

Board of Building Standards

ELECTRICAL SAFETY INSPECTOR ADVISORY COMMITTEE REQUEST FOR RECOMMENDATIONS

DATE: AUGUST 04, 2023

TIME: 10:00 AM

LOCATION: NO MEETING THIS MONTH

Personnel Certification Applications

Rybka, Michael - ESI P-1

Certification ID: 9151

Current Certifications - none, has passed ESI exams

Staff notes: Journeyman since 2010

ESIAC Recommendations: Committee recommendation:

Continuing Education Applications for Review

2017 vs. 2023 NEC Review (Southwest Ohio Electrical Organization) ER-1

All certifications (four 7.5-hour sessions)

Staff Notes: Southwest Ohio Electrical Organization is a new organization formed by Lorenzo Adam and others. The course submitted is a new course, never submitted

under IAEI. Submission includes sample slides (not the whole set)

ESIAC Recommendation: Committee Recommendation:

2023 NEC Code Changes Chapters 1-4 (Matthews Electrical Services) ER-2

All certifications (4 hours)

Staff Notes: Slides are a sampling.

ESIAC Recommendation: Committee Recommendation:

ER-3 2023 NEC Code Changes Chapters 5-9 (Matthews Electrical Services)

All certifications (4 hours)

Staff Notes: Slides are a sampling.

ESIAC Recommendation: Committee Recommendation:

ER-4 2023 NEC Significant Changes Overview (Matthews Electrical Services)

All certifications (4 hours)

Staff Notes: Slides are a sampling.

ESIAC Recommendation: Committee Recommendation: <u>ER-5</u> Motors, Transformers, and the 2020 NEC (Matthews Electrical Services)

All certifications (4 hours)

Staff Notes: Slides are a sampling.

ESIAC Recommendation: Committee Recommendation:

ER-6 Significant Changes to the 2023 NEC (Dayton Area Electrical JATC)

All certifications (12 hours, two 6-hour sessions)

Staff Notes:

ESIAC Recommendation: Committee Recommendation:

File Attachments for Item:

P-1 Rybka, Michael - ESI

Certification ID: 9151

Current Certifications - none, has passed ESI exams

Staff notes: Journeyman since 2010

ESIAC Recommendations:

Committee recommendation:

Board c	of Buildir	n g Standards Ap	plication for In	terim Cer	tification, Building Depar	tment Personnel
Rybk	а	N	/lichael			
Last Name			First Nan	ne		BBS Certification IL
SECTION 1: CHECK INTERIM CERTIFIC Building Official Building Plans Examiner Plumbing Plans Examiner Plumbing Inspector BECTION 2: LIST ANY OHIO LICENSE Mark "T" If Trainee)		Master Plans Examiner Plumbing Plans Examiner Plumbing Inspector	Building Inspector Mechani Plans Exa Mechani Inspector	Fire Protection Inspector Fire Protection Plans Examiner		
Descripti	············			Ce	ertificate Number	Date Received
Architectu	ıral Registi	ration				
P.E. Regi	istration					
Res	Non-Res			- 10		
		Building Official Certifi	cation			
		Plans Examiner Certif	ication			
		Building Inspector Cer	tification	y		
		Mechanical Inspector Certification				
Building F	Plans Exam	niner Certification				
Mechanic	al Plans E	xaminer Certification				
Fire Prote	ection Plan	s Examiner Certificatio	n			
Electrical	Plans Exa	miner Certification				
Plumbing	Plans Exa	miner Certification				
		ector Certification				
	-	pector Certification				
Plumbing	Inspector	Certification			3.00	
Fire Safe	ty Inspecto	r Certification				
	<u> </u>	em Designer Certificati	ion			
		Inspector Certification				

Rybka	Michael	tion, Building Department Personnel
Last Name	First Name	BBS Certification ID
SECTION 3: EMPLOYMENT	/EDUCATION	
Formal Education		Date Graduated

Formal Education	Date Graduated
Related Vocational or Technical Training	Years' Experience
Associated Builders and Contractors (ABC)	4 years
Electrical Apprentice	
U.S. Military construction experience (MOS or other designation):	Years' Experience
1341 Heavy equipment engineer	4 years
Place of Employment:	Years' Employed
IBEW Local Union #8	5 Years

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)

	Board of Building Standards	Application fo	r Interin	Certification,	Buildir	ng Depa	rtment Pe	rsonne	al.
	Rybka	Michael							
	Last Name	First	Name				BBS C	ertific	ation ID
	SECTION 6: ELECTRICAL SAFETY IN Applicants for Electrical Safety In Section 3783 of the Ohio Revis	spector <u>Only</u> sed Code s	Must pecifie	Complete T s that an a	his It	em ant f	ora Ce	ertific	ate of
	Competency as an Electrical Safe required examination. Please che					HOWIN	g to qua	ашу і	ю таке
1.	☐ Have been a journeyman electelectrician foreman, and have ha inspector trainee;	trician or equ	uivaler	t for four ye	ars,				
2.	☐ Have been a journeyman elect experience as a building departm					nd hav	/e had t	hree	years'
3.	☐ Have had for four years' exper	ience as a b	uilding	departmen	t elec	trical	inspect	or tra	ainee;
4.	Have been a journeyman elect	trician or equ	ivalen	t for six yea	rs;				
5.	☐ Am a graduate electrica Registration number:	l engineer	and	registered	in	the	State	of	Ohio.
6.	Applicant authorizes all testing	g organizatio	ns inc	luding ICC	to pr	ovide	test res	sults	to the

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

BBS.

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

Board of Building Standards Rybka

Application for Interim Certification, Building Department Personnel

Michael

Last Name

First Name

BBS Certification ID

List Each Construction Project <u>AND</u> Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To
Lexus of Toledo showroom remodel. Foreman for all new and existing electrical work performed.	Westfield Electric 2995 OH-51 Gibsonburg, OH (419)862-0078	May 2021-Oct 2021 (6 months)
Amazon Distribution center in Rossford, Ohio. Foreman of a 12 man crew to provide electric and controls to main distribution line.	BCU Electric 1019US-250 Ashland, OH 44805 (419)281-8944	March 2020-Dec 2020 (10 months)
Cleveland-Cliffs HBI Furnace Tower. Foreman of a 14 man crew to Installn various electrical components.	Rmf Nooter 915 Matzinger Rd. Toled, OH 43612 (419)727-1970	June 2019-Feb 2020 (9 months)
	Total Experience on This Page (In Months):	

Board of Building Standard	S Application for Interim Certification, Building De	partment Personnel
Rybka	Michael	
Last Name	First Name	BBS Certification ID
SECTION 8: PERSONAL HISTORY 1. Have you ever been convicted	of any felony, or any crime involving mora	al turpitude?
		☐ Yes ■ No
If you answered "Yes" please		
•	rmed services? (If No, skip question 3)	Yes No
3. If YES, were you discharged u		Yes No
If you answered "No" please e	xplain below:	
<u> </u>		
· · · · · · · · · · · · · · · · · · ·		
SECTION 9: CERTIFICATION		
may be grounds for not granting certifica I authorize the investigation of all staten may result from furnishing the same to C	application is true and complete, and I understand that tion or for immediate termination of certification at any parents contained herein and release all parties from all I Ohio Board of Building Standards. Falsification is Code and is punishable as a misdemeanous	oint in the future, if granted. liability for any damage that a violation of section
Signature o	f Applicant: ///ellaf //g/f/	<u></u>
	fore me according to law, by the above na	
day 27/ of June in	the year 2023 at Fosher, oh/v	, County of
Sene Cg and State of	of Ohio	
No	tary Public:	

RY PURCE OF STREET

RICHARD T LONG Notary Public, State of Ohio My Comm. Expires March 15, 2027



INTERNATIONAL CODE COUNCIL MICHAEL RYBKA

The International Code Council attests that the individual named on this certificate has satisfactorily demonstrated knowledge as required by the International Code Council by successfully completing the prescribed Code Council prerequisites based on codes and standards then in effect, and is hereby issued this certification as:

Residential Electrical Inspector

Michael Wich, CBO

President, Board of Directors

Mule P. Wil

Dominic Sims, CBO
Chief Executive Officer

Given this day April 24, 2023

Certificate No. 10281354



Rudolph Garza President, CEO

Joseph Wages, Jr.

Director of Digital Education







INTERNATIONAL CODE COUNCIL MICHAEL RYBKA

The International Code Council attests that the individual named on this certificate has satisfactorily demonstrated knowledge as required by the International Code Council by successfully completing the prescribed Code Council prerequisites based on codes and standards then in effect, and is hereby issued this certification as:

Commercial Electrical Inspector

Michael Wich, CBO

President, Board of Directors

Mule P. Wil

Dominic Sims, CBO
Chief Executive Officer

Given this day May 11, 2023

Certificate No. 10281354



Rudolph Garza President, CEO

Joseph Wages, Jr.

Director of Digital Education







INTERNATIONAL CODE COUNCIL MICHAEL RYBKA

The International Code Council attests that the individual named on this certificate has satisfactorily demonstrated knowledge as required by the International Code Council by successfully completing the prescribed Code Council prerequisites based on codes and standards then in effect, and is hereby issued this certification as:

Electrical Inspector

Given this day May 12, 2023

Certificate No. 10281354

Rudolph Garza President, CEO

Joseph Wages, Jr.

Director of Digital Education

Michael Wich, CBO

President, Board of Directors

Mule P. Wil

Dominic Sims, CBO

Chief Executive Officer







Tertificate of Completion of Apprenticeship

This is to certify that: MICHAEL A. RYBKA

has fulfilled the terms of the apprenticeship agreement in accordance with the registered standards and requirements, with related instruction and is hereby recognized and qualified as a journeyperson

ELECTRICIAN

together with all the rights, privileges and opportunities which everywhere pertain thereto.

In testimony Whereaf, the Ohio State Apprenticeship Council of the Ohio Department of Job and Family Services in cooperation with the Bureau of Apprenticeship and Training, U.S. Department of Labor, do affix the Great Seal of the State of Ohio.

Witnessed Gver Our Signatures and Seal:

Sponsored by:

Given at Columbus in the State of Ohio,

ABC - NOC

this 30th day of September A.D. 2010

Broadview Heights, OH

DIRECTOR, OHIO STATE APPRENTICESHIP COUNCIL

CHAIRMAN, OHIO STATE APPRENTICESHIP COUNCIL

TED STRICKLAND



File Attachments for Item:

ER-1 2017 vs. 2023 NEC Review (Southwest Ohio Electrical Organization)

All certifications (four 7.5-hour sessions)

Staff Notes: Southwest Ohio Electrical Organization is a new organization formed by Lorenzo Adam and others. The course submitted is a new course, never submitted under IAEI. Submission includes sample slides (not the whole set)

ESIAC Recommendation:

Committee Recommendation:



Mike DeWine, Governor Jon Husted, Lt. Governor

Provider Information:

Sheryl Maxfield, Director

Board of Building Standards

Application for Continuing Education Course Approval

Name:		Lorenzo M Adam				
Organization:	Southwest Ohio Electrical Organiz	Southwest Ohio Electrical Organization				
Address:	27 Penbrooke Court, Monroe, Ohio 45050					
E-mail:	lorenzomadam@gmail.com Telephone: 513-435-26					
Website:						
Conference Sp	ponsor (if applicable)Conference Email:					
Check here if	Course Renewal:Prior course number	(i.e. I	BBS2018-429)			
	only be granted for identical content and certifications, within th					
Attach a copy	of prior course approval letter for confirmation. No further infor	mation is require	ed.			
New Course In	nformation:					
	2017 vs 2023 NEC Review Chapter	1 & 2				
	ctor:Various ESIs (See Instructors					
	ption:					
An in-dept	th target analysis between the 2017 NEC and 2023 NEC includin	g potential error:	s from skipping			
	the 2020 NEC code adoption	<u>J </u>				
Instructional h	hours per session: 7.5 Number of Se	essions:	1			
	s) and Location: September 9, 2023 / Ma					
	,					
Special Conte	nt:					
	Code Administration: Conference Course: Conference Name:					
_	ruction: Yes Conference location:					
	ruction:					
	· · · · · · · · · · · · · · · · · · ·					
Course to be o	offered online? On Demand Webi	inar				
Course Websit	te:	1101				
Detail online o	course participation confirmation method (i.e. test, quizlets, part	icipant activity c	onfirmation):			
Course applica	able for the following certifications					
Residential Ce	ertifications Only: Commercial Certificat	ions: Yes				
Administrative	e Course, All Certifications:					
Application m	aterials included:					
Yes_	Course Outline or Course Learning Objectives					
Partial	Presentation Materials/Slides (not required for roundtable cou	urses)				
	Assessment Materials (for online courses)	•				
Yes	Presenter Bio					
Please submit	application and materials in .pdf format to: michael.lane@con	n.ohio.gov or BE	SS@com.ohio.gov			

Agenda for September 9th, 2023

Instructors: Dewayne Jenkins, Gaylord Poe, Caty Robinson, Lorenzo Adam, Pete Baldauf.

7:00 – 7:30 am	Registration
7:30 – 9:30 am	NEC Review Chapters 1 & 2
9:30 – 9:40 am	Break
9:40 – 12:00 m	NEC Review Chapters 1 & 2
12:00 – 1:00 pm	Lunch Break
1:00 – 2:35 pm	NEC Review Chapters 1 & 2
2:35 – 2:45 pm	Break
2:45 – 4:00 pm	NEC Review Chapters 1 & 2

Course outline for September 9th, 2023

This first Saturday will cover **Changes in Chapters 1 and 2** of the 2017 and 2023 NEC Review. The instruction will include the proper use and limitations for material and equipment used for electrical installations and the requirements for compliance with the NEC.

The instructor will also emphasize the importance of the changes and it affects future code proposals.

- Chapter 1. General
 - o Articles 100 and 110
- Chapter 2. Wiring and Protection.
 - o Articles 210 220 225 230

The presentation will be in Power Point format. Contractors and ESIs will benefit as well as Plans Examiners and Professional Designers by getting first-hand information on these changes. Both the Ohio Building Code, and the Residential Code of Ohio, in chapters 27 and 33 respectively refer to **2017 NFPA 70** as the standard to comply with electrical installations.

Even though the State of Ohio has not adopted the 2023 NFPA 70 version, the purpose of this class is to update the attendees on the code changes and not on the enforcement.



Mike DeWine, Governor Jon Husted, Lt. Governor Sheryl Maxfield, Director

Board of Building Standards

Application for Continuing Education Course Approval

Provider Infor	mation:					
Name:	me: Lorenzo M Adam					
Organization:_	rganization: Southwest Ohio Electrical Organization					
Addr e ss:	27 Penbrooke Court, Monroe, Ohio 45050					
E-mail:	lorenzomadam(@gmail.com		Telephone:	513-435-2622	
Website:						
Conference Sp	onsor (if applicable)	Confe	erence Email:			
Check here if C	Course Renewal:Pric	or course number		(i.e.	BBS2018-429)	
	only be granted for identical c					
Attach a copy	of prior course approval letter	for confirmation.	No further infor	mation is requir	ed.	
New Course In	formation:					
Course title:	20)17 vs 2023 NEC I	Review Chapter	3 & 4		
	tor:	Various ESIs	(See Instructors	List)		
Course descrip						
An in-dept	n target analysis between the	2017 NEC and 20	23 NEC includin	g potential error	s from skipping	
		e 2020 NEC code				
Instructional h	ours per session:	7.5	Number of Se	essions:	1	
Course Date(s)	and Location:		14, 2023 / Ma	son, Ohio		
Special Conter	it:					
Code Administ	ration:	Conference C	ourse:			
Existing Buildin		Conference N	ame:			
Electrical Instru	uction: Yes	Conference lo	cation:			
Plumbing Instr	uction:					
Course to be o	ffered online?	On Demand	Webi	nar		
	e:			<u> </u>		
Detail online co	ourse participation confirmati	on method <i>(i.e. te</i>	st. auizlets. part	icipant activity o	confirmation\:	
		•				
Course applica	ble for the following certifica	tions				
	tifications Only:	Comn	nercial Certificat	ions: <u>Yes</u>		
Administrative	Course, All Certifications:					
A 1:	and the territory					
Yes	terials included:	aunina Ol-ttt				
Partial	Course Outline or Course Le	-		,		
***************************************	Presentation Materials/Slide	•	r rounatable cou	ırses)		
Ves	Assessment Materials (for o	nine courses)				
Yes	Presenter Bio					
Please submit	application and materials in .	pdf format to: <u>mi</u>	chael.lane@con	n.ohio.gov or BE	SS@com.ohio.gov	

Agenda for October 14th, 2023

Instructors: Dewayne Jenkins, Gaylord Poe, Caty Robinson, Lorenzo Adam, Pete Baldauf.

7:00 – 7:30 am	Registration
7:30 – 9:30 am	NEC Review Chapters 3 through 4
9:30 – 9:40 am	Break
9:40 – 12:00 m	NEC Review Chapters 3 through 4
12:00 – 1:00 pm	Lunch Break
1:00 – 2:35 pm	NEC Review Chapters 3 through 4
2:35 – 2:45 pm	Break
2:45 – 4:00 pm	NEC Review Chapters 3 through 4

Course outline for October 14th, 2023

This second Saturday will cover **Changes in Chapter 3 through 4** of the 2017 and 2023 NEC Review. The instruction will include the proper use and limitations for material and equipment used for electrical installations and the requirements for compliance with the NEC.

The instructor will also emphasize the importance of the changes.

- Chapter 2. Wiring and Protection.
 - o Articles 240 250
- Chapter 3. Wiring Methods and Materials.
 - o Article 300
- Chapter 4. Equipment.
 - o Articles 400 404 406 410 422 440 445 450

The presentation will be in Power Point format. Contractors and ESIs will benefit as well as Plans Examiners and Professional Designers by getting first-hand information on these changes. Both the Ohio Building Code, and the Residential Code of Ohio, in chapters 27 and 33 respectively refer to **2017 NFPA 70** as the standard to comply with electrical installations.

Even though the State of Ohio has not adopted the 2023 NFPA 70 version, the purpose of this class is to update the attendees on the code changes and not on the enforcement.



Mike DeWine, Governor Jon Husted, Lt. Governor Sheryl Maxfield, Director

Board of Building Standards

Application for Continuing Education Course Approval Provider Information:

Name:	Lorenzo M Adam				
Organization:	Lorenzo M Adam Southwest Ohio Electrical Organization 27 Penbrooke Court, Monroe, Ohio 45050				
Address:	27 Penbrooke Court, Monroe, Ohio 45050				
E-mail: lorenzo	madam@gmail.com	Telephone: 513-435-2622			
Website:					
Conference Sponsor (if applicable)_	Conference Ema	ail:			
Check here if Course Renewal:	Prior course number	(i.e. BBS2018-429)			
Renewals will only be granted for ide	entical content and certifications, wit	thin the current code cycle.			
Attach a copy of prior course approv					
New Course Information:					
	2017 vs 2023 NEC Review Ch	apter 5 & 6			
Course instructor:	Various ESIs (See Instru	uctors List)			
Course description:					
	een the 2017 NEC and 2023 NEC in	cluding potential errors from skipping			
	the 2020 NEC code adoption	ordaning personalis or ore memorapping			
Instructional hours per session:	7.5 Number	r of Sessions: 1			
Course Date(s) and Location:		3 / Mason, Ohio			
Special Content:					
Code Administration:	Conference Course:				
Existing Buildings:	Conference Name:				
Electrical Instruction: Yes					
Plumbing Instruction:					
Course to be offered online?	_ On Demand	Wehinar			
Course Website:		webiildi			
Detail online course participation co	nfirmation method (i.e. test, quizlets	narticinant activity confirmation):			
		, participant activity confirmation;			
Course applicable for the following	certifications				
Residential Certifications Only:	Commercial Cer	tifications: Yes			
Administrative Course, All Certificati					
,	\$100-\$000000000000000000000000000000000				
Application materials included:					
1.1	ourse Learning Objectives				
Partial Presentation Materials/Slides (not required for roundtable courses)					
•	ls (for online courses)				
Yes Presenter Bio	,				
Please submit application and mate	rials in .pdf format to: michael.lane	@com.ohio.gov or BBS@com.ohio.gov			

Agenda for November 18th, 2023

Instructors: Dewayne Jenkins, Gaylord Poe, Caty Robinson, Lorenzo Adam, Pete Baldauf.

7:00 – 7:30 am	Registration
7:30 – 9:30 am	NEC Review Chapters 5 & 6
9:30 – 9:40 am	Break
9:40 – 12:00 m	NEC Review Chapters 5 & 6
12:00 – 1:00 pm	Lunch Break
1:00 – 2:35 pm	NEC Review Chapters 5 & 6
2:35 – 2:45 pm	Break
2:45 – 4:00 pm	NEC Review Chapters 5 & 6

Course outline for November 18th, 2023

This third Saturday will cover **Changes in Chapter 5 and 6** of the 2017 and 2023 NEC Review. The instruction will include the proper use and limitations for material and equipment used for electrical installations and the requirements for compliance with the NEC.

The instructor will also emphasize the importance of the changes.

- Chapter 5. Special Occupancies.
 - o Articles 500 511 514 517 525 590
- Chapter 6. Special Equipment.
 - o Article 600 625

The presentation will be in Power Point format. Contractors and ESIs will benefit as well as Plans Examiners and Professional Designers by getting firsthand information on these changes. Both the Ohio Building Code, and the Residential Code of Ohio, in chapters 27 and 33 respectively refer to **2017 NFPA 70** as the standard to comply with electrical installations.

Even though the State of Ohio has not adopted the 2023 NFPA 70 version, the purpose of this class is to update the attendees on the code changes and not on the enforcement.



Mike DeWine, Governor Jon Husted, Lt. Governor Sheryl Maxfield, Director

Board of Building Standards

Application for Continuing Education Course Approval

Provider Information:	_					
Name:	Lorenzo M Adam					
Organization:	Southwest Ohio Electrical Organization					
Address:	27 Penbrooke Court, Monroe, Ohio 45050					
E-mail: lorenzor	madam@gmail.com	_ Telephone:_	513-435-2622			
Conference Sponsor (if applicable)	Conference Email:_					
Check here if Course Renewal:	Prior course number	(i.e.	BBS2018-429)			
Renewals will only be granted for ide	entical content and certifications, within	the current code of	cycle.			
Attach a copy of prior course approv	al letter for confirmation. No further inf	ormation is requir	ed.			
New Course Information:						
Course title:	2017 vs 2023 NEC Review Chapte	er 7 & 8				
Course instructor:	Various ESIs (See Instructo	rs List)				
Course description:						
	een the 2017 NEC and 2023 NEC include	ling potential error	s from skipping			
	the 2020 NEC code adoption					
Instructional hours per session:		Sessions:	1			
Course Date(s) and Location:	December 9, 2023 / [Mason, Ohio				
Special Content:						
Code Administration:	Conference Course:					
Existing Buildings:	Conference Name:					
Electrical Instruction: Yes_	Conference location:					
Plumbing Instruction:						
Course to be offered online?	_ On Demand We	binar				
Course Website:						
	nfirmation method (i.e. test, quizlets, pa	rticipant activity o	confirmation):			
		· · · · · · · · · · · · · · · · · · ·				
Course applicable for the following	certifications					
Residential Certifications Only:	Commercial Certific	ations: Yes				
Administrative Course, All Certification	ons:					
Application materials included:						
	ourse Learning Objectives					
Partial Presentation Materia	als/Slides (not required for roundtable o	ourses)				
	ls (for online courses)					
Yes Presenter Bio						
Please submit application and mate	rials in .pdf format to: michael.lane@c	om.ohio.gov or Bl	3S@com.ohio.gov			

Agenda for December 9th, 2023

Instructors: Dewayne Jenkins, Gaylord Poe, Caty Robinson, Lorenzo Adam, Pete Baldauf.

7:00 – 7:30 am	Registration
7:30 – 9:30 am	NEC Review Chapters 7 through 8
9:30 – 9:40 am	Break
9:40 – 12:00 m	NEC Review Chapters 7 through 8
12:00 – 1:00 pm	Lunch Break
1:00 – 2:35 pm	NEC Review Chapters 7 through 8
2:35 – 2:45 pm	Break
2:45 – 4:00 pm	NEC Review Chapters 7 through 8

Course outline for December 9th, 2023

This second session will cover **Changes in Chapter 7 through 8** of the 2017 and 2023 NEC Review. The instruction will include the proper use and limitations for material and equipment used for electrical installations and the requirements for compliance with the NEC.

The instructor will also emphasize the importance of the changes.

- Chapter 6. Special Equipment.
 - o Articles 680 682 690 695
- Chapter 7. Special Conditions.
 - o Articles 700 701 702 725 760
- Chapter 8. Communications Systems.
 - o Article 800

The presentation will be in Power Point format. Contractors and ESIs will benefit as well as Plans Examiners and Professional Designers by getting first-hand information on these changes. Both the Ohio Building Code, and the Residential Code of Ohio, in chapters 27 and 33 respectively refer to **2017 NFPA 70** as the standard to comply with electrical installations.

Even though the State of Ohio has not adopted the 2023 NFPA 70 version, the purpose of this class is to update the attendees on the code changes and not on the enforcement.

INSTRUCTOR QUALIFICATIONS

Lorenzo M. Adam

Lorenzo started his electrical training in 1983. In 1988, he started his own electrical company. In 1996, he obtained the State Electrical Inspector certification. In 1997, he joined the City of Troy as a Building/Electrical Inspector. Currently, he works for the City of Mason. Lorenzo has an Electrical Plans Examiner, Residential Building Official, Building Inspector, Building Official interim certification from the State of Ohio. Lorenzo is currently the secretary/treasurer for the SW Division of IAEI, Ohio Chapter, secretary/treasurer for the Ohio Chapter IAEI and Treasurer and Past President of the Southwestern Ohio Building Officials Association (SWOBOA).

Address: 27 Penbrooke Ct., Monroe, Ohio 45050

Gaylord K. Poe

Gaylord Poe started his longstanding career in the electrical industry in 1969. He earned his Electrical Safety Inspector Certificate (#592) in 1978. He continued to work as an electrician until 1983 when he joined the IBI team as a commercial/industrial field inspector. He was promoted to Commercial Coordinator in 1986, to Assistant Chief Electrical Inspector in 1994, and to Chief Electrical Inspector and President in 2000. He earned his Ohio Electrical Plan Examiner and IAEI Electrical Inspector-Plan Review certificates in 2005. He is the only Ohio ESI certified by the IAEI as a Master Electrical Inspector (2009).

Gaylord is a member of the UL Electrical Council, the NFPA, the Cincinnati Business Development and Permit Center Advisory Committee, the Board of Trustees for the GCEA, the Electrical Trades Advisory Committee for Scarlet Oaks JVS, and is actively involved in course development and training classes for the continuing education programs of the IAEI, IEC, GCEA, and NECA. Gaylord has been involved with the IAEI since the early 1980's. He currently has become the Past-President of the IAEI SW Division, in which he served for 17 years combine.

Address: Suite 125-W, 250 West Court Street, Cincinnati, OH 45202

Caty Robinson

Caty Robinson began her electrical career working as an apprentice in the Dayton, Ohio area. As a member of IBEW Local 82 Caty served a full apprenticeship and worked in the field as a journeyman wireman for Kastle Electric. Caty's Ohio certification #2647 is for ESI (2004) and EPE (2013). Caty joined Inspection Bureau, Inc. (IBI) in 2008 as a commercial Electrical Safety Inspector. Caty currently serves as IBI's Commercial Coordinator and inspects in IBI's commercial territories and Kentucky. Caty is also a member of the IAEI Ohio Chapter SW Division

Address: Suite 125-W, 250 West Court Street, Cincinnati, OH 45202

Peter M. Baldauf

Peter has been in the electrical industry for over 15 years. He began his electrical career working through a trade school in Dayton, Ohio. After graduation, he enrolled in the Associated Builders and Contractors State certified electrical apprenticeship program. Peter attended the program for the full four years and upon completion of the program, he relocated to Tacoma, Washington. Tacoma, he sat for a State administered test and received State of Washington certification as a journeyman electrician, which is required by the Division of Labor and Industry in that State to perform work as an electrician. Upon his return to the State of Ohio, Peter sat for and was issued a license by the State of Ohio to perform duties associated with the installation and servicing of fire alarm systems. He also applied and sat for the test to become a State Certified Electrical Safety Inspector. He was awarded this Certification in September of 1998. Peter began his career in public service with Montgomery County Building Regulations as an Electrical Inspector in August of 1999. He is currently employed with the City of Vandalia as an Electrical Inspector. Peter also instructs classes for the Master Contractors Association, Adequate Wiring Committee. International Association of Electrical Inspectors. He also has certification through the City of Dayton Board of Education as an Adult Education Instructor.

Address: 3600 Shroyer Road, Kettering, OH 45429

Daniel Dewayne Jenkins

Dewayne started his career in the electrical field in 1982 in Dayton, Ohio and several years of experience in the electrical industry both as a contractor and inspector. He served 4 years in an electrical apprenticeship program and has over 8 years in the field as a journeyman electrician and he has 4 years, to his credit, as an electrical estimator and project manager.

Dewayne has been a licensed electrical contractor and a certified electrical safety inspector since 1996. He also holds Ohio certifications as building inspector (1998), electrical plans examiner (2006) and residential building official (2007) and chief building official (2008). He is currently employed by the City of Kettering in the position as an electrical plans examiner, electrical safety inspector and building inspector.

Dewayne is an adjunct lecturer II for Sinclair Community College in the electrical trades for several years. A technical presenter for the Ohio Board of Building Standards (OBBS), International Association of Electrical Inspectors (IAEI), Master Electrical Contractors Association (MECA), Adequate Wiring Committee (AWC) & Greater Cincinnati Electrical Association (GCEA). He has served as President for the Ohio Chapter IAEI (2010). Dewayne has also served as President of the Miami Valley Building Officials Council (2002 & 2003). He currently is the President of the Southwest Division, IAEI and serves on the Electrical Safety Inspector Advisory Committee for the Ohio Board of Building Standards.

Address: 3600 Shroyer Road, Kettering, OH 45429

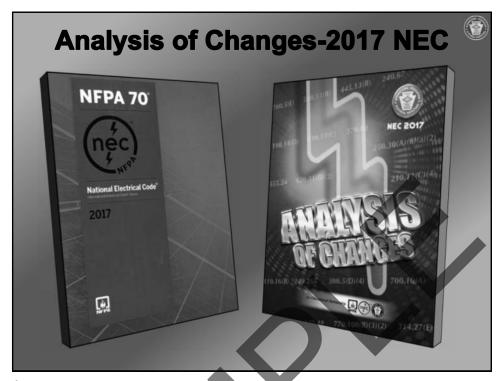
2023 30-Hour Course Sponsored by Southwest Division Ohio IAEI

Facility

The facility is conveniently located in Mason, about 1 mile from I-71 and 3 miles from I-75. Classes are held at the **City of Mason, Community Room, 6000 Mason-Montgomery Rd., Mason, Ohio**. The room occupancy is good for 100 students comfortably with tables and chairs. There are provisions for audio-visual equipment (screen, microphone, and speakers). Restrooms are located nearby the room for females and males. Refreshments are served during the morning. Duration of the instruction is 7.5 hours. 7:30am – 4:00pm.

Course Materials

Every attendee is responsible for bringing an edition of the 2017 and 2023 NEC. The instructors will also have on hand the necessary references to answer questions about other codes or standards. Most of the presentations are on a slide-format (Power Point).



4

Code-Wide Changes: (5) New Articles



Article 425 Fixed Resistance and Electrode Industrial Process Heating Equipment. This article covers fixed industrial process heating employing electric resistance or electrode heating technology (boilers, electrode boilers, duct heaters, strip heaters, immersion heaters, process air heaters, or other approved fixed electric equipment used for industrial process heating).

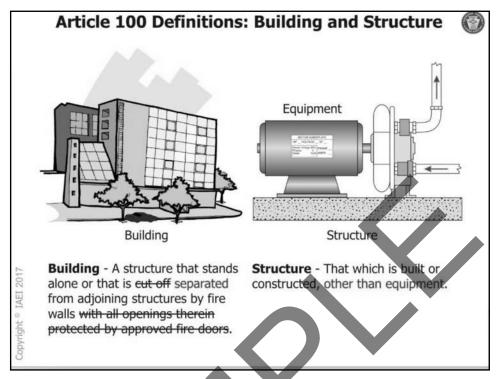
Article 691 Large-Scale Photovoltaic (PV) Electric Power Production Facility. This article covers the installation of large-scale PV electric power production facilities operated for the sole purpose of providing electric supply to a system operated by a regulated utility for the transfer of electrical energy with a generating capacity of no less than 5,000 kW (generating stations, substations, associated generator, storage battery, transformer, and switchgear areas).

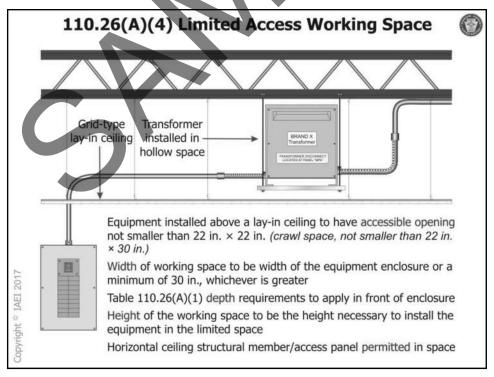
Article 706 Energy Storage Systems. This article applies to all permanently installed energy storage systems (ESS) operating at over 50 volts ac or 60 volts dc that may be stand-alone or interactive with other electric power production sources.

Article 710 Stand-Alone Systems. This article covers electric power production sources operating in stand-alone mode.

Article 712 Direct Current Microgrids (DC Microgrids). This article applies to direct current microgrids, which is a power distribution system consisting of more than one interconnected dc power sources, supplying dc-dc converters(s), dc loads(s), and/or ac loads(s) powered by dc-ac inverters(s).

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210.8(B)(9) GFCI for Non-Dwelling Unit (Commercial, Industrial) Crawl Spaces



All single-phase receptacles (150 volts to ground or less, 50 amperes or less) and three-phase receptacles (150 volts to ground or less, 100 amperes or less) installed in non-dwelling unit crawl spaces requires GFCI protection



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Table 240.6(A) Standard Ampacity Ratings for Fuses and Inverse Time Circuit Breakers



The standard ampere ratings for fuses and inverse time circuit breakers shall be considered as shown in Table 240.6(A)

		Select Disease and the Company of the		
15	20	25	30	35
40	45	50	60	70
80	90	100	110	125
150	175	200	225	250
300	350	400	450	500
600	700	800	1000	1200
1600	2000	2500	3000	4000
5000	6000			

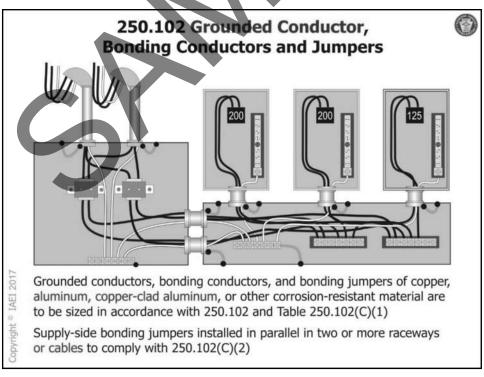
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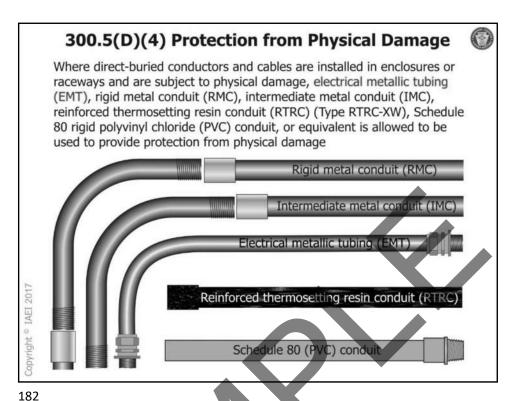
ratings shall be permitted

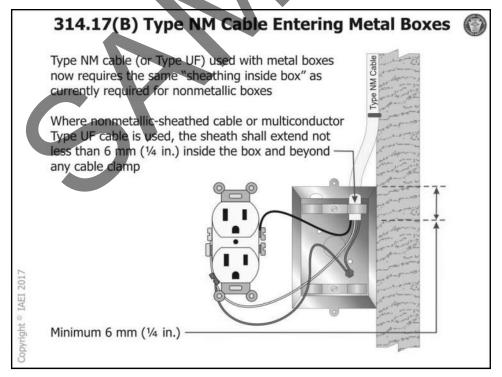
Additional standard ampere ratings for fuses shall be 1, 3, 6, 10, and 601. The use of fuses and inverse time circuit breakers with nonstandard ampere.

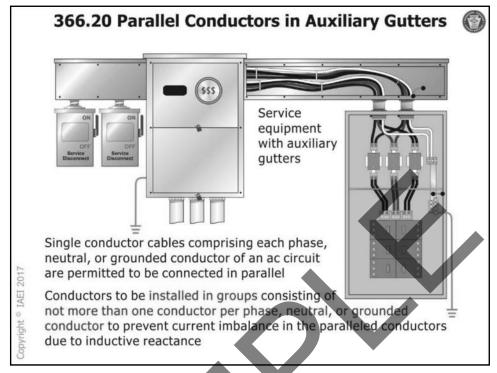
250.52(B)(3) Not Permitted for Use as Grounding Electrodes The structures and structural reinforcing steel of an in-ground swimming pool as described in 680.26(B)(1) and (B)(2) are prohibited from being used as a grounding electrode Permanently installed pool (side view) Grounding electrode system The provisions of 680.26 for equipotential bonding are to reduce voltage gradients (difference of voltage potential between two conducting objects), not to establish a grounding electrode system for a building or structure

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404.2(C) Grounded Conductor at Switch Locations

A grounded conductor is generally required to be installed and connected to the switching device at locations where switches control lighting loads that are supplied by a grounded general-purpose branch circuit

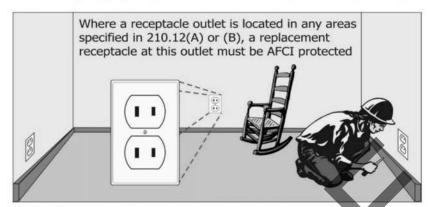
Grounded conductor is generally **NOT** required at the following locations:



Where multiple switch locations control the same lighting load such that the entire floor area of the room or space is visible from the single or combined switch locations, the grounded circuit conductor shall only be required at one location

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
- Ex. No. 2: Exception at 210.12(B) shall not apply to replacement of receptacles

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406.12 Tamper-Resistant Receptacles



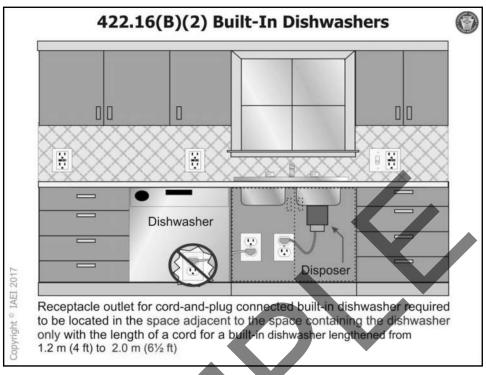
All 15- and 20-ampere, 125- and 250-volt nonlocking-type receptacles in areas specified in 406.12(1) through (7) must be listed tamper-resistant receptacles: (1) Dwelling units in all areas specified in 210.52 and 550.13; (2) Guest rooms and guest suites of hotels and motels; (3) Child care facilities

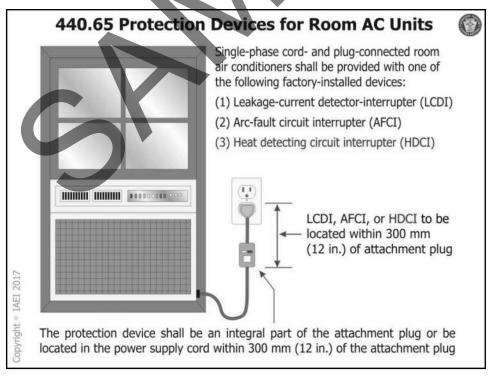




Tamper-resistant receptacle requirements have been expanded to include: all areas specified in 550.13 at mobile and manufactured homes

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445.20 GFCI Protection for Receptacles on 15-kW or Smaller Portable Generators

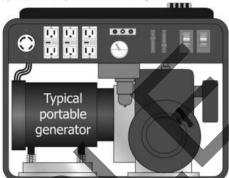
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Receptacle outlets that are a part of a 15-kW or smaller portable generator shall have listed GFCI for personnel integral to the generator or receptacle 445.20(A): Unbonded (floating neutral) generators with both 125-volt and

125/250-volt receptacle outlets require GFCI protection integral to the

generator or receptacle on all 125-volt and 15- and 20-ampere receptacle outlets

See exception where the 125-volt receptacle outlets(s) is interlocked such that it is not available for use when any 125/250-volt receptacle(s) is in use)



If the generator was manufactured or remanufactured prior to January 1, 2015, listed cord sets or devices incorporating listed GFCI protection for personnel identified for portable use shall be permitted

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500.5(A) Classifications of Locations General



The title of 500.5(A) was changed to "General" as it applies to all of 500.5

Refrigerant machinery rooms containing ammonia refrigeration may be classified as "unclassified" locations based on the use of gas detection and adequate ventilation (concentration not exceeding 150 ppm)

Class I, II, and III Locations and Groups

Substance	Gas	Dust	Fibers/Flyings
Class	Class I [500.5(B)]	Class II [500.5(C)]	Class III [500.5(D)]
Division 1 (Normally Hazardous)	Flammable or combustible concentrations exist under normal operating conditions	Group E, Groups F & G Normally in air in ignitible concentrations₄	Where they are manufactured
Division 2 (Normally Hazardous)	Confined within closed systems and closed containers	Groups F & G Not normally in air in ignitible quantities	Where they are stored
Groups	A, B, C, and D NEC 500.6(A)	E, F, and G NEC 500.6(B)	No Groups
NEC Article	501	502	503

10

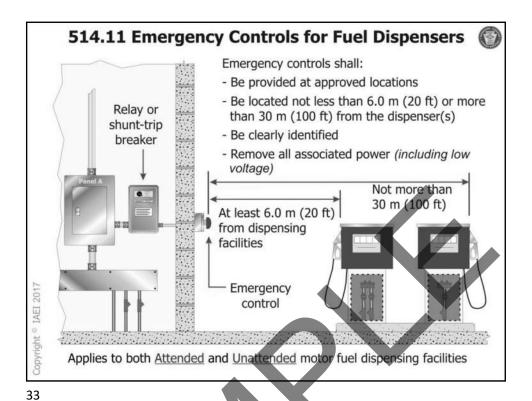
Rigid metal conduit (RMC) and intermediate metal conduit (IMC) with listed threadless fittings have been added to the allowable wiring methods in a Class I, Division 2 location

Cablebus also added to permitted wiring methods in a Class I, Division 2 location

Cablebus

RMC and IMC with listed threadless fittings

Class I, Division 2 location





Health Care Facilities. Buildings, portions of buildings, or mobile enclosures in which human medical, dental, psychiatric, nursing, obstetrical, or surgical care are provided. [99: 3.3.67]

517.2 Definitions (Health Care Facilities)





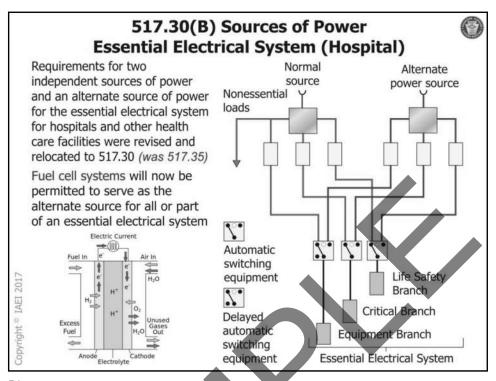






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Informational Note: Examples of health care facilities include, but are not limited to, hospitals, nursing homes, limited care facilities, clinics, medical and dental offices, and ambulatory care centers, whether permanent or movable.



551.71 Type Receptacles Provided at RV Parks



Every RV site (with electrical power provided) must be equipped with a certain number and type of receptacles [see 551.71(A) through (F)]



20-A, 125-V, 2-pole, 3-wire, grounding type



30-A, 125-V, 2-pole, 3-wire, grounding type



50-A, 125/250-V, 3-pole, 4-wire, grounding type

551.71 has been broken into six separate first level subdivisions with titles

The number of RV sites required to be equipped with 50-ampere, 125/250-volt receptacles has increased from 20 percent to 40 percent for all new RV sites

GFCI devices used in RV site electrical equipment not required to be weather or tamper resistant in accordance with 406.9 and 406.12

Convright 9 1A

555.19(B) GFCI Protection for Personnel



GFCI protection required for all 125-volt, single-phase, 15- and 20-ampere receptacles installed outdoors, in boathouses, and in buildings or structures used for storage, maintenance, or repair regardless of the intended use





The term, "where portable electrical hand tools, electrical diagnostic equipment, or portable lighting equipment are to be used" was deleted

The removal of this portable electrical hand tool, etc. conditional language will aid the AHJ in enforcement of the GFCI requirements at these locations

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605.9(C) Receptacles at Office Furnishings



An individual office furnishing or groups of interconnected individual office furnishings shall not contain more than (13) 15-ampere, 125-volt receptacles



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For purposes of this requirement, a receptacle is considered:

- (1) Up to two (simplex) receptacles provided within a single enclosure and that are within 0.3 m (1 ft) of each other or...
- (2) One duplex receptacle

680.2 Definitions - Electrically Powered Pool Lift



Electrically Powered Pool Lift. An electrically powered lift that provides accessibility to and from a pool or spa for people with disabilities.

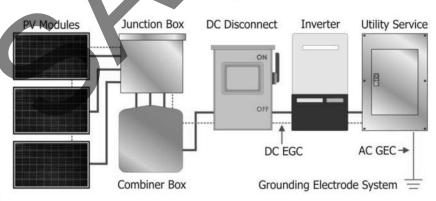


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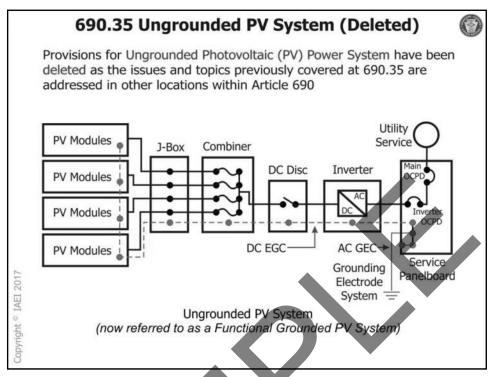
690.2 Definition: Functional Grounded PV System (



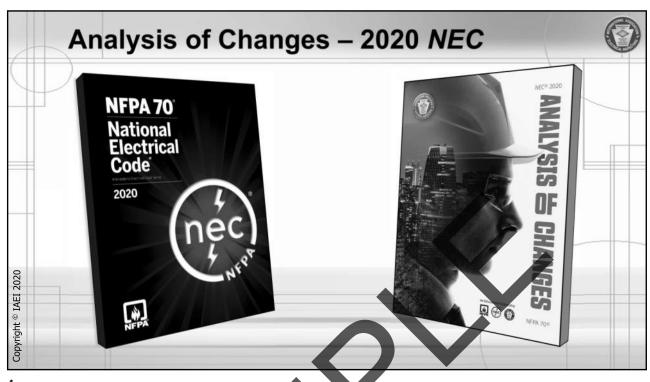
Functional Grounded PV System. A PV system that has an electrical reference to ground that is not solidly grounded.



Informational Note: A functional grounded PV system is often connected to ground through a fuse, circuit breaker, resistance device, non-isolated grounded ac circuit, or electronic means that is part of a listed ground-fault protection system. Conductors in these systems that are normally at ground potential may have voltage to ground during fault conditions.







New Articles for the 2020 NEC



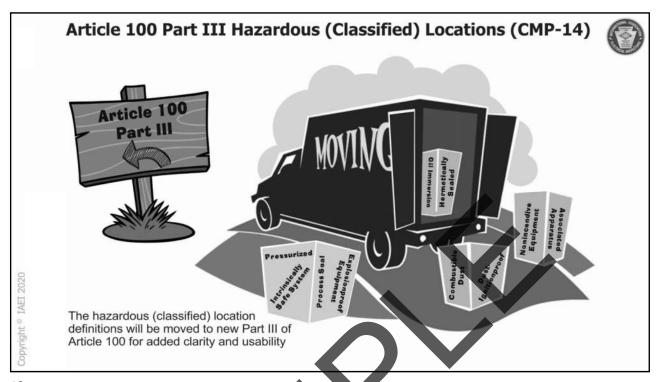
Article 242 Overvoltage Protection (CMP-10)
This article provides the general requirements, installation requirements, and connection requirements for overvoltage protection and overvoltage protective devices. Part II covers surge-protective devices (SPDs) permanently installed on premises wiring systems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

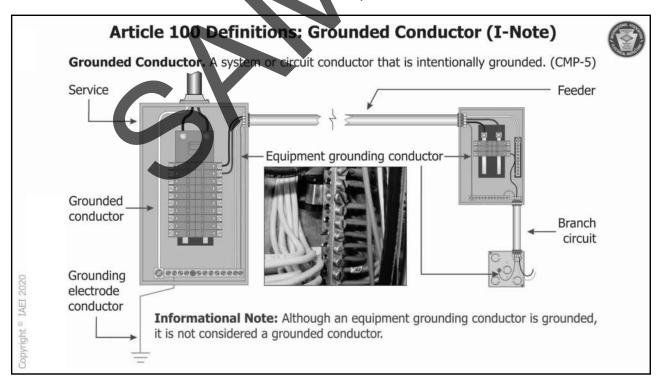
Article 337 Type P Cable (CMP-6) This article covers the use, installation, and construction specifications for up through 2000 volt Type P cable (armored and unarmored). Type P cable is a factory assembly of one or more insulated flexible tinned copper conductors, with associated equipment grounding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

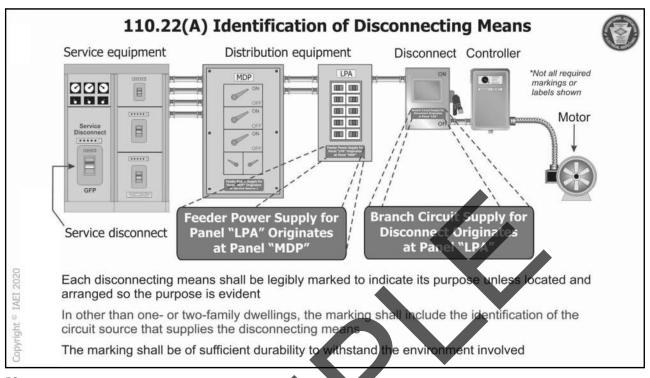
Article 311 Medium Voltage Conductors and Cable (CMP-6) This article covers the use, installation, construction specifications, and ampacities for Type MV medium voltage conductors and cable. Type MV conductor and cable requirements that were previously found in Articles 310 (Conductors or General Use)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

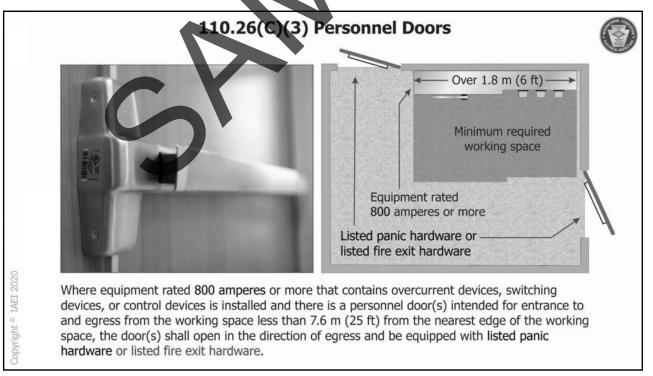
Article 800 General Requirements for Communications Systems (CMP-16) This article covers general requirements for communications systems. These general requirements apply to communications circuits, community antenna television and radio distribution systems, network-powered broadband communications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

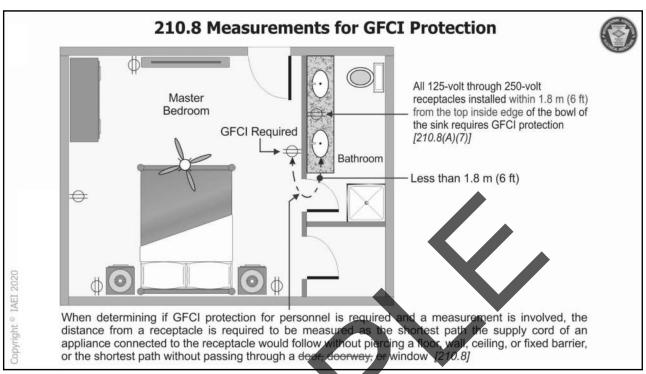
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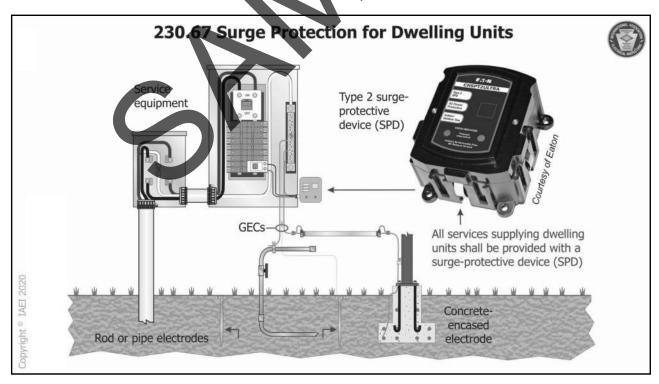






	Unit Load	
Type of Occupancy	Volt-amperes/m ²	Volt-amperes/ft ²
Automotive facility	16	1.5
Convention Center	15	1.4
Courthouse (was Courtreons)	15 22	1.4 2.0
Dormitory	16	1.5
Exercise center	15	1.4
Fire station	14	1.3
Gymnasium ^a (was Armories and auditoriums)	18 11	1.7 1.0
Health care clinic (was Hospitals)	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

	Unit Load	
Type of Occupancy	Volt-amperes/m ²	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 (was Restaurants and Clubs)	16 22	1.5 2.0
Retail ^{9, 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

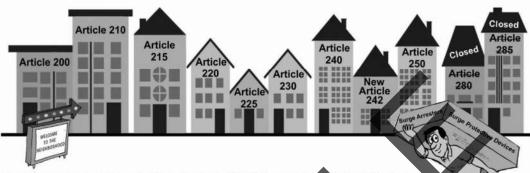


Article 242 Overvoltage Protection



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



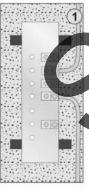
Part II covers surge-protective devices (SPDs) permanently installed on premises wiring systems of not more than 1000 volts, nominal

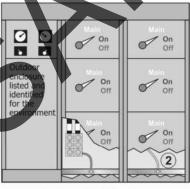
Part III covers surge arresters permanently installed on premises wiring systems over 1000 volts, nominal

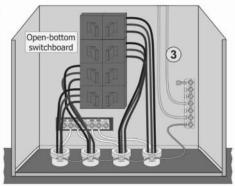
147

250.64(A) Aluminum or Copper-Clad Aluminum GECs





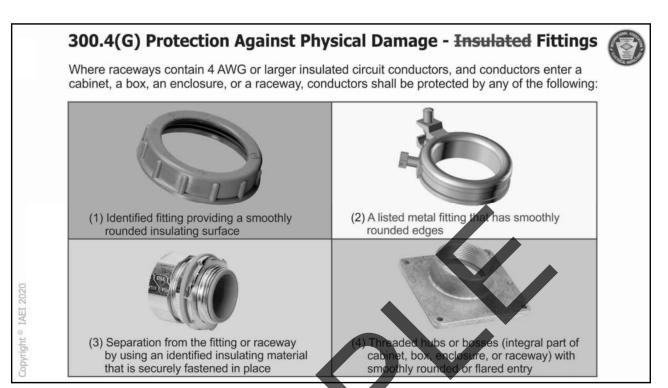


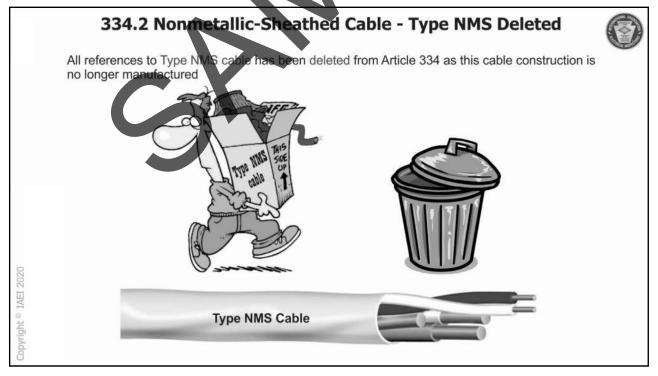


Grounding electrode conductors (GEC) of bare, covered, or insulated aluminum or copper-clad aluminum shall comply with the following:

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

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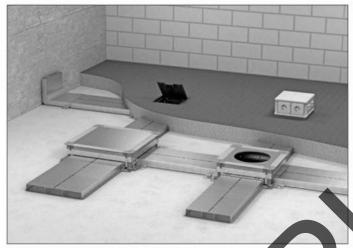




374.6 Listing Requirements for Cellular Metal Floor Raceways



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





Cellular Metal Floor Raceway

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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

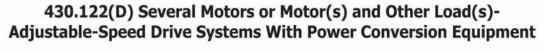


Dimmers



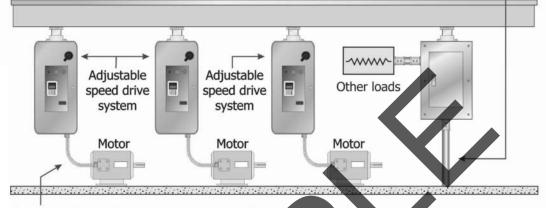
Control Switches

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

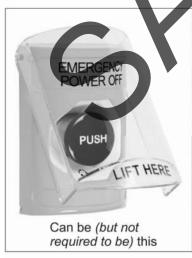


Output conductors between power conversion equipment and the motor must have an ampacity equal to or larger than 125 percent of the motor full-load current (w exception) [430.122(B)]

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445.18(D) Emergency Shutdown Device at Dwelling Units







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

500.7(K) Combustible Gas Detection System

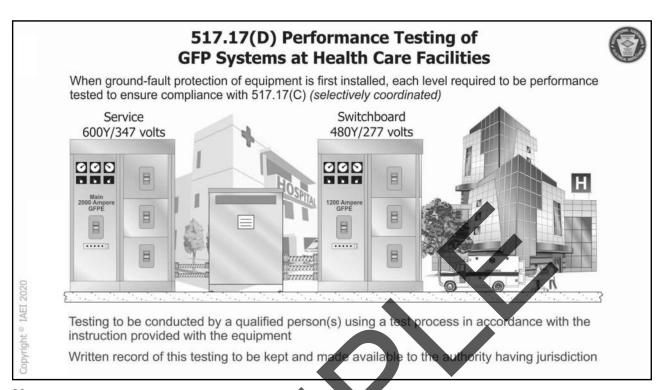


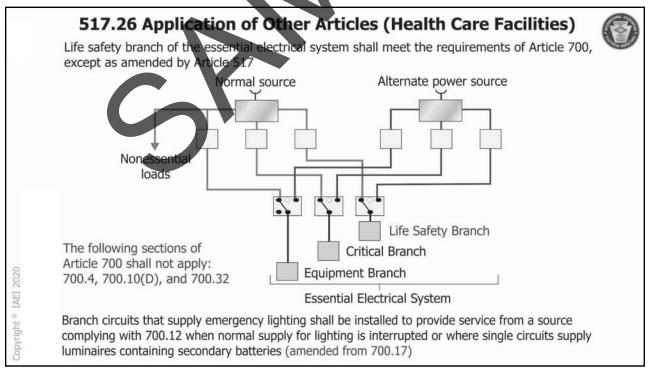




These requirements surrounding a combustible gas detection system as a protection technique were appropriately revised and expanded to provide more sufficient detail to install and operate a gas detection system

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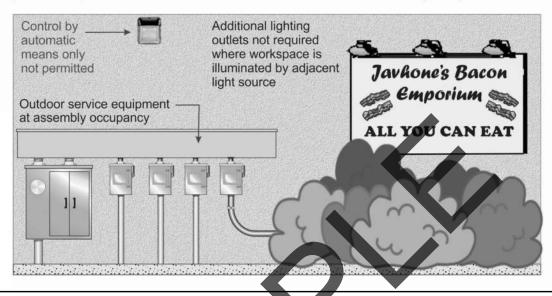








Illumination required for working spaces about fixed service equipment, switchboards, switchgear, panelboards, or motor control centers installed outdoors that serve assembly occupancies



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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

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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

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



Where more than three ecceptacles 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



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

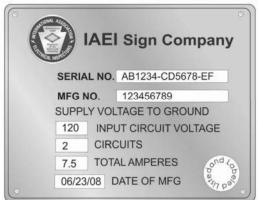
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600.4(D) Visibility of Markings - Electric Signs and Outline Lighting



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

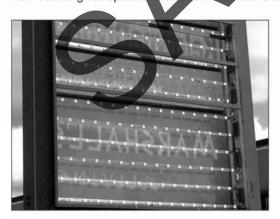
Marking permitted to be installed in a location not viewed

91

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

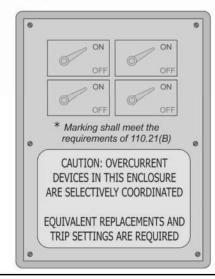
All parts that are not replaced by a retrofit kit shall be inspected for damage

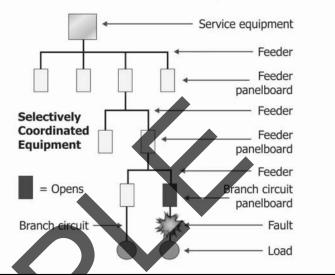


(Elevators, Dumbwaiters, Escalators, Moving Walks, Platform Lifts, and Stairway Chairlifts)



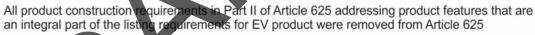
Equipment enclosures containing selectively coordinated overcurrent devices required to be legibly marked in the field to indicate that the overcurrent devices are selectively coordinated

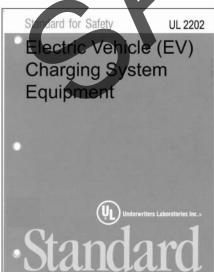


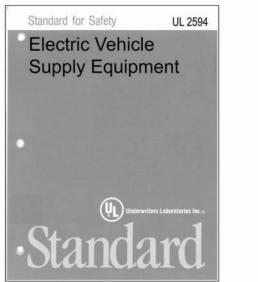


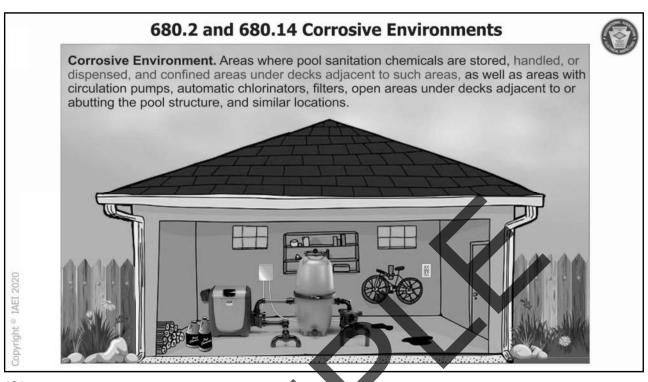
106

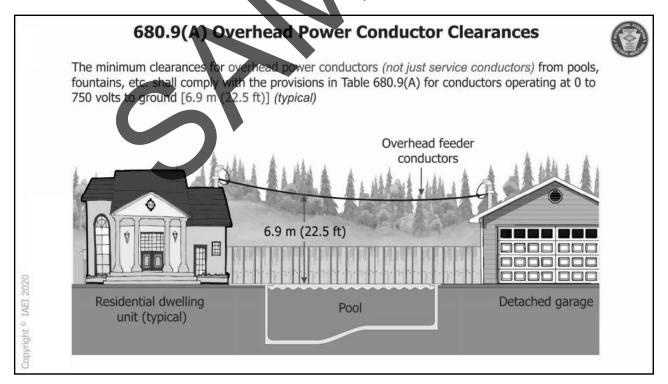
Article 625 - Part II EV Equipment Construction









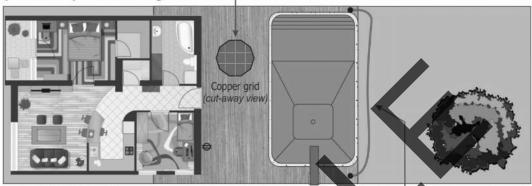


680.26(B)(2)(c) Copper Grid for Perimeter Surfaces



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

690.4(B) PV Equipment Listing and Evaluation



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

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

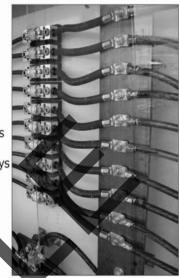
690.31 Wiring Methods for Solar Photovoltaic (PV) Systems



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



- (A) Wiring Systems
- (B) Identification and Grouping
 - (1) Identification
 - (2) Grouping
- (C) Cables
 - (1) Single-Conductor Cables
 - (2) Cable Tray
 - (3) Multiconductor Jacketed Cables
 - (4) Flexible Cords and Cables Connected to Tracking PV Arrays
 - (5) Flexible, Fine Stranded Cables
 - (6) Small-Conductor Cables
- (D) Direct-Cirrent on or in Buildings
 - (1) Flexible Wiring Methods
 - (2) Marking and labeling Required
- (E) Bipolar Photovoltaic Systems

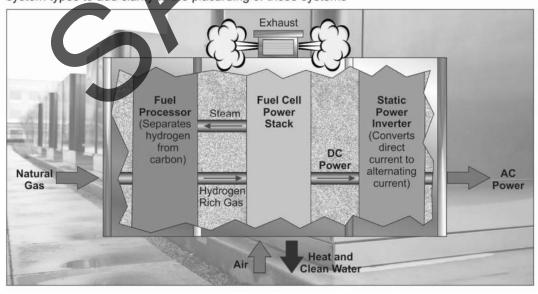


203

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

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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)

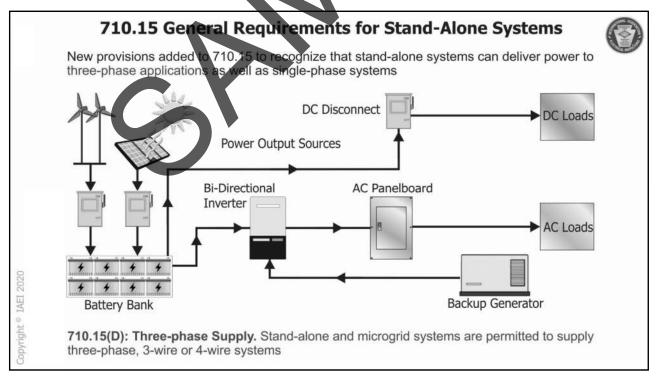






Selective coordination required to be selected by a ligensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems

226



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*)



Overhead premises-powered broadband communication system circuit leaving building to power equipment in second building



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

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

Authors Comment:

A short circuit occurs when there is an unintentional electrical connection between two phase conductors, or a phase conductor and neutral conductor.

Splash Pad. A fountain intended for recreational use by pedestrians with a water depth of 1 in. or less. This definition does not include showers intended for hygienic rinsing prior to use of a pool, spa, or other water feature (Article 680). ▶ Figure 100–24

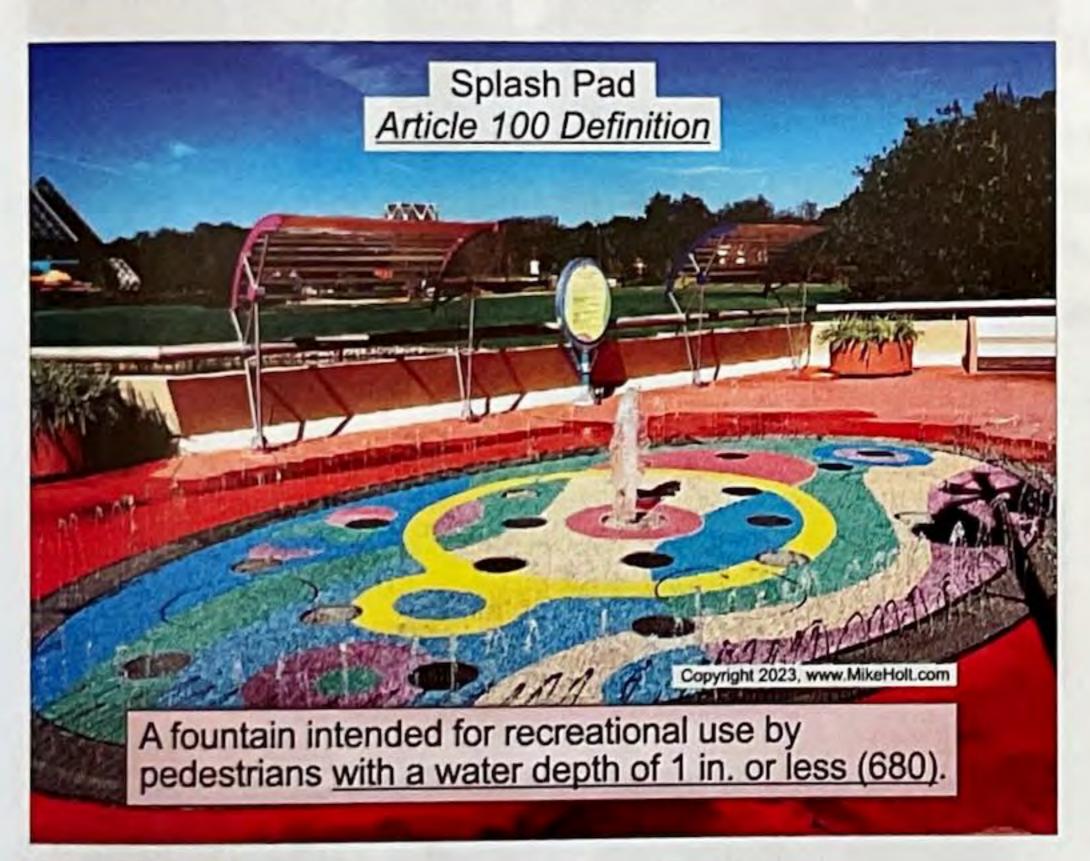


Figure 100-24

Analysis

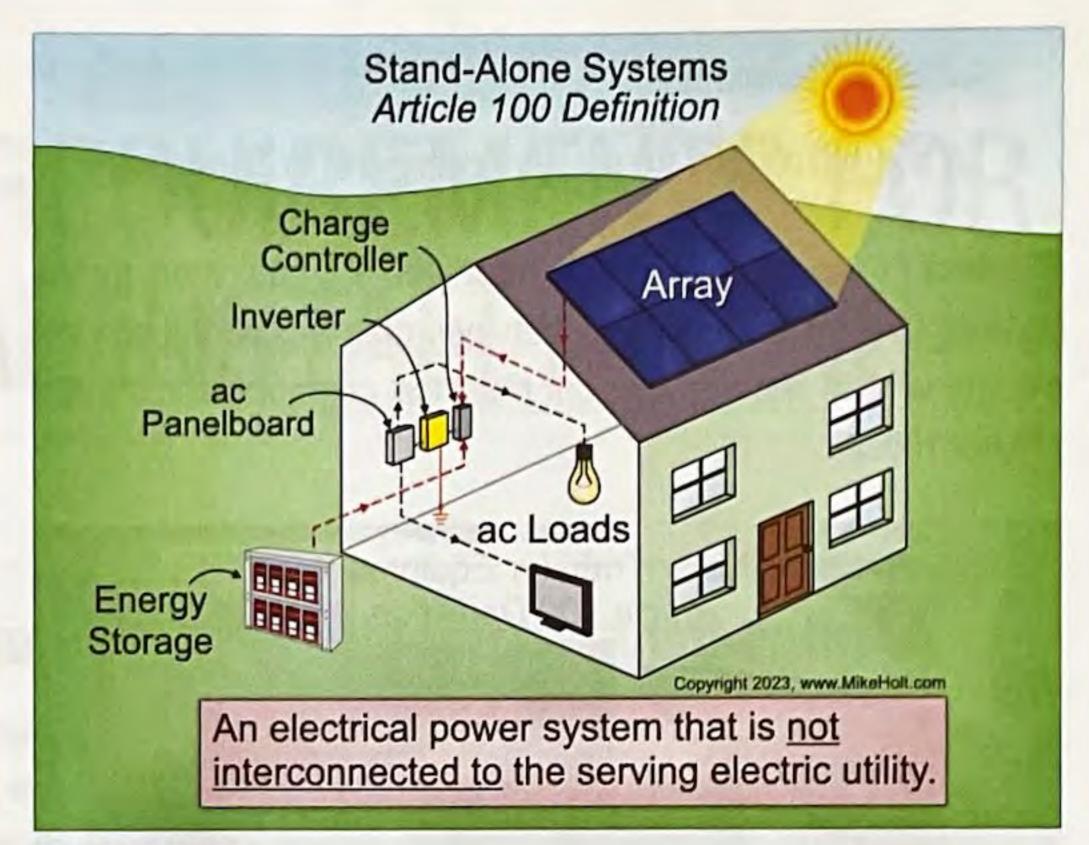


Stand-Alone System. This definition now clarifies that stand-alone systems are NOT connected to any other system.

Stand-Alone System. An electrical power system that is not interconnected to the electric utility power system. ▶ Figure 100–25

Author's Comment:

Although stand-alone systems can operate independently of the serving electric utility, they may include a connection to the serving electric utility for use when not operating in stand-alone mode ("island mode").



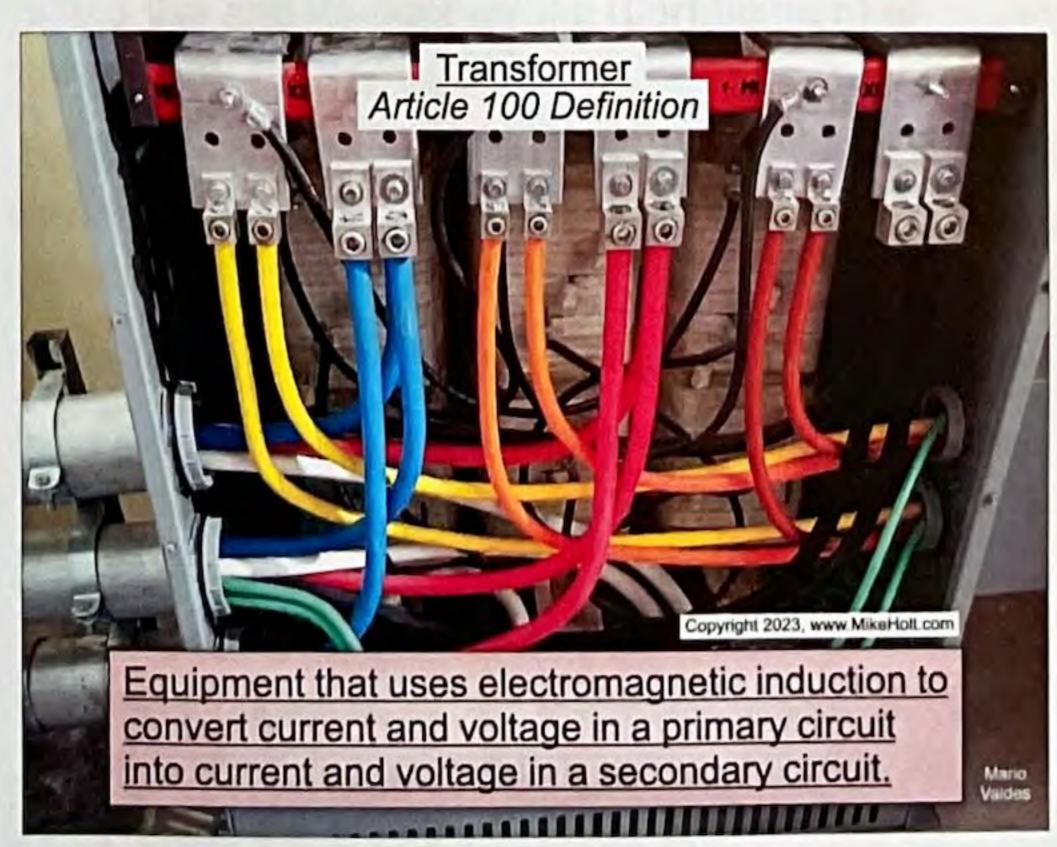
▶ Figure 100-25

Analysis



<u>Transformer.</u> I'm not sure we were confused on this one, but it's a great definition and it found a home in Article 100.

Transformer. Equipment, either single-phase or polyphase, that uses electromagnetic induction to convert current and voltage in a primary circuit into current and voltage in a secondary circuit. Figure 100–26



▶ Figure 100-26



▶ Figure 230-7

230.62 Service Equipment— Enclosed or Guarded

Language was added to clarify where line-side terminal barriers are required.

Analysis

The rule in 230.62(C) was changed to clarify that protective barriers are required for any uninsulated exposed parts on the line side of the service disconnect when in the open position. This was always the intent of the rule, but the language was not completely clear.

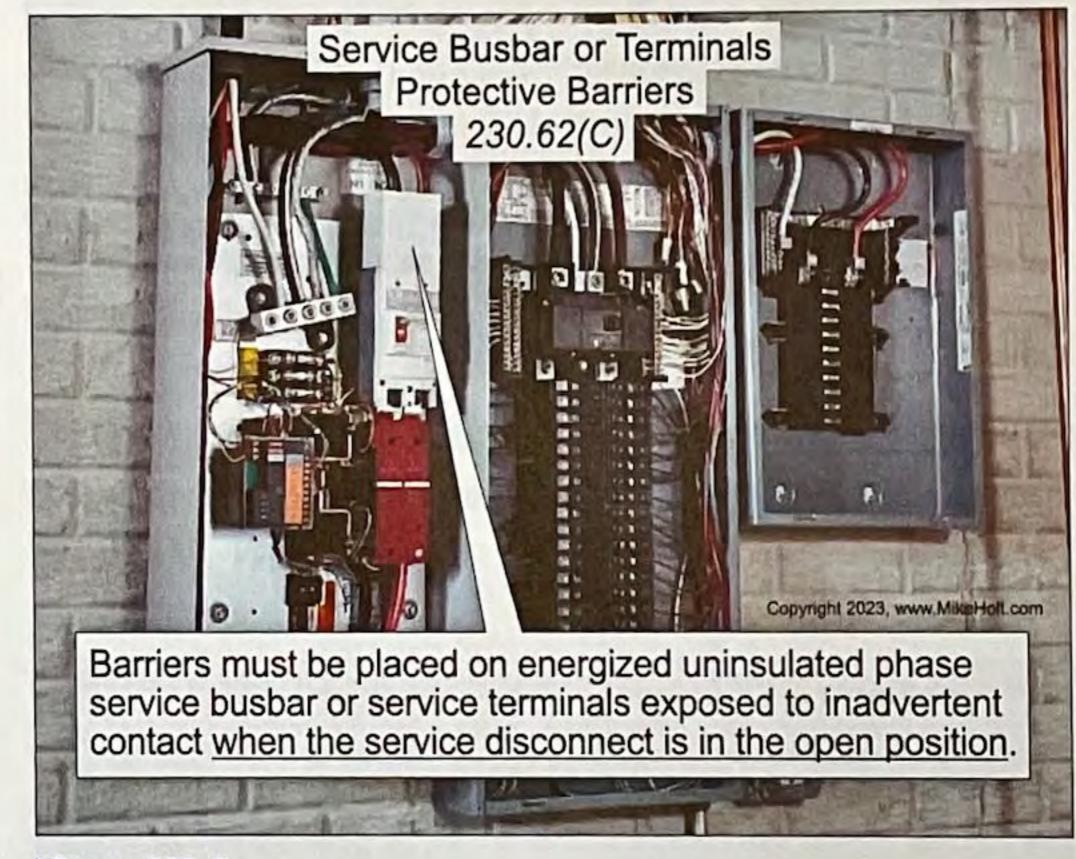
230.62 Service Equipment—Enclosed or Guarded

Energized parts of service equipment must be enclosed as specified in 230.62(A) or guarded as specified in 230.62(B).

(A) Enclosed. Energized parts must be enclosed so they will not be exposed to accidental contact or must be guarded in accordance with 230.62(B).

(B) Guarded. Energized parts that are not enclosed must be installed on a switchboard, panelboard, or control board and guarded in accordance with 110.18 and 110.27. Where energized parts are guarded as provided in 110.27(A)(1) and (A)(2), a means for locking or sealing doors providing access to energized parts must be provided.

(C) Barriers. Barriers must be placed on energized uninsulated phase service busbar or service terminals exposed to inadvertent contact when the service disconnect is in the open position. Figure 230-8



▶ Figure 230–8

Author's Comment:

The line-side of the service disconnect will have energized parts even with the disconnect in the open position. Barriers provide some measure of safety against inadvertent contact with line-side energized parts.

230.67 Surge Protection

This section was expanded to cover occupancies other than dwellings and to establish a minimum nominal discharge current for surge-protective devices.

distribution in the state of th

230.71 Maximum Number of Disconnects

This section caused a lot of stir in the 2020 Code cycle by requiring a physical barrier between each of the sections of a meter pack or switchgear without a main disconnecting means. Several revisions here aim to solve some of the field issues created by the rules last cycle while preserving the intended added safety.

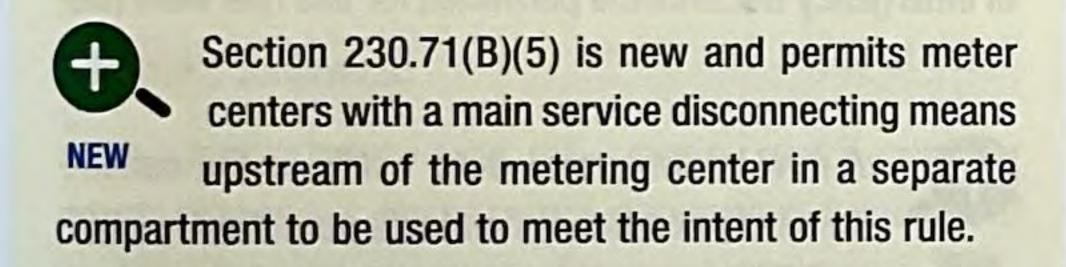
Analysis



The revision to 230.71(B)(3) clarifies that the vertical barriers between the sections of switchboards must maintain the inadvertent contact protective barriers between adjacent sections.



Section 230.71(B)(4) was expanded to require each have a separate compartment for multiple service disconnects in transfer switches.



Section 230.71(B)(6) is also new and adds MCCs to the types of service disconnecting equipment NEW covered under this rule. The previous Informational Note said that MCCs are one of the types of equipment covered by this rule, but this revision now places it in enforceable text. Up to two service disconnects in an MCC are permitted, provided each is in its own unit and there are barriers to prevent inadvertent contact between the units.

A new Exception was added to 230.71(B) permitting the use of spare service disconnect spaces in equipment installed prior to the adoption of the NEW 2020 NEC.

230.71 Number of Service Disconnects

Each service must have only one service disconnect except as permitted in 230.71(B). Figure 230-11

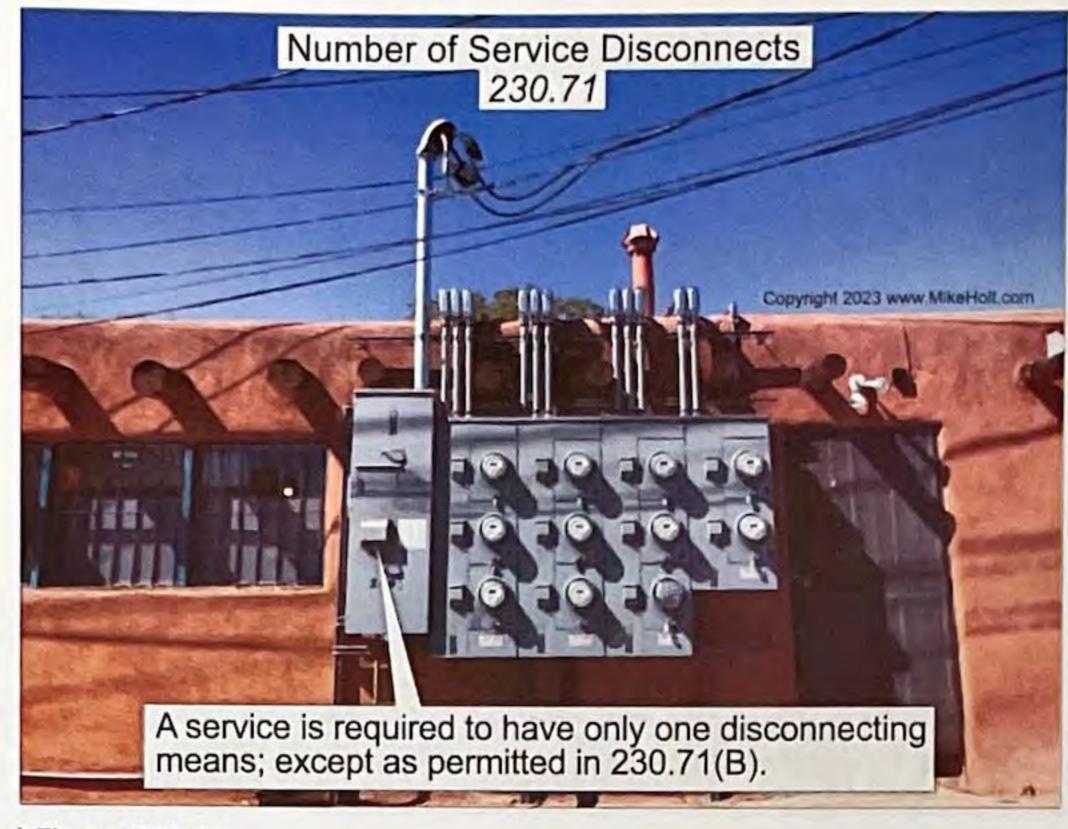


Figure 230-11

(B) Two to Six Service Disconnecting Means. Each service can have up to six service disconnects in accordance with 230.71(B)(1) through (5). ▶ Figure 230–12

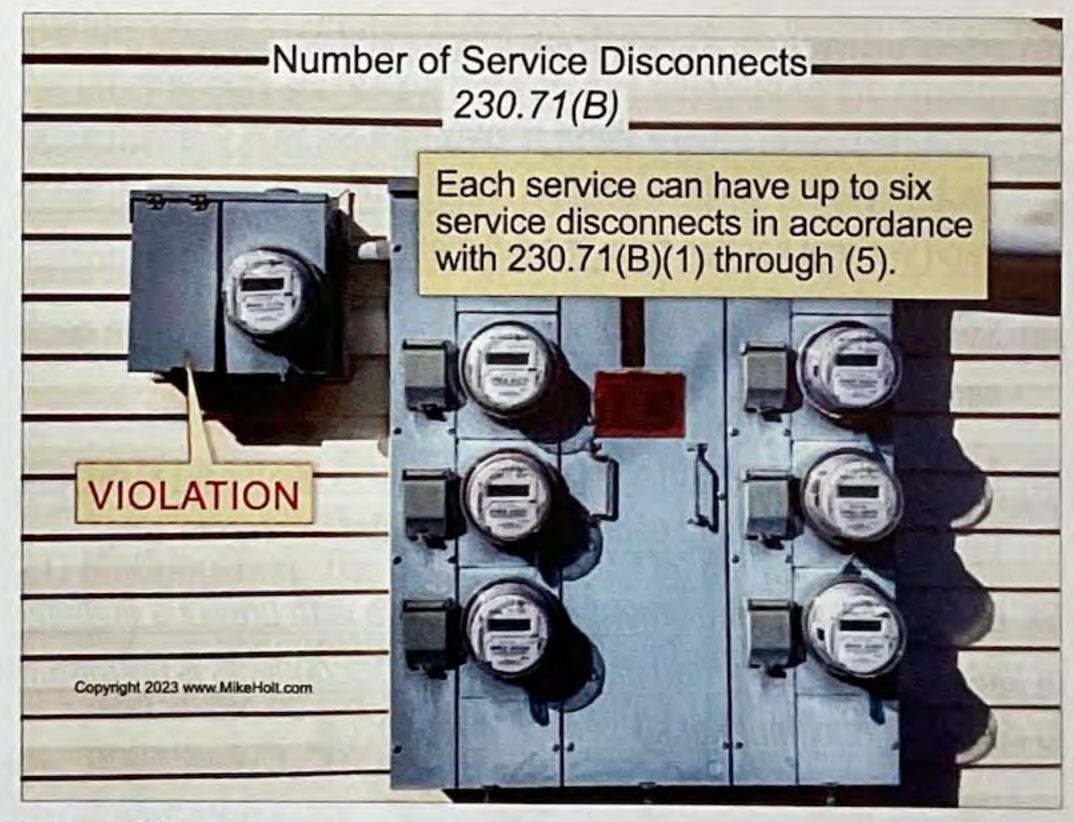


Figure 230–12

Caution

CAUTION: This rule limits six disconnects for each service or set of service-entrance conductors. For example, if the building has more than one service as permitted by 230.2, then there can be more than six service disconnects at the building. ▶Figure 230-13

ARTICLE 300

GENERAL REQUIREMENTS FOR WIRING METHODS AND MATERIALS

Introduction to Article 300—General Requirements for Wiring Methods and Materials

Article 300 contains the general requirements for all wiring methods included in the NEC. However, it does not apply to twisted-pair cable and coaxial cable (which are covered in Chapters 7 and 8), unless Article 300 is specifically referenced.

This article is primarily concerned with how to install, route, splice, protect, and secure cables, conductors, and raceways. How well you understand and apply the requirements of Article 300 will usually be evident in the finished work. Many of its requirements will affect the appearance, longevity, and even the safety of the installation. Installing conductors takes critical thinking, for example installing the phase conductors in one raceway and the neutral conductors in another raceway will cause inductive heating effects. Pay close attention to the building construction to be aware of what to do when cables are installed through framing members or penetrate fire walls. After studying and learning the rules in this article, you will immediately realize that the burial depth requirements of 300.5 were possibly overlooked or ignored.

A good understanding of this article will start you on the path to correctly and safely installing the wiring methods included in Chapter 3. Be sure to carefully consider the accompanying illustrations and refer to the definitions in Article 100 as needed.

300.3 Conductors

The rule requiring all conductors of the circuit to be in the same raceway added language to include conduit bodies. In addition, the voltage ranges were expanded to include both 1000V ac and the newly added 1500V dc.

EXPANDED

Subdivision (C) was expanded by allowing conductors carrying up to 1500V dc to occupy the same enclosure or raceway as conductors up to 1000V

ac, if all conductor insulation is rated for the maximum circuit voltage present.

Analysis



The rules in 300.3(B) require all conductors of the circuit, including any grounded or grounding conductors, to be in the same raceway. "Conduit

bodies" were added to that list to address possible confusion in applying this rule.

300.3 Conductors

(B) Conductors Grouped Together. All conductors of a circuit, including the neutral and equipment grounding conductors, must be installed together in the same raceway, conduit body, cable, trench, cord, or cable tray except as permitted by (1) through (4). ▶ Figure 300–1

300.6 Protection Against Corrosion

Raceways, cable trays, cable armor, boxes, cable sheathing, cabinets, enclosures, elbows, couplings, fittings, supports, and support hardware must be suitable for the environment.

(A) Ferrous Metal Equipment. Ferrous metal raceways, enclosures, cables, cable trays, cabinets, enclosures, fittings, and support hardware must be protected against corrosion by a coating of approved corrosion-resistant material. ▶ Figure 300–16

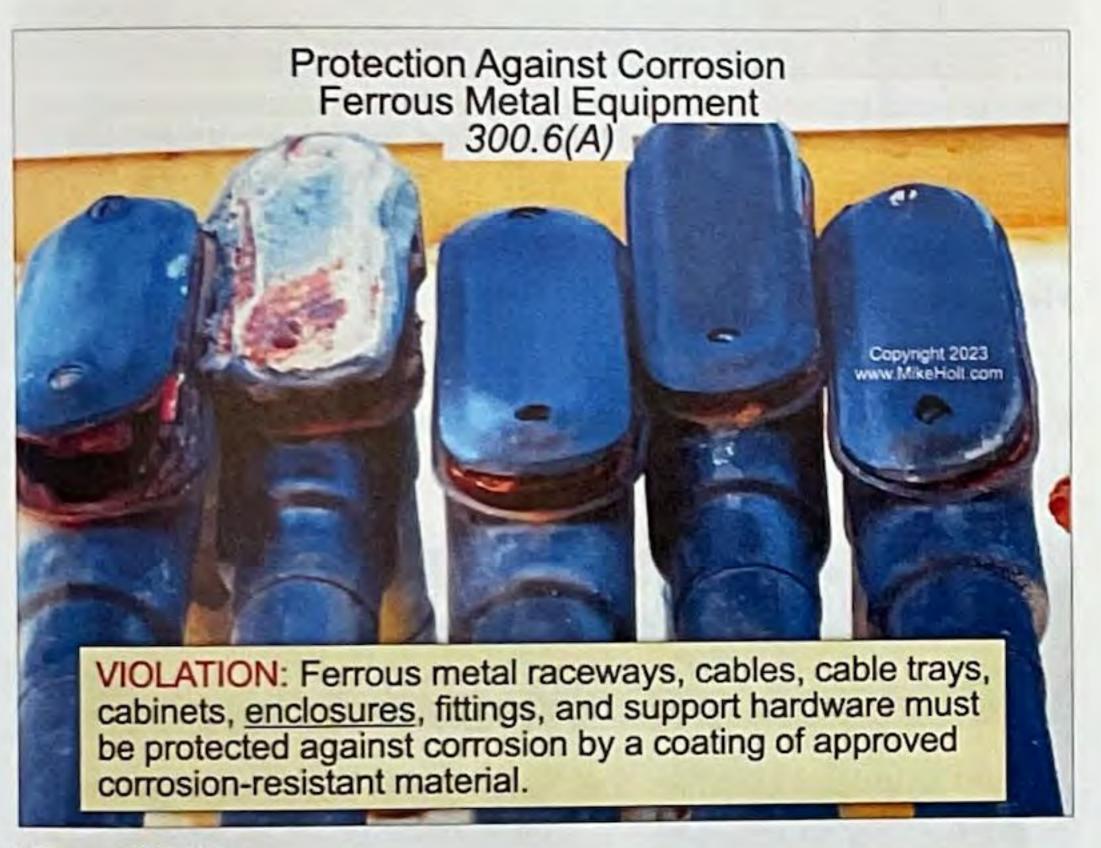


Figure 300-16

Author's Comment:

According to UL "DYIX" Guide, supplementary corrosion protection is required when a ferrous metal raceway transitions from concrete encasement to the soil. ▶Figure 300-17



Figure 300-17

Where corrosion protection is required and IMC or RMC is threaded in the field, the threads must be coated with an approved electrically conductive, corrosion-resistant compound.

300.12 Mechanical Continuity— **Raceways and Cables**

Conduit bodies were added to this rule for consistency with other sections.

Analysis

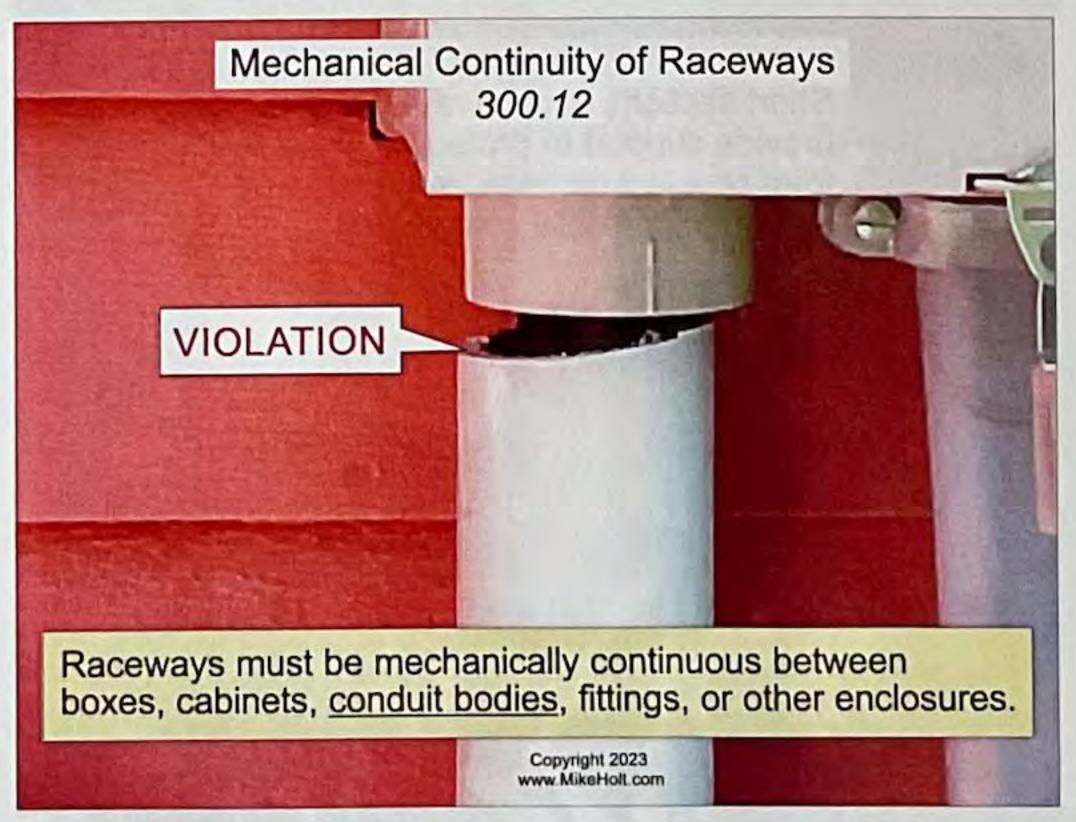
EXPANDED

Raceways and cables must be mechanically continuous between enclosures, boxes, cabinets, and newly added "conduit bodies." This addition was made to be consistent with the title of Section

300.12 Mechanical Continuity

300.15, which includes "conduit bodies."

Raceways and cable sheaths must be mechanically continuous between boxes, cabinets, conduit bodies, fittings, or other enclosures. ▶ Figure 300–18 and ▶ Figure 300–19



▶ Figure 300–18

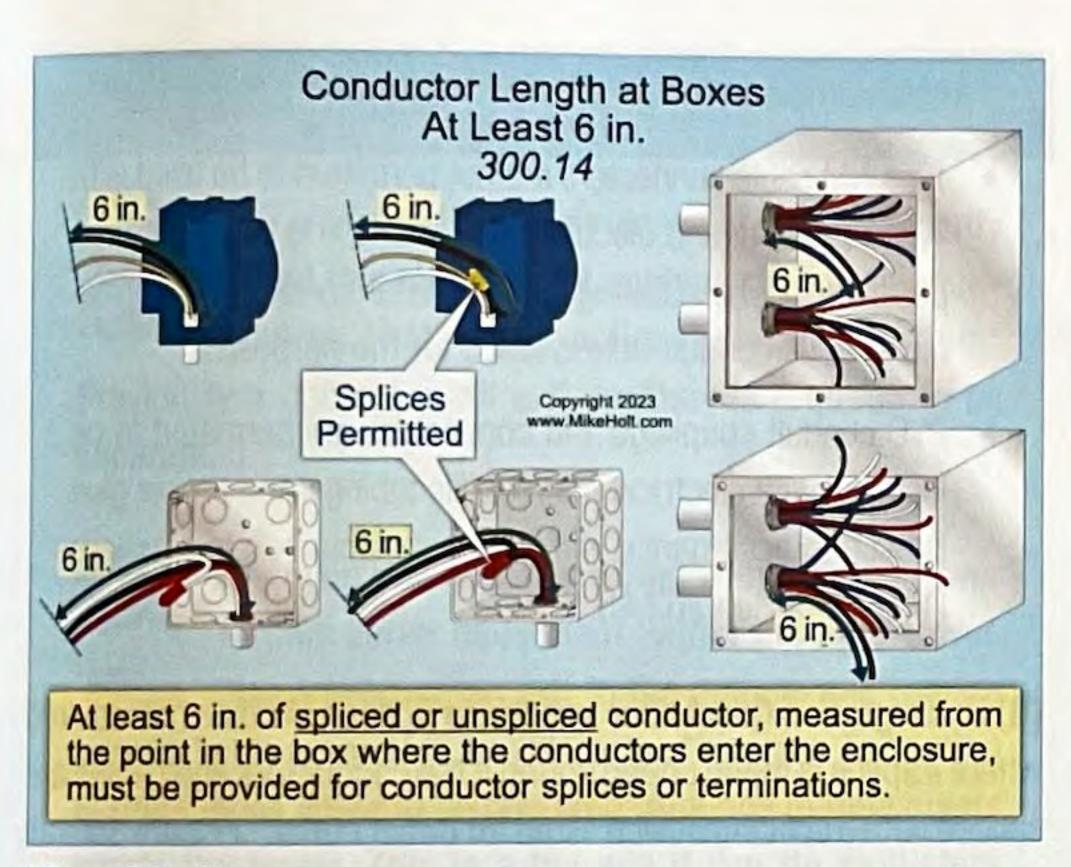


Figure 300-22

Boxes with openings less than 8 in. at any dimension must have at least 6 in. of conductor, measured from the point where the conductors enter the box, and at least 3 in. of conductor outside the box. Figure 300-23

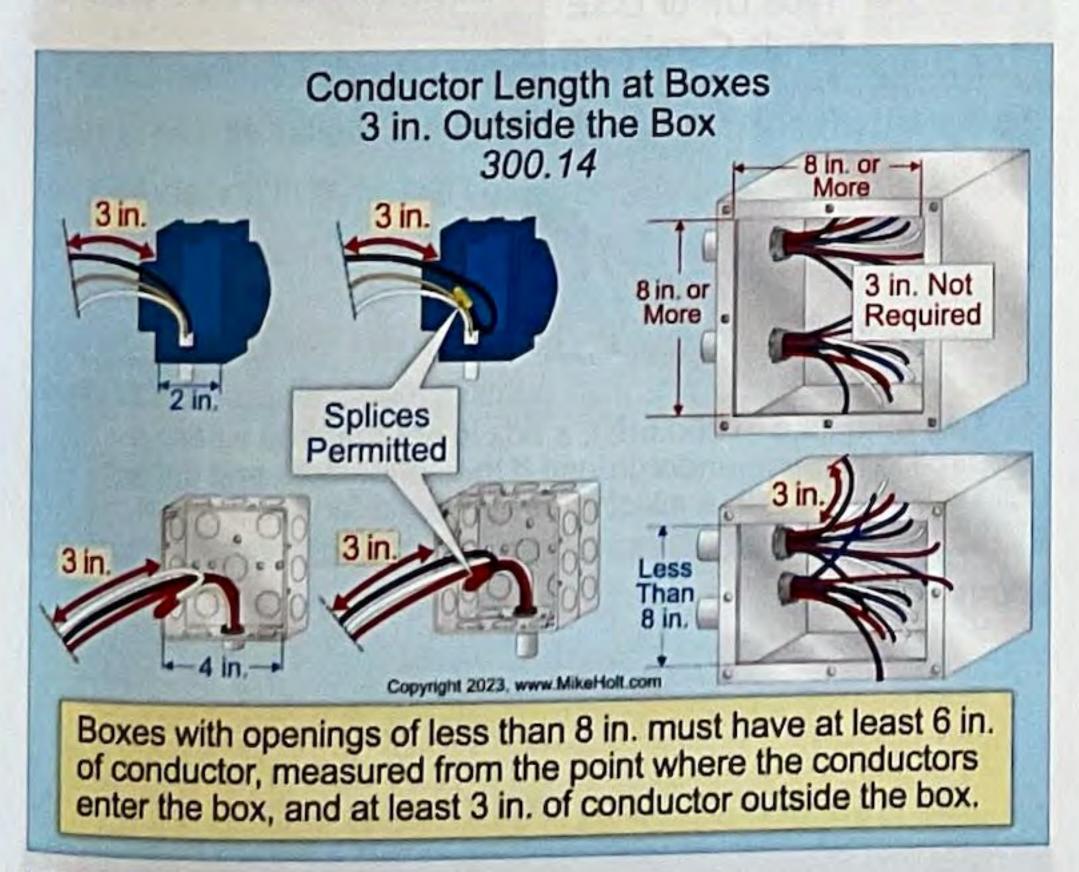


Figure 300-23

300.15 Boxes or Fittings

The language was revised to clarify that boxes are not required at wiring method transition points.

Analysis

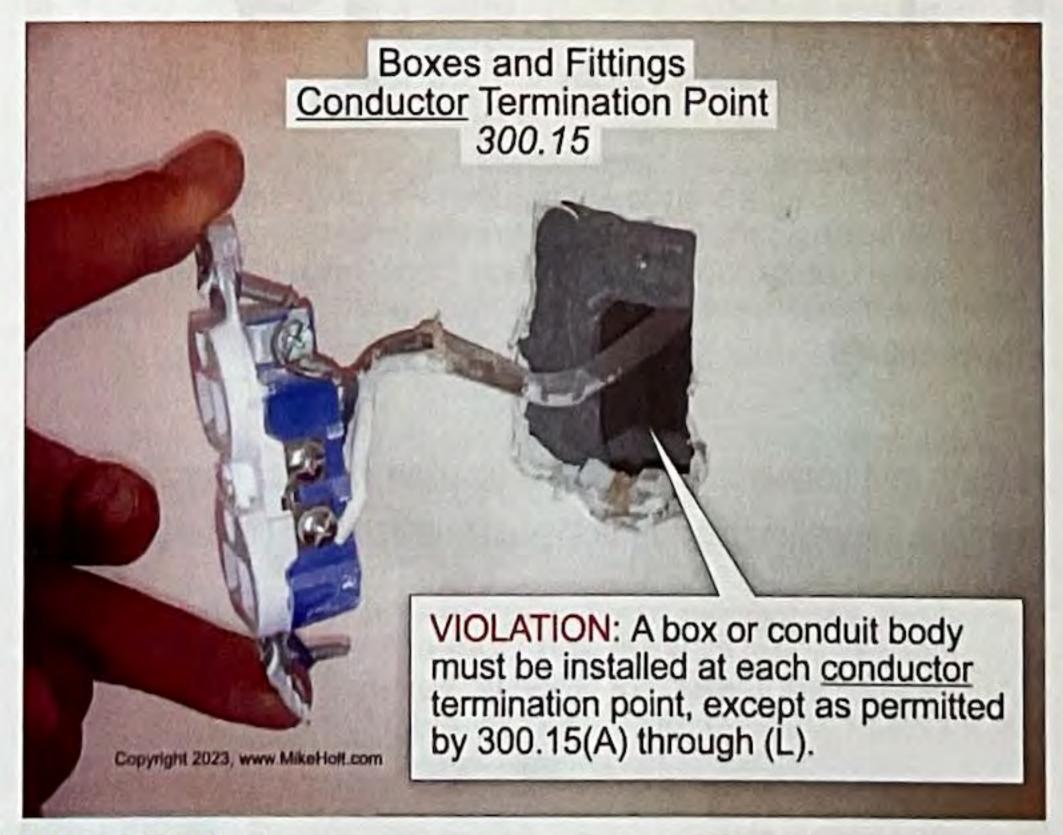
CLARIFIED

The word "conductor" was added throughout the charging text clarifying that a box is not required for a transition between two different hods if there is no splice. Even though this was

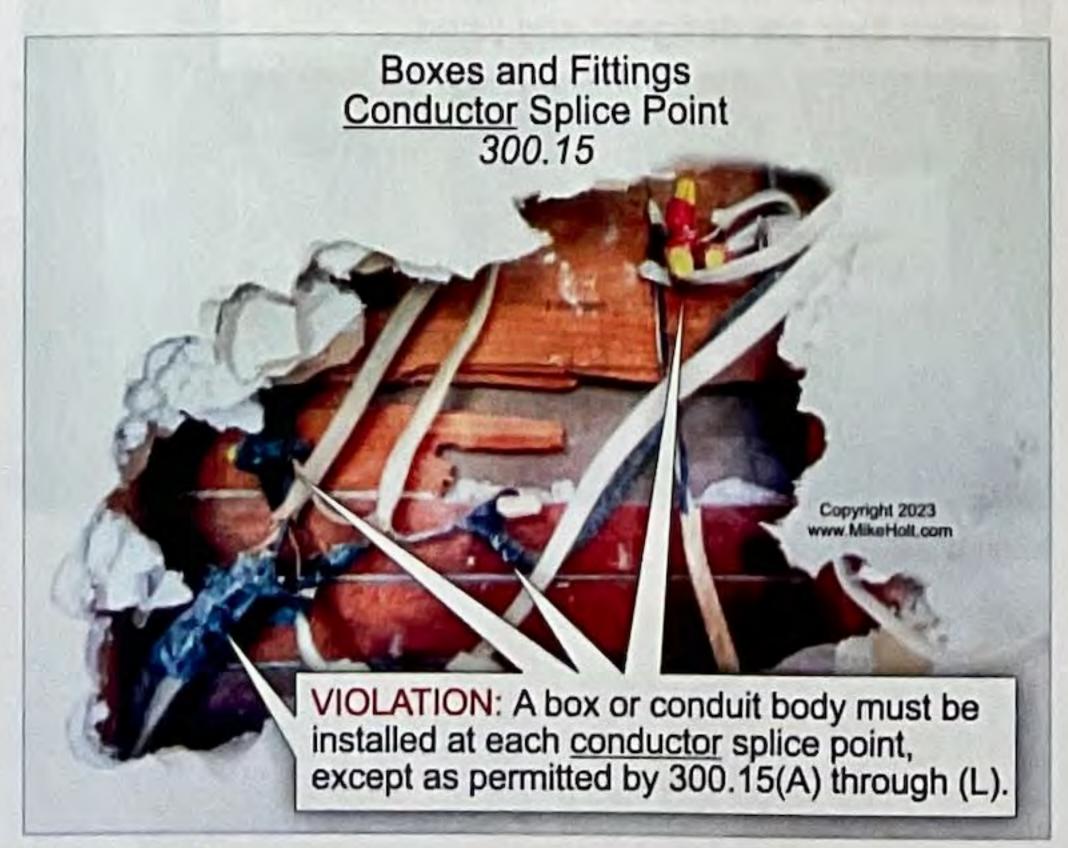
wiring methods if there is no splice. Even though this was already covered in 300.15(F), it was not part of the charging statement.

300.15 Boxes or Fittings

A box or conduit body must be installed at each <u>conductor</u> splice point and <u>conductor</u> termination point, except as permitted by 300.15(A) through (L): ▶ Figure 300-24 and ▶ Figure 300-25



▶ Figure 300-24



▶ Figure 300-25



Editorial revisions were made to (B) clarifying that power management equipment of either CLARIFIED the field-installed or listed kit type (these are two different product types and standards) may be installed in a switch or overcurrent device enclosure.

312.8 Overcurrent Device Enclosures

Cabinets for panelboards are permitted to contain wiring as provided in 312.8 (A) and (B).

(A) Splices, Taps, and Feed-Through Conductors. The wiring space within cabinets for panelboards can be used for conductors feeding through, spliced, or tapped where all the following conditions are met:

(1) The area of all conductors at any cross section does not exceed 40 percent of the cross-sectional area of that space. ▶ Figure 312-5

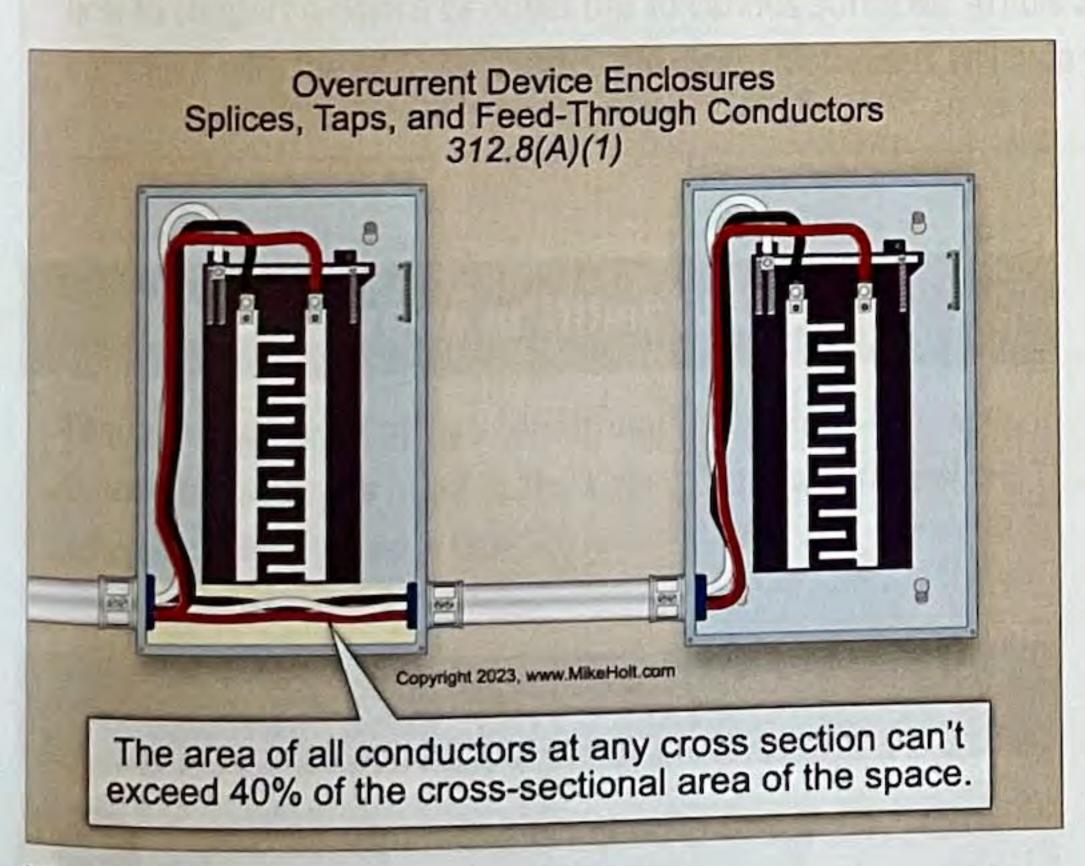
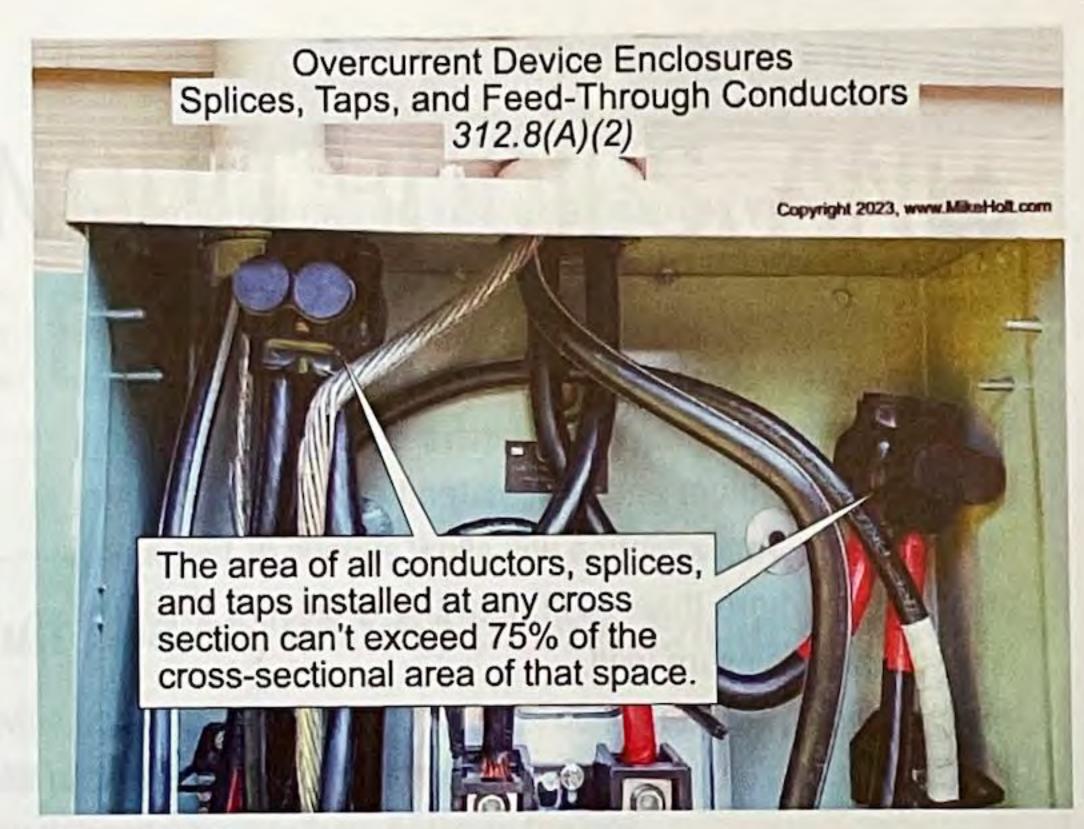


Figure 312-5

(2) The area of all conductors, splices, and taps installed at any cross section does not exceed 75 percent of the cross-sectional area of that space. ▶ Figure 312-6

Author's Comment:

- The 40 and 75 percent requirements apply to all conductors, all splices, and all taps within the cross-sectional area, not just conductors, splice(s), or tap(s) being added.
- (3) The bending space for conductors 4 AWG and larger complies with 314.28(A)(2).



▶ Figure 312-6

(4) Where conductors feed through the cabinet, a permanently affixed warning label sufficiently durable to withstand the environment involved, and complying with 110.21(B), must be applied on the cabinet to identify the location of the disconnect for the feedthrough conductors. Figure 312-7

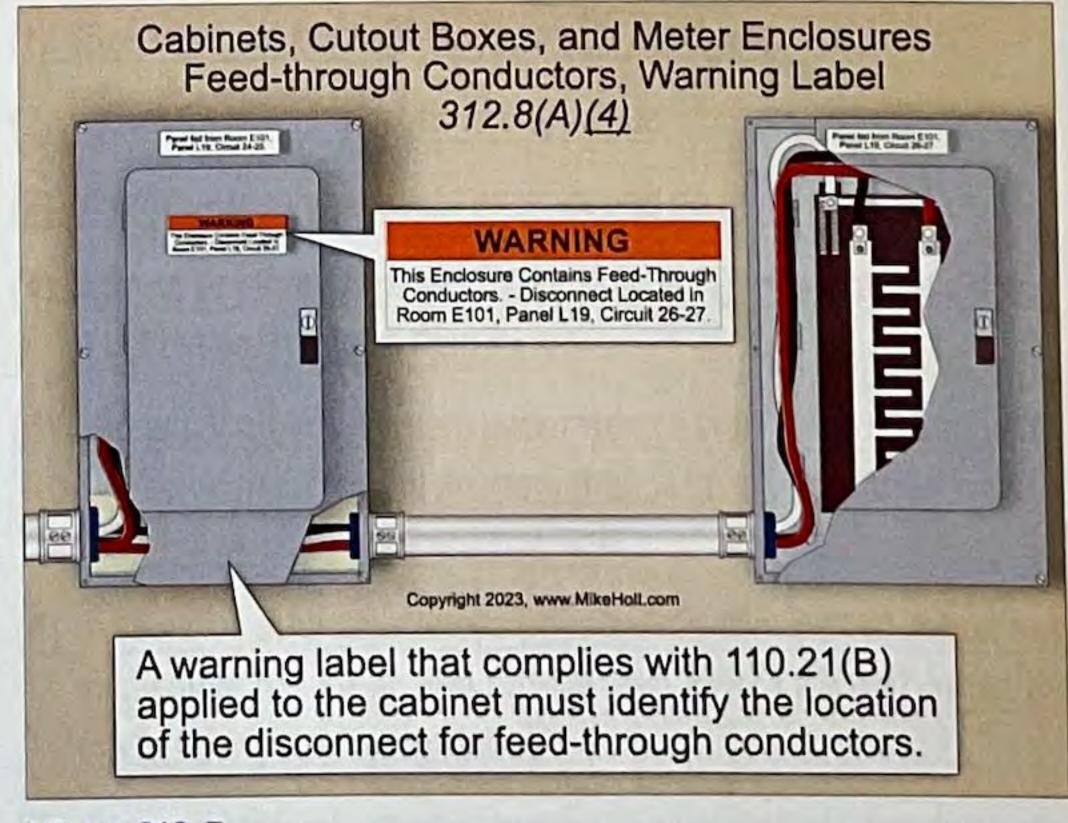


Figure 312-7

312.10 Screws or Other Fasteners

This new section addresses the hazards created by screws or fasteners that enter the wiring spaces of enclosures.

SWITCHES

Introduction to Article 404—Switches

The requirements of Article 404 address switches of all types including snap (toggle) switches, dimmer switches, fan switches, disconnect switches, circuit breakers, and automatic switches such as time clocks and timers.

404.1 Scope

New language tells us that Article 404 does not apply to battery-powered wireless control equipment.

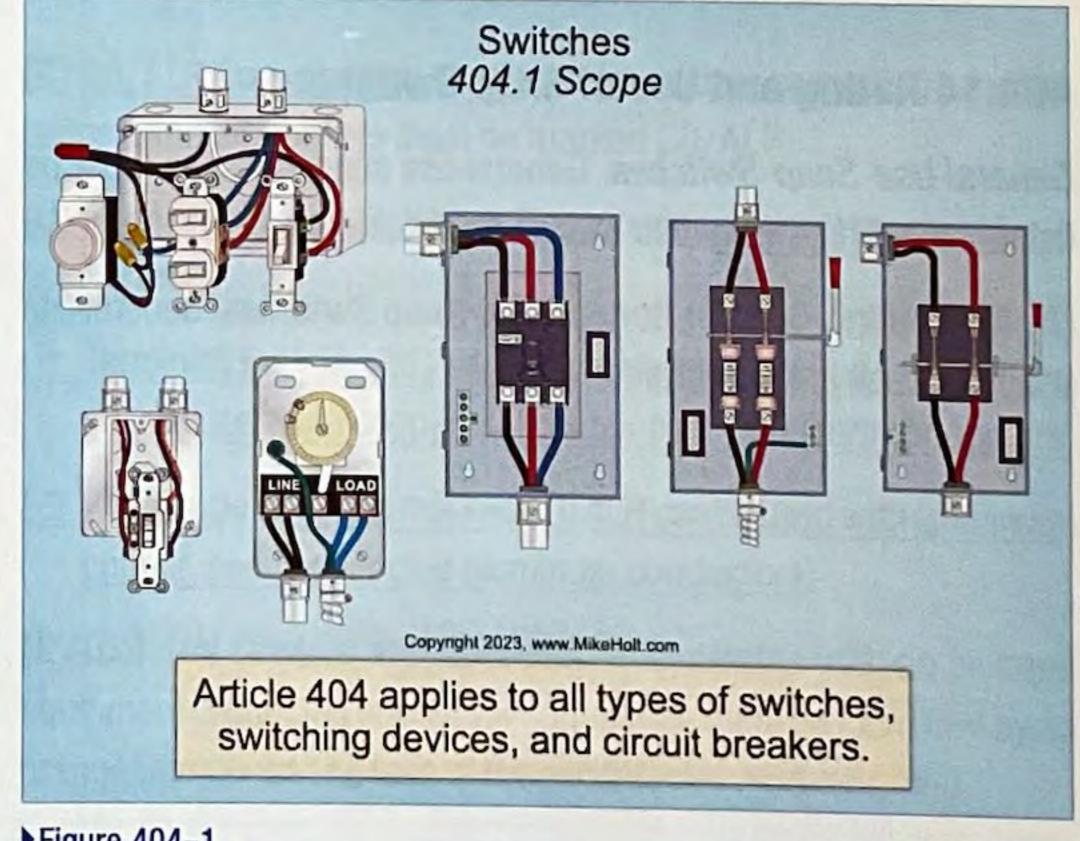
Analysis

CLARIFIED

A new sentence was added clarifying that Article 404 does not apply to wireless control equipment that is not connected to circuit conductors

like a wireless remote control. Now if we can just figure out what a listed wall-mounted control device is we are going to be doing well.

A new Informational Note tells us to see 210.70 for a related requirement where battery-powered control devices are used to control a required lighting outlet.



▶ Figure 404–1

404.1 Scope

The requirements of Article 404 apply to all types of switches, switching devices, and circuit breakers. ▶ Figure 404–1

This article does not cover wireless control equipment to which circuit conductors are not connected.

Note: See 210.70 for additional information related to branch circuits that include switches or listed wall-mounted control devices.

404.14 Rating and Use of Switches

A new subdivision (D) was added addressing push-in terminals, and 15A and 20A snap switches not marked CO/ALR can now be used with copper-clad aluminum.

SWITCHES

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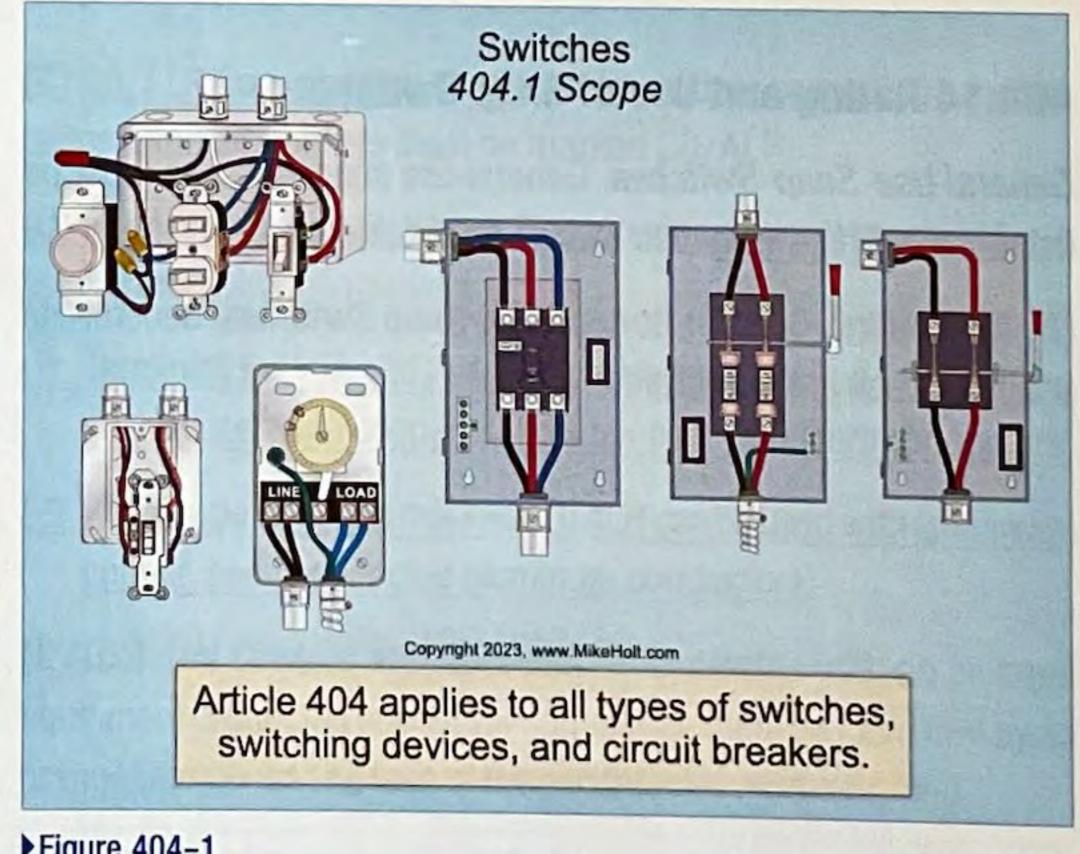
Analysis

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like a wireless remote control. Now if we can just figure out what a listed wall-mounted control device is we are going to be doing well.

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▶ Figure 404–1

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This article does not cover wireless control equipment to which circuit conductors are not connected.

Note: See 210.70 for additional information related to branch circuits that include switches or listed wall-mounted control devices.

404.14 Rating and Use of Switches

A new subdivision (D) was added addressing push-in terminals, and 15A and 20A snap switches not marked CO/ALR can now be used with copper-clad aluminum.

RECEPTACLES, ATTACHMENT PLUGS, AND FLANGED INLETS

Introduction to Article 406—Receptacles, Attachment Plugs, and Flanged Inlets

This article covers the rating, type, and installation of receptacles, attachment plugs, and flanged inlets. There are many types of receptacles such as self-grounding, isolated ground, tamper resistant, weather resistant, GFCls and AFCls, energy controlled, work surface and countertop assemblies, USBs, surge protectors, and so on. Examine the rules carefully and remember an outlet is not a receptacle.

406.3 Receptacle Rating and Type

The title of (C) was changed to clarify that this section covers receptacles marked CO/ALR and a new subdivision (D) is another change related to the use of copper-clad aluminum conductors.

Analysis

CLARIFIED

The title of (C) was changed to clarify that this section covers receptacles marked CO/ALR. This rule only applies to receptacles rated 20A

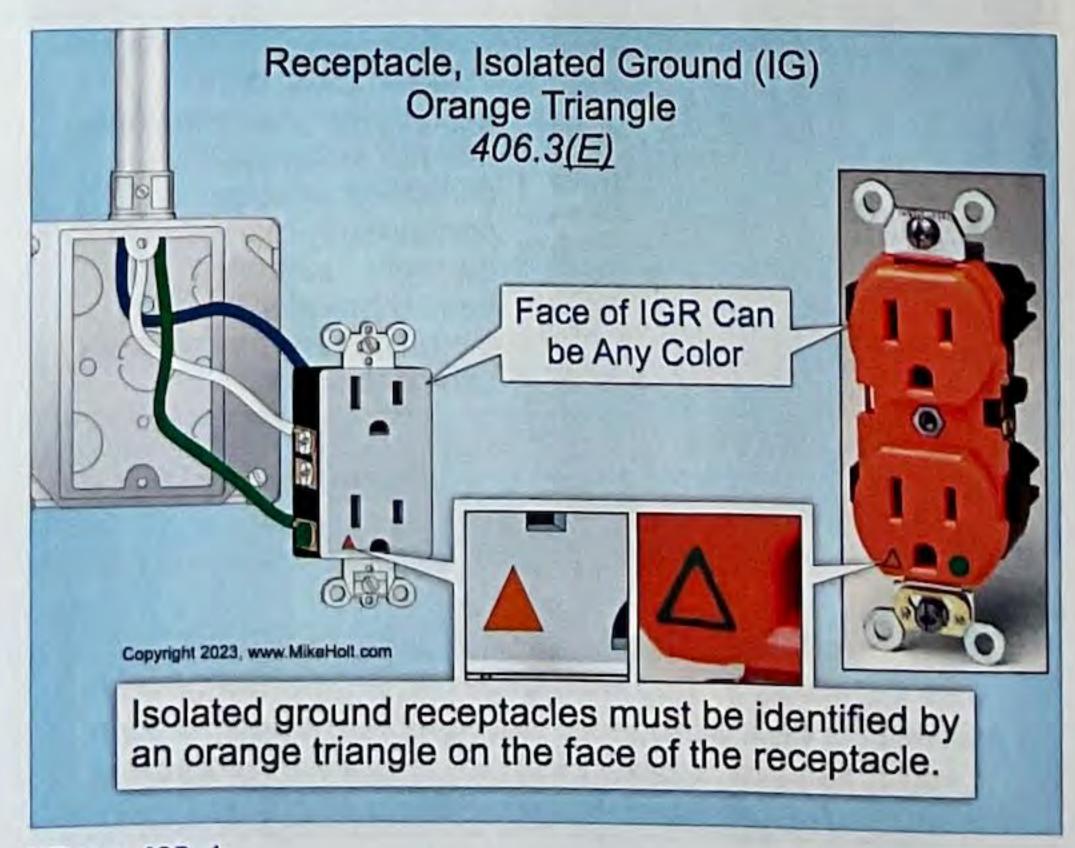
or less.

Subdivision (D) was added to address the use of copper-clad aluminum conductors. Where a 15A or 20A receptacle is not marked CO/ALR, it can only be used with copper or copper-clad aluminum conductors. The CO/ALR making permits the receptacle to be used with aluminum, copper, or copper-clad aluminum conductors. Where the receptacle has push-in terminals, it can only be installed on 14 AWG solid copper conductors.

406.3 Receptacle Rating and Type

(A) Receptacles. Receptacles must be listed and marked with the manufacturer's name or identification and voltage and ampere ratings.

- (C) <u>CO/ALR Receptacles.</u> Aluminum conductors connected to receptacles rated 20A or less must be marked CO/ALR.
- (D) Receptacle Terminations. Receptacle terminations must be in accordance with the following:
- (1) Terminals for 15A and 20A receptacles not marked CO/ALR can only be used with copper and copper-clad aluminum conductors.
- (2) Receptacle terminals marked CO/ALR can be used with aluminum, copper, and copper-clad aluminum conductors.
- (E) Isolated Ground Receptacles. Receptacles with an isolated equipment grounding conductor connection must be identified by an orange triangle on the face of the receptacle. ▶ Figure 406–1



▶Figure 406-1

RECEPTACLES, ATTACHMENT PLUGS, AND FLANGED INLETS

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Analysis

CLARIFIED

The title of (C) was changed to clarify that this section covers receptacles marked CO/ALR. This rule only applies to receptacles rated 20A

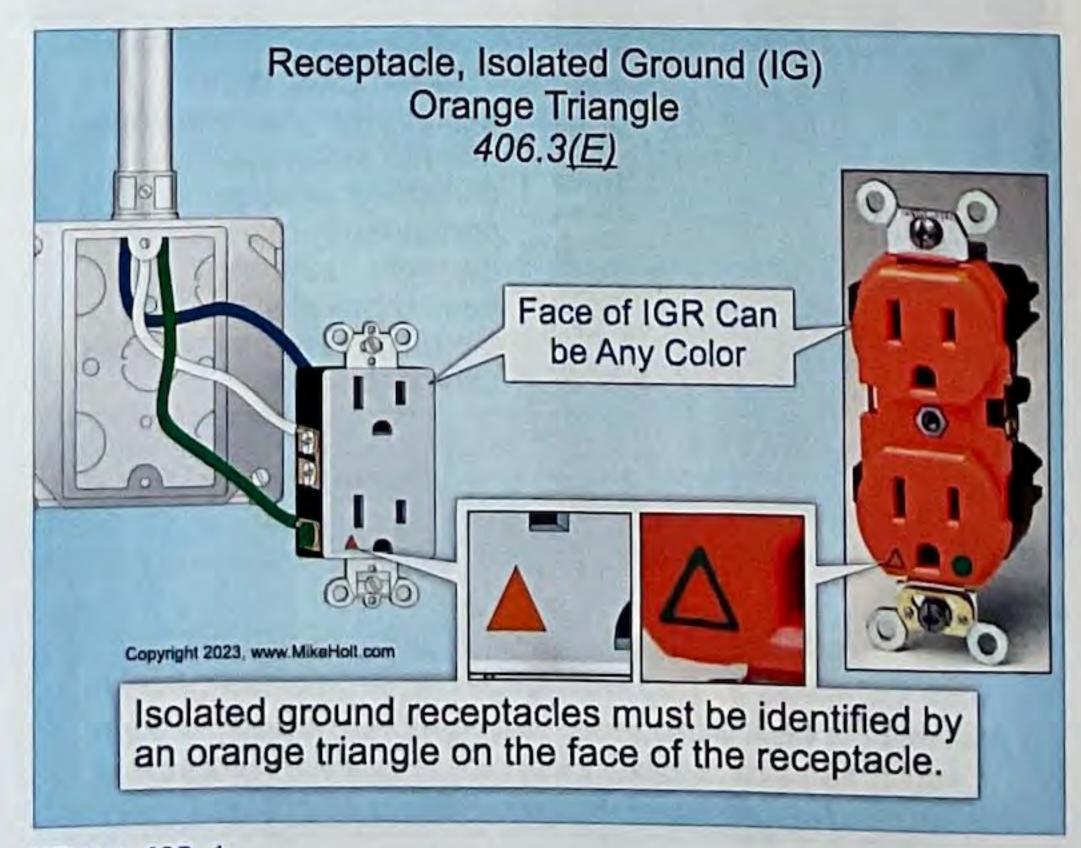
or less.

Subdivision (D) was added to address the use of copper-clad aluminum conductors. Where a 15A or 20A receptacle is not marked CO/ALR, it can only be used with copper or copper-clad aluminum conductors. The CO/ALR making permits the receptacle to be used with aluminum, copper, or copper-clad aluminum conductors. Where the receptacle has push-in terminals, it can only be installed on 14 AWG solid copper conductors.

406.3 Receptacle Rating and Type

(A) Receptacles. Receptacles must be listed and marked with the manufacturer's name or identification and voltage and ampere ratings.

- (C) <u>CO/ALR Receptacles.</u> Aluminum conductors connected to receptacles rated 20A or less must be marked CO/ALR.
- (D) Receptacle Terminations. Receptacle terminations must be in accordance with the following:
- (1) Terminals for 15A and 20A receptacles not marked CO/ALR can only be used with copper and copper-clad aluminum conductors.
- (2) Receptacle terminals marked CO/ALR can be used with aluminum, copper, and copper-clad aluminum conductors.
- (E) Isolated Ground Receptacles. Receptacles with an isolated equipment grounding conductor connection must be identified by an orange triangle on the face of the receptacle. ▶ Figure 406–1



▶Figure 406-1

TRANSFORMERS AND TRANSFORMER VAULTS (INCLUDING SECONDARY TIES)

Introduction to Article 450—Transformers and Transformer Vaults (Including Secondary Ties)

This article covers transformers supplying power and lighting loads. For the purposes of Article 450 only, a transformer is an individual power transformer, single- or poly-phase, identified by a single nameplate—unless otherwise indicated.

A major concern with transformers is preventing overheating. The *Code* does not completely address this issue. Article 90 explains that the *NEC* is not a design manual, and it assumes that anyone using the *Code* has a certain level of expertise. Proper transformer selection is an important part of preventing them from overheating. The *NEC* assumes you have already selected a transformer suitable for the load characteristics. For the *Code* to tell you how to do that would push it into the realm of a design manual. Article 450 then takes you to the next logical step—providing overcurrent protection and the proper connections. But this article does not stop there because 450.9 provides ventilation requirements, and 450.13 contains accessibility requirements.

Part I contains the general requirements such as guarding, marking, and accessibility, Part II contains those for different types of transformers, and Part III covers transformer vaults.

450.1 Scope

The previous exceptions in the text were converted to rules and the references to complete articles were removed to comply with the requirements of the *NEC* Style Manual.

Analysis

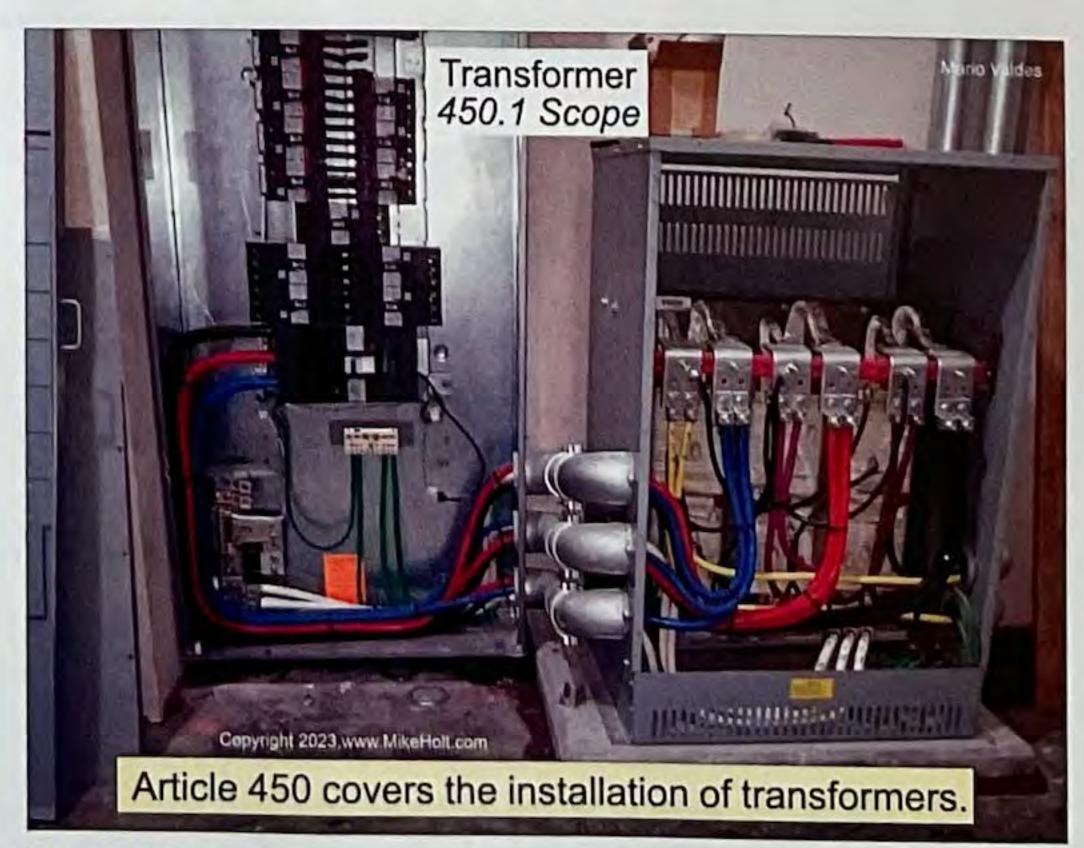
REORGANIZED

Although it looks like a lot happened here it was really a rework of the existing rules. This section previously had an odd start in

that it stated all the things it did not cover as Exceptions. The Exceptions have now been relocated into the scope text as list items (1) through (8). There were no technical changes with this reorganization.

450.1 Scope

Article 450 covers the installation requirements of all transformers other than the following: ▶Figure 450-1



▶ Figure 450-1

TRANSFORMERS AND TRANSFORMER VAULTS (INCLUDING SECONDARY TIES)

Introduction to Article 450—Transformers and Transformer Vaults (Including Secondary Ties)

This article covers transformers supplying power and lighting loads. For the purposes of Article 450 only, a transformer is an individual power transformer, single- or poly-phase, identified by a single nameplate—unless otherwise indicated.

A major concern with transformers is preventing overheating. The *Code* does not completely address this issue. Article 90 explains that the *NEC* is not a design manual, and it assumes that anyone using the *Code* has a certain level of expertise. Proper transformer selection is an important part of preventing them from overheating. The *NEC* assumes you have already selected a transformer suitable for the load characteristics. For the *Code* to tell you how to do that would push it into the realm of a design manual. Article 450 then takes you to the next logical step—providing overcurrent protection and the proper connections. But this article does not stop there because 450.9 provides ventilation requirements, and 450.13 contains accessibility requirements.

Part I contains the general requirements such as guarding, marking, and accessibility, Part II contains those for different types of transformers, and Part III covers transformer vaults.

450.1 Scope

The previous exceptions in the text were converted to rules and the references to complete articles were removed to comply with the requirements of the *NEC* Style Manual.

Analysis

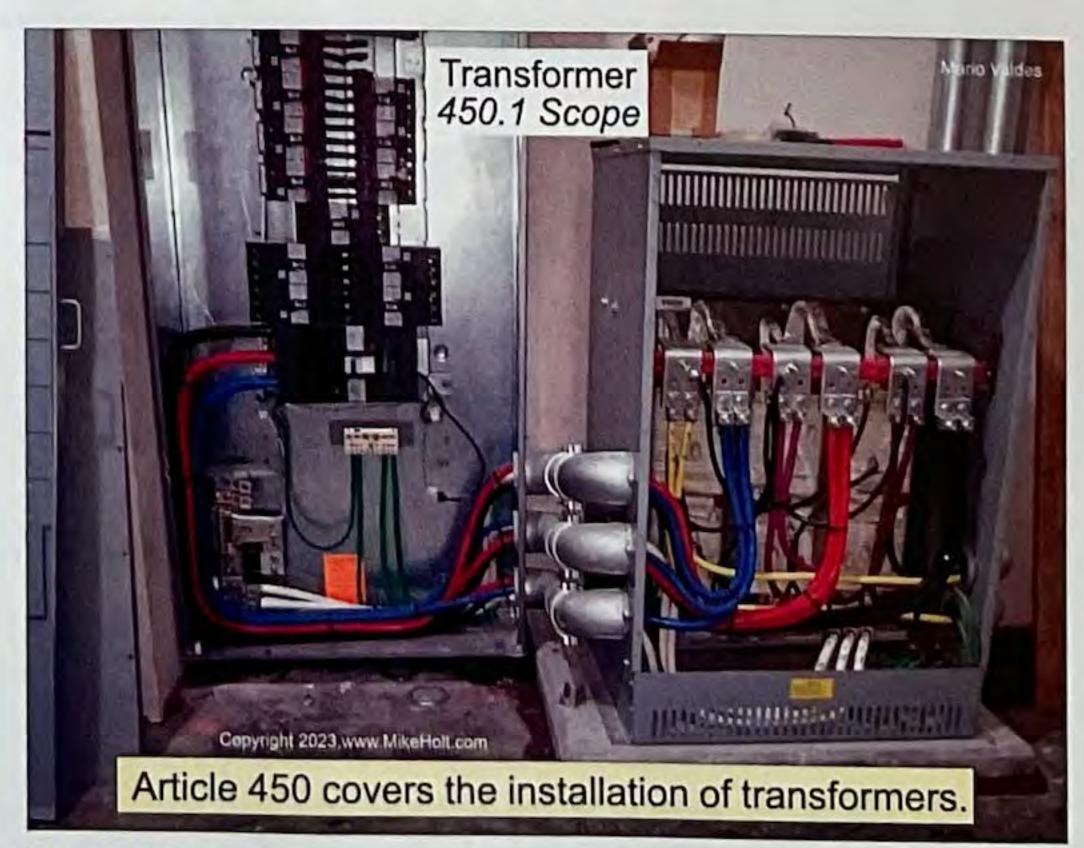
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that it stated all the things it did not cover as Exceptions. The Exceptions have now been relocated into the scope text as list items (1) through (8). There were no technical changes with this reorganization.

450.1 Scope

Article 450 covers the installation requirements of all transformers other than the following: ▶Figure 450-1



▶ Figure 450-1

CLASS II LOCATIONS

Introduction to Article 502—Class II Locations

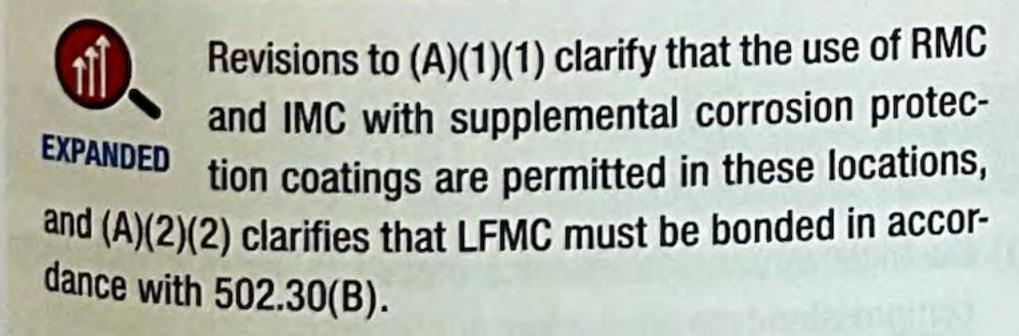
If an area has combustible dust present, it is considered a Class II location. Examples of such locations include flour mills, grain silos, coal bins, wood pulp storage areas, and munitions plants.

Article 502 follows a logical arrangement similar to that of Article 501 and provides guidance in selecting equipment and wiring methods for Class II locations, including distinctions between Class II, Division 1 and Class II, Division 2 requirements.

502.10 Wiring Methods

As we have seen in other areas of Chapter 5, revisions were made to allow the use of coated RMC and IMC. The bonding requirements for LFMC were clarified as well.

Analysis



New parent text was added to (B) to clarify that the wiring methods for Class II, Division 2 locations must be in accordance with 502.10(B)(1) through (4).

The rules in (B)(1)(2) now clarify that RMC and IMC with supplemental corrosion protection coatings (PCV coated conduit) are permitted, and (B)(1)(3) clarifies that the use of listed compression-type connectors and couplings are required for EMT in Class II, Division 2 locations.



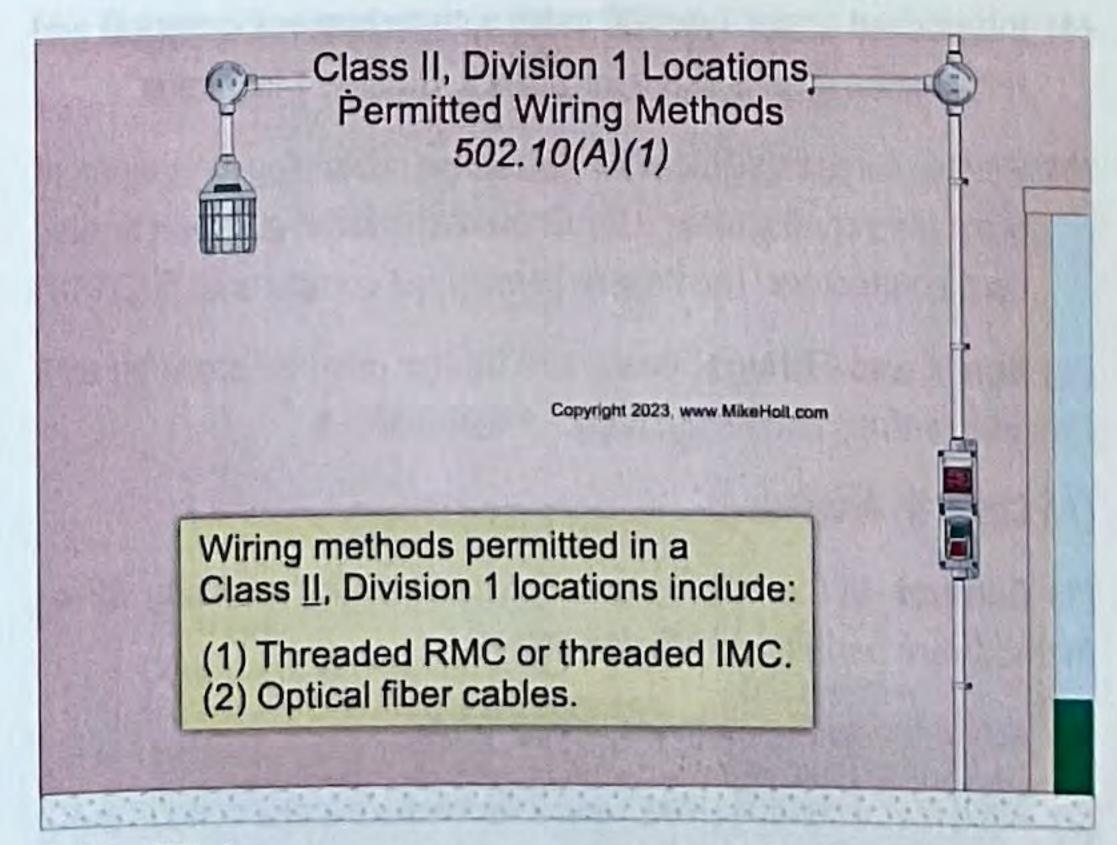
EXPANDED

The rule in (B)(1)(7) now clearly permits the use of other raceways like Schedule 80 PVC and RTRC in restricted industrial establishments.

502.10 Wiring Methods

(A) Class II, Division 1.

(1) General. The following wiring methods can be installed in a Class II, Division 1 location: ▶ Figure 502-1



▶ Figure 502-1

CLASS II LOCATIONS

Introduction to Article 502—Class II Locations

If an area has combustible dust present, it is considered a Class II location. Examples of such locations include flour mills, grain silos, coal bins, wood pulp storage areas, and munitions plants.

Article 502 follows a logical arrangement similar to that of Article 501 and provides guidance in selecting equipment and wiring methods for Class II locations, including distinctions between Class II, Division 1 and Class II, Division 2 requirements.

502.10 Wiring Methods

As we have seen in other areas of Chapter 5, revisions were made to allow the use of coated RMC and IMC. The bonding requirements for LFMC were clarified as well.

Analysis

Revisions to (A)(1)(1) clarify that the use of RMC and IMC with supplemental corrosion protection coatings are permitted in these locations, and (A)(2)(2) clarifies that LFMC must be bonded in accordance with 502.30(B).

New parent text was added to (B) to clarify that the wiring methods for Class II, Division 2 locations must be in accordance with 502.10(B)(1) through (4).

The rules in (B)(1)(2) now clarify that RMC and IMC with supplemental corrosion protection coatings (PCV coated conduit) are permitted, and (B)(1)(3) clarifies that the use of listed compression-type connectors and couplings are required for EMT in Class II, Division 2 locations.



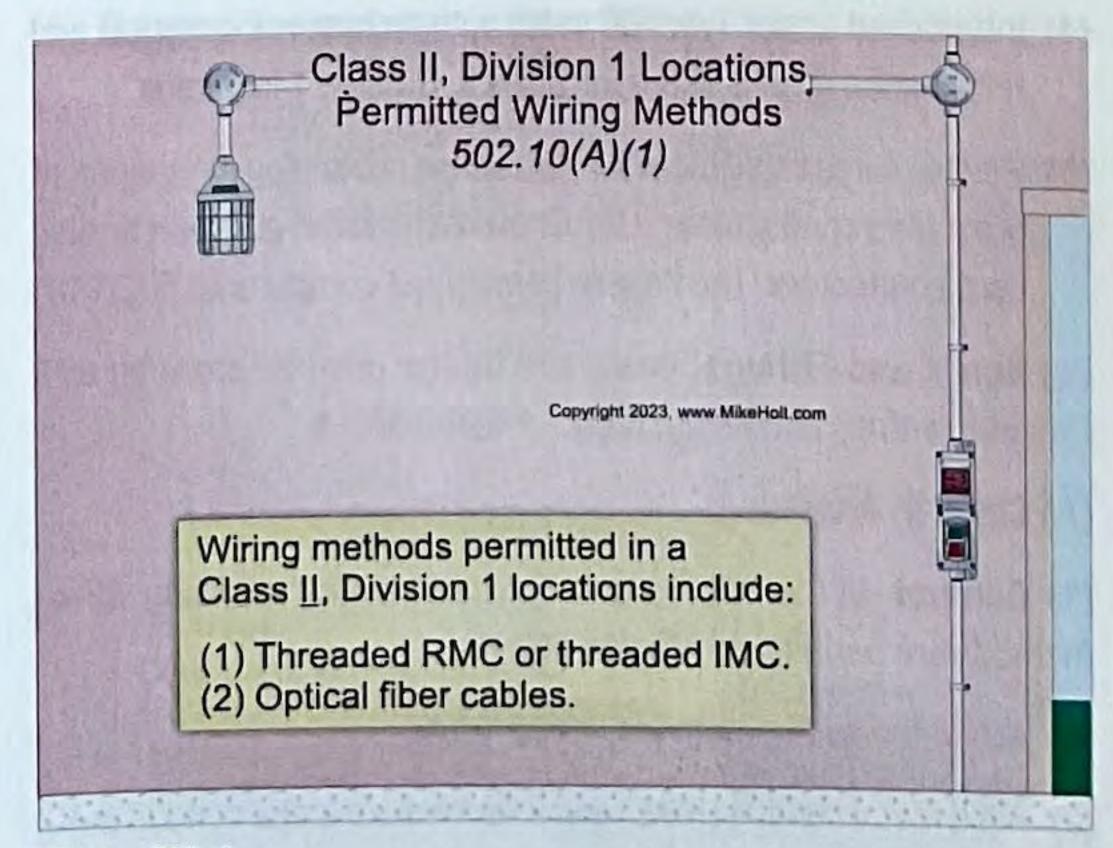
EXPANDED

The rule in (B)(1)(7) now clearly permits the use of other raceways like Schedule 80 PVC and RTRC in restricted industrial establishments.

502.10 Wiring Methods

(A) Class II, Division 1.

(1) General. The following wiring methods can be installed in a Class II, Division 1 location: ▶ Figure 502-1



▶ Figure 502-1



<u>Clothes</u> <u>Closet Storage Space</u>. The definition that was in Article 410 included many measurements which were requirements. The *NEC* Style

Manual does not permit definitions to contain requirements. Those requirements are now found in 410.16(A).

<u>Clothes</u> <u>Closet Storage Space</u>. The area within a clothes closet in which combustible materials can be kept (Article 410).

Analysis



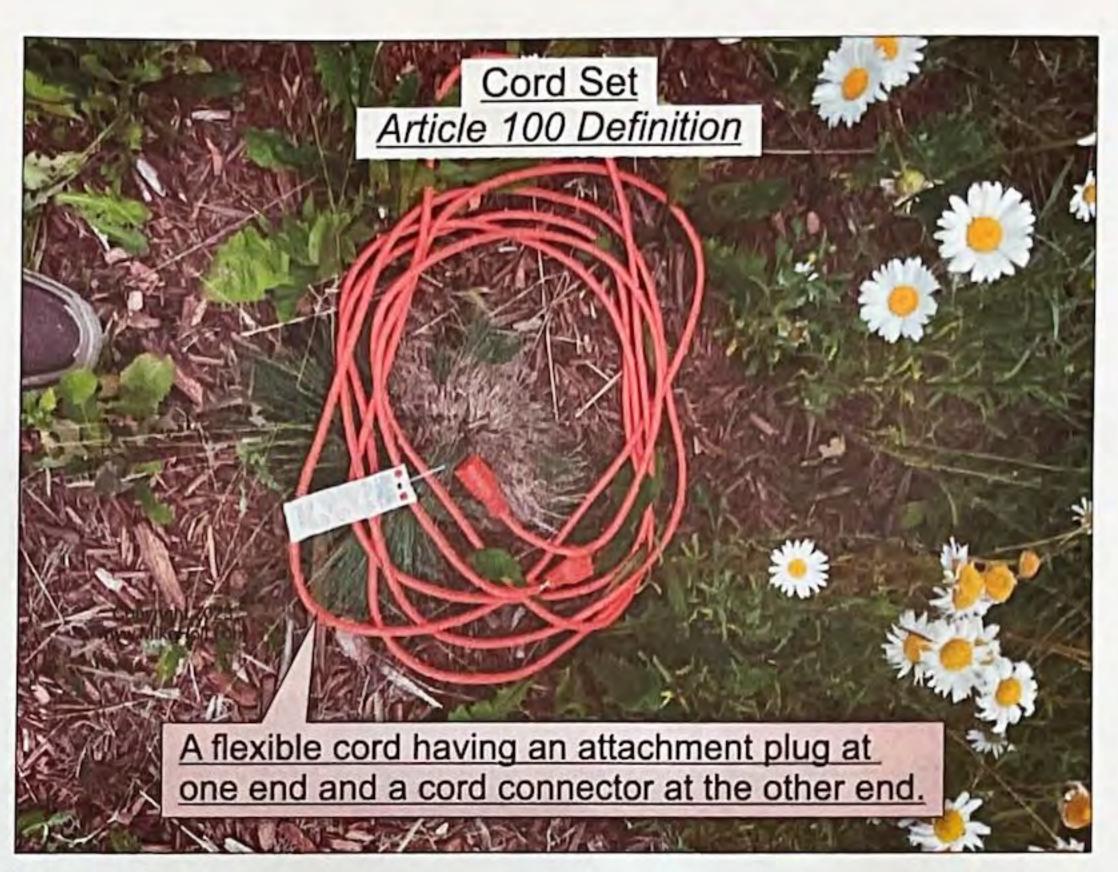
<u>Commissioning.</u> This is a new definition in the *NEC* but not a new on in the industry. It was added to support various rules in Chapter 7.

Commissioning. The process, procedures, and testing used to set up and verify the initial performance, operational controls, safety systems, and sequence of operation of electrical devices and equipment prior to them being placed into active service.

Author's Comment:

This term is used in Emergency Power Systems 700.3, Legally Required Standby Power Systems 701.3, Energy Storage Systems 706.7(A), and Critical Operations Power Systems 708.8.

Cord Set. A length of flexible cord having an attachment plug at one end and a cord connector at the other end. Figure 100-4

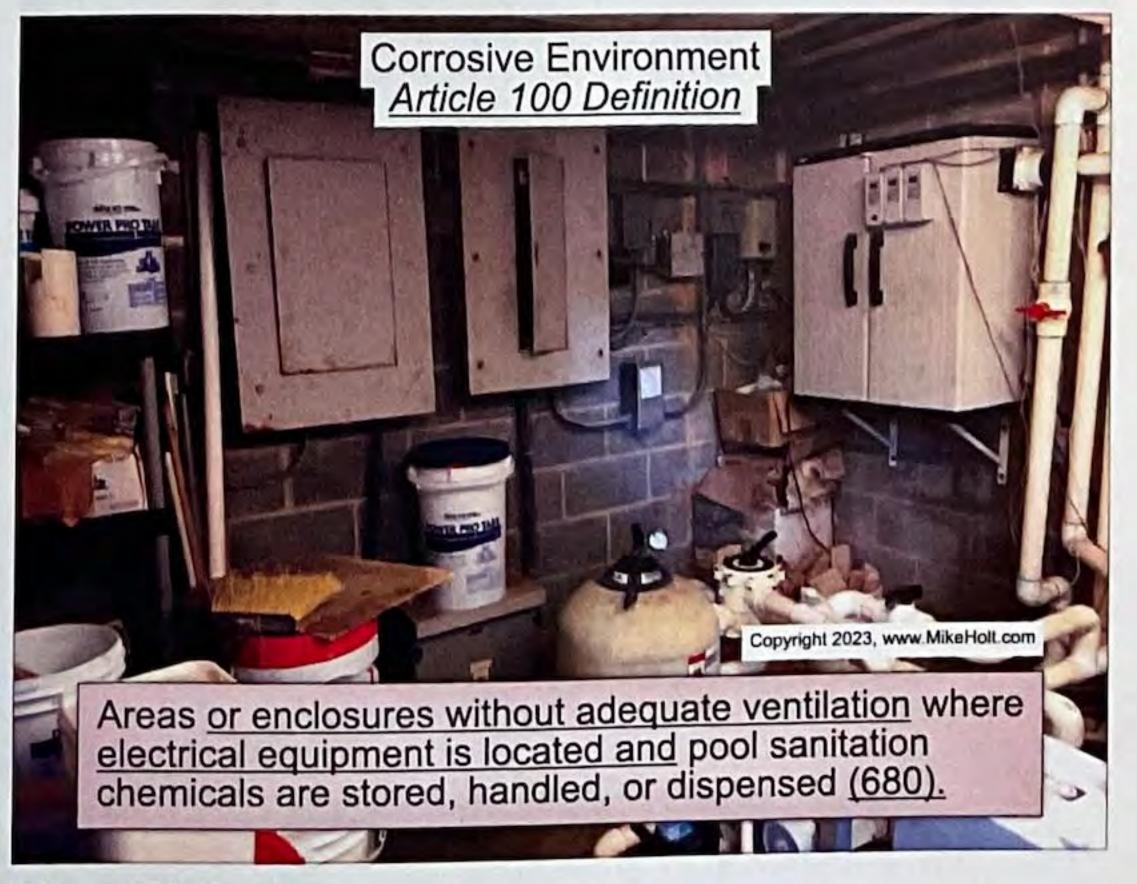


▶ Figure 100-4

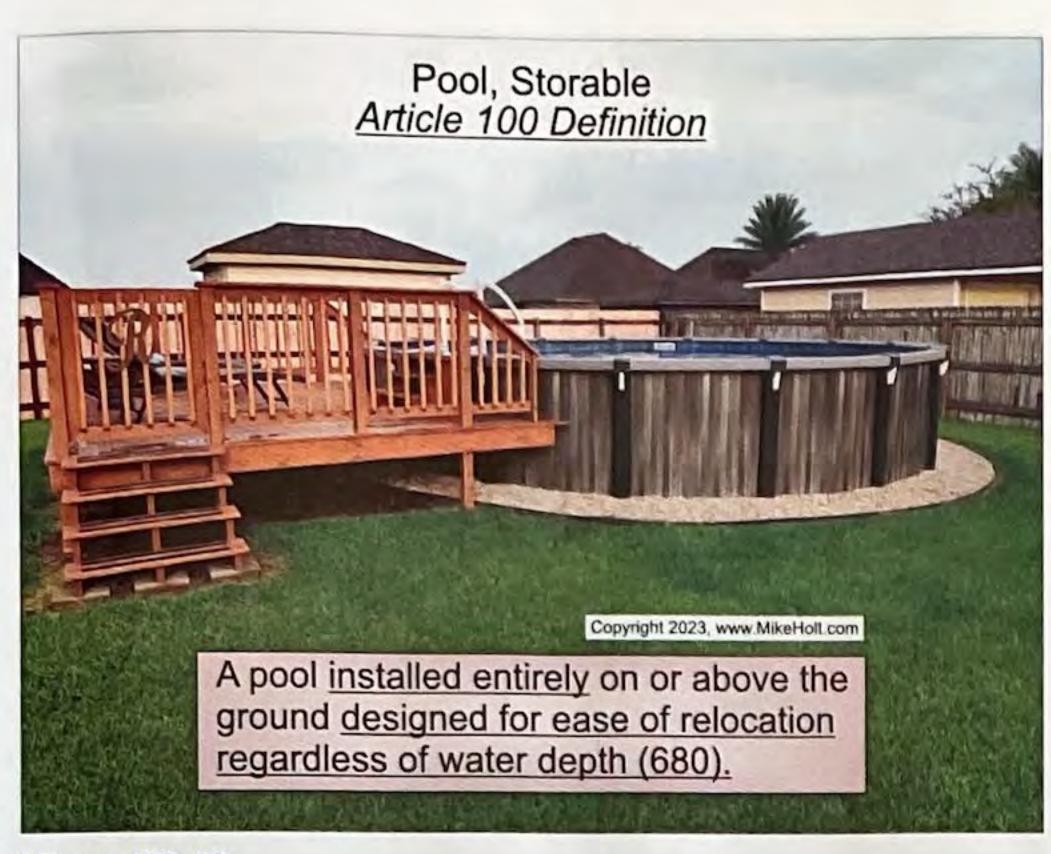
Analysis

Corrosive Environment. This is an example of a term that appears in one form or another in many Code articles, but this definition is specific to Article 680. This definition makes it possible to correctly enforce the requirements for corrosive environments in Article 680 instead of using a vague dictionary definition.

Corrosive Environment. Areas or enclosures without adequate ventilation where electrical equipment is located and pool sanitation chemicals are stored, handled, or dispensed (Article 680). ▶ Figure 100–5



▶ Figure 100-5



▶ Figure 100–19

NEW

Power-Supply Cord. This term has been misused over the years. Adding it to Article 100 makes it easier to understand the requirements that apply to these cords.

Power-Supply Cord. An assembly consisting of an attachment plug and a length of flexible cord connected to utilization equipment.

Author's Comment:

Article 400 contains information on the use of Power-Supply Cords.

Analysis

Primary Source. While there wasn't a great deal of confusion in the energy sector on this term, there was some misunderstanding that this defi-NEW nition will clear up. This is especially true for those new to Chapter 6 and Chapter 7 installations.

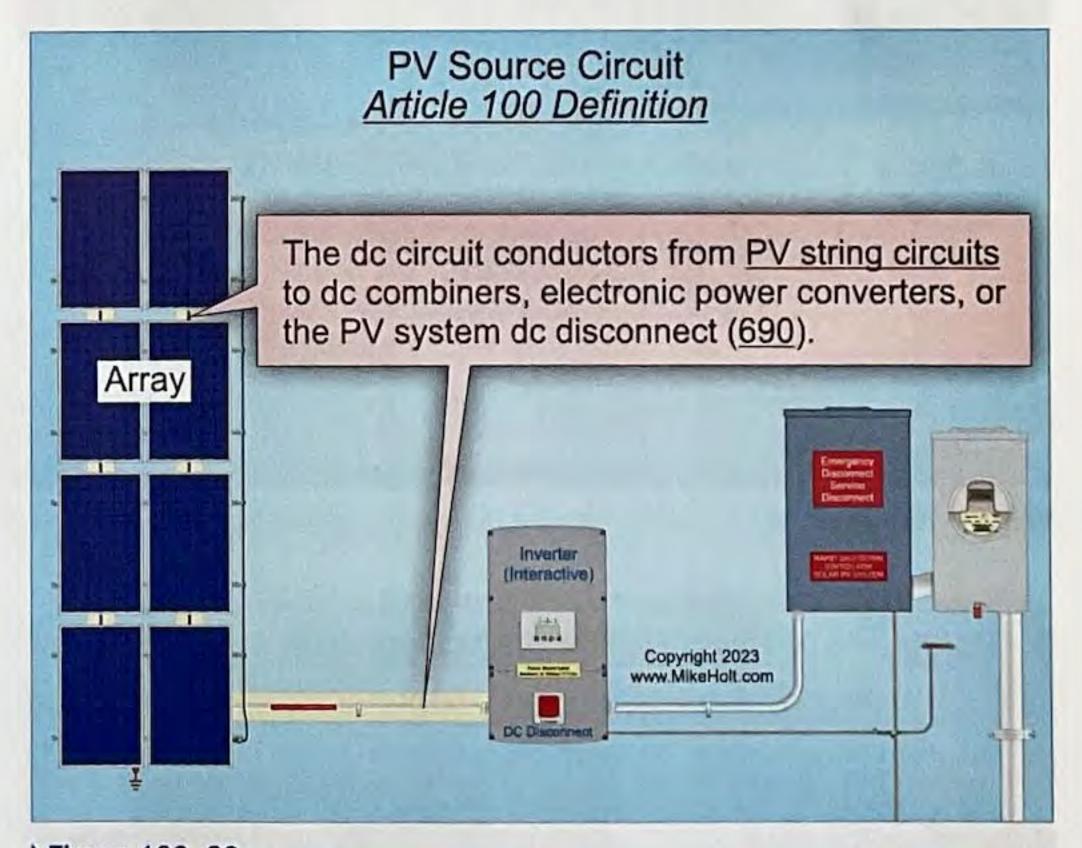
Primary Source. An electric utility or another source of power that acts as the main forming and stabilizing source in an electric power system.

Analysis



PV DC Circuit, Source. (PV Source Circuit). This term is one of many that are now in Article 100 to clarify the application of the rules contained in Article 690.

PV DC Circuit, Source. (PV Source Circuit). The PV source dc circuit consists of the dc circuit conductors between modules in a PV string and from PV string circuits to dc combiners, electronic power converters, or the PV system dc disconnect (Article 690). ▶ Figure 100-20



▶ Figure 100–20

PV DC Circuit, String. (PV String Circuit). The PV source circuit conductors of one or more series-connected PV modules. (Article 690)

Sealed [as applied to hazardous (classified) locations]. Constructed such that equipment is sealed effectively against entry of an external atmosphere and is not opened during normal operation or for any maintenance activities.

Author's Comment:

Articles 501, 502, 503 contains information on the use of the term Sealed as it relates to hazardous (classified) locations.

EDITED

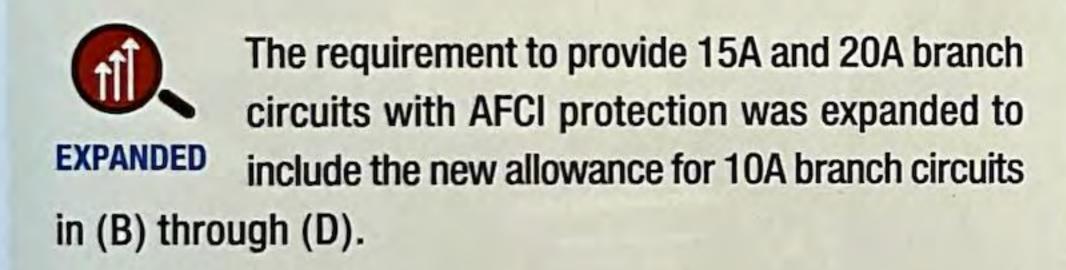
The global changes made in this section are not technical in nature but were a massive improvement from a usability standpoint. One change that stands out is changing the phrase "arc-fault circuit inter-

rupter" to "AFCI" throughout the section.



The rules for dwelling unit AFCIs were moved to subdivision (B), dormitory units were moved to (C), and the coverage requirements

were converted into simple numbered lists. Rules about AFCI protection for branch-circuit extensions or modifications were moved to (E), and all the associated references within 210.12 were updated to match.



Subdivision (C) became (D) and was retitled as Other Occupancies. The requirements were reor-NEW ganized into a list format which includes a list item 3 to clear up any confusion about AFCI protection requirements for branch circuits in the sleeping rooms of fire houses, rescue squads, police departments, and similar locations.

210.12 Arc-Fault Circuit-Interrupter Protection

Arc-fault circuit-interrupter protection (AFCI), in a readily accessible location, is required in accordance with 210.12(B) through (C).

Author's Comment:

According to Article 100, an "Arc-Fault Circuit Interrupter (AFCI)" is a device intended to de-energize the circuit when it detects the current waveform characteristics unique to an arcing fault. ▶Figure 210-47

(B) Dwelling Units. AFCI protection is required for 15A or 20A, 120V branch circuits supplying outlets or devices in the following dwelling unit locations: ▶Figure 210-48

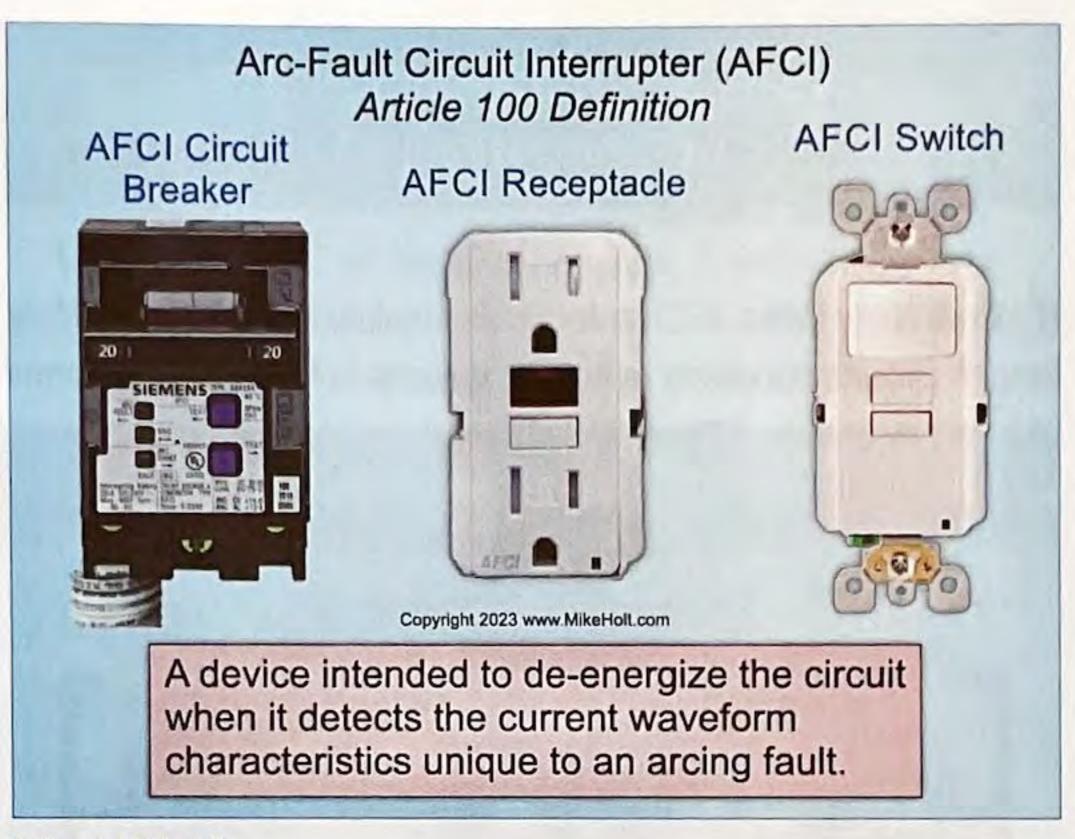


Figure 210-47

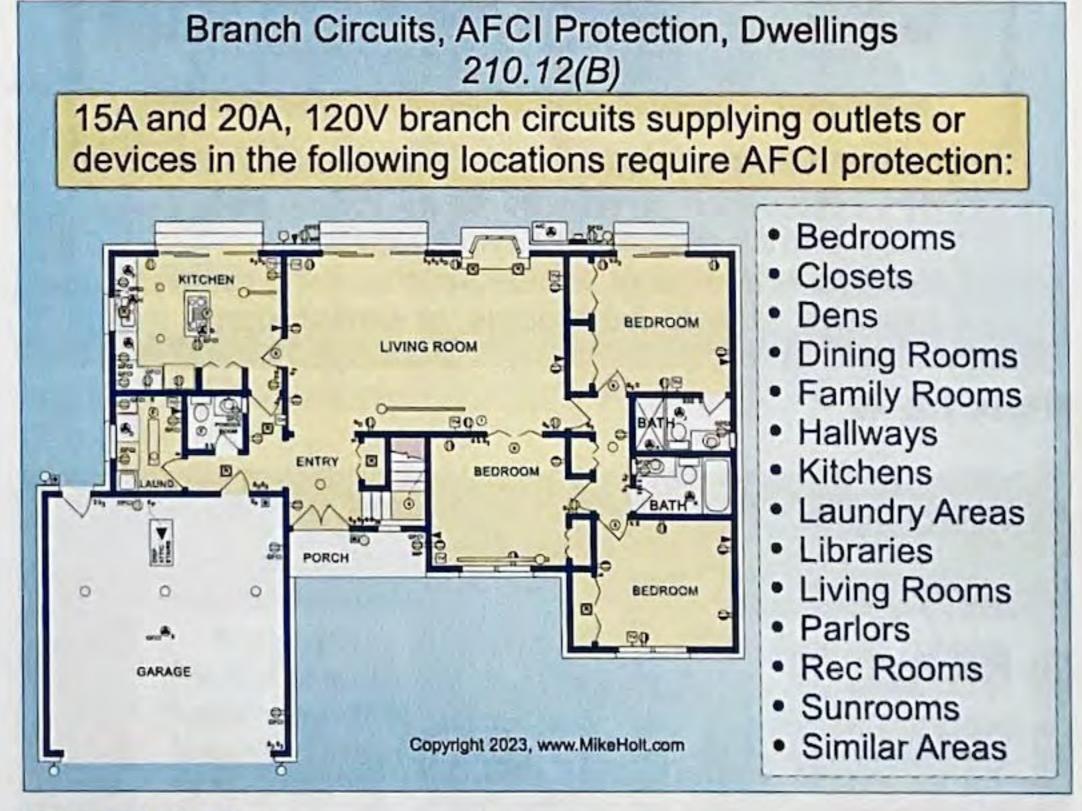
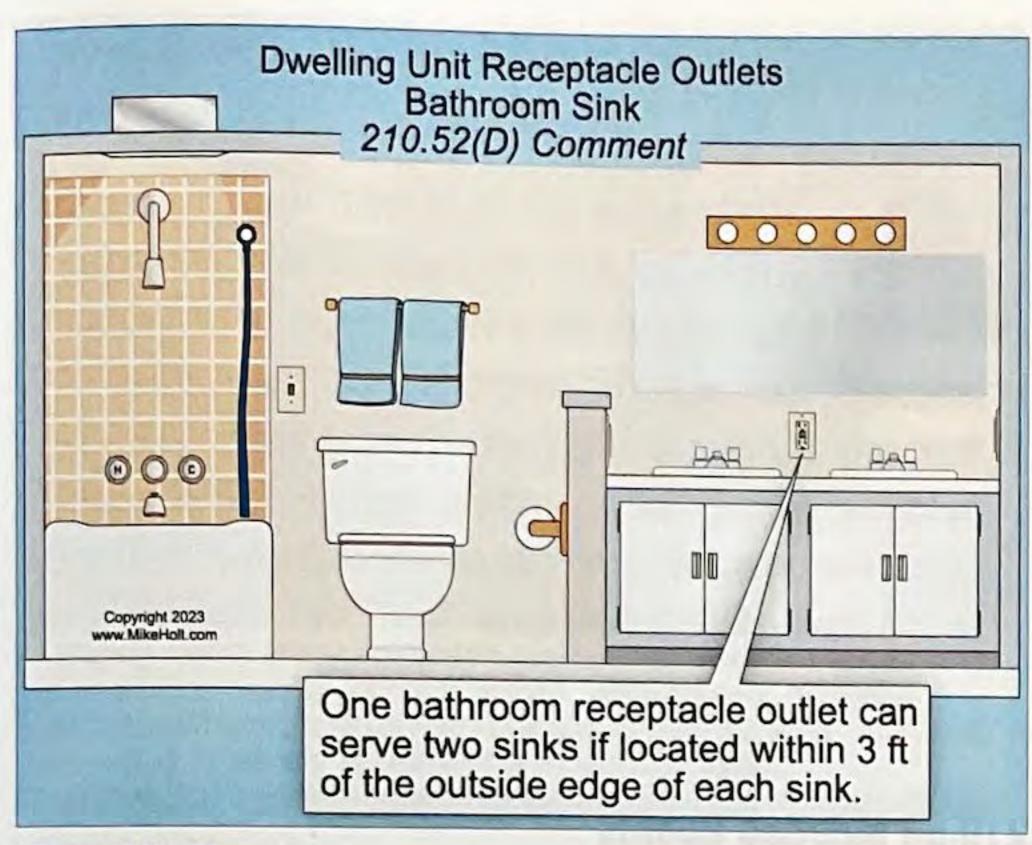


Figure 210-48

- (1) Kitchens
- (2) Family rooms
- Dining rooms
- Living rooms
- Parlors
- (6) Libraries
- (7) Dens
- (8) Bedrooms
- (9) Sunrooms
- (10) Recreation rooms
- (11) Closets
- (12) Hallways
- (13) Laundry areas
- Similar areas



▶ Figure 210-71

- (G) Garage, Basement, and Accessory Building Receptacle Outlet(s). For one- and two-family dwellings, and multifamily dwellings, at least one receptacle outlet must be installed in accordance with (1) through (3). Receptacles supplying only a permanently installed premises security system are not considered as meeting these requirements.
- (1) Garages. A receptacle outlet is required in each vehicle bay of a garage with electric power and must be installed no higher than 5 ft 6 in. above the floor. ▶ Figure 210–72

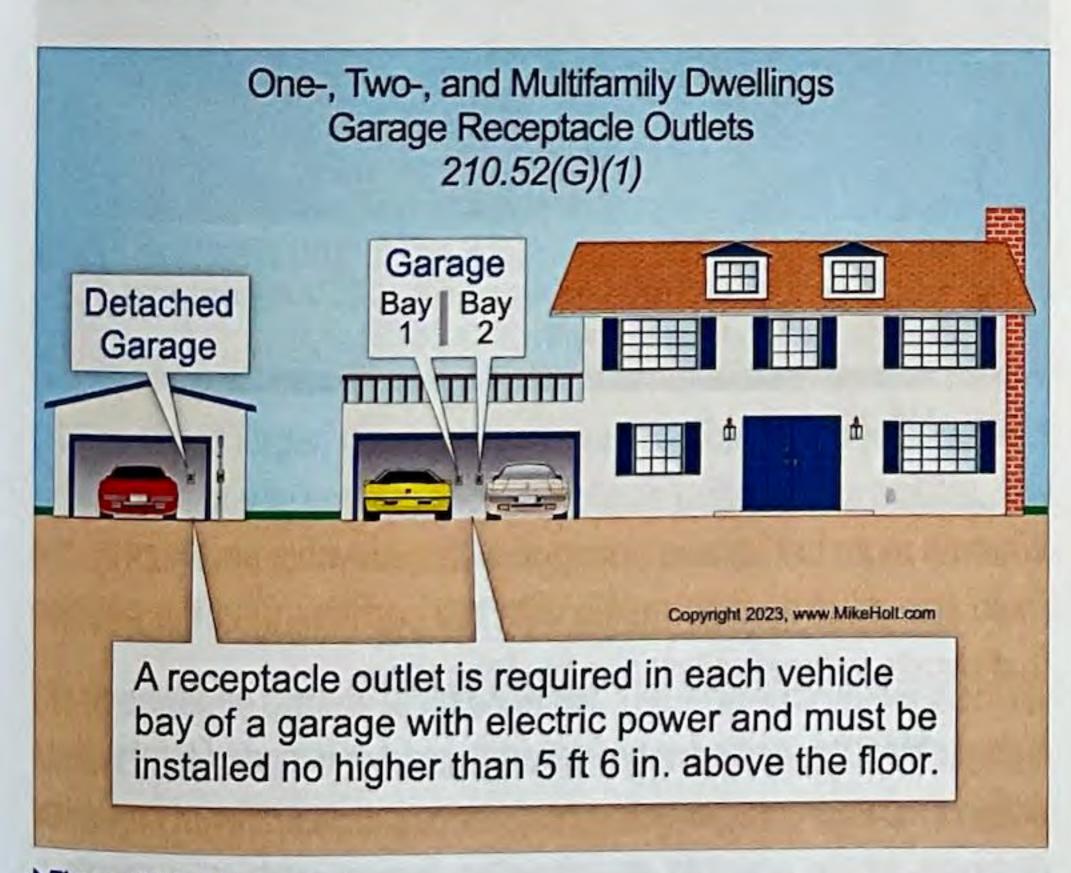
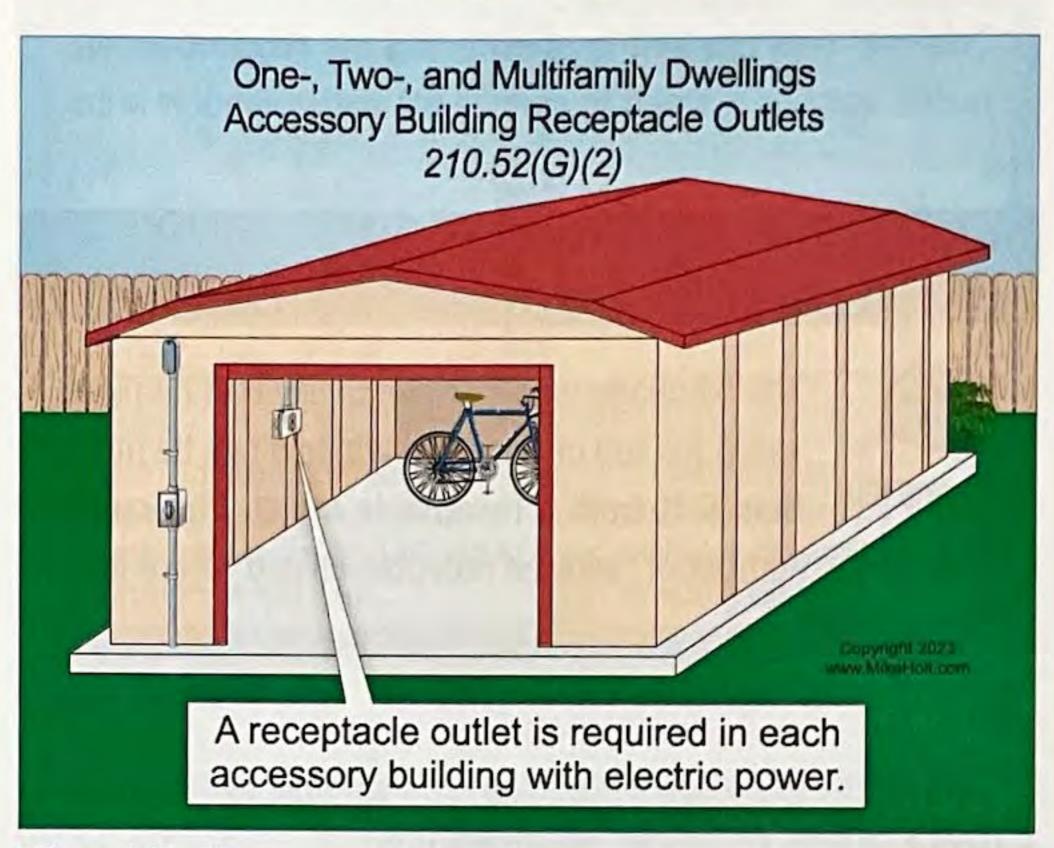


Figure 210-72

Ex: A receptacle outlet is not required in a garage space not attached to an individual dwelling unit of a multifamily dwelling.

(2) Accessory Building Receptacle Outlets. A receptacle outlet is required in each accessory building with electric power. Figure 210-73



▶ Figure 210–73

(3) Basements. Each unfinished portion of a basement must have a receptacle outlet. ▶ Figure 210-74



Figure 210-74

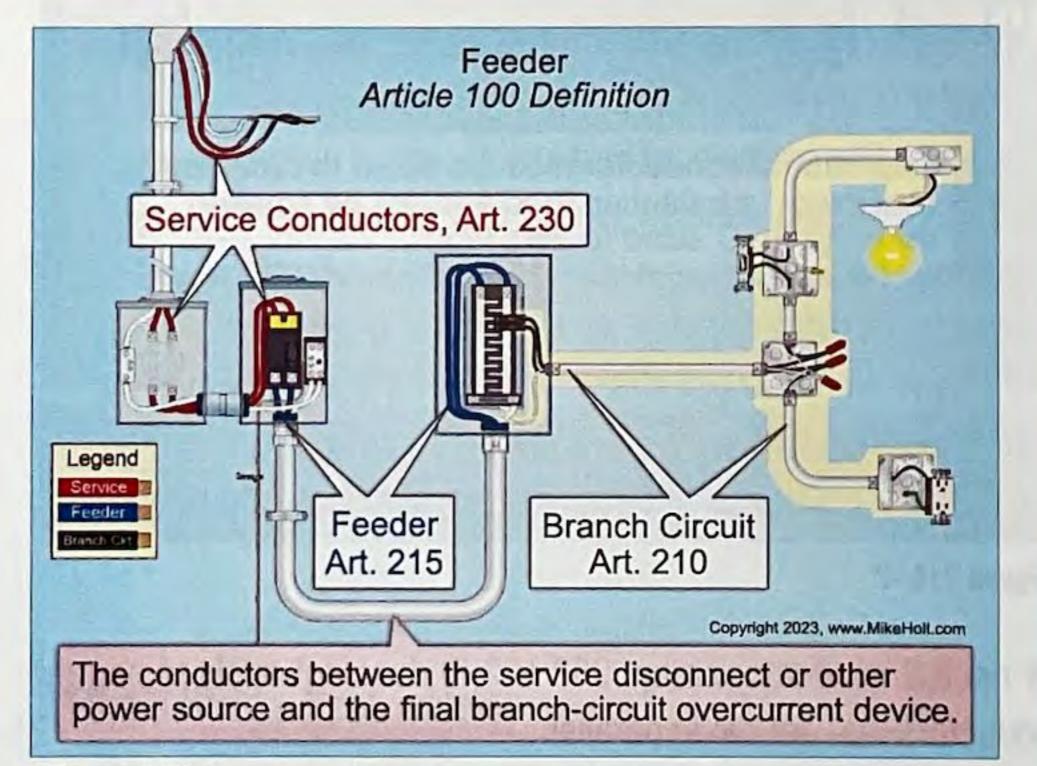
FEEDERS

Introduction to Article 215—Feeders

Article 215 covers the rules for the installation, protection, and ampacity of feeders. It is important to understand the distinct differences between these circuits to correctly apply the Code requirements.

Feeders are the conductors between the service disconnect, the separately derived system, or other supply source, and the final branch-circuit overcurrent protective device. Conductors past the final overcurrent protective device protecting the circuit and the outlet are branch-circuit conductors and fall within the scope of Article 210 [Article 100 Definitions]. ▶ Figure 215–1

It is easy to be confused between feeder, branch-circuit, and service conductors so it is important to evaluate each installation carefully using the Article 100 definitions to be sure the correct NEC rules are followed.



▶ Figure 215-1

215.2 Conductor Sizing

This section was reorganized for readability without technical changes. Changes to (B) clarify that the feeder grounded conductor cannot be smaller than the EGC.

Analysis



The information that was in (1)(a) and (1)(b) became list items (1) and (2) without change. Section 215.2(A)(2), grounded conductors,

became 215.52(B). Section 215.52(A)(3) is now (C) and the former (B) was deleted as that is now covered in Part III of Article 235.



CLARIFIED

The requirements for the feeder grounded conductor in 215.2(A)(2) now clearly state that it cannot be smaller than the equipment grounding conductor size required by 250.122. The rule previously referenced 250.122 but did not specify "the equipment grounding conductor size."



This section has been reorganized with 215.2(A)(2) and (A)(3) becoming 215.2(B) and 215.2(C). There were no technical

changes with the reorganization but the rules for feeders over 1000V were moved to Article 235.

BRANCH-CIRCUIT, FEEDER, AND SERVICE LOAD CALCULATIONS

Introduction to Article 220—Branch-Circuit, Feeder, and Service Load Calculations

This article focuses on the requirements for calculating demand loads (including demand factors) to size branch circuits [210.19(A)], feeders [215.2(A)(1)], and service conductors [230.42(A)].

Part I describes the layout of Article 220 and provides a table showing where other types of load calculations can be found in the *NEC*. Part II provides requirements for branch-circuit calculations and for specific types of branch circuits. Part III covers the requirements for feeder and service calculations using what is commonly called the "Standard Method of Calculation." Part IV provides optional calculations that can be used in place of the standard calculations [Parts II and III]. "Farm Load Calculations" are discussed in Part V of this article.

In some cases, the *Code* provides an optional method [Part IV] for feeder and service calculations in addition to the standard method [Part III], however they do not yield identical results. In fact, the optional method of calculation will often result in a smaller feeder or service. The neutral conductor must be calculated using the standard method [220.61]. As you work through Article 220, be sure to study the illustrations to help you fully understand this article's requirements. Also, be sure to review the examples in Annex D of the *NEC* to gain more practice with these calculations. The *Code* recognizes that not all demand for power will occur at the same time and it is because of this load diversity that certain demand factors are able to be applied.

220.1 Scope

The scope was edited to reflect the addition of Parts VI and VII.

Analysis



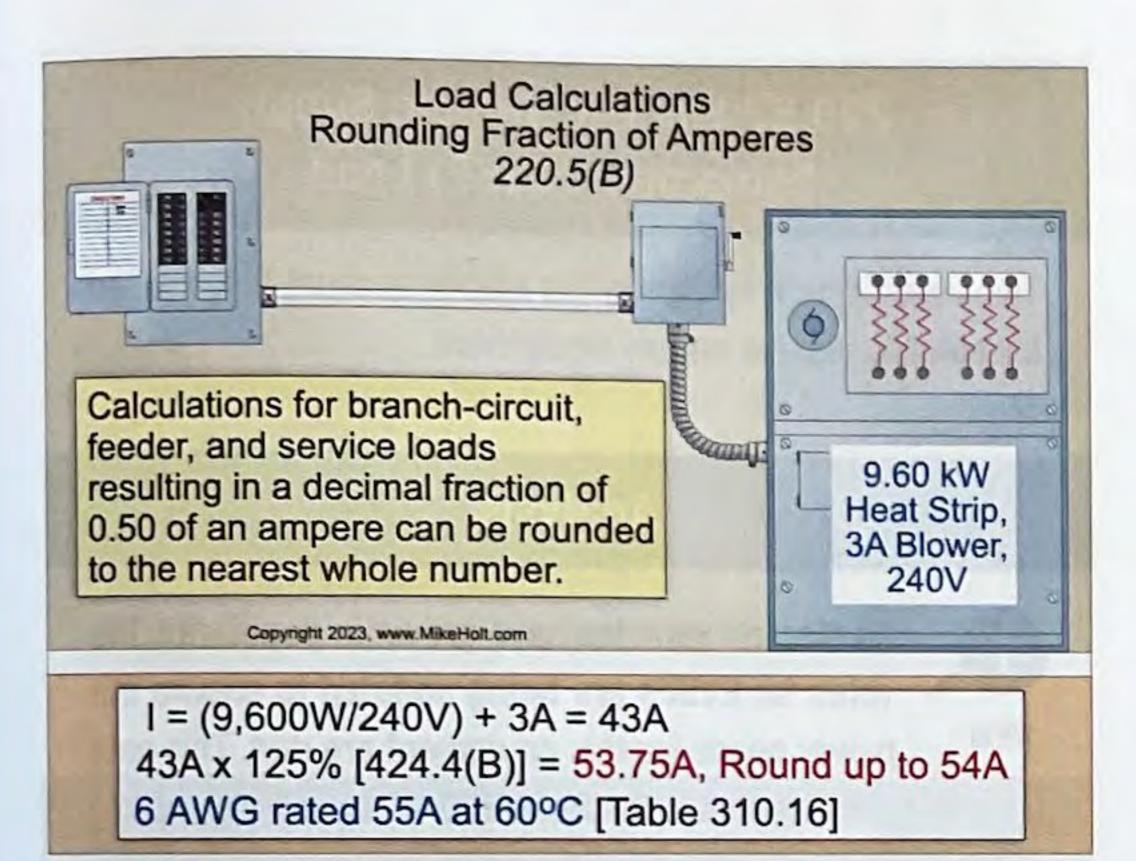
Part VI for health care facilities and Part VII for marinas were added to the article, and the scope was revised to include those new Parts.

220.1 Scope

This article contains the requirements necessary for calculating demand loads for branch circuits, feeders, and services. Figure 220-1

Branch-Circuit, Feeder, and Service Load Calculations 220.1 Scope Article 220 contains the requirements necessary for calculating demand loads for branch circuits, feeders, and services. Copyright 2023 www. MikerHoll.com

▶ Figure 220–1



▶ Figure 220-4

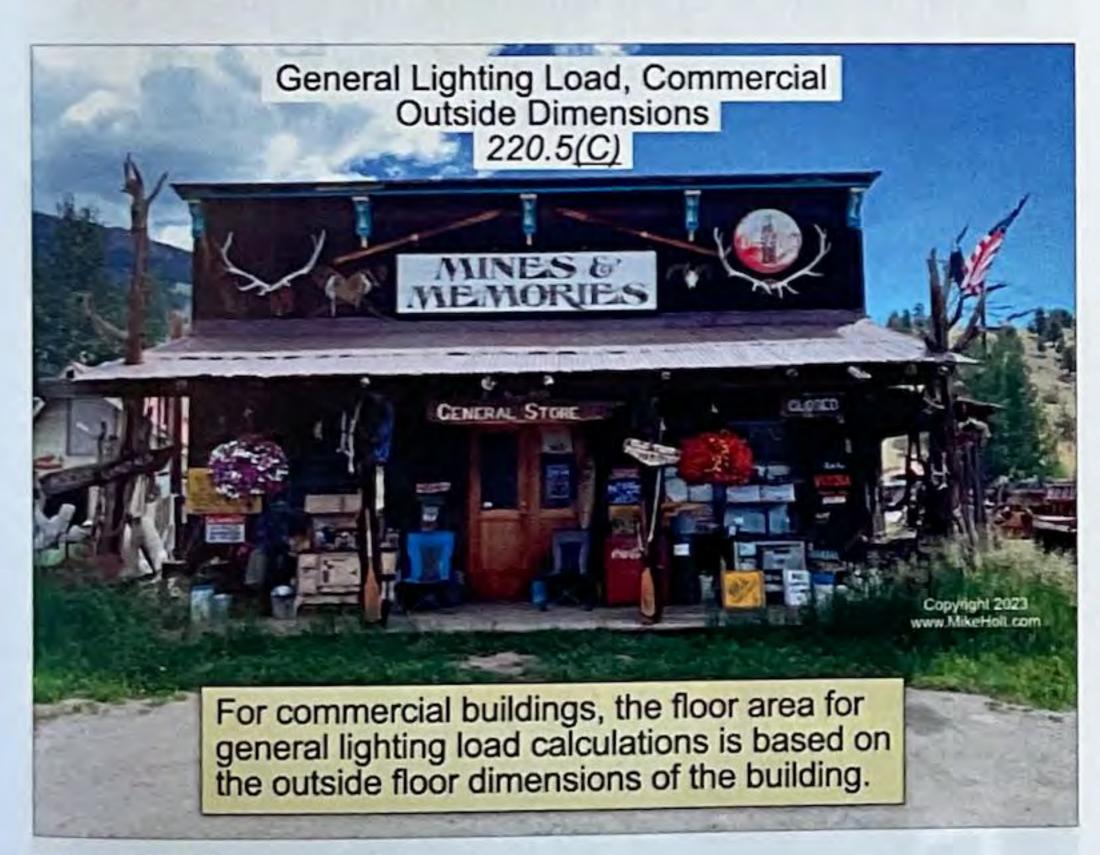


Figure 220-5

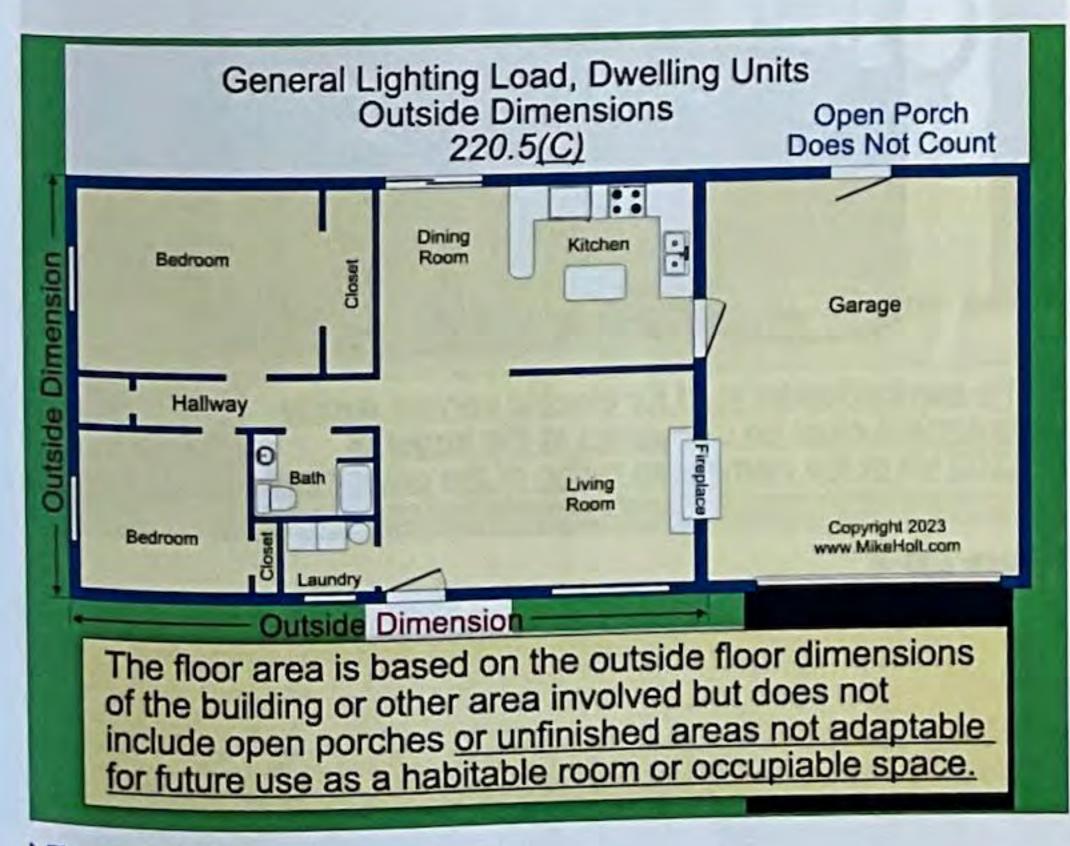


Figure 220-6

220.53 Appliance Load—Dwelling Unit(s)

Editorial changes were made in this section to clarify to what the rule applies.

Analysis



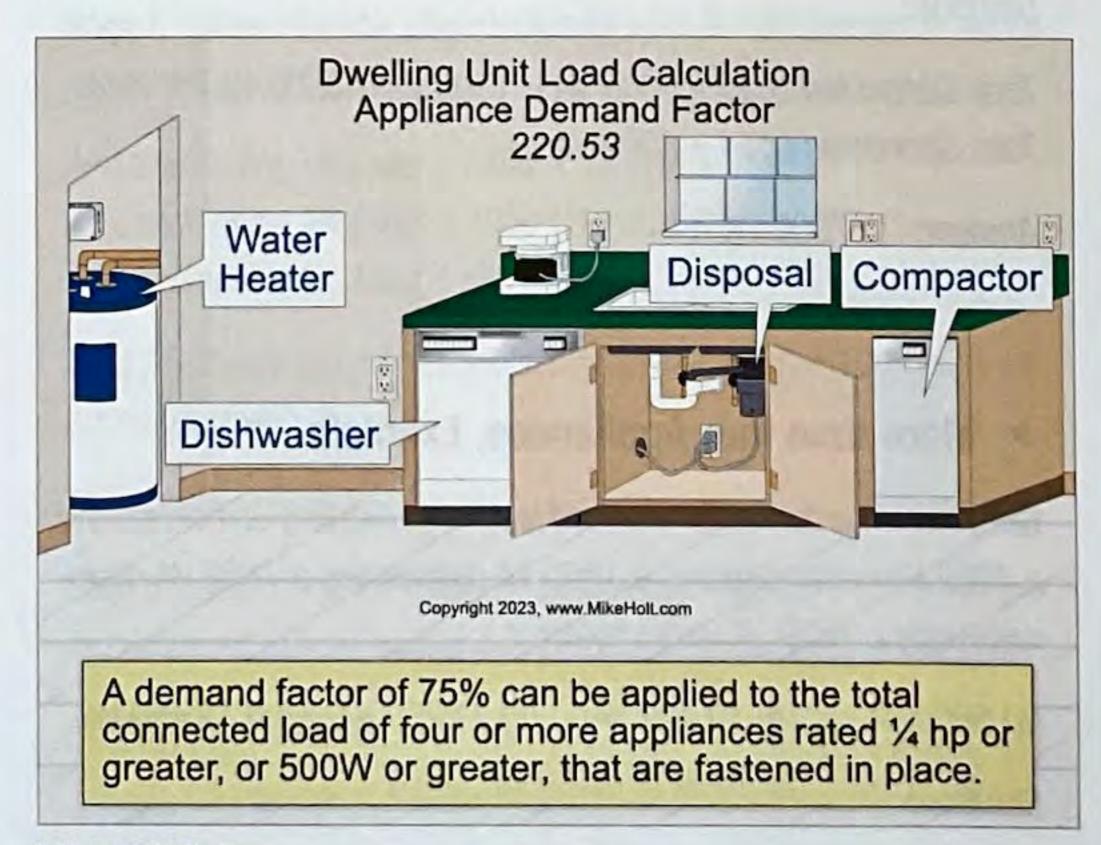


There were a few editorial changes made in this section to improve its usability with no real technical change.

Electric vehicle supply equipment (EVSE) was added as list item 5 to identify that these loads are significant, and no reduction is permitted.

220.53 Appliance Demand Load, Dwelling

A demand factor of 75 percent can be applied to the total connected load of four or more appliances rated ¼ hp or greater, or 500W or greater, that are fastened in place. Figure 220-7



▶ Figure 220-7

This demand factor does not apply to:

- (1) Household electric cooking equipment that is fastened in place
- (2) Clothes dryers
- (3) Space-heating equipment
- (4) Air-conditioning equipment
- (5) Electric vehicle supply equipment (EVSE)

▶ Example

Question: What is the load for ten 9600W EVSEs?

(a) 56,000 VA (b) 76,000VA (c) 86,000 VA (d) 96,000 VA

Solution:

EVSE Load = $9600 \text{ VA } \times 10$ EVSE Load = 96,000 VA

Answer: (d) 96,000 VA

220.60 Noncoincident Loads

Revisions in this section clarify that an air-conditioning load can be considered a noncoincident load.

Analysis

CLARIFIED

Revisions to this section are intended to clarify that when determining the largest noncoincident load where the air-conditioning unit itself

is the largest motor, you must use the air-conditioning load as the largest motor for the service calculation as well as the largest noncoincident load (which is usually the heat). This language is still a brain bender but if you take your time reading the rule, it makes sense.

220.60 Noncoincident Loads

If two or more loads are unlikely to be used at the same time, only the largest load is used for load calculations. The load must be the larger of the air-conditioning load at 125 percent [220.50(B)] as compared to the heating load at 100 percent [220.51].

THE RESERVE THE PROPERTY OF THE PARTY OF THE

Example

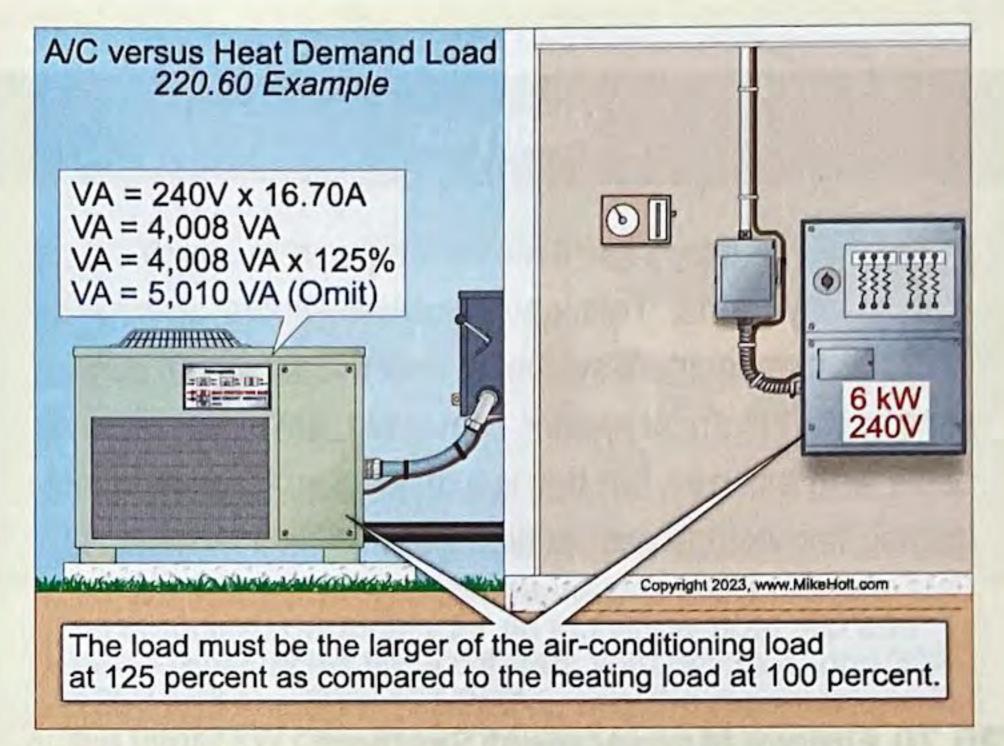
Question: What is the demand load for one 16.70A, 240V air-conditioning unit and one 6 kW, 240V electric space heater? ▶ Figure 220–10

(a) 5 kW

(b) 6 kW

(c) 11 kW

(d) none of these



▶ Figure 220-10

Solution:

Step 1: Determine the air-conditioning load at 125 percent in accordance with 220.50(B).

Air-Conditioning VA Load = 240V × 16.70A × 125%

Air-Conditioning VA Load = 4008 VA × 125%

Air-Conditioning VA Load = 5010 VA

Step 2: Determine the electric space heating load at 100 percent in accordance with 220.51.

Heat Load = 6000W

Step 3: Determine the larger of air-conditioning load at 125 percent as compared to heat load at 100 percent in accordance with 220.60.

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Heat Load = 6000W

Answer: (b) 6 kW



▶ Figure 100–19



Power-Supply Cord. This term has been misused over the years. Adding it to Article 100 makes it easier to understand the requirements that apply to these cords.

Power-Supply Cord. An assembly consisting of an attachment plug and a length of flexible cord connected to utilization equipment.

Author's Comment:

Article 400 contains information on the use of Power-Supply Cords.

Analysis

Primary Source. While there wasn't a great deal of confusion in the energy sector on this term, NEW there was some misunderstanding that this definition will clear up. This is especially true for those new to Chapter 6 and Chapter 7 installations.

Primary Source. An electric utility or another source of power that acts as the main forming and stabilizing source in an electric power system.

Analysis



PV DC Circuit, Source. (PV Source Circuit). This term is one of many that are now in Article 100 to clarify the application of the rules contained in Article 690.

PV DC Circuit, Source. (PV Source Circuit). The PV source dc circuit consists of the dc circuit conductors between modules in a PV string and from PV string circuits to dc combiners, electronic power converters, or the PV system dc disconnect (Article 690). ▶ Figure 100-20

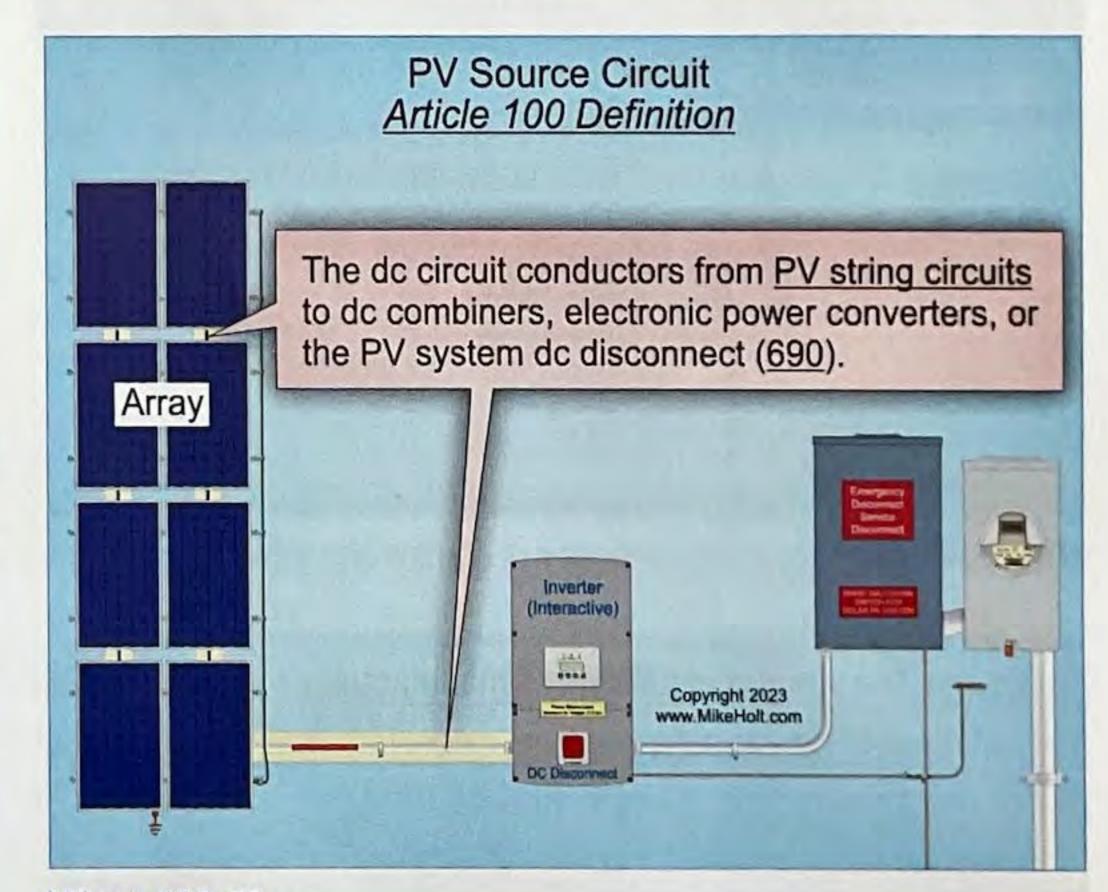


Figure 100-20

PV DC Circuit, String. (PV String Circuit). The PV source circuit conductors of one or more series-connected PV modules. (Article 690)

Sealed [as applied to hazardous (classified) locations]. Constructed such that equipment is sealed effectively against entry of an external atmosphere and is not opened during normal operation or for any maintenance activities.

Author's Comment:

Articles 501, 502, 503 contains information on the use of the term Sealed as it relates to hazardous (classified) locations.

File Attachments for Item:

ER-2 2023 NEC Code Changes Chapters 1-4 (Matthews Electrical Services)

All certifications (4 hours)

Staff Notes: Slides are a sampling.

ESIAC Recommendation:

Committee Recommendation:

BIOGRAPHY Henry P. Matthews PE, CPE, CESCP, PVA

Henry has over 31 years of experience in the electrical design, construction, engineering and safety fields. He has a passion for teaching and mentoring.

Henry obtained his Bachelor of Science degree in Electrical Engineering from Penn State University in 1989.

He also earned a Master of Business Administration from Bowling Green State University in 2003.

In addition, Henry earned several certificates including:

- Plumbing and Electrician from Penn Foster Career School
- Welding from Owens Community College in Findlay, Ohio
- Residential Solar PV Systems from Solar Engineering International

Henry currently holds the following licenses, and memberships:

- Licensed Electrical Contractor in Ohio
- Licensed Training Agency in Ohio
- Licensed Professional Engineer in Ohio, Michigan, Kentucky, Indiana, Illinois, Wisconsin
- Certified Plant Engineer (CPE)
- Certified Building Operator (CBO)
- Certified Electrical Compliance Safety Professional (CESCP) by NFPA
- Solar PV Associate by the North American Board of Certified Energy Practitioners
- Electric Vehicle Infrastructure Training Program (EVITP) certification
- Senior Member of the Institute of Electrical and Electronic Engineers (IEEE)
- Member of the International Association of Electrical Inspectors (IAEI)
- Member of the National Fire Protection Association (NFPA)

Henry is currently employed as an Advanced Senior Engineer for Marathon Petroleum Company in Findlay, Ohio. During his 16 years at Marathon, Henry has worked as an Electrical Design Engineer, Project Engineer, Engineering Supervisor and currently as a Reliability Engineer.

Henry is also the owner of Matthews Electrical Services, a small, but full-service electrical contractor company.

Prior to this, he worked 13 years as an Electrical Engineer and a Plant Engineering Manager in at Cooper Standard Automotive, a major automotive parts supplier in Bowling Green, Ohio

Henry is the past co-chair of American Petroleum Institute Recommended Practice 545 Lightning Protection for Above Ground Storage Tanks.

He was also past president of the Fostoria Toastmaster club.

2023 NEC Significant Code Changes Chapters 1 -4Outline

NEC Chapters and sections covered

- Scope: Article 90
- Chapters 1-4

Other Resources:

- 2021 NFPA 70E
- 2023 NFPA 70B
- NFPA 79

Referenced Websites:

- www.NFPA.org
 www.IAEI.org (International Association of Electrical Inspectors)
- www.mikeholt.com
- <u>www.esfi.org</u> Electrical Safety Foundation International)
- Various motor and transformer manufacturer websites.

Course Content:

- NEC Chapter 1 General
- NEC Chapter 2 Wiring and Protection
- NEC Chapter 3 Wiring Methods and Materials
- NEC Chapter 4 Equipment for General Use

2023 NEC Significant Code Changes Chapters 1 - 4 Syllabus

- 1. Welcome
- 2. Attendance and eligibility verification
- 3. Training session rules
- 4. Agenda review
- 5. Resources Used
- 6. Review of key points from NEC Overview
- 7. Chapters 1 4 Code Changes
 - a. New Articles
 - b. Deleted articles and sections
 - c. Discussion on key changes
- 8. Question and Answers
- 9. Wrap-up: post-class expectations (credits, certificates etc.)
- 10. Dismissal



Board of Building Standards

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 #
- o 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.

Phone: 614-644-2613

Board of Building Standards

Mike DeWine, Governor Jon Husted, Lt. Governor

Application for Continuing Education Course Approval

Provider Information:	
Name: Henry P. Matthews	
Organization: Matthews Electrical Services Address: 1203 McKinley Place; Fostoria, Ohio 4830	
Website: www.matthewselectrical.net	
Conference Sponsor (if applicable) Conference Email:	
Check here if Course Renewal:Prio	or course number (i.e. BB\$2018-429)
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: 2023 NEC Code Changes Chapters	s 1-4
Course instructor: Henry P. Matthews	
Course description: This course will cover some of the more significant code changes from Chapter 1-4 in the 2023 NEC.	
Instructional hours per session: 4	Number of Sessions: at least one per quarter
Course Date(s) and Location:	
Special Content:	
Code Administration:	Conference Course:
Existing Buildings:	Conference Name:
Electrical Instruction:	Conference location:
Plumbing Instruction:	
Course to be offered online?	On Demand Webinar V
Course Website: www.matthewselectrical.net	
Surveys, polls, and roll call after each break wil	ion method (i.e. test, quizlets, participant activity confirmation):
Surveys, polis, and roll call after each break will	The conducted.
Course applicable for the following certification	ations
Residential Certifications Only:	Commercial Certifications:
Administrative Course, All Certifications:	Commercial Certifications:
Application materials included:	
Course Outline or Course Le	arning Objectives
✓ Presentation Materials/Slide	es (not required for roundtable courses)
✓ Assessment Materials (for o	nline courses)
Application materials included: Course Outline or Course Le Presentation Materials/Slide Assessment Materials (for o Presenter Bio	5 55 5. 550/
Please submit application and materials in a	.pdf format to: michael.lane@com.ohio.gov or BBS@com.ohio.gov



Mike DeWine, Governor Sheryl Maxfield, Director

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

- 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.
- If the course is appropriate for any commercial certifications, check Commercial Certifications. The course, if approved, will be approved for all commercial certification <u>AND</u> 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

Welcome and Good Morning!

2023 NEC Code Changes Chapters 1 - 4

OCILB Course number: 4871438

OBBS Course number: Not yet approved



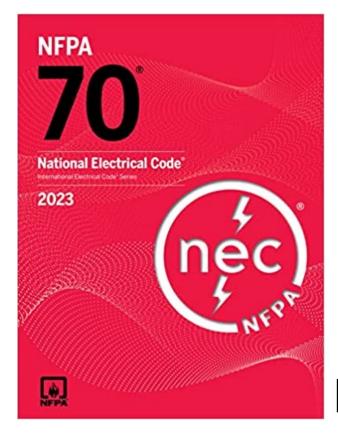
Please Accept Invitation to be a Panelist!
You will not be asked to present. This allows the host to verify your attendance and allows us to interact with each other like a classroom

Please mute your microphone

Text me at cell no. 419-575-3488 for any problems

Thank You!





Notice!

This course is based on the 2023 NEC.

The 2023 NEC has not been adopted in Ohio

Presented for INFORMATIONAL PURPOSES ONLY.



Current NEC Adoption

NEC® in Effect 2/1/2023



- The 2022 California Electrical Code, California Code of Regulations Title 24, Part 3 is based on the 2020 edition of NFPA 70®, National Electrical Code®.
- The 2011 New York City Electrical Code is based on the 2008 edition of NFPA 70®, National Electrical Code®.

Source: www.nfpa.org

Mike DeWine Governor

Sheryl Maxfield Director

Ohio Construction Industry Licensing Board Approved Training Agency

MATTHEWS ELECTRICAL SERVICES

Training Agency License: 48714

Expiration Date: 10/17/2023

Carol A. Ross Board Secretary William Koester

William Koester
Administrative Chairman

Mike DeWine Governor

BE MUST ICENSE

Sheryl Maxfield Director

LICENSE

MUS

BE

POSTED

Electrical

CONTRACTOR'S LICENSE HENRY P MATTHEWS MATTHEWS ELECTRIC SERVICES

OWNER

Ohio License# 46972

Expiration Date: December 17, 2023

Carol A. Ross **Board Secretary**

William Koester Administrative Chairperson

CERTIFICATE OF COMPLETION

THIS CERTIFIES THAT

BILL CODIE

OCILB License no: 12345 (EL,HV,PL,RE, HY)

HAS SUCCESSFULLY COMPLETED THE TRAINING REQUIREMENTS FOR

2023 NEC Significant Code Changes Overview

OCILB COURSE NO: 4871437 4 CODE CREDIT HOURS

April 15, 2023



HENRY P. MATTHEWS PE, CESCP

INSTRUCTOR

DATE

Agency #48714

Disclaimer



- I don't know everything!
- It will be IMPOSSIBLE to learn all of the changes in 4 hours!
- But we'll try to cover the main points

Disclaimer #2



The views and opinions presented in this class are those of Matthews Electrical Services and not necessarily those of the various entities the presenter represents or has previously or currently works for.



The material used in this class is based on documented publicly-available information (NFPA, OSHA, IEEE etc.)



The interpretation of this material is based on the presenter's experience and training of the subject matter.

Disclaimer #3

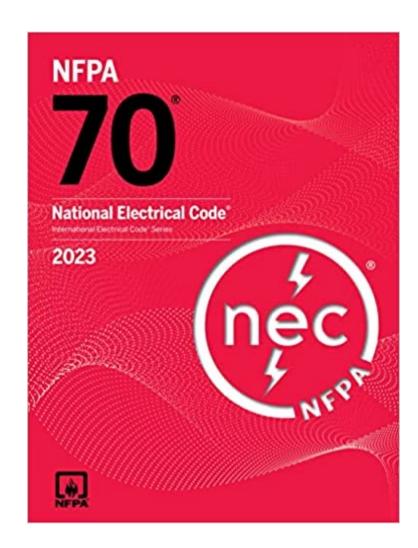


This presentation uses video and props from various electrical equipment manufacturers. This is not intended to endorse any particular products, vendors or manufacturers.



The content is shown for educational purposes only.

Resources



Copyrighted Material

5053 NEC_®

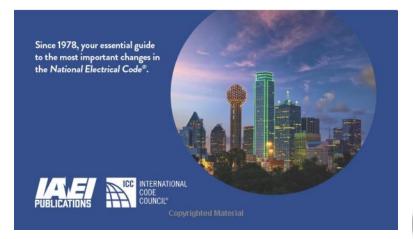


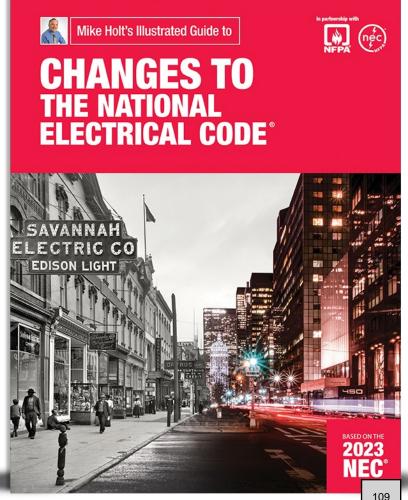
Analysis of Changes

Key changes in the 2023 NEC® as reported by Code-Panel Members IAEI subject matter experts, and input from IAEI industry partners

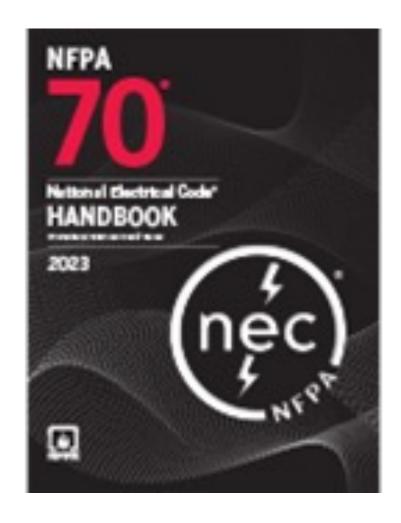


Cross-references to other electrical industry standards





Resources





Code-Making Panel No. 2

Articles 210, 220 Parts I through V, Annex D Examples D1 through D6

David G. Humphrey, Chair County of Henrico, Virginia, VA [E] Rep. International Association of Electrical Inspectors

Mathher Abbassi, New York City Department Of Buildings, NY [E]

Charles L. Boynton, Dow/The DuPont Company, Inc., TX [U]

Rep. American Chemistry Council

Daniel Buuck, National Association of Home Builders (NAHB), DC [U] Rep. National Association of Home Builders (NAHB)

Steve Campolo, Leviton Manufacturing Company, Inc., NY [M]

Mark Daniel Cook, Faith Technologies Electrical Contracting, WI [IM]

Thomas A. Domitrovich, Eaton Corporation, MO [M] Rep. National Electrical Manufacturers Association

Nehad El-Sherif, MNKYBR Technologies Inc., Canada [U] Rep. IEEE-IAS/PES JTCC

Thomas L. Harman, University of Houston-Clear Lake, TX [SE]

David W. Johnson, CenTex IEC, TX [IM] Rep. Independent Electrical Contractors, Inc.

Alan Manche, Schneider Electric, KY [M]

John McCamish, NECA IBEW Electrical Training Center, OR [L]
Rep. International Brotherhood of Electrical Workers

Fred Neubauer, Neubauer Electric Inc., CA [IM] Rep. National Electrical Contractors Association

Christopher J. Pavese, Duke Energy, KY [UT] Rep. Electric Light & Power Group/EEI

Frederick P. Reyes, UL LLC, NY [RT]

Alternates

William B. Crist, Jr., IES Residential Inc., TX [IM]
(Alt. to David W. Johnson)

Timothy M. Croushore, FirstEnergy, PA [UT]

(Alt. to Christopher J. Pavese)

Andrew Kriegman, Leviton Manufacturing Company, Inc., NY [M] (Alt. to Steve Campolo)

Brett Larson, Schneider Electric, IA [M] (Alt. to Alan Manche)

Cesar Lujan, National Association of Home Builders (NAHB), DC [U] (Alt. to Daniel Buuck)

Daniel J. Naughton, JATC of Greater Boston, MA [L] (Alt. to John McCamish)

Robert D. Osborne, UL LLC, NC [RT] (Alt. to Frederick P. Reyes)

Irozenell Pruitt, Corteva Company, Inc. /The DuPont Company, Inc., TX [U] (Alt. to Charles L. Boynton)

Brian E. Rock, Hubbell Incorporated, CT [M]
(Alt. to Thomas A. Domitrovich)

Joseph J. Wages, Jr., International Association of Electrical Inspectors, TX [E] (Alt. to David G. Humphrey)

112

14

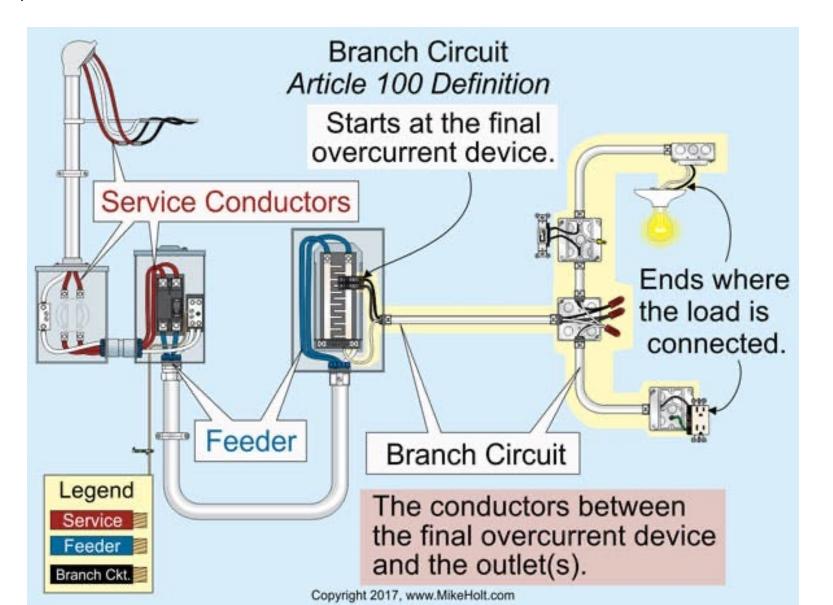


Mike Holt

NEC Global Changes

Review!

Service, Feeders and Branch Circuits



Review:

Receptacles, Outlets, Receptacle Outlets

Outlet



Receptacle



Receptacle Outlet



Symbols I will use for emphasis!

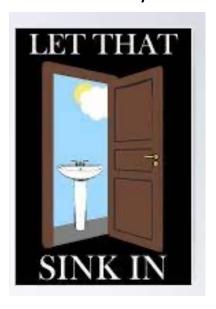
The NEC has tried many times
To get this right



Change that has major impact!

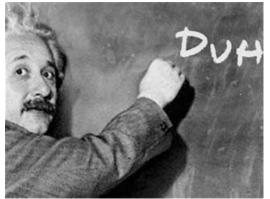


Head scratcher or Revolutionary idea

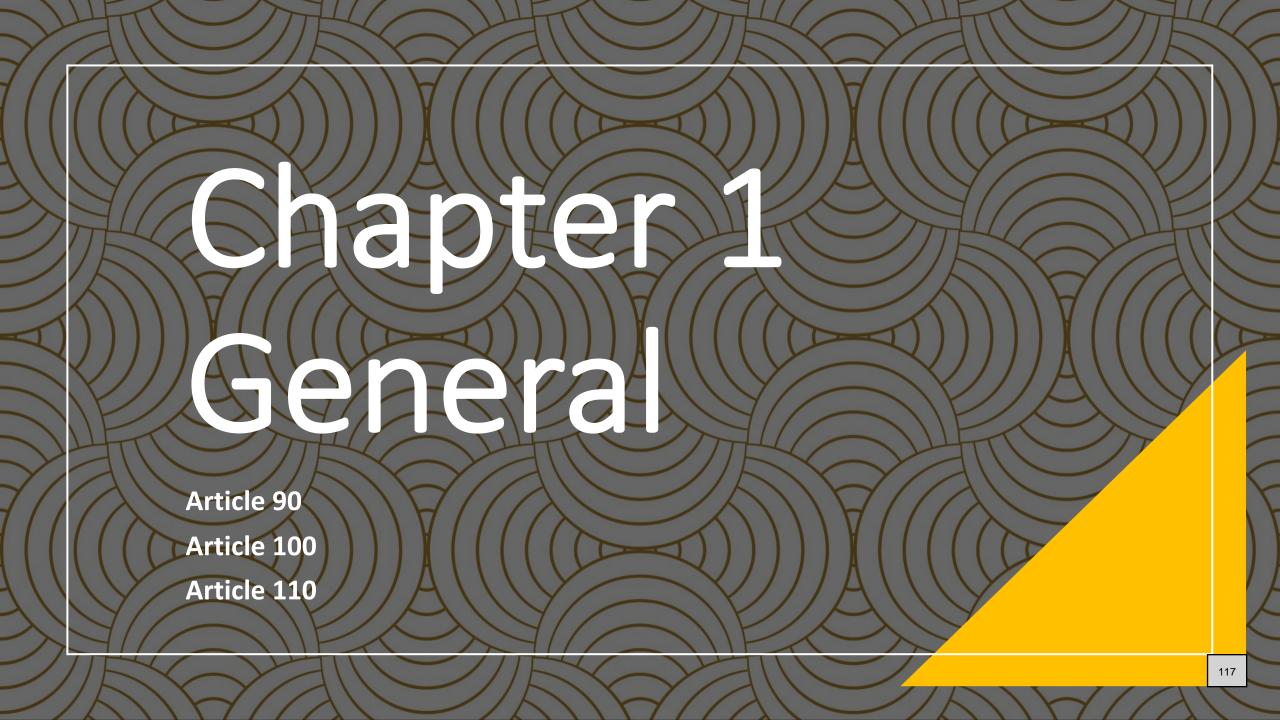


ATTENDON CHASE.

Attention Please!



Should be Obvious!



Article 100

• All definitions moved to the front



Article 100 Definitions- Counter (Countertop)

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

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



Article 100 Definitions- Counter (Countertop)

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



Features:

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



Article 100- Impedance Grounding Conductor

Substantiation was submitted for the creation of a new definition 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



Review

- Impedance denoted by Z, measured in ohms
- Impedance is made up of Resistance, Inductance and Capacitance
- Impedance equation:

$$Z=\sqrt{R^2+\left(X_L-X_C
ight)^2}$$

Z = impedance

R = resistance

 X_L = inductive reactance

 X_C = capacitive reactance

Article 100- Impedance Grounding Conductor

New definition for <u>"impedance grounding conductor"</u> was created to replace the phrase "grounded system conductor"

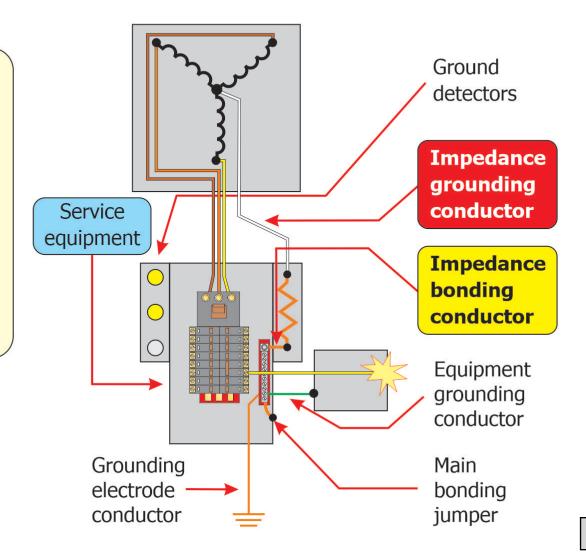


A Word from Engineer Nic:

There was no definition until the 2023 NEC

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

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



Article 100- Impedance Grounded System

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

- ⚠ There was no definition for an impedance grounded system before the 2023 NEC code cycle
- ⚠ This resulted in an inconsistent use and understanding of these systems as they applied with high impedance grounded neutral systems and impedance grounded neutral systems
- ⚠ Electrical professionals will have a new definition that is accurate and consistently defines elements that make up this system

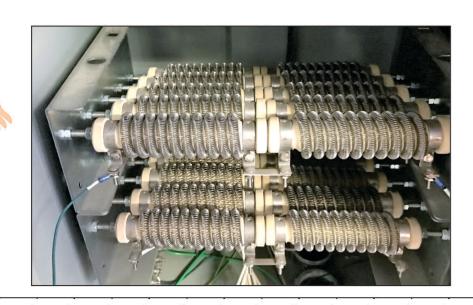
Article 100- Impedance Grounded System

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

Engineer Beth says:

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





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

CAUTION PRESS AND HOLD TEST BUTTON TO SIMULATE GROUND FAULT AND OPENING DISCONNECT WILL CREATE UNGROUNDED SYSTEM

Photo courtesy of Rob Bowman

110.17 Servicing and Maintenance of Equipment

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

Engineer Beth says:

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

Parts are to be provided by either the:

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

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









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



"Keep Trying" until they get it right

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)]



A Word from Electrician Jeff

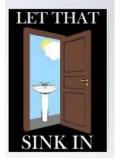
Transformer disconnecting means is located in the electrical panel and is labeled

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







Substantiation was submitted for the creation of a new definition explaining the phrase *Energized*, *Likely to Become*

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



Article 100- Energized, Likely to Become

Likely to become energized was up to interpretation with opinions that differed

from jurisdiction to jurisdiction



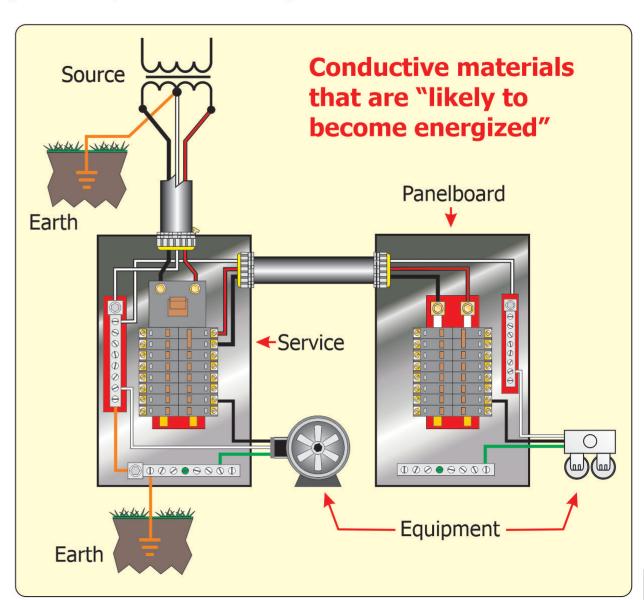
Engineer Nic

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

Many people have never heard of an NEC Style Manual

Definition factors:

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



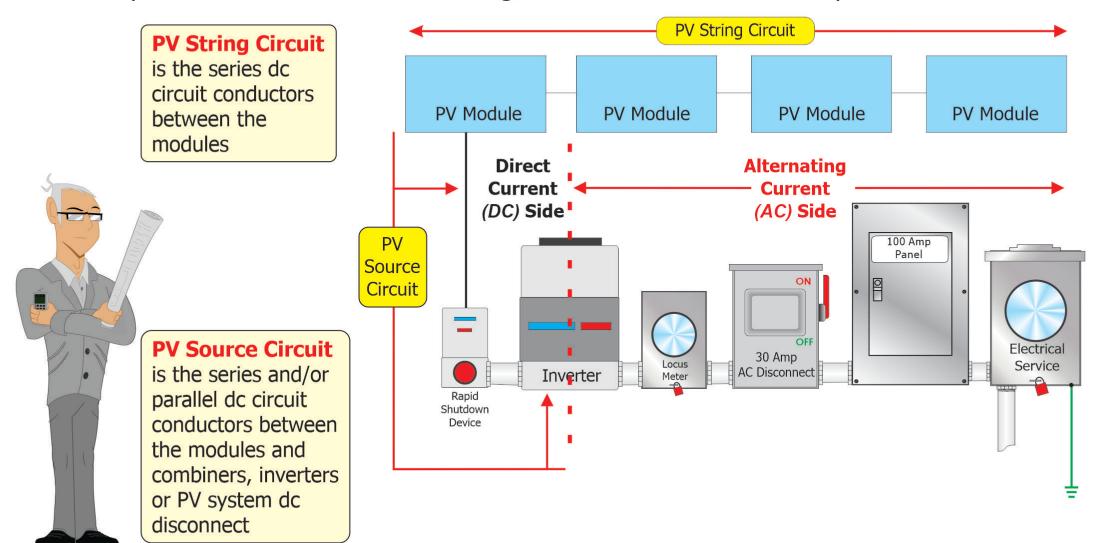
Article 100 Definitions- PV DC Circuit

New terms and revised definitions for PV System DC elements

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

Article 100- PV DC Circuit

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



Article 100 Definitions- Short Circuit

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

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



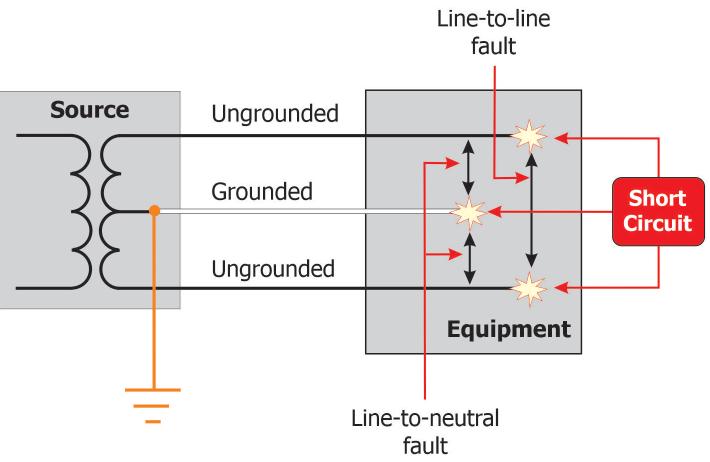
Definition: Short Circuit

Characteristics of a Short Circuit:

- It is a conducting connection
- can 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



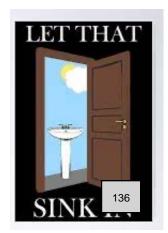
Random Current (Larry)



Article 100 Definitions- Work Surface

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

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



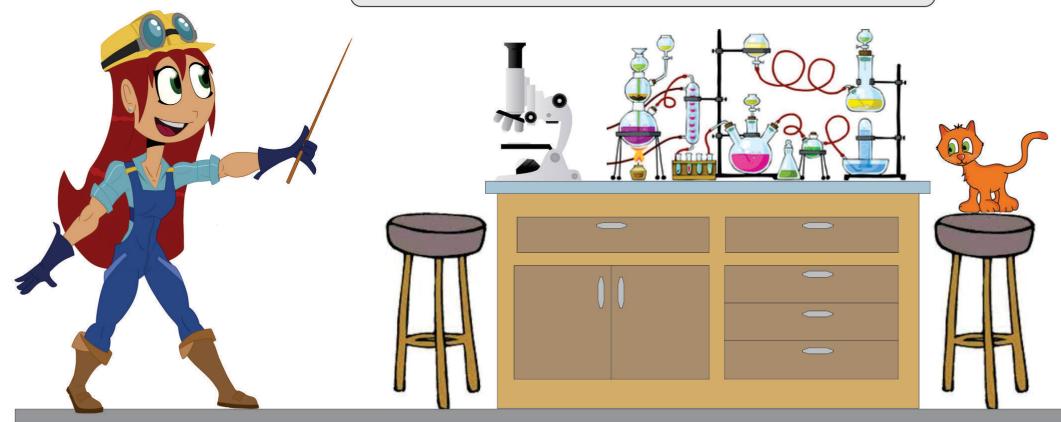


Article 100 Work Surface

New definition due to misapplications resulting from electrical equipment installed incorrectly on these surfaces

The electrical professional needs to consult industry standards that assists with proper application of receptacles

Key difference between a work surface and countertop is the **quantity of spillage** the surface is subjected



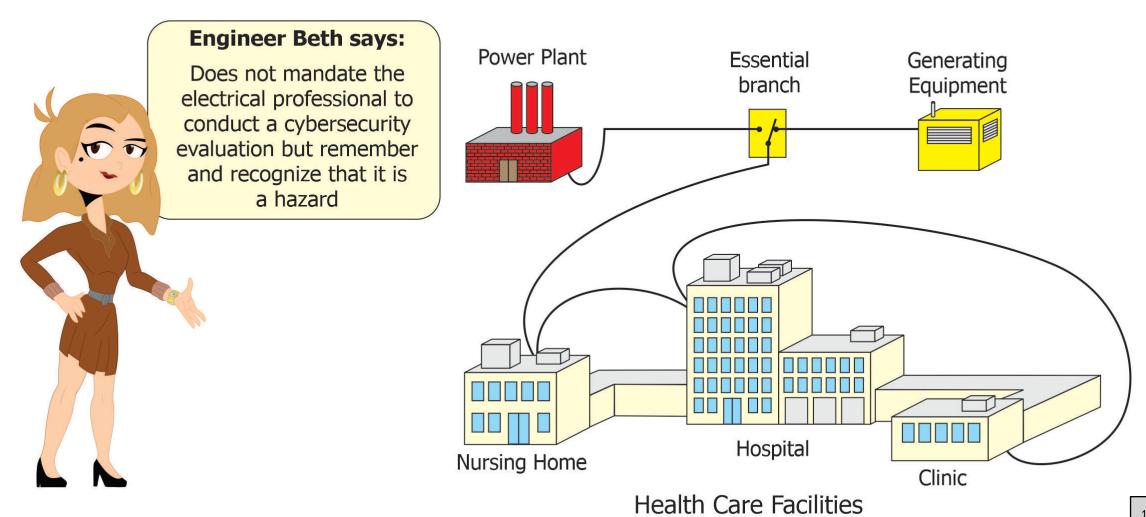
110.3 Examination, Identification, Installation, Use, and Listing (*Product Certification*) of Equipment. (A) Examination.

Substantiation was submitted that addresses cybersecurity for network-connected life safety equipment (list item 8)

- Cybersecurity is a technology hazard that can cause many disturbances to electronic equipment
- It needs to be considered when evaluating equipment for safety
- ⚠ Does not mandate that the electrical professional conduct a cybersecurity evaluation but to remember and recognizes that it is a hazard
- Informational Note No. 3 introduces the following valuable standards for consideration towards cybersecurity concerns for electrical equipment:
 - IEC 62443 series of standards for Industrial Automation and Control Systems
 - UL 2900 series of standards for Software Cybersecurity for Network-Connectable Products
 - UL 5500, the Standard for Remote Software Updates

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

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



110.16(B) Service Equipment/Feeder Supplied Equipment

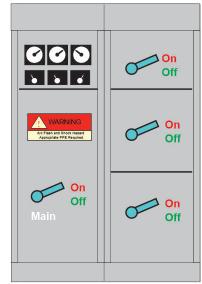
This adds "Feeder Supplied Equipment" to the title, adds the phrase "arc flash" for the type of permanent label required, and reduces 1200 to 1000 amperes for equipment rating amperes

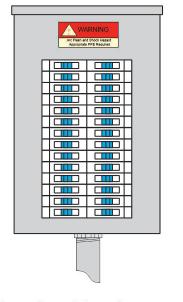
- Clarifies that the requirements apply to both service equipment and feeder-supplied equipment
- ⚠ It was necessary to add the phrase "arc flash" to clarify the type of permanent label required for this equipment
- ⚠ The revision from 1200 to 1000 amperes will protect worker safety
- ⚠ The four previous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

110.16(B) Service Equipment/Feeder Supplied Equipment

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

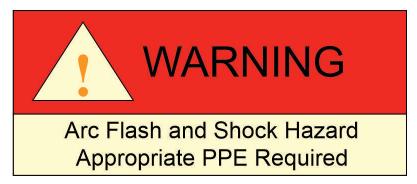






Service Equipment

Feeder Equipment



*Not all required warning labels shown

A Word from Engineer Nic

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



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

WARNING

Arc Flash and Shock Hazard
Failure to comply can result in death or serious injury.
Refer to NFPA 70E. Appropriate PPE Required.

Nominal System Voltage: 480 VAC

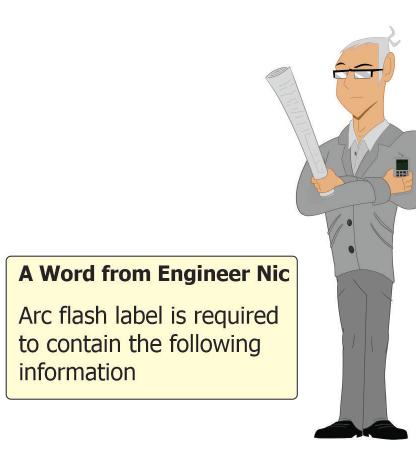
Available Fault Current: 23.3 kA

Clearing Time of Service OCPD: 0.03 sec (2 cycles)

Date Label Applied: 08/01/16

Equipment ID: Cannabis Production Panel 420

Sidewinder Electrical Contractors Celina, TX 800-444-1212



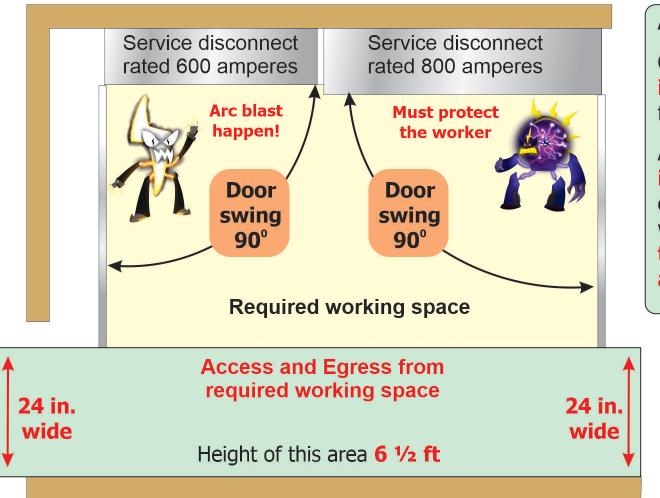
110.26 Spaces About Electrical Equipment

This change concerns equipment doors and their interference with egress and access from the working space

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

110.26 Spaces About Electrical Equipment

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



A Word from Engineer Nic

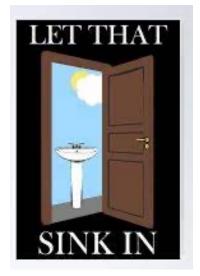
Open equipment doors **not to impede** the access or egress
from the working space

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

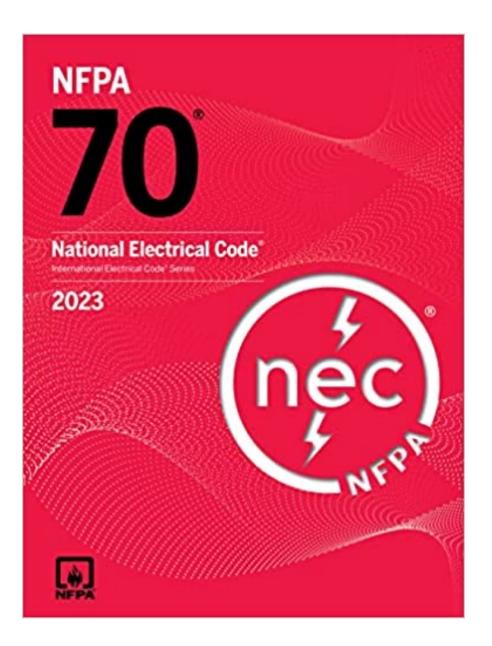
440.14 Location

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



Next Week: Chapters 5-9



CONGRATULATIONS!



Next Steps



A Certificate of Completion will be emailed to those who successfully completed course



4 hours of Code Class Hours will be reported to the OCILB fand OBBS or Code Continuing Education Credits



Contact instructor at hpmatthews@matthewselectrical.net for any questions or comments



Make sure you completely sign out of webinar after the next slide!



File Attachments for Item:

ER-3 2023 NEC Code Changes Chapters 5-9 (Matthews Electrical Services)

All certifications (4 hours)

Staff Notes: Slides are a sampling.

ESIAC Recommendation:

Committee Recommendation:

2023 NEC Significant Code Changes Chapters 5-9Outline

NEC Chapters and sections covered

- Scope: Article 90
- Chapters 5 9

Other Resources:

- 2021 NFPA 70E
- 2023 NFPA 70B
- NFPA 79

Referenced Websites:

- www.NFPA.org www.IAEI.org (International Association of Electrical Inspectors)
- www.mikeholt.com
- <u>www.esfi.org</u> Electrical Safety Foundation International)
- Various motor and transformer manufacturer websites.

Course Content:

- NEC Chapter 5 Special Occupancies
- NEC Chapter 6 Special Equipment
- NEC Chapter 7 Special Conditions
- NEC Chapter 8 Communication Systems
- NEC Chapter 9 Tables

2023 NEC Significant Code Changes Chapters 5 - 9Syllabus

- 1. Welcome
- 2. Attendance and eligibility verification
- 3. Training session rules
- 4. Agenda review
- 5. Resources Used
- 6. Review of key points from NEC Overview
- 7. Chapters 5 -9Code Changes
 - a. New Articles
 - b. Deleted articles and sections
 - c. Discussion on key changes
- 8. Question and Answers
- 9. Wrap-up: post-class expectations (credits, certificates etc.)
- 10. Dismissal



Board of Building Standards

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 #
- o BBS approved certifications
- Date of the continuing education program
- Number of approved credit hours awarded, and
- o 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.

Phone: 614-644-2613

Mike DeWine, Governor Jon Husted, Lt. Governor

Provider Information:

Board of Building Standards

Sheryl Maxfield, Director

Application for Continuing Education Course Approval

Name:	Henry P. Matthews			
Organizatio	n: Matthews Electrical Services			
Address:	1203 McKinley Place; Fostoria, Ohio	4830		
E-mail: hpm	atthews@matthewselectrical.net		Telephone: 419-575-3488	
Website:	www.matthewselectrical.net		· · ·	
Conference	Sponsor (if applicable)	Conference E	Email:	
Check here	if Course Renewal: Price	or course number	(i.e. BBS2018-429)	
	rill only be granted for identical c			
Attach a co	by of prior course approval letter	for confirmation. No furt	her information is required.	
New Course	e Information:			
	2023 NEC Codes Changes Chapte	er 5-9		
	ructor: Henry P. Matthews			-
		e of the more significant code	e changes from Chapter 5-9 in the 2023 NE	C.
	· -			
Instructiona	ıl hours per session: 4	Num	ber of Sessions: at least one per quarter	
	e(s) and Location:		1 1	
Course Butt	e(s) and Escation.			
Special Con	tent:			
Code Admir	nistration:	Conference Course:		
Existing Bui	ldings:	Conference Name:		
Electrical In	struction:	Conference location:		
Plumbing Ir	struction:			
	e offered online?	On Demand	WebinarV	
	osite: www.matthewselectrical.net			
	e course participation confirmat olls, and roll call after each break wi		lets, participant activity confirmation):	
Course ann	licable for the following certifica	ations		
course app	•			
Residential	Certifications Only:	Commercial	Certifications:	
	ive Course, All Certifications:			
	, _			
Application	materials included:			
	Course Outline or Course Learning Objectives			
	Presentation Materials/Slide	es (not required for round	dtable courses)	
	Assessment Materials (for o	online courses)		
	Presenter Bio			
Please subr	nit application and materials in	.pdf format to: michael.la	ane@com.ohio.gov_or BBS@com.ohio.	.gov



Mike DeWine, Governor

Sheryl Maxfield, Director

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

- 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.

614-644-2613

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.
- If the course is appropriate for any commercial certifications, check Commercial Certifications. The course, if approved, will be approved for all commercial certification <u>AND</u> 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

BIOGRAPHY Henry P. Matthews PE, CPE, CESCP, PVA

Henry has over 31 years of experience in the electrical design, construction, engineering and safety fields. He has a passion for teaching and mentoring.

Henry obtained his Bachelor of Science degree in Electrical Engineering from Penn State University in 1989.

He also earned a Master of Business Administration from Bowling Green State University in 2003.

In addition, Henry earned several certificates including:

- Plumbing and Electrician from Penn Foster Career School
- Welding from Owens Community College in Findlay, Ohio
- Residential Solar PV Systems from Solar Engineering International

Henry currently holds the following licenses, and memberships:

- Licensed Electrical Contractor in Ohio
- Licensed Training Agency in Ohio
- Licensed Professional Engineer in Ohio, Michigan, Kentucky, Indiana, Illinois, Wisconsin
- Certified Plant Engineer (CPE)
- Certified Building Operator (CBO)
- Certified Electrical Compliance Safety Professional (CESCP) by NFPA
- Solar PV Associate by the North American Board of Certified Energy Practitioners
- Electric Vehicle Infrastructure Training Program (EVITP) certification
- Senior Member of the Institute of Electrical and Electronic Engineers (IEEE)
- Member of the International Association of Electrical Inspectors (IAEI)
- Member of the National Fire Protection Association (NFPA)

Henry is currently employed as an Advanced Senior Engineer for Marathon Petroleum Company in Findlay, Ohio. During his 16 years at Marathon, Henry has worked as an Electrical Design Engineer, Project Engineer, Engineering Supervisor and currently as a Reliability Engineer.

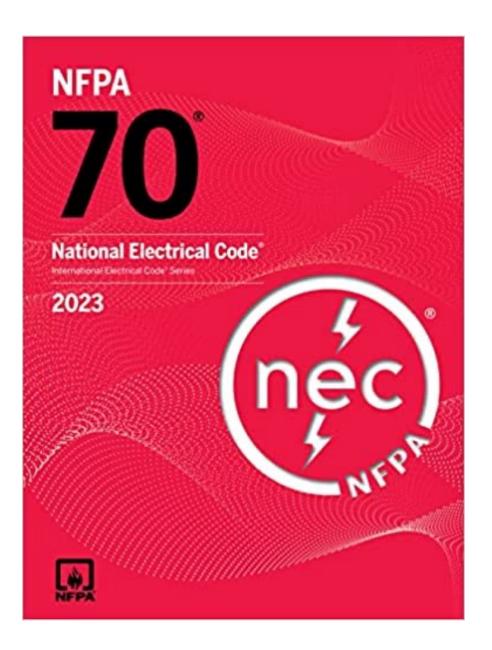
Henry is also the owner of Matthews Electrical Services, a small, but full-service electrical contractor company.

Prior to this, he worked 13 years as an Electrical Engineer and a Plant Engineering Manager in at Cooper Standard Automotive, a major automotive parts supplier in Bowling Green, Ohio

Henry is the past co-chair of American Petroleum Institute Recommended Practice 545 Lightning Protection for Above Ground Storage Tanks.

He was also past president of the Fostoria Toastmaster club.

Chapters 5-9



Notice!

This course is based on the 2023 NEC.

The 2023 NEC has not been adopted in Ohio

Presented for INFORMATIONAL PURPOSES ONLY.

Current NEC Adoption

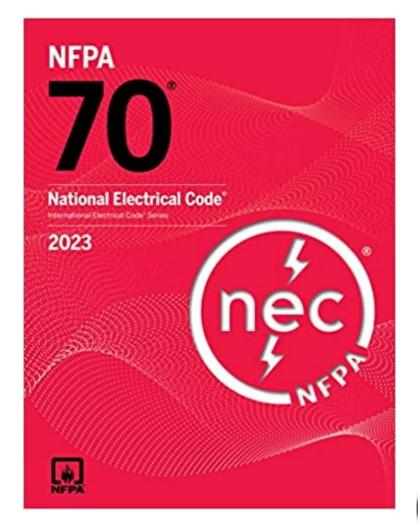
NEC® in Effect 2/1/2023

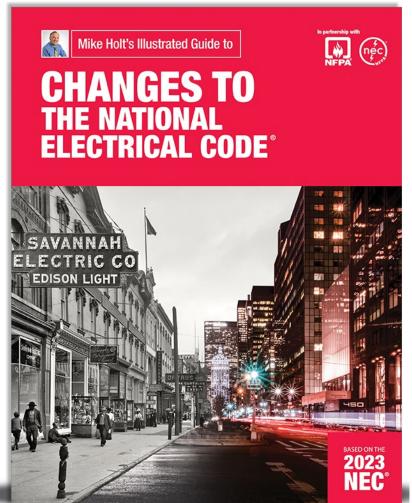


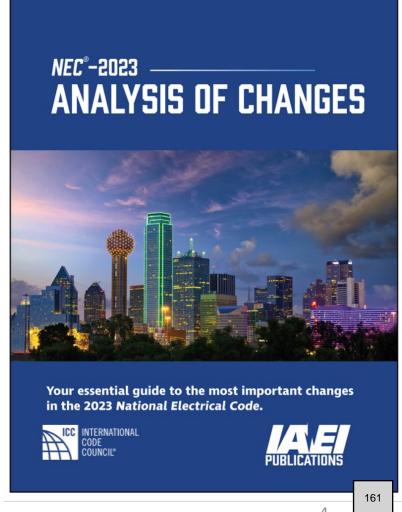
Source: www.nfpa.org

- The 2022 California Electrical Code, California Code of Regulations Title 24, Part 3 is based on the 2020 edition of NFPA 70®, National Electrical Code®.
- The 2011 New York City Electrical Code is based on the 2008 edition of NFPA 70®, National Electrical Code®.

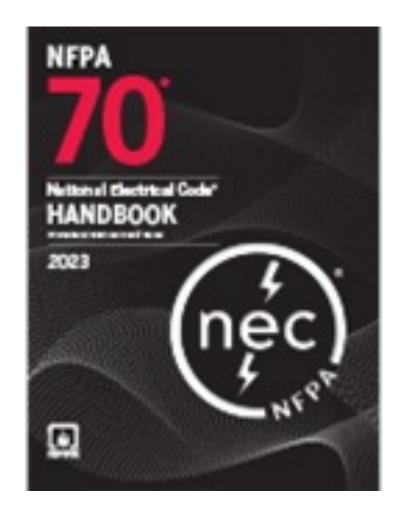
Resources







Resources





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

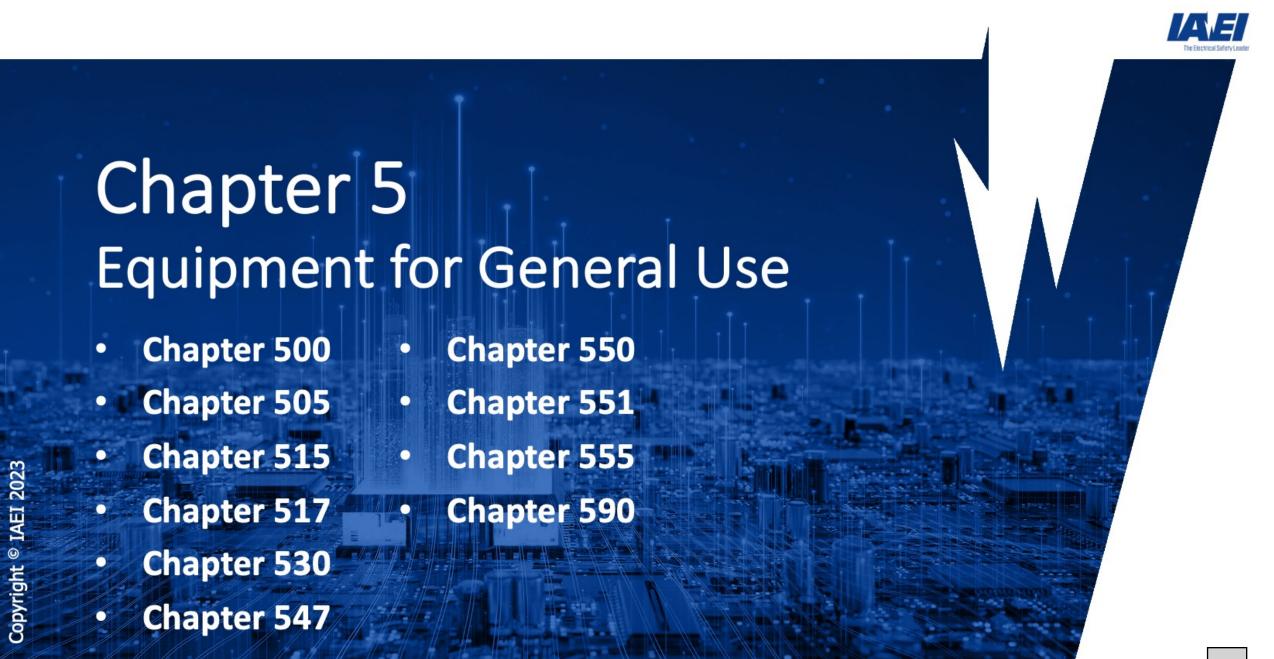
NEMA- National Equipment Manufacturers Association

NFPA- National Fire Protection Association

UL- Underwriters Laboratories

Listed!



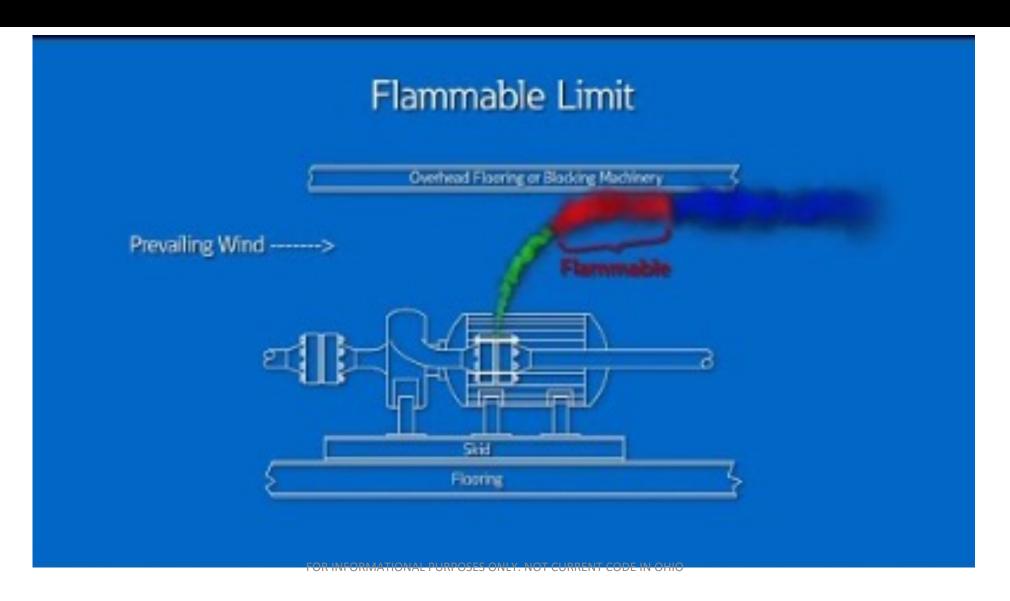




Mike Holt

Chapter 5

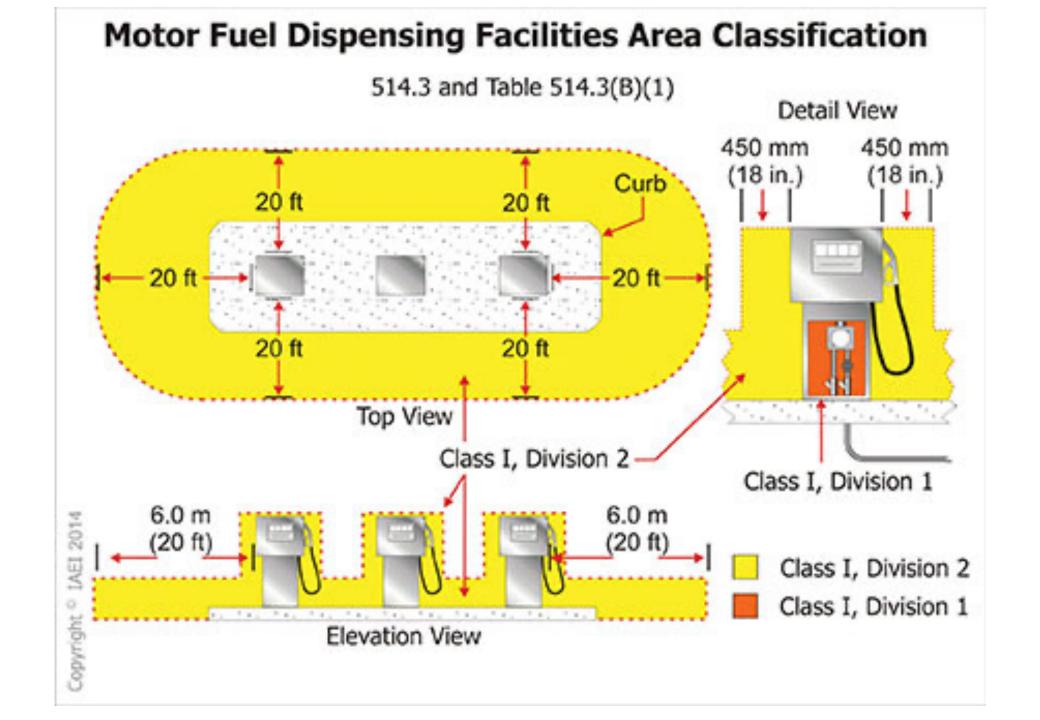
Hazardous Locations



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





FOR INFORMATIONAL PURPOSES ONLY. NOT CURRENT CODE IN OHIO

500.5(D)(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

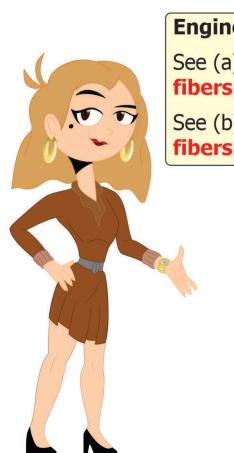
- Change involving Class III locations resulted from members of several technical committees as part of a Task Group
- ⚠ Members from NFPA 70, NFPA 499, NFPA 652, and NFPA 654 worked to develop new definitions that would provide consistency in all the documents
- ⚠ Necessary for correlation with changes 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

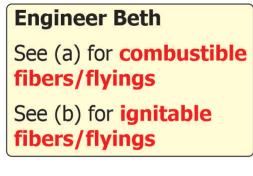


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500.5(D)(1)(a) Combustible Fibers/Flyings

For information on Class III, Division 1 locations see 500.5(D)(1)(a) and (D)(1)(b)







Combustible Fibers and Flyings



2020

(D) Class III Locations.

Class III locations shall be locations meeting the requirements of 500.5(D)(1) and (D)(2).

(1) Class III, Division 1.

Class III, Division 1 locations shall include those locations specified in 500.5(D)(1)(a) and (D)(1)(b).

a) Combustible Fibers/Flyings. Locations where nonmetal combustible fibers/flyings are in the air under normal operating conditions in quantities sufficient to produce explosible mixtures or where mechanical failure or abnormal operation of machinery or equipment might cause combustible fibers/flyings to be produced and might also provide a source of ignition through simultaneous failure of electrical equipment, through operation of protection devices, or from other causes shall be classified as Class III, Division 1. Locations where metal combustible fibers/flyings are present shall be classified as Class II, Division 1, Group E.

Informational Note No. 1: Such locations usually include some parts of rayon, cotton, and other textile mills; associated manufacturing and processing plants; cotton gins and cotton-seed mills; flax-processing plants; clothing manufacturing plants; woodworking plants; and establishments and industries involving similar hazardous processes or conditions.

Informational Note No. 2: Combustible fibers/flyings include flat platelet-shaped particulate such as metal flakes and fibrous board such as particle board.

(D) Class III Locations.

Class III locations shall be locations meeting the requirements of 500.5(D)(1) and (D)(2).

(1) Class III, Division 1.

Class III, Division 1 locations shall include those locations specified in $\frac{500.5(D)(1)(a)}{(D)(1)(b)}$ and (D)(1)(b).

a) Combustible Fibers/Flyings. Locations where nonmetal combustible fibers/flyings are in the air under normal operating conditions in quantities sufficient to produce explosible mixtures or where mechanical failure or abnormal operation of machinery or equipment might cause combustible fibers/flyings to be produced and might also provide a source of ignition through simultaneous failure of electrical equipment, through operation of protection devices, or from other causes shall be classified as Class III, Division 1. Locations where metal combustible fibers/flyings are present shall be classified as Class II, Division 1, Group E.

Informational Note No. 1: Such locations usually include some parts of rayon, cotton, and other textile mills; associated manufacturing and processing plants; cotton gins and cotton-seed mills; flax-processing plants; clothing manufacturing plants; woodworking plants; and establishments and industries involving similar hazardous processes or conditions.

Informational Note No. 2: Combustible fibers/flyings include flat platelet-shaped particulates, such as metal flakes, and fibrous board, such as particle board.

505.9(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

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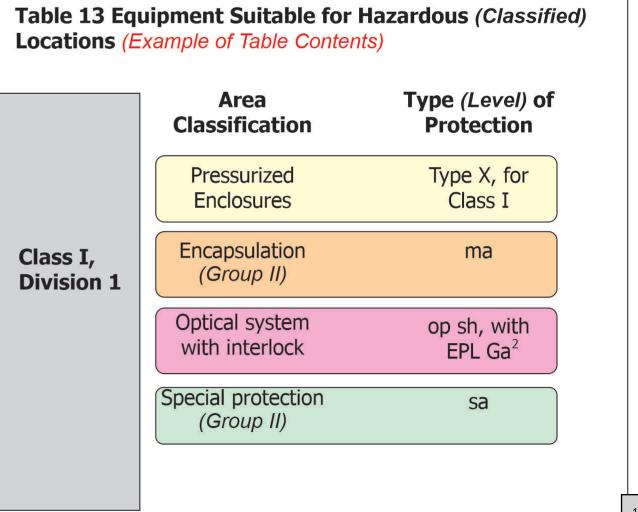
505.9(C) Equipment Suitable for Hazardous (Classified) Locations **Chapter 9 Table 13**

Created a new Table 13 in Chapter 9 entitled Equipment Suitable for Hazardous (Classified) Locations

The requirements at 505.9(C)(2)(4) discuss zone equipment marking requirements was 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



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

Article 512 Cannabis Oil Equipment

Covers cannabis oil extraction equipment, booths, post processing equipment, and systems using flammable materials in commercial and industrial facilities



Article 512 Cannabis Oil Equipment and

Cannabis Oil Systems Using Flammable Materials

Part I. General

512.1 Scope.

This article covers cannabis oil preparatory equipment, extraction equipment, booths, post-processing equipment, and systems using flammable materials (flammable gas, flammable liquid-produced vapor, combustible liquid-produced vapor) in commercial and industrial facilities.

Informational Note No. 1: See ANSI/UL 1389, Plant Oil Extraction Equipment for Installation and Use in Ordinary (Unclassified) Locations and Hazardous (Classified) Locations, for information on cannabis oil equipment and systems for hazardous (classified) locations.

Informational Note No. 2: See NFPA 1, Fire Code; NFPA 55, Compressed Gases and Cryogenic Fluids Code; NFPA 58, Liquefied Petroleum Gas Code; and ICC IFC, International Fire Code, together with the manufacturer's installation instructions, for information on the installation of cannabis oil equipment and systems.



Commercial Cannabis Business License 2022

Leslie's Fine Cannabis, Hookah and Fishing Tours (with locations in Colorado, California and Pakistan)

Owner: Leslie Tokenoften

Location: Walkabout Stumbling, Texas

Type of Permit

- Cultivation
- Sales
- Dining
- Fishing

Annual Inspection and Renew of Cannabis Operation

April 20, 2023

Annual Permit fee: \$4,200.00

By Order of: Kumar Vansmokin

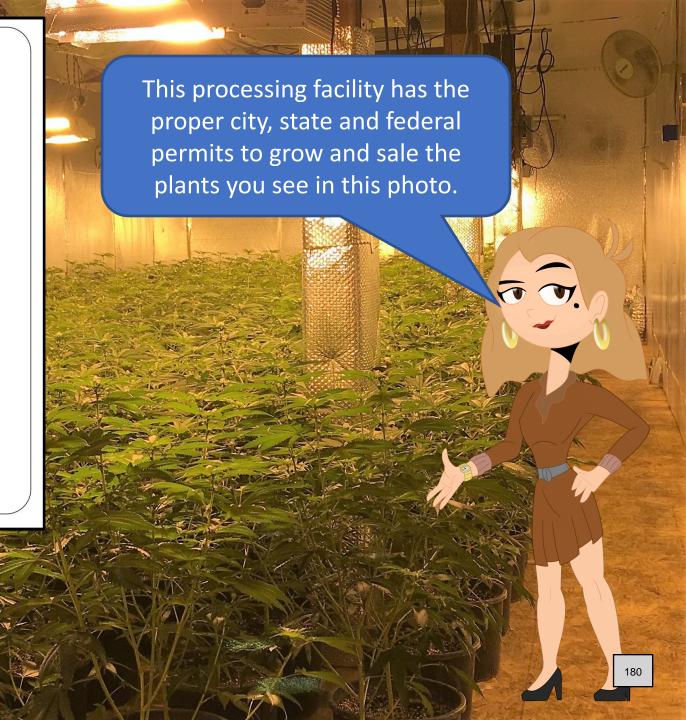
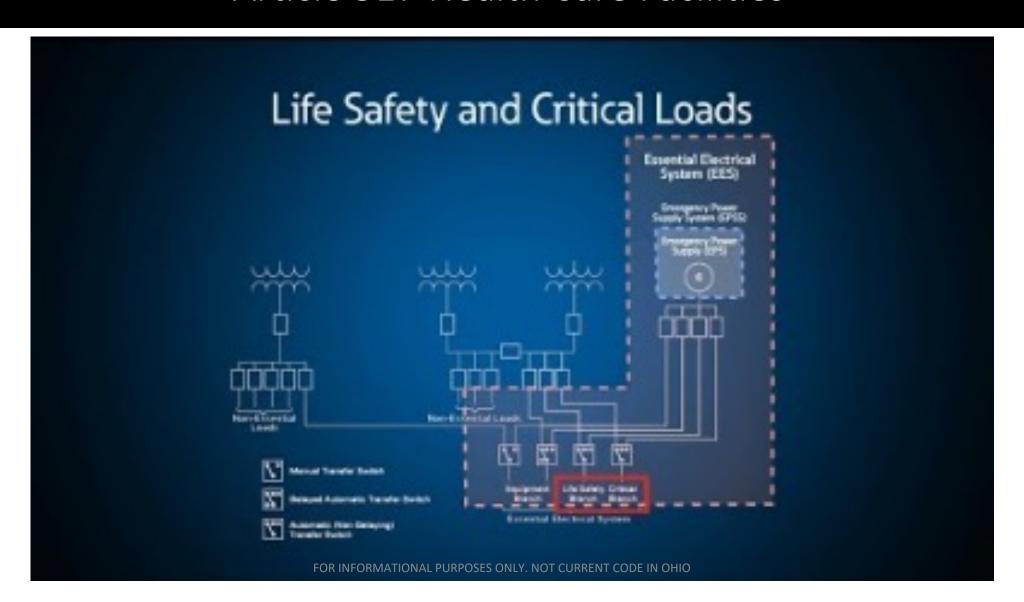


Photo courtesy of Steve Thomas

Article 517 Health Care Facilities



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



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 3 Space:

- Examination or treatment rooms in clinics
- Medical and dental offices
- Nursing homes
- Limited care facilities

Category 2 Space:

- Inpatient bedrooms
- Dialysis rooms
- In vitro fertilization rooms
- Procedural rooms
- Similar rooms

Category 4 Space:

- Anesthesia work rooms
- Sterile supply
- Laboratories
- Morgues
- Waiting rooms
- Utility rooms
- Lounges

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

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

517.22 Demand Factors (Health Care Facilities)



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

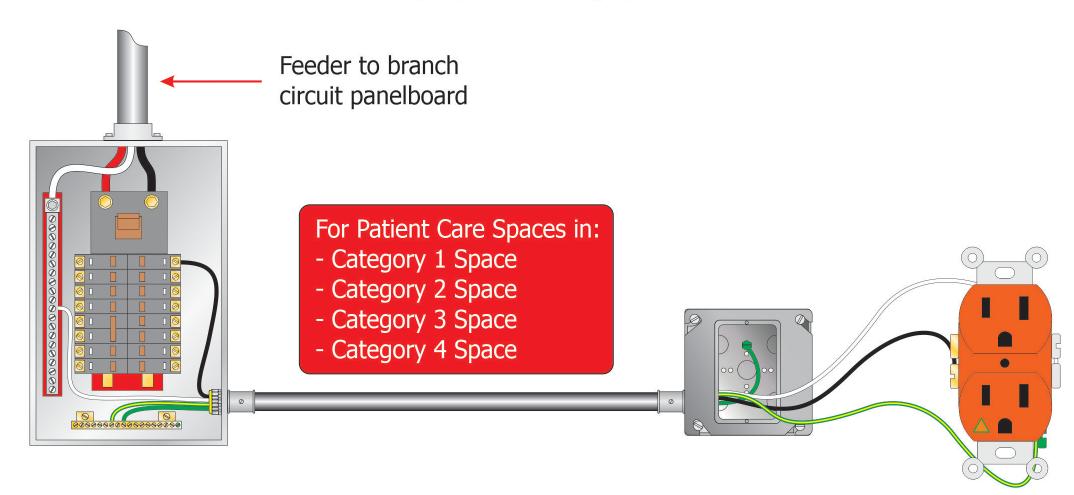






Table 220.110(1) Demand Factors for Receptacles Supplied by General-Purpose Branch Circuits in Category 1 and Category 2 Patient Care Spaces

Portion of Receptacle Load to Which Demand Factor	
Applies (Volt-Amperes)	Demand Factor (%)
First 5000 or less	100
From 5001 to 10,000	50
Remainder over 10,000	25





Table 220.110(2) Demand Factors for Receptacles Supplied by General-Purpose Branch Circuits in Category 3 and Category 4 Patient Care Spaces

Portion of Receptacle Load to Which Demand Factor	
Applies (Volt-Amperes)	Demand Factor (%)
First 10,000 or less	100
Remainder over 10,000	50

Essential Electrical System.

A system comprised of alternate power sources and all connected distribution systems and ancillary equipment, designed to ensure continuity of electrical power to designated areas and functions of a health care facility during disruption of normal power sources, and also to minimize disruption within the internal wiring system. [99:3.3.52] (517) (CMP-15)

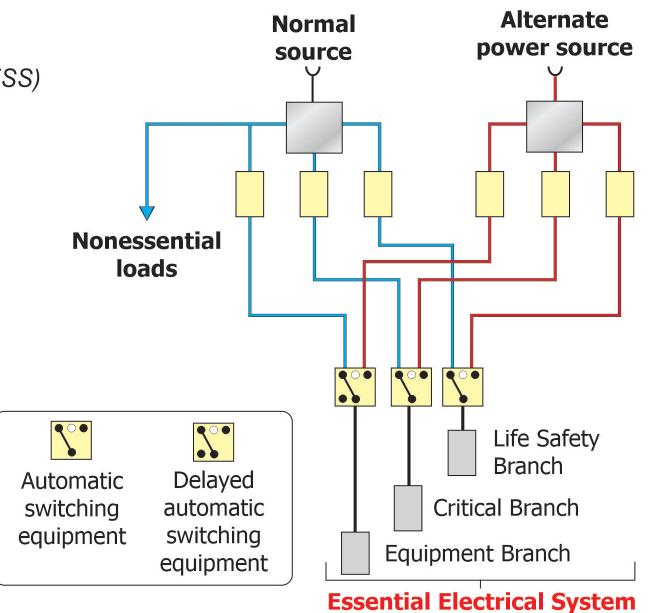
517.30 Sources of Power (Health Care Facilities)

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:

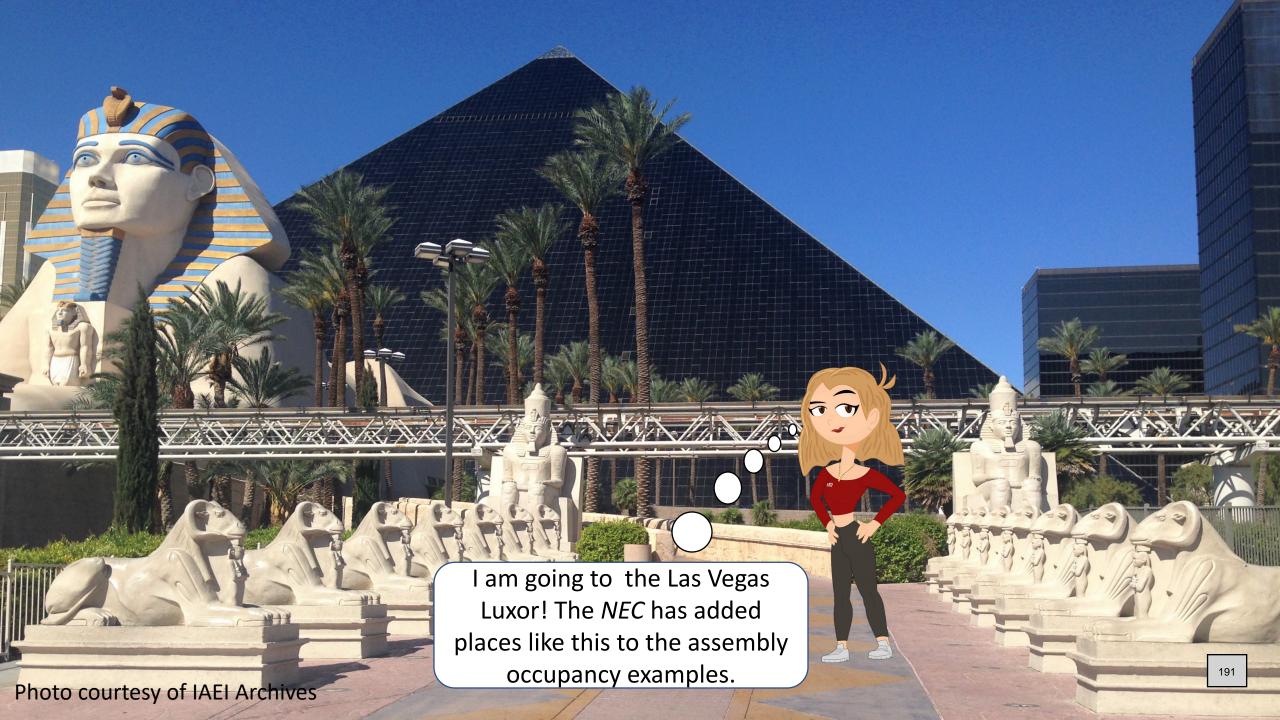
- Energy Storage Systems
- Health Care Microgrids



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



518.5 Supply (Assembly Occupancies)

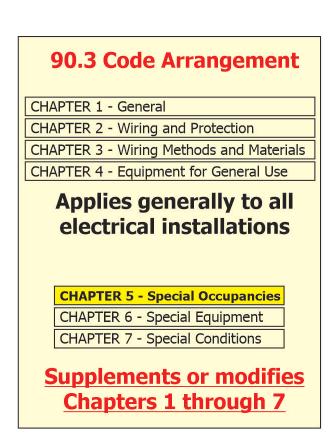
The section was reorganized for clarity and revised which included new requirements for commercial appliance outlet centers and panelboard orientation

- 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

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



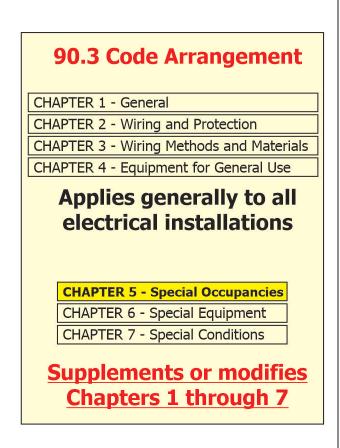




518.5 Supply (Assembly Occupancies)

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







(A) Power Outlets and Commercial Appliance Outlet Centers.

(1) Overcurrent Protection.

Power outlets and commercial appliance outlet centers shall provide overcurrent protection or shall be protected by overcurrent devices.

(2) Accessibility.

Overcurrent devices, power outlets, and commercial appliance outlet centers shall not be accessible to the general public.

(3) Equipment Grounding Conductor Connections.

Connecting means for an equipment grounding conductor shall be provided.

(4) Markings.

Power outlets and commercial appliance outlet centers shall be marked as follows:

FOR USE BY QUALIFIED PERSONS ONLY. RISK OF ELECTRIC SHOCK.

DISCONNECT ALL POWER BEFORE SERVICING. DISCONNECTING MEANS LOCATION:

(5) Panelboard Orientation.

A panelboard installed in a listed commercial appliance outlet center designed for in-floor mounting shall be permitted to be orientated in the face-up position, if such orientation is part of the listing, and <u>408.43</u> shall not apply.

Section 547.26 Physical Protection (Agricultural Buildings)

- Nonmetallic cables will be prohibited from being concealed within walls and above ceilings of buildings that are connected or attached to livestock confinement areas.
- Rodents and pests can damage wiring



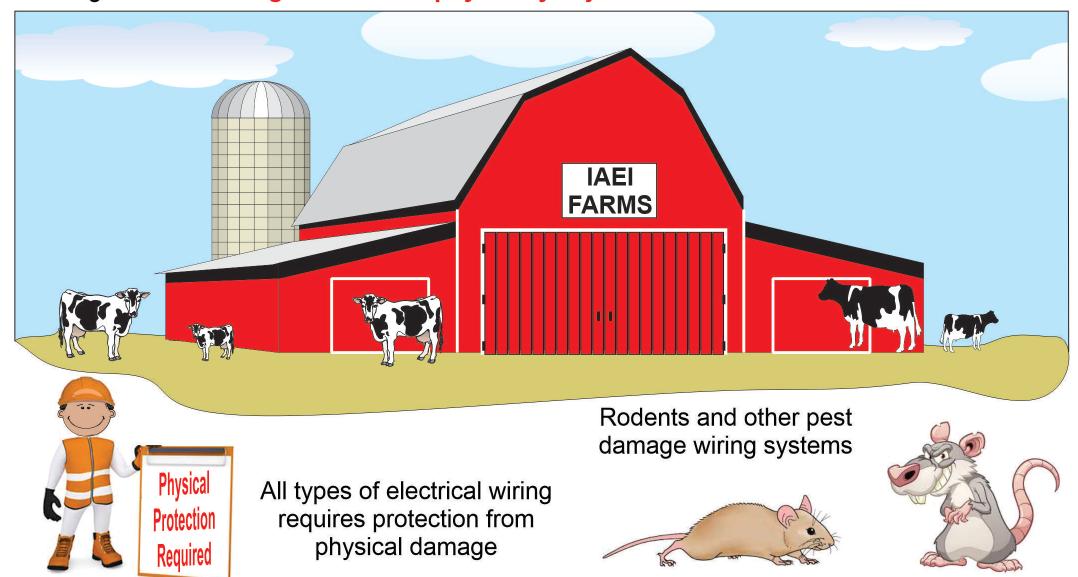
547.26 Physical Protection (Agricultural Buildings)

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

- ⚠ It has been substantiated that 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

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



2023



547.26 Physical Protection.

All electrical wiring and equipment subject to physical damage shall be protected.

Nonmetallic cables shall not be permitted to be concealed within walls and above ceilings of buildings (i.e., offices, lunchrooms, ancillary areas, etc.) or portions thereof, which are contiguous with or physically adjoined to livestock confinement areas.

Informational Note: Rodents and other pests are common around such installations and will damage nonmetallic cable by chewing the cable jacket and conductor insulation concealed within walls and ceilings of livestock containment areas of agricultural buildings.

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

547.44 Equipotential Planes and Bonding of Equipotential Planes

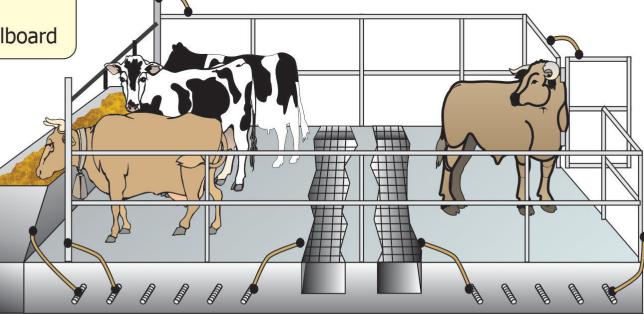
Clarifies the indoor and outdoor locations requiring equipotential planes and specifies the bonding locations for these planes at **agricultural buildings**

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





Mobile Homes, Manufactured Homes and Mobile Home Parks

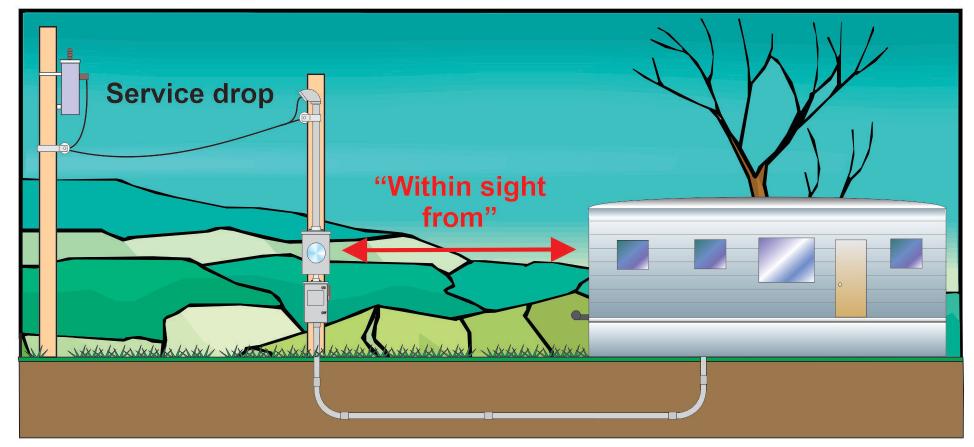


550.32(A) Service Equipment

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)
- A Reference 250.32 in the NEC for requirements concerning grounding
- <u>Note:</u> Manufactured homes (with permanent foundation) are not required to have remote service equipment

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)





A Certificate of Completion will be emailed to those who successfully completed course



4 hours of Code Class Hours will be reported to the OCILB for Code Continuing Education Credits



Contact instructor at hpmatthews@matthewselectrical.net for any questions or comments



Make sure you completely sign out of webinar after the next slide!



File Attachments for Item:

ER-4 2023 NEC Significant Changes Overview (Matthews Electrical Services)

All certifications (4 hours)

Staff Notes: Slides are a sampling.

ESIAC Recommendation:

Committee Recommendation:

BIOGRAPHY Henry P. Matthews PE, CPE, CESCP, PVA

Henry has over 31 years of experience in the electrical design, construction, engineering and safety fields. He has a passion for teaching and mentoring.

Henry obtained his Bachelor of Science degree in Electrical Engineering from Penn State University in 1989.

He also earned a Master of Business Administration from Bowling Green State University in 2003.

In addition, Henry earned several certificates including:

- Plumbing and Electrician from Penn Foster Career School
- Welding from Owens Community College in Findlay, Ohio
- Residential Solar PV Systems from Solar Engineering International

Henry currently holds the following licenses, and memberships:

- Licensed Electrical Contractor in Ohio
- Licensed Training Agency in Ohio
- Licensed Professional Engineer in Ohio, Michigan, Kentucky, Indiana, Illinois, Wisconsin
- Certified Plant Engineer (CPE)
- Certified Building Operator (CBO)
- Certified Electrical Compliance Safety Professional (CESCP) by NFPA
- Solar PV Associate by the North American Board of Certified Energy Practitioners
- Electric Vehicle Infrastructure Training Program (EVITP) certification
- Senior Member of the Institute of Electrical and Electronic Engineers (IEEE)
- Member of the International Association of Electrical Inspectors (IAEI)
- Member of the National Fire Protection Association (NFPA)

Henry is currently employed as an Advanced Senior Engineer for Marathon Petroleum Company in Findlay, Ohio. During his 16 years at Marathon, Henry has worked as an Electrical Design Engineer, Project Engineer, Engineering Supervisor and currently as a Reliability Engineer.

Henry is also the owner of Matthews Electrical Services, a small, but full-service electrical contractor company.

Prior to this, he worked 13 years as an Electrical Engineer and a Plant Engineering Manager in at Cooper Standard Automotive, a major automotive parts supplier in Bowling Green, Ohio

Henry is the past co-chair of American Petroleum Institute Recommended Practice 545 Lightning Protection for Above Ground Storage Tanks.

He was also past president of the Fostoria Toastmaster club.



Board of Building Standards

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 #
- o 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.

Phone: 614-644-2613

Board of Building Standards

Mike DeWine, Governor Jon Husted, Lt. Governor

Application for Continuing Education Course Approval

Provider Information:		
Name: Henry P. Matthews		
Organization: Matthews Electrical Services Address: 1203 McKinley Place; Fostoria, Ohio 4830		
Website: www.matthewselectrical.net		
Conference Sponsor (if applicable)	Conference Email:	
Check here if Course Renewal:Prio	r course number (i.e. BB\$2018-429)	
Renewals will only be granted for identical co	ontent 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: 2023 NEC Significant Code Changes Overview		
Course instructor: Henry P. Matthews		
Course description: This course will cover approximately 30 of the most significant code changes in the 2023 NEC		
	,	
Instructional hours per session: 4	Number of Sessions: at least one per quarter	
Course Date(s) and Location:	-	
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: www.matthewselectrical.net		
Surveys, polls, and roll call after each break will	on method (i.e. test, quizlets, participant activity confirmation):	
Surveys, poils, and foil call after each break will	The conducted.	
Course applicable for the following certification	tions	
Residential Certifications Only:	Commercial Certifications:	
Administrative Course, All Certifications:	Commercial Certifications:	
Application materials included:		
Course Outline or Course Learning Objectives		
Application materials included:		
✓ Assessment Materials (for o	nline courses)	
✓ Presenter Bio		
Please submit application and materials in .	.pdf format to: michael.lane@com.ohio.gov or BBS@com.ohio.gov	



Mike DeWine, Governor Sheryl Maxfield, Director

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

- 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.

614-644-2613

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.
- 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

2023 NEC Significant Code Changes Overview Outline

NEC Chapters and sections covered

- Scope: Article 90
- Chapters 1-9
- Annexes

Other Resources:

- 2021 NFPA 70E
- 2023 NFPA 70B
- NFPA 79

Referenced Websites:

- www.NFPA.org
 www.IAEI.org (International Association of Electrical Inspectors)
- www.mikeholt.com
- www.esfi.org Electrical Safety Foundation International)
- Various motor and transformer manufacturer websites.

Course Content:

- How to be involved in the code-making process
- How changes are integrated into the NEC
- Focus areas of the 2023 NEC
- Scope changes
- Format changes
- Significant changes in Chapters 1-9
 - o Note: detailed changes will be covered in separate classes or webinars

2023 NEC Significant Code Changes Overview



Notice!

This course is based on the 2023 NEC.

The 2023 NEC has not been adopted in Ohio

Presented for INFORMATIONAL PURPOSES ONLY.



WELCOME!

- Goals
 - Promote learning
 - Make session engaging
 - Discussion
 - Videos
 - Case Studies
 - Polls
 - Make 4 hours as productive as possible!

Your Instructor: Henry Matthews

- Advanced Senior Engineer (Current): Oil and Gas Company (16 yrs)
- Plant Engineering Manager: Cooper Standard Automotive (13 yrs)
- Electrical Designer: Toledo Engineering Company (4 yrs)
- BS Electrical Engineering Penn State University
- MBA Bowling Green State University
- Registered Professional Engineer OH, IN, KY, WI, MI, IL,WV
- Certified Professional Engineer CPE
- Certified Electrical Safety Compliance Professional (CESCP) by NFPA
- Licensed Electrical Contractor OH
- Registered Training Agency OCILB OH #48714
- Registered Training Agency Ohio Board of Building Standards (BBS)
- Senior Member of IEEE
- Member of NFPA Builders and Architects division
- Member of International Association of Electrical Inspectors (IAEI)
- Member of Association of Facility Engineers (AFE)
- Co-chair API RP 545 Lightning Protection for Above Ground Storage Tanks
- Over 29 years in the electrical design, construction and standards industry

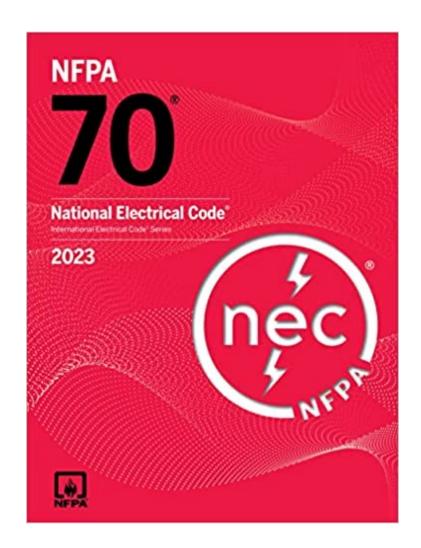
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Resources



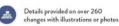
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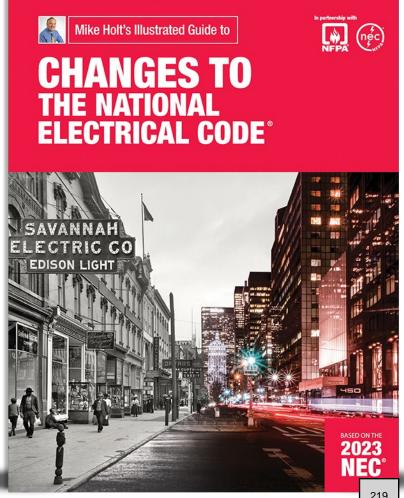
Analysis of Changes





Cross-references to other electrical industry standards





Current NEC Adoption

NEC® in Effect 2/1/2023



- The 2022 California Electrical Code, California Code of Regulations Title 24, Part 3 is based on the 2020 edition of NFPA 70®, National Electrical Code®.
- The 2011 New York City Electrical Code is based on the 2008 edition of NFPA 70®, National Electrical Code®.

Source: www.nfpa.org



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

- 900 Second Revisions
- 1805 First Revisions
- 441 Correlating Notes
- 1956 Public Comments
 55 Certified Amending Motions
- Several IAEI members served on NFPA Correlating Committee Task Groups to work on issues needing to be resolved

How to Get Involved in the Code-Making Process



2023 NEC Themes and Focus

GFCI, Ground Fault, AFCI Expansion

Continuation of External Disconnects

Medium Voltage Expansion

Listing of Equipment

Extending some Service requirements to Feeders

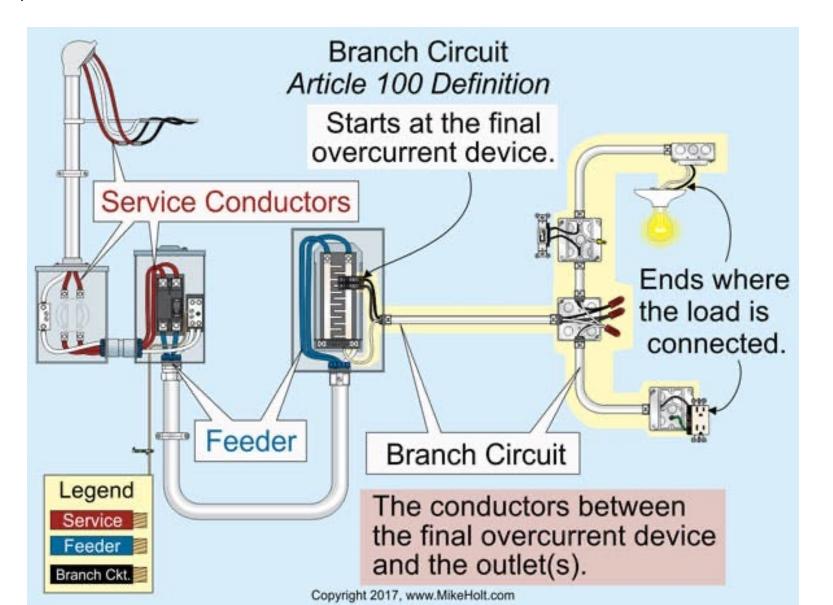
Addressing flaws of 2020 NEC

Gearing up for communication and renewables

Introduction of the Special Purpose GFCI (SPGFCI) for circuits with voltage > 150V to ground

Review!

Service, Feeders and Branch Circuits



New Articles (Medium Voltage)

- Article 235: Branch Circuits, Feeders, and Services over 1000 vac, 1500 vdc, nominal
- Article 245: Overcurrent Protection for Systems Rated Over 1000 vac, 1500 vdc
- Article 305: General Requirements for Wiring Methods and Materials for Systems Rated Over 1000 vac, 1500 vdc, nominal
- Article 315: Medium Voltage Conductors, Cable, Cable Joints, and Cable Terminations
- Article 495: Equipment Over 1000 vac, 1500 vdc, nominal

New Articles

- Article 369: Insulated Bus Pipe (IBP)/Tubular Covered Conductors (TCC) Systems
- Article 371: Flexible Bus Systems
- Article 722: Cables for Power-Limited Circuits, Fault-Managed Power Circuits and Optical Fiber
- Article 724: Class 1 Power-Limited Circuits and Class 1 Power-Limited Remote-Control and Signaling Circuits
- Article 726: Class 4 Fault Managed Power Systems

2023 NEC Key Changes

• Scope: 90.4 "Special Permission". This term has been removed from many sections because the scope in 90.4 gives the AHJ to waive certain NEC requirements.

 Can use QR (Quick Response) codes to find information regarding equipment



2023 NEC Key Changes

Article 110: Cybersecurity provisions



Introducing My Top 25 Code Changes!

(In chronological order)



#1. Article 100

• All definitions moved to the front





Definitions

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

- Article 100 now contains approximately 840 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
- An article number appearing after the defined term indicates the definition only applies to that article

#2. Section 110.17

- New Section!
- Servicing and Maintenance of Equipment
- Emphasizing importance of maintenance
- Promotes alignment with NFPA 70E and NFPA 70B



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110.17 Servicing and Maintenance of Equipment

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

Engineer Beth says:

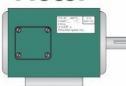
Requires the use of identified replacement parts that have been verified per applicable product standards

Parts are to be provided by either the:

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

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









110.17 Servicing and Maintenance of Equipment.

Servicing and electrical preventive maintenance shall be performed by qualified persons trained in servicing and maintenance of equipment and shall comply with the following:

NEW

- (1) The servicing and electrical preventive maintenance shall be performed in accordance with the original equipment manufacturer's instructions and information included in the listing information, applicable industry standards, or as approved by the authority having jurisdiction.
- (2) The servicing and electrical preventive maintenance shall be performed using identified replacement parts that are verified under applicable product standards. The replacement parts shall comply with at least one of the following:
 - a. Be provided by the original equipment manufacturer
 - Be designed by an engineer experienced in the design of replacement parts for the type of equipment being serviced or maintained
 - c. Be approved by the authority having jurisdiction

Informational Note No. 1: For equipment that is not listed or field labeled, or for which components are no longer available from the original equipment manufacturer, one way to determine suitability is to review the documentation that accompanies the replacement parts.

Informational Note No. 2: See NFPA 70B, Recommended Practice for Electrical Equipment Maintenance, for information related to preventive maintenance for electrical, electronic, and communication systems and equipment.

#3. Section 210.8(A)(6) Dwelling Unit Kitchens

- GFCI protection has been expanded to include any cord and plug equipment in the kitchen!
- It no longer matters if it serves the countertop or not

Major Impact!







210.8(A)(6) Dwelling Units- Kitchens

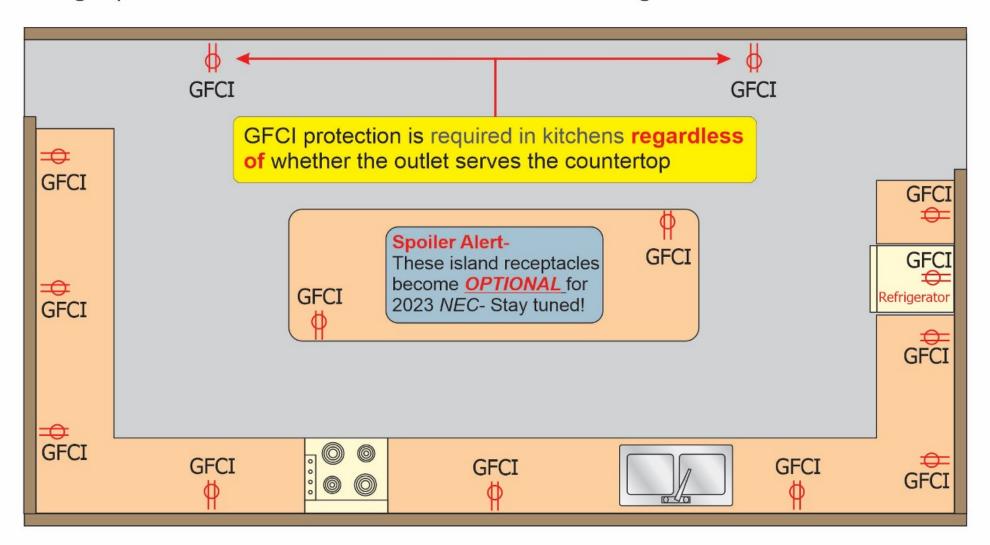
Ground-fault circuit-interrupter (GFCI) protection has been expanded to include any cord-and-plug equipment in the kitchen, regardless of whether the outlet serves the countertop

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

210.8(A)(6) Dwelling Unit Kitchens

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

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



2020

(A) Dwelling Units.

All 125-volt through 250-volt receptacles installed in the locations specified in 210.8(A)(1) through (A)(11) and supplied by single-phase branch circuits rated 150 volts or less to ground shall have ground-fault circuit-interrupter protection for personnel.

- (1) Bathrooms
- (2) Garages and also accessory buildings that have a floor located at or below grade level not intended as habitable rooms and limited to storage areas, work areas, and areas of similar use
- (3) Outdoors

Exception to (3): Receptacles that are not readily accessible and are supplied by a branch circuit dedicated to electric snow-melting, deicing, or pipeline and vessel heating equipment shall be permitted to be installed in accordance with **426.28** or **427.22**, as applicable.

- (4) Crawl spaces at or below grade level
- (5) Basements

Exception to (5): A receptacle supplying only a permanently installed fire alarm or burglar alarm system shall not be required to have ground-fault circuit-interrupter protection.

Informational Note: See 760.41(B) and 760.121(B) for power supply requirements for fire alarm systems.

Receptacles installed under the exception to <u>210.8(A)(5)</u> shall not be considered as meeting the requirements of **210.52(G)**.

(6) Kitchens — where the receptacles are installed to serve the countertop surfaces

2023

Δ

(A) Dwelling Units.

All 125-volt through 250-volt receptacles installed in the following locations and supplied by single-phase branch circuits rated 150 volts or less to ground shall have ground-fault circuit-interrupter protection for personnel:

- (1) Bathrooms
- (2) Garages and also accessory buildings that have a floor located at or below grade level not intended as habitable rooms and limited to storage areas, work areas, and areas of similar use
- (3) Outdoors
- (4) Crawl spaces at or below grade level
- (5) Basements
- (6) Kitchens

210.8 Ground-Fault Circuit-Interrupter Protection for Personnel

Parent text Changes

- GFCI required to be listed
- GFCI acronym use for efficiency
- Removed the language for measurement passing through a window. The measurement is the shortest path regardless of window. Only floor, wall, ceiling, and fixed barrier remain.







#4. Section 210.8(B)

Multiple changes involving GFCIs for Other than Dwelling Units



210.8(B) Other Than Dwelling Locations

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



2020

(B) Other Than Dwelling Units.

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 the locations specified in 210.8(B)(1) through (B)(12) shall have ground-fault circuit-interrupter protection for personnel.

- Bathrooms
- (2) Kitchens or areas with a sink and permanent provisions for either food preparation or cooking
- (3) Rooftops

Exception: Receptacles on rooftops shall not be required to be readily accessible other than from the rooftop.

(4) Outdoors

Exception No. 1 to (3) and (4): Receptacles that are not readily accessible and are supplied by a branch circuit dedicated to electric snow-melting, deicing, or pipeline and vessel heating equipment shall be permitted to be installed in accordance with 426.28 or 427.22, as applicable.

Exception No. 2 to (4): In industrial establishments only, where the conditions of maintenance and supervision ensure that only qualified personnel are involved, an assured equipment grounding conductor program as specified in <u>590.6(B)(2)</u> shall be permitted for only those receptacle outlets used to supply equipment that would create a greater hazard if power is interrupted or having a design that is not compatible with GFCI protection.

(5) Sinks — where receptacles are installed within 1.8 m (6 ft) from the top inside edge of the bowl of the sink

Exception No. 1 to (5): In industrial laboratories, receptacles used to supply equipment where removal of power would introduce a greater hazard shall be permitted to be installed without GFCI protection.

Exception No. 2 to (5): Receptacles located in patient bed locations of Category 2 (general care) or Category 1 (critical care) spaces of health care facilities shall be permitted to comply with 517.21.

2023

(B) Other Than Dwelling Units.

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 the following locations shall be provided with GFCI protection:

- (1) Bathrooms
- (2) Kitchens
- (3) Areas with sinks and permanent provisions for food preparation, beverage preparation, or cooking
- 4) Buffet serving areas with permanent provisions for food serving, beverage serving, or cooking
- (5) Rooftops

2020

- (6) Indoor damp and wet locations
- (7) Locker rooms with associated showering facilities
- (8) Garages, accessory buildings, service bays, and similar areas other than vehicle exhibition halls and showrooms
- (9) Crawl spaces at or below grade level
- (10) Unfinished areas of basements

Exception to (1) through (5), (8), and (10): Listed locking support and mounting receptacles utilized in combination with compatible attachment fittings installed for the purpose of serving a ceiling luminaire or ceiling fan shall not be required to be ground-fault circuit-interrupter protected. If a general-purpose convenience receptacle is integral to the ceiling luminaire or ceiling fan, GFCI protection shall be provided.

- (11) Laundry areas
- (12) Bathtubs and shower stalls where receptacles are installed within 1.8 m (6 ft) of the outside edge of the bathtub or shower stall

2023

- (6) Outdoors
- 7) Sinks where receptacles or cord-and-plug-connected fixed or stationary appliances are installed within 1.8 m (6 ft) from the top inside edge of the bowl of the sink
- (8) Indoor damp or wet locations
- (9) Locker rooms with associated showering facilities
- Garages, accessory buildings, service bays, and similar areas other than vehicle exhibition halls and showrooms
- (11) Crawl spaces at or below grade level
- (12) Unfinished areas of basements
- (13) Aquariums, bait wells, and similar open aquatic vessels or containers, such as tanks or bowls, where receptacles are installed within 1.8 m (6 ft.) from the top inside edge or rim or from the conductive support framing of the vessel or container
- (14) Laundry areas
- (15) Bathtubs and shower stalls where receptacles are installed within 1.8 m (6 ft) of the outside edge of the bathtub or shower stall



210.8(B) Other Than Dwelling Locations

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

- ⚠ 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 <u>making contact with</u> 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

Important!

- Note: in 2020 NEC, the <u>receptacle</u> had to be located within 6 ft of a sink
- Now in the 2023 NEC, it is the receptacle or the equipment within 6
 ft of a sink whichever is closest!

Major Impact!



Six Foot Rule Amended

- 6 ft used to be defined as distance from the edge of sink to the receptacle
- However, the shock hazard is not the receptacle, but the energized frame of the appliance



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

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

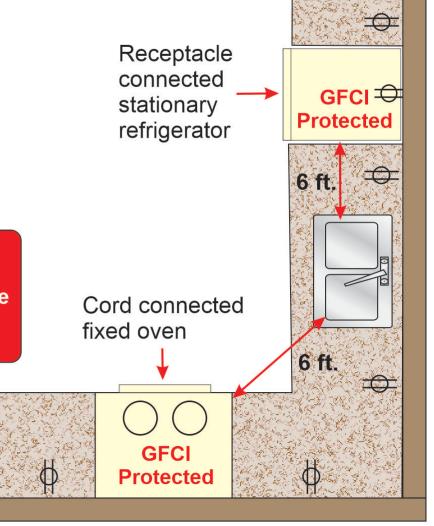
A word from Inspector Ivan:

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

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

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

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





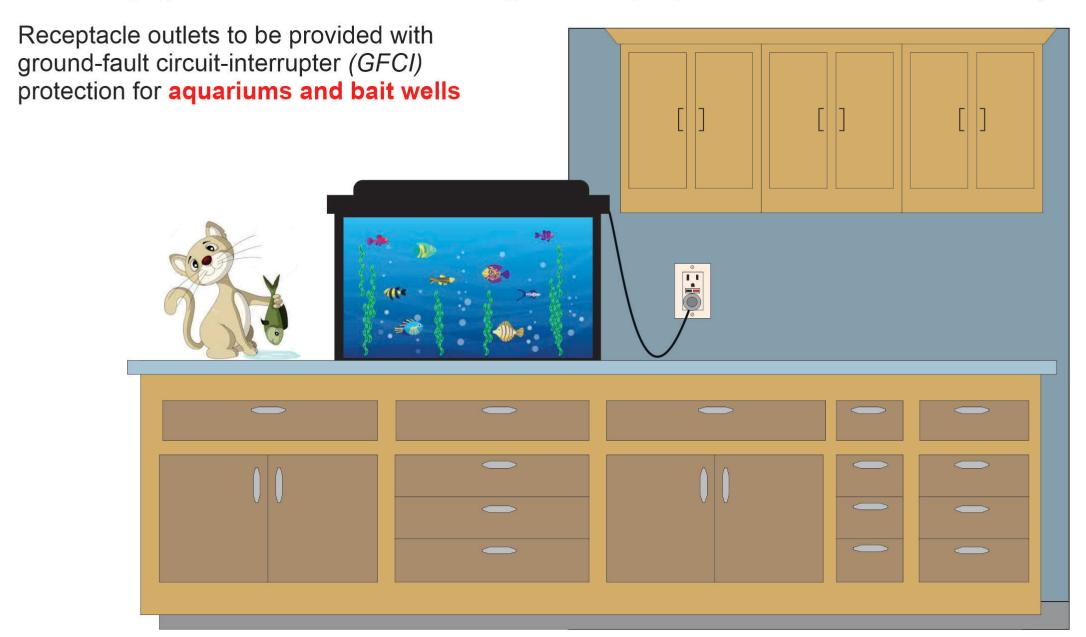
210.8(B) Other Than Dwelling Locations

A new list item (13) has been added for aquariums and bait wells in locations other than dwelling units

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

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



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







Bonus Slide: Honorable Mention



210.8(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

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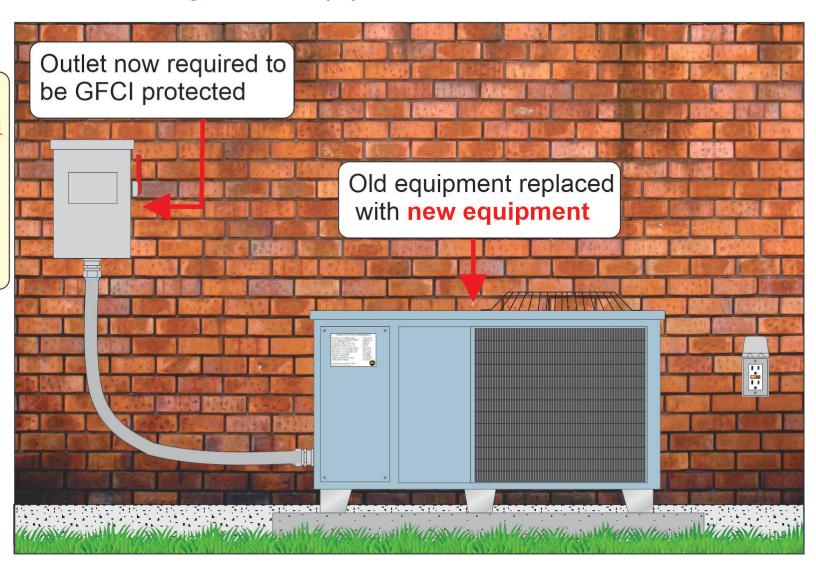
210.8(F) Outdoor Outlets (GFCI)

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







Bonus Slide: Honorable Mention

Section 210.23 Permissible Loads

Until the release of the 2023 NEC, the smallest branch circuit recognized by the NEC for power and lighting circuits has been 15 amps.

The NEC now recognizes 10-ampere branch circuits for select power and lighting loads

This is significant for the NEC and the industry as a whole.

The decision by the NEC to recognize 10-amp branch circuit conductors and overcurrent devices is likely in response to the availability of new higher efficiency lighting systems.

210.23 Permissible Loads

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

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

210.23 Permissible Loads

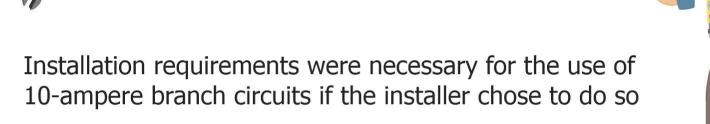
10 ampere branch circuits are now addressed in the NEC

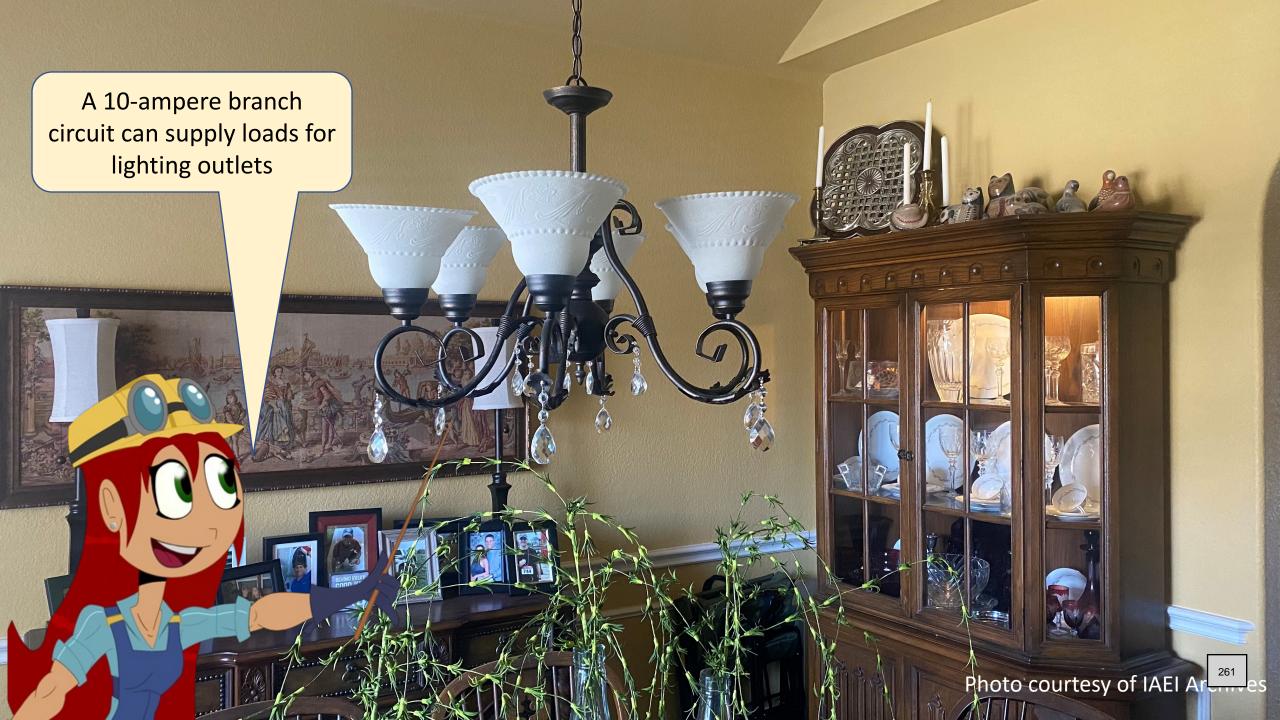
A 10-ampere branch circuit can supply loads for:

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

A 10-ampere branch circuit <u>cannot</u> supply loads for:

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











#5 Section 210.52(C): Islands and Peninsulas

Island and Peninsular Countertops and Work

AGAIN!



CONGRATULATIONS!



Next Steps



A Certificate of Completion will be emailed to those who successfully completed course



4 hours of Code Class Hours will be reported to the OCILB and OBBS for Code Continuing Education Credits



Contact instructor at hpmatthews@matthewselectrical.net for any questions or comments



Make sure you completely sign out of webinar after the next slide!



File Attachments for Item:

ER-5 Motors, Transformers, and the 2020 NEC (Matthews Electrical Services)

All certifications (4 hours)

Staff Notes: Slides are a sampling.

ESIAC Recommendation:

Committee Recommendation:

BIOGRAPHY Henry P. Matthews PE, CPE, CESCP, PVA

Henry has over 31 years of experience in the electrical design, construction, engineering and safety fields. He has a passion for teaching and mentoring.

Henry obtained his Bachelor of Science degree in Electrical Engineering from Penn State University in 1989.

He also earned a Master of Business Administration from Bowling Green State University in 2003.

In addition, Henry earned several certificates including:

- Plumbing and Electrician from Penn Foster Career School
- Welding from Owens Community College in Findlay, Ohio
- Residential Solar PV Systems from Solar Engineering International

Henry currently holds the following licenses, and memberships:

- Licensed Electrical Contractor in Ohio
- Licensed Training Agency in Ohio
- Licensed Professional Engineer in Ohio, Michigan, Kentucky, Indiana, Illinois, Wisconsin
- Certified Plant Engineer (CPE)
- Certified Building Operator (CBO)
- Certified Electrical Compliance Safety Professional (CESCP) by NFPA
- Solar PV Associate by the North American Board of Certified Energy Practitioners
- Electric Vehicle Infrastructure Training Program (EVITP) certification
- Senior Member of the Institute of Electrical and Electronic Engineers (IEEE)
- Member of the International Association of Electrical Inspectors (IAEI)
- Member of the National Fire Protection Association (NFPA)

Henry is currently employed as an Advanced Senior Engineer for Marathon Petroleum Company in Findlay, Ohio. During his 16 years at Marathon, Henry has worked as an Electrical Design Engineer, Project Engineer, Engineering Supervisor and currently as a Reliability Engineer.

Henry is also the owner of Matthews Electrical Services, a small, but full-service electrical contractor company.

Prior to this, he worked 13 years as an Electrical Engineer and a Plant Engineering Manager in at Cooper Standard Automotive, a major automotive parts supplier in Bowling Green, Ohio

Henry is the past co-chair of American Petroleum Institute Recommended Practice 545 Lightning Protection for Above Ground Storage Tanks.

He was also past president of the Fostoria Toastmaster club.

Motors, Transformers and the NEC

Outline

Relevant NEC Chapters and Articles (Based on the 2020 NEC)

- Article 430 Motors, Motor Circuits and Controllers
- Article 450 Transformers and Transformer vaults
- Article 240 Overcurrent Protection
- Article 250 Grounding and Bonding
- Chapter 3 Wiring Methods and Materials
- Chapter 9 Tables

Other Resources:

- NFPA 70E (2021) Electrical Safety in the Workplace
- OSHA 1910 Subpart S Electrical Safety

Referenced Websites:

- www.NFPA.org
 www.IAEI.org (International Association of Electrical Inspectors)
- www.mikeholt.com
- www.esfi.org Electrical Safety Foundation International)
- www.Eaton.com
- Various motor and transformer manufacturer websites.

Course Content:

- History of Motors
- Definitions
- Motor and generator theory
- Types of motors and applications
- How to apply article 430 to motor installations
- History of Transformers
- Definitions
- Transformer theory
- Types of transformers
- How to apply article 450 to transformer installations
- Transformer system grounding per Article 250



Board of Building Standards

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.

Phone: 614-644-2613

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Mike DeWine, Governor Jon Husted, Lt. Governor Sheryl Maxfield, Director

Board of Building Standards

Application for Continuing Education Course Approval

Provider Information:	
Name: Henry P. Matthews	
Organization: Matthews Electrical Services Address: 1203 McKinley Place; Fostoria, Ohio 4830	
Website: www.matthewselectrical.net Conference Sponsor (if applicable) Conference Email:	
Renewals will only be granted for identical content and certifications, within the current code cycle.	
Attach a copy of prior course approval letter fo	r confirmation. No further information is required.
New Course Information:	
Course title: Motors, Transformers and the NEC	
Course instructor: Henry P. Matthews	
	nt motor terms and installation requirement from article 430 in NEC.
It will also cover terms and installation requirements for transformers in article 450.	
Instructional hours per session: 4	Number of Sessions: at least one per quarter
Course Date(s) and Location:	
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: www.matthewselectrical.net	On Demand Webmar
	method (i.e. test, quizlets, participant activity confirmation):
Surveys, polls, and roll call after each break will be	conducted
Carroyo, pono, ana ron can anor cach broak min be	, 001144404
Course applicable for the following certification	ons
	/
Residential Certifications Only:	Commercial Certifications:
Administrative Course, All Certifications:	
Application materials included:	
	ning Ohjectives
✓ Presentation Materials/Slides (not required for roundtable courses)	
✓ Assessment Materials (for onli	•
Course Outline or Course Learn Presentation Materials/Slides (Assessment Materials (for online) Presenter Bio	ic courses,
Please submit application and materials in .pc	If format to: michael.lane@com.ohio.gov or BBS@com.ohio.gov



Mike DeWine, Governor

Instructions for new Continuing Education Approval form

Provider Information

Shervl Maxfield, Director

- 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.
- 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

Motors and Transformers

Matthews Electrical Services *Ohio Training Agency #48714*Henry Matthews, PE, CPE, CESCP







WELCOME!

- Goals
 - Review electrical theory
 - Review important NEC Calculations
 - Make session engaging
 - Discussion
 - Videos
 - Polls
 - Make 4 hours as productive as possible!

Your Instructor: Henry Matthews

- Advanced Senior Engineer (Current): Oil and Gas Company (17 yrs)
- Plant Engineering Manager: Cooper Standard Automotive (13 yrs)
- Electrical Designer: Toledo Engineering Company (4 yrs)
- BS Electrical Engineering Penn State University
- MBA Bowling Green State University
- Registered Professional Engineer OH, IN, KY, WI, MI, IL,WV
- Certified Professional Engineer CPE
- Certified Electrical Safety Compliance Professional (CESCP) by NFPA
- Licensed Electrical Contractor OH
- Registered Training Agency OCILB OH #48714
- Registered Training Agency Ohio Board of Building Standards (BBS)
- Senior Member of IEEE
- Member of NFPA Builders and Architects division
- Member of International Association of Electrical Inspectors (IAEI)
- Member of Association of Facility Engineers (AFE)
- Co-chair API RP 545 Lightning Protection for Above Ground Storage Tanks
- Over 29 years in the electrical design, construction and standards industry



Agenda

Applicable Codes and NEC Standards

Motor Theory

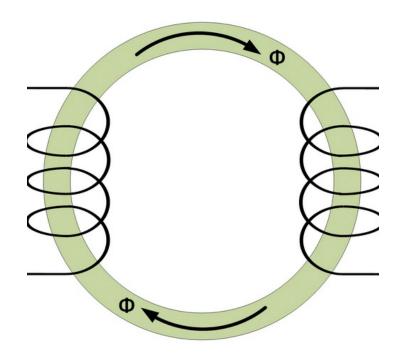
Transformer Theory

Article 430 Motors

Article 450 Transformers

Why Motors and Transformers?

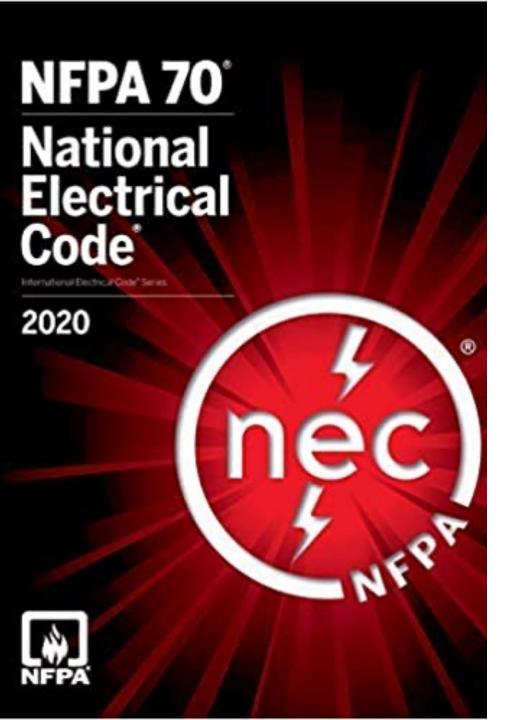
- Both use mutual induction and magnetism
- Transformer: stationary magnetic field
- Motors: rotating magnetic field
- Motors are similar to generators
 - Motors require electric power to create work
 - Generator require work to create electric power



Goal:

Take the Mystery out of Motors and Transformers





Motors and Transformers

Motors: Article 430

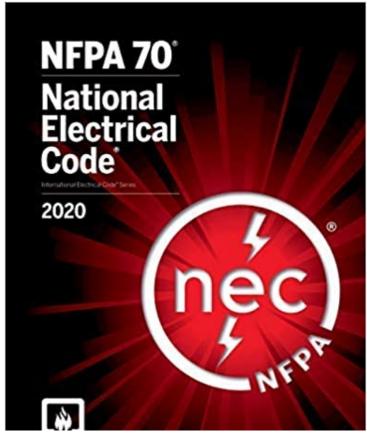
• 27 pages

Transformers: Article 450

• 7 pages

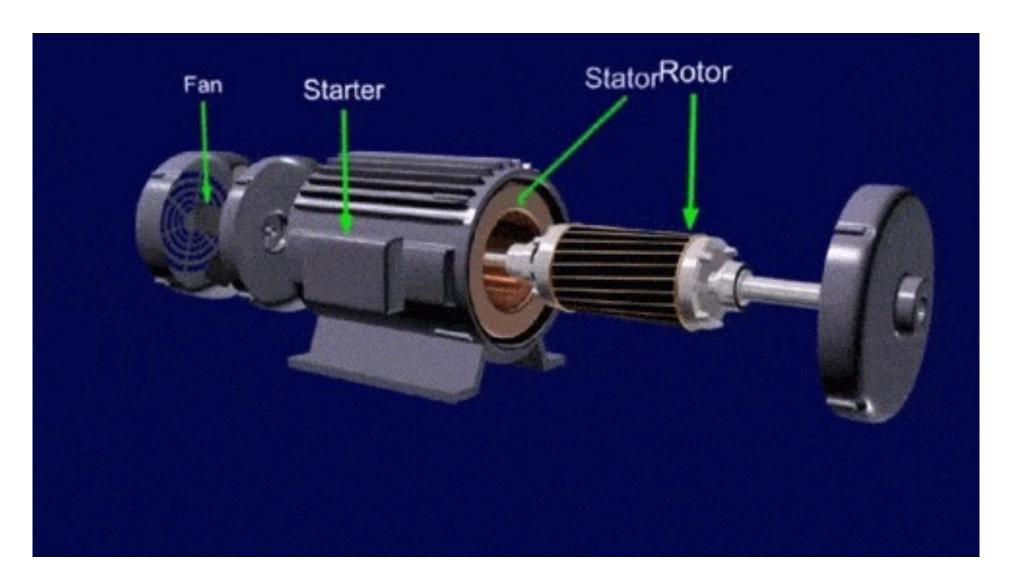
Recommendations for This Course

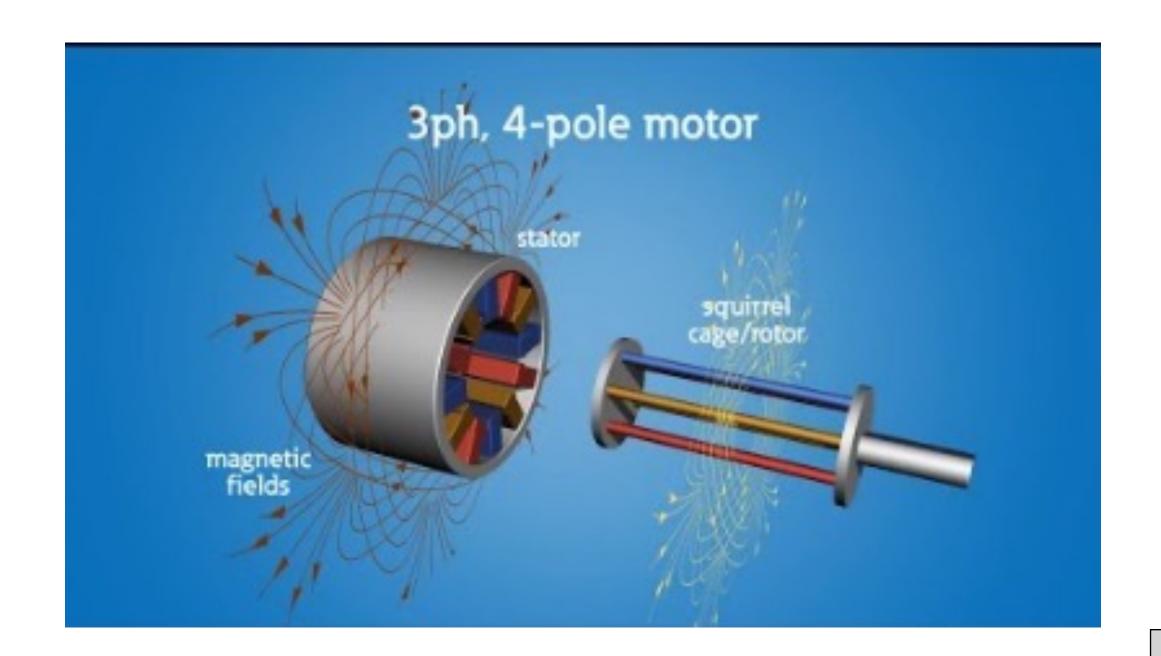




- Have copy of NEC for reference
- Grab a basic calculator perform simple calculations
- Advise me to slow down if something is not clear
- Don't be afraid to question something if you don't agree

Motors! Article 430





Motor Challenges

- Motors present unique challenges
 - High starting (inrush current)
 - How to start motor without tripping circuit breaker
 - Motors are very expensive protection motor is a priority in many cases
 - Adequately protecting motor feeder
 - Multiple motors on a circuit
 - High Inertia



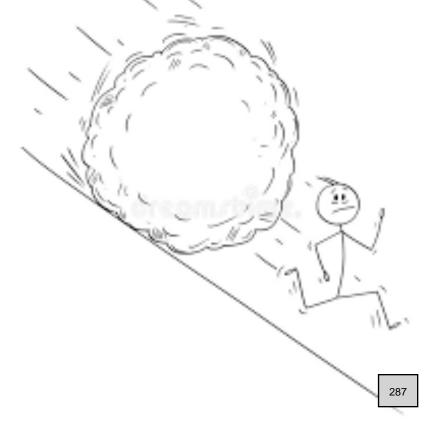
Newton's First Law: Inertia

Newton's first law states that every object will remain at rest or in uniform motion in a straight line unless compelled to change its state by the action of an external force.

In other words... an object in motion will stay in motion unless

acted upon by another force





Motor Challenges

- Safety: stopping, torque, speed control, guarding moving parts
- Lots of energy: inductive
- Produce heat
- Vibration: impacts connections and cabling
- Impacts power factor
- What is a motor running backwards?

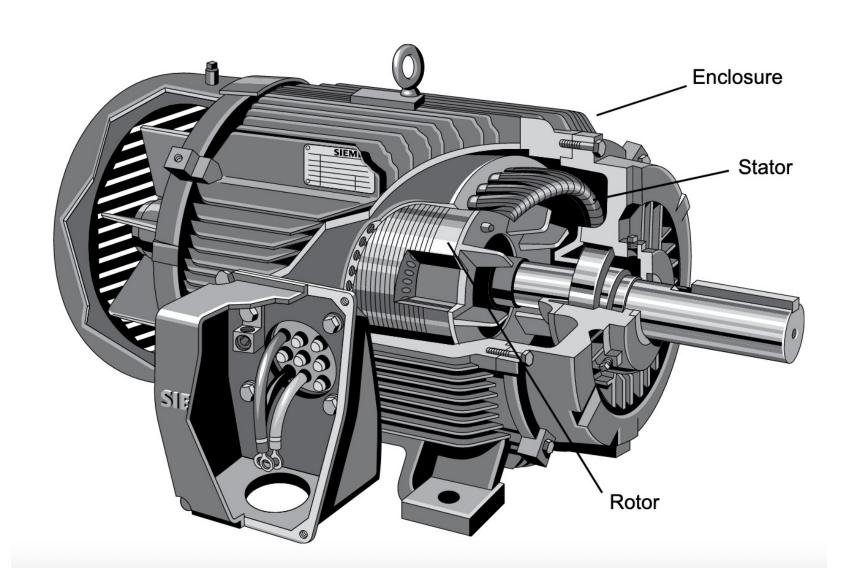
Goals

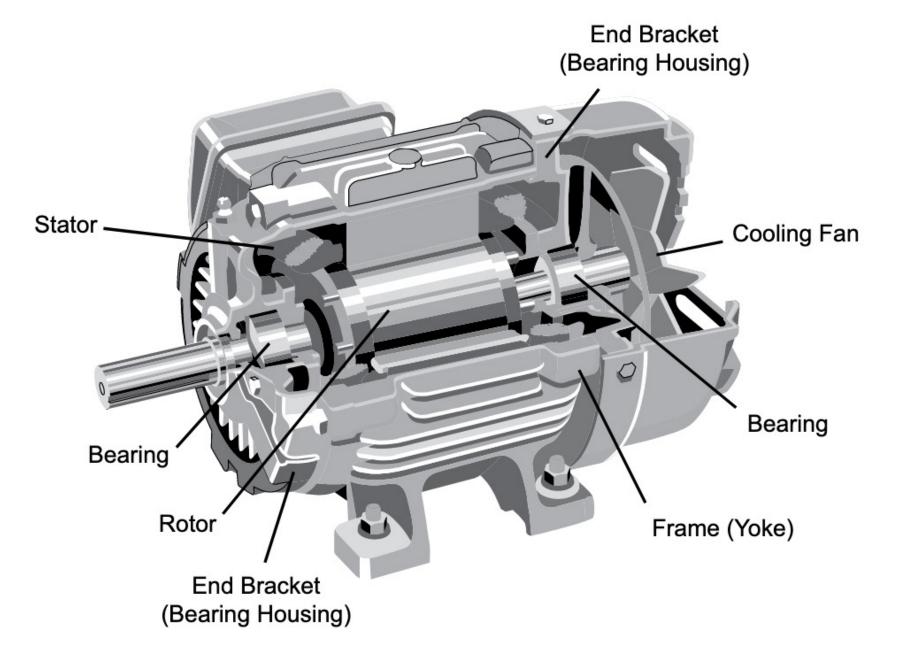
- Protect motor from overcurrent (short-circuits and ground faults)
- Protect motor from overload (heat, excessive current from overloads)
- Protect motor conductors
- Protect people (shocks, arc flash, burns etc.). Also see NFPA 70E



Definitions (Not in NEC)

- Torque: rotational force
- Slip: the difference between the rotating magnetic field and the rotor





Motor Nameplate Information

- HP (Horsepower): Rotational Power of a motor
- Voltage: Rated voltage of a motor
- Frequency: Number of cycles/sec of the incoming power (design)
 - 60 Hz for USA, 50 Hz for Europe
- RPM (Revolutions per Minute): speed of a motor
 - Determined by number of poles and motor frequency
 - RPM = $(120 \times F)$ /number of poles of motor
 - For example: What is the speed of a 60HZ, 2 pole induction motor?
 - RPM = $(120 \times 60)/2 = 7200/2 = 3600 \text{ rpm}$
 - Note: the more poles a motor has, the lower the RPM

Motor Nameplate Continued

- Full load Amps (FLA)
 - The current the motor draws when running at rated voltage, frequency and RPM
- Frame size: provides information on
 - Size of motor
 - Mounting of motor
 - Connection to load (C-face, gearbox, coupling etc.)

Motor Nameplate Information

Service Factor:

- The percentage of overloading the motor can handle for short periods
- Example: a 10 hp motor with a service factor of 1.15 could provide 10 x 1.15 = 11.5 hp for a short time.
- Locked rotor amps and code:
 - The KVA (kilo-volt-amps) of a motor when starting. This is usually 6 to 8 times the full load current.
 - KVA can be converted to amps to determine the locked rotor amps. Can be used to help size the overcurrent protective devices (fuses and circuit breakers)

Motor Nameplate Information

- Locked Rotor amps (cont.)
 - Code Letters: A-H, J-N, P-V
 - Used to help size the overcurrent protection of a motor
- See Table 430.7(B)
- Example: What is the Locked Rotor Amps of a 3-phase, 20 HP,
 208V motor with a code letter B?

Code Letter and Locked Rotor Amps

- 20 HP
- 208 volts, 3 phase
- Code letter B:
 - 3.15 3.54 per Table 430.7(B)
 - Use 3.54 for worst case

- Amps = KVA per HP x 1000/(Volts x 1.732)
- Amps = $3.54 \times 20 \times 1000/(208 \times 1.732)$
- Amps = 196.52

Pin Header Table 430.7	(B) Locked-Rotor Indicating Code Letters
Code Letter	Kilovolt-Amperes per Horsepower with Locked Rotor
А	0-3.14
В	3.15-3.54
С	3.55-3.99
D	4.0-4.49
Е	4.5-4.99
F	5.0-5.59
G	5.6-6.29
Н	6.3-7.09
J	7.1-7.99
K	8.0-8.99
L	9.0-9.99
M	10.0-11.19
N	11.2-12.49
Р	12.5-13.99
R	14.0-15.99
S	16.0-17.99
Т	18.0-19.99
II	20 0-22 39

Temperature (T-Codes)

Maximum 7	Temperature Class (T-Code)			
Degrees C	Degrees F			
450	842	T1		
300	572	T2		
280	536	T2A		
260	500	T2B		
230	446	T2C		
215	419	T2D		
200	392	T3		
180	356	T3A		
165	329	T3B		
160	320	T3C		
135	275	T4		
120	248	T4A		
100	212	T5		
85	185	T6 24		

ties, is provided in Table 4.4.2.

Table 4.4.2 Selected Chemicals

CAS No.	Class I Division Group	Typeª	Flash Point (°C)	AIT (°C)	%LFL	%UFL	Vapor Density (Air = 1)	Vapor Pressure ^b (mm Hg)	Class I Zone Group ^c	MIE (mJ)	MIC Ratio	MESO (mm)
75-07-0	C_q	I	-38	175	4.0	60.0	1.5	874.9	IIA	0.37	0.98	0.92
64-19-7	$\mathbf{D^d}$	П	39	426		19.9	2.1	15.6	IIA		2.67	1.76
540-88-5	D	II			1.7	9.8	4.0	40.6				
108-24-7	D	П	49	316	2.7	10.3	3.5	4.9	IIA			1.23
67-64-1	$\mathbf{D^d}$	I	-20	465	2.5	12.8	2.0	230.7	IIA	1.15	1.00	1.02
75-86-5	D	IIIA	74	688	2.2	12.0	2.9	0.3				
75-05-8	D	I	6	524	3.0	16.0	1.4	91.1	IIA			1.50
74-86-2	A^d	GAS		305	2.5	100	0.9	36600	IIC	0.017	0.28	0.25
107-02-8	B(C)d	I		235	2.8	31.0	1.9	274.1	IIB	0.13	61 (St. Alex)	2022
79-10-7	D	II	54	438	2.4	8.0	2.5	4.3	ΠВ			0.86
107-13-1	$\mathbf{D^d}$	I	0	481	3	17	1.8	108.5	ΠВ	0.16	0.78	0.87
111-69-3	D	IIIA		550			1.0	0.002				
107-18-6	C_q	I		378	2.5	18.0	2.0	25.4	IIB			0.84
107-05-1	D	I	-32	485	2.9	11.1	2.6	366	IIA		1.33	1.17
106-92-3	B(C)e	П		57			3.9					
98-83-9	D	II	1000000	574	0.8	11.0	4.1	2.7	9000 April 190			POS 2014 0 14
628-63-7	D	I	25	360	1.1	7.5	4.5	4.2	IIA			1.02
626-38-0	D	I	23		1.1	7.5	4.5		IIA			
7664-41-7	$D^{d,f}$	GAS		651	15	28	0.6	7498.0	IIA	680	6.85	3.17
62-53-3	D	IIIA	70	615	1.2	8.3	3.2	0.7	IIA			
71-43-2	$\mathbf{D^d}$	I	-11	498	1.2	7.8	2.8	94.8	IIA	0.20	1.00	0.99
98-87-3	D	IIIA		585	1.1		4.4	0.5				
106-96-7	D	I	10	324	3.0							
106-97-8	-	GAS		288	1.9	8.5	2.0		IIA	0.25	0.94	1.07
106-99-0	$B(D)^{d,e}$	GAS		420	2.0	11.5	1.9		IIB	0.13	0.76	0.79
71-36-3	$\mathbf{D^d}$	I	36	343	1.4	11.2	2.6	7.0	IIA			0.91
78-92-2	D^d	I	23.8	405	1.7	9.8	2.6		IIA			30
	75-07-0 64-19-7 540-88-5 108-24-7 67-64-1 75-86-5 75-05-8 74-86-2 107-02-8 79-10-7 107-13-1 111-69-3 107-18-6 107-05-1 106-92-3 98-83-9 628-63-7 626-38-0 7664-41-7 62-53-3 71-43-2 98-87-3 106-96-7 106-97-8 106-99-0 71-36-3	CAS No. Group 75-07-0 C ^d 64-19-7 D ^d 540-88-5 D 108-24-7 D 67-64-1 D ^d 75-86-5 D 75-05-8 D 74-86-2 A ^d 107-02-8 B(C) ^d 79-10-7 D 107-13-1 D ^d 111-69-3 D 107-18-6 C ^d 107-05-1 D 106-92-3 B(C) ^e 98-83-9 D 628-63-7 D 626-38-0 D 7664-41-7 D ^{d,f} 62-53-3 D 71-43-2 D ^d 98-87-3 D 106-96-7 D 106-97-8 D ^{d,g} 106-99-0 B(D) ^{d,e} 71-36-3 D ^d	Division Group Typea	CAS No. Group Typea Point (°C) 75-07-0 Cd I -38 64-19-7 Dd II 39 540-88-5 D II 49 67-64-1 Dd I -20 75-86-5 D IIIA 74 75-05-8 D I 6 74-86-2 Ad GAS 1 107-02-8 B(C)d I -79-10-7 D 107-13-1 Dd I 0 1 111-69-3 D IIIA 93 107-18-6 Cd I 22 107-05-1 D I 22 107-05-1 D I 23 106-92-3 B(C)e II 98-83-9 D II 25 626-38-0 D I 23 7664-41-7 Ddf GAS 62-53-3 D IIIA 70 71-43-2 Dd I -11	CAS No. Group Type ^a Point (°C) AIT 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75-86-5 D IIIA 74 688 2.2 12.0 2.9 75-05-8 D I 6 524 3.0 16.0 1.4 74-86-2 A³ GAS 305 2.5 100 0.9 107-02-8 B(C)³ I 235 2.8 31.0 1.9 79-10-7 D II 54 438 2.4 8.0 2.5 107-13-1 D³ I 0 481 3 17 1.8</td> <td>CAS No. Division Group Type* Flash Point (°C) AIT (°C) %LFL (Air = 1) Pressure (Air = 1) Pressure (mm Hg) 75-07-0 C³ I -38 175 4.0 60.0 1.5 874.9 64-19-7 D⁴ II 39 426 19.9 2.1 15.6 540-88-5 D II 49 316 2.7 10.3 3.5 4.9 67-64-1 D⁴ I -20 465 2.5 12.8 2.0 230.7 75-86-5 D IIIA 74 688 2.2 12.0 2.9 0.3 75-05-8 D I 6 524 3.0 16.0 1.4 91.1 74-86-2 A⁴ GAS 305 2.5 100 0.9 36600 107-02-8 B(C)⁴ I 235 2.8 31.0 1.9 274.1 79-10-7 D II 54 438 2.4 8.0<!--</td--><td> CAS No. Croup Type* Point (*C) C*C %LFL %UFL (Air = 1) (mm Hg) Croup* </td><td>CAS No. Division Group Type* Flash Point (*C) AIT (*C) % LFL (*Air = 1) Density (mm Hg) (mm Hg) Zone (mI) 75-07-0 G4-19-7 C* I −38 175 4.0 60.0 1.5 874.9 IIA 0.37 64-19-7 D* II 39 426 19.9 2.1 15.6 IIA 0.37 108-24-7 D III B 316 2.7 10.3 3.5 4.9 IIA 1.15 67-64-1 D* II 49 316 2.7 10.3 3.5 4.9 IIA 1.15 67-64-1 D* III 49 316 2.7 10.3 3.5 4.9 IIA 1.15 67-86-5 D IIIA 74 688 2.2 12.0 2.9 0.3 75-05-8 D I 6 524 3.0 16.0 1.4 91.1 IIA 79-05-8 D I 6 524 3.0 16.0 1.4 91.1 IIA<!--</td--><td> Plash Cas No. Croup Type Point (°C) Croup Croup Point (°C) Croup Croup Pressure Croup Croup</td></td></td>	CAS No. Division Group Type ^a Flash Point (°C) AIT (°C) %LFL 75-07-0 C ^d I -38 175 4.0 64-19-7 D ^d II 39 426 540-88-5 D II 49 316 2.7 67-64-1 D ^d I -20 465 2.5 75-86-5 D IIIA 74 688 2.2 75-05-8 D I 6 524 3.0 74-86-2 A ^d GAS 305 2.5 107-02-8 B(C) ^d I 235 2.8 79-10-7 D II 54 438 2.4 107-13-1 D ^d I 0 481 3 111-69-3 D IIIA 93 550 107-18-6 C ^d I 22 378 2.5 107-05-1 D I -32 485 2.9 106-92-3<	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	CAS No. Division Group Type* Point (°C) C°C) %LFL %UFL (Air = 1) 75-07-0 C³ I -38 175 4.0 60.0 1.5 64-19-7 D³ II 39 426 19.9 2.1 540-88-5 D II 49 316 2.7 10.3 3.5 67-64-1 D³ I -20 465 2.5 12.8 2.0 75-86-5 D IIIA 74 688 2.2 12.0 2.9 75-05-8 D I 6 524 3.0 16.0 1.4 74-86-2 A³ GAS 305 2.5 100 0.9 107-02-8 B(C)³ I 235 2.8 31.0 1.9 79-10-7 D II 54 438 2.4 8.0 2.5 107-13-1 D³ I 0 481 3 17 1.8	CAS No. Division Group Type* Flash Point (°C) AIT (°C) %LFL (Air = 1) Pressure (Air = 1) Pressure (mm Hg) 75-07-0 C³ I -38 175 4.0 60.0 1.5 874.9 64-19-7 D⁴ II 39 426 19.9 2.1 15.6 540-88-5 D II 49 316 2.7 10.3 3.5 4.9 67-64-1 D⁴ I -20 465 2.5 12.8 2.0 230.7 75-86-5 D IIIA 74 688 2.2 12.0 2.9 0.3 75-05-8 D I 6 524 3.0 16.0 1.4 91.1 74-86-2 A⁴ GAS 305 2.5 100 0.9 36600 107-02-8 B(C)⁴ I 235 2.8 31.0 1.9 274.1 79-10-7 D II 54 438 2.4 8.0 </td <td> CAS No. Croup Type* Point (*C) C*C %LFL %UFL (Air = 1) (mm Hg) Croup* </td> <td>CAS No. Division Group Type* Flash Point (*C) AIT (*C) % LFL (*Air = 1) Density (mm Hg) (mm Hg) Zone (mI) 75-07-0 G4-19-7 C* I −38 175 4.0 60.0 1.5 874.9 IIA 0.37 64-19-7 D* II 39 426 19.9 2.1 15.6 IIA 0.37 108-24-7 D III B 316 2.7 10.3 3.5 4.9 IIA 1.15 67-64-1 D* II 49 316 2.7 10.3 3.5 4.9 IIA 1.15 67-64-1 D* III 49 316 2.7 10.3 3.5 4.9 IIA 1.15 67-86-5 D IIIA 74 688 2.2 12.0 2.9 0.3 75-05-8 D I 6 524 3.0 16.0 1.4 91.1 IIA 79-05-8 D I 6 524 3.0 16.0 1.4 91.1 IIA<!--</td--><td> Plash Cas No. Croup Type Point (°C) Croup Croup Point (°C) Croup Croup Pressure Croup Croup</td></td>	CAS No. Croup Type* Point (*C) C*C %LFL %UFL (Air = 1) (mm Hg) Croup*	CAS No. Division Group Type* Flash Point (*C) AIT (*C) % LFL (*Air = 1) Density (mm Hg) (mm Hg) Zone (mI) 75-07-0 G4-19-7 C* I −38 175 4.0 60.0 1.5 874.9 IIA 0.37 64-19-7 D* II 39 426 19.9 2.1 15.6 IIA 0.37 108-24-7 D III B 316 2.7 10.3 3.5 4.9 IIA 1.15 67-64-1 D* II 49 316 2.7 10.3 3.5 4.9 IIA 1.15 67-64-1 D* III 49 316 2.7 10.3 3.5 4.9 IIA 1.15 67-86-5 D IIIA 74 688 2.2 12.0 2.9 0.3 75-05-8 D I 6 524 3.0 16.0 1.4 91.1 IIA 79-05-8 D I 6 524 3.0 16.0 1.4 91.1 IIA </td <td> Plash Cas No. Croup Type Point (°C) Croup Croup Point (°C) Croup Croup Pressure Croup Croup</td>	Plash Cas No. Croup Type Point (°C) Croup Croup Point (°C) Croup Croup Pressure Croup Croup

57 deg C = 134.6 deg F

(continues)

Nameplate Information

- Hazardous location classification
 - Gives information for what locations this motor can be used
 - Class I, Class II, Class III; Divisions 1 and 2 for example

Altitude:

- Standard motors are designed to operate below 3300 feet. Above 3300 feet, air is thinner and the ability to dissipate heat is not as good.
- Most motors must be derated for altitudes above 3300 feet.
- The derating factor may or may not be stamped on the motor nameplate. Check manufacturing manual for more information.

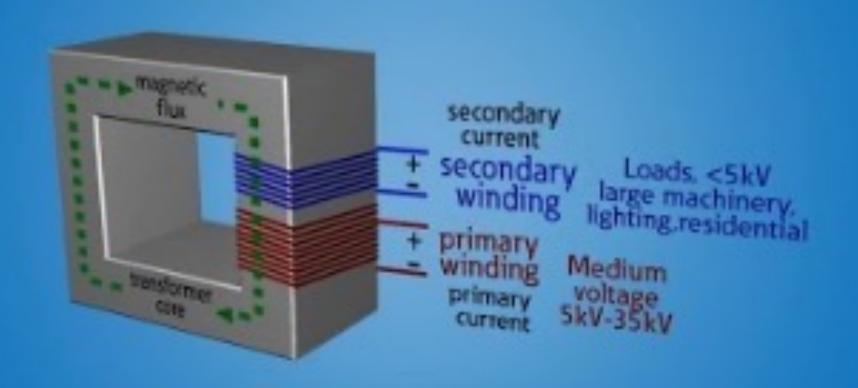
Article 450: Transformers and Transformer Vaults







Transformer construction



Transformer Basics

- Works on the principle of mutual induction
- Power measured in VA (Volts-Amps)
- Can be single phase or three phase
- Typically have a primary and secondary winding
- Current in one winding induces a current in another winding
- Voltage and current determined by the number of turns of wire in the windings
- Can step up or step down voltage and current
- Used for circuit isolation
- Windings require protection from damage

Issues with Transformer Installations

- Inrush current
 - Allowing transformer to start without tripping, similar to motors
- Dealing with two sets of voltages and currents
- Confusing overcurrent protection requirements
 - Primary only
 - Primary and secondary
 - Supervised
 - Unsupervised
- Can be extremely high fault currents on the secondary of the transformer due to low impedance

Issues with Transformer Installations

- Heat: cooling
- Grounding and bonding can be complicated
- Environment, many installed outdoors
- Environmental, some are oil-filled, leaks
- Noise
- Security, recent issues with shootings of transformers
- Expensive
- Large, heavy, hard to transport and maneuver
- Vibration

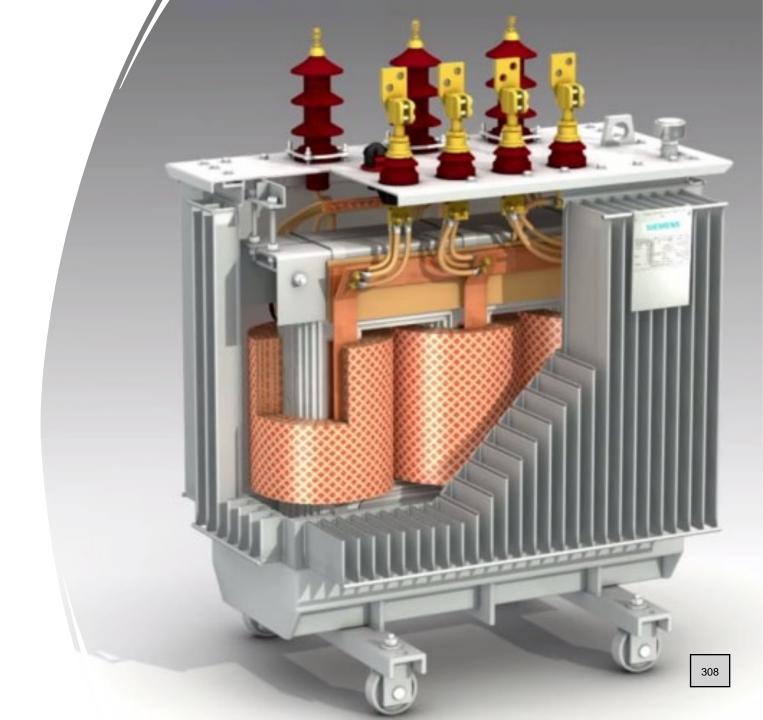
Overcurrent Protection

- Article 450: goal is to protect the TRANSFORMER, not the conductors
- Article 240: goal is to protect the transformer FEEDERS
- The overcurrent protection requirements of 450 may also protect the feeders
- The overcurrent protection requirements of 240 may also protect the

transformer

• BUT they may not!

Transformers
Protected
According to
Article 450



Transformer Secondary Feeder Protection

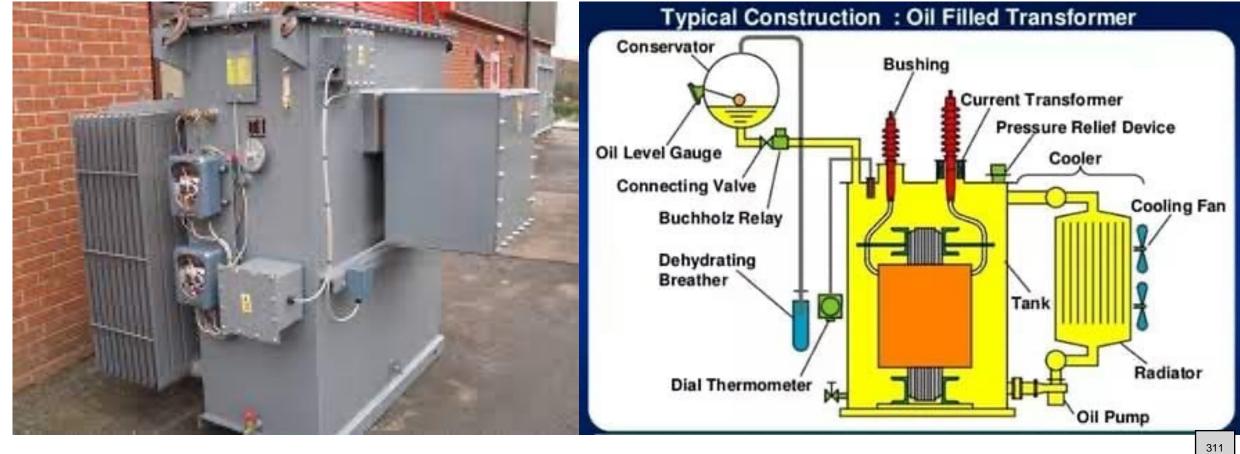
- Required with few exceptions
- Primary side protection of secondary feeders is allowed when requirements of 240.21(C)(1) are met
- Secondary OCPD is not required when the conductor is short and meets the tap rule requirements in 240.21(C)(2), (3) (5) and (6)
- Secondary OCPD is not required for outside conductors when the requirements of 240.21(C)((4) are met (another tap rule)

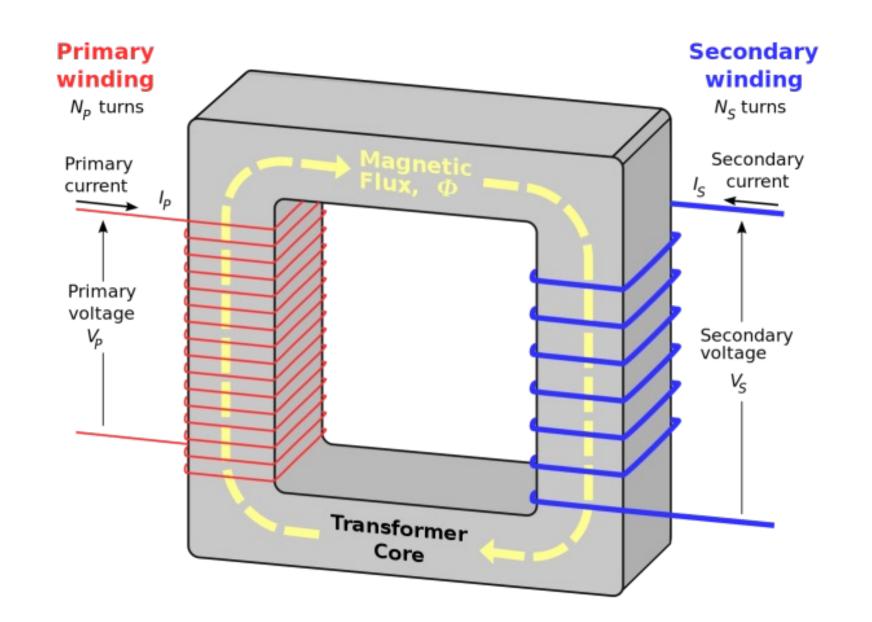
Types • Dry-type





Oil -Filled





Guarding 450.8

 Mechanical protection shall be provided to minimize the possibility of damage to transformers, examples: barriers, bollards, fencing, walls etc.

- Exposed energize parts shall be guarded
- Voltage warning labels or other types of identification shall be installed to indicate the operating voltage of the transformer

Ventilation (450.9)

 Transformers shall be installed such that vents won't be blocked by walls or other obstacles



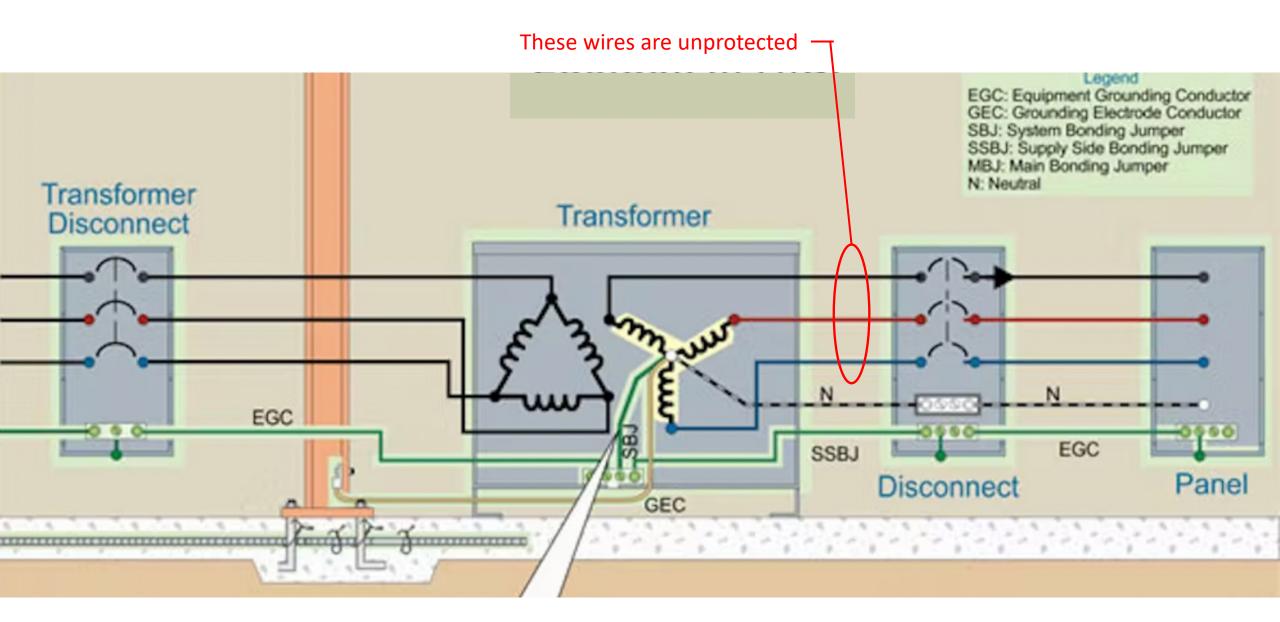
Marking Requirements (450.11)

- Name of manufacturer
- Rated Kilovolt-amperes
- Frequency
- Primary and secondary voltage
- Impedance of transformers 25 kva and larger
- Required clearances for transformers with ventilation openings
- Amount and kind of insulating liquid where used
- For dry-type transformers, temperature class for the insulating system.



Where would you put a circuit breaker or a fuse on the secondary side (X1, X2, X3)?

Next available location is the service-rated disconnect down stream from the transformer



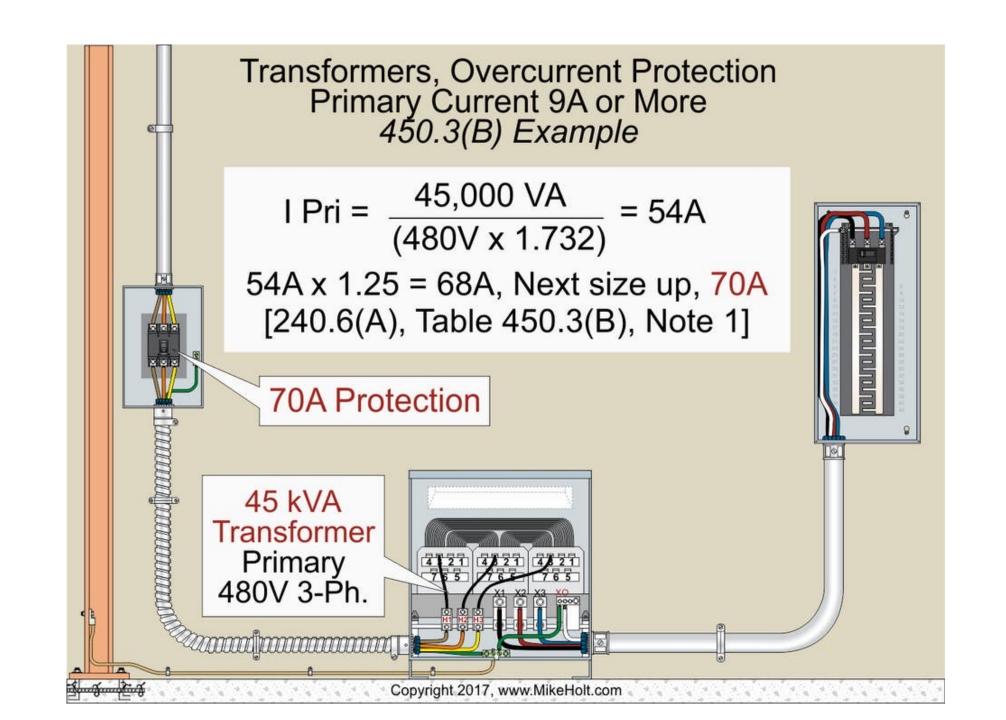
Transformer Overcurrent Protection

- Objective: To protect the windings, not the conductors
- Reference section 450.3(B)

Table 450.3(B) Primary Protection Only 1000V and Less

Primary Current Rating	Maximum Protection
9A or more	125%, note 1
Less than 9A	167%
Less than 2A	300%

Note 1: Where 125% of the primary current doesn't correspond to a standard rating of a fuse or nonadjustable circuit breaker, the next higher rating is permitted[240.6(A)]



Transformer Primary Conductor Sizing

 Conductors must be sized no less than 125% of the continuous loads, plus 100 percent of the noncontinous loads, based on the terminal temperature rating ampacities as listed in Table 310.15(B)(16) before and ampacity adjustment [210.19(A)(1)]

Pin Header

Table 450.3(A) Maximum Rating or Setting of **Overcurrent Protection for Transformers Over** 1000 Volts (as a Percentage of Transformer-Rated Current)

	Secondary Protection (See Note 2.)	
00 V	alta	100

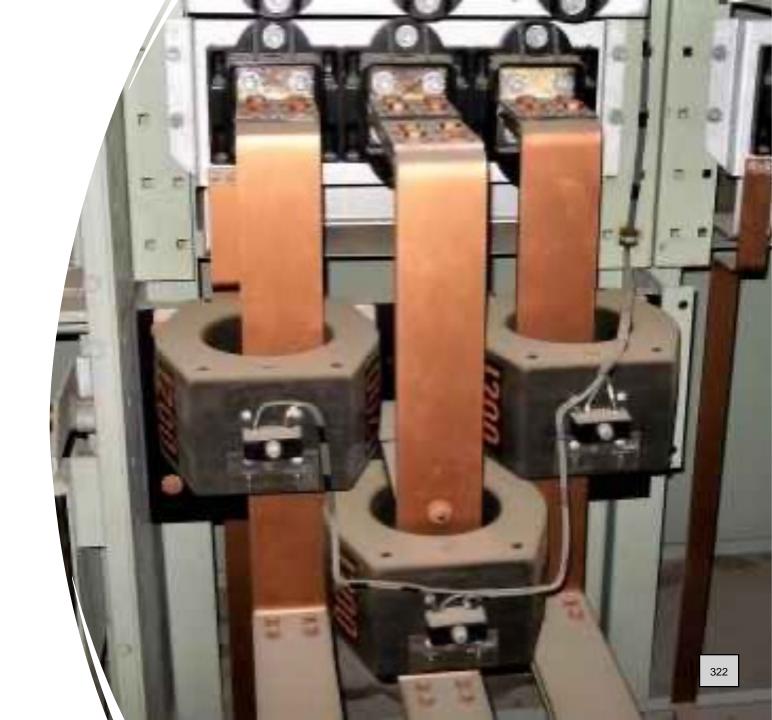
	Transferment Dated	Primary Protection over 1000 Volts		Over 1000 V	1000 Volts or Less	
Location Limitations	Transformer Rated Impedance	Circuit Breaker (See Note 4.)	Fuse Rating	Circuit Breaker (See Note 4.)	Fuse Rating	Circuit Breaker or Fuse Rating
Anylogotion	Not more than 6%	600% (See Note 1.)	300% (See Note 1.)	300% (See Note 1.)	250% (See Note 1.)	125% (See Note 1.)
Any location	More than 6% and not more than 10%	400% (See Note 1.)	300% (See Note 1.)	250% (See Note 1.)	225% (See Note 1.)	125% (See Note 1.)
Supervised locations only (See Note 3.)	Any	300% (See Note 1.)	250% (See Note 1.)	Not required	Not required	Not required
	Not more than 6%	600%	300%	300% (See Note 5.)	250% (See Note 5.)	250% (See Note 5.)
	More than 6% and not more than 10%	400%	300%	250% (See Note 5.)	225% (See Note 5.)	250% (See Note 5.)

- 1. Where the required fuse rating or circuit breaker setting does not correspond to a standard rating or setting, a higher rating or setting that does not exceed the following shall be permitted:
- a. The next higher standard rating or setting for fuses and circuit breakers 1000 volts and below, or
- b. The next higher commercially available rating or setting for fuses and circuit breakers above 1000 volts.
- 2. Where secondary overcurrent protection is required, the secondary overcurrent devices are utilized, the total of all the device ratings shall not exceed the allowed value of a single overcurrent device. If both circuit breakers and fuses are used as the overcurrent device, the total of the device ratings shall not exceed that allowed for fuses.
- 3. A supervised location is a location where conditions of maintenance and supervision ensure that only qualified persons monitor and service the transformer installation.
- 4. Electronically actuated fuses that may be set to open at a specific current shall be set in accordance with settings for circuit breakers.
- 5. A transformer equipped with a coordinated thermal overload protection by the manufacturer shall be permitted to have separate secondary protection omitted.

X

Current Transformers

- Safely converts electrical current into a voltage signal
- Used for metering, relays, test instruments etc.
- Can read positive and negative flow
- Correct orientation to indicate proper current direction is important



How a CT Works Main Primary Conductor Main Primary Conductor Hollow Core Ammeter Secondary C.T. Winding 15 Secondary Winding Primary Current Circuit Symbol Construction

CONGRATULATIONS!





File Attachments for Item:

ER-6 Significant Changes to the 2023 NEC (Dayton Area Electrical JATC)

All certifications (12 hours, two 6-hour sessions)

Staff Notes:

ESIAC Recommendation:

Committee Recommendation:

Significant Changes

TO THE NEC® 2023

Code-Wide Revisions and Chapter 1





Reconditioned Equipment

- 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.

Definitions

- 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.

New, Deleted, and Relocated Articles and Revised Article Titles for the 2023 NEC

- 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)

New, Deleted, and Relocated Articles and Revised Article Titles for the 2023 NEC (continued)

- 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)

New, Deleted, and Relocated Articles and Revised Article Titles for the 2023 NEC (continued)

- 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)

NEC Style Manual Changes

- 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.

Medium- and High-Voltage Requirements

- 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

Medium- and High-Voltage Requirements (continued)

- 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 highvoltage articles.

Not a Change?

- 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.

Not a Change? (continued)

- 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*.

NEW

Scope

- 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*.

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.

•••



Use and Application

- 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.

RELOCATE REORGANIZE

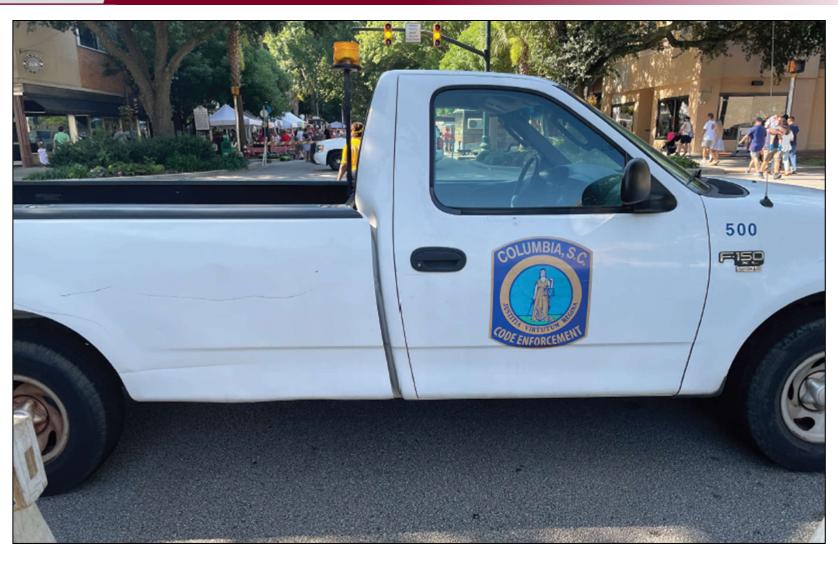
- 90.2 Scope Use and Application
- (A) Practical Safeguarding (Formerly 90.1(A))
- (B) Adequacy (Formerly 90.1(B))
- (C) <u>Installations</u> Covered (Formerly 90.2(A))
- (D) <u>Installations</u> Not Covered (Formerly 90.2(B))
- (E) Relation to Other International Standards (Formerly 90.1(C))
- (F) Special Permission (Formerly 90.1(D))



Enforcement

- 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.

REORGANIZE



90.5(C)

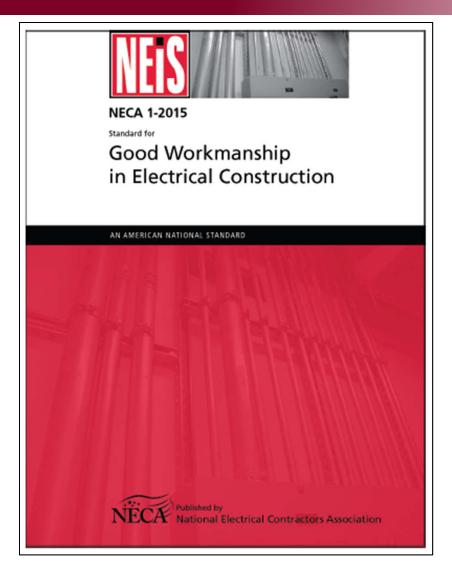
REVISION

Explanatory Material

- 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.

90.5(C)

REVISION



REORGANIZE

Article 100 Reorganization

- 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.

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)

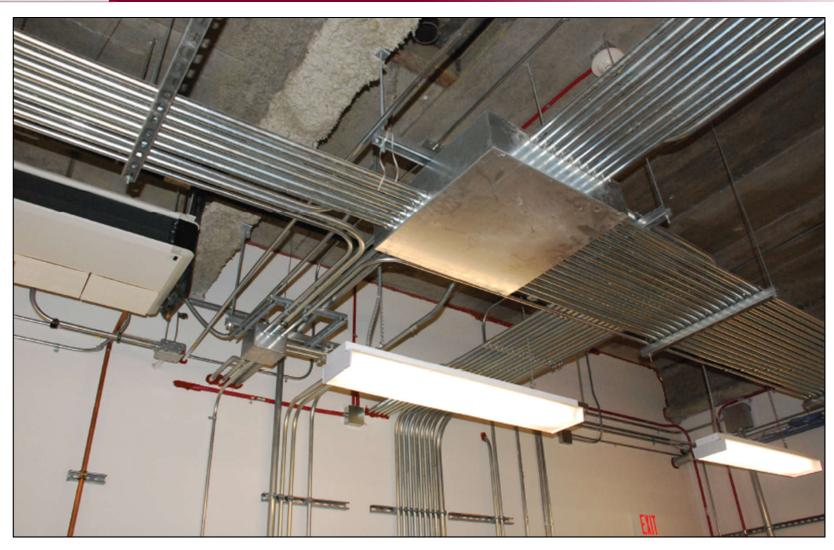
A device capable of providing protection for service, feeder, and branch circuits and equipment over the full range of overcurrents between its rated current and its interrupting rating. (CMP-10)

REVISION

Definition of Accessible (as applied to wiring methods)

- 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.

REVISION



REVISION

Definition of Attachment Fitting, Weight Supporting

- 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.

REVISION



NEW

Definition of Motor Branch Circuit

- 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.

NEW

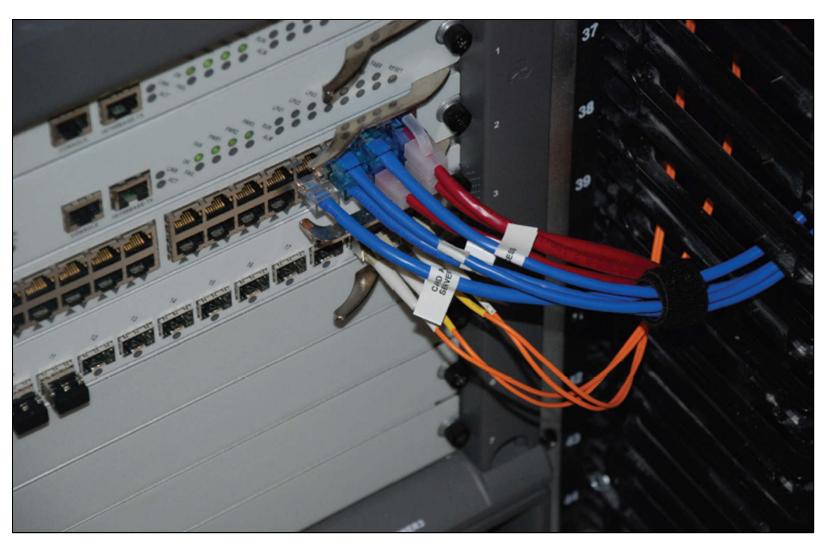


NEW

Definition of Class 4 Definitions

- 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.

NEW

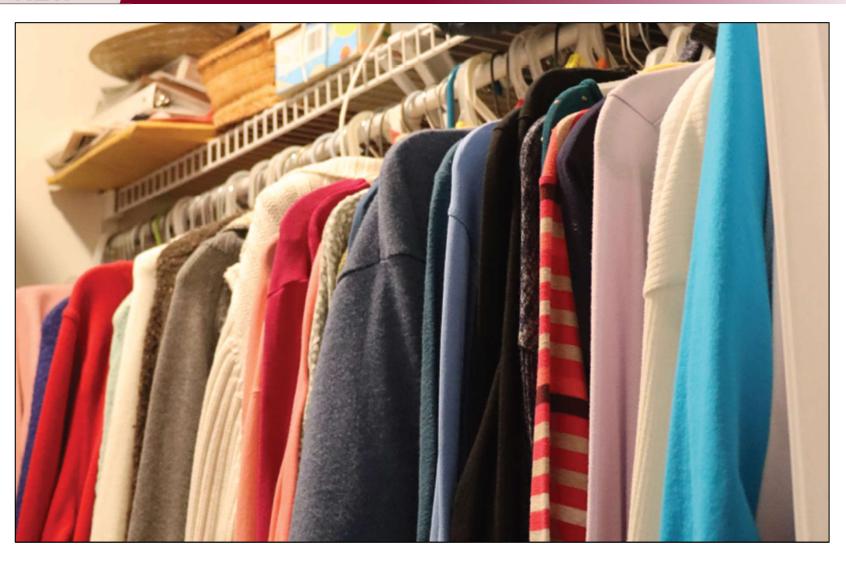


NEW

Definition of Clothes Closet Storage Space

- 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.

NEW



REVISION

Definition of Commissioning

- 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.

REVISION



REVISION

Definition of Corrosive Environment

- 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.

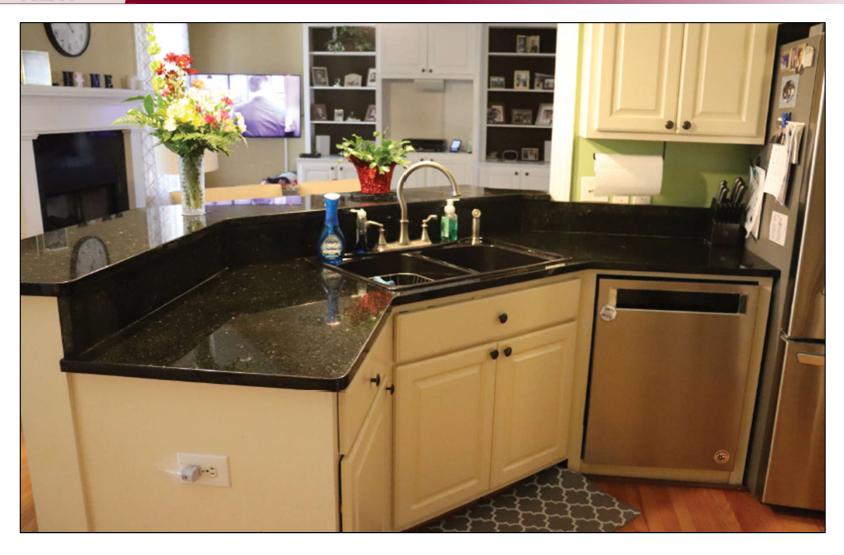
REVISION



NEW

Definition of Counter (Countertop)

- 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.



NEW

Definition of Energized, Likely to Become

- 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.

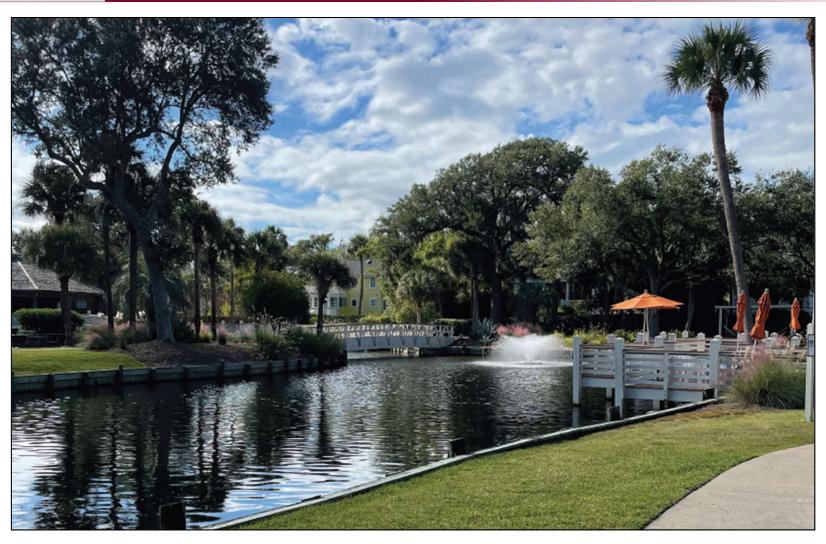


REVISION

Definitions of Equipotential Plane

- 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.

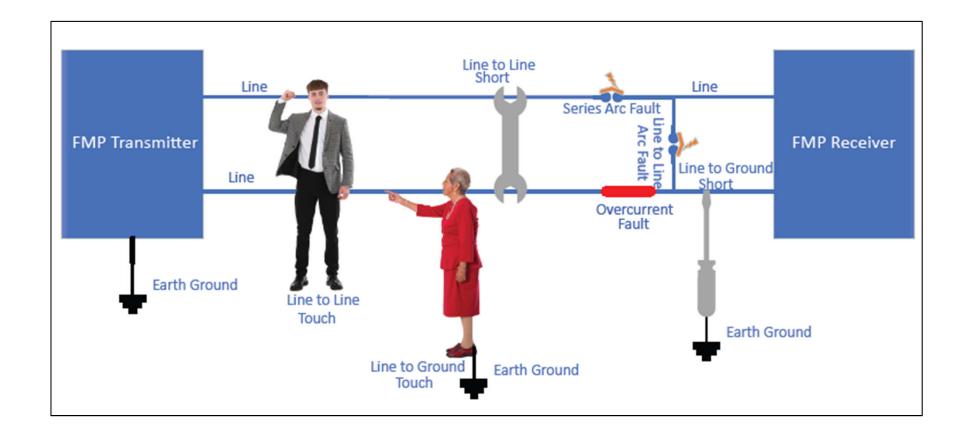
REVISION



NEW

Definition of Fault Managed Power

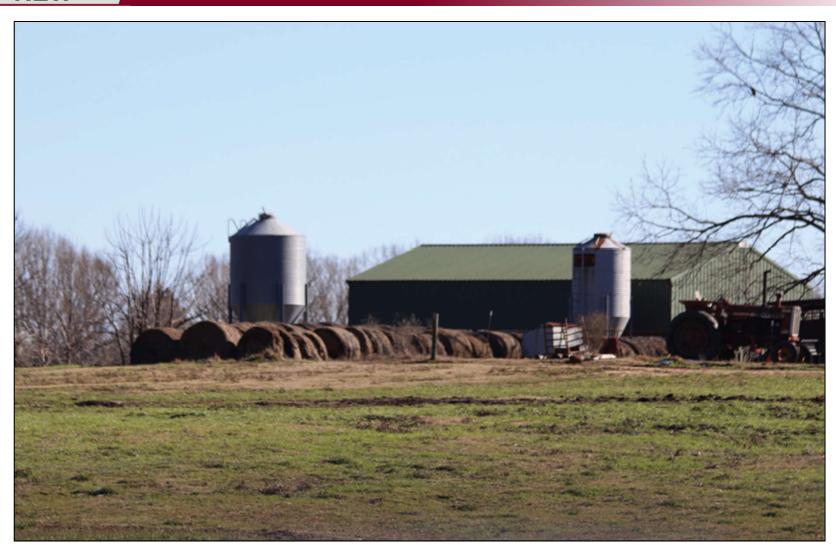
- Fault-managed power is one of the key definitions for new Article 726.
 Class 4 power systems are fault-managed power systems.
- Class 4 power systems provide a pulsed power output that relies on a continuous handshake to provide fault detection and ensure proper operation.
- Class 4 power systems can supply up to 450 volts dc line-to-line or 225 volts dc to ground to provide power and control of electronic equipment.



NEW

Definition of Fibers/Flyings, Combustible

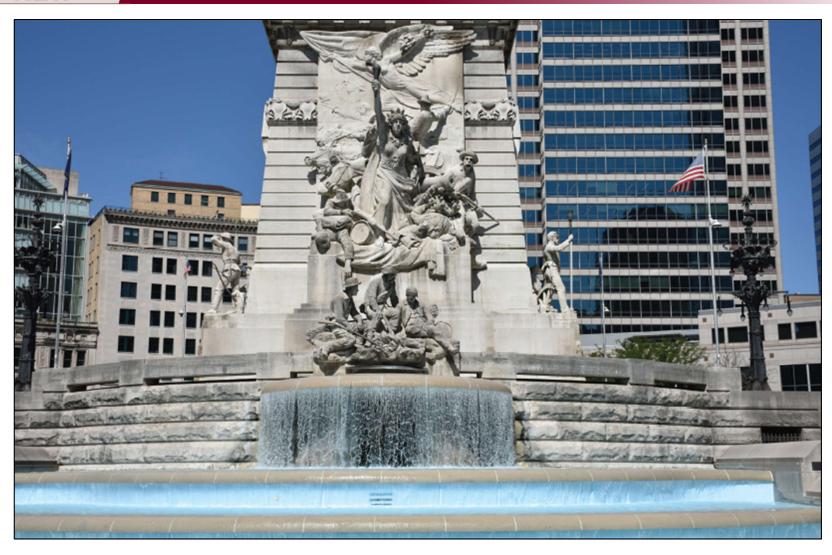
- A new definition was added for combustible fibers/flyings.
- Combustible fibers/flyings consist of solid particles greater than 500
 µm in size that can form an explosible mixture when suspended in air
 at standard atmospheric pressure and temperature.
- In contrast, combustible dusts consist of solid particles that are 500 µm or smaller that can form an explosible mixture.



NEW

Definition of GFCI, Special Purpose

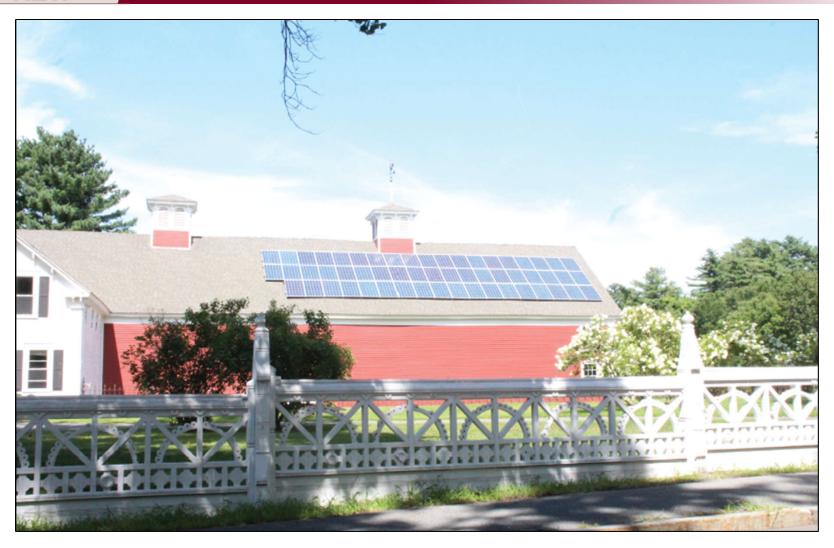
- A new definition was added for Special Purpose Ground-Fault Circuit-Interrupter.
- SPGFCIs are used on circuits with voltage greater than 150 volts to ground.
- Traditional GFCIs are also known as Class A GFCIs. Special purpose GFCIs are either Class C, D, or E GFCIs.



NEW

Definition of Ground-Fault Detector-Interrupter

- 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.



NEW

Definition of Industrial Installation, Supervised

- 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.



REVISION

Definition of Inverter, Multimode

- 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.

REVISION



REVISION

Definition of Location, Wet

- 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.

REVISION



NEW

Definition of Locations, Hazardous (Classified)

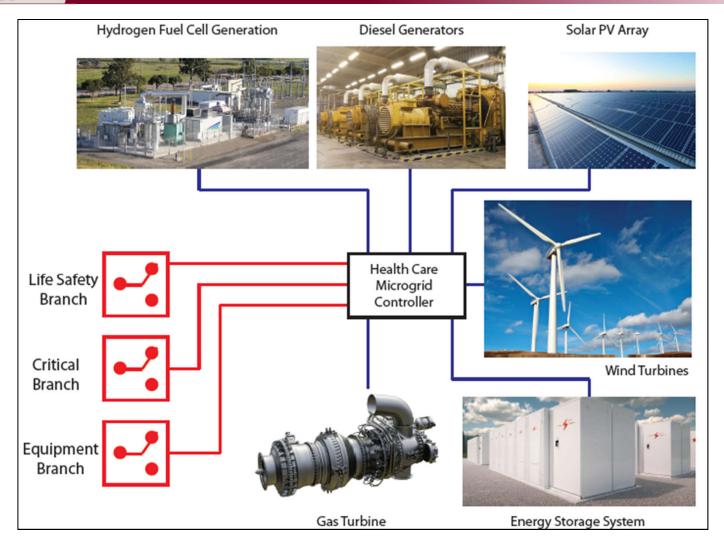
- A new general definition has been added for Hazardous (Classified) Locations.
- Article 500 defines Classes I, II, and III, as well as the divisions and groups.
- Article 505 provides the classification system for gases, vapors, and liquids using the IEC Zone system.
- Article 506 provides the classification 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.



NEW

Definition of Microgrid, Health Care

- 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*.



NEW

Definitions of Panelboard and Panelboard, Enclosed

- 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.



NEW

Definition of Receptacle, Weight-Supporting Ceiling

- 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.



NEW

Definition of Servicing

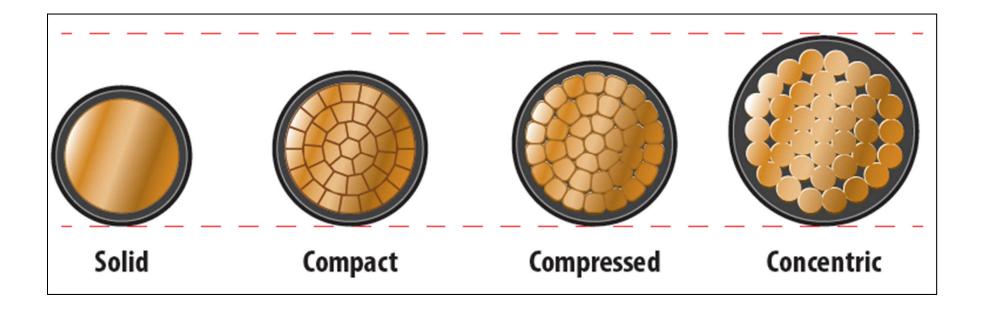
- "Servicing" is defined as: The process of following a manufacturer's set of instructions or applicable industry standards to analyze, adjust, or perform prescribed actions upon equipment with the intention to preserve or restore the operational performance of the equipment.
- "Reconditioned" is defined 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.



NEW

Definition of Stranding (Compact and Compressed)

- 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.



REVISION

Definition of Type P Cable

- 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.

REVISION



110.3(A)

REVISION

Examination

- 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.

110.3(A)



110.3(B)

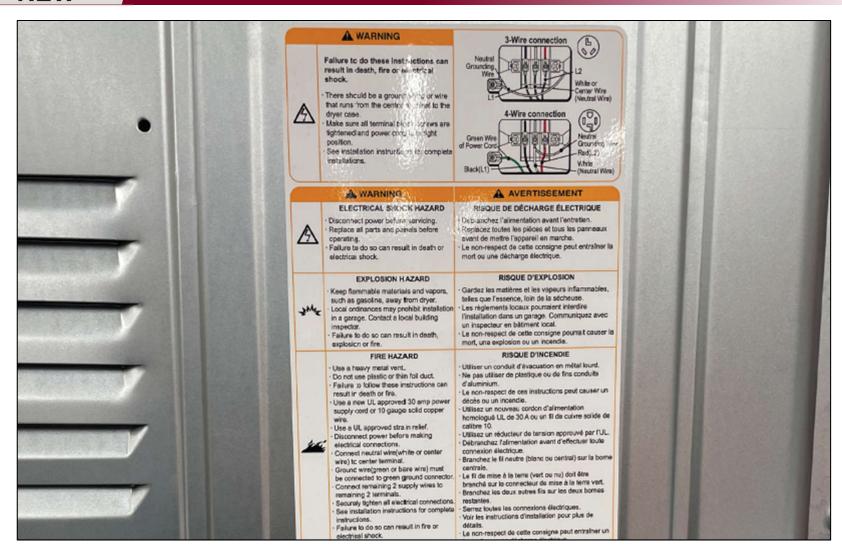
NEW

Installation and Use

- 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.

110.3(B)

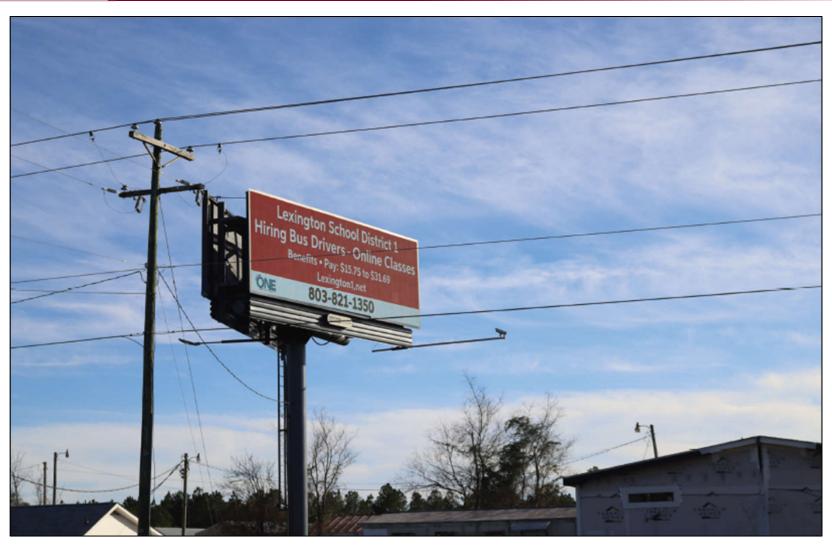
NEW



REVISION

Wiring Methods

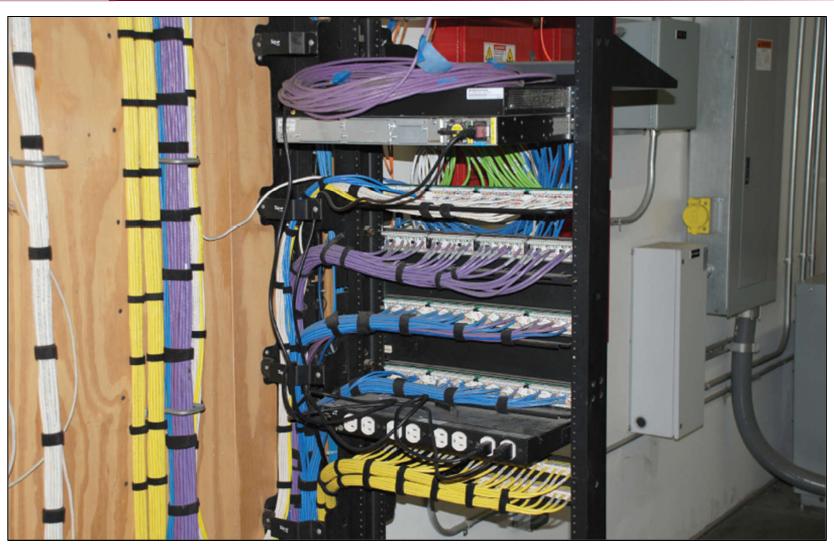
- Section 90.2(C) indicates that if the installation is covered by the *Code*, the wiring methods recognized by the *Code* are permitted to be installed in any building, occupancy, or premises wiring system.
- The definition of premises wiring in Article 100 includes interior and exterior wiring and associated hardware.
- Premises wiring does not include the internal wiring of appliances, luminaires, motor controllers, motor control centers, and similar equipment.



REVISION

Mechanical Execution of Work

- 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.



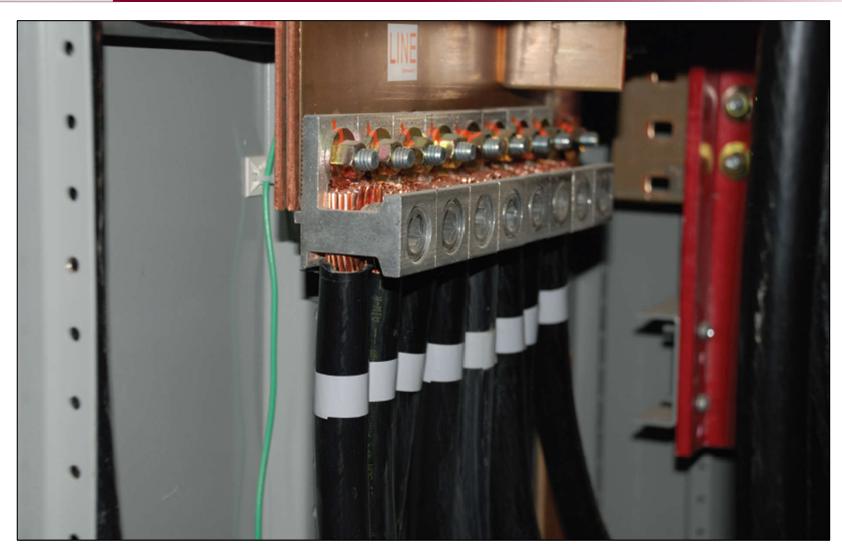
110.14(A)

REVISION

Terminals

- 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.

110.14(A)



110.16(B)

REVISION

Service Equipment and Feeder Equipment

- 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).

110.16(B)

REVISION

AWARNING

Arc Flash & Shock Hazard Appropriate PPE Required

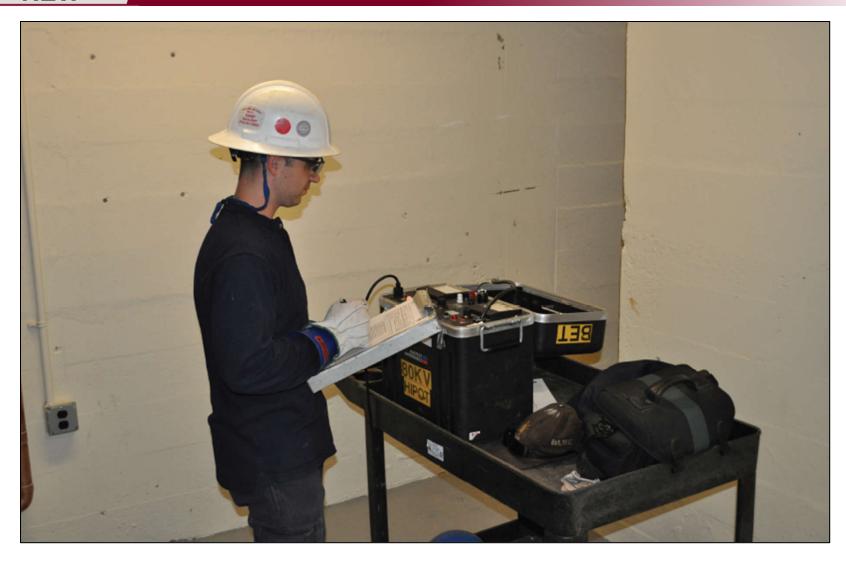
Yellow Highlights indicate arc-flash warning label requirements in the NEC

NEW

Servicing and Maintenance of Equipment

- 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.

NEW



NEW

Reconditioned Equipment

- 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.

NEW



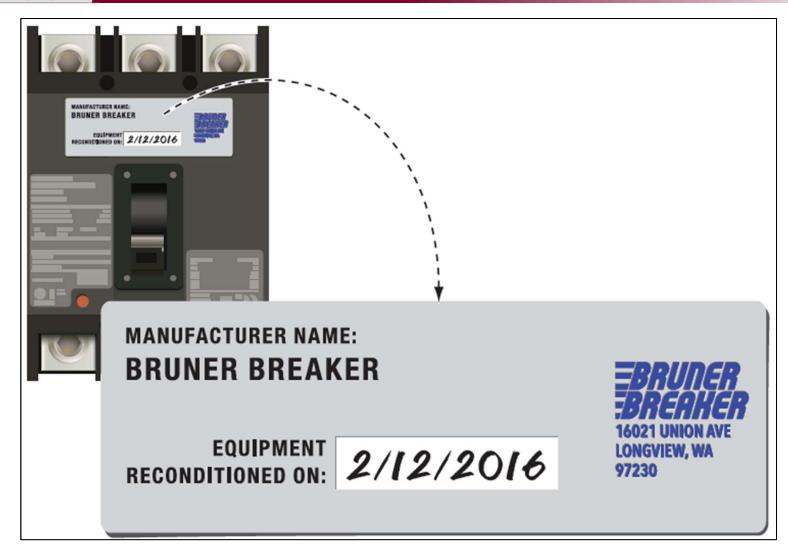
110.21(A)

REVISION

Reconditioned Equipment, Marking Requirements

- 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.

110.21(A)



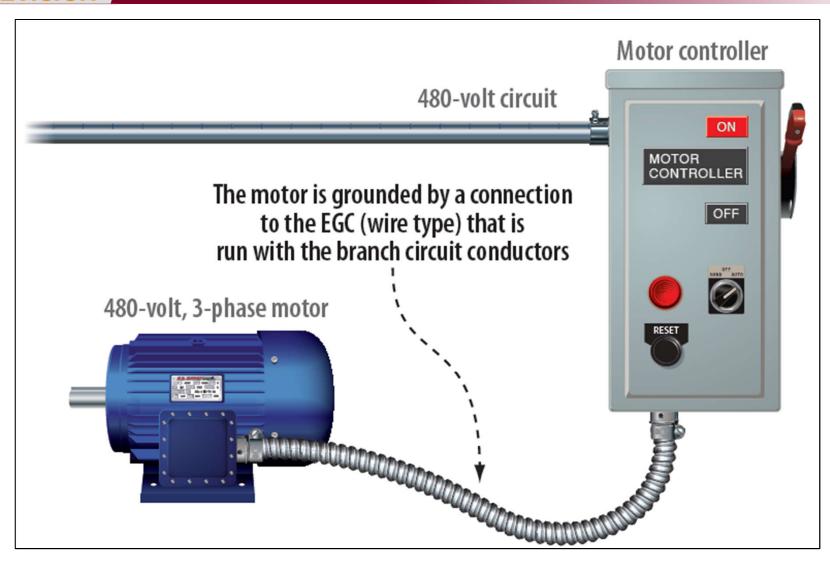
110.22(A)

REVISION

Identification of Disconnecting Means, General

- 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.

110.22(A)



REORGANIZE

Depth and Width of Working Space

- 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.

REORGANIZE



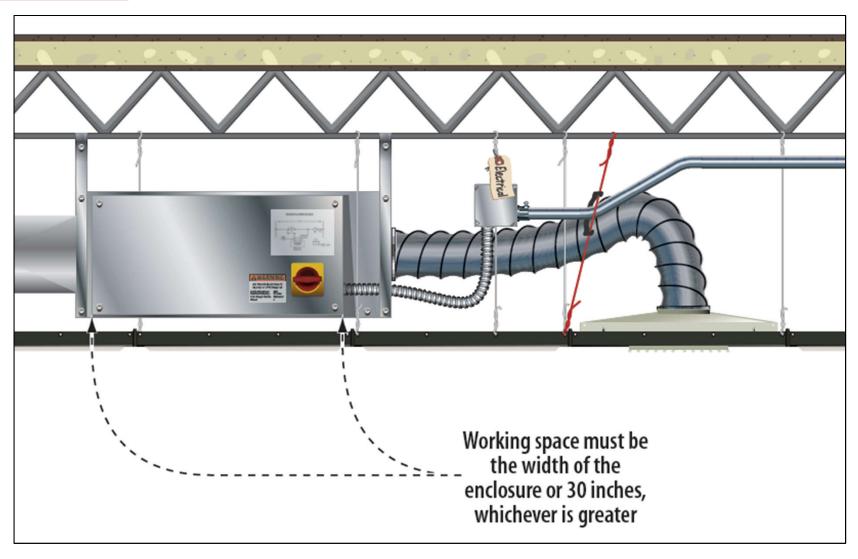
110.26(A)(4)

REVISION

Limited Workspace Requirements

- 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.

110.26(A)(4)



110.26(A)(6)

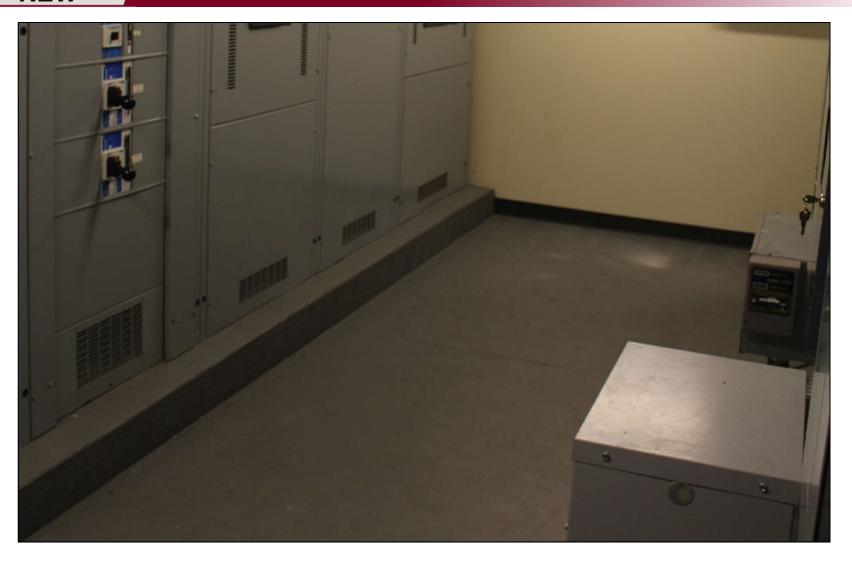
NEW

Grade, Floor, or Working Platform

- 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.

110.26(A)(6)

NEW



110.26(E)

REVISION

Dedicated Equipment Space

- 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 twofamily 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.

110.26(E)



Table 110.28

REVISION

Table 110.28 Enclosure Types, Informational Notes

- 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.

Table 110.28



NEW

In Sight From (Within Sight From, Within Sight)

- 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.

NEW



110.31(A)(4)

REVISION

Locks, Personnel Doors

- 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.

110.31(A)(4)



Significant Changes **TO THE NEC® 2023** Chapter 2





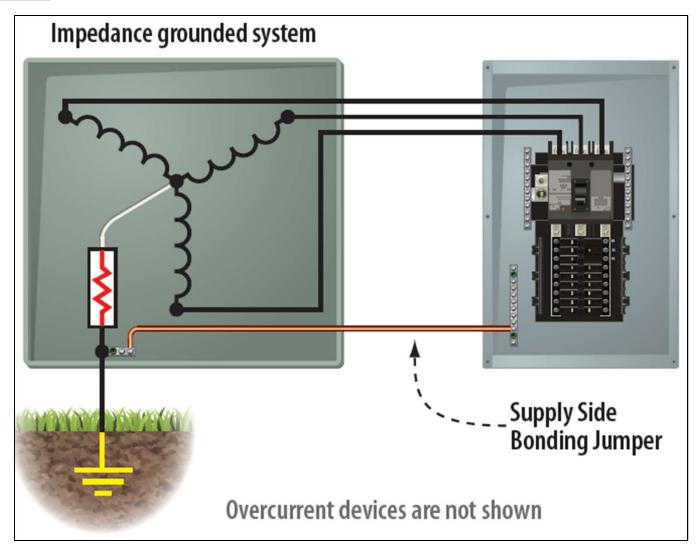
200.2(A)

REVISION

General

- 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.

200.2(A)



210.6(D) & (E)

REVISION | RELOCATE

Branch Circuit Voltage Limitations

- 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.

210.6(D) & (E)

REVISION | RELOCATE



REVISION

GFCI Protection for Personnel

- 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.



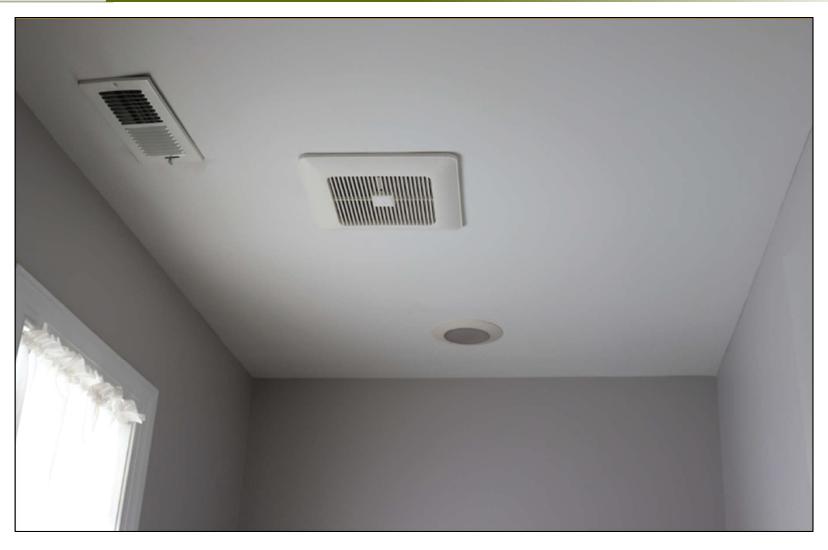
210.8(A)

REVISION

Dwelling Units

- 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.

210.8(A)



210.8(B)

REVISION

Other Than Dwelling Units

- 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.

210.8(B)



210.8(D)

REVISION

GFCI Protection for Personnel-Specific Appliances

- 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.

210.8(D)



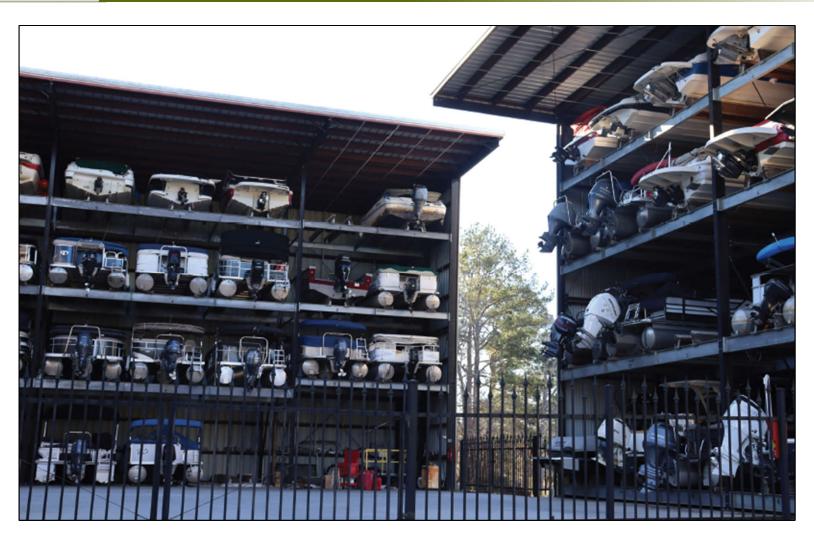
210.8(F)

REVISION

GFCI Protection for Personnel-Outdoor Outlets

- 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.

210.8(F)



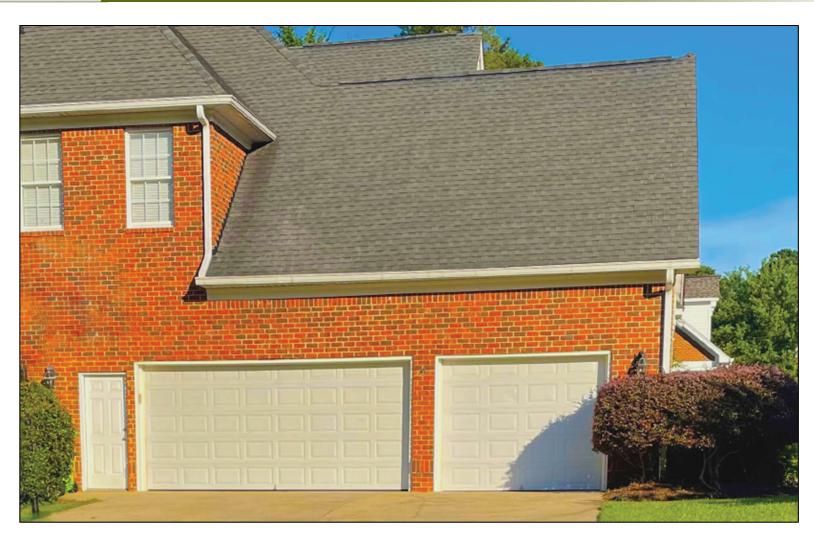
210.11(C)(4)

REVISION

Garage Branch Circuits

- 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.

210.11(C)(4)



REVISION

Arc-Fault Circuit-Interrupter Protection

- 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.



REVISION

Rating

- 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.

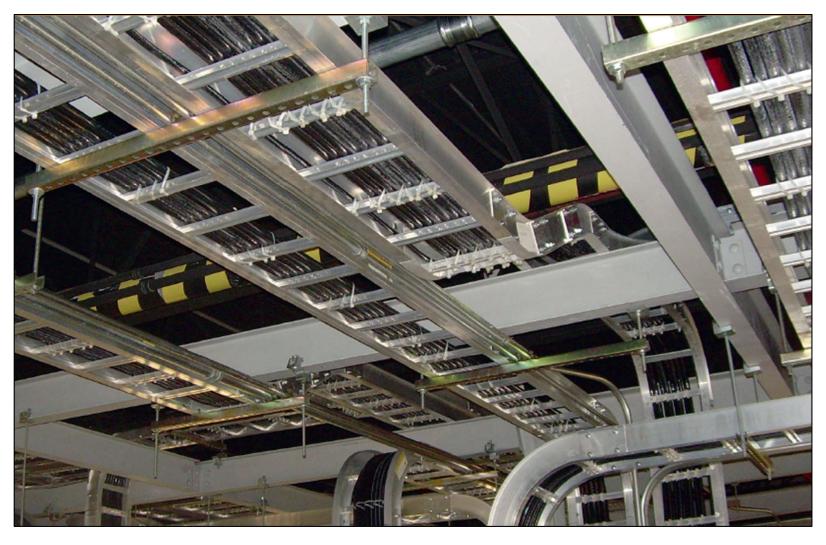


REVISION RELOCATE

Conductors – Minimum Ampacity and Size

- New branch circuit voltage limits have been added for ac and do 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.

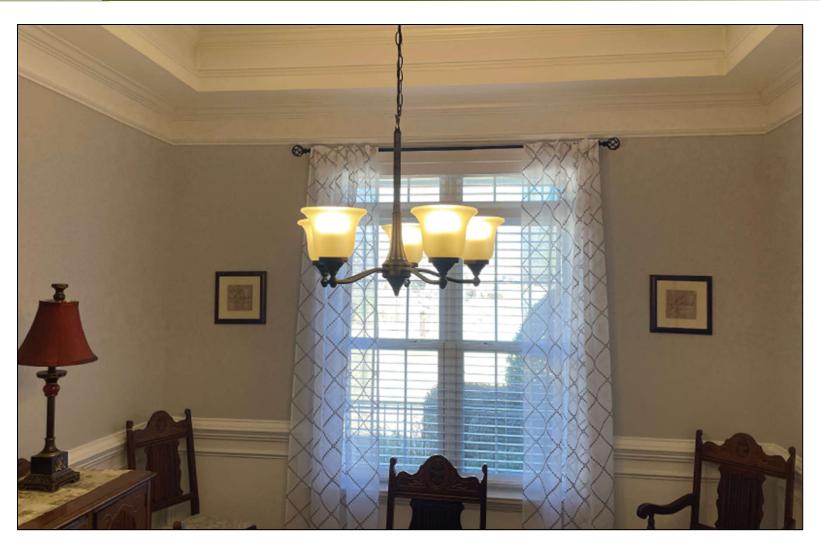
REVISION | RELOCATE



REVISION

Permissible Loads, Multiple-Outlet Branch Circuits

- 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.



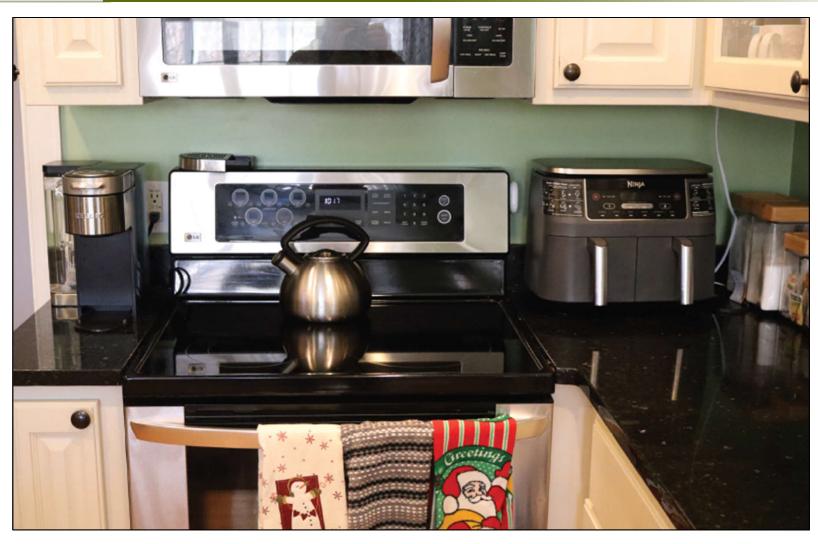
210.52(A)(2)

REVISION

Wall Space

- 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.

210.52(A)(2)



210.52(C)

REVISION

Countertops and Work Surfaces

- 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.

210.52(C)



REVISION

Lighting Outlets Required

- 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.



NEW

Barriers

- 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.

NEW



NEW

Surge Protection

- 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.

NEW



Article 220

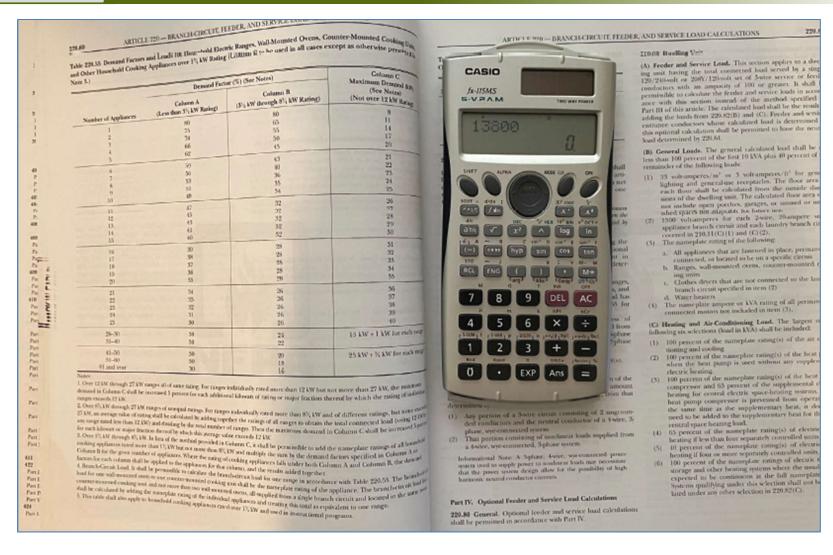
REORGANIZE

Article 220 Reorganization

- 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.

Article 220

REORGANIZE



220.5(C)

REVISION

Floor Area

- 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.

220.5(C)



REVISION

Lighting Load for Non-Dwelling Occupancies

- 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.



REVISION

Motors and Air-Conditioning Equipment

- 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 motorcompressors.
- 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.



REVISION

Appliance Load – Dwelling Units

- 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 ½ 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.

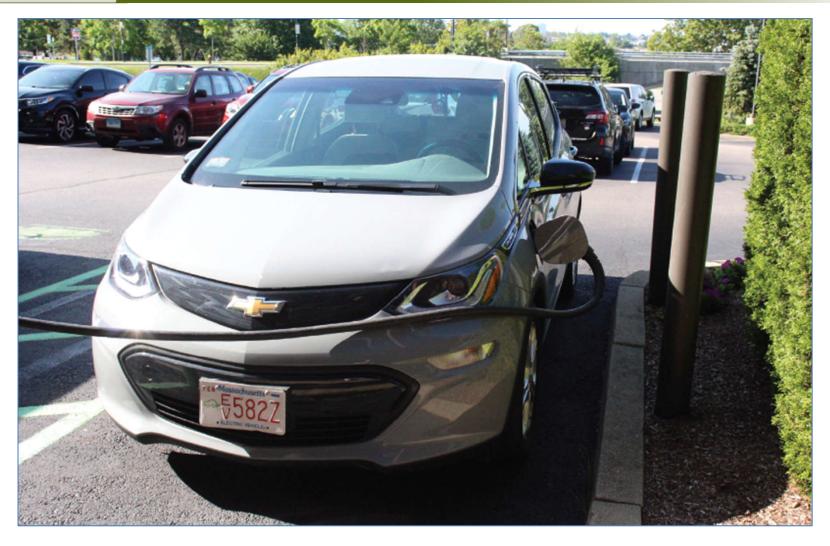


NEW

Electric Vehicle Supply Equipment (EVSE) Load

- 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.

NEW



REVISION

Noncoincident Loads

- 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.



NEW

Energy Management Systems (EMSs)

- 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.

NEW



NEW

Receptacle Loads – Health Care Facilities

- 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.

NEW



REVISION

Receptacle Loads

- 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.



NEW

Emergency Disconnects

- 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.

NEW



NEW

Surge Protection

- 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 remotelylocated SPD protection for upstream feeder or service equipment.

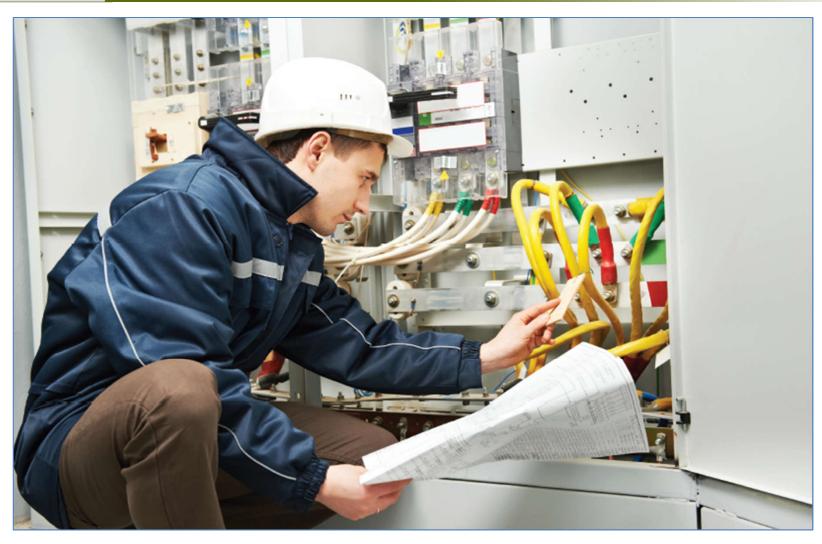
NEW



REVISION

Other Conductors

- 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.



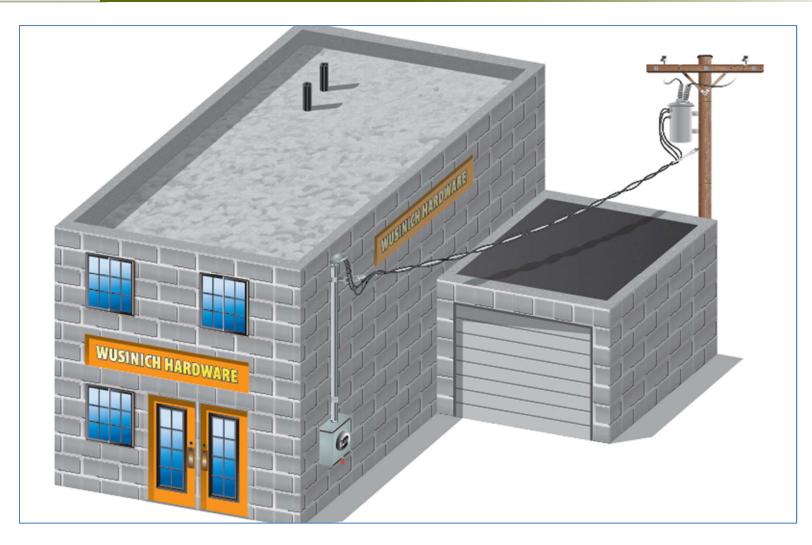
230.24(A)

REVISION

Above Roofs

- 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.) to 2.6 meters (8 ft.)
- 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*.

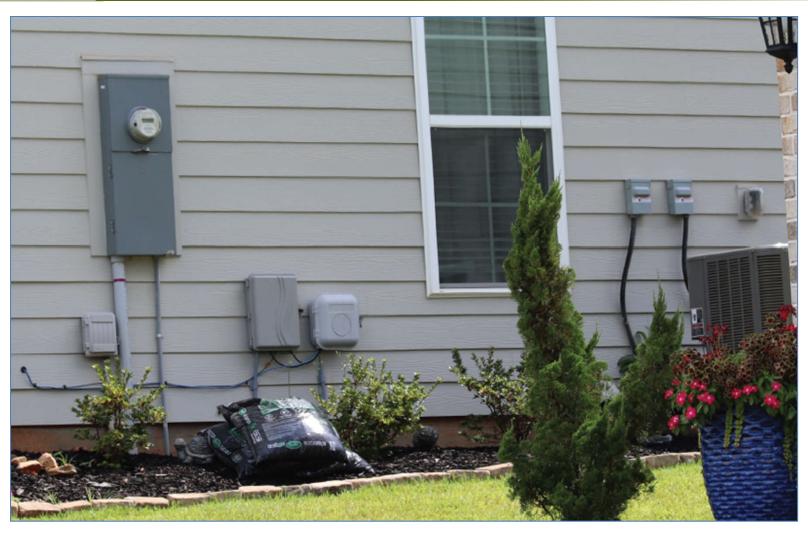
230.24(A)



REVISION

Wiring Methods for 1000 Volts, Nominal, or Less

- 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.



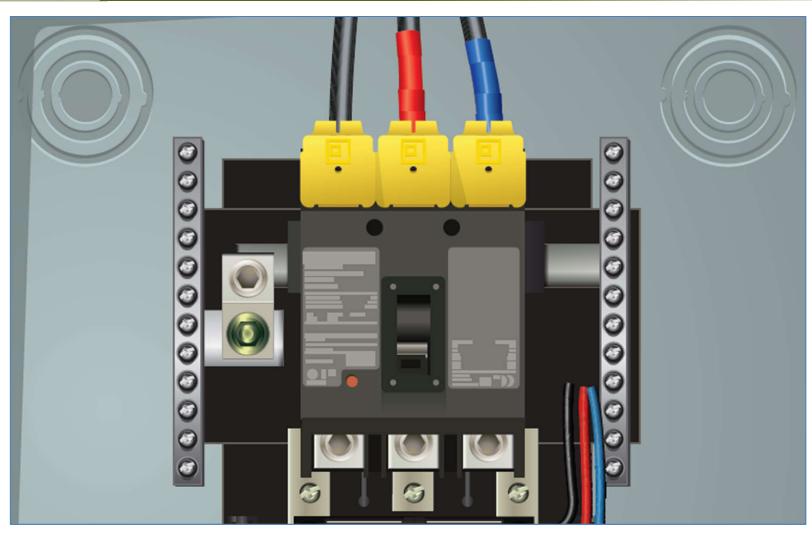
230.62(C)

REVISION

Barriers

- 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.

230.62(C)



REVISION

Surge Protection

- 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.



230.71(B)

REVISION

Two to Six Service Disconnecting Means

- 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.

230.71(B)



REVISION

Emergency Disconnects

- 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.



Article 235

NEW

Branch Circuits, Feeders, and Services Over 1000 Vac...

- 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.

Article 235

NEW



NEW

Reconditioned Equipment

- 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, moldedcase 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.

NEW



506

240.4(B)

REVISION

Overcurrent Devices Rated 800 Amperes or Less

- 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).

240.4(B)



240.6(D)

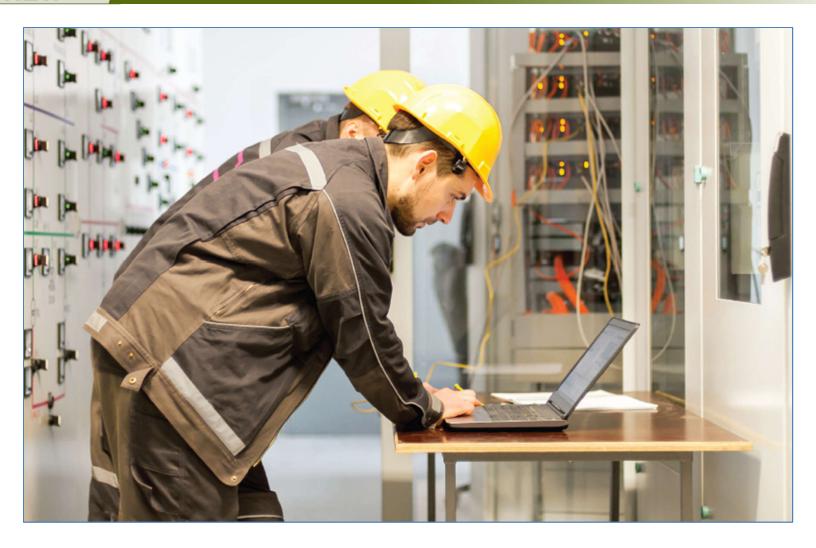
NEW

Remotely Adjustable Trip Circuit Breakers

- 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.

240.6(D)

NEW

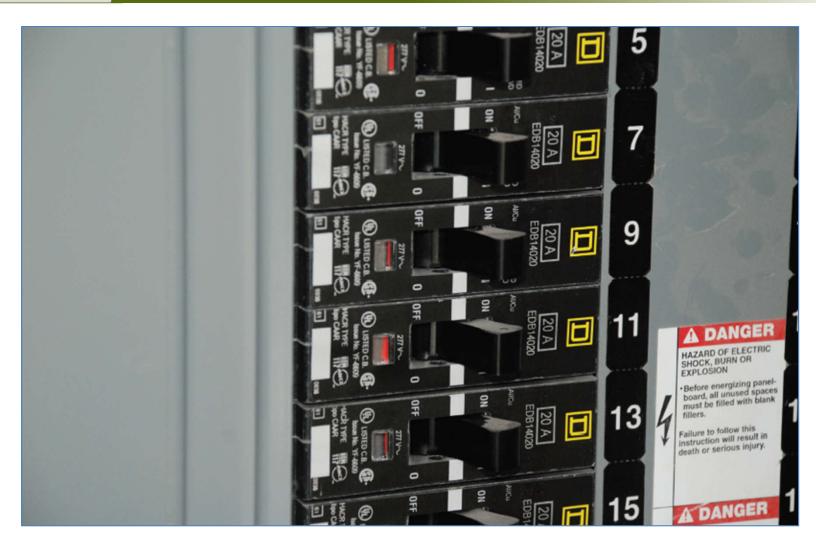


NEW

Listing Requirements

- 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.

NEW

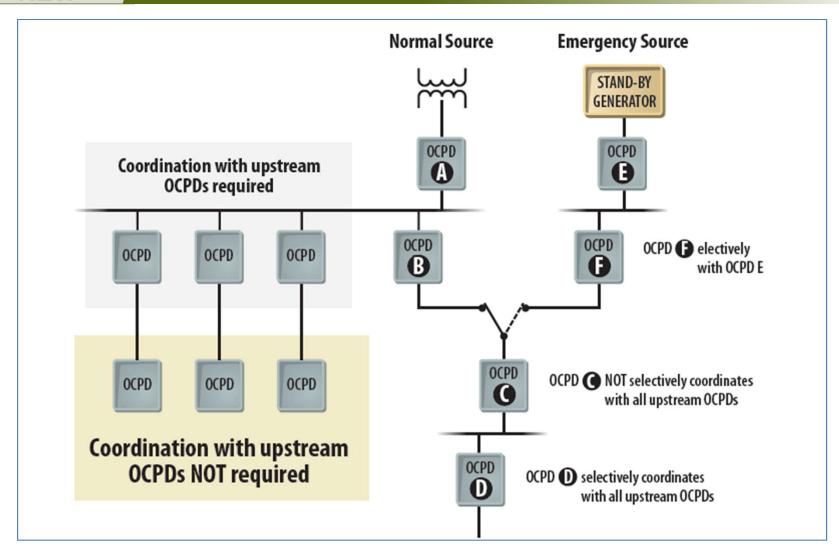


NEW

Selective Coordination

- 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.

NEW



REVISION

Location in or on Premises

- 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.



NEW

Replacement Trip Units

- 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).

NEW



NEW

Indicating

- 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.

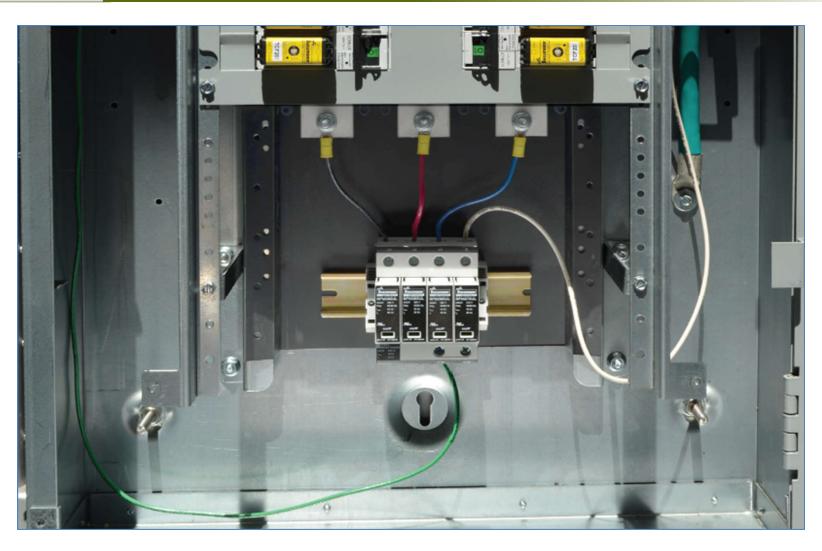
NEW



REVISION

Surge Arrester Rating

- 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.



Article 245

NEW

Overcurrent Prot. Sys. Rated Over 1000 Vac, 1500 Vdc

- 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.

Article 245

NEW



REVISION

Reconditioned Equipment

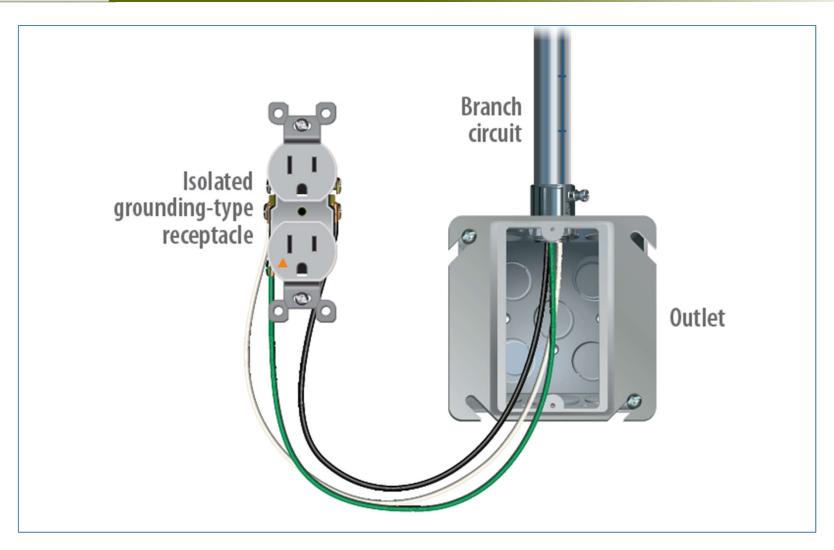
- This section was revised, placed into list format, and relocated to become 245.2.
- Medium- and high-voltage circuit breakers are now permitted to be reconditioned.
- Electromechanical protective relays and current transformers are now permitted to be reconditioned.
- Medium-voltage fuseholders and medium-voltage nonrenewable fuseholders are not permitted to be reconditioned.



REVISION

Objectionable Current

- 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.



REVISION

Alternating-Current Systems to Be Grounded

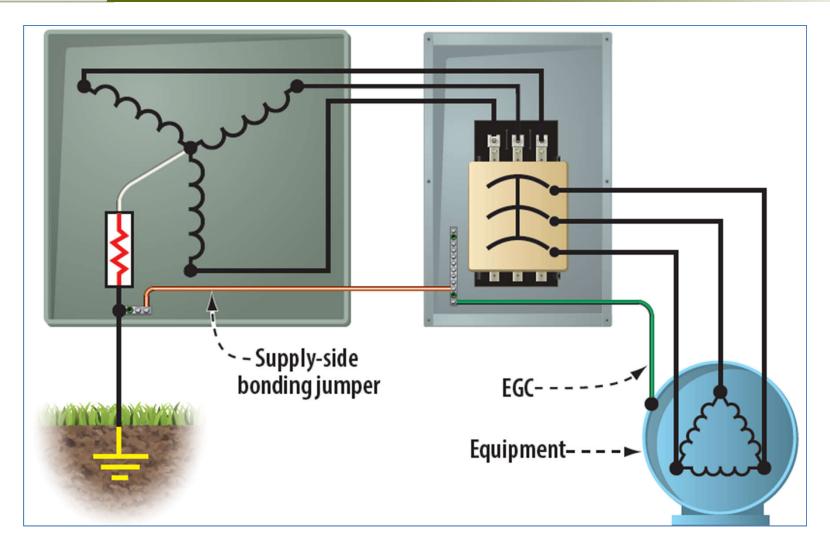
- Alternating current systems are now required to be grounded in accordance with 250.20, unless prohibited elsewhere in the *Code*.
- A new informational note has been added to point to specific examples
 of applications where grounding is prohibited. In addition, 250.22 was
 deleted because it was a 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.



REVISION

Grounding of Service-Supplied AC Systems

- 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.



REVISION

Impedance Grounded Systems – 480 V to 1000 V

- 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.



REVISION

Grounding Electrode Conductor Installation

- 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.



250.68(C)

REVISION

Grounding Electrode Conductor Connections

- 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.

250.68(C)



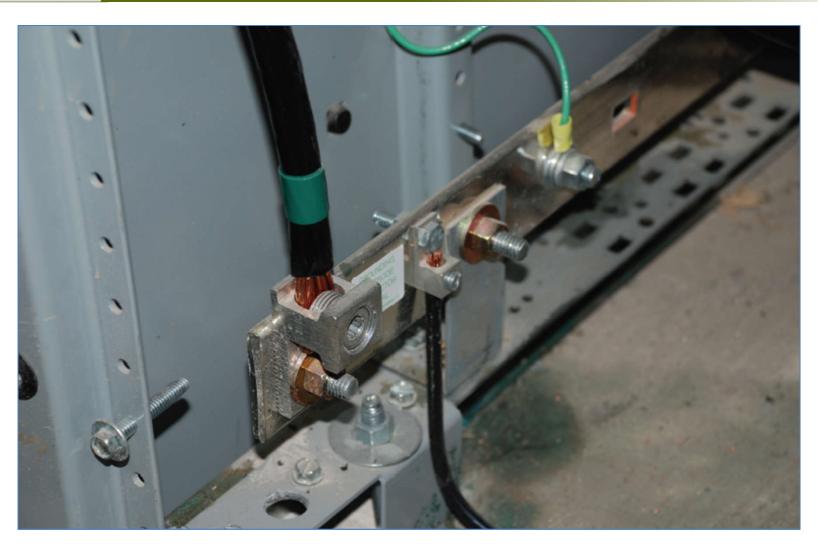
250.94(B)

REVISION

Bonding for Communications Systems-Other Means

- 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)

250.94(B)



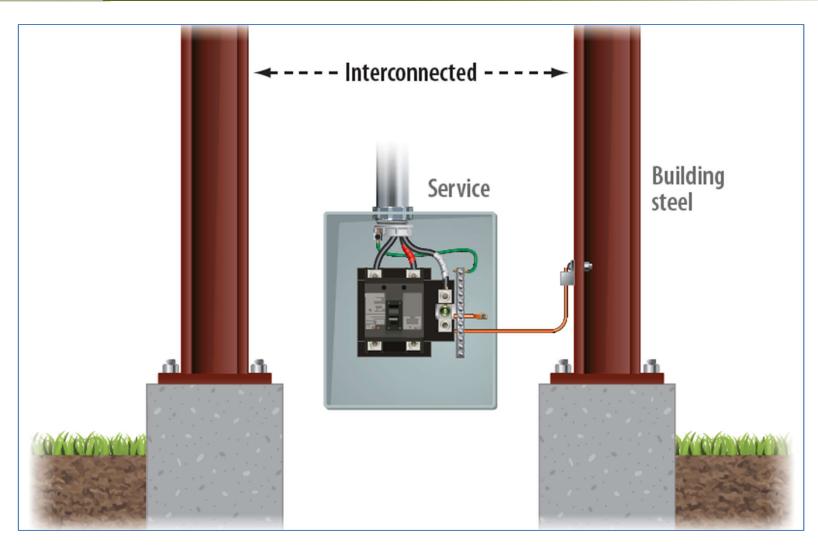
250.104(C) & (D)

REVISION

Bonding of Piping Systems and Exposed Struct. Metal

- 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).

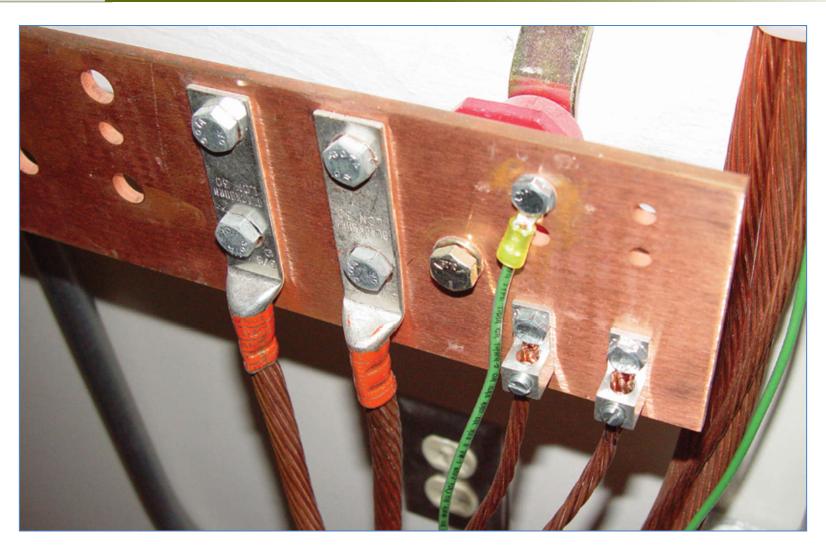
250.104(C) & (D)



REVISION

Types of Equipment Grounding Conductors

- 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).



Significant Changes

TO THE NEC® 2023

Chapter 3





Article 300

REORGANIZE

NEW

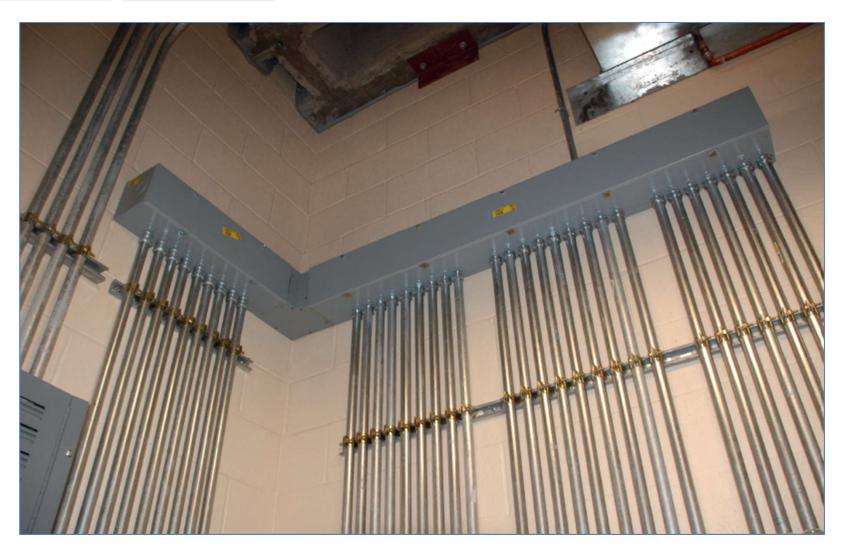
Limitations

- 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.

Article 300

REORGANIZE

NEW



300.2 & 300.3

REVISION

Limitations

- 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.

300.2 & 300.3



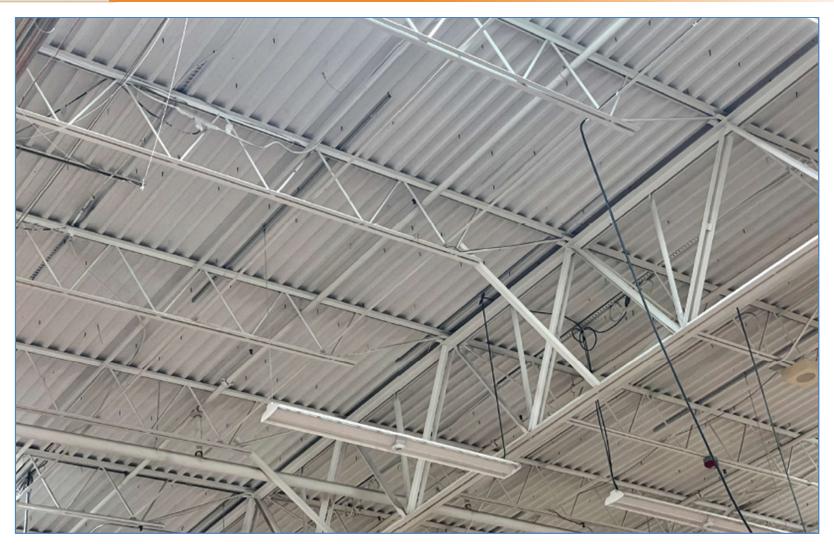
300.4(E)

REVISION

Cables, Raceways, or Boxes Under Metal Decking

- Section 300.4(E) will now only apply to installations beneath metalcorrugated 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.

300.4(E)



300.7(B)

NEW

Expansion, Expansion-Deflection, Deflection Fittings

- Section 300.7(B) requires raceways to be provided with expansiondeflection 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.

300.7(B)

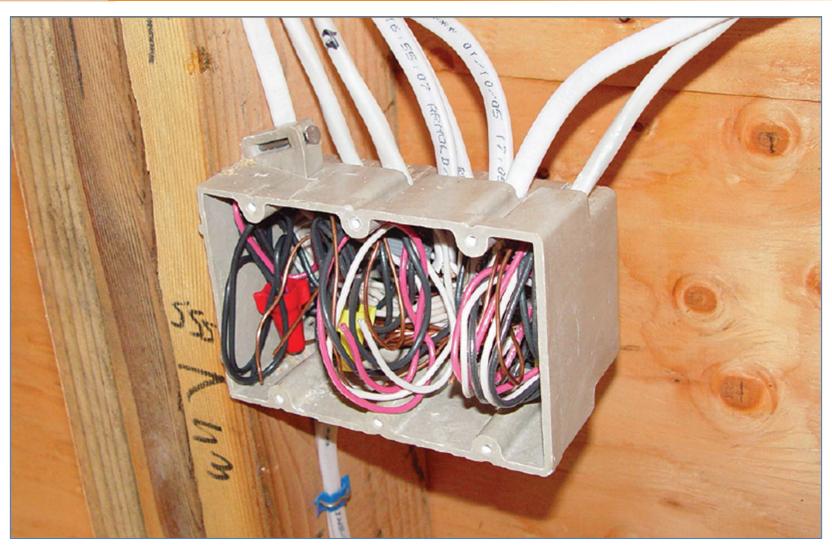
NEW



REVISION

Boxes, Conduit Bodies, or Fittings – Where Required

- 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 directburied cables in addition to direct-buried conductors.



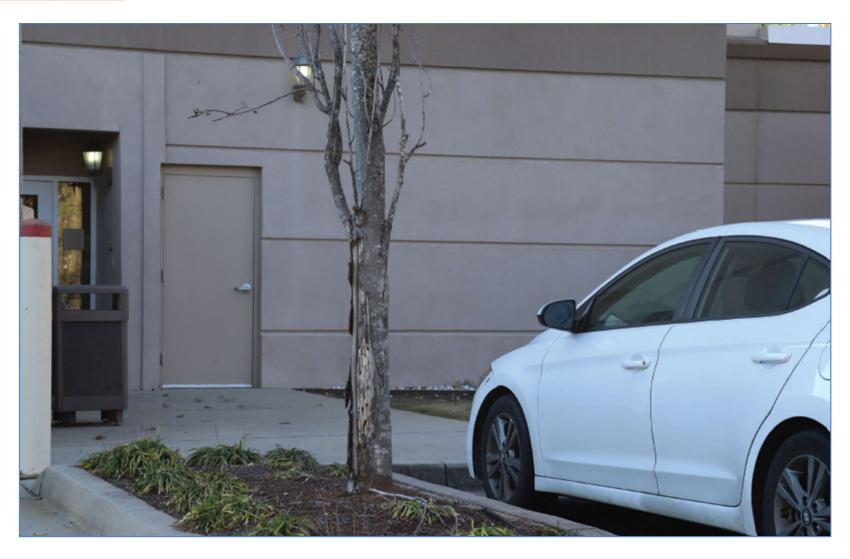
300.25 & Exception

REVISION

Exit Enclosures (Stair Towers)

- 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.

300.25 & Exception



NEW

Remote-Control and Signaling Circuits Classification

- 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.

NEW



Article 305

NEW

Systems Rated Over 1000 V ac, 1500 V dc, Nominal

- 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.

Article 305

NEW



NEW

Splices, Taps, and Feed-Through Conductors

- 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.

NEW



NEW

Screws or Other Fasteners

- 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.

NEW



NEW

Screws or Other Fasteners

- 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.

NEW



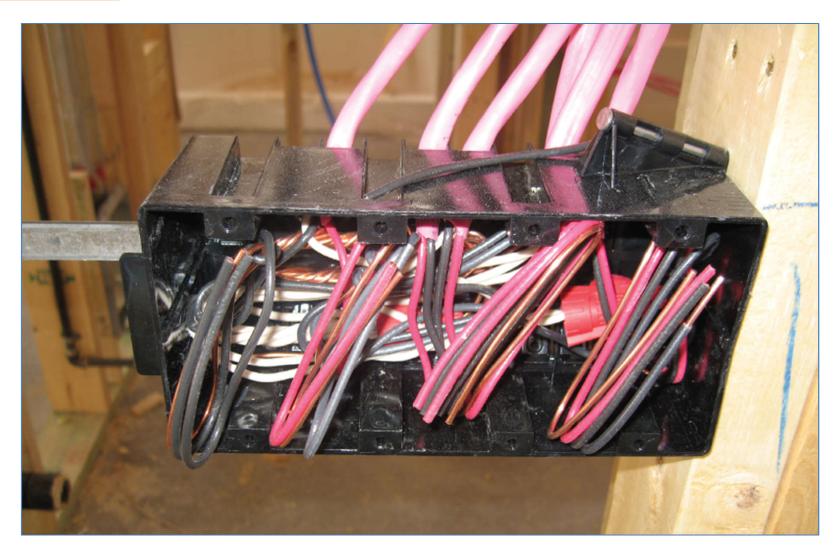
314.16(B)

REVISION

Box Fill Calculations

- 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.

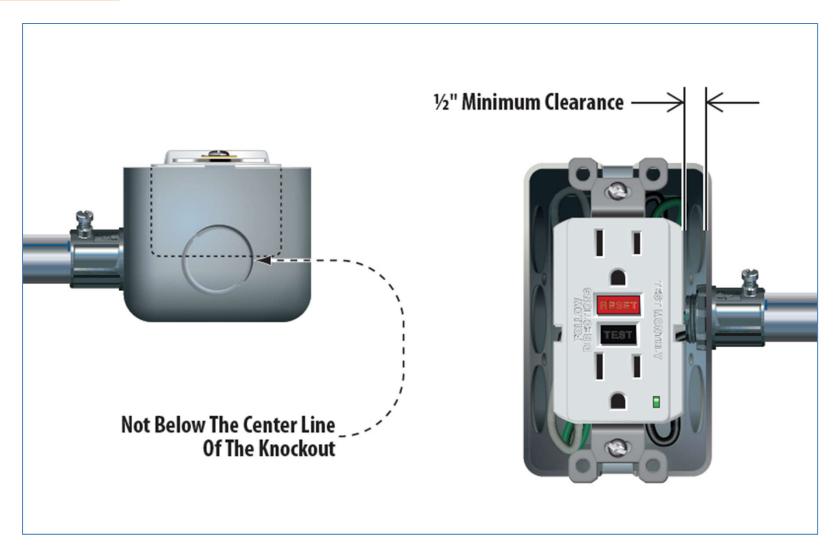
314.16(B)



REVISION

Dimensions of Boxes

- 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.



REVISION

Covers and Canopies

- 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.



314.27(C) & (E)

REVISION

Outlet Boxes, Ceiling-Suspended (Paddle Fans)

- 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."

314.27(C) & (E)



Article 315

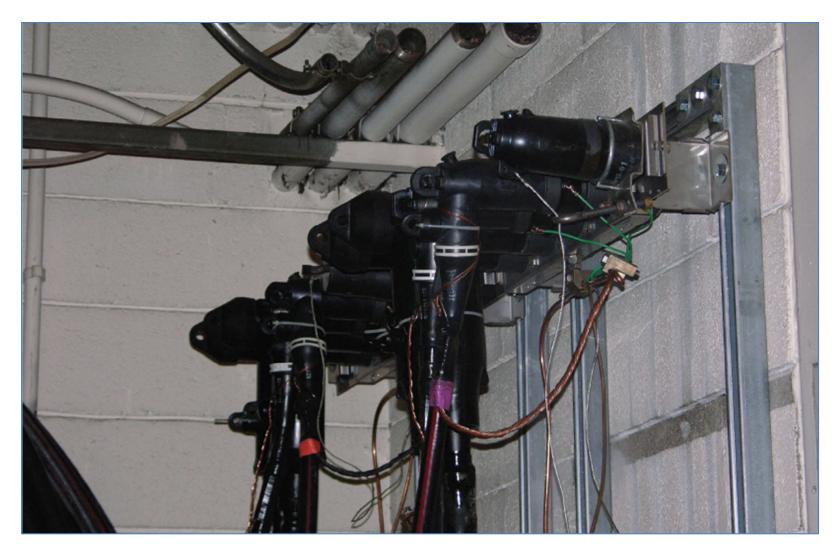
REVISION RELOCATE

Medium Voltage Conductors and Cables

- 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.

Article 315

REVISION | RELOCATE



REVISION REORGANIZE

Bends

- 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.

REVISION REORGANIZE



342.30(A)

NEW

Securing and Supporting

- 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.

342.30(A)

NEW



REVISION

Reaming and Threading

- 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.



REVISION REORGANIZE

Insert Uses Permitted

- 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.

REVISION REORGANIZE



REVISION

Uses Permitted

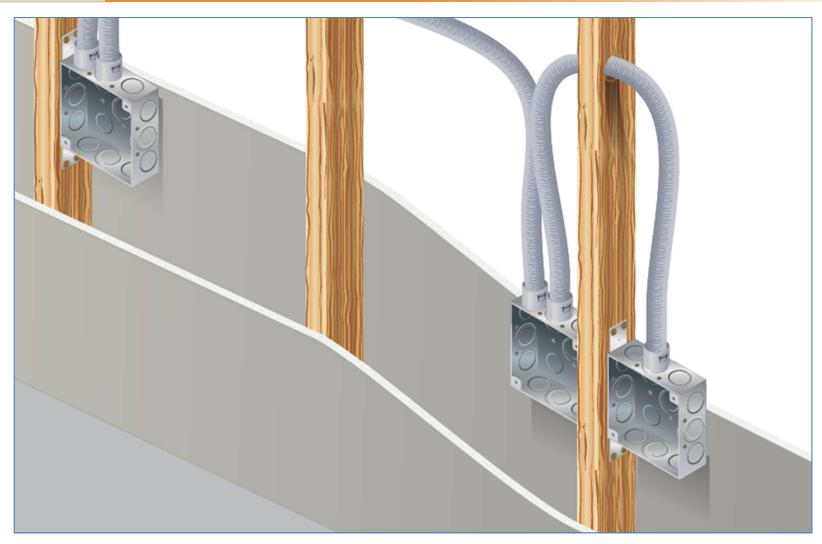
- Section 358.10 was revised to recognize two new permitted uses for EMT.
- EMT is permitted in direct burial applications where it is used with fittings that are identified for direct burial.
- EMT is recognized for manufactured wiring systems as permitted in 604.100(A)(2).



REVISION

Uses Permitted

- 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.



Article 369

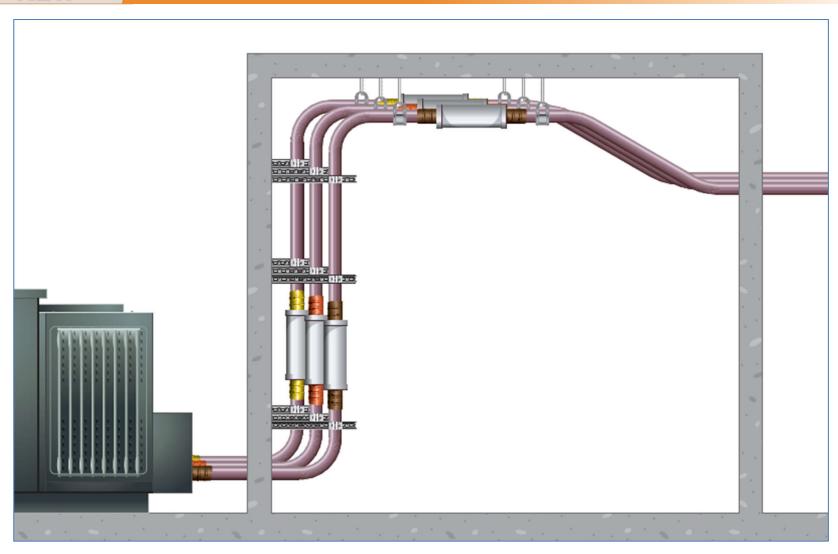
NEW

Insulated Bus Pipe (IBP)/Tubular Covered Conductors

- 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.

Article 369

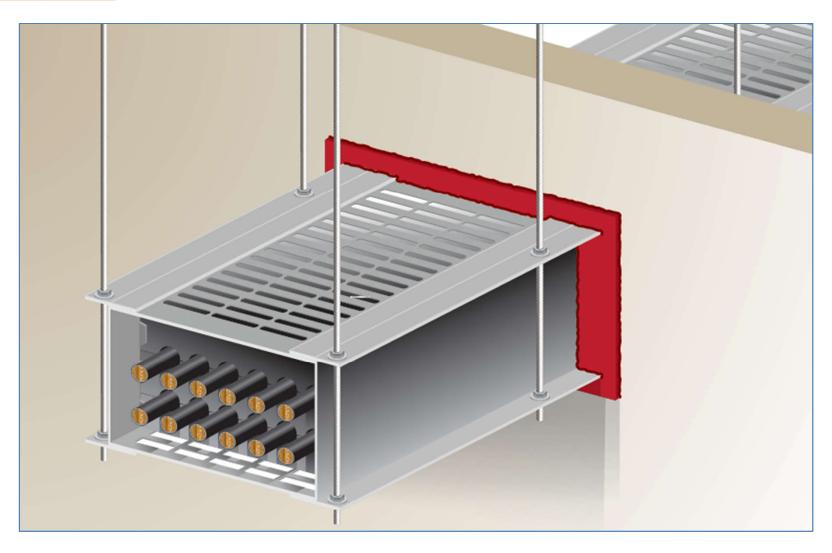
NEW



REVISION

Cablebus Installation

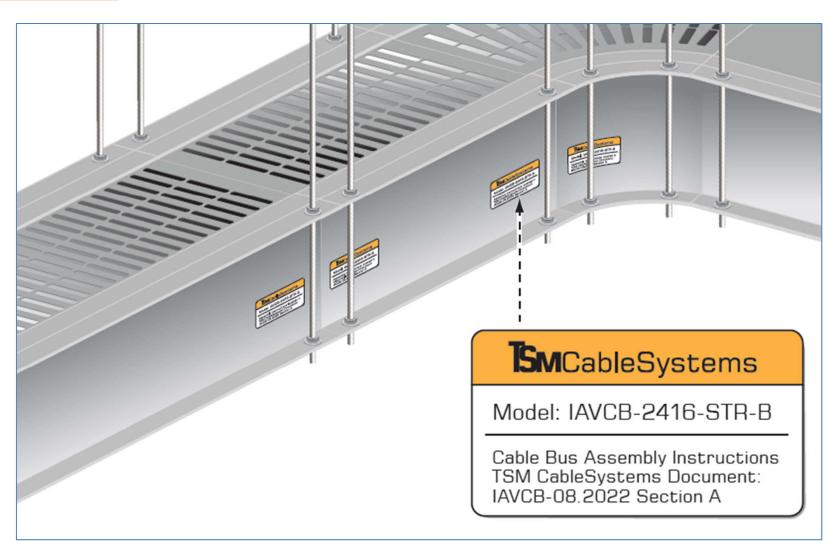
- Cablebus installation requirements have been simplified.
- Cablebus is permitted to be run through fire walls in accordance with 300.21.
- Since cablebus is a support system, similar to cable trays, the firestop requirements now refer to 300.21.
- The previous requirement for curbs where cablebus penetrates floors has been removed because cablebus is permitted in wet locations.



REVISION

Marking

- 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.



Article 371

NEW

Flexible Bus Systems

- 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.

Article 371

NEW



Significant Changes

TO THE NEC® 2023

Chapter 4





400.40 through 400.52

NEW REVISION

Portable Power Feeder Cables Over 2000 V, Nominal

- 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.

400.40 through 400.52

NEW



REVISION

Scope

- 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.



404.14 & 404.14(D)

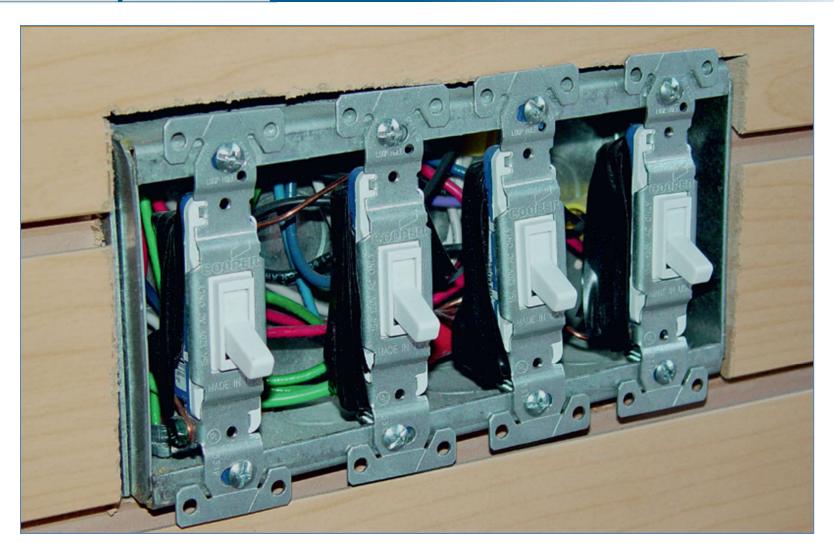
NEW REVISION

Snap Switch Terminations

- 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.

404.14 & 404.14(D)

NEW



NEW

Reconditioned Equipment

- 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.

NEW



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606

NEW

Switch Enclosures with Doors

- 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.

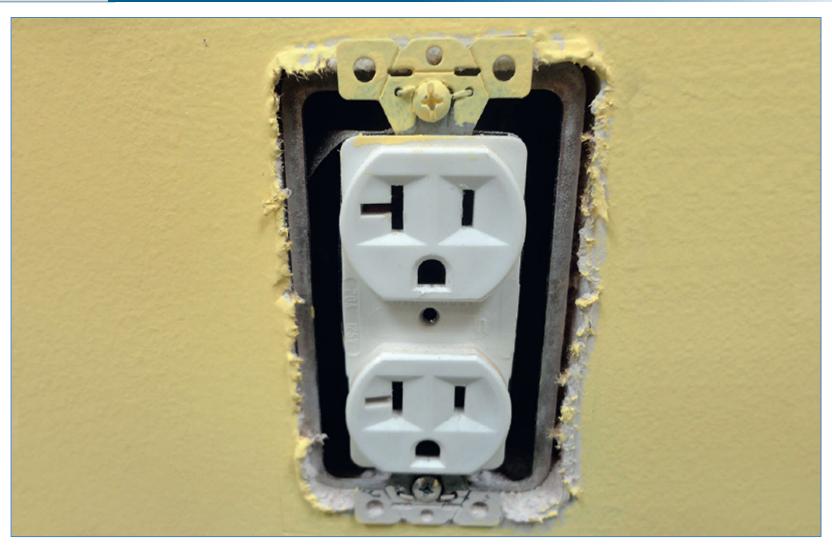
NEW



REVISION

Receptacle Rating and Type

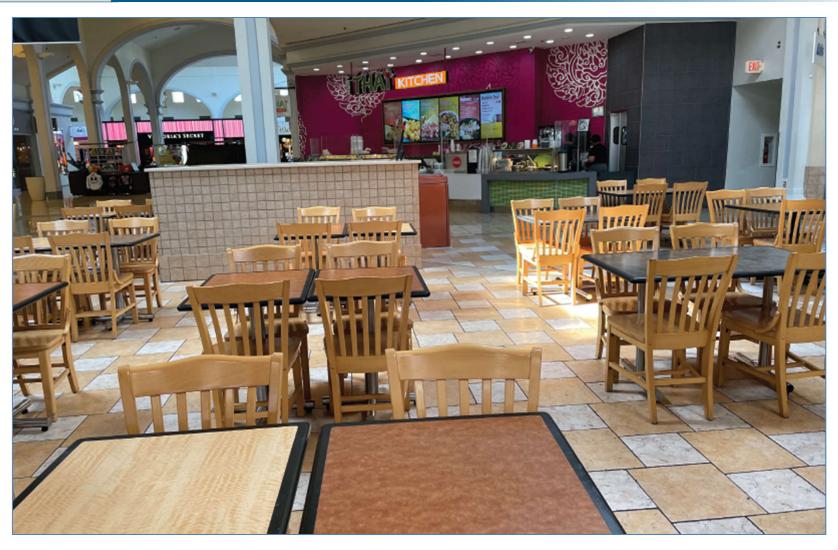
- The title of 406.3(C) has been changed to CO/ALR Receptacles.
- Section 406.3(D) has been added to cover requirements for termination of conductors to receptacles.
- Push-in terminals are only listed for 14 AWG copper conductors and can only be used to connect receptacles on 15-ampere branch circuits.



REVISION

General Installation Requirements

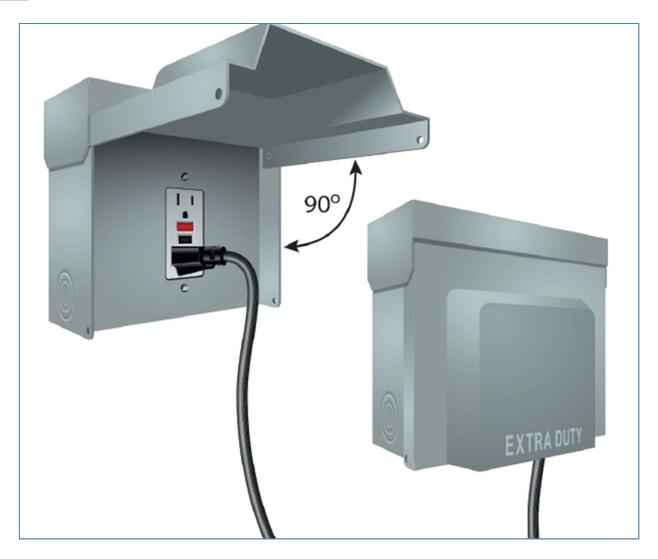
- Section 406.4(D)(3) now requires replacement GFCI-type receptacles to be listed.
- Section 406.4(D)(5) provides requirements for replacement tamperresistant receptacles. A tamper-resistant receptacle is not required if a non–grounding-type receptacle is replaced with another non– grounding-type receptacle. 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).



REVISION

Receptacles in Damp or Wet Locations

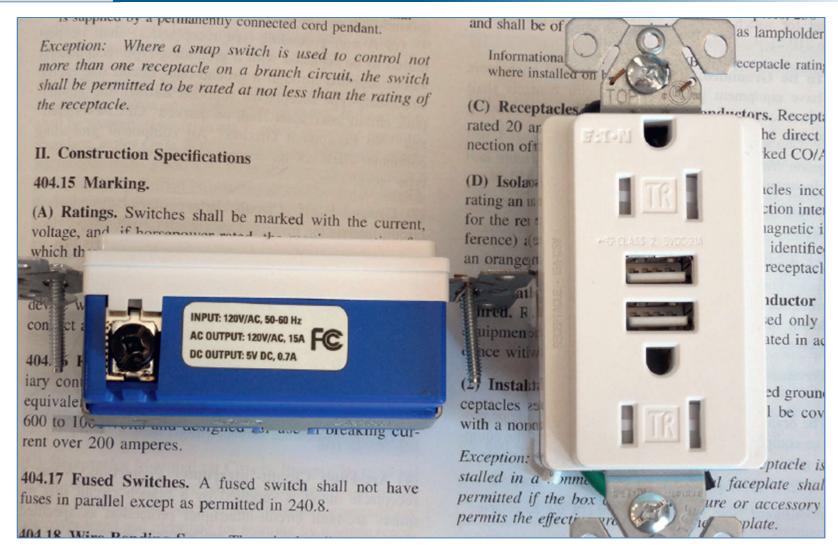
- Hinged covers of outlet box hoods in damp locations must be able to open at least 90° from the open to the closed position.
- If not designed to open 90°, it must be able to open fully.
- All receptacles in wet locations must be listed and identified as weather resistant.
- Other receptacles in wet locations that are attended while in use must be weatherproof with the attachment plug removed.
- The bathtub and shower space zones have been revised.



REVISION

Tamper-Resistant Receptacles

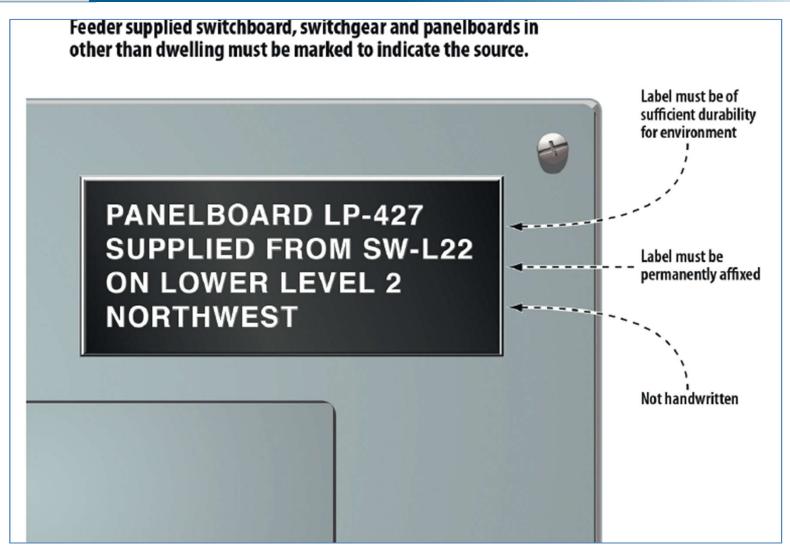
- Tamper-resistant receptacle requirements now include all dwelling units, boathouses, mobile homes, and manufactured homes, including their attached and detached garages.
- Requirements for tamper-resistant receptacles in medical facilities and other types of residential facilities have been revised 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.



REVISION

Descriptions Required

- 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.

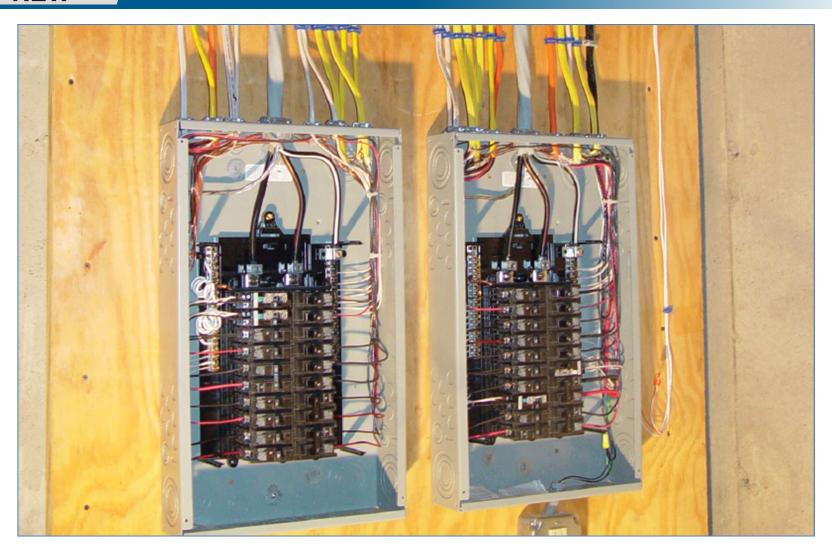


NEW

Replacement Panelboards

- 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.

NEW



REVISION

Panelboard Orientation

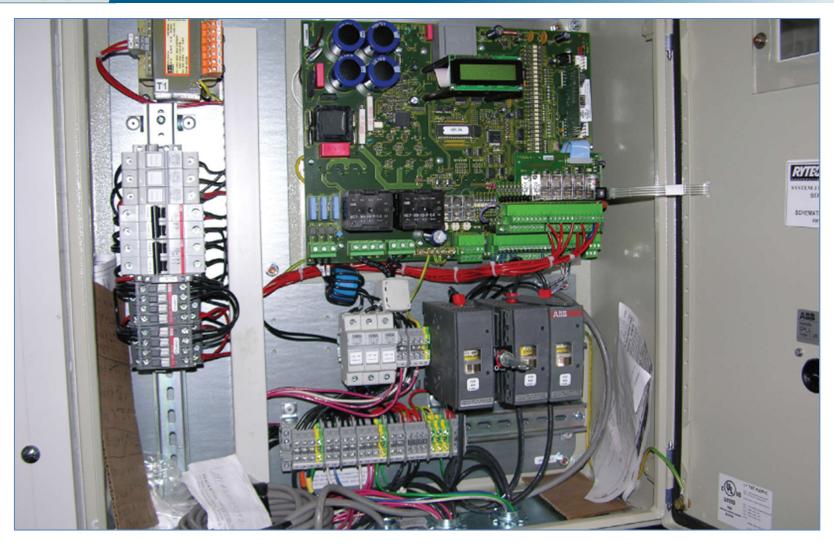
- The 2020 Code prohibited panelboards from being installed in the face-up position because it created an unsafe working position and increased the likelihood that debris could accumulate in the panelboard.
- The requirement has also been modified for the 2023 *Code* to prohibit installation in the face-down 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.



REVISION

Bonding

- 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).

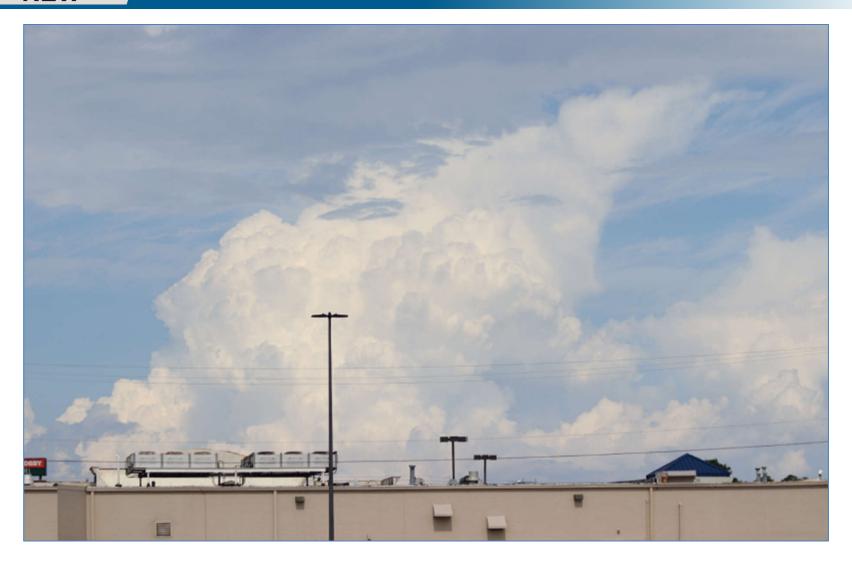


NEW

Surge Protection

- 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.

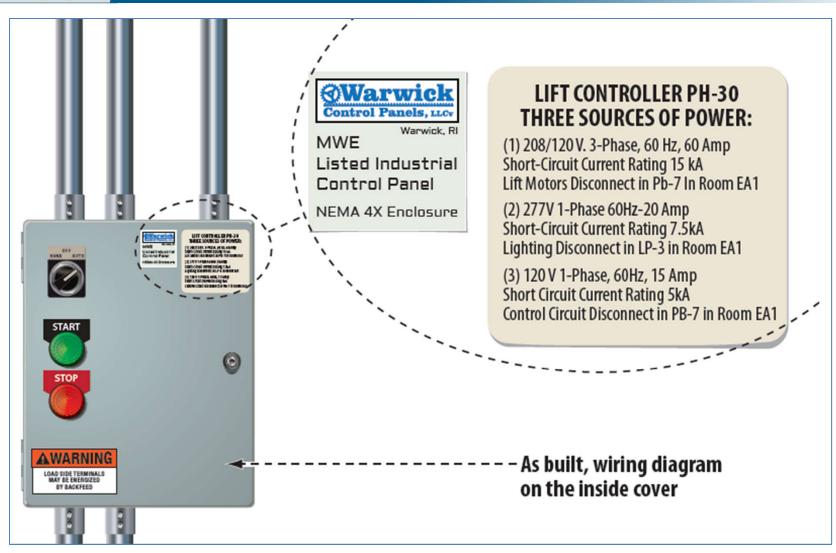
NEW



REVISION

Marking

- 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.

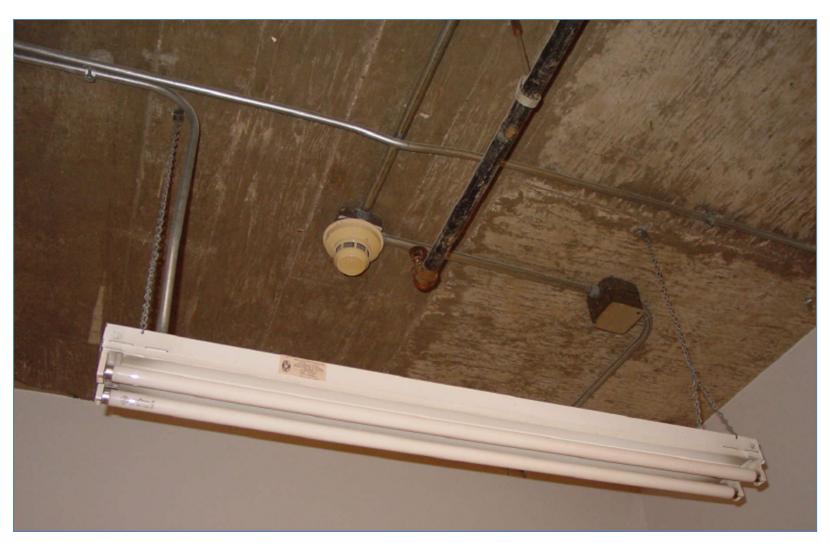


REORGANIZE

Luminaires with Exposed Conductive Surfaces

- 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.

REORGANIZE



REVISION | RELOCATE

Disconnecting Means-Fluorescent or LED Luminaires

- 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.

REVISION RELOCATE



410.190 through 197

NEW

Provisions for Germicidal Irradiation Luminaires

- 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.

410.190 through 197

NEW



Article 422

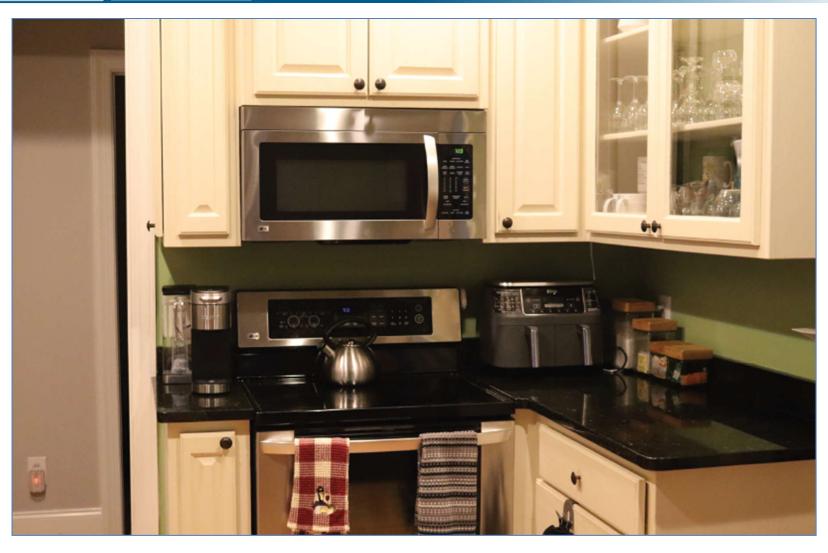
DELETION REORGANIZE

Appliances

- 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).

Article 422

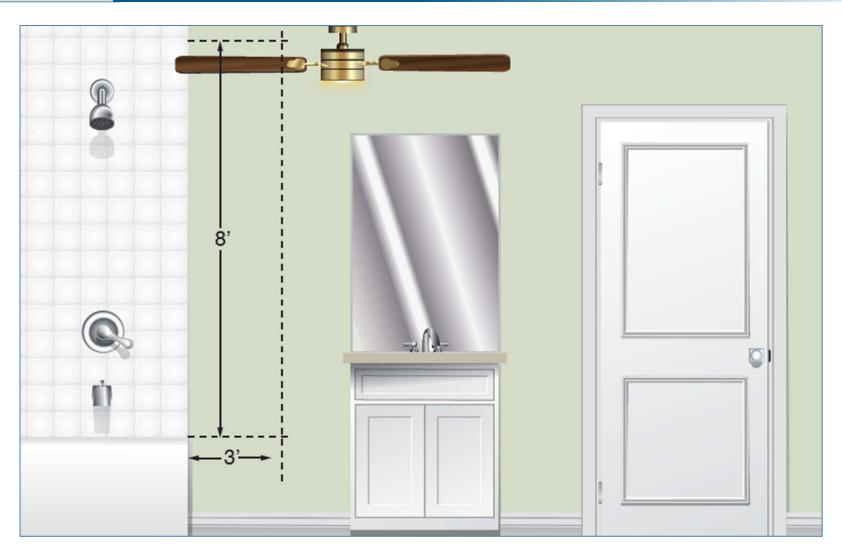
DELETION REORGANIZE



REVISION

Ceiling-Suspended (Paddle) Fans

- 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.

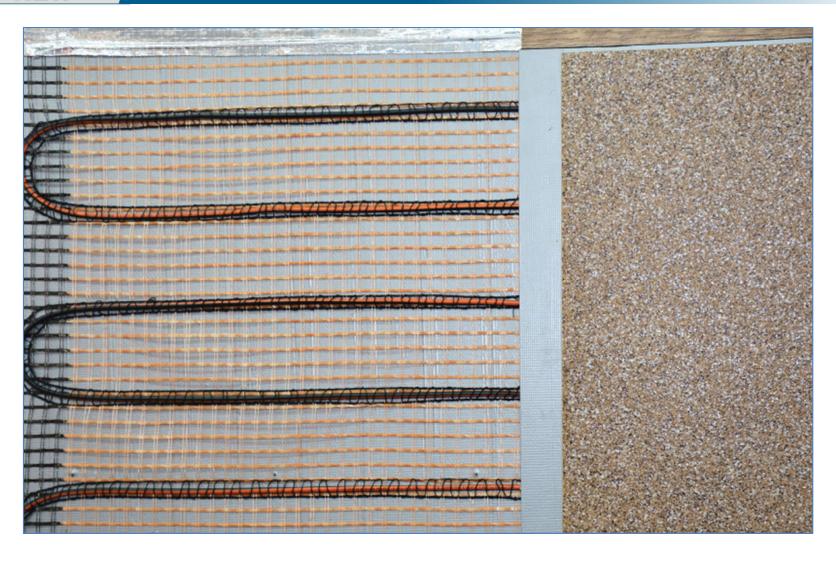


NEW

Installation of Cables in Walls

- 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.

NEW



REVISION

Scope

- 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.



REVISION

Conductor Ampacity and Motor Rating Determination

- 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.



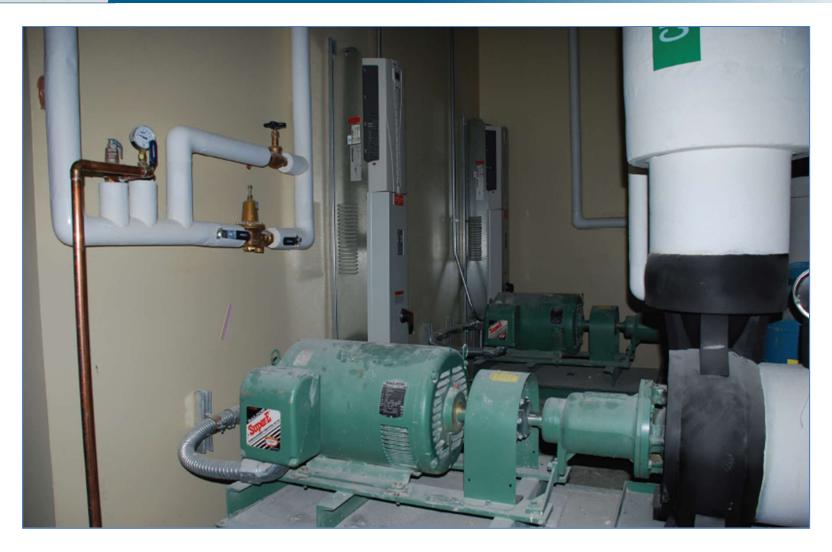
430.52(C)

REVISION

Rating or Setting

- 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 selfprotected 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 lowimpedance equipment.

430.52(C)



430.83(F)

NEW

Ratings

- 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.

430.83(F)

NEW



REVISION

Single Machine and Location

- 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 airconditioning 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.



440.22(A)

REVISION

Rating or Setting for Individual Motor-Compressor

- 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.

440.22(A)



REVISION

Listing

- Previously, stationary generators rated 600 volts or less were required to be listed.
- This section now requires all generators to be listed. However, one-ofa-kind custom manufactured generators are permitted to be field labeled.
- UL 2200, Stationary Generator Assemblies, now also covers mediumvoltage generators.



REVISION

Marking

- 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.



445.18 & 445.19

NEW REVISION

Disconnecting Means

- 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.

445.18 & 445.19

NEW



450.43(C)

REVISION

Accessibility

- 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).

450.43(C)



460.24(A)

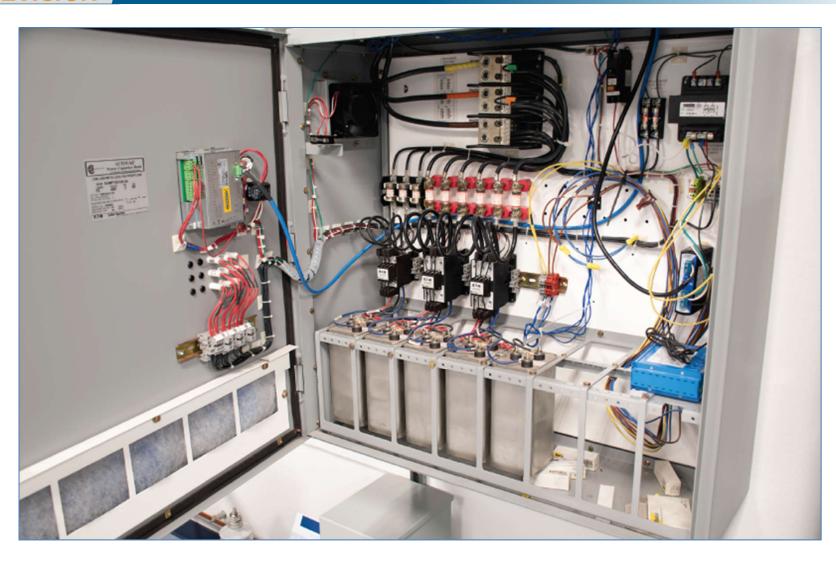
REVISION

Load Current

- 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.

460.24(A)

REVISION



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REVISION

Stationary Standby Batteries

- 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.



REVISION | RELOCATE

Equipment Over 1000 Volts ac, 1500 Volts dc, Nominal

- 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.

REVISION RELOCATE



Significant Changes

TO THE NEC® 2023

Chapter 5





REVISION

Scope

- The scope of Article 500 was revised. As previously written, it provided a scope for Articles 500 through 504.
- The new scope only covers what is in Article 500.
- Article 500 now only covers the traditional Class I, II, and III locations.
- The zone classification systems are covered in Article 505 for Zones 0,
 1, and 2, and Article 506 for Zones 20, 21, and 22.



REVISION

Documentation

- The documentation required by 500.4 now includes areas that have been determined to be unclassified.
- The documentation of the hazardous location must also be available to the authority having jurisdiction.
- The edition dates have been deleted for many of the referenced standards.
- It is important to remember that referenced standards are for information only.



500.5(D)

REVISION

Class III Locations

- The definitions of Class III locations have been rewritten.
- The new definitions now align with the definitions of Class II locations.
- A Class III, Division 1 location is one in which combustible fibers/flyings can be present in the air under normal conditions in quantities to produce explosive or ignitible mixtures. Previously, combustible fibers/flyings were considered fast burning fire hazards, rather than explosion hazards.
- A Class III, Division 2 location is one in which nonmetal combustible fibers/flyings can be released through the abnormal operation of equipment and will not interfere with equipment operation.

500.5(D)



500.6(C) & (D)

NEW

Class III Combustible and Ignitible Fibers/Flyings

- New 500.6(C) and (D) were added to correlate with NFPA 499:
 Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas.
- Combustible fibers/flyings are materials with any dimension that is greater than 500 µm in nominal size that can form an explosible mixture when suspended in air at standard atmospheric pressure and temperature.
- Ignitible fibers/flyings are larger than 500 µm in nominal size, which are not likely to be in suspension in quantities to produce an explosible mixture but could produce an ignitable layer fire hazard.

500.6(C) & (D)

NEW



2021

NFPA 499

Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas

Origins

Committee Personnel

- > Chapter 1 Administration
- > Chapter 2 Referenced Publications
- > Chapter 3 Definitions
- > Chapter 4 Combustible Dusts
- > Chapter 5 National Electrical Code (NEC) Criteria
- > Chapter 6 Classification of Combustible

 Dust Locations
- > Annex A Explanatory Material
 - Annex B Informational References

REVISION

Protection Techniques

- A reference was added for the new Chapter 9, Table 13 on protection techniques.
- Section 500.7(E) was revised to delete references to entire articles.
- New protection techniques were added to this section, including electrical resistance trace heating, impedance heating, enclosed break, non-sparking, sealed, and other techniques that are identified for use in hazardous (classified) locations.



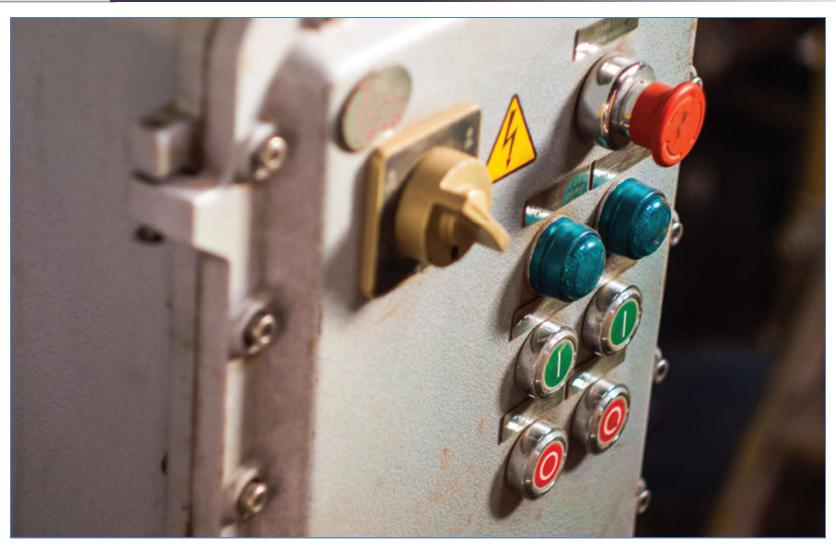
500.8(E)(3)

REVISION

Unused Openings

- Unused openings must be closed with blanking elements or close-up plugs that are listed for the location.
- If the equipment has threaded entries of NPT-threaded conduit or fittings, the NPT-threaded entries must be made up with at least five threads fully engaged.
- For listed explosionproof equipment, joints with factory-threaded entries must be made up with at least 4 ½ threads fully engaged.
- For metric threaded entries, either the entry must be listed as being metric or listed adapters must be used.

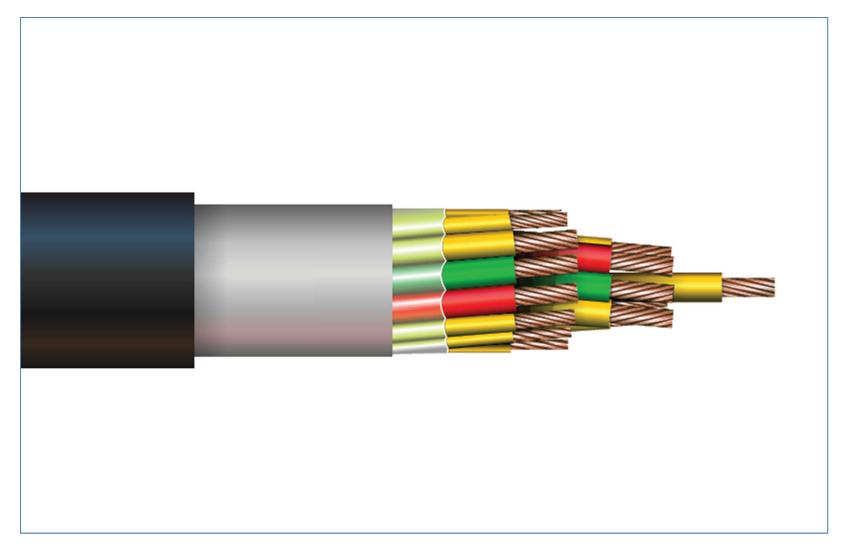
500.8(E)(3)



REVISION

Wiring Methods, Class I

- The previous Exception to 501.10(A)(1)(1) was converted into positive text and now appears as (A)(1)(2).
- The wiring methods in (A)(4), (5), (7), and (8) are for restricted industrial establishments.
- Requirements for cable tray applications have been added to 501.10(A)(1)(4), (A)(1)(7) and (A)(1)(8) which now reference 392.22.
- The reference to 337.10 has been corrected to Article 337, Part II.



REVISION

Sealing and Drainage

- The boundary seal requirement for seals in Division 2 locations has been relocated to 501.15(A)(4). This requires Division 1 wiring methods up to the seal fitting in the Division 2 location.
- A revision to 501.15(B)(2) permits Type RTRC to be used from the boundary conduit seal to the point where it exits the Division 2 location.
- Types TC-ER-HL and Type P cable were inadvertently omitted from the cable seal requirements in 501.15(D)(1) in the 2020 Code.



NEW

Flexible Cables, Class I, Division 2

- A new Section 501.141 was added to provide requirements for flexible cables in Class I, Division 2 locations.
- This new section is primarily focused on permitting the use of Type P cable.
- The means of terminating the cables requires the use of cable connectors that are listed for Class I, Division 2 locations.
- A new definition of "cable connector [as applied to hazardous (classified) locations]" has been added to Article 100.

NEW



REVISION

Receptacles and Attachment Plugs, Class I Locations

- Section 501.145 now requires receptacles and attachment plugs to be listed for the location, except as permitted by 501.105(B)(6) for meters, instruments, and relays.
- Listing for Class I, Division 2 is not required if the circuit only involves nonincendive wiring.
- Listing is not required in restricted industrial establishments complying with 501.105(B)(6), Exception No. 2, which also requires compliance with 501.6(B)(6)(2) through (4).



REVISION

Wiring Methods Class II Locations

- PVC-coated metal conduit is permitted in Class II, Division 2 locations, even where there is not an increased level of corrosion.
- EMT with compression-type fittings or connectors is now permitted in Class II, Division 2 Locations.
- Type RTRC-XW conduit is permitted in industrial establishments with restricted public access where conditions of maintenance and supervision ensure that only qualified persons service the installation.



REVISION

Sealing, Class II, Divisions 1 and 2

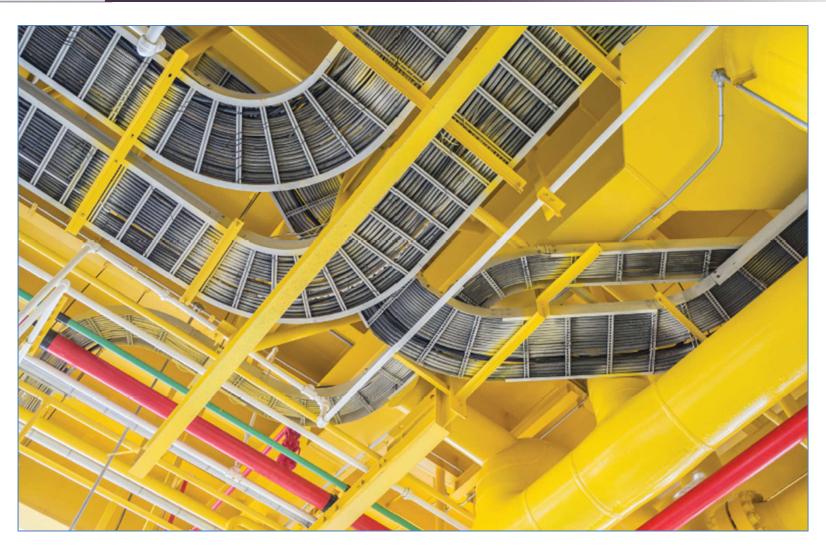
- The informational note was changed to become 502.15(5). It indicates that electrical sealing putty is a recognized means to prevent the entrance of dust into a dust-ignition-proof enclosure.
- Informational notes cannot be used to provide permissions or recommendations.
- Seal fittings are required to be accessible, but they are not required to be explosion proof.



REVISION

Grounding and Bonding

- References to Article 250 were changed to refer to Article 250, Part VI for grounding and Part V for bonding.
- Cable trays were added to 502.30(B)(1), which addresses specific bonding means, to make it clear that cable trays must be bonded in the same manner as raceways.
- Requirements were added for bonding of metal struts, angles, or channels if used with Types TC-ER, PLTC-ER, or ITC-ER.
- Section 502.30(B)(2)(3) was changed from "not a power utilization load" to "part of a meter, instrument, or relay circuit."



REVISION

Wiring Methods

- Type P cable is now permitted in Class III, Division 1 locations in restricted industrial establishments.
- Criteria is established for the installation of Type P cable in cable trays.
- Wiring in Class III, Division 2 locations must comply with the Division 1 requirements.
- In sections, compartments, or areas that do not contain machinery and are used solely for storage, open wiring on insulators is permitted.



REVISION

Grounding and Bonding

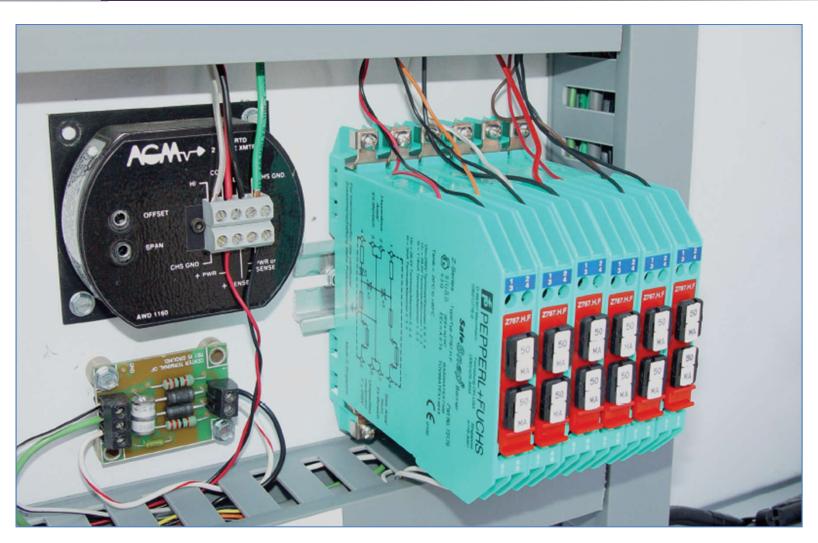
- References to Article 250 were changed to refer to the general requirements in Part I of Article 250, as well as to Part VI for grounding and Part V for bonding.
- Cable trays were added to 503.30(B)(1), on specific bonding means, to make it clear that cable trays must be bonded in the same manner as raceways.
- Requirements were added for bonding of metal struts, angles, or channels if used with Types TC-ER, PLTC-ER, or ITC-ER.



REVISION

Separation of Intrinsically Safe Conductors

- Section 504.30(A)(1), installations in raceways, cable trays, and cables, had a simple rule, four exceptions, and three informational notes. It has been converted into more usable positive text.
- Section 504.30(A)(2), installations within enclosures, had three informational notes that were incorporated into enforceable *Code* text.
- Section 504.30(A)(3), other installations, contained an exception that was converted into positive text and incorporated into the existing text.



Article 505

DELETION REVISION

Zone 0, 1, and 2 Locations

- 505.1 was revised to make it clear that this article does not cover the class/division classification system and that it does not cover explosives, pyrotechnics, or blasting agents.
- Section 505.3 was deleted because 90.3 makes it unnecessary.
- Section 505.4 on documentation was revised for consistency with the requirements for documentation in other articles in Chapter 5.
- Section 505.5(A) was revised for consistency with 500.5(A).

Article 505

DELETION REVISION



NEW

Protection Techniques

- Section 505.8 has been revised to recognize new protection techniques.
- Impedance heating is a protection technique that is now recognized.
 Its design is based on IEEE 844.3.
- A pressurized room "p" is a protection technique that is recognized for Zone 1 or 2 locations.
- Special protection "s" is a protection technique that is recognized for Zones 0, 1, and 2.

NEW



REVISION

Sealing and Drainage

- Section 505.16(B)(3) has been expanded to include pressurized rooms. An informational note was added to reference the IEC Standard for pressurized rooms.
- Section 505.16(C)(1) was rewritten into list format, and the exceptions were rewritten into positive language.
- New requirements were added to provide sealing requirements for cables that enter breathing-type enclosures "nR."

REVISION



2021

NFPA 496

Standard for Purged and Pressurized Enclosures for Electrical Equipment

Committee Personnel

- > Chapter 1 Administration
- > Chapter 2 Referenced Publications
- > Chapter 3 Definitions
- > Chapter 4 General Requirements for Pressurized Enclosures
- > Chapter 5 Pressurized Enclosures for Class I, or Zone 1, or Zone 2
- > Chapter 6 Pressurized Enclosures for Class II
- > Chapter 7 Pressurized Control Rooms
- > Chapter 8 Pressurized Enclosures Having an Internal Source of Flammable Gas or Vapor
- > Chapter 9 Pressurized Analyzer Rooms Containing a Source of Flammable Gas, Vapor, or Liquid
 - Annex A Explanatory Material
 - Annex B Informational References

505.20(C), Exc. Nos. 5 & 6

NEW

Equipment Requirements, Zone 2

- Two new exceptions were added to 505.20(C) to make the requirements for Zone 2 locations consistent with the requirements for Class I, Division 2 locations.
- Exception No. 5 permits the use of certain space heaters in Zone 2 locations where the space heaters are used to reduce condensation during shutdown periods.
- Exception No. 6 permits the use of sliding contact shaft bonding devices that are used on certain motors where the potential discharge is determined to be nonincendive.

505.20(C), Exc. Nos. 5 & 6

NEW



Article 506

REVISION

Zone 20, 21, and 22 Locations

- 506.1 was revised to clarify that this article does not cover the class/division classification system and that it does not cover explosives, pyrotechnics, or blasting agents.
- 506.3 was deleted because 90.3 makes it unnecessary.
- 506.4, on documentation, was revised for consistency with similar requirements in other articles in Chapter 5.
- Table 506.9(C)(2)(3) has been deleted. The information is now located in Chapter 9, Table 13.

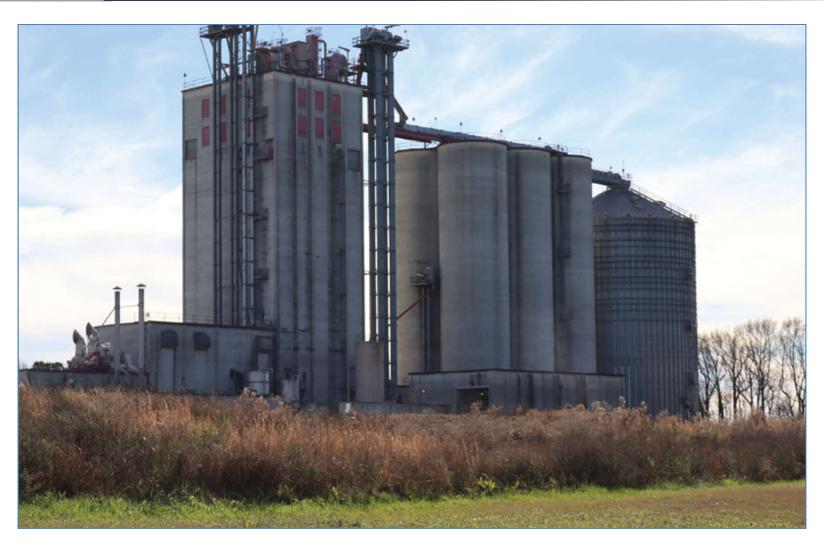
Article 506



REVISION

Material Groups

- The definition of the material groups has been updated for consistency with NFPA 499: Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas.
- Group IIIC consists of combustible metal dusts and combustible metal fibers/flyings.
- Group IIIB includes combustible dusts other than combustible metal dust.
- Group IIIA, includes combustible fibers/flyings or ignitible fibers/flyings.



NEW

Other Articles

- A new Section 511.2 was created with a table that points to requirements in Articles 500, 501, and 505.
- The table is intended to simplify the use of either the traditional class/division classification system or the zone classification system.
- Articles 511 through 516 provide occupancy-specific requirements that are predicated on the use of Articles 500 and 501, or Article 505.
- Similar tables have been added to 512.2, 513.2, 514.2, 515.2, and 516.2.

NEW



511.7(A)

REVISION

Fixed Wiring Above Hazardous (Classified) Locations

- Section 511.7(A)(1) was converted into list format to make it easier to navigate.
- "Rigid Nonmetallic Conduit" was changed to "PVC Conduit."
- Reinforced thermosetting resin conduit, RTRC, was added as a permitted fixed wiring method.
- The same changes were made in 514.7 for Wiring Above Hazardous (Classified) locations in Motor Fuel Dispensing Facilities.

511.7(A)



REVISION

Underground Wiring Below Hazardous Locations

- The title of this section was changed to "Underground Wiring Below Hazardous (Classified) Locations."
- The language permitting intermediated metal conduit has been revised to clarify that it must be threaded.
- The exception has been rewritten into positive language.



Article 512

NEW

Cannabis Oil Equipment and Cannabis Oil Systems

- A new Article 512 has been created on cannabis oil equipment and cannabis oil systems using flammable materials.
- Flammable materials are used to extract cannabis oil, including butane, ethanol, hexane, pentane, propane, and LPG.
- Article 512 provides detailed classification diagrams to help to evaluate hazardous areas.

Article 512

NEW



516.7(A)

REVISION

Wiring & Equipment Not Within Hazardous Locations

- Section 516.7(A) was converted into a list format to make it easier to navigate.
- "Rigid Nonmetallic Conduit" was changed to "PVC Conduit."
- Reinforced thermosetting resin conduit, RTRC, was added as a permitted fixed wiring method.
- Similar changes were made in 511.7(A) and 514.7(A).

516.7(A)

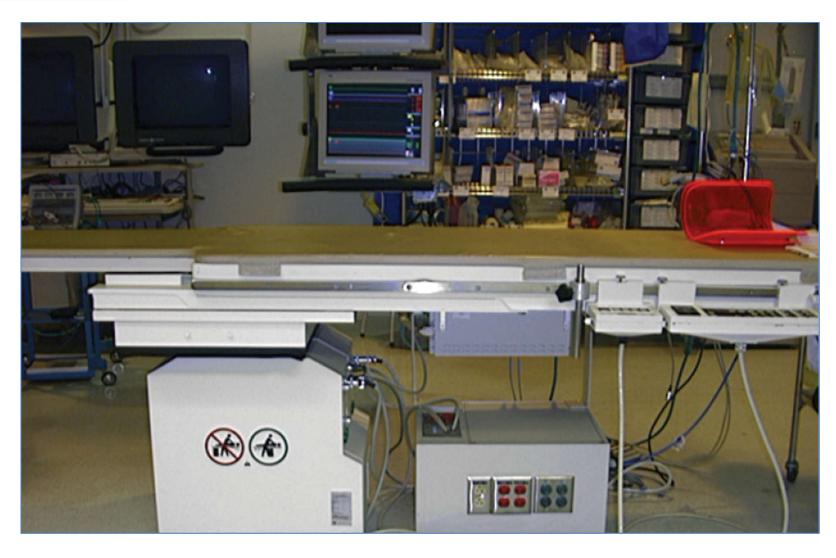


NEW

Patient Care-Related Electrical Equipment

- A new requirement has been added that indicates that patient carerelated equipment is not subject to the reconditioning requirements in the Code.
- Patient care-related equipment is subject to a recertification process after it is reconditioned.
- Patient care-related equipment is also subject to recommissioning or recertification when it is relocated.

NEW



517.10(B)

REVISION

Not Covered

- Informational Note No. 1 was added to point to certain receptacles in health care business offices that are required to be tamper-resistant.
- Informational Note No. 2 was added to point to requirements for AFCI protection for branch-circuit outlets in patient sleeping rooms that are required to be AFCI protected.
- A new list item (3) was added to exempt pharmacy services not contiguous to health care facilities from the requirements of Article 517.

517.10(B)

REVISION



725

REVISION

Equipment Grounding Conductor

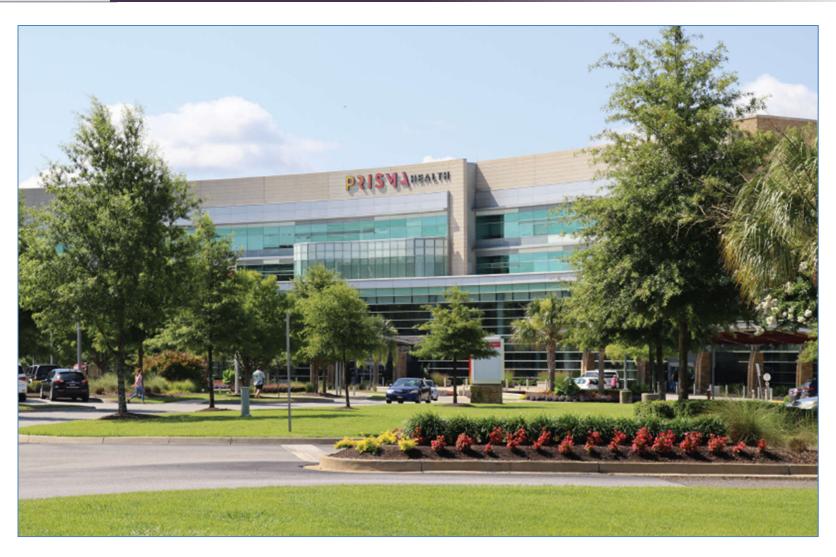
- 517.13(B)(1), Exception No. 2 was relocated to 517.13 following the main rule.
- The requirement for grounding and bonding of metal faceplates was relocated from 517.13(B)(1)(3) to 517.13(B)(1), Exception No. 2. Faceplates are normally grounded through the attachment screws that connect them to the yoke of the switch or receptacle.
- All branch-circuit wiring for a patient care space must comply with 517.13, including wiring that originates outside of the patient care space.



REVISION

Panelboard Bonding

- An exception was added to 517.14 on panelboard bonding to permit an insulated copper conductor not smaller than 10 AWG to be terminated on listed connections to an aluminum or copper busbar.
- The busbar must be at least ¼ inch thick by two inches wide and of sufficient length to accommodate the number of terminations necessary for the bonding of the panelboards.
- The busbar must be securely fastened and installed in an accessible location.



517.20(A)

REVISION

Wet Procedure Locations

- Wet procedure locations are required to be provided with protection against electric shock.
- 517.20(A)(1) was clarified to indicate that it applies to isolated power systems that remain in operation in the event of a single line-to-ground fault.
- The informational note was revised to clarify that isolated power systems can eliminate the danger of electric shock.

517.20(A)



NEW

Demand Factors

- New demand factors have been added for general-use receptacles and individual branch circuits not exceeding 150 volts to ground.
- This information is based on hospital load studies and a study by the Fire Protection Research Foundation.
- For cord-connected equipment, the table provides two sets of demand factors. One set applies to Category 1 and 2 spaces. The second applies to Category 3 and 4 spaces.
- For receptacle loads, the first 5 kVA is calculated at 100%, the next 5–10 kVA is calculated at 50%, and the remainder is calculated at 25%.

NEW



REVISION

Sources of Power

- 517.30 requires that essential electrical systems (EES) have two or more independent sources or sets of sources.
- At least one source or set of sources must be entirely onsite and it must be capable of serving the entire EES load.
- 517.30(B) now provides a list of power sources for the EES, which includes utility supply power, generating units, fuel cell systems, energy storage systems, and health care microgrids.



REVISION

Required Power Sources

- Section 517.41 requires that the essential electrical system (EES)
 have two or more independent sources or sets of sources, one of
 which must be onsite and capable of supplying the entire EES load.
- At least one source or one set of sources must be entirely onsite.
- EES components are required so that they are not exposed to interruptions from storms, floods, earthquakes, or hazards from adjoining structures or nearby activities.



Article 517, Part V.

REVISION

Diagnostic Imaging and Treatment Equipment

- The title of Part V has been changed to "Diagnostic Imaging and Treatment Equipment."
- A new Informational Note No. 3 has been added that provides examples of 12 types of diagnostic imaging equipment covered by Part V.
- A new Informational Note No. 4 was added that provides examples of five types of treatment equipment covered by Part V.

Article 517, Part V.



REVISION

Patient Care Spaces

- Section 517.80 was revised to recognize that Class 2 circuits that transmit power and data to a powered device do not need to comply with the grounding requirements in 517.13.
- Power over Ethernet (PoE) is an example of a Class 2 circuit that can transmit power for applications, such as wireless access points and lighting, while also transmitting data.
- A new informational note was added to reference a NEMA standard on PoE lighting.



518.2(A)

REVISION

Examples

- Casinos and gaming facilities have been added to the list of examples of assembly occupancies that are covered by Article 518.
- Casinos can have transient crowds of people hovering over machines and table games that can grow larger than in traditional places of assembly.
- Many casinos also have entertainment to retain customers at the machines.

518.2(A)



REVISION

Wiring Methods-General

- Section 518.4 was reformatted into list format.
- Section 518.4(B)(4) was added to recognize power over Ethernet (PoE) supplying lighting.
- A new informational note was added to 518.4(B)(4) that references a NEMA standard for the installation of PoE lighting.
- The wiring methods for buildings or portions of buildings of non-fire rated construction were expanded to include the permitted Chapter 3 wiring methods.



520.53(C)

REVISION

Construction

- A new sentence was added to the main rule to clarify that the requirements of 408.18(C) do not apply to portable stage switchboards.
- In the 2020 *Code*, single-pole separable connectors were relocated into 406.13.
- This section has been revised to point to 406.13. Since the general requirements would continue to apply to this section, there is no reason to repeat the requirements here.
- Section 520.53(C) now only covers those requirements that are unique to occupancies that are covered by Article 520.

520.53(C)



520.68(D)

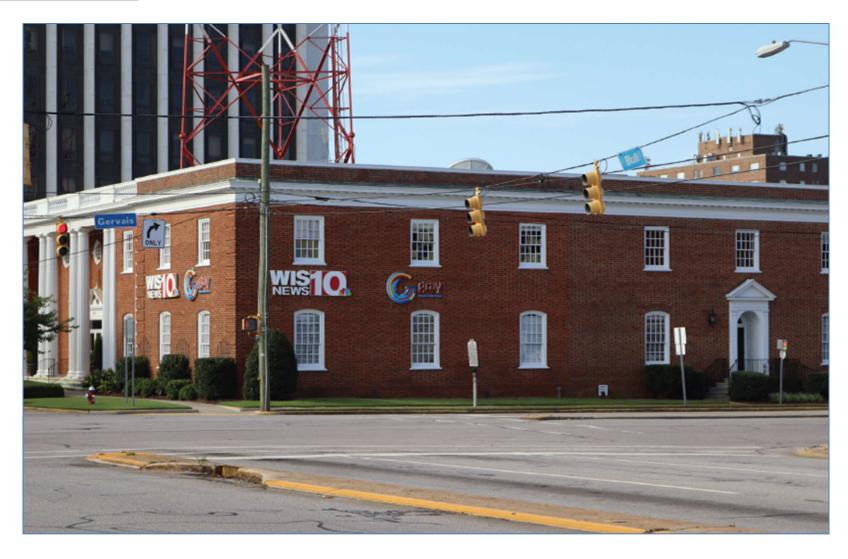
NEW

Special-Purpose Multi-Circuit Cable Systems

- A new 520.68(D) was created to provide requirements for multi-circuit cable systems.
- These circuits are limited to not more than 20 amperes and not more than 150 volts to ground.
- Trunk cables, breakout assemblies, and multi-circuit enclosures are required to be listed.
- Installation and operation of special-purpose multi-circuit cable systems requires qualified persons.

520.68(D)

NEW



Article 530

REVISION

Motion Picture and TV Studios and Remote Locations

- Article 530 has been rewritten and updated.
- Several technologies have disappeared or are being phased out, including carbon arc luminaires, tungsten luminaires, fused extension cables, video tape, and film.
- Several newer technologies are being used, including the use of generators, AC enclosed arc luminaires, and digital cameras.

Article 530



REVISION

Power Supply

- This section was revised to clarify that relocatable structures must be supplied by a feeder.
- This correlates with Article 550, which does not allow service equipment on a structure without a permanent foundation.
- Two or more relocatable structures joined into a single unit are permitted to use a chassis bonding conductor as the tap conductor.



REVISION

Physical Protection

- Section 547.26 has been revised to prohibit nonmetallic sheathed cable from being concealed within walls and above ceilings of buildings or portions thereof which are contiguous with or physically adjoined with livestock areas.
- Rodents and other pests frequently chew through cables.
- The requirement also provides examples of areas where this commonly happens, including within walls and ceilings of offices, lunchrooms, and ancillary areas adjoining animal confinement areas.



547.44(B)

REVISION

Bonding of Equipotential Planes

- The bonding requirements in agricultural buildings have been clarified.
- Equipotential planes must be bonded to the grounding electrode system or an equipment grounding terminal in any panelboard associated with the equipotential plane.
- The bonding conductor must be an insulated, covered, or bare solid copper conductor that is not smaller than 8 AWG.

547.44(B)



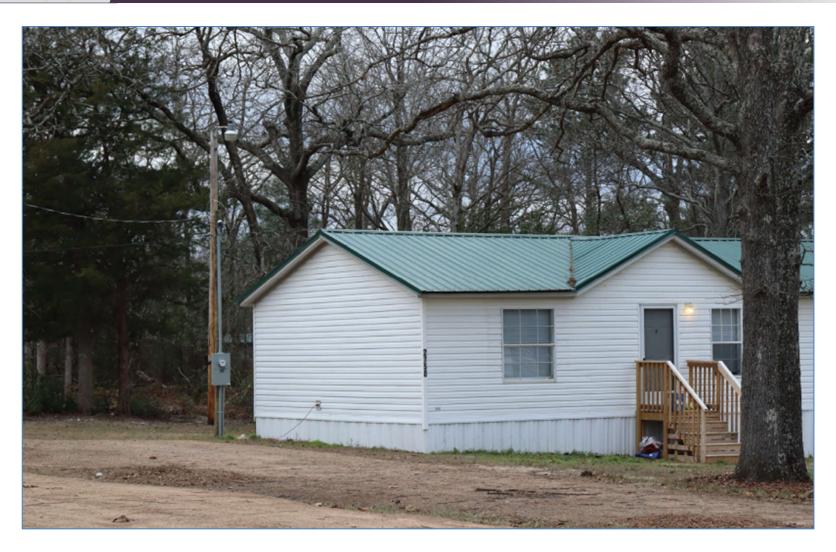
550.10(I)

REVISION

Mast Weatherhead or Raceway

- The reference to Article 230 has been clarified to indicate that Part II applies.
- This section previously permitted metal raceways. It has been clarified to indicate that the permitted metal raceways are rigid metal conduit or intermediate metal conduit.
- Previously, this section permitted rigid nonmetallic conduit. It now recognizes rigid polyvinyl conduit or other raceways suitable for the location.

550.10(I)



550.16(C)(1)

REVISION

Exposed Non-Current-Carrying Metal Parts

- Mobile homes often consist of multiple units that are joined together.
- Multiple sections of a mobile home are now required to be bonded with a solid copper conductor that is at least 8 AWG. It can be insulated or bare.
- Bonding conductor terminations must be in accordance with 250.8 and 250.12.

550.16(C)(1)



550.32(A)

REVISION

Mobile Home Service Equipment

- Section 550.32(A) was revised to make it clear that mobile home service equipment is not permitted to be mounted in or on the mobile home.
- The service equipment must be mounted in a readily accessible outdoor location, and it must be visible from the mobile home it serves.
- The mobile home service disconnect is permitted to serve as the emergency disconnect specified in 230.85.

550.32(A)



550.33(A)

NEW

Feeder Equipment

- A new 550.33(A) has been added. The previous 550.33(A) has become 550.33(B).
- Service equipment is not permitted to be mounted in or on a mobile home.
- The feeder assembly is not permitted to be mounted in or on the mobile home.
- Manufactured home feeder disconnecting means are permitted to be installed in or on the manufactured home in accordance with 550.32(B).

550.33(A)

NEW



NEW

Electrical Datum Plane Distances

- Electrical datum plane requirements were added to Article 551 because RV parks often border bodies of water.
- In areas subject to tidal fluctuations, the datum plane is two feet above the highest high-tide level under normal conditions.
- In areas not subject to tidal fluctuation, the plane is two feet above the normal high-water level.

NEW



551.40(D)

NEW DELETION

Loss of Ground Device

- The previous 551.40(D), titled "Reverse Polarity Device," was deleted.
- The reverse polarity device may only indicate that the pedestal is miswired but may not interrupt power.
- A new 551.40(D) was added to require a listed grounding monitor interrupter to be installed between the feeder assembly connection to the vehicle and before either a transfer switch (if installed) or the panelboard.

551.40(D)

NEW

DELETION



REVISION

Distribution System

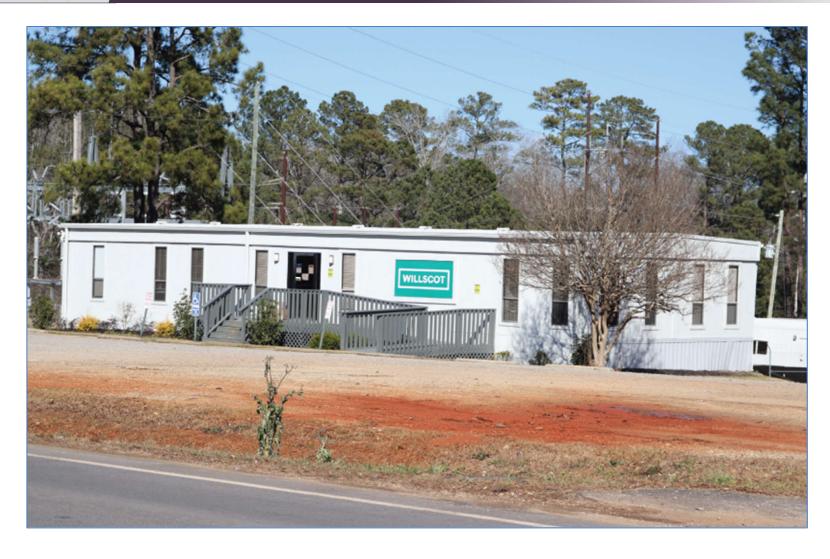
- Section 551.72(A) was revised to recognize 208Y/120 three-phase distribution systems in RV parks.
- The prohibition against reducing the size of the neutral conductor was moved from 551.72(C) to (D).
- An informational note was added indicating that RV loads are line-toneutral and non-permanently connected loads.
- The prohibition of the use of cord- and plug-connected autotransformers used on RV park distribution systems has been deleted.



REVISION

General Requirements

- Park trailers are designed for seasonal use. They are not permitted as permanent dwelling units.
- Section 552.4 makes it clear that trailers used as banks, clinics, offices, or similar applications are considered relocatable structures and are covered in Part II of Article 545.
- This change correlates with the action of CMP 7 to create a new Part II in Article 545 on relocatable structures.



REVISION

Location of Service Equipment

- Service equipment for a floating building, dock, or marina must be no closer than five feet horizontally from and adjacent to the structure.
- Service equipment must also be located a minimum of 12 inches above the datum plane.
- An electrical datum plane is a specified vertical distance above the normal high-water level at which electrical equipment can be installed and connections can be made.



NEW

Equipotential Planes and Bonding of the Planes

- Articles 555 and 682 have overlaps in coverage. This change is intended to improve correlation between the articles.
- A new 555.14 has been added to correlate requirements for equipotential planes and bonding of equipotential planes with Article 682.
- This section is intended to reduce step and touch potentials. It is also intended to reduce the hazards that have resulted in electric shock drownings.

NEW



NEW

Replacement of Equipment

- A new requirement has been added titled "replacement of equipment," which addresses modification of equipment as well as repairs.
- This new requirement recognizes the harsh environment that exists at marinas. The intent is to ensure that the installation remains in compliance.
- NFPA 303 requires annual inspections of marinas. Periodic inspections are outside the scope of the NEC.

NEW



REVISION

Electrical Equipment and Connections

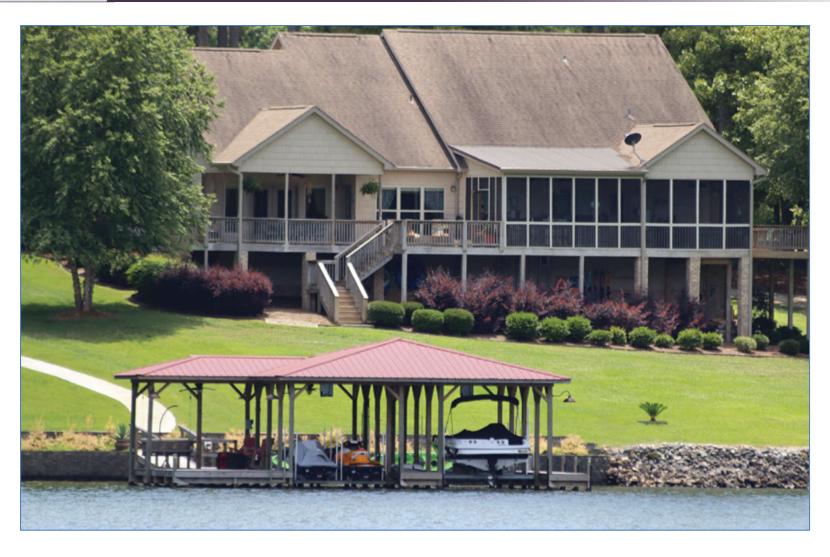
- The term pier has been replaced with the term structure to apply to all fixed and floating structures.
- The separate section on fixed piers has been deleted as the requirements apply to both fixed and floating piers.
- Electrical components within electrical equipment and connections that are not intended for use while submerged are required to be located at least 12 inches above the deck of the structure.



REVISION

GFPE and GFCI

- The requirements for GFPE of feeder-supplied installations have been rewritten. Coordination with downstream GFPE is permitted.
- Requirements for GFCI protection of boat hoist receptacles have been relocated from 555.9 to 555.35(C).
- The requirements for GFCI protection have been expanded to include all docking facilities, not just those at dwelling unit docks.
- A new requirement was added in 555.35(B)(2) for GFCI protection of outlets for other than shore power not exceeding 150 volts and 60 amperes and 100 amperes or less, three-phase.



555.36(C)

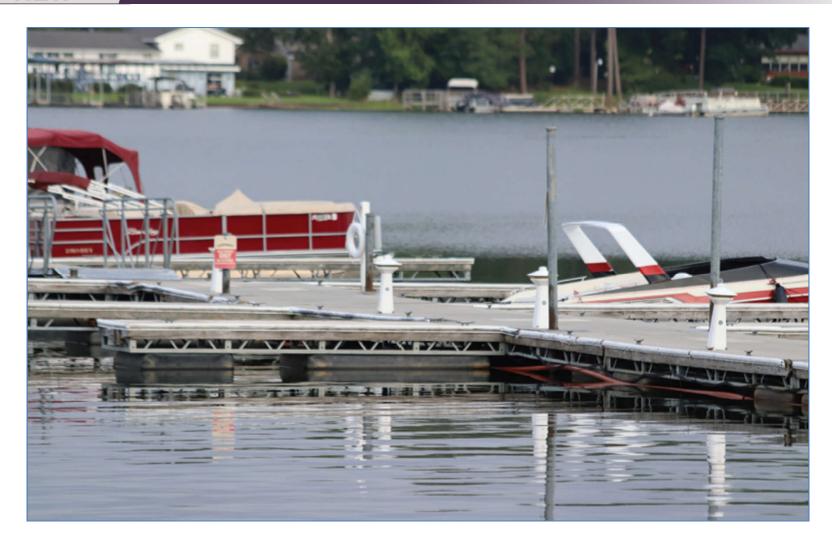
NEW

Disconnecting Means for Shore Power Connection(s)

- A new requirement has been added for an emergency disconnect for each power outlet or enclosure that provides shore power to boats.
- The emergency disconnect must be a listed emergency shutoff device or disconnect that is clearly marked "emergency shutoff."
- The emergency shutoff must be located within sight of the marina power outlet or other device that provides shore power.

555.36(C)

NEW



REVISION

Equipment Grounding Conductor

- Section 555.37(B) and (C) were consolidated to require that the EGCs be insulated wire-type EGCs, sized in accordance with 250.122, but not smaller than 12 AWG.
- Section 555.37(E) has been added to provide requirements for EGCs for equipment that is not double-insulated.
- An exception was added to (E) that permits the EGC to be uninsulated
 if it is part of a listed cable assembly that is identified for the
 environment.



NEW

Luminaires

- New requirements have been added for luminaires in marinas, boatyards, and docking facilities.
- Luminaires and retrofit kits are required to be listed and identified for use in the environment.
- Luminaires and their supply connectors must be secured to the structural elements of the marina in a manner that limits damage from watercraft impacts and from marine life.

NEW



REVISION

Overcurrent Protective Devices

- A new requirement has been added for wye-connected temporary service installations of more than 150 volts to ground, but not more than 1,000 volts phase-to-phase.
- If the available fault current exceeds 10,000 amperes, the overcurrent protection is required to be current-limiting.
- Where available fault current is less than 10 kA, conventional OCPDs will operate quickly enough to clear a fault before damage occurs.



Significant Changes

TO THE NEC® 2023

Chapter 6





REVISION

Branch Circuits

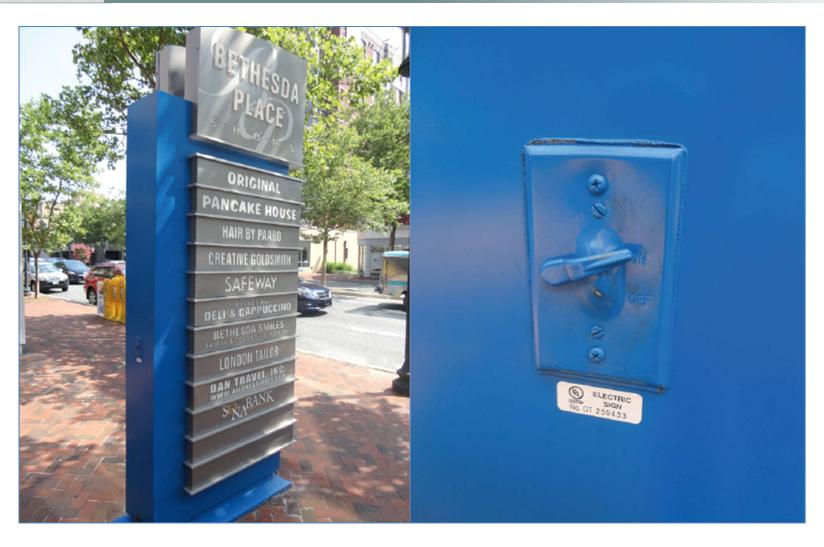
- The last sentence of 600.5(A) was converted into an exception that exempts some entrances, corridors, and hallways.
- A second exception was added that permits the branch circuit to supply other loads that are directly related to the control of the sign.
- Section 600.5(D)(2) now permits electrical enclosures integral to the sign that are listed and labeled as electrical enclosures to be used as pull or junction boxes for up to 600 volts.



REVISION

Disconnects

- The general requirements of Chapters 1 through 4 of the *Code* apply, including the requirements of 404.7, requiring disconnects to indicate whether they are open or closed.
- The disconnecting means is required to be accessible and located at the point of entry to the sign, within sight of the sign, or within sight of the controller.
- If the disconnecting means is remote from the sign, it must be mounted at an accessible location that is available to first responders and service personnel.



620.12(A)

REVISION

Traveling Cables

- A new 620.12(A)(2) has been added to recognize Class 2 and communications cables used on Class 2 circuits, including power over Ethernet, in traveling cables.
- The minimum size of Class 2 and communications circuit conductors is 24 AWG.
- New requirements were added to require parallel conductors of traveling cables to be not smaller than 20 AWG.

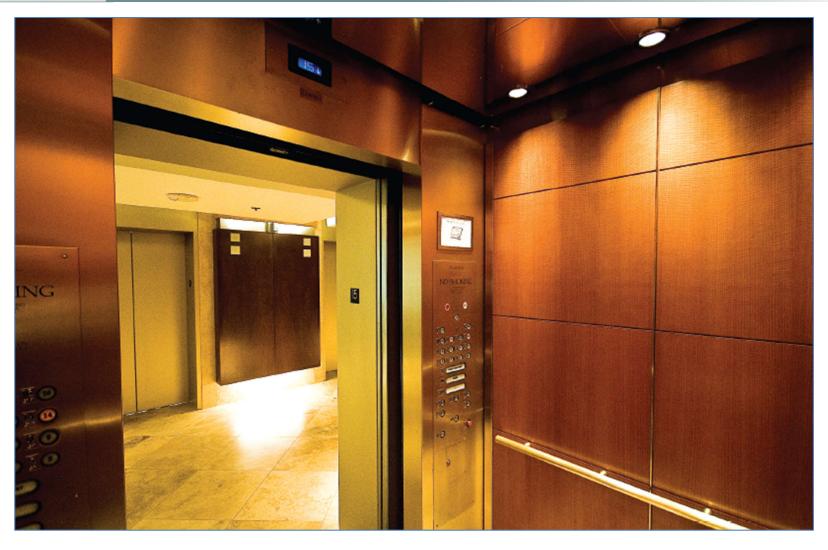
620.12(A)



REVISION

Branch Circuits for Car Lighting, Receptacles, HVAC

- Section 620.22(A) permits car lighting branch circuits to supply additional loads.
- The lighting circuit is now permitted to supply emergency responder radio coverage circuits, car ventilation purification systems, car emergency signaling, and communications devices, including charging circuits.
- The permitted location of the OCPD for the circuit for the air conditioning and heating source has been revised to correlate with the OCPD locations permitted for other branch circuits in 620.22(A).



REVISION

Branch Circuits for Machine Room, Control Room...

- The title of 620.23 was revised to include truss interior lighting.
- Truss interiors are the structure of moving walkways and escalators.
- At least one 125-volt, single-phase, 15- or 20-ampere duplex receptacle is now required for truss interiors.



625.1 Info. Notes

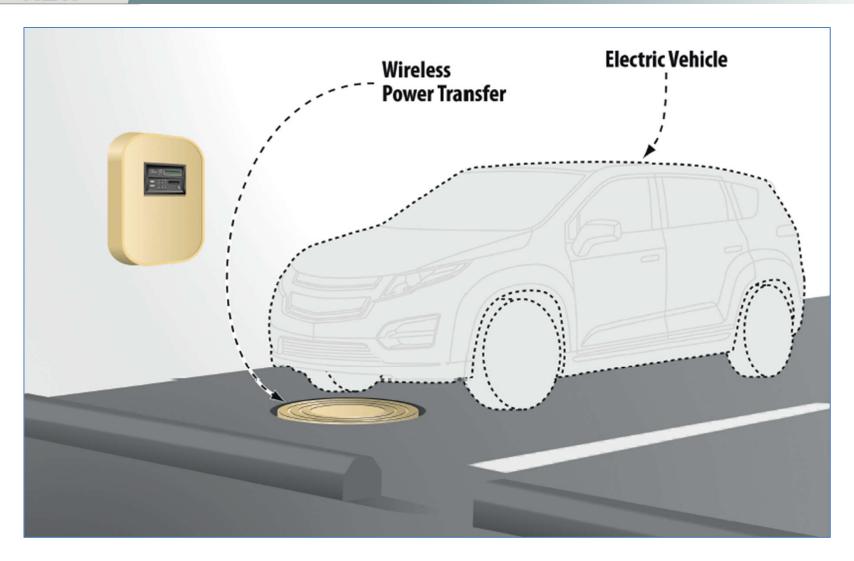
NEW

Scope

- Two new informational notes were added to 625.1 to provide additional information for installation of electric vehicle infrastructure.
- UL 2750 provides information that was developed by UL when they were investigating wireless power transfer equipment.
- NECA 413 provides information on installation and maintenance of AC Level 1 and 2 and fast-charging dc EVSE.

625.1 Info. Notes

NEW



REVISION

Cords and Cables

- "Stationary equipment" was changed to "fastened-in-place equipment" for consistency with 625.44(B).
- The overall cord and cable length is not permitted to exceed 25 feet unless equipped with a cable management system.
- Section 625.17(C) has been revised to indicate how the power supply cords for the output cable is measured.



REVISION

Electric Vehicle Circuit

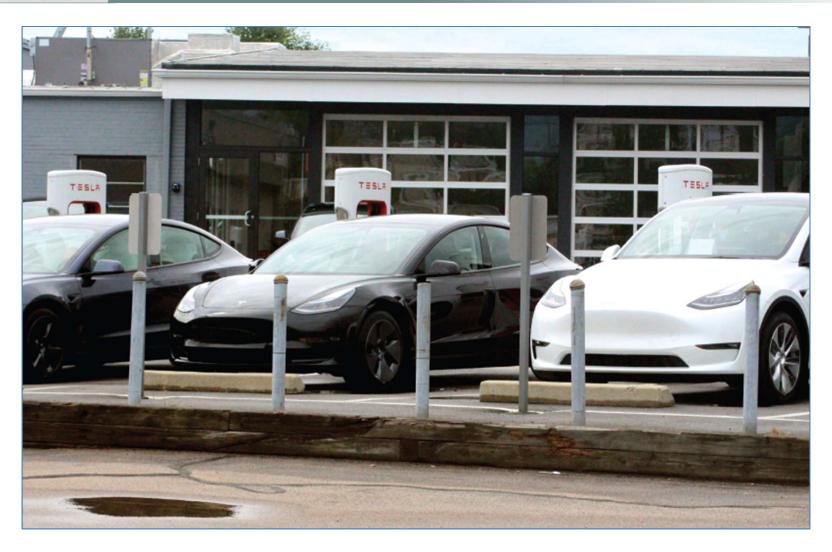
- Section 625.40 requires each outlet installed for supplying EVSE to be supplied by an individual branch circuit.
- The requirement for an individual branch circuit applies to outlets greater than 16 amperes or 120 volts.
- A new exception has been added that permits branch circuits to supply multiple EVSEs in accordance with 625.42(A) or (B).



REVISION

Rating

- Section 624.42 was split into two subsections to clearly provide separate requirements for load management systems and EVSE with adjustable settings.
- Energy management systems are permitted to be integral to one piece of equipment or to a listed system. If integral load management is provided, the system must be marked to indicate that control is provided.
- EVSE with adjustable settings is permitted if access to the settings is restricted.



REVISION

Disconnecting Means

- Section 625.43 was revised so that it applies to EVSE and WPTE rather than to all equipment.
- The disconnect must be installed in a readily accessible location.
- If the disconnect is in a remote location, a plaque must be installed on the equipment indicating the location of the disconnecting means.



NEW

Island Mode

- EVPE and EVSE with a power export function is now permitted to be part of an interconnected power system that operates in island mode.
- Some electric vehicle installations can function as optional standby power systems.
- The rest of the connected system must be capable of operating in island mode.

NEW



REVISION

Installation

- Changes were made to 625.102 to better integrate wireless power transfer into the *Code*.
- The title of 625.102(B) was changed to "Control Box." The term charger power converter is no longer used.
- The title of 625.102(D) has been changed from "Protection of Cables" to "Protection of Cords and Cables to the Primary Pad."
- If there is not a control box, the cord or cable supplying power to the primary pad must be secured in place to restrict movement and prevent strain at the connection points.

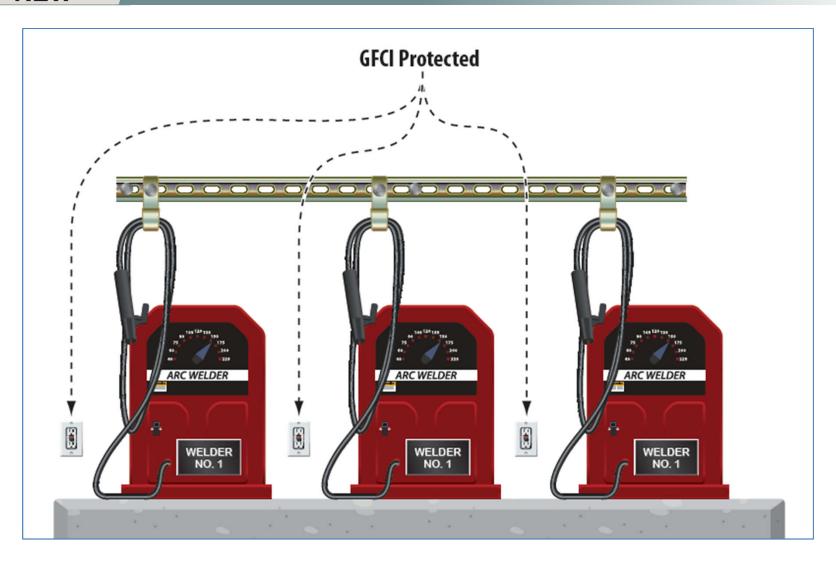


NEW

Ground-Fault Circuit-Interrupter Protection

- All 125-volt, single-phase, 15- and 20-ampere receptacles installed in work areas where welders are operated are required to be GFCI protected.
- This requirement is to protect workers who are using electric hand tools or portable lighting equipment.
- The work area is not defined in this requirement.

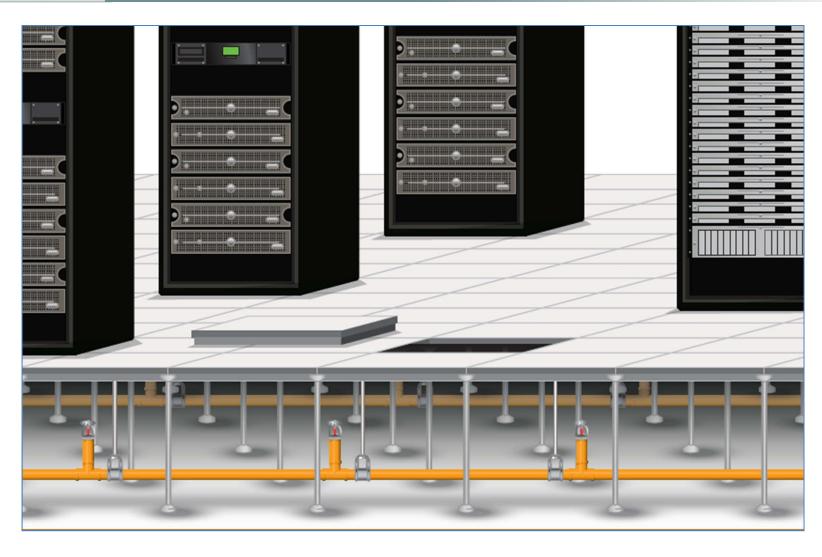
NEW



REVISION

Supply Circuits and Interconnecting Cables

- New 645.5(B)(3) was added to ensure that the plugs and receptacles that connect power supply cords are listed and have properly-mated components.
- Sections 645.5(D), (E), and (F) were modified to use properly descriptive terminology.
- Section 645.5(H) was rearranged into list format to improve clarity.



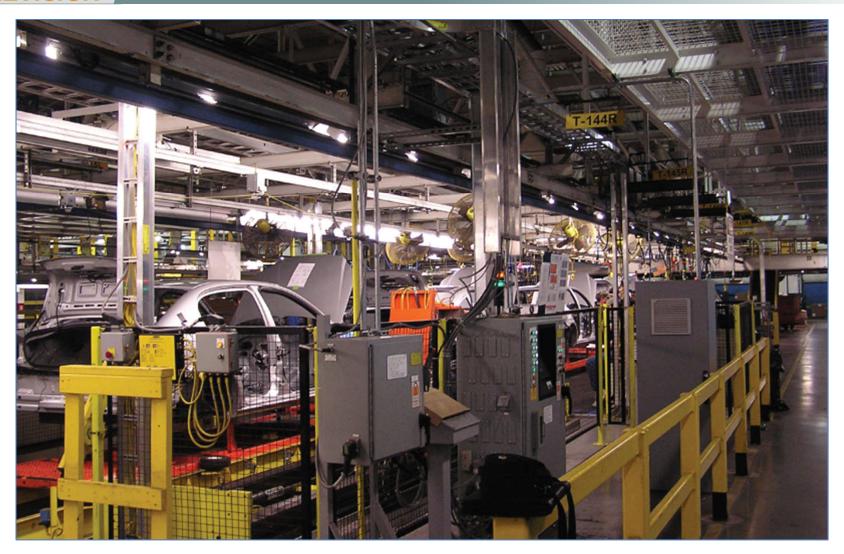
670.3(A)

REVISION

Permanent Nameplate

- The requirements for nameplates on industrial machinery were revised for consistency with NFPA 79 regarding industrial machinery.
- The nameplate must be attached to the outside of the control equipment enclosure or on the machine immediately adjacent to the main control equipment enclosure so that it is visible after installation.
- The requirement previously required that the nameplate be "plainly visible," which was unenforceable.

670.3(A)



REVISION

GFCI and SPGFCI Protection

- The first sentence of 680.8 was deleted because it described the types of devices used for GFCI protection, which was not needed.
- Some GFCI requirements from other parts of Article 680 were consolidated into 680.5.
- The informational note to 680.5(B) points out that the high leg of a 120/240-volt, 4-wire, delta-connected system exceeds the limits for Class A GFCIs.
- A new 680.5(C) has been added to address ground-fault protection of receptacles and outlets on single- and 3-phase circuits exceeding 150 volts to ground.



680.6 & 680.7

DELETION REVISION

Grounding and Bonding

- Section 680.6, Bonding and Equipment Grounding, was deleted as it was redundant with requirements in Article 250.
- Section 680.7 was retitled "Grounding and Bonding." The previously existing text was revised and relocated to 680.7(C).
- The requirements for cord- and plug-connected equipment were relocated to 680.7(B) from 680.21(A)(3) and 680.8(B).
- Requirements for feeders and branch circuits were relocated into 680.7(A) from 680.21(A)(3) and 680.8(B).

680.6 & 680.7

DELETION REVISION



REVISION

Electric Pool Water Heater

- The title of 680.10 has been changed to indicate that it applies to heaters incorporating resistive heating elements and electrically-powered swimming pool heat pumps and chillers.
- Section 680.10(A) only applies to heaters incorporating the traditional resistive heating elements.
- Section 680.10(B) recognizes the newer technology of electric heat pumps and chillers to heat or cool the pool water. They may do both.



REVISION

Equipment Rooms, Vaults, and Pits

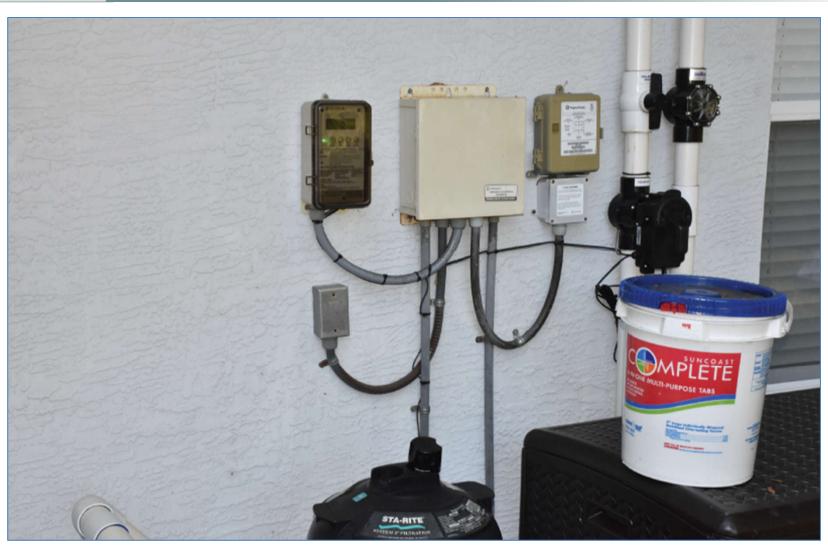
- The title of the section and 680.12(A) have been revised so that the requirements also apply to equipment in vaults.
- Equipment in rooms or vaults that do not have drainage that prevents water accumulation must be identified for submersion.
- A new 680.12(B) has been added to require at least one GFCIprotected, 125-volt, 15- or 20-ampere receptacle in the equipment room or vault.
- All other receptacles rated 150 volts or less to ground must be GFCI protected.



REVISION

Corrosive Environments

- Section 680.14 now covers wiring methods and other equipment in corrosive environments.
- Liquidtight flexible nonmetallic conduit is now permitted to be used in corrosive environments.
- Aluminum conduit and tubing are not permitted for use in corrosive environments.
- Other equipment in corrosive environments must be installed in identified corrosion-resistant enclosures.
- Equipment listed for spa and pool use is suitable.



REVISION

Motors

- The requirements for corrosive environments were removed from this section because they are covered by 680.14.
- The title of 680.21(C) has been changed to "Ground-Fault Protection," which now refers to 680.5(B) or (C).
- Section 680.21(D) has been revised to require that pool pump motors that are replaced or repaired be provided with ground-fault protection in accordance with 680.5.



REVISION

Location of Other Equipment

- This section was retitled "Location of Other Equipment."
- The emergency switch for spas and hot tubs has been relocated to 680.41(A). It will not apply to installations in one- and two-family dwellings.
- A new 680.41(B) was added to provide requirements for equipment exceeding the low-voltage contact limit.



680.43(A)

REVISION

Ground-Fault Protection for Receptacles

- The requirements for ground-fault protection for receptacles have been revised.
- All receptacles rated 125 through 250 volts, 60 amperes or less, that are located within 10 feet of the inside walls of a spa or hot tub must have ground-fault protection complying with 680.5(B) or (C).
- Receptacles that provide power for spas and hot tubs are not permitted to exceed 150 volts to ground.

680.43(A)



REVISION

GFCI and SPGFCI Protection

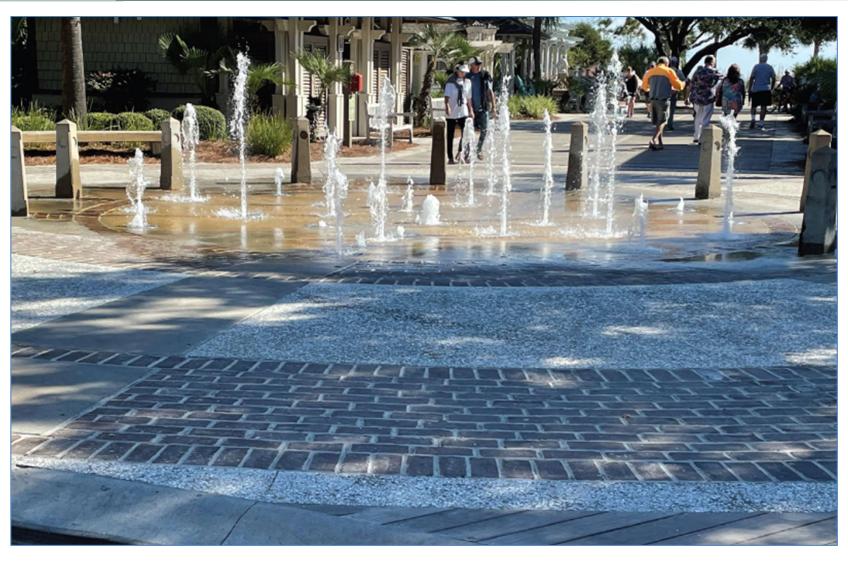
- The first sentence of this section has been relocated to become 680.44(A), and has been revised so that it requires the outlet that supplies a self-contained spa or hot tub, a packaged spa or hot tub equipment assembly, or a field-assembled spa or hot tub to have ground-fault protection in accordance with 680.5(B) or (C), as applicable.
- Section 680.44(C), "Other Units," has been deleted because the reference to 680.5(C) covers ground-fault protection for 3-phase units.
- The new 680.44(C) provides requirements for gas-fired water heaters operating above the low-voltage contact limit.



REVISION

Bonding

- Section 680.54(B) was revised to require that a conductor used for bonding be a minimum 8 AWG solid copper conductor.
- Section 680.54(B)(6) was revised by replacing *devices and controls* with the more general term *equipment*.
- A new first-level subdivision 680.54(C) was added to require equipotential bonding of splash pads.



REVISION

GFCI and SPGFCI Protection for Receptacles

- The requirements for ground-fault protection for adjacent receptacle outlets have been expanded to apply to all receptacles rated 125 through 250 volts, 60 amperes or less.
- The requirements apply to single-phase and 3-phase receptacles within 20 feet of the edge of the fountain.
- The protection will be GFCI or SPGFCI protection, in accordance with 680.5(B) or (C), as applicable.



REVISION

Ground-Fault Protection for Nonsubmersible Pumps

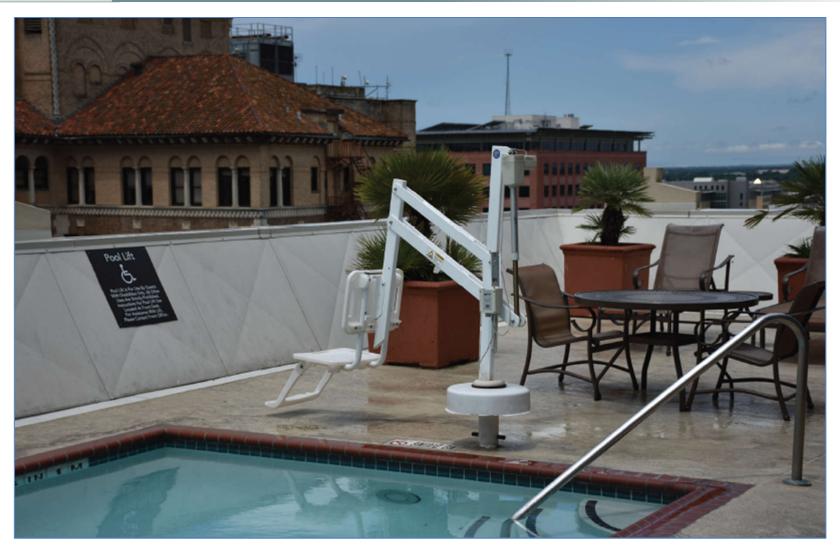
- The title of 680.59 has been revised to recognize that it applies to GFCI and SPGFCI protection for permanently installed nonsubmersible pumps.
- If the voltage to ground is 150 volts or less, GFCI protection is required.
- If the voltage to ground exceeds 150 volts, SPGFCI protection is required.
- An exception was added for listed low-voltage motors not requiring grounding that do not exceed the low-voltage contact limit, if the motor is supplied by listed transformers or power supplies that comply with 680.23(A)(2).



REVISION

Equipotential Bonding

- Equipotential bonding of pool lift equipment must use solid copper conductors that are not smaller than 8 AWG and may be covered, insulated, or bare.
- Connection to bonded parts must comply with 250.8.
- The bonding jumpers in the pool area are not required to be extended to remote panelboards, service equipment, or electrodes.



REVISION

Location of Electrical Distribution Equipment

- Section 682.11 has been revised to apply to electrical distribution equipment. It previously applied only to service equipment. It now provides two options for the location of the installation.
- Electrical distribution equipment can be located at least five feet horizontally from the shoreline where live parts of the equipment are located at least 12 inches above the datum plane.
- Electrical equipment can be located no closer than the shoreline where live parts of equipment are located at least 10 feet above the datum plane.



REVISION

Electrical Connections

- Section 682.12, Electrical Connections, was divided into two subsections.
- Conductor splices located above the waterline but below the datum plane must be in junction boxes identified for wet locations, using sealed wire connector systems listed and identified for submersion.
- Replacement electrical connections that are located below the electrical datum plane and above the waterline must be listed and identified for submersion.



Article 690

REVISION

Solar Photovoltaic (PV) Systems

- The informational note figures in 690.1 have been redrawn.
- Requirements for stand-alone systems were deleted from 690.10.
 Article 710 covers stand-alone systems.
- Parts VI and VIII were deleted. Part VII, Connection to Other Sources, became Part VI, Source Connections. Part VIII, Energy Storage Systems, was deleted because that is covered in Article 706.

Article 690



REVISION

General Requirements

- There is a new definition of "electronic power converter" in Article 100, which includes inverters and dc-to-dc converters. Electronic power converters were added to the list of equipment in 690.4(B) to replace inverters and dc-to-dc converters. PV hazard control equipment and PV hazard control systems were also added.
- Acronyms were added for rapid shutdown (PVRSE), hazard control system (PVHCS), and hazard control equipment (PVHCE).
- New requirements were added for PV equipment floating on or attached to structures floating on bodies of water.



REVISION

Maximum Voltage

- Section 690.7 was revised for clarity and to remove requirements for systems over 1,000 volts.
- Section 690.7(A) through (D) were revised to eliminate the terminology source and output and to add the defined term PV string circuit in 690.7(B).
- Section 690.7(B) was also updated by deleting "source and output" from the term dc-to-dc converter circuits.
- The marking requirements for dc PV circuits were relocated to 690.7(D) from 690.53.



REVISION

Circuit Sizing and Current

- An informational note was added to 690.8(A)(1) noting that some modules can produce electricity when exposed to light on multiple surfaces.
- Section 690.8(B) requires a minimum conductor size without adjustment and correction factors based on an ampacity not less than the current calculated in 690.8(A) multiplied by 125%.
- Section 680.8(D) was updated to use the term PV string circuits, which describes how some PV circuits are arranged.



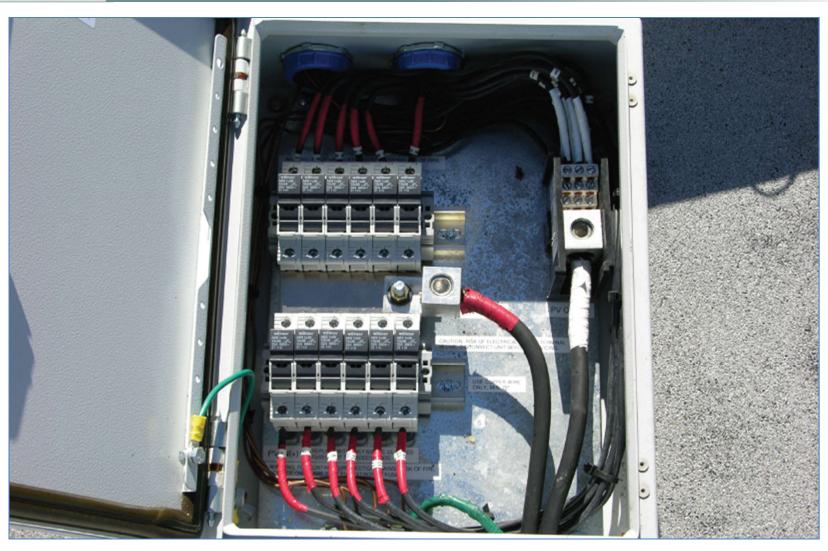
690.9(D)

REVISION

Transformers

- The requirements for protection of transformers are now covered in 705.30(C).
- The requirements in 450.3 are based on the primary being one side at a time.
- Section 705.30(F) is based on interconnected power production sources. It is applicable to installations where there can be multiple sources.

690.9(D)



690.12, Exception

REVISION

Rapid Shutdown of PV Systems on Buildings

- Section 690.12 establishes requirements for rapid shutdown of PV systems on buildings.
- A new exception was added to exempt non-enclosed detached structures, such as those that provide parking shade, carports, solar trellises, and similar structures.
- The exception aligns with requirements for firefighter rooftop access in the building and fire codes.

690.12, Exception



REVISION

Disconnecting Means for Isolating PV Equipment

- 690.15(D), Type of Disconnecting Means, has been relocated to 690.15(A). Revised wording clarifies that disconnecting means complying with 690.15(C) are permitted in any circuit, regardless of current rating.
- 690.15(A)(2) was revised to permit an isolating device that is part of listed equipment where an interlock prevents opening the isolating switch under load.
- 690.15(D) was rewritten to remove the distances and to replace them with the terms *readily accessible* and *in sight from*.



REVISION

Wiring Methods

- Section 690.31(A)(2) has been expanded to cover all PV dc circuits, and it has been clarified to indicate the conditions to which it applies.
- Section 690.31(B)(1) has been rewritten into list format and clarified regarding which conductors can be intermingled.
- Requirements have been added that provide more detail on cable tray installations.



691.1 & 691.4

REVISION

Large-Scale Photovoltaic (PV) Electric Supply Stations

- Large-scale PV systems are those that have an inverter generating capacity of 5,000 kW or larger that are not under exclusive utility control.
- The 5,000 kW lower limit was moved from the scope to 691.4(7).
- Section 691.4(6) now requires large-scale PV systems to be monitored from a central command center.

691.1 & 691.4



Article 692

REVISION

Fuel Cell Systems

- Section 692.4(B) now points to the requirement of a plaque or directory in 705.10.
- Part V, Grounding, was deleted because it did not modify the general rules of Article 250.
- Part VI, Marking, became Part V, Marking.
- Sections 692.60 through 692.65 were deleted in order to remove sections that did not modify the requirements of Chapters 1 through 4.
 In addition, requirements that are addressed during product listing were also deleted.

Article 692



694.50 & 694.68

DELETION

Interactive System Point of Interconnection

- The marking requirement for interactive points of interconnection with other sources that was in Section 694.50 was deleted. The new requirement is located in 705.14, which is a more general requirement for labeling an interactive point of connection to other sources.
- The requirement for points of connection was deleted from 694.68.
 The intent is that all sources combined with other sources must comply with Article 705.
- Requirements for identification of power sources in 694.54 requires a plaque or directory installed in accordance with 705.10.

694.50 & 694.68

DELETION



695.1(B)

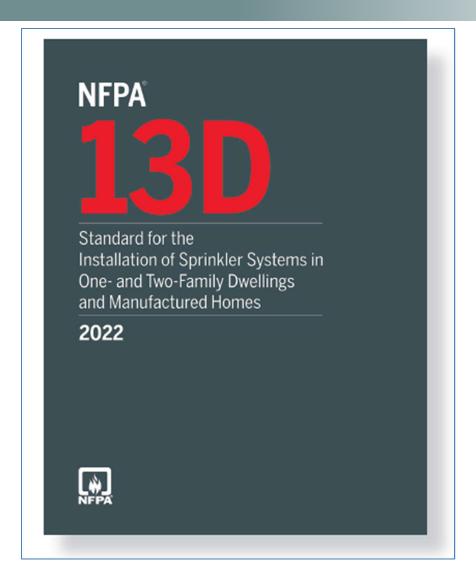
NEW

Not Covered

- The small water pumps that may be installed in one- and two-family dwellings for fire suppression are not the fire pumps covered by Article 695.
- These water pumps would have to comply with Article 430 rather than Article 695.
- Larger homes may have a sprinkler system in accordance with NFPA 13 or NFPA 13R, which could require a fire pump in accordance with NFPA 20 and Article 695.

695.1(B)

NEW



NEW

Voltage Drop

- The exception to 695.7(A) which permits the voltage to drop more than 15% below normal is now 695.7(B), Emergency Run.
- A new 695.7(C) has been added to recognize bypass mode.
- Both emergency run mode and bypass mode are permitted to exceed 15% voltage drop, provided the pump can still be started while supplied by a generator.

NEW



Significant Changes

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Chapter 7





REVISION

Tests and Maintenance

- The permanent connection point for the temporary generator must be located outdoors. Cables must not be run through exterior windows, doors, or similar openings.
- The switching means, including the interlocks, are required to be listed to prevent inadvertent interconnection of power sources.
- A permanent label must be field-applied at the permanent connection point that indicates the system voltage, maximum load, and shortcircuit current rating of the load-side equipment.



REVISION

Capacity and Rating

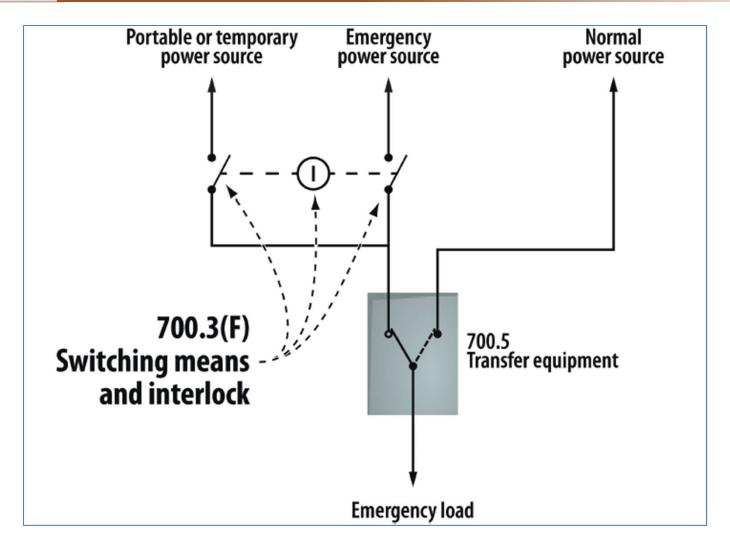
- Section 700.4(A) was deleted because this is a general requirement covered by 110.9 and 110.10.
- Emergency systems are now required to have sufficient capacity for rapid load changes and transient energy requirements associated with expected loads.
- Peak load shaving requirements are now covered in 700.4(C), Parallel Operations.
- A new 700.4(C) addresses requirements for the two types of parallel operations. Section 700.4(C)(1) covers parallel operation of normal and emergency sources, while 700.4(C)(2) covers emergency sources that operate in parallel.



REVISION

Transfer Equipment

- The requirement in 700.5(A) for approval by the AHJ of transfer equipment was deleted.
- The prohibition of reconditioning emergency transfer switches has been relocated to 700.2.
- A new 700.5(D), Redundant Transfer Equipment, has been added to require emergency loads that are supplied by a single feeder to have a redundant transfer switch or a bypass isolation switch.
- Where the redundant transfer switch or bypass isolation switch is manual or not automatic, it must be supervised when the primary is out of service.



NEW

Wiring, Class-2-Powered Emergency Lighting Systems

- New Section 700.11 recognizes Class 2 emergency lighting systems that could use power over ethernet technology or low-power LED luminaires.
- These are directly-controlled luminaires and must comply with 700.24.
- In addition to other separation requirements, Class 2 emergency circuits must be separated from nonemergency Class 2 circuit conductors. If bundled, they must be bundled separately.
- Wiring must comply with 300.4 and be installed in a raceway, armored or metal-clad cable, or cable tray.

NEW



REVISION

General Requirements

- Section 700.12(B) was revised to correlate with the occupancy requirements in 700.10(D)(1).
- The title of 700.12(C) has been changed from "storage battery" to "supply duration" to cover the duration of all supplies. Battery and UPS durations are covered under 700.10(C)(4).
- The exception to 700.12(C)(3) recognizes that where the AHJ approves a public gas system to supply an emergency source, an onsite fuel supply is not required.

REVISION



889

REVISION

Directly Controlled Emergency Luminaires

- Directly controlled luminaires can be energized in two different ways.
- An active control signal can be sent from a listed external control system. This requires the controller and the luminaire to be listed for use in emergency systems.
- Systems that are activated by disconnection of the control input by a listed control device, such as an automatic load control relay, would not require the luminaire to be listed for use in emergency systems.

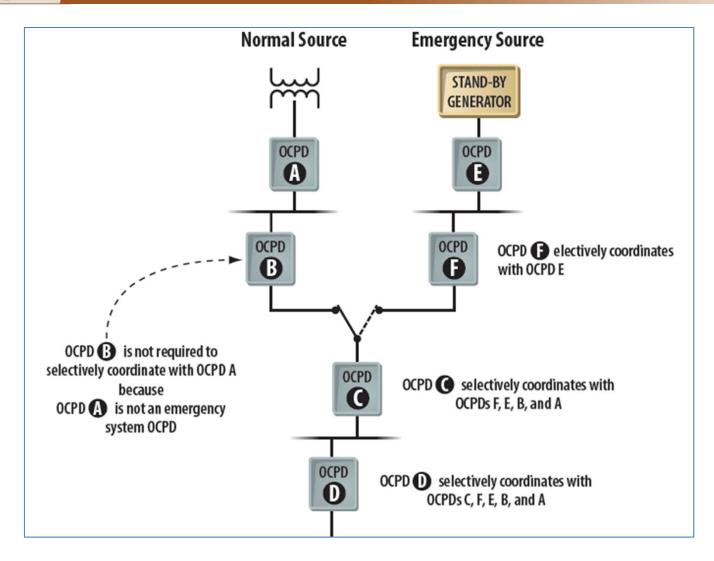


NEW

Selective Coordination

- Selective coordination of emergency systems is required to ensure that overcurrent protective device operation does not affect other loads supplied by the emergency systems.
- The text has been revised by adding "load-side" to ensure that coordination applies upstream and downstream.
- New text states that if OCPDs are replaced, modified, deleted, or added, coordination must be reevaluated.

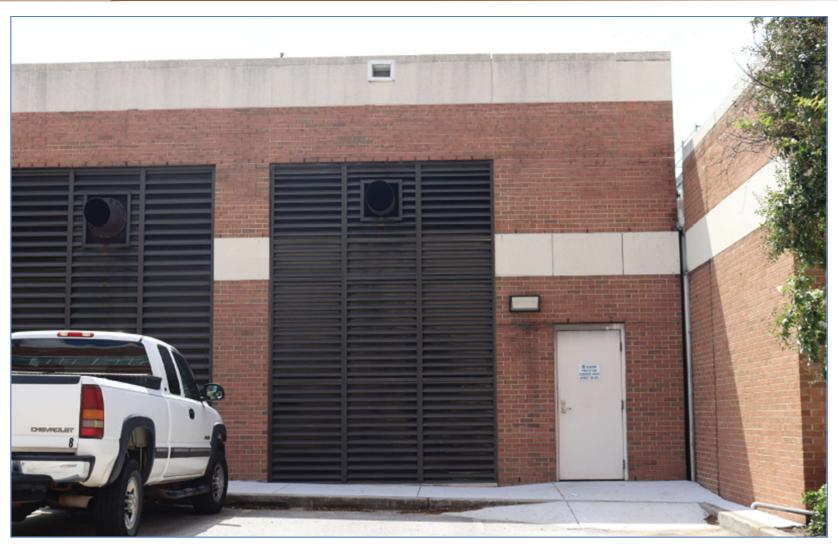
NEW



REVISION

Parallel Operation

- Section 705.14 has been relocated to become 705.5.
- The title was changed from "Output Characteristics" to "Parallel Operation."
- The previous first sentence of 705.14 has become 705.5(A).
- The marking requirements from 705.14 were deleted because listed equipment is required, which addresses the marking requirements.
- The last sentence of 705.14 has become 705.5(B).

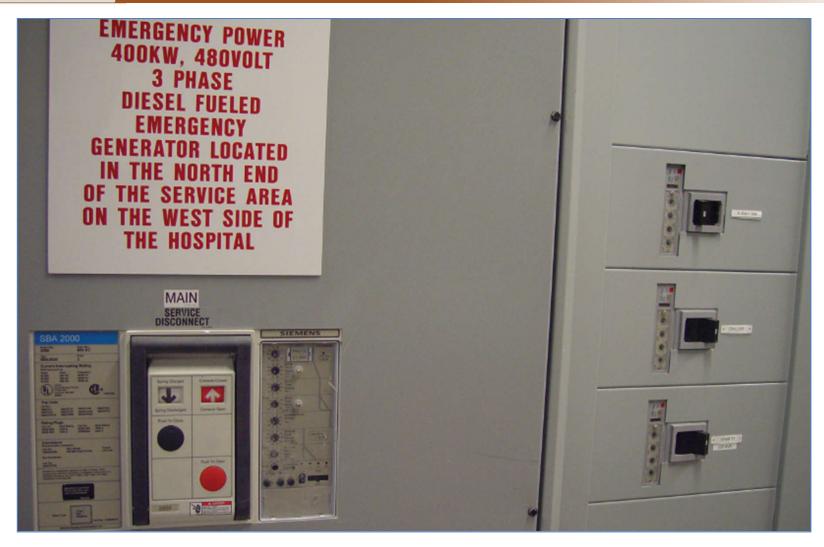


NEW

Identification of Power Sources

- The identification requirements have been reorganized into list format.
- The plaques, labels, or directories are now required to indicate the emergency telephone numbers of off-site entities that service the installation.
- A reference was added to NFPA 1: Fire Prevention Code, which provides installer information.

NEW



REVISION

Source Connections to a Service

- The title of 705.11 was revised to make it clear that it refers to any connection of an interconnected source to a service.
- The requirements for service conductors were moved to 705.11(B).
- The former 705.11(D) was relocated to (C) and was completely rewritten.
- The new 705.11(E) was added to provide requirements for bonding and grounding.



REVISION

Load-Side Source Connections

- The first paragraph was revised for clarity by deleting unnecessary words.
- 705.12(A) was deleted because disconnecting requirements are covered in 705.20 and overcurrent protection is covered in 705.30.
- Requirements were revised for ampere ratings of busbars for connection to distribution equipment with no specific listing and instructions for combining multiple loads.



NEW

Source Disconnecting Means

- Section 705.20 provides requirements for disconnecting means for interconnected electric power production sources.
- Most articles that cover power sources also include disconnecting means requirements.
- If an installation complies with 705.20, a single disconnecting means is permitted to disconnect multiple sources.

NEW



705.80 through 705.82

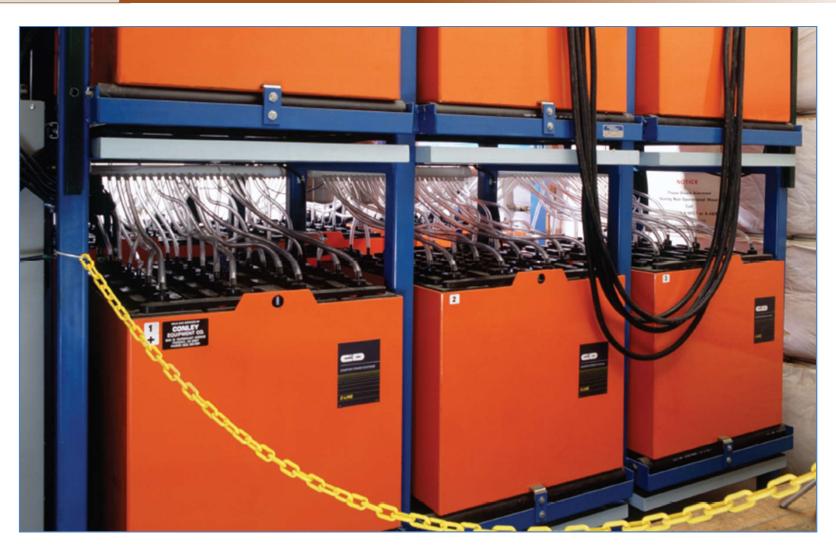
NEW

Interconnected Systems Operating in Island Mode

- A new Part III has been added to provide requirements for operating an interconnected electric power production source in island mode.
- The three categories of operation are automatic load management, manual load management, and no-load management.
- Operation in island mode requires voltage and frequency to be controlled within limits.

705.80 through 705.82

NEW



706.1 & 706.8

REVISION

Scope

- Informational Note No. 1 points out that Article 480 covers installation of stationary-standby batteries.
- Other battery applications that are not stationary standby batteries are covered by Article 706.
- NFPA 1 and NFPA 855 were added to the list of reference standards because some battery chemistries require special fire protection precautions.

706.1 & 706.8

REVISION



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REVISION

Commissioning and Maintenance

- Section 706.7 has been expanded to require that energy storage systems be commissioned before being placed into service.
- This does not apply to ESS installations in one- and two-family dwellings.
- An informational note was added to point to NFPA 855 for information on commissioning of energy storage systems.



REVISION

Disconnecting Means

- Requirements for disconnecting means for energy storage systems have been expanded.
- For one- and two-family dwellings, an emergency shutdown function must cease export of power from the ESS to the premises wiring of other systems.
- New requirements have been added for disconnecting means for batteries where the battery is separate from the ESS electronics and is subject to field servicing.

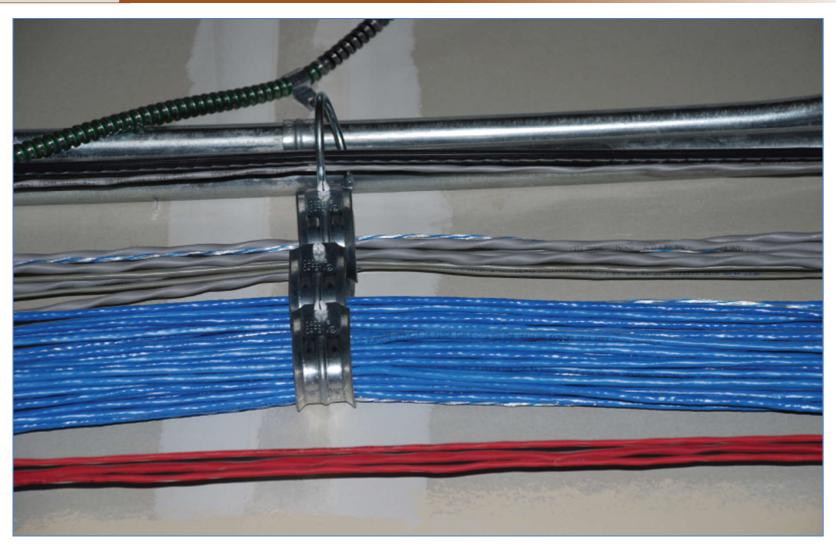


NEW

Cables for Power-Limited Circuits

- A new Article 722 has been created to cover cable requirements for Class 2 and 3 power-limited circuits, power-limited fire alarm circuits, and Class 4 fault-managed power systems.
- Many of the installation requirements for these types of cables were repeated in Articles 725 and 760.
- Part I provides general requirements for power-limited circuit conductors and cables.
- Part II covers listing requirements for conductors and cables.
- The requirements for Class 4 circuits are new for this cycle.

NEW

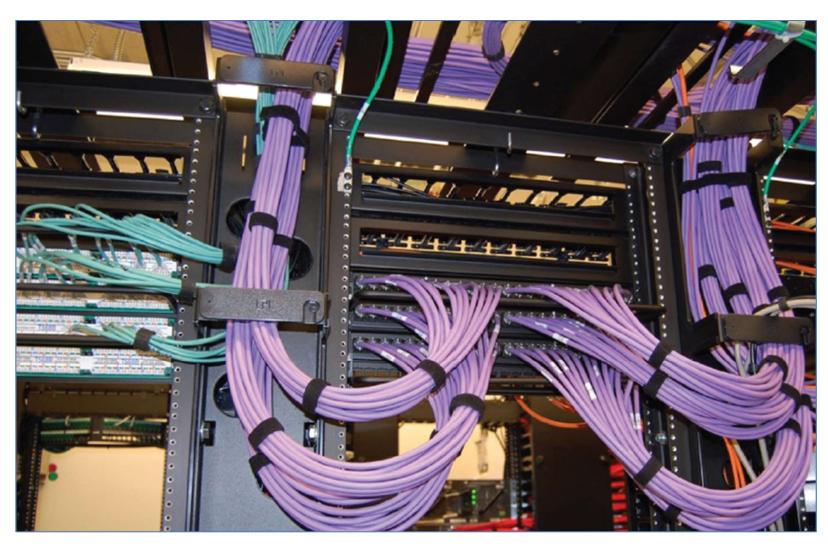


NEW

Hazardous (Classified) Locations

- Class 4 cables are permitted in hazardous (classified) locations where specifically permitted in the applicable article elsewhere in the *Code*.
- Similar language permitting wiring and applicable equipment has also been added to 725.10, 726.10, and 760.10 to provide a consistent approach in each of these articles.
- All of these sections have been rewritten into positive language by the NEC Correlating Committee.

NEW



915

NEW

Class 1 Power-Limited Circuits

- Class 1 circuit requirements have been moved from Article 725 to the new Article 724.
- Class 1 circuits are now limited to not more than 30 volts and 1,000 volt-amperes.
- The remote control and signaling circuits that are not power-limited are no longer considered to be Class 1 circuits. They are now covered by the first four chapters of the *Code*.

NEW

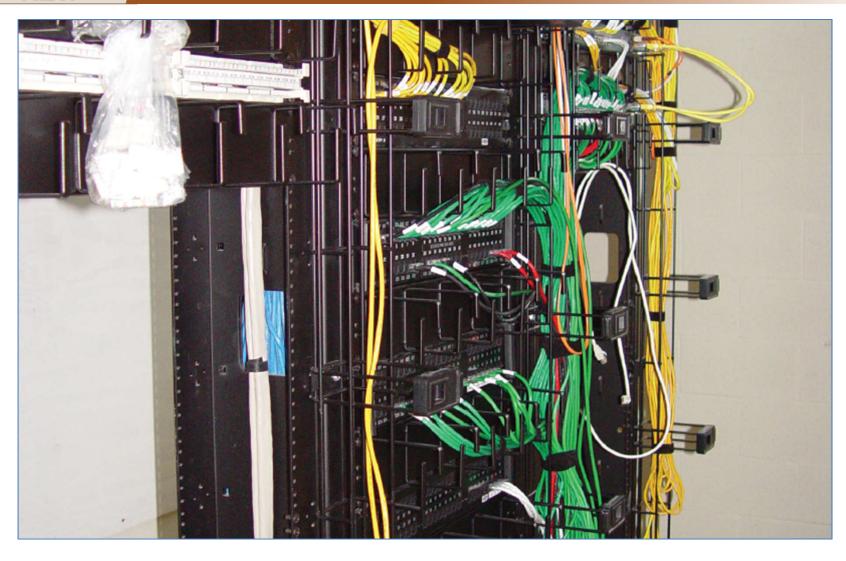


NEW

Class 2 and 3 Power-Limited Circuits

- Requirements for Class 1 circuits have been removed from Article 725, which now only applies to Class 2 and 3 power-limited remote control and signaling circuits.
- General requirements for wiring of Class 2 and 3 circuits have been relocated to new Article 722, Cables for Power-Limited Circuits.
- The relocated material includes substitution tables, abandoned cables, mechanical execution of work, and other requirements that are common to Articles 725, 760, and 770.

NEW



REVISION

Safety-Control Equipment

- If damage to Class 2 and 3 power-limited safety-control equipment can result in a direct fire or life safety hazard, the power-limited circuit must be installed in accordance with 724.31.
- Such circuits are no longer permitted to be reclassified as Class 1, but are required to be installed using Class 1 wiring methods.
- Reclassifying the wiring as Class 1 would require recertification of the source and load equipment as Class 1 equipment.



NEW

Class 4 Power Systems

- A new Article 726, Class 4 Power-Limited Circuits, has been created to provide requirements for fault-managed power systems.
- Fault-managed power systems monitor the circuit for faults and control power delivery to ensure that fault energy is limited.
- Class 4 circuits can have a peak output voltage of 450 volts dc line-toline or 225 volts line-to-ground.

NEW



REVISION

Energy Management Systems

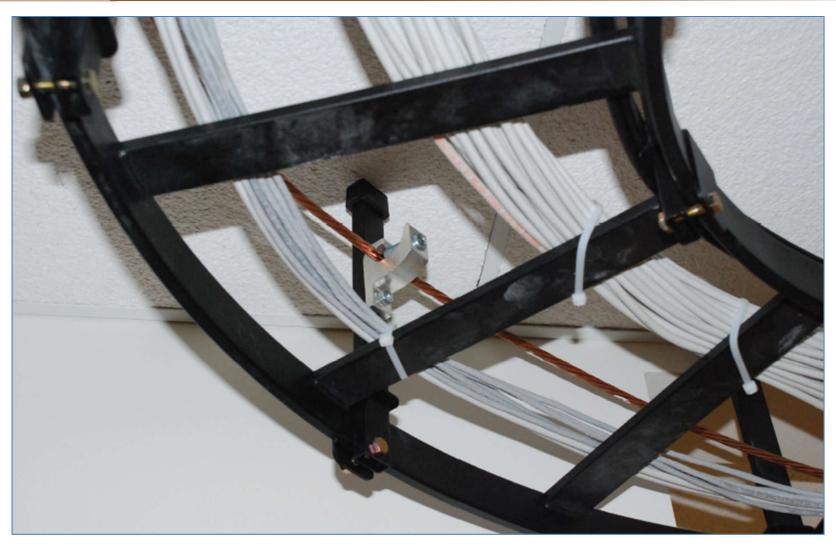
- Energy management systems are required to be listed.
- Three options are provided for listing, including a complete listed system, a field installation kit, or listed components assembled as a system.
- 750.30(C) was expanded to provide requirements for current set point, system malfunction, settings, and marking requirements.



REVISION

Mechanical Execution of Work

- Fire alarm circuit cables and conductors must be supported by hardware, including straps, hangers, and cable ties, that are listed and identified for securement and support.
- This correlates with requirements in 320.30, 330.30, 334.30, and 337.30, which all require mounting hardware that is listed for securement and support.
- A similar requirement in 722.24 covers Class 2, 3, and 4 wiring.



Significant Changes

TO THE NEC® 2023

Chapter 8

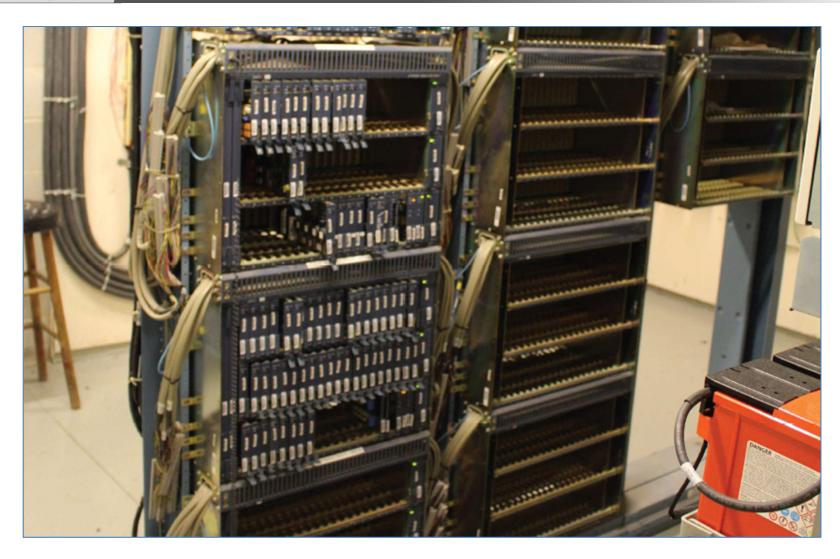




REVISION

General Requirements for Communications Systems

- During the 2020 cycle, communications circuit requirements were moved from Article 800 to Article 805.
- A new Article 800, General Requirements for Communications Circuits, was created as a location for the Chapter 8 articles.
- The task was incomplete in the 2020 cycle. This cycle, several additional sections have been moved into Article 800.



REVISION

Antenna Systems

- The title of Article 810 has been changed from "Radio and Television Equipment" to "Antenna Systems."
- Most radio receiving equipment covered by Article 810 is cord- and plug connected to branch-circuit wiring.
- This article covers all radio receiving equipment.
- The only radio transmitting equipment covered by Article 810 is transmitters used for amateur radio and citizens band radio.

