contractors Association
NEMA- National Equipment Manufacturers Association
NFPA- National Fire Protection Association
UL- Underwriters Laboratories

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IAEI Industry Partnerships

THANK YOU for your continued partnership with the IAEI in the promotion of electrical safety

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Chapter 5
Equipment for General Use

- Chapter 500
- Chapter 505
- Chapter 515
- Chapter 517
- Chapter 530
- Chapter 547
- Chapter 550
- Chapter 551
- Chapter 555
- Chapter 590

15

Article 500
Hazardous *(Classified)* Locations
Classes I, II, and III, Divisions 1 and 2

16

500.4 Documentation

Added additional language to assist the authority having jurisdiction *(AHJ)* for requirements on documentation for hazardous *(classified)* locations

- Revised to require that the documentation provided includes an **area classification drawing**
- Will **create a consistent method** of documenting hazardous *(classified)* locations
- Documentation will clearly indicate the boundaries between the classified areas and unclassified areas
- New language will assist the electrical plans examiner, inspector, and installer verify the installation meets *NEC* requirements for all hazardous *(classified)* locations

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500.5 Classification of Locations

(D) Class III Locations

(1) Class III, Division 1

(a) Combustible Fibers/Flyings

Previous language has been completely reworded to align with the new definition for combustible fibers/flyings and the edits for combustible dust

- Change involving Class III locations resulted from members of several technical committees as part of a Task Group
- Members from *NFPA 70, NFPA 499, NFPA 652, and NFPA 654* worked to develop new definitions that would provide consistency in all the documents
- Necessary for correlation with changes to *NEC Articles 502, 503, and 506* and with other *NFPA* dust-related standards
- Will help the industry determine the type of hazardous *(classified)* locations that exist

19

500.5(D)(1)(a) Combustible Fibers/Flyings

For information on Class III, Division 1 locations see 500.5(D)(1)(a) and (D)(1)(b)

500.5(D)(1)(a) for **combustible fibers/flyings**

500.5(D)(1)(b) for **ignitable fibers/flyings**

NFPA 499-Recommended Practice for the Classification of Combustible Dusts and of Hazardous *(Classified)* Locations for Electrical Installations in Chemical Process Areas

NFPA 652- Standard on the Fundamentals of Combustible Dust

NFPA 654- Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids

Photo courtesy of IAEI Achives

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500.8 Equipment

(D) Temperature

(2) Class II Temperature / (3) Class III Temperature

Previous language for Class II and Class III temperature has been edited and revised to align with the new definition for combustible fibers/flyings

- *NFPA Standards Committee* directed committees to resolve conflicts among the documents
- Revisions are based on the revised definitions for combustible fibers/flyings and ignitible fibers/flyings
- Now includes requirements concerning metal fibers/flyings in 500.8(D)(2)
- Was necessary for correlation with changes to Articles 502, 503, and 506, and other *NFPA* dust-related standards
- Will help the industry to determine the type of equipment permitted in these locations

21

500.8(D)(2) and (3) Class II and III Temperature

Language for Class II and Class III temperature has been edited and revised to align with the new definition for combustible fibers/flyings

This was necessary for correlation with changes to Articles 502, 503, and 506 as well as other NFPA dust-related standards

Definition factors:

- 500 µm in nominal size
- can form an explosible mixture
- needs suspended in air
- can occur at standard atmospheric pressure and temperature

Examples of various equipment suitable for these locations

22

23

505.9 Equipment

(C) Equipment Suitable for Hazardous (Classified) Locations

The text was deleted at 505.9(C)(2)(4) referencing Table 505.9(C)(2)(4) with new text added to reference the new Chapter 9 Table 13

- The requirements at 505.9(C)(2)(4) discuss zone equipment marking requirements
- The new Table 13 in Chapter 9 provides a complete list of the types of protection for hazardous *(classified)* locations
- The table also improves the readability of 505.9(C)(2)(4)
- This new table was determined by the CMP to be a vast improvement over the previous Table 505.9(C)(2)(4)
- This table will assist the designer, contractors, and the AHJ in verifying compliance with the Code and the manufacturer's listing of the equipment installed in a hazardous *(classified)* location

24

505.9(C) Equipment Suitable for Hazardous *(Classified)* Locations Chapter 9 Table 13

Created a new Table 13 in Chapter 9 entitled Equipment Suitable for Hazardous *(Classified)* Locations

The requirements at **505.9(C)(2)(4)** discussing zone equipment marking requirements were deleted

Table 13 in Chapter 9 provides a complete list of the types of protection for hazardous *(classified)* locations and improves the readability of 505.9(C)(2)(4) *[Zone Equipment- Protection]*

Table 13 will assist the electrical industry by providing an improved list of equipment suitable for various locations

Table 13 Equipment Suitable for Hazardous *(Classified)* Locations *(Example of Table Contents)*

	Area Classification	Type (Level) of Protection
Class I, Division 1	Pressurized Enclosures	Type X, for Class I
	Encapsulation *(Group II)*	ma
	Optical system with interlock	op sh, with EPL Ga
	Special protection *(Group II)*	sa

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Article 512
Cannabis Oil Equipment

26

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Article 512 Cannabis Oil Equipment

Created a new article, which covers cannabis oil extraction equipment, booths, postprocessing equipment, and systems using flammable materials in commercial and industrial facilities

- The authorities having jurisdiction *(AHJ)* and other industry members have expressed concerns about safety
- Several fire and explosion hazards are associated with equipment used to process and extract plant oils from cannabis
- Flammable solvents such as butane, pentane, hexane, propane, and ethanol can be released during the processing and extraction of plant oils
- This includes high temperatures and high pressures, which increase the risk of fire and explosion
- This information is intended to address the hazards associated with the extraction of cannabis oil

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Article 512 Cannabis Oil Equipment

Part I General

512.1 Scope

512.2 Other Articles

512.3 Classified Locations

Part II Wiring

512.10 Wiring Installation and Operation

512.13 Wiring Installed Above Hazardous (Classified) Locations

Part III Equipment

512.20 Equipment and Systems

512.22 Equipment Installed in Hazardous *(Classified)* Locations

512.32 Marking

28


Photo courtesy of Steve Thomas

29


Article 515
Bulk Storage Plants
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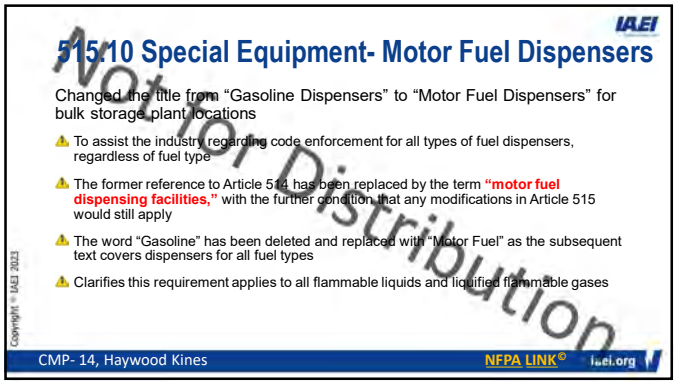
30


515.10 Special Equipment- Motor Fuel Dispensers
Changed the title from "Gasoline Dispensers" to "Motor Fuel Dispensers" for bulk storage plant locations
To assist the industry regarding code enforcement for all types of fuel dispensers, regardless of fuel type
The former reference to Article 514 has been replaced by the term "motor fuel dispensing facilities," with the further condition that any modifications in Article 515 would still apply
The word "Gasoline" has been deleted and replaced with "Motor Fuel" as the subsequent text covers dispensers for all fuel types
Clarifies this requirement applies to all flammable liquids and liquified flammable gases
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Article 517
Health Care Facilities

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Article 517 Health Care Facilities

This edition of the *NEC* has completed the phased approach of changing the references from critical, general, basic, and support spaces to Category 1, 2, 3, and 4 Spaces

- Starting with the 2014 *NEC*, the migration from the previous terms started
- For the 2017 *NEC*, the Category terms as parenthetical references were included, and then the order of parenthetical references was reversed in the 2020 *NEC*
- This "phased approach" of aligning with NFPA 99 *(Health Care Facilities Code)* was completed this cycle, and the parenthetical references were deleted, leaving only the Category space references
- This will allow for harmony between the two documents with fewer conflicts between designers and installers/inspectors
- Consistent use of the terminology related to patient care and support spaces will bring better useability to the *Code*

34

Article 517 Health Care Facilities

Category 1 Space:
- Special care units patient rooms used for critical care
- Intensive care
- Special care treatment rooms
  - Angiography laboratories
  - Cardiac catheterization labs
  - Delivery rooms
  - Operating rooms
  - Post-anesthesia care units
  - Trauma rooms

Category 2 Space:
- Inpatient bedrooms
- Dialysis rooms
- In vitro fertilization rooms
- Procedural rooms
- Similar rooms

Category 3 Space:
- Examination or treatment rooms in clinics
- Medical and dental offices
- Nursing homes
- Limited care facilities

Category 4 Space:
- Anesthesia work rooms
- Sterile supply
- Laboratories
- Morgues
- Waiting rooms
- Utility rooms
- Lounges

35

517.6 Patient Care-Related Electrical Equipment

Reconditioning requirements found elsewhere in the *Code* do not apply to patient care-related electrical equipment

- This electrical equipment is different from the other electrical equipment
- It will be reconditioned or recertified in accordance with U.S. Federal Food, Drug, and Cosmetic Act *(FDCA)* when relocated
- Marking and labeling requirements found at 110.21(A)(2) and other restrictions on the use of reconditioned equipment will not apply to electrical equipment used in these locations

36

517.6 Patient Care-Related Electrical Equipment

Reconditioning requirements for electrical equipment located in health care facilities

Reconditioning requirements found elsewhere in the *NEC* do not apply to patient care-related electrical equipment within a health care facility

Note: For the 2023 *NEC* the xxx.2 sections will become placeholders in the various article that contain requirements for reconditioning of electrical equipment

37

517.13 Equipment Grounding Conductor

Equipment Grounding Conductor for Receptacles and Fixed Electrical Equipment in Patient Care Spaces

- Revised for clarity by relocating former Exception No. 2 to follow the opening paragraph and by stating **wiring "serving" patient care spaces**
- It will be clear the wiring methods must comply with 517.13(A) and (B) unless the conditions of the exception are met
- As previously worded, the requirements literally only applied to the part of the branch circuit that was "in" the patient care vicinity
- For the safety of staff and patients, it must be clear the equipment grounding requirements of 517.13(A) and (B) are enforced for the entire circuit

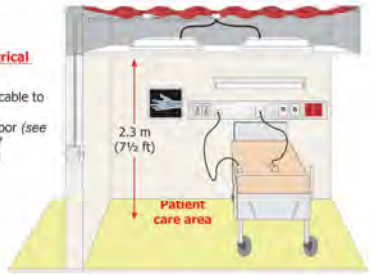
38

517.13 Equipment Grounding Conductor

Wiring that serves a patient care area to comply with 517.13(A) and 517.13(B) unless the conditions o the exception are met

Note from the Electrical Inspector:

The exception is applicable to luminaires more than 2.3 m (7½ ft) above floor *(see additional language of exception in the NEC)*



39

517.22 Demand Factors

The use of demand factors for Health Care Facilities is acceptable and permitted for general-purpose receptacle loads in Category 1, 2, 3, and 4 patient care spaces

- Without the ability to apply demand factors to the receptacle load calculations required by Article 220, unnecessarily large feeders to branch circuit panelboards supplying patient care areas resulted
- The task group's work resulted in Table 220.110(1)
  - Demand Factors for Receptacles Supplied by General-Purpose Branch Circuits in **Category 1 and Category 2** Patient Care Spaces
- The Task Group also created Table 220.110(2)
  - Demand Factors for Receptacles Supplied by General-Purpose Branch Circuits in **Category 3 and Category 4** Patient Care Spaces
- Both of these tables apply to branch circuits not exceeding 150 volts to ground

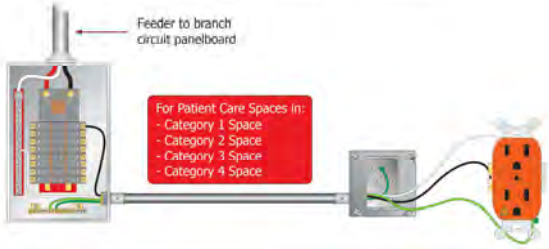
40

517.22 Demand Factors *(Health Care Facilities)*

2 New Tables

Table 220.110(1) - Demand Factors for Receptacles Supplied by General-Purpose Branch Circuits in Category 1 and Category 2 Patient Care Spaces

Table 220.110(2) - Demand Factors for Receptacles Supplied by General-Purpose Branch Circuits in Category 3 and Category 4 Patient Care Spaces



41

517.30 Sources of Power

This change will result in consistent use of terminology, clarify the types of sources of power, and also recognize energy storage systems and health care microgrids

- Under the direction of the *NEC* Correlating Committee, a task group harmonized the terminology across the *NEC*
  - ***(Example- "alternate power sources" and "power sources")***
- Revisions were also made to clarify that the essential electrical system *(ESS)* must have two independent sources
  - One on-site and one off-site
- Two new list items, 517.30(B)(4) and (5), were added to recognize:
  - Energy Storage Systems
  - Health Care Microgrids

42

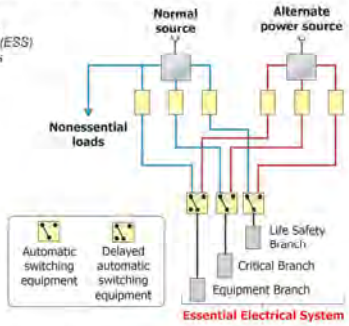
517.30 Sources of Power *(Health Care Facilities)*

Revisions were also made to clarify that the Essential Electrical System *(ESS)* must have two independent sources

- one on-site
- one off-site

Two new list items added at 517.30(B)(4) and (5) for:

- Energy Storage Systems
- Health Care Microgrids



43

517 Part V- Diagnostic Imaging and Treatment

The title and other applicable text have been changed from "X-Ray Installations" to "Diagnostic Imaging and Treatment Equipment"

- The previous language did not adequately distinguish between x-ray equipment and other modalities for diagnostic imaging
- Non X-ray diagnostic equipment is becoming the industry norm
- The *NEC* needed to better define these items
- These changes will make the *NEC* more user friendly for the electrical professional

44

Article 517 Part V- Diagnostic Imaging and Treatment Equipment

Prior to the 2023 *NEC* this was titled "X-Ray Installations" and did not adequately distinguish between x-ray equipment and other modalities for diagnostic imagining

45

Article 518
Assembly Occupancies

46

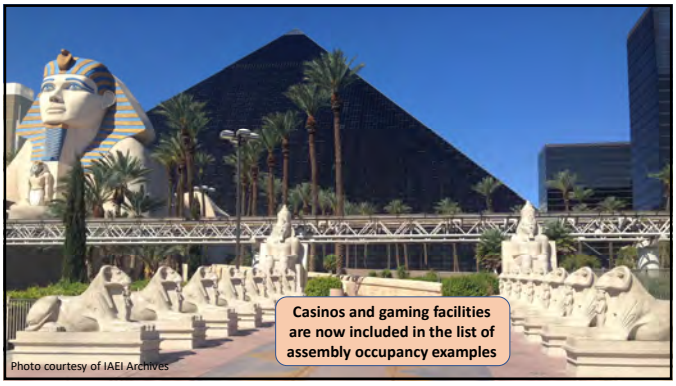
518.2 General Classification

(A) Examples

Casinos and gaming facilities are now included in the list of **assembly occupancy** examples

- Substantiation shows that casinos and gaming facilities are more prevalent than some of the assembly occupancies already included in the list of current examples
- Electrical equipment that is suitable for use in exhibition halls is also installed in casinos and similar gaming facilities
- Including these items in the list format will ensure that there is no confusion or misapplications of *NEC* requirements for these locations

47



Casinos and gaming facilities are now included in the list of assembly occupancy examples

Photo courtesy of IAEI Archives

48

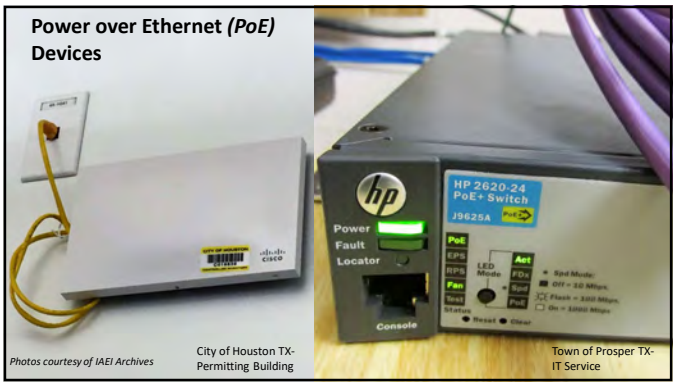
518.4 Wiring Methods

Section 518.4(A) and the Exception were revised and placed into a list format with two titled subdivisions

- Editorially revised by converting the main text of (A) into a list format with four items and converting the exception into positive text as a new (B) covering power-limited wiring
- The section now has four first-level subdivisions and no exceptions
- Content has been added to clarify that Power over Ethernet *(PoE)* is included
- Previously, the reference to Class 2 and 3 circuits in Article 725 was specific to remote control and signaling circuits
- Class 2 circuits that transmit power, data, or both to a powered device, have been added
- This change was to make it clear that Power over Ethernet *(PoE)* is permitted as a fixed wiring method for that specific application ***[see Section 518.4(B)(4)]***

49

Power over Ethernet *(PoE)* Devices



Photos courtesy of IAEI Archives

City of Houston TX- Permitting Building

Town of Prosper TX- IT Service

50

518.5 Supply

The section was reorganized for clarity and revised which included new requirements for commercial appliance outlet centers and panelboard orientation

- Revisions to specifically reference commercial outlet appliance centers
- Outlet appliance centers have unique features, such as panelboards in a face face-up position
- Section 408.43 no longer permits the mounting of panelboards in a face face-up position
- It was necessary to permit the orientation for listed commercial appliance outlet centers designed for in-floor mounting
- Marking requirements for use by qualified persons, identifying the disconnecting means location, and a shock hazard warning requiring disconnection before servicing were all included to provide additional safety to the worker

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518.5 Supply *(Assembly Occupancies)*

Outlet appliance centers have unique features such as panelboards in a face-up position

It was necessary to permit the orientation for listed commercial appliance outlet centers designed for in-floor mounting

90.3 Code Arrangement

CHAPTER 1 - General
CHAPTER 2 - Wiring and Protection
CHAPTER 3 - Wiring Methods and Materials
CHAPTER 4 - Equipment for General Use

Applies generally to all electrical installations

CHAPTER 5 - Special Occupancies
CHAPTER 6 - Special Equipment
CHAPTER 7 - Special Conditions

Supplements or modifies Chapters 1 through 7

(Interior View)

Photos courtesy of Hubbell Incoporated

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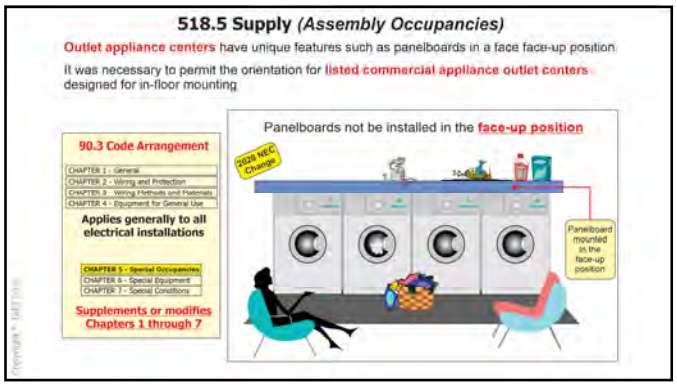
518.5 Supply (Assembly Occupancies)
Outlet appliance centers have unique features such as panelboards in a face face-up position
It was necessary to permit the orientation for listed commercial appliance outlet centers designed for in-floor mounting
90.3 Code Arrangement
CHAPTER 1 - General
CHAPTER 2 - Wiring and Protection
CHAPTER 3 - Wiring Methods and Materials
CHAPTER 4 - Equipment for General Use
Applies generally to all electrical installations
CHAPTER 5 - Special Occupancies
CHAPTER 6 - Special Equipment
CHAPTER 7 - Special Conditions
Supplements or modifies Chapters 1 through 7
Panelboards not be installed in the face-up position
2026 NEC Change
Panelboard mounted in the face-up position

53


IAEI
Article 530
Motion Picture and Television Studios and Remote Locations
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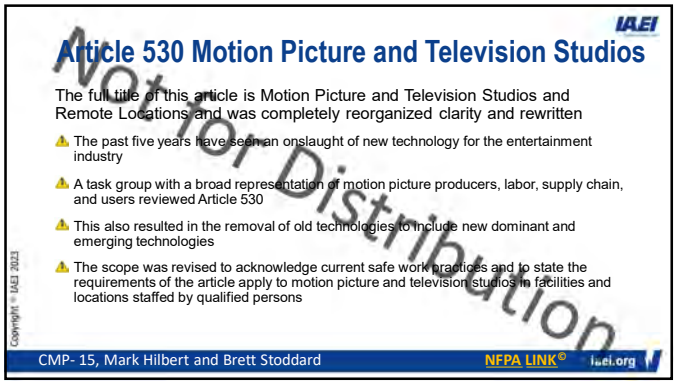
IAEI
Article 530 Motion Picture and Television Studios
Not for Distribution
The full title of this article is Motion Picture and Television Studios and Remote Locations and was completely reorganized clarity and rewritten
The past five years have seen an onslaught of new technology for the entertainment industry
A task group with a broad representation of motion picture producers, labor, supply chain, and users reviewed Article 530
This also resulted in the removal of old technologies to include new dominant and emerging technologies
The scope was revised to acknowledge current safe work practices and to state the requirements of the article apply to motion picture and television studios in facilities and locations staffed by qualified persons
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55


Studio set for outdoor resort matched a location in Bora Bora
Courtesy of IATSE Local 728

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Article 530 Motion Picture and Television Studios

Photos courtesy of IATSE Local 728

57

Article 530 Motion Picture and Television Studio

This article was completely reorganized for clarity and rewritten

The IAEI Digital Education Studio at the International Office dedicated to L. Keith Lofland in 2021

Chuck Mello, IAEI IO Instructor in the studio presenting IAEI's Soares Grounding and Bonding- 2020 NEC

58

Article 547
Agricultural Buildings

59

547.26 Physical Protection

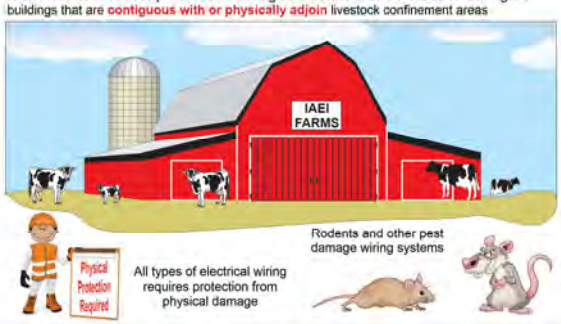
Nonmetallic cables will be prohibited from being concealed within walls and above ceilings of buildings that are contiguous with or physically adjoin livestock confinement areas

- Rodents and other pests have caused damage to wiring systems such as nonmetallic sheathed cables
- There is also a requirement that protection is to be provided for all types of electrical wiring that are subject to physical damage
- Electrical wiring installed in this environment should be protected against physical damage

60

547.26 Physical Protection *(Agricultural Buildings)*

Nonmetallic cables will be prohibited from being concealed within walls and above ceilings of buildings that are **contiguous with or physically adjoin** livestock confinement areas



61

547.44 Equipotential Planes and Bonding of Equipotential Planes

Clarifies the indoor and outdoor locations requiring equipotential planes and specifies the bonding locations for these planes at **agricultural buildings**

- Text provides clarification on where the equipotential plane can be connected in agricultural environments
- Bonding should take place to the following items:
  - a circuit equipment grounding conductor *(EGC)*
  - any metal part connected to a circuit equipment grounding conductor
  - the grounding electrode conductor *(GEC)*
  - any grounding electrode of the grounding electrode system *(GEC)* or
  - the equipment-grounding terminal in a panelboard

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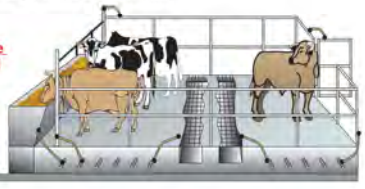
547.44 Equipotential Planes and Bonding of Equipotential Planes

Clarifies the indoor and outdoor locations requiring equipotential planes and specifies the bonding locations for these planes at **agricultural buildings**

Bonding should take place to the following items:

- a circuit equipment grounding conductor *(EGC)*
- any metal part connected to a circuit equipment grounding conductor
- the grounding electrode conductor *(GEC)*
- any grounding electrode of the grounding electrode system *(GEC)* or
- the equipment-grounding terminal in a panelboard

Livestock are very susceptible to currents in the agricultural environment



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Livestock in contact with metal and connected to energized equipment could cause milk production issues if voltages are not equalized through bonding

64

Article 550
Mobile Homes, Manufactured Homes, and Mobile Home Parks

65

550.32 Service Equipment

(A) Mobile Home Service Equipment

The electrical service disconnect can now be located **"within sight from"** the mobile home as opposed to the previously required 30 feet

- Service equipment cannot be installed in or on mobile homes
- The service disconnect can also serve as the emergency disconnect *(230.85)*
- "Within sight from" is a defined term in Article 100 ***[see In Sight From (Within Sight From, Within Sight)(purview of CMP-1)]***
  - Visible and not more than 15 m *(50 feet)*
- Reference 250.32 in the *NEC* for requirements concerning grounding
- **Note:** Manufactured homes *(with permanent foundation)* are not required to have remote service equipment

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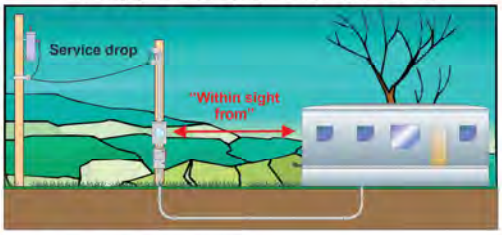
550.32(A) Service Equipment *(Mobile Homes)*



Note from the Electrical Inspector:

- Service equipment cannot be installed in or on the mobile home
- Can serve as the emergency disconnect per 230.85
- Must be "within sight from" the mobile home *(see Article 100)*

67

Article 551
Recreational Vehicles and Recreational Vehicle Parks

68

551.3 Electrical Datum Plane Distances

Changes address recreational vehicle sites located next to natural bodies of water

- This change was necessary to clarify some of the inconsistencies related to all electrical equipment installations around bodies of water
- With the changes to the definitions for "Electrical Datum Plane" and "Normal High-Water Level," the inclusion of these requirements in Article 551 for recreational vehicles and recreational vehicle parks made sense
- This will clarify the requirements for the AHJ when applying electrical elevation requirements in an RV park located next to a body of water
- The installer and AHJ will need to determine if the area will be subject to tidal fluctuations or not

69

551.3 Electrical Datum Plane Distances

The water level is a determining factor as to the distance(s) of the electrical datum plane from the RV *(extremes caused by natural or manmade disaster should not be considered)*

Where **tidal fluctuations** may occur, the electrical datum plane should be 606 mm (2 ft) above the **highest high tide level** for normal conditions *(distance on a horizontal plane)*

Where **tidal fluctuations** do not occur, the electrical datum plane should be 606 mm (2 ft) above the **normal high water level** for normal conditions *(distance on a horizontal plane)*

70

551.40 120-volt or 120/240-Volt, Nominal Systems

(D) Loss of Ground Device

Substantiation was submitted to eliminate the need for a "reverse polarity device" in a recreational vehicle and, in its place, a "**grounding monitor interrupter**"

- A grounding monitor interrupter would prohibit power if grounding is not present when the recreational vehicle *(RV)* is connected to power and interrupts power to the RV when grounding is lost during operation
- If the power to the RV is interrupted when grounding is not present, it will prevent a hazardous condition known as "hot skin" *(electrical current on the frame of the RV)*
- Previously, CMP-7 has not required GFCI protection on the feeder assembly connected to the RV; however, panel members agree that this level of protection *(grounding monitor interrupter)* is very important to ensure electrical safety
- Ultimately, the RV manufacturers would be required to factory install a grounding monitor interrupter device between the feeder assembly connection to the vehicle and the transfer switch *(if installed)* or panelboard with an **effective date of January 1, 2026**

71

551.40(D) Loss of Ground Device

A **grounding monitor interrupter** would prohibit power if grounding is not present when the recreational vehicle *(RV)* is connected to power and interrupts power to the RV when grounding is lost during operation

72

551.40(D) Loss of Ground Device

A possible solution to notify recreational vehicle (RV) user of the loss of ground condition *(see E2- Open Ground Code)*

Photo courtesy of Progressive Industries

73

Article 555

Marinas, Boatyards, Floating Buildings, and Commercial and Noncommercial Docking Facilities

74

555.4 Location of Service Equipment

Modified to state that services for a marina or docking facility must be located on land and **no closer than 1.5 m (5 ft) horizontally** from the structure served and elevated to a distance of **12 in. above** the electrical datum plane

- Previous language stated that the electrical service for a marina or docking facility must be located on land adjacent to the structure served
- This is vague with regards to the minimum distance horizontally, and for the height, the service should be located above the electrical datum plane
- Adding the distance for the service location and height above the electrical datum plane promotes electrical safety and enforceability
- This new language will provide a correlation between similar requirements in Articles 682 and 555

CMP- 7, Dean Hunter NFPA LINK© iaei.org

75

555.4 Location of Service Equipment

Electrical services for a marina or docking facility must be on land and no closer than 1.5 m (5 ft) horizontally from the structure served and elevated to a distance of 12 in. above the electrical datum plane

76

555.6 Load Calculations for Service and Feeder Conductors

Relocated text concerning demand factors for marinas and boatyards from Section 555.6 to 220.120 to better align with the "calculations" for services and feeders

- This was to correlate and standardize articles and chapters according to 90.3 of the *NEC*
- Recognized that articles in Chapter 5 contained various demand factor calculations
- There was hesitation on CMP-7 to move this section to Chapter 2 due to concerns of purview over the section and retaining the technical expertise when considering these calculations
- These specific measurements being added to this section will promote usability and consistency for both the AHJ enforcing the *Code* and the installer

77

555.6 Load Calculations for Service and Feeder Conductors

Relocated text and table concerning demand factors for marinas and boatyards from Section 555.6 to 220.120 to better align with the "calculations" for services and feeders

This will promote usability and consistency for both the AHJ enforcing the Code and the electrical professionals

CMP-7 retains purview over this material even though it appears in an article under the purview of CMP-2

Photo courtesy of IAEI Archives

78

555.14 Equipotential Planes and Bonding

Substantiation was submitted that enhanced safety could result from requiring an equipotential plane to equalize or eliminate step and touch voltages for electrical equipment located at or on docks

- Equipotential planes were added in marina environments to correlate with Article 682 *(Natural and Artificial Bodies of Water)*
- This will help to mitigate step and touch voltage where electrical equipment is located within **10 feet** of the water's edge and exceeding **250 volts** to ground
- The installer and AHJ will need to verify the presence of the equipotential plane or develop plans for the installation of one

79

555.14 Equipotential Planes and Bonding of Equipotential Planes

To reduce or mitigate step and touch potential at electrical equipment, equipotential planes may need to be installed

They should be installed adjacent to outdoor service equipment or disconnecting means that control equipment where:

- a system voltage is in excess of 250 volts to ground
- if the equipment is within 3 m (10 ft) of the body of water

Note: Not required for docks and floating building with service equipment or disconnect means for controlled utilization equipment

80

555.15 Replacement of Equipment

Equipment at Marinas, Boatyards, Floating Buildings, and Commercial and Noncommercial Docking Facilities

- The **"replacement"** of electrical equipment at docking facilities to be installed to the current edition of the *NEC*
- The new language will allow the authority having jurisdiction *(AHJ)* to inspect the existing electrical equipment for any damage
- The damage found for existing equipment needs only to be repaired to the *NEC* edition for which it was originally installed
- Determining which edition of the *NEC* that damaged electrical equipment was installed could also be problematic

81

555.15 Replacement of Equipment *(Marinas, Boatyards, etc.)*

The **"replacement"** of electrical equipment at marinas, boatyards, floating buildings, and commercial and noncommercial docking facilities to be installed to the **current edition of the *NEC***

Note: New language allows the AHJ to inspect the existing electrical equipment for damage

Damaged electrical equipment needs only be repaired to the *NEC* edition it was originally installed *(good luck figuring that out)*

82

Photo courtesy of IAEI Archives

83

Photo courtesy of Bellingham Marine

84

555.35 Ground-Fault Protection of Equipment *(GFPE)* and Ground-Fault Circuit-Interrupter *(GFCI)* Protection Interrupter

(D) Leakage Current Measurement Device

Language was added recognizing that the leakage current device is required to be listed by **January 1, 2026** *(future effective date)*

- The required leakage current testing device had no specific standard in place to build, test, or construct this metering equipment specific for a marina environment
- Requiring a "listed" Leakage Current Measurement Device for use in Marina Applications by January 1, 2026, will ensure that the device complies with specific safety and performance requirements
- The listed test device will allow the marina or facility operators to identify vessels that are leaking current and help mitigate electrical hazards that could lead to potential electric shock drowning *(ESD)* events
- *UL 1379, The Outline of Investigation for Leakage Currently, Measurement Devices for use in Marina Applications*, is under development to help the industry certify these devices

CMP- 7, Dean Hunter NFPA LINK© iaei.org

85

555.35(D) Leakage Current Measurement Device

Language was added recognizing that the leakage current device is **required to be listed by January 1, 2026** *(future effective date)*

Will allow the marina or facility operators **to identify vessels** that are leaking current and **help mitigate electrical hazards** that could lead to potential electric shock drowning *(ESD)* events

If you encounter stray current while swimming around boatyards and marinas **swim away** from the boat and dock locations

86

Remember Lucas Ritz

Lucas died when he swam into energized water

This is known as **electric shock drowning *(ESD)***

He was only 6 years old

Never swim or allow your family and friends to swim at marinas and boatyards

See Lucas and his families story at:

TLC Video-Lucas Story

SafeElectricity.org

87

555.36 Disconnecting Means for Shore Power Connection(s)

(C) Emergency Electrical Disconnect

Language has been added at a new subsection 555.36(C) to mandate that an emergency disconnect be located **within sight of a marina power outlet** or **enclosure** that provides shore power to boats

- The location of the emergency disconnect is critical
- A circuit breaker handle is expressly prohibited from being used for this purpose
- Time is critical, and disconnecting the boat nearest the swimmer is very important
- This will help to save the lives of electric shock drowning *(ESD)* victims and responders
- The installer and the AHJ will need to make sure that this requirement is adhered to for these locations
- **Note:** The source of voltage threatening a swimmer may not be the nearest boat

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89

90

555.38 Luminaires

This new section should help both installers and AHJs address electrically safe installations of luminaires at docking facilities to help reduce the incidents of electric shock drowning *(ESD)*

- Luminaires and retrofit kits need to be identified and listed for the environment
- These items should be secured to the structure of the marina
- If a luminaire is installed underwater in this environment:
  - it should be identified as a submersible type
  - conform to the low-voltage contact limit and
  - receive power from an isolating transformer or power supply

91

92


Photo courtesy of Bellingham Marine

93


IAEI
Article 590
Temporary Installations
Not for Distribution
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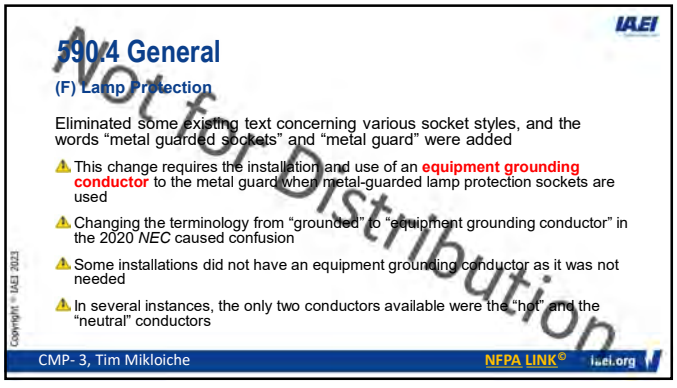
94


IAEI
590.4 General
(F) Lamp Protection
Not for Distribution
Eliminated some existing text concerning various socket styles, and the words "metal guarded sockets" and "metal guard" were added
This change requires the installation and use of an equipment grounding conductor to the metal guard when metal-guarded lamp protection sockets are used
Changing the terminology from "grounded" to "equipment grounding conductor" in the 2020 NEC caused confusion
Some installations did not have an equipment grounding conductor as it was not needed
In several instances, the only two conductors available were the "hot" and the "neutral" conductors
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590.4(F) Lamp Protection (Temporary Power)
Eliminated some of the existing text concerning various socket styles at and the words "metal guarded sockets" and "metal guard" were added
Requires the installation and use of an equipment grounding conductor (EGC) to the metal guard when metal guarded lamp protection sockets used
Photos courtesy of Lind Equipment
Photos courtesy of Southwire

96

Chapter 6
Special Equipment

- Article 600
- Article 620
- Article 625
- Article 630
- Article 646
- Article 670
- Article 680
- Article 690

97

Article 600
Electric Signs and Outline Lighting

98

600.5 Branch Circuits

(A) Required Branch Circuits

Two exceptions have been created for **sign branch circuits**

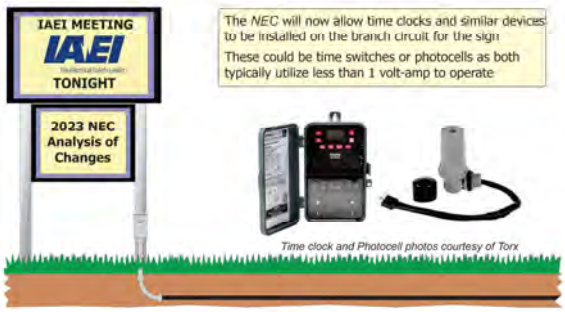
- Exception No. 1 moved text that was originally in the last sentence of the main body of the requirement
- No change in language - just moved as it is an exception to the main rule
- Exception No. 2 permits time clocks and similar devices to be on the sign circuit
- Signs are sometimes controlled by time switches or photocontrols, both of which would be considered "loads"
- These controls use a small amount of power, although it is typically less than 1 volt-amp
- This small usage will not burden the branch circuit providing power to the sign

CMP- 18, Bob Fahey NFPA LINK© iaei.org

99

600.5(A) Exceptions *(Electric Signs and Outline Lighting)*

Two exceptions have been created for sign branch circuits



100

600.35 Retrofit Kits

Redundant requirements already covered in Chapters 1-4 of the *NEC* have been removed

- Retrofit kits used in signs are uniquely different from other retrofit kits in other articles of the *Code*
  - The kits must include instructions and requirements "for field conversion of a host sign"
- Sections 600.3, 110.3(B), 110.8, 110.12, and 600.4(B) already address requirements that were being addressed at 600.35
- Sign installers and other electrical professionals will need to become familiar with the other areas of the *NEC* that apply to electric signs and outline lighting installations

CMP- 18, Bob Fahey NFPA LINK© iaei.org

101

600.35 Retrofit Kits *(Electric Signs and Outline Lighting)*

Retrofit kits used in signs are uniquely different from other retrofit kits in other articles of the Code

Sign installers and other electrical professionals will need to become familiar with the other areas of the *NEC* that apply to electric signs and outline lighting installations

Redundant requirements were removed

(see Chapter 1-4 for these requirements)

Photos courtesy of Wes Wilkens, ISA

102

Article 620

Elevators, Dumbwaiters, Escalators, Moving Walks, Platform Lifts, and Stairway Chairlifts

103

620.12 Minimum Size of Conductors

(A) Traveling Cables

New requirements allow a Class 2 communication conductor(s) for use with elevator traveling cables

- Allows elevator communications conductors to be compatible with standard building wiring infrastructure and hardware
- Cables used for elevators as traveling cables for Class 2 or communications circuits to have a current limit equal to or greater than the current required to power the powered Class 2 or communications device
- The smallest size for the communication circuit is specified as a 24 AWG conductor
- The communication cable(s) are also required to comply with 800.179, *Wires and Cables for Communication Systems*

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620.12(A) Traveling Cables *(Elevators)*

Allow for Class 2 communication conductor(s) for use with elevator travelling cables

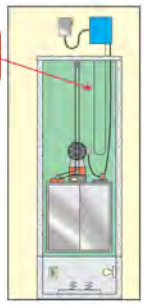
Travelling cables used for Class 2 or communications circuits to have **current limit equal to or greater than** the current required to power the powered Class 2 or communications device

Elevator traveling cable

Communication cable(s) are also required to comply with 800.179

Wires and Cables for Communication Systems

Photos courtesy of IAEI Archives



105

620.22 Branch Circuits for Car Lighting, Receptacle(s), Ventilation, Heating, and Air-Conditioning

IAEI

(A) Car Light Receptacles, Auxiliary Lighting and Ventilation

Revised the requirements to specify permissible loads on the car light circuit

- Article 620 covers elevators, dumbwaiters, escalators, moving walks, platform lifts, and stairway chairlifts
- Clearly limits which loads may be powered by the car light circuit
- Equipment now includes:
  - emergency responder radio coverage
  - air purification equipment
  - car emergency signing
  - communication devices
- Amperage for these additional items is very small, with the risk of tripping the overcurrent protective device minimal

106

620.22(A) Car Light Receptacles, Auxiliary Lighting and Ventilation

Revised the requirements to specify **permissible loads** on the elevator car light circuit

This revision **limits** which loads may be powered by the **car light circuit**

Equipment now includes:
- emergency responder radio coverage
- air purification equipment
- car emergency signing
- communication devices

Elevator Equipment Room

107

IAEI

620.36 Different Systems in One Raceway or Traveling Cable

Specifies which cable types may be installed in elevator raceway or traveling cable

- The following cables are now specifically permitted:
  - shielded pair
  - coaxial and
  - other communication circuits
- **CMP-LP or CMR-LP cables** that comply with 800.179 are permitted **in raceways**
- The addition of coaxial and shielded pair cables will allow for greater design flexibility
- Will allow for **maximum flexibility** while maintaining electrical safety

108

620.36 Different Systems in One Raceway or Traveling Cable

Specifies which cable types may be installed in elevator raceway or traveling cable

The following cables are now specifically permitted:
- shielded pair
- coaxial
- other communication circuits

Elevator Traveling Cable

Photos courtesy of IAEI Archives

Will allow **maximum flexibility** while maintaining electrical safety

109

620.51 Disconnecting Means

(A) Type

Exception No. 2

Clarification for situations where cord-and-plug connection of a stairway chair lift utilizing batteries is permitted

- Revised existing exception concerning cord-and-plug connections
- Some modern chairlifts are supplied by batteries as their primary power source
- Recognizes this type of stairway chair lift as being suitable for plug-and-cord connection
- This is in lieu of the previous requirement for a fused motor switch/lockable circuit breaker
- Must comply with 422.16(A), and the cord cannot exceed 6 feet in length

CMP- 12, Phil Clark

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110

Recognizes a **stairway chair lift with batteries as primary source** as being suitable for plug-and-cord connection

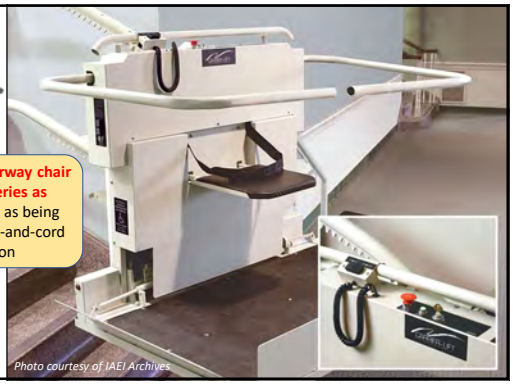

Photo courtesy of IAEI Archives

111

Article 625
Electric Vehicle Power Transfer System

112

625.6 Listed

Clarifies equipment for electric vehicle power transfer *(charging, power export, or bi-directional current flow) that is* required to be listed

- The xxx.6 section has become the location associated with listing requirements in many articles of the *NEC*
- This change removes confusion by stating plainly *NEC* listing requirements involved in this type of equipment
- It will aid in achieving safety and simplify decisions for electrical professionals

113

625.6 Listed *(Electric Vehicle Power Transfer)*

Equipment for electric vehicle power transfer is required to be listed

Clarifies that EV equipment for **charging, power export, or bi-directional current flow** is **required to be listed**

The xxx.6 section has become the location associated with listing requirements in many articles of the *NEC*

Photos courtesy of IAEI Archives

114

625.44 Equipment Connection

(A) Portable Equipment

Adds 14-60R type receptacles to the list of permitted receptacles for portable Electric Vehicle Supply Equipment *(EVSE)*

- This was added in an attempt to help **reduce charging time** for electric vehicles
- EV manufacturers have specified larger capacity circuits for charging their vehicles
- Applies to a nonlocking, 2-pole, 3-wire or 3-pole, 4-wire grounding-type receptacle
- Permits charging receptacles **up to 125/250 volts, 60 amperes** *(for portable equipment)*
- See additional change for **fastened-in-place equipment** utilizing nonlocking, 3-pole, 4-wire grounding-type receptacle outlet
  - rated at 125/250 volts, single phase
  - 30, 50, or **60 amperes**

115

Electric vehicle charging is available at numerous commercial locations around the country

Photo courtesy of IAEI Archives

116

625.49 Island Mode

Creates a new section stating that **electric vehicle power export equipment** *(EVPE)* and **bidirectional electric vehicle supply equipment** *(EVSE)* are permitted to be a part of interconnected power systems operating in an island mode condition

- This change was brought forth by the PV Industry Forum *(PVIF)*
- This addresses the continued expansion of EVPE and EVSE equipment operated within interconnected power systems
- Island mode allows energy to be supplied to loads that have been disconnected from an electric power production and distribution network or other primary power sources
- The section further clarifies that this EVPE and EVSE equipment can be a source for these types of systems

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625.49 Island Mode *(Electric Vehicles)*

States that **electric vehicle power export equipment** *(EVPE)* and **bidirectional electric vehicle supply equipment** *(EVSE)* are permitted to be a part of interconnected power systems operating in an island mode condition

Photo courtesy of IAEI Archives

118

Article 630
Electric Welders

119

630.8 GFCI Protection for Personnel *(Electric Welders)*

Creates a new Section requiring ground-fault circuit-interrupter *(GFCI)* protection for personnel involved with electric welder applications

- This change is **not for the welder receptacle** but rather for **other receptacles** within the area where the welder is being used and other tools might be connected
  - These other receptacles are the 125-volt, 15- and 20-ampere receptacles supplied by single-phase branch circuits rated 150 volts or less to ground
- It was observed that secondary, trade schools, and community colleges provide welding equipment for their students
- The use of this equipment and associated equipment exposes these users to electrical risk
- GFCI protection has been expanded for students using hand tools in these learning environments
- **Note:** There was also concern expressed that CMP-2 had purview over GFCI protection requirements and should be involved in this new requirement

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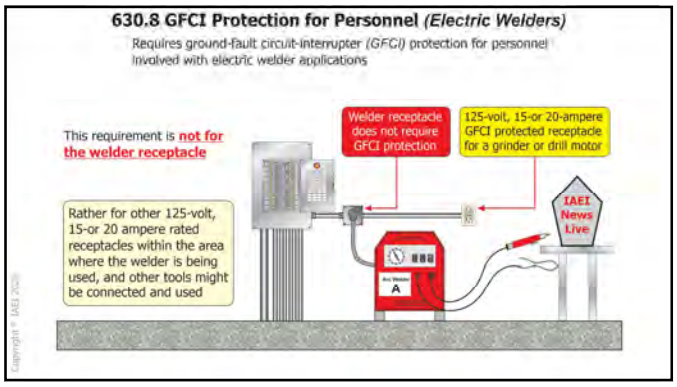

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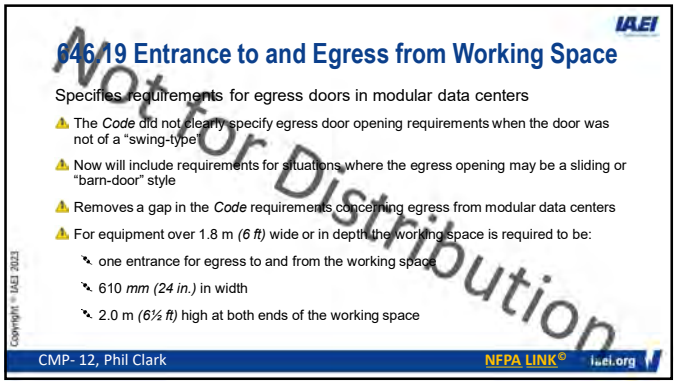

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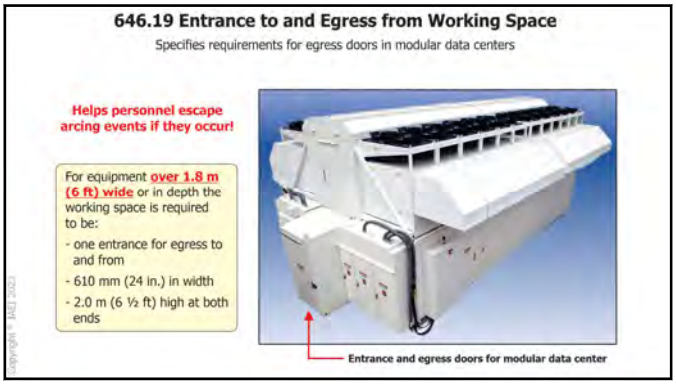

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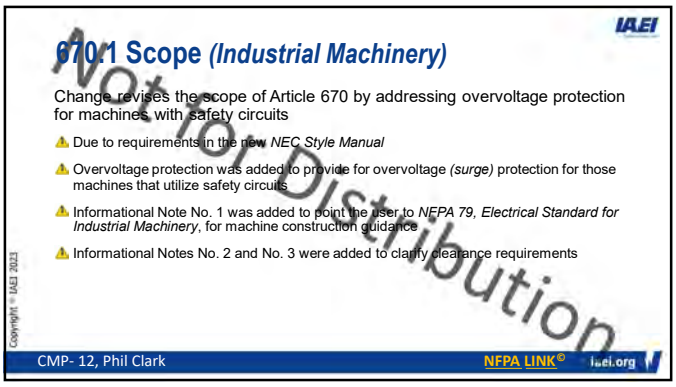

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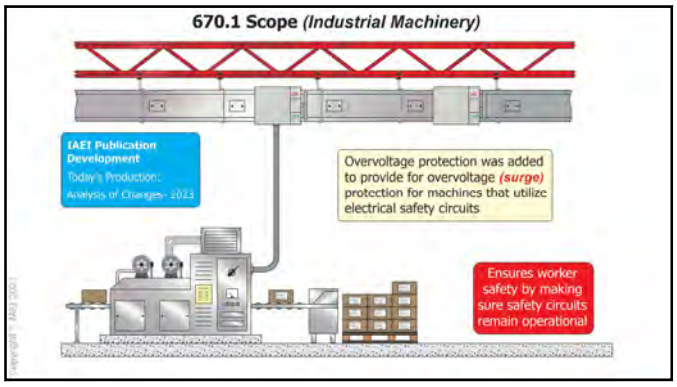

127

128

Article 680
Swimming Pools, Fountains, and Similar Installations

129

Article 680 Swimming Pools and Similar Installations

Article 680 underwent a major re-organization to improve usability and compliance with the *NEC Style Manual*

- Several sections were identified as redundant or unnecessary
- Many provisions previously included in Article 680 repeated general requirements from Chapters 1-4
- Structure requirements in 90.3 indicates requirements in Chapters 5, 6, and 7 to supplement or modify the general requirements in Chapters 1-4
- Significant work was done to better comply with 90.3

130

131

680.5 GFCI and SPGFCI Protection

Text has been revised and subdivided to address ground-fault circuit-interrupter *(GFCI)* protection and introduce Special Purpose Ground-Fault Circuit-Interrupter *(SPGFCI)* protection in swimming pool locations

- SPGFCI protection is a relatively new GFCI protection requirement for circuits above 150 volts to ground, but not more than 480 volts phase to phase, single or three phase
- The protection for higher voltage circuits shall not exceed 20-mA ground-fault trip current
- GFCI protection has been required, and the equipment to be readily available for pool installations at typical single-family dwellings and smaller commercial facilities ***(120/240, single phase and 208Y/120, single and three phase installations)***
- Some larger installations utilize electrical systems that operate outside the voltage system parameters of Class A GFCI protection
- This change is directed at providing protection at those installations

132

680.5 GFCI and SPGFCI Protection

Revised and subdivided to address ground-fault circuit-interrupter *(GFCI)* protection and introduce Special Purpose Ground-Fault Circuit-Interrupter *(SPGFCI)* protection

Ground-Fault Circuit-Interrupter *(GFCI)* protection

Special Purpose Ground-Fault Circuit-Interrupter *(SPGFCI)* protection

GFCI photos courtesy of Leviton and Legrand

SPGFCI photos courtesy of Littlefuse

133

680.9 Overhead Conductor Clearances

(A) Power

Clarifies that **overhead wiring in raceways** are not subject to the clearance requirements in Table 680.9(A) and Figure 680.9(A)

- Literal reading of previous text had the potential to be a problem for overhead wiring in raceways in ceilings of indoor pool installations
- This change clarifies the clearance requirements were focused on outdoor open wiring- type installations
- Will help bring clarity and useability to the *Code* and eliminate misunderstandings between the AHJ and the installer

CMP- 17, Donny Cook

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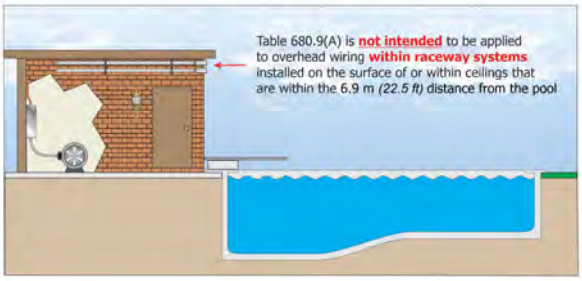
680.9(A) Power *(Swimming Pools)*

This change clarifies the clearance requirements were focused on **outdoor open wiring** type installations



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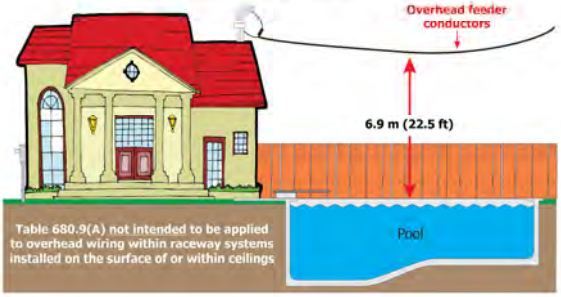
680.9(A) Power *(Swimming Pools)*

This change clarifies the clearance requirements were focused on **outdoor open wiring** type installations



136

Homeowner installed festoon lighting with clearances in violation of the National Electrical Code

Sometimes this is seen on TV or other media post and assumed to be acceptable

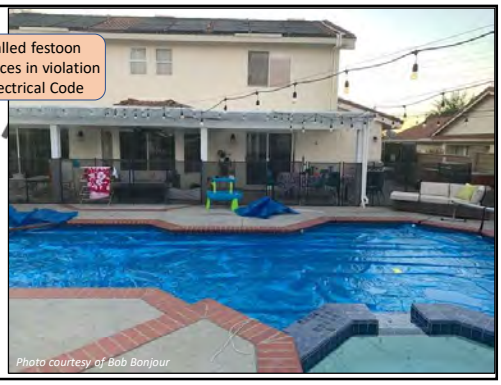


Photo courtesy of Bob Bonjour

137

680.10 Electric Pool Water Heaters

Text has been revised by and subdivided to include provisions for pool water temperature conditioning equipment that incorporates technology other than resistance heating

- The full title of this section is **Electric Pool Water Heaters Incorporating Resistive Heating Elements and Electrically Powered Swimming Pool Heat Pumps and Chillers**
- Has traditionally addressed installation of electric resistance heating equipment to improve water temperature in pools
- More recently, the installation of heat pumps and chiller equipment has been used to heat or cool water temperature
- Recognizes that this type of installation and provides requirements to size circuits and protective devices

CMP- 17, Donny Cook

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Section now entitled "Electric Pool Water Heaters Incorporating Resistive Heating Elements and Electrically Powered Swimming Pool Heat Pumps and Chillers"

Traditionally addressed electric resistance heating equipment.

Now applies to heat pump and chiller equipment used to heat or cool water temperature.

Photo courtesy of Jim Sankey

139

680.12 Equipment Rooms, Vaults, and Pits

Revised and subdivided to require equipment rooms, vaults, or **pits with equipment to have drainage** or be suitable for submersion and a receptacle for maintenance

- Addresses concerns related to the risk of water rising over electrical equipment
- Mandates a general-purpose receptacle for maintenance
  - **requires a 125-volt, 15-or 20-ampere receptacle**
- Provide shock protection for personnel for any receptacle installed
  - require any receptacle in the space rated 150 volts or less to be ground-fault circuit-interrupter *(GFCI)* protected

CMP- 17, Donny Cook

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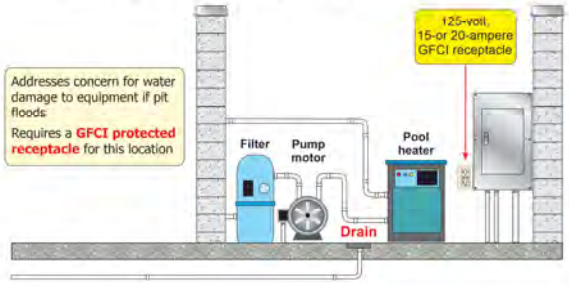
140

680.12 Equipment Rooms, Vaults, and Pits *(Swimming Pools)*

Requires equipment rooms, vaults, or pits with equipment to have drainage or be suitable for submersion and a receptacle for maintenance



141

680.21 Motors

(A) Pool Pump Motor Replacement

Expands the requirement to provide ground-fault circuit-interrupter *(GFCI)* protection for replaced pool pump motors and now includes those that are repaired

- GFCI protection enhances safety for pool users and workers maintaining pool equipment
- Previous edition only required GFCI protection for installations where the pump motor was replaced
- Now adds an additional condition where GFCI protection must be provided *(motor repair)*
- Includes repair of motors that operate on systems that exceed Class A GFCI limitations
- These motors must be addressed by Special Purpose Ground-Fault Circuit-Interrupter *(SPGFCI)* Protection
- The electrical professional, facility owner, and pool maintenance personnel will need to be aware of these important safety requirements.

142

680.21(D) Pool Pump Motor Replacement

Requires ground-fault circuit-interrupter *(GFCI)* protection for **repaired pool pump motors**

Repairing pool pump motors just got safer for the customer

This applies to motors requiring **Class A GFCI** protection

Also includes motors **exceeding** Class A GFCI limitations ***(SPGFCI protection)***

Photo courtesy of IAEI Archives

143

680.23 Underwater Luminaires

(B) Wet-Niche Luminaires

(2) Wiring Extending Directly to the Forming Shell

(a) Metal Conduit

Rigid metal conduit extending directly to wet niche luminaires in forming shells of pools **must be listed** red brass or listed stainless steel

- Previous text required metal conduit for this application to be listed and identified
- It did not clearly describe the purpose of the identification
- Clarifies the requirement and limits the materials permitted for this application
- *UL 6A Standard for Safety Electrical Rigid Metal Conduit- Aluminum, Red Brass and Stainless Steel* includes the certification requirements for the permitted metal conduit products
- Benefits the electrical professional and brings clarity to this requirement

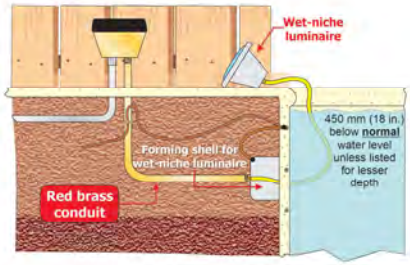
144

680.23(B)(2)(a) Forming Shell *(Metal Conduit)*

Rigid metal conduit extending directly to wet niche luminaires in forming shells of pools must be **listed red brass or listed stainless steel**

Conduit identification is no longer required

Stainless steel and red brass conduit **must be listed**



145

680.32 GFCI and SPGFCI Protection

Revision to the title and text indicating **both ground-fault circuit interrupter *(GFCI)* and special-purpose ground-fault circuit interrupter *(SPGFCI)*** requirements are covered in this section and adding a reference back to 680.5(B) and (C)

- Part of a correlating committee request to review the term "GFCI" and other terminology associated with ground-fault protective equipment throughout the *NEC*
- The task group was to ensure consistency with how these are defined in Article 100
- Revision includes both GFCI and SPGFCI protection, which more accurately depicts the requirements covered in this section
- This addition aligns with the new definition "SPGFCI" in Article 100

146

680.32 GFCI and SPGFCI Protection

Revision to the title and text indicating both **ground-fault circuit interrupter** *(GFCI)* and **special-purpose ground-fault circuit interrupter** *(SPGFCI)* requirements are covered in this section

Revision includes both GFCI and SPGFCI protection, which more accurately depicts the requirements covered in this section

This addition aligns with the new definition "SPGFCI" in Article 100

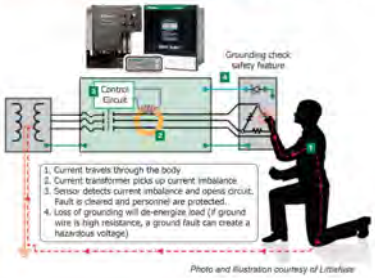


Photo and illustration courtesy of Littelfuse

147

680.41 Location of Other Equipment

(A) Emergency Switch for Spas and Hot Tubs

Clarifies the emergency switch requirement at one-family dwellings for hot tub and spa installations

- There was confusion about emergency switch requirements for hot tubs and spas at single-family dwellings
- Previously, some AHJs have interpreted the *NEC* to require emergency shutoff devices at single-family dwelling locations
- CMP-17 reviewed and stated that emergency switch requirements **do not apply** for indoor or outdoor hot tub or spa installations **at single-family dwellings**
- This change should alleviate misunderstanding in the electrical professional community

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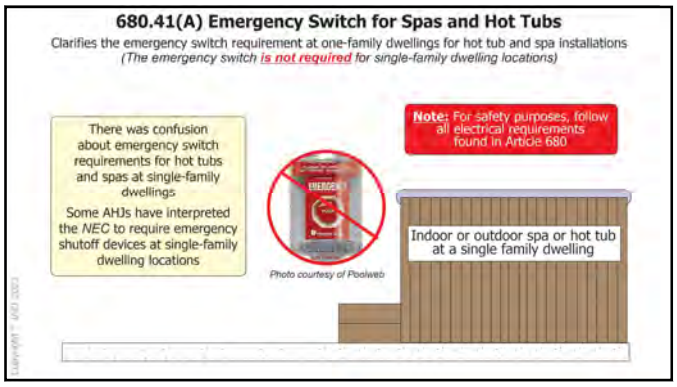

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680.44 GFCI and SPGFCI Protection

Revised to indicate that both Ground-Fault Circuit-Interrupter *(GFCI)* and Special Purpose Ground-Fault Circuit-Interrupter *(SPGFCI)* requirements are addressed for spa and hot tub installations

- The Correlating Committee established a task group to review the term "GFCI" and other terminology associated with ground-fault protective equipment throughout the *NEC*
- It was to help with consistency as to how these are defined in Article 100
- This change will more accurately depict the requirements covered in this section as it applies to GFCI and SPGFCI requirements
- It also aligns with the new definition of "SPGFCI" in Article 100
- The wording "listed, labeled, and identified" in 680.44(B) was changed to "listed" for clarity of the requirement

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680.44 GFCI and SPGFCI Protection

Ground-Fault Circuit-Interrupter *(GFCI)* and Special Purpose Ground-Fault Circuit-Interrupter *(SPGFCI)* requirements are now addressed for **spa and hot tub installations**

Not too sure SPGFCI protection is currently available for this application

Check manufacturers for details

Photo courtesy of IAEI Archives

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680.54 Grounding and Bonding

(C) Equipotential Bonding of Splash Pads

Creation of 680.54(C) to address **bonding requirements** for splash pads

- Provides additional information to assist with the identification of the splash pad boundary
- Many splash pads are constructed such that the area outside the splash pad perimeter is also concrete
- This change is an effort to identify the termination point(s)
- This will help to assure the electrical safety of the user of this equipment
- The electrical professional should seek information and understanding of the splash pad structure from the splash pad *(pool)* designer
- Communication will have a significant impact on the installation and inspection approval of these bonding provisions

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Photo courtesy of IAEI Archives

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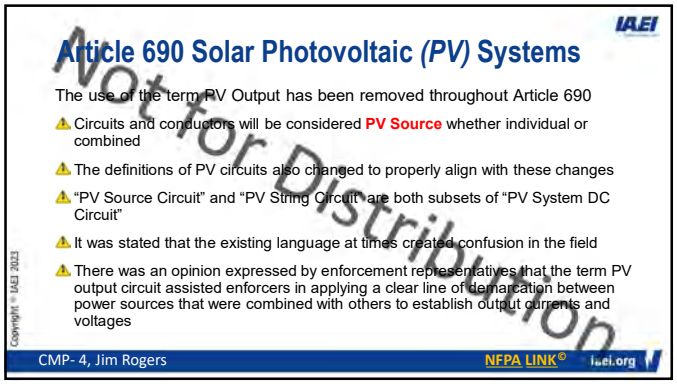

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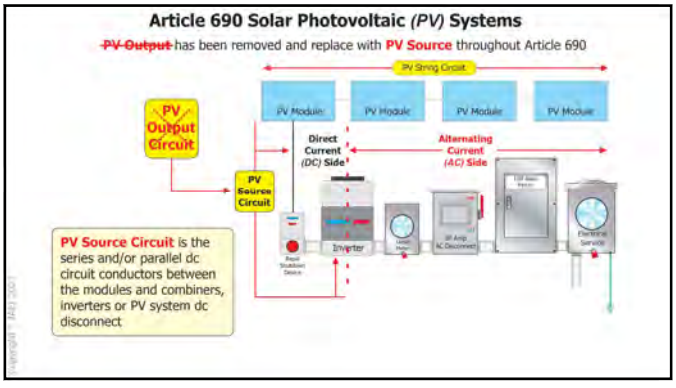

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690.1 Figure Informational Note

New simplified illustrations using new and revised definitions were added identifying typical photovoltaic *(PV)* system dc components and conductors

- The result of substantiation provided by the PV Industry Forum *(PVIF)*
- Previous illustrations included non-PV elements and did not reflect current usage
- Panel combined the previous three figures into one figure for simplicity
- These changes also addressed *NEC Style Manual* issues

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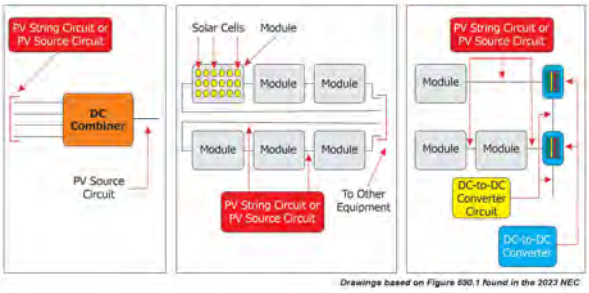
690.1 Figure Informational Note

New simplified illustrations using new and revised definitions were added identifying typical photovoltaic *(PV)* system dc components and conductors



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690.4 General Requirements

(G) PV Equipment Floating on Bodies of Water

Recognizes the installation of **floating PV arrays over a body of water** and the additional product identification requirements

- This change was submitted by Underwriters Laboratories *(UL)* as they recognize that installations like this are becoming more plentiful
- UL states that there is no additional product standard, but that designers and installers should consider items such as humidity, corrosion and mechanical stress due to movement
- This will add another layer of consideration when evaluating these PV installations

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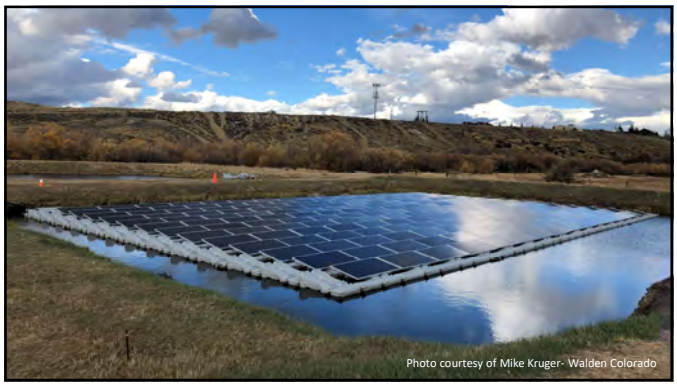

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690.9 Overcurrent Protection

(D) Transformers

New language provides a pointer to 705.30(F), where specific requirements applicable to interconnected systems are addressed

- This language has been in place since the 1984 *NEC* edition prior to the inclusion of Article 705 ***(Interconnected Electric Power Production Sources)***
- Text was not correlated with Article 240 or the current product safety standard
- 705.30(F) addresses interconnected electric power production sources, where there may be sources of supply connected to both the primary and secondary windings of the transformer
- Ensures proper overcurrent protection is provided for transformers where sources of supply are connected to both sides
- Clarifies and adds consistency for the identification of transformer primary and secondary circuits
- Overcurrent protection rules are simplified for electrical professionals

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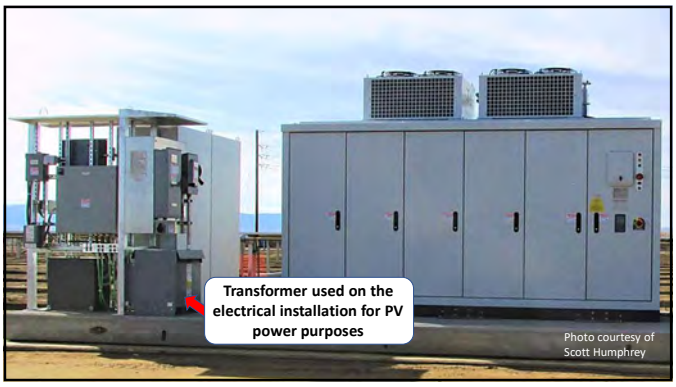

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690.12 Exception No.2 and Informational Note

New language to eliminate rapid shutdown requirements for structures where firefighters will not need to access the roof

- The PV Industry Forum (PVIF) helped provide substantiations for these changes
- Rapid shutdown requirements were created to provide a greater degree of safety for rooftop firefighting operations
- Previous language did not clearly delineate any exceptions for rapid shutdown requirements
- Ground-mounted PV system and carport structures do not present similar hazards as a roof-mounted system on buildings for first responders
- Rapid shutdown equipment is not as critical for a ground-mounted PV system because it is not installed on the roof of a structure

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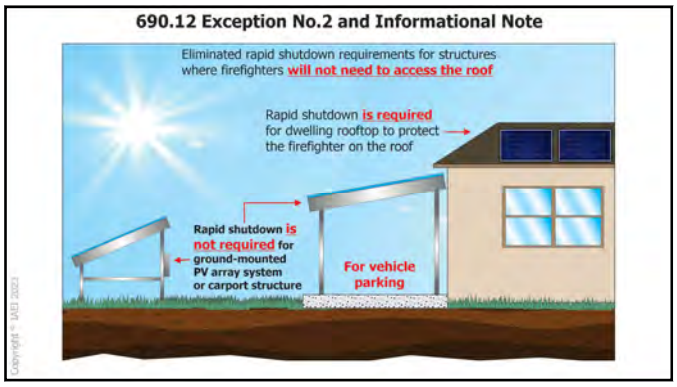

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690.12 Rapid Shutdown of PV Systems on Buildings

(B) Controlled Limits

(2) Inside the Array Boundary

Two options were revised for rapid shutdown compliance inside the PV array and previous option three was eliminated

- The first option available is PV shock hazard control which is listed and labeled per installation instructions
- The second is to reduce shock hazards for first responders to a maximum of 80 volts dc within the array boundary and inside the PV equipment within 30 seconds
- A new UL 3741, *PV Hazard Control*, standard provides the necessary degree of safety for firefighters
- These revisions, along with the new UL standard, will help clarify understanding and compliance for these important safety requirement

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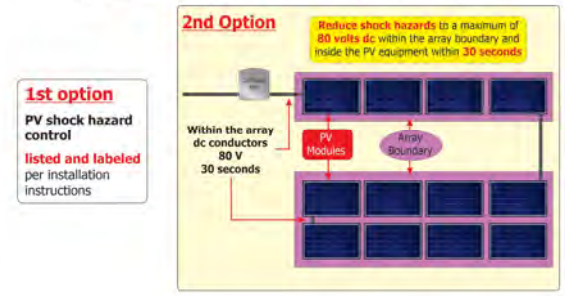
690.12(B)(2) Inside the Array Boundary

Two options were revised for rapid shutdown compliance inside the PV array



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690.15 Disconnecting Means for Isolating PV Equipment

A requirement for an equipment disconnecting means to be within 10 feet of the equipment and also be within sight was modified

- The change goes toward the reorganization of 690.15(C) and (D) in the 2020 *NEC*
- 690.15(A) now refers to 690.15(C) for an equipment disconnect
  - Requires the disconnecting means to be within sight and within 10 feet of the equipment or
  - capable of being lockable in accordance with 110.25
- Changes in the reorganizing of 690.15(C) does not mandate the 10-foot requirements provided the disconnect complies with 110.25
- This only applies to disconnecting means and not isolating devices
- Also, a few grammatical changes were made to the existing text

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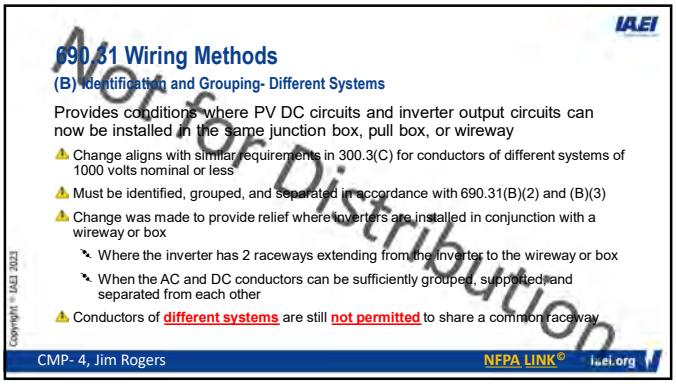

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690.31(B) Identification and Grouping- Different Systems

Provides conditions where PV DC circuits and inverter output circuits can now be installed in the same junction box, pull box or wireway

Photo courtesy of Pete Jackson

Must be **identified, grouped and separated** in accordance with 690.31(B)(2) and (B)(3)

Change was made to **provide relief** where inverters are installed in conjunction with a wireway or box

- Where the inverter has 2 raceways extending from the inverter to the wireway or box
- When the AC and DC conductors can be **sufficiently grouped, supported,** and **separated from each other**

185

690.31 Wiring Methods

(B) Identification and Grouping- Different Systems

Exception permits the dc and ac conductors of a PV system to be **located within the same enclosure** where all the conductors are insulated for the highest voltage present and grouped appropriately

- Previous language prohibited an inverter's dc and ac conductors from being located within the same field-installed enclosure without a divider
- Because the dc and ac conductors will all terminate within the inverter, there is a **benefit from a workmanship perspective** to permit these conductors within the associated wireway enclosure
- Conductors of different systems are permitted within listed PV equipment such as inverters, in accordance with the product safety standard
- New language will align with similar requirements in 300.3(C) for conductors of different systems of 1000 volts nominal or less

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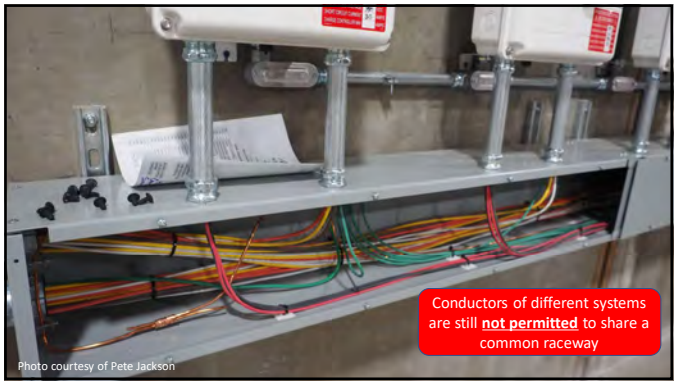

Conductors of different systems are still **not permitted** to share a common raceway

Photo courtesy of Pete Jackson

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Chapter 7
Special Conditions

- Article 700
- Article 701
- Article 705
- Article 706
- Article 722
- Article 725
- Article 726
- Article 760

188

Article 700
Emergency Systems

189

700.2, 701.2, 702.2, and 708.2 Reconditioned Equipment

Reconditioning of transfer switches is not permitted for emergency systems, legally required standby systems, optional standby systems, and critical operations power systems *(COPS)*

- There does not exist a practical method that ensures a transfer switch can be properly reconditioned without testing it to destruction
- This raised doubt and uncertainty that a reconditioned transfer switch would operate when required for emergency conditions
- Deletes the previous reconditioning statement found at 700.5(C), 701.5(C), 702.5(B)(1)
- Relocates previous references to the .2 sections being consistent across much of the *NEC*
- Reconditioned language was added to Article 708 at 708.2 and did not appear prior to this edition of the *NEC*

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700.2, 701.2, 702.2, and 708.2 Reconditioned Equipment

Reconditioning of transfer switches **is not permitted** for emergency systems, legally required standby systems, optional standby systems, and critical operations power systems *(COPS)*

No practical method to ensure a transfer switch can be properly reconditioned without testing it to destruction

Doubt and uncertainty that a reconditioned transfer switch **would operate** in emergency conditions

References are now in the .2 sections being consistent across much of the *NEC*

Photos courtesy of IAEI Archives

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700.3 Tests and Maintenance

(F) Temporary Source of Power for Maintenance or Repair of the Alternate Source of Power

Revised subsection (4) for Maintenance or Repair of the Alternate Source of Power to require listing

- There have been failures to properly isolate the two out-of-phase sources from each other, resulting in injury or damage
- The switching device should be listed, and the interlock should be listed for use with the specific switching device
- Language revised pertaining to a permanent switching means connecting a portable or temporary alternate source of power
- This switching means is also responsible for functioning as a transfer switch
- The switching device and interlocking are critical to operator safety and the emergency system's overall operations

192

700.3(F) Temporary Source of Power- List Item (4)

Language was revised pertaining to a permanent switching means to a portable or temporary alternate source of power

This switching means is also responsible for functioning as a **transfer switch**

The switching device and interlocking are critical to operator safety and the emergency system's overall operations

Failure to properly isolate the two out-of-phase sources have resulted in injury or damage

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700.3 Tests and Maintenance *(cont.)*

(F) Temporary Source of Power for Maintenance or Repair of the Alternate Source of Power

Added subsection (6) for Maintenance or Repair of the Alternate Source of Power for the permanent connection point and routing requirements for cables

- List item (6) is new and directs that the permanent connection point must be accessible at an exterior location for the temporary power source
- Cables cannot be routed through exterior windows, doors, or similar openings
- This helps to assure that building egress pathways remain unimpeded by these cables and that the cables are not subject to being pinched and damaged by door or window operation

194

700.3(F) Temporary Source of Power- List Item (6)

Permanent connection point to be accessible at an exterior location for the temporary power source

Cables cannot be routed through exterior windows, doors, or similar openings

Helps assure that building **egress pathways remain clear** and cables are **not being pinched and damaged**

Permanent Connection Point

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700.3 Tests and Maintenance

(F) Temporary Source of Power for Maintenance or Repair of the Alternate Source of Power

Added subsection (7) for Maintenance or Repair of the Alternate Source of Power requiring a label to be field applied at the permanent connection point

- This is necessary to prevent incorrect connection to the source resulting in the misuse of the temporary power source
- **Permanent label** to be field applied at the permanent connection point identifying:
  - system voltage
  - maximum amperage
  - short-circuit current rating of the load side of equipment supplied and
  - ungrounded conductor identification in accordance with 210.5
- The installer and inspector must work together to ensure a safe system is in place during the repair or maintenance of alternate power sources

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700.3(F) Temporary Source of Power- List Item (7)

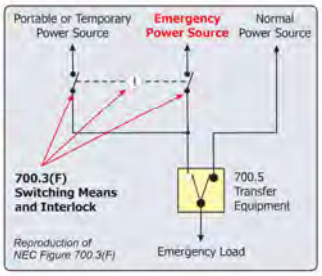
The permanent switching means for **maintenance or repair of the alternate source of power** now requires a label to be **field applied** at the permanent connection point

Necessary to prevent incorrect connection to the source resulting in the misuse of the temporary power source

Label must be **permanent** and applied to the equipment after it has been installed at the project

Example of a Permanent Lable

Voltage 277/480 V
Amperage 800 A
SCSR 42,000 A
Ungrounded conductor identified with gray tape
Leslie's Electric Services "Happy to Help"



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700.5 Transfer Equipment

(D) Redundant Transfer Equipment

The structure of 700.5 concerning transfer equipment now mirrors the subsections for transfer equipment found in Article 708.24

- This pertains to emergency loads supplied by a single feeder
- Includes redundant transfer equipment on a bypass isolation transfer switch allowing for repair and maintenance as required in 700.3(C)
- New subsection (D) describes the functionality needed when a single feeder supplies emergency loads
- Previously, the language described how to do this based on a single product available on the market
- There are multiple ways to meet the requirements safely and reliably and ensure continuity of power when a single feeder supplies an emergency load
- The term for **Bypass Isolation Transfer Switches** has been revised to correlate with the defined definition found in Article 100

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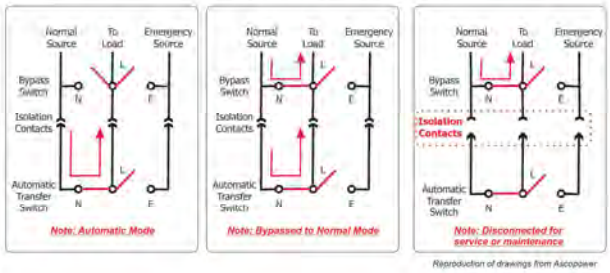
700.5(D) Redundant Transfer Equipment

The structure of 700.5 concerning transfer equipment now mirrors the subdivisions for transfer equipment found in Article 708.24



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700.11 Wiring Class-2-Powered Emergency Lighting Systems

(C) Wiring, Class 2 Powered Emergency Lighting Systems

New requirements for the separation of Class 2 circuits that are designated as emergency or nonemergency circuits used with **Emergency Systems**

- New technologies such as **Power over Ethernet** and **low-power consumption LED luminaires**, have resulted in a new type of emergency lighting system
- When an emergency system receives power from Class 2 circuits, alternative methods are required to ensure the performance and safety of those systems using line-voltage conductors
- Class 2 emergency lighting circuits are not permitted to be mixed with other wiring
- Circuits to be separated by **bundling** when installed with nonemergency Class 2 circuits
- **If not bundled** and installed with nonemergency Class 2 circuits, the Class 2 emergency circuits are to the **separated by a sleeve or barrier that is nonconductive**
- Protection is to be provided in accordance with a 300.4 wiring method
- (**Note:** *Separation from other classes of circuits must adhere to the system separation rules in 725.136)*

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700.11(C) Wiring, Class 2 Powered Emergency Lighting Systems

New requirements for the separation of **Class 2 circuits** that are designated as emergency or nonemergency circuits used with **emergency systems**

New technologies such as **Power over Ethernet** and low-power consumption **LED luminaires**, have resulted in a new type of emergency lighting system

Circuits to be **separated by bundling** when installed with nonemergency Class 2 circuits

If **not bundled** and installed with nonemergency Class 2 circuits, the Class 2 emergency circuits are to the **separated by a sleeve or barrier that is nonconductive**

Class 2 Powered Circuits

Low-power consumption LED Lighting

201

700.12 General Requirements

(C) Separation of Circuits

A new informational note has been added referencing classification information for emergency power supply systems *(EPSS)* used with **Emergency Systems**

- A task group was formed to harmonize terminology across the *NEC, NFPA 99, NFPA 110, and NFPA 111* that concern emergency and standby power and energy storage
- Clarifies that all EPSS require a minimum of **not less than 2 hours of fuel** for operation *(previously 1 ½ hours of fuel)*
- Ensures all EPSS have the same required rating and capacity to supply and maintain the total load for a **minimum period of 2 hours** without being **refueled or recharged**
- The note references *NFPA 110-2022, Standard for Emergency and Standby Power Systems*

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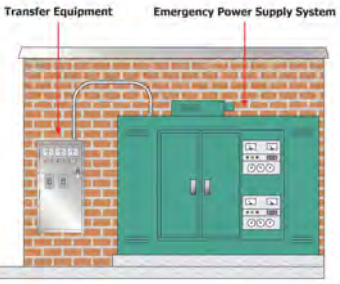
700.12(C) Supply Duration *(Emergency Systems)*

New informational note has been added referencing classification information for **emergency power supply systems *(EPSS)*** used with Emergency Systems

Ensures all EPSS have the same required rating and capacity

Can supply and maintain the total load for a minimum period of **2 hours** without being refueled or recharged



See NFPA 110-2022, Standard for Emergency and Standby Power Systems

203

Photo courtesy of IAEI Archives

204

700.12 & 701.12 General Requirements

(E) Stored-Energy Power Supply Systems *(SEPSS)*

The title of Sections 700.12(E) and 701.12(E) have been changed from "Uninterruptible Power Supplies" to "Stored-Energy Power Supply Systems *(SEPSS)*"

- These revisions expand items that meet the newly defined SEPSS
- This includes items such as a(n):
  - uninterruptible power supply *(UPS)*
  - fuel cell systems
  - energy storage systems *(ESS)*
  - storage batteries for DC loads and
  - any "other" stored energy source complying with 700.12
- New informational note references *NFPA 853-2020, Standard for the Installation of Stationary Fuel Cell Power Systems*, and *NFPA 855-2020, Standard for the Installation of Stationary Energy Storage Systems*

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700.12(E) and 701.12(E) Stored-Energy Power Supply Systems

The title have been changed from Uninterruptible Power Supplies to **Stored-Energy Power Supply Systems *(SEPSS)***

See NFPA 853-2020, Standard for the Installation of Stationary Fuel Cell Power Systems, and NFPA 855-2020, Standard for the Installation of Stationary Energy Storage Systems for more information

All forms of electricity are dangerous and should be addressed by a qualified person *(see Article 100 for definition)*

Examples of Stored-Energy Power Supply Systems *(SEPSS)*

- Uninterruptible Power Supply
- Fuel Cell Systems
- Energy Storage System
- Storage Batteries for DC Loads
- Other Stored Energy Sources complying with 700.12

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700.12 General Requirements

(G) Microgrid Systems

Modified text to recognize there are different types of microgrids, in addition to any that might be categorized as dc only

- On-site sources designated as emergency sources are allowed to be connected to microgrid systems
- When this is done, the non-emergency loads to be isolated from the emergency sources during emergency operations
- Failures with emergency sources require a malfunction signal as required by 700.6
- These conditions should be evaluated during the installation of such a system
- Where a stored-energy emergency source is used as part of the emergency power system, the source is allowed to be charged by other sources *(not only from an emergency source)*
- An assessment is needed to ensure that the lack of any of these sources will not impact the ability of the emergency system to supply the emergency loads

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700.12(G) Microgrid Systems

Modified text to recognize there are different types of microgrids used as emergency sources

On-site sources designated as emergency sources are allowed to be connected to microgrid systems

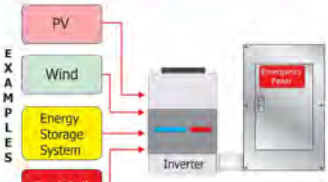
When this is done, **non-emergency loads to be isolated from emergency sources** during emergency operations

These conditions should be evaluated during the installation of the system

Failures with emergency sources require a **malfunction signal** as required by 700.6

EXAMPLES

- PV
- Wind
- Energy Storage System
- Fuel Cell



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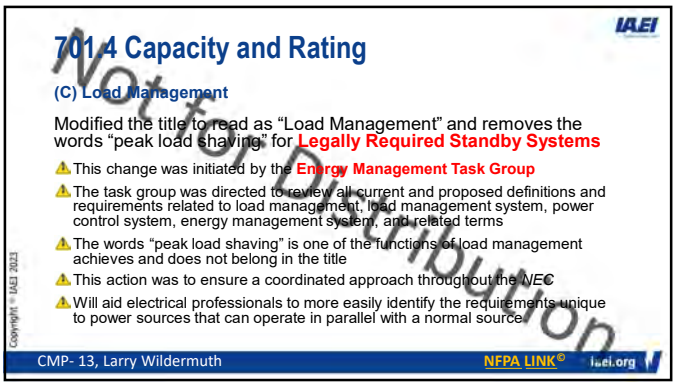

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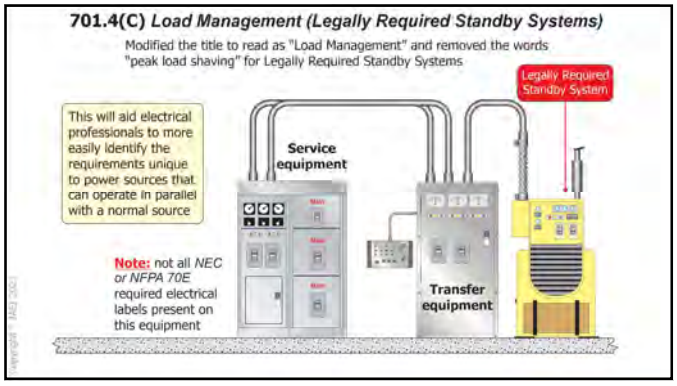

211

212

701.4 Capacity and Rating

(D) Parallel Operation

Added language that identifies two different types of parallel operation, **normal and alternate sources**, of legally required standby systems

- **Normal Source** was added at 701.4(D)(1) to provide the requirements of interconnected electric power production sources found in Article 705
- **Alternate Source** was added at 701.4(D)(2) for paralleling alternate sources of power that are within the requirements of legally required standby systems
- The alternate source is capable of maintaining source capacity while the normal source is being refueled, recharged, or operating at the same time in some application
- These are to be maintained at all times and also comply with Part I and II of Article 705
- Signaling of system malfunction per 701.6(A) now notifies the user of the operating system(s) distress

CMP- 13, Larry Wildermuth, Jr. NFPA LINK© iaei.org

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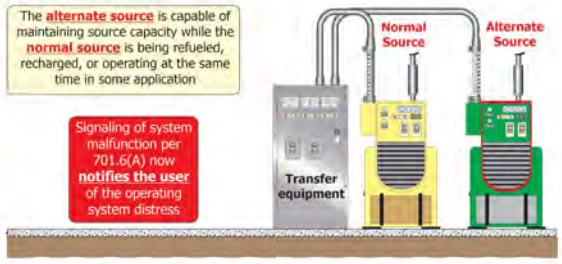
701.4(D) Parallel Operation

Added language that identifies two different types of parallel operation, normal and alternate sources, of legally required systems

The **alternate source** is capable of maintaining source capacity while the **normal source** is being refueled, recharged, or operating at the same time in some application

Signaling of system malfunction per 701.6(A) now **notifies the user** of the operating system distress



214

701.10 Wiring Legally Required Standby Systems

A new first-level subdivision (B) and new figure informational notes were added concerning wiring requirements for **legally required standby systems**

- This addition provides a correlation with 700.10(B)(5)(b)
- These systems are installed to supply legally required loads such as:
  - heating and refrigeration systems
  - communications systems
  - ventilation
  - smoke removal systems
  - sewage disposal
  - lighting systems
  - industrial processes
- Interruption due to a failure could create hazards or hamper first responder operations
- Two new figure informational notes are now included for an understanding of these requirements

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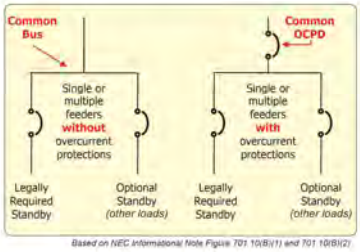
701.10 Wiring Legally Required Standby Systems

A new first-level subdivision (B) and new figure informational notes were added concerning wiring requirements for legally required standby systems

Supplying **legally required standby system** loads such as:
- heating and refrigeration systems
- communications systems
- ventilation
- smoke removal systems
- sewage disposal
- lighting systems
- industrial processes

Note: Interruption due to a failure could create hazards or hamper first responder operations



Based on NEC Informational Note Figure 701.10(B)(1) and 701.10(B)(2)

216

701.12 General Requirements

(C) Supply Chain

A new informational note has been added referencing classification information for **emergency power supply systems *(EPSS)*** used with **Legally Required Standby Systems**

- A task group was formed to harmonize terminology across the *NEC, NFPA 99, NFPA 110, and NFPA 111* that concern emergency and standby power and energy storage
- Clarifies that all EPSS require a minimum of **not less than 2 hours of fuel** for operation *(previously 1 ½ hours of fuel)*
- Ensures all EPSS have the same required rating and capacity to supply and maintain the total load for a **minimum period of 2 hours** without being **refueled or recharged**
- The note references *NFPA 110-2022, Standard for Emergency and Standby Power Systems*

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217

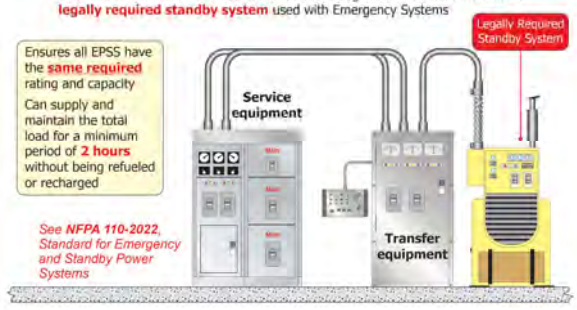
701.12(C) Supply Duration *(Legally Required Standby Systems)*

New informational note has been added referencing classification information for **legally required standby system** used with Emergency Systems

Ensures all EPSS have the **same required** rating and capacity

Can supply and maintain the total load for a minimum period of **2 hours** without being refueled or recharged

*See **NFPA 110-2022**, Standard for Emergency and Standby Power Systems*



218

Article 705
Interconnected Electric Power Production Sources

219

705.11 Source Connections to a Service

This section was rewritten due to numerous public inputs and public comments

- NFPA Correlating Committee *(CC)* established a multi-panel task group to review the requirements in 705.11
- Asked to determine how these requirements will either work with or conflict with the requirements located in Articles 230 and 250
- Grounding and bonding requirements were added at 705.11(E) with a reference to Parts II through V and Part VIII of Article 250 for these requirements
- Without these revisions, the possibility existed for inspectors to improperly enforce some requirements such as what disconnects having to be grouped and what disconnects can be remote from one another

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705.13 Energy Management Systems *(EMS)*

Most of the requirements that were located in 705.13 have been deleted

- Requirements that were previously located in 705.13 were relocated to **Article 750** entitled **Energy Management Systems** which is under the purview of CMP-13
- Should have a positive impact on the electrical industry as the requirements are all now in one location
- Will aid in usability and greater understanding by the electrical professional concerning these requirements

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222

705.13 Energy Management Systems *(EMS)*

Components of a listed energy management system

223

705.20 Source Disconnecting Means

The requirement for enclosure covers requiring a tool to open or a be locked have been deleted from Article 705

- Action was taken due to the language that exists at 404.30
- The information located at 404.30 entitled ***Switch Enclosures with Doors*** will provide the necessary information for these installations, in the sense that when switches are installed, 404.30 will govern
- This information located at 404.30 is applicable throughout the *NEC*
- This will continue to protect unqualified people from accessing the equipment and becoming injured

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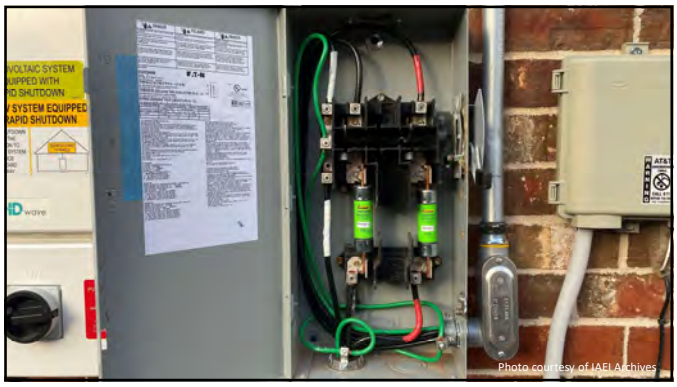

225

705.30 Overcurrent Protection

(F) Transformers

New language has been added addressing transformer requirements for interconnected systems

- Language correlates with the transformer installation rules of Articles 240, 450, and the transformer product safety standard
- The new language defines the primary of a transformer as the side connected to the largest source of available fault-current in alignment with the product safety standard
- Ensure that proper overcurrent protection is provided for transformers where sources of supply are connected to both sides
- Clarifies and adds consistency for the identification of transformer primary and secondary circuits and the overcurrent protection rules
- Simplifies *NEC* text for the electrical professional

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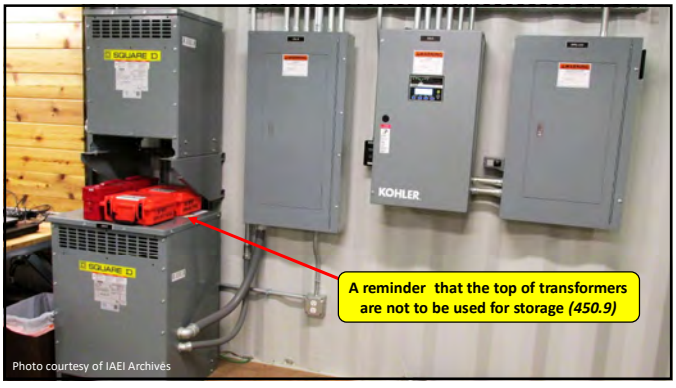

228

705.50 System Operation

Language describing the **operational modes of a microgrid** were rewritten and clearly state that a microgrid can operate in parallel with other systems or in island mode

- Clarification was achieved by rewriting the requirement to make sure the language is consistent with other *NEC* sections
- New Informational Note has been added to address health care facilities that have plans for microgrid installations
- Electrical professionals and health care governing bodies should consult the following documents for additional information
  - *NFPA 70 NEC- Article 517 Health Care Facilities*
  - *NFPA 99 Health Care Facilities Code*

CMP- 4, Jim Rogers

NFPA LINK©

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A Faith Technologies and Schneider Electric renewable energies project in Wisconsin

Microgrid consisting of:

- Solar *(PV)*
- Natural gas generator
- Microturbine
- Fuel Cells
- Batteries

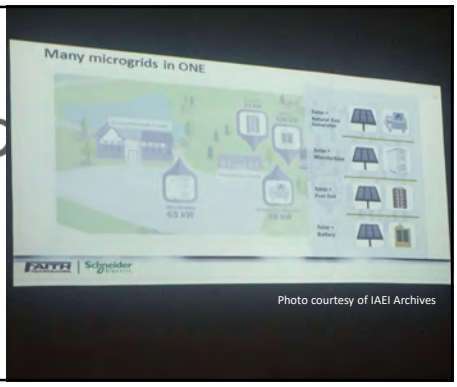

Photo courtesy of IAEI Archives

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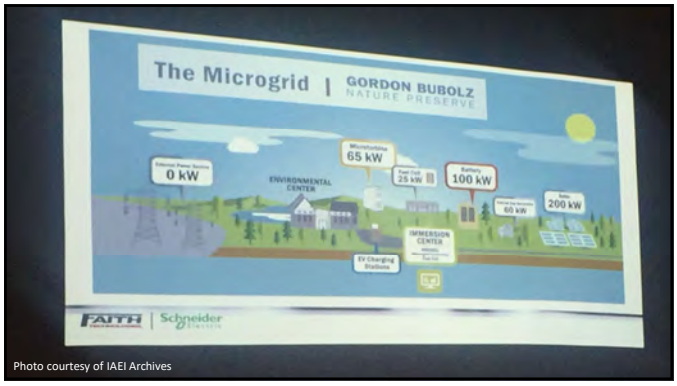

Photo courtesy of IAEI Archives

231

Article 706
Energy Storage Systems

232

706.7 Commissioning and Maintenance

Added commissioning requirements for ESS in a new subsection (A) with the existing requirements for maintenance of these systems moved into the new (B)

- Commissioning requirements have been added and aligned with Chapter 6 of *NFPA 855-2020, Standard for the Installation of Stationary Energy Storage Systems*
- An energy storage system requires the manufacturer or qualified individual to set up the system and equipment to operate properly and in a safe manner
- Examples of items typically covered during commissioning activities include
  - operational controls
  - system sequence of operation and
  - fire safety systems
- These requirements do not apply to one- and two-family dwellings installations
- Informational Note to (B) has been revised to comply with the *NEC Style Manual*

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706.7 Commissioning and Maintenance *(Energy Storage Systems)*

Commissioning requirements were added for energy storage systems (ESS) in a new subsection (A) with the existing requirements for maintenance of these systems moved into the new (B)

An energy storage system requires the manufacturer or qualified individual to set up the system and equipment to operate properly and in a safe manner

Does not apply to one- and two-family dwellings installations

Examples of commissioning activities include:
- operational controls
- system sequence of operation
- fire safety systems

Photo courtesy of Doug Smith

234

Article 722

Cables for Power-Limited Circuits and Fault-Managed Power Circuits

235

Article 722

Cables for Power-Limited Circuits, Fault-Managed Power *(Class 4)* Circuits

- New Article 722 was created for the **general requirements** for these cables
- There are concerns that installations and inspections of Chapter 7 work are not conducted to the level that you would find for installations covered by Chapters 1-4
- In some jurisdictions, an electrical permit is not required for installations of this nature
- Combines common cabling requirements found in Articles 725, 760, and 770 and also relocates other cabling requirements from those articles into a single article
- This change is intended to make it easier for the electrical professional to find requirements, which will aid with installation and enforcement

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Article 725
Class 2 and Class 3 Power-Limited Circuits

238

725.144 Bundling of Cables Transmitting Power and Data

Removed the words "4-Pair" from the title subsection (A) where it was applicable to the types of cables discussed

- This makes it clear that 725.144 applies to any pair cables
- Only subsection (A) and Table 725.144 apply to 4 pair cables
- Subsection (B) covers cables of any pair count and requires an "LP" listing
- See UL 13, *Standard for Safety Power-Limited Circuit Cables* that does not limit rating to 4-pair cables
- This helps both installers and inspectors by providing much-needed clarity with the requirements for 4-pair cables and other cables
- This change also provides a possible placeholder for future requirements concerning single-pair ethernet cables

239

725.144 Bundling of Cables Transmitting Power and Data

Removed the words "4- Pair" from the title and added to the title of subdivision (A) where it was applicable to the types of cables discussed

Makes it clear that 725.144 applies to any pair cables

Subdivision (A), and Table 725.144 apply to 4 pair cables

Subdivision (B) covers cables of any pair count and requires an "LP" listing

UL 13, UL Standard for Safety Power-Limited Circuit Cables

These requirements cover 60-250°C (140-482°F) single- and multiple-conductor power-limited circuit cables for use as fixed wiring within buildings (*some are also marked for direct burial*) principally for Class 3 and Class 2 circuits as described in Article 725 and other applicable parts of the *NEC*

Cables covered by these requirements are:

a) Types CL3P and CL2P (plenum cables),

b) Types CL3R and CL2R (riser cables),

Note: See UL 13 for remaining information

UL 13

STANDARD FOR SAFETY

Power-Limited Circuit Cables

240

Article 726
Class 4 Fault-Managed Power Systems

241

Article 726 Class 4 *(CL4)* Power Systems

A new Article 726 was created for wiring systems and equipment *(including utilization equipment)* for Class 4 fault-managed power *(FMP)* systems

- There have been over 1,000 installations of **"Digital Electricity"** in the United States
- These are mostly at stadiums where large numbers of people gather
- These systems are **not permitted in dwelling units** *(see 726.12)*
- Class 4 systems have ground-fault circuit-interrupter *(GFCI)* equivalent protection *(line to ground)* while also introducing similar protection line to line
- This allows for installations that do not require raceway systems
- The higher voltage associated with this technology leads to lower current allowing the electrical professional to install smaller conductors when compared to 120-volt AC systems

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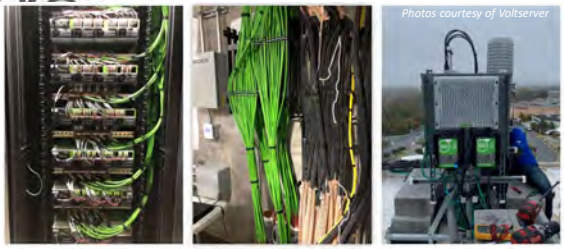
Article 726 Class 4 *(CL4)* Power Systems *(cont.)*



Photos courtesy of Voltserver

Transmitters Structured Cable Receivers

243

Article 726 Class 4 *(CL4)* Power Systems

A new Article 726 was created for wiring systems and equipment *(including utilization equipment)* for Class 4 fault-managed power *(FMP)* systems

Covers installations of wiring systems as well as equipment

Only sections of Article 300 that are referenced by this article shall apply

Circuits are characterized by monitoring and control systems and are different than electric circuits for light and power

Article 726 contains three parts:

Part I. General
Part II. Class 4 Circuits
Part III. Listing Requirements

The "active" component of this type of system **to be listed** as a Type 4 device

A dependent active device example would be a transmitter which relies on a particular receiver as part of a monitoring or control system

These systems are **not permitted** in dwelling units

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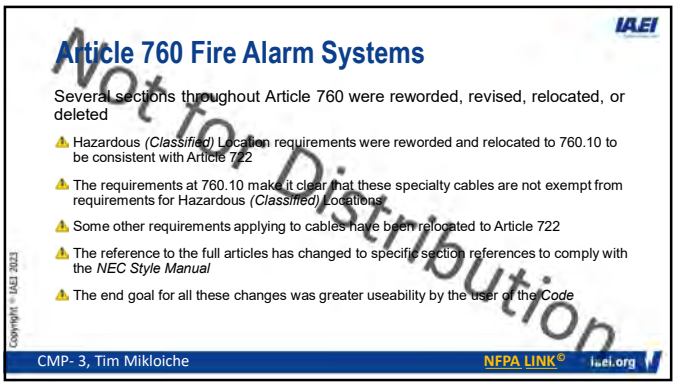

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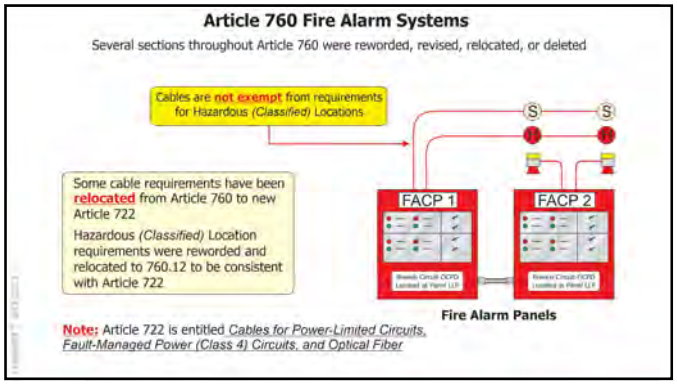

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248

Article 800
General Requirements for Communications Systems

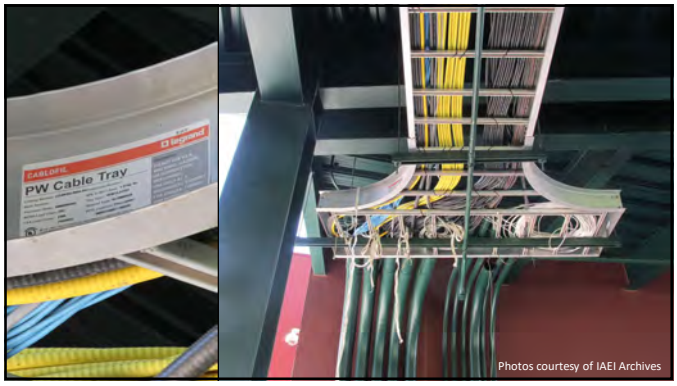
249

800.179 Wires and Cables

Hybrid power and communications cable general requirements moved to Article 800 with the other communication cable types

- Hybrid power and communications cables contain requirements that appear in more than one article
- They are being removed from Article 805 and relocated to Article 800
- Listing and marking requirements were also relocated to Article 800 for enhanced usability
- A voltage rating of 300 volts was clarified to apply to all wires and cables with an exception of CATV-type cables

250



251

Article 805
Communications Circuits

252

805.170 Protectors

Equipment listing requirements were moved to Article 800, leaving two subdivisions (A) and (B) for **primary and secondary** protectors

- Requires listing of primary and secondary protectors
- They are to be listed in accordance with:
  - 805.170(A) Primary Protectors
  - 805.170(B) Secondary Protectors
- Primary and secondary protectors provide protection to sensitive communication equipment by limiting the current below the current-carrying capacity
- Listing is an important part of assuring these items can provide this protection

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805.170 Protectors *(Communication Circuits)*

Primary and secondary protectors provide protection to sensitive communication equipment by **limiting the current** below the current-carrying capacity

Protectors **are to be listed** in accordance with:
805.170(A) Primary Protectors
805.170(B) Secondary Protectors

254

Article 840
Premises-Powered Broadband Communications Systems

255

840.160 Powering Circuits

Changed the reference for premises powering of communication equipment over communication cable from Article 725.154(A) to Article 722.135(E)

- Cable substitution and installation requirements are now in Article 722
- Listing requirements for communications cables moved to Article 800 ***(previously found in Article 805)***
- This relocation resulted in the previous reference to 805.179 for listed communications cables to be incorrect ***(Note: 800.179 for information on Types CMP, CMR, CM, and CMX)***
- Changes the incorrect reference of 725.154(A) and provides the new reference at 722.135(E)
- This was done to make Chapter 8 more user-friendly and helps avoid confusion

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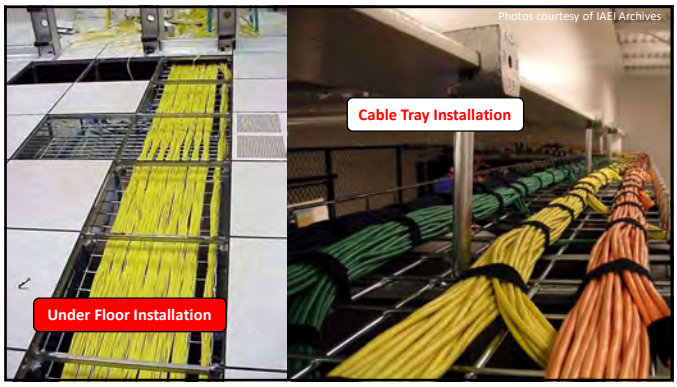

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Chapter 9
Tables and Informative Annexes

- Chapter 9 Table 13
- Informative Annex A
- Informative Annex E

258

Informative Annex A
Product Safety Standards

259

Informative Annex A- Product Safety Standards

The safety standards found within Informative Annex A have been reviewed and revised.

- Revised in order to reflect the current editions of safety standards
- This revision was completed to the latest revisions set forth by the *NEC Style Manual*
- Task groups and participants of a UL research and development project group helped update and address some of the items in this Annex
- In addition, new Table A.1(b) addresses product safety standards for conductors and equipment **that do not have associated listing requirements**

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Informative Annex A- Product Safety Standards

The safety standards found within Informative Annex A have been reviewed and revised

Revised in order to reflect the current editions of safety standards

This revision was completed to the latest revisions set forth by the *NEC Style Manual*

Task groups and participants of a UL research and development project group helped update and address some of the items in this Annex

Table A.1(b) addresses product safety standards for conductors and equipment that do not have associated listing requirements

Table A.1(a) ***Product Safety Standards for Conductors and Equipment that have an Associated Listing Requirement***
(Example of Table Contents)

	Standards Number	Standard Title
Article 110	UL 10C	Positive Pressure Fire Tests of Door Assemblies
	UL 305	Panic Hardware
	UL 486D	Sealed Wire Connector Systems
	UL 62275	Cable Management Systems-Cable Ties for Electrical Installations

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Table 13 Equipment Suitable for *Hazardous (Classified)* Locations

Created new Table 13 in Chapter 9 entitled Equipment Suitable for Hazardous *(Classified)* Locations

- Text has been deleted at 505.9(C)(2)(4) referencing Table 505.9(C)(2)(4) and new text has been added to reference Chapter 9 Table 13
- Requirements at 505.9(C)(2)(4) discuss zone equipment marking requirements
- Table 13 in Chapter 9 provides a complete list of the types of protection for hazardous *(classified)* locations
- Improves the readability of 505.9(C)(2)(4)
- Will assist the electrical professional in verifying compliance with the Code and the manufacturer's listing of the equipment installed in a hazardous *(classified)* location for both zone and other classified locations

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Informative Annex E
Types of Construction

265

Informative Annex E- Fire Resistance Construction

Changes were made at E.2.1 for **Type IV construction** which now includes traditional heavy timber construction and mass timber construction

- Reviewed for correlation with NFPA 5000 *(Building Construction and Safety Code)* and the International Building Code *(IBC 2018)* concerning the various construction types
- The description of Type IV **covering fire resistance construction** types was no longer accurate as it does not discuss **mass timber construction**
- These new changes provide alignment with the model building codes

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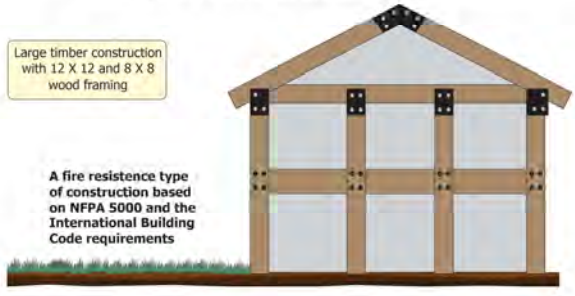
Informative Annex E- Fire Resistance Construction

Changes were made at E.2.1 for Type IV construction which now includes traditional heavy timber construction and mass timber construction



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Informative Annex E- Fire Resistance Construction

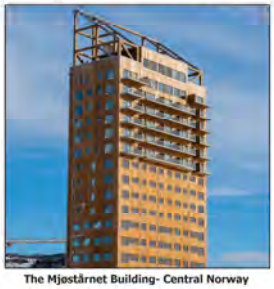
Reviewed for correlation with NFPA 5000 *(Building Construction and Safety Code)* and the International Building Code *(IBC 2018)* concerning the various construction types

This is currently the worlds tallest timber framed building located in Central Norway

The building stands at 280 feet and pushed the limits of architecture

Large timber buildings can result in **greater fire resistance** than metal frame structures

Heat from the fire will cause the metal used in typical metal skyscrapers to sag aiding in structural collapse



The Mjøstårnet Building- Central Norway

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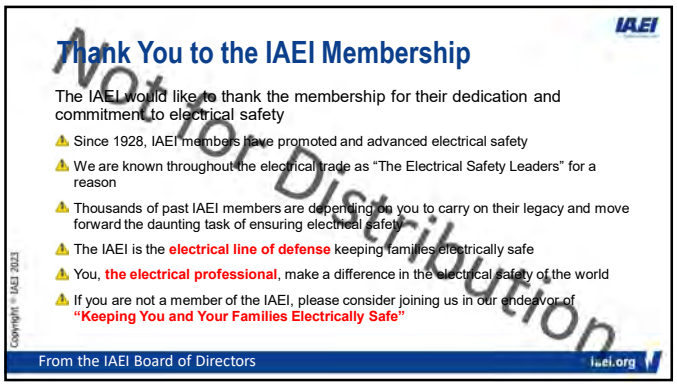
Thank You to the IAEI Membership
The IAEI would like to thank the membership for their dedication and commitment to electrical safety
Since 1928, IAEI members have promoted and advanced electrical safety
We are known throughout the electrical trade as "The Electrical Safety Leaders" for a reason
Thousands of past IAEI members are depending on you to carry on their legacy and move forward the daunting task of ensuring electrical safety
The IAEI is the electrical line of defense keeping families electrically safe
You, the electrical professional, make a difference in the electrical safety of the world
If you are not a member of the IAEI, please consider joining us in our endeavor of "Keeping You and Your Families Electrically Safe"
From the IAEI Board of Directors
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File Attachments for Item:

ER-2 Electrical Safety Inspector Training and Updated 2023 NEC (Sonnenstein Training Agency)

All certifications (25 hours in five sessions)

Staff Notes: There is no slide presentation, only the book. "Students are required to bring their own code book and follow along our screen presentation. It is a lecture presentation with plenty of open discussion and questions."

ESIAC Recommendation:

Committee Recommendation:

APPLICATION

FOR

Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.

Board of Building Standards
6606 Tussing Road, P.O. Box 4009
Reynoldsburg, Ohio 43068-9009
(614) 644-2613 Fax (614) 644-3147
dic.bbs@com.state.oh.us
www.com.state.oh.us/dic/dicbbs.htm

COURSE SUBMITTER:

Course Submitter: Howard Sonenstein (Contact Name)

Organization: Howard Sonenstein Train Agency #253 (Organization/Company)

Address: 1604 SOM Center Rd (Include Room Number, Suite, etc.)

City: Mayfield Hts. State: OH Zip: 44124

E-Mail: HowardSonenstein@aol.com

Telephone: 4403430008 Fax:

Course Sponsor: Howard Sonenstein Train Agency #253

COURSE INFORMATION:

Course Title: Electrical Safty Inspector Training & Updated 2023 NEC

New Course Submittal: ☐ Update Course: ■ Prior Approval Number: BBS 2023 002-008t to BBS-2023011

Purpose and Objective: To review current electrical code updates

This class will identify and teach in the electrical code book with the intent of learning electrical code requirements and how to apply them in chapters 1 through 8 Students are required to bring their code book . And follow along our screened presentation . It is a lecture presentation with plenty of open discussion and questions

Number of Instructional Contact Hours that can be obtained upon completion: 25

If Multi-Session, Number of Instructional Contact Hours Per Session: 5

Program Applicable for the Following Participants:

Building Official ■ Master Plans Examiner ■ Building Inspector ■ Fire Protection Inspector ■ Mechanical Inspector ■
Plumbing Plans Exam. ■ Plumbing Inspector ■
Electrical Plans Exam. ■ Non-Res IU Inspector ■
Mechanical Plans Exam. ■

Res Building Official ■ Res Plans Examiner ■ Res Building Inspector ■ Res Mechanical Inspector ■ Res IU Inspector ■

Electrical Safety Inspectors ☐
Location of ESI Course: See Attached Date(s) of ESI Course(s): See Attached

SUBMITTAL CHECKLIST: **Make Sure** all of the Following Information is **Submitted**		Check Off
Course Submitter:	Name of contact person and their certification numbers, organization, address, fax, phone	
Course Sponsor:	Organization sponsoring or requesting the program (if any)	
Course Title:	Name of course (related to content)	
Purpose/Objective:	Describe purpose and how course will improve competency of certification(s) listed	
Contact Hours:	Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	
Participants:	Check off each certification for which credit is requested (for which course relates to certification)	
Content of Program:	Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered	
Course Materials:	Collated workbooks, handouts, hard copy or electronic versions of program is available	
Instructor(s) Info.:	Resume of professional/educational qualifications & teaching/training experience/BBS certifications	
Test Materials:	Copy of quizzes or tests to be given	
Completed Application:		

NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.

25

25 Hour Electrical Code Class

~~**2020 NEC Analysis of Changes**~~

Course 1 - Day 1 Article 100 Definitions

* Requirement for electrical installations
* Spaces about electric equipment

Course 2 - Day 2 Wiring and Protection

Chapter 2

*Use and identification of grounded conductors
*Branch circuits
*GFCI protection for personnel
*GFCI protection
*Feeders

Course 3 - Day 3

*General requirement for wiring methods and materials.
*Conductors for general wiring.
*Cables permitted uses.

Course 4 - Day 4 Article 700

*Emergency systems
*Energy storage systems
*Critical operation power systems
*Fire alarm

Course 5 - Day 5 Article 800

*General requirement for communication systems
*Overhead communication wires and cables
*Premises powered broadband communication systemscx

Mark J. Patterson

9620 Omega Court • Mentor, OH 44060
440-520-8605 • mpatterson@live.com

31 YEARS EXPERIENCE IN THE CONSTRUCTION AND INSPECTION FIELDS.

Providing a well rounded view of building codes and construction methods, and possessing excellent communication, leadership and management skills, I am able to create an environment that delivers results while fostering trust, integrity, and respect.

CERTIFICATIONS

Building Official (#1133 Ohio) ♦ Residential Building Official (#1133 Ohio) ♦ Building Inspector (#1133 Ohio) ♦ Electrical Safety Inspector (#1133 Ohio) ♦ Certified Flood Plain Manager ASFPM ♦ Journeyman Electrician (Ohio)♦Fire Alarm License (#54-43-0158 Ohio)

PROFESSIONAL HISTORY

LAKE COUNTY BUILDING DEPARTMENT, Painesville, OH (2000-2010)

Supervising Inspector (2006-2010)

Scheduled and conducted building inspections on residential, commercial, and industrial buildings reporting activities to the Chief Building Official.

Essential duties included:

- Interpreting and enforcing the State of Ohio Building Code and other codes pertinent to the department.
- Supervising the inspection staff in review of residential construction documents and specifications for compliance with building codes, state laws, and county resolutions.
- Conferring with contractors, architects, engineers, owners and others regarding compliance and interpretation of building, zoning, fire, American with Disabilities Act, flood plain ordinances and other codes and ordinances being enforced by the County.
- Providing assistance to the general public on requirements for making application for construction or alteration permits.
- Assisting the Chief Building Official with periodic plan review for compliance with the OBC, NEC, NFPA 72, and NFPA13 and other codes and resolutions being enforced by the County.
- Assisting the Chief Building Official in budget presentations for the Lake County Commissioners.
- Supervising the archiving of documents per document retention regulations.

Certified Building/ Electrical Inspector (2003-Present)

- Interpreted and enforced the State of Ohio Building Code and other codes pertinent to the department.
- Reviewed residential construction documents and specifications for compliance with building codes, state laws, and county resolutions.
- Conducted commercial and residential building and electrical inspections.

Mark J. Patterson

Certified Electrical Inspector (2003-Present)

- Interpreted and enforced the State of Ohio Building Code and other codes pertinent to the department.
- Reviewed residential construction documents and specifications for compliance with building codes, state laws, and county resolutions.
- Conducted residential building and commercial electrical inspections.

LOCAL 673 INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS (1980-2000)

Electrical construction union employing journeyman wiremen serving Lake, Geauga, and Ashtabula counties in Northeast Ohio.

Journeyman Wireman (1980-2011)

Worked as a general foreman, foreman, and journeyman wireman and test technician for various contractors on a variety of commercial, industrial and residential jobs, including Perry Nuclear Power Plant, Lake Hospital Systems, and City of Painesville and Lake County government offices.

UNITED STATES AIR FORCE

Crew Chief on F-4 Phantom aircraft. (1977-1980)

Lakeland Community College

Instructor Electrical re-certification course (2009 - Present)

EDUCATION

Journeyman Wireman

Four Year Apprenticeship approved by the State of Ohio

Attended Lakeland Community College

Graduate, Lake Catholic High School

PROFESSIONAL AFFILIATIONS

Building Officials Conference of Northeast Ohio (BOCONEO)
Association of State Flood Plain Managers (ASFPM)
International Code Council (ICC)
International Brotherhood of Electrical Workers (IBEW)
Lake County Citizen Corps

File Attachments for Item:

ER-3 Significant Changes to the 2023 NEC Part A (Electrical Trades Center)

All certifications (10 hours in three sessions: 3.5 + 3.5 + 3)

Staff Notes: Recommend approval.

ESIAC Recommendation:

Committee Recommendation:

Application for Continuing Education Course Approval

Application for Continuing Education Course Approval

Provider Information

Name *	Organization	Email *	Phone Number *
Trent Parker	The Electrical Trades Center-	parker@electricaltrades.org	(614) 463-5282

Address *	City *	State *	Zip Code *
947 GOODALE BLVD	COLUMBUS	OH	43212

Website	Conference Sponsor (if applicable)	Conference Email
electricaltrades.org		

☐ Check here if Course Renewal

Prior course number(s)' (i.e. BBS2018-429)

Renewals will only be granted for identical content and hours, within the current code cycle. Attach a copy of prior course approval letter for confirmation. No further information is required

New Course Information

Course title	Course instructor
Significant Changes to the 2023 NEC Part A	Sam Cronk

Course description

This extensive and popular program analyzes the major changes found in the first two Chapters of the 2023 NEC. Members of the twenty code-making panels contributed to the development of the authoritative text, which covers more than 400 of the most significant changes and includes interpretations by the group that enforces the NEC. This course will provide users a solid understanding and application of the requirements contained in the first two Chapters of the 2023 NEC.

This is a 3 night series that will meet for a total of 10 hours. Nights one and two will meet for 3.5 hours and the third night will meet for 3 hours.

Instructional hours per session	Number of Sessions	Course Date	Course Location
3.5	3	2024-03-11	947 Goodale Blvd. Columbus

Special Content

- ☐ Code Administration
- ☐ Existing Buildings
- ☑ Electrical Instruction
- ☐ Plumbing Instruction

Conference Course	Conference Name	Conference location

445

☐ On Demand ☐ Webinar

Course to be offered online?

- [ ] Yes
- [x] No

Course Website

Detail online course participation confirmation method (i.e. test, quizlets, participant activity confirmation):

Course applicable for the following certifications *

- [ ] Residential Certifications Only
- [x] Administrative Course, All Certifications
- [ ] Commercial and Residential Certifications

Application materials included *

- [x] Course Outline or Course Learning Objectives
- [x] Presentation Materials/Slides (not required for roundtable courses)
- [ ] Assessment Materials (for online courses)
- [x] Presenter Bio
- [ ] Prior Course Approval Letter

Upload less than 100mb (Please attach PDF files only) *

File Name	Size
OBBS PART A.pdf	14.70 MB

Applicant Full Name *

Trent Parker

Date of Submission

09/13/2023

Instructions for new Continuing Education Approval form

Provider Information

1. Please include all contact information.
2. If course is not part of a conference, leave conference sponsor and email blank.

Course Renewal

1. Indicate if the course is being submitted for renewal. Include prior approval letter and write in prior course number.
2. Certification approval for courses has now changed: all existing courses being renewed will be approved within the new classification system.
    a. Courses previously approved for only residential certifications will be approved for all residential certifications.
    b. Courses previously approved for at least one commercial certification will now be approved for all commercial certifications and all residential certifications.
    c. Courses on required instruction topics, Ohio Ethics, Code Administration and Existing Buildings, will be noted as Administrative Courses and be approved for all certifications.
3. Courses being renewed should skip the New Course information section and are not required to submit outline, agenda, slides or other instructional materials for review.

Skip to Special Content, and mark any item that applies to the course.

New Course Information

1. Enter course title, name of instructor, and a brief description of the course content.
Learning objectives may be substituted for course description, if desired.
2. Number of instructional hours per session is the length of instructional time.
3. Number of sessions: can be 1 or the number of sessions planned.
4. Course date(s) and location: not necessary at this time, enter if known.

Special Content

1. Indicate if the course will meet instructional time in Code Administration or Existing Buildings.
2. Indicate if the course is a plumbing or electrical course, for ESIAC review and trainee course tracking.
3. If the course is associated with a conference, indicate the conference name and location, as this will allow BBS to coordinate approvals with the conference provider.
4. If the course will be offered online, specify whether it will be on demand or offered as a virtual webinar, or both. Include website where the course will be provided.

Significant Changes to the NEC 2023 Part A

Syllabus

Course Description: This extensive and popular program analyzes the major changes to the *NEC*. Members of the twenty code-making panels contributed to the development of the authoritative text, which covers more than 400 of the most significant changes and includes interpretations by the group that enforces the *NEC*. This comprehensive course will provide users a solid understanding and application of the requirements contained in the 2023 NEC.

The course is a comprehensive anaylsis of the most important changes found in the first two Chapter of the 2023 NEC.

Prerequisite: None

Required Material: 2023 NEC Codebook
Significant Changes to the NEC 2023 by the NJATC

Course Outline:

Day 1
Introduction, Code-Wide Changes, New Articles for the 2023 NEC

90 Introduction

Chapter 1: General, Articles 100 – 110

100 Definitions
110 Requirements for Electrical Installations

Day 2
Chapter 2: Wiring and Protection, Articles 200 – 220

200 General
210 Branch Circuits
215 Feeders
220 Branch-Circuit, Feeder, and Service Calculations

Day 3
Chapter 2: Wiring and Protection, Articles 225 – 220

225 Outside Branch Feeders and Circuits
230 Services
235 Branch-Circuit, Feeder, and Services over 1000 V
240 Overcurrent Protection
242 Surge Arresters
245 Overcurrent Protection Systems Rated Over 1000V

250 Grounding and Bonding

SAMUEL D. CRONK

459 NORTHWOODS DRIVE
MARYSVILLE, OH 43040

937-642-9352 HOME • 937-266-9550 CELL • spanielhunter1@gmail.com

EDUCATION:

- **Lebanon High School** • Lebanon, VA • Honors Graduate 1985
- **Charleston Trident Technical College** • Charleston, SC • Programmable Logic Controllers

PROFESSIONAL EXPERIENCE:

Assistant Building Official/Building Official – November 2020- Present
Union County Building Department • 233 W 6th St. Marysville., OH 43040

Building Compliance Manager – July 2013 to November 2020
City of Columbus Dept of Building and Zoning Services• 757 Carolyn Ave, Columbus, OH 43224

Electrical Inspection Field Supervisor – November 2002 to July 2013
City of Columbus Dept of Building and Zoning Services • 757 Carolyn Ave, Columbus, OH 43224

Electrical Inspector – August 1998 to November 2002
City of Columbus Dept of Building and Zoning Services • 757 Carolyn Ave, Columbus, OH 43224

Journeyman Wireman – October 1996 to August 1998
Atlas Industrial Electric • 5275 Sinclair Road, Columbus, OH 43229 • 614-841-4500

Electrical Estimator & Project Manager – April 1994 to October 1996
MJB Electric • 804 Busch Court, Columbus, OH 43229 •614-847-1952

Electrician – August 1985 to April 1994

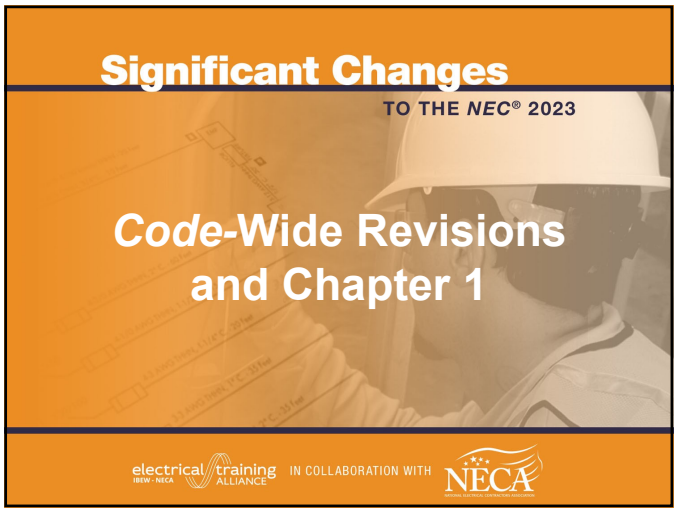
QUALIFICATIONS:

- Extensive knowledge and experience with the interpretation and application of the National Electric Code as it applies to design and installation in industrial, commercial and housing applications.
- Considerable experience working with other professionals, such as engineers and contractors, within the electrical community as well as the general public and homeowners.
- Highly trained, multi-certified journeyman electrician skilled in all aspects of numerous electrical, alarm and signal systems, with 31 years of experience in positions requiring increasing responsibility and managerial skills.
- Superb ability to adapt quickly to changes in policy and procedures.
- Very organized with excellent communication skills.
- Respond well to pressure and consistently meet deadlines with a positive attitude

TRADE ACHIEVEMENTS:

Ohio Certified Building Official, PID# 303
Ohio Certified Residential Building Official, interim, PID# 303
Ohio Certified Building Inspector, interim, PID# 303
Ohio Certified Electrical Safety Inspector, PID# 303
Ohio Certified Electrical Plans Examiner, PID# 303
I.A.E.I. Electrical Code Instructor for the Central Ohio Division
ICC Analysis of the 2005 and 2008 NEC Code Changes Instructor
IBEW Certified Journey Wireman
Former South Carolina Certified Journeyman Wireman
Former Ohio Licensed Electrical Contractor
Former Columbus JATC Instructor (Local 683)
Former Columbus Public Schools Adult Community Education Instructor

REFERENCES AVAILABLE UPON REQUEST



1

Code-Wide Revisions

Reconditioned Equipment

Change Summary

- There are now several reconditioned equipment requirements in the *NEC*.
- The second section of some articles (XXX.2) is now reserved for any requirements that either permit or prohibit reconditioning of equipment that is covered by the article.

2

Code-Wide Revisions

Definitions

Change Summary

- Article 100 now contains all definitions. No definitions will be in the other articles of the *Code*.
- Article 100 will no longer be divided into parts.
- Definitions are assigned to code-making panels based on the articles assigned to the panel and how closely the panel aligns with the definition. The responsible panel is indicated in each definition.
- Some definitions only apply to a single article. Where that is the case, the article number appears toward the end of the definition.
- In a few cases, multiple definitions continue to be required.

3

Code-Wide Revisions

New, Deleted, and Relocated Articles and Revised Article Titles for the 2023 NEC

Change Summary

- Some Articles are new, three were deleted, some had title revisions, and others were relocated.
  - 110 General Requirements for Electrical Installations (Revised title)
  - 210 Branch Circuits, Not Over 1000 Volts ac, 1500 Volts dc, Nominal (Revised title)
  - 235 Branch Circuits, Feeders, and Services Over 1000 Volts ac, 1500 Volts dc, Nominal (New)
  - 245 Overcurrent Protection for Systems Rated Over 1000 Volts ac, 1500 Volts dc, Nominal (New)
  - 305 General Requirements for Wiring Methods and Materials for Systems Rated Over 1000 Volts ac, 1500 Volts dc, Nominal (New)

4

Code-Wide Revisions

New, Deleted, and Relocated Articles and Revised Article Titles for the 2023 NEC (continued)

Change Summary

- 315 Medium Voltage Conductors, Cable, Cable Joints, and Cable Terminations (Revised title and relocated)
- 335 Instrument Tray Cable: Type ITC (Relocated)
- 369 Insulated Bus Pipe (IBP)/Tubular Covered Conductors (TCC) Systems (New)
- 371 Flexible Bus Systems (New)
- 395 Outdoor Overhead Conductors over 1000 Volts (Relocated)
- 480 Stationary Standby Batteries (Revised title)
- 495 Equipment Over 1000 Volts ac, 1500 Volts dc, Nominal (Revised title and Relocated)
- 510 Hazardous (Classified) Locations-Specific (Deleted)

5

Code-Wide Revisions

New, Deleted, and Relocated Articles and Revised Article Titles for the 2023 NEC (continued)

Change Summary

- 512 Cannabis Oil Equipment and Cannabis Oil Systems Using Flammable Materials (New)
- 712 Direct Current Microgrids (Deleted)
- 720 Circuits and Equipment Operating at Less Than 50 Volts (Deleted)
- 722 Cables for Power-Limited Circuits and Fault-Managed Power Circuits (New)
- 724 Class 1 Power-Limited Circuits and Class 1 Power-Limited Remote Control and Signaling Circuits (New)
- 725 Class 2 and Class 3 Power-Limited Circuits (Revised title)
- 726 Class 4 Fault-Managed Power Systems (New)
- 810 Antenna Systems (Revised title)

6

Code-Wide Revisions

***NEC Style Manual* Changes**

Change Summary

- A new version of the style manual was issued in 2020.
- Text was simplified to avoid long paragraphs and long sentences by placing complex requirements into a list format.
- Many of the changes improved readability, and those changes are not covered in this book.

7

Code-Wide Revisions

Medium- and High-Voltage Requirements

Change Summary

- Many medium- and high-voltage requirements were removed from existing articles and moved to an article ending in number 5.
- For example, Article 235 now covers medium- and high-voltage services.
- New articles:
  - 235 Branch Circuits, Feeders, and Services Over 1000 Volts ac, 1500 Volts dc, Nominal
  - 245 Overcurrent Protection for Systems Rated Over 1000 Volts ac, 1500 Volts dc, Nominal
  - 305 General Requirements for Wiring Methods and Materials for Systems Rated Over 1000 Volts ac, 1500 Volts dc, Nominal

8

Code-Wide Revisions

Medium- and High-Voltage Requirements (continued)

Change Summary

- 315 Medium Voltage Conductors, Cable, Cable Joints, and Cable Terminations
- 395 Outdoor Overhead Conductors over 1000 Volts
- 495 Equipment Over 1000 Volts ac, 1500 Volts dc, Nominal

- Articles 395 and 495 were relocated from 399 and 490, respectively, for consistency with the numbering scheme for medium- and high-voltage articles.

9

Code-Wide Revisions

Not a Change?

Change Summary

- Prior to the 2002 *Code*, NM cable was limited to buildings of three stories or less.
- Section 334.10 permitted NM cable in buildings of Types III, IV, and V construction, but the cables had to be concealed within walls, floors, or ceilings that provided a thermal barrier of material that provided at least a 15-minute finish rating.
- Limitations in 334.12 provided some applications and occupancies where NM cable was not permitted to be used.
- *International Building Code* and *NFPA 5000* limited Type IV heavy timber construction to five stories above grade.
- The *NEC* requirements were based on these limitations for 20 years.

10

Code-Wide Revisions

Not a Change? (continued)

Change Summary

- The *International Building Code* changed its definition of Class IV construction to permit a heavy timber constructed building of up to 18 stories.
- *NFPA 5000* permits a Type IV heavy timber constructed building of up to 24 stories.
- These changes resulted in a significant change to the *NEC* that was not processed through the *NEC*.
- CMP 6 did not change the language.
- Significant changes took place in other codes outside of the *NEC* but affect the *NEC*.

11

90.1

NEW

Scope

Change Summary

- Article 90 now has a scope that provides the scope of Article 90, rather than the scope of the *Code*.
- The material previously found in 90.1 has been combined with 90.2, which is now titled “Use and Application.”
- This change provides consistency and clarity but does not make any technical change to the *Code*.

12

90.1

NEW

Article 90 Introduction

90.1 Scope

This article covers use and application, arrangement, and enforcement of this *Code*. It also covers the expression of mandatory, permissive, and nonmandatory text, provides guidance on the examination of equipment and on wiring, planning, and specifies the use and expression of measurements.

~~90.1 Purpose.~~

~~(A) Practical Safeguarding.~~

~~The purpose of this *Code* is the practical safeguarding or persons and property from hazards arising from the user of electricity. This *Code* is not intended as a design specification or an instruction manual for untrained persons.~~

~~(B) Adequacy.~~

...

13

90.2

RELOCATE REORGANIZE

Use and Application

Change Summary

- Section 90.2 has a new title: Use and Application.
- All previous text in Section 90.1 has been blended into a reorganized 90.2
- The titles of 90.2(C) and (D) have been changed to accommodate the reorganization.

14

90.2

RELOCATE REORGANIZE

90.2 Scope Use and Application

(A) Practical Safeguarding (Formerly 90.1(A))

(B) Adequacy (Formerly 90.1(B))

(C) Installations Covered (Formerly 90.2(A))

(D) Installations Not Covered (Formerly 90.2(B))

(E) Relation to Other International Standards (Formerly 90.1(C))

(F) Special Permission (Formerly 90.1(D))

15

90.4

REORGANIZE

Enforcement

Change Summary

- This section was reorganized for clarity.
- A list format is used to make this section clearer.
- A new reference was added to Informative Annex H to comply with the *NEC Style Manual*.

16

90.4

REORGANIZE

17

90.5 (C)

REVISION

Explanatory Material

Change Summary

- If a referenced standard does not have an edition date, the latest edition can be assumed.
- Newer editions of standards could have been released after the *Code* committee considered the latest edition.
- Since references are not mandatory, there is no prohibition against using an updated edition.
- Standards references are for convenience only. Most installations can be completed without referring to the referenced standards.

18

90.5 (C)

REVISION

19

Article 100

REORGANIZE

Article 100 Reorganization

Change Summary

- Article 100 has been consolidated into an article that is not divided into parts.
- All of the definitions from other articles have been relocated into Article 100.
- The XXX.2 sections of various articles no longer contain definitions.
- If a term had multiple uses, it has been modified to facilitate each use. In many cases, terms were modified to cover all appropriate applications.

20

Article 100

REORGANIZE

Article 100 Definitions

~~Part I. General~~
~~Part II. Over 1000 Volts, Nominal~~
~~Part III. Hazardous (Classified) Locations~~

This definition is extracted from the definitions chapter of *NFPA 99* (3.3.30). In most other NFPA documents, definitions are numbered.

Equipment Branch.
A system of feeders and branch circuits arranged for delayed, automatic, or manual connection to the alternate power source and that serves primarily 3-phase power equipment. [99:3.3.30] (517) (CMP-15)

This definition only applies within Article 517.

Assigned Code-Making Panel

The format of many defined terms were edited to comply with the new *NEC Style Manual*. To assist in electronic searching, some defined terms appear in parentheses as it would be found in the document.

Overcurrent Protective Device, Branch-Circuit. (Branch-Circuit Overcurrent Protective Device)
A device capable of providing protection for service, feeder, and branch circuits and equipment over the full range of overcurrents between its rated current and its interrupting rating. (CMP-10)

21

Article 100

REVISION

Definition of Accessible (as applied to wiring methods)

Change Summary

- For a wiring method to be considered accessible, it must not be closed in or blocked by the structure.
- Accessible wiring methods must also not be blocked by other electrical equipment.
- Coordination with other trades is often needed to ensure that accessible wiring methods are not blocked by building mechanical or plumbing systems.

22

Article 100

REVISION

23

Article 100

REVISION

Definition of Attachment Fitting, Weight Supporting

Change Summary

- This definition was revised to better describe the function of WSAF.
- The WSAF is a recognized component that is part of a listed luminaire or paddle fan.
- The combination of the WSAF and WSCR facilitate the modular replacement of luminaires and paddle fans in one- and two-family dwellings.
- Note also at the end of the definition the notation (CMP-18). This indicates the code-making panel that is responsible for the definition.
- NEMA WD6 recognizes WSAF configurations.

24

Article 100

REVISION

Courtesy of SKYX Platforms

25

Article 100

NEW

Definition of Motor Branch Circuit

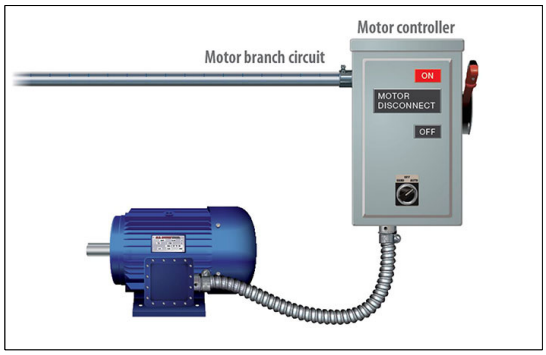
Change Summary

- A new definition was added to differentiate between a branch circuit and a motor branch circuit.
- Branch circuits originate at the last overcurrent protective device supplying the circuit.
- Motor branch circuits include controllers and adjustable speed drives.

26

Article 100

NEW



27

Article 100

NEW

Definition of Class 4 Definitions

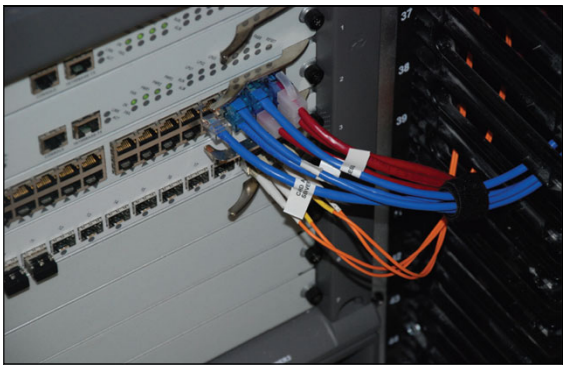
Change Summary

- These definitions are for terms used in new Article 726, Class 4 (CL4) Power Systems.
- Class 4 power systems will be used with equipment used in 5G Internet communications systems.
- A Class 4 Power System is a fault-managed system that relies on a continuous electronic handshake to ensure proper operation.
- Faults in Class 4 Power Systems result in immediate termination of output power.

28

Article 100

NEW



Courtesy of Michael J. Johnston

29

Article 100

NEW

Definition of Clothes Closet Storage Space

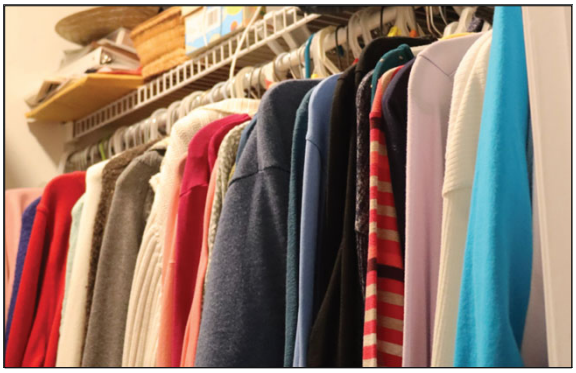
Change Summary

- A new simplified definition for clothes closet storage space has been added to Article 100.
- A clothes closet storage space is the area within a clothes closet in which combustible materials may be kept.
- The requirements for installation of luminaires remains in 410.16.

30

Article 100

NEW



31

Article 100

REVISION

Definition of Commissioning

Change Summary

- Revised definition to provide consistency in a commissioning process.
- Commissioning was previously covered only in Article 708, Critical Operations Power Systems.
- New commissioning requirements are found in 700.3, 701.3, and 706.7.
- Commissioning documentation should include as-built drawings and test results.

32

Article 100

REVISION

Courtesy of PDE Total Energy Solutions

33

Article 100

REVISION

Definition of Corrosive Environment

Change Summary

- Pool chemicals can cause corrosion of electrical equipment.
- Corrosive locations are those where pool sanitizing chemicals are present, and there is inadequate ventilation.
- Reference to *NFPA 400* was removed because it was not helpful for pool electrical equipment installers.
- The reference to the EPA website was removed, as a direct reference to the appropriate publications is more helpful.

34

Article 100

REVISION

35

Article 100

NEW

Definition of Counter (Countertop)

Change Summary

- A new definition was added for “counter (countertop)” to distinguish it from other work surfaces.
- An informational note reference was added for UL standards for receptacles and attachment plugs and GFCI devices.
- A second informational note references requirements for receptacles in countertops and work surfaces.

36

Article 100

NEW

37

Article 100

NEW

Definition of Energized, Likely to Become

Change Summary

- There is a new definition of the term *likely to become energized*.
- The term is used in 25 places in the 2020 *NEC*.
- *Likely to become energized* has been on a list of standard terms used in the *NEC Style Manual*, where it meant "failure of insulation on." The new definition adds electrical spacing failure as an additional consideration.

38

Article 100

NEW

  Courtesy of Michael J. Johnston

39

Article 100

REVISION

Definitions of Equipotential Plane

Change Summary

- There are now two definitions in Article 100 for Equipotential plane.
- The general definition is "Conductive elements that are connected together to minimize the voltage differences." This definition is not limited to a single article.
- The second definition applies to natural and man-made bodies of water. This definition applies only to Article 682.

40

Article 100

REVISION

41

Article 100

NEW

Definition of Fault Managed Power

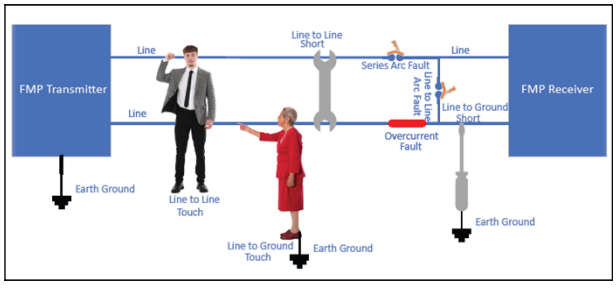
Change Summary

- Fault-managed power is one of the key definitions for new Article 726. Class 4 power systems are fault-managed power systems.
- Class 4 power systems provide a pulsed power output that relies on a continuous handshake to provide fault detection and ensure proper operation.
- Class 4 power systems can supply up to 450 volts dc line-to-line or 225 volts dc to ground to provide power and control of electronic equipment.

42

Article 100

NEW



  Courtesy of Cisco

43

Article 100

NEW

Definition of Fibers/Flyings, Combustible

Change Summary

- A new definition was added for combustible fibers/flyings.
- Combustible fibers/flyings consist of solid particles greater than 500 µm in size that can form an explosible mixture when suspended in air at standard atmospheric pressure and temperature.
- In contrast, combustible dusts consist of solid particles that are 500 µm or smaller that can form an explosible mixture.

44

Article 100

NEW

45

Article 100

NEW

Definition of GFCI, Special Purpose

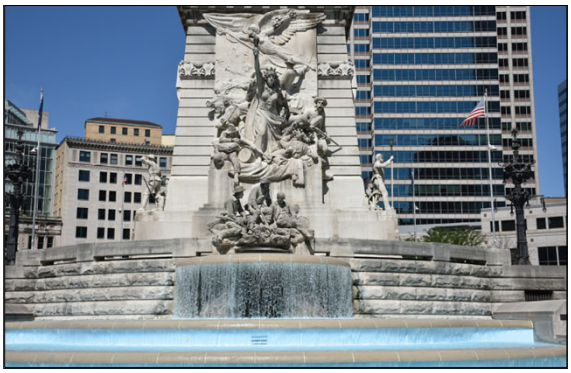
Change Summary

- A new definition was added for Special Purpose Ground-Fault Circuit-Interrupter.
- SPGFCIs are used on circuits with voltage greater than 150 volts to ground.
- Traditional GFCIs are also known as Class A GFCIs. Special purpose GFCIs are either Class C, D, or E GFCIs.

46

Article 100

NEW



47

Article 100

NEW

Definition of Ground-Fault Detector-Interrupter

Change Summary

- GFDI protection is designed to provide ground-fault protection of photovoltaic dc circuits.
- As noted in 690.41(B), equipment that does not have ground-fault protection will often have a warning in the manual that indicates that the unit does not have a GFDI device.
- GFDIs are equipment protection, not personnel protection.

48

Article 100

NEW

49

Article 100

NEW

Definition of Industrial Installation, Supervised

Change Summary

- The term *Supervised Industrial Installation* is used in Articles 240 and 702, but it has been undefined until now.
- Industrial installations typically have a relaxation of some rules of the *Code*, as industrial installations are usually designed, installed, monitored, and maintained by qualified personnel.
- The definition was initially developed by CMP 10 and was revised by a task group including CMPs 1, 10, and 14; it remains limited to Article 240.

50

Article 100

NEW

51

Article 100

REVISION

Definition of Inverter, Multimode

Change Summary

- Multimode inverters can operate in both interactive mode and island mode.
- In the interactive mode, an inverter operates in parallel with the utility and can supply power back to the utility.
- In the island mode, it will separate from the utility to supply power to the premises through an energy storage system.

52

Article 100

REVISION

53

Article 100

REVISION

Definition of Location, Wet

Change Summary

- The definition of “wet location” has been rewritten into a list format.
- The previous format consisted of a sentence with commas, which made it more difficult to interpret.
- An informational note was added that gives an example of a wet location.
- The definitions of damp location and dry location were much shorter and clearer, so no changes to them were necessary.

54

Article 100

REVISION

55

Article 100

NEW

Definition of Locations, Hazardous (Classified)

Change Summary

- A new general definition has been added for Hazardous (Classified) Locations.
- Article 500 defines Classes I, II, and III, as well as the divisions and groups.
- Article 505 provides the classification system for gases, vapors, and liquids using the IEC Zone system.
- Article 506 provides the classification system for dusts and combustible fibers and flyings using the IEC Zone System.
- IEC uses the same zone system for dusts that is uses for fibers and flyings.

56

Article 100

NEW

57

Article 100

NEW

Definition of Microgrid, Health Care

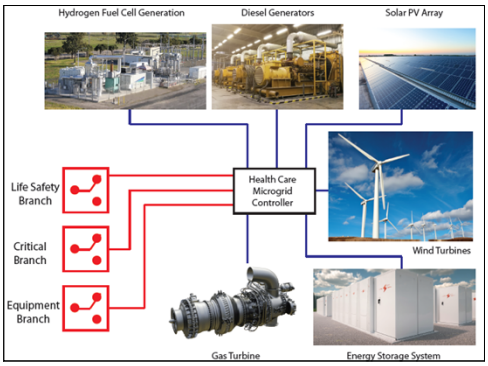
Change Summary

- A health care microgrid is now permitted to be used as the normal power source.
- If a health care microgrid is used as the normal source, it is not permitted to be used as the alternate source.
- Essential electrical systems are permitted to be supplied by a health care microgrid that also supplies non-essential loads.
- Note the nomenclature at the end of the definition that indicates that the source of this definition is *NFPA 99*, the *Health Care Facilities Code*.

58

Article 100

NEW



59

Article 100

NEW

Definitions of Panelboard and Panelboard, Enclosed

Change Summary

- The definition of “panelboard” was revised to recognize panelboards that are installed in an enclosure other than a cabinet or cutout box.
- A new definition was added for an “enclosed panelboard,” which is installed in a cabinet, cutout box, or enclosure suitable for a panelboard application.
- Sections 110.16(A) and 110.26(D) are among the requirements that apply to enclosed panelboards.

60

Article 100

NEW

61

Article 100

NEW

Definition of Receptacle, Weight-Supporting Ceiling

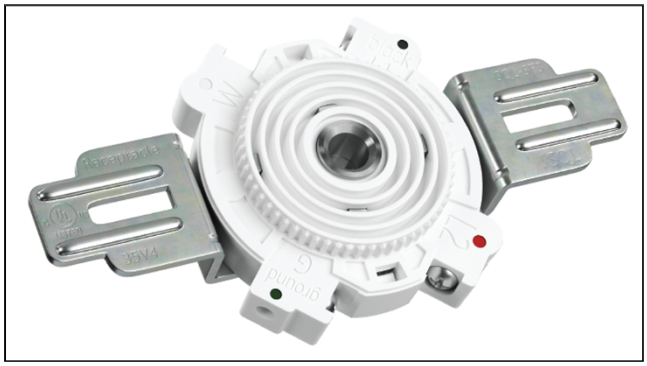
Change Summary

- This is a new definition of a receptacle that was introduced in the 2017 *Code*.
- Weight-supporting ceiling receptacles (WSCR) are contact devices that are designed to mate with a weight-supporting attachment fitting (WSAF) to make an electrical connection and to support the weight of luminaires or paddle fans.
- A WSCR that is listed for fan support can also support luminaires without fans, while a WSCR that is listed for luminaire support will reject a paddle fan.

62

Article 100

NEW



  Courtesy of SKYX Platforms

63

Article 100

NEW

Definition of Servicing

Change Summary

- "Servicing" is defined as: The process of following a manufacturer's set of instructions or applicable industry standards to analyze, adjust, or perform prescribed actions upon equipment with the intention to preserve or restore the operational performance of the equipment.
- "Reconditioned" is defined as: Electromechanical systems, equipment, apparatus, or components that are restored to operating conditions. This process differs from normal servicing of equipment that remains within a facility, or replacement of listed equipment on a one-to-one basis.
- The informational note points out that servicing includes maintenance and repair.

64

Article 100

NEW

Courtesy of Michael J. Johnston

65

Article 100

NEW

Definition of Stranding (Compact and Compressed)

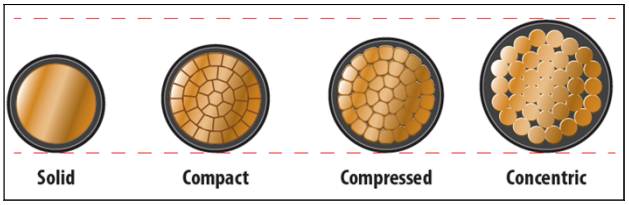
Change Summary

- New stranding definitions have been provided.
- Compact stranding: each layer is pressed together to minimize gaps between strands, reducing the overall diameter.
- Compressed stranding: conductors are pressed together, result is an overall diameter that is less than a concentric stranded conductor but greater than a compact stranded conductor.

66

Article 100

NEW



67

Article 100

REVISION

Definition of Type P Cable

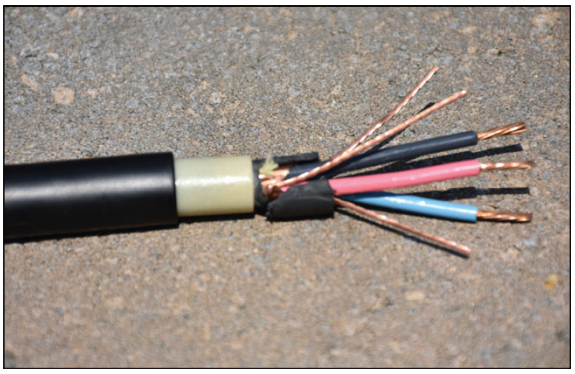
Change Summary

- Type P Cable has been used on drilling rigs for four decades.
- Type P Cable is limited to industrial locations where maintenance and supervision ensure that qualified personnel monitor and service the installation.
- Type P Cable is permitted in hazardous locations, where permitted in the article covering the location.

68

Article 100

REVISION



69

110.3(A)

REVISION

Examination

Change Summary

- Cyber attacks on network connected electronic equipment are an increasing threat.
- Section 110.3(A)(8) now requires the evaluation of cyber security for network-connected life-safety equipment.
- An informational note was added that references standards for including the IEC 62443 series of standards on Industrial Automation and Control Systems and UL standards on cyber security, including UL 2900 and UL 5500.

70

110.3(A)

REVISION

71

110.3(B)

NEW

Installation and Use

Change Summary

- Listed or labeled equipment is required to be installed and used in accordance with any instructions included in the listing or labeling. The same now applies to equipment that is identified for a use.
- Installation instructions are often misplaced after installation. This informational note points out that QR codes on products or information on manufacturer websites can provide installation instructions.
- Online product information is often easier to access after the product is installed.

72

110.3 (B)

NEW

73

110.8

REVISION

Wiring Methods

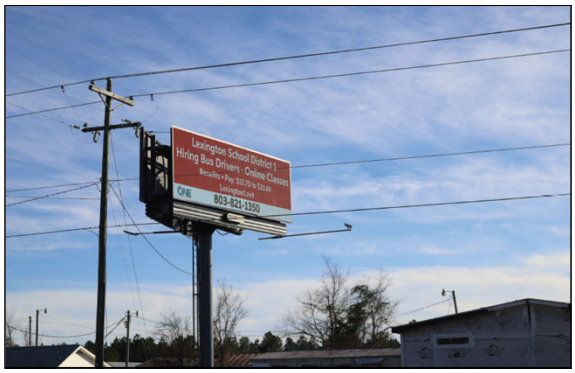
Change Summary

- Section 90.2(C) indicates that if the installation is covered by the *Code*, the wiring methods recognized by the *Code* are permitted to be installed in any building, occupancy, or premises wiring system.
- The definition of premises wiring in Article 100 includes interior and exterior wiring and associated hardware.
- Premises wiring does not include the internal wiring of appliances, luminaires, motor controllers, motor control centers, and similar equipment.

74

110.8

REVISION



75

110.12

REVISION

Mechanical Execution of Work

Change Summary

- The terms *neat* and *workmanlike* were replaced with *professional* and *skillful*.
- This editorial change uses more descriptive and gender-neutral terms.
- The informational note change is simply editorial.
- Informational Note No. 1 to 110.12(C) was deleted because this section applies to cables and conductors; it does not apply to fiber optic cables.

76

110.12

REVISION

77

110.14 (A)

REVISION

Terminals

Change Summary

- The requirement that terminal connections be “thoroughly good” has been replaced with the term *mechanically secure* to replace vague and unenforceable terminology.
- The text was revised to clarify that terminal connections must provide a good electrical connection.
- Requirements for connection methods for certain equipment, such as receptacles (covered by CMP 18), are the responsibility of the panel that covers that equipment.

78

110.14 (A)

REVISION

79

110.16 (B)

REVISION

Service Equipment and Feeder Equipment

Change Summary

- Section 110.16(B) is expanded to apply to feeder supplied equipment, as well as service equipment.
- The requirement has been modified to make it clear that the required label is an arc flash warning label.
- The threshold for a required label has been lowered from 1,200 amperes to 1,000 amperes.
- The requirements for the content of the label have been deleted because they are included in 110.21(B).

80

110.16(B)

REVISION

⚠ WARNING

Arc Flash & Shock Hazard
Appropriate PPE Required

Date Label was Applied_____
Nominal System Voltage_____
Available Fault Current_____
Service Overcurrent Device Clearing Time_____

Arc Flash Boundary_____
At least one of the following:_____
(1) Incident Energy_____ at working distance of_____ or
Arc Flash PPE Category_____
(2) Minimum arc rating of clothing_____
(3) Specific level of PPE_____

Yellow Highlights indicate arc-flash warning label requirements in the NEC

81

110.17

NEW

Servicing and Maintenance of Equipment

Change Summary

- This addition is significant because in addition to requiring a *qualified person* (a defined term), the individual must be a qualified person trained in servicing and maintenance of equipment.
- Servicing and maintenance must be performed in accordance with the manufacturer's instructions and applicable industry standards or as approved by the AHJ.
- Identified replacement parts must be verified under applicable product standards.

82

110.17

NEW

  Courtesy of Burlington Electrical Testing

83

110.20

NEW

Reconditioned Equipment

Change Summary

- Equipment is generally permitted to be reconditioned, unless prohibited elsewhere in the *Code*.
- Requirements are provided for parts and sources of information.
- If listing is required, the equipment must be listed or field-labeled as reconditioned.
- If listing is not required, it must be listed or field-labeled as reconditioned or reconditioned in accordance with the manufacturer's instructions.

84

110.20

NEW

85

110.21(A)

REVISION

Reconditioned Equipment, Marking Requirements

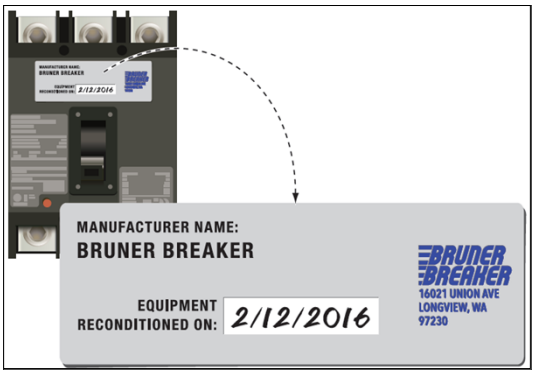
Change Summary

- The marking requirements for reconditioned equipment have been reorganized into list format.
- The original listing mark must be removed or made permanently illegible.
- The original equipment nameplate can remain, but the listing mark must be removed.
- The exception for industrial facilities still applies.

86

110.21(A)

REVISION



87

110.22(A)

REVISION

Identification of Disconnecting Means, General

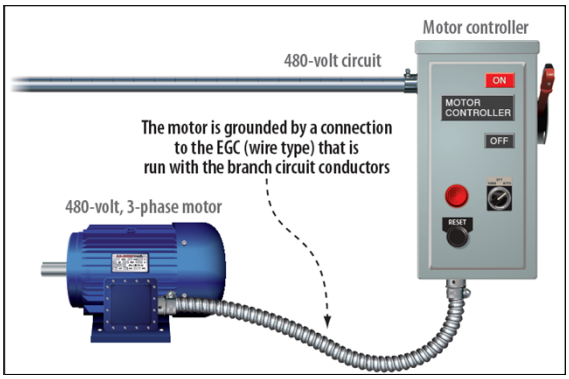
Change Summary

- Disconnecting means are required to be legibly marked to indicate their purpose, unless located and arranged to make the purpose evident.
- The marking must include the identification and location of the circuit source that supplies the disconnecting means, unless located and arranged to make the identification of the circuit source evident.
- This change is intended to make it easier for service personnel to quickly locate the power source. This is especially important in large and high-rise buildings.

88

110.22(A)

REVISION



89

110.26

REORGANIZE

Depth and Width of Working Space

Change Summary

- The requirement that open equipment doors must not impede entry or egress to the working space was relocated from 110.26(C)(2) to 110.26.
- Relocation of the open equipment door requirement to 110.26 means that it now applies to all equipment, not just large equipment.
- Access or egress is impeded if one or more simultaneously-opened equipment doors restricts access to less than 24 inches wide or 6 ½ feet high.

90

110.26

REORGANIZE

91

110.26(A)(4)

REVISION

Limited Workspace Requirements

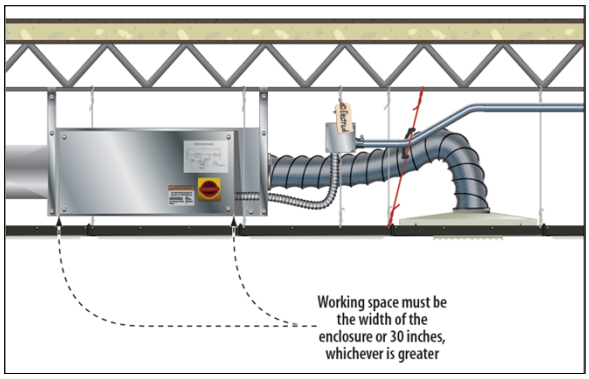
Change Summary

- The limited access workspace requirements were modified to provide requirements for workspaces in front of duct heaters installed above partitions.
- The workspace must be unobstructed to the floor by fixed cabinets, walls, or partitions.
- A horizontal ceiling structural member or access panel is permitted in the space if the location of weight-bearing structural members does not result in a side reach of more than 6 inches to work inside the enclosure.

92

110.26(A)(4)

REVISION



93

110.26(A)(6)

NEW

Grade, Floor, or Working Platform

Change Summary

- Section 110.26 requires access and workspace around all electrical equipment to permit ready and safe operation and to permit maintenance.
- The grade, floor, or platform in the workspace must be clear of obstructions and tripping hazards.
- The grade, floor, or platform in the workspace must be as level and flat as possible.
- Similar requirements have been added to 110.34(A) for equipment operating over 1,000 volts.

94

110.26(A)(6)

NEW

95

110.26(E)

REVISION

Dedicated Equipment Space

Change Summary

- The requirement for dedicated equipment space in 110.26(E) has been expanded to include all service equipment rated 1,000 volts or less.
- The requirement will now include service equipment for one- and two-family dwellings, including the emergency disconnects now required in 230.85
- A service rated disconnect will now have the same equipment space requirements as service rated switchgear and service rated panelboards for 1,000 volts or less.

96

110.26(E)

REVISION

97

Table 110.28

REVISION

Table 110.28 Enclosure Types, Informational Notes

Change Summary

- Informational Note No. 3 was revised to add a reference to 502.10(A)(2) for Class II, Division 1 locations.
- Informational Note No. 5 notes that some Type 4X enclosures are marked “for indoor use only.”
- Informational Note No. 6 notes that some Type 4, 4X, and 12 enclosures are ventilated, but still provide the required ingress protection.
- Informational Note No. 7 references the NEMA Standard for enclosure type ratings.

98

Table 110.28

REVISION

  Courtesy of Michael J. Johnston

99

110.29

NEW

In Sight From (Within Sight From, Within Sight)

Change Summary

- A new requirement has been added that establishes that “in sight from” means that the equipment must be visible and not more than 50 feet from the other equipment.
- This requirement was created to comply with the *NEC Style Manual*.
- Definitions are not permitted to contain requirements. The establishment of limits constitutes a requirement.
- The definition with the requirement still exists.

100

110.29

NEW

101

110.31(A)(4)

REVISION

Locks, Personnel Doors

Change Summary

- Personnel doors for electrical vaults containing equipment rated over 1,000 volts are now required to open at least 90 degrees. These doors are required to be equipped with listed panic hardware or listed fire exit hardware.
- There is a similar requirement in 110.26(C)(3) for equipment rated 1,000 volts and less.
- An informational note was added to reference two UL Standards: UL 305, Standard for Panic Hardware; and UL 10C, Standard for Safety for Positive Pressure Fire Tests of Door Assemblies.

102

110.31(A)(4)

REVISION

103

Significant Changes

TO THE *NEC*® 2023

Chapter 2

electrical training ALLIANCE IN COLLABORATION WITH NECA

1

200.2 (A)

REVISION

General

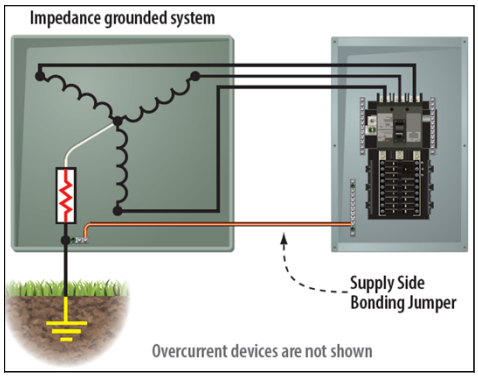
Change Summary

- This section was revised to correlate with the change in 250.36.
- "High-impedance grounded systems" are now referred to as "impedance grounded systems."
- The grounded system conductor of impedance grounded systems is now referred to as the "impedance grounded conductor." This section does not apply to the impedance grounded conductor.
- This section was changed from paragraph to list format.

2

200.2 (A)

REVISION



3

210.6 (D) & (E)

REVISION RELOCATE

Branch Circuit Voltage Limitations

Change Summary

- The voltage limit in Section 210.6(D) was increased from 600 volts between conductors to 1,000 volts between conductors for consistency with other voltage limitations across the *Code*.
- The section has also been revised to reference a limit of 1,500 volts dc between conductors.
- Section 210.6(E) has been deleted.
- A new Article 235 has been created that will contain requirements for medium and high-voltage branch circuits, feeders, and services.

4

210.6 (D) & (E)

REVISION RELOCATE

5

210.8

REVISION

GFCI Protection for Personnel

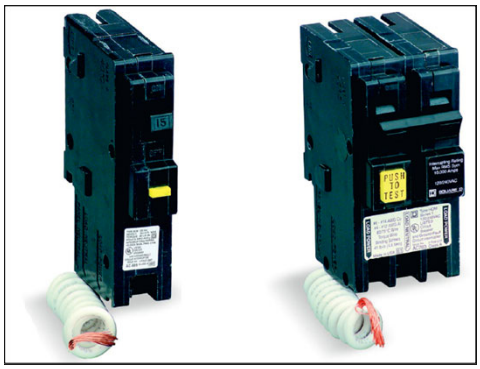
Change Summary

- The term *ground-fault circuit-interrupter protection for personnel* in the first sentence is replaced with the term *listed Class A GFCI*.
- Elsewhere in the section, the acronym GFCI is used to comply with the *NEC Style Manual*, which requires the use of acronyms where practical.
- The definition of “Ground-fault Circuit Interrupter (GFCI)” in Article 100 makes it clear that the term is used to describe a device that is intended to protect personnel. The informational note makes it clear that the device referred to is a Class A GFCI.

6

210.8

REVISION



  Courtesy of Schneider Electric

7

210.8 (A)

REVISION

Dwelling Units

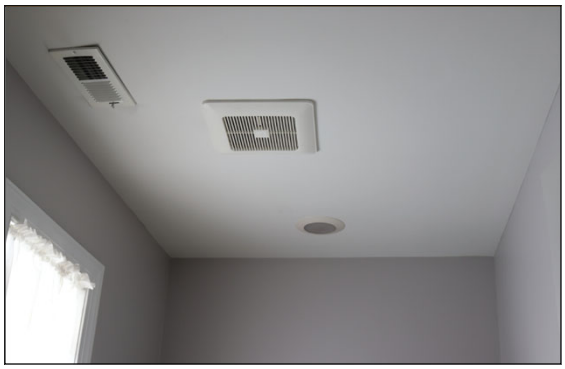
Change Summary

- The reference to fire alarm systems in an informational note to list item (5) has been deleted because it is covered in Article 760.
- GFCI requirements for kitchens now apply to all kitchen receptacles.
- GFCI requirements apply to any area of a dwelling unit with permanent provisions for food preparation, drink preparation, or cooking.
- Receptacles in bathroom exhaust fan assemblies that are not readily accessible do not require GFCI protection.

8

210.8 (A)

REVISION



9

210.8 (B)

REVISION

Other Than Dwelling Units

Change Summary

- The GFCI requirements for other than dwelling units have been revised and clarified.
- List items (3) through (5) have been revised to clarify GFCI requirement for kitchens, food and beverage preparation and food serving areas, and any other preparation or food/beverage serving area where there is also cooking.
- A new requirement for GFCI protection of cord-and plug-connected fixed or stationary appliances has been added.
- A new GFCI requirement for receptacles within 6 feet of aquariums, bait wells, and similar open aquatic vessels or containers has been added.

10

210.8 (B)

REVISION

11

210.8 (D)

REVISION

GFCI Protection for Personnel-Specific Appliances

Change Summary

- In the 2020 *Code*, the determination of which appliances required GFCI protection was assigned to CMP 17, who placed them in 422.5.
- Section 422.5(A) specified several appliances that require GFCI protection. They could be protected via a branch circuit device, or they could be protected by a device in the cord.
- This section contained convoluted cross references to 422.5(A) for the list of appliances and 422.5(B) for the protection method.
- This revision brings back the list of appliances to 210.8, and it now requires GFCI protection of the branch circuit or the outlet.

12

210.8 (D)

REVISION

13

210.8 (F)

REVISION

GFCI Protection for Personnel-Outdoor Outlets

Change Summary

- The requirements of 210.8(F) have been revised to indicate that it applies to all outdoor outlets other than those covered by 210.8(A), Exception No. 1, rated 150 volts or less to ground, and 50 amperes or less.
- A list of three locations has been added to clarify which locations are included.
- If equipment supplied by one of the specified outlets is replaced, the outlet will now be required to be GFCI protected.
- Exception No. 2 does not require GFCI protection for listed HVAC equipment installed prior to September 1, 2026.

14

210.8 (F)

REVISION

15

210.11 (C) (4)

REVISION

Garage Branch Circuits

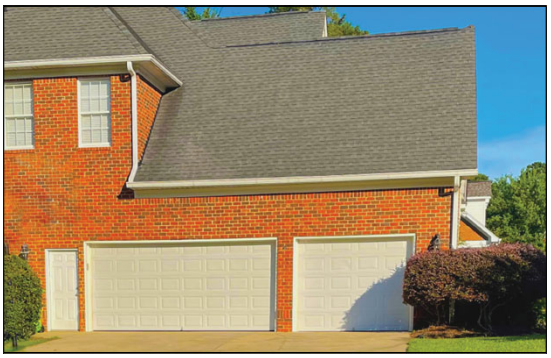
Change Summary

- Section 210.11(C)(4) was revised to clarify that garages must be supplied by at least one 20-ampere branch circuit for receptacles with at least one receptacle for each vehicle bay. The circuits are not permitted to supply other garage receptacles.
- In a single-vehicle bay garage, the circuit is permitted to supply other outlets.
- The 20-ampere branch circuit was previously permitted to supply only readily accessible outdoor receptacle outlets. Exception No. 1 was revised to permit it to supply outdoor receptacle outlets.
- Additional branch circuits rated at least 15 amperes are permitted to supply other receptacle outlets.

16

210.11(C)(4)

REVISION



17

210.12

REVISION

Arc-Fault Circuit-Interrupter Protection

Change Summary

- The main rule of 210.12 was rewritten to align with changes made to the subsections of 210.12, including a new requirement that all AFCIs be listed.
- The title of 210.12(A) was changed to “means of protection.” Information regarding the specific areas of the dwelling unit requiring AFCI protection has been moved into 210.12(B).
- Section 210.12(B), (C), and (D) have been changed into lists.
- Section 210.12(D)(3) has been added to require AFCI protection of 120-volt, single-phase 15- and 20-ampere branch circuits in areas designed exclusively for sleeping in fire stations, stations for rescue squads, and police stations.

18

210.12

REVISION

19

210.18

REVISION

Rating

Change Summary

- Section 210.18 now recognizes 10-ampere individual branch circuits.
- Exception No. 1 has been revised to permit individual branch circuits greater than 50 amperes that supply non-lighting loads in locations with conditions of maintenance to ensure that only qualified persons service the installations. This had previously been limited to industrial locations.
- A new Exception No. 2 was added that prohibits 10-ampere branch circuits from serving receptacle outlets.

20

210.18

REVISION

21

210.19

REVISION RELOCATE

Conductors – Minimum Ampacity and Size

Change Summary

- New branch circuit voltage limits have been added for ac and dc circuits.
- Section 210.19 now applies to branch circuits not exceeding 1,000 volts ac and 1,500 volts dc.
- The requirements for branch circuits exceeding 1,000 volts ac and 1,500 volts dc have been removed from this section and relocated to Article 235.
- There are several minor editorial changes to comply with the *NEC Style Manual*.

22

210.19

REVISION RELOCATE

  Courtesy of Bill McGovern, City of Plano, TX

23

210.23

REVISION

Permissible Loads, Multiple-Outlet Branch Circuits

Change Summary

- New requirements have been added to 210.23(A) for 10-ampere branch circuits.
- This section contains an ascending list from the smallest sized branch circuit to the largest. Therefore, the 10-ampere branch circuits appear first.
- 210.23(A)(1) lists the types of loads that are permitted to be supplied by a 10-ampere branch circuit, while 210.23(A)(2) lists the loads that are not permitted to be supplied by a 10-ampere branch circuit.

24

210.23

REVISION

25

210.52(A)(2)

REVISION

Wall Space

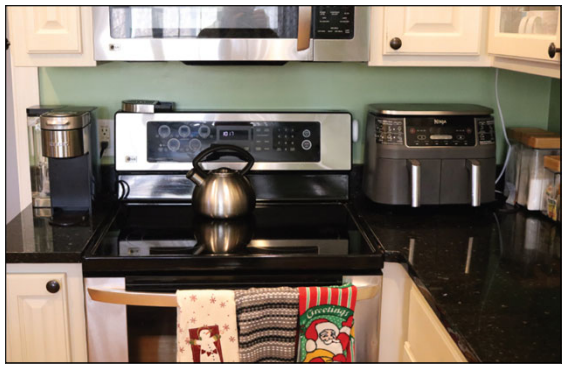
Change Summary

- The criteria for what is considered wall space that requires receptacles in dwelling units has been revised.
- Since there are wall spaces where receptacle installation is impractical, Section 210.52(A)(2) spells out which spaces must be considered wall space for receptacles.
- The space behind stationary appliances has been added to 210.52(A)(2)(1) to indicate that the wall space behind stationary appliances need not be considered as wall space that requires receptacles.

26

210.52(A)(2)

REVISION



27

210.52(C)

REVISION

Countertops and Work Surfaces

Change Summary

- A new exception was added to 210.52(C)(1) for countertops with wall space where a receptacle cannot be installed in the required wall space to permit installation as near as practicable.
- Receptacles are no longer required in 210.52(C)(2) for island and peninsular counter tops. If not installed, provision is required for a future installation.
- Receptacles are permitted to be in or on but not below countertops.

28

210.52 (C)

REVISION

Courtesy of ABB Inc.

29

210.70

REVISION

Lighting Outlets Required

Change Summary

- Section 210.70 has been revised to make it clear that switches of control devices are not permitted to rely only on battery power unless the lighting outlets are energized upon battery failure.
- A lighting outlet that is controlled by a listed wall-mounted control device is now required in laundry areas of dwelling units.
- A lighting outlet is required for exterior illumination of exits or entrances of dwelling units, attached garages, and detached garages with power. This does not apply to doors for vehicles.
- Dimmer control of lighting in accordance with 210.70(A)(2)(3) is not permitted, unless the listed control devices can provide dimming control that can provide maximum brightness at each location for stairway illumination.

30

210.70

REVISION

31

215.15

NEW

Barriers

Change Summary

- The widespread acceptance of *NFPA 70E, Electrical Safety in the Workplace*, has brought attention to the need to prevent electrical hazards that can exist while trying to establish an electrically-safe work condition.
- In the 2020 *Code*, the requirements for barriers in panelboards, switchboards, and switchgear were relocated from 408.3(A)(2) to 230.62(C), where they only applied to services.
- A similar hazard exists for panelboards, switchboards, switchgear, and motor control centers that are supplied by feeders or transformer secondary conductors.

32

215.15

NEW

33

215.18

NEW

Surge Protection

Change Summary

- During the 2020 *Code* cycle, a new surge protection requirement was added for dwelling unit services in 230.67 (expanded for 2023).
- Surge protection is now required for feeders that supply dwelling units, dormitory units, guest rooms and guest suites of hotels and motels, and patient sleeping rooms of nursing homes and limited care facilities.
- The use of sensitive electronic equipment in these newly added areas, supplied by services, is identical to its usage in dwelling units.
- A similar requirement was adopted in 225.42 for outside feeders.

34

215.18

NEW

35

Article 220

REORGANIZE

Article 220 Reorganization

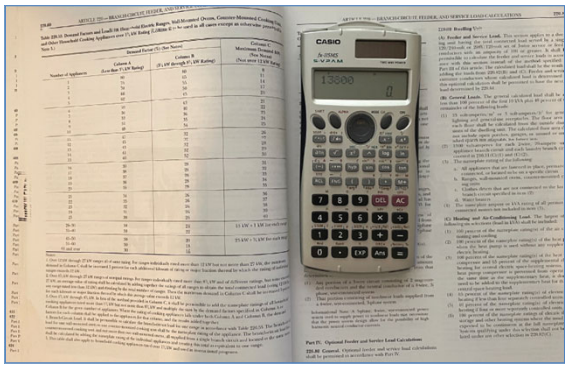
Change Summary

- Article 220 has been rewritten to improve its usability. This change covers the reorganization only.
- Requirements that were in 220.11 and 220.10 were moved from Part II, Branch-Circuit Load Calculations, to Part I, General.
- Section 220.12 was relocated to Part III because it addresses feeder and service load calculations.
- Sections 220.14(J), (K), and (M) were relocated to 220.41, 220.43, and 220.44, respectively, because they deal with loads.

36

Article 220

REORGANIZE



37

220.5 (C)

REVISION

Floor Area

Change Summary

- Section 220.11 has been relocated from Part II of Article 220 to become 220.5(C).
- Garages and unfinished spaces, as well as unused spaces, are now included in the floor area calculations.
- Open porches continue to not be included in the floor area calculation if they cannot be adapted for future use as a habitable room or occupiable space.

38

220.5 (C)

REVISION

39

220.42

REVISION

Lighting Load for Non-Dwelling Occupancies

Change Summary

- The lighting load requirements for non-dwelling occupancies have been moved from Part II to Part III, Feeder and Service Load Calculations.
- The informational note to 200.42(A) points out that unit load conditions of the table are now based on minimum load conditions and 80% power factor, not 100%, as previously indicated. These values might not provide sufficient capacity.
- The note to the table has been revised to make it clear that no additional multiplier is required for the unit loads.

40

220.42

REVISION

41

220.50

REVISION

Motors and Air-Conditioning Equipment

Change Summary

- The title of Section 220.50 has been changed to “Motors and Air-Conditioning Equipment” to reflect the fact that it also provides a reference to the requirements for hermetic refrigerant motor-compressors.
- The section has been reformatted to clearly delineate the requirements for motors from those for air-conditioning equipment.
- The air-conditioning requirements now reference all of Part IV of Article 440 for sizing of the branch circuit conductors.

42

220.50

REVISION

43

220.53

REVISION

Appliance Load — Dwelling Units

Change Summary

- Section 220.53 permits a demand factor of 75% to be applied to the nameplate rating of four or more appliances fastened in place rated at least ¼ horsepower or 500 watts.
- Electric vehicle supply equipment has been added to the list of loads that are not permitted to have a reduced demand factor.
- Section 625.41 requires that the EVSE branch circuit be sized for continuous duty loads.

44

220.53

REVISION

45

220.57

NEW

Electric Vehicle Supply Equipment (EVSE) Load

Change Summary

- A new requirement has been added for sizing the load for electric vehicle supply equipment.
- The load must be sized at 7,200 volt-amperes or the nameplate rating of the equipment, whichever is larger.
- An informational note was added to reference 625.42, which provides the requirement for sizing an EVSE circuit.

46

220.57

NEW

47

220.60

REVISION

Noncoincident Loads

Change Summary

- This section covers requirements for calculating noncoincident loads on feeders and services. Noncoincident loads are loads that are unlikely to be used simultaneously, such as heating and air conditioning.
- The largest of the loads is permitted to be used for calculating the size of the feeder or service.
- Where a motor or air-conditioning load is part of the noncoincident load and is not the largest of the noncoincident loads, 125% of the larger of the motor load or the air-conditioning load must be used.

48

220.60

REVISION

49

220.70

NEW

Energy Management Systems (EMSs)

Change Summary

- Section 220.70 will allow listed energy management systems to be used to limit the load on feeders or services.
- Upon malfunction, the EMS must disconnect the loads.
- Access to the settings must be restricted to authorized personnel in accordance with 750.30(C)(3).
- There are field marking requirements indicating the maximum current setting, the date of the calculation and setting, and identification of current-limited loads and sources.

50

220.70

NEW

51

220.110

NEW

Receptacle Loads – Health Care Facilities

Change Summary

- Demand factors for receptacle loads in health care facilities have been added in 220.110, which is located in the new Part VI, Health Care Facilities.
- These new requirements are based on receptacle load data from health care facilities.
- Since load calculations and demand factors are found in Article 220, the demand factors are referenced in 517.22.

52

220.110

NEW

53

220.120

REVISION

Receptacle Loads

Change Summary

- Table 555.6 has been relocated to 220.120.
- The relocation of demand factors is consistent with the decision to place requirements for demand factors in health care facilities into 220.110.
- Note No. 2 was revised to provide a method for shore power load calculations for slips using individual kilowatt-hour submeters.
- A new note has been added to the table that notes that if a circuit feeds a boat hoist and shore power for the same boat slip, only the load with the larger demand factor must be counted in the calculation because the loads are not coincident.

54

220.120

REVISION

55

225.41

NEW

Emergency Disconnects

Change Summary

- One- and two-family dwelling units that are supplied by a feeder now require an emergency disconnect that is installed in an outdoor, readily accessible location.
- If more than one disconnect is required, they must be grouped.
- The disconnecting means must be marked “EMERGENCY DISCONNECT.”
- The disconnect marking is required to be on the outside front of the enclosure. The label must be red with white lettering.

56

225.41

NEW

57

225.42

NEW

59

225.42

NEW

Surge Protection

Change Summary

- During the 2020 cycle, a new surge protection requirement was added for dwelling unit services in 230.67 (expanded for 2023).
- Surge protection is now required for outside feeders that supply dwelling units, dormitory units, guest rooms and guest suites of hotels and motels, and patient sleeping rooms of nursing homes and limited care facilities.
- A similar requirement is now located in 215.18 for feeders.
- There is no exception for outside feeder equipment for remotely-located SPD protection for upstream feeder or service equipment.

58

230.7

REVISION

Other Conductors

Change Summary

- Service conductors have been prohibited from being in the same cable or raceway with branch-circuit or feeder conductors.
- Service conductors are now also prohibited from being installed in underground boxes or handhole enclosures with branch-circuit or feeder conductors.
- Intermingling service conductors with other conductors is a hazard to workers and to connected equipment.
- Grounding electrode conductors and supply-side bonding jumpers are permitted in the same raceway or enclosure as the service conductors.

60

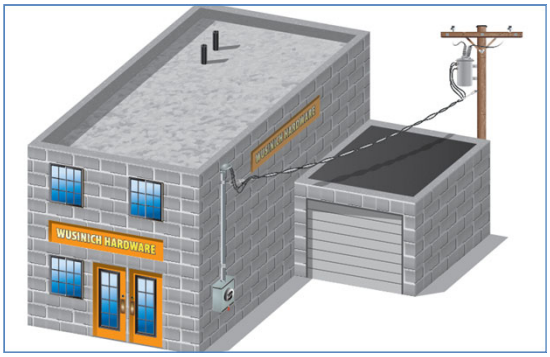
230.7

REVISION

61

230.24 (A)

REVISION



63

230.24 (A)

REVISION

Above Roofs

Change Summary

- The requirement for the minimum vertical clearance of overhead conductors above a roof surface has been increased from 2.5 meters (8 ft.) to 2.6 meters (8 ft. 6 in.)
- The vertical clearance extends 3 feet in every direction from the edge of the roof.
- The minimum clearance requirement for service conductors was less than for feeder conductors. Service conductors would be a greater hazard to workers on roofs than feeder conductors.
- The metric conversion in 225.19(A) was incorrect in the last edition of the *Code*.

62

230.43

REVISION

Wiring Methods for 1000 Volts, Nominal, or Less

Change Summary

- The list of permitted wiring methods for service entrance conductors has been revised.
- Type TC-ER cable is permitted where it is identified for use as service conductors.
- Flexible bus systems are a new wiring method that is now permitted for services.
- Article 371 provides installation requirements for flexible bus systems.

64

230.43

REVISION

65

230.62 (C)

REVISION

Barriers

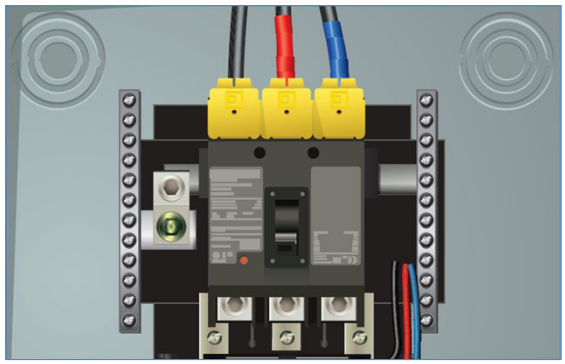
Change Summary

- Barriers are required in service equipment to minimize the likelihood of inadvertent contact with uninsulated, and ungrounded, service busbars and terminals.
- This requirement has been revised to make it clear that the requirement applies to protection from contact when the service disconnect is in the open position.
- The conductors and terminals being protected by barriers will remain energized when the service disconnect is in the open position.

66

230.62 (C)

REVISION



67

230.67

REVISION

Surge Protection

Change Summary

- Surge protection will now be required to be provided in service equipment for dormitories, guest rooms and guest suites of hotels and motels, and sleeping areas of nursing homes and limited care facilities.
- With the expansion of the requirements, the section was reformatted into list format.
- Surge protective devices must have a nominal discharge current rating of not less than 10 kA.

68

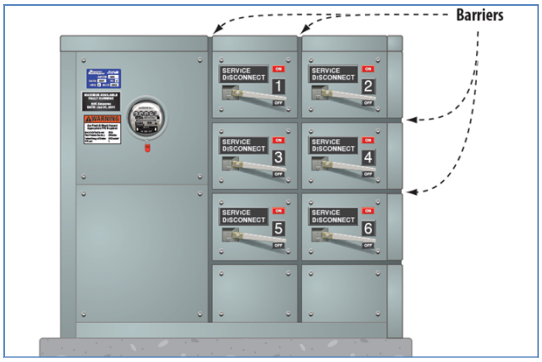
230.67

REVISION

69

230.71 (B)

REVISION



71

230.71 (B)

REVISION

Two to Six Service Disconnecting Means

Change Summary

- The requirements for barriers in vertical sections of switchboards were clarified.
- Transfer switches in service equipment are now required to be in separate compartments.
- Barriers between a service disconnect for a motor control center and motor disconnects are now required.
- An exception was added that permits the addition of service disconnects (up to six) in a single enclosure in an existing installation that was installed in compliance with editions of the *Code* prior to 2020.

70

230.85

REVISION

Emergency Disconnects

Change Summary

- Section 230.85 was rewritten into a list format and the language was clarified.
- An exception was added to not require an outdoor service disconnect to be readily accessible, where an outdoor feeder disconnect is installed in accordance with 225.41.
- If multiple disconnects are required, they must be grouped.
- If disconnects are replaced, all of the requirements of this section apply. However, the exception to (C) permits some repairs.

72

230.85

REVISION

73

Article 235

NEW

Branch Circuits, Feeders, and Services Over 1000 Vac…

Change Summary

- A new Article 235 has been created that covers requirements for branch circuits, feeders, and services over 1,000 volts ac or over 1,500 volts dc.
- This change is intended to locate the medium-voltage requirements to improve usability and clarity.
- Corresponding requirements have been deleted from Articles 210, 215, and 230.

74

Article 235

NEW

75

240.2

NEW

Reconditioned Equipment

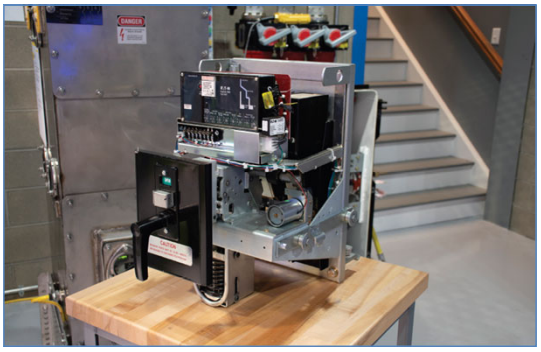
Change Summary

- Section 240.2 has been created to indicate which equipment is permitted to be reconditioned.
- Equipment not permitted to be reconditioned includes GFPE, GFCI, low-voltage fuseholders, low-voltage nonrenewable fuses, molded-case circuit breakers, and low-voltage circuit breaker electronic trip units.
- Equipment permitted to be reconditioned includes low-voltage power circuit breakers, electromechanical relays, and current transformers.
- Reconditioned equipment covered by Article 240 must be listed.

76

240.2

NEW



Courtesy of Eaton

77

240.4 (B)

REVISION

Overcurrent Devices Rated 800 Amperes or Less

Change Summary

- Conductors must be protected from overcurrent in accordance with their ampacity. Where the ampacity does not equal a standard OCPD rating, the next standard size (not to exceed 800 amperes) is permitted to be used in accordance with 240.4(B).
- An adjustable trip OCPD is permitted to be used as long as the setting does not exceed the next standard rating size above the conductor ampacity.
- The means to adjust the setting of the adjustable trip mechanism must have restricted access in accordance with 240.6(C).

78

240.4 (B)

REVISION

Courtesy of Michael J. Johnston

79

240.6 (D)

NEW

Remotely Adjustable Trip Circuit Breakers

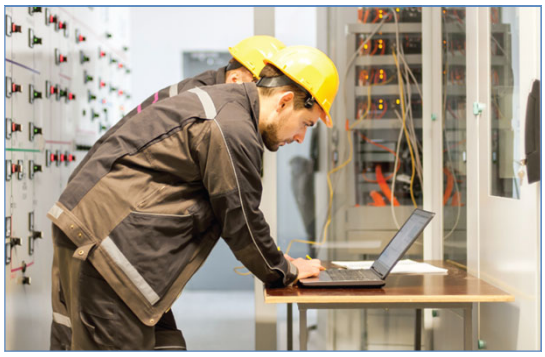
Change Summary

- Remotely adjustable circuit breakers are permitted to have an ampere rating that is equal to the adjusted current setting (long-time pickup setting).
- Access can be achieved directly through a local nonnetworked interface or through a networked interface where the circuit breaker and software are identified as being evaluated for cybersecurity or the network has had a documented cybersecurity assessment.
- Two informational notes were added that reference cybersecurity standards and recognized methods of commissioning to identify cyber threats.
- A third informational note points out that continuous vigilance is necessary.

80

240.6 (D)

NEW



81

240.7

NEW

Listing Requirements

Change Summary

- Branch-circuit overcurrent protective devices are now required to be listed.
- The listing standards include *UL 489 Standard for Safety: Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures*, and *UL 1066 Standard for Safety: Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures.*
- Products that are not listed must be evaluated for safety in accordance with 110.3(A) as the basis for approval by the AHJ. Jurisdictions do not have the facilities to properly evaluate circuit breakers.

82

240.7

NEW

Courtesy of Michael J. Johnston

83

240.11

NEW

Selective Coordination

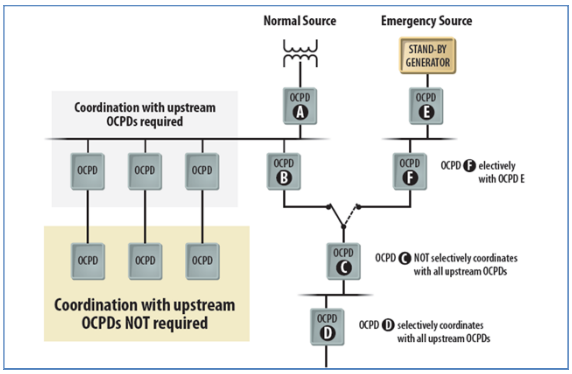
Change Summary

- Selective coordination of overcurrent protective devices limits the extent of an outage without opening the service.
- If there are feeders connected to the service that have loads that are not required to be coordinated, the uncoordinated loads could be capable of opening the service OCPD.
- The 2023 *Code* requires that when feeders are connected to a service that has loads that are required to be selectively coordinated, the feeders are also required to be selectively coordinated.

84

240.11

NEW



85

240.24

REVISION

Location in or on Premises

Change Summary

- The use of a tool to access overcurrent protective devices will be permitted in enclosures designed for hazardous (classified) locations and for enclosures to protect against environmental conditions.
- Branch-circuit overcurrent protective devices will not have to be accessible to all residents in sleeping rooms in dormitory units.
- The prohibition against locating overcurrent protection in bathrooms of dwelling units, dormitory units, and guest rooms and guest suites has been expanded to include all bathrooms, showering facilities, and locker rooms with showering facilities.

86

240.24

REVISION

87

240.89

NEW

Replacement Trip Units

Change Summary

- Replacement trip units for circuit breakers must be listed for use in the specific circuit breaker type.
- The trip unit may be identical to the original, or it could provide additional features.
- Listing ensures that the new trip unit will not compromise the operation of the circuit breaker.
- This action correlates with the action taken during the 2020 cycle in 490.21(A)(5) for circuit breakers rated over 1,000 volts (245.21(A)(5) in this edition).

88

240.89

NEW

89

242.9

NEW

Indicating

Change Summary

- Surge protective devices are required to provide an indication that they are operating properly.
- A surge protective device can be damaged by a high-level surge, even if it has protected the equipment.
- Previously, the occupant may not have known that the SPD operation may have damaged it, precluding future protection.

90

242.9

NEW

91

242.42

REVISION

Surge Arrester Rating

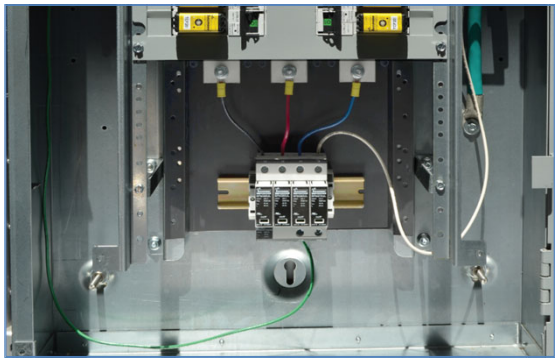
Change Summary

- Previously, the rating of a surge arrester was required to be equal to or greater than the maximum continuous operating voltage at the point of application.
- The duty cycle is now required to be not less than 125% of the maximum continuous operating voltage available at the point of application.
- The reference to silicon-carbon type surge arresters was deleted because they are no longer manufactured.

92

242.42

REVISION



93

Article 245

NEW

Overcurrent Prot. Sys. Rated Over 1000 Vac, 1500 Vdc

Change Summary

- A new Article 245 has been created on overcurrent protection for systems rated over 1,000 volts ac and 1,500 volts dc.
- This new article will replace previous requirements for systems over 1,000 volts, which were located in Articles 240 and 490.
- This is one of several new articles that are intended to enhance the *NEC*'s coverage of medium- and high-voltage applications.

94

Article 245

NEW

  Courtesy of Michael J. Johnston

95

245.2

REVISION

Reconditioned Equipment

Change Summary

- This section was revised, placed into list format, and relocated to become 245.2.
- Medium- and high-voltage circuit breakers are now permitted to be reconditioned.
- Electromechanical protective relays and current transformers are now permitted to be reconditioned.
- Medium-voltage fuseholders and medium-voltage nonrenewable fuseholders are not permitted to be reconditioned.

96

245.2

REVISION

97

250.6

REVISION

Objectionable Current

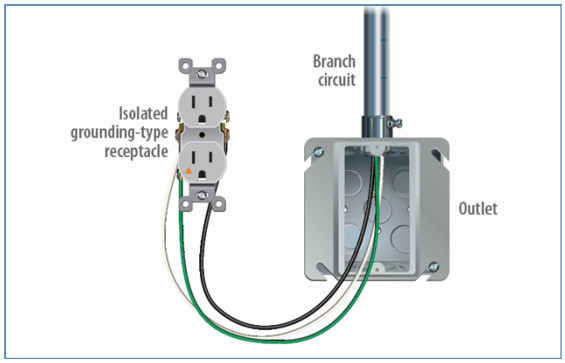
Change Summary

- This section was revised to recognize that bonding of various parts of electrical systems and equipment can also cause objectionable currents.
- 250.6(B) now provides remedies to objectionable currents resulting from bonding.
- 250.6(C) was revised to recognize that currents resulting from abnormal conditions may not be temporary and could also exist due to required grounding and bonding connections.

98

250.6

REVISION



99

250.20

REVISION

Alternating-Current Systems to Be Grounded

Change Summary

- Alternating current systems are now required to be grounded in accordance with 250.20, unless prohibited elsewhere in the *Code*.
- A new informational note has been added to point to specific examples of applications where grounding is prohibited. In addition, 250.22 was deleted because it was a reference to some of these requirements elsewhere in the *Code*.
- 250.20(D) was revised to recognize that impedance grounded systems do not have a neutral conductor.

100

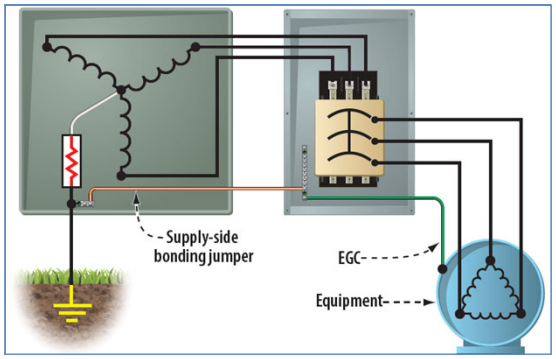
250.20

REVISION

101

250.24

REVISION



103

250.24

REVISION

Grounding of Service-Supplied AC Systems

Change Summary

- The term *high impedance grounded system* is now changed to *impedance grounded system.*
- The conductor that connects to the neutral point through an impedance is not a grounded conductor – it is an impedance grounded conductor. Correlating changes were made in 250.36.
- Parallel grounded service conductors in two or more parallel raceways are required to be connected in parallel. The grounded conductor in each raceway is to be sized based on the conductor in the raceway.

102

250.36

REVISION

Impedance Grounded Systems – 480 V to 1000 V

Change Summary

- The term *high impedance grounded neutral system* is now changed to *impedance grounded system.*
- The conductor that connects to the neutral point through an impedance is not a grounded conductor – it is an impedance grounded conductor.
- The conductor is also not a neutral conductor.

104

250.36

REVISION

105

250.64

REVISION

Courtesy of Copperweld Bimetallics LLC

107

250.64

REVISION

Grounding Electrode Conductor Installation

Change Summary

- Section 250.64(B) has been updated to include copper-clad aluminum conductors in the requirements for securing and supporting.
- Section 250.64(D)(2)(2) has been revised to recognize that some buildings are supplied by branch circuits, rather than by feeders or services. This removes a conflict with 250.24(A)(1).
- A new 250.64(G) was added to prohibit grounding electrode conductors from being run through the ventilation openings of equipment.
- There were several minor editorial corrections in this section.

106

250.68 (C)

REVISION

Grounding Electrode Conductor Connections

Change Summary

- Interior metal piping that is electrically continuous with a metal underground water pipe electrode that is not more than 5 feet from the point of entrance is permitted to extend the grounding electrode.
- The measurement has been clarified in three places to make it clear that the measurement is along the water piping.
- In 250.68(C)(2) and (C)(3), there were references to “the usual steel tie wires” without explanation. The phrase “the usual” was deleted.

108

250.68 (C)

REVISION

109

250.94 (B)

REVISION

Bonding for Communications Systems-Other Means

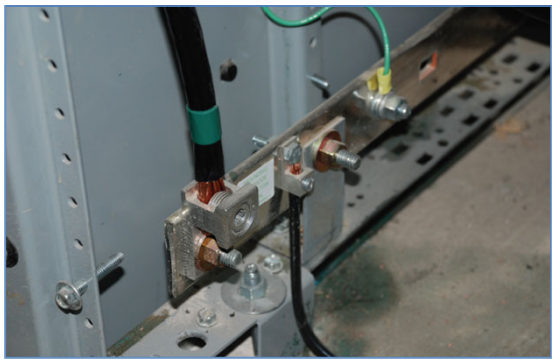
Change Summary

- Section 250.94(B) was revised to clarify the requirement for the connection to a busbar, which is connected to the grounding electrode conductor. The conductor must be the larger of one of the following:
  - A conductor that is sized at least as large as the largest conductor connected to the busbar.
  - A 6 AWG conductor in accordance with 250.94(A)(4)

110

250.94 (B)

REVISION



111

250.104 (C) & (D)

REVISION

Bonding of Piping Systems and Exposed Struct. Metal

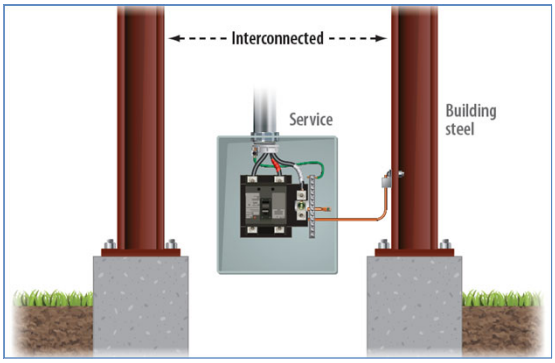
Change Summary

- Changes were made in 250.104(C) to replace the vague language about conductors of “sufficient size” with a reference to Table 250.102(C)(1) to specify the size.
- Changes were made in 250.104(D)(3) to make it clear that the piping being referred to is metal water piping.
- Changes were also made to recognize that connections to grounding electrodes in the earth may be extended through portions of the pipe or structural electrodes that are above ground, provided the installation complies with 250.68(C).

112

250.104 (C) & (D)

REVISION



113

250.118

REVISION

Types of Equipment Grounding Conductors

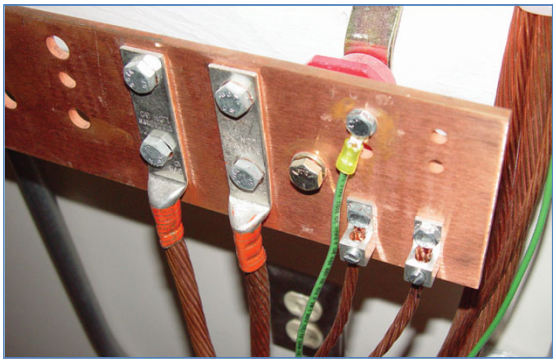
Change Summary

- Section 250.118, Types of Equipment Grounding Conductors, was reformatted into two subdivisions: (A) Permitted, and (B) Not Permitted.
- Section 250.118(A)(5)(f) and (A)(6)(f) were added for locations where there is a need for high resistance to corrosion. A stainless-steel core has a higher electrical resistance than other metals used in the construction of liquidtight flexible metal conduit. The bonding jumper can be internal or external to the liquidtight flexible metal conduit.
- A requirement for a bonding jumper was also added to 250.118(A)(5)(e).

114

250.118

REVISION



Courtesy of Michael J. Johnston

115

File Attachments for Item:

ER-4 Significant Changes to the 2023 NEC Part B (Electrical Trades Center)

All certifications (10 hours in three sessions: 3.5 + 3.5 + 3)

Staff Notes:

ESIAC Recommendation:

Committee Recommendation:

Application for Continuing Education Course Approval

Application for Continuing Education Course Approval

Provider Information

Name *	Organization	Email *	Phone Number *
Trent Parker	The Electrical Trades Center-	parker@electricaltrades.org	(614) 463-5282

Address *	City *	State *	Zip Code *
947 GOODALE BLVD	COLUMBUS	OH	43212

Website	Conference Sponsor (if applicable)	Conference Email
electricaltrades.org		parker@electricaltrades.org

☐ Check here if Course Renewal

Prior course number(s)' (i.e. BBS2018-429)

Renewals will only be granted for identical content and hours, within the current code cycle. Attach a copy of prior course approval letter for confirmation. No further information is required

New Course Information

Course title: Significant Changes to the 2023 NEC PartB

Course instructor: Sam Cronk

Course description

This extensive and popular program analyzes the major changes to Chapters 3 and 4 of the 2023 NEC. Members of the twenty code-making panels contributed to the development of the authoritative text, which covers more than 400 of the most significant changes and includes interpretations by the group that enforces the NEC. This comprehensive course will provide users a solid understanding and application of the requirements contained in Chapters 3 and 4 of the 2023 NEC.

Instructional hours per session	Number of Sessions	Course Date	Course Location
3.5	3		947 Goodale Blvd. Columbus

Special Content

- ☐ Code Administration
- ☐ Existing Buildings
- ☑ Electrical Instruction
- ☐ Plumbing Instruction

Conference Course	Conference Name	Conference location

Course to be offered online?

- ☐ Yes
- ☑ No

☐ On Demand ☐ Webinar

Course Website

508

Detail online course participation confirmation method (i.e. test, quizlets, participant activity confirmation):

Course applicable for the following certifications *

- [ ] Residential Certifications Only
- [x] Administrative Course, All Certifications
- [ ] Commercial and Residential Certifications

Application materials included *

- [x] Course Outline or Course Learning Objectives
- [x] Presentation Materials/Slides (not required for roundtable courses)
- [ ] Assessment Materials (for online courses)
- [x] Presenter Bio
- [ ] Prior Course Approval Letter

Upload less than 100mb (Please attach PDF files only) *

File Name	Size
OBBS PART B 2023.pdf	7.51 MB

Applicant Full Name *

Trent Parker

Date of Submission

09/13/2023

Instructions for new Continuing Education Approval form

Provider Information

1. Please include all contact information.
2. If course is not part of a conference, leave conference sponsor and email blank.

Course Renewal

1. Indicate if the course is being submitted for renewal. Include prior approval letter and write in prior course number.
2. Certification approval for courses has now changed: all existing courses being renewed will be approved within the new classification system.
    a. Courses previously approved for only residential certifications will be approved for all residential certifications.
    b. Courses previously approved for at least one commercial certification will now be approved for all commercial certifications and all residential certifications.
    c. Courses on required instruction topics, Ohio Ethics, Code Administration and Existing Buildings, will be noted as Administrative Courses and be approved for all certifications.
3. Courses being renewed should skip the New Course information section and are not required to submit outline, agenda, slides or other instructional materials for review.

Skip to Special Content, and mark any item that applies to the course.

New Course Information

1. Enter course title, name of instructor, and a brief description of the course content.
Learning objectives may be substituted for course description, if desired.
2. Number of instructional hours per session is the length of instructional time.
3. Number of sessions: can be 1 or the number of sessions planned.
4. Course date(s) and location: not necessary at this time, enter if known.

Special Content

1. Indicate if the course will meet instructional time in Code Administration or Existing Buildings.
2. Indicate if the course is a plumbing or electrical course, for ESIAC review and trainee course tracking.
3. If the course is associated with a conference, indicate the conference name and location, as this will allow BBS to coordinate approvals with the conference provider.
4. If the course will be offered online, specify whether it will be on demand or offered as a virtual webinar, or both. Include website where the course will be provided.

Significant Changes to the NEC 2023 Part B

Syllabus

Course Description: This extensive and popular program analyzes the major changes to the *NEC*. Members of the twenty code-making panels contributed to the development of the authoritative text, which covers more than 400 of the most significant changes and includes interpretations by the group that enforces the *NEC*. This comprehensive course will provide users a solid understanding and application of the requirements contained in the 2023 NEC.

The course is a comprehensive anaylsis of the most important changes found in the Chapter's 3-4 of the 2023 NEC.

Prerequisite: None

Required Material: 2023 NEC Codebook
Significant Changes to the NEC 2023 by the NJATC

Course Outline:

Day 1 Chapter 3: Wiring Methods, Articles 300 – 358

300 Wiring Methods and Materials
305 Systems Rated Over 1000V
312 Cabinets, Cutout Boxes, and Meter Socket Enclosures
314 Outlet, Device, Pull, and Junction Boxes; Conduit Bodies; Fittings; and
Handhole Enclosures
315 Medium Voltage Conductors and Cables
342 Intermediate Metal Conduit: Type IMC
344 Rigid Metal Conduit: Type RMC
352 Rigid Polyvinyl Chloride Conduit; Type PVC
358 Electrical Metallic Cable: Type EMT

Day 2 Chapter 3: Wiring Methods, Articles 300 – 398 and Chapter 4: Equipment for General Use, Articles 400 – 410

362 Electrical Nonmetallic Tubing: Type ENT
369 Insulated Bus Pipe: Type IBP
370 Cablebus
400 Portable Power Feeder Cables
404 Switches
406 Receptacles, Cord Connectors, and Attachment Plugs (Caps)
408 Switchboards, Switchgear, and Panelboards
409 Industrial Control Panels
410 Luminaires, Lampholders, and Lamps

Day 3: Chapter 4: Equipment for General Use, Articles 411 – 495

411 Lighting Systems Operating at 30 Volts or Less and Lighting Equipment Connected
to Class-2 Power Sources
422 Appliances
424 Fixed Electric Space-Heating Equipment
430 Motors
440 AC & Refrigeration Equipment
445 Generators
450 Transformers and Transformer Vaults
460 Capacitors
480 Stationary Standby Batteries
498 Equipment Over 1000 V AC

SAMUEL D. CRONK

459 NORTHWOODS DRIVE
MARYSVILLE, OH 43040

937-642-9352 HOME • 937-266-9550 CELL • spanielhunter1@gmail.com

EDUCATION:

- **Lebanon High School** • Lebanon, VA • Honors Graduate 1985
- **Charleston Trident Technical College** • Charleston, SC • Programmable Logic Controllers

PROFESSIONAL EXPERIENCE:

Assistant Building Official/Building Official – November 2020- Present
Union County Building Department • 233 W 6th St. Marysville., OH 43040

Building Compliance Manager – July 2013 to November 2020
City of Columbus Dept of Building and Zoning Services• 757 Carolyn Ave, Columbus, OH 43224

Electrical Inspection Field Supervisor – November 2002 to July 2013
City of Columbus Dept of Building and Zoning Services • 757 Carolyn Ave, Columbus, OH 43224

Electrical Inspector – August 1998 to November 2002
City of Columbus Dept of Building and Zoning Services • 757 Carolyn Ave, Columbus, OH 43224

Journeyman Wireman – October 1996 to August 1998
Atlas Industrial Electric • 5275 Sinclair Road, Columbus, OH 43229 • 614-841-4500

Electrical Estimator & Project Manager – April 1994 to October 1996
MJB Electric • 804 Busch Court, Columbus, OH 43229 •614-847-1952

Electrician – August 1985 to April 1994

QUALIFICATIONS:

- Extensive knowledge and experience with the interpretation and application of the National Electric Code as it applies to design and installation in industrial, commercial and housing applications.
- Considerable experience working with other professionals, such as engineers and contractors, within the electrical community as well as the general public and homeowners.
- Highly trained, multi-certified journeyman electrician skilled in all aspects of numerous electrical, alarm and signal systems, with 31 years of experience in positions requiring increasing responsibility and managerial skills.
- Superb ability to adapt quickly to changes in policy and procedures.
- Very organized with excellent communication skills.
- Respond well to pressure and consistently meet deadlines with a positive attitude

TRADE ACHIEVEMENTS:

Ohio Certified Building Official, PID# 303
Ohio Certified Residential Building Official, interim, PID# 303
Ohio Certified Building Inspector, interim, PID# 303
Ohio Certified Electrical Safety Inspector, PID# 303
Ohio Certified Electrical Plans Examiner, PID# 303
I.A.E.I. Electrical Code Instructor for the Central Ohio Division
ICC Analysis of the 2005 and 2008 NEC Code Changes Instructor
IBEW Certified Journey Wireman
Former South Carolina Certified Journeyman Wireman
Former Ohio Licensed Electrical Contractor
Former Columbus JATC Instructor (Local 683)
Former Columbus Public Schools Adult Community Education Instructor

REFERENCES AVAILABLE UPON REQUEST

Significant Changes

TO THE *NEC*® 2023

Chapter 4

electrical training ALLIANCE IBEW - NECA IN COLLABORATION WITH NECA

1

400.40 through 400.52

NEW REVISION

Portable Power Feeder Cables Over 2000 V, Nominal

Change Summary

- Article 400, Part III has a title change. It now covers portable cables of over 600 volts up to 2,000 volts.
- A new Part IV was added on portable power feeder cables over 2,000 volts, nominal.
- Portable power feeder cables can be used for connection of portable equipment and machinery or for wiring of cranes and hoists. Portable power feeder cables can also be used for temporary services and other temporary installations.

2

400.40 through 400.52

NEW REVISION

3

404.1

REVISION

Scope

Change Summary

- Article 404 applies to all switches, switching devices, and circuit breakers used as switches.
- Article 404 typically applies to switches operating at 1,000 volts or less but can apply to switches operating at higher voltages as specifically referenced elsewhere in the *Code*.
- There is a new generation of wireless control switches that are battery operated. These wireless switches are not covered by Article 404.
- An informational note was added that points to 210.70, which now has requirements that apply to wireless switches.

4

404.1

REVISION

5

404.14 & 404.14 (D)

NEW REVISION

Snap Switch Terminations

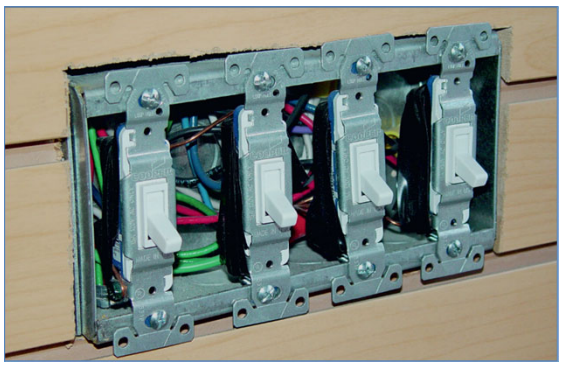
Change Summary

- Section 404.14 has been revised to require that switches be listed and marked with their ratings.
- New 404.14(D) was added to provide requirements for conductors used on the terminals of switches based on the markings of the switches.
- Section 404.14(D)(3) also addresses the limited use of push-in terminals, which are restricted to 14 AWG copper conductors only.

6

404.14 & 404.14 (D)

NEW REVISION



7

404.16

NEW

Reconditioned Equipment

Change Summary

- Lighting, dimmer, and electronic control switches are not permitted to be reconditioned.
- Snap switches are an inexpensive and easily-replaceable item. Therefore, they are not permitted to be reconditioned.
- Knife switches, switches with butt contacts, and bolted pressure switches are permitted to be reconditioned.

8

404.16

NEW

Courtesy of Leviton

9

404.30

NEW

Switch Enclosures with Doors

Change Summary

- Doors of enclosures for switches that provide access to live parts when opened must be constructed so that either a tool or other approved means is necessary to open the door if the switch is in the closed position.
- A similar change was made in 690.13(A) and 690.15(A) during the 2020 cycle.
- This does not prohibit the use of a lock to prevent access.
- These changes are intended to restrict access by unqualified persons. The primary intent is to protect children.

10

404.30

NEW

Courtesy of Michael J. Johnston

11

406.3

REVISION

Receptacle Rating and Type

Change Summary

- The title of 406.3(C) has been changed to CO/ALR Receptacles.
- Section 406.3(D) has been added to cover requirements for termination of conductors to receptacles.
- Push-in terminals are only listed for 14 AWG copper conductors and can only be used to connect receptacles on 15-ampere branch circuits.

12

406.3

REVISION

13

406.4

REVISION

General Installation Requirements

Change Summary

- Section 406.4(D)(3) now requires replacement GFCI-type receptacles to be listed.
- Section 406.4(D)(5) provides requirements for replacement tamper-resistant receptacles. A tamper-resistant receptacle is not required if a non–grounding-type receptacle is replaced with another non–grounding-type receptacle. A tamper-resistant receptacle is also not required if a CO/ALR receptacle is replaced with another CO/ALR receptacle.
- Replacement receptacles must be provided with GFPE if required elsewhere in the *Code*.
- Floor receptacles must be protected in accordance with 406.4(G).

14

406.4

REVISION

15

406.9

REVISION

Receptacles in Damp or Wet Locations

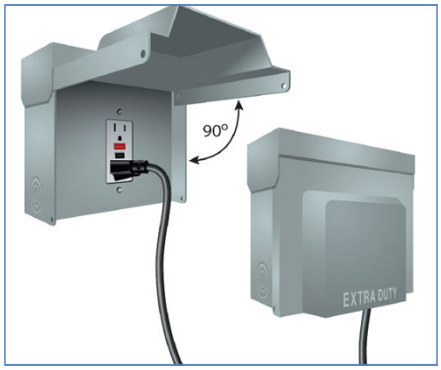
Change Summary

- Hinged covers of outlet box hoods in damp locations must be able to open at least 90° from the open to the closed position.
- If not designed to open 90°, it must be able to open fully.
- All receptacles in wet locations must be listed and identified as weather resistant.
- Other receptacles in wet locations that are attended while in use must be weatherproof with the attachment plug removed.
- The bathtub and shower space zones have been revised.

16

406.9

REVISION



17

406.12

REVISION

Tamper-Resistant Receptacles

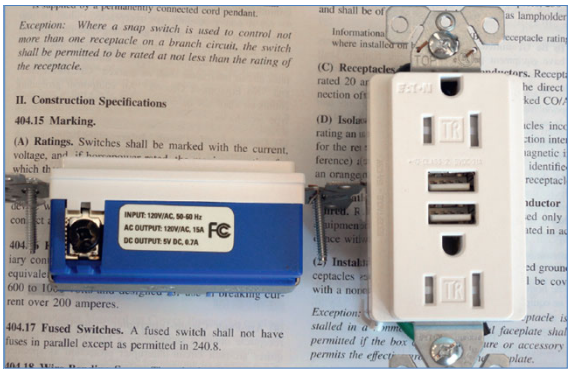
Change Summary

- Tamper-resistant receptacle requirements now include all dwelling units, boathouses, mobile homes, and manufactured homes, including their attached and detached garages.
- Requirements for tamper-resistant receptacles in medical facilities and other types of residential facilities have been revised and clarified.
- The exception has been clarified so that a tamper-resistant receptacle is not required for single receptacles that supply one appliance or duplex receptacles that are not readily accessible. The exception only applies if the receptacle is in the space designated for a specific appliance.

18

406.12

REVISION



  Courtesy of Eaton Corporation

19

408.4

REVISION

Descriptions Required

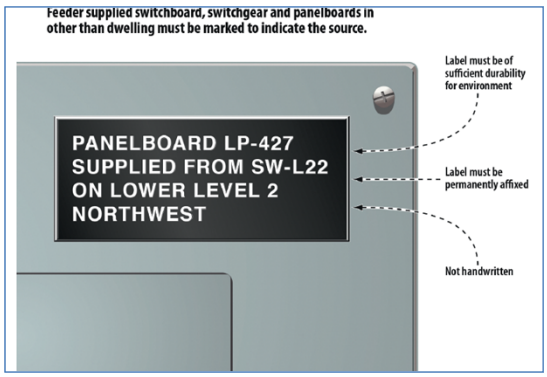
Change Summary

- The title of 408.4 has been changed from “Field Identification” to “Descriptions Required.”
- Every circuit and circuit modification is required to be legibly and permanently described with its clear, evident, and specific purpose or use.
- All switchboards, switchgear, and panelboards supplied by a feeder in other than one- and two-family dwellings must be marked to indicate the location of the power source.

20

408.4

REVISION



21

408.9

NEW

Replacement Panelboards

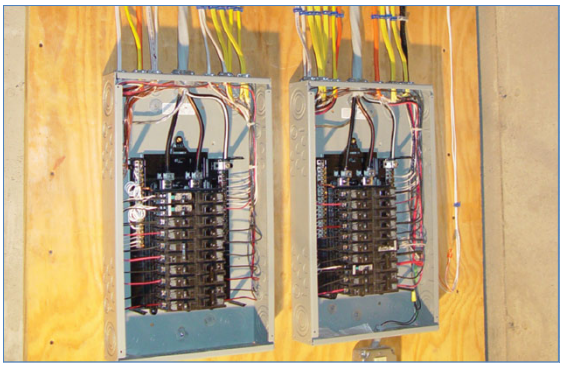
Change Summary

- A new 408.9 has been added to provide requirements for replacement panelboards.
- Panelboards listed for the specific enclosure are permitted to maintain their short-circuit current rating.
- Panelboards not listed for the specific enclosure with fault current over 10,000 amperes require field labeling. If fault current is less than 10,000 amperes, any previous listing marks must be removed.

22

408.9

NEW



  Courtesy of Michael J. Johnston

23

408.43

REVISION

Panelboard Orientation

Change Summary

- The 2020 *Code* prohibited panelboards from being installed in the face-up position because it created an unsafe working position and increased the likelihood that debris could accumulate in the panelboard.
- The requirement has also been modified for the 2023 *Code* to prohibit installation in the face-down position.
- Installation in a face-down position introduces working space concerns. Working on the panelboard would be awkward, increasing the likelihood of injury during an arc flash or arc blast incident.

24

408.43

REVISION

Courtesy of Michael J. Johnston

25

409.60

REVISION

Bonding

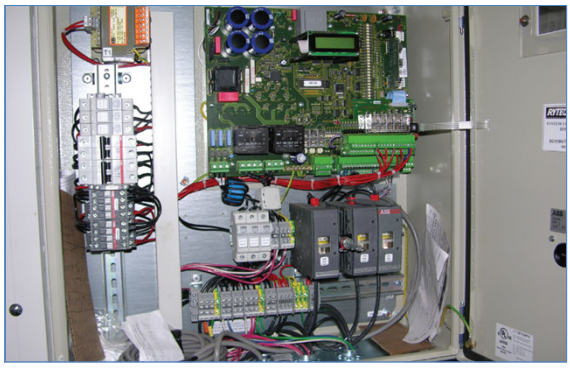
Change Summary

- Section 409.60 has been retitled “Bonding” and has been reorganized into list format for clarity.
- Section 409.60(A), “Grounding,” requires an EGC sized in accordance with 250.122 to be connected to an equipment grounding bus or equipment grounding termination point provided in a single-section industrial control panel.
- Section 409.60(B) requires multisection industrial control panels to be bonded together using a bonding jumper sized in accordance with 250.102(D).

26

409.60

REVISION



27

409.70

NEW

Surge Protection

Change Summary

- A new Section 409.70 has been added to require surge protection for safety circuits for personnel protection.
- A survey of facility managers in 2013 and 2014 by the Fire Protection Research Foundation found that 26% of safety circuits that were intended to protect personnel had surge damage.
- It was also found that 40% of the surges in industrial facilities were from causes within the plant rather than lightning-caused surges.

28

409.70

NEW

29

409.110

REVISION

Marking

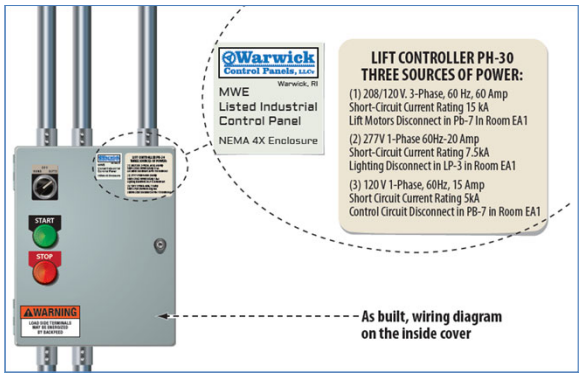
Change Summary

- The marking requirements for industrial control panels have been clarified.
- The voltage, number of phases, and full-load current are required to be marked on the exterior of the enclosure for each supply circuit.
- If the industrial control panel is supplied by multiple sources of supply with multiple disconnecting means, the location of all sources exceeding 50 volts is required to be marked on the exterior.
- The other required markings must be inside or outside of the enclosure.

30

409.110

REVISION



31

410.42

REORGANIZE

Luminaires with Exposed Conductive Surfaces

Change Summary

- Section 410.42 was reorganized into a main rule that requires exposed conductive surfaces of a luminaire to be connected to an equipment grounding conductor.
- An exception covers parts that do not require an EGC connection, including:
  - Surfaces that are separated by a listed system of double insulation.
  - Small, isolated parts such as screws, clips, and bands that are separated by at least 1 ½ inches from terminals.
  - Portable luminaires with polarized attachment plugs.

32

410.42

REORGANIZE

Courtesy of Michael J. Johnston

33

410.71

REVISION RELOCATE

Disconnecting Means-Fluorescent or LED Luminaires

Change Summary

- Section 410.130(G)(1) was moved into a new 410.71.
- The requirement has been expanded to include LED luminaire drivers that utilize double-ended lamps.
- LED luminaires are more energy-efficient but can still pose the same shock and electrocution hazards to workers.

34

410.71

REVISION RELOCATE

Courtesy of Tom Garvey and Michael J. Johnston

35

410.190 through 197

NEW

Provisions for Germicidal Irradiation Luminaires

Change Summary

- A new Part XVII on germicidal radiation luminaires has been added to Article 410.
- Luminaires intended to emit germicidal radiation are required to be listed.
- Germicidal radiation luminaires must be installed in accordance with the manufacturer's instructions.
- Germicidal luminaires are not permitted in dwellings, unless listed and identified for dwellings.

36

410.190 through 197

NEW

37

Article 422

DELETION REORGANIZE

Appliances

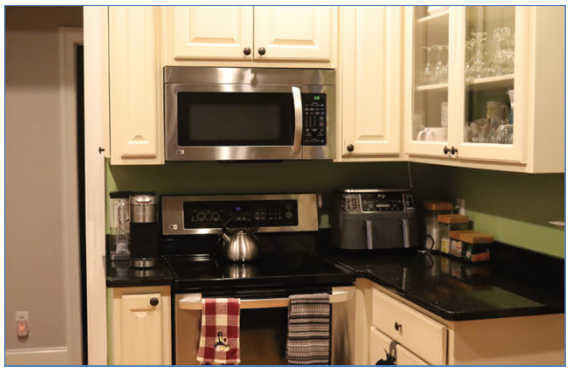
Change Summary

- Several sections in Article 422 were deleted because they were unnecessary for field applications.
- Section 422.6 requires that all appliances be listed. This eliminated the need for Sections 422.3 and 422.4.
- Sections 422.15 and 422.46 were deleted because they do not address unique field installation problems.
- Section 422.23 was deleted because it provides a redundant reference to the special permission requirement in 90.3.
- The flexible cord requirements in 422.43 were consolidated with other flexible cord requirements in 422.16(A).

38

Article 422

DELETION REORGANIZE



39

422.18

REVISION

Ceiling-Suspended (Paddle) Fans

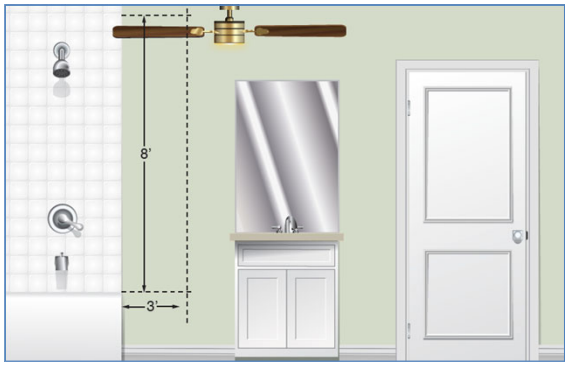
Change Summary

- 422.18(A)(1) was revised to clarify that listed outlet boxes or outlet box systems must be identified for fan support.
- 422.18(A)(2) was revised to use the new terms for weight-supporting ceiling receptacle and weight-supporting attachment fitting.
- 422.18(B) was added to prohibit metal parts of paddle fans from being located within three feet horizontally and eight feet vertically from the top of a bathtub rim or shower threshold.

40

422.18

REVISION



41

424.48

NEW

Installation of Cables in Walls

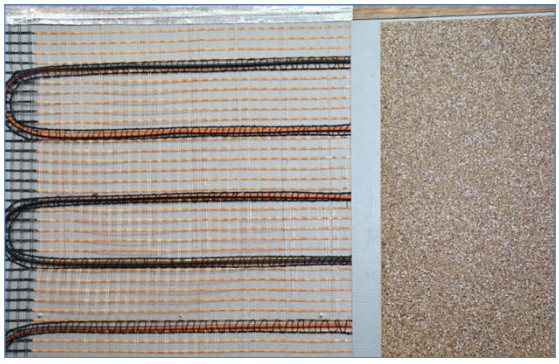
Change Summary

- Section 424.48 recognizes a new heating system that consists of heating cable sets or heating panel sets that can be installed in, on, or behind walls.
- Heating cables and cable sets are required to be GFCI and AFCI protected.
- Heating cables and cable sets are not permitted more than four feet above the floor.

42

424.48

NEW



43

430.1

REVISION

Scope

Change Summary

- Informational Note Figure 430.1 was revised to make it more useful. The table above the figure remains unchanged.
- For consistency, section numbers were removed from the figure.
- Blocks were added to the diagram indicating feeder overcurrent protection, motor controller disconnecting means, motor branch-circuit conductors, local motor branch-circuit disconnecting means (moved),and grounding.

44

430.1

REVISION

Courtesy of Michael J. Johnston

45

430.6

REVISION

Conductor Ampacity and Motor Rating Determination

Change Summary

- For most general applications, the current values used for determining the ampacity of conductors, the ampere rating of switches, and the ampere rating of branch-circuit short-circuit and ground-fault protection are based on table values from Article 430, Part IV.
- New 430.6(A)(2)(3) was added to permit the use of nameplate current ratings for motors that exceed the motor sizes in Part XIV.
- Section 430.6 was changed into list format to make it easier to use.

46

430.6

REVISION

Courtesy of Michael J. Johnston

47

430.52 (C)

REVISION

Rating or Setting

Change Summary

- Section 430.52(C)(3) was revised to recognize the higher available inrush current that is available for Design B premium efficiency motors that are protected by an instantaneous-trip circuit breaker.
- Section 430.52(C)(6) was revised to recognize the higher inrush current for Design B premium efficiency motors supplied by a self-protected combination motor controller.
- Design B premium efficiency motors have been mandated in new federal energy efficiency regulations. Design B and Design B premium efficiency motors have high inrush currents because they are low-impedance equipment.

48

430.52 (C)

REVISION

Courtesy of Michael J. Johnston

49

430.83 (F)

NEW

Ratings

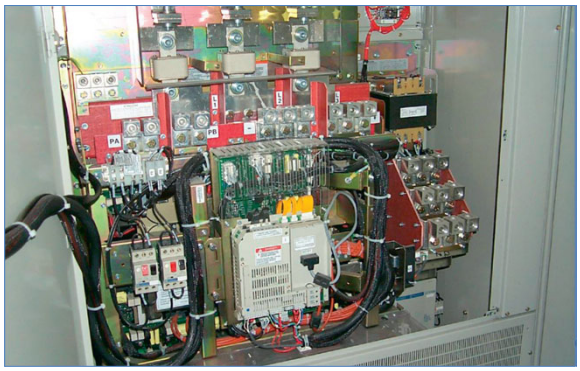
Change Summary

- The new 430.83(F) prohibits installing a motor controller on a circuit where the motor controller's short-circuit current rating is exceeded.
- Section 430.8 generally requires motor controllers to be marked with their short-circuit current ratings.
- Section 110.20 requires the equipment short-circuit current ratings and other characteristics of the circuit to be selected and coordinated to permit the circuit protective devices to clear faults without extensive damage to the electrical equipment.

50

430.83 (F)

NEW



51

440.8

REVISION

Single Machine and Location

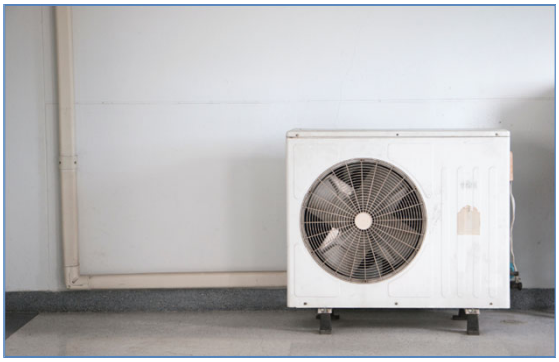
Change Summary

- Air-conditioning and refrigeration equipment is prohibited from being installed within three feet horizontally and eight feet vertically above a bathtub rim or shower threshold, including the space directly above the shower or tub.
- This requirement primarily affects the installation of mini-split air-conditioning system evaporators.
- Bathrooms are typically very small rooms. A change in bathroom configuration may be necessary to accommodate the equipment of this type of system.

52

440.8

REVISION



53

440.22(A)

REVISION

Rating or Setting for Individual Motor-Compressor

Change Summary

- Section 440.22(A) was revised by splitting the last sentence and creating two new exceptions. The existing exception became Exception No. 3.
- The first exception addresses installations where the determined value of branch-circuit short-circuit and ground-fault protection does not correspond with the standard sizes of OCPDs.
- The second exception permits the value of an OCPD to be increased in size to as much as 225% if the motor will not start.

54

440.22(A)

REVISION

55

445.6

REVISION

Listing

Change Summary

- Previously, stationary generators rated 600 volts or less were required to be listed.
- This section now requires all generators to be listed. However, one-of-a-kind custom manufactured generators are permitted to be field labeled.
- UL 2200, Stationary Generator Assemblies, now also covers medium-voltage generators.

56

445.6

REVISION

57

445.11

REVISION

Marking

Change Summary

- The generator marking requirements were clarified.
- This criterion is needed to ascertain the performance characteristics of the generator and to establish the overcurrent protective device settings.
- A new requirement was added that prohibits mounting equipment on the generator assembly that conceals or obscures the generator nameplate.

58

445.11

REVISION

59

445.18 & 445.19

NEW REVISION

Disconnecting Means

Change Summary

- Section 445.18 was divided into two sections. Section 445.18 addresses disconnecting means, and new Section 445.19 addresses emergency shutdown of the prime mover.
- Section 445.18(B) was revised to clarify the need for the ability to isolate the generator output terminals from the paralleling system bus.
- A labeling requirement was added to identify the generator emergency shutdown.

60

445.18 & 445.19

NEW REVISION

61

450.43 (C)

REVISION

Accessibility

Change Summary

- The title of 450.43(C) was changed from “Locks” to “Accessibility.”
- Transformer vault doors are required to open in the direction of egress. This has been modified to require that the door be capable of opening at least 90°.
- Similar changes for a 90° opening of egress doors have been implemented in 110.26(C), 110.33(A)(3), and 480.10(E).

62

450.43 (C)

REVISION

63

460.24 (A)

REVISION

Load Current

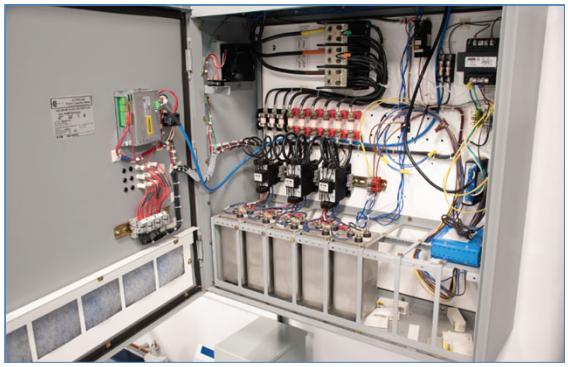
Change Summary

- Switches used to switch capacitive loads on circuits over 1,000 volts, nominal, shall be specifically rated for the switching of capacitive loads.
- Switches are often evaluated for switching inductive loads, but not capacitive loads.
- Capacitive loads can generate recovery voltages of two to three times the rated system voltage, which can cause external equipment flashovers, rupture of capacitors, and damage to surge protective devices.

64

460.24 (A)

REVISION



Courtesy of Eaton

65

Article 480

REVISION

Stationary Standby Batteries

Change Summary

- The title of Article 480 has been changed from “Storage Batteries” to “Stationary Standby Batteries.”
- The scope of Article 480 has been revised to limit it to stationary batteries exceeding one kilowatt-hour.
- A new Informational Note No. 1 points to Article 706 for batteries that do not meet the definition of stationary storage batteries.
- A reference was added in Informational Note No. 2 to point to *NFPA 855*, which is a fire protection standard for energy storage systems.
- *NFPA 111: Stored Energy Systems* also covers battery installations.

66

Article 480

REVISION

67

Article 495

REVISION RELOCATE

Equipment Over 1000 Volts ac, 1500 Volts dc, Nominal

Change Summary

- Article 490 has been relocated to become Article 495. The scope now covers equipment operating at more than 1,000 volts ac or 1,500 volts dc, nominal.
- Requirements for motors, capacitors, resistors, and reactors remain in Articles 430, 460, and 470, respectively.
- Requirements for transformers remain in Article 450. Moving those requirements may be warranted in the future.

68

Article 495

REVISION / RELOCATE

Courtesy of Michael J. Johnston

69

Significant Changes

TO THE *NEC*® 2023

Chapter 3

electrical training ALLIANCE IBEW - NECA IN COLLABORATION WITH NECA

1

Article 300

REORGANIZE NEW

Limitations

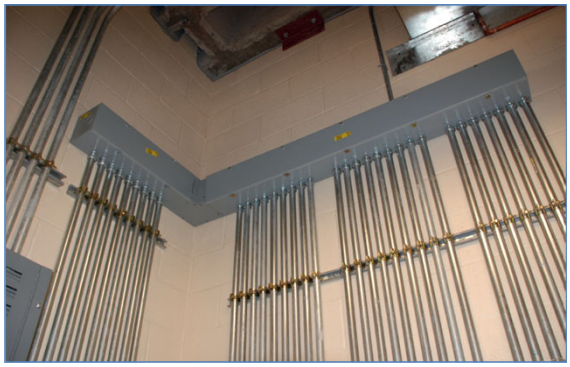
Change Summary

- Article 300 was reorganized to limit it to systems rated 1,000 volts ac, nominal, or less and 1,500 volts dc, nominal, or less.
- Medium- and high-voltage requirements have been moved to the new Article 305.
- This is the first cycle that 1,500 volts dc has been established as a limit.

2

Article 300

REORGANIZE NEW



Courtesy of Bill McGovern, City of Plano, TX

3

300.2 & 300.3

REVISION

Limitations

Change Summary

- Section 300.2 has added a voltage limitation for dc systems that are covered by Article 300.
- Chapter 3 wiring methods apply to systems operating at 1,000 volts ac or less or 1,500 volts dc or less.
- Chapter 3 wiring methods are only permitted on systems operating over 1,000 volts ac and 1,500 volts dc if specifically permitted elsewhere in the *Code*.
- The scope of Article 305 states that it applies to installations exceeding 1,000 volts ac or exceeding 1,500 volts dc.

4

300.2 & 300.3

REVISION

Courtesy of PDE Total Energy Solutions

5

300.4 (E)

REVISION

Cables, Raceways, or Boxes Under Metal Decking

Change Summary

- Section 300.4(E) will now only apply to installations beneath metal-corrugated roof decking.
- Exception No. 1 was revised to recognize that listed steel or malleable metal fittings and boxes provide protection from nail penetration.
- A new exception was added for corrugated roof decks that have a minimum 2-inch slab installed over the corrugated metal roof deck.

6

300.4 (E)

REVISION

7

300.7 (B)

NEW

Expansion, Expansion-Deflection, Deflection Fittings

Change Summary

- Section 300.7(B) requires raceways to be provided with expansion-deflection or deflection fittings where necessary to compensate for expansion, deflection, and contraction.
- Failure to provide these fittings can result in damage to the installation.
- Informational Note No. 1 provides references to tables that provide expansion information. It also provides information on the rate of expansion.
- A new informational note was added that references NEMA FB 2.40, *Installation Guidelines for Expansion and Expansion/Deflection Fittings*.

8

300.7 (B)

NEW

Courtesy of ABB Inc.

9

300.15

REVISION

Boxes, Conduit Bodies, or Fittings – Where Required

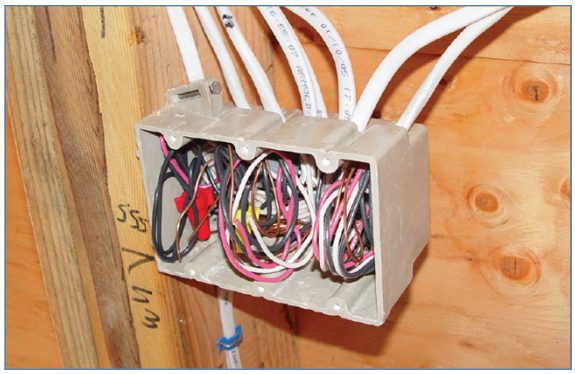
Change Summary

- Section 300.15 was clarified to indicate that a box or conduit body is required at conductor splice, termination, junction, and pull points.
- Wording was added to indicate that boxes or conduit bodies are required at “wiring method transition points,” which indicates a change in wiring method.
- Section 300.15(G) was revised to clarify that it also applies to direct-buried cables in addition to direct-buried conductors.

10

300.15

REVISION



11

300.25 & Exception

REVISION

Exit Enclosures (Stair Towers)

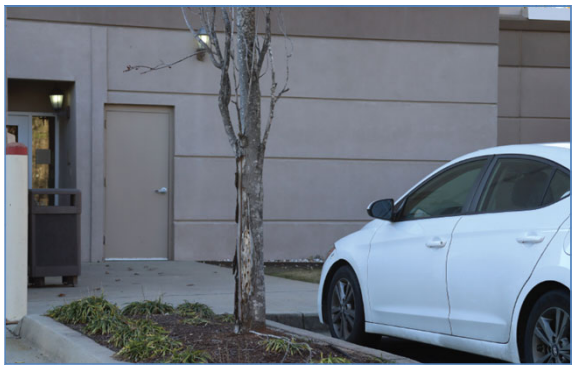
Change Summary

- Many buildings have exit enclosures (stair towers) to protect personnel who need to exit during a fire. These are often supported independently of the building.
- Exit enclosures that are required to have a fire rating must be served only by wiring methods serving equipment that is permitted by the AHJ to be in the stair tower.
- Luminaires for the exterior lighting of exit doors of exit enclosures are permitted to be supplied by a circuit that supplies the inside of the exit enclosure.

12

300.25 & Exception

REVISION



13

300.26

NEW

Remote-Control and Signaling Circuits Classification

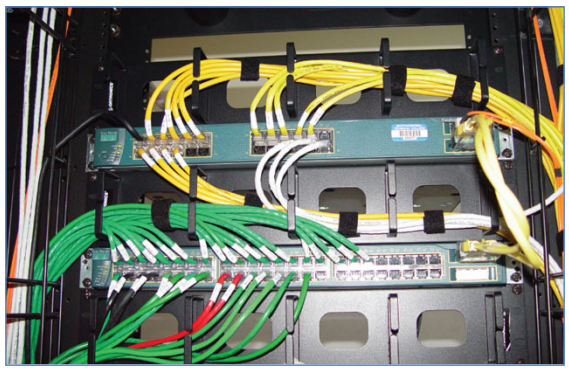
Change Summary

- The scope of Article 725 has been changed, requiring this clarification.
- Class 2 and 3 power-limited remote-control and signaling circuits remain in Article 725.
- Class 1 power-limited remote-control and signaling circuits were relocated to the new Article 724.
- Non–power-limited remote-control and signaling circuits are governed by the requirements of Chapters 1 through 4 of the *Code*.

14

300.26

NEW



15

Article 305

NEW

Systems Rated Over 1000 V ac, 1500 V dc, Nominal

Change Summary

- Article 305 has been created to separate the requirements for medium-voltage systems from the requirements of systems rated 1,000 volts ac or less and 1,500 volts dc or less.
- The bulk of Article 305 came from Part II of Article 300.
- Section 305.3 references the wiring methods permitted to be used over 1,000 volts ac and 1,500 volts dc.
- Requirements for services, feeders, and branch circuits for systems rated over 1,000 volts ac and over 1,500 volts dc are found in Article 235.

16

Article 305

NEW

Courtesy of Michael J. Johnston

17

312.8

NEW

Splices, Taps, and Feed-Through Conductors

Change Summary

- A new 312.8(A)(3) has been added to recognize the additional bending space needed for conductors 4 AWG and larger.
- Where splices or where angle or U pulls are made with insulated conductors, 314.28(A)(2) requires the distance between the raceway and the opposite wall to be at least six times the largest trade size in a row.
- The six times rule also applies to straight-through conduit entries if the conductors are spliced.

18

312.8

NEW

Courtesy of Tom Garvey

19

312.10

NEW

Screws or Other Fasteners

Change Summary

- Screws and other fasteners installed in the field that enter the wiring space are required to be those provided by or specified by the manufacturer.
- If not supplied or specified by the manufacturer, this section provides three criteria that can be used, where applicable.
- An exception allows screws that enter to extend into the enclosure not more than 7/16 inch if located within 3/8 inch of an enclosure wall.
- A similar requirement was added for screws and fasteners in 314.5.

20

312.10

NEW

Courtesy of Michael J. Johnston

21

314.5

NEW

Screws or Other Fasteners

Change Summary

- New requirements for screws and other fasteners have been added to 314.5. Screws and other fasteners are required to have blunt ends.
- Specific requirements are provided for the permitted length, based on where in the box the screw or fastener is used.
- Longer screws are permitted where protected with an approved means.

22

314.5

NEW

23

314.16(B)

REVISION

Box Fill Calculations

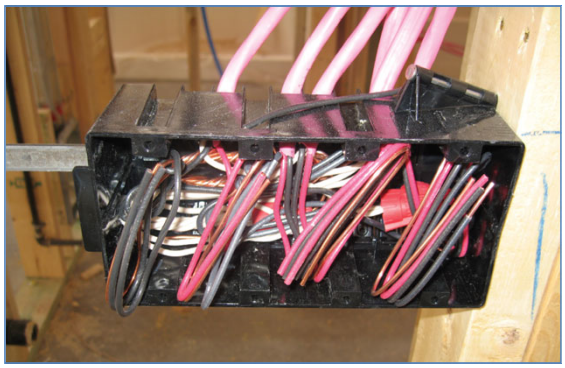
Change Summary

- The second paragraph of 314.16(B)(2) was deleted because the product line that it was intended for is not being produced.
- Equipment bonding jumpers were removed for the conductor fill calculation requirements in 314.16(B)(5). The panel concluded that if equipment bonding jumpers are run within raceways, they are considered an expansion of the equipment grounding conductor.
- 314.16(B)(6) was added to require a single volume allowance for a terminal block assembly based on the largest conductor terminated to the assembly.

24

314.16(B)

REVISION



25

314.24

REVISION

Dimensions of Boxes

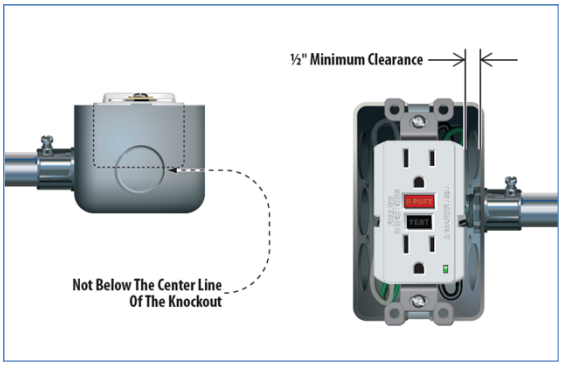
Change Summary

- The title of 314.24 has been changed from “depth of boxes” to “dimensions of boxes” to recognize that this section deals with more than depth.
- The rearward projection of devices or equipment must not be greater than the center line of a knockout used for a side wiring entrance or a ½-inch clearance must be maintained between the device and the sidewall of the box.
- Where wiring enters the center portion of the rear of a box opposite the equipment, the minimum clearance must be increased to ½ inch.

26

314.24

REVISION



27

314.25

REVISION

Covers and Canopies

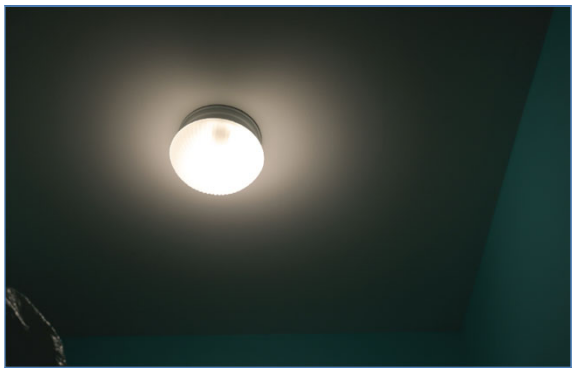
Change Summary

- Section 314.25 was revised to clarify that conduit body enclosures must be enclosed by a cover, a lampholder, or a device.
- Like boxes, conduit bodies can contain splices, terminations, and devices. Therefore, conduit bodies should also be covered.
- The language in 314.25(A) and the informational note were revised to clarify that they apply to equipment grounding conductors.

28

314.25

REVISION



29

314.27(C) & (E)

REVISION

Outlet Boxes, Ceiling-Suspended (Paddle Fans)

Change Summary

- Outlet boxes used as the sole support of ceiling-suspended (paddle) fans are now required to be marked on the inside of the box so that the marking can be seen during a rough-in inspection.
- 314.27(C)(2) was simplified to recognize boxes that provide direct access through the box to structural framing capable of supporting a paddle fan, without the need to remove the box.
- The locking support and locking receptacle and the compatible attachment fitting have been renamed as “weight-supporting ceiling receptacle” and “weight-supporting attachment fitting.”

30

314.27(C) & (E)

REVISION

31

Article 315

REVISION RELOCATE

Medium Voltage Conductors and Cables

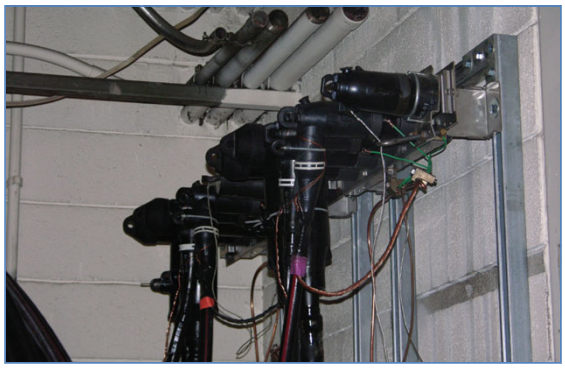
Change Summary

- Article 311 has been relocated to become Article 315, consistent with the numbering scheme for medium-voltage articles.
- The title and scope of Article 315 have been expanded to include cable joints and cable terminations.
- The scope of this article for dc cables is limited to cables rated 2,001 through 2,500 volts.

32

Article 315

REVISION / RELOCATE



33

342.24

REVISION / REORGANIZE

Bends

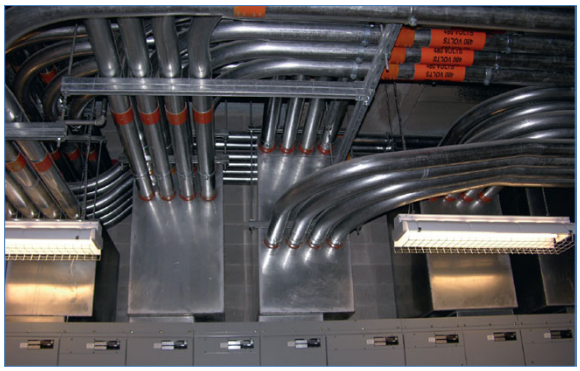
Change Summary

- Sections 342.24 and 342.26 have been combined into a 342.24, Bends.
- This now clarifies the total degrees of bends between pull points.
- Since Chapter 3 articles follow the same format, the same change was made in Article 344, 348, 350, 352, 353, 354, 355, 356, 358, 360, and 362.

34

342.24

REVISION / REORGANIZE



35

342.30(A)

NEW

Securing and Supporting

Change Summary

- Section 342.30(A) requires intermediate metal conduit (IMC) to be securely fastened.
- A new exception permits IMC in concealed work to be fished in finished buildings or in prefinished wall panels where secure fastening is impractical.
- This exception only applies to unbroken lengths of IMC without couplings in the concealed space.

36

342.30(A)

NEW

37

344.28

REVISION

Reaming and Threading

Change Summary

- PVC-coated RMC is often used in areas subject to corrosion.
- New text was added to this section to require that the manufacturer's instructions be followed when threading PVC-coated RMC to prevent damage to the exterior coating.
- A new informational note was added that references NECA 101, *Standard for Installing Steel Conduits (RMC, IMC, EMT)*, which provides information on threading PVC-coated RMC.

38

344.28

REVISION

  Courtesy of Corrosion College

39

352.10

REVISION REORGANIZE

Insert Uses Permitted

Change Summary

- The uses permitted for PVC conduit have been clarified.
- PVC conduit is permitted to be embedded in concrete.
- Exposure to physical damage requirements have been removed from 352.10(G) and moved to the new 352.10(K), Physical Damage.
- Where subject to physical damage, Schedule 80 PVC conduit, along with listed Schedule 80 PVC conduit fittings, must be used.

40

352.10

REVISION REORGANIZE

Courtesy of Michael J. Johnston and Tom Garvey

41

358.10

REVISION

Uses Permitted

Change Summary

- Section 358.10 was revised to recognize two new permitted uses for EMT.
- EMT is permitted in direct burial applications where it is used with fittings that are identified for direct burial.
- EMT is recognized for manufactured wiring systems as permitted in 604.100(A)(2).

42

358.10

REVISION

Courtesy of Michel J. Johnston

43

362.10

REVISION

Uses Permitted

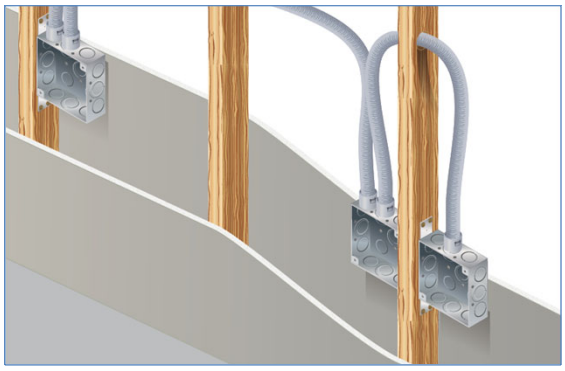
Change Summary

- Section 362.10(2) was revised to clarify that ENT is permitted to be installed in combustible or noncombustible buildings where the walls, floors, and ceilings meet the finish rating.
- The mandatory reference to *NFPA 13* was changed to an informational note reference.
- Section 362.10(6) was split into two sections to separate requirement for installations in poured concrete floors, ceilings, walls, and slabs from those where the ENT is embedded in concrete slabs.

44

362.10

REVISION



45

Article 369

NEW

Insulated Bus Pipe (IBP)/Tubular Covered Conductors

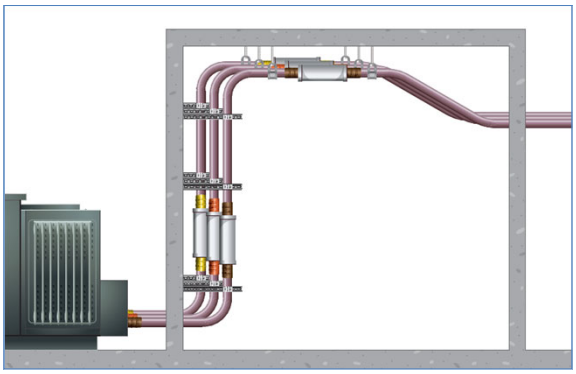
Change Summary

- The new Article 369 covers Insulated Bus Pipe (Type IBP).
- IBP is a cylindrical solid or hollow conductor with a solid insulation system having conductive grading layers and a grounding layer embedded in the insulation that is provided with an overall insulation or metallic material. It is permitted for up to 35 kV.
- IBP is required to be listed.
- IBP is permitted to be used in wet or damp locations when listed for wet or damp locations.
- IBP must not be accessible to unqualified persons.

46

Article 369

NEW



47

370.18

REVISION

Cablebus Installation

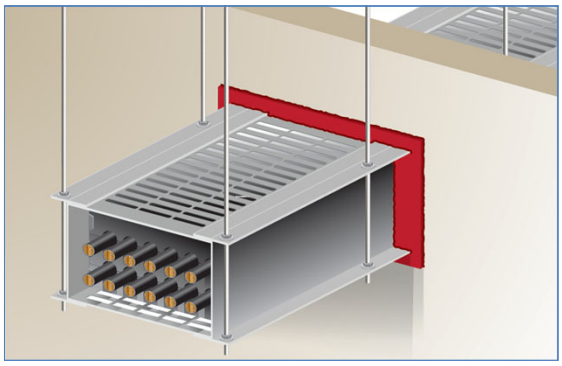
Change Summary

- Cablebus installation requirements have been simplified.
- Cablebus is permitted to be run through fire walls in accordance with 300.21.
- Since cablebus is a support system, similar to cable trays, the firestop requirements now refer to 300.21.
- The previous requirement for curbs where cablebus penetrates floors has been removed because cablebus is permitted in wet locations.

48

370.18

REVISION



49

370.120

REVISION

Marking

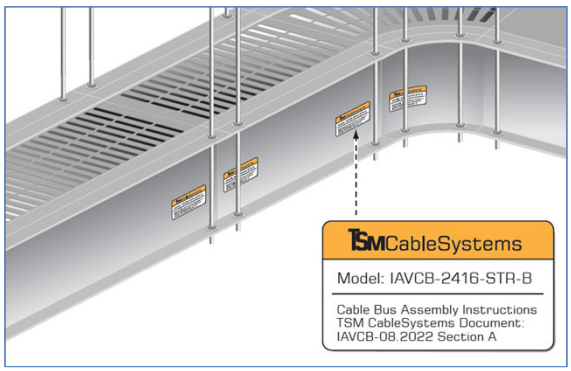
Change Summary

- Section 370.120 was revised to clarify cablebus marking requirements and to harmonize with requirements in Canada.
- Nameplates are required at each terminating end of the system, identifying the manufacturer as well as the ratings.
- Nameplates are required to be visible after installation.
- Each section and fitting of a cablebus system is required to be identified with a marking that corresponds with the installation instruction.

50

370.120

REVISION



51

Article 371

NEW

Flexible Bus Systems

Change Summary

- A new Article 371 was created for flexible bus systems, which are assemblies of flexible bus with associated fittings to secure, support, and terminate the bus.
- Flexible bus is permitted for services, feeders, and branch circuits.
- Flexible bus is permitted indoors, or outdoors if identified for outdoor use.
- Flexible bus is permitted to be used exposed or behind access panels as long as the space behind the access panels is not used for air handling.

52

Article 371

NEW

Courtesy of Ward Judson, nVent

53

File Attachments for Item:

ER-5 Transformers 2023 NEC Article 450 (Ohio Certificate Renewal)

All certifications (4 hours)

Staff Notes: Recommend approval.

ESIAC Recommendation:

Committee Recommendation:

Ohio Department of Commerce

Mike DeWine, Governor
Jon Husted, Lt. Governor

Sheryl Maxfield, Director

Board of Building Standards

Application for Continuing Education Course Approval

Provider Information:

Name: Harold L. Plant

Organization: Ohio Certificate Renewal

Address: P.O. Box 211102, Columbus, Ohio 43221

E-mail: mayda@ohiocertificate.com and Hal@ohiocertificate.com Telephone: 614-451-9003

Website: ohiocertificate.com

Conference Sponsor (if applicable) _____ Conference Email: _____

Check here if Course Renewal: _____ Prior course number _____ (*i.e. BBS2018-429*)

Renewals will only be granted for identical content and certifications, within the current code cycle.
Attach a copy of prior course approval letter for confirmation. No further information is required.

New Course Information:

Course title: Transformers 2023 NEC Article 450

Course instructor: J.D. White

Course description: This course provides a concise overview of transformer theory, including the components and functioning of a transformer. It explains the importance of transformers compared to other voltage modifiers, as well as primary and secondary isolation. The course covers installation locations and various connection methods, sizing, KVA, and calculations will be discussed.

Instructional hours per session: 4 Number of Sessions: _____

Course Date(s) and Location: 12/6/2023 webinar, online (TBD) and in-person (TBD)

Special Content:

Code Administration: ☑ Conference Course: _____

Existing Buildings: ☐ Conference Name: _____

Electrical Instruction: ☑ Conference location: _____

Plumbing Instruction: ☐

Course to be offered online? ☑ **On Demand** ☑ **Webinar** ☑

Course Website: ohiocertificate.com

Detail online course participation confirmation method *(i.e. test, quizlets, participant activity confirmation)*:
live proctor audio/visual confirmation or quizlets, activity confirmation

Course applicable for the following certifications

Residential Certifications Only: ☑ Commercial Certifications: ☑

Administrative Course, All Certifications: ☐

Application materials included:

☑ Course Outline or Course Learning Objectives
☑ Presentation Materials/Slides (not required for roundtable courses)
☑ Assessment Materials (for online courses)
☑ Presenter Bio

Please submit application and materials in .pdf format to: michael.lane@com.ohio.gov or BBS@com.ohio.gov

Ohio Certificate Renewal
(614) 451-9003
OhioCertificate.com
P.O. Box 211102 Columbus, Ohio 43221-1102

Transformers 2023 NEC Article 450

Transformer Theory:

- Know what's in the box
- How they work
- Magnetic Induction
- Turns Ratio

Reason for Transformers verses other Voltage Modifiers:

- Available Voltage
- Needed Voltage
- Primary and Secondary Isolation

Installation Locations:

- When set on Floors
- When elevated and set overhead
- In Building Voids, such as suspended ceilings

Connections:

- Primary Windings 1Ph & 3Ph
- Primary means other than higher voltage
  - Primary Voltage Adjustment Taps
- Secondary Windings 1Ph & 3Ph
- Creating and connecting to Grounded Phase 1Ph & 3Ph

Sizing Transformers:

- Calculation of Connected Load
- Sizing KVA of Transformer
- Sizing of Primary and Secondary OCP Device

Calculations:

- Using Square Root of 3 (1.732) Why and When
- Calculation of Primary Amps
- Calculation of Secondary Amps
  - Primary KVA = Secondary KVA

Course Objectives

- Gain understanding of transformer fundamentals
- Gain understanding of multiple reasons for transformers
- Learn how and where transformers can be installed
- Learn methods of terminal connections
- Learn how and methods of grounding secondary system
- Learn distinction of when secondary is separately derived or not

JD White

6048 Astor Avenue 614-546-7884
Columbus, OH 43232 jd.white2000@gmail.com

Objective:

To provide timely and informative teaching relative to Electrical Theory, Electrical Practices, and NEC Updates. All teaching is primarily geared for licensed contractors, architects, engineers, electrical inspectors, and electrician apprentices. Electrical Design and Drafting of small to moderate sized projects, using AutoCAD.

Work and Teaching Experience:

06/2007 - Present
Columbus State Community College
Title: Skilled Trades Apprenticeship Supervisor
Supervisor: Doug House, 614-287-2576

01/2006 – Present
Voltaire Electric Company, Inc. – Columbus, OH
Electrical System Design and Drafting
Title: Consultant 614-546-7884

06/2007 - Present
Columbus State Community College
Title: Adjunct Faculty Teaching:
Electrical Courses, National Electric Code, Employability, Construction Overview, Construction Estimating, Manual Drafting, and AutoCAD
Supervisor: Doug House, 614-287-2576

09/1999 – Present
Electrician Apprenticeship Instructor
Title: Year 1 – Year 4 Lead Instructor
OCILB Instructor, as needed
IEC Central Ohio 614-473-1050

10/2001 – Present
OCILB Instructor, 1-2 seminars per year
Ohio Contractor Training 614-203-1531

12/2008 – Present
OCILB Instructor, 4 seminars per year
Rebecca Warren Training 614-402-6551

JD White

6048 Astor Avenue 614-546-7884
Columbus, OH 43232 jd.white2000@gmail.com

11/2017 – Present
OCILB Instructor, 2-6 seminars per year
HalfMoon Education Services 715-835-5900

10/2005 - 08/2006
MG Abbott Electric Company – Columbus, OH
Title: Commercial Electrician, Estimator, and ITS Coordinator
Supervisor: Joe Abbott-President, 614-837-3614

07/1995 - 08/2005
Just Dandy Electric Systems, Inc. – Columbus, OH
Title: Owner, Electrician, Estimator, Project Designer...

08/1989 - 07/1995
Safeway Electric Company, Inc. – Columbus, OH
Title: Commercial Electrician, Commercial Division Manager
Supervisor: Andy Untch, 614-443-7672

10/1987 - 08/1989
Mansfield Wesleyan Church – Mansfield, OH
Title: Senior Pastor
Supervisor: Rev. Clyde Hanks-District Supervisor

09/1982 - 07/1987
Delphos Wesleyan Church – Delphos, OH
Title: Senior Pastor
Supervisor: Walter Jefferies-District Supervisor

07/1976 - 09/1982
MG Abbott Electric Company – Columbus, OH
Title: Electrician, Field Supervisor
Supervisor: Gene Abbott-Owner

07/1972 - 06/1974
US Navy – Quonset Point-RI
Title: ADJ (Aviation Machinist Mate Jet)
Supervisor: Various

JD White

6048 Astor Avenue
Columbus, OH 43232

614-546-7884
jd.white2000@gmail.com

Licensure:

Electrical
11/1990
Cities of: Columbus, Elyria, Springfield, Youngstown, Toledo, Dayton, and others
07/1992

Electrical State of Ohio
02/1996
State of Ohio #EL 14058

Fire Alarm Installer
02/2003
State of Ohio #54.25.3708

Education:

06/2005 – 05/2015
Columbus State Community College – Columbus, OH
ATS Electrical System Architecture Designer

09/1982 - 05/1987
Indiana Wesleyan University – Marion, IN
Christian Ministries & Biblical Literature

06/1981 - 05/1982
Columbus Technical Institute – Columbus, OH
General Education Studies

06/1973
GED Central High School, Columbus, OH

07/1972 - 08/1973
Naval Aviation Technical Training Center
Aviation A School Jet Engines – Memphis, TN
Naval Aviation Technical Training Center
Aviation B School Helicopters – Quonset Pt, RI
Rating: Aviation Machinist Mate Jet

References:

Joe Abbott - Previous Employer: 614-837-3614
Barb Tipton – Present Employer: 614-473-1050
Dr. Andy Rezin – Previous Supervisor: 614-551-8378
Doug House – Present Supervisor: 614-287-2576
Other References Available Upon Request

Quizlets for Transformers 2023 NEC Article 450

These will be used to confirm engagement for online on-demand courses.

1. Which motion will induce voltage into the conductor?
    a. A conductor passing through a magnetic field
    b. A magnetic field passing over a conductor
    c. Both a and b (correct answer)
    d. None of the above
2. To adjust the voltage level of an alternator, you can either
    a. Change the number of turns of conductor that are exposed to the revolving magnetic field (correct answer)
    b. Change the composition of the conductor
    c. Change the temperature of the conductor
    d. Adjust the level of the magnetic force you subject the conductors to
    e. None of the above
3. Between the primary and secondary coil is a
    a. Series of polished rings
    b. Magnetic coupler called the inductor (correct answer)
    c. Several spacers
    d. B and C
    e. None of the above
4. The phase is
    a. Where the relationship of primary to secondary is appreciated and calculated (correct answer)
    b. The intensity of the applied magnetic field
    c. The output voltage
    d. none of the above
5. What are recommended locations for transformers?
    a. In a sealed enclosure protected from air
    b. Spaced from combustible materials such as walls at least 12”
    c. Where they are protected from physical damage
    d. Outdoors 6 inches off the ground
    e. B and C (correct answer)
    f. none of the above

TRANSFORMERS

MORE THAN MEETS THE EYE!

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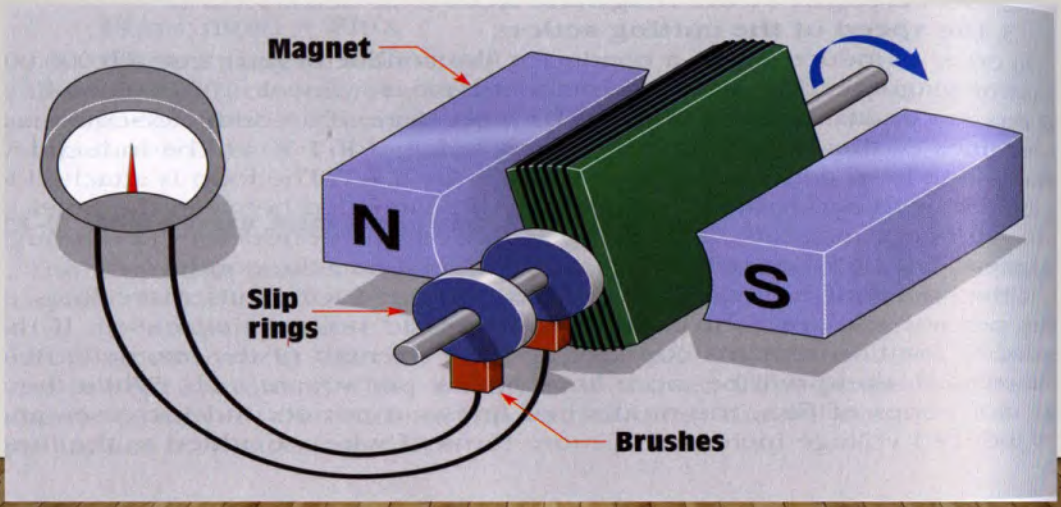
2023 NEC Article 450

TRANSFORMERS

- Transformer Theory:
  - Know what's in the box, and how it works.
- Installation Locations:
  - Here, There, but not everywhere.
- Connections:
  - Knowing your H's and X's?
- Sizing Transformers:
  - Not to Big, and not to small.
- Calculations:
  - Making it all add up.

UNDERSTANDING AC VOLTAGE

- To understand how transformers do what they do, and what makes it possible for them to function we must look at what AC Voltage is and what makes it so different from DC.



Voltage generation:

A conductor can pass through a magnetic field, or a magnetic field can pass over a conductor. Either motions will induce a voltage into the conductor

This circular motion creates at least two attributes and modus operandi of AC voltage.

1. A sine wave voltage output, where current tries to reduce the voltage level.

2. An expanding and collapsing magnetic field, where current increases the magnetic field.

To adjust the voltage level of an alternator, you can either change the number of turns of conductor that are exposed to the revolving magnetic field or you can adjust the level of magnetic force you subject the conductors to.

To adjust the frequency of the AC voltage produce you change the number of poles each phase has or you change the RPM.

PART 1: COMPONENTS OF TRANSFORMERS.

- The primary is always the coil which the source voltage is applied to the "H1, H2, and H3" terminals or leads.
- Current will be what causes a changing magnetic field (that is an expanding and collapsing magnetic field of flux) in the primary coil. This field of flux will have a circular or rotating motion and direction.

The secondary is always the coil which produces the induced voltage level, and is the terminal that loads are connected to.

Between these primary and secondary coils is a magnetic coupler called the inductor, the function of the inductor is to transfer the rotating magnetic field of the primary onto the stationary coil of the secondary. There by inducing voltage into the secondary coil.

To aide in the magnetic coupling, the primary is wound around the secondary and both are wound around a laminated steel ferrous inductor.

What creates a difference of voltage between the primary and secondary is a relationship of number of turns of the conductor on both the primary winding and secondary winding.

Primary and Secondary Windings

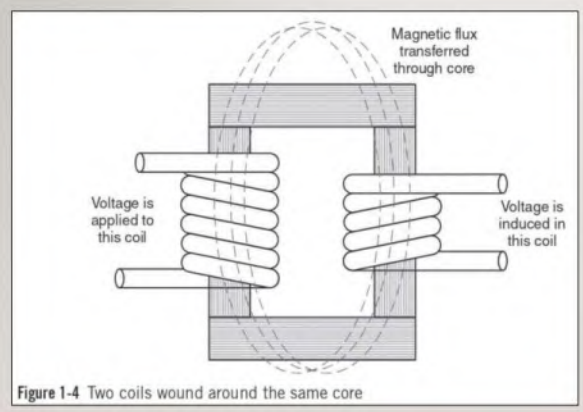


Figure 1-4 Two coils wound around the same core

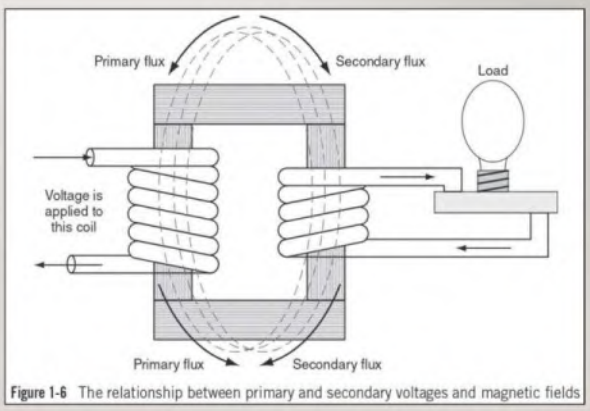


Figure 1-6 The relationship between primary and secondary voltages and magnetic fields

THIS RELATIONSHIP IS LOOKED AT AS A RATIO OF THE PRIMARY TO SECONDARY.

1:1 Both the primary and secondary have same voltage level.
Primary and Secondary have same number of turns.

1:4 Secondary voltages are 4 times the primary voltage level.
Primary has only 1 turn to each Secondary number of turns.

4:1 Primary voltage is 4 times the secondary voltage level.
Primary has 4 turns to each Secondary 1 turn.

The phase is where the relationship of primary to secondary is appreciated and calculated.

It is often easy to look at the level of voltage and current of the line conductor and forget that the line levels only reflect the relationship of the individual phases.

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Electricians need to understand what this ratio of primary : secondary is; for the purpose of understanding how voltage and amperage levels are affected.

Where the voltage level may be divided.
The amperage level will be multiplied.

Where the voltage level may be multiplied.
The amperage level will be divided.

Both: voltage and amperage will always be changed by the same ratio.

PART 2: TRANSFORMER LOCATIONS

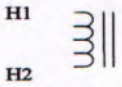
- Guard where subject to physical damage. NEC 450-8a
- Ventilated, transformers produce heat.
- Example of heat they produce, a 75KVA transformer is rated as 98% efficient that means 2% of 75,000 watts of heat are going to be put off at full load which is 1,500 watts of constant heat, heat that must be vented.

Spaced from walls must be at least 12" if wall is combustible, or greater if manufacture specifies so.
30" wide or width of transformer if greater than 30"
36" front access to terminal side of transformer and 42" front access if voltage is over 151V to ground.
6'- 6" from floor to bottom of support, if elevated above other equipment.
In hollow space of structure as in a drop ceiling, where transformer is 50KVA or less. NEC 450-13b

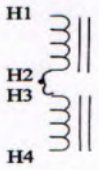
PART 3: TRANSFORMER CONNECTIONS SINGLE PHASE

- The "H" terminals denote the primary coil/winding point of connection.
- The source voltage is always connected to the primary, whether you are transforming to decrease voltage or increase voltage. Primary is designed to apply the magnetic field of flux to the inductor.

Single phase connections.

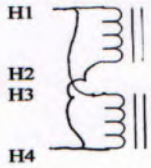


If dual voltage winding are provided on the primary:

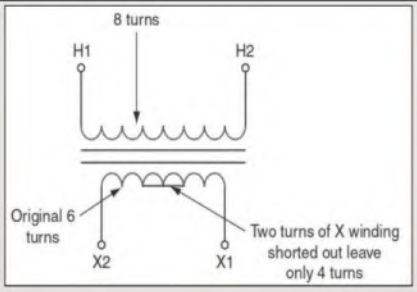


Higher of two listed Primary voltages.

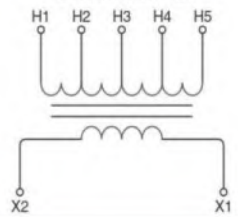
Or:



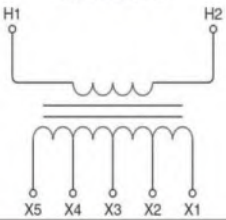
Lower of two listed Primary voltages.

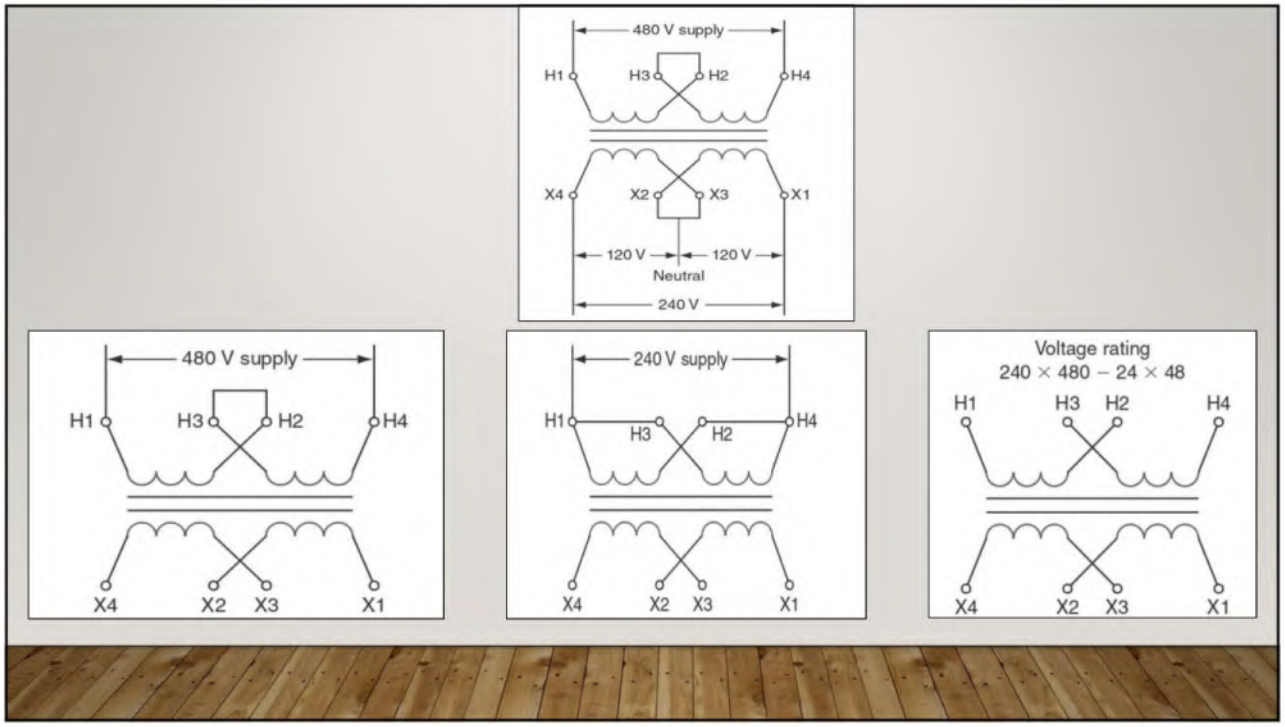


A transformer with a voltage rating of 120/208/240/277–120



A transformer with a voltage rating of 120–48/36/24/12





The "X" always denotes the secondary coil/winding terminals.

The secondary is where the induced voltage is.

It is here that loads of the voltage level sought are connected

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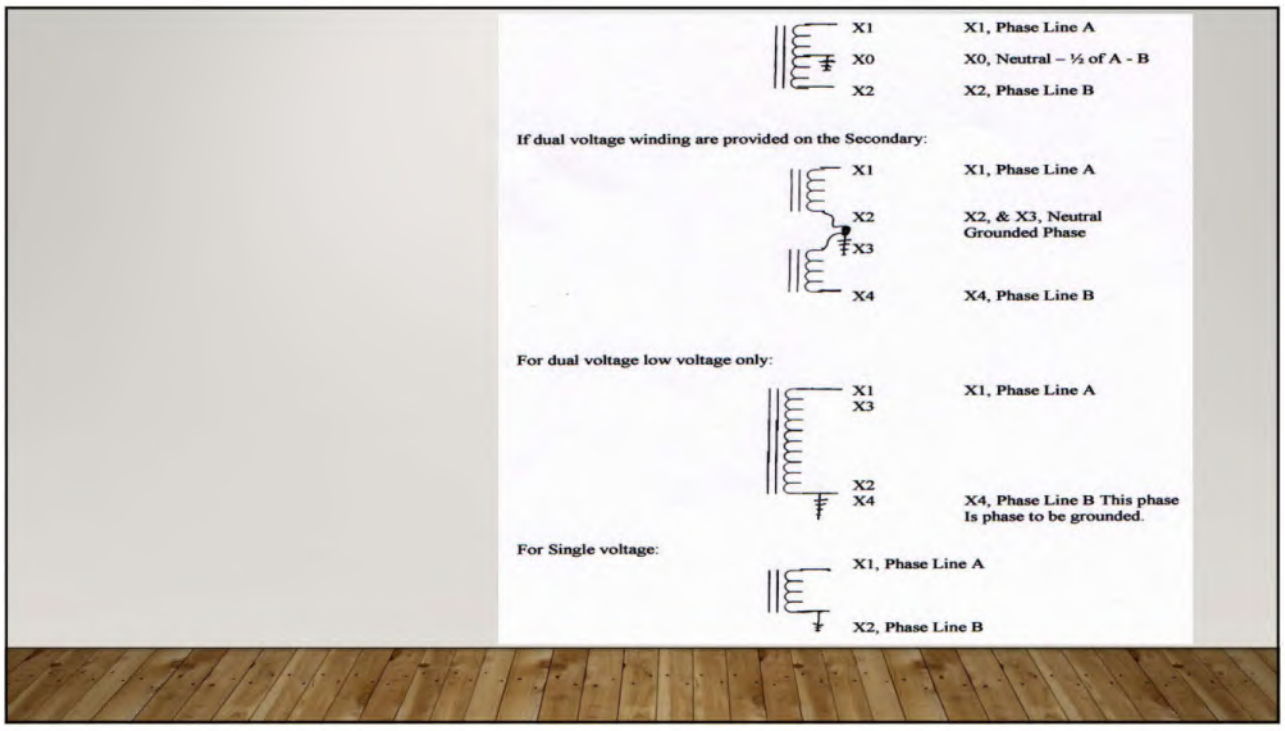


TRANSFORMER CONNECTIONS: THREE-PHASE CIRCUITS

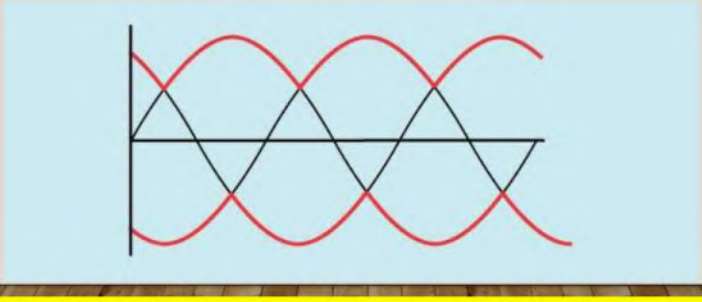
Three-Phase Advantages – Working Voltage

1. The horsepower rating of three-phase motors and the kVA rating of three-phase transformers are 150% greater than single-phase motors or transformers of similar frame size.
2. With Single Phase, apparent Voltage is Equal to Working Voltage ~ Work
3. With Three Phase, apparent Voltage is only 1.732 of the Working Voltage ~ Work
4. This is the reason 3Ph formulas use 1.732, which is the Square Root of 3.
5. Working of Voltage of 208=360V, 240=416V, 480=831V, & 600=1,039V
   a) Important Note: 208V is a Wye System, and 240V is a Delta Systems
   b) The way Volts and Amps are Calculated in these two systems is very different.

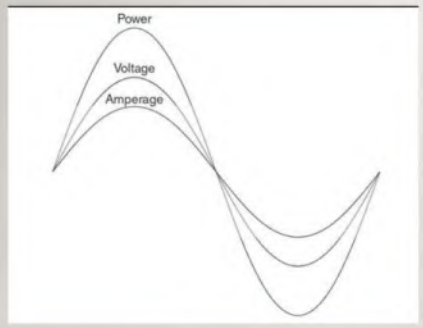
THREE-PHASE CIRCUITS

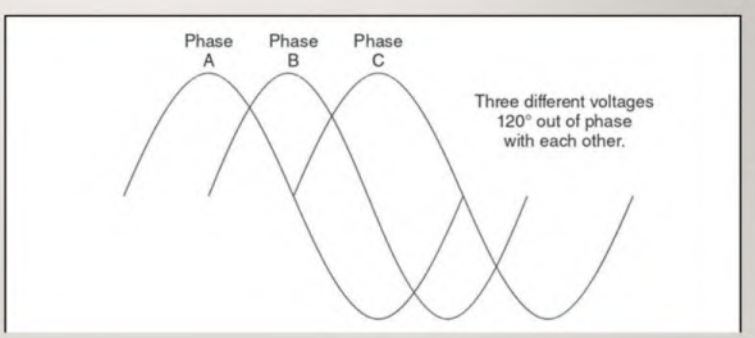
Three-Phase Advantages- Voltage always Present

2. The power delivered by a single-phase system pulsates and falls to zero. The three-phase power never falls to zero. The power delivered to the load in a three-phase system is the same at any instant. This produces superior operating characteristics for three-phase motors.

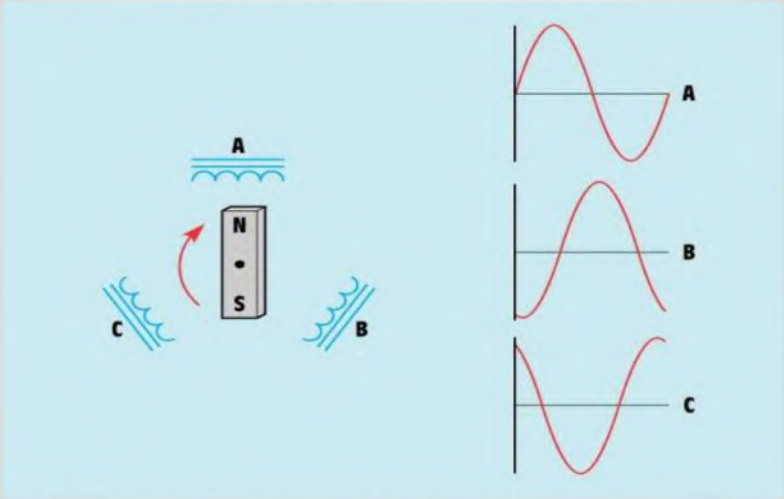


Three-phase power never falls to zero.



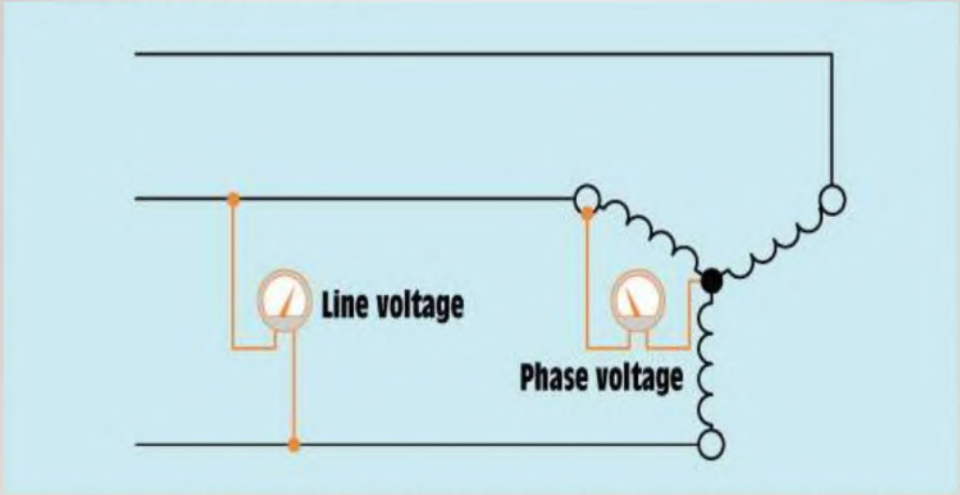


THREE-PHASE CIRCUITS



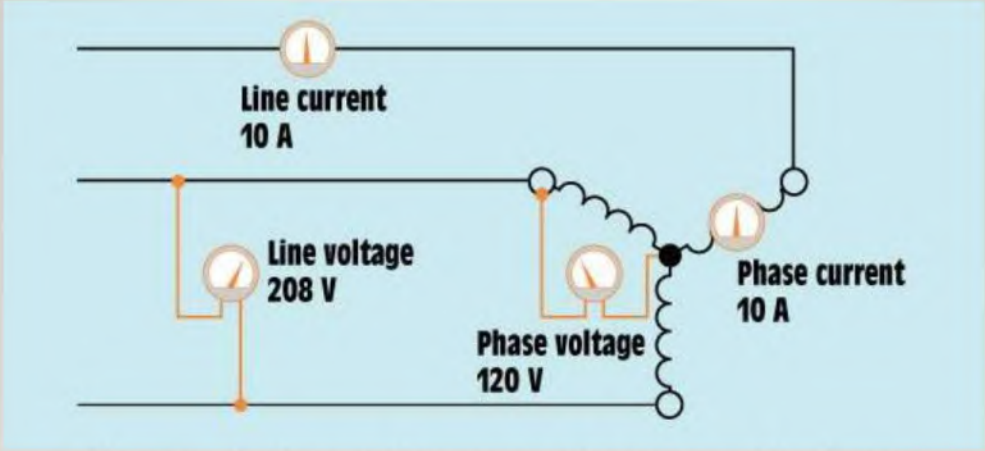
Three-phase voltages have 120 degrees of phase shift.

WYE SYSTEM: VOLTAGES



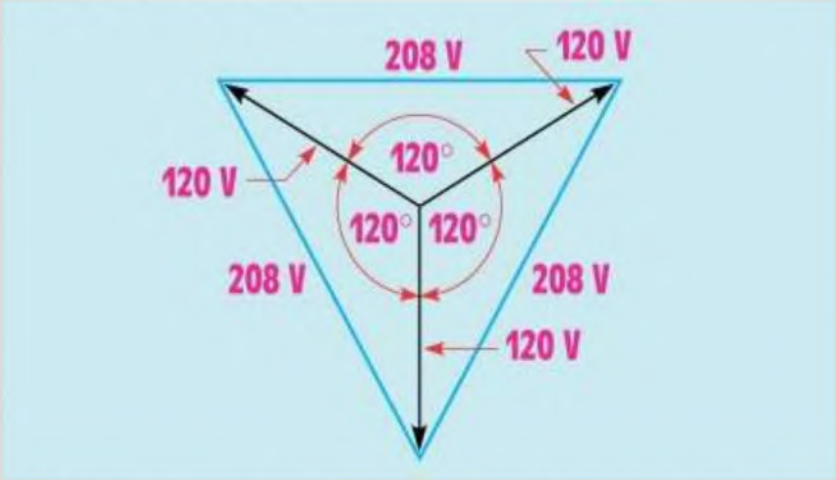
Line Volts is 1.732 of Phase volts in a wye System.

WYE SYSTEMS: AMPERAGES & VOLTAGES



Line and phase Amperage in a wye System.

THREE-PHASE CIRCUITS



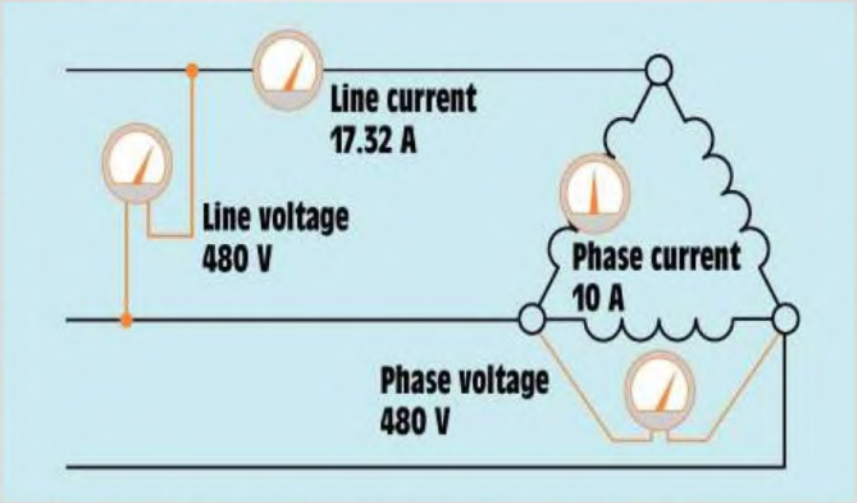
Vector sum of typical wye system voltages.

THREE-PHASE: DELTA SYSTEMS

Delta Connections

- In a Delta System, Line voltage is equal to the Phase voltage.
  - $E_{Line} = E_{Phase}$
- In a Delta System, Line Amperage is higher than the phase Amperage by a factor of the square root of 3 (1.732).
  - $I_{Line} = I_{Phase}$ x 1.732 or $I_{Phase} = I_{Line} / 1.732$
  - A Key factor in Circuit/Feeder Calculations

THREE-PHASE CIRCUITS



Delta system voltage and current relationships.

DELTA CIRCUIT CALCULATIONS

Example 20KW Heater Unit Calculation
Typical (Wye Calc) 20,000W / 240x1.732 = 48.11 Amps x 1.25 = 60A
310.16 #6CU, and 60A Breaker. Circuit will be Undersized.

Problem is Calculation was based on Phase Amps and not Line Amps
Needed: 20,000W / 240x1.732 = 48.11 Phase Amps
Multiply by 1.732 = 83.11 Line Amps x 1.25 = 104A
310.16 #2CU, and 125A Breaker.

THREE-PHASE CIRCUITS

Three-Phase Advantages – Amount of Conductor Needed

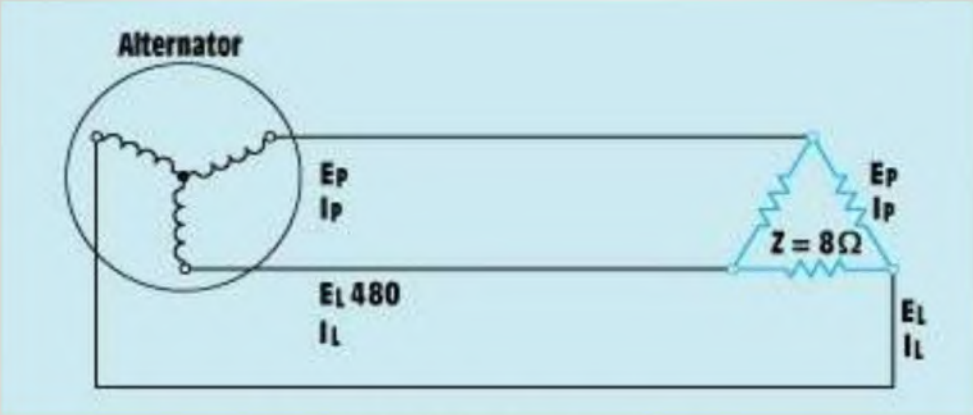
3. A three-phase system needs three conductors; however, each conductor is only 75% the size of the equivalent KVA rated single-phase system conductors.

THREE-PHASE CIRCUITS

Three-Phase Power

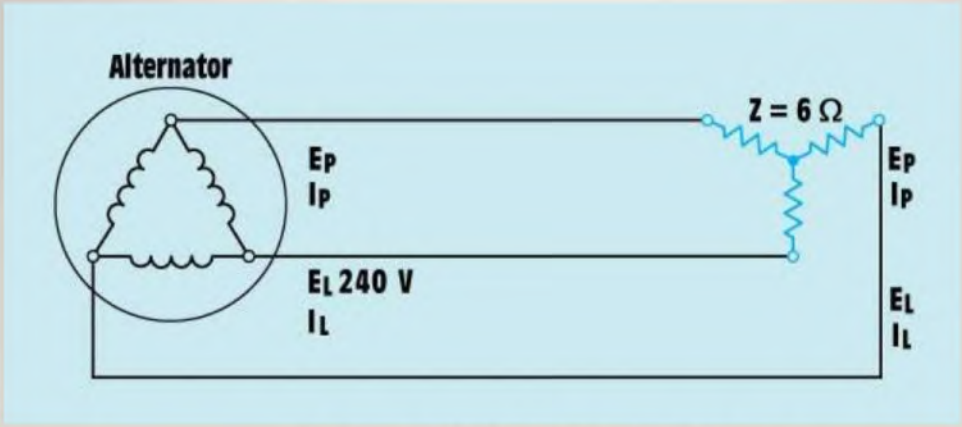
- Three-phase power can be computed in two ways, using line values or phase values.
- $VA = \sqrt{3} \times E_{Line} \times I_{Line}$
- $VA = 3 \times E_{Phase} \times I_{Phase}$
- This formula is the same for both: Wye or Delta circuits.
- The Line formula is best to use because you can always access the line for readings.

THREE-PHASE CIRCUITS



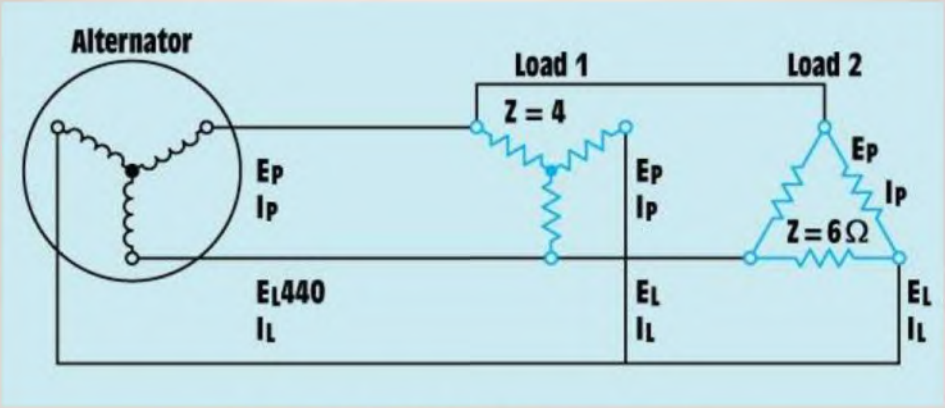
Example #1 given values.

THREE-PHASE CIRCUITS



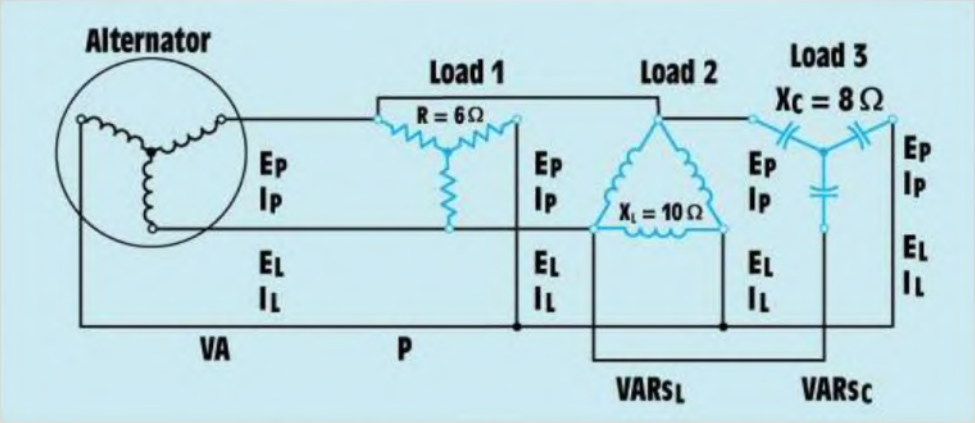
Example #2 given values.

THREE-PHASE CIRCUITS

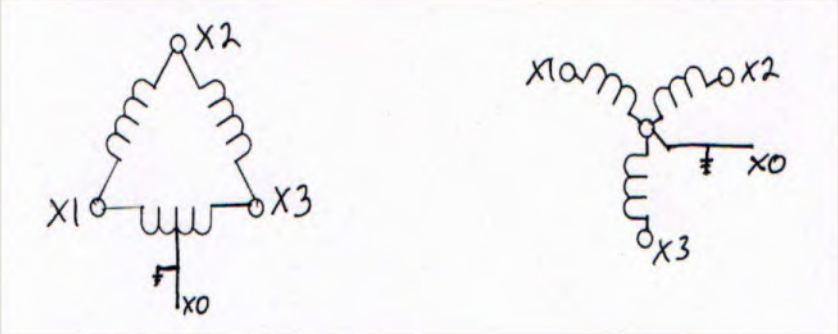


Example #3 given values.

THREE-PHASE CIRCUITS



Example #4 given values.



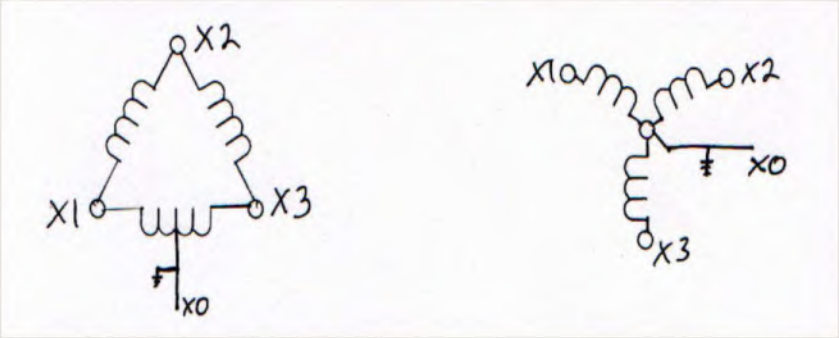
Now let's determine the load amps by looking at the impedance of the load circuit, which we will determine to be 6 ohms. 480V / 6 ohms = 80 amps

the phase current is 80 amps and therefore, the line current is 138.56 amps.
80 x 1.732 = 138.56

Second: WYE circuits, are shared series circuits.
Phase voltage is less than line voltage, it is line voltage / 1.732 the.
Notice that phase current and line current are the same.

A WYE circuit can be the primary of a transformer, the secondary of a transformer, or the circuit within the equipment that we connect power to.

A WYE circuit does not require every item of the circuit be a WYE configuration.
WYE/delta configurations are very common.



Line voltage is 480V and therefore the phase voltage is 277 to determine this
line voltage is / by 1.732 which equals 277V rounded.

Now lets determine the load amps by looking at the impedance of the load circuit, which we will determine to be 6 ohms.
480V / 6 ohms = 80 amps .
the phase current is 80 amps and is also the line current 80 amps.

Note that the delta has the same voltage line and phase therefore the WYE can not.

Note that neither one has a same phase and line values, therefore if the line and phase value of the voltage is the same then the line and phase value of current are different.

Note that in both situations the phase value is the lesser by 1.732, when they are not the same.

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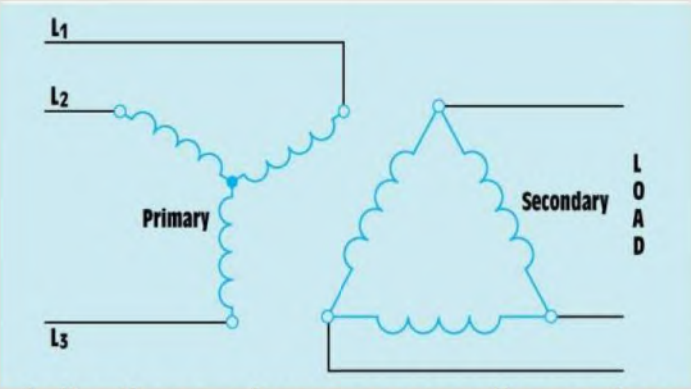
TRANSFORMER CONNECTIONS THREE PHASE

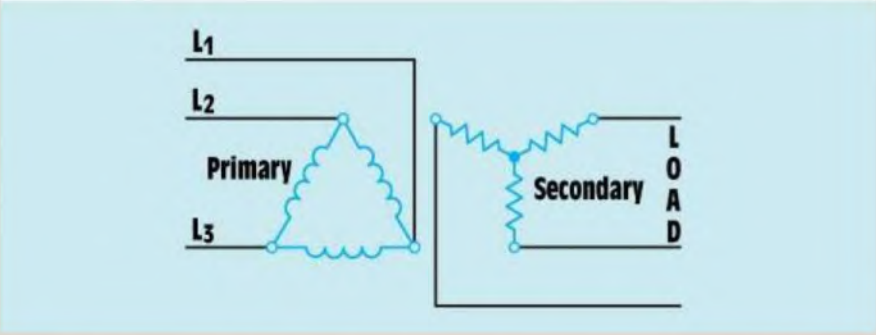
- Today, we enjoy transformer banks that are enclosed within 1 enclosure, and seldom do we look at the three phase transformer as a bank.
- However it is a bank of 3 single phase transformers, with 3 sets of primary coils wrapped around the secondary coils.
- Then to create the effect of a reactor (which enforces the 120° phase separation) they place these three sets of coils on one common inductor.

THREE-PHASE TRANSFORMERS



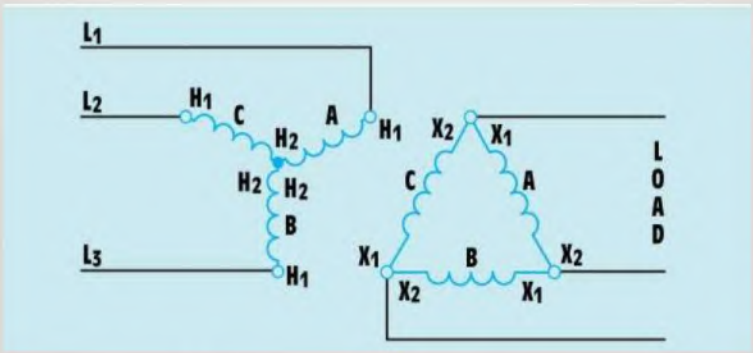
Wye-delta three-phase connection schematic.

THREE-PHASE TRANSFORMERS



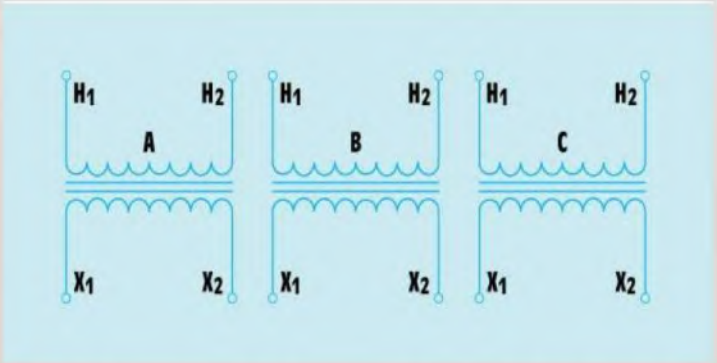
Delta-wye three-phase connection schematic.

THREE-PHASE TRANSFORMERS



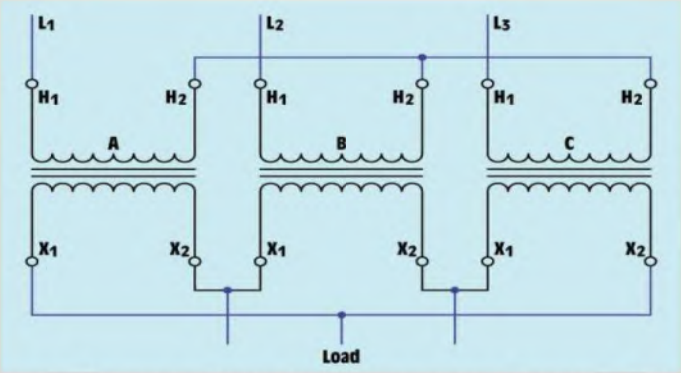
Winding identification.

THREE-PHASE TRANSFORMERS



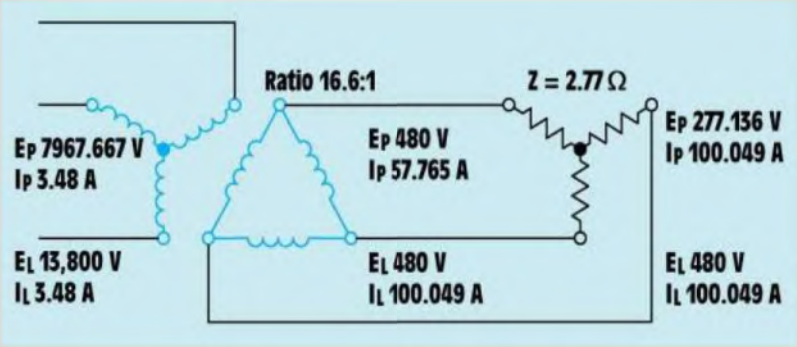
Transformer bank without connections.

THREE-PHASE TRANSFORMERS



Transformer bank connected wye-delta.

THREE-PHASE TRANSFORMERS



Example #1 schematic with all values.

Primary connections are made to H1, H2, H3 terminals or leads.

This does not vary from a delta or a WYE circuit.

Secondary connections are made to X1, X2, X3, and XO. XO is only provided as a termination point on a 4 wire secondary.

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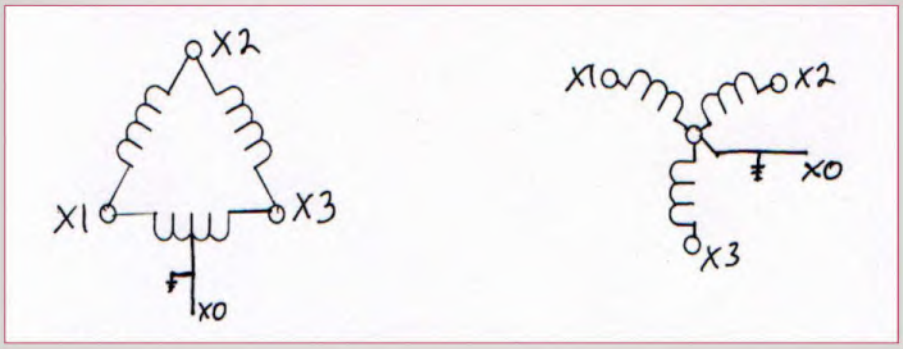
TRANSFORMER CONNECTIONS NEUTRALS

- Where does the neutral come from? And do I need to install one from my source voltage?
- First the neutral is created by the secondary circuit connection.
- Second you do not want to install a neutral form the source it is of no use and will create bad "Karma".



TRANSFORMER SECONDARY GROUNDING

- Grounding the secondary of isolation transformers is the only means by which you can ensure over current protection does it job if a fault from line to ground were to occur.
- Because the secondary is electrically isolated from the primary the induced voltage of the secondary does not recognize ground as a potential. It is this reason that the secondary must be tied to ground.

First rule of grounding the secondary, the neutral is always the grounded phase; but the grounded phase is not always the neutral.

To prevent a parallel path for faults, tie down at only one location, either at the transformer or at the secondary service disconnects.

The NEC does state one over the other however I've found one does make better sense than the other.

When best to ground at the transformer:

If the transformer is installed for the use of one piece of equipment and no service disconnect will be installed between the secondary and equipment, tie down at the transformer and install separate grounded phase and equipment ground conductors to the equipment.

When best to ground at the secondary service disconnect:

If the transformer is installed to feed a distribution panel that will have the service disconnecting means, then just as you would a utility provided power source ground there. That way all faults will be brought to the service disconnect and returned to the source via the grounded phase conductor.

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TRANSFORMER OVER CURRENT PROTECTION

- Primary OCP, you must know the KVA of the transformer to determine the full load amps.
- 3 Phase FLA = KVA * 1000 / (Voltage * 1.732)
- 1 Phase FLA = KVA * 1000 / Voltage

Most common transformer used to day is the 75KVA 480X120/208Y FLA=75,000/(480x1.732) 90.21Amps primary

If you only provide primary protection, it must be no greater than 125% of the 90.21 which is 112.76 amps or the next higher standard OCP rating which is 125 amps.

If you provide OCP for both the primary and secondary then the primary OCP is allowed to be 250% of primary FLA, 90.21Amps at 250% is 225.53 and 225 is a standard OCP rating. (The 0.53 may not be enough to sway the AHJ)

2. Secondary OCP, you must know the KVA of the transformer in order to determine the full load amps.

   3 phase FLA = KVA * 1000 / (voltage * 1.732)
   1 phase FLA = KVA * 1000 / voltage

Most common transformer used to day is the 75KVA 480X120/208Y FLA=75,000/(208x1.732) 208.19 amps secondary

If you provide secondary protection, it must be no greater than 125% of the 208.19 which is 260.24 amps or the next higher standard OCP rating which is 300 amps.

If the secondary OCP is a combination using the 6 switch rule which is allowed, note NEC 450-3b note #2. The aggregate of OCP can not exceed the maximum allowed for a single switch.

The reason 125% is used is because it is the reciprocal of 80%. 80% is the maximum load that OCP can handle as a constant load without opening.

Transformers are 100% rated.

OCR

Ohio Certificate Renewal

"Since 1994"

Secondary OCP locations:

1. The 10' rule.
   Conductors must be equal to or greater than computed loads.
   Conductors not allowed being less in ampacity than the OCP at termination.
   Conductors enclosed in a raceway.

2. The 25' rule.
   Conductors not allowed being less in ampacity than the FLA of the secondary.
   OCP must be a single device or the not to exceed 6 switches must be grouped.
   Conductors protected from physical damage.

SECTION I: TRANSFORMER SIZING

- 1. Determine load that must be met by the transformer.

- Use the same calculations you would for determining the size of a service, if that service were going to be provided by a utility.

2. If grouping of service panels is allowed by the physical layout of the facility it is more efficient to have 1-150KVA transformer than to have 2-75KVA units. Also, you may determine as is often the case that the load that would normally be served by 2-75KVA units can actually be met by 1-112.5KVA unit.

3. Don't supply loads with a transformer that can be serviced by other available voltages and or phase configurations on site.

   An example of this is having a 480/277Y, and using a 480X120/208Y transformer to provide 120V for lighting when that lighting could have been connected to the 277V available.

Presented by

JD White

jd.white2000@gmail.com

File Attachments for Item:

ER-6 Analysis of 2023 NEC Code Changes Part 1 (Central Electric Inspection Bureau)

All certifications (5 hours)

Staff Notes: For 2023 and 2024 presentation. Recommend approval.

ESIAC Recommendation:

Committee Recommendation:

Ohio | Department of Commerce

Mike DeWine, Governor
Jon Husted, Lt. Governor

Sheryl Maxfield, Director

Board of Building Standards

Application for Continuing Education Course Approval

Provider Information:

Name: John Grivensky

Organization: Electrical League of Eastern Ohio DBA Central Electric Inspection Bureau

Address: 201 E. Commerce St. Ste 160 Youngstown OH 44503

E-mail: office@centralinspections.org Telephone: 330-744-5238

Website: Centralinspections.org

Conference Sponsor (if applicable)_____ Conference Email:_____

Check here if Course Renewal:_____ Prior course number _____ *(i.e. BBS2018-429)*

Renewals will only be granted for identical content and certifications, within the current code cycle.
Attach a copy of prior course approval letter for confirmation. No further information is required.

New Course Information:

Course title: Analysis of 2023 Code Changes - Part 1

Course instructor: John Grivensky

Course description: To introduce the student to the new code changes and how it affects electrical system installations. This course was written using the reference material of the IAEI's Analysis of Changes 2023, the 2023 NEC & IAEI Analysis of 2023 Code Changes Powerpoint.

Instructional hours per session: 5 Number of Sessions: 1

Course Date(s) and Location: 12/9/23 - 201 E. Commerce St. Ste 160 Youngstown Ohio 44503

Special Content:

Code Administration:_____
Existing Buildings: _____
Electrical Instruction: ✓
Plumbing Instruction:_____

Conference Course: _____
Conference Name: _____
Conference location:_____

Course to be offered online?_____ **On Demand**_____ **Webinar**_____

Course Website: _____

Detail online course participation confirmation method *(i.e. test, quizlets, participant activity confirmation)*:

_____

Course applicable for the following certifications

Residential Certifications Only: _____ Commercial Certifications: _____
Administrative Course, All Certifications: _____

Application materials included:

✓ Course Outline or Course Learning Objectives
✓ Presentation Materials/Slides (not required for roundtable courses)
_____ Assessment Materials (for online courses)
✓ Presenter Bio

Please submit application and materials in .pdf format to: michael.lane@com.ohio.gov or BBS@com.ohio.gov

Analysis of 2023 Code Changes – Part I

5 Hour Course to be offered December 9, 2023

Timetable:

7:00am – 8:00am

Introduction:

1) General Information 2023 National Electric Code
2) Code-Wide changes
   - New Articles for 2023 NEC
   - Deleted Articles for the 2023 NEC
3) Article 90 Introduction

Chapter I: General

1) Article 100 – Definitions
2) Article 110 – General Requirements for Electrical Installations

BREAK: 8:00 to 8:15 AM

Chapter II: Wiring & Protection

1) Article 210 – Branch Circuits Not Over 1000 Volts ac, 1500 Volts dc, Nominal
2) Article 215 – Feeders
3) Article 220 – Branch-Circuit, Feeder and Service Load Calculations
4) Article 225 – Outside Branch-Circuits and Feeders
5) Article 230 – Services
6) Article 235 -- Branch Circuits, Feeders, and Services Over 1000 Volts ac, 1500Volts dc, Nominal
7) Article 240 – Overcurrent Protection
8) Article 242 – Overvoltage Protection
9) Article 245 -- Overcurrent Protection for Systems Rated Over 1000 Volts ac, 1500 Volts dc
10) Article 250 – Grounding and Bonding

BREAK: 9:15 to 9:30 AM

Chapter III: Wiring Methods and Material

1) Article 300 – General Requirements for Wiring Methods & Materials
2) Article 305 – Methods & Materials for Systems Rated Over 1000 Volts ac, 1500 Volts dc, Nominal
3) Article 310 – Conductors for General Wiring
4) Article 312 – Cabinets, Cutout Boxes, & Meter Socket Enclosures
5) Article 314 – Outlet, Device, Pull, and Junction Boxes, Conduit Bodies, Fittings & Handhole Enclosures
6) Article 315 – Medium Voltage Conductors, Cable, Cable Joints, and Cable Terminations
7) Article 320 – Armored Cable: Type AC
8) Article 322 – Flat Cable Assemblies: Type FC
9) Article 330 – Metal-Clad Cable: Type MC
10) Article 337 – Type P Cable

BREAK: 10:30 to 10:45 AM

Chapter III: Wiring Methods and Material cont'

11) Article 342 – Intermediate Metal Conduit *(IMC)*
12) Article 344 – Rigid Metal Conduit *(RMC)*
13) Article 352 – Rigid Polyvinyl Chloride Conduit *(PVC)*
14) Article 353 – High Density Polyethylene Conduit *(HDPE Conduit)*
15) Article 358 – Electrical Metallic Tubing *(EMT)*
16) Article 369 – Insulated Bus Pipe *(IBP) /* Tubular Covered Conductors *(TCC)* Systems
17) Article 371 – Flexible Bus Systems
18) Article 398 – Open Wiring on Insulators

Chapter IV: Equipment for General Use

1) Article 404 -- Switches
2) Article 406 – Receptacles, Cord Connectors and Attachment Plugs *(Caps)*
3) Article 408 – Switchboards, Switchgear, and Panelboards
4) Article 409 – Industrial Control Panels
5) Article 410 – Luminaires, Lampholders, and Lamps
6) Article 422 – Appliances

BREAK: 11:45 AM to 12:00 PM

7) Article 424 – Fixed Electric Space-Heating Equipment
8) Article 425 – Fixed Resistance & Electrode Industrial Process Heating Equipment
9) Article 426 – Fixed Outdoor Electric Deicing and Snow-Melting Equipment
10) Article 427 – Fixed Electric Heating Equipment for Pipelines & Vessels
11) Article 430 – Motors, Motor Controls, and Controllers
12) Article 440 – Air Conditioning and Refrigerating Equipment
13) Article 445 – Generators
14) Article 450 – Transformers & Transformer Vaults *(Including Secondary Ties)*
15) Article 470 – Resistors and Reactors
16) Article 495 – Equipment Over 1000 Volts ac, 1500 Volts dc, Nominal

Class Ends: 1:00 PM

Analysis of 2023 Code Changes – Part I
(5) Hours "Code"

References:

- I.A.E.I's Analysis of Changes NEC - 2023
- NFPA 70 National Electrical Code

Powerpoint

- I.A.E.I's Analysis of Changes – 2023 NEC

IAEI's Analysis of Changes 2023 *NEC*

Your essential guide to the most important changes in the 2023 National Electrical Code

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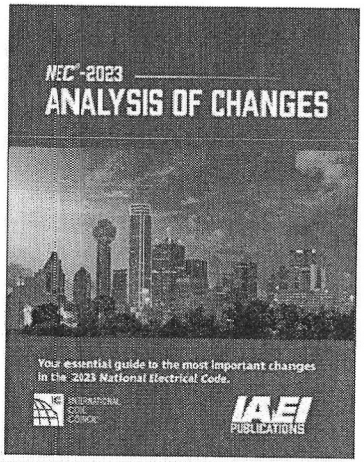
General Information
2023 National Electric Code

- Model Code Development
- IAEI Involvement
- IAEI Codes and Standards
- *NFPA NEC 1st and 2nd* Draft Meeting
- Public Input and Public Comments
- General Terms and IAEI Characters



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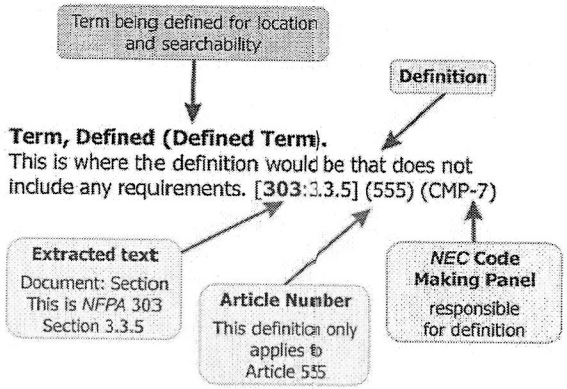
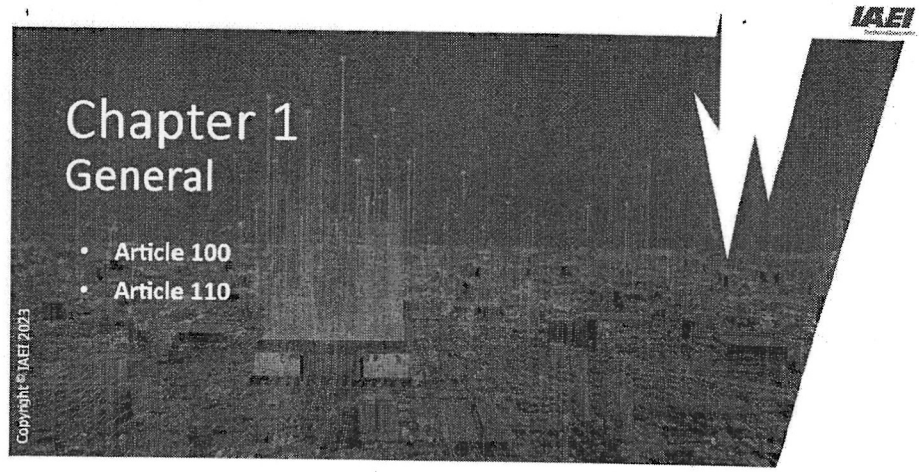
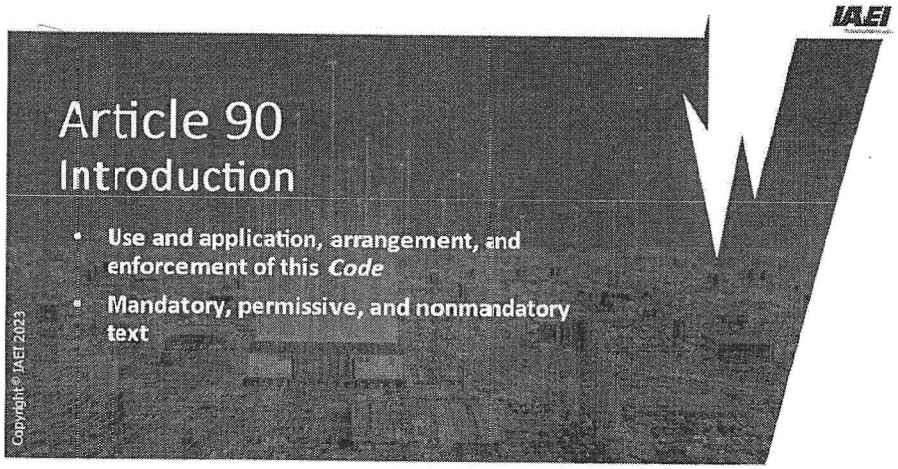
Code-Wide Changes

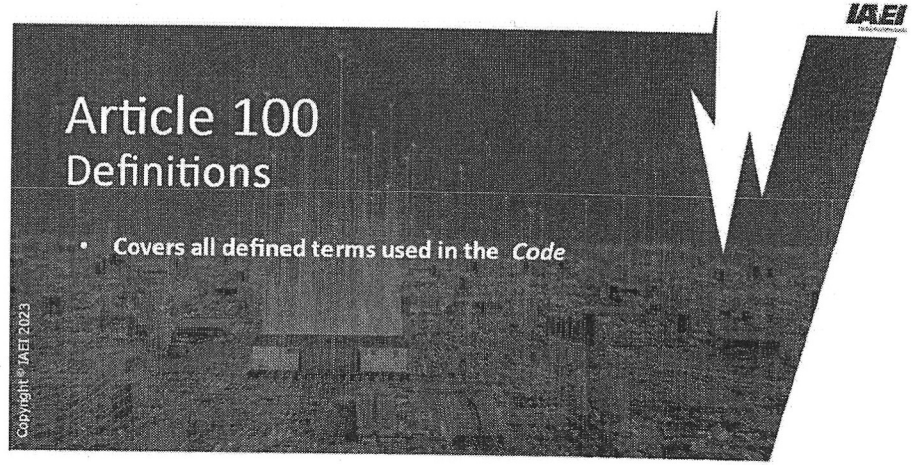
- *NEC* Style Manual Changes
- Definition Location
- Reconditioned Equipment
- Medium Voltage Requirements
- Copper Clad Aluminum
- New Articles for 2023 *NEC*

Article 100- Definitions







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General Requirements for Electrical Installations
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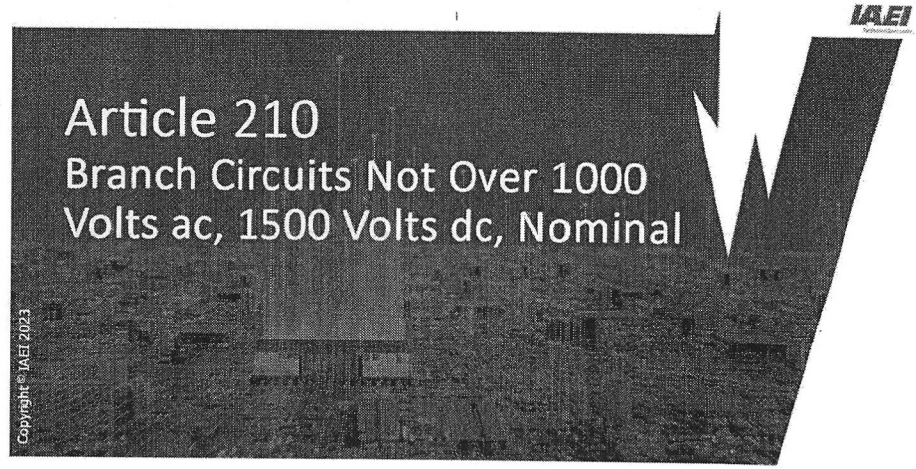
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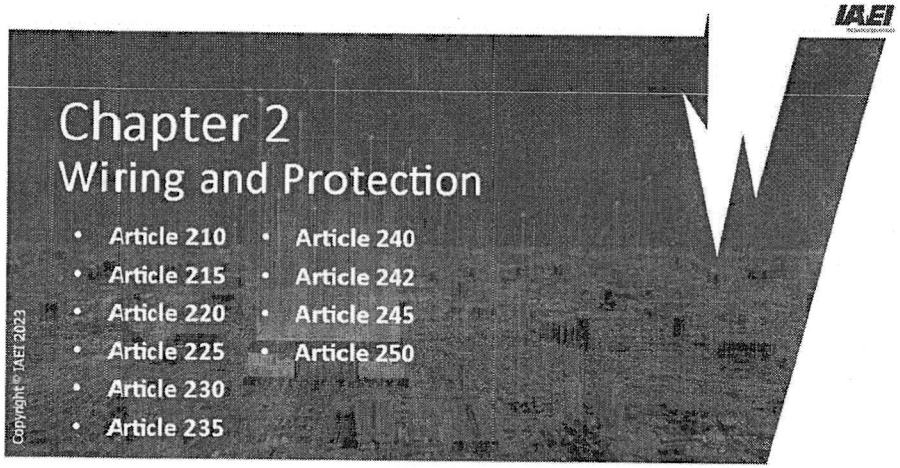
Chapter 2
Wiring and Protection
Article 210
Article 215
Article 220
Article 225
Article 230
Article 235
Article 240
Article 242
Article 245
Article 250
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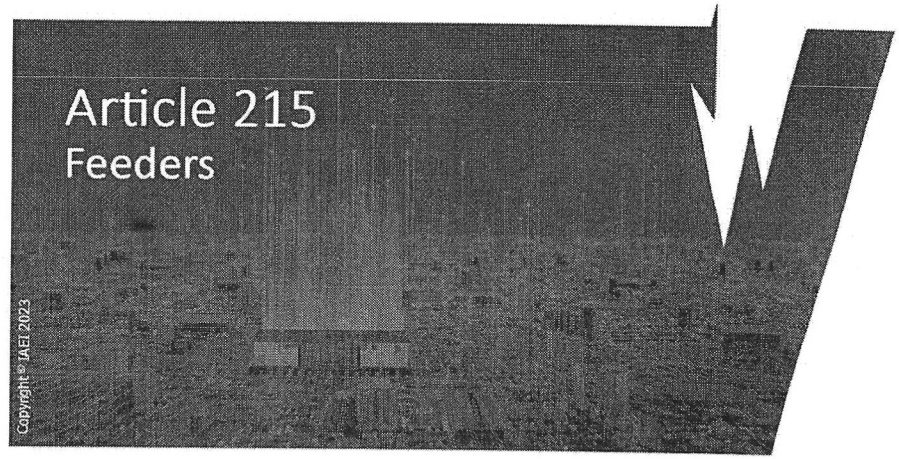
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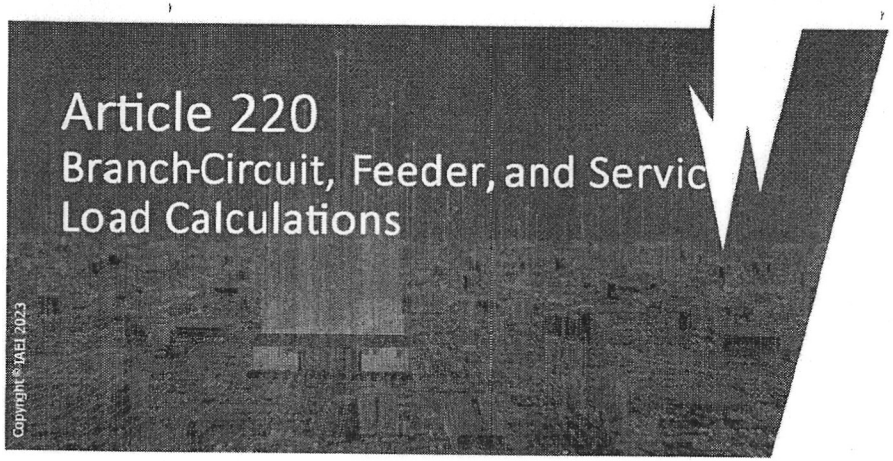
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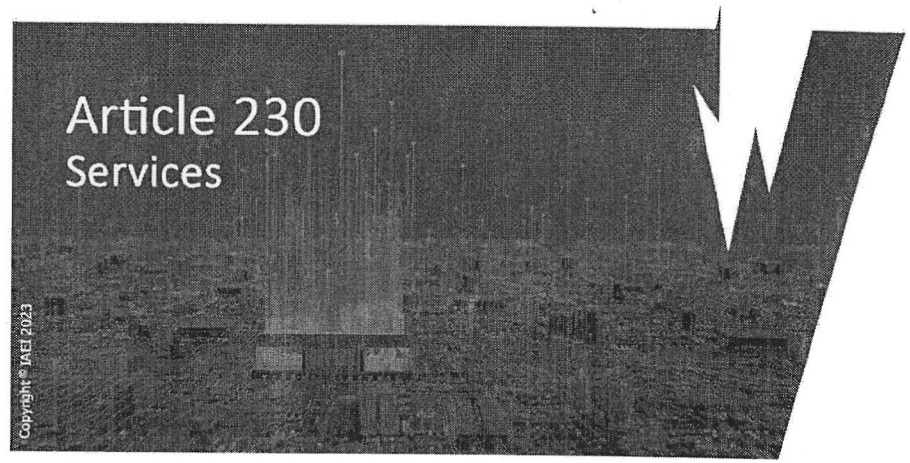
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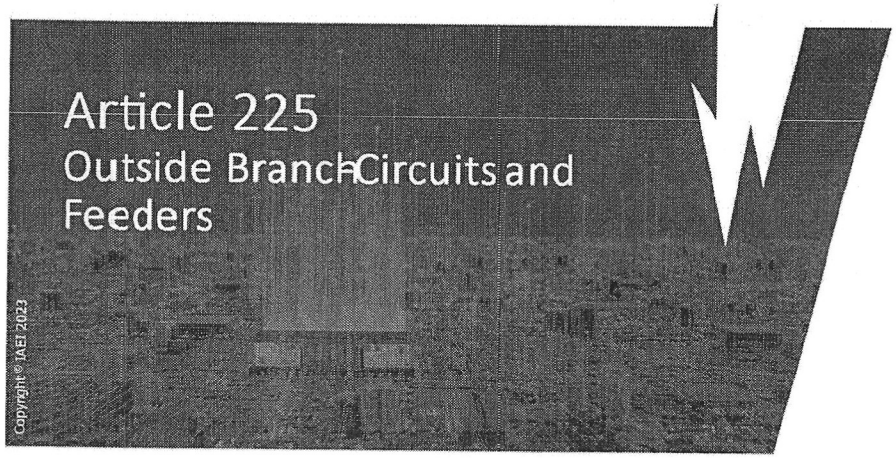
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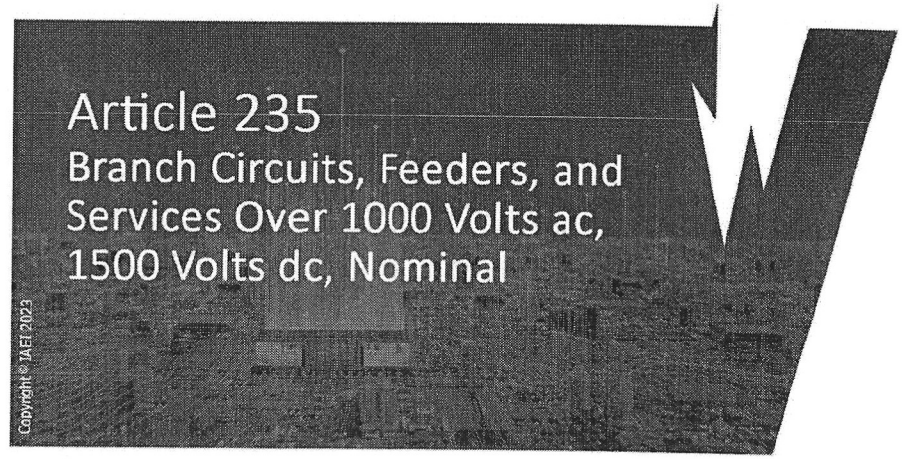
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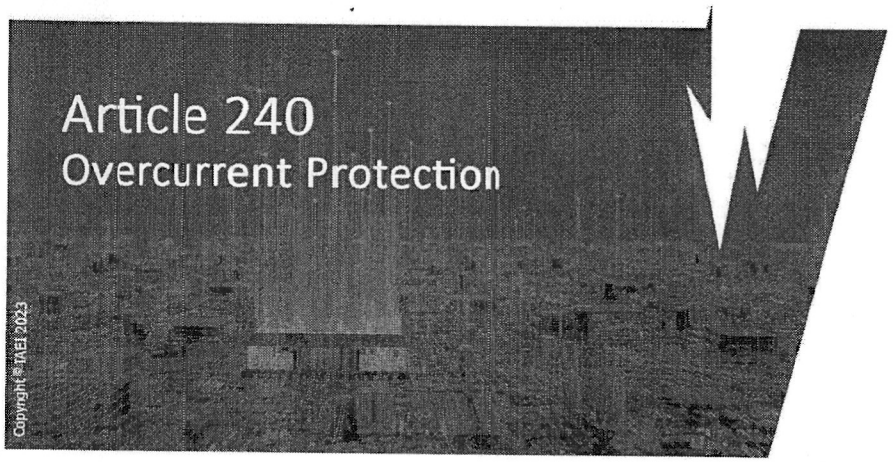
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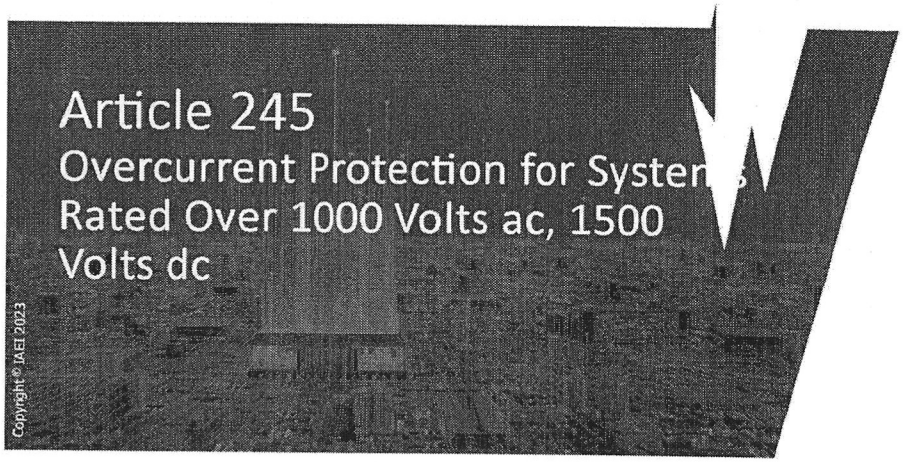
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Rated Over 1000 Volts ac, 1500
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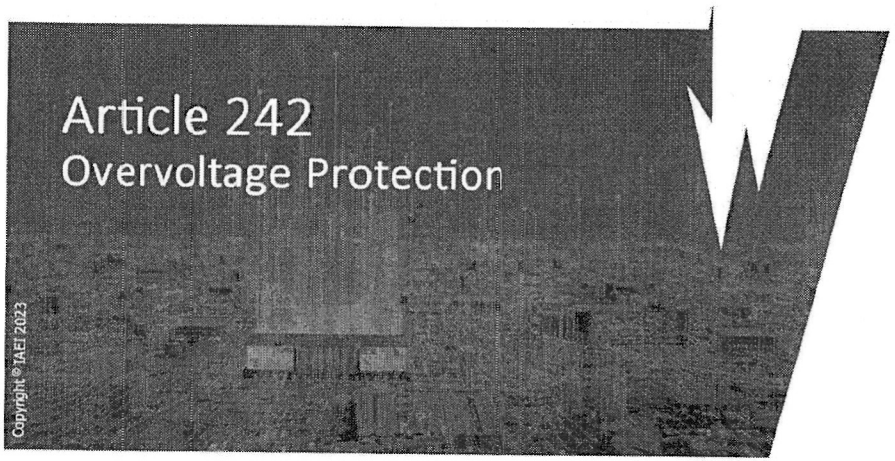
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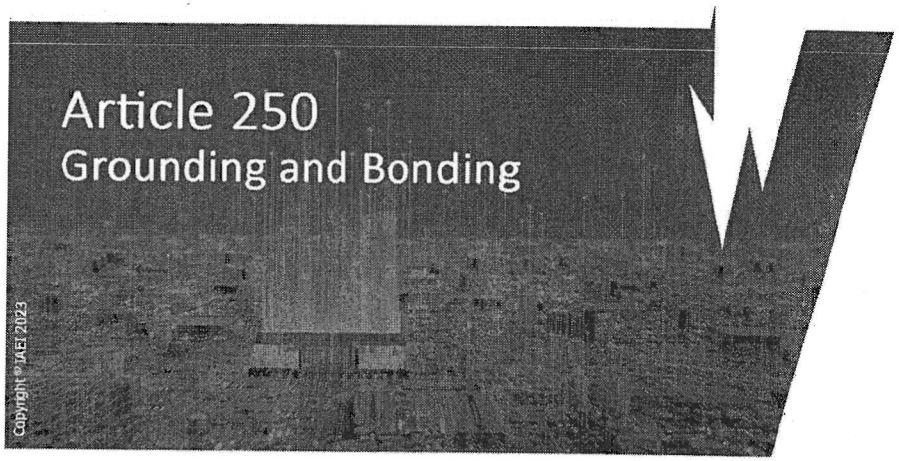
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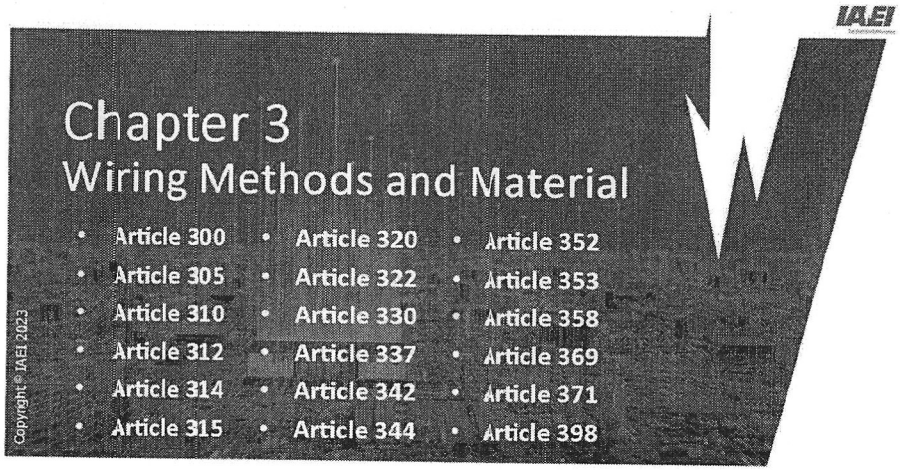
Chapter 3
Wiring Methods and Material
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• Article 305 • Article 322 • Article 353
• Article 310 • Article 330 • Article 358
• Article 312 • Article 337 • Article 369
• Article 314 • Article 342 • Article 371
• Article 315 • Article 344 • Article 398
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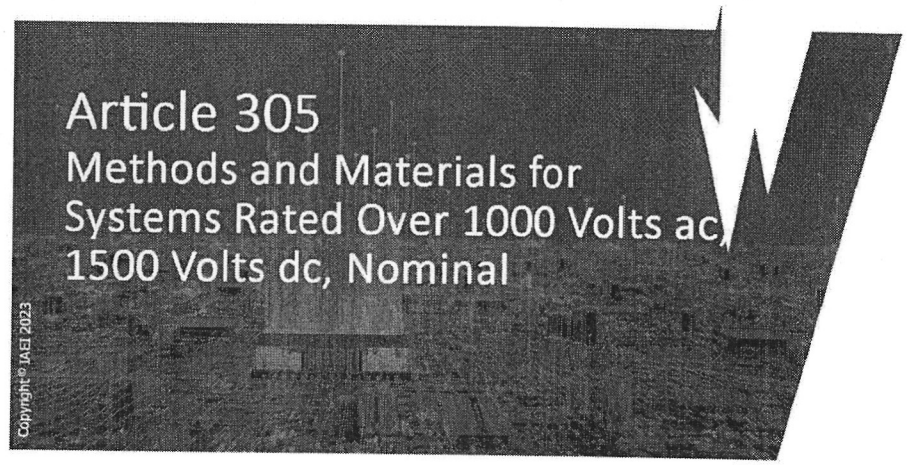
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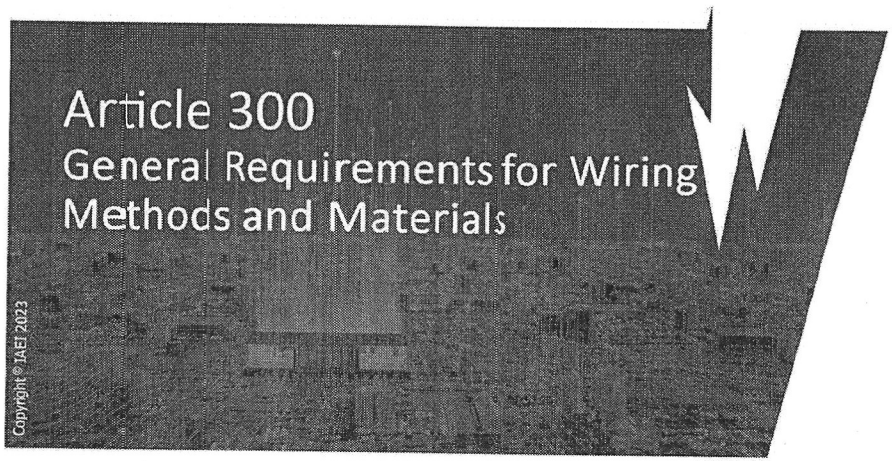
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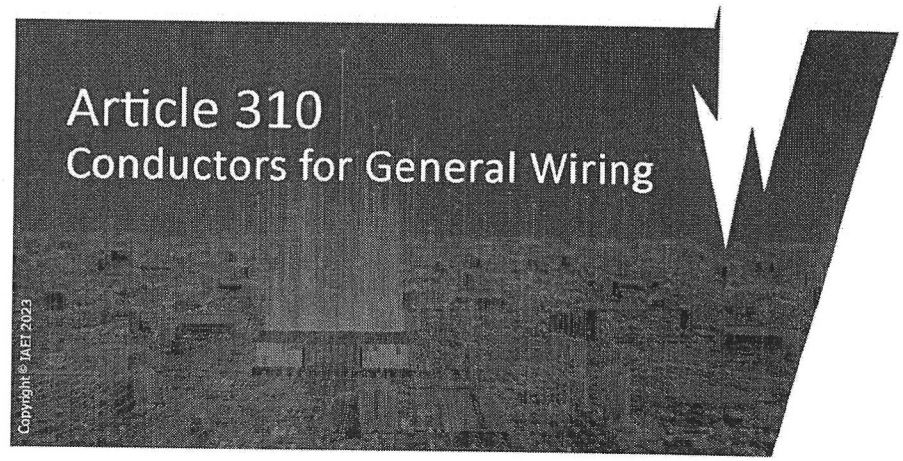
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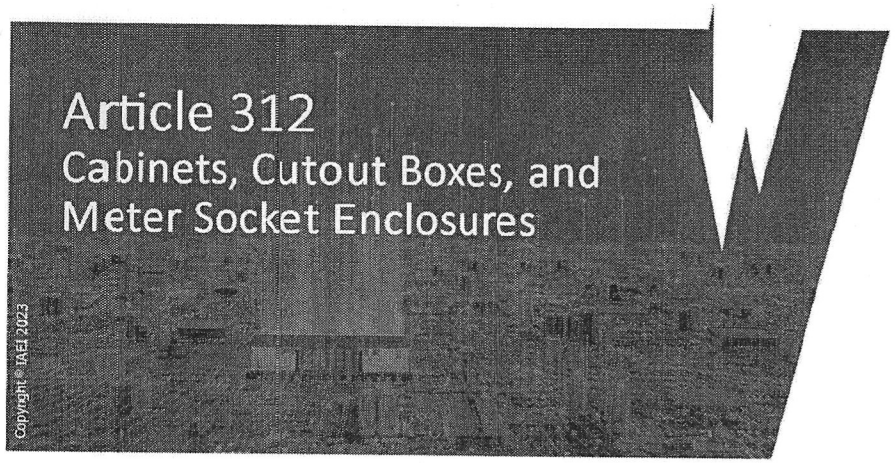
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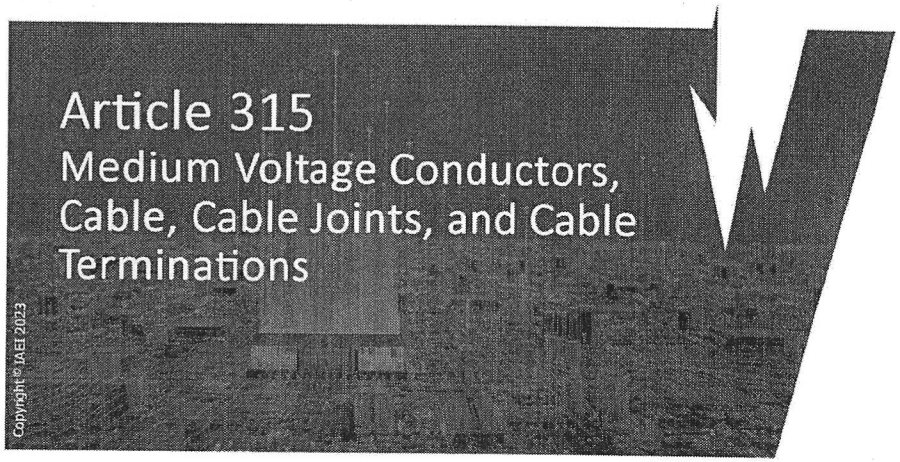
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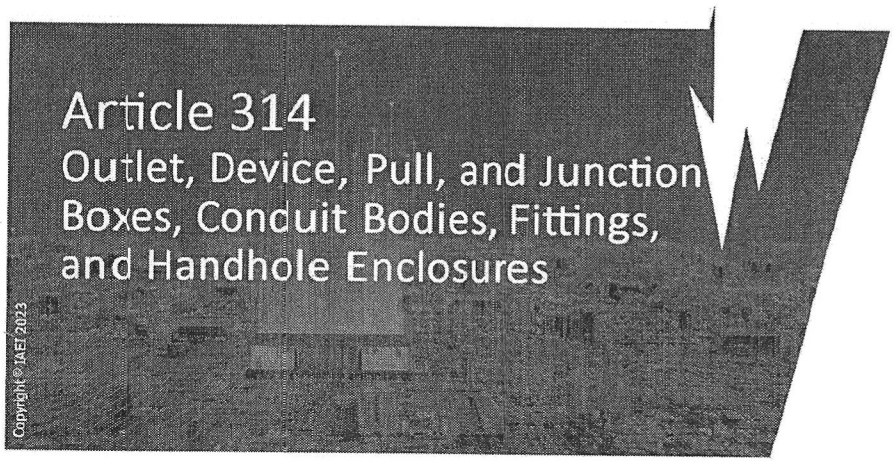
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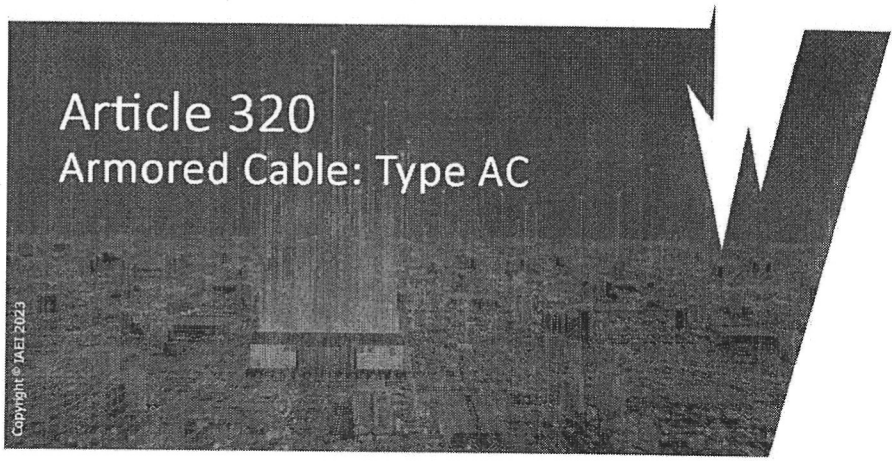
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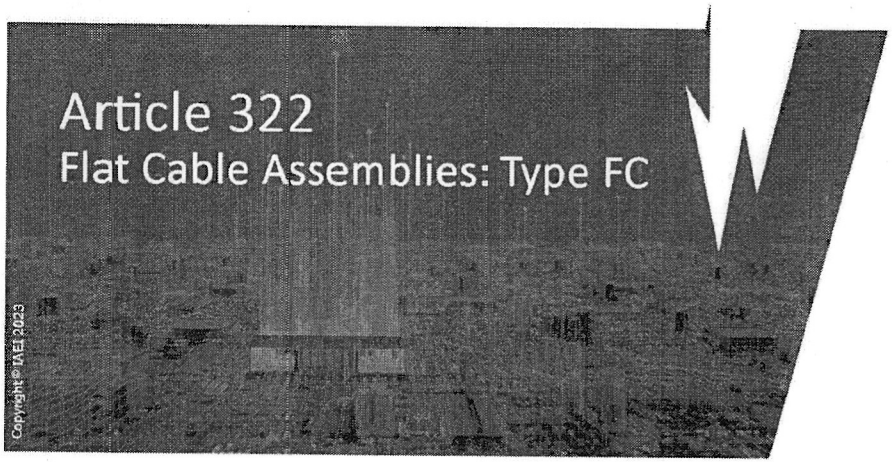
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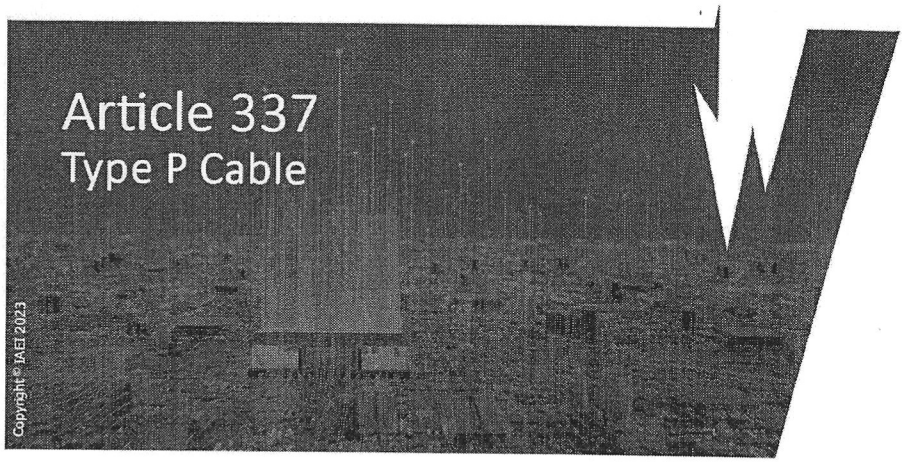
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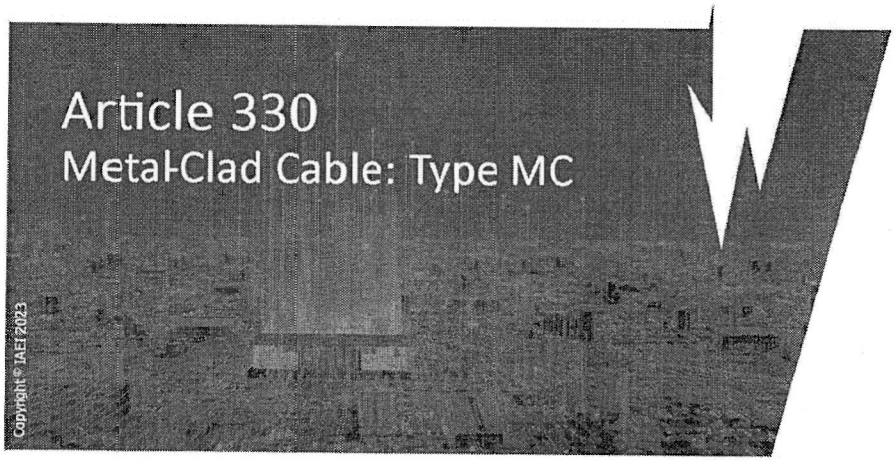
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Article 342
Intermediate Metal Conduit (IMC)
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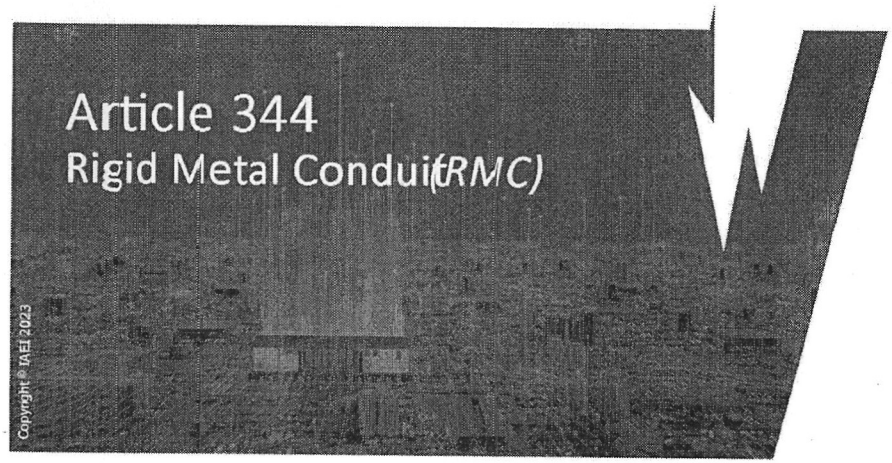
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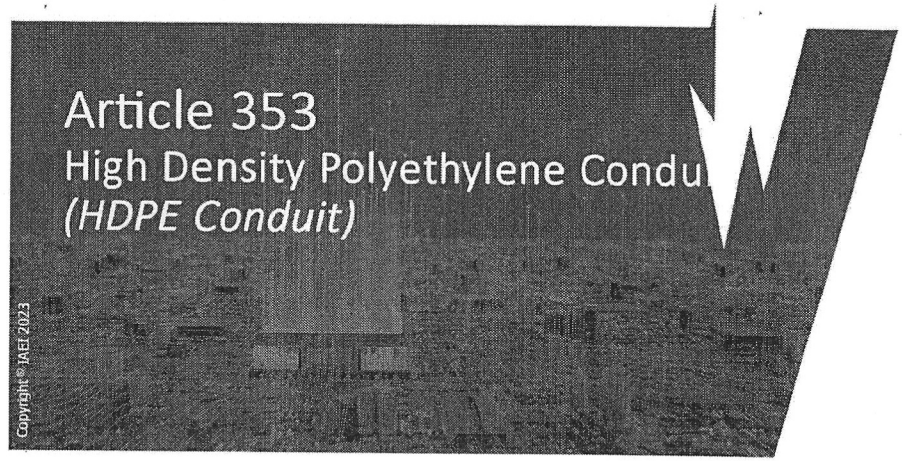
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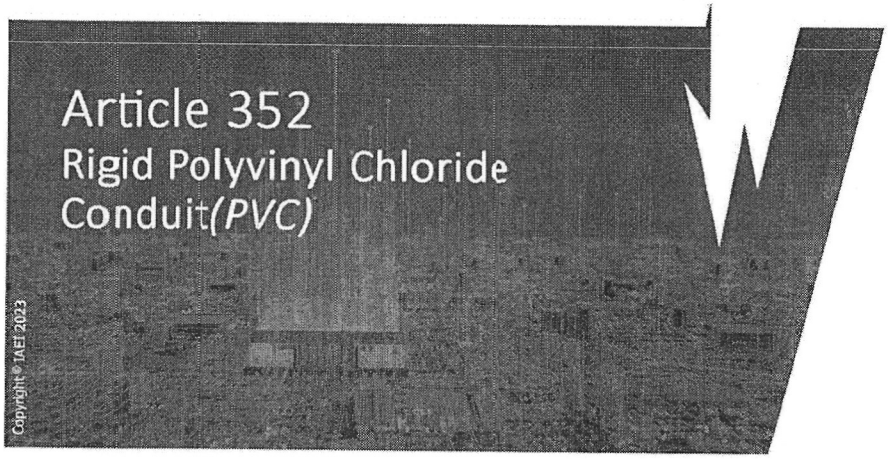
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Conduit (PVC)
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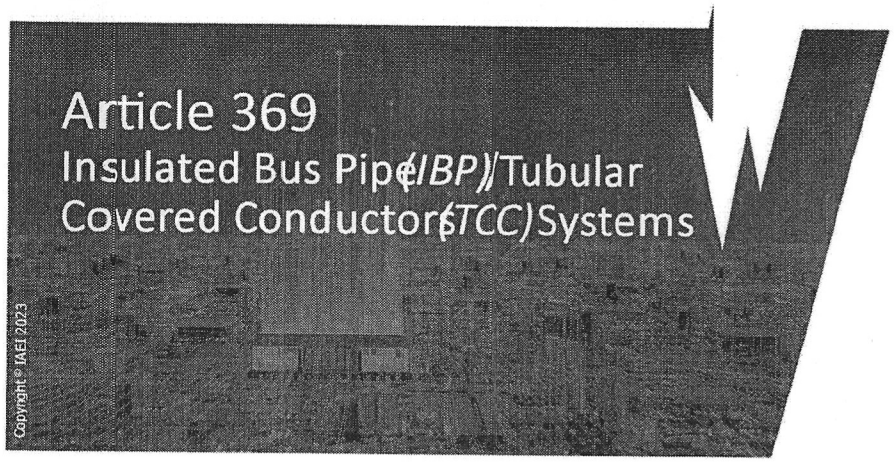
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Covered Conductors (TCC) Systems
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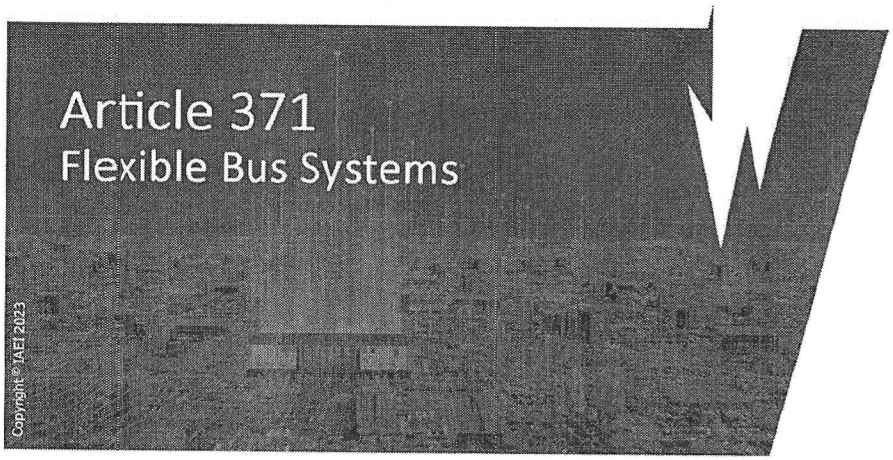
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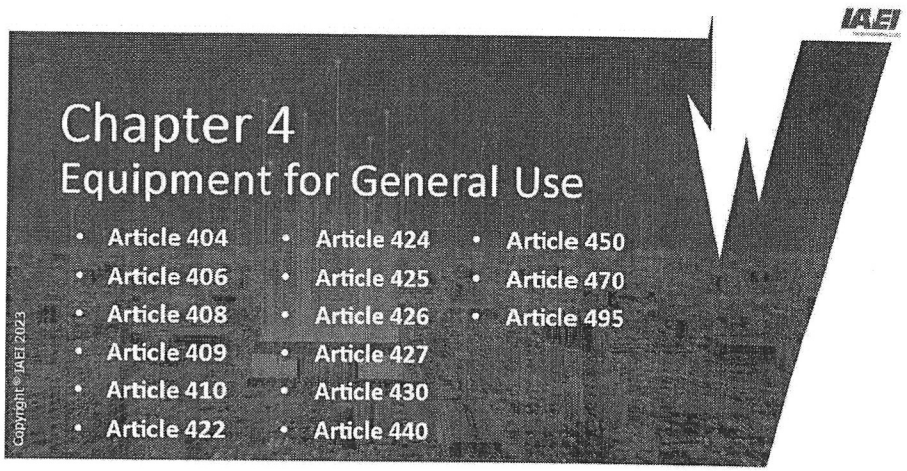
Chapter 4
Equipment for General Use
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• Article 495
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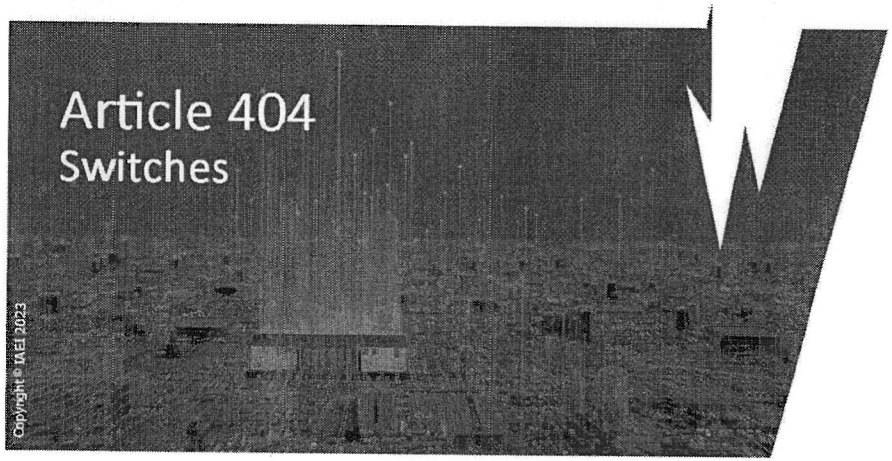
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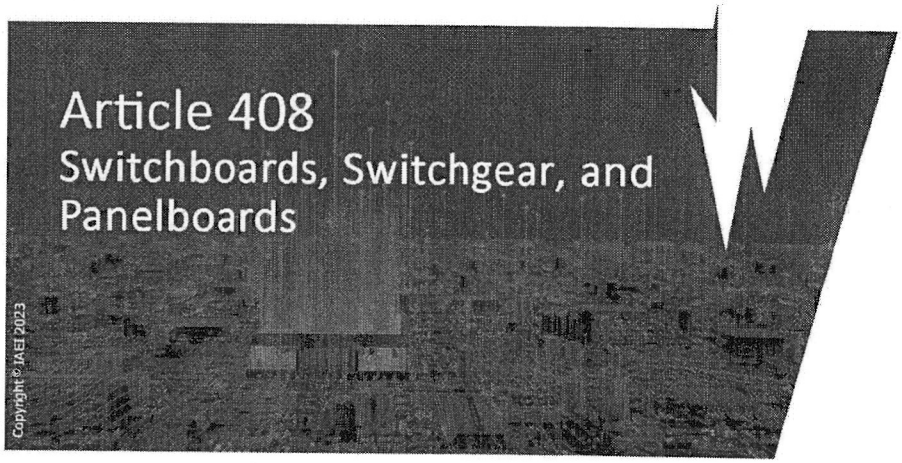
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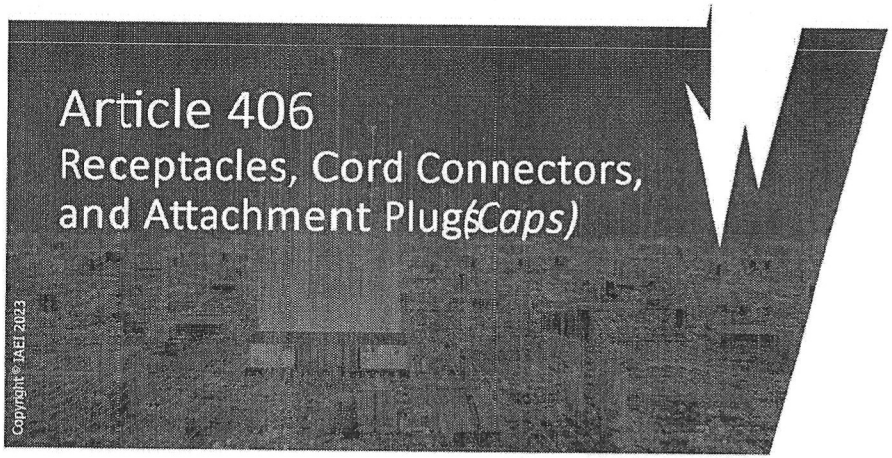
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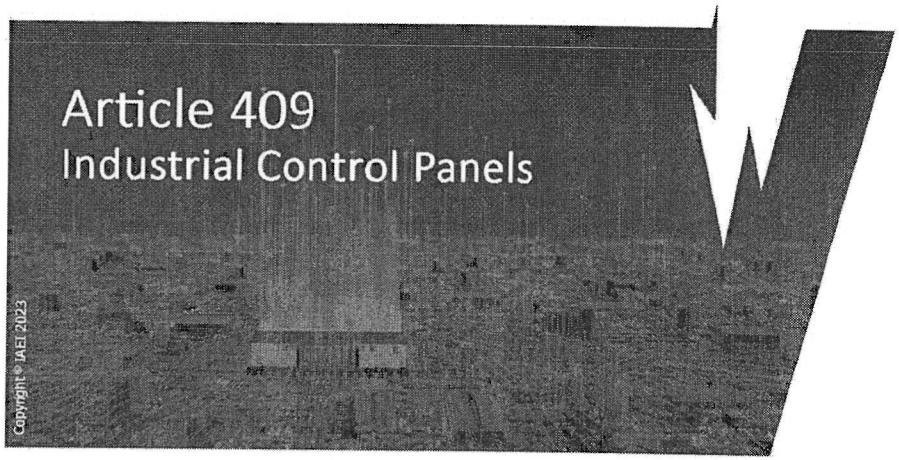
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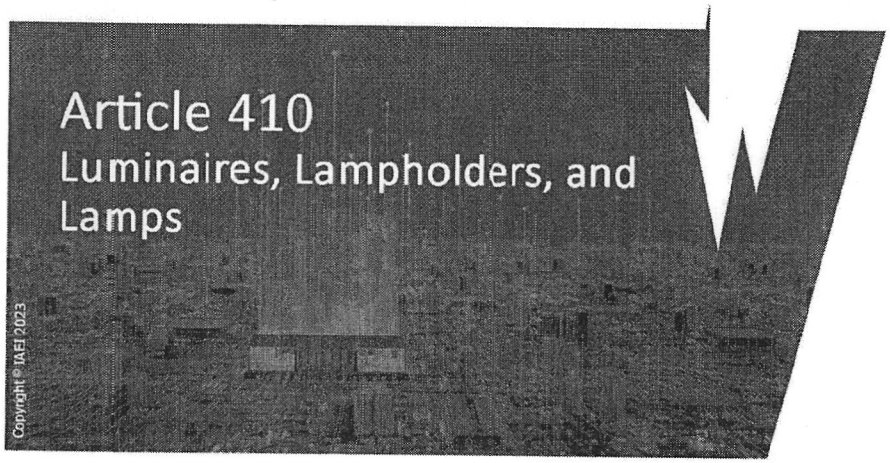
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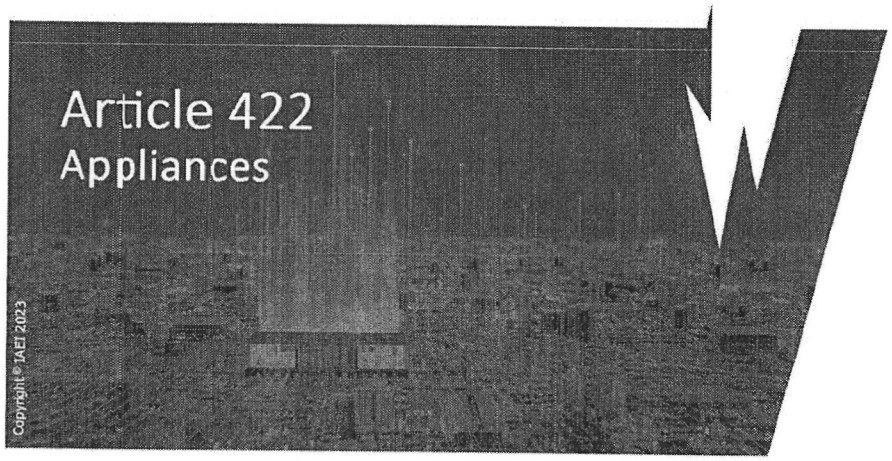
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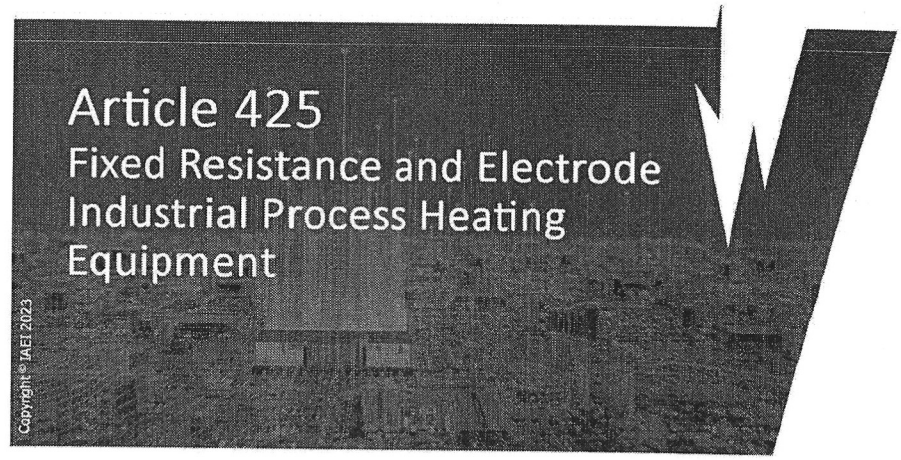
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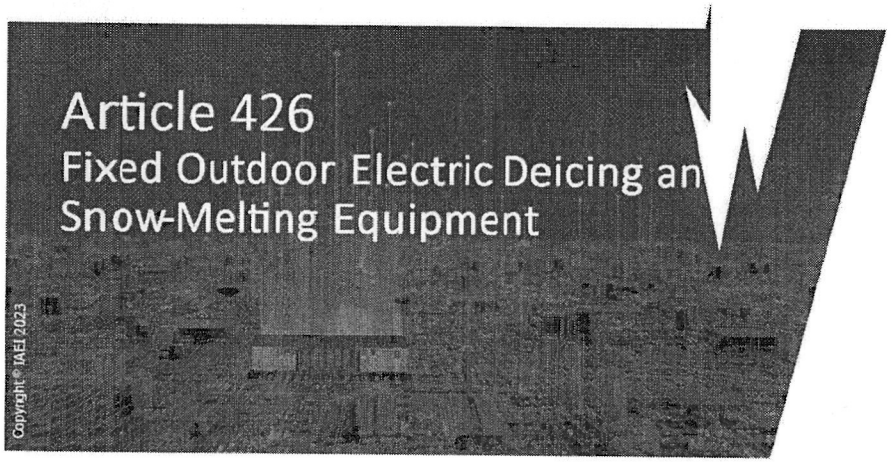
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Fixed Outdoor Electric Deicing an
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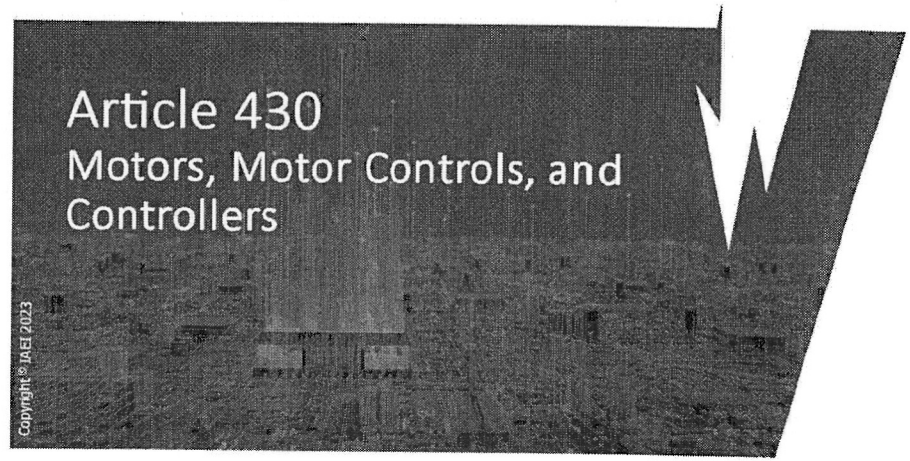
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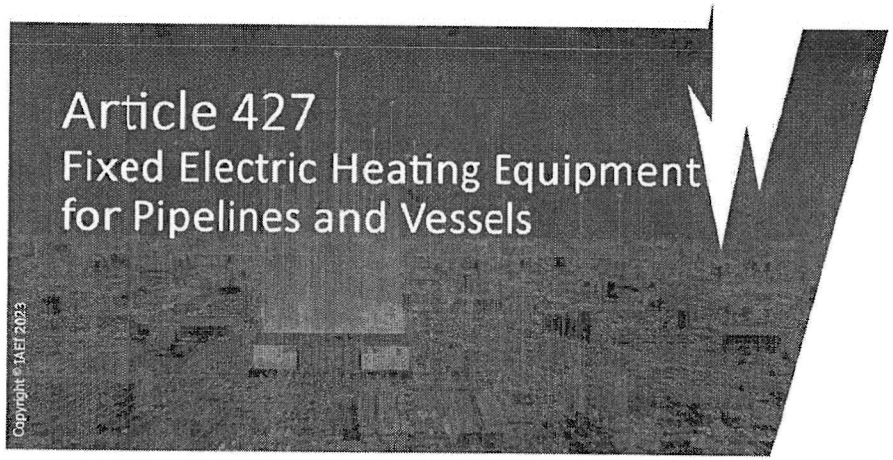
Article 427
Fixed Electric Heating Equipment
for Pipelines and Vessels
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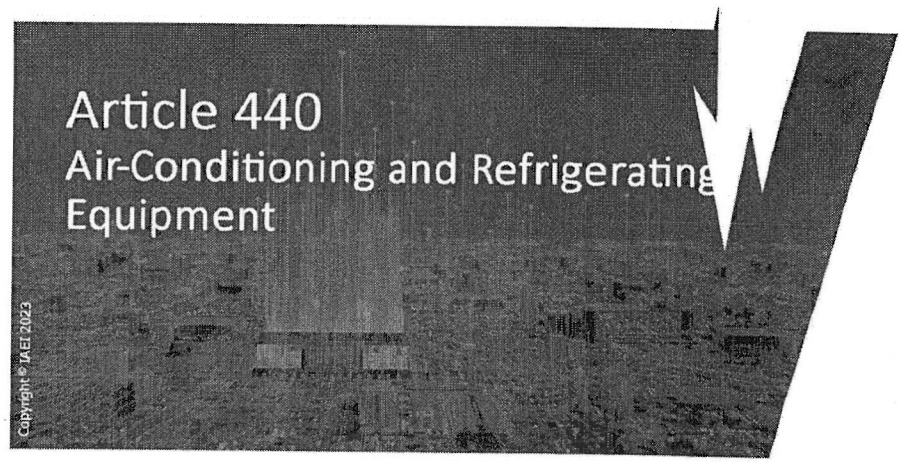
Article 440
Air-Conditioning and Refrigerating
Equipment
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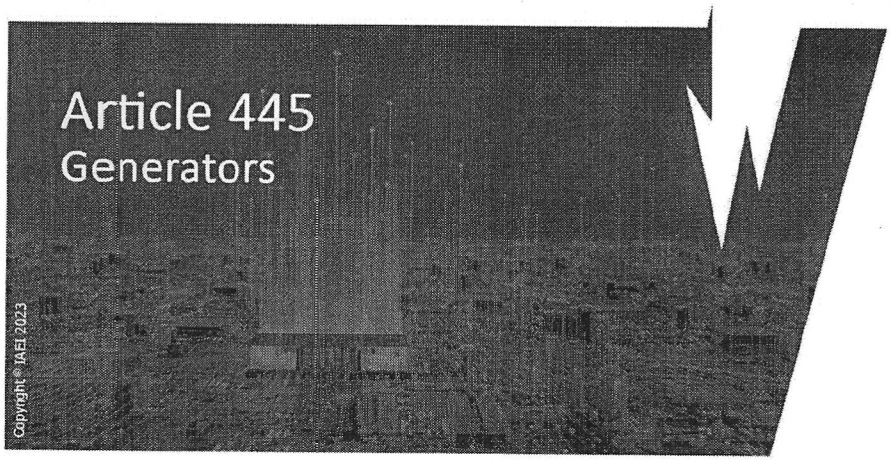
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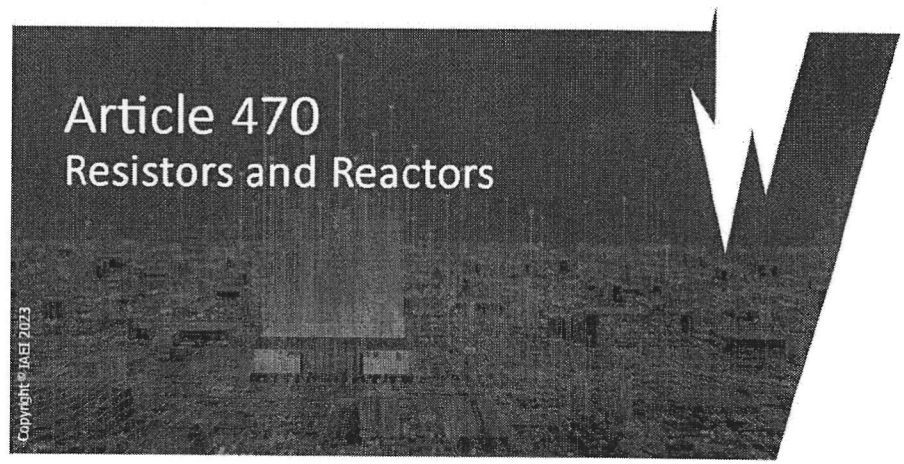
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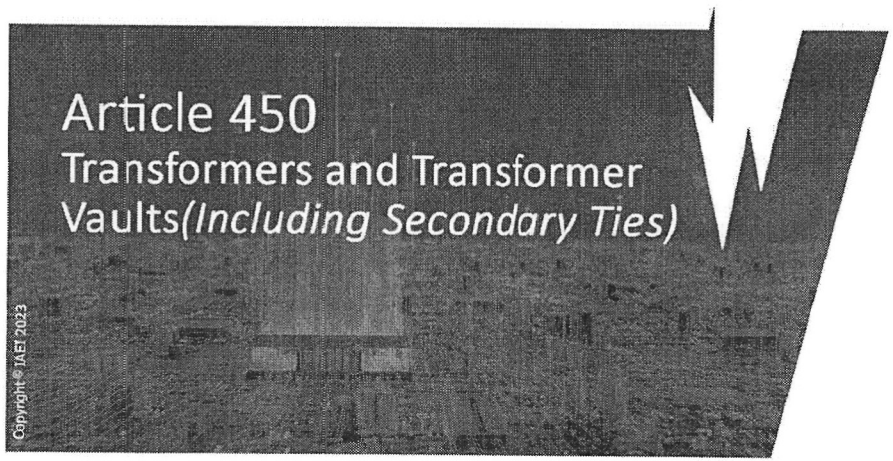
Article 450
Transformers and Transformer Vaults(Including Secondary Ties)
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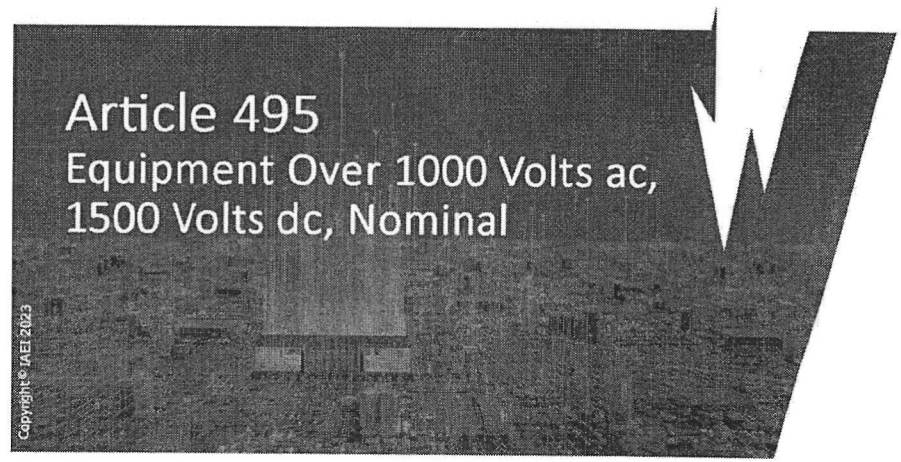
Article 495
Equipment Over 1000 Volts ac, 1500 Volts dc, Nominal
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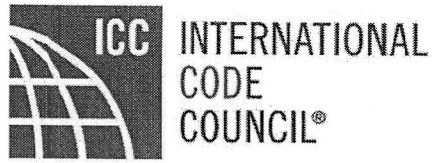

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iaei.org

John Z. Grivensky, ESI #565
1245 Sageberry Dr.
North Lima, Ohio 44452

Experience:

- Electrical Safety Inspector - 22 years
- Master Electrician (commercial/industrial/residential) – 39 years
- I.B.E.W. apprenticeship instructor – 29 years
- Mahoning County and City of Youngstown Electrical Plans Examiner – 15 years

Education:

- I.B.E.W. residential apprenticeship
- I.B.E.W. commercial/industrial apprenticeship
- Bachelor of Applied Science, Electrical Engineering from Youngstown State University
- Associate Degree, Vocational Instructor, from University of Tennessee

Affiliates:

- Past President of the International Association of Electrical Inspectors of the State of Ohio
- Current President of the International Association of Electrical Inspectors Association of Electrical Inspectors – Eastern Division
- Chairman of Mahoning County Licensing Board
- Secretary Treasurer of The Electrical League of Eastern Ohio

File Attachments for Item:

ER-7 Analysis of 2023 NEC Code Changes Part 2 (Central Electric Inspection Bureau)

All certifications (5 hours)

Staff Notes: For 2023 and 2024 presentation. Recommend approval.

ESIAC Recommendation:

Committee Recommendation:

Ohio | Department of Commerce

Mike DeWine, Governor
Jon Husted, Lt. Governor

Sheryl Maxfield, Director

Board of Building Standards

Application for Continuing Education Course Approval

Provider Information:

Name: John Grivensky

Organization: Electrical League of Eastern Ohio DBA Central Electric Inspection Bureau

Address: 201 E. Commerce St. Suite 1160 Youngstown OH 44503

E-mail: office@centralinspections.org Telephone: 330-744-5238

Website: Centralinspections.org

Conference Sponsor (if applicable)_____ Conference Email:_____

Check here if Course Renewal:_____ Prior course number _____ *(i.e. BBS2018-429)*

Renewals will only be granted for identical content and certifications, within the current code cycle.
Attach a copy of prior course approval letter for confirmation. No further information is required.

New Course Information:

Course title: Analysis of Code Changes -- Part 2

Course instructor: John Grivensky

Course description: To introduce the student to the new code changes and it how it affects electrical system installations. This course was written using the reference material of the IAEI's Analysis of Changes 2023, the 2023 NEC, + IAEI's Analysis of 2023 Changes Powerpoint.

Instructional hours per session: 5 Number of Sessions: 1

Course Date(s) and Location: 12/11/23 201 E. Commerce St. Ste 1160 Youngstown, OH 44503

Special Content:

Code Administration:_____
Existing Buildings: _____
Electrical Instruction: ✓
Plumbing Instruction:_____

Conference Course: _____
Conference Name: _____
Conference location:_____

Course to be offered online?_____ **On Demand**_____ **Webinar**_____

Course Website: _____

Detail online course participation confirmation method *(i.e. test, quizlets, participant activity confirmation)*:

_____

Course applicable for the following certifications

Residential Certifications Only: _____ Commercial Certifications: _____
Administrative Course, All Certifications: _____

Application materials included:

✓ Course Outline or Course Learning Objectives
✓ Presentation Materials/Slides (not required for roundtable courses)
_____ Assessment Materials (for online courses)
✓ Presenter Bio

Please submit application and materials in .pdf format to: michael.lane@com.ohio.gov or BBS@com.ohio.gov

Analysis of 2023 Code Changes – Part II

5 Hour Course to be offered December 16, 2023

Timetable:

7:00am – 8:00am

Introduction:

1) General Information 2023 National Electric Code

Chapter V: Equipment for General Use

1) Article 500 – Hazardous *(Classified)* Locations Classes I, II, and III, Divisions 1 and 2
2) Article 505 – Zone 0, 1, and 2 Locations
3) Article 512 – Cannabis Oil Equipment
4) Article 515 – Bulk Storage Plants
5) Article 517 – Health Care Facilities
6) Article 518 – Assembly Occupancies

BREAK: 8:00 to 8:15 AM

7) Article 530 – Motion Picture and Television Studios & Remote Locations
8) Article 547 – Agricultural Buildings
9) Article 550 – Mobile Homes, Manufactured Homes, and Mobile Home Parks
10) Article 551 – Recreational Vehicles and Recreational Vehicle Parks
11) Article 555 – Marinas, Boatyards, Floating Buildings, and Commercial and Noncommercial Docking Facilities
12) Article 590 – Temporary Installations

Chapter VI: Special Equipment

1) Article 600 – Electric Signs and Outline Lighting
2) Article 620 – Elevators, Dumbwaiters, Escalators, Moving Walks, Platform Lifts, and Stairway Chairlifts
3) Article 625 – Electric Vehicle Power Transfer

BREAK: 9:15 to 9:30 AM

4) Article 630 – Electric Welders

5) Article 646 – Modular Data Centers
6) Article 670 – Industrial Machinery
7) Article 680 – Swimming Pools, Fountains, and Similar Installations
8) Article 690 – Solar Photovoltaic *(PV)* Systems

Chapter VII: Special Conditions

1) Article 700 – Emergency Systems
2) Article 701 – Legally Required Standby Systems
3) Article 705 – Interconnected Electric Power Production Sources
4) Article 706 – Energy Storage Systems
5) Article 722 – Cables for Power-Limited Circuits and Fault-Managed Power Circuits

BREAK: 10:30 to 10:45 AM

6) Article 725 – Class 2 and Class 3 Power-Limited Circuits
7) Article 726 – Class 4 Fault-Managed Power Systems
8) Article 760 – Fire Alarm Systems

Chapter VIII: Communication Systems

1) Article 800 – General Requirements for Communications Systems
2) Article 805 – Communications Circuits
3) Article 840 – Premises-Powered Broadband Communications Systems

BREAK: 11:45 AM to 12:00 PM

Chapter VIIII: Tables and Informative Annexes

1) Chapter 9 Table 13
2) Informative Annex A – Product Safety Standards
3) Informative Annex E – Types of Construction

Class Ends: 1:00 PM

Analysis of 2023 Code Changes – Part II
(5) Hours "Code"

References:

- I.A.E.I's Analysis of Changes NEC - 2023
- NFPA 70 National Electrical Code

Powerpoint

- I.A.E.I's Analysis of Changes – 2023 NEC

IAEI's Analysis of Changes 2023 *NEC*

Your essential guide to the most important changes in the 2023 National Electrical Code

IAEI The Electrical Safety Code

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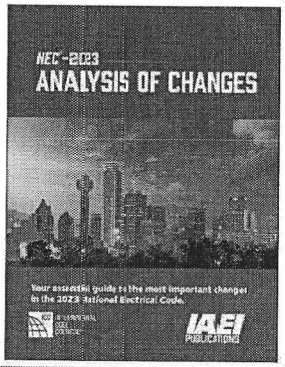

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IAEI

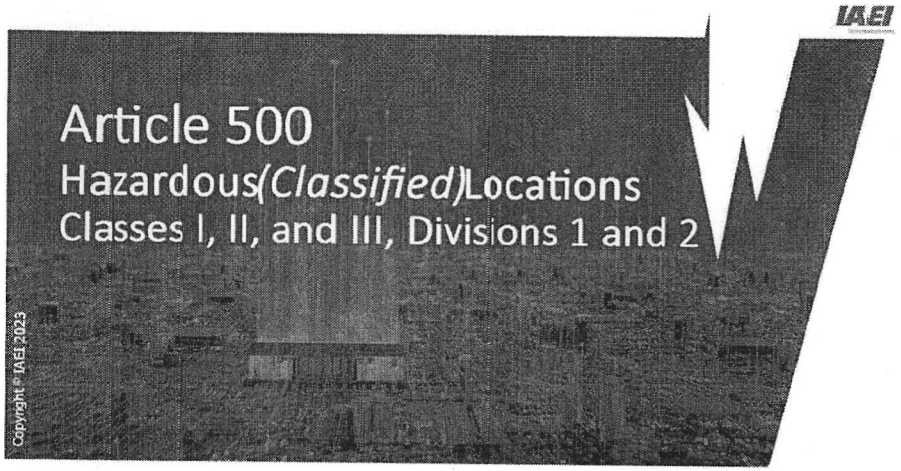
General Information
2023 National Electric Code

- Model Code Development
- IAEI Involvement
- IAEI Codes and Standards
- *NFPA NEC 1st and 2nd* Draft Meeting
- Public Input and Public Comments
- General Terms and IAEI Characters

IAEI

Chapter 5
Equipment for General Use

- Chapter 500
- Chapter 505
- Chapter 515
- Chapter 517
- Chapter 530
- Chapter 547
- Chapter 550
- Chapter 551
- Chapter 555
- Chapter 590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Hazardous *(Classified)* Locations
Classes I, II, and III, Divisions 1 and 2
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Cannabis Oil Equipment
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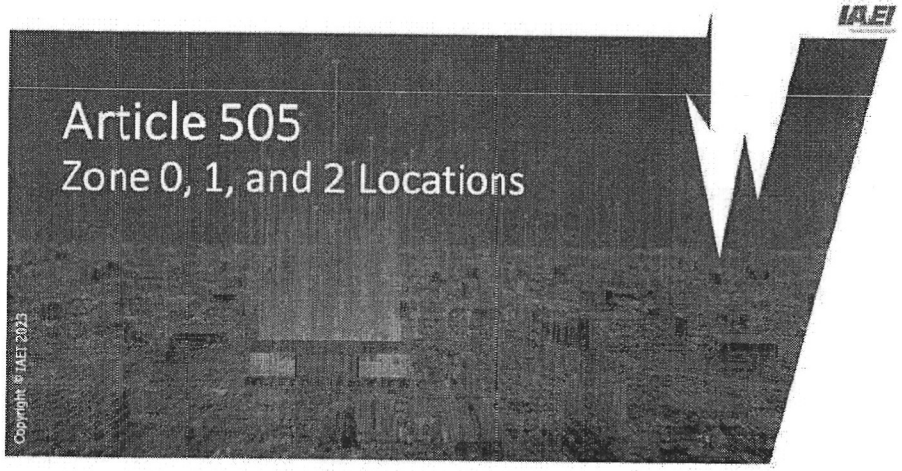
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Zone 0, 1, and 2 Locations
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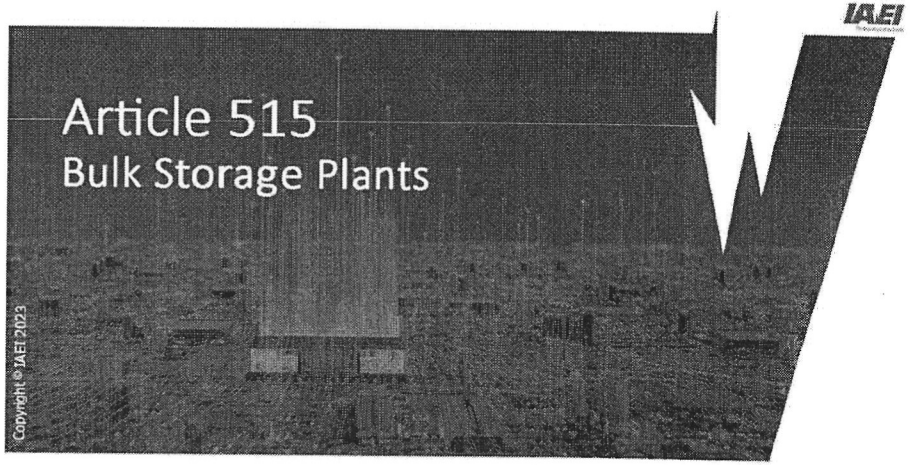
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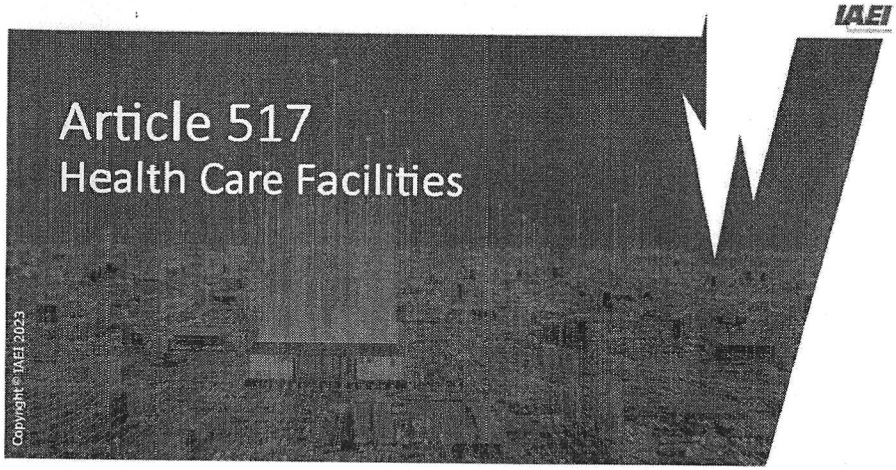
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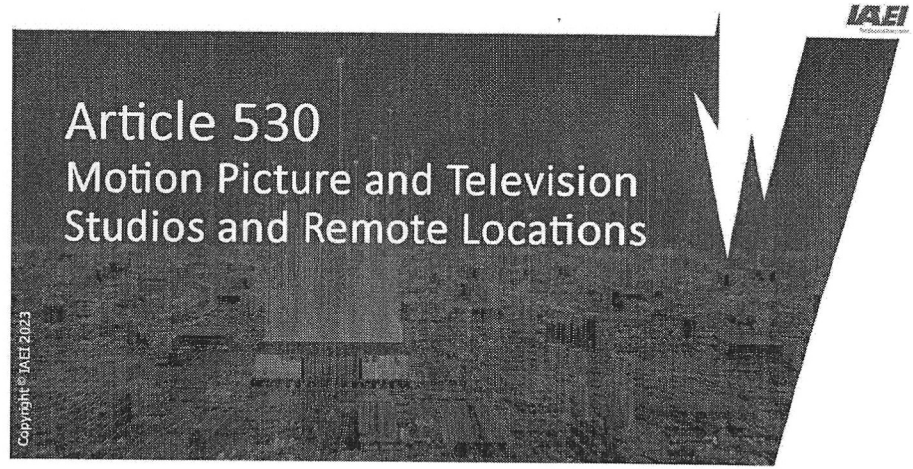
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Motion Picture and Television
Studios and Remote Locations
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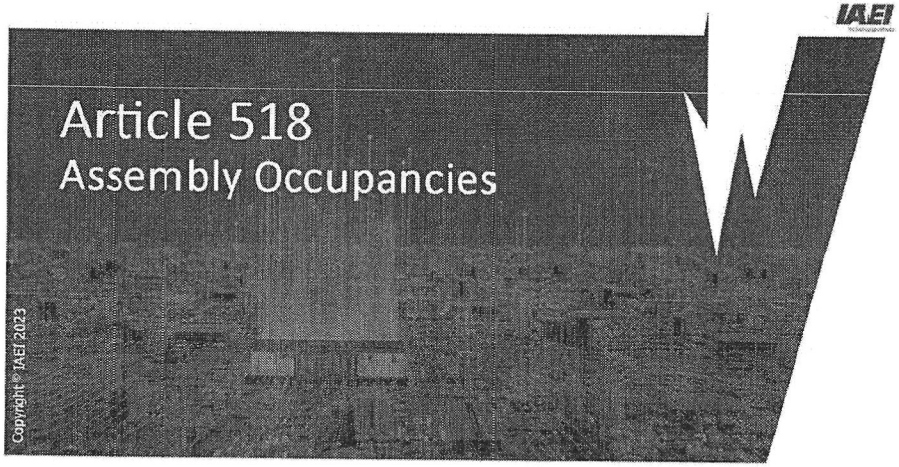
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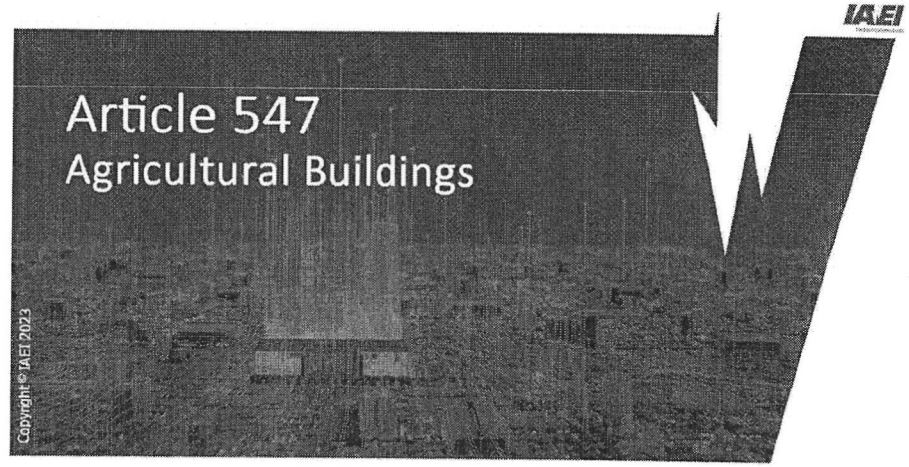
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Agricultural Buildings
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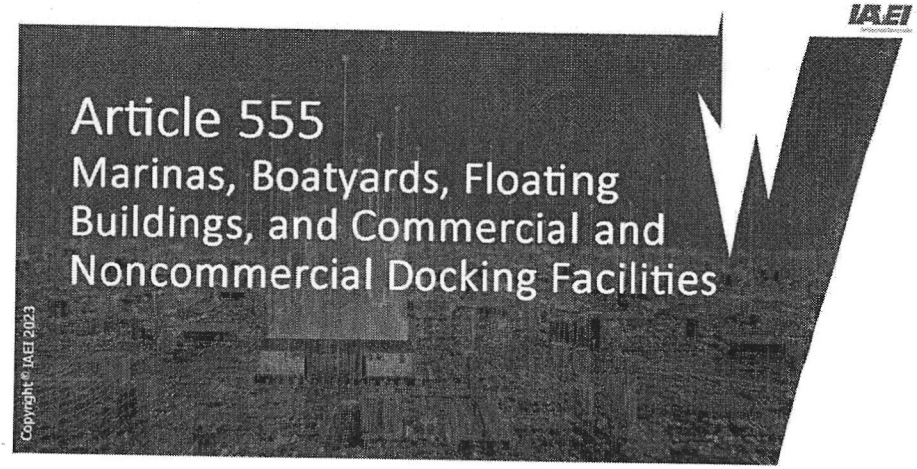
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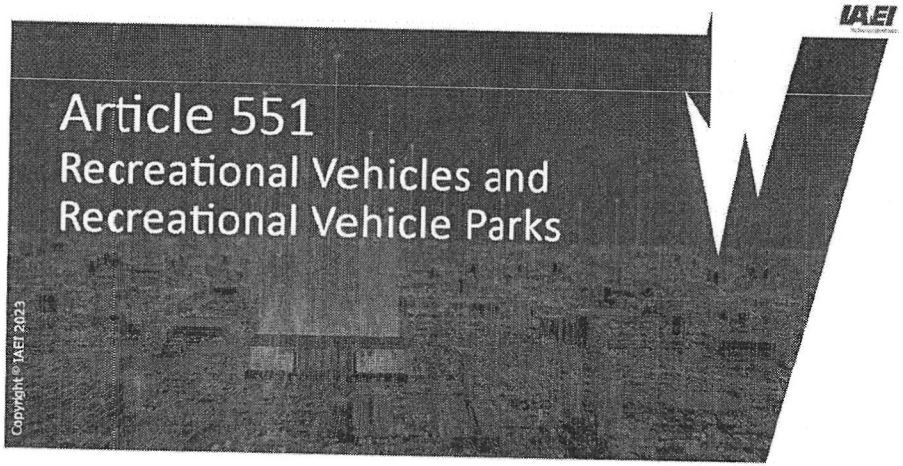
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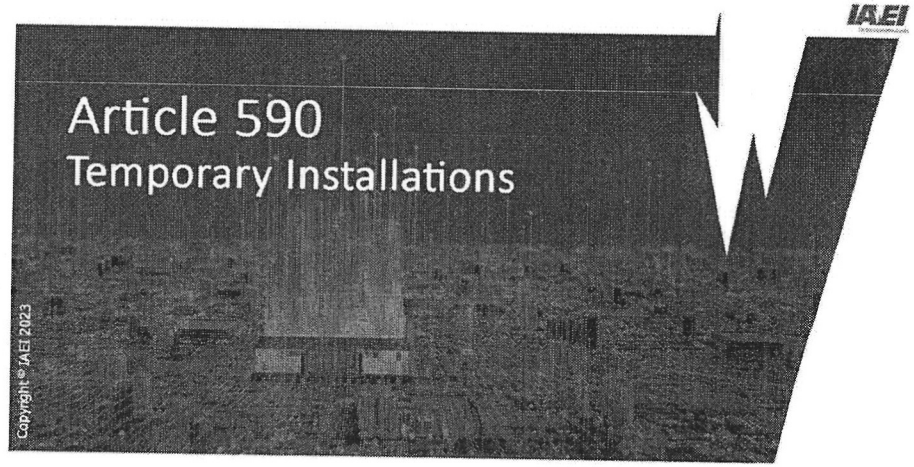
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Temporary Installations
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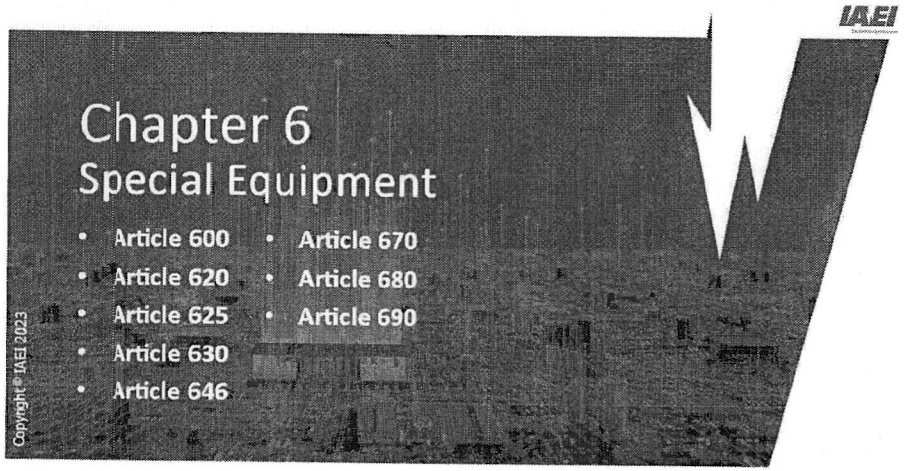
Chapter 6
Special Equipment
• Article 600
• Article 620
• Article 625
• Article 630
• Article 646
• Article 670
• Article 680
• Article 690
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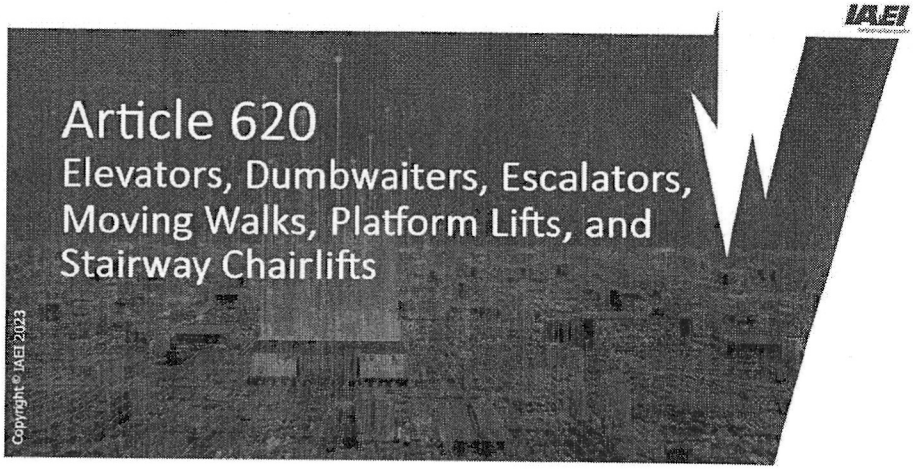
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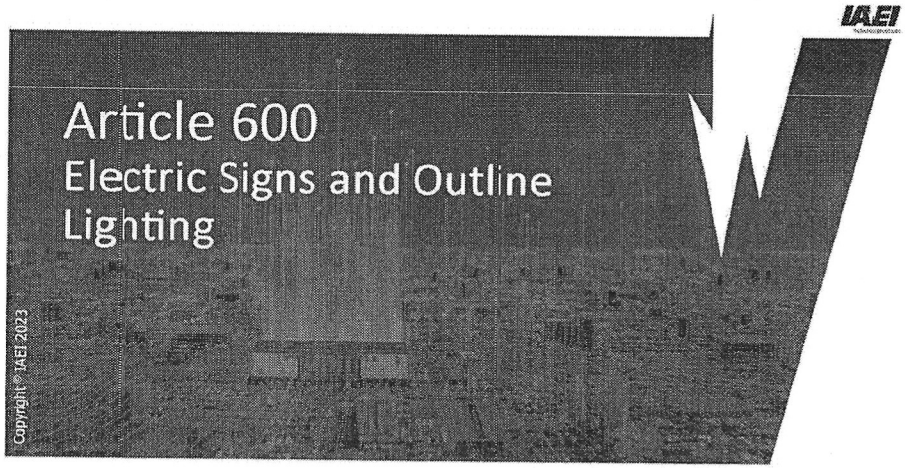
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Electric Signs and Outline Lighting
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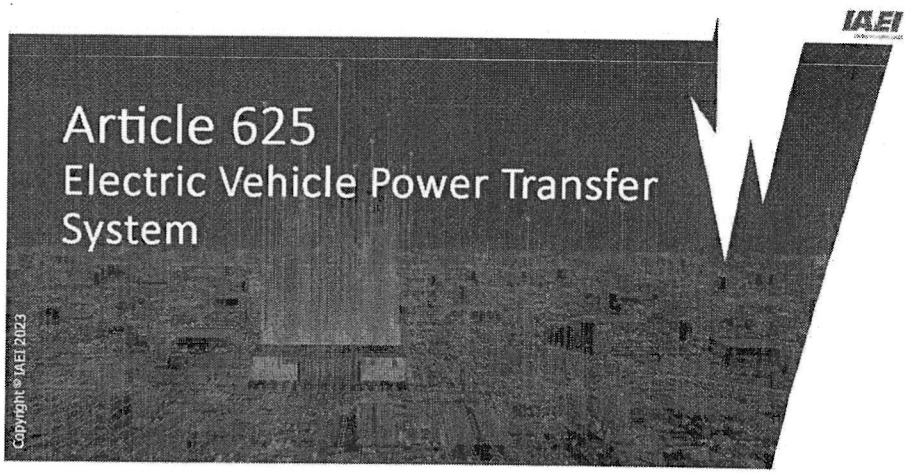
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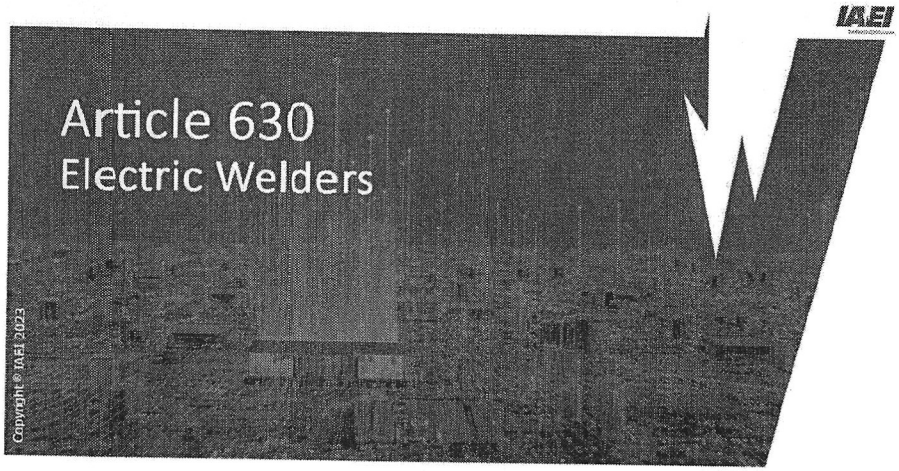
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Electric Welders
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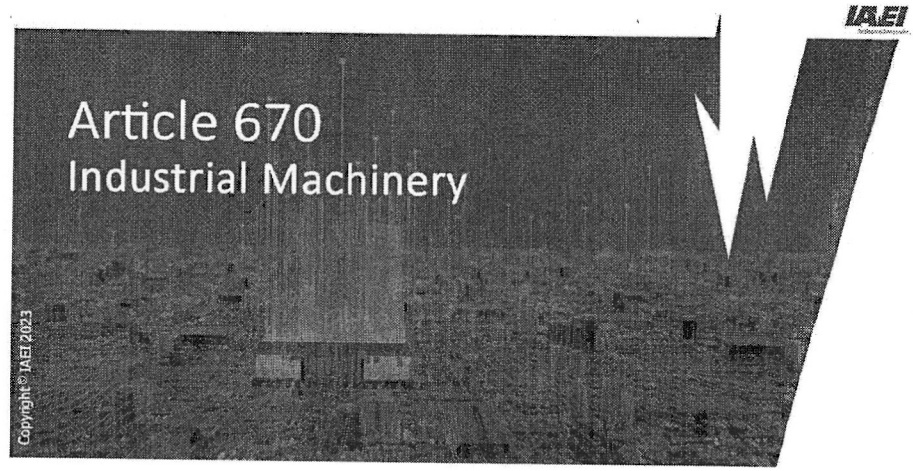
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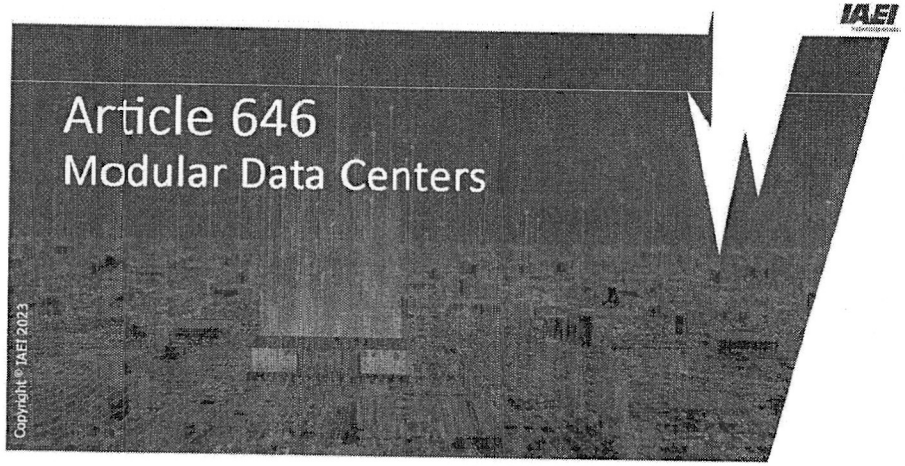
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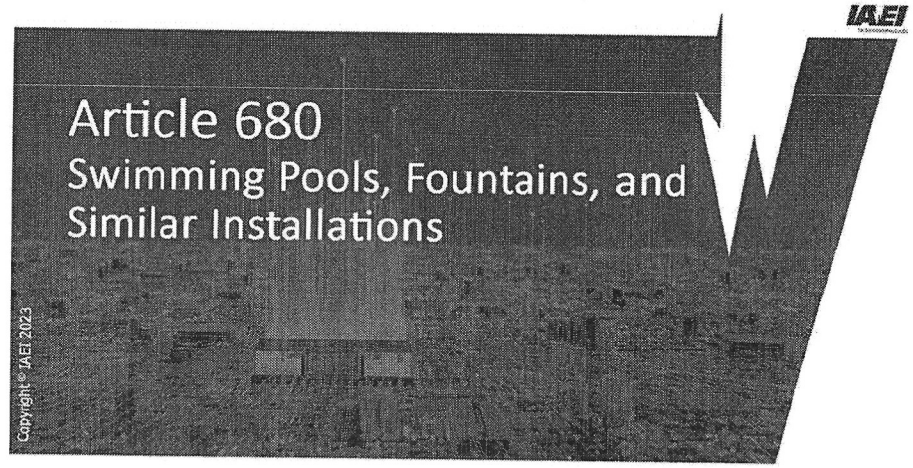
Article 680
Swimming Pools, Fountains, and
Similar Installations
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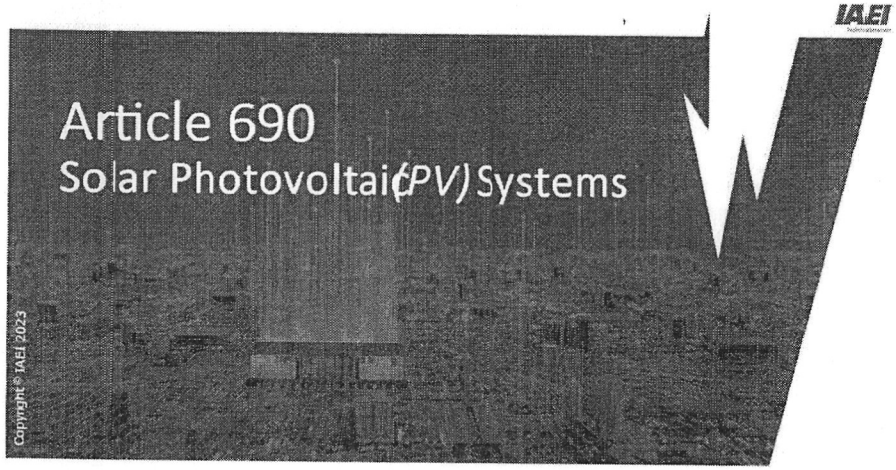
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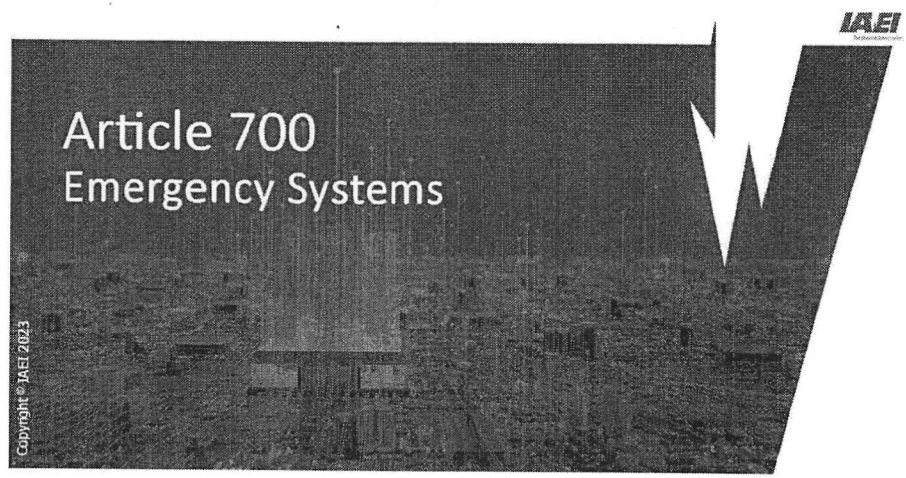
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Emergency Systems
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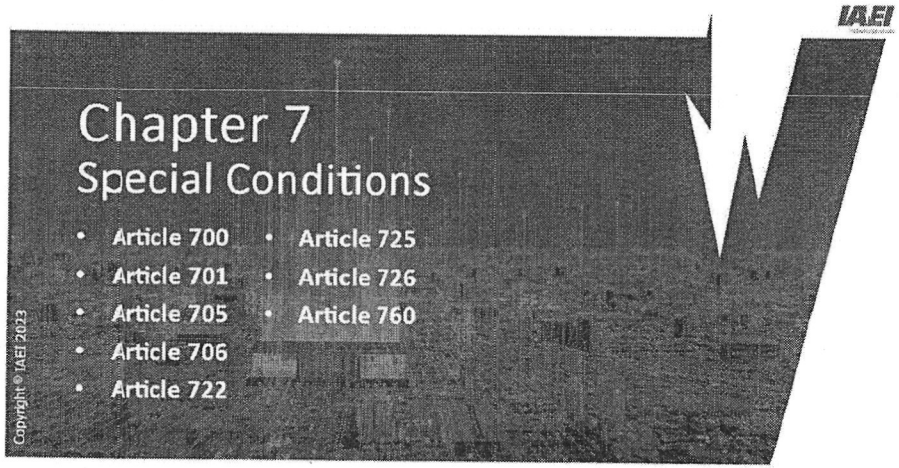
Chapter 7
Special Conditions
• Article 700
• Article 701
• Article 705
• Article 706
• Article 722
• Article 725
• Article 726
• Article 760
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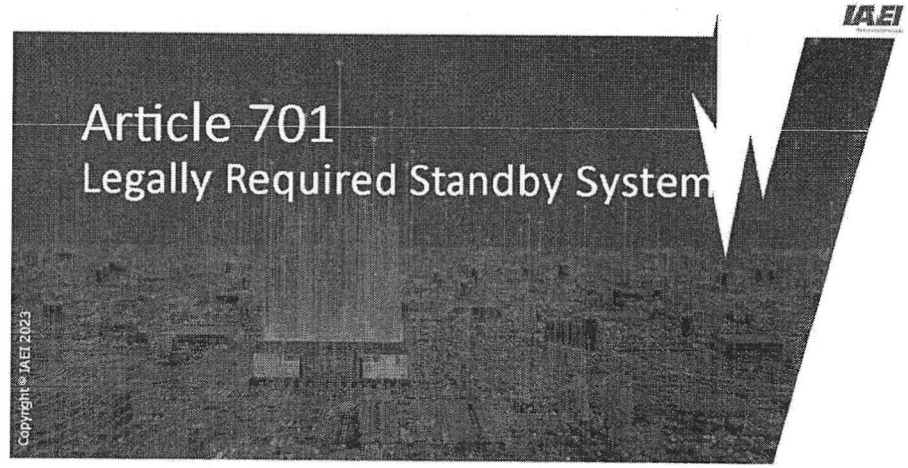
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Legally Required Standby System
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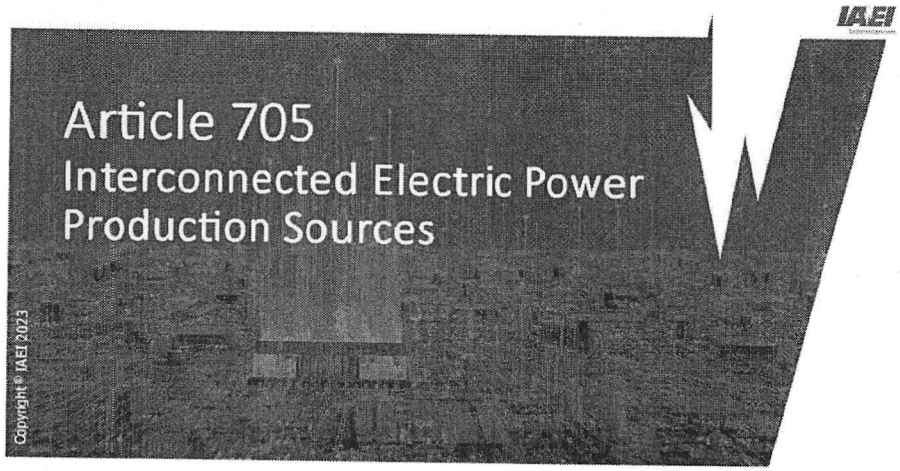
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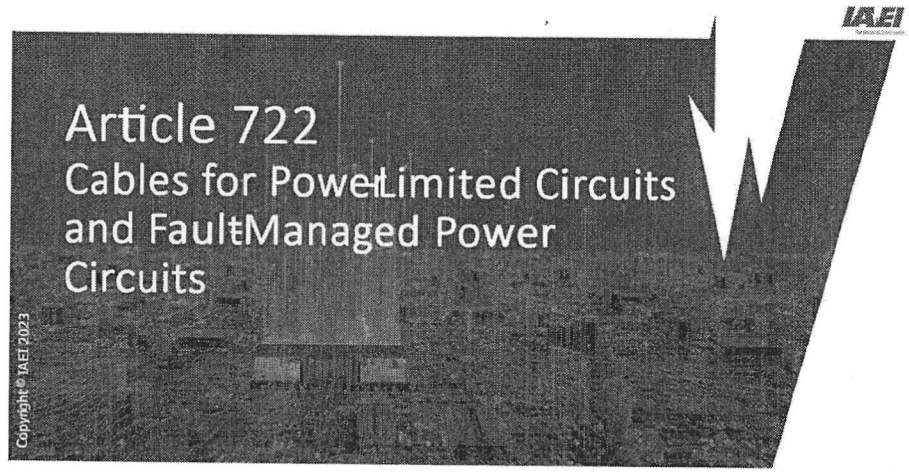
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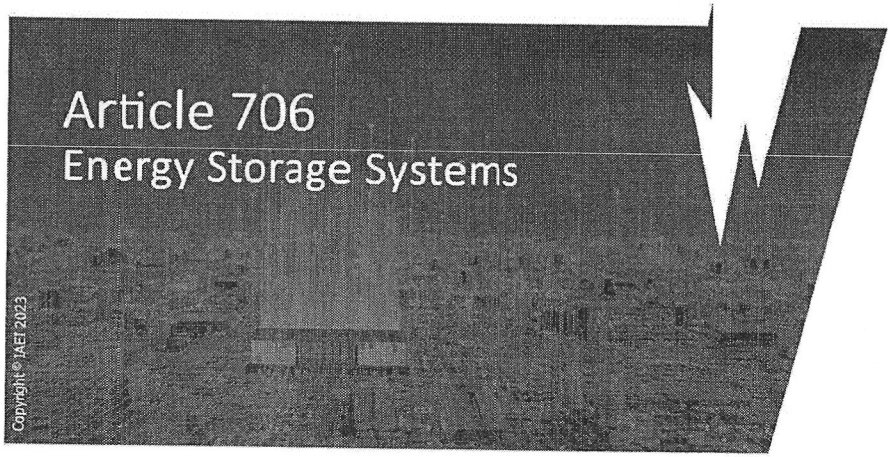
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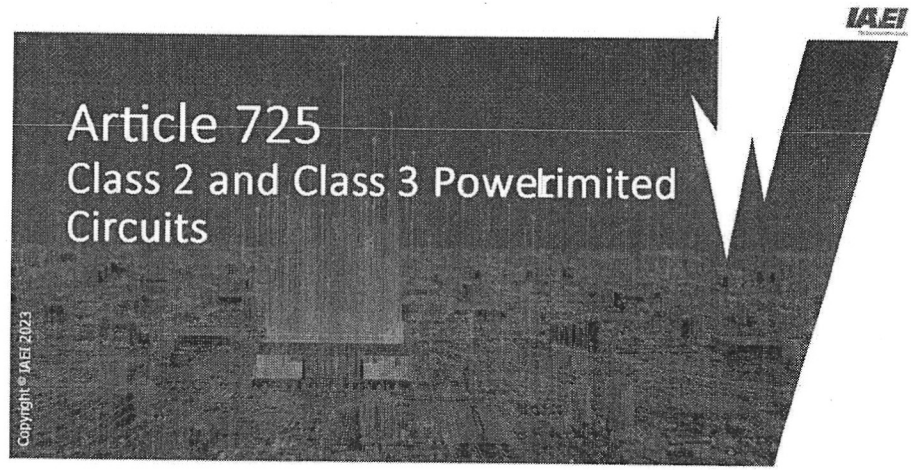
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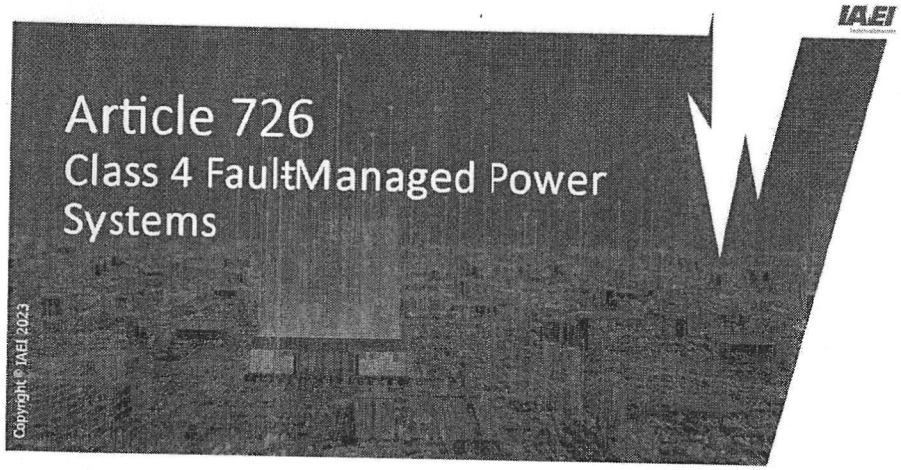
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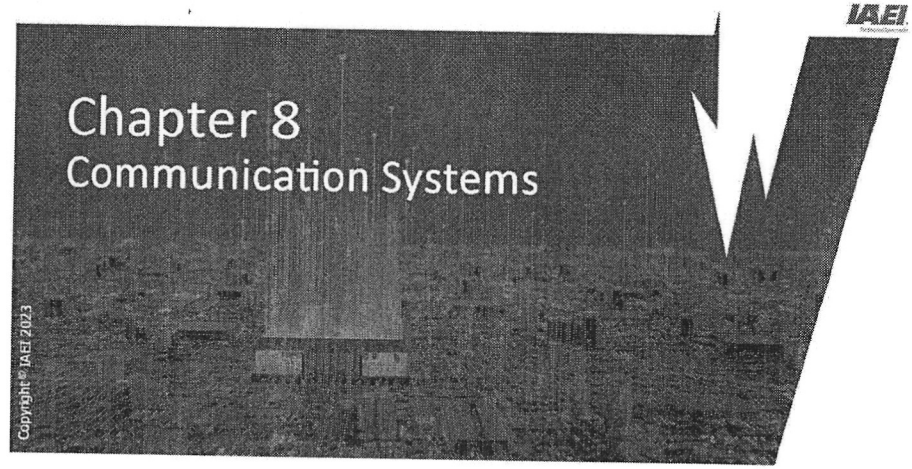
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Communication Systems
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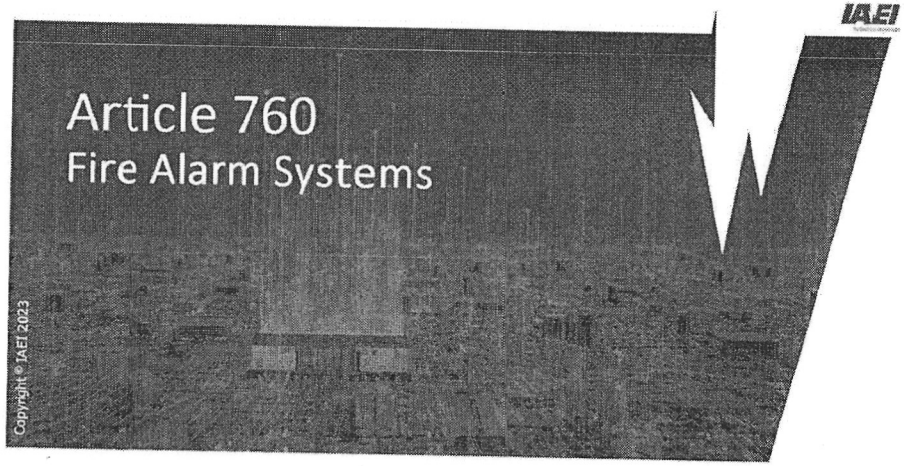
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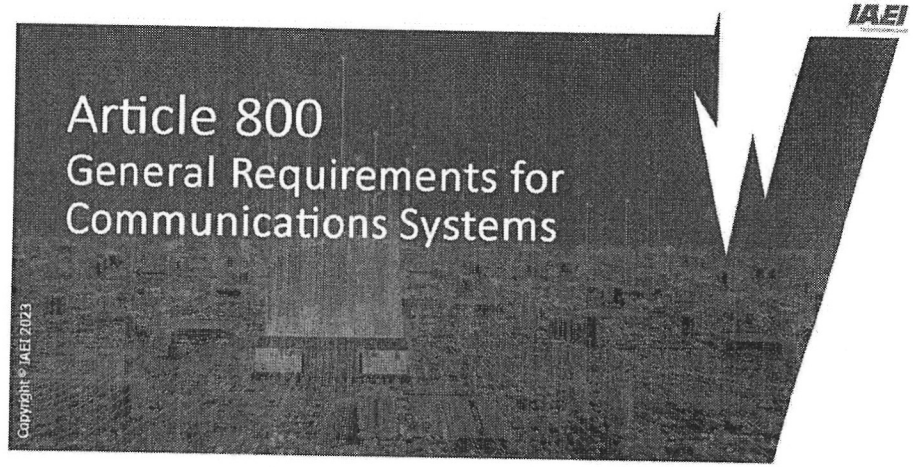
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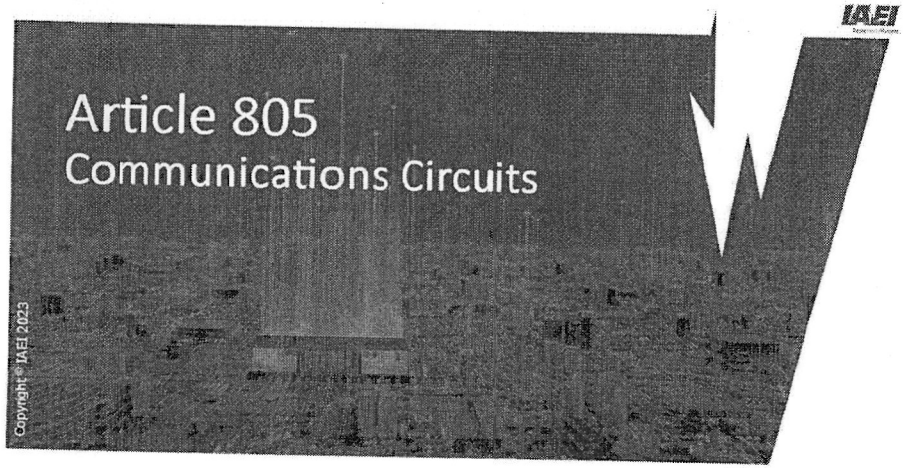
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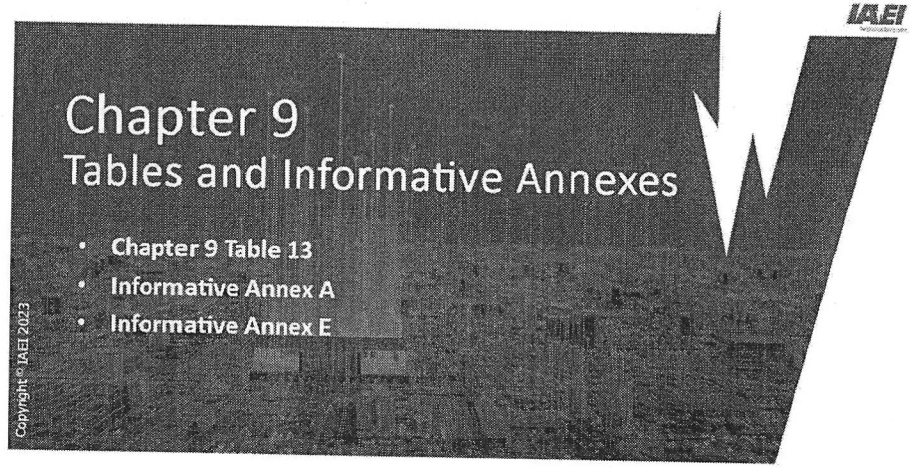
Chapter 9
Tables and Informative Annexes
• Chapter 9 Table 13
• Informative Annex A
• Informative Annex E
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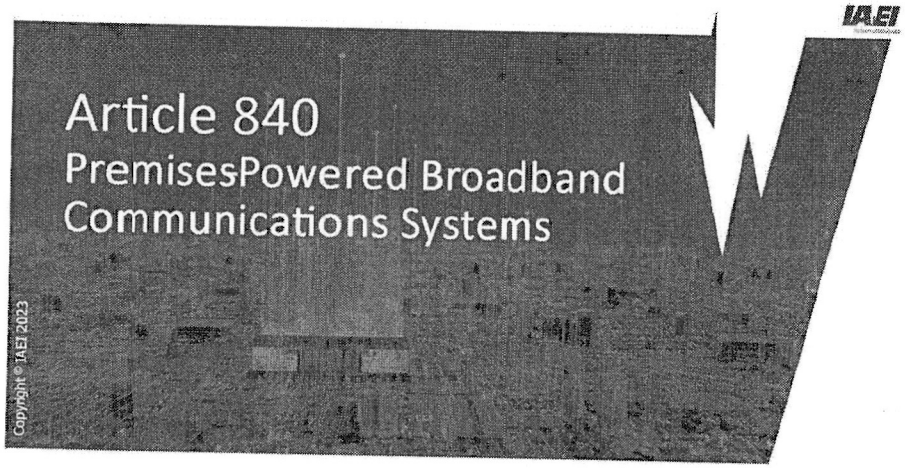
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PremisesPowered Broadband
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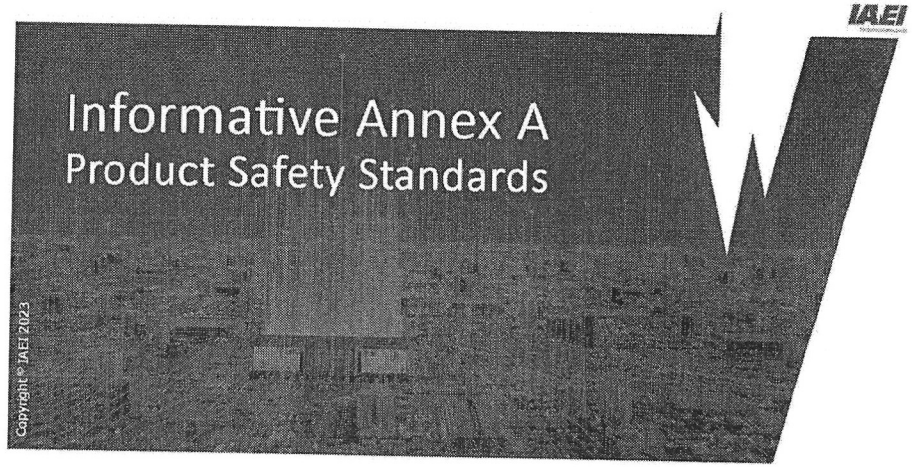
Informative Annex A
Product Safety Standards
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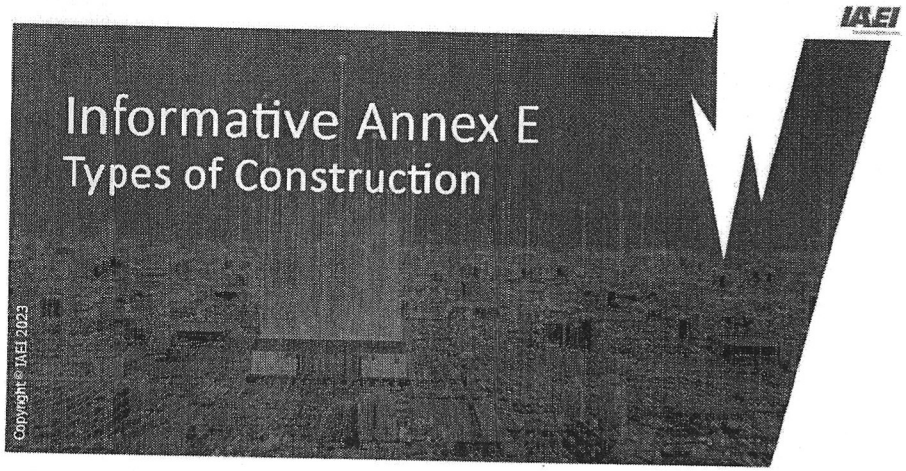

Developed and presented by the International Association of Electrical Inspectors

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iaei.org

John Z. Grivensky, ESI #565
1245 Sageberry Dr.
North Lima, Ohio 44452

Experience:

- Electrical Safety Inspector - 22 years
- Master Electrician (commercial/industrial/residential) – 39 years
- I.B.E.W. apprenticeship instructor – 29 years
- Mahoning County and City of Youngstown Electrical Plans Examiner – 15 years

Education:

- I.B.E.W. residential apprenticeship
- I.B.E.W. commercial/industrial apprenticeship
- Bachelor of Applied Science, Electrical Engineering from Youngstown State University
- Associate Degree, Vocational Instructor, from University of Tennessee

Affiliates:

- Past President of the International Association of Electrical Inspectors of the State of Ohio
- Current President of the International Association of Electrical Inspectors Association of Electrical Inspectors – Eastern Division
- Chairman of Mahoning County Licensing Board
- Secretary Treasurer of The Electrical League of Eastern Ohio

File Attachments for Item:

NB-1 City of Columbus ESI Trainee Alternative Program Proposal

The City of Columbus has been working to develop trainee programs to build their code administration team from the ground up.

The plan submitted is a structured trainee program incorporating observation, classroom instruction, and supervised practical learning.

ESIAC Comments:

Committee Recommendation:

SCOTT MESSER
Director

THE CITY OF
COLUMBUS
ANDREW J. GINTHER, MAYOR

DEPARTMENT OF BUILDING
AND ZONING SERVICES

Inspector Trainee Program (Electrical Safety Inspector)

In an effort to compete in today's marketplace for skilled trades workers, the City of Columbus Department of Building and Zoning Services is proposing to create a trainee program that would benefit the next generation of people who may want to work as an electrical safety inspector. As such, we are proposing an equivalent trainee program as permitted by paragraph (F) (5) (d) of Section 4101:7-3-01 of the Ohio Administrative Code (OAC).

Trainee supervisors and trainee sponsors will meet all requirements of Section 4101:7-3-01 (F) (5) (b) and (c) of the (OAC) as if written in this policy. Upon completion of the trainee program, the trainee will be issued an electrical safety inspector certification.

Where the term board is used, it shall mean the Ohio Board of Building Standards.

Electrical Safety Inspector Trainee

- Have at least one year of experience in the installation of electrical systems subject to inspection under either a model building code of a national model code organization or a code adopted for buildings or structures and within the scope of groups regulated by the rules of the board; or an applicant for a board certification may obtain credit for one year of the required experience through education pursuant to the following:
    - An acceptable vocational or apprenticeship program with 900 or more contact hours of training. The vocational or apprenticeship school and technical program must be approved by the board.
    - Completion of an associate degree program in electrical design. The technical program must be approved by the board.
- A trainee certification will require a minimum of one year in the program but shall expire not more than six years from the date of applicant approval by the board.
- A trainee shall;
    - Be under the direct supervision of a trainee supervisor.
    - Perform at least fifty residential and fifty commercial inspections while under the direct supervision of the trainee supervisor.
    - Attend and successfully complete at least two-hundred hours of board approved code education courses, including completion of the "Ohio Building Code Academy".
    - Attend and successfully complete at least three-hundred hours of education courses administered by an inspection or plan examiner supervisor or, in the case of safety courses, an industrial hygienist.
    - Have at least five hundred hours of ride along observation of certified inspectors.
    - Complete twenty-five trade specific plan reviews while under the direct supervision of a certified master plan examiner or trade specific plan examiner.
    - Complete examination requirements.

Code Education Courses

The inspector trainee will attend two-hundred credit hours of continuing education units approved by the Board of Building Standards. Coursework will include the following:

- Completion of the "Ohio Building Code Academy"
- Administrative Code
- Existing Buildings
- Ethics

The inspector trainee will attend three-hundred class hours of education administered by an inspection or plan examination supervisor or a safety hygienist. Coursework will include the following:

Electrical Inspector

- Residential Code of Ohio
    - Chapter 2,3,34 and 44
- Ohio Building Code
    - 2-4, 6, 7, 9-13, 15, 23, 27, 30-31, 34 and 35
- International Energy Conservation Code
- NFPA 20
- NFPA 70
- NFPA 72
- NFPA 110
- NFPA 111
- Safety Training
    - OSHA 30
    - Defensive Driving
    - Air-Bourne Health Hazards
    - Confined Spaces
- Building Administration Training
    - Customer Service
    - Adjudication Process and Orders
    - Site Compliance and Zoning
    - Map Room
    - Plan Review
    - Inspection Cross Training

Instructors

Instructors teaching technical courses are inspection or plan examination supervisors with extensive experience in the building construction trades. Each carry multiple certifications approved by the board. Instructors teaching safety courses are industrial hygienists.

Plan Examination

Mark Heckenmueller

- 21 years of experience with a certified building department
- Certifications:
    - Chief Building Official
    - Residential Building Official
    - Master Plan Examiner
    - Building Inspector

Electrical

Cliff Honeycutt

- 27 years of experience with a certified building department
- Certifications as listed:
    - Electrical Plan Examiner
    - Electrical Safety Inspector

Howard Todd

- 24 years of experience with a certified building department
- Certifications as listed:
    - Electrical Plan Examiner
    - Electrical Safety Inspector

Ralph Butcher

- 24 years of experience with a certified building department
- Certifications as listed:
    - Chief Building Official
    - Electrical Plan Examiner
    - Electrical Safety Inspector

Building

David Daniel

- 32 years of experience with a certified building department
- Certifications:
    - Chief Building Official
    - Residential Building Official
    - Building Plan Examiner
    - Building Inspector
    - Residential Building Inspector

Cliff Spruill

- 24 years of experience with a certified building department
- Certifications as listed:
    - Chief Building Official
    - Residential Building Official
    - Building Plan Examiner
    - Building Inspector
    - Residential Building Inspector

Ken Bruen

- 25 years of experience with a certified building department
- Certifications as listed:
    - Residential Building Official
    - Building Plan Examiner
    - Building Inspector
    - Residential Building Inspector

Brian Lauer

- 8 years of experience with a certified building department
- Certifications as listed:
    - Residential Building Official
    - Building Inspector
    - Residential Building Inspector

Shane Lawwell

- 6 years of experience with a certified building department
- Certifications as listed:
    - Residential Building Official
    - Building Plan Examiner
    - Building Inspector
    - Residential Building Inspector

Mechanical

Bert Morrison

- 6 years of experience with a certified building department
- Certifications as listed:
    - Mechanical Plan Examiner
    - Residential Mechanical Inspector
    - Commercial Mechanical Inspector

Bob O'Brian

- 19 years of experience with a certified building department
- Certifications as listed:
    - Mechanical Plan Examiner
    - Mechanical Inspector

Craig Amick

- 21 years of experience with a certified building department
- Certifications as listed:
    - Mechanical Inspector

Plumbing

Jim Richardson

- 11 years of experience with a certified building department
- Certifications as listed:
    - Plumbing Plan Examiner
    - Plumbing Inspector
    - Residential Mechanical Inspector
    - Commercial Mechanical Inspector

Guy Miller

- 6 years of experience with a certified building department
- Certifications as listed:
    - Plumbing Plan Examiner
    - Plumbing Inspector

Safety

Teresa Lenahan