Board of Building Standards

ELECTRICAL SAFETY INSPECTOR ADVISORY COMMITTEE
REQUEST FOR RECOMMENDATIONS

DATE: DECEMBER 09, 2022
TIME: 10:00 AM
LOCATION: NO MEETING THIS MONTH

Committee members are requested to submit recommendations by Friday December 9, 2022 for inclusion in the Certification Committee agenda.

Personnel Certification Applications

P-1 Budrevich Gerald ESI EPE
Certification ID#
Current certifications: None
Staff notes: Electrical Contractor License provided. Recommend approval.
ESIAC Recommendations:
Committee recommendation:

P-2 Danner, Dan ESI
Certification ID#
Current certifications- None
Staff notes: Recommend approval.
ESIAC Recommendations:
Committee recommendation:

P-3 Muncy, John - BI, MI, ESI, EPE, RBO
Certification ID:
Current Certifications: None in Ohio
Staff Notes: Has passed all exams, recommend approval for all certifications. OCILB licensed electrical contractor.
ESIAC Recommendations:
Committee Recommendation:

Continuing Education Applications for Review

ER-1 2020 National Electric Code (International Association of Electrical Inspectors SW)
All certifications (6 hours)
Staff Notes: Slides begin on p. 24 of the submission.
ESIAC Recommendation:
Committee Recommendation:

ER-2 2023 NEC Code Changes Part 1 (Wink Electric)
All certifications (5 hours)
Staff Notes: This course is not presented with visuals. A detailed outline is included. Since it is based on the 2023 code, not recommended for approval at this time.
ESIAC Recommendation:
Committee Recommendation:

ER-3 2023 NEC Code Changes Part 2 (Wink Electric)
All certifications (5 hours)
Staff Notes: This course is not presented with visuals. A detailed outline is included. Since this course is based on the 2023 code, not recommended for approval at this time.
ESIAC Recommendation:
Committee Recommendation:

ER-4 Electrical Code Review (IAEI Northwest)
All certifications (twelve sessions of two hours each)
Staff Notes:
ESIAC Recommendations:
Committee Recommendation:

File Attachments for Item:

P-1 Budrevich Gerald ESI EPE

Certification ID#

Current certifications: None

Staff notes: Electrical Contractor License provided. Recommend approval.

ESIAC Recommendations:

Committee recommendation:

Board of Building Standards

Application for Interim Certification, Building Department Personnel

Budrevich	Gerald	
Last Name	*First Name*	*BBS Certification ID*

SECTION 1: CHECK INTERIM CERTIFICATION(S) BEING REQUESTED

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

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

(Mark "T" If Trainee)

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

Budrevich Gerald

Last Name *First Name* *BBS Certification ID*

SECTION 3: EMPLOYMENT/EDUCATION

Formal Education	Date Graduated
Chaney High School	1982
Related Vocational or Technical Training	Years' Experience
South Florida Builder's Association (Aprenticeship)	4
Palm Beach County, Florida Journeymen License #J-14601	2
U.S. Military construction experience (MOS or other designation):	Years' Experience
Place of Employment:	Years' Employed
RB Thomas Electric Co. Hudson,Ohio (Vice-President of Operations)	15
Anything Electric LLC (Owner)	18

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)

Budrevich
Last Name

Gerald
First Name

BBS Certification ID

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

Applicants for Electrical Safety Inspector Only Must Complete This Item

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

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

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

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

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

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

List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
Example: *Children's Hospital, Toledo* *Structural steel work on addition*	*Homer Steel and Trade* *125 Anytown Street* *My City, OH, 45454* *(419)555-1212*	*July 2013-May 2014* *(10 months)*
Anything Electric LLC	3123 Orchard Rd. Silver Lake, OH 44224	April 2004- Present 18 Years 7 Months
Total Experience on This Page (In Months):		223 Months

Budrevich	Gerald	
Last Name	*First Name*	*BBS Certification ID*

SECTION 7 CONT.: EXPERIENCE

List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
Broadview Eye Center Broadview Hts, Oh 44147 Complete electrical and fire alarm system installation	Anything Electric LLC, 3123 Orchard Road Silver Lake, Ohio 44224 330-686-2279	May 2021- July 2022
Taco Bell North Canton, Ohio Complete electrical system installation	Anything Electric LLC, 3123 Orchard Road Silver Lake, Ohio 44224 330-686-2279	July 2020 - October 2020
First Church of Oberlin Oberlin, Ohio (Sanctuary Remodel) Complete electrical system installation	Anything Electric LLC, 3123 Orchard Road Silver Lake, Ohio 44224 330-686-2279	October 2019 - May 2020
ATA Tools Akron, Ohio Complete electrical system Design and installation	Anything Electric LLC, 3123 Orchard Road Silver Lake, Ohio 44224 330-686-2279	May 2017 - February 2018
Make Believe Entertainment Parma, Ohio Complete electrical system Design and installation	Anything Electric LLC, 3123 Orchard Road Silver Lake, Ohio 44224 330-686-2279	March 2016 - December 2016
Pyrotek Aurora, Ohio Complete electrical system Design and installation	Anything Electric LLC, 3123 Orchard Road Silver Lake, Ohio 44224 330-686-2279	April 2015 - July 2016
	Total Experience on This Page (In Months):	72 Months

Budrevich Gerald
Last Name *First Name* *BBS Certification ID*

SECTION 8: PERSONAL HISTORY

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

SECTION 9: CERTIFICATION

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

Signature of Applicant:

Subscribed and duly sworn before me according to law, by the above named applicant this day 30 of November in the year 2022 at Summit Chase, County of Summit and State of Ohio.

Notary Public:

MARIA CIANCI - NOTARY PUBLIC
COMM EXP: DEC 4, 2022

Construction Industry Licensing Board of
Palm Beach County

Planning, Zoning & Building Department
Contractors Certification Division
2300 N. Jog Road, 2nd Floor, Suite 2W-61
West Palm Beach, FL 33411

(561) 233-5525

GERALD L BUDREVICH
[redacted]

Congratulations on obtaining your **JOURNEYMAN ELECTRICIAN** Certificate and for applying for certification in Palm Beach County. With this Certificate, you become one of thousands of Floridians certified by the Construction Industry Licensing Board (CILB) of Palm Beach County.
The following is the certifiate issued to you with the allowable scope of work pursuant to Chapter 67-1876, Special Act as amended, Laws of Florida.

Gerry Kelly, Chair

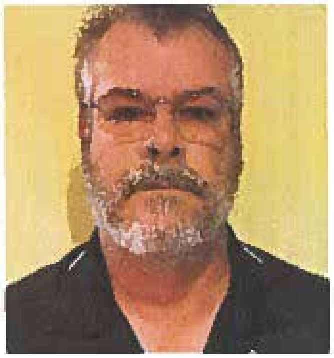
Construction Industry Licensing Board
of Palm Beach County

Oscar Alvarez, Director

License Number	Type of Competency Certification
J-14601	**JOURNEYMAN ELECTRICIAN**

The below named individual is certified as outlined in the Standards to perform under the provisions of Chapter 67-1876, Special Act as amended, Laws of Florida and as mandated by State Statute. *

NAME : GERALD L BUDREVICH
[redacted]



*** This certificate allows individual to perform work while employed under the supervision of a Certified Electrical/ Plumbing Contractor.**

Issued : 09/30/2022

Expiration date: 09/30/2024

Department of Commerce

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

Mike DeWine
Sheryl Maxfield

BUDREVICH, GERALD L
[redacted]

Mike DeWine
Governor

Sheryl Maxfield
Director

Electrical
CONTRACTOR'S LICENSE

Ohio License # 19470 **Expiration Date: 12/31/2023**

GERALD L BUDREVICH
ANYTHING ELECTRIC LLC
PARTNER

Carol Ross
Carol A. Ross
Board Secretary

William Koester
William Koester
Administrative Chairperson

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

Mike DeWine
Governor

Sheryl Maxfield
Director

LICENSE MUST BE POSTED ON JOB SITE

Electrical

CONTRACTOR'S LICENSE

GERALD L BUDREVICH

ANYTHING ELECTRIC LLC

PARTNER

Ohio License# **19470**

Expiration Date: **December 31, 2023**

LICENSE MUST BE POSTED ON JOB SITE

Carol Ross
Carol A. Ross
Board Secretary

William Koester
William Koester
Administrative Chairperson

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

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

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

State of Ohio
Department of Commerce
Division of State Fire Marshal

FIRE PROTECTION LICENSE
GERALD L BUDREVICH
54.77.1332
Expiration Date: 01/02/2024

Signature ________________________________

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

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

GERALD L BUDREVICH
[redacted]

Department of Commerce

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

Mike DeWine
Sheryl Maxfield

BUDREVICH, GERALD L
[redacted]

Mike DeWine
Governor

Sheryl Maxfield
Director

Electrical
CONTRACTOR'S LICENSE

Ohio License # 19470 **Expiration Date:** 12/31/2022

GERALD L BUDREVICH
ANYTHING ELECTRIC LLC
PARTNER

Carol Ross
Carol A. Ross
Board Secretary

William Koester
William Koester
Administrative Chairperson

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

Mike DeWine
Governor

Sheryl Maxfield
Director

LICENSE MUST BE POSTED ON JOB SITE

Electrical

CONTRACTOR'S LICENSE

GERALD L BUDREVICH

ANYTHING ELECTRIC LLC

PARTNER

Ohio License# **19470**

Expiration Date: **December 31, 2022**

LICENSE MUST BE POSTED ON JOB SITE

Carol Ross
Carol A. Ross
Board Secretary

William Koester
William Koester
Administrative Chairperson

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

State of Ohio
Department of Commerce
Division of State Fire Marshal

FIRE PROTECTION LICENSE
GERALD L BUDREVICH
54.77.1332
Expiration Date: 01/02/2023

Signature

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

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

GERALD L BUDREVICH
[redacted]

United States Environmental Protection Agency

This is to certify that

LEAD-SAFE EPA CERTIFIED FIRM

Anything Electric LLC

has fulfilled the requirements of the Toxic Substances Control Act (TSCA) Section 402, and has received certification to conduct lead-based paint renovation, repair, and painting activities pursuant to 40 CFR Part 745.89

In the Jurisdiction of:

All EPA Administered States, Tribes, and Territories

This certification is valid from the date of issuance and expires April 27, 2026

NAT-F163187-2
Certification #

October 16, 2020
Issued On

Michelle Price, Chief
Lead, Heavy Metals, and Inorganics Branch

Zack Academy Inc.
dba Green Education Services
2787 E. Oakland Park Blvd. Suite 303
Fort Lauderdale, FL 33306
(800) 355-1751

CERTIFICATE OF COMPLETION

THIS IS TO CERTIFY THAT

Gerald L. Budrevich

3123 Orchard Rd, Silver Lake, OH 44224

ATTENDED & SUCCESSFULLY COMPLETED:

Lead Renovator Refresher - English

Per 40 CFR Part 745.225

Certificate Number: R-R-74543-21-00464

Course Date: 04/17/2021
Examination Date: 04/17/2021
Expiration Date: 04/17/2024

Training Manager

04/17/2021
Date

Certificate Of Completion

This Is To Certify That

Gerald Budrevich

*** EL.19470 ***

has successfully completed the

(8) hrs Electrical Code (NEC) Update - Continuing Education

*for the 2022 OCILB, N.C. & Ky(ME/EE) Renewal * (Class# 6910031)*

Medina - Nov 09, 2022 (Wed)

Instructor - Joseph R. Ponzio
Ohio State Lic.# 10660
oh.electrical.training@gmail.com

Ohio Electrical Training
P.O. Box 59, Blacklick, Oh. 43004
OCILB #691 💡 OBBS #5167
(614) 581-5700
www.ohio-electrical-training.com

File Attachments for Item:

P-2 Danner, Dan ESI

Certification ID#

Current certifications- None

Staff notes: Recommend approval.

ESIAC Recommendations:

Committee recommendation:

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

Danner
Last Name

Dan
First Name

BBS Certification ID

SECTION 1: CHECK INTERIM CERTIFICATION(S) BEING REQUESTED

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

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

(Mark "T" If Trainee)

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

Danner	Dan	
Last Name	*First Name*	*BBS Certification ID*

SECTION 3: EMPLOYMENT/EDUCATION

Formal Education	Date Graduated
Shawnee High School Lima Ohio	1989
Related Vocational or Technical Training	Years' Experience
IBEW Local 648	May 2003 22
Apollo Career Center Industrial Maintenance OCAP	Nov. 1998 24
U.S. Military construction experience (MOS or other designation):	Years' Experience
Place of Employment:	Years' Employed
Cincinnati Childrens	3
IBEW	22

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)

Last Name ____________ First Name ____________ BBS Certification ID ____________

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

Applicants for Electrical Safety Inspector Only Must Complete This Item

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

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

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

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

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

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

SECTION 7 CONT.: EXPERIENCE

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

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

Last Name ____________ First Name ____________ BBS Certification ID ____________

List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
Mercy Health Winton Woods Community. Removed all electric and installed all electrical including seperate sevices on 73 apartments	Hilliard Electric they were located on SR 747 but are no longer in business.	04/1997 -04/2000
JW Harris new factory construction. Installed gear,buss,tap boxes, panels and all finish electrical.	Mayers Electric 4004 Erie Ct. Cincinnati Oh. 45227 513-272-2900	05/2000-08-2000
Proctor & Gamble Miami Valley Labs Ross Ohio Installed high voltage substation, gear, piping and low voltage panels and wiring.	Mayers Electric	08/2000-01/2001
Newport on the Levee. Installed lighting,piping and wired panels	Mayers Electric	01/2001-04/2001
Omni Hotel Cincinnati Replaced elevator feeders	Mayers Electric	04/2001-08/2001
Fifth Third Bank Operation Center. Ran pipe and wire to air handler units.	Mayers Electric	08/2001-12/2001
Graphic Packing Middletown. Removed and installed power for all types of equipment.	Mayers Electric	12/2001-02/2002
Proctor & Gamble Miami Valley Labs Ross Ohio. Installed 5 inch rigid pipe for high voltage feeders to new gear. Ran underground pipe and pulled high voltage feeder wires for sub stations.	Mayers Electric	02/2002-03/2004
Proctor & Gamble Mason Business Center Remodled several business areas and labs. Installed research manufactoring equipment. Installed power for new boilers and chillers. Types of work included lighting protection and grounding,transformers, MCCand gear,lighting and general power.	Mayers Electric	dates varied depending on progression of jobs 03/2004-05/2017
Proctor & Gamble 5201 Springdale Ave. Tear out and remodle of 1st,2nd and 3rd floors. Installed new control and electrical panels for research and development department.	Mayers Electric	dates varied depending on progression of jobs 03/2004-05/2017
Proctor & Gamble 5298 Springdale Rd. New construction building. I was involved with multiple area of construction.	Mayers Electric	dates varied depending on progression of jobs 03/2004-05/2017
Proctor & Gamble 6110 Center Hill Rd I worked all over the campus on varies projects including the remmoval of the old coffee equipment and the installation of a new 2 story roaster I also worked on the research of pringles ,diaper lines and other projects.	Mayers Electric	dates varied depending on progression of jobs 03/2004-05/2017
Sun Chemical 5000 Spring Grove Ave. Cincinnati Ohio moved the main service feeder from the North East of the facility to the south west of the facility. Upgraded the fire alarm system in the offices. Removed and installed power and electric in labs.	Mayers Electric	02/2007-10/2007
Astra Zeneca West Chester Ohio New construction Installed fire alarm,Mcc and panels and wiring.	Glenwood Electric 2107 Lawn Ave. Cincinnati Ohio 45212	01/2008-07/2008
Ikea 9500 Ikea Way west Chester Ohio Installed power for all elevators and escalators	United Electric 1309 Ethan Ave. Cincinnati Oh. 45225	11/2007-07/2008
Mercy Health Fairfied Ohio Remodled pre and post operation rooms and connecting hallaways. Ran power for boilers and chillers.	Kathman Electric 8969 Harrison Ohio 45002	11/2008-04/2010 & 02/2011-07/2011
AK Steel Middletown Ohio Removed and insstalled new panels and circuits with piping.	McGraw KoKoSing 101 Clark Bvld. Monroe Ohio 45044	01/2010-04/2010 & 02/2011-07/2011
Miller Brewery Trenton Ohio Installed power and contol wiring for beer line.	ESI electric 4696 Devitt Dr Cincinnati Ohio 45246	07/2010- ? no records
Bible Baptist Church 1249 Symmes Rd Fairfield,Ohio Installed fire alarm and service entrance.	Vogt Electric	04/2012
No records and I can't remember	Archiable Electric 3803 Ford Circle Cincinnati Ohio 45227	No records and I can't remember
AK Steel Middletown Ohio Removed and insstalled new panels and circuits with piping.	Debra Kuempel 3976 Southern Ave Cincinnati Ohio 45227	Week of 10/2017
Middle town Coke Plant Installed underground wiring and new gear	Stone and Webster Boston Mass.	10/2010-04/2011
I have also worked as maintenace in manufactoring, pharmacuetical, and hospital settings. Installing all kinds of equipment and devices from machines,aquais waste sytems, door controls and parking gates.	Astra Zeneca, Fuayao Glass and Childrens Hospital	worked these places in between working for the union. Currently at Childrens Hospital.
	Total Experience on This Page (In Months):	

Danner	Dan	
Last Name	*First Name*	*BBS Certification ID*

SECTION 8: PERSONAL HISTORY

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

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

   If you answered "No" please explain below:

SECTION 9: CERTIFICATION

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

Signature of Applicant: Dan Danner

Subscribed and duly sworn before me according to law, by the above named applicant this day 30 of November in the year 2022 at Hamilton, County of Butler and State of Ohio.

Notary Public: Amy S Beckett

SEAL

AMY S BECKETT
Notary Public
State of Ohio
Commission Expires December 3, 2022

My first contractor I worked for was Hilliard Electric when I moved to Fairfield from Lima Ohio. They are no longer in business. I worked for Hilliard from the fall of 1997 to the spring of 2000. At the same time I attended Great Oaks electrical apprenticeship for 2 years. During this time I wired several homes, an apartment complex and several commercial businesses. Being new to the area at that time I cannot remember the location of these jobs. I then ran the remodel of the Franciscan Friary on Mill Road which is now Mercy Health-Winton Woods Community. The job entailed complete electrical gutting and then remodeling this location into 73 apartments and open areas. The job ran from the summer of 1998 to the spring of 2000. I then joined IBEW local 648 on May 8th and finished the 3 last years of my apprenticeship.

I have enclosed my work history report from IBEW Local 648. I called each contractor and had them email my work history. A few of them did not have records going back more than 7 years. I have listed each contractor and the jobs I remember working on and the dates to the best of my memory.

MAYERS ELECTRIC COMPANY
INCORPORATED

Established 1948

ELECTRICAL CONTRACTORS * COMMERCIAL and INDUSTRIAL WIRING

4004 Erie Court, Cincinnati, OH 45227 Phone (513) 272-2900 FAX (513) 272-2904

October 13, 2022

To Whom It May Concern:

Please find listed below projects/jobsites that Dan Danner worked on as an electrician while employed with Mayers Electric:

Fifth Third Bank Operations Center, Cincinnati, Ohio – April 2001
General Electric, Evendale, Ohio – September 2007 thru October 2007
Graphic Packing, Middletown, Ohio – December 2001 thru February 2002
JW Harris, Mason, Ohio – May 2000 thru August 2000
Newport on Levee, Newport, Kentucky – April 2001
Omni Hotel Renovation, Cincinnati, Ohio – April 2001
Procter and Gamble 5201 Springdale Ave and 5298 Springdale Ave Cincinnati Ohio – February 2004 thru June 2004, January 2007 – September 2007, June 2017 thru July 2017
Procter and Gamble Miami Valley Labs, Ross, Ohio – August 2000 thru January 2004
Procter and Gamble Winton Hill Business Center, Cincinnati, Ohio – August 2003 thru January 2004, July 2004 thru December 2006
Sun Chemical, Cincinnati, Ohio – February 2007 thru April 2007
Sun Chemical Fire Alarm, Cincinnati, Ohio – March 2007 thru April 2007

Please note that Mr. Danner could have moved between different jobs at various times. Example being moving between different Proctor and Gamble jobs within the same month.

Mayers Electric Co., Inc.

Rhonda Ruprich
Payroll Department

File Attachments for Item:

P-3 Muncy, John - BI, MI, ESI, EPE, RBO

Certification ID:

Current Certifications: None in Ohio

Staff Notes: Has passed all exams, recommend approval for all certifications. OCILB licensed electrical contractor.

ESIAC Recommendations:

Committee Recommendation:

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

Last Name: Muncy

First Name: John

BBS Certification ID:

SECTION 1: CHECK INTERIM CERTIFICATION(S) BEING REQUESTED

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

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

(Mark "T" If Trainee)

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

RECEIVED
DEC 02 2022
BOARD OF BUILDING STANDARDS

Muncy
Last Name

John
First Name

BBS Certification ID

SECTION 3: EMPLOYMENT/EDUCATION

Formal Education	Date Graduated
Clermont High School Coral Springs, Florida	1991 GED
Related Vocational or Technical Training	Years' Experience
U.S. Military construction experience (MOS or other designation):	Years' Experience
Ohio Army National Guard	1991-1997 6 years
71L Administrative Specialist E-4 16th Engineer Brigade	
Place of Employment:	Years' Employed
2170 Howey Rd Columbus, Ohio and Fort Jackson SC	1991-1997 6 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)**

Last Name: Muncy
First Name: John
BBS Certification ID: ______

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

Applicants for Electrical Safety Inspector Only Must Complete This Item

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

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

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

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

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

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

SECTION 7 CONT.: EXPERIENCE

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

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

Muncy	John	
Last Name	*First Name*	*BBS Certification ID*

List Each Construction Project AND Specific Type of Work Performed	**Name of Employer, Contact, Address, Telephone Number**	**Project Time: From_ To _ (MM/YY)**
Ohio Army National Guard 16th Engineer Brigade *71 L Provided Support for Battalion units during Emergency events and Building Temporary Structures*	Ohio Army National Guard 2170 Howey Rd Columbus Ohio	Training varied from 91-97 Weekends and 2 weeks in the summer
Safeway Electric Co. INC. * Wired Many houses during this time builders include Dominion- Diyanni Homes-Ryland homes-Residential	Safeway Electric Co. Inc 1973 Lockbourne Rd Columbus,Ohio 614-443-7672	Many different houses Between 09/91-10/93
StreetsBoro Apartments-Wired Apartments (Multifamily) Commercial	Accurate Electric Construction Inc 6901 Americana Pkwy Reynoldsburg, Ohio 614-863-1844	10/93-03/94
Arbors Of Marysville-Wired Apartments (Multifamily)Commercial	Accurate Electric Construction Inc 6901 Americana Pkwy Reynoldsburg, Ohio 614-863-1844	03/94-07-94
Kroger Grocery-Columbus-Wired Commercial Store-Journeyman Electrician	Accurate Electric Construction Inc 6901 Americana Pkwy Reynoldsburg, Ohio 614-863-1844	07/94-12/94
Foxboro Communties-Columbus Townhouses-single family houses-Residential-Journeyman Electrician	Accurate Electric Construction Inc 6901 Americana Pkwy Reynoldsburg, Ohio 614-863-1844	12/94-01/96
New Albany High School -Commercial Electrical wiring-Journeyman Electrician	Accurate Electric Construction Inc 6901 Americana Pkwy Reynoldsburg, Ohio 614-863-1844	01/96-10/97
Ohio State University Fisher College of Business-Commercial Electrical wiring and Services-Journeyman Electrician	Accurate Electric Construction Inc 6901 Americana Pkwy Reynoldsburg, Ohio 614-863-1844	10/97-10/99
The Farms Columbus- Electrical Wiring and services for Commercial Condos-Journeyman Electrician	Accurate Electric Construction Inc 6901 Americana Pkwy Reynoldsburg, Ohio 614-863-1844	10/99-12/00
Columbus Public Schools(Woodcrest) Commercial Electrical wiring and Services-Journeyman Electrician	Accurate Electric Construction Inc 6901 Americana Pkwy Reynoldsburg, Ohio 614-863-1844	12/00-05/01
	Total Experience on This Page (In Months):	Electrician 116 Months

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

Muncy	John	
Last Name	*First Name*	*BBS Certification ID*

List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
Pickerington High School - Commercial Electrical wiring and Services - Journeyman Electrician	Accurate Electric Construction Inc 6901 Americana Pkwy Reynoldsburg, Ohio 614-863-1844	05/01-07/03
Project Manager/Estimator/Journeyman El Helped layout of Electrical plans and Load calculations-Overseen many Commercial Build-outs	Accurate Electric Construction Inc 6901 Americana Pkwy Reynoldsburg, Ohio 614-863-1844	07/03-08/04
Peninsular Place Ypsilanti,Michigan-Commercial Student Housing & Community areas 198 units-Journeyman Electrician	Accurate Electric Construction Inc 6901 Americana Pkwy Reynoldsburg, Ohio 614-863-1844	08/04-11/05
Jeffery Park Columbus, Ohio- Commercial wiring of Community Center-Journeyman Electrician	Accurate Electric Construction Inc 6901 Americana Pkwy Reynoldsburg, Ohio 614-863-1844	11/05-11/06
Moved to Florida and unemployed from		11/06-01/07
Electrical Inspector for Marion County Florida Performed Electrical Inspections on Commercial and Residential Projects Obtained Florida Commercial Electrical inspector License and Electrical Plans Examiner license	Marion County Building Department 2710 E Silver Springs, Fl 352-438-2400 Commercial Electrical License 07/09/07 Electrical Plans Examiner License 09/12/07	01/07-01/08
Unemployed from Construction due to the crash of the housing market		01/08-10/08
Kings Bay Naval Base Kings bay, Georgia Residential Electrical Wiring Of Military homes-Journeyman Electrician	American Residential Services 2548 Oscar Johnson North Charleston, SC 843-932-7464	10/08-05/09
Fredericksburg Apartments, Fredericksburg, Virgina- Commercial Electrical wiring and Services for apartments and Community Area-Journeyman Electrician	American Residential Services 2548 Oscar Johnson North Charleston, SC 843-932-7464	05/09-02/10
Fort Jackson Columbia, SC- Residential and Commercial Electrical Wiring Of Military Apartments & Houses-Journeyman Electrician	American Residential Services 2548 Oscar Johnson North Charleston, SC 843-932-7464	02/10-05/10
Joint Base Charleston North Charleston, SC Commercial Electrical Wiring Of Military Apartments-Journeyman Electrician	American Residential Services 2548 Oscar Johnson North Charleston, SC 843-932-7464	05/10-12/10
Arnold Air Force Base Tullahoma, TN-Commercial wiring of retail spaces and Community Center-Journeyman Electrician	American Residential Services 2548 Oscar Johnson North Charleston, SC 843-932-7464	12/10-05/11
	Total Experience on This Page (In Months):	~~Electrician 108 Months~~ Electrical Inspector 12 Months

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

Muncy
Last Name

John
First Name

BBS Certification ID

List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
Naval Air Force Station Pensacola, Fl Military Commercial Retail spaces-Electrical Wiring and Service- Journeyman Electrician	American Residential Services 2548 Oscar Johnson North Charleston, SC 843-932-7464	05/11-08/12
Kessler Air Force Base Biloxi, Mississippi Military Commercial Retail spaces and houses-Electrical Wiring and Service- Journeyman Electrician	American Residential Services 2548 Oscar Johnson North Charleston, SC 843-932-7464	08/12-07/13
City of Tampa Building Department Lead Construction Inspector Assist Contractors and Homeowners with issues pertaining to code issues, Perform Inspection for the Following-All 4 trades on residential(Mechanical-Electrical-Building and Plumbing)—Performs Inspections all all the Following Commercial trades(Commercial Electrical and Commercial Building- Have worked all areas of Tampa in my 9 years with them(Downtown High rises as well as many Hospitals)	City Of Tampa Development and Growth Dept. 1400 N Blvd, Tampa, Florida 813-274-3100	08/13-Current date
Received the One and 2 Family License and Completed the Cross training Course through BOAF (Building Officials association of Florida) 450 hours of OJT Time and 84 hours of Class Completed (Certificate Enclosed) **ICC Residential Building Inspector Exam** passed #5311950 Expires 12/24 **ICC Residential Electrical Inspector Exam** passed #5311950 Expires 12/24 **ICC Residential Mechanical Inspector** Exam passed #5311950 Expires 12/24 **ICC Residential Plumbing Inspector Exam** passed #5311950 Expires 12/24 **Florida 1 and 2 family License** Issued on06/15License #BN5863Expires11/30		Received license on 06/15
Received Commercial Building Inspector License-Completed the Cross training Course through BOAF (Building Officials association of Florida) 150 Hours of OJT time and 50 hours of Class Completed (Certificate Enclosed) **ICC Commercial Building Inspector Exam** Passed # 5311950 Expires 12/24 **Florida Commercial Building License** Issued on08/18License#BN5863 Exp 11/23 **Received Electrical Plans Examiner** ~~License # PX2997 Exp 11/23~~		Received License on 08/18 Electrician 26 months Res Insp 89month+Cross training Comm Electrical
ICC Electrical Plans Examiner	**Total Experience on This Page (In Months):**	Inspector 111

#5311950 Exp 12/24
Ohio Electrical Contractor License
#34335 Escrow Exp 06/25

Muncy	John	
Last Name	*First Name*	*BBS Certification ID*

SECTION 8: PERSONAL HISTORY

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

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

   If you answered "No" please explain below:

SECTION 9: CERTIFICATION

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

Signature of Applicant: ______

Subscribed and duly sworn before me according to law, by the above named applicant this day 1 of December in the year 20 22 at Tampa, County of Hillsborough and State of Florida.

Notary Public: ______

SEAL

Kathryn Higgins
Notary Public
State of Florida
Comm# HH077945
Expires 1/6/2025

Ron DeSantis, Governor

Melanie S. Griffin, Secretary

Florida dbpr

STATE OF FLORIDA
DEPARTMENT OF BUSINESS AND PROFESSIONAL REGULATION

BUILDING CODE ADMINISTRATORS & INSPECTOR

THE STANDARD PLANS EXAMINER HEREIN IS CERTIFIED UNDER THE
PROVISIONS OF CHAPTER 468, FLORIDA STATUTES
ELEC

MUNCY, JOHN B

[redacted]

LICENSE NUMBER: PX2997

EXPIRATION DATE: NOVEMBER 30, 2023

Always verify licenses online at MyFloridaLicense.com

Do not alter this document in any form.

This is your license. It is unlawful for anyone other than the licensee to use this document.

Ron DeSantis, Governor

Melanie S. Griffin, Secretary

STATE OF FLORIDA
DEPARTMENT OF BUSINESS AND PROFESSIONAL REGULATION

BUILDING CODE ADMINISTRATORS & INSPECTOR

THE STANDARD INSPECTOR HEREIN IS CERTIFIED UNDER THE
PROVISIONS OF CHAPTER 468, FLORIDA STATUTES
ELEC, RESI, BLDG

MUNCY, JOHN B

[redacted]

LICENSE NUMBER: BN5863

EXPIRATION DATE: NOVEMBER 30, 2023

Always verify licenses online at MyFloridaLicense.com

Do not alter this document in any form.

This is your license. It is unlawful for anyone other than the licensee to use this document.

ICC
INTERNATIONAL
CODE COUNCIL

Electrical Plans Examiner

Promissor ID: XX4144089885

Name: JOHN MUNCY

Date: 08/25/2007

Address: [redacted]

EXAMINATION RESULT: **PASS**

Congratulations! You have passed the Electrical Plans Examiner examination. Your wallet card and certificate will be forwarded to you by ICC within six weeks from the last day of the month in which you tested. This certificate is current for three years.

It is extremely important that you notify Promissor and ICC of any changes in name and/or address to avoid the possibility of your certificate not being received. Please contact Promissor at 800-275-8301 and ICC at 888-422-7233 ext. 33815 with changes to your name and address. There may be an additional fee if a certification is re-issued due to a misspelled name or incorrect address.

Eastern Regional
Office Assessment Center
900 Montclair Road
Birmingham, Alabama 35213
Tel: 888-icc-safe (422-7233)
Fax: 205-599-9897

www.iccsafe.org

To: John Muncy
[redacted]

From: Certification and Testing Department
Date: July 16, 2018

Subject: June 09, 2007 Administration

Examination: Commercial Electrical Inspector

Congratulations! You have passed the above-named examination. If you have not already received one of our new wallet cards, which contain a QR code, one will be sent to you separately. If you already have one of the new cards, the above certification has been added to your record. You may access your profile online at verify.iccsafe.org. This certification is current for three years. You may request a wall certificate from ICC as well. This certificate will be provided at no cost to you, if you request it within 90 days of your exam. Only one wall certificate per exam passed will be provided to you at no charge. For more information on requesting a wall certificate, go to www.iccsafe.org/inspector.

It is extremely important that you notify ICC of any changes in name and/or address to avoid the possibility of documentation not being received. Please contact ICC at certexam@iccsafe.org with changes to your name and/or address (name changes may require additional documentation).

RENEWAL: Prior to the expiration date shown on your wallet card, we will send you a renewal reminder notice. You may obtain all of the certification maintenance information for renewal on the ICC Website at www.iccsafe.org.

Renewal of a certification is the responsibility of the certified individual. Please make sure you keep track of your renewal date(s).

Yours very truly,

Michelle Porter

Director, Certification & Testing

The authenticity of this result letter can be validated by using the "Search ICC Code Professionals" link, which can be found on the navigation bar at www.iccsafe.org

Department of Commerce

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

Mike DeWine
Sheryl Maxfield

Mike DeWine
Governor

Electrical
CONTRACTOR'S LICENSE

Sheryl Maxfiel
Director

Ohio License # 34335
Expiration Date: 06/30/2025

JOHN B MUNCY
ESCROW

Carol Ross
Carol A. Ross
Board Secretary

William Koester
William Koester
Administrative Chairperso

MUNCY, JOHN B
[redacted]

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

Mike DeWine
Governor

Sheryl Maxfield
Director

LICENSE MUST BE POSTED ON JOB SITE

Electrical

CONTRACTOR'S LICENSE

JOHN B MUNCY

ESCROW

Ohio License# **34335**

Expiration Date: **June 30, 2025**

LICENSE MUST BE POSTED ON JOB SITE

Carol Ross
Carol A. Ross
Board Secretary

William Koester
William Koester
Administrative Chairperson

PROMISSOR
knowledge beyond doubt™

Florida Department of Business and Professional Regulation

JOHN MUNCY

[redacted]

Promissor ID: FLP#####4265

Exam Date: 04/28/2007

Examination Name: Building Code Principles and Practice

Exam Result: **PASS**

A minimum score of 70% is required to pass the Florida Principles and Practice portion of the Building Code Administrators and Inspectors Examination.

A person seeking licensure as an Inspector or Plans Examiner must pass both the International Code Council (ICC) technical portion of the Building Code Administrators and Inspectors Examination and the Florida Principles and Practice Examination.

A person seeking licensure as a Building Official must be certified as a Code Enforcement and Administration Professional or must pass both the Certified Building Official (CBO) examination (both modules) and successfully complete the Florida Principles and Practice Examination.

If you have now achieved passing scores on both applicable examinations, please fax a copy of your passing certificates o the Central Intake Unit, 850-921-0038, or mail them to the Department of Business and Professional Regulation, Central Intake Unit, 1940 N. Monroe St, Tallahassee, FL 32399-2211 in order for your license to be issued.

Your license will be issued in approximately 30 days. Once your license has been issued or an additional category has een added to your existing license and this information can be verified on the Department's website, www.myfloridalicense.com, you may begin work under your new license or category. You are not required to wait until you eceive a hard copy of your actual license.

Questions relating to licensure can be directed to the Customer Contact Center at 850.487.1395.

Building Officials Association of Florida, Inc.

PRESIDENT
Doug Wise
dwise@boaf.net
Building Official Palm
Beach County

VICE PRESIDENT
Jim Schock
jschock@boaf.net
Plans Examiner
First Coast

TREASURER
Clayton Parker
cparker@boaf.net
Building Official
City of Sunny Isles Beach

SECRETARY
Mickey Matison
mmatison@boaf.net
Building Official
City of Auburndale

IMMEDIATE PAST PRESIDENT
John Jackson, MCP
jjackson@boaf.net
Building Code Administrator
University of Central Florida

EXECUTIVE DIRCTOR
Ann Russo
arusso@boaf.net

Building Officials Association of Florida (BOAF)
528 West Lake Mary Blvd.
Sanford, Florida 32773
V 407-804-1001

www.boaf.net

April 30, 2018

Mr. John Muncy
[redacted]

Dear Mr. Muncy:

Congratulations on the successful completion of the approved BOAF Training Program in the category of Building Inspector, Certificate # 12632523 issued in your name, is enclosed.

Completion of this training program is recognized as meeting the alternative eligibility requirements for examination. Please include a copy of this letter and your certificate, in lieu of proof of 5 years of experience in the licensure category sought, with the exam application you will submit to the BCAIB. If any questions arise regarding your successful completion of this program or its acceptance by the BCAIB, please feel free to contact me.

Again...congratulations!

Sincerely,

AnnRusso

Ann Russo
Executive Director, BOAF

Certificate #12632523

THIS
CERTIFICATE OF SATISFACTORY COMPLETION

Is awarded to:

John Muncy

Who meets the eligibility requirements of 468.609(2)(c)4,F.S. and 61G19-7.001, FAC and has successfully completed a training program approved by the Florida Building Code Administrator's and Inspector's Board in the Category of:

Building Inspector

This certificate shall qualify the applicant for examination in the category shown (61G19-7.008.3, FAC)

Issuing Authority

Building Officials Association of Florida

Ann Russo

BOAF Executive Director

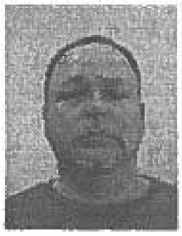
4/30/2018

Date

BOAF Provider # 001001
Course #5007981
Total Hours: 208.50

INTERNATIONAL
CODE COUNCIL®

DBPR Commercial Building Inspector



Candidate ID:

Name:

Address:

[redacted]

Date: 8/24/2018

EXAMINATION RESULT: **PASS**

Congratulations on your successful completion of the above examination certification requirement for licensing by the State of Florida, Department of Business and Professional Regulation (DBPR). Your wallet card will be forwarded to you by ICC within six weeks from the last day of the month in which you tested. This certification is current for three years. You may request a wall certificate from ICC as well. This certificate will be provided at no cost to you, if you request it within 90 days of your exam. Only one wall certificate per exam passed will be provided to you at no charge. For more information on requesting a wall certificate, go to www.iccsafe.org/inspector.

You should be eligible to receive licensure in the specific category applied for upon receipt of a passing score for the ICC technical examination and Principles and Practice examination (if applicable). Your license will be issued by DBPR in approximately 30 days. Once your license has been issued or an additional category has been added to your existing license, you can verify this on Florida DBPR's website at www.myfloridalicense.com. You may begin to work under your new license or category. You are not required to wait until you receive your actual license to work.

Please note, ICC does not administer the Principles and Practice examination. To schedule the Florida Principles and Practice examination, please call Pearson VUE at 1-888-204-6230. To access the Principles and Practice Candidate Information Booklet (CIB), visit www.MyFlorida.com/dbpr and select Education and Testing. If you do not have access to the Internet, please call DBPR at 1-850-487-1395 for assistance.

A successful Florida Principles and Practice examination score is valid as long as you maintain your license in good standing, per rule 61G19-6.0085, Florida Administrative Code.

It is extremely important that you notify Pearson VUE and ICC of any changes in name and/or address to avoid the possibility of your wallet card and/or certificate not being received. Please contact Pearson VUE at 800-275-8301 and ICC at certexam@iccsafe.org with changes to your name and address (name changes may require additional documentation). There may be an additional fee if a certification is re-issued due to a misspelled name or incorrect address.

Department of Business & Professional Regulation

The authenticity of this score report can be validated by using Pearson VUE's Online Score Report Authentication found at:
www.PearsonVUE.com/authenticate
Digital embossing eliminates the possibility of unauthorized embossing of counterfeit score reports.

Registration Number: ***339727886*** *Validation Number:* ***953498402***

Building Officials Association of
Florida, Inc.

February 5, 2015

Mr. John B Muncy
[redacted]

Dear Mr. Muncy,

Congratulations on the successful completion of the approved BOAF Training Program in the category of 1 & 2 Family Dwelling Inspector, Certificate #3243 issued in your name, is enclosed.

Completion of this training program is recognized as meeting the alternative eligibility requirements for examination. Please include a copy of this letter and your certificate, in lieu of proof of 5 years of experience in the licensure category sought, with the exam application you will submit to the BCAIB. If any questions arise regarding your successful completion of this program or its acceptance by the BCAIB, please feel free to contact me.

Again...congratulations!

Sincerely,

Ann Russo

Ann Russo
Executive Director, BOAF

3697 Lake Emma Road • Lake Mary, Florida 32746
Office: 407-804-1001 • Fax: 407-804-0308
www.boaf.net

CERTIFICATE OF COMPLETION

awarded to

John Muncy

BN0005863 PX0002997

For completion 21 hours of

Plumbing Inspector Principles & Code Applications

BCAIB Approval # 5007518

Presented by the

Building Officials Association of Florida

Linda Patrick
President

April 30, May 1 and 2, 2014

BOAF Provider # 0001001
Course #5007518
Total Class Hours: 21

Issuing Authority
Building Officials Association of Florida
Gary Brevoort
Executive Director

05/02/2014
Date

Celeste Roman

CERTIFICATE OF COMPLETION

awarded to

John Muncy

BN0005863 PX0002997

For completion 7 hours of

Fuel Gas Principles & Code Applications

BCAIB Approval # 5007513

Presented by the

Building Officials Association of Florida

Linda Patrick

President

May 3, 2014

Issuing Authority

Building Officials Association of Florida

Gary Brevoort 05/03/2014

Executive Director Date

Celeste Roman

BOAF Provider # 0001001
Course #5007513
Total Class Hours: 7

CERTIFICATE OF COMPLETION

awarded to

John Muncy

PX0002997 BN0005863

For completion 21 hours of

Mechanical Inspector Principles & Code Applications

BCAIB Approval # 5007520

Presented by the

Building Officials Association of Florida

Linda Patrick
President

April 23, 24 and 25, 2014

Issuing Authority

Building Officials Association of Florida

Gary Brevoort
Executive Director

04/25/2014
Date

BOAF Provider # 0001001
Course #5007520
Total Class Hours: 21

Celeste [illegible]

CERTIFICATE OF COMPLETION

awarded to

John B. Muncy

PX0002997 BN0005863

For completion 35 hours of

Building Inspector Principles & Code Applications

BCAIB Approval # 5007521

Presented by the

Building Officials Association of Florida

Linda Patrick

President

March 17, 18, 19, 27, and 28, 2014

BOAF Provider # 0001001
Course #5007521
Total Class Hours: 35

Issuing Authority

Building Officials Association of Florida

Gary Brevoort

Executive Director

03/28/2014

Date

Honorable Discharge

from the Armed Forces of the United States of America

This is to certify that

JOHN BENJAMIN MUNCY [redacted] SPC USAR

was Honorably Discharged from the

United States Army

on the 30TH *day of* MARCH 1999 *This certificate is awarded as a testimonial of Honest and Faithful Service*

Donald G Conaway
DONALD G. CONAWAY
COL, AV
COMMANDING

DD FORM NO. 256A MAY 80

ARMY NATIONAL GUARD RETIREMENT POINTS HISTORY STATEMENT

[redacted] BENJAMIN
Former Members of OHIO ARNG ARNG
2825 W. Dublin Granville Rd
Columbus, OH 43235
Notice Of Eligibility: NO
Highest Grade Held: E04

Date Prepared: 2002/04/08
AYE: 03/27
BASD:
Output Reason:

This summary is a statement of your points earned towards retirement. You should review all entries and report any discrepancies to your unit clerk. Particular attention should be given to any period of service with a verification status (VS) of "B" because points are not credited until verified.

Begin Date (yyyymmdd)	End Date (yyyymmdd)	MMSI	IDT	MEM	ACCP Misc Pts	AD Pts	VS	Total Career Points	Total Pts For Ret Pay	Creditable Svc For Ret Pay
1991/03/28	1991/04/23	B1	0	--	0	0	V	---	---	--/--/--
1991/04/24	1991/08/24	B7	0	--	0	123	V	---	---	--/--/--
1991/08/25	1992/03/27	B1	28	15	0	1	V	167	167	01/00/00
1992/03/28	1993/03/27	B1	42	15	0	10	V	67	67	01/00/00
1993/03/28	1994/03/27	B1	43	15	0	15	V	73	73	01/00/00
1994/03/28	1995/03/27	B1	41	15	0	18	V	74	74	01/00/00
1995/03/28	1996/03/27	B1	45	15	0	11	V	71	71	01/00/00
1996/03/28	1997/03/27	B1	35	15	0	1	V	51	51	01/00/00
Grand Totals						179		503	503	06/00/00

MILITARY MEMBERSHIP STATUS IDENTIFIERS

B1 - Army National Guard Unit Member
B7 - Army National Guard Unit Member on Initial Entry Training

NON-CREDITABLE PERIODS OF SERVICE

From Date	To Date	Reason

DISTRIBUTION:
1 Soldier
1 Requester

NGB FORM 23B
20 July 1998

DEPARTMENT OF THE ARMY AND THE AIR FORCE
NATIONAL GUARD BUREAU

REPORT OF SEPARATION AND RECORD OF SERVICE

REPORT OF SEPARATION AND RECORD OF SERVICE IN THE [1] ARMY NATIONAL GUARD OF OHIO AND AS A RESERVE OF THE [2] ////////

[1] Insert either Army or Air Force   [2] Enlisted personnel only - insert only Army of Air Force

1. LAST NAME - FIRST NAME - MIDDLE NAME: KUNCY JOHN BENJAMIN

2. DEPARTMENT, COMPONENT AND BRANCH: ARNGUS/OHARNG

3. SOCIAL SECURITY NUMBER: [redacted]

4. DATE OF ENL	YR	MO	DA
	91	03	28

5a. RANK: SPC

5b. PAY GRADE: E4

6. DATE OF RANK	YR	MO	DA
	92	09	01

7. DATE OF BIRTH (YR MO DA): [redacted]

8a. STATION OR INSTALLATION AT WHICH EFFECTED: HHC 16 ENGR BDE COLUMBUS OH 43211 - 2098

8b. EFFECTIVE DATE	YR	MO	DA
	97	03	27

9. COMMAND TO WHICH TRANSFERRED
USAR CONTROL GROUP (REINFORCEMENT)
RCPAC
9700 PAGE BLVD
ST LOUIS, MO 63132-5260

10. RECORD OF SERVICE	YRS	MOS	DAYS
(a) NET SERVICE THIS PERIOD	06	00	00
(b) PRIOR RESERVE COMPONENT SERVICE	00	00	00
(c) PRIOR ACTIVE FEDERAL SERVICE	00	00	00
(d) TOTAL SERVICE FOR PAY	06	00	00

11. TERMINAL DATE OF RESERVE / MILITARY SERVICE OBLIGATION	YR	MO	DA
	99	03	27

12. MILITARY EDUCATION *(Course Title, number of weeks, month and year completed)*
ADMIN SP 8 WKS 0891//

13. PRIMARY SPECIALTY NUMBER TITLE AND DATE AWARDED *(Additional specialty numbers and titles)*
71L10 ADMIN SP 910824//

14. HIGHEST EDUCATION LEVEL SUCCESSFULLY COMPLETED
SECONDARY / HIGH SCHOOL 12 YRS (Gr 1-12) COLLEGE ____ YRS

15. DECORATIONS, MEDALS, BADGES, COMMENDATIONS CITATIONS AND CAMPAIGN RIBBONS AWARDED *(State Awards may be included)*
ARMY-SVC-RBN/NTL-DEF-SVC-MDL/OHBCTR/OHSSR/OHAWM(NUM3)/OHFSR/AR-COMP-ACHVMT-MDL//

16. SERVICEMEN'S GROUP LIFE INSURANCE COV
☒ YES ☐ NO
AMT $100,000

17. PERSONNEL SECURITY INVESTIGATION
a. TYPE: ENTNAC
b. DATE COMPLETED: 910404

18. REMARKS PEBD: 910328. SRIP PARTICIPANT: BONUS, GI BILL AND TUITION GRANT. DD 214 WAS ISSUED FOR IADT PERIOD: 910424 - 910824. SOLDIER TRANSFERRED TO USAR CONTROL GROUP FOR A PERIOD OF 2 YRS TO COMPLETE REMAINING STATUTORY MILITARY SERVICE OBLIGATION. NGB FORM 22 AND NGB FORM 55a WERE MAILED TO INDIVIDUAL'S LAST KNOWN ADDRESS AS INDICATED IN ITEM #19//

19. MAILING ADDRESS [redacted] RD, City, County Zip Code)

20. SIGNATURE OF PERSON BEING SEPARATED
SOLDIER NOT AVAILABLE FOR SIGNATURE

TITLE OF AUTHORIZING OFFICER
CAROL A. HUDY, CW2, ARNGUS, PSB CHIEF

22. SIGNATURE OF OFFICER AUTHORIZED TO SIGN

23. AUTHORITY AND REASON
PARA 8-27E NGR 600-200 EXPIRATION OF ACTIVE GUARD COMMITMENT

24. CHARACTER OF SERVICE: HONORABLE

25. TYPE OF CERTIFICATE: 55a

26. REENLISTMENT ELIGIBILITYTY: RE-1

27. ☐ REQUEST ☐ DECLINE COPIES OF MY NGB FORM 22 INITIALS ____________

NGB FORM 22 1 FEB 83 *(Replaces NGB Form 22, dated Oct 76 and NGB Form 22-1, dated 1 Jun 78, which is obsolete)* (4)

Honorable Discharge

from the Federally Recognized Army National Guard

This is to certify that

JOHN BENJAMIN MUNCY [redacted] SPECIALIST
HEADQUARTERS HEADQUARTERS COMPANY 16TH ENGINEER BRIGADE

was Honorably Discharged from the

Army National Guard

of OHIO

on the 27TH *day of* MARCH 1997 *This certificate is awarded as a testimonial of Honest and Faithful Service*

"This discharge does not relieve the individual named herein from any unfulfilled obligation to perform military service which may be imposed on him/her by law."

DEPARTMENTS OF THE ARMY AND THE AIR FORCE · NATIONAL GUARD BUREAU ·

Thomas G Kemp
THOMAS G. KEMP
COL, GS, OHARNG
Mil Pers Off

FORM 55a (Replaces NGB Form 55a, dated 1 Oct 83,
' 85

ICC INTERNATIONAL CODE COUNCIL®

INTERNATIONAL CODE COUNCIL

JOHN MUNCY

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 written examination based on codes and standards then in effect, and is hereby issued this certification as:

Electrical Plans Examiner

Given this day August 25, 2007

Certificate No. 5311950

Michael Wich, CBO
President, Board of Directors

Dominic Sims, CBO
Chief Executive Officer

This certificate is the property of ICC and must be returned to ICC in the event of suspension or revocation of the certificate.

ICC INTERNATIONAL CODE COUNCIL®

INTERNATIONAL CODE COUNCIL

JOHN MUNCY

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 written examination based on codes and standards then in effect, and is hereby issued this certification as:

Commercial Electrical Inspector

Given this day June 9, 2007

Certificate No. 5311950

Michael Wich, CBO
President, Board of Directors

Dominic Sims, CBO
Chief Executive Officer

This certificate is the property of ICC and must be returned to ICC in the event of suspension or revocation of the certificate.

ICC INTERNATIONAL
CODE
COUNCIL®

INTERNATIONAL CODE COUNCIL

JOHN MUNCY

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 written examination based on codes and standards then in effect, and is hereby issued this certification as:

Commercial Building Inspector

Given this day August 24, 2018

Certificate No. 5311950

Michael Wich, CBO
President, Board of Directors

Dominic Sims, CBO
Chief Executive Officer

This certificate is the property of ICC and must be returned to ICC in the event of suspension or revocation of the certificate.

ICC INTERNATIONAL
CODE
COUNCIL®

INTERNATIONAL CODE COUNCIL

JOHN MUNCY

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 written examination based on codes and standards then in effect, and is hereby issued this certification as:

Residential Mechanical Inspector

Given this day November 22, 2014

Certificate No. 5311950

Michael Wich, CBO
President, Board of Directors

Dominic Sims, CBO
Chief Executive Officer

This certificate is the property of ICC and must be returned to ICC in the event of suspension or revocation of the certificate.

ICC INTERNATIONAL CODE COUNCIL®

INTERNATIONAL CODE COUNCIL

JOHN MUNCY

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 written examination based on codes and standards then in effect, and is hereby issued this certification as:

Residential Building Inspector

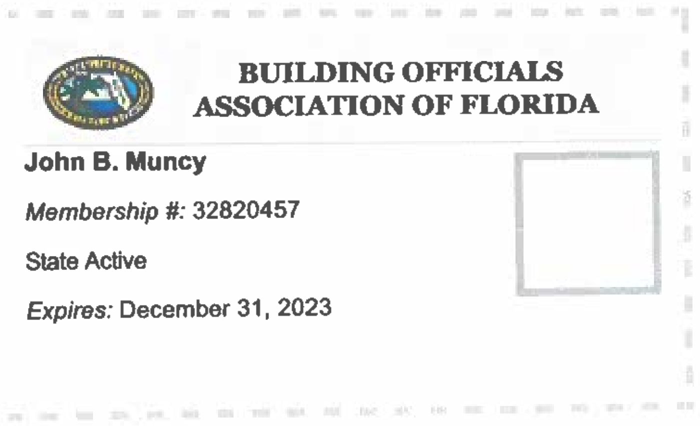
Given this day November 30, 2013

Certificate No. 5311950

Michael Wich, CBO
President, Board of Directors

Dominic Sims, CBO
Chief Executive Officer

This certificate is the property of ICC and must be returned to ICC in the event of suspension or revocation of the certificate.



BUILDING OFFICIALS ASSOCIATION OF FLORIDA

John B. Muncy

Membership #: 32820457

State Active

Expires: December 31, 2023

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

Muncy	John	
Last Name	*First Name*	*BBS Certification ID*

SECTION 1: CHECK INTERIM CERTIFICATION(S) BEING REQUESTED

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

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

(Mark "T" If Trainee)

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

RECEIVED

DEC 02 2022

BOARD OF BUILDING STANDARDS

Section 3: Employment/Education

a. Formal Education	Date Graduated
Clermont High School Coral Springs, Florida	1991 GED
b. Related Vocational or Technical Training	Years' Experience
c. U.S. Military construction experience (MOS or other designation):	Years' Experience
Ohio Army National Guard	1991-1997 6 years
71 L Administrative Specialist E-4 --16th Engineer Brigade	
d. Place of Employment:	Years' Employed
2170 Howey Rd Columbus, Ohio and Fort Jackson Columbia, SC	1991-1997 6 years

Muncy
Last Name

John
First Name

BBS Certification ID

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

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

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

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

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

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

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

Last Name: Muncy
First Name: John
BBS Certification ID:

SECTION 5 CONT.: EXPERIENCE

List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
Ohio Army National Guard 16th Engineer Brigade *71 L Provided Support for Battalion units during Emergency events and Building Temporary Structures*	Ohio Army National Guard 2170 Howey Rd Columbus Ohio	Training varied from 91-97 Weekends and 2 weeks in the summer
Safeway Electric Co. INC. * Wired Many houses during this time builders include Dominion- Diyanni Homes-Ryland homes-Residential	Safeway Electric Co. Inc 1973 Lockbourne Rd Columbus,Ohio 614-443-7672	Many different houses Between 09/91-10/93
StreetsBoro Apartments-Wired Apartments (Multifamily) Commercial	Accurate Electric Construction Inc 6901 Americana Pkwy Reynoldsburg, Ohio 614-863-1844	10/93-03/94
Arbors Of Marysville-Wired Apartments (Multifamily)Commercial	Accurate Electric Construction Inc 6901 Americana Pkwy Reynoldsburg, Ohio 614-863-1844	03/94-07-94
Kroger Grocery-Columbus-Wired Commercial Store-Journeyman Electrician	Accurate Electric Construction Inc 6901 Americana Pkwy Reynoldsburg, Ohio 614-863-1844	07/94-12/94
Foxboro Communties-Columbus Townhouses-single family houses-Residential-Journeyman Electrician	Accurate Electric Construction Inc 6901 Americana Pkwy Reynoldsburg, Ohio 614-863-1844	12/94-01/96
New Albany High School -Commercial Electrical wiring-Journeyman Electrician	Accurate Electric Construction Inc 6901 Americana Pkwy Reynoldsburg, Ohio 614-863-1844	01/96-10/97
Ohio State University Fisher College of Business-Commercial Electrical wiring and Services-Journeyman Electrician	Accurate Electric Construction Inc 6901 Americana Pkwy Reynoldsburg, Ohio 614-863-1844	10/97-10/99
The Farms Columbus- Electrical Wiring and services for Commercial Condos-Journeyman Electrician	Accurate Electric Construction Inc 6901 Americana Pkwy Reynoldsburg, Ohio 614-863-1844	10/99-12/00
Columbus Public Schools(Woodcrest) Commercial Electrical wiring and Services-Journeyman Electrician	Accurate Electric Construction Inc 6901 Americana Pkwy Reynoldsburg, Ohio 614-863-1844	12/00-05/01
	Total Experience on This Page (In Months):	Electrician 116 Months

Muncy	John	
Last Name	*First Name*	*BBS Certification ID*

SECTION 5 CONT.: EXPERIENCE

List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
Pickerington High School - Commercial Electrical wiring and Services - Journeyman Electrician	Accurate Electric Construction Inc 6901 Americana Pkwy Reynoldsburg, Ohio 614-863-1844	05/01-07/03
Project Manager/Estimator/Journeyman El Helped layout of Electrical plans and Load calculations-Overseen many Commercial Build-outs	Accurate Electric Construction Inc 6901 Americana Pkwy Reynoldsburg, Ohio 614-863-1844	07/03-08/04
Peninsular Place Ypsilanti,Michigan-Commercial Student Housing & Community areas 198 units-Journeyman Electrician	Accurate Electric Construction Inc 6901 Americana Pkwy Reynoldsburg, Ohio 614-863-1844	08/04-11/05
Jeffery Park Columbus, Ohio- Commercial wiring of Community Center-Journeyman Electrician	Accurate Electric Construction Inc 6901 Americana Pkwy Reynoldsburg, Ohio 614-863-1844	11/05-10/06
Moved to Florida and unemployed from		10/06-01/07
Electrical Inspector for Marion County Florida Performed Electrical Inspections on Commercial and Residential Projects Obtained Florida Commercial Electrical inspector License and Electrical Plans Examiner license	Marion County Building Department 2710 E Silver Springs, Fl 352-438-2400 Commercial Electrical License 07/09/07 Electrical Plans Examiner License 09/12/07	01/07-01/08
Unemployed from Construction due to the crash of the housing market		01/08-10/08
Kings Bay Naval Base Kings bay, Georgia Residential Electrical Wiring Of Military homes-Journeyman Electrician	American Residential Services 2548 Oscar Johnson North Charleston, SC 843-932-7464	10/08-05/09
Fredericksburg Apartments, Fredericksburg, Virgina- Commercial Electrical wiring and Services for apartments and Community Area-Journeyman Electrician	American Residential Services 2548 Oscar Johnson North Charleston, SC 843-932-7464	05/09-02/10
Fort Jackson Columbia, SC- Residential and Commercial Electrical Wiring Of Military Apartments & Houses-Journeyman Electrician	American Residential Services 2548 Oscar Johnson North Charleston, SC 843-932-7464	02/10-05/10
Joint Base Charleston North Charleston, SC Commercial Electrical Wiring Of Military Apartments-Journeyman Electrician	American Residential Services 2548 Oscar Johnson North Charleston, SC 843-932-7464	05/10-12/10
Arnold Air Force Base Tullahoma, TN-Commercial wiring of retail spaces and Community Center-Journeyman Electrician	American Residential Services 2548 Oscar Johnson North Charleston, SC 843-932-7464	12/10-05/11
	Total Experience on This Page (In Months):	Electrician 108 Months Electrical Inspector 12 Months

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

Muncy
Last Name

John
First Name

BBS Certification ID

SECTION 5 CONT.: EXPERIENCE

List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
Naval Air Force Station Pensacola, Fl Military Commercial Retail spaces-Electrical Wiring and Service- Journeyman Electrician	American Residential Services 2548 Oscar Johnson North Charleston, SC 843-932-7464	05/11-08/12
Kessler Air Force Base Biloxi, Mississippi Military Commercial Retail spaces and houses-Electrical Wiring and Service- Journeyman Electrician	American Residential Services 2548 Oscar Johnson North Charleston, SC 843-932-7464	08/12-07/13
City of Tampa Building Department Lead Construction Inspector Assist Contractors and Homeowners with issues pertaining to code issues, Perform Inspection for the Following-All 4 trades on residential(Mechanical-Electrical-Building and Plumbing)—Performs Inspections all all the Following Commercial trades(Commercial Electrical and Commercial Building- Have worked all areas of Tampa in my 9 years with them(Downtown High rises as well as many Hospitals)	City Of Tampa Development and Growth Dept. 1400 N Blvd, Tampa, Florida 813-274-3100	08/13-Current date
Received the One and 2 Family License and Completed the Cross training Course through BOAF (Building Officials association of Florida) 450 hours of OJT Time and 84 hours of Class Completed (Certificate Enclosed) **ICC Residential Building Inspector Exam** passed #5311950 Expires 12/24 **ICC Residential Electrical Inspector Exam** passed #5311950 Expires 12/24 **ICC Residential Mechanical Inspector Exam** passed #5311950 Expires 12/24 **ICC Residential Plumbing Inspector Exam** passed #5311950 Expires 12/24 **Florida 1 and 2 family License** Issued on06/15License #BN5863Expires11/30		Received license on 06/15
Received Commercial Building Inspector License-Completed the Cross training Course through BOAF (Building Officials association of Florida) 150 Hours of OJT time and 50 hours of Class Completed (Certificate Enclosed) ICC Commercial Building Inspector Exam Passed # 5311950 Expires 12/24 **Florida Commercial Building License** Issued on08/18License#BN5863 Exp 11/23 **Received Electrical Plans Examiner**		Received License on 08/18 Electrician 26 months Res Insp 89month+Cross training Comm Electrical Inspector 111
License # PX2997 Exp 11/23	**Total Experience on This Page (In Months):**	Comm Building Insp51months +Cross Training

ICC Electrical Plans Examiner#5311950
Exp 12/24
Ohio Electrical Contractor License #34335
Escrow Exp 06/25

Muncy	John	
Last Name	*First Name*	*BBS Certification ID*

SECTION 6: PERSONAL HISTORY

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

SECTION 7: CERTIFICATION

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

Signature of Applicant:

Subscribed and duly sworn before me according to law, by the above named applicant this day 1 of December in the year 2022 at Tampa, County of Hillsborough and State of Florida.

Notary Public:

SEAL

FLORIDA NOTARY ASSOCIATION • SINCE 1978 •

Kathryn Higgins
Notary Public
State of Florida
Comm# HH077945
Expires 1/6/2025

File Attachments for Item:

ER-1 2020 National Electric Code (International Association of Electrical Inspectors SW)

All certifications (6 hours)

Staff Notes: Slides begin on p. 24 of the submission.

ESIAC Recommendation:

Committee Recommendation:

Ohio | Department of Commerce

Mike DeWine, Governor
Jon Husted, Lt. Governor

Sheryl Maxfield, Director

Board of Building Standards

Application for Continuing Education Course Approval

Provider Information:

Name: Lorenzo Adam

Organization: Southwest Division IAEI

Address: 27 Penbrooke Court, Monroe, Ohio 45050

E-mail: ladam@masonoh.org Telephone: 513-229-8520

Website: ______

Conference Sponsor (if applicable) ______ Conference Email: ______

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

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

New Course Information:

Course title: 2020 National Electrical Code

Course instructor: Various IAEI Instructors (See Attached Bios)

Course description:
Seminar based on the 2020 NEC will cover Electric Calculations, Electrical Services and Overall Important Code Sections

Instructional hours per session: 6 Number of Sessions: 1

Course Date(s) and Location: Receptions Conference Center, Fairfield ,Ohio

Special Content:

Code Administration: ______

Existing Buildings: ______

Electrical Instruction: x

Plumbing Instruction: ______

Conference Course: ______

Conference Name: ______

Conference location: ______

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

Course Website: ______

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

______

Course applicable for the following certifications

Residential Certifications Only: ______ Commercial Certifications: x

Administrative Course, All Certifications: ______

Application materials included:

x Course Outline or Course Learning Objectives
x Presentation Materials/Slides (not required for roundtable courses)
______ Assessment Materials (for online courses)
x Presenter Bio

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

Agenda

2020 National Electrical Code
February 4th 2023

Topic: See outlines for more details on these topics.

Instructors: Dewayne Jenkins, Pete Baldauf, Lorenzo Adam, Gaylord Poe

7:30 am to 8:00 am	Registration	
8:00 am to 9:00 am	Electrical Calculations	1.00 h
9:00 am to 9:30 am	Break	
9:30 am to 10:30 am	Electrical Calculations	1.00 h
10:30 am to 10:45 am	Break	
10:45 am to 12:00 m	Electrical Services	1.25 h
12:00 pm to 1:00 pm	Break for lunch	
1:00 pm to 1:45 pm	Electrical Services	0.75 h
1:45 pm to 2:30 pm	2020 NEC	0.75 h
2:30 pm to 2:45 pm	Break	
2:45 pm to 4:00 pm	2020 NEC	1.25 h
4:00 pm	Certificates Distributed	
	Total	6.00 h

Course Outline for Jointly Sponsored Seminar Series
February 4, 2023

Electrical Calculations

Several calculations take place in the NEC, to properly apply certain applications such as conductor voltage drop, ambient conditions, load types and over current protection selection, sizing of conductors and equipment a proper run through the calculations will help contractors, inspectors and plan examiners ease through the permitting process, plan review and inspections.

The code requirements are different from each application. We will be discussing wiring methods and how it affects which facility you are operating under.

- **Definitions Art. 100**
- **Requirements:**
    - **Art. 110**
        - Requirements for Electrical Installation
    - **Art. 220**
        - Branch Circuit, Feeder, and Service Load Calculations
    - **Art. 240**
        - Overcurrent Protection
    - **Art. 310**
        - Conductors for General Wiring
    - **Art. 430**
        - Motors and Motor Circuits
    - **Art. 450**
        - Transformers
    - **Art. 690**
        - PV Systems
    - **Art. 695**
        - Fire Pumps

Electrical Services

This class will address the electrical services that supplies all structures. The class will cover these **articles 230, 240 and 250** as well as the proper application of the codes as they relate to the installation and overcurrent protection of specific equipment, conductors, and services. This article covers service conductors and equipment for control and protection of services and their installation requirements. Parts I through VII in article 240 will provide the general requirements for overcurrent protection and overcurrent protective devices not more than 600 volts, nominal. Part VIII covers overcurrent protection for those portions of supervised industrial installations operating at voltages of not more than 600 volts, nominal. Part IX covers overcurrent protection over 600 volts, nominal. Inspectors, electrical plan examiners, and contractors will obtain the basics steps for determining if plans, projects and/or upgrading projects will comply with the minimum requirements of the Code.

2020 National Electrical Code

This segment of the seminar will cover those articles that are most controversial not only for interpretations but also for their conflict with contractor's perspective and inspector's point of view. At the end, it is the job of the Building Official to the final interpretation of the Code.

- Various important articles will be discussed throughout this topic.
  - **Art. 100, 210, 300, 450, 517, 600, 700.**

- The presentation will focus on:
  - Plan Review Deficiencies
  - Field Deficiencies
  - Code Interpretations

These presentations will be in Power Point format and each participant will be encouraged to discuss and to participate on the subjects presented. Contractors and ESIs will benefit as well as Plans Examiners and Professional Designers by getting firsthand information on these subjects. Both, the Ohio Building Code and the Residential Code of Ohio, in chapters 27 and 33 respectively refers to **2017 NFPA 70** as the standard to comply with electrical installations. Even though the State of Ohio has not adopted the **2020 NFPA 70 version**, the purpose of this class is to let the attendees know of these items in this version of the NEC and not to the enforcement of such version.

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

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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. In 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 Electrical Contractors Association, Adequate Wiring Committee, and International Association of Electrical Inspectors. He also has certification through the City of Dayton Board of Education as an Adult Education Instructor.

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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.

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Course Materials

Every attendee is responsible for bringing an edition of the NEC. We will use the NEC 2017 and NEC 2020. 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).

Informative Annex D Examples

This informative annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

Selection of Conductors. In the following examples, the results are generally expressed in amperes (A). To select conductor sizes, refer to the 0 through 2000 volt (V) ampacity tables of Article 310 and the rules of 310.15 that pertain to these tables.

Voltage. For uniform application of Articles 210, 215, and 220, a nominal voltage of 120, 120/240, 240, and 208Y/120 V is used in calculating the ampere load on the conductor.

Fractions of an Ampere. Except where the calculations result in a major fraction of an ampere (0.5 or larger), such fractions are permitted to be dropped.

Power Factor. Calculations in the following examples are based, for convenience, on the assumption that all loads have the same power factor (PF).

Ranges. For the calculation of the range loads in these examples, Column C of Table 220.55 has been used. For optional methods, see Columns A and B of Table 220.55. Except where the calculations result in a major fraction of a kilowatt (0.5 or larger), such fractions are permitted to be dropped.

SI Units. For metric conversions, 0.093 m^2 = 1 ft^2 and 0.3048 m = 1 ft.

Example D1(a) One-Family Dwelling

The dwelling has a floor area of 1500 ft^2, exclusive of an unfinished cellar not adaptable for future use, unfinished attic, and open porches. Appliances are a 12-kW range and a 5.5-kW, 240-V dryer. Assume range and dryer kW ratings equivalent to kVA ratings in accordance with 220.54 and 220.55.

Calculated Load *(see 220.40)*

General Lighting Load 1500 ft^2 at 3 VA/ft^2 = 4500 VA

Minimum Number of Branch Circuits Required *[see 210.11(A)]*

General Lighting Load: 4500 VA ÷ 120 V = 38 A

This requires three 15-A, 2-wire or two 20-A, 2-wire circuits.

Small-Appliance Load: Two 2-wire, 20-A circuits *[see 210.11(C)(1)]*

Laundry Load: One 2-wire, 20-A circuit *[see 210.11(C)(2)]*

Bathroom Branch Circuit: One 2-wire, 20-A circuit (no additional load calculation is required for this circuit) *[see 210.11(C)(3)]*

Minimum Size Feeder Required *[see 220.40]*

General Lighting		4,500 VA
Small Appliance		3,000 VA
Laundry		1,500 VA
	Total	9,000 VA
3000 VA at 100%		3,000 VA
9000 VA – 3000 VA = 6000 VA at 35%		2,100 VA
	Net Load	5,100 VA
Range *(see Table 220.55)*		8,000 VA
Dryer Load *(see Table 220.54)*		5,500 VA
Net Calculated Load		18,600 VA

Net Calculated Load for 120/240-V, 3-wire, single-phase service or feeder

18,600 VA ÷ 240 V = 78 A

Sections 230.42(B) and 230.79 require service conductors and disconnecting means rated not less than 100 amperes.

Calculation for Neutral for Feeder and Service

Lighting and Small-Appliance Load		5,100 VA
Range: 8000 VA at 70% *(see 220.61)*		5,600 VA
Dryer: 5500 VA at 70% *(see 220.61)*		3,850 VA
	Total	14,550 VA

Calculated Load for Neutral

14,550 VA ÷ 240 V = 61 A

Example D1(b) One-Family Dwelling

Assume same conditions as Example No. D1(a), plus addition of one 6-A, 230-V, room air-conditioning unit and one 12-A, 115-V, room air-conditioning unit,* one 8-A, 115-V, rated waste disposer, and one 10-A, 120-V, rated dishwasher. See Article 430 for general motors and Article 440, Part VII, for air-conditioning equipment. Motors have nameplate ratings of 115 V and 230 V for use on 120-V and 240-V nominal voltage systems.

*(For feeder neutral, use larger of the two appliances for unbalance.)

From Example D1(a), feeder current is 78 A (3-wire, 240 V).

	Line A	Neutral	Line B
Amperes from Example D1(a)	78	61	78
One 230-V air conditioner	6	—	6
One 115-V air conditioner and 120-V dishwasher	12	12	10
One 115-V disposer	—	8	8
25% of largest motor *(see 430.24)*	3	3	2
Total amperes per conductor	99	84	104

Therefore, the service would be rated 110 A.

Example D2(a) Optional Calculation for One-Family Dwelling, Heating Larger Than Air Conditioning

(see 220.82)

The dwelling has a floor area of 1500 ft², exclusive of an unfinished cellar not adaptable for future use, unfinished attic, and open porches. It has a 12-kW range, a 2.5-kW water heater, a 1.2-kW dishwasher, 9 kW of electric space heating installed in five rooms, a 5-kW clothes dryer, and a 6-A, 230-V, room air-conditioning unit. Assume range, water heater, dishwasher, space heating, and clothes dryer kW ratings equivalent to kVA.

Air Conditioner kVA Calculation

6 A × 230 V ÷ 1000 = 1.38 kVA

This 1.38 kVA [item 1 from 220.82(C)] is less than 40% of 9 kVA of separately controlled electric heat [item 6 from 220.82(C)], so the 1.38 kVA need not be included in the service calculation.

General Load

1500 ft² at 3 VA	4,500 VA
Two 20-A appliance outlet circuits at 1500 VA each	3,000 VA
Laundry circuit	1,500 VA
Range (at nameplate rating)	12,000 VA
Water heater	2,500 VA
Dishwasher	1,200 VA
Clothes dryer	5,000 VA
Total	29,700 VA

Application of Demand Factor *[see 220.82(B)]*

First 10 kVA of general load at 100%	10,000 VA
Remainder of general load at 40% (19.7 kVA × 0.4)	7,880 VA
Total of general load	17,880 VA
9 kVA of heat at 40% (9000 VA × 0.4) =	3,600 VA
Total	21,480 VA

Calculated Load for Service Size

21.48 kVA = 21,480 VA

21,480 VA ÷ 240 V = 90 A

Therefore, the minimum service rating would be 100 A in accordance with 230.42 and 230.79.

Feeder Neutral Load in Accordance with 220.61

1500 ft² at 3 VA	4,500 VA
Three 20-A circuits at 1500 VA	4,500 VA
Total	9,000 VA
3000 VA at 100%	3,000 VA
9000 VA - 3000 VA = 6000 VA at 35%	2,100 VA
Subtotal	5,100 VA
Range: 8 kVA at 70%	5,600 VA
Clothes dryer: 5 kVA at 70%	3,500 VA
Dishwasher	1,200 VA
Total	15,400 VA

Calculated Load for Neutral

15,400 VA ÷ 240 V= 64 A

Example D2(b) Optional Calculation for One-Family Dwelling, Air Conditioning Larger Than Heating

[see 220.82(A) and 220.82(C)]

The dwelling has a floor area of 1500 ft², exclusive of an unfinished cellar not adaptable for future use, unfinished attic, and open porches. It has two 20-A small-appliance circuits, one 20-A laundry circuit, two 4-kW wall-mounted ovens, one 5.1-kW counter-mounted cooking unit, a 4.5-kW water heater, a 1.2-kW dishwasher, a 5-kW combination clothes washer and dryer, six 7-A, 230-V room air-conditioning units, and a 1.5-kW permanently installed bathroom space heater. Assume wall-mounted ovens, counter-mounted cooking unit, water heater, dishwasher, and combination clothes washer and dryer kW ratings equivalent to kVA.

Air Conditioning kVA Calculation

Total amperes = 6 units × 7 A = 42 A

42 A × 240 V ÷ 1000 = 10.08 kVA (assume PF = 1.0)

Load Included at 100%

Air Conditioning: Included below *[see item 1 in 220.82(C)]*

Space Heater: Omit *[see item 5 in 220.82(C)]*

General Load

1500 ft² at 3 VA	4,500 VA
Two 20-A small-appliance circuits at 1500 VA each	3,000 VA
Laundry circuit	1,500 VA
Two ovens	8,000 VA
One cooking unit	5,100 VA
Water heater	4,500 VA
Dishwasher	1,200 VA
Washer/dryer	5,000 VA
Total general load	32,800 VA
First 10 kVA at 100%	10,000 VA
Remainder at 40% (22.8 kVA × 0.4 × 1000)	9,120 VA
Subtotal general load	19,120 VA
Air conditioning	10,080 VA
Total	29,200 VA

Calculated Load for Service

29,200 VA ÷ 240 V = 122 A (service rating)

Feeder Neutral Load, in accordance with 220.61
Assume that the two 4-kVA wall-mounted ovens are supplied by one branch circuit, the 5.1-kVA counter-mounted cooking unit by a separate circuit.

1500 ft^2 at 3 VA	4,500 VA
Three 20-A circuits at 1500 VA	4,500 VA
Subtotal	9,000 VA
3000 VA at 100%	3,000 VA
9000 VA - 3000 VA = 6000 VA at 35%	2,100 VA
Subtotal	5,100 VA

Two 4-kVA ovens plus one 5.1-kVA cooking unit = 13.1 kVA. Table 220.55 permits 55% demand factor or 13.1 kVA × 0.55 = 7.2 kVA feeder capacity.

Subtotal from above	5,100 VA
Ovens and cooking unit: 7200 VA × 70% for neutral load	5,040 VA
Clothes washer/dryer: 5 kVA × 70% for neutral load	3,500 VA
Dishwasher	1,200 VA
Total	14,840 VA

Calculated Load for Neutral
14,840 VA ÷ 240 V = 62

Example D2(c) Optional Calculation for One-Family Dwelling with Heat Pump (Single-Phase, 240/120-Volt Service)

(see 220.82)
The dwelling has a floor area of 2000 ft^2, exclusive of an unfinished cellar not adaptable for future use, unfinished attic, and open porches. It has a 12-kW range, a 4.5-kW water heater, a 1.2-kW dishwasher, a 5-kW clothes dryer, and a 2½-ton (24-A) heat pump with 15 kW of backup heat.

Heat Pump kVA Calculation
24 A × 240 V ÷ 1000 = 5.76 kVA
This 5.76 kVA is less than 15 kVA of the backup heat; therefore, the heat pump load need not be included in the service calculation *[see 220.82(C)]*.

General Load

2000 ft^2 at 3 VA	6,000 VA
Two 20-A appliance outlet circuits at 1500 VA each	3,000 VA
Laundry circuit	1,500 VA
Range (at nameplate rating)	12,000 VA
Water heater	4,500 VA
Dishwasher	1,200 VA
Clothes dryer	5,000 VA
Subtotal general load	33,200 VA
First 10 kVA at 100%	10,000 VA
Remainder of general load at 40% (23,200 VA× 0.4)	9,280 VA
Total net general load	19,280 VA

(continues)

Heat Pump and Supplementary Heat*
240 V × 24 A = 5760 VA

15 kW Electric Heat:

5760 VA + (15,000 VA × 65%) = 5.76 kVA + 9.75 kVA = 15.51 kVA

***If supplementary heat is not on at same time as heat pump, heat pump kVA need not be added to total.**

Totals

Net general load	19,280 VA
Heat pump and supplementary heat	15,510 VA
Total	34,790 VA

Calculated Load for Service

34.79 kVA × 1000 ÷ 240 V= 145 A

Therefore, this dwelling unit would be permitted to be served by a 150-A service.

Example D3 Store Building

A store 50 ft by 60 ft, or 3000 ft^2, has 30 ft of show window. There are a total of 80 duplex receptacles. The service is 120/240 V, single phase 3-wire service. Actual connected lighting load is 8500 VA.

Calculated Load *(see 220.40)*

Noncontinuous Loads	
Receptacle Load *(see 220.44)*	
80 receptacles at 180 VA	14,400 VA
10,000 VA at 100%	10,000 VA
14,400 VA – 10,000 VA = 4400 at 50%	2,200 VA
Subtotal	12,200 VA
Continuous Loads	
General Lighting*	
3000 ft^2 at 3 VA/ft^2	9,000 VA
Show Window Lighting Load	
30 ft at 200 VA/ft *[see 220.14(G)]*	6,000 VA
Outside Sign Circuit *[see 220.14(F)]*	1,200 VA
Subtotal	16,200 VA
Subtotal from noncontinuous	12,200 VA
Total noncontinuous loads + continuous loads =	28,400 VA

*In the example, the actual connected lighting load (8500 VA) is less than the load from Table 220.12, so the minimum lighting load from Table 220.12 is used in the calculation. Had the actual lighting load been greater than the value calculated from Table 220.12, the actual connected lighting load would have been used.

Minimum Number of Branch Circuits Required

General Lighting: Branch circuits need only be installed to supply the actual connected load *[see 210.11(B)]*.

8500 VA × 1.25 = 10,625 VA

10,625 VA ÷ 240 V = 44 A for 3-wire, 120/240 V

The lighting load would be permitted to be served by 2-wire or 3-wire, 15- or 20-A circuits with combined capacity equal to 44 A or greater for 3-wire circuits or 88 A or greater for 2-wire circuits. The feeder capacity as well as the number of branch-circuit positions available for lighting circuits in the panelboard must reflect the full calculated load of 9000 VA × 1.25 = 11,250 VA.

Show Window

6000 VA × 1.25 = 7500 VA

7500 VA ÷ 240 V = 31 A for 3-wire, 120/240 V

The show window lighting is permitted to be served by 2-wire or 3-wire circuits with a capacity equal to 31 A or greater for 3-wire circuits or 62 A or greater for 2-wire circuits.

Receptacles required by 210.62 are assumed to be included in the receptacle load above if these receptacles do not supply the show window lighting load.

Receptacles

Receptacle Load: 14,400 VA ÷ 240 V = 60 A for 3-wire, 120/240 V

The receptacle load would be permitted to be served by 2-wire or 3-wire circuits with a capacity equal to 60 A or greater for 3-wire circuits or 120 A or greater for 2-wire circuits.

Minimum Size Feeder (or Service) Overcurrent Protection *(see 215.3 or 230.90)*

Subtotal noncontinuous loads		12,200 VA
Subtotal continuous load at 125% (16,200 VA × 1.25)		20,250 VA
	Total	32,450 VA

32,450 VA ÷ 240 V = 135 A

The next higher standard size is 150 A *(see 240.6)*.

Minimum Size Feeders (or Service Conductors) Required *[see 215.2, 230.42(A)]*

For 120/240 V, 3-wire system, 32,450 VA ÷ 240 V = 135 A

Service or feeder conductor is 1/0 Cu in accordance with 215.3 and Table 310.15(B)(16) (with 75°C terminations).

Example D3(a) Industrial Feeders in a Common Raceway

An industrial multi-building facility has its service at the rear of its main building, and then provides 480Y/277-volt feeders to additional buildings behind the main building in order to segregate certain processes. The facility supplies its remote buildings through a partially enclosed access corridor that extends from the main switchboard rearward along a path that provides convenient access to services within 15 m (50 ft) of each additional building supplied. Two building feeders share a common raceway for approximately 45 m (150 ft) and run in the access corridor along with process steam and control and communications cabling. The steam raises the ambient temperature around the power raceway to as much as 35°C. At a tee fitting, the individual building feeders then run to each of the two buildings involved. The feeder neutrals are not connected to the equipment grounding conductors in the remote buildings. All distribution equipment terminations are listed as being suitable for 75°C connections. Each of the two buildings has the following loads:

Lighting, 11,600 VA, comprised of electric-discharge luminaires connected at 277 V

Receptacles, 22 125-volt, 20-ampere receptacles on general-purpose branch circuits, supplied by separately derived systems in each of the buildings

1 Air compressor, 460 volt, three phase, 5 hp

1 Grinder, 460 volt, three phase, 1.5 hp

3 Welders, AC transformer type (nameplate: 23 amperes, 480 volts, 60 percent duty cycle)

3 Industrial Process Dryers, 480 volt, three phase,15 kW each (assume continuous use throughout certain shifts)

Determine the overcurrent protection and conductor size for the feeders in the common raceway, assuming the use of XHHW-2 insulation (90°C):

Calculated Load {Note: For reasonable precision, volt-ampere calculations are carried to three significant figures only; where loads are converted to amperes, the results are rounded to the nearest ampere *[see 220.5(B)]*}.

Noncontinuous Loads	
Receptacle Load *(see 220.44)*	
22 receptacles at 180 VA	3,960 VA
Welder Load *[see 630.11(A), Table 630.11(A)]*	
Each welder: 480V × 23A × 0.78 = 8,610 VA	
All 3 welders *[see 630.11(B)]* (demand factors 100%, 100%, 85% respectively)	
8,610 VA + 8,610 VA + 7,320 VA =	24,500 VA
Subtotal, Noncontinuous Loads	**28,500 VA**
Motor Loads *(see 430.24, Table 430.250)*	

(continues)

Air compressor: 7.6 A × 480 V × √3 =		6,310 VA
Grinder: 3 A × 480 V × √3 =		2,490 VA
Largest motor, additional 25%:		1,580 VA
Subtotal, Motor Loads		**10,400 VA**
By using 430.24, the motor loads and the noncontinuous loads can be combined for the remaining calculation.		
Subtotal for load calculations, Noncontinuous Loads		**38,900 VA**
Continuous Loads		
General Lighting		11,600 VA
3 Industrial Process Dryers	15 kW each	45,000 VA
Subtotal, Continuous Loads:		**56,600 VA**

Overcurrent protection *(see 215.3)*
The overcurrent protective device must accommodate 125% of the continuous load, plus the noncontinuous load:

Continuous load	56,600 VA
Noncontinuous load	38,900 VA
Subtotal, actual load [actual load in amperes] [99,000 VA ÷ (480V × √3) = 119 A]	**95,500 VA**
(25% of 56,600 VA) (*See 215.3*)	**14,200 VA**
Total VA	**109,700 VA**

Conversion to amperes using three significant figures: 109,700 VA / (480V × √3) = 132 A
Minimum size overcurrent protective device: 132 A
Minimum standard size overcurrent protective device *(see 240.6)*: 150 amperes

Where the overcurrent protective device and its assembly are listed for operation at 100 percent of its rating, a 125 ampere overcurrent protective device would be permitted. However, overcurrent protective device assemblies listed for 100 percent of their rating are typically not available at the 125-ampere rating. *(See 215.3 Exception.)*

Ungrounded Feeder Conductors
The conductors must independently meet requirements for (1) terminations, and (2) conditions of use throughout the raceway run.

Minimum size conductor at the overcurrrent device termination *[see 110.14(C) and 215.2(A)(1), using 75°C ampacity column in Table 310.15(B)(16)]*: 1/0 AWG.

Minimum size conductors in the raceway based on actual load *[see Article 100, Ampacity, and 310.15(B)(3)(a) and correction factors to Table 310.15(B)(16)]*:

95,500 VA / 0.7 / 0.96 = 142,000 VA
[70% = 310.15(B)(3)(a)] & [0.96 = correction factors to Table 310.15(B)(16)]
Conversion to amperes:
142,000 VA / (480V × √3) = 171 A

Note that the neutral conductors are counted as current-carrying conductors *[see 310.15(B)(5)(c)]* in this example because the discharge lighting has substantial nonlinear content. This requires a 2/0 AWG conductor based on the 90°C column of Table 310.15(B)(16). Therefore, the worst case is given by the raceway conditions, and 2/0 AWG conductors must be used. If the utility corridor were at normal temperatures [(30°C (86°F)], and if the lighting at each building were supplied from the local separately derived system (thus requiring no neutrals in the supply feeders), the raceway result (95,500 VA / 0.8 = 119,000 VA; 119,000 VA / (480V × √3) = 143 A, or a 1 AWG conductor @ 90°C) could not be used, because the termination result (1/0 AWG) based on the 75°C column of Table 310.15(B)(16) would become the worst case, requiring the larger conductor.

In every case, the overcurrent protective device shall provide overcurrent protection for the feeder conductors in accordance with their ampacity as provided by this *Code (see 240.4)*. A 90°C 2/0 AWG conductor has a Table 310.15(B)(16) ampacity of 195 amperes. Adjusting for the conditions of use (35°C ambient temperature, 8 current-carrying conductors in the common raceway),

195 amperes × 0.96 × 0.7 = 131 A

The 150-ampere circuit breaker protects the 2/0 AWG feeder conductors, because 240.4(B) permits the use of the next higher standard size overcurrent protective device. Note that the feeder layout precludes the application of 310.15(A)(2) Exception.

Feeder Neutral Conductor *(see 220.61)*

Because 210.11(B) does not apply to these buildings, the load cannot be assumed to be evenly distributed across phases. Therefore the maximum imbalance must be assumed to be the full lighting load in this case, or 11,600 VA. (11,600 VA / 277V = 42 amperes.) The ability of the neutral to return fault current *[see 250.32(B) Exception (2)]* is not a factor in this calculation.

Because the neutral runs between the main switchboard and the building panelboard, likely terminating on a busbar at both locations, and not on overcurrent devices, the effects of continuous loading can be disregarded in evaluating its terminations *[see 215.2(A)(1) Exception No. 2]*. That calculation is (11,600 VA ÷ 277V) = 42 amperes, to be evaluated under the 75°C column of Table 310.15(B)(16). The minimum size of the neutral might seem to be 8 AWG, but that size would not be sufficient to be depended upon in the event of a line-to-neutral short circuit *[see 215.2(A)(1), second paragraph]*. Therefore, since the minimum size equipment grounding conductor for a 150 ampere circuit, as covered in Table 250.122, is 6 AWG, that is the minimum neutral size required for this feeder.

Example D4(a) Multifamily Dwelling

A multifamily dwelling has 40 dwelling units.
Meters are in two banks of 20 each with individual feeders to each dwelling unit.
One-half of the dwelling units are equipped with electric ranges not exceeding 12 kW each. Assume range kW rating equivalent to kVA rating in accordance with 220.55. Other half of ranges are gas ranges.
Area of each dwelling unit is 840 ft^2.
Laundry facilities on premises are available to all tenants. Add no circuit to individual dwelling unit.

Calculated Load for Each Dwelling Unit *(see Article 220)*
General Lighting: 840 ft^2 at 3 VA/ft^2 = 2520 VA
Special Appliance: Electric range *(see 220.55)* = 8000 VA

Minimum Number of Branch Circuits Required for Each Dwelling Unit *[see 210.11(A)]*
General Lighting Load: 2520 VA ÷ 120 V = 21 A or two 15-A, 2-wire circuits; or two 20-A, 2-wire circuits
Small-Appliance Load: Two 2-wire circuits of 12 AWG wire *[see 210.11(C)(1)]*
Range Circuit: 8000 VA ÷ 240 V = 33 A or a circuit of two 8 AWG conductors and one 10 AWG conductor in accordance with 210.19(A)(3)

Minimum Size Feeder Required for Each Dwelling Unit *(see 215.2)*

Calculated Load *(see Article 220)*:	
General Lighting	2,520 VA
Small Appliance (two 20-ampere circuits)	3,000 VA
Subtotal Calculated Load (without ranges)	5,520 VA

Application of Demand Factor *(see Table 220.42)*

First 3000 VA at 100%	3,000 VA
5520 VA - 3000 VA = 2520 VA at 35%	882 VA
Net Calculated Load (without ranges)	3,882 VA
Range Load	8,000 VA
Net Calculated Load (with ranges)	11,882 VA

Size of Each Feeder *(see 215.2)*
For 120/240-V, 3-wire system (without ranges)
Net calculated load of 3882 VA ÷ 240 V = 16 A For 120/240-V, 3-wire system (with ranges)
Net calculated load, 11,882 VA ÷ 240 V = 50 A

Feeder Neutral

Lighting and Small-Appliance Load	3,882 VA
Range Load: 8000 VA at 70% *(see 220.61)*	5,600 VA
(only for apartments with electric range)	5,600 VA
Net Calculated Load (neutral)	9,482 VA

Calculated Load for Neutral

9482 VA ÷ 240 V= 39.5 A

Minimum Size Feeders Required from Service Equipment to Meter Bank (For 20 Dwelling Units — 10 with Ranges)

Total Calculated Load:	
Lighting and Small Appliance	
20 units × 5520 VA	110,400 VA
Application of Demand Factor	
First 3000 VA at 100%	3,000 VA
110,400 VA - 3000 VA = 107,400 VA at 35%	37,590 VA
Net Calculated Load	40,590 VA
Range Load: 10 ranges (not over 12 kVA) *(see Col. C, Table 220.55, 25 kW)*	25,000 VA
Net Calculated Load (with ranges)	65,590 VA

Net calculated load for 120/240-V, 3-wire system,

65,590 VA ÷ 240 V = 273 A

Feeder Neutral

Lighting and Small-Appliance Load	40,590 VA
Range Load: 25,000 VA at 70% *[see 220.61(B)]*	17,500 VA
Calculated Load (neutral)	58,090 VA

Calculated Load for Neutral

58,090 VA ÷ 240 V = 242 A

Further Demand Factor *[220.61(B)]*

200 A at 100%	200 A
242 A - 200 A = 42 A at 70%	29 A
Net Calculated Load (neutral)	229 A

Minimum Size Main Feeders (or Service Conductors) Required (Less House Load) (For 40 Dwelling Units — 20 with Ranges)

Total Calculated Load:	
Lighting and Small-Appliance Load	
40 units × 5520 VA	220,800 VA

Application of Demand Factor *(from Table 220.42)*

First 3000 VA at 100%	3,000 VA
Next 120,000 VA - 3000 VA = 117,000 VA at 35%	40,950 VA
Remainder 220,800 VA - 120,000 VA = 100,800 VA at 25%	25,200 VA
Net Calculated Load	69,150 VA
Range Load: 20 ranges (less than 12 kVA) *(see Col. C, Table 220.55)*	35,000 VA
Net Calculated Load	104,150 VA

For 120/240-V, 3-wire system

Net calculated load of 104,150 VA ÷ 240 V = 434 A

Feeder Neutral

Lighting and Small-Appliance Load	69,150 VA
Range: 35,000 VA at 70% *[see 220.61(B)]*	24,500 VA
Calculated Load (neutral)	93,650 VA

93,650 VA ÷ 240 V = 390 A

Further Demand Factor *[see 220.61(B)*

200 A at 100%	200 A
390 A - 200 A = 190 A at 70%	133 A
Net Calculated Load (neutral)	333 A

[See Table 310.15(B)(16) through Table 310.15(B)(21), and 310.15(B)(2), (B)(3), and (B)(5).]

2020 NEC Study Guide For "Service Grounding Basics"

(This Study Guide was prepared by Gaylord Poe)

Like many code topics, there are numerous NEC rules about the grounding of service installations. As with most of the "complicated" code topics, our problems with these rules begin to disappear as we better understand the basic concepts. Within the numerous NEC rules regarding service grounding, I believe there are three basic concepts that stand out. These concepts apply to all service installations. This study guide will address the three basic concepts. Understand the "Big Three" and the other rules become much easier to understand. *(Note: For the purpose of this study guide the grounded conductor of grounded systems will be referred to as the "neutral".)*

1. **There's a difference between "System Grounding" and "Equipment Grounding".** Don't let a "misread" of the code rules send you down the wrong path. All service installations require a grounding electrode conductor (GEC) and a grounding electrode system. For a grounded system (where a service conductor is intentionally grounded) the GEC is connected to the grounded conductor. For an ungrounded system (a Delta 3ϕ - 3-wire system is the most common example) the GEC is connected to any metal enclosure that contains service conductors. The big difference is an ungrounded system has no "neutral" to connect the GEC to – everything else stays the same.

2. **Everything that's metal and contains service conductors shall be bonded.** How do you determine what is defined as "service" and what is not? Easy. Whatever is going to stay "hot" after you turn off the main(s) is "service". There's a lot of ways to accomplish the required bonding. For example, on a grounded system anything that's directly connected to the neutral is considered to be bonded. Examples of enclosures that are bonded by the neutral are: Service switches (the neutral bonding jumper), and CT cabinets or termination boxes or wireways where the neutral is bolted directly to the enclosure. Because of the neutral connection, whatever is bolted to or connected to these enclosures with bonding fittings is bonded too. Anything that is connected to the neutral through an approved connection is considered to be bonded. What are recognized bonding paths? For grounded systems, paths that provide continuity to the neutral conductor using bonding fittings such as bonding-type locknuts, bonding bushings, and threaded hubs. For ungrounded systems, paths that provide continuity between all enclosures using bonding fittings such as bonding-type locknuts, bonding bushings, and threaded hubs. Look at each individual component in the service scheme and imagine a fault within that component. Will all fault current flow through approved bonding paths?

3. **When a neutral is available in the system, the neutral must be run to and bonded to every service disconnecting means.** This rule recognizes that if a fault can be disposed of by using the neutral (as opposed to just enclosures and bonding fittings) then the neutral shall be used for that purpose – even if there is no need for the neutral downstream of the service disconnect. Don't worry about

multiple disconnects within switchboards, there's a rule covering that. Don't worry about having the neutral bonded more than once either – it's OK on service installations – as a matter of fact, when it's not mandatory it's recommended.

Summary of the "Big Three": The concepts are simple. What we're trying to do here is get rid of a fault quickly before it starts a fire. Service installations often have numerous enclosures containing service conductors located ahead of the main overcurrent device. The main overcurrent device offers no protection for faults in these enclosures. Because of this, a fault in any of these enclosures will continue until it burns clear or burns open or the supply fails. The primary role of the grounding electrode conductor (GEC) during a fault is to keep voltage off of exposed conductive enclosures until the fault clears. *(Note: The GEC only performs this function during a ground fault and even then it will only conduct a very small amount of the fault current.)*

There are two basic kinds of faults encountered ahead of the mains: Line-to-line faults and line-to-ground faults. Direct line-to-line faults are very rare.

Line-to-ground fault, Ungrounded System: A line-to-ground fault on an ungrounded system basically "does nothing" until a second line conductor faults to ground. At that point there is in effect a "short" between the two faulted line conductors with the grounded conductive enclosures serving as the "conductors" between them. The better the bonding path, the lower resistance of the fault path. The lower the resistance of the fault path, the faster the fault will clear.

Line-to-ground fault, Grounded System: Unlike an ungrounded system, a line-to-ground fault on a grounded system instantly causes extreme current flow. Since the system is grounded and the neutral is bonded, a line-to-ground fault is actually a "short" that uses the grounded conductive enclosures between the faulted line conductor and the neutral as "conductors". The better the bonding path, the lower resistance of the fault path. The lower the resistance of the fault path, the faster the fault will clear.

All Faults: Remember, regardless of the type of fault, fault current flows between the fault and the supply. For Services, that supply is the utility transformer. Our job is to make sure that whatever is part of that path is large enough (low resistance) to handle the fault, can do so without failing (main & equipment bonding jumper sizes and connections) and is "tight" enough to eliminate arcs and sparks at all fittings that are conducting the fault for the duration of the fault (bonding fittings).

Example: Let's examine a ground fault on a simple 200A residential service. Suppose the fault is between a line conductor and the service main enclosure: The fault current flows from the utility transformer through the line conductor, through the service enclosure, through the main bonding jumper, through the neutral, and back to the utility transformer. In this example, whatever amount of fault current that is available flows not only though the conductors but also through the enclosure and the main bonding jumper.

On a multiple disconnect grounded service installations this type of fault will use all of the metal enclosures and raceways that are between the fault and wherever the neutral is bonded to work it's way to the neutral and then on to the supply. The quality of that path depends on the quality of the bonding.

The "bottom line" is "get the fault home" as quick as you can (low resistance path) without any arcing or sparking (from loose or non-bonding type fittings) along the way. Accomplish this and the fault won't last long enough to cause a fire. It is really that simple.

The NEC rules that are covered in this study guide are:

RE: "**There's a difference between "System Grounding" and "Equipment Grounding"**
Art. 250.4 (A) & (B), 250.24 (A) & (E), 250.64, 250.50

RE: "**Everything that's metal and contains service conductors shall be bonded."**
Art. 250.92 (A) & (B)

RE: "**When a neutral is available in the system, the neutral must be run to and bonded to every service disconnecting means."**
Art. 250.24 (C), 250.24 (C) – Exception

RE: "**Summary of the "Big Three"**
Art. 250.4 (A) (5), 250.4 (B) (4)

2020 NEC Study Guide For “Services”

(This Study Guide was prepared by Gaylord Poe)

Many questions come to mind when reviewing NEC Article 230. This study guide will address some of the more common code questions that frequently arise concerning service installations for residential and light commercial projects.

1. **What is considered to be “Service”?** In my experience, one of the biggest problems that arise when people (usually “non-technical people” vs. trained electrical professionals) are debating Art. 230 is that often what the parties are arguing as being “Service” is not “Service” at all! So first things first...let’s discuss what “Service” is and what it isn’t.

   a. Art. 100 of the NEC defines **Service** as: “The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.”

   b. Art. 100 of the NEC defines **Service Conductors** as: “The conductors from the service point to the service disconnecting means.”

   c. Art. 100 of the NEC defines **Service Point** as: “The point of connection between the facilities of the serving utility and the premises wiring.”

   You’ll also see in Article 100 that there are definitions for “Service Cable”, “Service Drop”, “Service-Entrance Conductors, Overhead”, “Service-Entrance Conductors, Underground”, “Service-Entrance Conductors, Overhead System”, “Service-Entrance Conductors, Underground System”, “Service Equipment”, and “Service Lateral” and others. Remember that when you are discussing any of these items you are still discussing items that are covered by the term **“Service”**. Only these items are subject to the rules found in Art. 230.

2. **Consider this example -** A small commercial retail strip center is fed underground from the utility and has an 800-amp meter center with an 800-amp main circuit breaker. There are eight individual meters. Seven meters each have a 100-amp circuit breaker supplying a 100-amp feeder run to each tenant space. The eighth meter supplies a 60-amp house panel. In this example, “Service” consists of the underground supply to and including the 800 amp main section in the meter center. That’s it...nothing downstream of this main section is “Service”.

3. **Misinterpretations -** In reviewing the above example, it’s not uncommon to hear comments that the installation failed either in Plan Review or failed during field inspection because: “There are eight services on the building.” Or “The tenant services are not grouped.” Or “There are eight service disconnects.” The reality of the example is there is only one service supplying the building, there are no tenant

"services", there are only tenant feeders, and there is only one service disconnect - the 800-amp main. I've stated many times – "If you're unsure, turn off the main(s). Whatever stays 'hot' is 'Service' whatever 'goes off' is not!"

4. **Number of Services allowed -** This issue probably receives more discussion than any other part of Art. 230 especially when it comes to underground service conductors. The basic rule is that (unless you meet certain conditions permitting additional services) you can only install one service of any given voltage to a building. When the service drop is "in the air" (overhead) the number of services to a building is quite obvious. However because of certain verbiage in 230.2, you can have (figuratively speaking) multiple underground "services" without having to count them as multiple services. 230.2 provides "For the purposes of 230.40, Exception No. 2 only, underground sets of conductors, 1/0 AWG and larger, running to the same location and connected together at their supply end but not connected together at their load end shall be considered to be supplying one service." Note some key points in the above quotation. The sentence doesn't deny that this is actually "multiple services" it simply states that it can be considered to be supplying one service. There are other conditions that must be met before you can use this section too. You must have the conditions of 230.40 Exception No. 2 *(the most important part of this exception is that the service disconnecting means must be grouped at one location)* and the underground conductors must be a minimum size *(1/0 AWG)* and all of the underground service conductors must come from the same transformer *(connected together at their supply end).* In layman's terms, if everything "fits" this NEC rule, you can, for example run six 1/0 AWG underground service conductor sets to six individual meters to six 100-amp service disconnects and have a "600 Amp Service" at a very economical price. Without the rule, you would need one set of underground service conductors (single or multiple in parallel) rated at 600 amps run to a distribution board or box or wireway, and have to deal with the larger conductor(s), splices, taps, labor, etc. When you were all done you would still only have a 600-amp service, just at a much higher cost. All that being said, there are a number of installations that get "red-tagged" because the contractor installed multiple sets of underground service conductors to multiple locations on a building obviously thinking it was OK to do so. That same contractor wouldn't even think of having multiple overhead drops hitting the building in the same manner but assumes it's OK because "it's underground". My advice for when you're considering what is acceptable and what is not regarding this is to mentally change the elevations (from underground to overhead) when you're figuring this out. If it's not OK "in the air" it's probably not OK underground except as provided above in 230.2.

5. **Definition of Building –** One point that needs to be considered first and foremost is this – when the NEC uses the word "building", it is used as the NEC defines "building" in Art. 100. Art. 100 of the NEC contains definitions "essential to the proper application of this Code." That being said, when we use the NEC, we can't

take definitions of words (such as “building”) from other codes or standards and use NEC rules with the “foreign” definitions. If a definition of a word is in the NEC, we must use that definition. If a definition of a word is not in the NEC, the definition is often subject to debate. In NEC Art. 100, the definition of building is “A structure that stands alone or that is separated from adjoining structures by fire walls.” Note that there are no references to “1-hour rated wall” or “2-hour rated wall” or “3-hour rated wall”. There are also no references to masonry walls etc. The key words are: “A structure that stands alone” and “fire walls”. A “structure that stands alone” is pretty easy to determine but when we talk about “separated...by fire walls” the water often gets just a little muddy. To complicate the matter, Art. 100 contains no definition of “fire wall”. Often someone will want to install a second service to a building and when the inspector says “No” they will come back and say, “We have a 2-hour rated wall.” That statement by itself does not mean they have a fire wall. My advice is this: when seeking to define a word not found in Art. 100, the next best place to look is the applicable building code. According to the Ohio Building Code (OBC) the definition of Fire Wall is: “A fire-resistance-rated wall having protected openings, which restricts the spread of fire and extends continuously from the foundation to or through the roof, with sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of the wall.” The point is it’s going to take more than just additional layers of drywall (for example) to make a wall a fire wall. Structural considerations are also required. My advice is this: If you can’t easily make the determination on this matter for the purposes of interpreting 230.2, ask the building department. And, don’t ask them for the rating (in hours) of the wall in question. Instead ask them if the project in question is actually two separate buildings...period. If you have two buildings, you have no problem.

6. **Number of Disconnects -** The basic rule that we are taught is the maximum number of service disconnects is six. It’s not quite that simple. Art. 230.71 (A) provides a little more detail. The “six disconnect rule” is per service or per each set of service entrance conductors permitted by 230.40 Exceptions. But it goes on to state that there can’t be more than six sets of disconnects per service grouped in any one location. Conflicting? Not at all. Confusing? It can be. The exceptions to 230.40 not only permit multiple subsets of service entrance grouped together and fed from one service point but they also permit service entrance conductors to be run to more than one “place” on a building. What 230.71 (A) says is the “six disconnect rule” can be used for each set of service conductors permitted by 230.40 as long as you don’t have more than six disconnects grouped in any one location. Also note that if you have another service as permitted by 230.2 (A) through (D), these rules apply separately to that service. For example, you could have 12 disconnects grouped in one electric room if you had a 120/240V service and a 480V service supplying the building and be NEC compliant.

7. **Emergency Disconnects –** NEC 2020 provides a new rule for emergency disconnects for dwelling units. The emergency disconnect shall be installed at a readily accessible outdoor location. At this point in time (December 2022) Ohio has not adopted the 2020NEC for 1, 2, and 3-Family Dwellings. (*Note: There will likely be efforts to exclude or amend this rule upon adoption. This study guide will be updated as necessary. GP*)

8. **Length of Service Conductors permitted in a building –** You'll often hear that there is a "10 foot rule". There is not. 10 foot is often used as a "rule of thumb" by electrical inspectors but it has no basis in code text but plenty of basis in the practical application of the code! When I was much younger, old-timers of the day told me they were told by the old-timers who taught them that the "10 foot rule" came about in the days when all service entrance work was installed in threaded rigid conduit and the inspector would only let you run "one stick of pipe" into a building without a disconnect. I believe that this is a pretty accurate "story" as I have a copy of a memo dated June 11th, 1926, containing minutes of a meeting held in Cincinnati on March 9th 1926 where the phrase "nearest readily accessible" from the (then current) 1925 NEC was defined locally as <u>being 10 feet</u> with "service conduits" being duly noted. The 2020 NEC provides three basic rules in 230.70 (A)(1) for locating the service disconnecting means: it shall be readily accessible, it can outside, or inside nearest the point of entrance (meaning if it is inside it must be installed where the conductors enter the building). It should be noted that in addition to these three basic rules, Art. 230.70 provides additional rules.

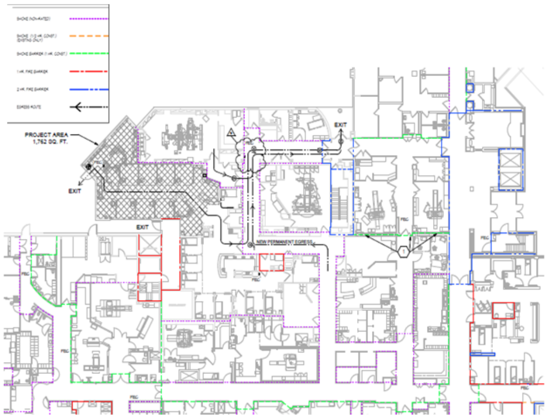
Welcome from the Joint Venture Committee

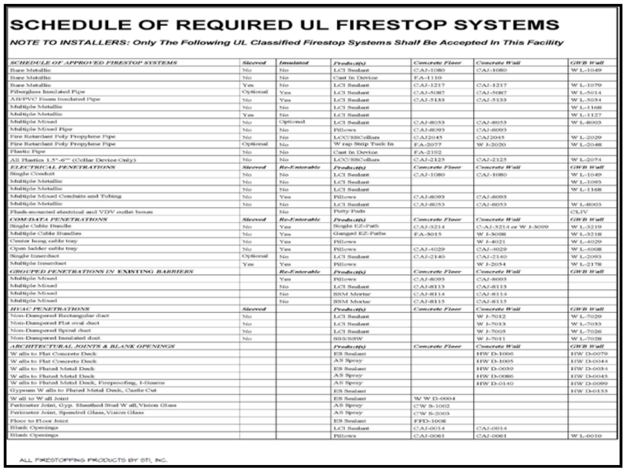
INTERNATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS
Established 1928
Keystone of the Electrical Industry

PRESENTED BY LORENZO ADAM & DEWAYNE JENKINS

Who is responsible for rated assembly penetrations?

- Typically the installer of the wiring method making the penetration into rated assemblies.
- 3rd party companies
- Read the specifications or approved plans!
- Provide documentation on proposed method, preferably prior to the installation.





SCHEDULE OF REQUIRED UL FIRESTOP SYSTEMS

NOTE TO INSTALLERS: Only The Following UL Classified Firestop Systems Shall Be Accepted In This Facility

SCHEDULE OF APPROVED FIRESTOP SYSTEMS	*Sleeved*	*Insulated*	*Product(s)*	*Concrete Floor*	*Concrete Wall*	*GWB Wall*
Bare Metallic	No	No	LCI Sealant	CAJ-1080	CAJ-1080	W L-1049
Bare Metallic	No	No	Cast In Device	FA-1110		
Bare Metallic	Yes	No	LCI Sealant	CAJ-1217	CAJ-1217	W L-1079
Fiberglass Insulated Pipe	Optional	Yes	LCI Sealant	CAJ-5087	CAJ-5087	W L-5014
AB/PVC Foam Insulated Pipe	No	Yes	LCI Sealant	CAJ-5133	CAJ-5133	W L-5034
Multiple Metallic	No	No	LCI Sealant			W L-1168
Multiple Metallic	Yes	No	LCI Sealant			W L-1127
Multiple Mixed	No	Optional	LCI Sealant	CAJ-8053	CAJ-8053	W L-8003
Multiple Mixed Pipe	No	No	Pillows	CAJ-8093	CAJ-8093	
Fire Retardant Poly Propylene Pipe	No	No	LCC/SSCollars	CAJ2045	CAJ2045	W L-2029
Fire Retardant Poly Propylene Pipe	Optional	No	Wrap Strip Tuck In	FA-2077	W J-2020	W L-2048
Plastic Pipe	No	No	Cast In Device	FA-2192		
All Plastics 1.5"-6"" (Collar Device Only)	No	No	LCC/SSCollars	CAJ-2125	CAJ-2125	W L-2074
ELECTRICAL PENETRATIONS	*Sleeved*	*Re-Enterable*	*Product(s)*	*Concrete Floor*	*Concrete Wall*	*GWB Wall*
Single Conduit	No	No	LCI Sealant	CAJ-1080	CAJ-1080	W L-1049
Multiple Metallic	No	No	LCI Sealant			W L-1093
Multiple Metallic	No	No	LCI Sealant			W L-1168
Multiple Mixed Conduits and Tubing	No	Yes	Pillows	CAJ-8093	CAJ-8093	
Multiple Metallic	No	No	LCI Sealant	CAJ-8053	CAJ-8053	W L-8003
Flush-mounted electrical and VDV outlet boxes		No	Putty Pads			CLIV
COM/DATA PENETRATIONS	*Sleeved*	*Re-Enterable*	*Product(s)*	*Concrete Floor*	*Concrete Wall*	*GWB Wall*
Single Cable Bundle	No	Yes	Single EZ-Path	CAJ-3214	C-AJ-3214 or W J-3099	W L-3219
Multiple Cable Bundles	No	Yes	Ganged EZ-Paths	FA-3015	W J-3098	W L-3218
Center hung cable tray	No	Yes	Pillows		W J-4021	W L-4029
Open ladder cable tray	No	Yes	Pillows	CAJ-4029	CAJ-4029	W L-4008
Single Innerduct	Optional	No	LCI Sealant	CAJ-2140	CAJ-2140	W L-2093
Multiple Innerduct	Yes	Yes	Pillows		W J-2054	W L-2178
GROUPED PENETRATIONS IN EXISTING BARRIERS		*Re-Enterable*	*Product(s)*	*Concrete Floor*	*Concrete Wall*	*GWB Wall*
Multiple Mixed		Yes	Pillows	CAJ-8093	CAJ-8093	
Multiple Mixed		No	LCI Sealant	CAJ-8113	CAJ-8113	
Multiple Mixed		No	SSM Mortar	CAJ-8114	CAJ-8114	
Multiple Mixed		No	SSM Mortar	CAJ-8115	CAJ-8115	
HVAC PENETRATIONS	*Sleeved*		*Product(s)*	*Concrete Floor*	*Concrete Wall*	*GWB Wall*
Non-Dampered Rectangular duct	No		LCI Sealant		W J-7012	W L-7029
Non-Dampered Flat oval duct	No		LCI Sealant		W J-7013	W L-7033
Non-Dampered Spiral duct	No		LCI Sealant		W J-7005	W L-7026
Non-Dampered Insulated duct	No		SSS/SSW		W J-7011	W L-7028
ARCHITECTURAL JOINTS & BLANK OPENINGS			*Product(s)*	*Concrete Floor*	*Concrete Wall*	*GWB Wall*
Walls to Flat Concrete Deck			ES Sealant		HW D-1006	HW D-0079
Walls to Flat Concrete Deck			AS Spray		HW D-1005	HW D-0044
Walls to Fluted Metal Deck			ES Sealant		HW D-0039	HW D-0034
Walls to Fluted Metal Deck			AS Spray		HW D-0086	HW D-0043
Walls to Fluted Metal Deck, Fireproofing, I-Beams			AS Spray		HW D-0140	HW D-0099
Gypsum Walls to Fluted Metal Deck, Castle Cut			ES Sealant			HW D-0153
Wall to Wall Joint			ES Sealant	W W D-0004		
Perimeter Joint, Gyp. Sheathed Stud Wall, Vision Glass			AS Spray	CW S-1002		
Perimeter Joint, Spandrel Glass, Vision Glass			AS Spray	CW S-2003		
Floor to Floor Joint			ES Sealant	FFD-1008		
Blank Openings			LCI Sealant	CAJ-0014	CAJ-0014	
Blank Openings			Pillows	CAJ-0061	CAJ-0061	W L-0010

ALL FIRESTOPPING PRODUCTS BY STI, INC.


2 HOUR
FIRE BARRIER
ROTECT ALL OPENINGS AND PENETRATIONS
arning: Do Not Penetrate Wall without Firestop Permit

7

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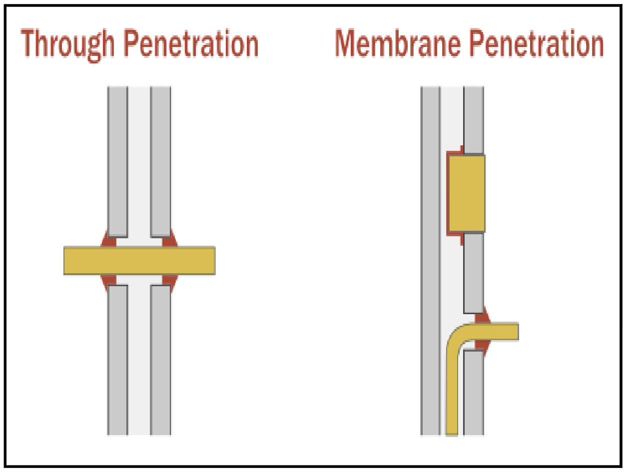
Through Penetration
Membrane Penetration

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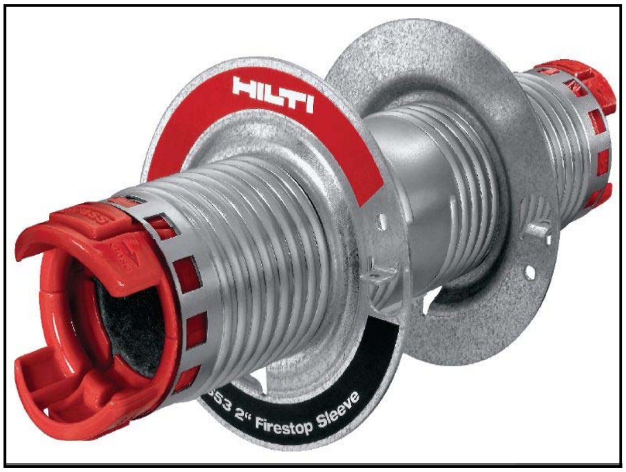
HILTI
2" Firestop Sleeve

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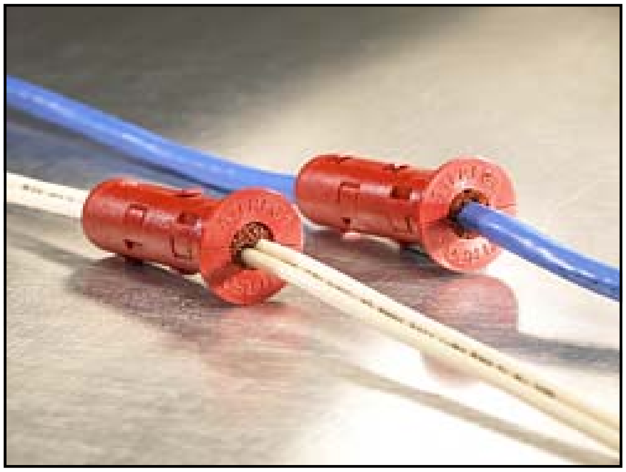

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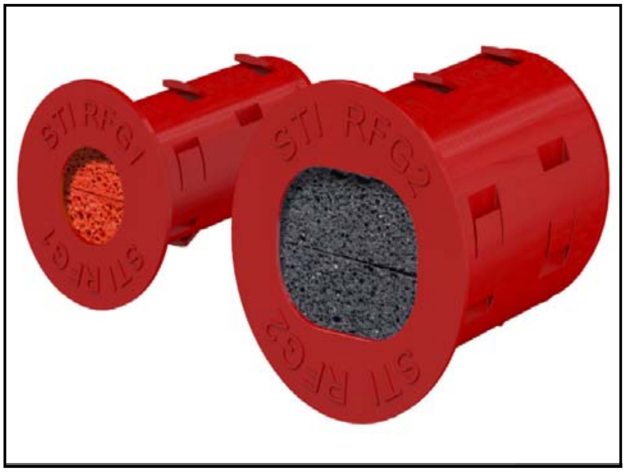
STI RFG1
STI RFG2

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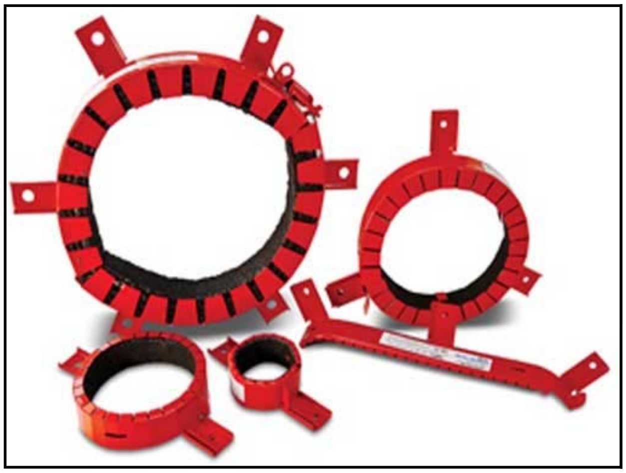

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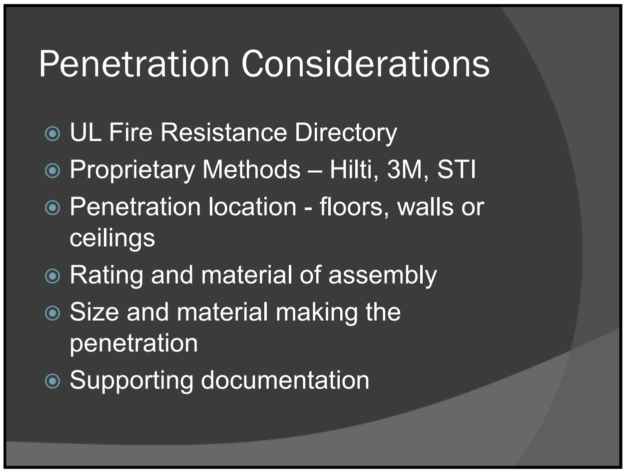

Penetration Considerations

- UL Fire Resistance Directory
- Proprietary Methods – Hilti, 3M, STI
- Penetration location - floors, walls or ceilings
- Rating and material of assembly
- Size and material making the penetration
- Supporting documentation

14

How far is service entrance conductors permitted to be ran inside a building?

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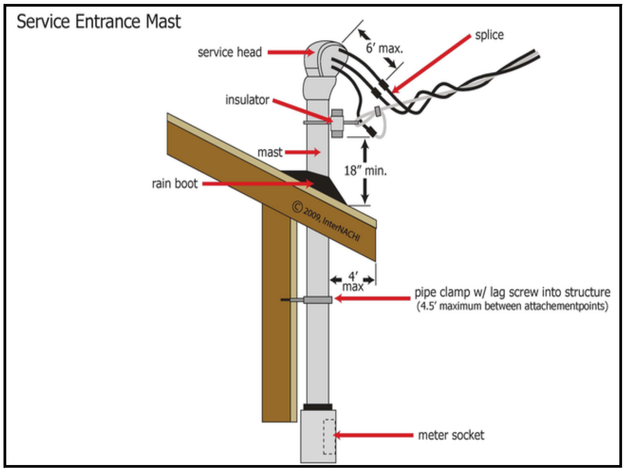

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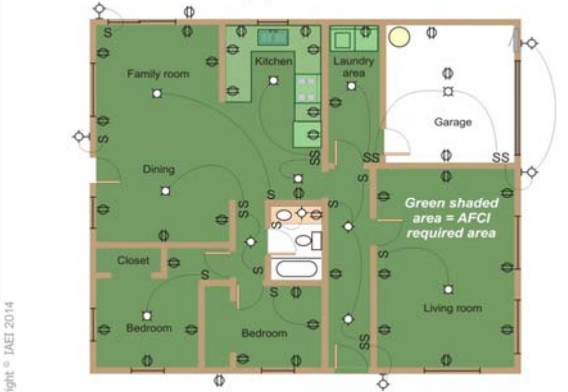
Where are AFCI's required within a dwelling?

210.12(A) AFCI Protection



AFCI protection expanded to kitchen and laundry areas

AFCI's

- List in the NEC not intended to be all inclusive.
- Six areas not included

1. Bathrooms
2. Garages
3. Outdoors
4. Unfinished basements areas
5. Crawl spaces
6. Unfinished attic areas

AFCI parameters

- Applies only to 15 and 20 ampere circuits
- Applies only to 120-volt circuits
- Then look at the location to decide
- RCO amendment - Exception No. 2: Branch circuits supplying receptacle outlets installed to serve only the kitchen countertop surfaces shall be permitted to be installed without arc-fault circuit interrupter protection.

History of AFCI's in the NEC

- 1996 – Introduced as a NEC code proposal
- 1999 – AFCI's Adopted in code cycle to become effective in January 1st, 2002
- 2002 – Became required for all 15 & 20 ampere, 120-volt outlets installed in bedrooms.
- 2005 – Combination type AFCI's became required

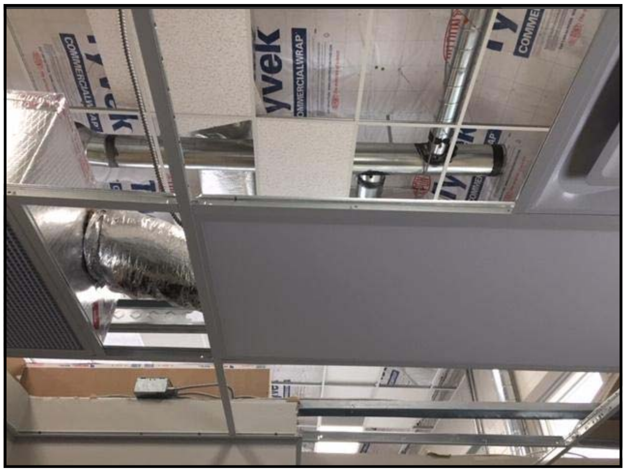
History of AFCI's in the NEC

- 2008 – Large list of areas included for this requirement
- 2011 – Added to the list, included modified circuits and replacement receptacles
- 2014 – Kitchen and laundry areas were added & the term device
- 2017 – No new changes - Was supposed to complete the incremental adoption.
- 2020 ? – We'll see

Are light fixtures required to be fastened to the grid ceiling?

31

32



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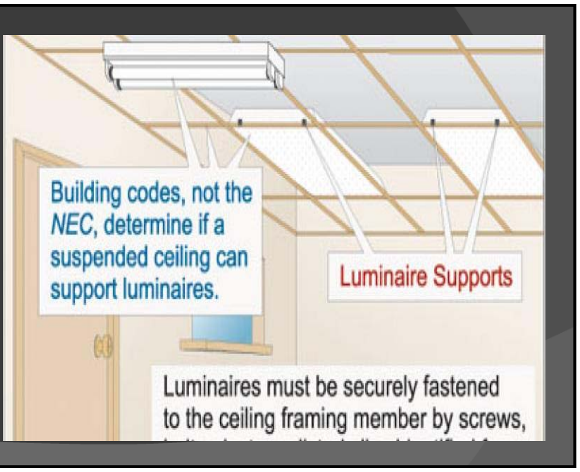


Building codes, not the *NEC*, determine if a suspended ceiling can support luminaires.

Luminaire Supports

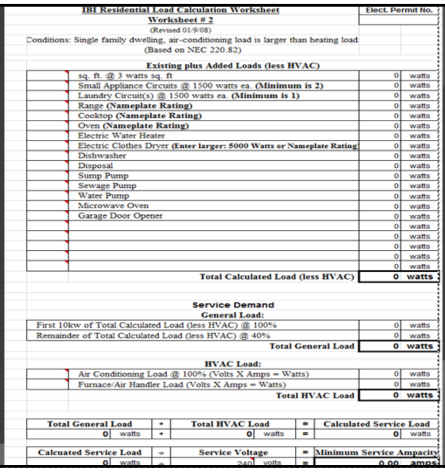
Luminaires must be securely fastened to the ceiling framing member by screws,

34

Is a load calculation required for a new dwelling? Modifications?

- Depends on jurisdictional requirements
- Additions, generators, pool heat pumps, HVAC upgrades

35



IBI Residential Load Calculation Worksheet

Worksheet # 2

(Revised 01/9/08)

Conditions: Single family dwelling, air-conditioning load is larger than heating load

(Based on NEC 220.82)

Elect. Permit No.

Existing plus Added Loads (less HVAC)

	sq. ft. @ 3 watts sq. ft	0	watts
	Small Appliance Circuits @ 1500 watts ea. **(Minimum is 2)**	0	watts
	Laundry Circuit(s) @ 1500 watts ea. **(Minimum is 1)**	0	watts
	Range **(Nameplate Rating)**	0	watts
	Cooktop **(Nameplate Rating)**	0	watts
	Oven **(Nameplate Rating)**	0	watts
	Electric Water Heater	0	watts
	Electric Clothes Dryer **(Enter larger: 5000 Watts or Nameplate Rating)**	0	watts
	Dishwasher	0	watts
	Disposal	0	watts
	Sump Pump	0	watts
	Sewage Pump	0	watts
	Water Pump	0	watts
	Microwave Oven	0	watts
	Garage Door Opener	0	watts
		0	watts
		0	watts
		0	watts
		0	watts
		0	watts
	Total Calculated Load (less HVAC)	**0**	**watts**

Service Demand

General Load:

First 10kw of Total Calculated Load (less HVAC) @ 100%	0	watts
Remainder of Total Calculated Load (less HVAC) @ 40%	0	watts
Total General Load	**0**	**watts**

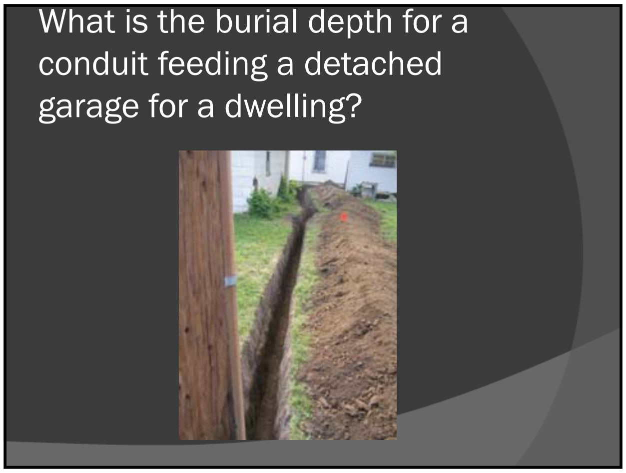
HVAC Load:

	Air Conditioning Load @ 100% (Volts X Amps = Watts)	0	watts
	Furnace/Air Handler Load (Volts X Amps = Watts)	0	watts
	Total HVAC Load	**0**	**watts**

Total General Load		+	Total HVAC Load		=	Calculated Service Load	
0	watts	+	0	watts	=	0	watts

Calcuated Service Load		÷	Service Voltage		=	Minimum Service Ampacity	
0	watts	÷	240	volts	=	0.00	amps

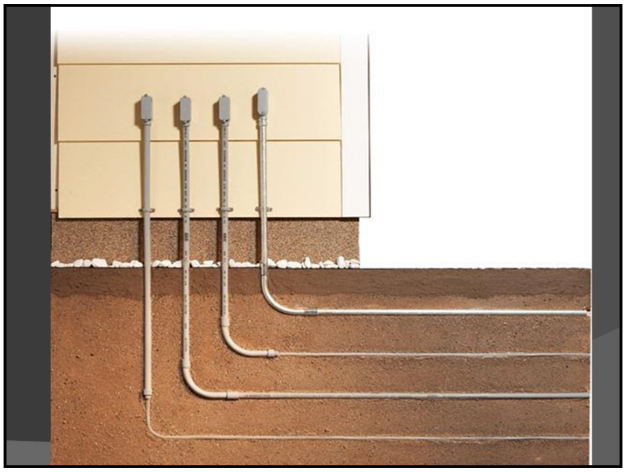
36



What is the burial depth for a conduit feeding a detached garage for a dwelling?

37

38

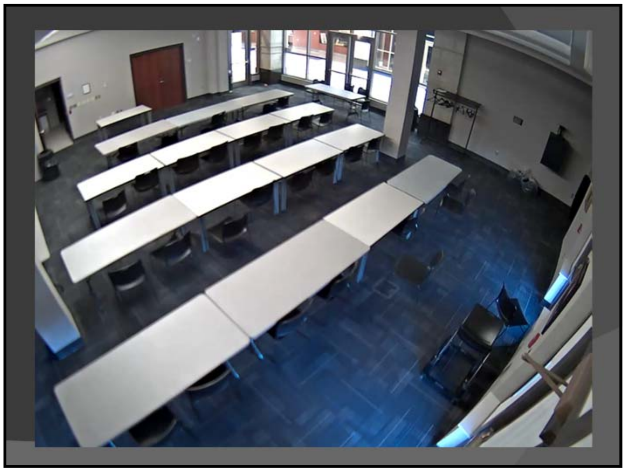


39

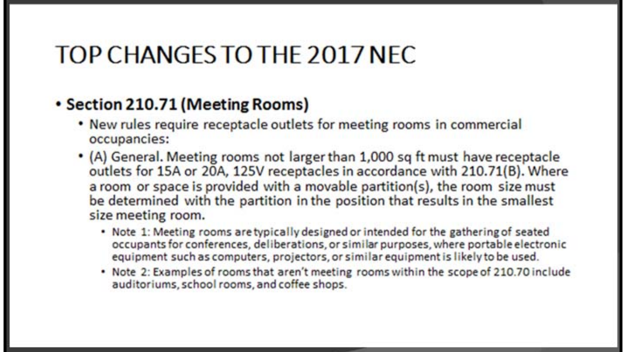
Is all meeting rooms required to have floor receptacles?

40

41

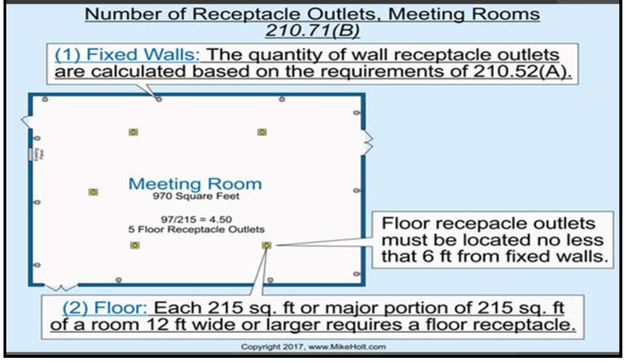


42



TOP CHANGES TO THE 2017 NEC

- **Section 210.71 (Meeting Rooms)**
  - New rules require receptacle outlets for meeting rooms in commercial occupancies:
  - (A) General. Meeting rooms not larger than 1,000 sq ft must have receptacle outlets for 15A or 20A, 125V receptacles in accordance with 210.71(B). Where a room or space is provided with a movable partition(s), the room size must be determined with the partition in the position that results in the smallest size meeting room.
    - Note 1: Meeting rooms are typically designed or intended for the gathering of seated occupants for conferences, deliberations, or similar purposes, where portable electronic equipment such as computers, projectors, or similar equipment is likely to be used.
    - Note 2: Examples of rooms that aren't meeting rooms within the scope of 210.70 include auditoriums, school rooms, and coffee shops.



Number of Receptacle Outlets, Meeting Rooms
210.71(B)

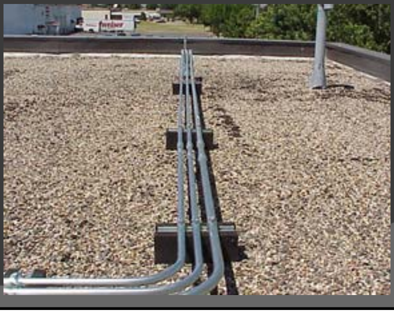
(1) Fixed Walls: The quantity of wall receptacle outlets are calculated based on the requirements of 210.52(A).

Floor recepacle outlets must be located no less that 6 ft from fixed walls.

(2) Floor: Each 215 sq. ft or major portion of 215 sq. ft of a room 12 ft wide or larger requires a floor receptacle.

Is it permitted to have multiple circuits feeding a detached garage?

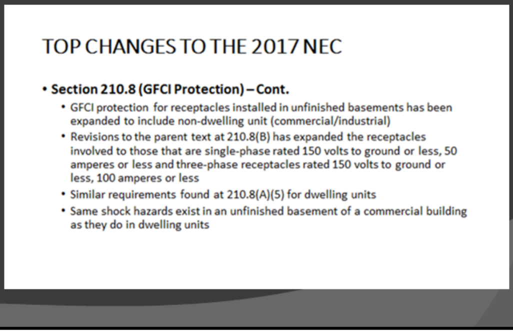
Do conduits installed on a roof top require conductors to be derated?



Does your city still allow fuse panels or FPE panels to remain?

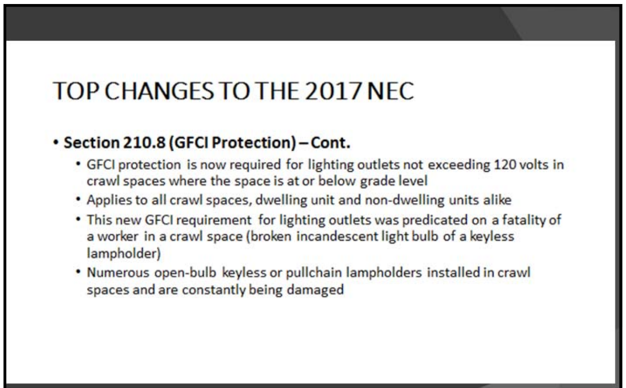
Do I have AFCI protect a furnace in an upstairs closet?

Do I have to GFCI protect crawl space lighting ? Unfinished basements?



TOP CHANGES TO THE 2017 NEC

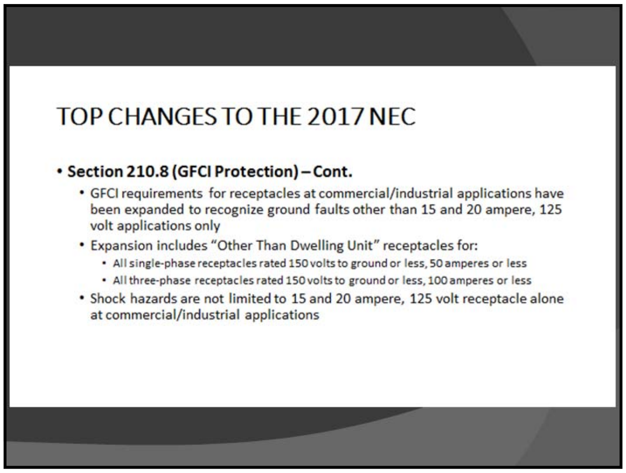
- **Section 210.8 (GFCI Protection) – Cont.**
  - GFCI protection for receptacles installed in unfinished basements has been expanded to include non-dwelling unit (commercial/industrial)
  - Revisions to the parent text at 210.8(B) has expanded the receptacles involved to those that are single-phase rated 150 volts to ground or less, 50 amperes or less and three-phase receptacles rated 150 volts to ground or less, 100 amperes or less
  - Similar requirements found at 210.8(A)(5) for dwelling units
  - Same shock hazards exist in an unfinished basement of a commercial building as they do in dwelling units



TOP CHANGES TO THE 2017 NEC

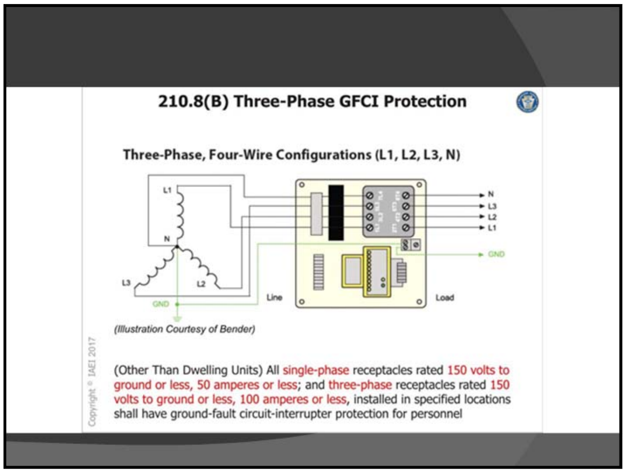
- **Section 210.8 (GFCI Protection) – Cont.**
  - GFCI protection is now required for lighting outlets not exceeding 120 volts in crawl spaces where the space is at or below grade level
  - Applies to all crawl spaces, dwelling unit and non-dwelling units alike
  - This new GFCI requirement for lighting outlets was predicated on a fatality of a worker in a crawl space (broken incandescent light bulb of a keyless lampholder)
  - Numerous open-bulb keyless or pullchain lampholders installed in crawl spaces and are constantly being damaged

Do I have to GFCI protect a 30 amp, 125-250 volt receptacle in a commercial kitchen?



TOP CHANGES TO THE 2017 NEC

- **Section 210.8 (GFCI Protection) – Cont.**
  - GFCI requirements for receptacles at commercial/industrial applications have been expanded to recognize ground faults other than 15 and 20 ampere, 125 volt applications only
  - Expansion includes "Other Than Dwelling Unit" receptacles for:
    - All single-phase receptacles rated 150 volts to ground or less, 50 amperes or less
    - All three-phase receptacles rated 150 volts to ground or less, 100 amperes or less
  - Shock hazards are not limited to 15 and 20 ampere, 125 volt receptacle alone at commercial/industrial applications



210.8(B) Three-Phase GFCI Protection

Three-Phase, Four-Wire Configurations (L1, L2, L3, N)

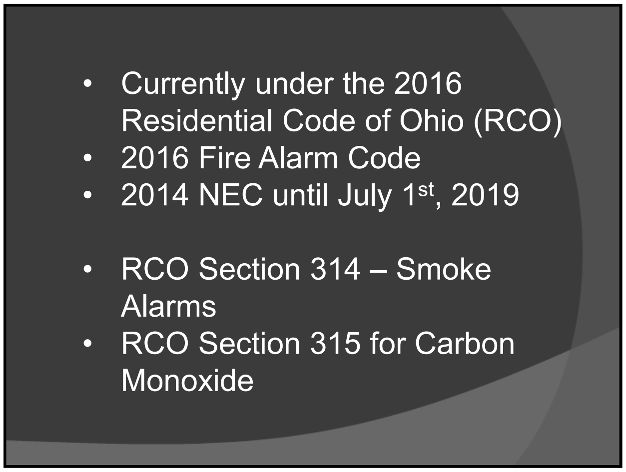
(Illustration Courtesy of Bender)

Copyright © IAEI 2017

(Other Than Dwelling Units) All single-phase receptacles rated 150 volts to ground or less, 50 amperes or less; and three-phase receptacles rated 150 volts to ground or less, 100 amperes or less, installed in specified locations shall have ground-fault circuit-interrupter protection for personnel

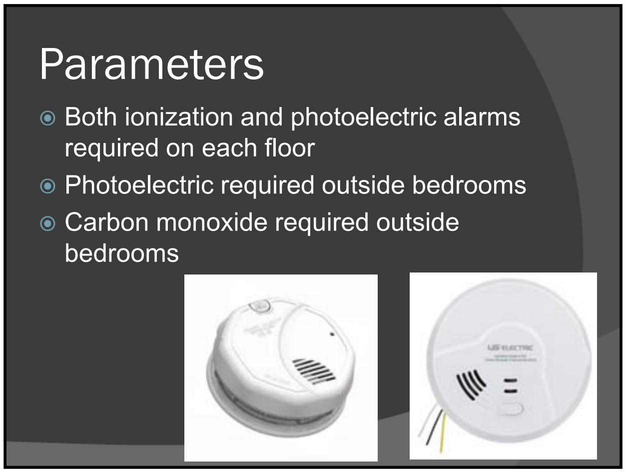
Photo Courtesy of Littlefuse

Do I have to install smoke alarms throughout the house when I do a remodel project?



- Currently under the 2016 Residential Code of Ohio (RCO)
- 2016 Fire Alarm Code
- 2014 NEC until July 1st, 2019

- RCO Section 314 – Smoke Alarms
- RCO Section 315 for Carbon Monoxide



Parameters

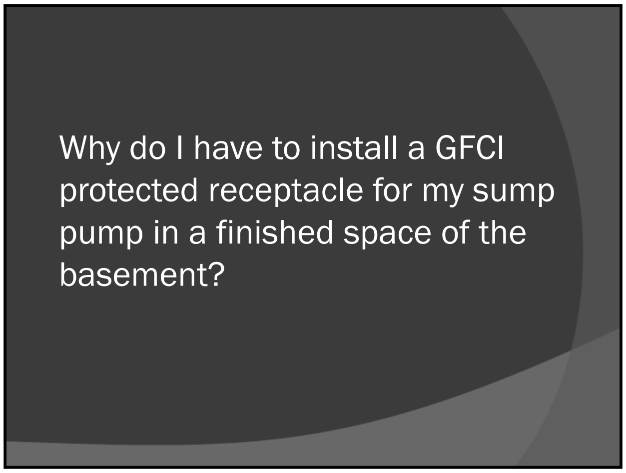
- Both ionization and photoelectric alarms required on each floor
- Photoelectric required outside bedrooms
- Carbon monoxide required outside bedrooms

Hazardous Locations

- Within 3 feet of bathrooms with tubs or showers
- Within 3 feet of heating vents and return air grills
- Within 3 feet of paddle fans measured from the tips of the blades
- Not permitted within 4 inches of ceilings or walls and not more than 12 inches down from ceiling
- Follow the manufactures installation

Do I have to install a bubble cover under a covered patio canopy?

Why is the ground to the transformer the wrong size? I used the table …

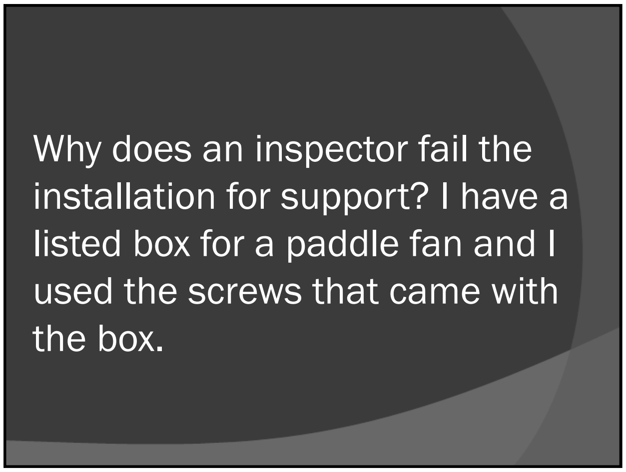


Why do I have to install a GFCI protected receptacle for my sump pump in a finished space of the basement?

67

68

69



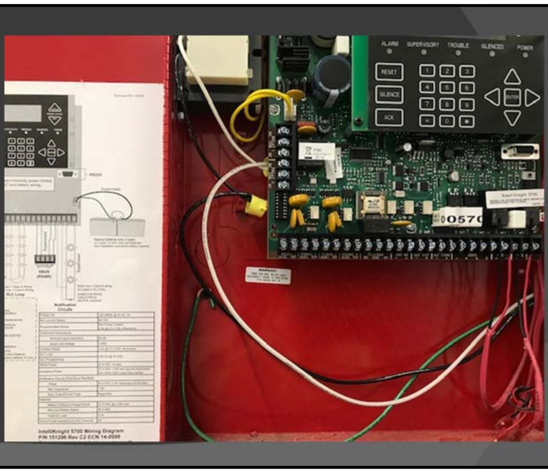
Why does an inspector fail the installation for support? I have a listed box for a paddle fan and I used the screws that came with the box.

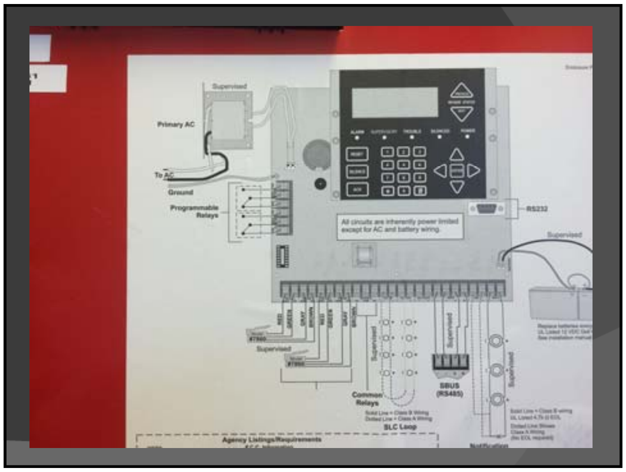
70

71

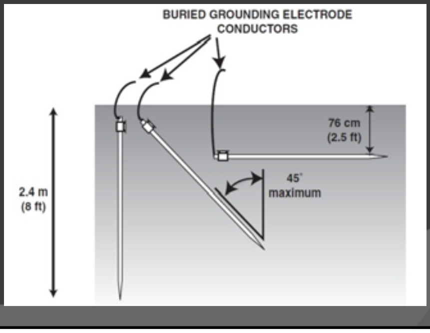
72

Why did the electrical inspector reject my fire alarm panel installation? I thought the building inspector did those inspections.





Why can I not splice my ground rod copper conductor?



Do I need receptacles by my Butler’s pantry?

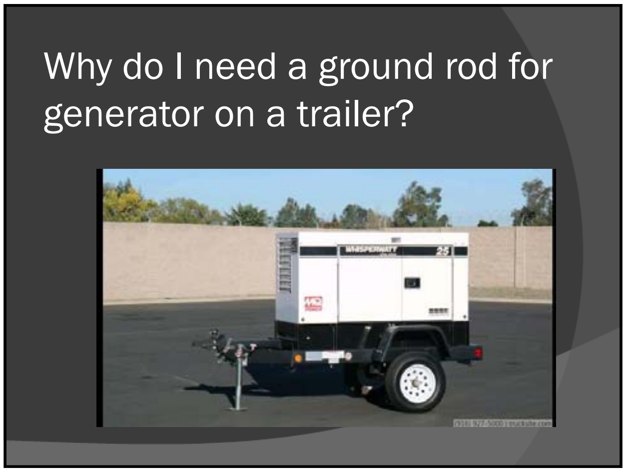
Am I ok running my branch circuit conductors under the joist, using the plate as a running board? After all a 2x6 is a board …

Unfinished Basements and Crawl Spaces

- Two # 6's or larger before you run on the bottom
- Bored or drilled holes
- Running boards

85

86

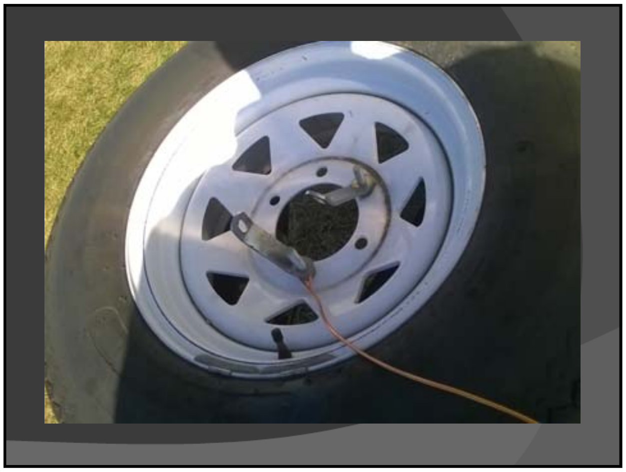


Why do I need a ground rod for generator on a trailer?

87

88

89



90

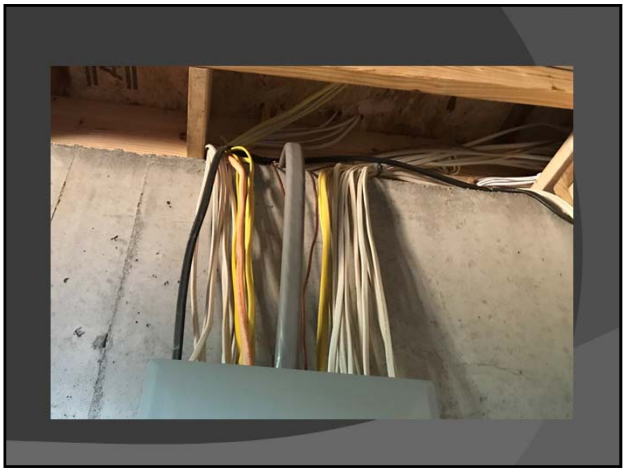
How deep do I have go for my post lamp wires?

91

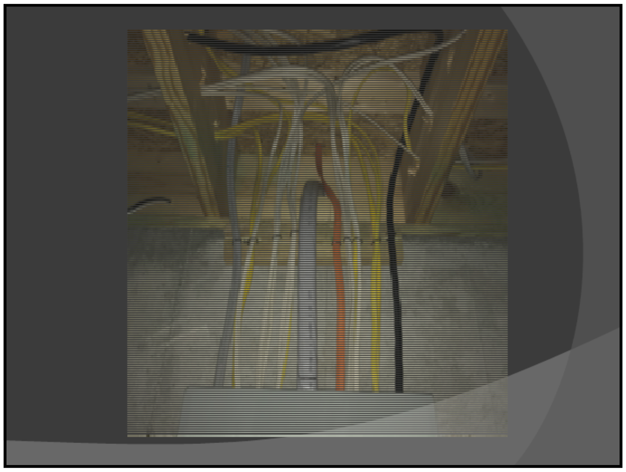
92

The inspector does not like the way I installed my branch circuit conductors to the panel. Is he or she right?

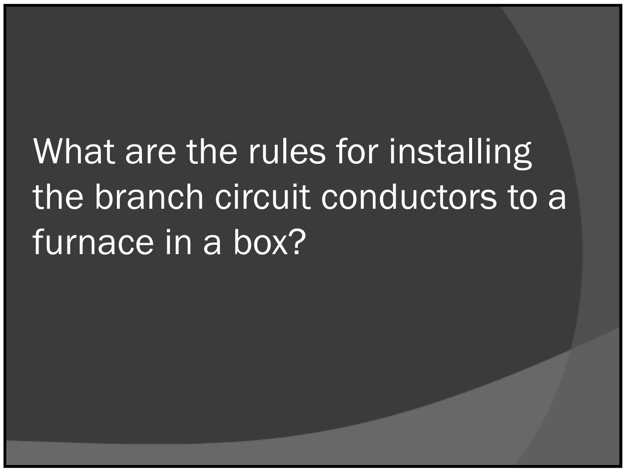
93



94

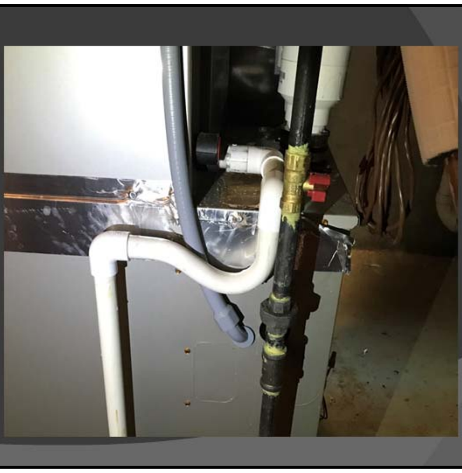


95



What are the rules for installing the branch circuit conductors to a furnace in a box?

96

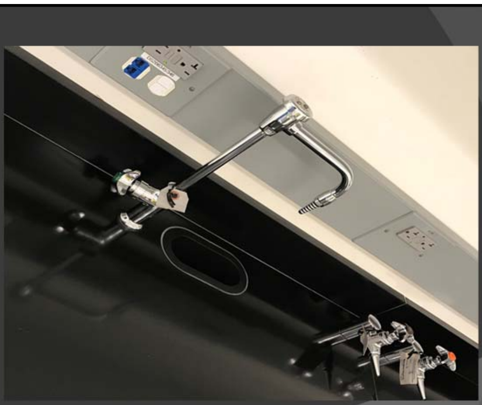


97

98

Are there any sink size limitations for the installation of GFCI protected receptacles within the 6 feet of such?

99

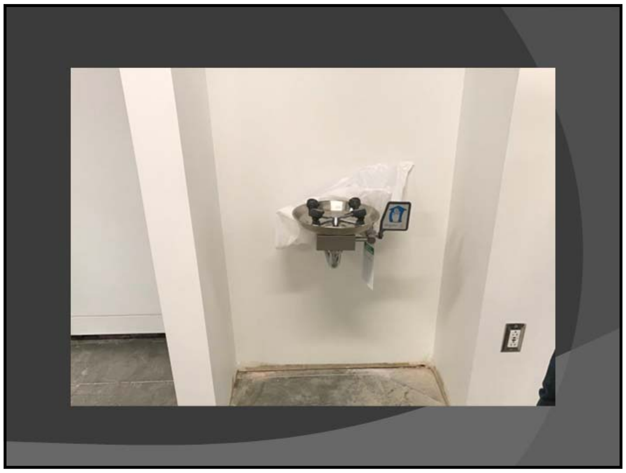


100

101

What are the GFCI protection requirements around an eye washing station?

102



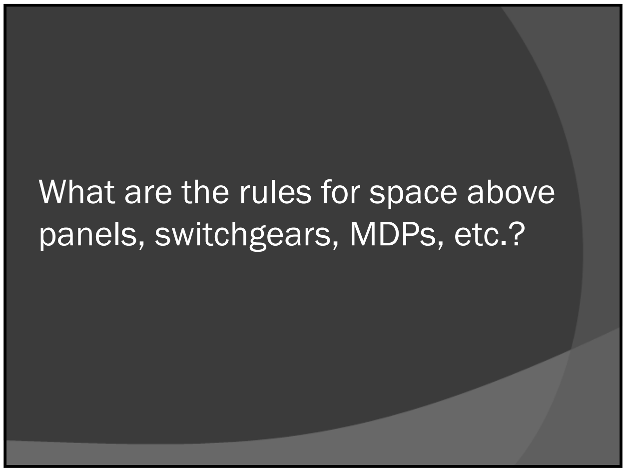
103

What are rules for supporting luminaires whips?

104

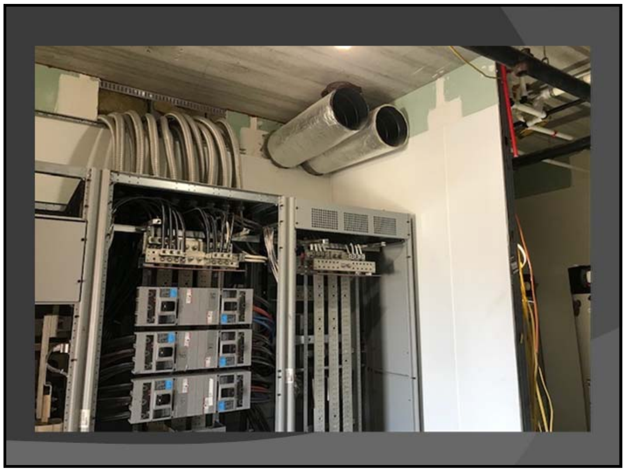
105

106



What are the rules for space above panels, switchgears, MDPs, etc.?

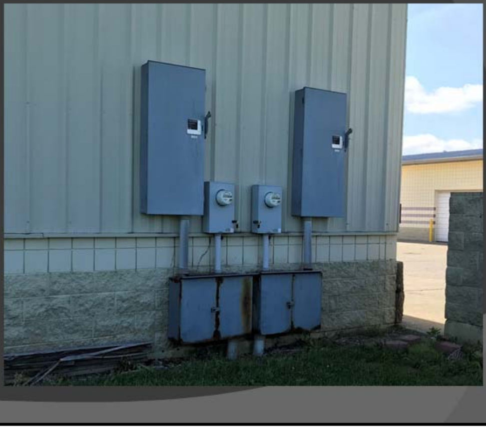
107



108

How high can I install my service disconnects?

109



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111

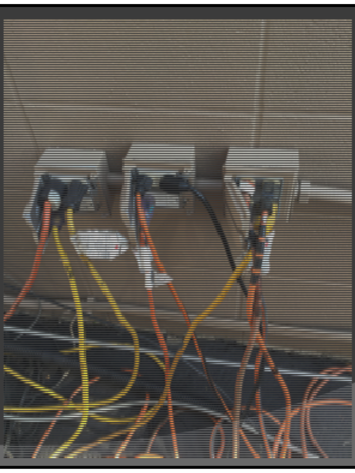
How low can I install any disconnects?

112

113

Do the bubble cover requirements apply to temporary electrical installations?

114



How close can install a receptacle to a water fountain?

Questions?

Thank you for attending!

See you next year!

File Attachments for Item:

ER-2 2023 NEC Code Changes Part 1 (Wink Electric)

All certifications (5 hours)

Staff Notes: This course is not presented with visuals. A detailed outline is included. Since it is based on the 2023 code, not recommended for approval at this time.

ESIAC Recommendation:

Committee Recommendation:

Ohio | **Department of Commerce**

Mike DeWine, Governor
Jon Husted, Lt. Governor

Sheryl Maxfield, Director

Board of Building Standards

Application for Continuing Education Course Approval

Provider Information:

Name: CLIFFORD WINKEL

Organization: WINK ELECTRIC

Address: 5640 BROAD N.RIDGEVILLE OH 44039

E-mail: WINKELECTRIC@HOTMAIL.COM Telephone: 440 346 4125

Website: WINKELECTRIC.NET

Conference Sponsor (if applicable)________ Conference Email:________

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

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

New Course Information:

Course title: 2023 NEC CODE CHANGES PART I

Course instructor: CLIFFORD WINKEL

Course description:
CODE CHANGES 2023 REVIEW

Instructional hours per session: 5 Number of Sessions: 1

Course Date(s) and Location:________

Special Content:

Code Administration:____
Existing Buildings: ____
Electrical Instruction: X
Plumbing Instruction:____

Conference Course: ________
Conference Name: ________
Conference location:________

Course to be offered online? YES **On Demand** X **Webinar**____

Course Website: WINKELECTRIC.NET

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

Course applicable for the following certifications

Residential Certifications Only: ____ Commercial Certifications: X

Administrative Course, All Certifications: ____

Application materials included:

____ Course Outline or Course Learning Objectives
____ Presentation Materials/Slides (not required for roundtable courses)
____ Assessment Materials (for online courses)
____ Presenter Bio

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

Clifford Winkel
5640 Broad Blvd.
North Ridgeville, Ohio 44039
440-346-4125
winkelectric@hotmail.com

BIO

Hello, my name is Cliff Winkel and I am an electrical contractor operating out of North Ridgeville, Ohio. I have been an electrician since 1990 beginning with simple house remodels and rewiring working for various companies. In 1997 I started working for an outfit out of Cleveland, Ohio which dealt with commercial, residential, and industrial applications. In 2000 I applied, tested, passed, and received my Ohio Electrical Contractor's License (#23838) and started my own business, Winkelectric. In 2004 I applied, tested, passed and received my Ohio Electrical Safety Inspector's License (#1862). In 2005 I applied for, and received my Approved Training Agency License (#517). I also am licensed as a fire alarm contractor and am entry level NABCEP certified in photovoltaic installations. I also currently have a NICET level III fire alarm certification. In 2005, 2009 – 2022 I taught OCLIB electrical continuing education classes for electrical contractors (focused on 2005 2008 2011 and 2014/2017/2020 code changes and grounding). From 2000 to current I am continuing work as an electrical contractor. Some of the projects I have been involved in projects including residential buildings, commercial shopping centers, cellular tower land sites, and industrial high voltage maintenance and testing work. I have been registered and operated in numerous municipalities throughout Ohio.

Clifford Winkel

Wink Electric
11/14/22

Wink Electric Class Syllabus
2023 NEC Code Changes Part I
5 hour continuing education class

Saturday 2/4/22 8A-1P, Saturday 3/4/22 8A-1P
Saturday 4/15/22 8A-1P, Tuesday 8/8/22 8A-1P
Saturday 9/23/22 7A-12P, Saturday 11/18/22 7A-12P
Instructor: Clifford Winkel

February location: Fields Sweet School 8540 Root Rd North Ridgeville, Ohio 44039
March location: Jims Electric 39221 Center Ridge Rd North Ridgeville, Ohio 44039
April location: Net Electric 12925 Pearl Rd Strongsville, Ohio 44136
August Location Wink Electric Inc – 34400 Lorain Rd, North Ridgeville, Ohio 44039
September location: Wolff Brothers – 38777 Taylor Parkway North Ridgeville, Ohio 44039
November location: City of Elyria – 1194 Gulf Rd Elyria, Ohio 44035

Office Hours:

Please feel free to call our office at any time if any need arises. Our office hours are Monday through Friday 8am – 4pm. For any immediate issues, you can contact me vie cell phone at 440-346-4125

Course Objectives:

- Review National Electrical Code changes to the 2023 NEC.
- Apply covered 2023 NEC codes to circumstances in the field with discussion of practical use and actual examples of 2023 NEC applications.
- Use the ability to relate to the changes with the class from an instructor who also works in the field.
- As detailed below, there are certain changes we will be discussing. Due to the amount of changes I wish to cover, we will run a part I and a part II of this course. Both courses will be 5 hours in length to give shorter class time per day. With 5 hour classes, I believe the amount of retention will be higher opposed to a 10 hour class.

Teaching Approach and Methods:

Portions of this course will be taught in the traditional lecture note taking format. However, a large part of the class will involve class discussions, sample illustrations, handouts, and hands on code book participation. All class members will be asked to bring their 2023 NEC book. There will also be preordered 2020 NEC books available for sale on site if any class member does not own one yet. Every hour there will be a ten minute period for open discussion. At the end of the class every applicant will fill out their individual attendance form and it will be signed then, with identification verification.
.

Schedule of Topics and time schedule

7AM – 8AM

Code	Discussion
General	Discuss any of the following codes pertaining to 2020 NEC code updates. Confirm with class that this will go into effect once 2020 NEC is adopted.

Wink Electric Class Syllabus
2023 NEC Code Changes Part I
5 hour continuing education class

Saturday 2/4/22 8A-1P, Saturday 3/4/22 8A-1P
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ARTICLE 100 DEFINITIONS – Discuss all definitions now being found in article 100 of the NEC. Definitions shall not contain requirements or recommendations. If a definition only applies to one articles, the article number will appear in parentheses after the definition.

90.5 (C) Mandatory Rules, Permissive Rules – Subdivision (C) was revised to state that unless a standard referenced in the NEC contains a date, that reference is to be considered the latest edition of the standard.

ARTICLE 100 Bonding jumper, equipment bonding jumper, main bonding jumper, supply-side bonding jumper, system bonding jumper, solidly grounded, equipment grounding conductor. - Discuss revisions to definitions for simplicity.

ARTICLE 100 Accessible – Discuss revision to define obstacles which would cause installations to not be accessible.

ARTICLE 100 Class 4 Circuit – Discuss new definition.

ARTICLE 100 Counter (Countertop) – Discuss new definition pertaining to countertop installations.

ARTICLE 100 Energy Management System – Discuss new definition pertaining to energy management system installations.

ARTICLE 100 Feeder Assembly – Discuss new definition pertaining to feeder assemblies in pre-wired facilities.

Wink Electric Class Syllabus
2023 NEC Code Changes Part I
5 hour continuing education class

Saturday 2/4/22 8A-1P, Saturday 3/4/22 8A-1P
Saturday 4/15/22 8A-1P, Tuesday 8/8/22 8A-1P
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ARTICLE 100 Fibers/Flyings Combustible – Discuss new definition covering combustible fibers and flyings.

ARTICLE 100 Impedance Grounding Conductor – Discuss new definition for Grounded Conductor, Impredance.

ARTICLE 100 In Sight – Discuss revision of definition of In Sight pertaining to sections of code.

ARTICLE 100 Likely to become energized.- Discuss new definition of likely to become energized pertaining to other sections of the NEC>

ARTICLE 100 Load Management – Discuss new definition for load management

ARTICLE 100 Restricted Industrial Establishment – Discuss new definition pertaining to hazardous area locations.

ARTICLE Servicing – Discuss new definition pertaining to maintenance and repair activities.

ARTICLE 100 Transformer – Discuss new definition of transformer (which there was no definition before).

ARTICLE 100 Work Surface – Discuss new definition establishing the difference between work surface and countertop.
8:00 – 9:00

ARTICLE 110.3(A) – Examination, identification, installation, use, and listing (Product certification) of equipment – Discuss new number 8 now including cybersecurity as something that needs considered and evaluated.

ARTICLE 110.3(B) – Examination, identification, installation, use, and listing (Product certification) of equipment – Discuss new informational note discussing the use of QR codes to gather information.

ARTICLE 110.14(A) – Terminals. Discuss the use of electrical opposed to mechanical connections.

ARTICLE 110.16(B) – Service equipment and feeders supplied equipment. Discuss revised amperage threshold for labeling.

ARTICLE 110.17 – Servicing and maintenance of equipment. Discuss revised code to limit service and maintenance of equipment to qualified persons.

ARTICLE 110.20 – Reconditioned equipment. Discuss new language defining what is considered acceptable to being reconditioned.

ARTICLE 110.21(A)(1) – Equipment markings. Discuss requirements for equipment marking for affixing labels on all electrical equipment.

ARTICLE 110.21(A)(2) – Reconditioned equipment. Discuss language that clarifies that the original listing mark is to be removed or made permanently illegible.
9:00 – 10:00

Wink Electric Class Syllabus
2023 NEC Code Changes Part I
5 hour continuing education class

Saturday 2/4/22 8A-1P, Saturday 3/4/22 8A-1P
Saturday 4/15/22 8A-1P, Tuesday 8/8/22 8A-1P
Saturday 9/23/22 7A-12P, Saturday 11/18/22 7A-12P
Instructor: Clifford Winkel

February location: Fields Sweet School 8540 Root Rd North Ridgeville, Ohio 44039
March location: Jims Electric 39221 Center Ridge Rd North Ridgeville, Ohio 44039
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ARTICLE 110.21(B)(1) – Field applied hazard marking. Discuss revision pertaining to field applied hazard markings.

ARTICLE 110.22(A) – General. Discuss revised text clarifying when the identification of a disconnecting means is required or not required.

ARTICLE 110.26 – Spaces about electrical equipment. Discuss language pertaining to doors impeding access from electrical equipment areas.

ARTICLE 110.26 (A)(6) – Grade, floor, or working platform. Discuss new language pertaining to keeping areas clear of objects.

ARTICLE 110.29 – In sight from (within sight). Discuss new language pertaining to spaces about electrical equipment.

ARTICLE 110.33(A) – Entrance. Discuss language for working space for equipment over 1000 volts.

ARTICLE 110.34(A) – Working space and guarding. Discuss revisions regarding the conditions of the work space about equipment.

10AM – 10:15 BREAK

10:15AM – 11:15AM

ARTICLE 210.2 – Reconditioned equipment. Discuss relocation from 210.15 to 210.2 as it applies to branch circuitry.

ARTICLE 210.8(A)(6) – Dwelling units kitchens. Discuss expansion of GFCI protection in kitchens (cord and plug).

ARTICLE 210.8(A) – Dwelling units bathrooms. Discuss revision of GFCI protection regarding exhaust fans.

ARTICLE 210.8(A)(8) – GFCI Protection for personnel. – Discuss weight supporting attachment fitting and GFCI protection of said fitting.

ARTICLE 210.8(B)(4) – Other than dwelling units. Discuss addition of buffet style locations requiring GFCI protection.

ARTICLE 210.8(B)(7) – Other than dwelling units sinks. Discuss addition of cord and plug connected equipment to code language.

ARTICLE 210.8(B)(13) – Other than dwelling units aquariums. Discuss addition of new item 13 discussing aquariums and bait wells.

ARTICLE 210.8(D) – Specific appliances. Discuss additional language pertaining to specific appliances listed in 218.8(D).

ARTICLE 210.8(F) – Outdoor outlets. Discuss revision regarding replacements of existing receptacles and their GFCI requirements.

ARTICLE 210.11(C)(4) – Branch circuits required. Discuss revision regarding the use of 15 amp circuits feeding garage areas.

Wink Electric Class Syllabus
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ARTICLE 210.11(C)(4) – Branch circuits required. Discuss new exception 4 allowing 20 amp garage bay circuits to feed other items.

ARTICLE 210.12 – AFCI protection. Discuss and review reformatted section.

ARTICLE 210.12(D)(3) – Other occupancies. Discuss new language adding sleeping areas to other occupancy types.

ARTICLE 210.17 – Guest rooms and suites. Discuss revision adding requirements for assisted living buildings and their receptacle layouts.

ARTICLE 210.19 – Minimum ampacity and size. Discuss revision regarding the use of circuit size vs conductor ampacity.

ARTICLE 210.23 – Permissable loads. Discuss 10 amp branch circuitry language added to the 2023 NEC.

ARTICLE 210.52(C) – Dwelling units islands/peninsulas. Discuss revisions regarding placement of receptacles in islands/peninsula areas.

ARTICLE 210.52(G) – Basements, garages, accessory buildings. Discuss clarification of the security receptacle not meeting the requirements of 210.52(G).

Wink Electric Class Syllabus
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ARTICLE 210.70 – Lighting outlets required. Discuss revision adding laundry areas to list of areas requiring wall mounted control devices.

ARTICLE 215.15 – Barriers. Discuss new language requiring barriers for line voltage breaker situations.

ARTICLE 215.18, 225.42, 230.67 – SPD. Discuss the expansion of SPD requirements in the 2023 NEC.

ARTICLE 220.1 – Scope. Discuss new language pertaining to calculations for health care facilities, marina, boatyards, and docking facilities.

ARTICLE 220.5 – Floor areas. Discuss new language including unused/unfinished areas of buildings to load calculations.

ARTICLE 220.57 – Electric Vehicle Supply Equipment. Discuss new section pertaining to load calculations for EVSE.

ARTICLE 220.70 – EMS. Discuss new language calculating load demands for EMS systems.

ARTICLE 220.110 – Receptacle loads. Discuss new tables pertaining to receptacle loads in patient care spaces.

11:15 – 12:15

ARTICLE 220.120 – Marinas, boatyards, etc. Discuss relocation of 555.6 to 220.120.

ARTICLE 225.5/225.7 – Deletion. Discuss deletion of 225.5 and 225.7 referring this information to articles 215 and 220.

ARTICLE 225.41 – Emergency disconnects. Discuss new language requiring emergency disconnects for one and two family dwelling units being served by feeders.

ARTICLE 230.62(C) – Barriers. Discuss revision regarding requirements of barriers in service equipment.

ARTICLE 230.67(A) – SPDs. Discuss change in language from dwelling units to list specific occupancies.

ARTICLE 230.71(B) – Two to six service disconnecting means. Discuss language requiring transfer switches to be listed as service equipment.

ARTICLE 230.71(B) EXCEPTION – Discuss exception grandfathering older installations installed in accordance with older versions of the NEC.

ARTICLE 230.85 – Emergency disconnects. Discuss new sub divisions regarding the use of emergency disconnects.

ARTICLE 240.2 – Reconditioned equipment. Discuss relocation of 240.62 and 240.88.

ARTICLE 240.4(B) – Overcurrent devices 800 amps or less. Discuss addition of adjustable trip overcurrent devices to 240.6(A).

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ARTICLE 240.4(D)(3) – 14 AWG copper clad aluminum. Discuss addition of copper clad aluminum to 240.4(D).

ARTICLE 240.6(D) – Remotely accessible adjustable trip circuit breakers. Discuss revision to allow remote access to adjustable trip circuit breakers.

ARTICLE 240.7 – Listing requirements. Discuss new section requiring listing of these GFPE and GFCI devices.

ARTICLE 240.11 – Selective coordination. Discuss new requirement clarifying feeder overcurrent devices and their interaction with service overcurrent devices.

ARTICLE 240.16 – Interrupting ratings. Discuss new requirement regarding minimum interrupting ratings.

ARTICLE 240.24(A) – Accessibility – Exception. Discuss revision regarding updating “similar enclosures”.

ARTICLE 240.2E (E) – Not located in bathrooms. Discuss revision clarifying over current devices not being acceptable in bathroom areas.

ARTICLE 242.2 – Reconditioned equipment. Discuss new language stating SPDs cannot be reconditioned.

ARTICLE 242.9 – Indicating. Discuss requirement for indicating lights for SPDs.

ARTICLE 250.24 – Grounding of AC systems. Discuss revision to clarify requirements of parallel installations.

ARTICLE 250.24 (D)(2) – Grounding of AC systems. Discuss revision clarifying parallel service conductor installations.

ARTICLE 250.50, 250.52(A)(3)(1), 250.52 (B)(2) – Grounding electrode system. Discuss change of language regarding concrete encased electrodes.

ARTICLE 250.64(G) – Enclosures with vent openings. Discuss new requirements not allowing vented areas to be used to install GEC.

ARTICLE 250.70 – Methods of grounding and bonding. Discuss revision to grounding electrode installation methods.

ARTICLE 250.94(A) – Intersystem bonding termination. Discuss revision in intersystem bonding terminal requirements.

ARTICLE 250.118(A) – Types of EGC. Discuss new item (6)(F) that was added along with the special rules associated with it.

ARTICLE 250.130 – EGC connections. Discuss revision adding snap switches.

ARTICLE 250.140 – Frames of ranges and dryers. Discuss revision trying to streamline understanding of this section.

ARTICLE 250.148 – Continuity of EGC. Discuss revision adding subdivision (A) clarifying connections of EGC in boxes.

ARTICLE 300.4 (E) EX 1/2 – Discuss revision discussing concrete located on a metal corrugated roof.

ARTICLE 300.4 (G) – Fittings. Discuss revision dealing with bushing being installed before installation.

TABLE 300.5 – Minimum cover requirements. Discuss revision adding EMT to the table.

ARTICLE 300.5 (D) – Protection from damage. Discuss deletion of “direct buried” language.

ARTICLE 300.6 (A) – Ferrous metal equipment. Discuss revision of language.

File Attachments for Item:

ER-3 2023 NEC Code Changes Part 2 (Wink Electric)

All certifications (5 hours)

Staff Notes: This course is not presented with visuals. A detailed outline is included. Since this course is based on the 2023 code, not recommended for approval at this time.

ESIAC Recommendation:

Committee Recommendation:

Wink Electric Class Syllabus
2023 NEC Code Changes Part II
5 hour continuing education class

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Schedule of Topics and time schedule

7AM – 8AM

ARTICLE 300.11 (C) – Raceways used as means of support. Discuss revision adding class 3 circuits as a conductors allowed to be supported in this fashion.

ARTICLE 300.14 – Length of free conductors at openings. Discuss revision allowing splicing of short conductors.

ARTICLE 300.17 – Number and size of conductors in raceways. Discuss revision in language safeguarding conductors during and after installation.

ARTICLE 300.25 – Exit enclosures. Discuss language adding the use of fire barriers in addition to being separated from the building.

ARTICLE 300.26 – Remote control and signaling circuits. Discuss new 300.26 with these types of circuitry.

TABLES 310.16, 310.17, 310.20 – Ampacity of conductor tables. Discuss deletion of XHWN from the 90 degree tables.

ARTICLE 312.10 – Screws and other fasteners. Discuss new section dealing with field installed screws.

ARTICLE 314.5 – Screws and other fasteners. Discuss new section dealing with screws and other fasteners entering enclosures.

ARTICLE 315.1 – Dimensions of boxes. Discuss revision adding language about side entries.

ARTICLE 315.1 – Scope. Discuss new language regarding the voltages covered by article 315.

ARTICLE 320.23 (A) – Cables run across framing members. Discuss revision of language to framing members opposed to joists.

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ARTICLE 322.56 (B) – Taps. Discuss revision dealing with flat cable being marked and not necessarily colored.

ARTICLE 330.112 (A) – 1000 volts or less MC cable. Discuss revision of language in the MC section.

ARTICLE 342.20 (B) – Maximum. Discuss revision of largest size of IMC allowed to be installed.

ARTICLE 344.28 – Reaming and threading. Discuss revision in language regarding PVC coated rigid.

ARTICLE 352.44 (B) – Expansion fittings. Discuss new requirements for expansion joints.

ARTICLE 358.48 – Revision. Discuss revision regarding joining methods.

ARTICLE 358.20 (B) – Maximum. Discuss revision allowing up to 6" EMT to be used.

ARTICLE 404.1 – Scope. Discuss new informational note regarding wall mounted devices.

ARTICLE 404.14 (D) – Snap switch terminations. Discuss new language dealing with 14 awg wire and snap switches.

ARTICLE 404.16 – Reconditioned equipment. Discuss new language prohibiting reconditioning of switches.

ARTICLE 404.30 – Switch enclosures. Discuss new **requirements** for doors with switch mechanisms.

ARTICLE 406.2 – Reconditioned equipment. Discuss relocation from 406.3 (A) and 406.7 to new section 406.2.

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8:00 – 9:00

ARTICLE 406.30 (D) – Receptacle terminations. Discuss new language regarding the limitations of 15 amp branch circuits.

ARTICLE 406.4 (D)(3) – GFCI protection. Discuss revision of language to require listing of products.

ARTICLE 406.4 (D)(8) – GFPE protection. Discuss new language requiring GFPE protection when replacing devices in areas which require it.

ARTICLE 406.6 (D) – Receptacle faceplates. Discuss revision regarding lighting faceplates and what kind of screws are allowable.

ARTICLE 406.9 (C) – Bathtub and shower space. Discuss revision regarding limitations of receptacles around these areas.

ARTICLE 406.12 – TR receptacles. Discuss revision in language attempting to streamline language regarding areas where TR receptacles are required.

ARTICLE 408.4 – Descriptions required. Discuss revision regarding circuit directories.

ARTICLE 408.9 – Replacement panelboards. Discuss revision in requirements for replacement panelboards.

ARTICLE 408.38 – Enclosure. Discuss revision regarding listing of equipment with available arc fault current greater than 10k.

ARTICLE 408.43 – Panelboard orientation. Discuss revision prohibiting panelboards being installed in a face gown position.

ARTICLE 409.60 – Bonding. Discuss reorganization of this article.

ARTICLE 409.70 – Surge protection. Discuss new section requiring surge protection for industrial control panels.

ARTICLE 410.2 – Reconditioned equipment. Discuss revision adding LED drivers and lamps to items that are prohibited from recondition.

ARTICLE 410.10 (F) – Luminaires installed in or under roof decking. Discuss revision requiring 1 ½” space under roof decking.

ARTICLE 410.71 – Disconnecting means for luminaires. Discuss relocation from 410.71 to this section.

ARTICLE 410 PART XVII – Special provisions for germicidal irradiation luminaires. Discuss new part XVII added to the NEC.

ARTICLE 410.184 – GFCI and SPGFCI protection. Discuss revision clarifying when to use these types of devices.

ARTICLE 422 – Appliances. Discuss deletion of sections 422.3, 422.4, 422.15, 422.23, 422.46, 422.50.

ARTICLE 422.16 (B)(2) – Built in dishwashers and compactors. Discuss revision to provisions regarding pass through cords in these installations.

ARTICLE 422.18 – Paddle fans. Discuss revision prohibiting certain kinds of ceiling fan installations.

ARTICLE 424.10 – General – Discuss deletion of special permission.

ARTICLE 424.48 – Installation of cables in walls. Discuss new section allowing heating cables to be installed in walls.

ARTICLE 424.93 (C) – Installation of heating panels in walls. Discuss new section allowing heating panels to be installed in walls.

ARTICLE 425.10 – General. Discuss deletion of special permission.

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9:00 – 10:00
ARTICLE 426.14 – Special permission. Discuss deletion of special permission.

ARTICLE 426.28 – Ground fault protection. Discuss revision recognizing manufacturer's requirements on snow melting equipment.

ARTICLE 427.35 – Scope. Discuss deletion of article 427.35.

ARTICLE 430.1 – Scope. Discuss revision of figure 430.1.

ARTICLE 430.2 – Reconditioned motors. Discuss new section regarding guidance on reconditioning motors.

ARTICLE 440.8 – Single machine and location. Discuss revision to 440.8 prohibiting mini split installation in certain areas.

ARTICLE 440.11 – General – Discuss revision requiring locking of disconnects.

ARTICLE 440.14 – Location. Discuss revision regarding workspace clearance for HVAC equipment.

ARTICLE 445.18 (A) & 445.19 – Disconnecting means and emergency shutdown. Discuss revision allowing disconnection to be behind hinged covers.

ARTICLE 450.2 – Interconnection of transformers. Discuss new section adding guidance for transformer interconnection.

ARTICLE 470.2 – Reconditioned equipment. Discuss new section prohibiting reconditioning of resistors.

ARTICLE 495 – Equipment over 1000 volts AC. Discuss requirements formerly found in 490 are now found in article 495.

ARTICLE 500.4 – Documentation. Discuss revision in documentation requirements by the

AHJ.

Wink Electric Class Syllabus
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ARTICLE 500.5 (D)(1)(A) – Combustible fibers/flyings. Discuss revision definition of combustible fibers.

ARTICLE 500.8 (D)(2) AND (D)(3) – Equipment temperature. Discuss revision in this section to align with the new definition of combustible fibers.

ARTICLE 505.9 (C) CHAPTER 9 TABLE 13 – Equipment suitable for hazardous locations. Discuss new table 13 in Chapter 9 and deletion of table 505.9 (C)(2)(4).

ARTICLE 512 – Cannabis oil equipment. Discuss new article 512 covering this kind of installation area.

ARTICLE 515.10 – Special equipment motor fuel. Discuss language change from gas dispenser to motor fuel dispenser.

ARTICLE 517 – Health care facilities. Discuss revision in definitions of Category 1-4 spaces.

ARTICLE 517.6 – Patient care related equipment. Discuss new language confirming reconditioning requirements in other areas of the code do not apply to patient care equipment.

ARTICLE 517.13 – EGC in patient care spaces. Discuss revision in language regarding installations in these areas.

ARTICLE 517.22 – Demand factors. Discuss new section regarding demand factors in heath care facilities.

ARTICLE 517.30 – Sources of power. Discuss revisions in terminology in this section.

ARTICLE 517 PART V – Diagnostic imaging and treatment equipment. Discuss revision in language from Xray installations to diagnostic imaging and treatment equipment.

10AM – 10:15 BREAK

10:15AM – 11:15AM

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10:15 – 11:15

ARTICLE 518.2 – Casinos and gaming facilities. Discuss revision adding these areas to assembly examples.

ARTICLE 518.4 – Wiring methods. Discuss revision in language including POE cabling.

ARTICLE 518.5 – Supply. Discuss revision reorganizing assembly occupancies.

ARTICLE 547.26 – Physical protection. Discuss new section regarding nonmetallic cables.

ARTICLE 547.44 – Equipotential planes and bonding. Discuss new section clarifying indoor and outdoor locations of these areas.

ARTICLE 550.32 – Service equipment. Discuss revision for disconnect location.

ARTICLE 551.3 – Electrical datum plane. Discuss new section dealing with datum planes at RV areas.

ARTICLE 551.40 (D) – Loss of ground device. Discuss revision eliminating the requirement for reverse polarity devices.

ARTICLE 555.4 – Location of service equipment. Discuss revision modifying 555.4 and distances for docking services.

ARTICLE 555.6 – Load calculations for service and feeder conductors. Discuss relocation from 555.6 to 220.120 for calculations.

ARTICLE 555.14 – Equipotential planes and bonding. Discuss new section regarding installing equipotential planes in marinas and boatyards.

ARTICLE 555.15 – Replacement of equipment. Discuss new section requiring replacement devices to be installed to the new requirements of the NEC.

ARTICLE 555.35 (E) – Leakage current measurement device. Discuss new language requiring these devices to be listed by 1/1/26.

ARTICLE 555.36 (C) – Emergency electrical disconnect. Discuss new requirements mandating the emergency disconnect be located within sight of a marina power outlet.

ARTICLE 555.38 – Luminaires. Discuss new section dealing with luminaires in marinas and dockyards.

ARTICLE 590.4 (F) – Lamp protection. Discuss new revision requiring metal caged temp lighting.

ARTICLE 600.5 (A) – Exception. Discuss new exception relocation of timeclock language.

ARTICLE 600.35 – Retrofit kits. Discuss deletion of section 600.35.

ARTICLE 620.12 (A) – Traveling cables. Discuss new addition of class 2 cables to this section.

ARTICLE 620.22 (A) – Car light receptacles. Discuss revision to specify permissible loads on the car light circuit.

ARTICLE 620.36 – Different systems. Discuss revision specifying which cable types can be run.

ARTICLE 620.51 (A) TYPE EX NO. 2 – Stairway chair lift. Discuss revision determining where stairway chair lifts are allowed.

ARTICLE 625.6 – Listed. Discuss revision determining which EV systems are to be listed.

ARTICLE 625.44 (A) – Portable equipment. Discuss revision adding 60 amp receptacles to this section.

ARTICLE 625.49 – Island mode. Discuss new language dealing with island mode on EV’s.

ARTICLE 630.8 – GFCI for welders. Discuss new section laying out when to install these.

ARTICLE 646.19 – Entrance to and egress from working space. Discuss revision regarding egress doors in modular areas.

ARTICLE 670.1 – Scope. Discuss revision requiring over voltage protection in these environments.

ARTICLE 680 – Swimming pools etc. Discuss reorganization to try to elevate usability of article 680.

ARTICLE 680.5 – GFCI and SPGFCI protection. Discuss revision requirements for these devices in article 680 areas.

ARTICLE 680.9 (A) – Power. Discuss revision clarifying open overhead wiring in raceways.

ARTICLE 680.10 – Electric pool water heaters. Discuss revision including electric pool water installations.

ARTICLE 680.21 (D) – Pool pump motor replacement. Discuss revision requiring GFCI for pumps replacement and reconditioned.

ARTICLE 680.12 – Equipment rooms. Discuss revision requiring drainage.

ARTICLE 680.23 (B)(2)(a) – Forming shell. Discuss revision requiring listing for rigid in certain pool areas.

ARTICLE 680.32 – GFCI and special purpose SPGFCI protection. Discuss revision regarding when to install these devices.

Wink Electric Class Syllabus
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11:15 – 12:15

ARTICLE 680.41 (A) – Emergency switch for spas and hot tubs. Discuss revision excluding the need to these installations at single family dwellings.

ARTICLE 680.44 – GFCI and SPGFCI protection. Discuss revision regarding these devices installed in these areas.

ARTICLE 680.54 (C) – Equipotential bonding of splash pads. Discuss new section addressing bonding requirements in these areas.

ARTICLE 690 – Solar photovoltaic systems. Discuss removal of PV output circuit.

ARTICLE 700.2, 701.2, 702.2, AND 708.2 – Reconditioned equipment. Discuss reconditioning of transfer switches being prohibited.

ARTICLE 700.3 (F) – List items 4, 6, 7. Discuss new/revision requiring listing of devices.

ARTICLE 700.5 (D) – Redundant transfer equipment. Discuss revision pertaining to emergency loads supplied by single feeders.

ARTICLE 700.11 (C) – Wiring class 2 powered emergency lighting systems. Discuss new section citing requirements for the separation of class 2 circuits.

ARTICLE 700.12 (C) – Supply duration. Discuss new informational note to reference classification information for EPSS systems.

ARTICLE 700.12 (E) & 701.12 (E) – Stored energy power supply systems. Discuss revision in language from uninterruptible power supplies to stored energy power supply systems.

ARTICLE 700.12 (G) – Microgrid systems. Discuss revision to microgrid system management.

Wink Electric Class Syllabus
2023 NEC Code Changes Part II
5 hour continuing education class

Saturday 2/11/22 8A-1P, Saturday 3/11/22 8A-1P
Saturday 4/22/22 8A-1P, Tuesday 8/15/22 8A-1P
Saturday 9/23/22 1P-6P, Saturday 11/18/22 1P-6P
Instructor: Clifford Winkel

February location: Fields Sweet School 8540 Root Rd North Ridgeville, Ohio 44039
March location: Jims Electric 39221 Center Ridge Rd North Ridgeville, Ohio 44039
April location: Net Electric 12925 Pearl Rd Strongsville, Ohio 44136
August Location Wink Electric Inc – 34400 Lorain Rd, North Ridgeville, Ohio 44039
September location: Wolff Brothers – 38777 Taylor Parkway North Ridgeville, Ohio 44039
November location: City of Elyria – 1194 Gulf Rd Elyria, Ohio 44035

ARTICLE 701.4 (C) – Load management. Discuss revision to load management requirements.

ARTICLE 701.4 (D) – Parallel operation. Discuss new section adding language identifying two different types of parallel operations.

ARTICLE 701.10 – Wiring legally required standby systems. Discuss new section concerning wiring requirements for legally required standby systems.

ARTICLE 701.12 (C) – Supply duration. Discuss new informational note referencing classification information.

ARTICLE 705.11 – Source connections to a service. Discuss revision applying to systems interconnected with new or existing utility services.

ARTICLE 705.13 – EMS systems. Discuss relocation of much of the language from this article to article 750.

ARTICLE 705.20 – Source disconnecting means. Discuss deletion of requirements to lock and/or use tools to open.

ARTICLE 705.30 (F) – Transformers. Discuss new language addressing transformer requirements for interconnected systems.

ARTICLE 705.50 – System operation. Discuss revision discussing operational modes of microgrid systems.

ARTICLE 706.7 – Commissioning and maintenance (energy storage systems). Discuss new section regarding commissioning requirements.

ARTICLE 722 – Cables for power limited circuits. Discuss new article 722 covering general requirements for class 4 circuits.

Wink Electric Class Syllabus
2023 NEC Code Changes Part II
5 hour continuing education class

Saturday 2/11/22 8A-1P, Saturday 3/11/22 8A-1P
Saturday 4/22/22 8A-1P, Tuesday 8/15/22 8A-1P
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Page 12/12

ARTICLE 725.144 – Bundling of cables transmitting power and data. Discuss revision removing 4 pair from title section.

ARTICLE 726 – Class 4 power systems. Discuss new article 726 dealing with FMP systems.

ARTICLE 760 – Fire alarm systems. Discuss several section that were revised and reworded in article 760.

ARTICLE 800.179 – Wires and cables. Discuss relocation of hybrid power and comm systems to article 800.

ARTICLE 805.170 – Protectors. Discuss relocation of communications listing to article 800 from 805.

ARTICLE 840.160 – Powering circuits. Discuss relocation of communication cable wiring to article 800.

CHAPTER 9 TABLE 13 – Equipment suitable for hazardous locations. Discuss new table located in chapter 9.

ANNEX A – Discuss new table A.1(b).

ANNEX E – Fire resistance construction. Discuss changes to type IV construction.

Clifford Winkel
5640 Broad Blvd.
North Ridgeville, Ohio 44039
440-346-4125
winkelectric@hotmail.com

BIO

Hello, my name is Cliff Winkel and I am an electrical contractor operating out of North Ridgeville, Ohio. I have been an electrician since 1990 beginning with simple house remodels and rewiring working for various companies. In 1997 I started working for an outfit out of Cleveland, Ohio which dealt with commercial, residential, and industrial applications. In 2000 I applied, tested, passed, and received my Ohio Electrical Contractor’s License (#23838) and started my own business, Winkelectric. In 2004 I applied, tested, passed and received my Ohio Electrical Safety Inspector’s License (#1862). In 2005 I applied for, and received my Approved Training Agency License (#517). I also am licensed as a fire alarm contractor and am entry level NABCEP certified in photovoltaic installations. I also currently have a NICET level III fire alarm certification. In 2005, 2009 – 2022 I taught OCLIB electrical continuing education classes for electrical contractors (focused on 2005 2008 2011 and 2014/2017/2020 code changes and grounding). From 2000 to current I am continuing work as an electrical contractor. Some of the projects I have been involved in projects including residential buildings, commercial shopping centers, cellular tower land sites, and industrial high voltage maintenance and testing work. I have been registered and operated in numerous municipalities throughout Ohio.

Clifford Winkel

Wink Electric
11/14/22

Ohio | Department of Commerce

Mike DeWine, Governor
Jon Husted, Lt. Governor

Sheryl Maxfield, Director

Board of Building Standards

Application for Continuing Education Course Approval

Provider Information:

Name: CLIFFORD WINKEL

Organization: WINK ELECTRIC

Address: 5640 BROAD N.RIDGEVILLE OH 44039

E-mail: WINKELECTRIC@HOTMAIL.COM Telephone: 4403464125

Website: WINKELECTRIC.NET

Conference Sponsor (if applicable)________ Conference Email:________

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

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

New Course Information:

Course title: 2023 NEC CODE CHANGES PART II

Course instructor: CLIFFORD WINKEL

Course description:
CODE CHANGES 2023 REVIEW

Instructional hours per session: 5 Number of Sessions: 1

Course Date(s) and Location:________

Special Content:

Code Administration:______
Existing Buildings:______
Electrical Instruction: X
Plumbing Instruction:______

Conference Course:________
Conference Name:________
Conference location:________

Course to be offered online? YES **On Demand** X **Webinar**______

Course Website: WINKELECTRIC.NET

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

____

Course applicable for the following certifications

Residential Certifications Only: ______ Commercial Certifications: X
Administrative Course, All Certifications: ______

Application materials included:

______ Course Outline or Course Learning Objectives
______ Presentation Materials/Slides (not required for roundtable courses)
______ Assessment Materials (for online courses)
______ Presenter Bio

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

File Attachments for Item:

ER-4 Electrical Code Review (IAEI Northwest)

All certifications (twelve sessions of two hours each)

Staff Notes:

ESIAC Recommendations:

Committee Recommendation:

Zachary D Jenkins
BIO/Profile 2022

I currently employed by the Division of Building Inspection, Ottawa County, Ohio as the Building Official, Residential Building Official, Flood Plain Manager, and Building and Electrical Inspector. I am also the President of the North West Ohio Building Officials Association and Vice President of the Ohio Chapter IAEI. In addition to the IAEI, I am a member of the IBEW. I hold my ESI, BI, RBO and CBO certificates.

I am married to my wife Heidi and have 2 kids Zoey and Harrison. I enjoy fishing and hunting.

Ohio | **Department of Commerce**

Mike DeWine, Governor
Jon Husted, Lt. Governor

Sheryl Maxfield, Director

Board of Building Standards

Application for Continuing Education Course Approval

Provider Information:

Name: Greg Capucini
Organization: IAEI Northwest Division Ohio Chapter
Address: P.O. Box 167667 Oregon Ohio 43616
E-mail: gcapucini@cityofsandusky.com Telephone: 419·656·3108
Website: nwohioiaei@ nwohioiaei@yahoo.com
Conference Sponsor (if applicable)______ Conference Email:______

Check here if Course Renewal:______ Prior course number ______ (*i.e. BBS2018-429*)
Renewals will only be granted for identical content and certifications, within the current code cycle.
Attach a copy of prior course approval letter for confirmation. No further information is required.

New Course Information:

Course title: Electrical Code Review
Course instructor: Zach Jenkins
Course description: 2017 NEC updates @ 803 Lime City Road
Rossford, Ohio 43460

Instructional hours per session: 2 Number of Sessions: 12
Course Date(s) and Location: 1-10-23 • 2-14-23 • 3-14-23 • 4-11-23 • 5-9-23 • 6-13-23
7-11-23 • 8-8-23 • 9-12-23 • 10-10-23 • 11-14-23 • 12-12-23

Special Content:

Code Administration:	✓	Conference Course:	
Existing Buildings:		Conference Name:	
Electrical Instruction:	✓	Conference location:	
Plumbing Instruction:			

Course to be offered online?______ **On Demand**______ **Webinar**______
Course Website:______
Detail online course participation confirmation method (*i.e. test, quizlets, participant activity confirmation*):______

Course applicable for the following certifications

Residential Certifications Only:______ Commercial Certifications:______
Administrative Course, All Certifications: ✓

Application materials included:

✓	Course Outline or Course Learning Objectives
✓	Presentation Materials/Slides (not required for roundtable courses)
	Assessment Materials (for online courses)
Comming Soon	Presenter Bio

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

Class Outline Northwest Division Ohio IAEI -Training Agency

2021 OBBS classes held at:
Toledo Electrical JATC 803 Lime City Rd. Rossford, Ohio 43460 on the 2nd Tuesday of each month from 9:30 to 11:30 am. (2 hrs)

All classes will be based on and utilize the 2017 National Electrical Code (NFPA70-17), all participants are encouraged to bring one to classes.

10th 2023
January ~~12th, 2021~~ – Introduction to the 2017 NEC, review code wide changes and the editorial changes made to the NEC based on the NEC Style Manual. Cover Chapter 1 changes to Article 100 Definitions.

14 2023
February ~~9th, 2021~~ – Cover changes to Chapter 1, Article 110 Requirements for Electrical Installations. Review effect of increasing voltage thresholds from 600v or less to 1000v or less, addition of reconditioned equipment to Article 110.3(A), addition of new torqueing requirements for electrical equipment installations in Article 110.14(D),changes to working space clearances in Table 110.26(A)(1).

14th 2023
March ~~9th, 2021 (3/23/2021)~~ – Cover changes to Chapter 2, Article 200 and 210. Review labeling requirements of Article 210.5, expansion of GFCI requirements in Article 210.8(A) and (B), new requirements in Article 210.12(C) for guest rooms and suites of motel/hotels, branch circuit requirements of Article 210.19 thru 210.24, outlet requirements of 210.52 and 210.70.

April 11th 2023
~~April 13th, 2021~~ – Cover changes to Chapter 3, Article 300 and 310. Review requirements for Protection against Physical Damage found in Article 300.4, Burial and cover requirements of Article 300.5 for Underground Installations, Firestopping requirements of article 300.21, requirements for Installations over 1000 volts in Article 110 Part II, Conductor Requirements of Article 310 for parallel installations and derating of conductors.

9th 2023
May ~~11th, 2021~~ – Cover changes to Chapter 2, Article 220 and 230. Review requirements of Article 220 Calculations for branch circuits, lighting and service load calculations, Article 230 Services Part I General and Part III and IV for Overhead and Underground Installations.

13th 2023
June ~~8th, 2021~~ – Cover changes to Chapter 2, Article 240 and 250. Review requirements of Article 240 Overcurrent Protection, Part II Tap Rules, new Arc Energy Reduction of Article 240.67, and Article 250 Grounding and Bonding and the grounding electrode system.

11th 2023
July ~~13th, 2021~~ – Cover changes to Chapter 4, Articles 404 thru 424. Review requirements for Switches per Article 404, Receptacles in Article 406 including the expansion of tamper-resistant receptacles in 406.12, labeling requirements in Article 408.4, Luminaires (fixtures) in Article 410, and Appliance requirements in Article 422 with a link from Article 422.5 to Article 210.8 GFCI Protection.

8th 2023
August ~~10th, 2021~~ – Cover changes to Chapter 4, Articles 430 thru 490, and Chapter 5. Review requirements for Article 430 Motors and their disconnects per 430 Part IX, Generators Article 445 and their markings per 445.11, Storage Batteries- Article 480 and Article 706 Energy Storage Systems, Article 490 Equipment over 1000 volts, Chapter 5, Articles 500 thru 506 for Hazardous locations, Article 517 Health Care Facilities and their Essential Electrical Systems, Article 590 Temporary Wiring Installations.

12th 2023
September ~~14th, 2021~~– Cover changes to Chapter 6, Articles 600 thru 680, Review requirements for Article 600 Signs, article 625 Electric Vehicle Charging, Article 680 Part I, II and III Swimming Pools, Part IV Hot Tubs and Spas, Part V Fountains.

October ~~12th, 2021~~ 10th 2023 –Cover changes to Chapter 6, Articles 685 thru 694, Review requirements for Article 685 Integrated Electrical Systems, Article 690 Solar Photovoltaic (PV) Systems, Article 694 Wind Electric Systems, new Article 691 Large-Scale Photovoltaic (PV) Electric Power Production Facility, new Article 712 Direct Current Micro-grids, Review tie-in to Article 685 for alternative energy systems.

November ~~9th, 2021~~ 14th 2023 – Cover changes to Article 695 Fire Pumps and Chapter 7 Articles 700 thru 760. Review requirements for Article 700 Emergency Systems, Article 701 and 702 for Standby Systems, Article 708 Critical Operations Power Systems (COPS), Article 760 Fire Alarm Systems and Article 728 Fire-Resistive Cable Systems.

December ~~14th, 2021~~ 12th 2023 – Cover changes to Chapter 8 Communications Systems Articles 800 thru 840, Chapter 7, Article 725 Class 1, 2, and 3 Wiring and Power Limited Cables and Article 750 Energy Management Systems.

Analysis of Changes – 2017 *NEC*

Part 2

Training Presentation By:

International Association of Electrical Inspectors

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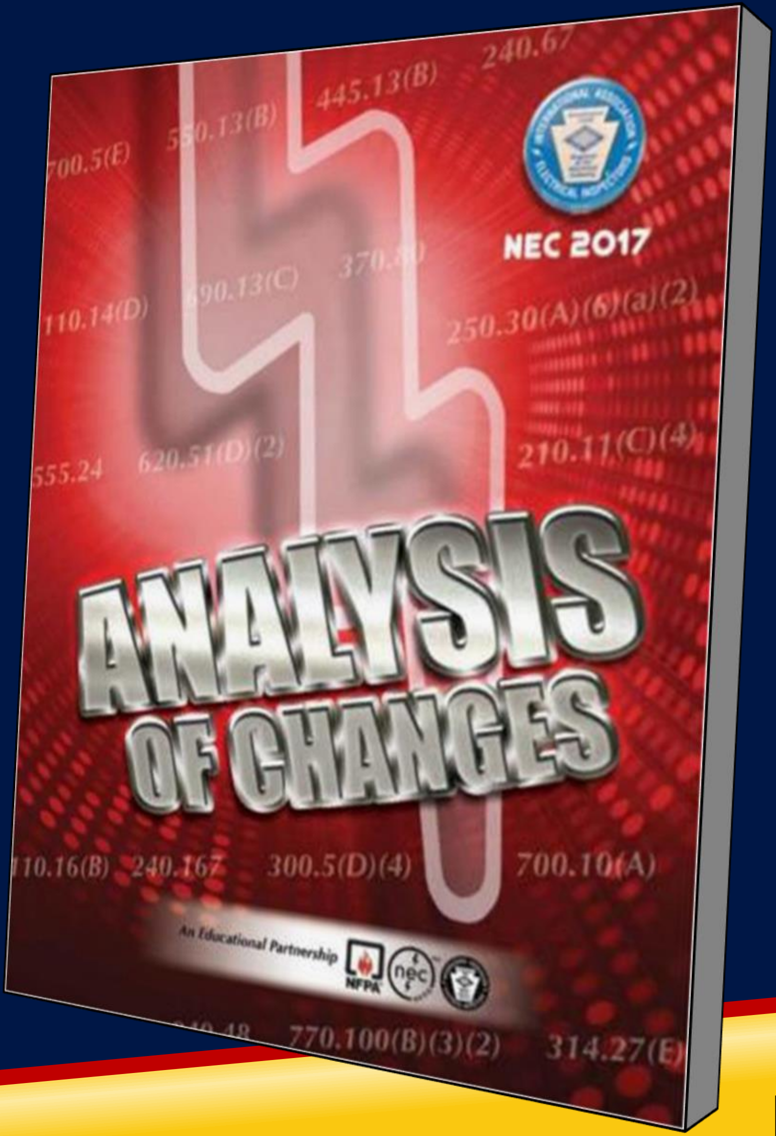

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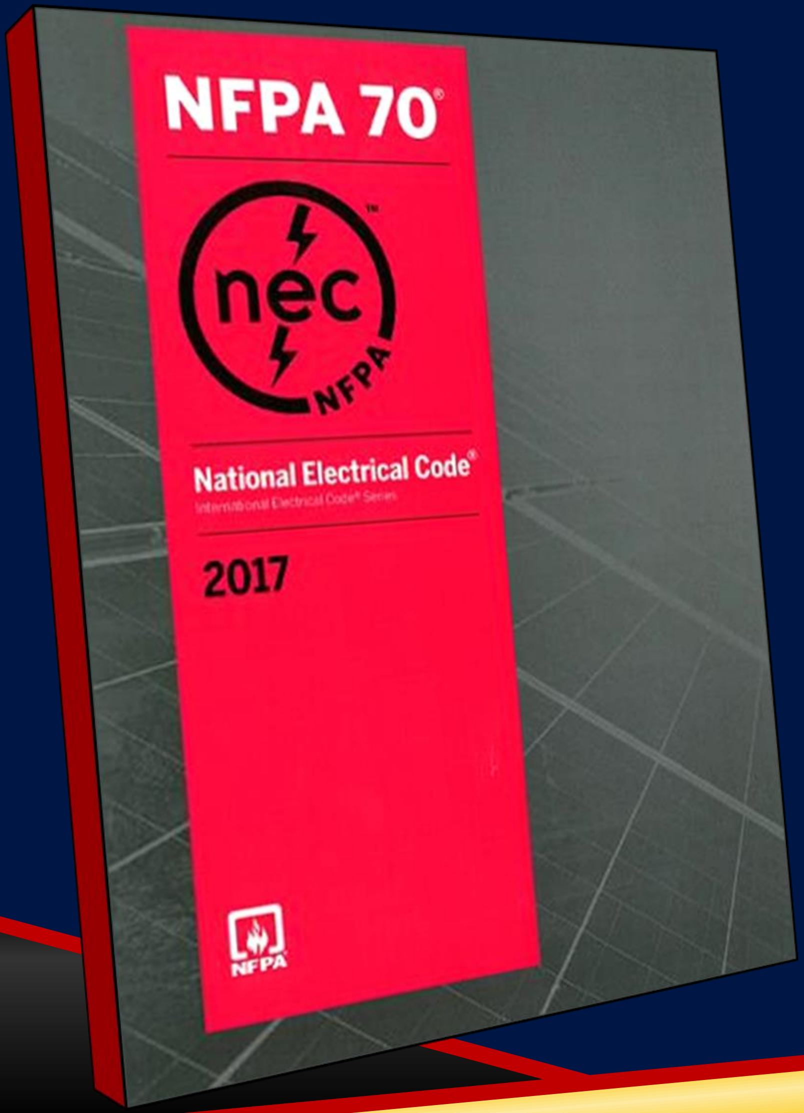

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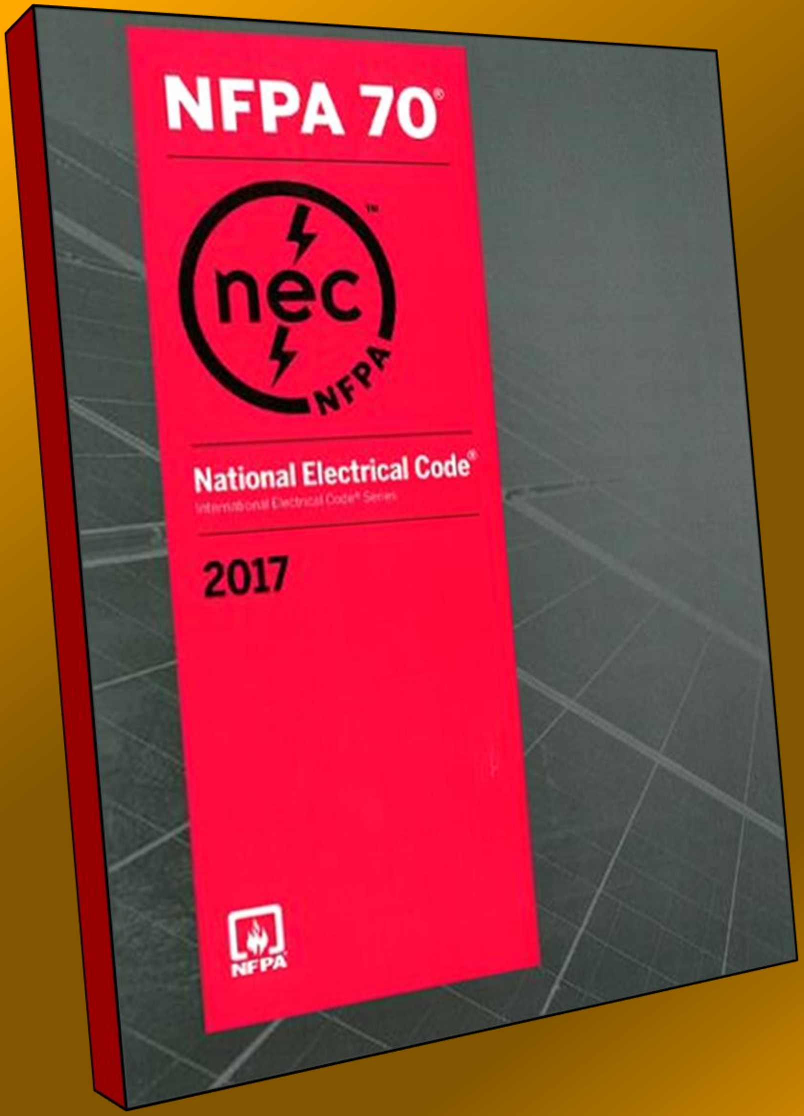
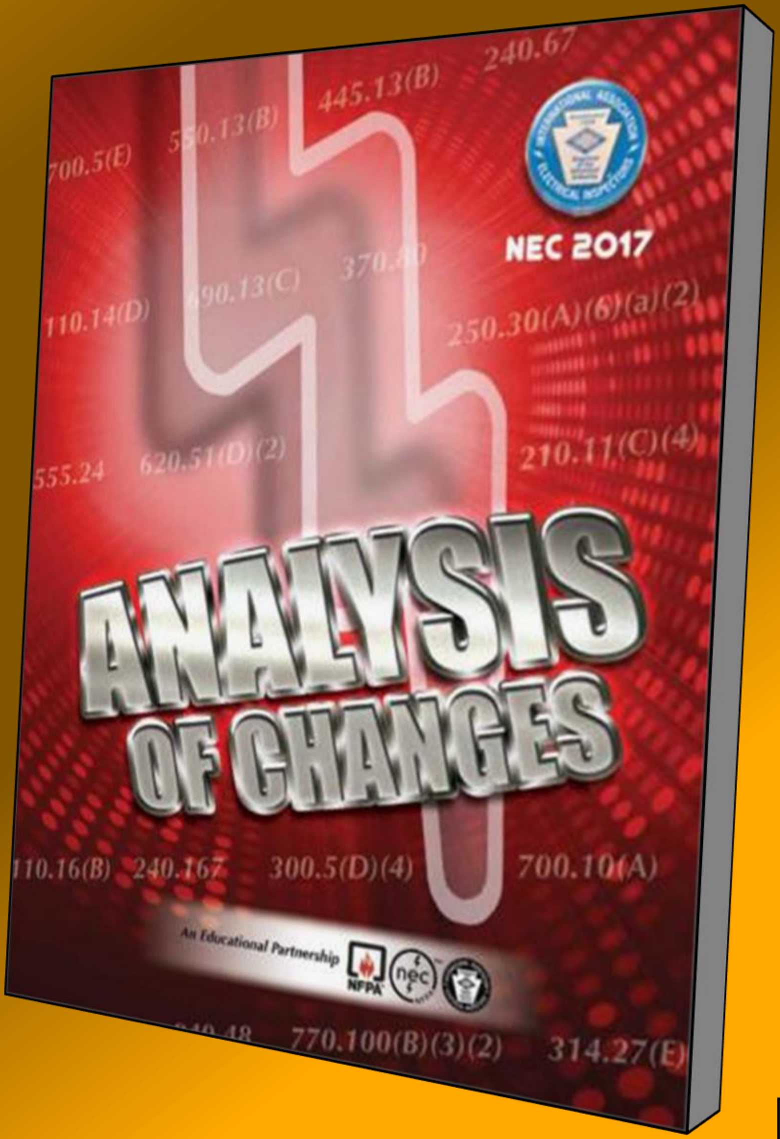
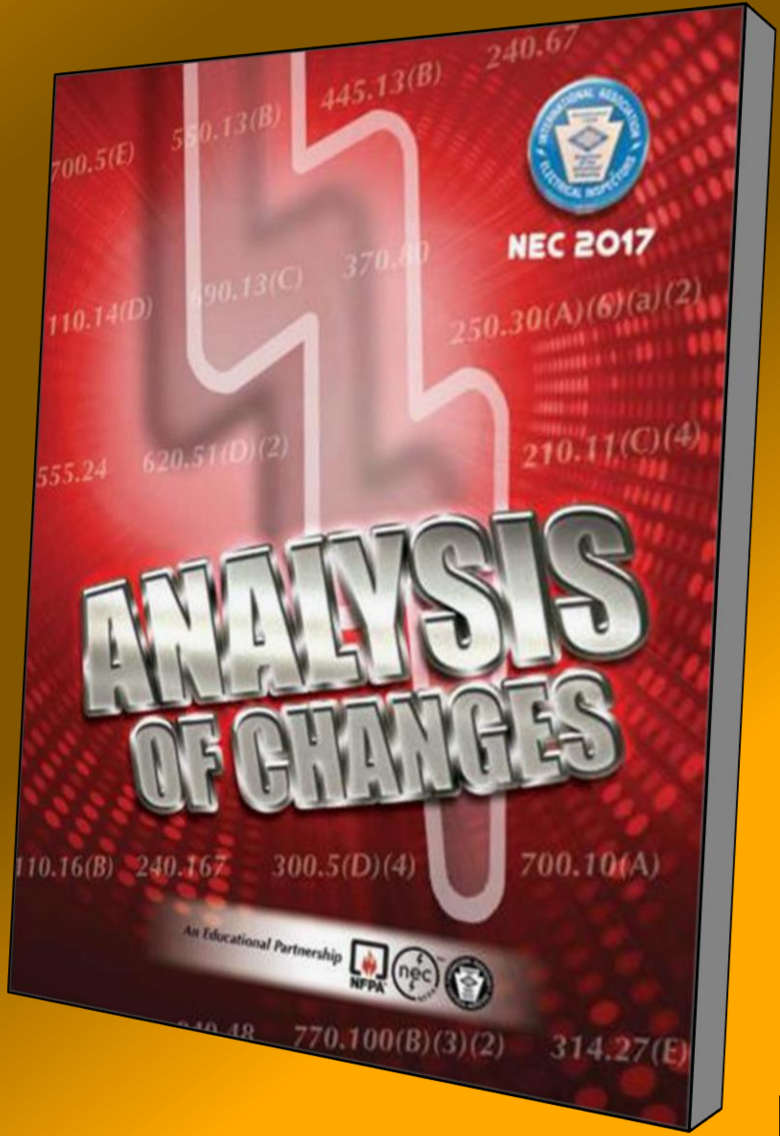
Analysis of Changes-2017 NEC





Analysis of Changes-2017 NEC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ANALYSIS OF CHANGES

700.5(E) 550.13(B) 445.13(B) 240.67 110.14(D) 690.13(C) 370.80 250.30(A)(6)(a)(2) 555.24 620.51(D)(2) 210.11(C)(4) 110.16(B) 240.167 300.5(D)(4) 700.10(A) 770.100(B)(3)(2) 314.27(E)

An Educational Partnership

Chapter Five
Special Occupancies

500.2 Definitions Moved to Article 100

- Fourteen existing definitions have been **relocated** to Article 100 from 500.2
- Article 500, and in particular 500.2 has been a safe “landing spot” for any definition that applied to more than one hazardous *(classified)* location article rather than locate these multi-article definitions in Article 100 *(as prescribed by the NEC Style Manual)*
- To comply with the *NEC* Style Manual, fourteen definitions that were located at 500.2 have been relocated to Article 100
- Relocated hazardous *(classified)* location definitions will include the term **“[as applied to Hazardous *(Classified)* Locations]**” immediately following the identification of the defined term prior to the actual definition

~~500.2~~ Article 100 - Definitions

Fourteen definitions that resided at 500.2 in previous editions of the *Code* have been relocated to Article 100 of the *NEC*

- **Combustible Dust**
- **Combustible Gas Detection System**
- **Control Drawing**
- **Dust-Ignitionproof**
- **Dusttight**
- **Hermetically Sealed**
- **Nonincendive Circuit**
- **Nonincendive Component**
- **Nonincendive Equipment**
- **Nonincendive Field Wiring**
- **Nonincendive Field Wiring Apparatus**
- **Oil Immersion**
- **Purged and Pressurized**
- **Unclassified Locations**

These relocated hazardous *(classified)* location definitions will include the phrase "[as applied to Hazardous *(Classified)* Locations]" at each of these Article 100 definitions

500.5(A)

~~Classifications of Locations~~ General

- Title of 500.5(A) changed from "Classifications of Locations" to "**General**" as 500.5(A) applies to all of 500.5 *[including 500.5(B), (C), and (D)]*
- Revisions to 500.5(A) clarify that "**refrigerant machinery rooms**" containing ammonia refrigeration may be classified as "**unclassified**" locations based on the use of gas detection and adequate ventilation
- "Adequate ventilation" defined as "continuous or initiated by a detection system at a concentration not exceeding 150 ppm (parts per million)"
- Harmonizes with applicable standards that govern ammonia refrigeration systems *(ANSI/IIAR 2 and ANSI/ASHRAE 15)*

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 concentrations	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

Deletion of Table 500.8(D)(2) Class II Temperatures

- Previous **Table 500.8(D)(2)** Class II Temperatures has been **deleted**
- Previous table is no longer applicable as the **fixed ignition temperature limits** referenced in the table are **no longer used** to evaluate Class II temperature limitations on equipment
- Requirement for maximum surface temperature for Class II dust locations changed from the fixed limits to the **temperature class numbers** during 2002 *NEC* revision cycle

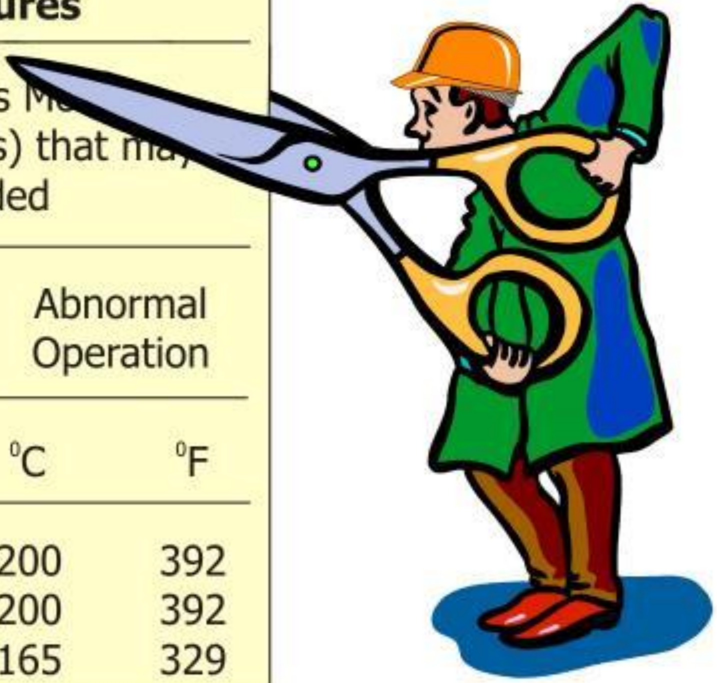
Table 500.8(D)(2) Deleted

Previous Table 500.8(D)(2) has been deleted as the table is no longer applicable

Fixed ignition temperature limits referenced in the table are no longer used to evaluate Class II temperature limitations on equipment

Table 500.8(D)(2) - Class II Temperatures

	Equipment Not Subject to Overloading		Equipment (Such as M Power Transformers) that ma be overloaded			
			Normal Operation		Abnormal Operation	
Class II Group	°C	°F	°C	°F	°C	°F
E	200	392	200	392	200	392
F	200	392	150	302	200	392
G	165	329	120	248	165	329



501.10(B)(1)
Wiring Methods for Class I, Division 2

- **Rigid metal conduit** (RMC) and **intermediate metal conduit** (IMC) with listed threadless fittings as well as **cablebus** added as acceptable wiring methods in Class I, Division 2 locations
- Class I, Division 2 locations are locations in which volatile flammable gases, flammable liquid-produced vapors, or combustible liquid-produced vapors are handled, processed, or used
- Some cables with threadless fittings already permitted to be installed in Class I, Division 2 locations
- Cablebus provides a level of safety equivalent to the other wiring methods permitted for Class I, Division 2 locations *(such as cable tray)*

501.10(B)(1) Class I, Division 2

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

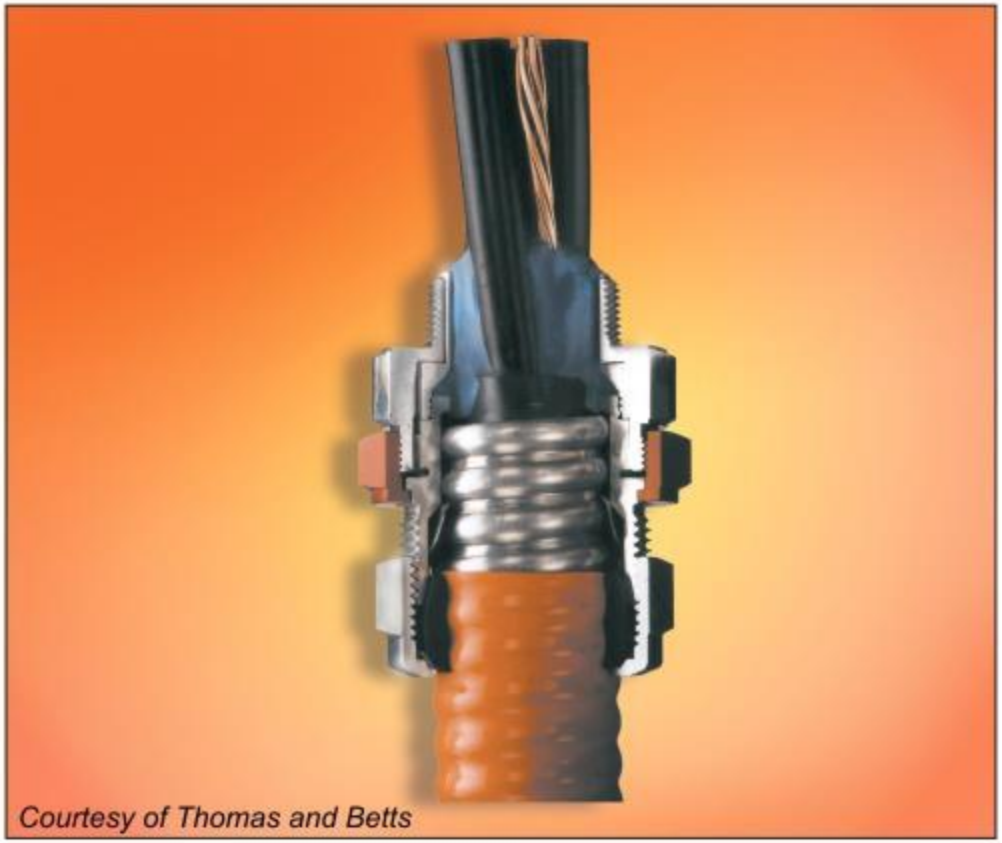
Class I, Division 2 location

501.15(D)(1)
Cable Seals - Class I, Division 1

- Text added to identify the **explosionproof fittings** that can be installed between a cable seal and an enclosure in Class I, Division 1 locations
- Only **explosionproof unions**, **couplings**, **reducers**, **elbows**, and **capped elbows** that are not larger than the trade size of the enclosure entry are permitted between the cable sealing fitting and the enclosure in a Class I, Division 1 location
- Some explosionproof enclosures require seal fittings to be located as much as 450 mm (18 in.) away and are so marked
- This situation lends itself to fittings being installed between the enclosure and a cable seal

501.15(D)(1) Cable Seals - Class I Division 1

Seals for cables entering enclosures shall be installed within 450 mm (18 in.) of the enclosure or as required by the enclosure marking



Courtesy of Thomas and Betts

Only explosionproof unions, couplings, reducers, elbows, and capped elbows that are not larger than the trade size of the enclosure entry are permitted between the sealing fitting and the enclosure

Table 511.3(C) and Table 511.3(D)

- Two new tables added at 511.3 for clarification of area classification of **major** and **minor** commercial repair garages
  - **Table 511.3(C)** Extent of Classified Locations for Major and Minor Repair Garages with Heavier-Than-Air Fuel
  - **Table 511.3(D)** Extent of Classified Locations for Major Repair Garages with Lighter-than-Air Fuel
- Previous requirements of 511.3(C) and (D) were replaced with a new Table 511.3(C) covering **both major and minor repair garages** where **heavier than air** gaseous Class I liquids are transferred or dispensed
- New Table 511.3(D) covers **major repair garages** where vehicles using **lighter than air** gaseous fuels are repaired or stored

Table 511.3(C) and Table 511.3(D) *(cont.)*

- **Major Repair Garage**. A building or portions of a building where major repairs, such as engine overhauls, painting, body and fender work, and repairs that require draining of the motor vehicle fuel tank are performed on motor vehicles, including associated floor space used for offices, parking, or showrooms.
- **Minor Repair Garage**. A building or portions of a building used for lubrication, inspection, and minor automotive maintenance work, such as engine tune-ups, replacement of parts, fluid changes (e.g., oil, antifreeze, transmission fluid, brake fluid, air-conditioning refrigerants), brake system repairs, tire rotation, and similar routine maintenance work, including associated floor space used for offices, parking, or showrooms.
- See 511.2

Table 511.3(C) Extent of Classified Locations for Major and Minor Repair Garages with Heavier-Than-Air Fuel

(Part 1 of 2)

Location	Class I Division (Group D)	Class I Zone (Group IIA)	Extent of Classified Locations
Repair garage, major (where Class I liquids or gaseous fuels are transferred or dispensed*)	1	1	Entire space within any pit, below-grade work area, or subfloor work area that is not ventilated
	2	2	Entire space within any pit, below-grade work area, or subfloor work area that is provided with ventilation of at least 0.3 $m^3/min/m^2$ (1 $ft^3/min/ft^2$) of floor area, with suction taken from a point within 300 mm (12 in.) of floor level
	2	2	Up to 450 mm (18 in.) above floor level of the room, except as noted below, for entire floor area
	Unclassified	Unclassified	Up to 450 mm (18 in.) above floor level of the room where room is provided with ventilation of at least 0.3 $m^3/min/m^2$ (1 $ft^3/min/ft^2$) of floor area, with suction taken from a point within 300 mm (12 in.) of floor level
	2	2	Within 0.9 m (3 ft) of any fill or dispensing point, extending in all directions
Specific areas adjacent to classified locations	Unclassified	Unclassified	Areas adjacent to classified locations where flammable vapors are not likely to be released, such as stock rooms, switchboard rooms, and other similar locations, where mechanically ventilated at a rate of four or more air changes per hour or designed with positive air pressure or where effectively cut off by walls or partitions

*Includes draining of Class I liquids from vehicles.

Table 511.3(C) Extent of Classified Locations for Major and Minor Repair Garages with Heavier-Than-Air Fuel

(Part 2 of 2)

Location	**Class I**		**Extent of Classified Locations**
	Division (Group D)	**Zone (Group IIA)**	
Repair garage, minor (where Class I liquids or gaseous fuels are transferred or dispensed*)	2	2	Entire space within any pit, below-grade work area, or subfloor work area that is not ventilated
	2	2	Up to 450 mm (18 in.) above floor level, extending 0.9 m (3 ft) horizontally in all directions from opening to any pit, below-grade work area, or subfloor work area that is not ventilated
	Unclassified	Unclassified	Entire space within any pit, below-grade work area, or subfloor work area that is provided with ventilation of at least 0.3 $m^3/min/m^2$ (1 $ft^3/min/ft^2$) of floor area, with suction taken from a point within 300 mm (12 in.) of floor level
Specific areas adjacent to classified locations	Unclassified	Unclassified	Areas adjacent to classified locations where flammable vapors are not likely to be released, such as stock rooms, switchboard rooms, and other similar locations, where mechanically ventilated at a rate of four or more air changes per hour or designed with positive air pressure or where effectively cut off by walls or partitions

*Includes draining of Class I liquids from vehicles.

Table 511.3(D) Extent of Classified Locations for Major Repair Garages with Lighter-Than-Air Fuel

	Class I		
Location	**Division**[2]	**Zone**[3]	**Extent of Classified Locations**
Repair garage, major (where lighter-than-air gaseous fueled[1] vehicles are repaired or stored)	2	2	Within 450 mm (18 in.) of ceiling, except as noted below
	Unclassified	Unclassified	Within 450 mm (18 in.) of ceiling where ventilation of at least 0.3 $m^3/min/m^2$ (1 $ft^3/min/ft^2$) of floor area, with suction taken from a point within 450 mm (18 in.) of the highest point in the ceiling
Specific areas adjacent to classified locations	Unclassified	Unclassified	Areas adjacent to classified locations where flammable vapors are not likely to be released, such as stock rooms, switchboard rooms, and other similar locations, where mechanically ventilated at a rate of four or more air changes per hour or designed with positive air pressure or where effectively cut off by walls or partitions

[1] Includes fuels such as hydrogen and natural gas, but not LPG.

[2] For hydrogen (lighter than air) Group B, or natural gas Group D.

[3] For hydrogen (lighter than air) Group IIC or IIB+H2, or natural gas Group IIA.


NO STEP
DANGER
BRAKE FLUSH SYSTEM
RTI
FluidPRO

511.8 Underground Wiring - Commercial Garages, Repair and Storage

- New section added to address **acceptable wiring methods** for an underground installation under a commercial repair garage

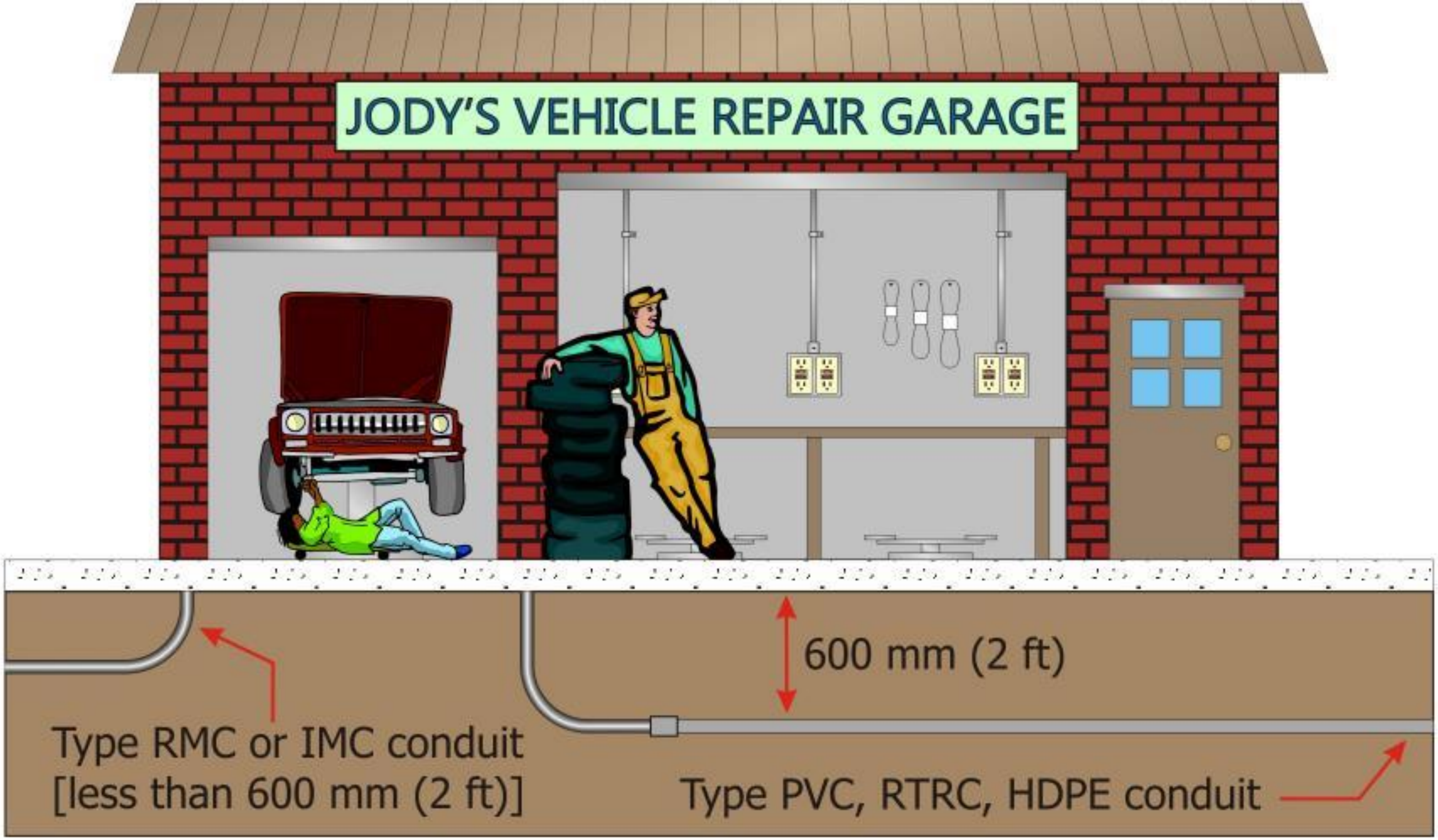
- Underground wiring method for a commercial repair garage to be installed in **threaded rigid metal conduit** (RMC) or **threaded steel intermediate metal conduit** (IMC)

- New exception permits **PVC** conduit, **RTRC** conduit, and high density polyethylene (**HDPE**) conduit to be used where buried under not less than **600 mm (2 ft)** of cover

- Added text patterned after similar underground wiring provisions such as 514.8 and 515.8(A)

511.8 Underground Wiring

Underground wiring method for a commercial repair garage to be installed in threaded RMC conduit or threaded steel IMC conduit



Type PVC, RTRC, and HDPE conduit permitted to be used where buried under not less than 600 mm (2 ft) of cover

514.3(B)(3) Classification of Fuel Storage - Motor Fuel Dispensing Facilities

- New classification information for storage tanks for **compressed natural gas**, **liquefied natural gas**, and **liquefied petroleum gas** fuel storage has been added
- References to other NFPA documents that offer further detail were also added
- Modern storage tanks for these gases are typically full containment type, which has a pre-stressed concrete outer wall and a high-nickel steel inner tank, with extremely efficient insulation between the walls
- New information is extracted material from **NFPA 30A** *(Code for Motor Fuel Dispensing Facilities and Repair Garages)*


NO SMOKING
FLAMMABLE
PROPANE
NORTHWEST

514.8 Ex. No. 2 Underground Wiring - Motor Fuel Dispensing Facilities

- **High density polyethylene (HDPE)** conduit was added to 514.8, Ex. No. 2 as an acceptable wiring method for underground installations for motor fuel dispensing facilities where buried under not less than **600 mm (2 ft)** of cover

- HDPE provides at least the same level of protection and is an equivalent wiring method to PVC or RTRC when installed underground under not less than 600 mm (2 ft) of cover

- HDPE is a nonmetallic flexible raceway manufactured from high density polyethylene for use in underground and innerduct applications

514.8 Ex. No. 2 Underground Wiring

Underground wiring for motor fuel dispensing facilities is required to be installed in threaded RMC or threaded steel IMC

Photos Courtesy of Carlon

High density polyethylene (HDPE) conduit *(along with Type PVC and RTRC conduit)* was added as an acceptable wiring method for underground installations for motor fuel dispensing facilities where buried under not less than 600 mm (2 ft) of cover

514.11 Circuit Disconnects – Motor Fuel Dispensing Facilities

- Emergency shutoff device requirements for a motor fuel dispensing facilities was revised to reflect the requirements of NFPA 30A and for clarity
- Fuel dispensing systems required to be provided with one or more clearly identified emergency shutoff devices or electrical disconnects
- Such devices or disconnects to be installed in approved locations but **not less than 6 m (20 ft) or more than 30 m (100 ft)** from the fuel dispensing devices that they serve
- 514.11 revised to clearly indicate that these minimum and maximum distances hold true at both **attended** and **unattended** motor fuel dispensing facilities

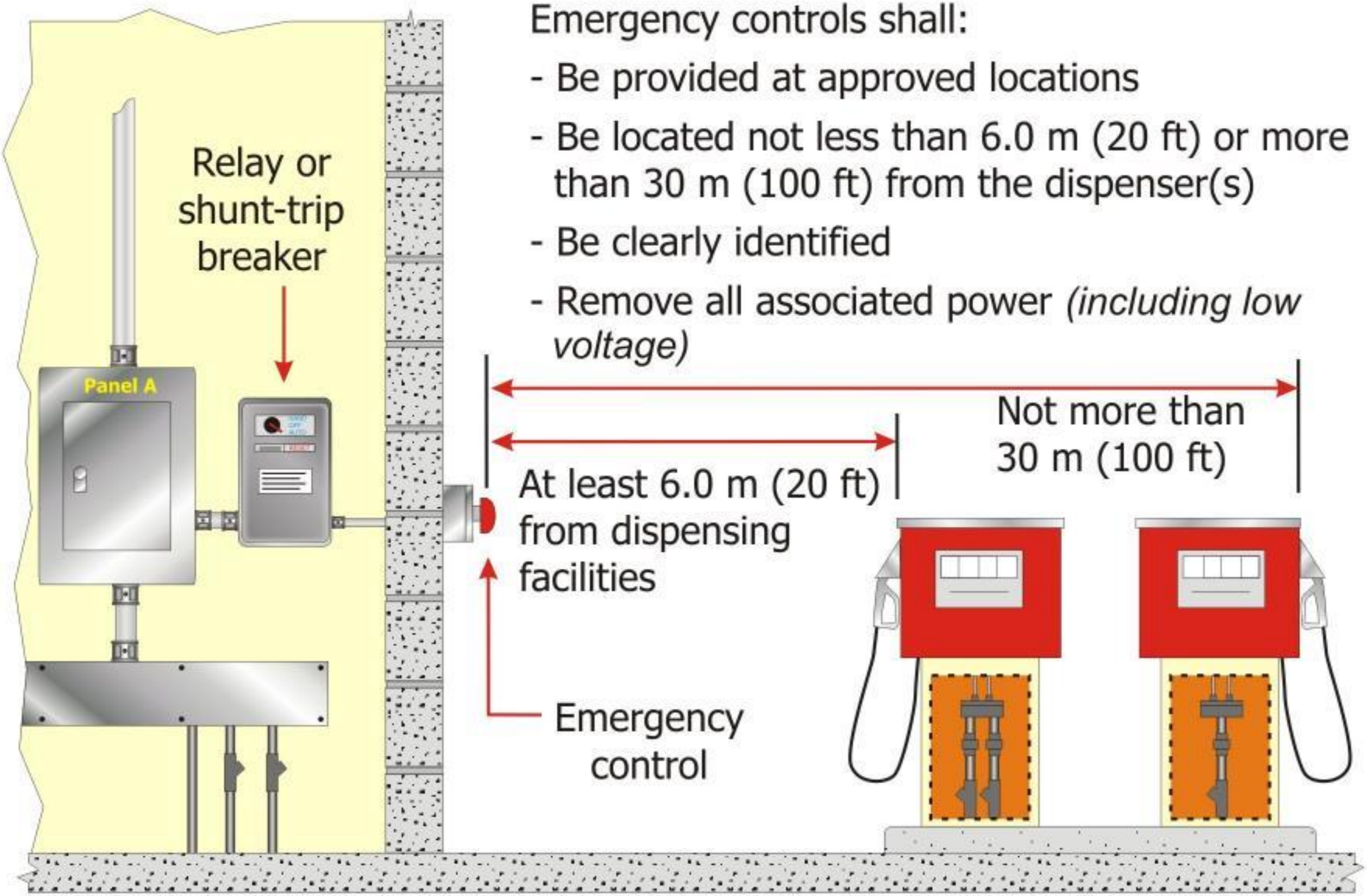
514.11 Circuit Disconnects – Motor Fuel Dispensing Facilities *(cont.)*

- Previous language could be interpreted as requiring emergency controls to be within 30 m (100 ft) of the **closest dispenser of a group** while allowing the other dispensers to be located further than 30 m (100 ft) from emergency control device
- Revised language clearly requires emergency shutoff device not less than 6 m (20 ft) from and not more than 30 m (100 ft) from **any of the fuel dispensing devices that they serve**
- Allows attendant or anyone the ability to quickly shut off all external power to a dispenser at a **safe distance** while having the emergency shutoff devices located within a **reasonable distance** in order to take advantage of these emergency shutoff devices during an emergency situation

514.11 Emergency Controls for Fuel Dispensers

Emergency controls shall:

- Be provided at approved locations
- Be located not less than 6.0 m (20 ft) or more than 30 m (100 ft) from the dispenser(s)
- Be clearly identified
- Remove all associated power *(including low voltage)*



Relay or shunt-trip breaker

Not more than 30 m (100 ft)

At least 6.0 m (20 ft) from dispensing facilities

Emergency control

Applies to both Attended and Unattended motor fuel dispensing facilities


EMERGENCY PUMP SHUT-OFF SWITCH
BUC-EE'S


BUC-EE'S
EMERGENCY PUMP SHUT OFF
EMERGENCY PUMP SHUT OFF
BUC-EE'S

Article 516 Entire Article Revised

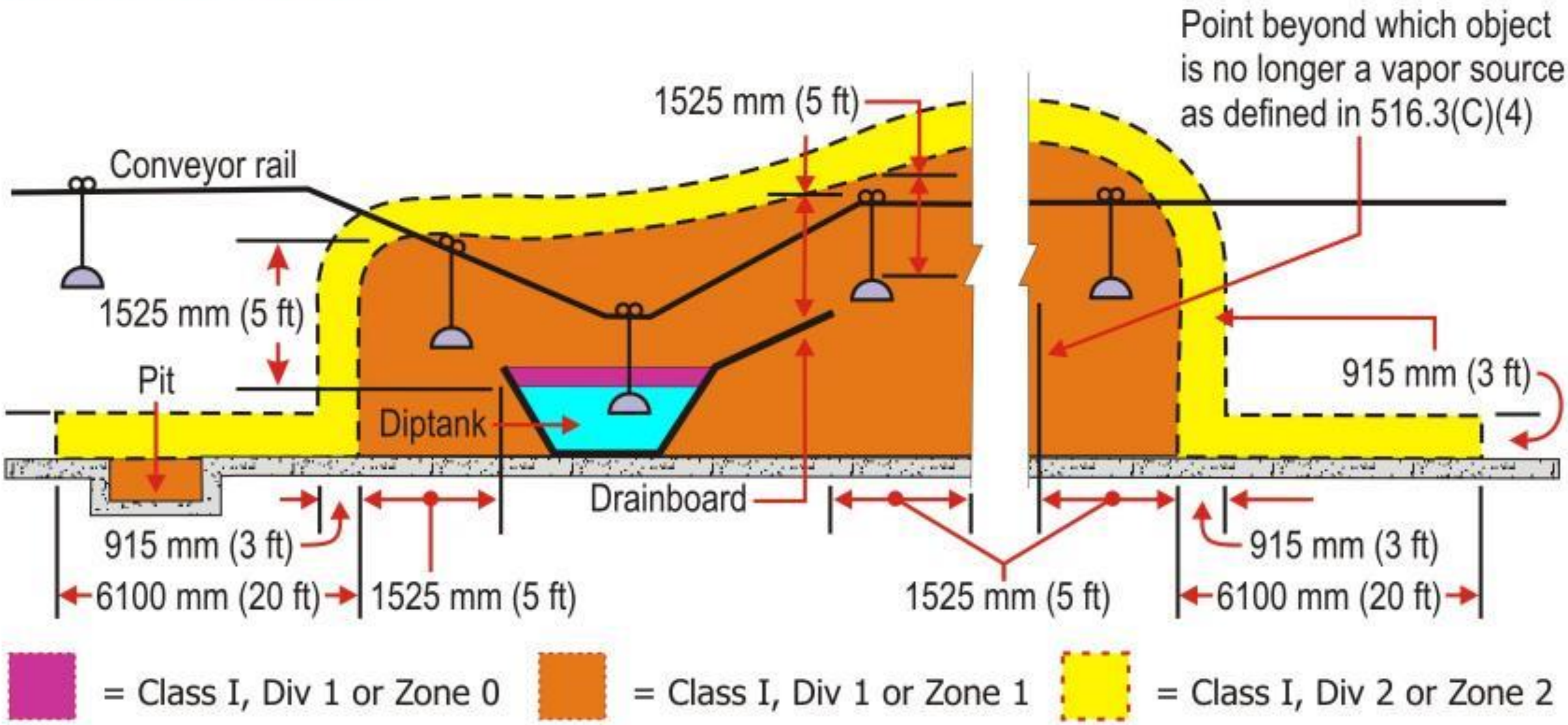
Spray Application, Dipping, Coating, and Printing Processes Using Flammable or Combustible Materials

- Article 516 was re-arranged and revised to give the article a clearer outline
- Four individual parts were added to the article
  - Part I. General
  - Part II. Open Containers
  - Part III. Spray Application Processes
  - Part IV. Spray Application Operations in Membrane Enclosures
- Requirements now align with **NFPA 33** *(Standard for Spray Application Using Flammable and Combustible Materials)* and **NFPA 34** (*Standard for Dipping, Coating, and Printing Processes Using Flammable or Combustible Liquids)*

Article 516: Entire Article Revised

Article 516 Spray Application, Dipping, Coating, and Printing Processes Using Flammable or Combustible Materials

Article 516 was extensively revised for clarity and to align with NFPA 33 *Standard for Spray Application Using Flammable and Combustible Materials* and NFPA 34 *Standard for Dipping, Coating, and Printing Processes Using Flammable or Combustible Liquids*



🟪 = Class I, Div 1 or Zone 0

🟧 = Class I, Div 1 or Zone 1

🟨 = Class I, Div 2 or Zone 2

Figure 516.29(a) Electrical Area Classification for Open Dipping and Coating Processes Without Vapor Containment or Ventilation

517.2 Definitions: Governing Body - Health Care Facilities

- New definition for "**Governing Body**" added to Article 517

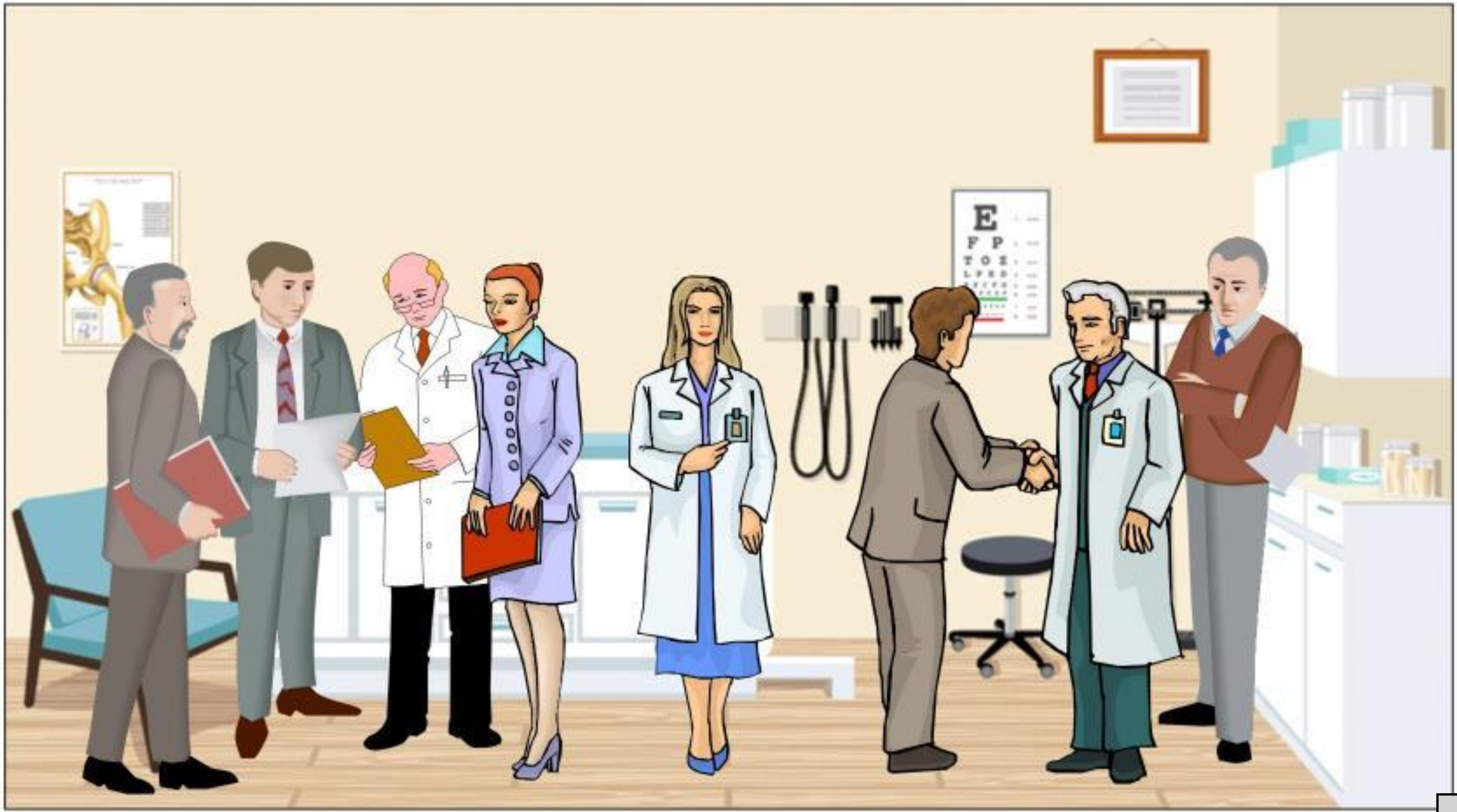
- Term "governing body" appears at 7 different locations in Article 517

- New definition will be followed by "[99: 3.3.62]" as this is **extracted material from NFPA 99** *(Healthcare Facilities Code)*

- New definition will eliminate some of the confusion that may exist for users of the *Code* when trying to determine who has responsibility for making decisions on certain matters in a health care facility

517.2 Definitions (Health Care Facilities)

Governing Body. The person or persons who have the overall legal responsibility for the operation of a health care facility.



517.2 Definitions: Health Care Facilities

- Definition of "Health Care Facility" was revised to include "**mobile enclosures**"
- Examples of a health care facility that were included in the definition in the previous edition of the *Code* are now found in an informational note below the revised definition
- Revised definition is extracted material from NFPA 99 *(Healthcare Facilities Code)*
- Health care facility is not limited to a traditional "brick and mortar" permanently constructed building
- Health care facility can include a **mobile or portable facility** such as a mobile blood bank or mobile facilities as seen at sporting events

517.2 Definitions (Health Care Facilities)

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]

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.

517.2 Definitions:
Medical Office (Dental Office)

- To define a well-used term in Article 517, a new definition for "**Medical Office (Dental Office)**" was added at 517.2
- New definition will provide needed clarity when determining health care facility requirements such as branch circuit requirements at patient bed locations
- New definition will make it clear that overnight stays for patients or 24-hour operation facilities do not encompass a medical or dental office

517.2 Definitions:
Medical Office (Dental Office) *(cont.)*

- To define a well-used term in Article 517, a new definition for "**Medical Office (Dental Office)**" was added at 517.2 *(cont.)*

- The use of **sedation or local anesthesia** is involved in minor treatment or procedures under the continuous supervision of a medical or dental professional would be involved at a medical or dental office

- New definition is extracted material from NFPA 99 *(Health Care Facilities Code)*

517.2 Definitions (Health Care Facilities)

Medical Office (Dental Office). A building or part thereof in which the following occur:

(1) Examinations and minor treatments or procedures are performed under the continuous supervision of a medical or dental professional;
(2) Only sedation or local anesthesia is involved and treatment or procedures do not render the patient incapable of self-preservation under emergency conditions; and
(3) Overnight stays for patients or 24-hour operation are not provided. [99: 3.3.98]

517.2 Definitions: Patient Care Space - Health Care Facilities

- Revised definition of "Patient Care Space" will include four NFPA 99 numbered categories for:
  - Basic Care **(Category 3)** Space
  - General Care **(Category 2)** Space
  - Critical Care **(Category 1)** Space
  - Support **(Category 4)** Space
- Bracketed NFPA 99 references were added after each description and informational note
- Informational notes were relocated after each definition with examples of each of the different categories
- Revised definitions and the related informational notes will help clarify the meaning and use of these spaces

517.2 Definitions (Health Care Facilities)

Definition for “**Patient Care Space**” was revised for clarity and to align with definitions in NFPA 99

Basic Care (Category 3) Space:
- Examination or treatment rooms in clinics
- Medical and dental offices
- Nursing homes
- Limited care facilities

Critical Care (Category 1) Space:
- Special care unit 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

General Care (Category 2) Space:
- Inpatient bedrooms
- Dialysis rooms
- In vitro fertilization rooms
- Procedural rooms
- Similar rooms

Support (Category 4) Space:
- Anesthesia work rooms
- Sterile supply
- Laboratories
- Morgues
- Waiting rooms
- Utility rooms
- Lounges

517.16
Use of Isolated Ground Receptacles

- Revisions divided 516.16 into two subdivisions for prohibition of isolated ground receptacles:
  - (A) Inside of a Patient Care Vicinity
  - (B) Outside of a Patient Care Vicinity
- New provisions identify the requirement of ***three*** grounding paths when isolated ground receptacles are required *[metal raceway equipment grounding path, green wire type equipment grounding conductor for the 517.13 "redundant grounding" requirements, and a separate isolated ground equipment grounding conductor to comply with 250.146(D)]*
- Color designation of **green with one of more yellow stripes** required for the isolated ground EGC

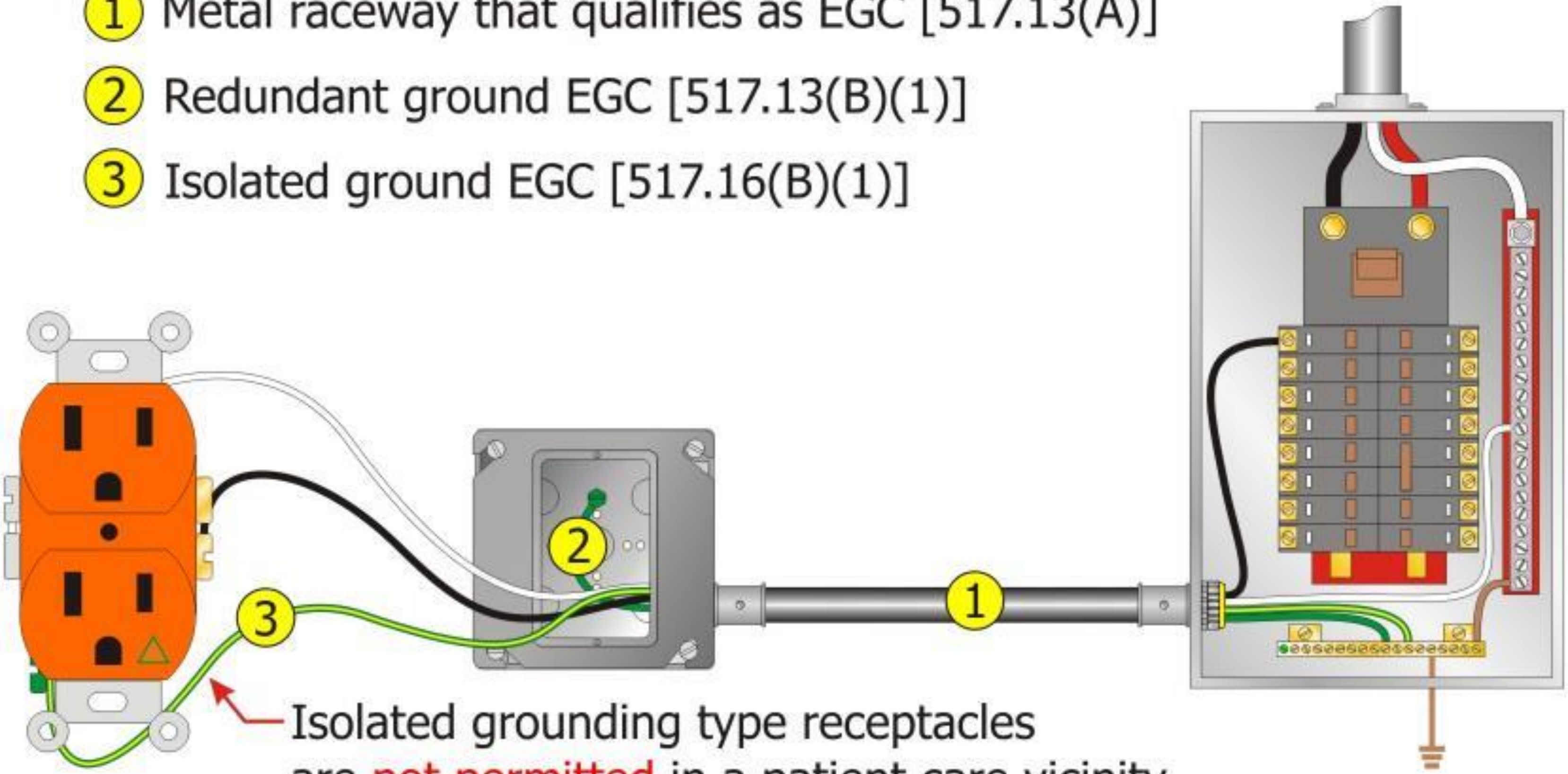
517.16 Use of Isolated Ground Receptacles

New provisions were added to 517.16 pertaining to the proper installation of isolated ground receptacles located outside of a patient care vicinity

① Metal raceway that qualifies as EGC [517.13(A)]

② Redundant ground EGC [517.13(B)(1)]

③ Isolated ground EGC [517.16(B)(1)]



Isolated grounding type receptacles are not permitted in a patient care vicinity

The probation of isolated ground receptacle inside a patient care vicinity are addressed at 517.16(A) and isolated ground receptacles installed outside a patient care vicinity are addressed at 517.16(B)

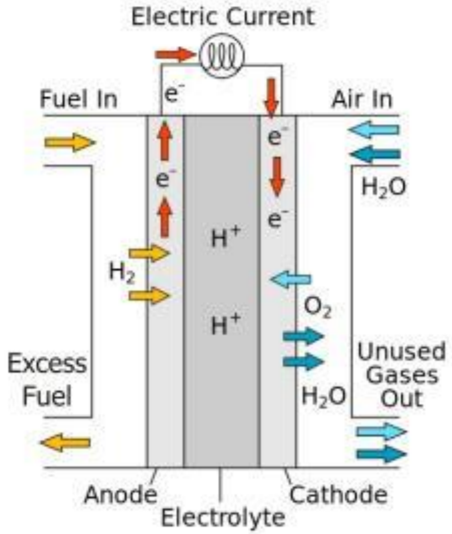
517.30 Types of Power Sources for Essential Electrical System - Health Care Facilities

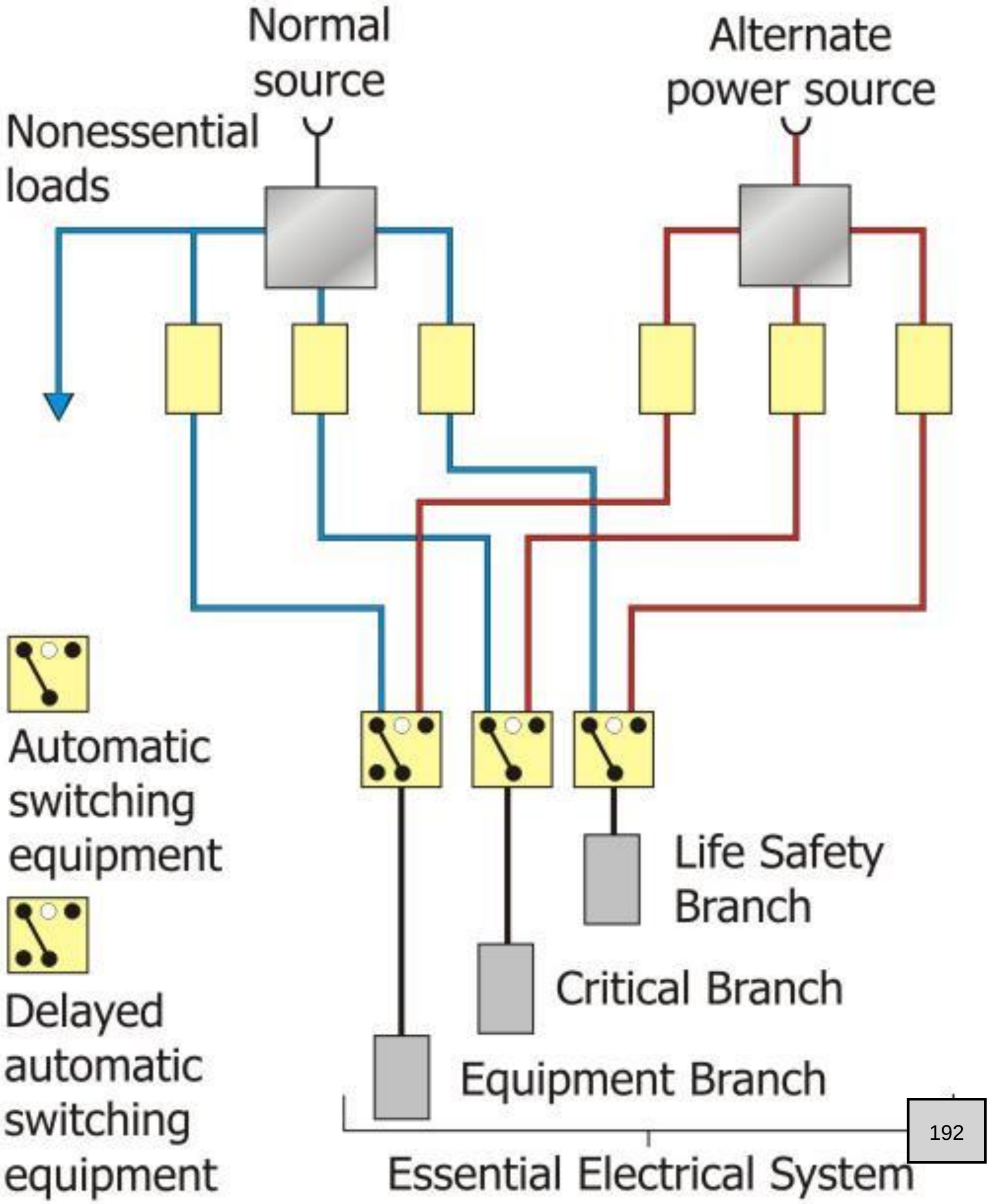
- Requirements for **two independent sources of power** and an alternate source of power for the essential electrical system for hospitals and other health care facilities were revised and relocated to 517.30
- **Fuel cell systems** will now be permitted to serve as the alternate source for all or part of an essential electrical system as any reference to a battery system has been deleted
- Fuel cells provide a **high level of reliability** and have a proven reliability track record in data centers and other mission critical facilities
- Relocation and revision of "**Sources of Power**" requirements from 517.35 to 517.30 provides a more logical sequence and flow of the text while providing added clarity

517.30(B) Sources of Power Essential Electrical System (Hospital)

Requirements for two independent sources of power and an alternate source of power for the essential electrical system for hospitals and other health care facilities were revised and relocated to 517.30 *(was 517.35)*

Fuel cell systems will now be permitted to serve as the alternate source for all or part of an essential electrical system





Normal source

Alternate power source

Nonessential loads

Automatic switching equipment

Delayed automatic switching equipment

Life Safety Branch

Critical Branch

Equipment Branch

Essential Electrical System

Photo Courtesy of Scott Humphrey

517.34(B) Switching on Critical Branch

- New language was added to specifically allow the **control of task illumination** on the critical branch of the essential electrical system *(switching permitted)*

- Task illumination is the "provision for the minimum lighting required to carry out necessary tasks in the described areas, including safe access to supplies and equipment, and access to exits"

- Critical task illumination lighting is provided in part for the comfort and convenience of the patient

- This lighting should be allowed to be controlled by the patient at his or her own discretion

Hill-Rom

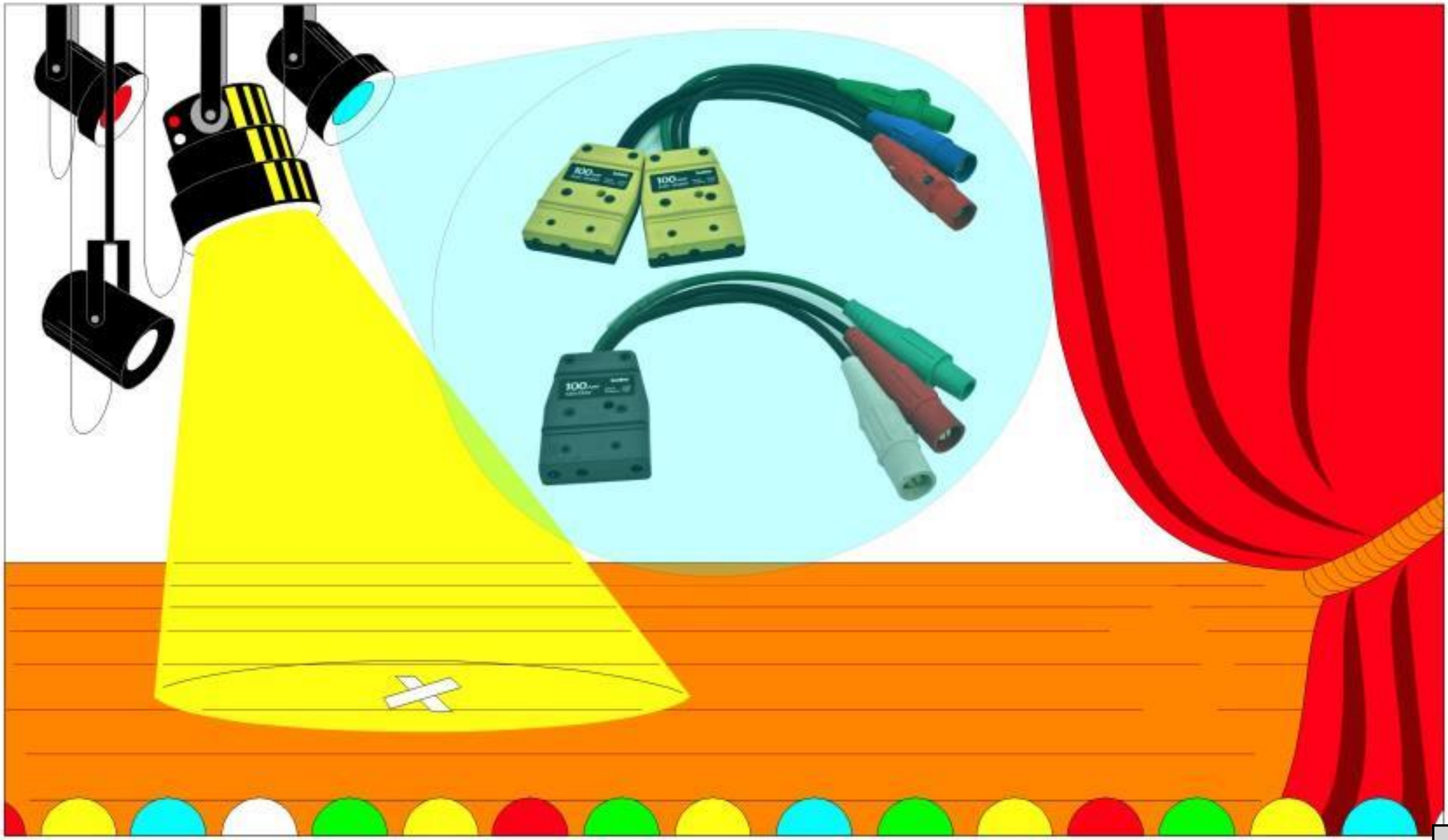
520.2 Definitions: Adapter –

Theaters, Audience Areas of Motion Picture and Television Studios, Performance Areas, and Similar Locations

- A new definition for “**Adapter**” was added to address misapplication of this term in Article 520
- Adapters are often used in these entertainment environments to connect multiple devices together or to a single source
- 520.69, titled “Adapters” details performance of “**two-fers**” and other single- and multiple-circuit outlet devices used as adapters
- Rules for adapters have sometimes been misapplied in the entertainment industry to portable extension cords
- Added definition was needed to correct field misapplication of adapters

520.2 Definitions: Adapter

Adapter. A device used to adapt a circuit from one configuration of an attachment plug or receptacle to another configuration with the same current rating.



520.2 Definitions: Stage Switchboard, Portable

Theaters, Audience Areas of Motion Picture and Television Studios, Performance Areas, and Similar Locations

- A new definition for "**Stage Switchboard, Portable**" was added and the phrase "permanently installed" was added to the existing definition of "Stage Switchboard"
- New definition for a portable stage switchboard clarifies that these devices can only feed stage equipment, while a permanent stage switchboard can feed both stage and non-stage equipment
- Some of the more common terms used for "switchboard" in the entertainment industry are "dimmer rack" or a "relay rack/panel" depending on its function

520.2 Definitions: Stage Switchboard

Stage Switchboard. A permanently installed switchboard, panelboard, or rack containing dimmers or relays with associated overcurrent protective devices, or overcurrent protective devices alone, used primarily to feed stage equipment.

Stage Switchboard, Portable. A portable rack or pack containing dimmers or relays with associated overcurrent protective devices, or overcurrent protective devices alone that are used to feed stage equipment.

525.23(D) GFCI Protection
Carnivals, Circuses, Fairs, and Similar Events

- New requirement for listed, labeled, and **identification for portable use** when said GFCI protection is provided through the use of GFCI receptacles, when the branch circuits supplying these receptacles utilize a **flexible cord**
- Portable GFCIs are plug-in type GFCIs provided with male blades or an integral power-supply cord for connection to a receptacle outlet
- Standard GFCI receptacle used at the end of a flexible cord is common at carnivals, fairs, etc.
- This same type of temporary GFCI installation has resulted in a number of documented fatalities on **construction sites**, which resulted in a comparable restriction at **590.6(A)(2)**

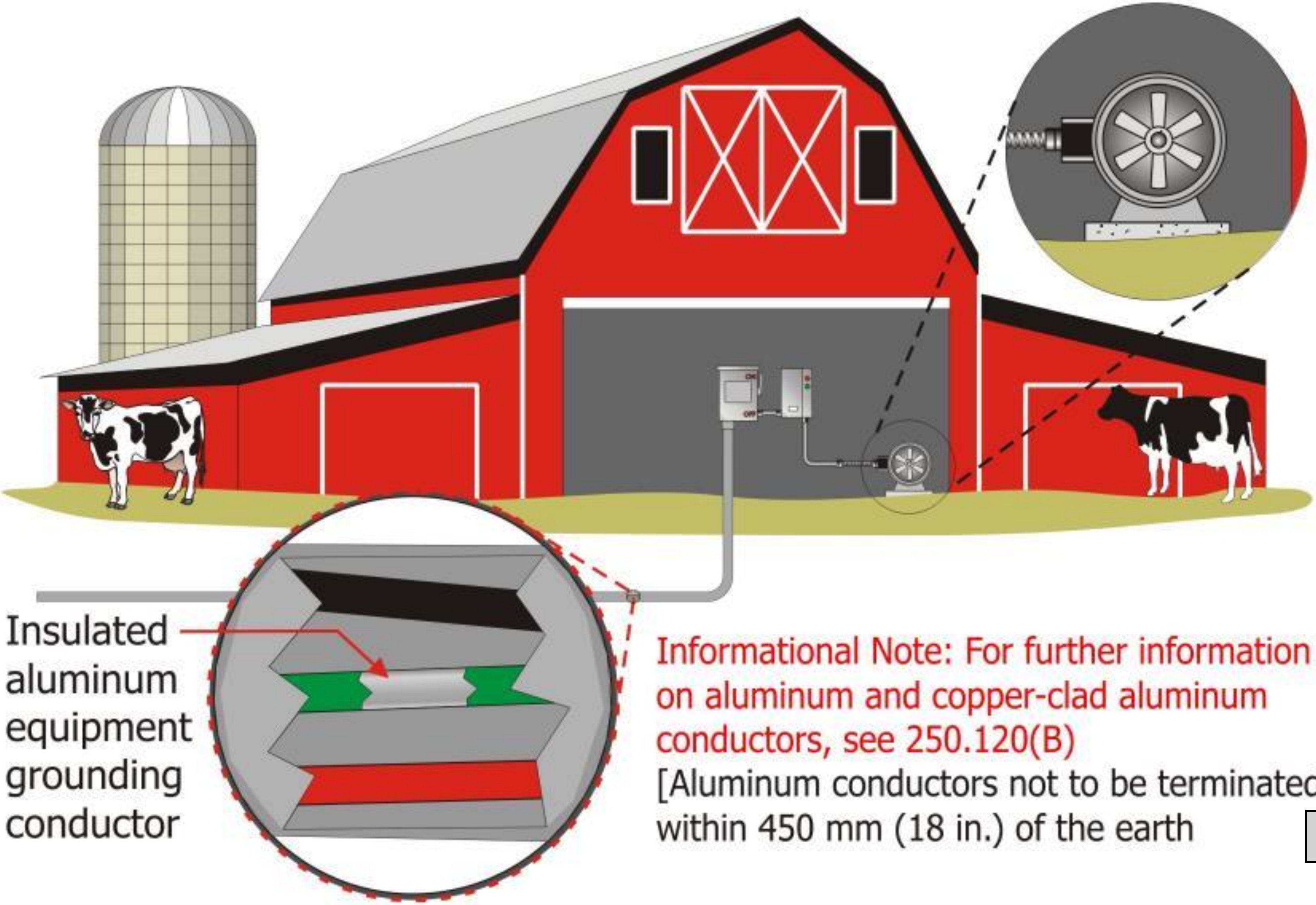

SUGAR SHACK
ICE CREAM
ICE COLD DRINKS

547.5(F) Separate Equipment Grounding Conductor for Agricultural Buildings

- A separate equipment grounding conductor (EGC) for an underground installation at an agricultural building must be insulated ***(covered conductor removed)***
- Further revision removed allowance of a “**covered**” conductor for underground applications at agricultural buildings
- “**Covered conductor**” is defined in Article 100 as “a conductor encased within material of composition or thickness that is *not recognized* by *[the NEC]* as electrical insulation”
- No safety standard, product standard, evaluation or testing of material placed on a conductor so it is considered "covered“

547.5(F) Separate EGC (Agricultural Buildings)

An insulated ~~or covered~~ aluminum or copper equipment grounding conductor is now permitted for underground agricultural building installations



Informational Note: For further information on aluminum and copper-clad aluminum conductors, see 250.120(B)

[Aluminum conductors not to be terminated within 450 mm (18 in.) of the earth

550.2 Definitions: Manufactured Home

- The existing definition for a "**manufactured home**" was revised for consistency with the definition of a "manufactured home" found in **NFPA 501** *(Standard on Manufactured Housing)*
- The last sentence of the definition was **revised to exclude park trailers**
- Park trailer is intended for seasonal use, not intended as a permanent dwelling unit or for commercial uses such as banks, clinics, offices, or similar uses
- Since 1976, the Federal Government *[Department of Housing and Urban Development (HUD)]* has regulated the construction of all manufactured and prefabricated homes

550.2 Definitions: Manufactured Home

- **Manufactured Home.** A structure, transportable in one or more sections, ~~that,~~ which in the traveling mode is 2.4 m (8 ~~body~~ ft) or more in width or 12.2 m (40 ~~body~~ ft) or more in length, or when erected on site, is 29.77 m^2 (320 ft^2) or more ~~and that~~ is built on a permanent chassis and designed to be used as a dwelling with or without a permanent foundation, whether or not connected to the utilities, and includes plumbing, heating, air conditioning, and electrical systems contained ~~when connected~~ therein. The term manufactured home includes any structure that meets all the ~~provisions~~ requirements of this paragraph except the size requirements and with respect to which the manufacturer voluntarily files a certification required by the regulatory agency~~, and except that such term does not include any self-propelled recreational vehicle~~. Calculations used to determine the number of square meters (square feet) in a structure are based on the structure's exterior dimensions~~, measured at the largest horizontal projections when erected on site. These dimensions~~ and include all expandable rooms, cabinets, and other projections containing interior space, but do not include bay windows [501: 1.2.14].
- For the purpose of this *Code* and unless otherwise indicated, the term *mobile home* includes manufactured homes and excludes park trailers defined in 552.4.


6

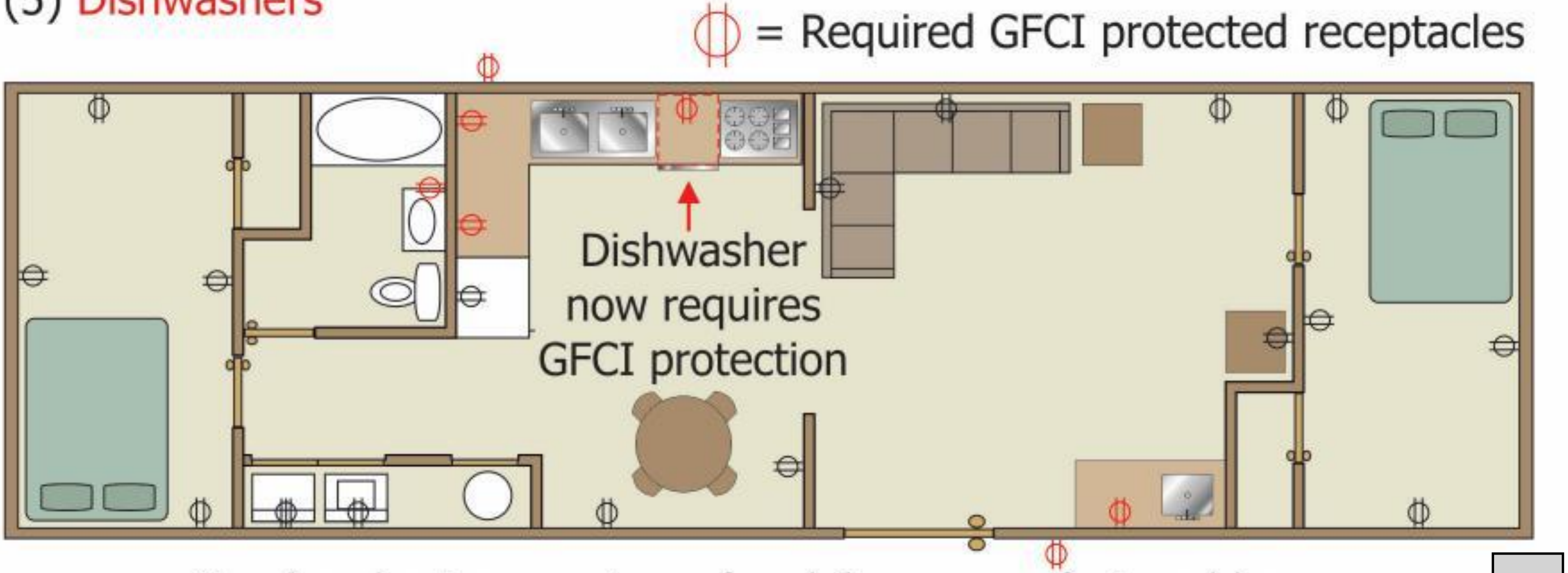
550.13(B) GFCI Protection for Receptacle Outlets at Mobile Homes

- GFCI protection for mobile and manufactured homes was revised to reflect GFCI coverage for all sinks, dishwashers and other locations similarly found at **210.8(A)**
- Clarification was added to the GFCI provisions for **outdoor receptacle outlets** to include all outdoor receptacle outlet including *(but not limited to)* outdoor receptacle outlets located in compartments accessible from outside the unit
- Option of delivering the required GFCI protection through a **feeder** that supplied the branch circuits associated with the receptacle outlets requiring GFCI protection was **removed**
- GFCI requirements for mobile and manufactured homes has not always kept pace with the same GFCI requirements for a conventional dwelling unit

550.13(B) GFCI Protection Required for Mobile and Manufactured Homes

All 125-volt, single-phase, 15- and 20-ampere receptacle outlets installed in the following locations shall be provided with GFCI protection:

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



Overhead cut-away view of mobile or manufactured home

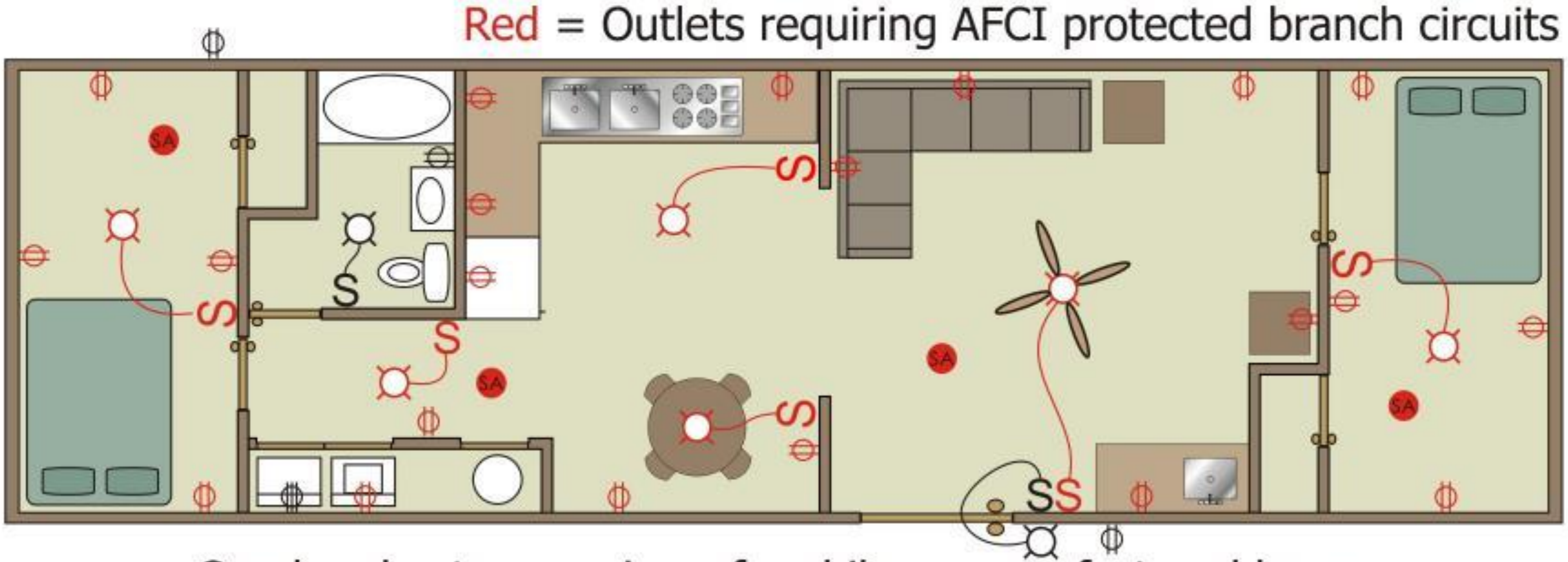

HIGHLAND
PARK
12

550.25(B) AFCI Protection at Mobile and Manufactured Homes

- AFCI protection at mobile and manufactured homes was revised by eliminating specific list of rooms and areas requiring AFCI protection and simply **requiring compliance with 210.12**
- AFCI protection at mobile and manufactured homes has not keep pace with the expansion of AFCI protection at conventional dwelling units
- Equal AFCI protection is warranted at all dwelling unit locations regardless of the type of dwelling unit involved
- With this reference to **210.12**, any future changes to AFCI protection for conventional dwelling units will have the same effect at mobile and manufactured homes

550.25 AFCI Protection at Mobile and Manufactured Homes

AFCI protection at mobile and manufactured homes was revised by eliminating the specific "laundry list" of rooms and areas requiring AFCI protection at mobile and manufactured homes and simply requiring compliance with 210.12



Overhead cut-away view of mobile or manufactured home

All 120-volt branch circuits that supply 15- and 20-ampere outlets shall comply with 210.12

551.2 Definitions:
Recreational Vehicle Park

- The definition of "**Recreational Vehicle Park**" was revised to correlate with the same definition in **NFPA 1194** *(Standard for Recreational Vehicle Parks and Campgrounds)*
- NFPA 1194 provides minimum construction requirements for safety and health for occupants using facilities supplied by RV parks
- Changes to this definition were needed to make the definition less specific and limiting and more encompassing such as the definition of "Mobile Home Park" at 550.2
- Revised definition correctly **excludes** locations such as **RV sales lots** and **storage areas for RVs**

551.2 Definition: RV Park

Recreational Vehicle Park. Any parcel or tract of land under the control of any person, organization, or governmental entity wherein two or more RV, recreational park trailer, and/or other camping sites are offered for use by the public or members of an organization for overnight stays.

The definition of "Recreational Vehicle Park" was revised to make the definition consistent with that in NFPA 1194 *(Standard for RV Parks and Campgrounds)*

551.71 Type of Receptacles Provided for RV Parks

- 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 recreational vehicle sites
- Over 30 percent of new RV production currently are being equipped with 50-ampere power supplies installed
- These percentages will continue to increase year by year
- As the RV industry increases the number of RVs equipped with 50-ampere supply cords, it is important to ensure that RV parks and campgrounds can safely accommodate these power supplies so "cheater cord” adaptors are not a viable option

551.71 Type of Receptacles Provided for RV Parks *(cont.)*

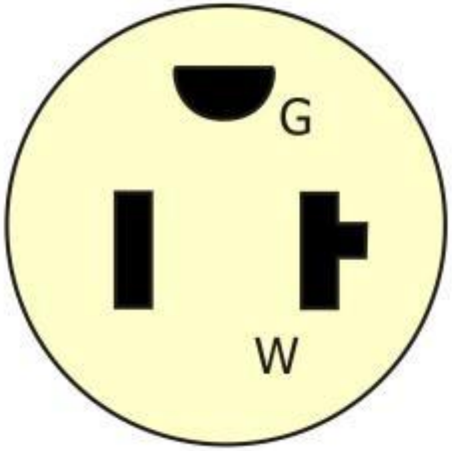
- GFCI devices used in RV site electrical equipment are **not required to be weather or tamper resistant** in accordance with 406.9 and 406.12

- RV site electrical equipment listed for use in RV parks is **NEMA 3R rated**, weather resistant rated equipment and the weather-resistant receptacle requirements of 406.9 are not needed

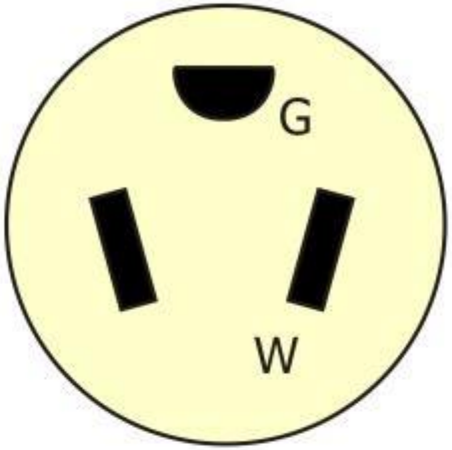
- RV site electric equipment is not for use in a dwelling, so the tamper resistant receptacle requirements of 406.12 is not necessary

551.71 Type Receptacles Provided at RV Parks

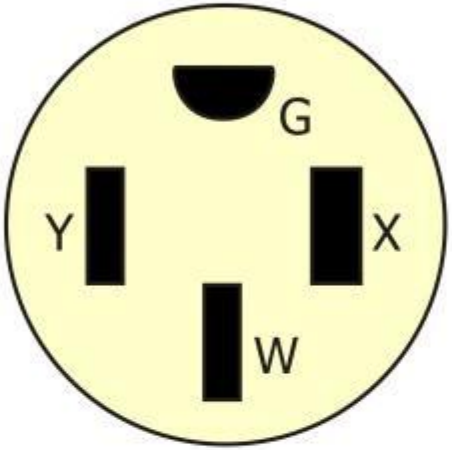
Every RV site (with electrical power provided) must be equipped with a certain number and type of receptacles *[see 551.71(A) through (F)]*



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

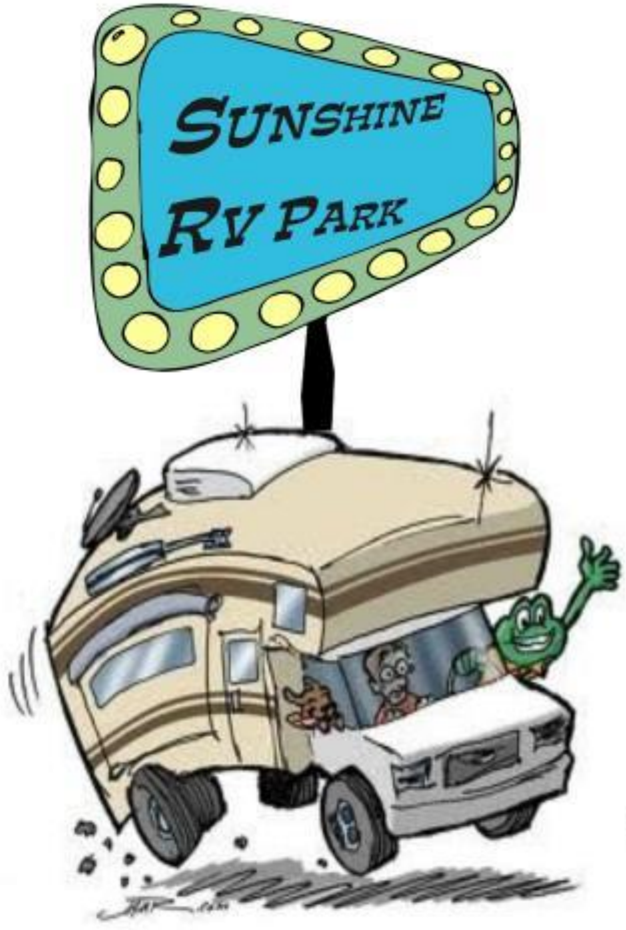

5
5
5

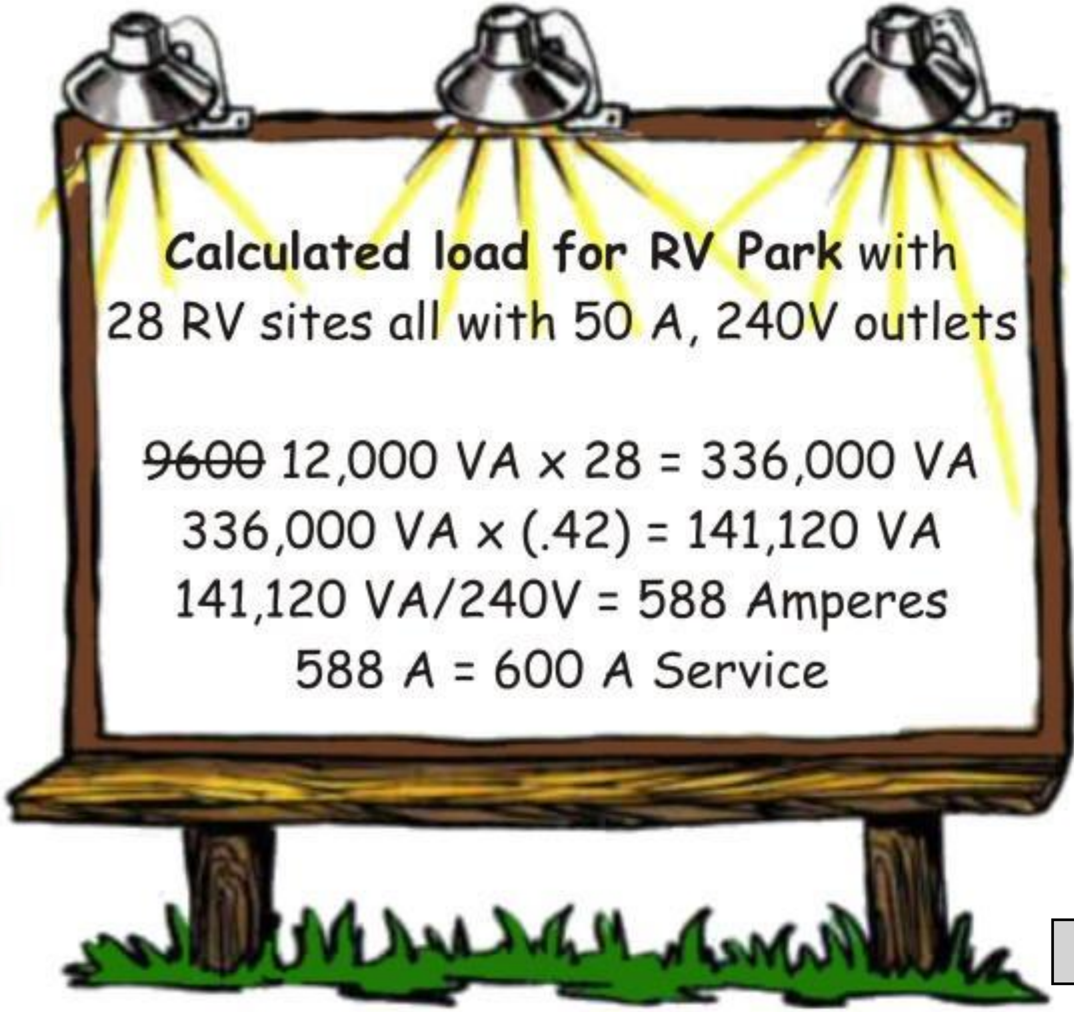
551.73(A) Calculated Load for RV Parks

- Minimum calculated load for RV parks sites equipped with **50-ampere, 208Y/120 or 120/240-volt** supply facilities increased from 9600 volt-amperes to **12,000 volt-amperes** per site
- 9600 VA was based on 40 amperes at 240 volts, 12,000 VA is based on 50 amperes and 240 volts
- As recreational vehicles become larger and demand more electrical power consumption, RV site feeders should be more realistically sized to meet the actual load served
- This change will serve to require larger service or feeder conductors to properly serve the load or fewer RV sites supplied by a service to an RV park

551.73(A) Calculated Load for RV Parks

The calculated load for electrical services and feeders at RV parks shall be calculated on the basis of not less than 12,000 volt-amperes per RV site equipped with 50-ampere, 208Y/120 or 120/240-volt supply facilities.





Calculated load for RV Park with
28 RV sites all with 50 A, 240V outlets

~~9600~~ 12,000 VA x 28 = 336,000 VA
336,000 VA x (.42) = 141,120 VA
141,120 VA/240V = 588 Amperes
588 A = 600 A Service

551.75(B) Grounding Electrode Requirements at RV Parks

- New provisions added to state that power outlets or RV site supply equipment *(other than those used as service equipment)* are **not required to have a grounding electrode established** at RV site pedestals *(electrical equipment)*
- New requirement has to be considered in direct correlation with the revised definitions for a "building" and a "structure" found in Article 100
- A "**Structure**" is now defined as "that which is built or constructed, <u>other than equipment</u>"
- The addition of the phrase "other than equipment" at the end of the definition of "Structure" provides clarification that **structures do not include equipment**

551.75(B) Grounding Electrode Requirements at RV Parks *(cont.)*

- New "structure" definition establishes a difference between a "structures" and "equipment" for the purpose of establishing a grounding electrode system as compared to installing optional or auxiliary electrodes at something like an RV pedestal
- Equipment can be mounted on a structure, but the **equipment itself is not a structure**
- New provisions at 551.75(B) will make it clear that a grounding electrode system will not be required for feeders supplying RV site equipment *(RV pedestal)*
- Previous **informational note that referenced 250.32(A) has been deleted** as this reference implied that the installation of grounding electrode was required at the RV site electrical equipment such as an RV pedestal


31

40

Article 555 Marinas, Boatyards, and Commercial and Noncommerical Docking Facilities

- Title of Article 555 was changed from “Marinas and Boatyards” to “**Marinas, Boatyards, and Commercial and Noncommerical Docking Facilities**”
- Revisions to 555.1 make Article 555 relevant to **dwelling unit docking facilities** as well as commercial docking facilities
- As previously written, the *NEC* rules in Article 555 would not apply to residential boat docking facilities, yet the majority of the rules in Article 555 would be necessary for implication at residential boat docks associated with single-family and multi-family dwelling occupancies
- Article 555 will now apply to all wiring, equipment, and electrical systems installed at boat docking facilities regardless of its location

555.3 GFP at Marinas, Boatyards and Commercial/Noncommercial Docking Facilities

- The **ground-fault protection (GFP)** required for OCPD for marinas, boatyards, and commercial and noncommercial docking facilities cannot exceed **30 mA** *(rather than 100 mA)*

- GFP protection is required in **all supply overcurrent protective devices**, not necessarily in the main OCPD

- The alternative of GFCI protection in each individual branch or feeder was deleted as this 30 mA GFP protection is required in all supply OCPDs

- GFCI protection is still required for 15- and 20-ampere, single-phase, 125-volt receptacles *[see 555.19(B)(1)]*

555.3 Ground-Fault Protection

The ~~main~~ overcurrent protective devices that supply the marina, boatyards, and commercial and noncommercial docking facilities shall have ground fault protection not exceeding 30 mA

GFP protection required for OCPDs for marinas, and now boatyards, and commercial and noncommercial docking facilities as well reduced to a maximum of 30 mA rather than 100 mA

This GFP protection is required on all supply OCPDs *(not necessarily the main OCPD)*

555.19(B)(1)

GFCI Protection for Personnel

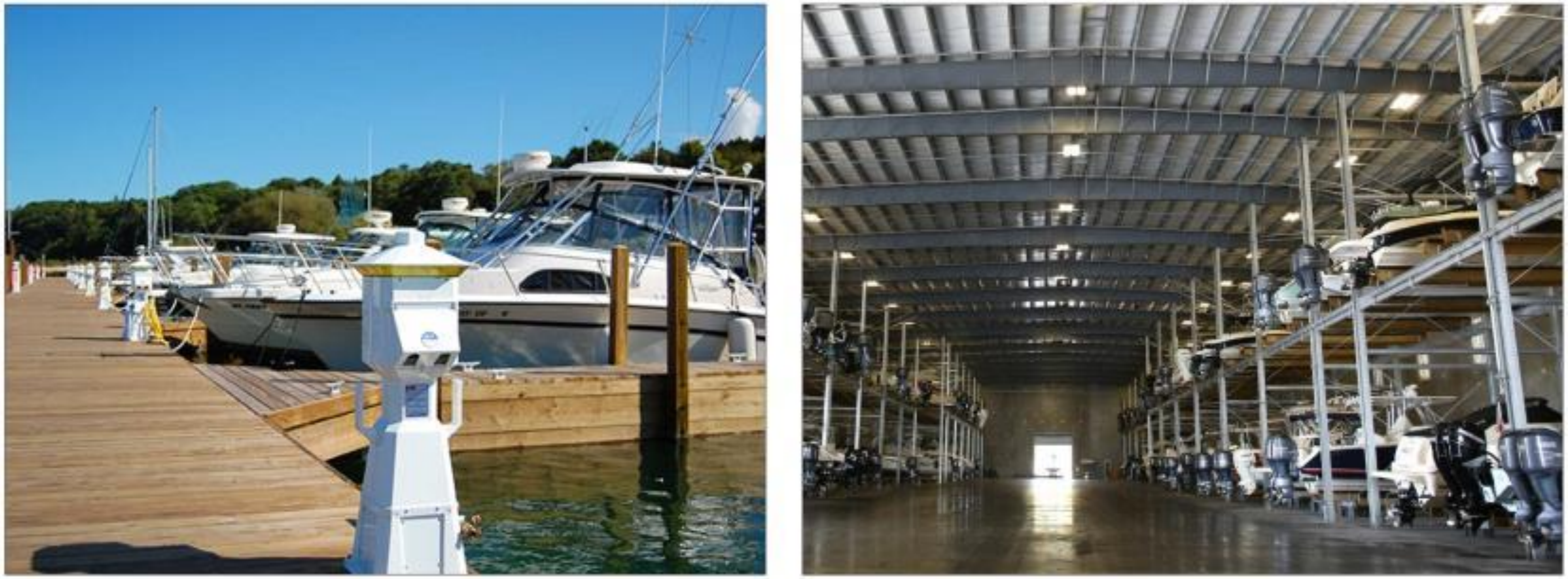
- The term "**where portable electrical hand tools, electrical diagnostic equipment, or portable lighting equipment are to be used**" was deleted
- GFCI protection for personnel will now be required for all 125-volt, single-phase, 15- and 20-ampere receptacles installed outdoors, in boathouses, and in buildings or structures used for storage, maintenance, or repair regardless of the intended use of these receptacles
- Difficult for AHJ to determine which receptacles will employ "portable electrical hand tools, electrical diagnostic equipment, or portable lighting equipment" and which receptacles will not

555.19(B)(1)
GFCI Protection for Personnel *(cont.)*

- The removal of this portable electrical hand tool, etc. conditional language will greatly aid the AHJ to enforce the GFCI requirements at these locations without debate from the installer, builder, or homeowner as to whether or not portable tools, portable lighting and such will be used
- This exact same scenario and deletion of the same condition played out during the 2014 *NEC* revision process at 210.8(B)(8) for non-dwelling unit garages, service bays, and similar areas

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 location

555.24 Signage - Marinas, Boatyards and Commercial/Noncommercial Docking Facilities

- New signage requirement for **precautionary signage** related to electric shock hazard in water around marinas and boatyards
- Gives notice of electrical shock hazard risks to persons using or swimming near a boat dock or marina
- Signage must comply with **110.21(B)(1)** and be clearly visible from all approaches to a marina or boatyard facility
- The signs shall state:

WARNING — POTENTIAL SHOCK HAZARD — ELECTRICAL CURRENTS MAY BE PRESENT IN THE WATER

- Due to stray circulating currents in the water, swimming at marinas and boatyards presents a significant danger of **electric shock drowning (ESD)** to people engaging in aquatic activities

555.24 Signage at Marinas, Boatyards, Etc.

New requirements added for permanent safety signs to be installed to give notice of electrical shock hazard risks to persons using or swimming near a boat dock or marina

WARNING - POTENTIAL SHOCK HAZARD -
ELECTRICAL CURRENTS MAY BE PRESENT IN THE WATER

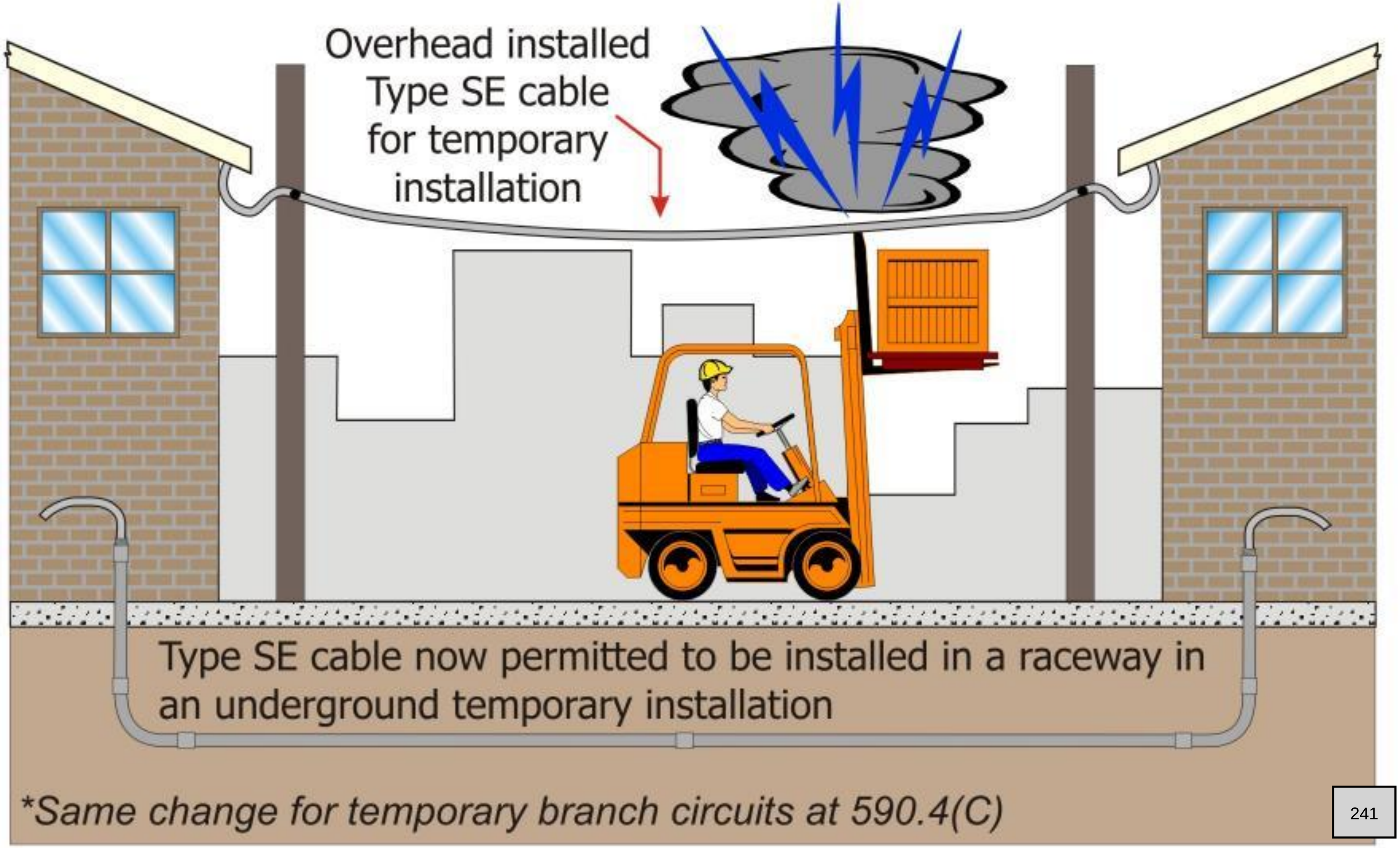
The signs shall be clearly visible from all approaches to a marina or boatyard facility

590.4(B) Feeders for Temporary Installations

- **Type SE cable** has been added to the acceptable cable assembly wiring methods for a temporary installation along with Type NM and Type NMC cable
- Type SE cable is now permitted to be installed in a raceway in a temporary underground installation as well
- 338.12(A)(2) indicates that Type SE cable is not permitted to be installed underground, with or without a raceway
- New provision at 590.4(B)(2) will allow underground installation on a temporary basis while still prohibiting underground use for Type SE cable on a permanent basis
- Same allowance of Type SE cable for temporary installations was installed at **590.4(C)** for **branch circuits**

590.4(B) Feeders (Temporary Installations)

Type SE cable has been added to the acceptable cable assembly wiring methods for a temporary installation along with Type NM and Type NMC cable



Overhead installed Type SE cable for temporary installation

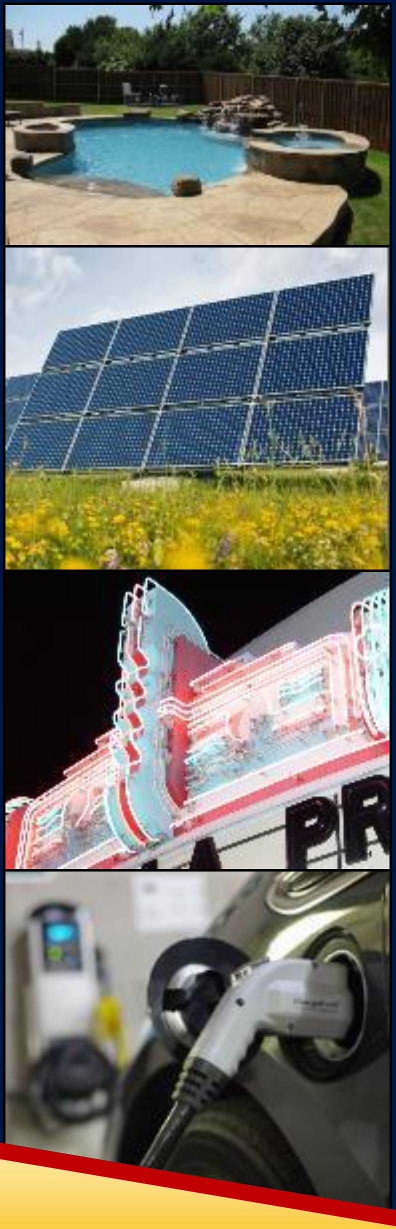
Type SE cable now permitted to be installed in a raceway in an underground temporary installation

**Same change for temporary branch circuits at 590.4(C)*

590.6(A)(1) GFCI - Temporary Installations Receptacle Outlets Not Part of Permanent Wiring

- GFCI protection is permitted in the form of **portable GFCI cord sets in addition to** GFCI protection required for all 125-volt, single-phase, 15-, 20-, and 30-ampere receptacle outlets that are **not a part of the permanent wiring** of the building or structure
- This added language mirrors the added text by **TIA 70-14-6**
- Portable GFCI cord set devices cannot be used as a substitute for protecting temporary wiring, thus protecting the worker on the construction site from damaged supply cables
- If the GFCI protection were permitted at “splitting device” rather than at the source, there would be no GFCI protection for the temporary cable leading to the splitting device where damage often occurs

DANGER



Chapter Six
Special Equipment

600.4(B)
Marking for Retrofitted Signs

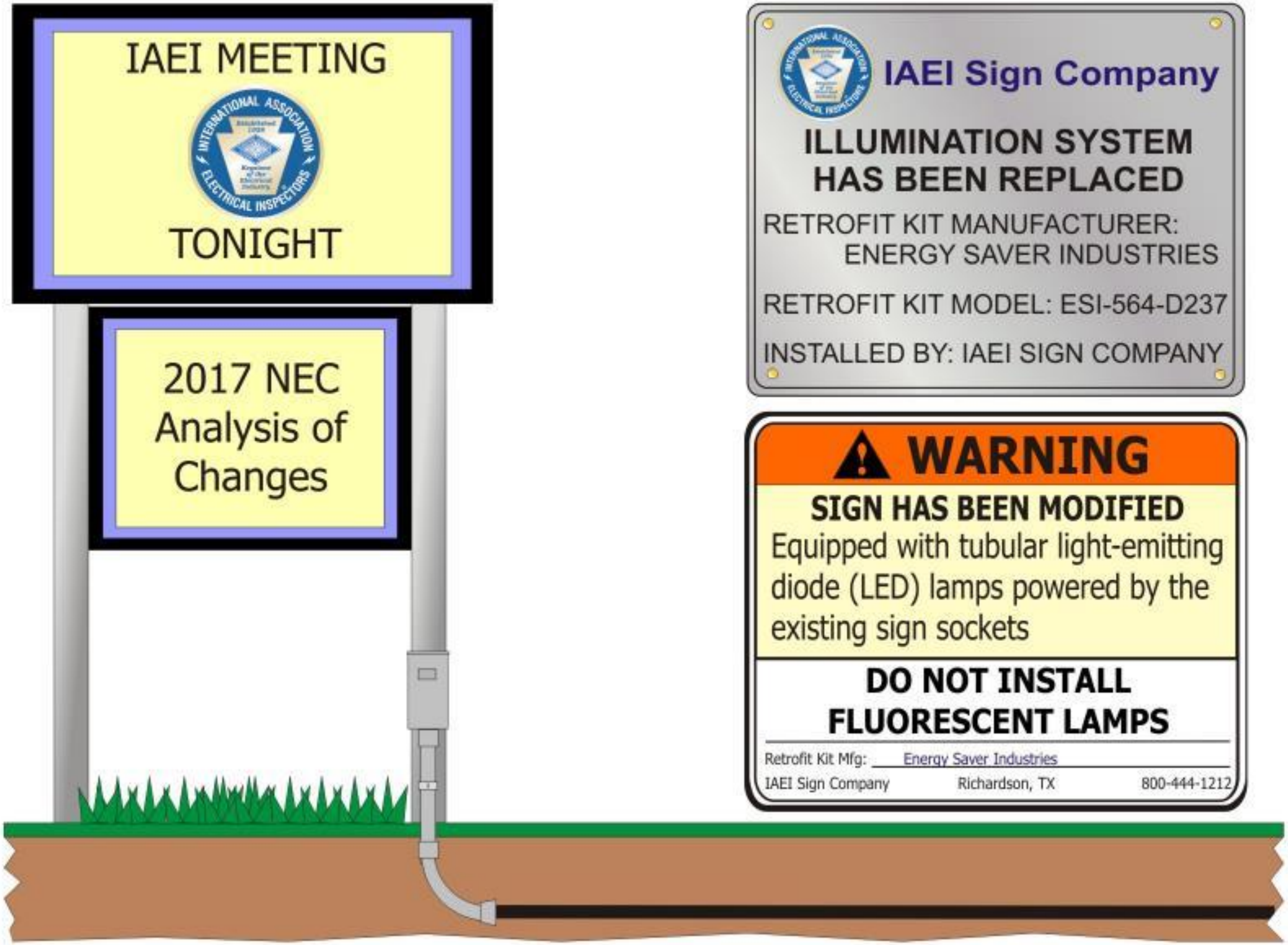
- A new marking requirement was added to indicate that an illumination system has been replaced with a **listed retrofit kit**
- Sign and lighting industries have experienced extensive movement toward the use of “retrofit kits” in an effort to achieve greater energy efficiency in signs and luminaires by replacing the in-place illumination systems with more energy efficient technology such as light emitting diodes (LED)
- Existing electric signs that have been retrofitted need to be marked for the AHJ to inspect the retrofit based on the installation instructions which need to be provided as part of the retrofit kits listing

600.4(B)
Marking for Retrofitted Signs *(cont.)*

- Installer and/or serving company needs to be notified that the sign has a retrofitted lighting system as a safety concern for future maintenance activities involving the sign
- Retrofit will require **additional marking** alerting service personnel that the sign has been modified
- Reference to **110.21(B)** will require label to address the hazard involved with words and/or symbols as required by this *NEC* Chapter One labeling requirement
- New marking requirement for retrofit kits addresses the **location of the required label** as well
- Markings must include the **kit providers** and **installer's name**, **logo**, or **unique identifier**

600.4(B) Marking for Retrofit Kit (Signs)

Retrofitted sign shall be marked that the illumination system has been replaced



IAEI Sign Company

ILLUMINATION SYSTEM HAS BEEN REPLACED

RETROFIT KIT MANUFACTURER: ENERGY SAVER INDUSTRIES

RETROFIT KIT MODEL: ESI-564-D237

INSTALLED BY: IAEI SIGN COMPANY

⚠ WARNING

SIGN HAS BEEN MODIFIED

Equipped with tubular light-emitting diode (LED) lamps powered by the existing sign sockets

DO NOT INSTALL FLUORESCENT LAMPS

Retrofit Kit Mfg: Energy Saver Industries

IAEI Sign Company Richardson, TX 800-444-1212

600.6(A)(1), Ex. No. 2 Disconnects – Energized Conductors Warning Label

- **New exception** added permitting energized conductors ***(with warning label)*** in a Chapter 3 raceway or metal-jacketed cable identified for the location to be run through a sign body or enclosure to a feeder panelboard(s) located within the sign body or enclosure
- **Field-applied permanent warning label** that is visible during servicing is required to be applied to the raceway containing these energized conductors at or near the point of entry into the sign enclosure or sign body complying with **110.21(B)**
- Marking on warning label must include location of the disconnecting means for energized conductor(s) with this disconnecting means being **capable of being locked in the open position** in accordance with **110.25**

600.6(A)(1), Ex. No. 2 Disconnects – Energized Conductors Warning Label *(cont.)*

- The warning label shall state the following:

DANGER - THIS RACEWAY

CONTAINS ENERGIZED CONDUCTORS

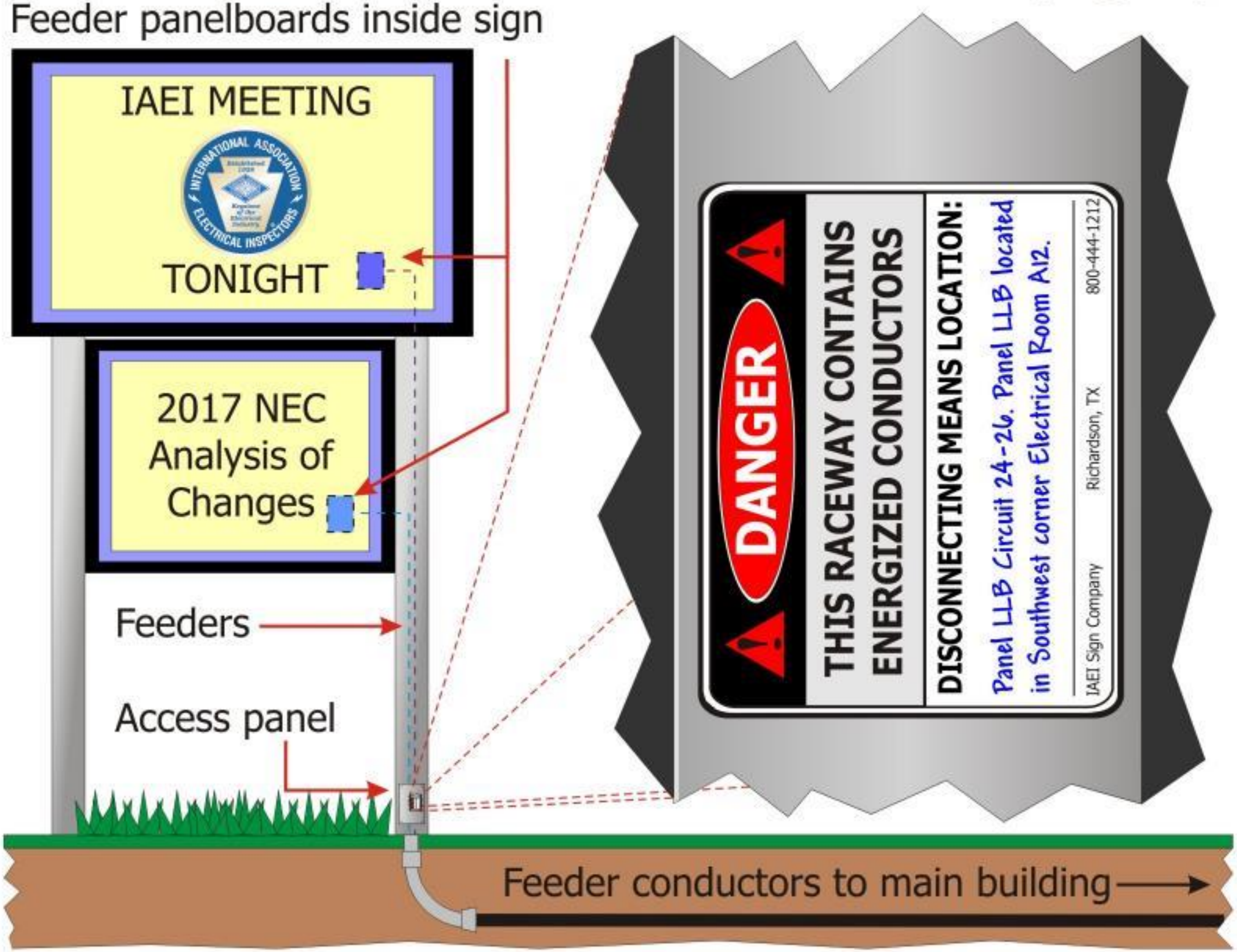
- Electrical safety dictates that these raceways be identified to prevent accidental or deliberate exposure to energized conductors
- Providing a field-applied label with the location of the disconnecting means will contribute to electrical safety for service personnel as well as emergency first responders

600.6(A)(1), Ex. No. 2 Disconnects – Energized Conductors Warning Label *(cont.)*

- The **field-applied permanent warning label** shall:
  - Be applied to the raceway at or near the point of entry into the sign enclosure or sign body
  - Be visible during servicing
  - Comply with 110.21(B)
  - Include the location of the disconnecting means for the energized conductor(s) with the disconnecting means capable of being locked in the open position in accordance with 110.25

600.6(A)(1), Ex. No. 2 Energized Conductors Warning Label - Disconnect Locations (Signs)

Feeder panelboards inside sign



600.6(A)(1), Ex. No. 2 Energized Conductors Warning Label - Disconnect Locations (Signs)

DANGER

THIS RACEWAY CONTAINS ENERGIZED CONDUCTORS

DISCONNECTING MEANS LOCATION:

Panel LLB Circuit 24-26. Panel LLB located in Southwest corner Electrical Room A12.

IAEI Sign Company Richardson, TX 800-444-1212


THE MIRAGE
TERRY FATOR
VENTRILOQUISM IN CONCERT
THE COSMOPOLITAN
THE MIRAGE
CASINO & RESORT
THE BEATLES LOVE
CAESARS PALACE
JET


CIRQUE DU SOLEIL
ZARKANA
Aria
Aria
GRASS
The Thai Restaurant On The Strip
Retail And Self Park
Aria

600.33 ~~LED~~ Class 2 Sign Illumination Systems, Secondary Wiring

- Title changed to "**Class 2 Sign Illumination Systems, Secondary Wiring**" and section was expanded to cover all types of Class 2 lighting systems ***(not just LED lighting systems)***
- LED lighting systems have become an increasingly popular light source over the past decade or so, but LED technology is not the only Class 2 lighting source
- Previous title and content of 600.33 singularly limited rules for use of Class 2 to LED systems, thus leaving other light sources powered by Class 2 sources outside the scope of the section
- 600.33 now references "**low-voltage lighting and equipment connected to a Class 2 power source**" without specifying any particular illumination type such an LED lighting system

600.33 ~~LED~~ Class 2 Sign Illumination Systems, Secondary Wiring *(cont.)*

- Reference to Part III of Article 725 *(Class 2 and Class 3 Circuits)* has been removed and replaced with proper Article 600 references *[600.12(C), 600.24, and 600.33(A), (B), (C), and (D)]*

- For sizing of Class 2 conductors for secondary wiring of sign illumination systems, the minimum size conductor is not to be sized smaller than **18 AWG** *(rather than 22 AWG)*

- Typically, Class 2 conductors referred to in UL product standards relating to secondary wiring for signs and outline lighting all refer to 18 AWG as the minimum size


IAEI

New Tables Added:
Table 600.33(A)(1) and Table 600.33(A)(2)

- Two new tables added detailing the applications of power limited cable in signs and outline lighting and companion table added detailing Class 2 cable substitutions
    - **Table 600.33(A)(1) Applications of Power Limited Cable in Signs and Outline Lighting**
    - **Table 600.33(A)(2) Class 2 Cable Substitutions**
- Previous language at 600.33(A) gave a reference to Table 725.154 *(Applications of Listed Class 2, Class 3, and PLTC Cables in Buildings)* and required that “listed Class 2 cable that complies with Table 725.154 shall be installed on the load side of the Class 2 power source”

New Tables Added: *(cont.)* Table 600.33(A)(1) and Table 600.33(A)(2)

- Permitted Class 2 cables for electric signs is not readily identifiable in Table 725.154, making it difficult or impossible to determine the permitted cable types for Class 2 sign wiring
- Having new tables located in Article 600 avoid the difficulty and uncertainty of searching a table in Article 725 that does not incorporate a specific reference to types of power limited cable for signs
- New Table 600.33(A)(2) provides the necessary information and directions for ascertaining permitted cable substitutions
- Text revision in 600.33(A) facilitates the use of Class 2 conductors that are acceptable for use in listed electric signs

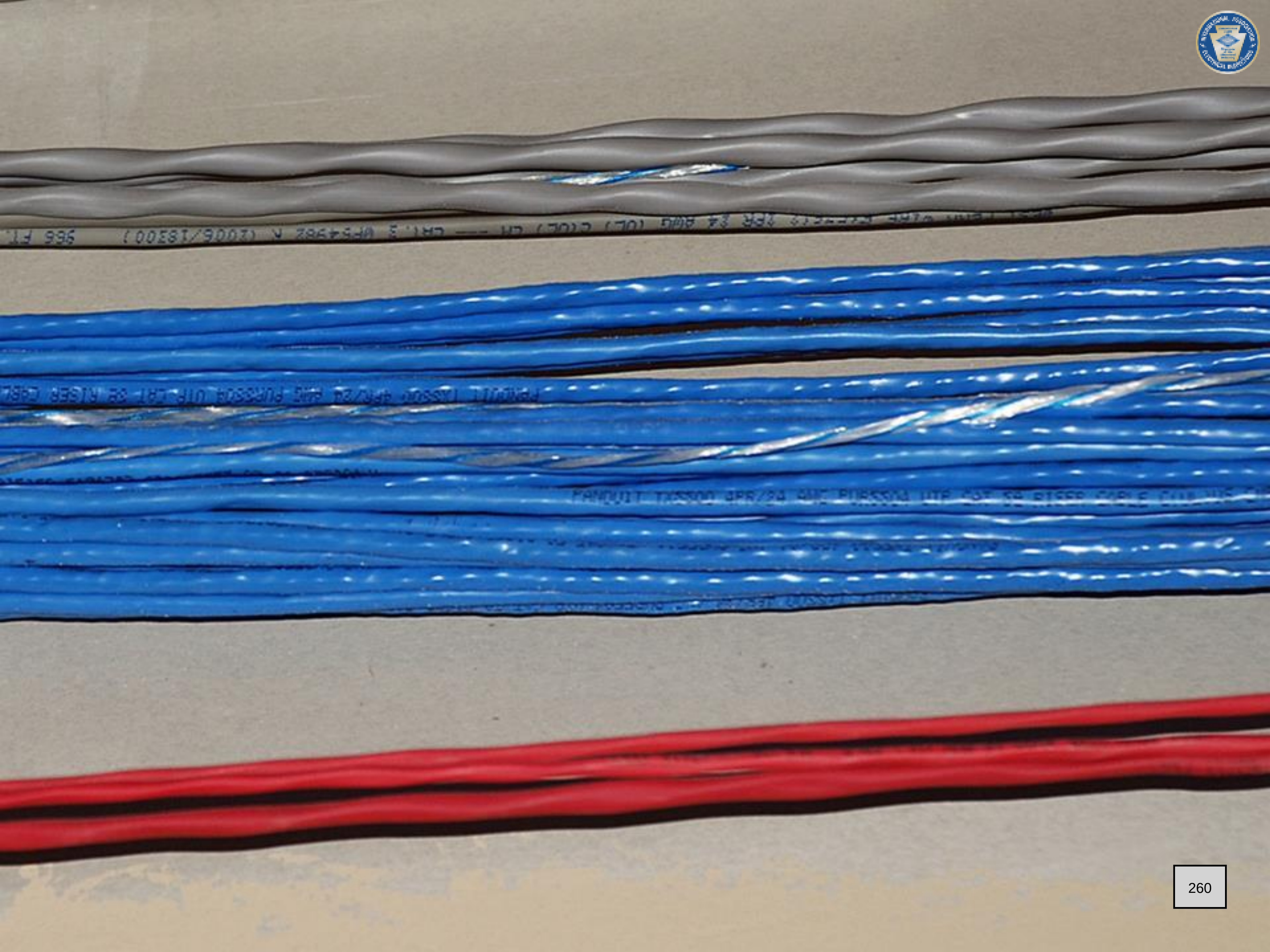


Table 600.33(A)(1) Applications of Power Limited Cable in Signs and Outline Lighting

Location	CL2	CL3	CL2R	CL3R	CL2P	CL3P	PLTC
Non-concealed spaces inside buildings	Y	Y	Y	Y	Y	Y	Y
Concealed spaces inside buildings that are not used as plenums or risers	Y	Y	Y	Y	Y	Y	Y
Environmental air spaces plenums- or risers	N	N	N	N	Y	Y	N
Wet locations	N	N	N	N	N	N	Y

Y = Permitted. N = Not Permitted.

Reproduction of NEC Table 600.33(A)(1)

Table 600.33(A)(2) Class 2 Cable Substitutions

Cable Type	Permitted Substitutions
CL3P	CMP
CL2P	CMP, CL3P
CL3R	CMP, CL3P, CMR
CL2R	CMP, CL3P, CL2P, CMR, CL3R
Cl3	CMP, CL3P, CMR, CL3R, CMG, CM, PLTC
CL2	CMP, CL3P, CL2P, CMR, CL3R, CL2R, CMG CM, PLTC, CL3
CL3X	CMP, CL3P, CMR, CL3R, CMG, CM, PLTC, CL3, CMX
CL2X	CMP, CL3P, CL2P, CMR, CL3R, CL2R, CMG, CM, PLTC, CL3, Cl2, CMX, CL3X

Reproduction of NEC Table 600.33(A)(2)

600.34 and 600.2
Photovoltaic (PV) Powered Signs

- A new definition for "**Photovoltaic (PV Powered) Sign**" was added to **600.2** and new provisions for PV powered signs were added at **600.34**

- **Photovoltaic (PV) Powered Sign.** A complete sign powered by solar energy consisting of all components and subassemblies for installation either as an off-grid stand-alone, on-grid interactive, or non-grid interactive system.

- This new definition provides the basis for new **600.34** with field wiring rules for installation and electrically safe usage

600.34 and 600.2
Photovoltaic (PV) Powered Signs *(cont.)*

- Sign and PV industry seeing more and more PV powered signs
- New definition provides the basis for new 600.34 with field wiring **rules for installation** and electrically safe usage
- Signs powered by PV system require special installation instructions and new 600.34 will provide these **installation instructions** in addition to application rules of Article 690
- PV powered signs are a special application of PV equipment that is described and covered by **UL 48** *(Standard for Electric Signs)*
- 600.34 **harmonizes** with **Articles 600 and 690** and the end use of PV powered signs constructed in accordance with **UL 48**


CAMPSITES
GROS VENTRE
JENNY LAKE
SIGNAL MTN
COLTER BAY
LIZARD CREEK
FLAGG RANCH


Benedictine Hospital
← Main Entrance
← Administration Bldg.
↑ Medical Arts Bldg.
HealthAlliance
of the Hudson Valley


STOP
Tropica
3F

605.9(C)
Receptacles at Office Furnishings

- Individual office furnishing or groups of interconnected individual office furnishings now cannot contain more than **(13) 15-ampere, 125-volt "receptacles"**
- Receptacle considered up to **two (simplex) receptacles** provided within a single enclosure that are within 0.3 m (1 ft) of each other or **one duplex receptacle**
- The term "receptacle outlets" was changed to "receptacles"
- Moves requirement away from defined term of "receptacle outlet" where "one or more receptacles" can be installed
- New language makes it clear that **(26) individual 15-ampere, 125-volt contact points (receptacles)** is the maximum number of receptacles for this application

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

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

610.42(B)(3) Brake Coil Taps Deleted - Cranes and Hoists

- **Brake coil taps** for cranes or hoists **without separate overcurrent protection** has been **deleted**
- Break coils are passive devices designed to resist changes in current and store energy in the form of a magnetic field
- Taps to brake coils should follow the same tap rules as every other installation
- With the advent of variable frequency drives and other electronic controls, there is typically a **longer conductor run** between the control cabinet and the brake coil on most newly-installed cranes or hoist
- Risk of fire and more severe damage for new applications goes **beyond the original intent** of the previous *Code* language and warrants elimination of this brake coil provision

620.16 SCCR at Elevator Control Panels

- Elevator control panels required to be marked with its **short-circuit current rating (SCCR)** and shall not be installed where the available short-circuit current exceeds its short-circuit current rating
- Elevator control panels being misapplied in a large number of applications due to an inadequate SCCR for the equipment
- Elevator control panels are often installed without being marked with SCCR
- SCCR determined by its listing process or by an “approved method”
- UL 508A-2013 (Standard for Industrial Control Panels), Supplement SB, is an example of an approved method

620.16 SCCR at Elevator Control Panels

Elevator control panels required to be marked with its short-circuit current rating and shall not be installed where the available short-circuit current exceeds its short-circuit current rating

Short-circuit current rating to be based on listing of assembly or established utilizing an approved method *(such as UL 508A)*

Article 625
Electric Vehicle Charging System

- Article 625 was **reorganized** and **reformatted** with provisions for wireless power transfer equipment being incorporated into the article
- Article 625 has experienced extensive growth and change over the past twenty years since its inception
- Revisions include deletion of requirements pertaining to polarization and noninterchangeability of EV couplers as this is a construction feature evaluated as part of product standard
- New provision added at 625.40 calling for each outlet installed for the purpose of charging electric vehicles to be supplied by an individual branch circuit with no other outlets *(relocation from previous 210.17)*

Article 625
Electric Vehicle Charging System *(cont.)*

- Equipment connection rules were added and/or revised to facilitate provisions for a parallel construction format for portable, stationary, and fixed equipment *(see 625.44)*

- New Part IV titled, "**Wireless Power Transfer Equipment**" was added as well as two new definitions, "**Wireless Power Transfer (WPT)**" and "**Wireless Power Transfer Equipment (WPTE)**" added at 625.2

- See details concerning wireless power transfer equipment at specific changes for Part IV of Article 625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ELECTRIC VEHICLE

625.2 Definitions – Electric Vehicle Charging Systems

- Two new definitions added:
  - **Wireless Power Transfer (WPT)**
  - **Wireless Power Transfer Equipment (WPTE)**
- New definitions support the new requirements added at **Part IV of Article 625** titled, “Wireless Power Transfer Equipment”
- These definitions derived from terminology as set forth in a **Society of Automotive Engineers (SAE)** standard, **SAE J2954**
- Wireless EV charging offers the advantage of **seamless charging** without having to physically connect the EV to the electrical grid for ease of customer use

625.2 Definitions - EV Charging Systems

Wireless Power Transfer (WPT). The transfer of electrical energy from a power source to an electrical load via electric and magnetic fields or waves by a contactless inductive means between a primary and a secondary device.

Wireless Power Transfer Equipment (WPTE). Equipment consisting of a charger power converter and a primary pad. The two devices are either separate units or contained within one enclosure.

625.10 Electric Vehicle Coupler

- Provisions for **polarization and noninterchangeability** of electric vehicle couplers were **deleted**
- **Design issue** addressed by the listing of the product
- **Electric Vehicle Coupler.** A mating electric vehicle inlet and electric vehicle connector set.
- Noninterchangeability of EV couplers is likewise associated with a given configuration and evaluated as part of the requirements of UL 2251 *(Standard for Safety of Plugs, Receptacles and Couplers for Electric Vehicles)*
- Feature associated with a given configuration and does not lend itself to easy verification or practical enforcement


VOLT


POWER
ERROR
TEST
RESET

Article 625, Part IV - EV Charging System Wireless Power Transfer Equipment

- A new Part IV of Article 625 titled, “**Wireless Power Transfer Equipment**” was added as well as two new definitions, “Wireless Power Transfer (WPT)” and “Wireless Power Transfer Equipment (WPTE)” added at 625.2
- Wireless EV charging creates a connection between a **transmitting pad** on ground level *(such as a garage floor)* and a **receiving pad** integrated on the bottom of the electric vehicle
- New Part IV of Article 625 consist of two sections:
  - **625.101** - requirements for grounding of the non-ferrous metal primary pad base plate *(or listed double-insulation system)*
  - **625.102** - construction requirements

Photo courtesy of Oak Ridge National Laboratory

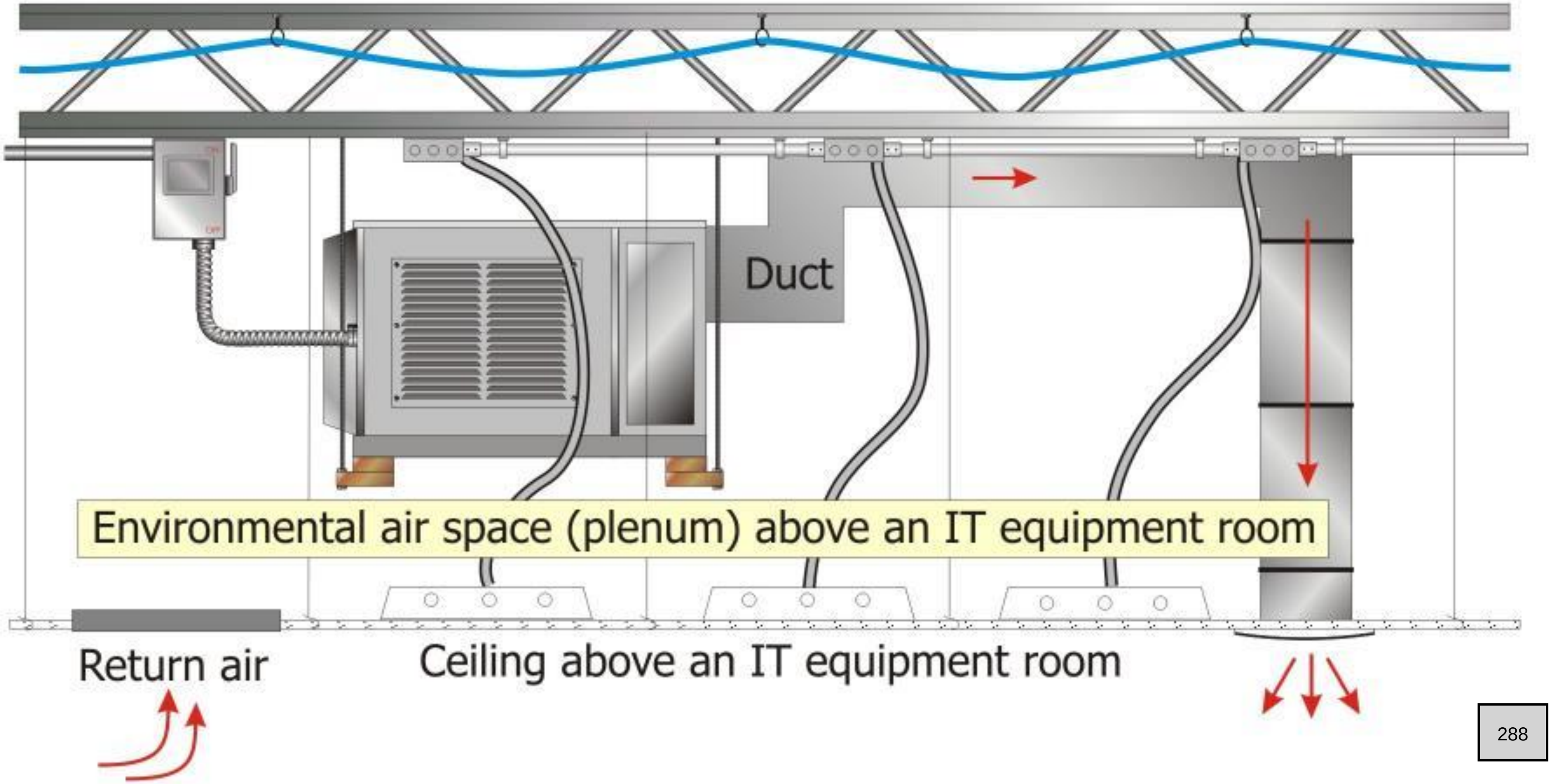
645.3(B) Other Articles (Plenums) – Information Technology (IT) Equipment

- Information pertaining to "Other Articles" and sections applying to wiring and cabling in plenums above an IT equipment room has been reformatted into a **list format** with appropriate titles added at each *Code* reference
- Title changed from "Plenums" to "**Wiring and Cabling in Other Spaces Used for Environmental Air (Plenums)**"
- Correlates with other *Code* language such as **300.22(C)**
- List format improves usability and readability detailing other articles and sections that can be applied to wiring and cabling in plenums above an IT equipment room

645.3(B) Other Articles (Plenums)

Other article and section references applying to wiring and cabling in plenums above an IT equipment rooms has been reformatted into a list format with appropriate titles added at each *Code* reference

The title was changed from "Plenums" to "Wiring and Cabling in Other Spaces Used for Environmental Air (Plenums)"

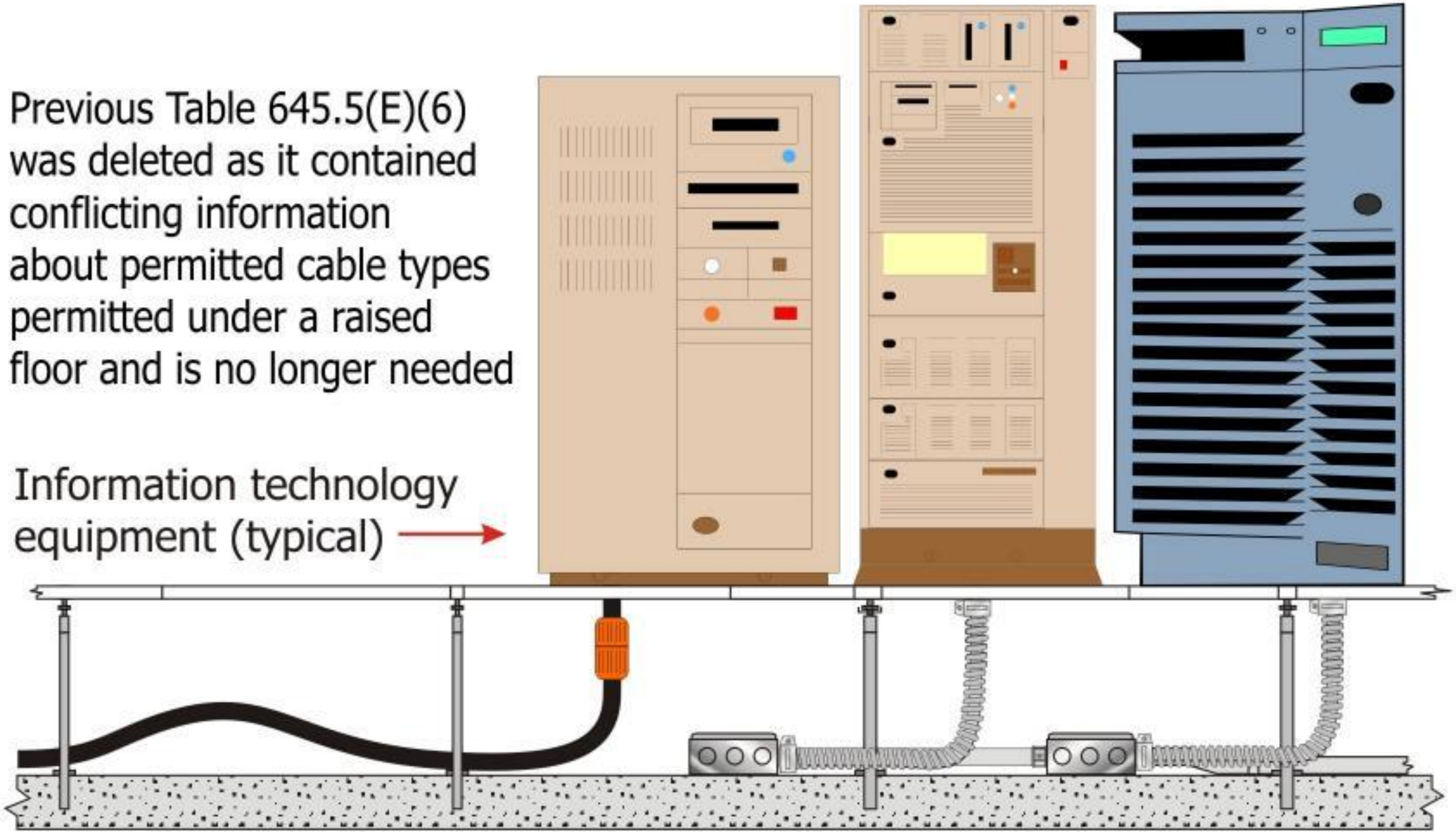


645.5(E) Wiring Under Raised Floors – IT Equipment Rooms

- Requirements for installing wiring methods and cables under a raised floor in an IT equipment room **revised for clarity**
- List format was incorporated for usability
- Previous **Table 645.5(E)(6)** was **deleted** *(no longer needed)*
- New revised text organizes conditions for using the underfloor area for wiring from an **installation requirements standpoint**
  - **645.5(E)(1)** Branch circuit wiring
  - **645.5(E)(2)** Data, cords, interconnection cables and grounding conductors
  - **645.5(E)(3)** Optical fiber cabling

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

Requirements for installing wiring methods and cables under a raised floor in an IT equipment room have been revised into a list format for clarity



Previous Table 645.5(E)(6) was deleted as it contained conflicting information about permitted cable types permitted under a raised floor and is no longer needed

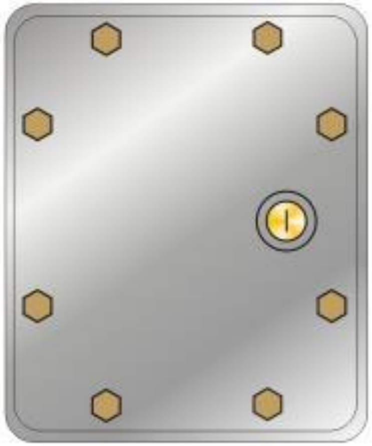
Information technology equipment (typical) →

645.18 Surge Protection for Critical Operations Data Systems (IT Equipment)

- New requirement added for **surge protection** for critical operations data systems
- **Critical Operations Data System.** An information technology equipment system that requires continuous operation for reasons of public safety, emergency management, national security, or business continuity.
- **Surge arresters** and **surge-protective devices (SPD)** are typically the devices installed to achieve the desired surge protection and ensure reliable electrical power
- New surge protection requirement in Article 645 correlates with **708.20(D)**

645.18 Surge Protection for Critical Operations Data Systems

Surge protection is now required to be provided for critical operations data systems



Surge arresters

Surge protective devices (SPD)

Article 650 Pipe Organs

- Article 650 covering pipe organs was **revised for clarity**
- Revised by adding **650.2** for three definitions pertaining to Article 650:
  - Electronic Organ
  - Pipe Organ
  - Sounding Apparatus
- New **650.9** added pertaining to protection against accidental contact of the sounding apparatus
- Access to the interior of the sounding apparatus should be limited to qualified personnel

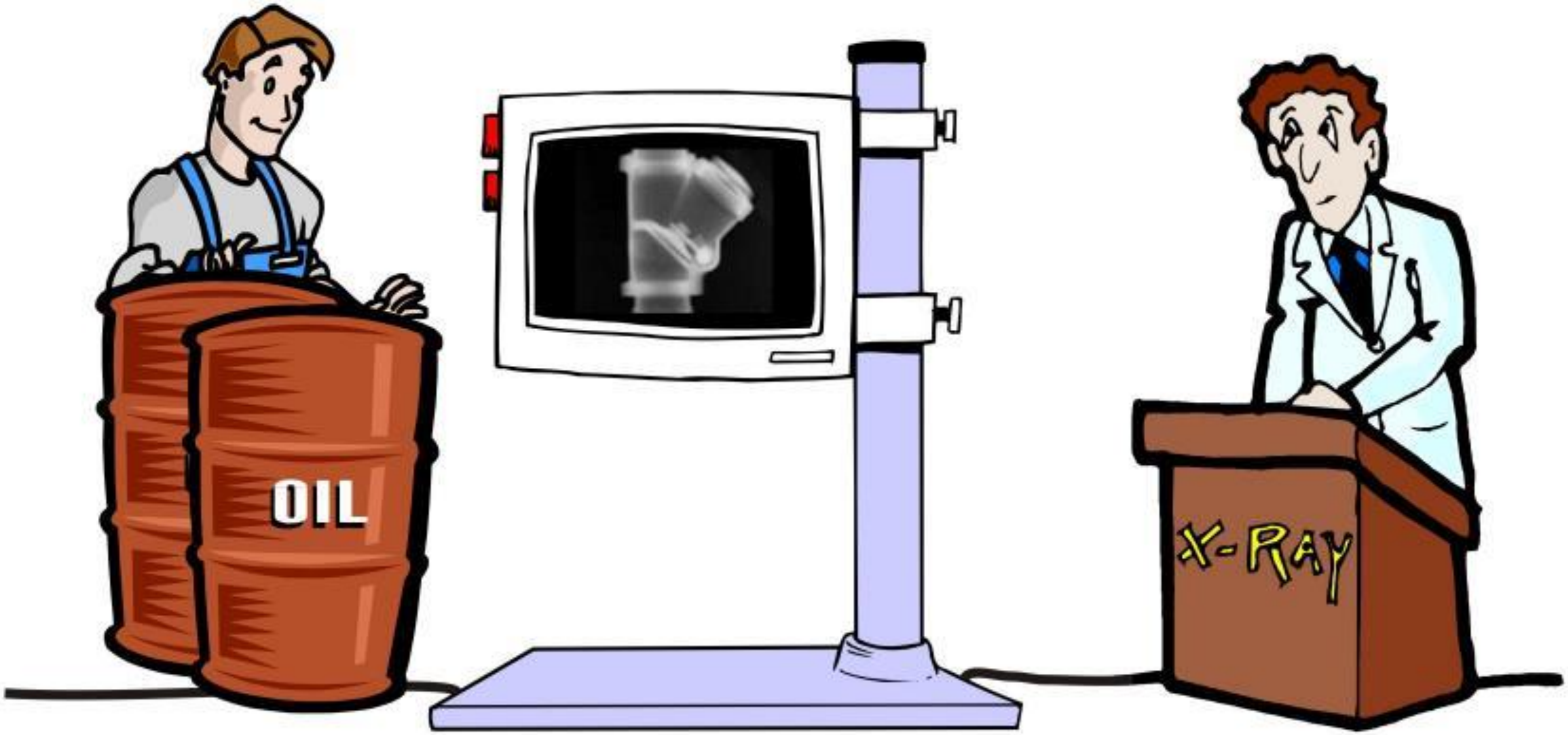

MERRY
CHRISTMAS
MERRY
CHRISTMA

660.5 Disconnecting Means – Industrial X-Ray Equipment

- Disconnecting means for industrial-type X-ray equipment required to be located “**within sight**” of the X-ray controls and **readily accessible**
- Ensures proper location of the disconnecting means
- New exception added where disconnecting means would be **impracticable or introduces additional or increased hazards** to persons or property in industrial installations *(with written safety procedures)* where conditions of maintenance and supervision ensure that only qualified persons service the equipment

660.5 Disconnecting Means (X-Ray Equipment)

Disconnecting means for industrial-type X-ray equipment required to be located "within sight" of the X-ray controls and readily accessible



Previous language indicated that the disconnecting means could be placed anywhere (several rooms away) as long as the disconnecting means was "readily accessible" regardless of its location

670.6 Surge Protection for Industrial Machinery

- New requirement added for **surge protection** of industrial machinery with safety interlocking circuits
- Study titled, “Data Assessment for Electrical Surge Protective Devices” showed that **26 percent** of the responders had damage to safety interlocking systems on machines due to electrical surges
- Safety interlocking systems are in place to protect workers from serious injuries and death due to interactions with the machinery
- Protecting workers by protecting the industrial machinery safety interlocking systems from damage due to surges is a step forward in electrical safety

670.6 Surge Protection (Industrial Machinery)

Industrial machinery with safety interlock circuits is now required to have surge protection installed

Photo Courtesy of Eaton

680.2 and Part VIII, Article 680 – Electrically Powered Pool Lift

- New definition for "**Electrically Powered Pool Lift**" along with a new **Part VIII** titled, "**Electrically Powered Pool Lifts**" was added to Article 680
- These lifts allow persons with disabilities to have access to public swimming pools, spas, and hot tubs
- Required components at public aquatic facilities by the **Department of Justice and the Americans with Disabilities Act (ADA)**
- At least two **accessible means of entry** must be provided for each public use and common use swimming pool *(ADA, Section 15.8.2)*

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.

Art. 680 Part VIII-Electrically Powered Pool Lifts

680.80 General. Electrically powered pool lifts as defined in 680.2 shall comply with Part VIII of Article 680

680.81 Equipment Approval.

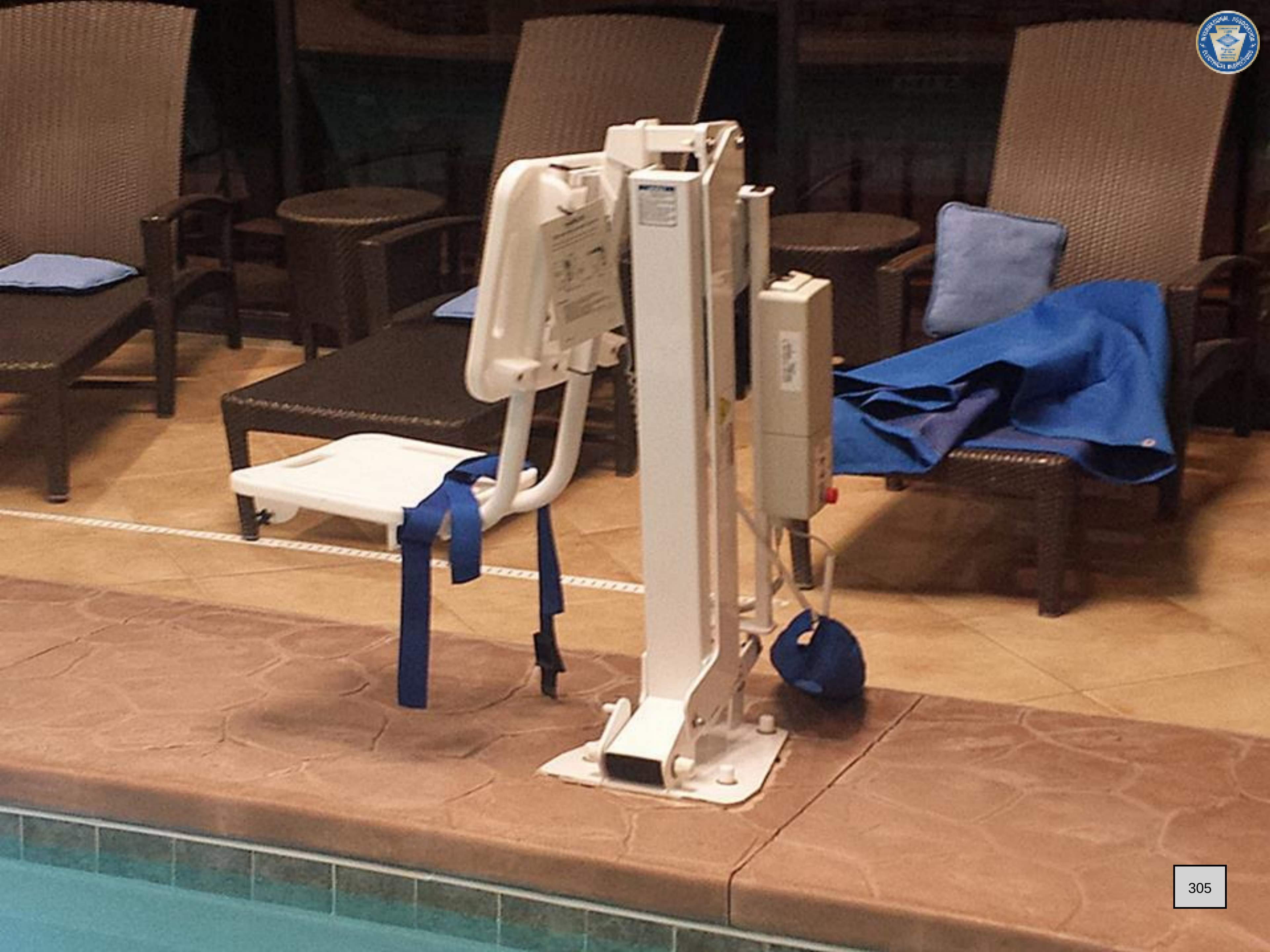
680.82 Protection. (GFCI)

680.83 Bonding.

680.84 Switching Devices.

680.85 Nameplate Marking.

New definition for "Electrically Powered Pool Lift" was added to 680.2 and a new Part VIII titled, "Electrically Powered Pool Lifts" was added to Article 680



680.2 Definitions: Storable Swimming, Wading, or Immersion Pools; or Storable/Portable Spas and Hot Tubs

- Definition clarified with adding the term "**constructed on or above the ground**" before storable/portable "nonmetallic, polymeric or inflatable tubs, spas, or pools regardless of the dimension"
- Clarifies that storable/portable pool, spa, or hot tub with nonmetallic, molded polymeric walls or inflatable fabric walls regardless of dimension is always installed "**on or above the ground**"
- Any pool "constructed in the ground or partially in the ground, and all others capable of holding water in a depth greater than 1.0 m (42 in.)" are considered to be a **permanently installed** swimming, wading, immersion, or therapeutic pool


Lay-Z-Spa
Vegas

680.7 Grounding and Bonding Terminals

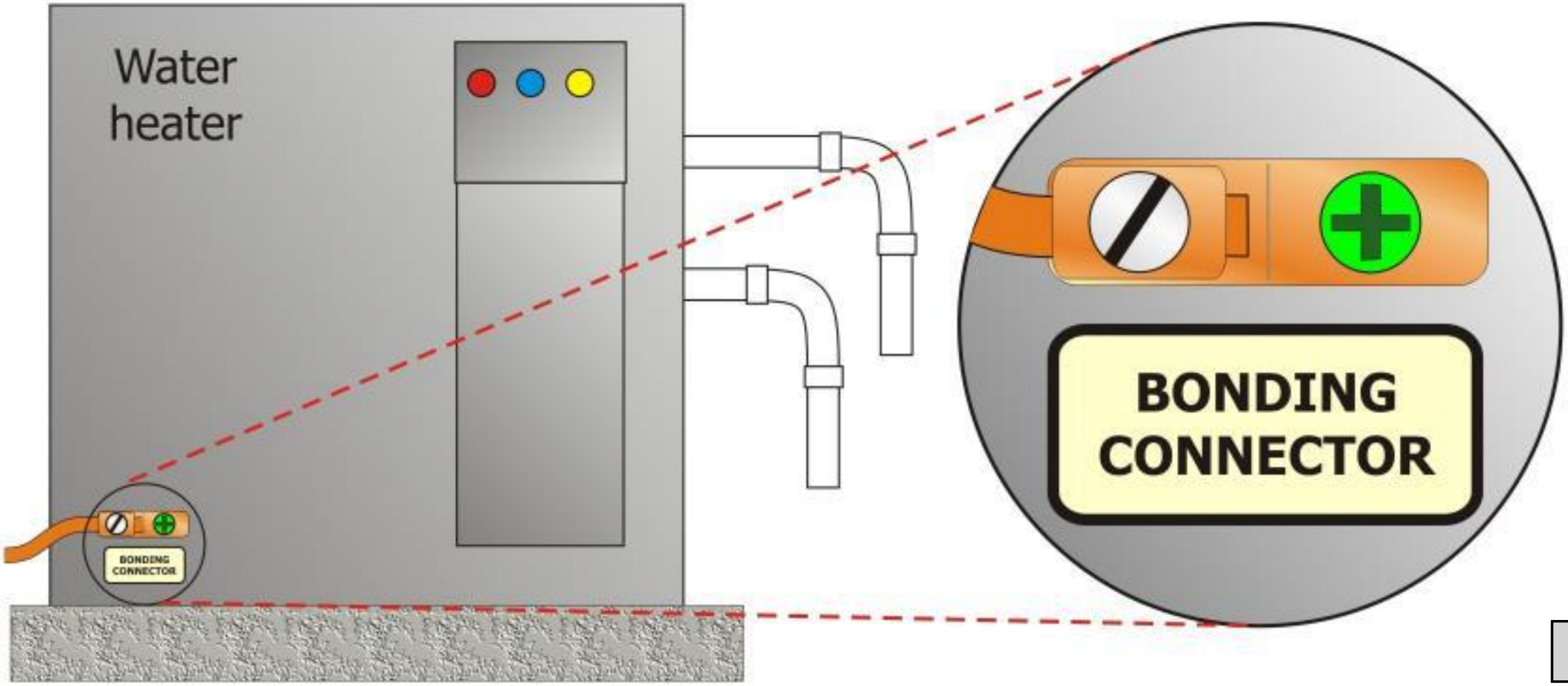
- New requirements call for grounding and bonding terminals to be **identified for use** in **wet and corrosive environments** and **listed for direct burial** applications as well
- Grounding and bonding terminals at pools, spas, hot tubs, etc. are subjected to **severe environmental conditions** including wet and corrosive conditions
- Field-installed grounding and bonding connections installed in a damp, wet, or corrosive environment will need to be composed of **copper, copper alloy, or stainless steel**

680.7 Grounding and Bonding Terminals

Grounding and bonding terminals shall be identified for use in wet and corrosive environments

Field-installed grounding and bonding connections in a damp, wet, or corrosive environment shall be composed of copper, copper alloy, or stainless steel

Grounding and bonding terminals shall be listed for direct burial use




Bonding Connector.
Connecteur de Raccordement.
Conector de Enlace.
472277
HOT


BONDING CONNECTOR

Previous Table 680.10 *(Deleted)* Underground Wiring Burial Depths

- Previous 680.10 *(Underground Wiring Location)* moved to 680.11 and previous **Table 680.10 was deleted**
- The minimum burial depth cover requirements around pools will now be facilitated by **Table 300.5**
- Underground wiring now permitted to be installed in **close proximity** of the pool regardless of its location to the pool and no consideration needs to be given as to whether this wiring is "**necessary to supply pool equipment**" or not
- Revised text will allow service lateral or underground feeder to be routed **within 1.5 m (5 ft)** or close proximity to the pool even though this service or feeder is not "necessary to supply pool equipment"

Table 680.10 Minimum Cover Depths (Deleted)

Previous 680.10 (Underground Wiring Location) moved to 680.11 and previous Table 680.10 Minimum Cover Depths was deleted

Table 680.10 was "kicked out" of the *Code*

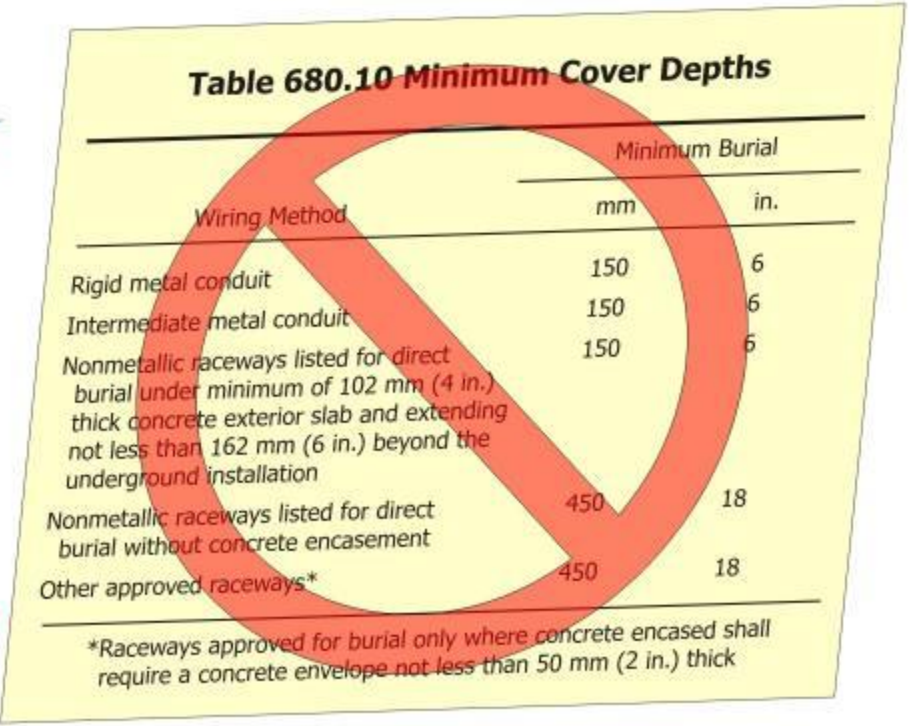


Table 680.10 Minimum Cover Depths

Wiring Method	*Minimum Burial* mm	in.
Rigid metal conduit	*150*	*6*
Intermediate metal conduit	*150*	*6*
Nonmetallic raceways listed for direct burial under minimum of 102 mm (4 in.) thick concrete exterior slab and extending not less than 162 mm (6 in.) beyond the underground installation	*150*	*6*
Nonmetallic raceways listed for direct burial without concrete encasement	*450*	*18*
*Other approved raceways**	*450*	*18*

**Raceways approved for burial only where concrete encased shall require a concrete envelope not less than 50 mm (2 in.) thick*

Table 300.5 burial depth requirements will now apply around swimming pools, spas, hot tubs, fountains, and similar installations


GUNITE
TO
LINE

680.12 Equipment Rooms and Pits and 680.14 Corrosive Environments

- New requirement for **protection against a corrosive environment** for electrical equipment installed in equipment rooms and pits added at **680.12** and **680.14**

- Important to make sure that **proper drainage** is provided to prevent water accumulation at the electrical equipment during normal operation or maintenance

- Electrical equipment should not be installed in areas where the electrical equipment and metal components are going to be subject to a corrosive environment without proper corrosion protection being implemented

680.12 Equipment Rooms and Pits and 680.14 Corrosive Environments *(cont.)*

- Swimming pool and spa equipment is often subject to deteriorating chemicals, especially in rooms or pits
- New provisions added at **680.14** identify areas where pool sanitation chemicals are stored, as well as areas with circulation pumps, automatic chlorinators, filters, open areas under decks adjacent to or abutting the pool structure, and similar locations as being considered to be a **corrosive environment**
- **Chlorine** and other pool chemicals severely deteriorate electrical connections of conductors, and accelerate rust and deterioration of metal parts of electrical equipment


OUTLET
INLET

Photo Courtesy of Dave Williams, Michigan

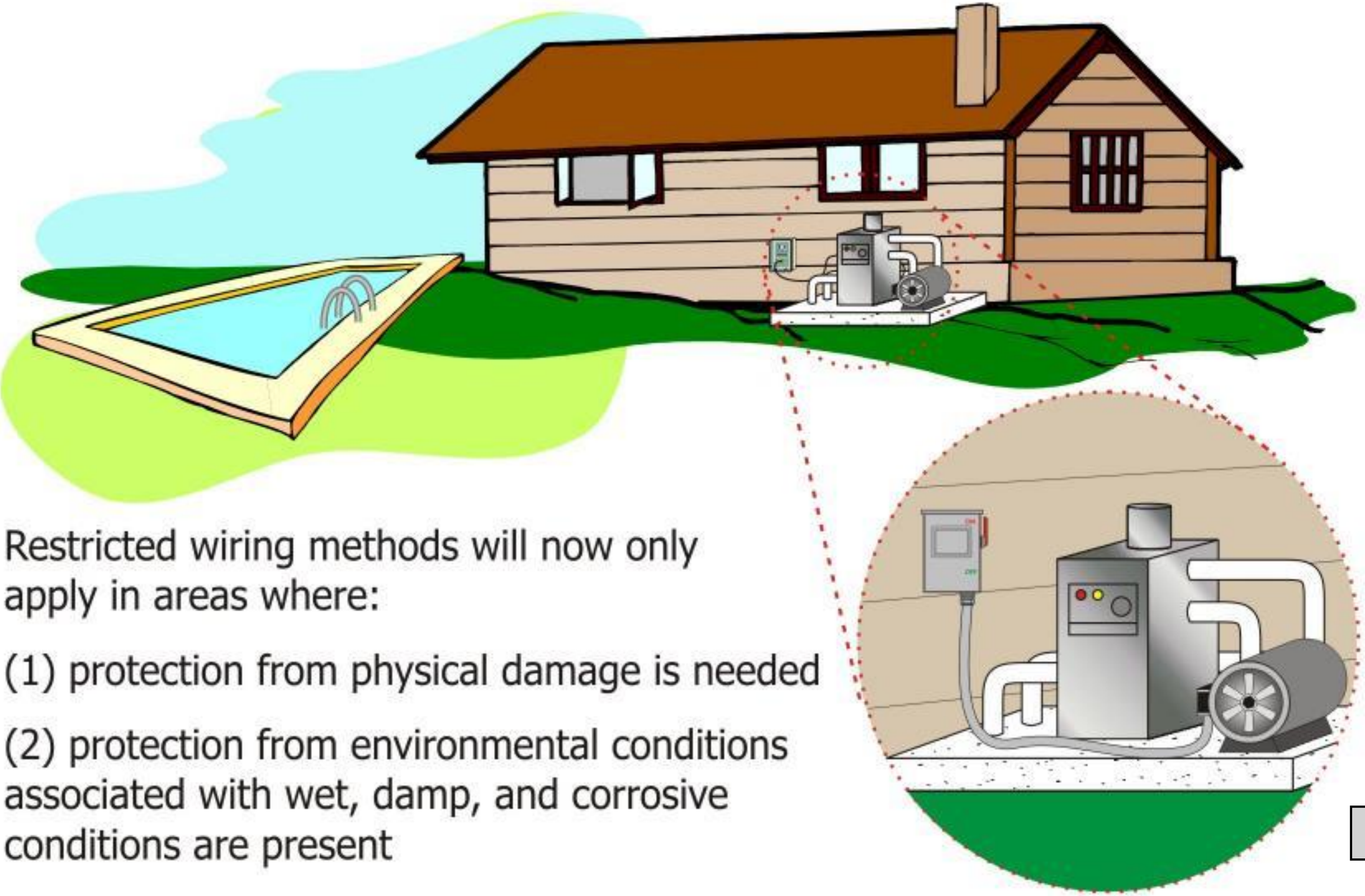
Photo Courtesy of Dave Williams, Michigan

680.21(A) Wiring Methods for Motors – Swimming Pools and Similar Installations

- Restricted wiring methods previously described at 680.21(A) will now only apply in areas where **protection from physical damage** is needed or where **protection from environmental conditions** associated with wet, damp, and corrosive conditions are present
- Where installed in **noncorrosive environments** *(such as in the interior of a dwelling unit)*, branch circuits wiring methods for permanently installed pool pump motors need only comply with requirements of the ***NEC* Chapter 3 wiring methods**
- Distinctions for noncorrosive environments no longer needed as new text added at 680.21(A)(1) now indicates that "where installed in noncorrosive environments, branch circuits shall comply with the general requirements in Chapter 3"

680.21(A) Wiring Methods (Motors)

Where installed in noncorrosive environments, branch circuits wiring methods for permanently installed swimming pool pump motors are to comply with the general requirements of *NEC* Chapter 3 wiring methods



Restricted wiring methods will now only apply in areas where:

(1) protection from physical damage is needed

(2) protection from environmental conditions associated with wet, damp, and corrosive conditions are present

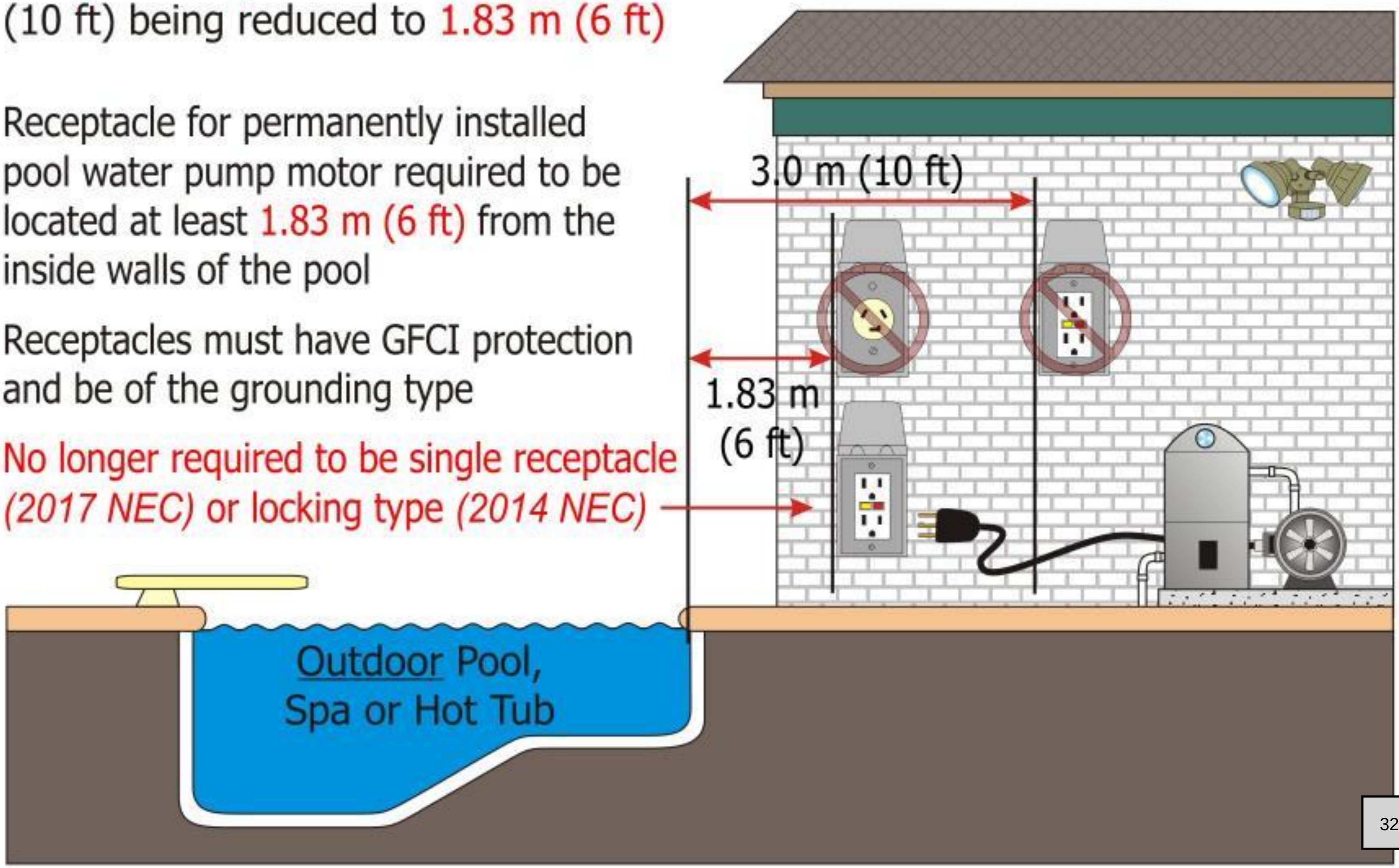

WPC

680.22(A)(2) Location of Circulation and Sanitation System Receptacle

- Receptacles that supply power for pool pump motors or other loads directly related to the circulation and sanitation system can now be located not less than **1.83 m (6 ft)** from the inside walls of the pool with the receptacle(s) being of the grounding type and provided with GFCI protection
- Requirement for the pool pump motor receptacle outlet needing to consist of a **single receptacle configuration** was also **eliminated**
- Pool pump motor receptacle outlet need not be located 3.0 m (10 ft) for the inside walls of the pool or be a single receptacle configuration if convenience receptacle outlet can be located not less than 1.83 m (6 ft) from the inside walls of the pool and be of the duplex type configuration

680.22(A)(2) Circulation and Sanitation Receptacle - Location

Requirements for the pool pump motor receptacle were revised with single receptacle requirement removed and minimum distance from the pool of 3.0 m (10 ft) being reduced to 1.83 m (6 ft)



Receptacle for permanently installed pool water pump motor required to be located at least 1.83 m (6 ft) from the inside walls of the pool

Receptacles must have GFCI protection and be of the grounding type

No longer required to be single receptacle *(2017 NEC)* or locking type *(2014 NEC)*

680.22(B)(7) Low-Voltage Gas-Fired Luminaires, Equipment, Etc.

- New provisions added to specifically address **low-voltage gas-fired luminaires, decorative fireplaces, fire pits, and similar equipment**
- With the inclusion of electronic ignitors for these devices, *NEC* regulations were need for this type of equipment
- New provisions for low-voltage gas fire equipment needed with the conversion of gas luminaire technology away from manual ignition and toward the use of low-voltage electronic ignitors

680.22(B)(7) Low-Voltage Gas-Fired Equipment

New requirements added for low-voltage gas-fired luminaires, decorative fireplaces, fire pits, and similar equipment

Listed low-voltage gas-fired luminaires, decorative fireplaces, fire pits, and similar equipment using low-voltage ignitors with outputs that do not exceed the low-voltage contact limit shall be permitted to be located less than 1.5 m (5 ft) from the inside walls of a permanently installed pool

680.25 Feeders – Swimming Pools, Fountains, and Similar Installations

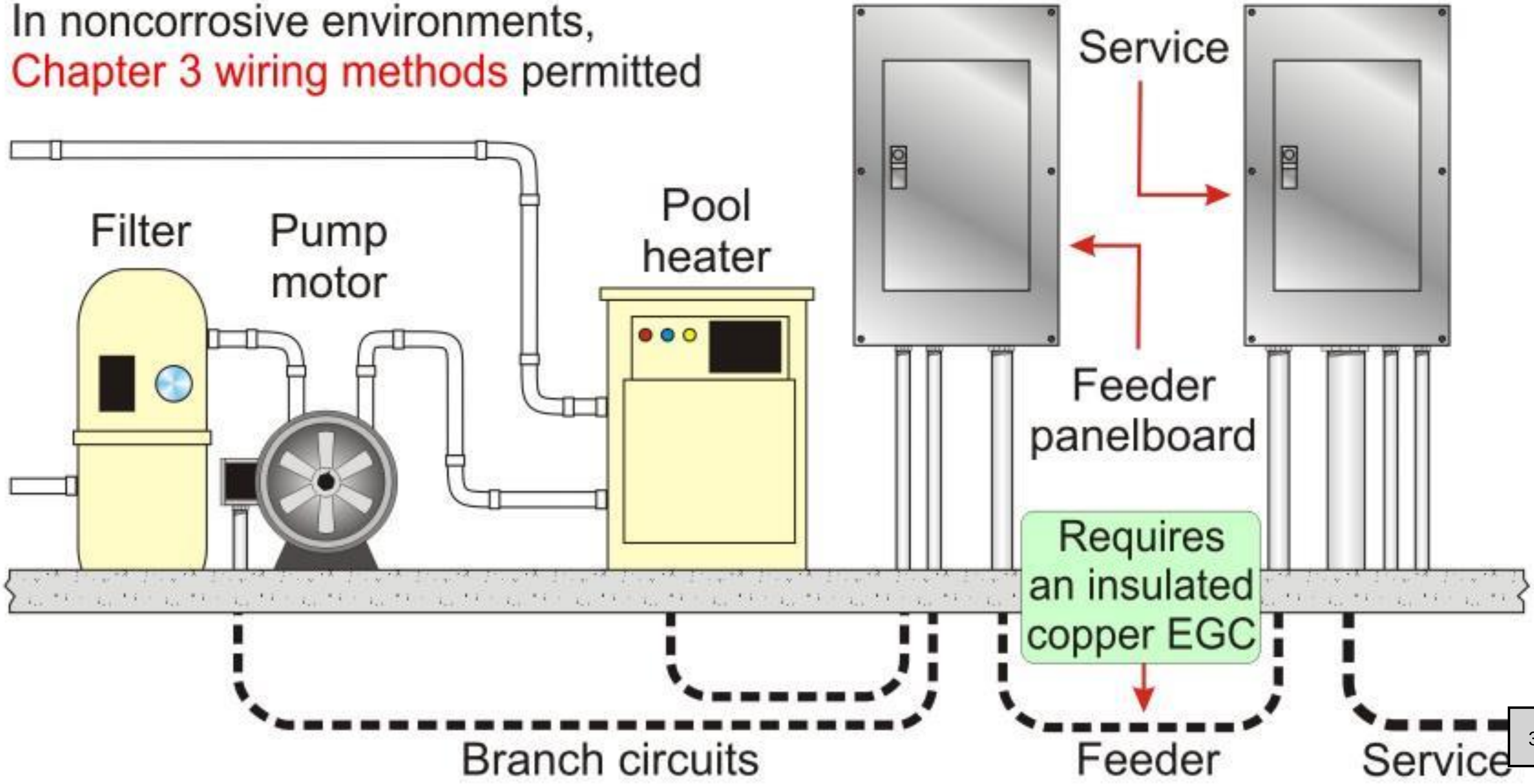
- Previous **680.25(B)** for grounding of swimming pool panelboard feeders was **deleted** in its entirety as grounding provisions for swimming pool panelboard feeders have been incorporated into the revised text at 680.25(A)
- Revised text at **680.25(A)** requires restricted wiring methods **only in areas where harsh conditions** *(physical damage, environmental conditions, corrosive conditions, etc.)* **are present**
- Chapter 3 wiring methods are now otherwise permitted
- Probation of aluminum conduit in the pool area where subject to corrosion was retained

680.25 Feeder to Swimming Pool Panelboard

Previous 680.25(B) for grounding of swimming pool panelboard feeders was deleted as grounding provisions for swimming pool panelboard feeders have been incorporated into the revised text at 680.25(A)

The revised text at 680.25(A) requires restricted wiring methods only in areas where harsh conditions *(physical damage, environmental conditions, corrosive conditions, etc.)* are present

In noncorrosive environments, Chapter 3 wiring methods permitted



680.27(B)(1), Ex. and 680.27(B)(2), Ex. Electrically Operated Pool Covers

- New exceptions added for pool cover motors that would allow motors that are rated to not exceed the low-voltage contact limit to be installed **less than 1.5 m (5 ft)** from the inside walls of the pool and **omit GFCI protection**
- Parent text of 680.27(B)(1) and (B)(2) deals with electrically operated pool cover motors running at nominal voltage
- New designs in pool cover motors are becoming available that are powered by swimming pool transformers and operate at **voltages not exceeding the low-voltage contact limit**
- Added exceptions fashioned from existing text for low-voltage underwater luminaires not requiring grounding at 680.22(B)(6)

680.28 Gas-Fired Water Heater – Swimming Pools, Fountains, and Similar Installations

- New provisions added requiring branch circuits serving **gas-fired swimming pool and spa water heaters** operating at voltages **above the low-voltage contact limit** to be provided with GFCI protection for personnel
- GFCI protection not required for electric water heaters with proper grounding provisions *[see 680.6(3)]* and the listing installation requirement for the use of "**current collectors**"
- Current collectors are not present with a gas-fired swimming pool heater
- 125-volt branch circuit to a gas-fired water heater is susceptible to loss of current and ground-fault condition as much as any other piece of electrical equipment


Pentair Pool Products
MasterTemp 400
Pentair Pool Products
78
SERVICE HEATER
SERVICE SYSTEM
HEATING
SPA ON
POOL ON
HEATER OFF

680.74

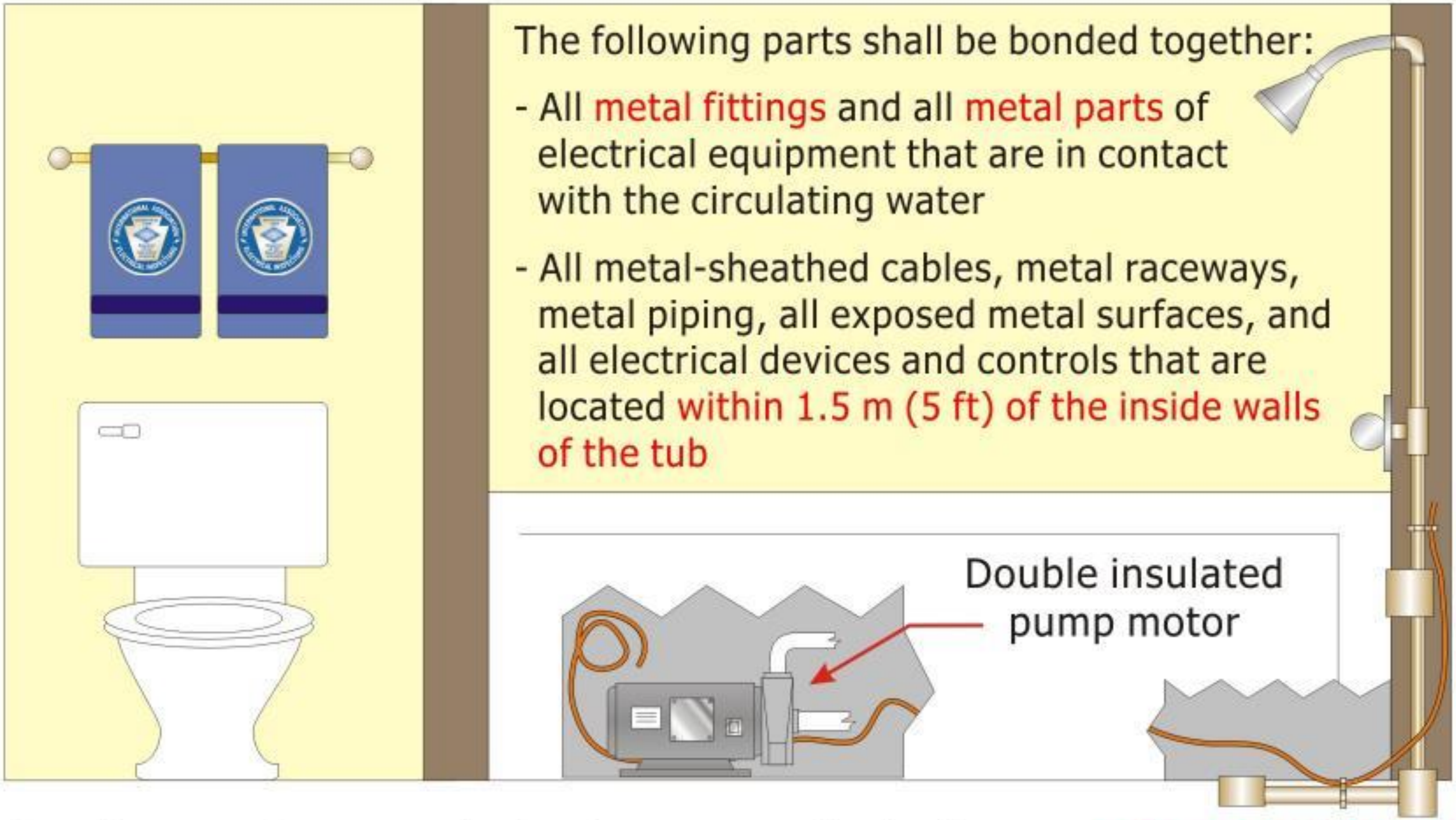
Bonding of Hydromassage Bathtubs

- Bonding requirements for hydromassage bathtubs was reformatted into a **list format**
- New exception added to exempt bonding of "**small conductive surfaces**"
- A list of metallic items located "**within 1.5 m (5 ft) of the inside walls of the tub**" were added to the required items required to be bonded:
  - All metal-sheathed cables, metal raceways, metal piping, and all exposed metal surfaces
  - All electrical devices and controls that are not associated with the hydromassage tub

680.74
Bonding of Hydromassage Bathtubs *(cont.)*

- Besides the metal parts of electrical equipment associated with the tub water circulating system, **all metal fittings within or attached to the tub structure** that are in contact with the circulating water are now required to be bonded together
- New exception added to exempt "**small conductive surfaces not likely to become energized**" from hydromassage bathtub bonding requirements:
    - Isolated air and water jets, supply valve assemblies, and drain fittings not connected to metallic piping
    - Towel bars, mirror frames, and similar nonelectrical equipment not connected to metal framing
- This "small conductive surfaces" exception is very similar to the "exception" in the parent text of 680.26(B)(5)

680.74 Hydromassage Bathtub - Bonding



The following parts shall be bonded together:

- All metal fittings and all metal parts of electrical equipment that are in contact with the circulating water
- All metal-sheathed cables, metal raceways, metal piping, all exposed metal surfaces, and all electrical devices and controls that are located within 1.5 m (5 ft) of the inside walls of the tub

Double insulated pump motor

Bonding requirements for hydromassage bathtubs was reformatted into a list format

New exception was added to exempt "small conductive surfaces not likely to become energized" from hydromassage bathtub bonding requirements

682.15 GFCI Protection at Natural and Artificially Made Bodies of Water

- GFCI protection for personnel will now be required for **all** 15- and 20-ampere single-phase, 125-volt through 250-volt receptacles installed outdoors and in or on floating buildings or structures within the electrical datum plane area

- Previous GFCI requirements applied only to those receptacles in areas where used for "storage, maintenance, or repair where portable electric hand tools, electrical diagnostic equipment, or portable lighting equipment" were to be used

- Eliminate the debate in these areas concerning the use of **portable tools, portable lighting and the like** being used or not

690.2 Definitions:
Functional Grounded PV System

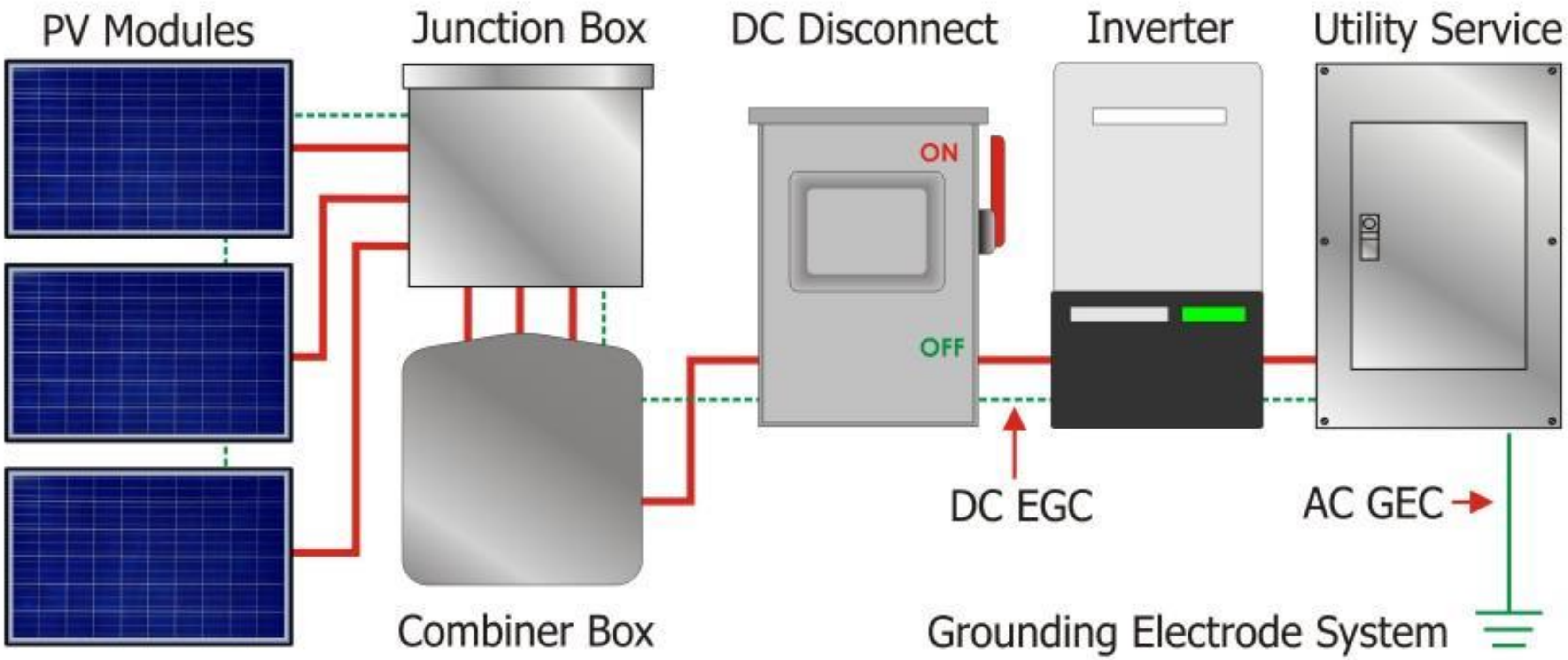
- A new definition for "**Functional Grounded PV System**" was added at 690.2 *(see definition on additional slide)*
- Term used in six different locations throughout Article 690
- New definition needed to clear up confusion over the use of the terms "**functional grounded PV systems**," "**reference grounded PV systems**" and "**solidly grounded systems**"
- Most PV systems are not solidly grounded; however, the installation requirements are written as if they are
- By clearly delineating "functional grounded PV systems" from solidly-grounded PV systems, the safety requirements for installation become much clearer

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

- In system grounding, one of the ungrounded circuit *(current-carrying)* conductors is bonded *(connected)* to the equipment grounding system and also to earth *(referred to as reference or **functional grounding** in most cases)*
- Ungrounded conductor connected to the EGC system and to earth is known as the "**grounded conductor**"
- Connection between the grounded conductor and the EGC system is known as the **system bonding jumper**
- With a non-isolated inverter, the lack of isolation to the grounded ac service conductors requires that the dc PV array be ungrounded for the inverter to work
- While operating, the dc PV array actually becomes referenced to ground through the ac output conductors

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.

690.7 Maximum Voltage – Solar Photovoltaic (PV) Systems

- Maximum voltage requirements for PV systems revised for clarity
- Revised 690.7 has only three first level subdivisions now:
  - (A) Photovoltaic Source and Output Circuits
    - *[Previous (A) Maximum Photovoltaic System Voltage and (C) Photovoltaic Source and Output Circuits combined together into one first level subdivision]*
  - (B) DC-To-DC Converter Source and Output Circuits
  - (C) Bipolar Source and Output Circuits
- Provides for a more logical order

690.7 Maximum Voltage – Solar Photovoltaic (PV) Systems *(cont.)*

- Revised requirements of 690.7(A) simplifies the language related to the three methods used to calculate maximum voltage
- New recognized method of determining the maximum voltage for larger PV systems is addressed at 690.7(A)(3) for PV systems of 100 kW or larger
- This method permits a documented and stamped PV system design, using an "**industry standard method**" and provided by a licensed professional electrical engineer for PV systems with a generating capacity of **100 kW or greater**
- Example of "industry standard method" would be SAND 2004-3535, Photovoltaic Array Performance Model published by Sandia National Laboratories

690.7 Maximum Voltage – Solar Photovoltaic (PV) Systems *(cont.)*

- Previous 690.7(B) *(Direct-Current Utilization Circuits)* removed as it referred to the output of PV modules which is not applicable for the output of dc-to-dc converters and these loads that are not under the scope of Article 690
- Previous 690.7(D) *(Circuits over 150 Volts to Ground)* removed as it dealt more with the wiring method
- Previous 690.7(E) (Bipolar Source and Output Circuits) relocated to 690.7(C) and revised to recognize the newly defined functional grounded PV systems
- Removing the solidly grounded system requirements at 690.7(C) addresses the safety issues that a solidly grounded array system present


NEGATIVE
POSITIVE

690.8(A)(1)
PV Source Circuit Currents

- Second option added for calculating the maximum current for a PV source circuit using an industry standard method provided by a **licensed professional electrical engineer**
- This is in addition to the **125 percent method** permitted by previous editions of the *Code*
- Engineering method would only apply to PV systems with a generating capacity of **100 kW or greater**
- An engineer qualified to design PV systems is capable of making the necessary calculations to develop accurate maximum circuit currents of PV source circuits based on the specifics of an installation location

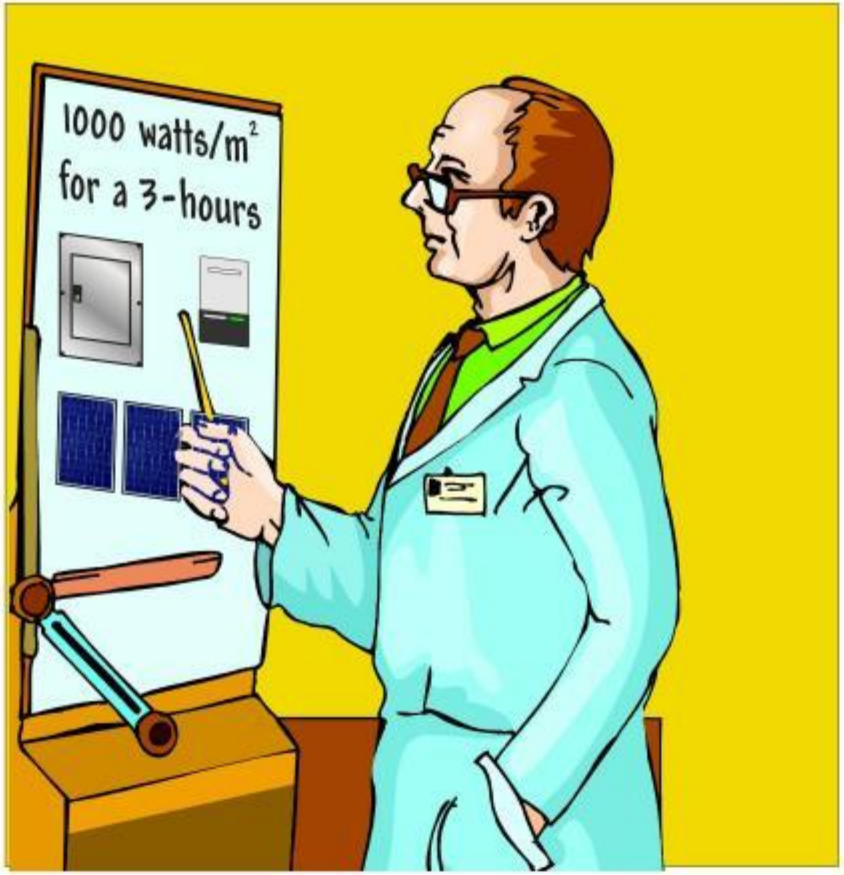
690.8(A)(1)
PV Source Circuit Currents *(cont.)*

- **125 percent calculation method** is **extremely conservative** and based on PV systems without ground-fault protection and capable of operating in short circuit conditions indefinitely
- 125 percent calculation method is fine for small systems as a simple calculation but engineering supervision should be allowed for larger PV systems to use more accurate, less conservative calculations
- Computer software is readily available to engineers that can calculate the actual current generated on PV source circuits based on all the design parameters of a given location
- Added engineering supervision option allows for engineers to calculate the maximum current and apply that current to sizing of PV source circuit conductors

690.8(A)(1) PV Source Circuit Currents

In addition to the 125 percent method permitted by 690.8(A)(1)(1), a second option was added for calculating the maximum current for a PV source circuit using an industry standard method provided by a licensed professional electrical engineer *[690.8(A)(1)(2)]*

Cannot be less than 70 percent of the value calculated using the 125 percent method



Applies to PV systems with a generating capacity of 100 kW or greater

690.11, Exception Arc-Fault Circuit Protection (dc) for PV Systems

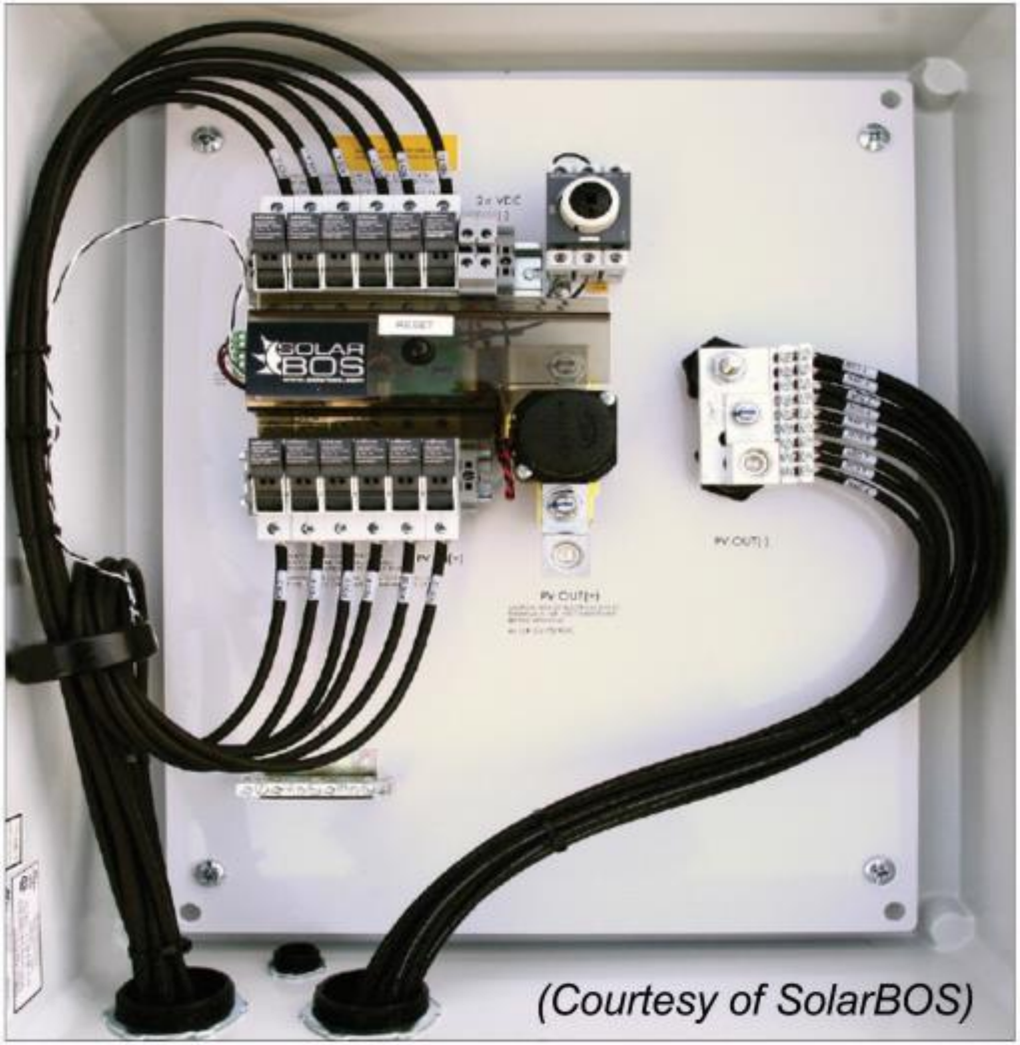
- New exception added for PV systems allowing **PV AFCI protection to be omitted** for PV output circuits and dc-to-dc converter output circuits **not installed on or in buildings** that are direct buried, installed in metallic raceways, or installed in enclosed metallic cable trays
- PV source circuits commonly installed in free air, exposed to environmental hazards and physical damage at the array structure deserve PV AFCI protection
- New exception **does not apply** to PV output circuits and dc-to-dc converter output circuits **installed on or in buildings** such as rooftop-mounted PV systems as these systems are deserving of PV AFCI protection

690.11, Exception Arc-Fault Circuit Protection (dc) for PV Systems *(cont.)*

- Terms “dc source circuits” and “dc output circuits” replaced by “PV system dc circuits,” which includes PV source circuits, dc-dc converter source circuits, PV output circuits, and dc-dc converter output circuits
- Previous language implied that the required PV AFCI protection only applied to PV source and output circuits
- Revision ensures that all dc-dc converter circuits are arc-fault protected

690.11 PV (dc) Arc-Fault Protection

PV AFCI protection requirements and 690.11 received extensive revision and a new exception was added


(Courtesy of SolarBOS)

New exception added for PV systems allowing PV output circuits and dc-to-dc converter output circuits *(not installed on or in buildings)* that are direct buried, installed in metallic raceways, or installed in enclosed metallic cable trays to omit PV AFCI protection

AFCI Combiner, 600 Volt (dc), 12 input circuits with NEMA-4X fiberglass enclosure

690.12 Rapid Shutdown of PV Systems on Buildings

- The requirements for "**Rapid Shutdown**" for PV systems have been revised and divided into four sub-sections

- Revision emphases that the primary existence of the rapid shutdown requirements is to **reduced shock hazard for emergency responders** *(not intended to provide electrical isolation for electrical worker safety as addressed by NFPA 70E and disconnecting means requirements in Part III of Article 690)*

- Revision answers questions regarding the functionality of the PV rapid shutdown device itself

- Controlled rapid shutdown conductors outside the "**array boundary**" must comply with new 690.12(B)(1) *[**305 mm (1 ft)** from the array in all directions]*

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

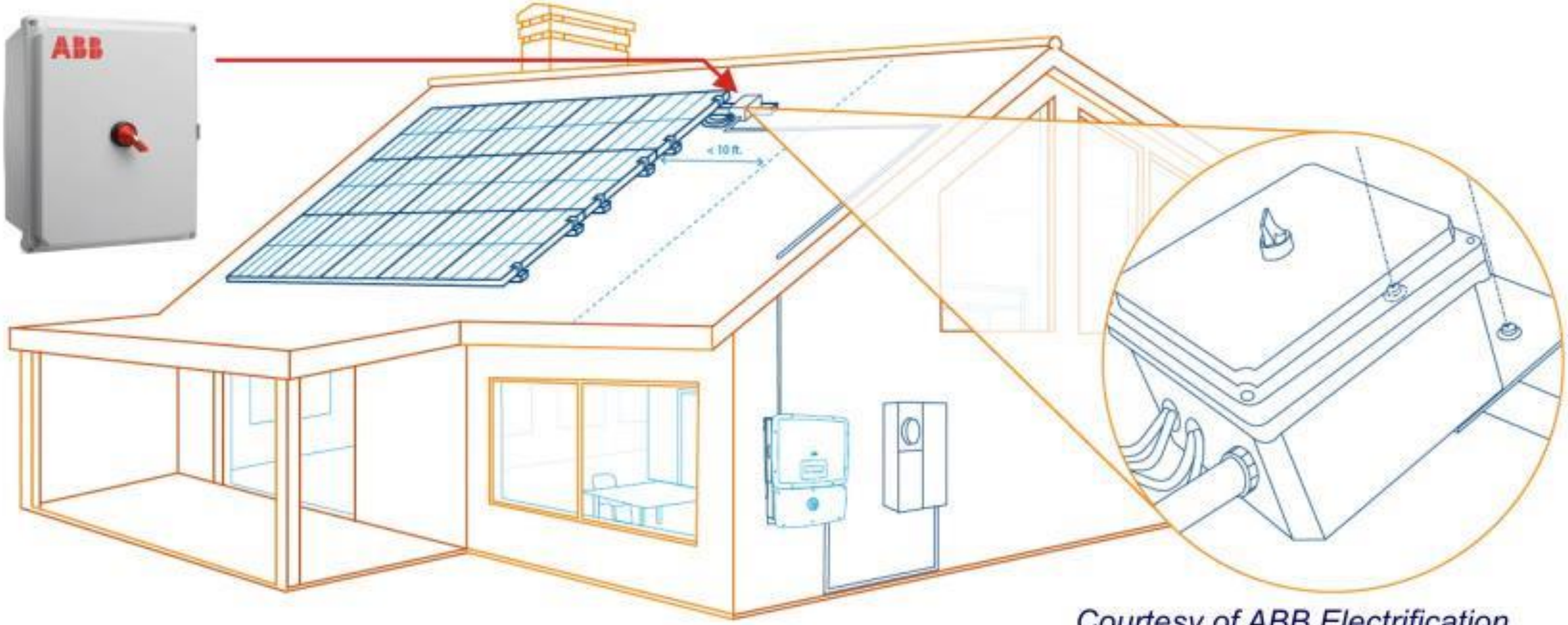
- Controlled conductors located outside the array boundary to be limited to not more than **30 volts** within **30 seconds** of rapid shutdown initiation *(was 10 second initiation in the 2014 NEC)*

- Controlled rapid shutdown conductors located inside the array boundary or not more than 1 m (3 ft) from the point of penetration of the surface of the building are limited to not more than **80 volts** within **30 seconds** of rapid shutdown initiation *(future effective date of January 1, 2019)*

- Rapid shutdown initiator device to be located on the **outside** of the building for **one- and two-family dwellings**

690.12 Rapid Shutdown of PV Systems

The rapid shutdown requirements for PV systems has been revised to emphases the primary existence of the rapid shutdown requirements is to reduced shock hazard for emergency responders and to answer questions regarding the functionality of the PV rapid shutdown device itself



Courtesy of ABB Electrification Products Division (Thomas & Betts)

The structure of 690.12 is now divided into four separate sub-sections titled, 690.12(A) Controlled Conductors, (B) Controlled Limits, (C) Initiation Device, and (D) Equipment

690.13
PV System Disconnecting Means

- New **interrupting rating** and type of disconnect requirements added along with extensive revision to existing requirements
- PV disconnecting means connected to the supply side of a service disconnecting means must be "**listed as suitable for use as service equipment**"
- If a PV system is being directly connected to a servicing utility, important safety aspect that the first disconnecting means be "listed and marked as suitable for service equipment"
- Revision removed the "**nearest the point of entrance**" language and the accompanying exception
- PV disconnecting means must meet the provisions of **690.12** for **rapid shutdown** and full compliance with this rule would satisfy the previous provisions of 690.13(A)

690.13
PV System Disconnecting Means *(cont.)*

- Previous requirement of no PV disconnecting means located in bathrooms moved to **690.4(E)** as it pertains to both equipment and disconnecting means
- **Marking requirement** at **690.13(B)** for marking or identifying of PV disconnecting means has been expanded with marking requirements moved to one location at 690.13(B)
- "***The*** PV system disconnecting means" revised to "***each*** PV disconnecting means" to clearly indicate that it is permissible to have **multiple PV systems** on a building or structure
- Each such system is permitted to have **up to six means of disconnect** as the PV system disconnecting means

690.13
PV System Disconnecting Means *(cont.)*

- New **690.13(E)** requires PV system disconnecting means to have an interrupting and voltage ratings **sufficient for the maximum available short-circuit current ratings** that are available at the terminals of the PV system disconnect
- Important safety aspect to any disconnecting means, including a PV disconnecting means *(see 110.9)*
- New **690.13(F)** added to the PV disconnecting means provisions detailing **three aspects of the PV disconnecting means** including **simultaneous disconnection**
- dc PV system disconnecting means to be marked for use in PV systems or be suitable for **backfeed operation**


PHOTOVOLTAIC SYSTEM SAFETY DC DISCONNECT SWITCH (1 OF 2)
PHOTOVOLTAIC DC POWER SOURCES (3 TYP)
OPERATING CURRENT(MAX-POWER): 43.08 AMPS
OPERATING VOLTAGE(MAX-POWER): 390.6 VOLTS
MAXIMUM SYSTEM VOLTAGE: 600 VOLTS
SHORT CIRCUIT CURRENT: 45.96 AMPS
WARNING - ELECTRIC SHOCK HAZARD
DO NOT TOUCH TERMINALS
TERMINALS ON BOTH LINE AND LOAD
SIDES MAY BE ENERGIZED
IN THE OFF POSITION
DANGER / PELIGRO
PHOTOVOLTAIC SYSTEM SAFETY DC DISCONNECT SWITCH (2 OF 2)
PHOTOVOLTAIC DC POWER SOURCES (3 TYP)
OPERATING CURRENT(MAX-POWER): 43.08 AMPS
OPERATING VOLTAGE(MAX-POWER): 390.6 VOLTS
MAXIMUM SYSTEM VOLTAGE: 600 VOLTS
SHORT CIRCUIT CURRENT: 45.96 AMPS
WARNING - ELECTRIC SHOCK HAZARD
DO NOT TOUCH TERMINALS
TERMINALS ON BOTH LINE AND LOAD
SIDES MAY BE ENERGIZED
IN THE OFF POSITION
DANGER / PELIGRO


PHOTOVOLTAIC SYSTEM SAFETY
DC DISCONNECT SWITCH (1 OF 2)
ON
PHOTOVOLTAIC DC POWER SOURCES (3 TYP)
OPERATING CURRENT(MAX-POWER): 43.08 AMPS
OPERATING VOLTAGE(MAX-POWER): 390.6 VOLTS
MAXIMUM SYSTEM VOLTAGE: 600 VOLTS
SHORT CIRCUIT CURRENT: 45.96 AMPS
WARNING - ELECTRIC SHOCK HAZARD
DO NOT TOUCH TERMINALS
TERMINALS ON BOTH LINE AND LOAD
SIDES MAY BE ENERGIZED
IN THE OFF POSITION
HEAVY DUTY
SAFETY SWITCH
INTERRUPTOR DE
SEGURIDAD DE
SERVICIO PESADO
100 A

690.31(C)(1) Wiring Methods Permitted – Solar Photovoltaic (PV) Systems

- Exception requiring raceways to be used when required by 690.31(A) was removed as long as the wiring remains within the PV array footprint
- Limits exposed conductors to within the array footprint only
- Permits Type USE-2 conductors to be installed in ungrounded as well as grounded systems
- Term “listed and labeled” was replaced with “**listed and identified**” when describing single-conductor PV wire
- New installation requirement and reference to 338.10(B)(4)(b) and 334.30 added to 690.31(C)(1) for PV wiring in a PV array


SHARP
SOLAR MODULE
NT-S5E1U


USA WIRE AN
800-890-9473 10 AWG XLP (UL) TYPE RHH OR RHW-2 OR USE-2 600V 90C (-40C) OIL RES II

690.35
Ungrounded PV Systems *(Deleted)*

- Requirements for an ungrounded photovoltaic (PV) power system at 690.35 have been **deleted** as these requirements are covered elsewhere in Article 690

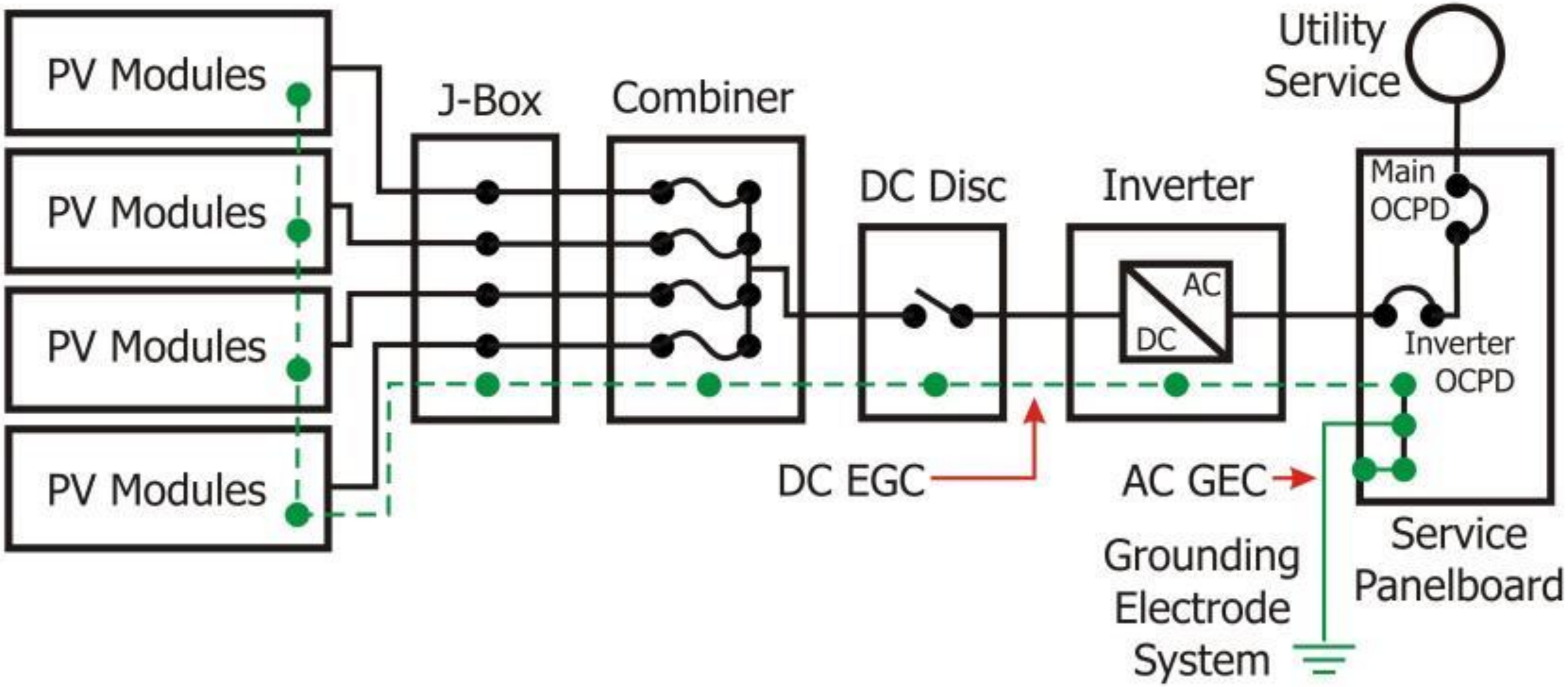
- Ungrounded systems are now defined as a "**functional grounded PV system**"

- No longer a need to distinguish between ungrounded systems and what is now defined as a functional grounded PV system *(see new definition at 690.2)*

- Only distinction needed is between a **solidly grounded PV systems** and all other PV systems

690.35 Ungrounded PV System (Deleted)

Provisions for Ungrounded Photovoltaic (PV) Power System have been deleted as the issues and topics previously covered at 690.35 are addressed in other locations within Article 690



Ungrounded PV System

(now referred to as a Functional Grounded PV System)

690.41
System Grounding for PV Systems

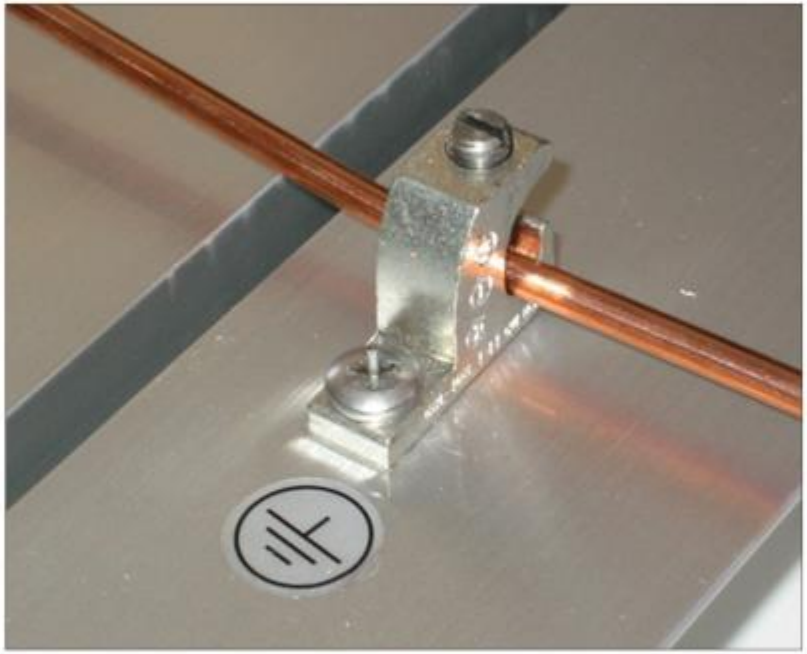
- Requirements for "**System Grounding**" of PV systems revised to properly address the methods by which PV systems are grounded
- Newly defined term "**functional grounded**" addressed at **690.41(A)**
- Previous text of 690.5 *(Ground-Fault Protection)* was moved to **690.41(B)** to better coincide with grounding requirements
- Ground-fault protection is related to system grounding and the issues that system grounding address, better to have GFP grouped with the requirements for system grounding

690.41
System Grounding for PV Systems *(cont.)*

- While the PV ground fault protection function is often a built-in feature of an inverter or charge controller, it may also be built into stand-alone products and other PV system products like PV combiners and dc/dc converters
- This new text will better support the PV ground fault protection functionality in equipment other than inverters and charge controllers

690.41 System Grounding of PV Systems

The requirements for System Grounding of PV systems was revised to properly address the methods by which PV systems are grounded (six configurations)



690.41(A) PV System Grounding Configurations

690.41(B) (GFP) Ground-Fault Protection

The previous text of 690.5 for ground-fault protection of PV systems was moved to 690.41(B) to better coincide with grounding requirements

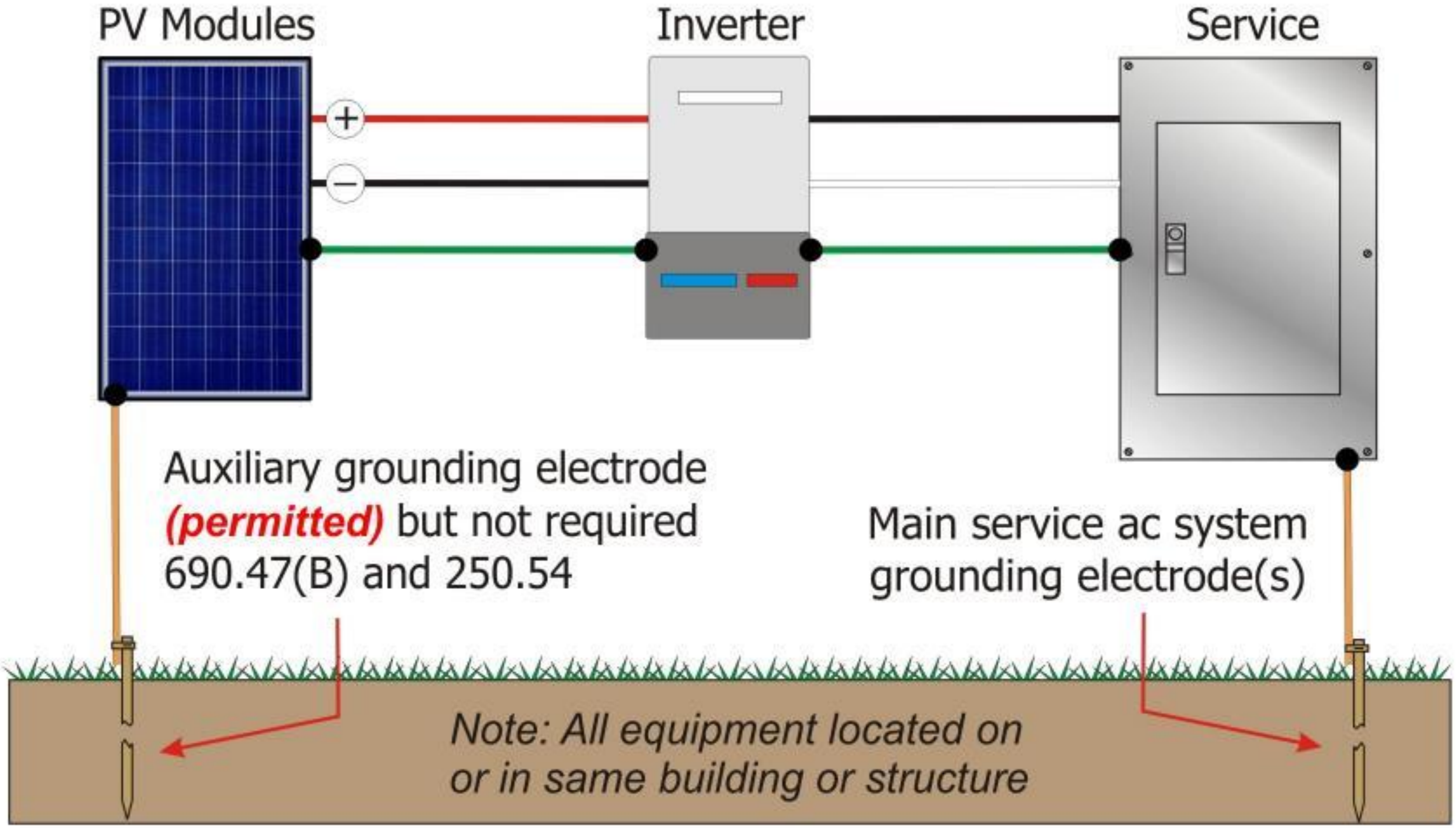
690.47 Grounding Electrode System for PV Systems

- Requirements for the installation of grounding electrodes and grounding electrode conductors for PV systems have been **simplified**, while increasing the safety of PV systems
- 690.47(A) now refers to sections or parts of **Article 250** without repeating the specific grounding electrode rules
- Further simplified to only require a GEC to be attached to solidly grounded PV systems
- Safety provisions of former 690.47(B) reworded and moved to parent text of 690.47(A) while 690.47(B) was deleted
- New ground-mounted PV system will require a new grounding electrode system *(as will a building-mounted system)*, but only if that building did not previously have a GE system

690.47 Grounding Electrode System for PV Systems *(cont.)*

- Text for auxiliary electrodes for PV array grounding has been revised to ***permit*** an auxiliary electrode *(not require one)*
- Auxiliary grounding electrode system helps to minimize the effects of such things as a lightning strike
- Primary purpose of an auxiliary grounding electrode is to maintain the frames of the PV array to as close to local earth voltage potential as possible
- This can also be achieved through a properly installed **equipment grounding conductor** back to an established grounding electrode system for the building or structure

690.47 Grounding Electrode System



Auxiliary grounding electrode *(permitted)* but not required 690.47(B) and 250.54

Main service ac system grounding electrode(s)

Note: All equipment located on or in same building or structure

The requirements for the installation of a grounding electrode system for PV systems have been revised and simplified

Code language for auxiliary electrodes-for PV array grounding has been revised to *permit* an auxiliary electrode *(not to require one)*

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

- Provisions for identifying a PV “**Rapid Shutdown System**” have been extensively revised
- **Two new figures** with illustrated labels have been added to indicate to first responders that rapid-shutdown is provided
  - **Figure 690.56(C)(1)(a)**: Label for PV Systems that Shut Down the Array and the Conductors Leaving the Array
  - **Figure 690.56(C)(1)(b)**: Label for PV Systems that Shut Down the Conductors Leaving the Array Only
- **Detailed roof diagram** required in certain situations showing each different PV system and a “dotted line” around areas that remain energized after rapid shutdown initiated

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

- Rapid shutdown switch to have a **label** located directly on the **rapid shutdown initiator (RSI)** or no more than **1 m (3 ft)** from the rapid shutdown switch that includes the words:

RAPID SHUTDOWN SWITCH FOR SOLAR PV SYSTEM

- Anything that is not touch safe should be labeled as energized
- Revisions direct firefighters and first responders to the **location of the RSI switch** and it clearly identifies what equipment is still live after the system has been shut down
- Allows proper precautions to be taken when responding to an **emergency situation** on a building or structure involving a PV system and a rapid shutdown device

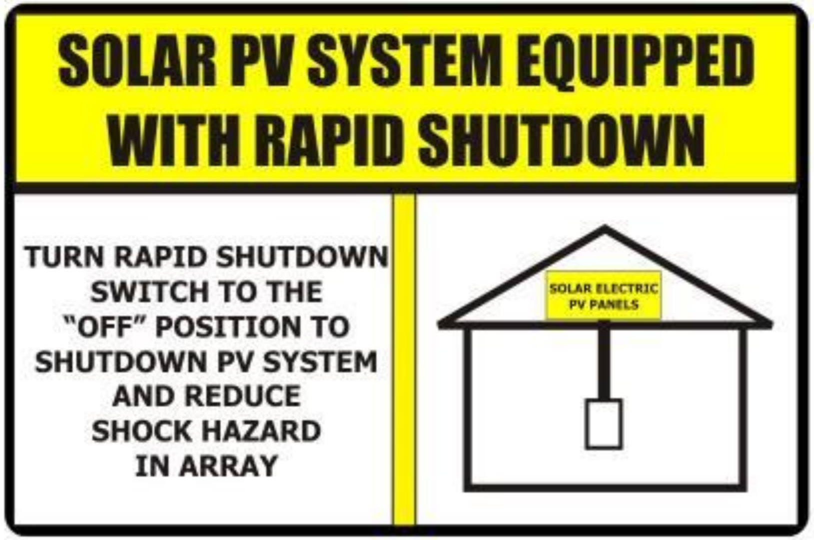
690.56(C) ID of Power Sources Buildings with Rapid Shutdown

Two different labels are required on buildings depending on what type of rapid shutdown system is on the building

Systems with multiple rapid shutdown types will be required to have a detailed directory as simple sign will not be sufficient to clarify the levels of hazard

Plaque or directory required within 1 m (3 ft) of service

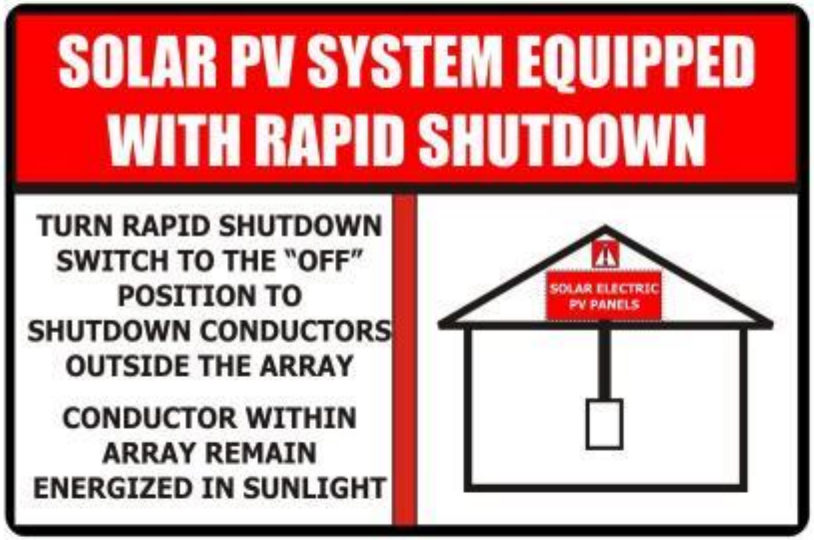
Revision requires any building with a rapid-shutdown PV system to have a plaque to indicate to first responders that rapid-shutdown is provided



SOLAR PV SYSTEM EQUIPPED WITH RAPID SHUTDOWN

TURN RAPID SHUTDOWN SWITCH TO THE "OFF" POSITION TO SHUTDOWN PV SYSTEM AND REDUCE SHOCK HAZARD IN ARRAY

Figure 690.56(C)(1)(a): Label for PV Systems that Shut Down the Array and the Conductors Leaving the Array



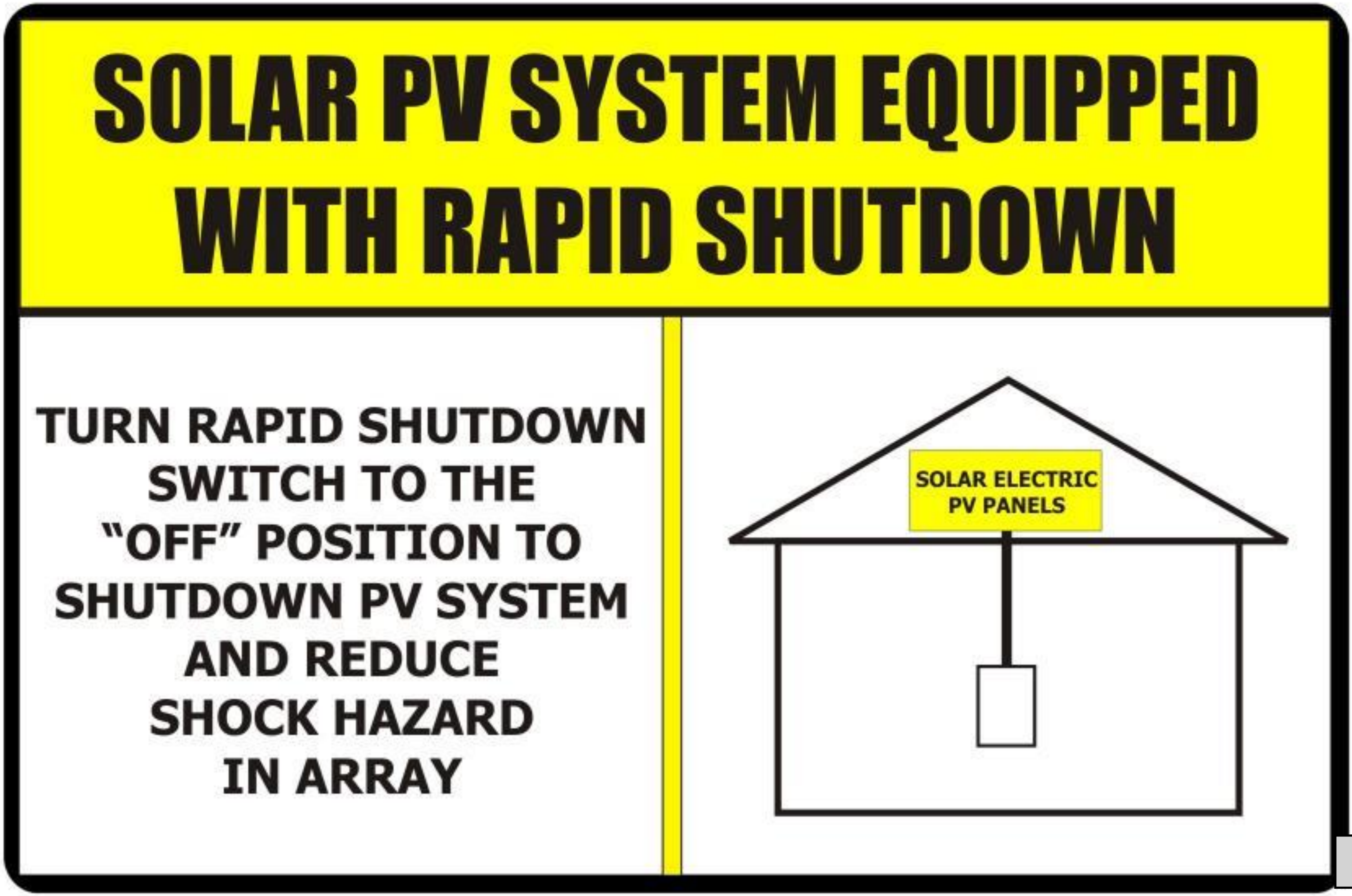
SOLAR PV SYSTEM EQUIPPED WITH RAPID SHUTDOWN

TURN RAPID SHUTDOWN SWITCH TO THE "OFF" POSITION TO SHUTDOWN CONDUCTORS OUTSIDE THE ARRAY

CONDUCTOR WITHIN ARRAY REMAIN ENERGIZED IN SUNLIGHT

Figure 690.56(C)(1)(b): Label for PV Systems that Shut Down the Conductors Leaving the Array Only

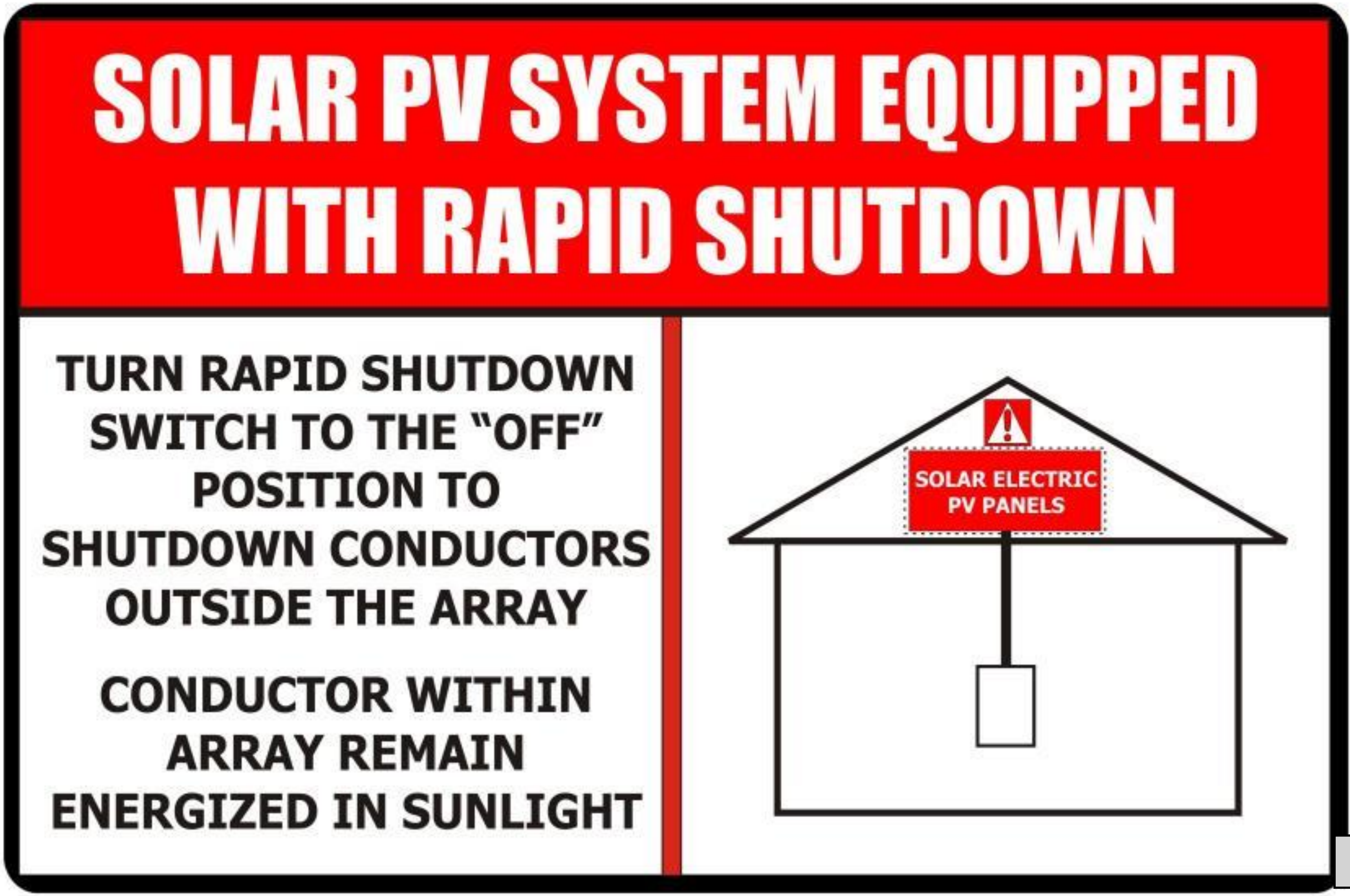
Figure 690.56(C)(1)(a): Label for PV Systems that Shut Down the Array and the Conductors Leaving the Array



SOLAR PV SYSTEM EQUIPPED WITH RAPID SHUTDOWN

TURN RAPID SHUTDOWN SWITCH TO THE "OFF" POSITION TO SHUTDOWN PV SYSTEM AND REDUCE SHOCK HAZARD IN ARRAY

Figure 690.56(C)(1)(b): Label for PV Systems that Shut Down the Conductors Leaving the Array Only



SOLAR PV SYSTEM EQUIPPED WITH RAPID SHUTDOWN

TURN RAPID SHUTDOWN SWITCH TO THE "OFF" POSITION TO SHUTDOWN CONDUCTORS OUTSIDE THE ARRAY

CONDUCTOR WITHIN ARRAY REMAIN ENERGIZED IN SUNLIGHT

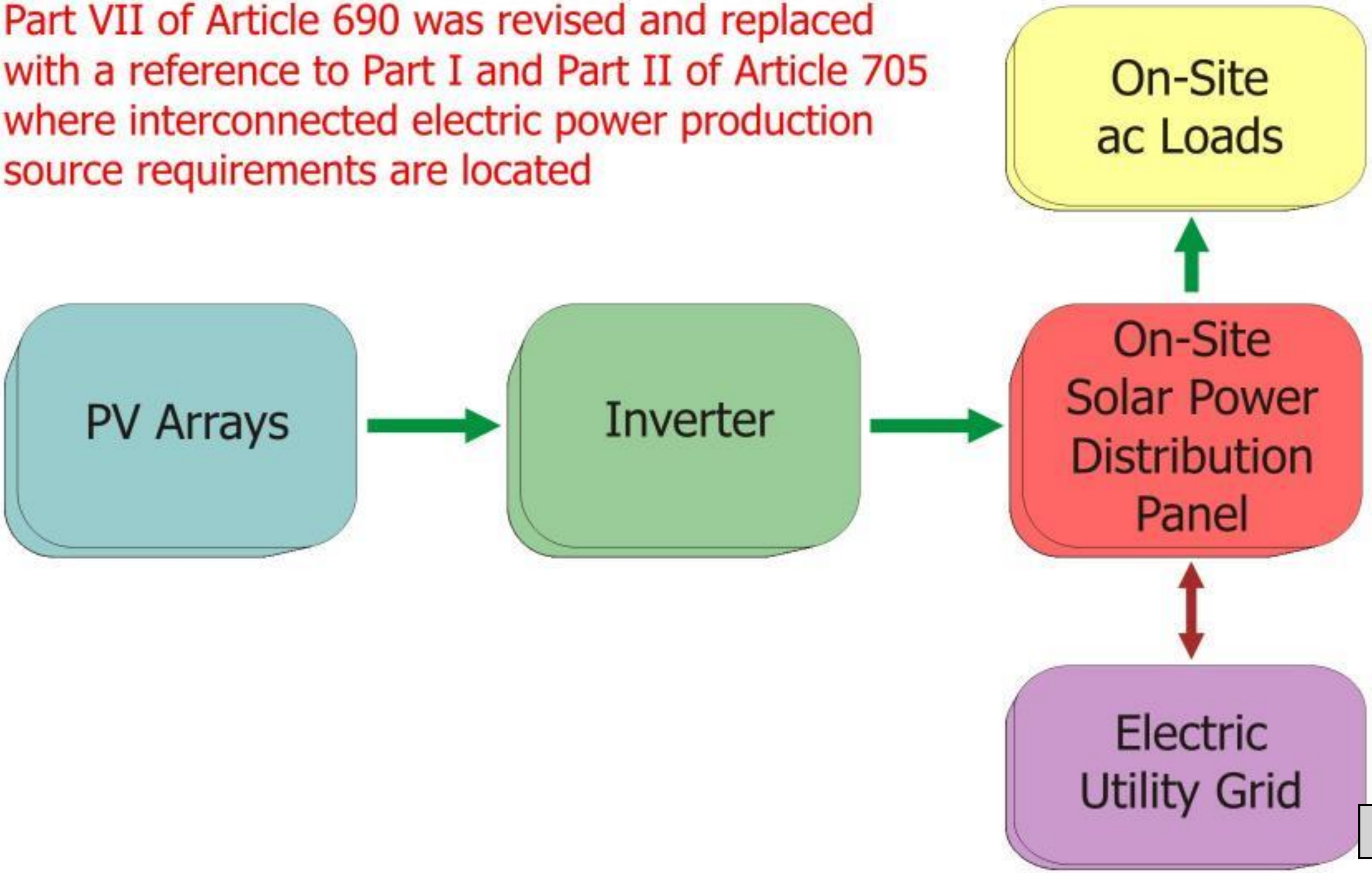
Article 690 Part VII – Connection to Other Sources [Solar Photovoltaic (PV) Systems]

- Part VII of Article 690 was revised and replaced with a reference to **Article 705** where interconnected electric power production source requirements are found
- Part VII of Article 690 is now one simple sentence at **690.59** which states “PV systems connected to other sources shall be installed in accordance with Parts I and II of Article 705”
- Part I of Article 705 covers “General” requirements for interconnected electric power production sources while Part II of Article 705 concerns requirement for **utility-interactive inverters**

Article 690 Part VII Connection to Other Sources

690.59 Connection to Other Sources. PV systems connected to other sources shall be installed in accordance with Parts I and II of Article 705.

Part VII of Article 690 was revised and replaced with a reference to Part I and Part II of Article 705 where interconnected electric power production source requirements are located



PV Arrays

Inverter

On-Site Solar Power Distribution Panel

On-Site ac Loads

Electric Utility Grid


SIEMENS
SIEMENS
SIEMENS
IG Plus
IG Plus
ON
OFF

690.71 Energy Storage Systems – PV Systems

- Former provisions of 690.71 for installation of **PV storage battery systems** have been **relocated to Part III Article 706**, leaving one reference to new Article 706 at 690.71
- New Article 706 titled, “Energy Storage System” has been introduced to the 2017 *NEC*
- No need to have identical language in two different articles
- Simpler for 690.71 to refer users of the *Code* to Article 706
- Storage batteries for PV systems accumulate excess energy created by the PV system and store it to be used at night or when there is no other energy input

Article 691 Large-Scale Photovoltaic (PV) Electric Power Production Facility

- New Article 691 for "**Large-Scale Photovoltaic (PV) Electric Power Production Facility**" added to the 2017 *NEC*
- New article covers the installation of large-scale PV electric power production facilities operated for the sole purpose of **providing electric supply to the utility transmission or distribution system** with a generating capacity of **no less than 5,000 kW**
- Typically connected at **medium voltages (4.16kV to 34.5kV)** or even **transmission voltages (69kV or higher)** rather than at 480 volts or lower
- Large-scale PV systems typically connect to grid on the **utility side of the metering system** rather than the customer side

Article 691 Large-Scale Photovoltaic (PV) Electric Power Production Facility *(cont.)*

- These large scale PV systems are typically **accessible only to qualified personnel** rather than to the general public
- Unlike smaller scale PV systems, large-scale PV electric power production facilities are designed and operated similarly to traditional utility power generating plants
- Unqualified individuals must not access the system for their own safety and for protection of the system which is crucial to grid stability
- Access to large-scale PV electric supply stations must be restricted by a **fencing structure** to ensure that systems are adequately protected from the general public
- These large-scale PV systems are difficult if not impossible to fit under the current scope of Article 690

Photo Courtesy of Scott Humphrey

Photo Courtesy of Scott Humphrey

Photo Courtesy of Jim Rogers

695.6(G) Ground-Fault Protection Not Permitted for Fire Pumps

- Revision occurred to clarify that ground-fault protection of equipment is ***not permitted*** for fire pump power circuit(s)
- Fire pumps are required to have an **extra measure of protection** in the event of a fire to allow the fire pump to do its job and try to extinguish the fire
- Fire pumps and their wiring methods should be **sacrificial by nature**
- Previous text indicated that ground-fault protection of equipment shall not be “permitted” for fire pumps
- Some incorrectly interpreted this rule to mean that providing GFP for fire pumps was an option rather than a prohibition

695.6(G) Fire Pumps (GFP Prohibited)

Ground-fault protection of equipment shall not be installed in any fire pump power circuit

Revision changed 695.6(G) from "ground-fault protection of equipment shall not be permitted for fire pumps" to "ground-fault protection of equipment shall not be installed in any fire pump power circuit"

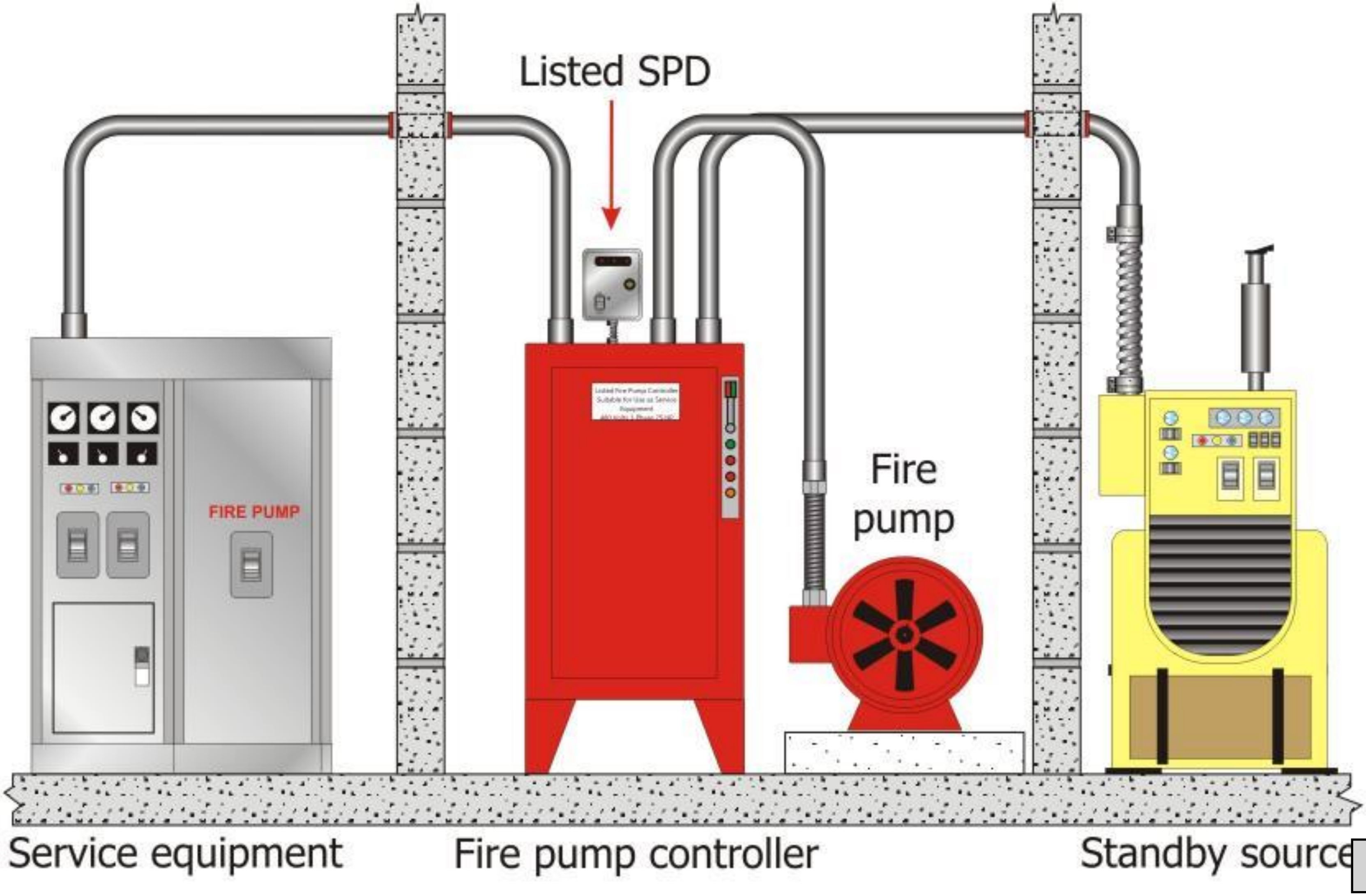
Photo Courtesy of Randy Hunter

695.15 Surge Protection for Fire Pumps

- A listed **surge protection device (SPD)** will now be required to be installed in or on fire pump controllers
- An SPD is necessary to provide protection for the fire pump controller
- The location and type of SPD is a design issue and will remain with the designer and/or installer
- These SPDs for fire pump controllers will be required to be **listed devices** as already required by former 285.5 *(now 285.6)*
- Practical and feasible to protect fire pump installations from damage with a listed SPD

695.15 Surge Protection (Fire Pumps)

A listed surge protection device (SPD) shall be installed in or on the fire pump controller



Chapter Seven Special Conditions

700.2 and 700.25 Branch Circuit Emergency Lighting Transfer Switch

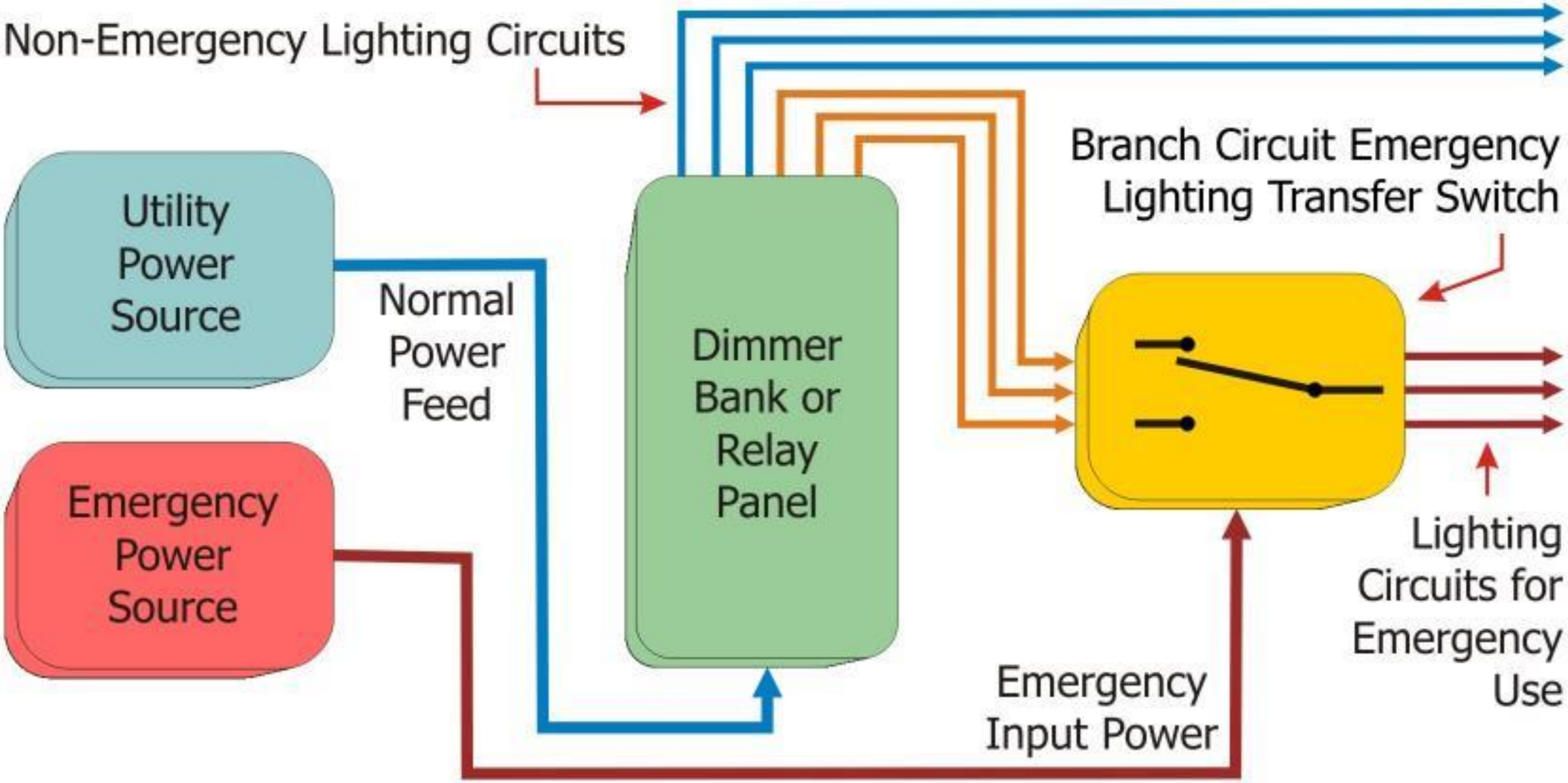
- New definition for "**Branch Circuit Emergency Lighting Transfer Switch**" along with provisions for same at 700.25 has been added to the 2017 *NEC*
- Added to allow these devices to **transfer emergency lighting loads** supplied by branch circuits rated at not greater than **20 amperes** from the normal branch circuit to an emergency branch circuit
- Accommodates a new class of **transfer switching devices** intended for operation of individual branch circuits in an emergency lighting system

700.2 and 700.25 Branch Circuit Emergency Lighting Transfer Switch *(cont.)*

- In some past situations, an **automatic load control relay (ALCR)** has been used to transfer emergency lighting loads from the normal supply to an emergency supply *(even though this is a Code violation of 700.26)*
- ALCRs were never intended for use as general purpose transfer equipment
- ALCRs have not undergone any evaluation as emergency transfer switches

700.2 and 700.25 Branch Circuit Emergency Lighting Transfer Switch

Branch Circuit Emergency Lighting Transfer Switch allowed to be used to transfer emergency lighting loads supplied by branch circuits rated at 20 amperes or less from the normal branch circuit to an emergency branch circuit



Branch Circuit Emergency Lighting Transfer Switch. A device connected on the load side of a branch circuit overcurrent protective device that transfers only emergency lighting loads from the normal supply to an emergency supply.

700.2 and 700.25 Branch Circuit Emergency Lighting Transfer Switch

Branch Circuit Emergency Lighting Transfer Switch allowed to be used to transfer emergency lighting loads supplied by branch circuits rated at 20 amperes or less from the normal branch circuit to an emergency branch circuit

Courtesy of Electronic Theatre Controls, Inc.

Branch Circuit Emergency Lighting Transfer Switch. A device connected on the load side of a branch circuit overcurrent protective device that transfers only emergency lighting loads from the normal supply to an emergency supply.

700.3(F) Temporary Source of Power for Maintenance or Repair of the Alternate Source of Power

- New provisions added providing performance based requirements for **portable or temporary alternate source of power** to be available whenever a single alternate source of power for emergency system is out of service for **maintenance or repair**

- Permanent switching means must be available for the duration of the maintenance or repair

- New requirement comes with an **exception** with **four conditions**

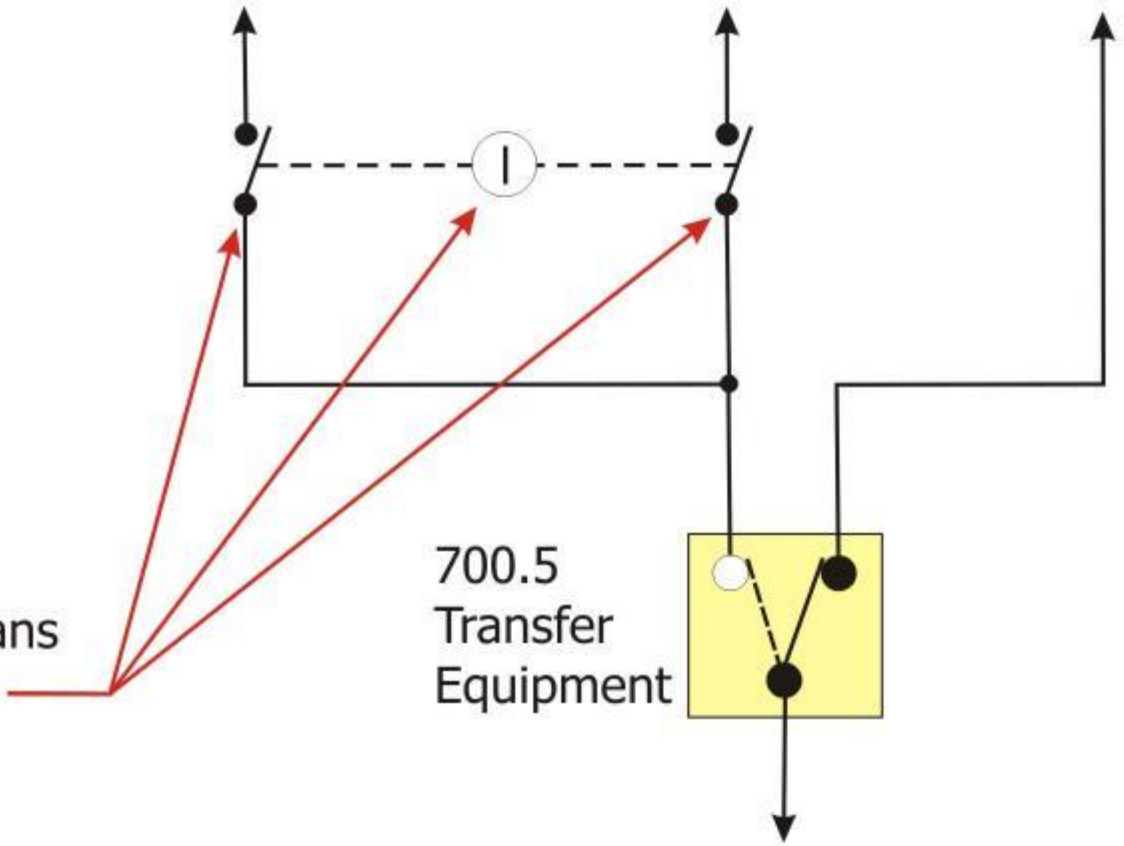
- New **Figure 700.3(F)** also added to show one possible method to utilize manual switching from the single alternate source of power to the portable or temporary alternate source of power

700.3(F) Temporary Source of Power for Maintenance or Repair of the Alternate Source of Power *(cont.)*

- Previous requirements called for temporary alternate source to be available whenever the emergency generator is out of service for **major maintenance or repair**
- It was difficult to determine what would be considered “**major**” maintenance or repair
- Oil changes are not generally a major maintenance item, but on a large generator, this can take several hours to perform

700.3(F) and Figure 700.3(F)

Temporary Source of Power for Maintenance or Repair of the Alternate Source of Power



Portable or Temporary Power Source

Emergency Power Source

Normal Power Source

700.3(F) Switching Means and Interlock

700.5 Transfer Equipment

Emergency Load

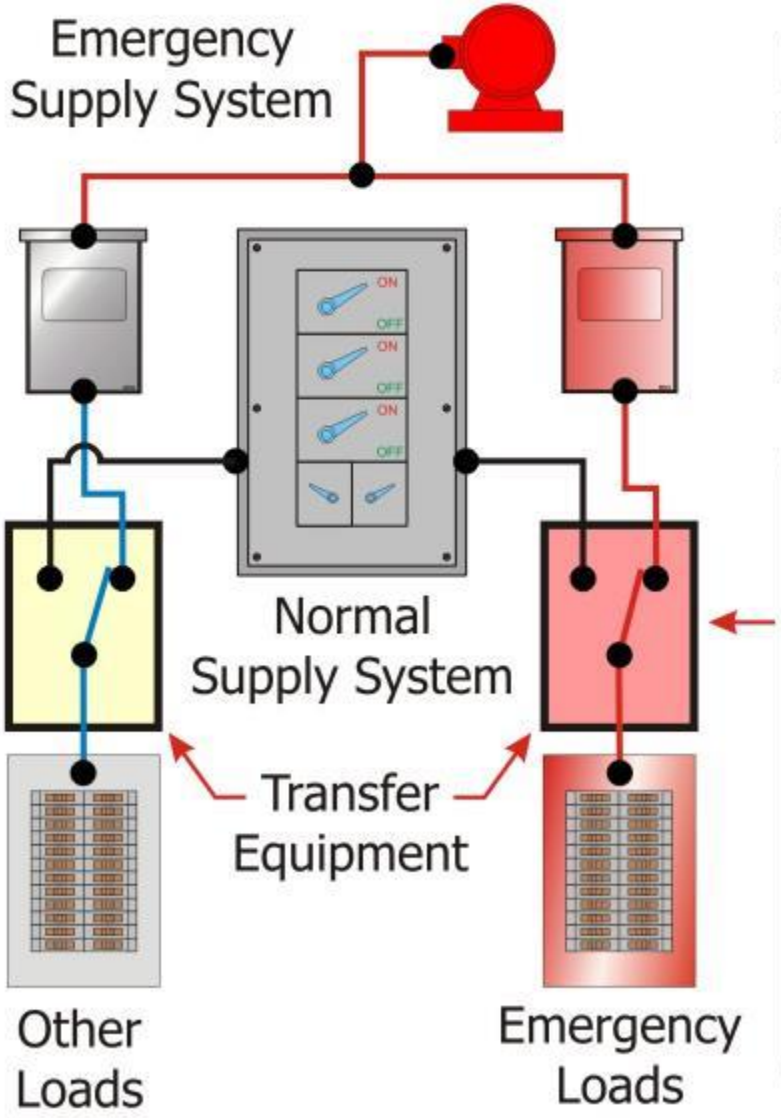
Reproduction of NEC Figure 700.3(F)

700.5(E) Emergency Systems Transfer Equipment Documentation

- New requirements added for **available short-circuit current rating (SCCR) documentation** and **field-marking** at emergency system transfer equipment
- SCCR to be based on the **specific overcurrent protective device type and settings** protecting the transfer equipment
- Additional field marking on the exterior of transfer equipment was deemed necessary as a transfer switch of this nature is typically marked by the manufacturer with several different options resulting in numerous SCCR values
- New field marking of the SCCR value based on the specific type OCPD, ampere rating, and installed settings, which are known factors by the designer and/or installer

700.5 Documentation of Transfer Equipment

New requirements added for available short-circuit current rating documentation and field-marking at emergency system transfer equipment



Required to be field marked on the exterior of the transfer equipment

SCCR based on the specific overcurrent protective device type and settings protecting the transfer equipment

⚠ WARNING

Maximum Available Fault Current at Transfer Equipment: **35.4 kA**

Voltage: **480**

SCCR: **50 kA**

Date: **Oct 2014**

XYZ Electrical Contractors Richardson, TX 800-444-1212


PRIVATE CHECK METER
SS10050
TR


MAINS
PLANT
LOAD

700.10(A)
Identification – Emergency Systems

- Identification for emergency circuits has been expanded to include **cables and raceways not associated with boxes or enclosures**
- Example of this could be a metallic cable system "**daisy chained**" from emergency luminaire to emergency luminaire without installing a junction box between luminaires
- This is in addition to boxes and enclosures associated with emergency system
- New provisions now require exposed emergency circuit or system cable or raceway systems to be **permanently marked** as a component of an emergency circuit or system, at intervals not to exceed **7.6 m (25 ft)** where boxes or enclosures are not encountered

700.10(A)
Identification – Emergency Systems *(cont.)*

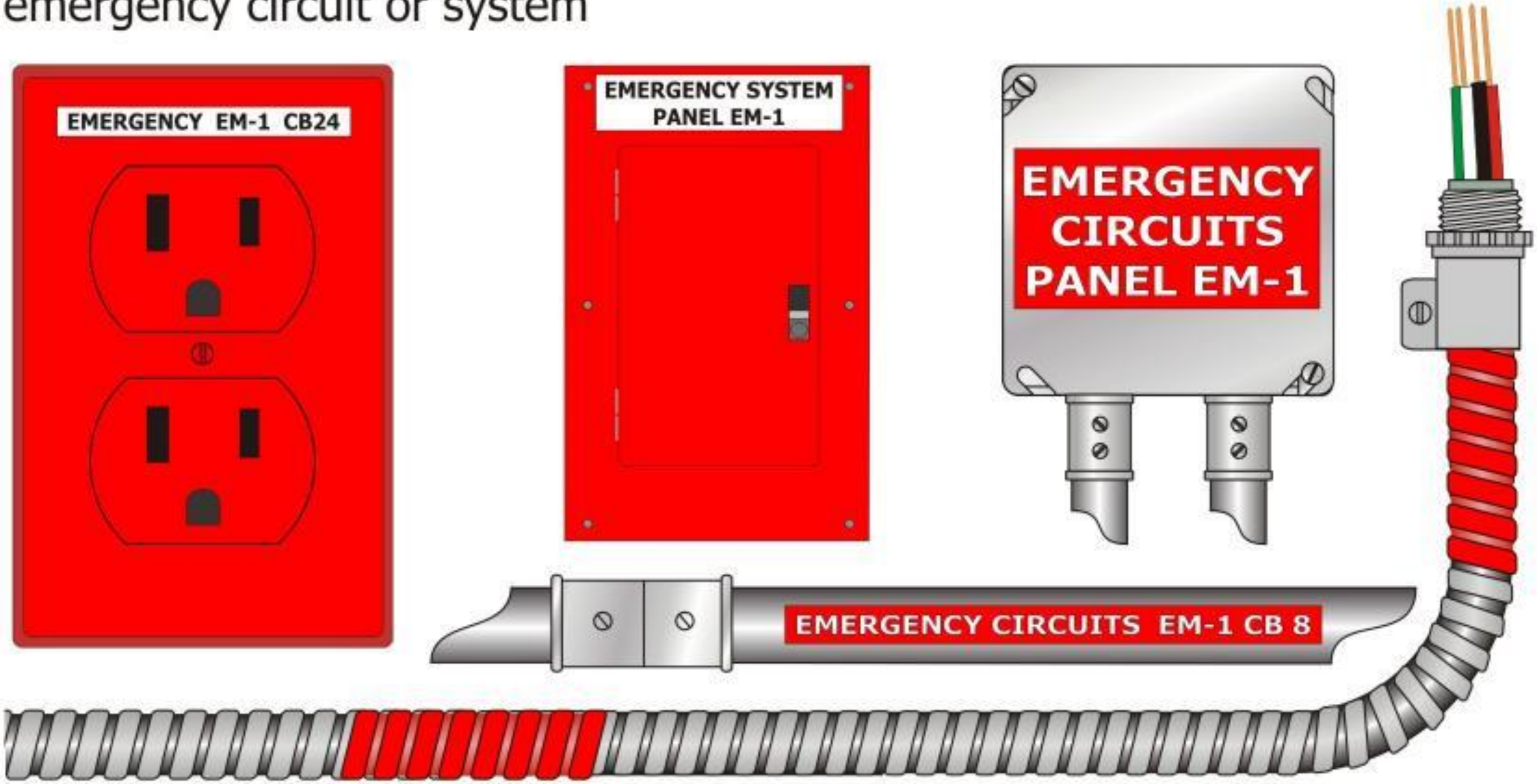
- Identification method could be as simple as **spray painting the cable or raceway** every 7.6 m (25 ft) similar to identification of independent grid wires specific to support of wiring methods above a suspended ceiling as required by 300.11(A)(1) and (A)(2)

- Emergency system **receptacles** now require identification with a "**distinctive color or marking**" on the receptacle cover plates or the receptacle

- The *Code* is not specific as to the means or method to be used to accomplish the receptacle "distinctive color or marking" requirements *(red receptacles and covers, etc.)*

700.10(A) Identification of Emergency Systems

In addition to boxes and enclosures, exposed emergency system cables and raceway systems not associated with boxes or enclosures required to be permanently marked to be readily identified as a component of an emergency circuit or system



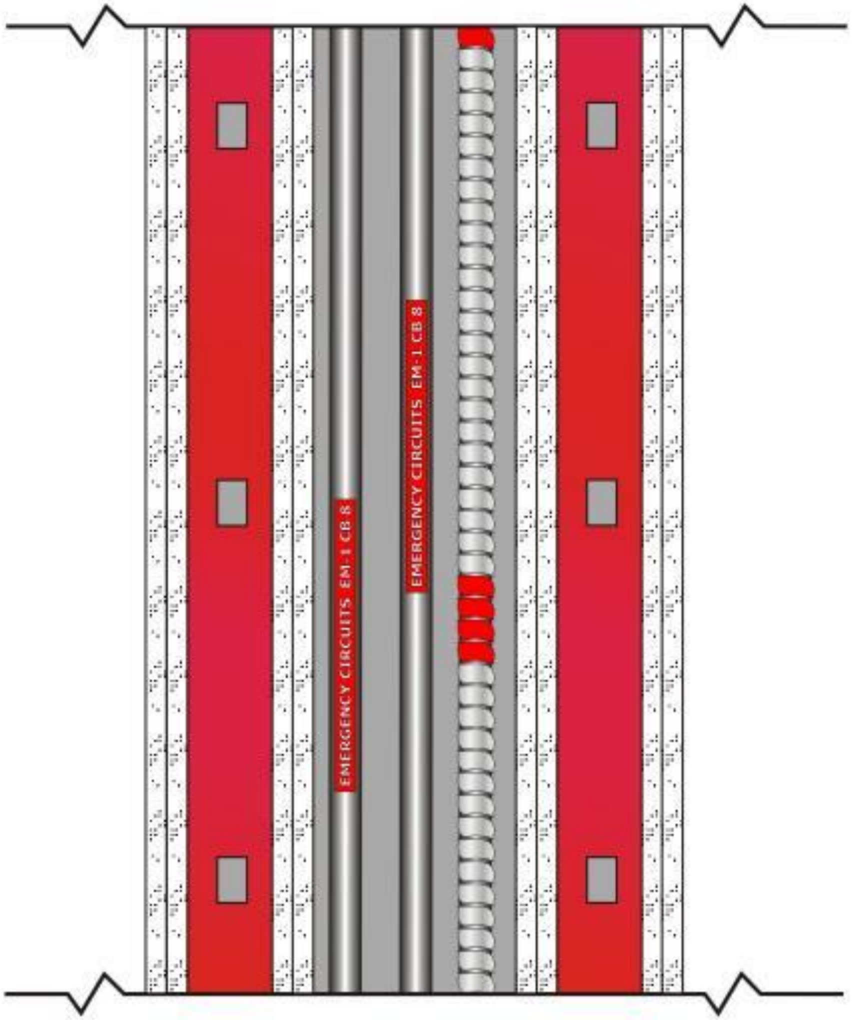
Receptacles supplied from the emergency system now required to be identified by a "distinctive color or marking" on the receptacle cover plates or the receptacle

700.10(D) Fire Protection for Emergency System

- Requirements have been added for **fire protection of emergency system feeders** for:
  - **Health care occupancies** where persons are not capable of self-preservation and
  - **Educational occupancies** with more than 300 occupants
- This is in addition to high-rise buildings and those buildings with large occupancy loads
- Recognizes that schools, learning centers, universities, hospitals, and nursing homes could qualify and the challenges of safe evacuation in the event of fire are similar and just as critical
- This revision/addition had a correlation effect at provisions of **700.12** for **sources of power equipment** to an emergency system

700.10(D) Fire Protection for Emergency Systems

Occupancy areas requiring fire protection requirements for emergency system feeders was expanded for the 2017 *NEC*



Fire protection provisions for emergency system feeders required for the following occupancies:

(1) Assembly occupancies for not less than 1000 persons

(2) Buildings above 23 m (75 ft) in height

(3) Health care occupancies where persons are not capable of self preservation

(4) Educational occupancies with more than 300 occupants

701.6(D) GFP Sensors for Legally Required Standby Systems

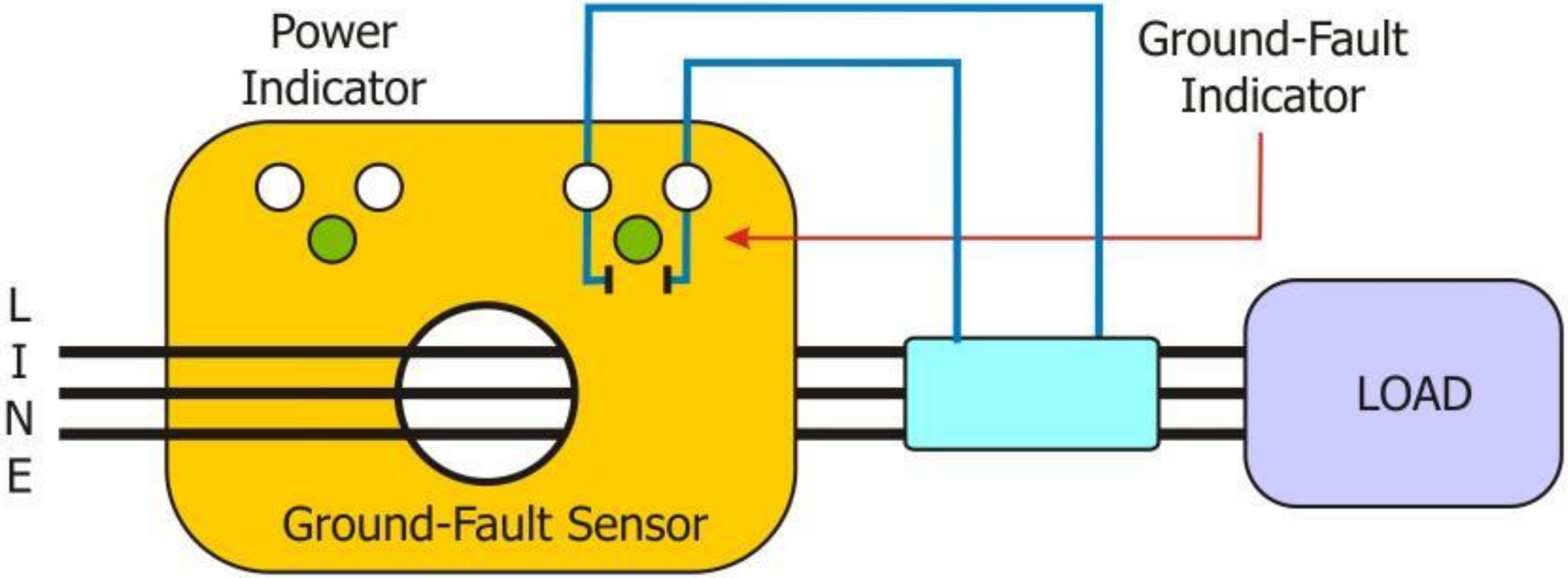
- New text added to allow a **ground-fault sensor** to be located at an **alternate location** for legally required standby systems with **multiple emergency sources** connected to a paralleling bus
- The provisions of 701.6(D) generally calls for ground-fault sensor signal devices to be located **at or ahead of the main system disconnecting means** for the legally required standby source
- A properly installed ground-fault sensor can provide a reliable and cost effective method for sensing ground faults
- New language dealing with systems with **multiple emergency sources connected to a paralleling bus** will help clarify the requirements for installing the ground fault sensor at an alternate location

701.6(D) GFP Sensors for Legally Required Standby Systems *(cont.)*

- For multiple emergency sources, ground fault sensing may be determined by:
  - Zero sequence sensing
  - Differential relaying of the paralleling bus in conjunction with residual ground fault sensing device of the feeders or
  - Other equivalent means
- Same change occurred at **700.6(D)** for **Emergency Systems**

701.6(D) GFP Sensors

The sensor for ground-fault signal devices is generally required to be located at, or ahead of, the main system disconnecting means for the legally required standby source of a legally required standby system



Code language was added at 701.6(D) to allow the ground fault sensor to be located at an alternate location for systems with multiple emergency sources connected to a paralleling bus

702.12(C) Power Inlets for Portable Generators at Optional Standby Systems

- New requirements added for **power inlets used with optional standby generators** to ensure that disconnection of the power inlet **does not occur under load**
- New language requires optional standby equipment containing power inlets **rated 100 amperes or more** for the connection of a generator source to be **listed for the intended use** and be equipped with an **interlocked disconnecting means**
- Not uncommon to find **power inlet boxes** serving as gateway between inside need for electricity and outside supply source
- Disconnecting under load can present a safety hazard if the inlet is not rated for load break or the "intended use"

702.12(C) Power Inlets for Portable Generators at Optional Standby Systems *(cont.)*

- **Two new exceptions** were added omitting power inlet box from being listed for the intended use and being an interlocking disconnecting means:
  - First exception pertains to the power inlet device **rated as a disconnecting means** itself
  - Second exception pertains to **supervised industrial installations** where permanent space is identified for the portable generator to be located within line of sight of the power inlets
- New language intended to either require the power inlet devices used with portable outdoor generators be **load break rated** or be **interlocked with a disconnecting means**


LEVITON PowerSwitch™
MECHANICAL INTERLOCK
100A 3 PHASE Y 120/208VAC
CATALOG NUMBER: 5100MB9W
TYPE 3R, 4X, 12K
IP67
TO RESET: TURN HANDLE TO OFF AND REMOVE PLUG
SEE WARNING BELOW
LOOSEN COVER SCREWS AND OPEN COVER
FOLLOW RESET INSTRUCTIONS ON INSIDE OF COVER
RÉARMEMENT : METTRE L'INTERRUPTEUR
À LA POSITION ARRÊT ET RETIRER LA FICHE
LIRE L'AVERTISSEMENT CI-DESSOUS
DESSERRER LES VIS DU COUVERCLE ET
SUIVRE LES DIRECTIVES DE RÉARME
À L'INTÉRIEUR DU COUVERCLE
PARA REINICIAR : MUEVA LA MAN
Y SAQUE LA CLAVIJA
VEA LAS ADVERTENCIAS ABAJ
AFLOJE LOS TORNILLOS DE LA
SIGUIENDO LAS INSTRUCCIONE
PARTE INTERIOR DE LA CUBIER
TRIP
ON
OFF
TURN OFF TO REMOVE PLUG
INSERT PLUG TO TURN SWITCH ON
METTRE L'INTERRUPTEUR EN POSITION ARRET POUR RETIRER LA FICHE
INSEREZ LA FICHE POUR METTRE L'INTERRUPTEUR EN POSITION MARCHE
DESCONECTE PARA QUITAR LA CLAVIJA
INSERTE LA CLAVIJA PARA ENCENDER EL INTERRUPTOR
OVERCURRENT PROTECTED
UL
LISTED 40KF
MANUAL MOTOR CONTROLLER
SUITABLE AS MOTOR DISCONNECT
LR 51334
NOM 057-ANCE
CE
SC39V
MADE IN SWEDEN
99420772
WARNING
ARC FLASH AND SHOCK HAZARD - MORE THAN ONE SUPPLY DISCONNECT MAY BE REQUIRED TO DE-ENERGIZE EQUIPMENT BEFORE SERVICING.
AVERTISSEMENT
RISQUE D'ARC ELECTRIQUE ET D'ELECTROCUTION - PLUS D'UN INTERRUPTEUR GENERAL PEUVENT ETRE REQUIS POUR METTRE HORS TENSION AVANT L'ENTRETIEN
ADVERTENCIA
EL ARCO ELECTRICO Y PELIGRO DE CHOQUE ELECTRICO - PUEDE REQUERIR DE MAS DE UN INTERRUPTOR PARA DESCONECTA LA ENERGIA DEL EQUIPO ANTES DE HACER MANTENIMIENTO

Article 705 Part IV Microgrid Systems
(Interconnected Electric Power Production Sources)

- New Part IV added to Article 705 recognizing **microgrid systems** as an interconnected electric power production source
- Microgrids are an example of one or more **interconnected electric power production source** operating in parallel with a primary source(s) of electricity
- Microgrid systems are modern, localized, small-scale grids, contrary to the traditional, centralized electricity grid
- Microgrids are a way to add resiliency against loss of power in premises wiring systems
- Microgrid systems are sometimes referred to as “**intentionally islanded systems**” and “**stand-alone systems**”

Article 705 Part IV. Microgrid Systems
Interconnected Electric Power Production Sources

A new Part IV was added to Article 705 recognizing "Microgrid Systems" as an interconnected electric power production source

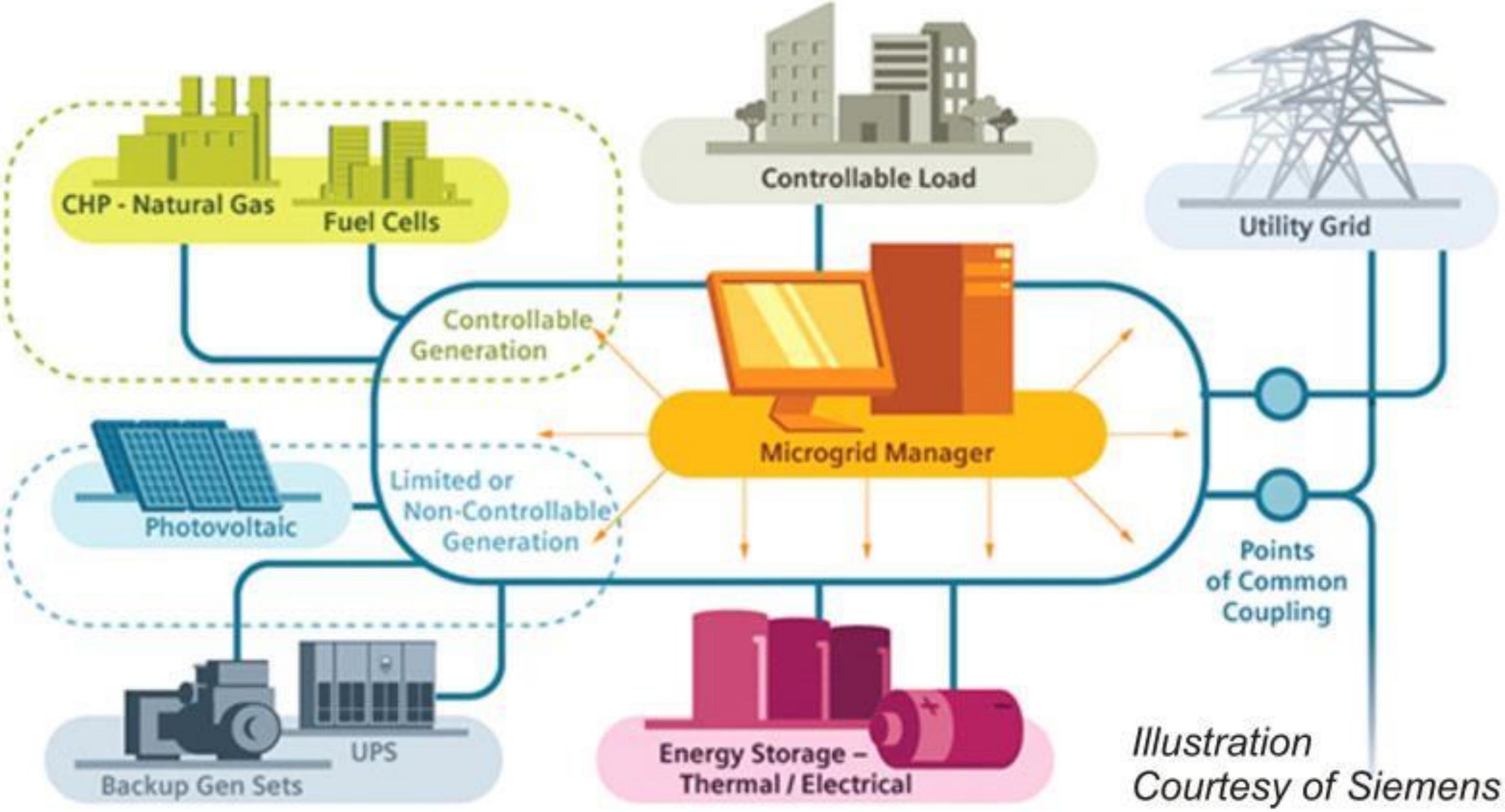


Illustration Courtesy of Siemens

Microgrid systems, sometimes referred to as "intentionally islanded systems" and "stand-alone systems" are a way to add resiliency against loss of power in premises wiring systems

Article 706 Energy Storage Systems

- **New Article** “**Energy Storage Systems**” applies to all permanently installed energy storage systems (ESS) operating at **over 50 volts ac** or **60 volts dc**
- May be **stand-alone** or **interactive** with other electric power production sources
- An ESS is defined as “**one or more components assembled together capable of storing energy for use at a future time**”
- Energy storage involves converting energy from forms that are difficult to store to more conveniently or economically storable forms

Article 706 Energy Storage Systems *(cont.)*

- Energy storage systems (ESS) can consist of the following:
  - Batteries, capacitors, and/or kinetic energy devices *(e.g., flywheels and compressed air)*
  - ac or dc output for utilization
  - Inverters and/or converters to change stored energy into electrical energy
- Energy storage is the capture of energy produced at one time for use at a later time

Illustration Courtesy of A123 Systems

708.10(A)(2) Receptacle Identification for Critical Operations Power Systems (COPS)

- New requirements call for nonlocking-type, 125-volt, 15- and 20-ampere receptacles supplied from the COPS to have an **illuminated face or an indicator light** to indicate that there is power to the receptacle
- This is in addition to the existing requirement for a **distinctive color or marking** so as to be readily identifiable
- New illuminator or indicator light provision provides for ready and continuous ability to identify receptacles that are part of the COPS system
- Alleviate issues arising from remodeling *(such as painting)* and original COPS receptacle cover plate not being re-installed properly on its original COPS receptacle

708.10(A)(2) Receptacle Identification for Critical Operations Power Systems (COPS)

- *Continued from previous slide*

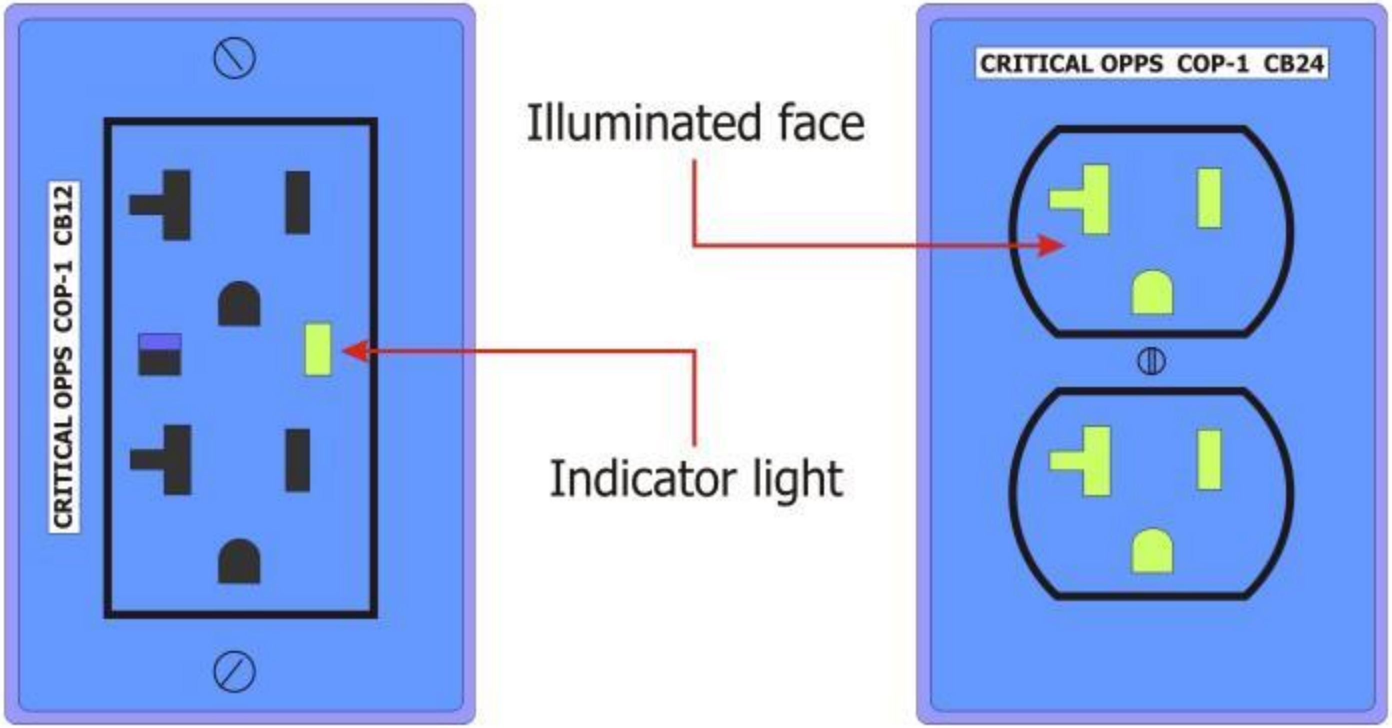
- Essential that COPS receptacles have additional identification by either an **indicator light or an illuminated face** so that users of said receptacles knows they are **energized in an emergency** when all other receptacles are not working

- Not uncommon for receptacles from the COPS system to remain dormant until called upon during an emergency situation

708.10(A)(2) Receptacle Identification (COPS)

In a building in which COPS are present with other types of power systems:

The receptacle cover plates or the receptacles themselves supplied from the COPS shall have a distinctive color or marking so as to be readily identifiable



Nonlocking-type, 125-volt, 15- and 20-ampere receptacles supplied from the COPS must have an illuminated face or an indicator light to indicate that there is power to the receptacle

Illuminated Face

Indicator Light

Receptacles courtesy of Pass & Seymour/Legrand

Article 710 Stand-Alone Systems

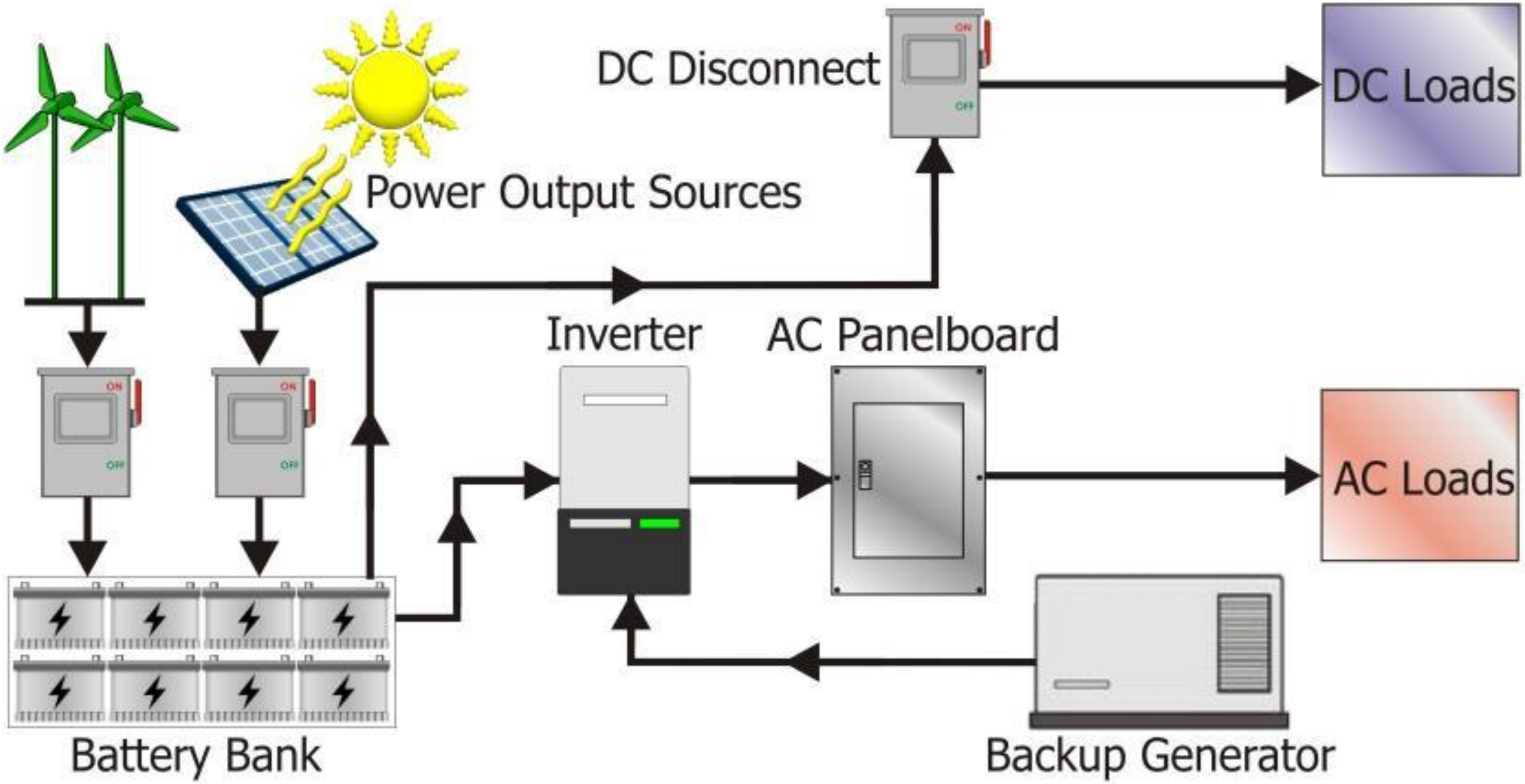
- Requirements of stand-alone systems were brought to one location and **new article** for “**Stand-Alone Systems**” added to address the operating parameters for electric power production sources in a stand-alone mode
- New article covers electric power production sources operating in a stand-alone mode
- Stand-alone power system, sometimes referred to as a remote area power supply, is an **off-the-grid electricity system** for locations not fitted with an electricity distribution system
- Stand-alone power systems will typically include one or more methods of electricity generation, energy storage, and regulation

Article 710 Stand-Alone Systems *(cont.)*

- While these safety requirements existed in Articles 690, 692 and 694, the requirements for a stand-alone system should apply to other power sources such as engine generators
- Stand-alone systems are expected to become more prevalent due to emerging technology in energy storage and local generation

Article 710 Stand-Alone Systems

A new article for "Stand-Alone Systems" was added to address the operating parameters for electric power production sources in a stand-alone mode



Stand-alone power systems typically include one or more methods of electricity generation, energy storage, and regulation

Article 712
Direct Current Microgrids

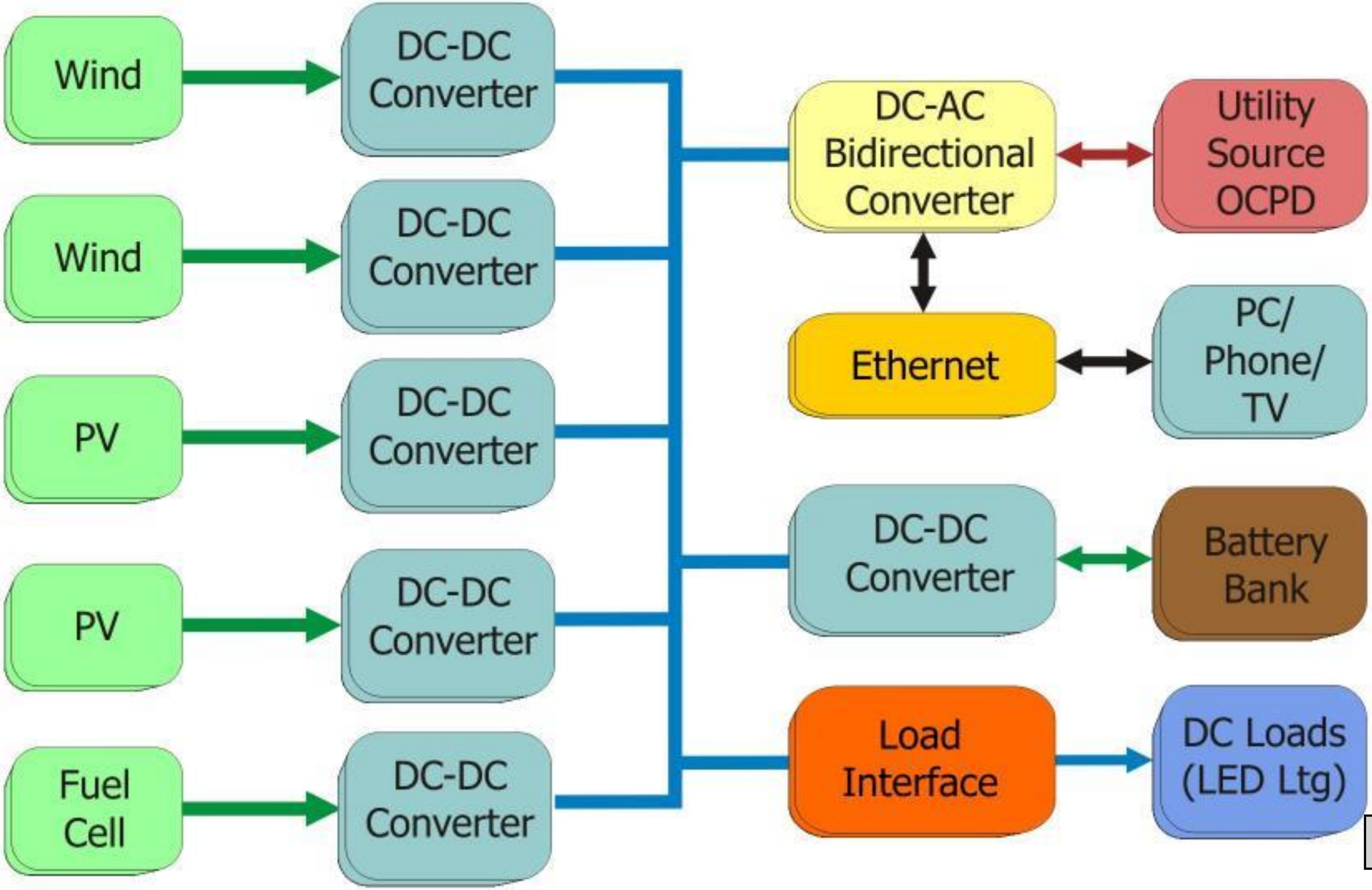
- New Article 712 “**Direct Current Microgrids**” added for power distribution systems consisting of more than one interconnected dc power sources, supplying:
  - dc-dc converters(s)
  - dc loads(s) and/or
  - ac loads(s) powered by dc-ac inverters(s)
- A dc microgrid typically **not directly connected to an ac primary source of electricity**, but some dc microgrids interconnect via one or more dc-ac bi-directional converters or dc–ac inverters
- DC microgrids related to direct utilization of power from dc sources to dc loads such as LED lighting, communications equipment, computers, variable-speed motor drives, etc.

Article 712
Direct Current Microgrids *(cont.)*

- DC microgrids with energy storage offer **inherent resilience and security** from failure of primary power sources
- Need for higher efficiency in **telecom and data centers** has driven these industries to implement dc microgrids in hundreds of data centers around the world
- While the basic requirements for wiring methods, overcurrent protection and grounding are specified in other articles of the *NEC*, they do not cover all of the issues involved when dc multiple sources and dc loads are interconnected
- This is an important first step, and **a place-holder for future requirements** in this rapidly developing arena

Article 712 DC Microgrids

DC Microgrid - A power distribution system consisting of more than one inter-connected dc power sources, supplying dc-dc converters(s), dc loads(s), and/or ac loads(s) powered by dc-ac inverters(s).

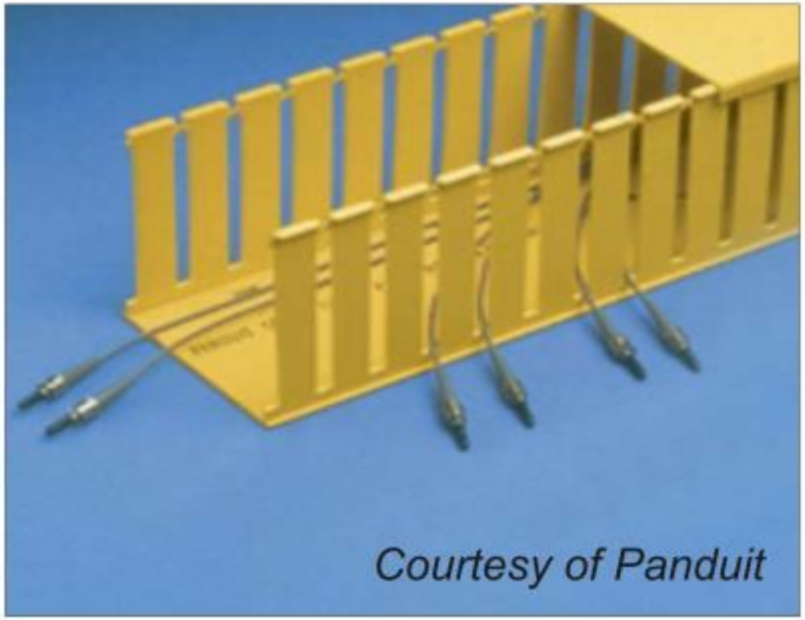


725.3(M) Cable Routing Assemblies and 725.3(N) Communication Raceways

- New requirements added to 725.3 for **cable routing assemblies** and **communications raceways**
- Provide guidance in the selection, listing and installation requirements used for **Class 2, Class 3 and PLTC cables**
- **725.3(M)** provides consistency for **cable routing assemblies** as referenced in Table 800.154(c), 800.182, 800.110(C) and 800.113
- **725.3(N)** provides consistency for **communications raceways** with references to Table 800.154(b), 800.182, 800.113 and 362.24 through 362.56 where requirements applicable to electrical nonmetallic tubing (ENT) apply

725.3(M) Cable Routing Assemblies and 725.3(N) Communications Raceways

New provisions were added to 725.3 (Other Articles) for cable routing assemblies and communications raceways used with Class 2, Class 3 and PLTC cables



Courtesy of Panduit

Cable Routing Assembly

Communications Raceways

New 725.3(M) and (N) will provide guidance in the selection, listing and installation requirements for cable routing assemblies and communication raceways used for Class 2, Class 3 and PLTC cables

725.135(K), (L), and (M) Installation of Type CMUC

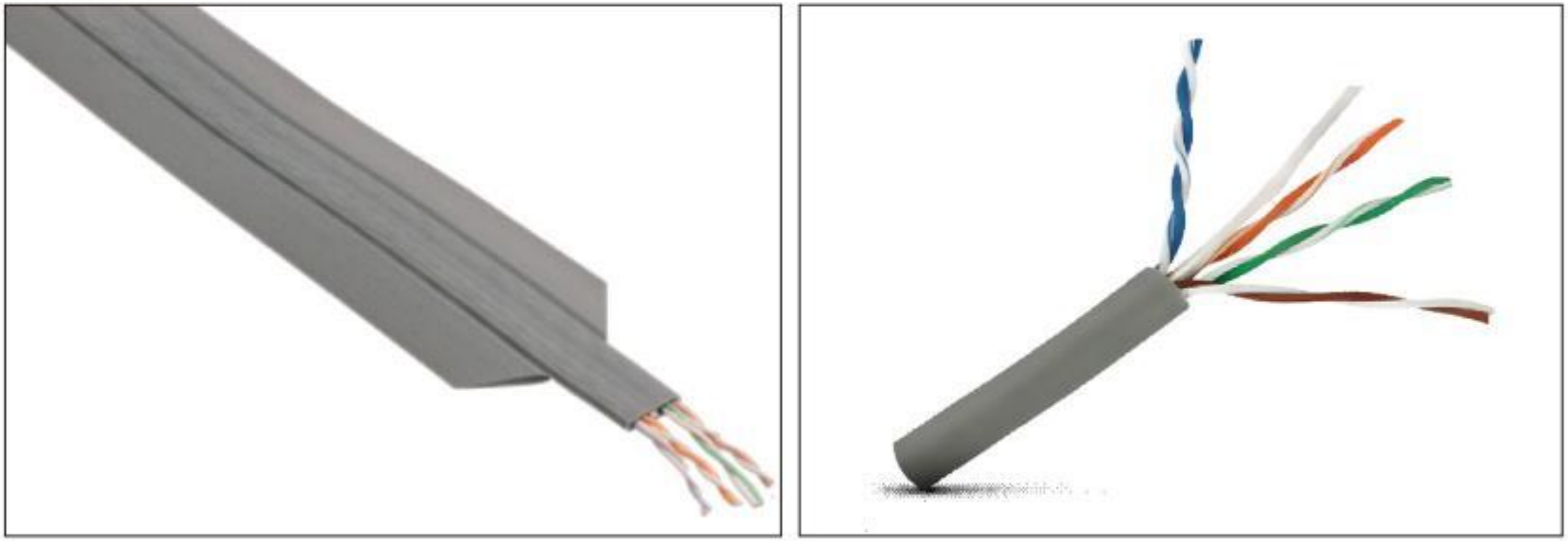
- Type **CMUC undercarpet communication wiring and cables** is now permitted to be installed **under modular flooring, and planks** as well as under carpet
- New *Code* language and Type CMUC applies to one- and two-family dwellings, multifamily dwellings, and other building locations
- Type CMUC is often used in areas that are not easily accessible by traditional cabling methods
- Commercial and retail building owners are rapidly adopting **alternate flooring covering** for use in their facilities in addition to carpet squares, such as modular vinyl planks and tile, laminate and hard wood

725.135(K), (L), and (M) Installation of Type CMUC *(cont.)*

- Type CMUC wire and cable is similar in nature to Type FCC *(flat conductor cable)* addressed at Article 324
- A UL Fact Finding investigation found no additional heating effects caused by the alternate flooring when tested using Type FCC cables
- Type FCC cables carry more power than Type CMUC and the results of the UL fact finding report should be applicable to Type CMUC
- Same change occurred at **800.113(K), (L) and (M)** for the installation of communication wires, cables and raceways, and cable routing assemblies

725.135(K), (L), and (M) Type CMUC Cable

Type CMUC undercarpet communication wiring and cables is permitted to be installed under modular flooring, and planks as well as under carpet



Wiring methods for the installation of Class 2, Class 3, and power-limited tray cables (PLTC) at one- and two-family dwellings, multifamily dwellings, and other building locations is described at 725.135(K), (L), and (M)

This would include CL2P, CL3P, CL2R, CL3R, CL2, CL3, and PLTC cables as well as Type CMUC undercarpet communications wires and cables

725.144 Transmission of Power and Data

(Class 1, Class 2, and Class 3 Remote-Control, Signaling, and Power-Limited Circuits)

- New **725.144** with accompanying **Table 725.144** added to introduce new cable **Type "LP" (Limited Power)** that provides the current limitation due to cable bundling
- Other installation considerations added for **Power over Ethernet (PoE)** type cables
- The **"-LP" cable designation** indicates cable has been evaluated to carry marked current under reasonable worst-case installation scenarios without exceeding the temperature rating of the cable
- These new provisions introduce special cable designs developed that might be used as alternatives to more traditional cables with less restrictions on cable designs and the installations

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

(Class 1, Class 2, and Class 3 Remote-Control, Signaling, and Power-Limited Circuits)

- Limited power (LP) cables must be **listed as suitable for carrying power and data circuits** up to a specified current limit for each conductor **without exceeding the temperature rating** of the cable *[see 725.179(I)]*
- Cables must also be marked with the suffix **"-LP"** with the **ampere limit** located immediately following the suffix LP *[example: CL2-LP (1.0A)]*
- New 725.144 and accompanying table added based on **UL Fact Finding Report on Power over Local Area Network Type Cables**
- No conductor (or cable) should be used in such a manner that its operating temperature exceeds its rated maximum temperature

Table 725.144

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

AWG	Number of 4-Pair Cables in a Bundle																				
	1			2-7			8-19			20-37			38-61			62-91			92-192		
	Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating		
	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C
26	1	1	1	1	1	1	0.7	0.8	1	0.5	0.6	0.7	0.4	0.5	0.6	0.4	0.5	0.6	NA	NA	NA
24	2	2	2	1	1.4	1.6	0.8	1	1.1	0.6	0.7	0.9	0.5	0.6	0.7	0.4	0.5	0.6	0.3	0.4	0.5
23	2.5	2.5	2.5	1.2	1.5	1.7	0.8	1.1	1.2	0.6	0.8	0.9	0.5	0.7	0.8	0.5	0.7	0.8	0.4	0.5	0.6
22	3	3	3	1.4	1.8	2.1	1	1.2	1.4	0.7	0.9	1.1	0.6	0.8	0.9	0.6	0.8	0.9	0.5	0.6	0.7

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

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

Informational Note: The conductor sizes in data cables in wide-spread use are typically 22–26 AWG.

727.4(5) Ex. to (5)
Uses Permitted for Type ITC-ER Cable

- **New exception** added for **Type ITC-ER cable** to allow transition between cable trays and and utilization equipment or devices for a distance not to exceed **1.8 m (6 ft)** without continuous support where not subject to physical damage
- Same exception exist for power and control tray cable (**Type TC-ER**) at **336.10(7)**
- Cable must be mechanically supported where exiting the cable tray to ensure minimum bending radius is not exceeded
- This will provide consistency between installations practices for Type ITC-ER and Type TC-ER

727.4(5), Ex. to (5) Type ITC-ER Cable

Type ITC cable (without a metallic sheath or armor) that complies with the crush and impact requirements of Type MC cable and is identified for such use with the marking "ITC-ER" shall be permitted to be installed exposed

The cable shall be continuously supported and protected against physical damage using mechanical protection such as dedicated struts, angles, or channels and secured at intervals not exceeding 1.8 m (6 ft)

Instrumentation Tray Cable (Type ITC)

A new exception has been added for Type ITC-ER to allow transition between cable trays and between cable trays and utilization equipment or devices for a distance not to exceed 1.8 m (6 ft) without continuous support where not subject to physical damage

760.176(G) and 760.179(I)
Cable Markings for Fire Alarm Systems

- New **marking requirements** added for temperature ratings and conductor size to be marked on the jacket of **NPLFA** and **PLFA** cables when a temperature rating exceeding **60° C (140 F°)**
- Fire alarm cables must also be marked with **conductor size**
- Temperature rating reference of 60°C (140°F) is consistent with the **product standard listing requirements** for fire alarm cables
- Temperature rating information important when utilizing **"Power over Ethernet" (PoE)** and other technologies where the fire alarm cable pairs carry data and power
- This can be an issue as far as **dissipating generated heat**

760.176(G) and 760.179(I) *(cont.)*
Cable Markings for Fire Alarm Systems

- Current levels on these fire alarm circuits continues to increase *(in some cases as much as 1 ampere)*
- NPLFA and PLFA cables must be marked with the **conductor size** to identify specific size of conductors in the cables so that **determination of maximum current** for fire alarm circuits can be properly evaluated
- In order to design, install, and inspect these systems, **obtainable, detailed information** concerning fire alarm cables is essential

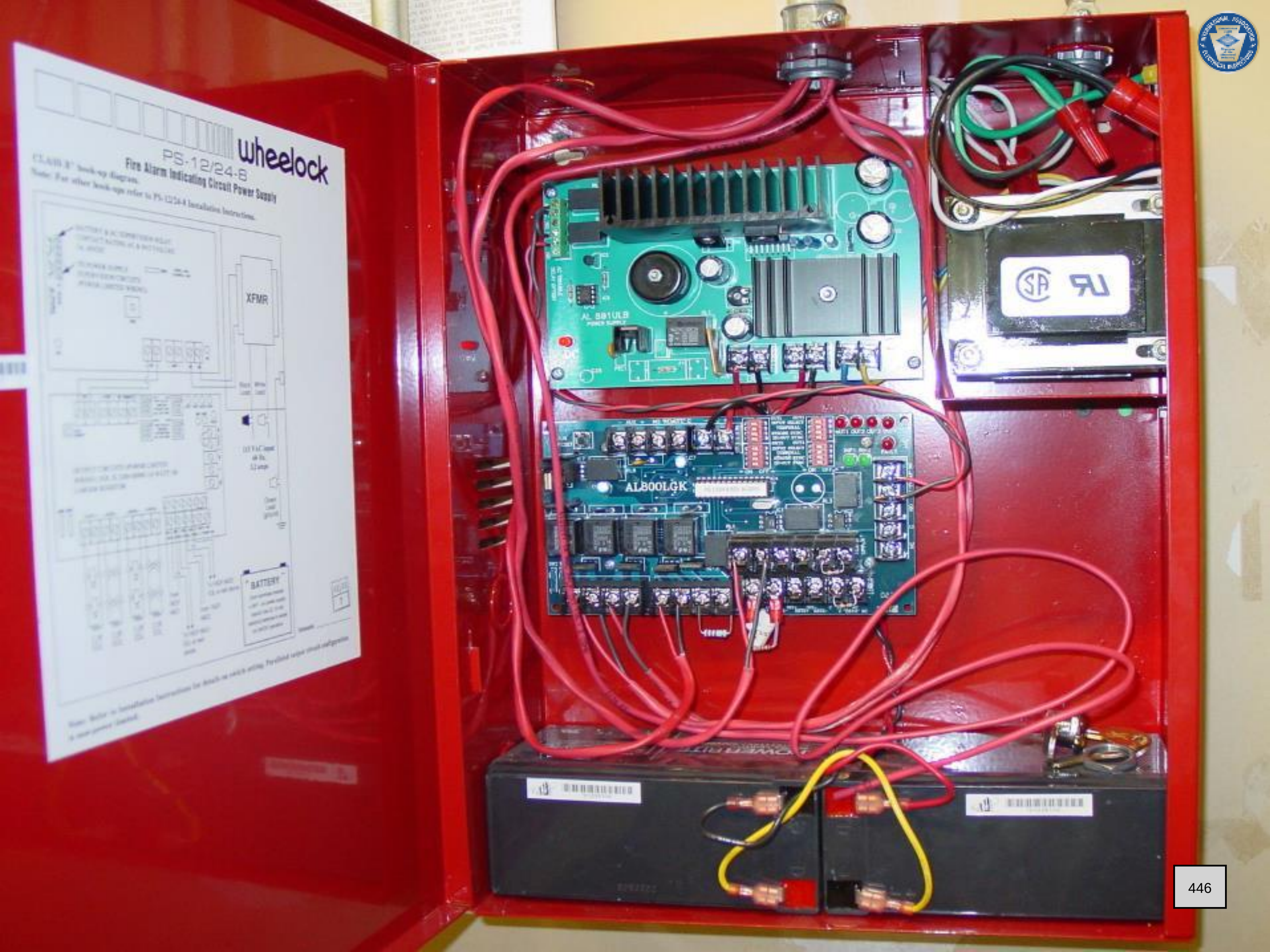
760.176(G) and 760.179(I) Cable Marking

Listing and marking requirements for fire alarms circuits are addressed at 760.176 for NPLFA circuits and 760.179 for PLFA circuits respectfully

Unshielded Non-Plenum Fire Alarm Cable

New marking requirements were added for fire alarm circuits requiring a temperature rating to be marked on the jacket of NPLFA and PLFA cables that have a temperature rating exceeding 60°C (140°F)

The jacket of these cables must now also be marked with the conductor size as well


wheelock
PS-12/24-8
Fire Alarm Indicating Circuit Power Supply
XFMR
BATTERY
AL 881ULB
AL800LGK

770.44
Overhead (Aerial) Optical Fiber Cables

- New requirements added for **overhead (aerial) optical fiber cables** that **enter a building**

- Previous editions of the *Code* did not contain information pertaining to optical fiber cables installed overhead to a building or structure

- New language structured after same language for overhead *(aerial)* spans located at **800.44** *(Communications Circuits),* **820.44** *(Community Antenna Television and Radio Distribution Systems),* **830.44** *(Network-Powered Broadband Communications Systems),* **840.44** *(Premises-Powered Broadband Communications Systems)*

770.44 *(cont.)*
Overhead (Aerial) Optical Fiber Cables

- Some of the new selected requirements for **overhead (aerial) optical fiber cables** that **enter a building** are as follows:
  - Generally **located below** electric light or power conductors
  - Attachment to cross-arm that carries electric light or power conductors **not permitted**
  - **Climbing space** to comply with **225.14(D)** *[typically 750 mm (30 in.)]*
  - **Minimum separation** of **300 mm (12 in.)** at any point in the span from service drops and sets of overhead service conductors of 0 to 750 volts
  - Vertical clearance of not less than **2.5 m (8 ft)** from all points of **roofs** above which they pass *(with exceptions)*

Overhead Electric Service Drop

Overhead (Aerial) Optical Fiber Cables

770.48 Optical Fiber Cables and Raceways Entering Buildings

- **Point of entrance** for optical fiber cables can now be extended when enclosed in **rigid metal conduit (RMC)** or **intermediate metal conduit (IMC)**
- Optical fiber cables are generally permitted to be installed in building spaces where the length of the cable within the building, measured from its point of entrance, does **not exceed 15 m (50 ft)** and the cable enters the building from the outside and is terminated in an enclosure
- New text allows "**point of entrance**" for optical fiber cable to be extended **anywhere within a building** as long as the entering optical fiber cable is contained in **RMC** or **IMC**
- "**Point of emergence**" becomes the end of said conduit

770.48 Optical Fiber Cables and Raceways Entering Buildings *(cont.)*

- New language also added at **770.48(B)** to clarify that nonconductive outside plant optical fiber cables installed in **PVC** or **EMT cannot be installed** in risers, ducts and plenums for environmental air, and other places used for **environmental air**
- Provides consistency between requirements of 770.48(A) and (B)
- Same basic change occurred at 800.48 and 820.48
- Title of 770.48 deleted the term “and Raceways” to make Article 770 title consistent with the titles of 800.48 and 820.48

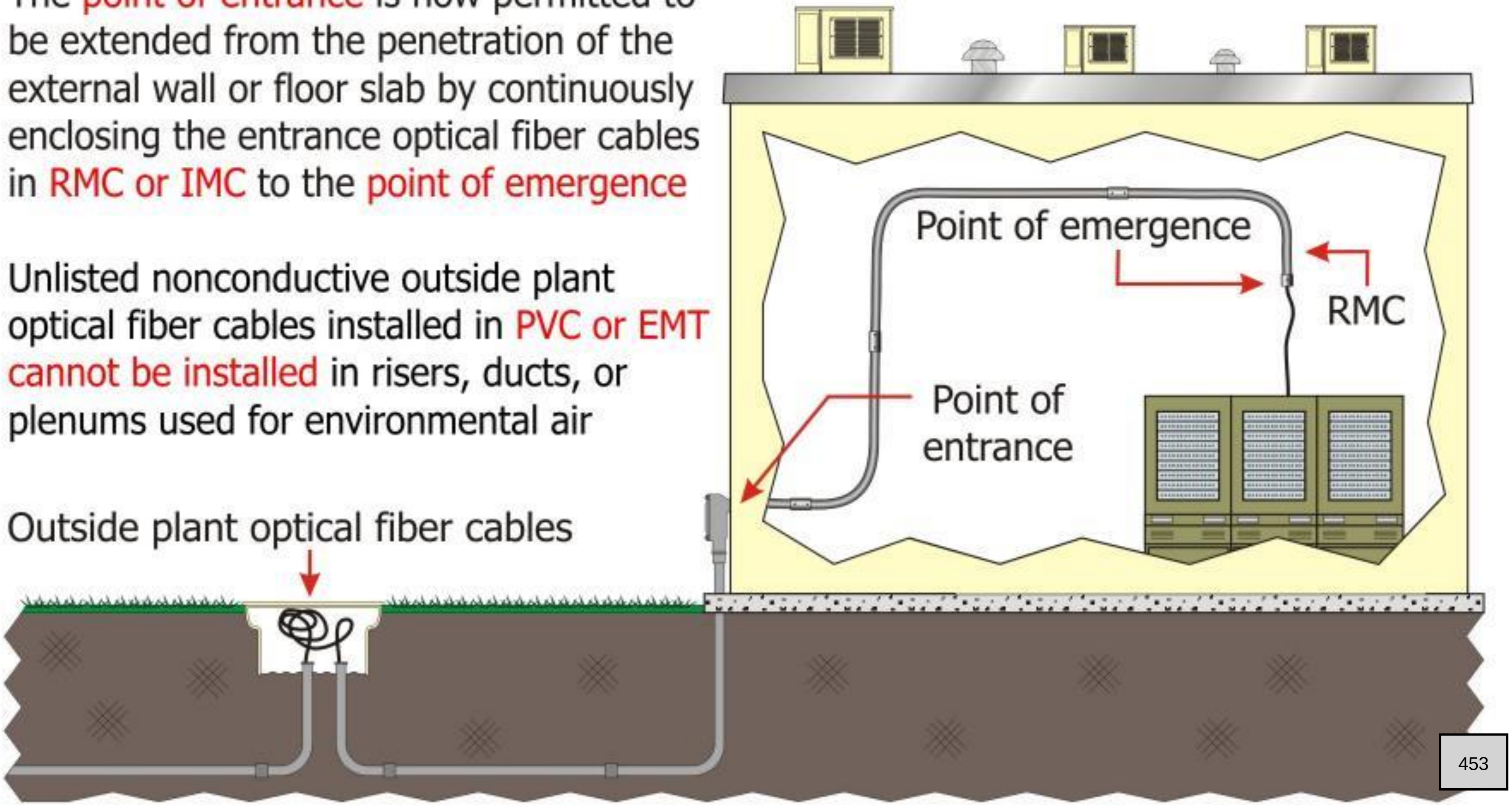
770.48 Optical Fiber Cables Entering Building

Unlisted conductive and nonconductive outside plant optical fiber cables are generally permitted to be installed in building spaces where the length of the cable within the building *(measured from its point of entrance)* does not exceed 15 m (50 ft) and the cable enters the building from the outside and is terminated in an enclosure

The point of entrance is now permitted to be extended from the penetration of the external wall or floor slab by continuously enclosing the entrance optical fiber cables in RMC or IMC to the point of emergence

Unlisted nonconductive outside plant optical fiber cables installed in PVC or EMT cannot be installed in risers, ducts, or plenums used for environmental air

Outside plant optical fiber cables

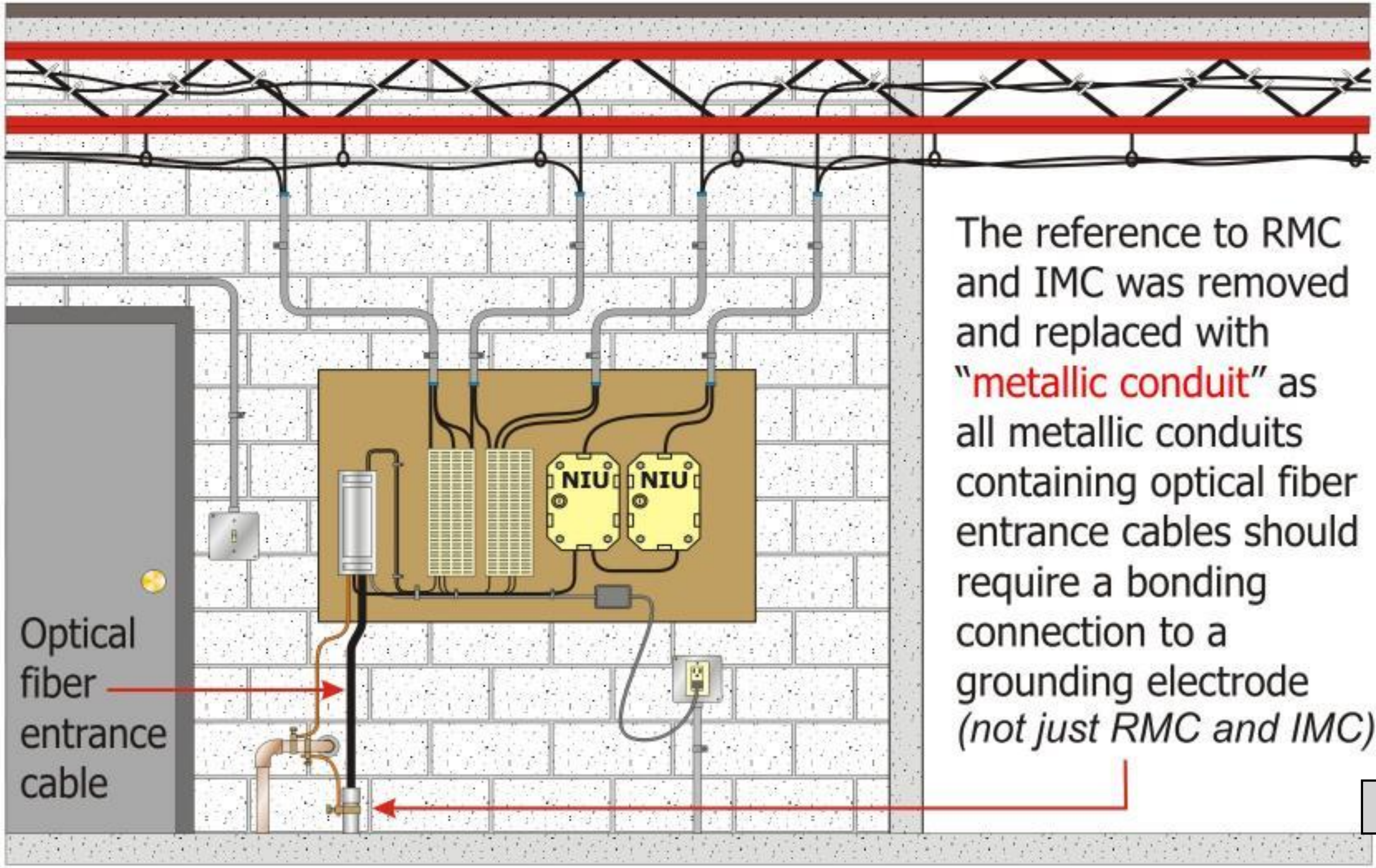


770.49 Metallic Entrance Conduit Grounding for Optical Fiber Cables and Raceways

- **All metallic conduit** *(not just RMC and IMC)* enclosing optical fiber entrance cable must be connected by a **bonding conductor** or **grounding electrode conductor** to a grounding electrode
- As previously written this only applied to rigid metal conduit (RMC) or intermediate metal conduit (IMC)
- Electrical metallic tubing (EMT) should also be grounded and bonded for electrical safety *(see uses permitted)*
- Same change occurred at **800.49** for communications circuits, **820.49** for community antenna television and radio distribution systems, and **830.49** for network-powered broadband communications systems

770.49 Metallic Entrance Conduit Grounding

Metallic conduit containing optical fiber entrance cable shall be connected by a bonding conductor or grounding electrode conductor to a grounding electrode in accordance with 770.100(B)



Optical fiber entrance cable

The reference to RMC and IMC was removed and replaced with "metallic conduit" as all metallic conduits containing optical fiber entrance cables should require a bonding connection to a grounding electrode *(not just RMC and IMC)*

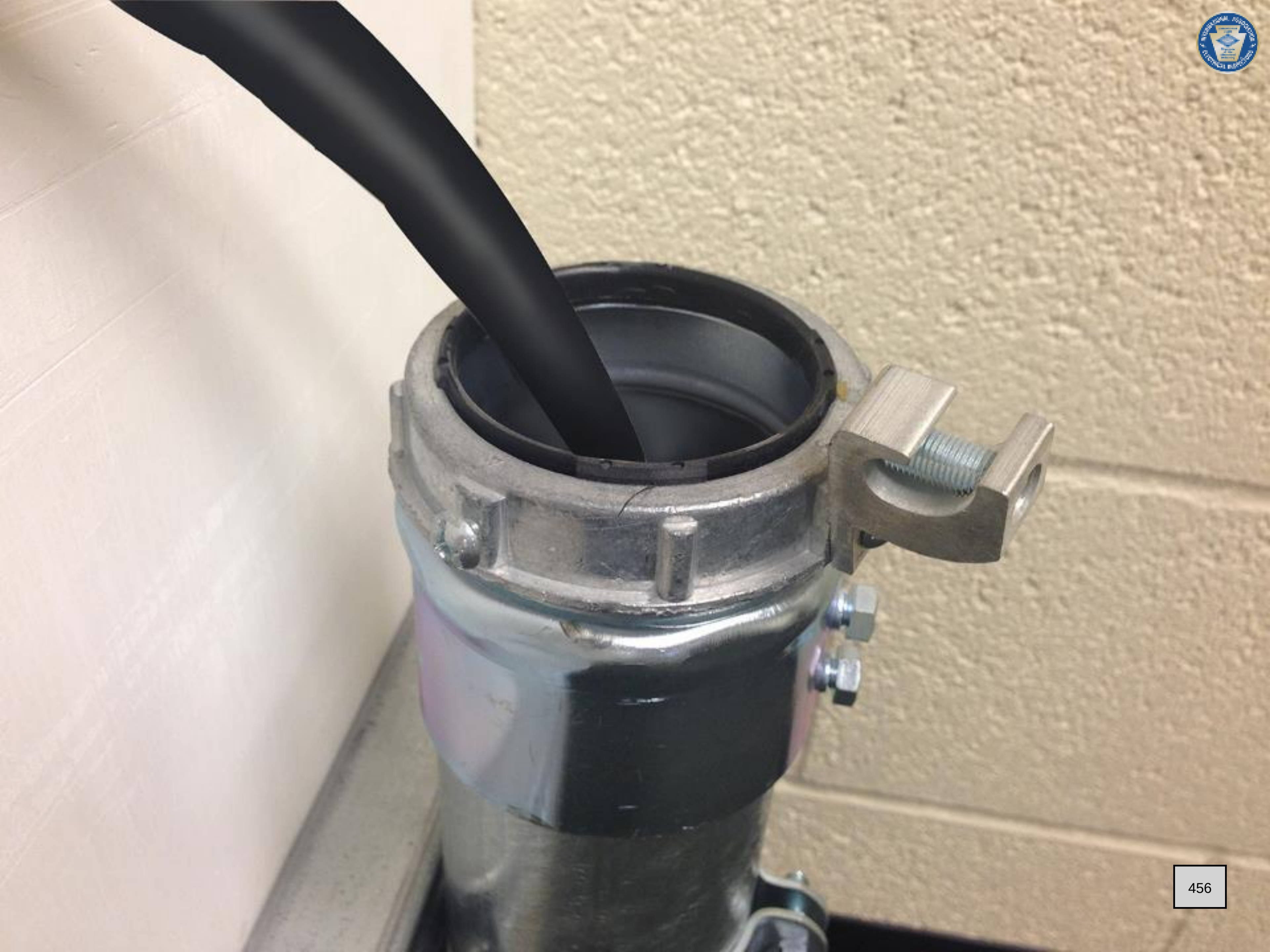


Photo Courtesy of Scott Humphrey

770.100(B)(3)(2) Entrance Cable Bonding and Grounding of Optical Fiber Cables and Raceways

- Revised language added to clarify that **lightning protection system conductors**, *(not just air terminal conductors)*, are **not to be used** as part of the **grounding electrode conductor** or as a **grounding electrode** for optical fiber systems or any communication system in **buildings or structures without intersystem bonding termination or grounding means**
- Term “air terminal conductors (lightning-rod conductors)” was replaced with the broader term “**lightning protection system conductors**”
- Items associated with lightning protections should not be used as a part of the grounding electrode conductor or as a grounding electrode for optical fiber systems or any communication syste

770.100(B)(3)(2) Entrance Cable Bonding and Grounding of Optical Fiber Cables and Raceways

- *Continued from previous slide*
- A lightning protection system is a complete system of rods, cables and groundings designed to intercept a lightning strike and divert it safely to ground (the earth), avoiding structural damage to buildings and other vulnerable objects
- Air terminal conductors are just a part of complete lightning protection system conductors
- Same change occurred at **800.100(B)(3)(2)** for communications circuits, **820.100(B)(3)(2)** for community antenna television and radio distribution systems, and **830.100(B)(3)(2)** for network-powered broadband communications systems

Chapter Eight
Communications Systems

810.15 Grounding of Radio and Television Equipment

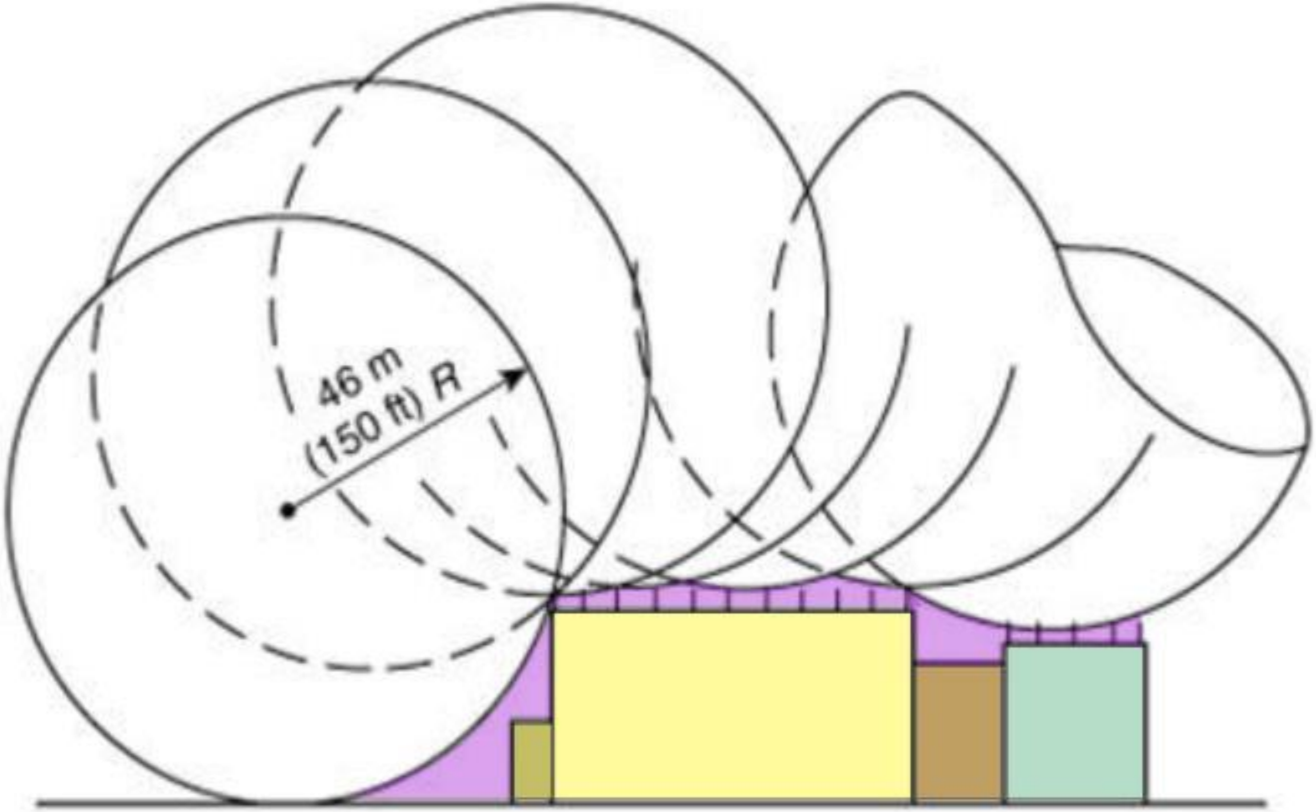
- Radio and television antennas required to be grounded unless they are located within a **zone of protection** afforded by surrounding taller structures as determined by **"rolling sphere"** theory of lightning protection
- Grounding of masts and metal supporting structures **not required** when antenna and its related supporting mast or structure are within a zone of protection defined by a **46 m (150 ft) radius "rolling sphere"** described in NFPA 780-2014, *Standard for the Installation of Lightning Protection Systems*
- Where sphere is tangent to earth and resting against a strike termination device(s), all space in the vertical plane between the two points of contact and under the sphere is considered to be in the **"rolling sphere" zone of protection**

810.15 Grounding of Radio and Television Equipment *(cont.)*

- **All possible placements** of the rolling sphere shall be considered when determining zone of protection using rolling sphere model
- Revision will bring the *Code* up to date with technology surrounding smaller antennas where they are **not likely to be impacted by transient voltages** using the “rolling sphere” model of lightning protection
- Antennas, when installed in protected areas are **highly unlikely to become energized** - no sound reason to require these protected antennas and mast to be grounded per 810.15 and 810.21

810.15 Grounding of Radio and TV Equipment

Masts and metal structures supporting antennas shall be grounded in accordance with 810.21 unless...



Zone of protection as determined by the "Rolling Sphere" method

the antenna and its related supporting mast or structure are within a zone of protection defined by a 46 m (150 ft) radius "rolling sphere"

840.2 Definitions: ~~Optical~~ Network Terminal ~~(ONT)~~ *(Premises-Powered Broadband Communications Systems)*

- Definition of “Optical Network Terminal (ONT)” was revised to “**Network Terminal**”
- This more generic term of “Network Terminal” helps to expand the coverage of Article 840 to recognize **twisted-pair** and **coaxial cable** in addition to **optical fiber** based systems
- Types of **twisted-pair cable** include unshielded twisted-pair (UTP) and shielded twisted-pair (STP)
- The other transmission medium that was recognized was the **coaxial cable system** which can provide a higher transmission rate than twisted-pair

840.2 Definitions: Network Terminal

~~Optical~~ Network Terminal ~~(ONT)~~. A device that converts ~~an optical signal~~ network-provided signals (optical, electrical, or wireless) into component signals, including voice, audio, video, data, wireless, optical, and interactive ~~service electrical~~ services, and is considered ~~to be~~ a network ~~interface equipment~~ device on the premises that is connected to a communications service provider and is powered at the premises.

Revisions occured throughout Article 840 to accommodate twisted pair-based and coaxial cable-based systems in addition to optical fiber-based systems for premises-powered broadband communication systems

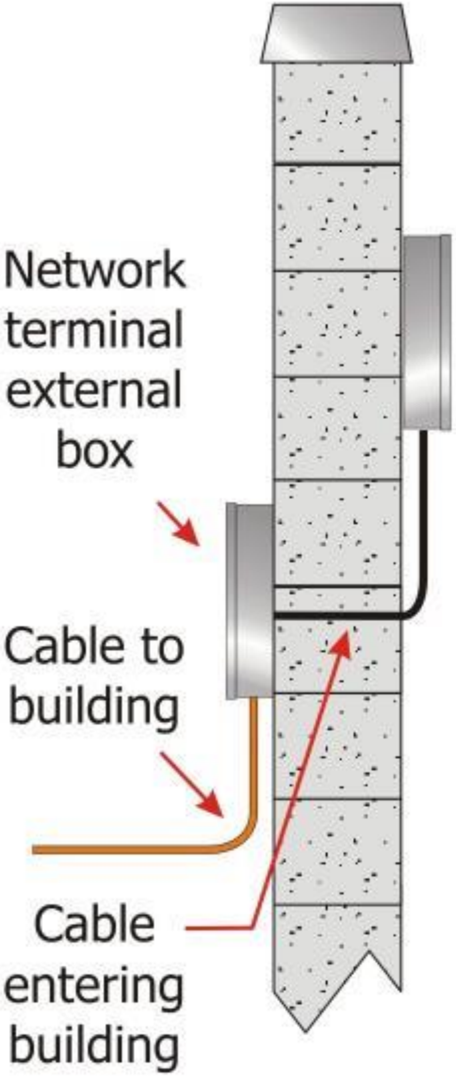
840.48 Unlisted Wires and Cables Entering Buildings *(PPBCS)*

- Three new first level subdivisions which outline specific requirements for unlisted optical fiber cables, communication wires and cables, and coaxial cables were added to 840.48
- Premises-powered broadband communications system *(PPBCS)* wires and cables will now be required to comply with:
  - **770.48** for unlisted **optical fiber cables** entering buildings
  - **800.48** for unlisted communications wires and unlisted multipair **communications cables** entering buildings
  - **820.48** for unlisted **coaxial cables** entering buildings
- Title was changed to "**Unlisted Wires and Cables Entering Buildings**" rather than "Unlisted Cables and Raceways Entering Buildings" as this section deals with **wires and cables**

840.48 Unlisted Wires and Cables Entering Buildings *(PPBCS) (cont.)*

- Articles 770, 800, and 820 each have paragraphs that describe how unlisted communication cables are permitted to be installed where the length of the cable within the building, measured from the point of entrance, **does not exceed 15 m (50 ft)** and the cable enters the building from the outside
- These same rules will now apply to premises-powered broadband communications system wires and cables

840.48 Unlisted Wires and Cables Entering Buildings

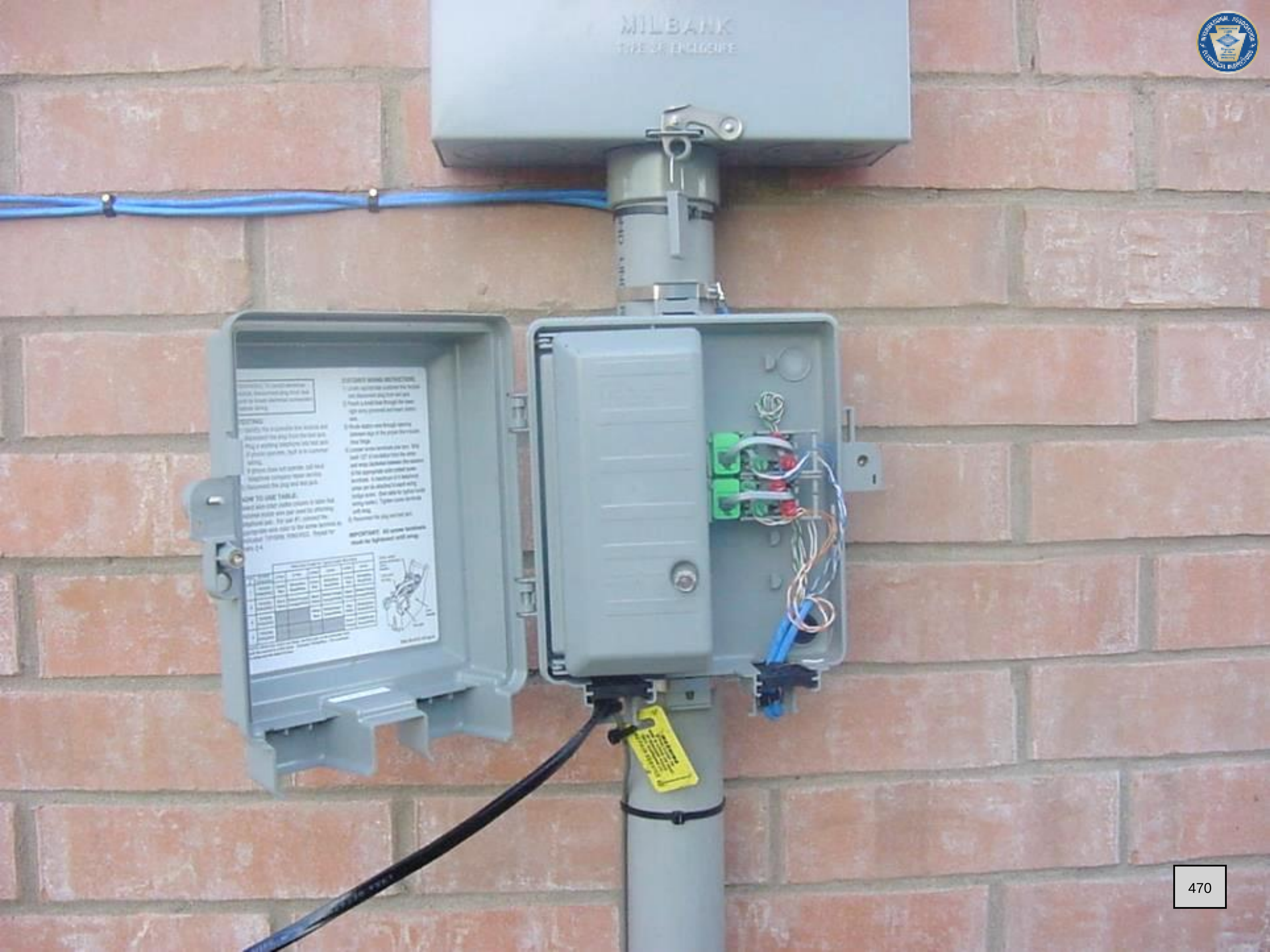


Installations of unlisted premises-powered broadband communication wires and cables entering buildings shall comply with 840.48(A), (B), or (C), as applicable

(A) Optical Fiber Cables - Installations of unlisted optical fiber cables entering buildings shall comply with 770.48

(B) Communications Wires and Cables - Installations of unlisted communications wires and unlisted multipair communications cables entering buildings shall comply with 800.48

(C) Coaxial Cables - Installations of unlisted coaxial cables entering buildings shall comply with 820.48

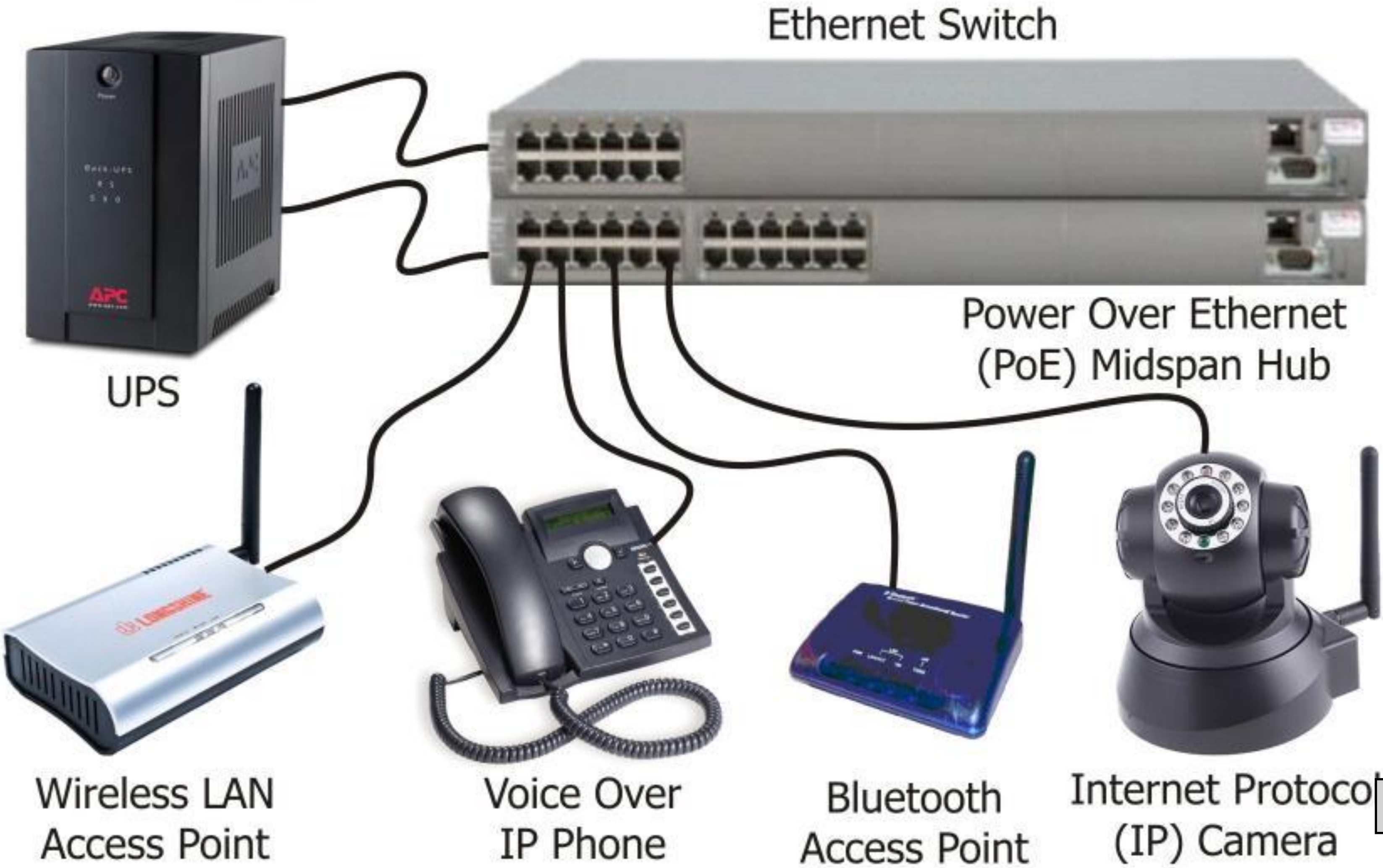

MILBANK
TYPE 3R ENCLOSURE

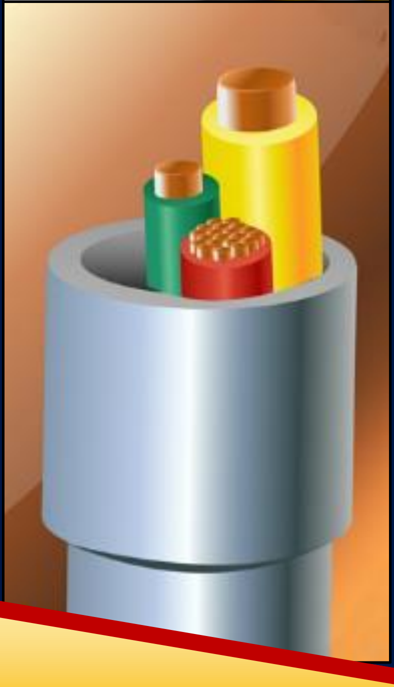
840.160 Premises Powering of Communications Equipment over Communications Cables

- New 840.160 *(Powering Circuits)* added with direction to new 725.144 for power delivery circuits that exceed **60 watts** on communications cables
- New requirements give permission for communication cables to carry circuits for powering communications equipment
- Where power supplied over a communications cable is **greater than 60 watts**, communication cables and the power circuit **must comply with new 725.144** where communications cables are used in place of Class 2 and Class 3 cables
- A new type of "**limited-power**" cable has been introduced to simplify the cable choice and installation considerations
- New "LP" cables are marked Type CMP-LP, Type CMR-LP and Type CM-LP

840.160 Powering Circuits

New 840.160 (Powering Circuits) was added under new Part VI (Premises Powering of Communication Equipment over Communication Cables) with direction to new 725.144 for power delivery circuits that exceed 60 watts on communications cables





Chapter Nine
Tables

Chapter 9, Notes to Tables, Note 9

- New language added at Note 9 to specify assemblies of **single insulated conductors** without an overall covering are **not considered a cable** when determining conduit and tubing fill area
- Conduit or tubing fill for the assemblies is to be calculated **based upon the individual conductors**
- Note 9 of the notes to the tables of Chapter 9 directs users of the *Code* to treat multiconductor cables, optical fiber cables, or flexible cords of two or more conductors as a **single conductor** for calculating percentage conduit or tubing fill area
- If cable is an **elliptical-shaped cable** (such as nonmetallic-sheathed cable), cross-sectional area calculation shall be based on using the **major diameter of the ellipse as a circle diameter**

Chapter 9, Notes to Tables, Note 9 *(cont.)*

- Provision for conduit fill for cables is intended to allow the cable wiring methods in Chapter 3 to be considered as a **single entity when calculating conduit fill**
- Industry practice has developed of twisting several single conductors together and placing the assembly on one reel for shipping and installation
- This twisting action does not change the essential nature of the pull or the product or change the conduit fill properties of the individual conductors *(does not make this a cable)*
- This new language will provide clarity to this sometimes misinterpreted cable application

Chapter 9, Notes to Tables, Note 9

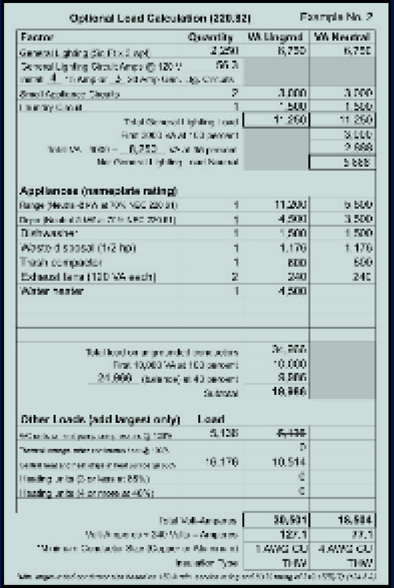
A multiconductor cable, optical fiber cable, or flexible cord of two or more conductors shall be treated as a single conductor for calculating percentage conduit or tubing fill area

For cables that have elliptical cross sections, the cross-sectional area calculation shall be based on using the major diameter of the ellipse as a circle diameter

Assemblies of single insulated conductors without an overall covering shall not be considered a cable when determining conduit or tubing fill area

The conduit or tubing fill for the assemblies shall be calculated based upon the individual conductors

Twisted "assembly" with
(4) individual conductors



Informative Annexes

Informative Annex D – Example D3 Store Building

- Example D3 *(Store Building)* was revised to remove the "**125%**" for continuous loads for calculating the volt-amperes (VA) for the **actual connected lighting loads**
- Factoring a continuous connected lighting load at 125% is **not appropriate in the "Calculated Load" section** of this example
- No such "125%" factor in the 220.12 provision
- Factoring for continuous loads at **125% is covered in the "Minimum Size Feeder *(or Service)* Overcurrent Protection"** as required by 215.3 or 230.90 respectively

Informative Annex D-Example D3 (Store Building)

A store 50 ft by 60 ft, or 3000 ft^2, has 30 ft of show window. There are a total of 80 duplex receptacles. The service is 120/240 V, single phase 3-wire service. Actual connected lighting load is 8500 VA.

Calculated Load *(see 220.40)*

Noncontinuous Loads

Receptacle Load *(see 220.44)*	80 receptacles at 180 VA	14,400 VA
10,000 VA at 100%		10,000 VA
14,400 VA − 10,000 VA = 4400 at 50%		2,200 VA
	Subtotal	12,200 VA

Continuous Loads

General Lighting*	3000 ft^2 at 3 VA/ft^2	9,000 VA
Show Window Lighting Load	30 ft at 200 VA/ft *[see 220.14(G)]*	6,000 VA
Outside Sign Circuit *[see 220.14(F)]*		1,200 VA
	Subtotal	16,200 VA
	Subtotal from noncontinuous	12,200 VA
	Total noncontinuous loads + continuous loads =	28,400 VA

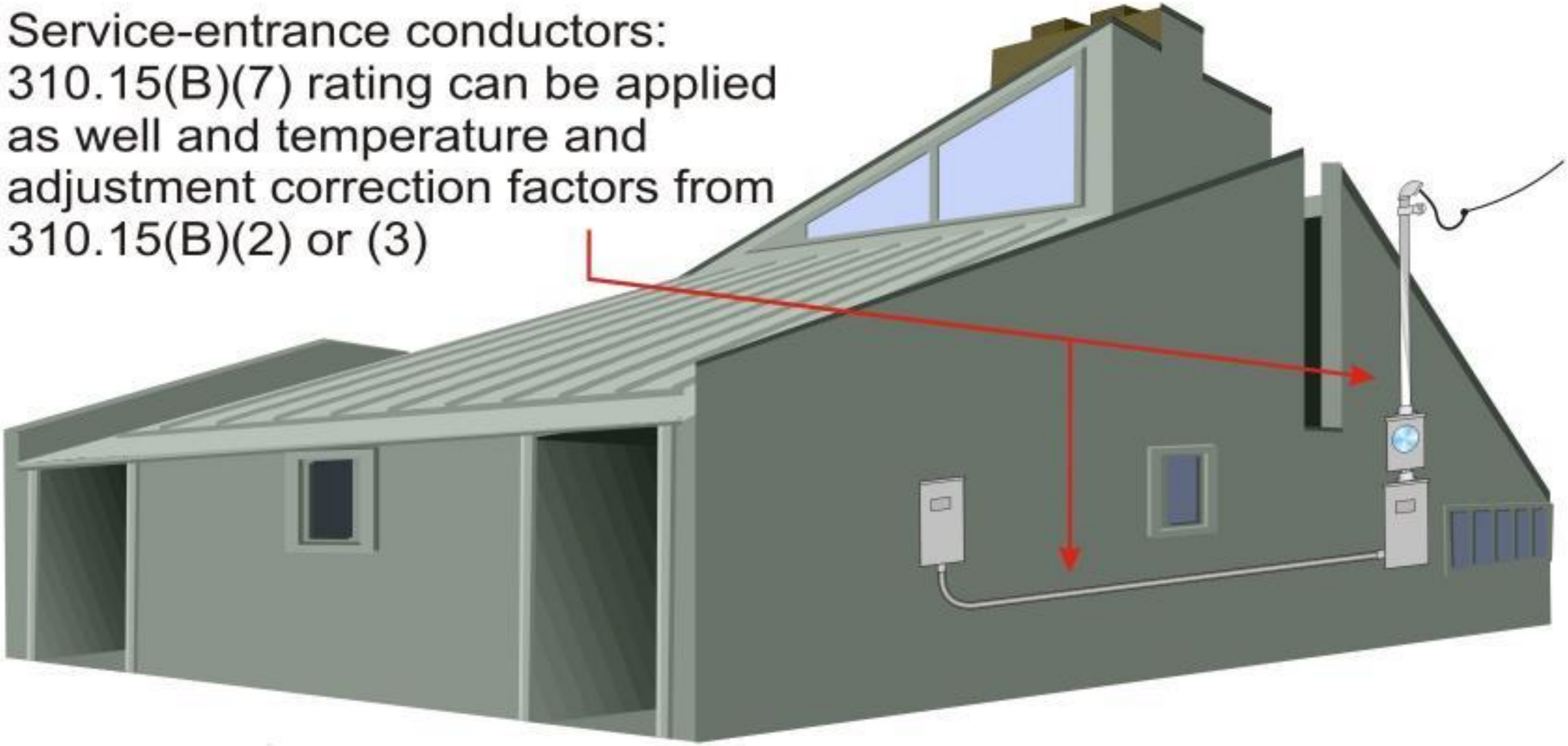
*In the example, ~~125% of~~ the actual connected lighting load (8500 VA ~~× 1.25 = 10,625 VA~~) is less than ~~125% of~~ the load from Table 220.12, so the minimum lighting load from Table 220.12 is used in the calculation. Had the actual lighting load been greater than the value calculated from Table 220.12, ~~125% of~~ the actual connected lighting load would have bee used.

Informative Annex D, Example D7
Sizing of Service Conductors for Dwelling(s)

- Example for "**Sizing of Service Conductors for Dwelling(s)**" revised clarifying the use of **temperature corrections** and **adjustment factors**
- New text added at **310.15(B)(7)** indicates that where correction or adjustment factors are required by **310.15(B)(2) or (3)**, they are **permitted to be applied** to the ampacity associated with the temperature rating of the conductor
- Example D7 now has two examples:
  - "With No Required Adjustment or Correction Factors"
  - "With Required Temperature Correction Factor"
- **Previous Table 310.15(B)(7)** inserted after the example for reference and use

Informative Annex Example D7 [310.15(B)(7)] Sizing of Service Conductors for Dwelling(s)

Example D7 for "Sizing of Service Conductors for Dwelling(s)" has been revised clarifying the use of temperature corrections and adjustment factors along with the 83% adjustment from 310.15(B)(7)



Service-entrance conductors: 310.15(B)(7) rating can be applied as well and temperature and adjustment correction factors from 310.15(B)(2) or (3)

Previous Table 310.15(B)(7) was inserted after Example D7 for reference and use with sizing of dwelling unit service and main feeder conductors

Informative Annex D - Example D7
Sizing of Service Conductors for Dwelling(s)
[Former Table 310.15(B)(7)]

If no temperature correction or ampacity adjustment factors are required, the following table includes conductor sizes calculated using the requirements in 310.15(B)(7). This table is based on 75°C terminations and without any adjustment or correction factors.

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

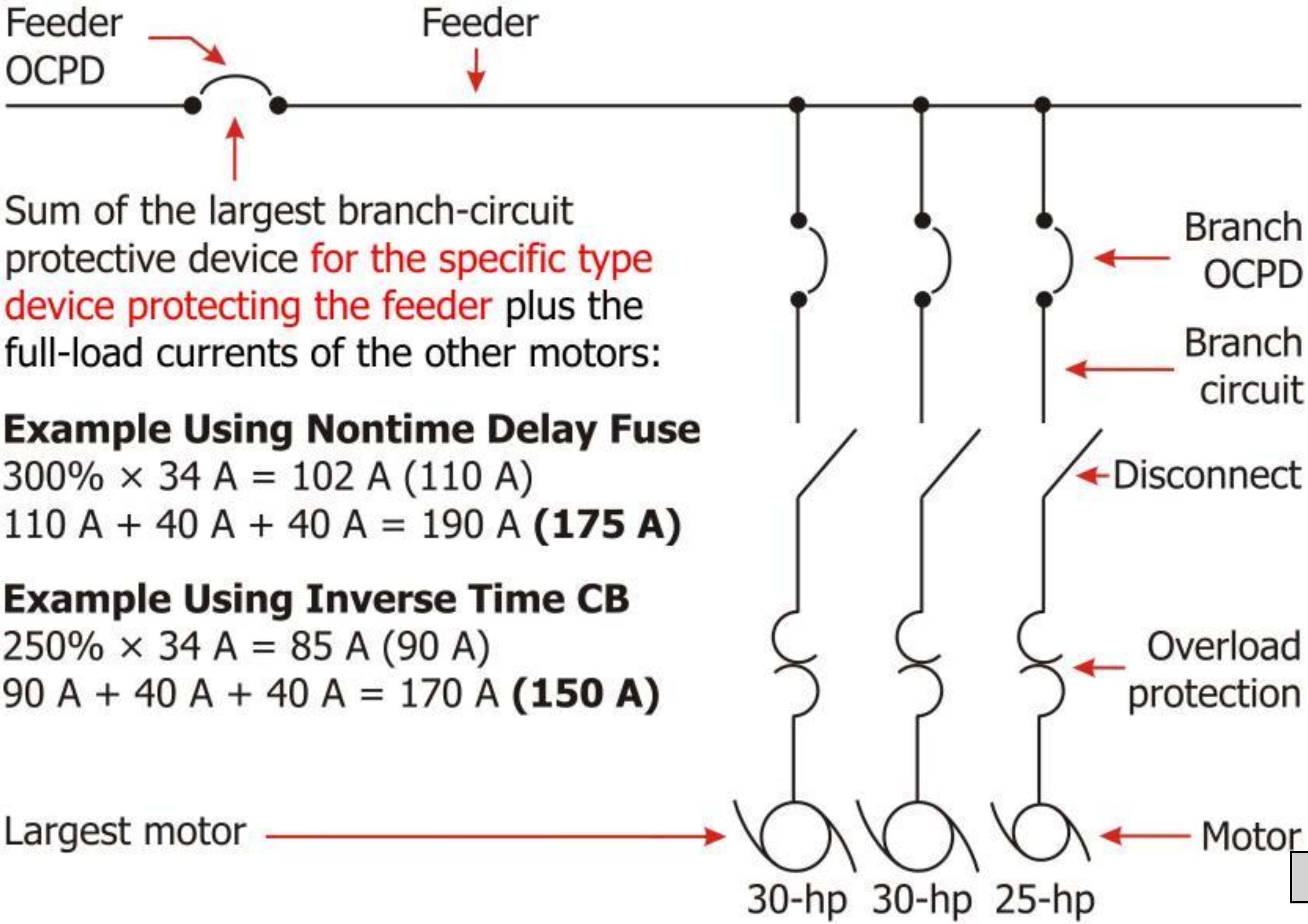
Informative Annex D – Example D8
Motor Feeder Short-Circuit and Ground-Fault

- Example D8 was revised to provide an additional example using different types of protective devices for feeder short-circuit and ground-fault protection
- “Feeder Short-Circuit and Ground-Fault Protection” portion to show:
    - (a) Example using **nontime delay fuse** and
    - (b) Example using **inverse time circuit breaker**
- New phrase "***for the specific device protecting the feeder***" properly corresponds with 430.62(A)

Informative Annex D – Example D8 *(cont.)*
Motor Feeder Short-Circuit and Ground-Fault

- Example D8 is based on:
  - One **25-hp**, 460-V, 3-phase, squirrel-cage motor, nameplate full-load current **32 A**, Design B, Service Factor 1.15
  - Two **30-hp**, 460-V, 3-phase, wound-rotor motors, nameplate primary full-load current **38 A**, nameplate secondary full-load current 65 A, 40°C rise.
- The rating of the feeder protective device is based on the sum of the largest branch-circuit protective device **for the specific type of device protecting the feeder**, plus the sum of the full-load currents of the other motors

Informative Annex D - Example D8
Feeder Short-Circuit and Ground-Fault Protection



Sum of the largest branch-circuit protective device for the specific type device protecting the feeder plus the full-load currents of the other motors:

Example Using Nontime Delay Fuse

300% × 34 A = 102 A (110 A)

110 A + 40 A + 40 A = 190 A **(175 A)**

Example Using Inverse Time CB

250% × 34 A = 85 A (90 A)

90 A + 40 A + 40 A = 170 A **(150 A)**

Analysis of Changes – 2017 *NEC*

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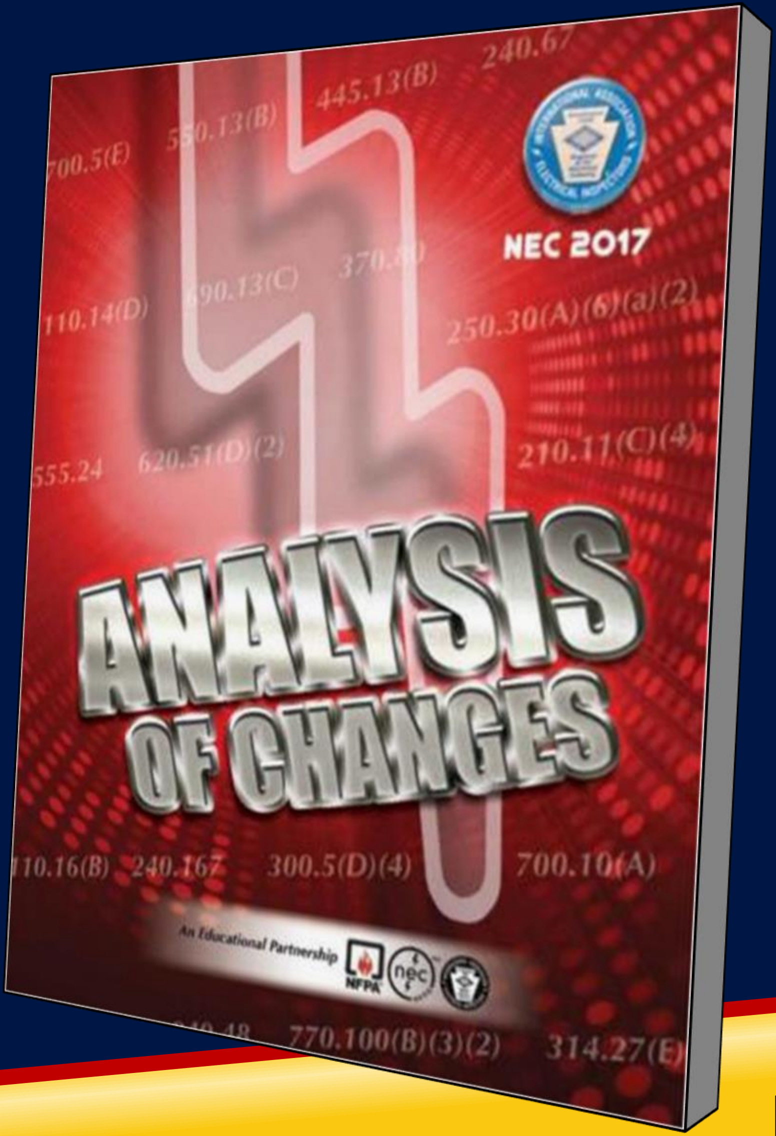

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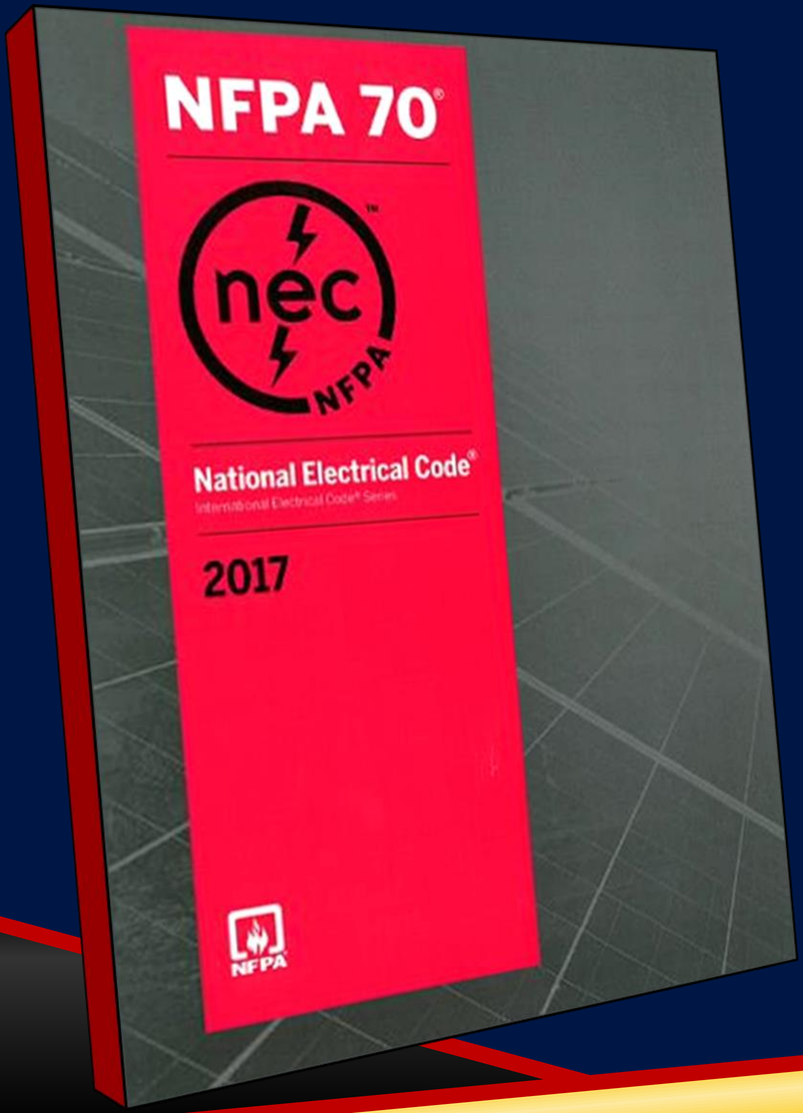

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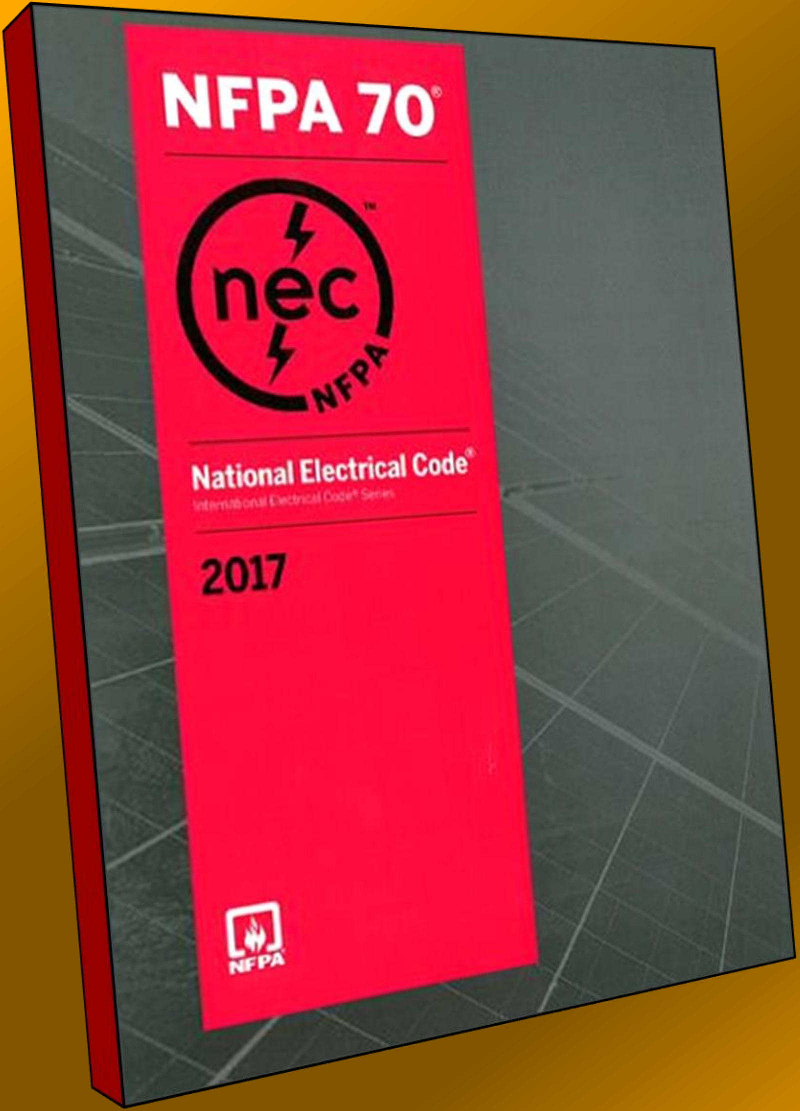

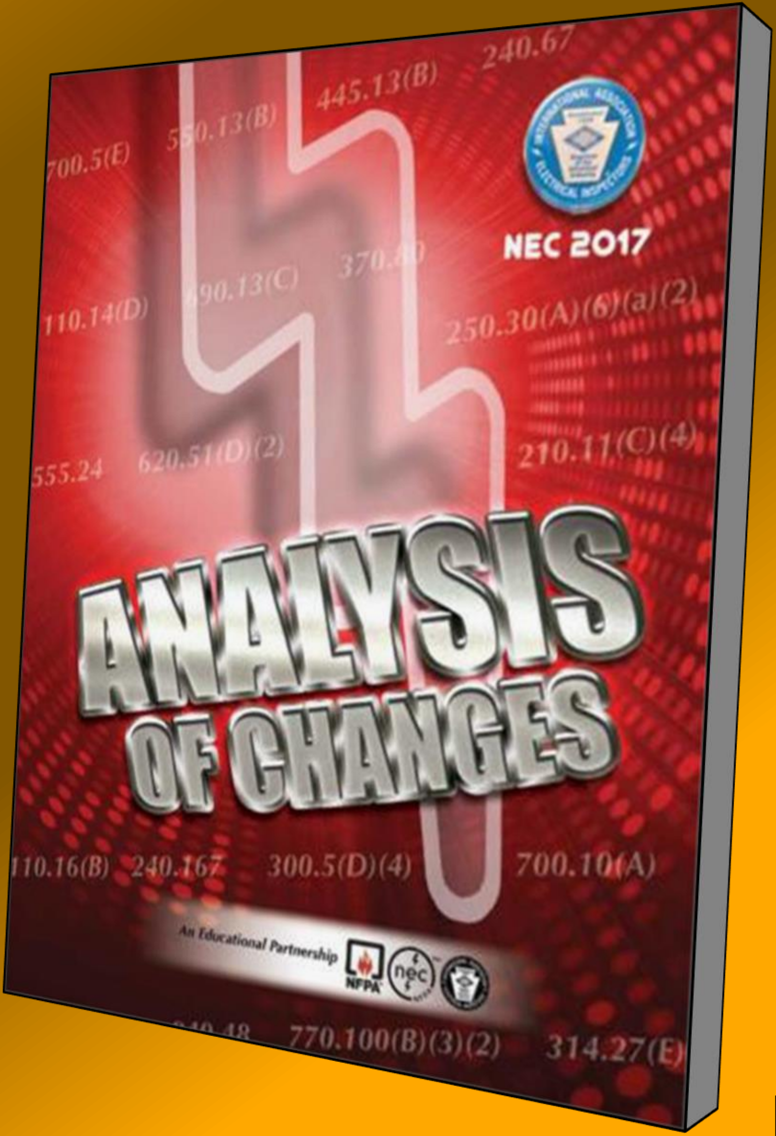

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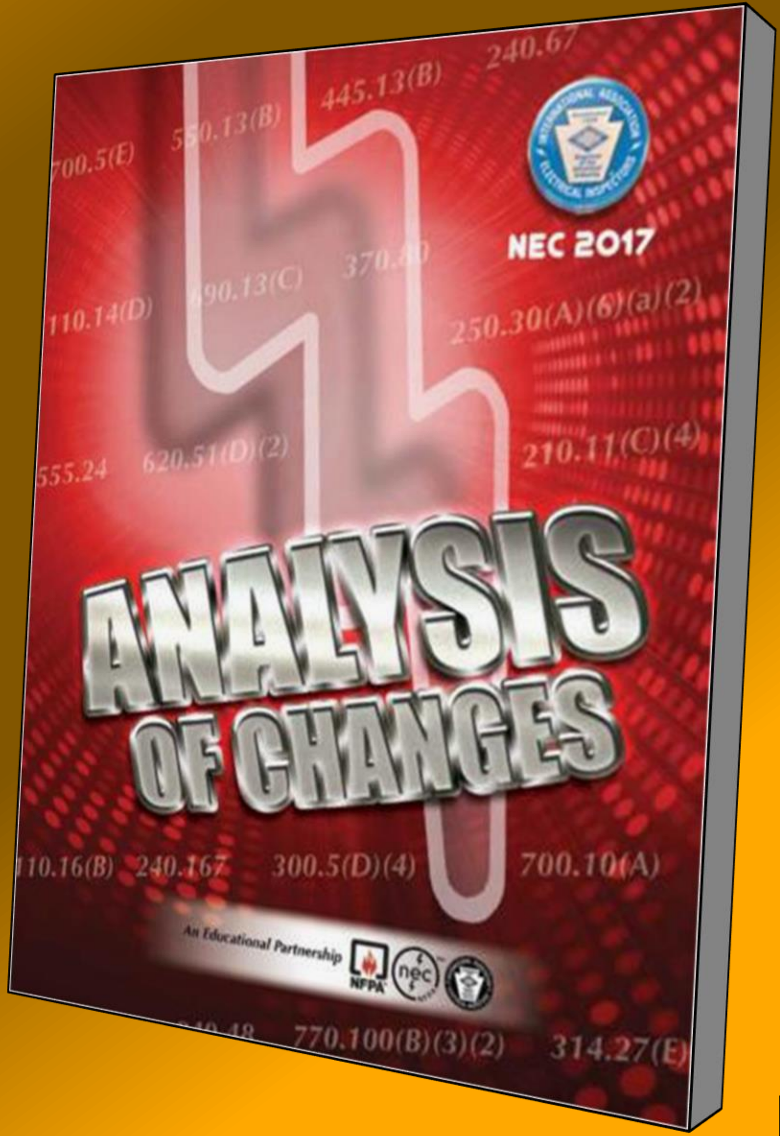


Code-Wide Changes

Code-Wide Changes

- There were approximately **4,102** public inputs (PI) and **1,513** public comments (PC) submitted for modifications to the 2017 edition of the *NEC*

- **Definitions Relocated to Article 100.** Several existing definitions which appeared in the definitions of a particular article have been relocated to Article 100 as these terms are also found in other articles, not just the article where the previous definition was located

- **Limited Access Working Space.** New requirements added at 110.26(A)(4) concerning working space for equipment located in a space with limited access *(above suspended ceiling, crawl spaces, etc.)*

Code-Wide Changes *(cont.)*

- **Documentation of Available Short-Circuit Current.** There were several new requirements added throughout the *NEC* involving the documentation of the available short-circuit current (fault current) at specific types of equipment, and the date the short-circuit current calculation was performed, with this documentation made available to the AHJ
- **600 Volts to 1000 Volts.** Numerous changes for the voltage threshold continued this *Code* cycle for other articles within the *NEC* increasing the threshold from 600 volts to 1000 volts
- **New Articles.** Five new articles added to the 2017 *NEC*

Code-Wide Changes

Definitions Relocated to Article 100

Limited Access Working Space

600 Volts Threshold to 1000 Volts

Available Short-Circuit Current

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).

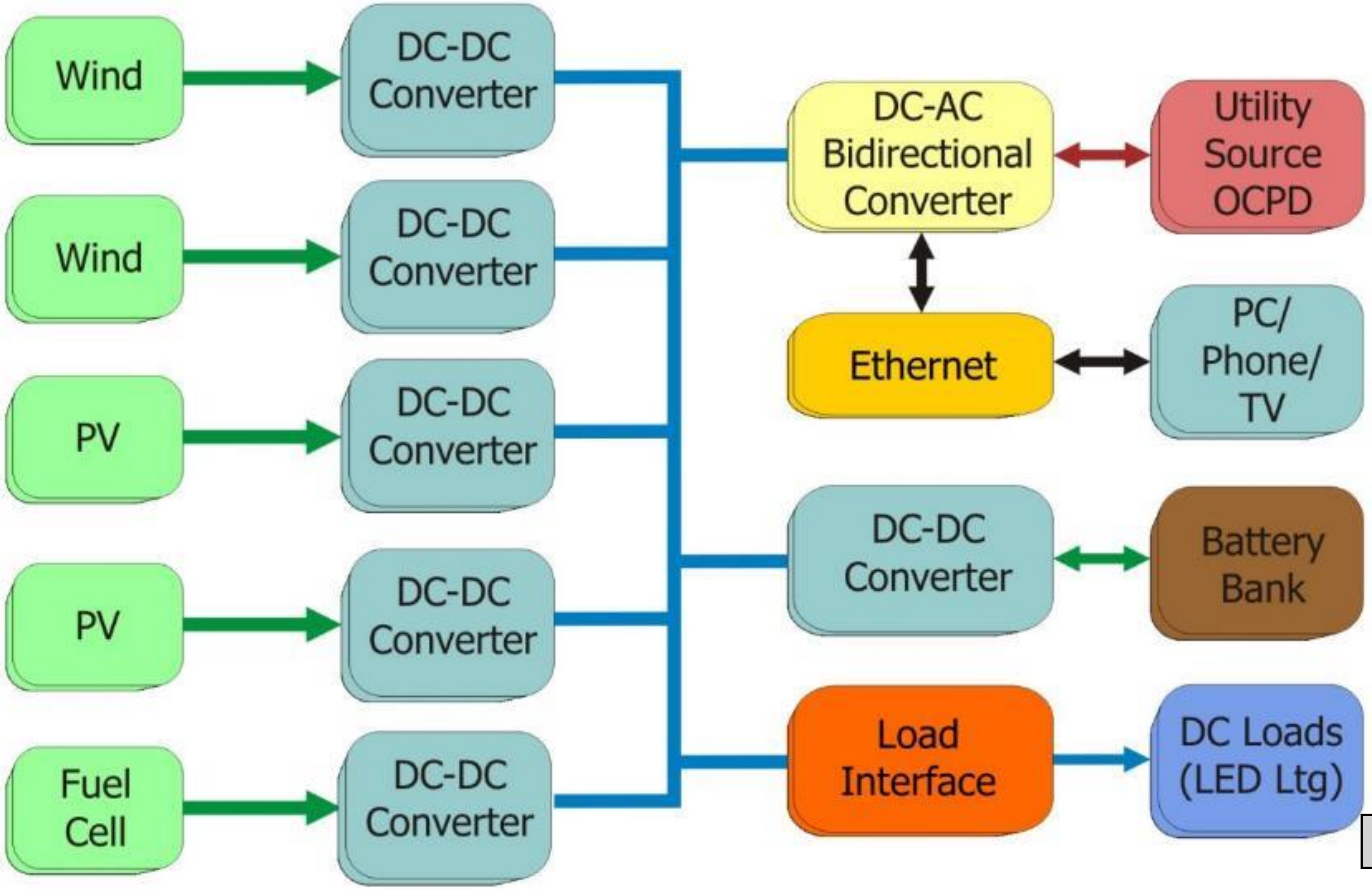
Article 706 Energy Storage Systems. This article applies to all permanently installed energy storage systems (ESS) operating at over 50 volts ac or 60 volts dc that may be stand-alone or interactive with other electric power production sources.

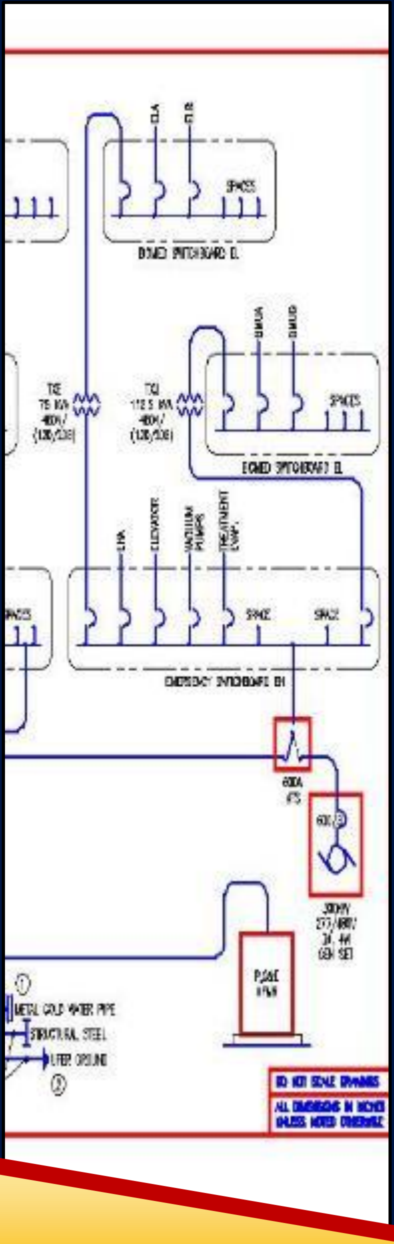
Article 710 Stand-Alone Systems. This article covers electric power production sources operating in stand-alone mode.

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).

Article 712 DC Microgrids

DC Microgrid - A power distribution system consisting of more than one inter-connected dc power sources, supplying dc-dc converters(s), dc loads(s), and/or ac loads(s) powered by dc-ac inverters(s).





Article 90 Introduction

90.3 Code Arrangement

- Chapters 5 - 7 may supplement or modify the general requirements in Chapters 1 through 7 *(not just Chapters 1 - 4)*
- Revision to 90.3 and Figure 90.3 will now indicate that Chapters 5, 6, and 7 can supplement or modify Chapters 1 through 7
- Rules in these latter chapters to not only modify Chapters 1 through 4 but can modify each other as well
- Figure 90.3 is a “roadmap” of the *NEC*

90.3 Code Arrangement

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

Applies generally to all electrical installations

Supplements or modifies Chapters 1 through 7

- Chapter 5 - Special Occupancies
- Chapter 6 - Special Equipment
- Chapter 7 - Special Conditions

- Chapter 8 - Communication Systems

Chapter 8 is NOT subject to the requirements of Chapters 1 through 7 except where the requirements are specifically referenced in Chapter 8

- Chapter 9 - Tables

Applicable as referenced

- Informative Annexes A through J

Information only - not mandatory

Chapter One
General

Article 100 Definitions: Accessible, Readily *(Readily Accessible)*

- **Accessible, Readily.** Capable of being reached quickly for operation, renewal, or inspections without requiring those to whom ready access is requisite to take actions such as to use tools *(other than keys)*, to climb over or under, to remove obstacles, or to resort to portable ladders, and so forth
- Informational Note: Use of keys is a common practice under controlled or supervised conditions and a common alternative to the ready access requirements under such supervised conditions as provided elsewhere in the *NEC*
- The use of a key is not considered taking an action such as the use of a "tool" to gain ready access
- Crawling under or over something to get to equipment required to be readily accessible is no longer acceptable


April
Mesquite
June
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June
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AT&T

Article 100 Definitions: Associated Apparatus

- The definition of "Associated Apparatus" was relocated to Article 100
- ***Associated Apparatus*** ***[as applied to Hazardous (Classified) Locations]*****.** Apparatus in which the circuits are not necessarily intrinsically safe themselves but that affects the energy in the intrinsically safe circuits and is relied on to maintain intrinsic safety. Such apparatus is one of the following:
  - (1) Electrical apparatus that has an alternative type of protection for use in the appropriate hazardous *(classified)* location
  - (2) Electrical apparatus not so protected that shall not be used within a hazardous *(classified)* location

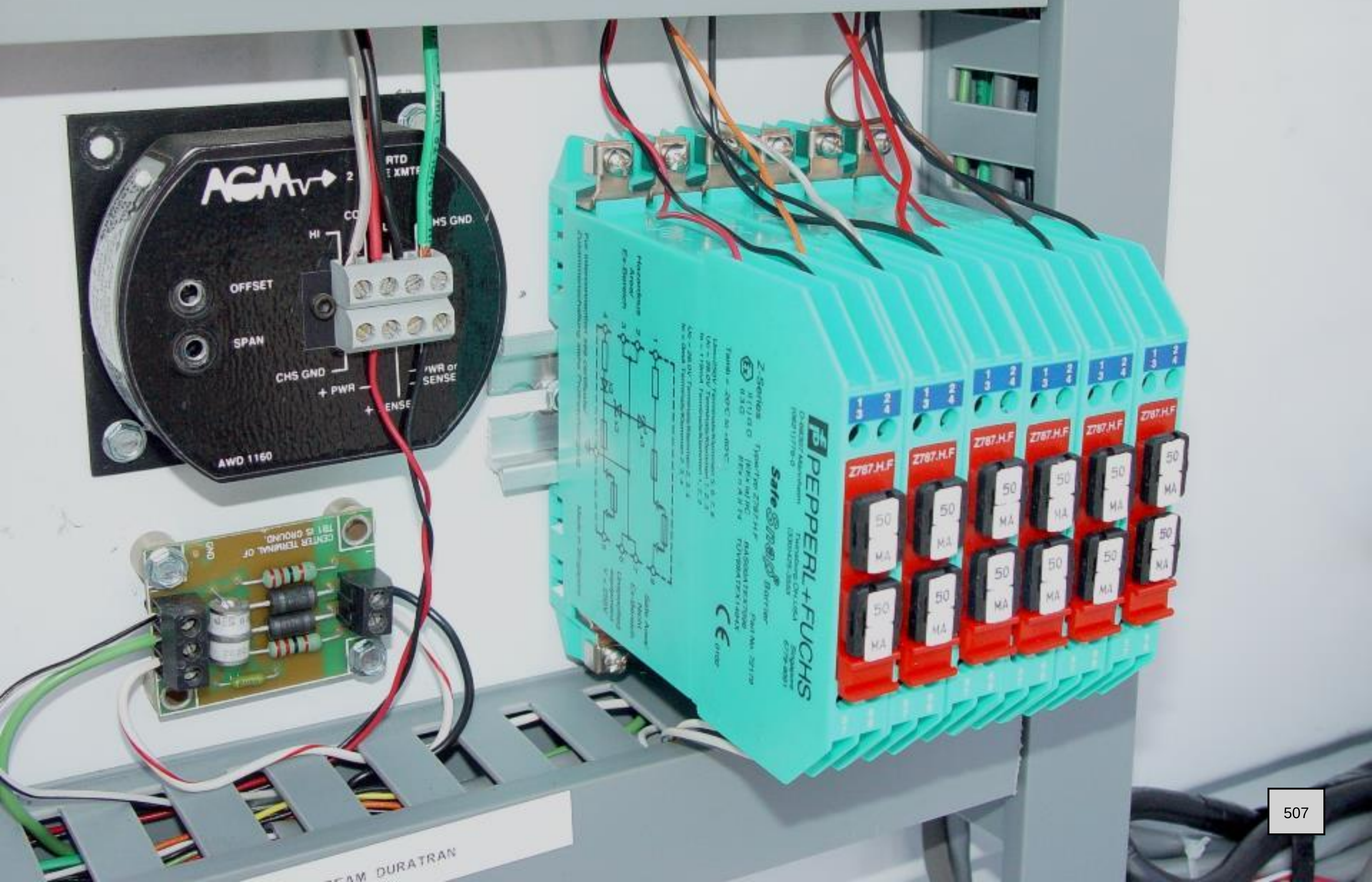
Article 100 Definitions: Associated Apparatus *(cont.)*

- **Informational Note No. 1:** Associated apparatus has identified intrinsically safe connections for intrinsically safe apparatus and also may have connections for nonintrinsically safe apparatus.

- **Informational Note No. 2:** An example of associated apparatus is an intrinsic safety barrier, which is a network designed to limit the energy (voltage and current) available to the protected circuit in the hazardous *(classified)* location, under specified fault conditions.

- This relocation coincides with the relocation of **14 existing definitions** that were located at 500.2 that will now be located in Article 100

Intrinsically safe barriers *(Associated Apparatus)* installed in an IS control panel

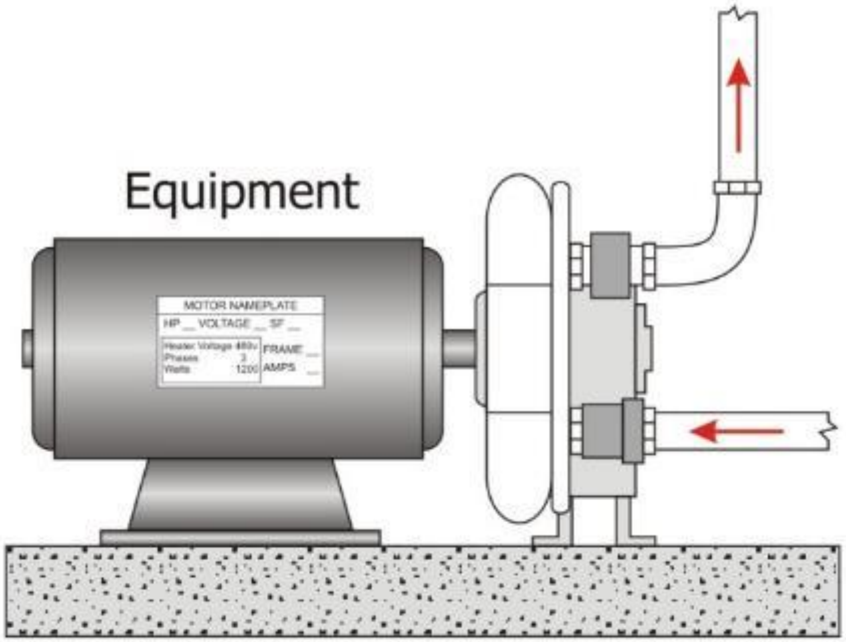


Article 100 Definitions: "Building" and "Structure"

- The related definitions for "**Building**" and "**Structure**" were revised to align with current Building Code terms
- Definition of "**Building**" included unnecessary text that has been removed as it was better suited for the Building Code
- "**Structure**" was defined as that which was built or constructed and could be interpreted as to included equipment
- Including new language "**other than equipment**" to the definition of "**Structure**" will reduce confusion
- Equipment can be mounted on a structure, but the equipment itself is not a "**Structure**"

Article 100 Definitions: Building and Structure

Building



Structure

Building - A structure that stands alone or that is ~~cut off~~ separated from adjoining structures by fire walls ~~with all openings therein protected by approved fire doors~~.

Structure - That which is built or constructed, other than equipment.


HEEDE
SOUTHEAST
SKYTRAK


blink
blink
blink
blink
EV

Article 100 Definitions: Coaxial Cable

- **Coaxial Cable.** A cylindrical assembly composed of a conductor centered inside a metallic tube or shield, separated by a dielectric material, and usually covered by an insulating jacket.
- The definition of "**Coaxial Cable**" was relocated to Article 100 to have an application to other articles across the *NEC*
- Definition was previously located at 820.2
- The term "**Coaxial Cable**" appears in Articles 800, 820, 830 and 840
- Definitions of terms that appear in two or more articles are to be located in Article 100 *(NEC Style Manual)*

Coaxial Cable

Article 100 Definitions:
Field Evaluation Body (FEB) and Field Labeled

- Two new terms were added for "**Field Evaluation Body (FEB)**" and "**Field Labeled**"
- **Field evaluations** of electrical products are a recognized process in the electrical community
- In order for the *NEC* to use terms related to a **field evaluation**, these terms need to be defined
- **Field evaluation** is a process whereby products that do not have a certification acceptable to AHJ, owner, or other regulatory body can be evaluated to **applicable product safety standard(s)** for the specific application and location where the product is being utilized
- Definitions are extracted material from **NFPA 790** *(Standard for Competency of Third-Party Field Evaluation Bodies)*

Article 100 Definitions: Field Labeled and Field Evaluation Body (FEB)

Field Evaluation Body (FEB). An organization or part of an organization that performs field evaluations of electrical or other equipment. [NFPA 790, 2012]

Field Labeled (as applied to evaluated products). Equipment or materials to which has been attached a label, symbol, or other identifying mark of an FEB indicating the equipment or materials were evaluated and found to comply with requirements as described in an accompanying field evaluation report.

Article 100 Definitions: Receptacle

- The definition of a "**receptacle**" has been revised to recognize mating devices used to install luminaires and ceiling-suspended (paddle) fans

- Definition accommodates electrical utilization equipment employing a means to connect directly to the corresponding contact device *(**other than a traditional attachment plug cap**)*

- Revised definition was necessary to correlate with new **314.27(E)** *(Separable Attachment Fittings)*

Article 100 Definitions: Receptacle

Listed locking support and mounting receptacle with compatible attachment fitting

Courtesy of Safety Quick Lighting and Fans Corp

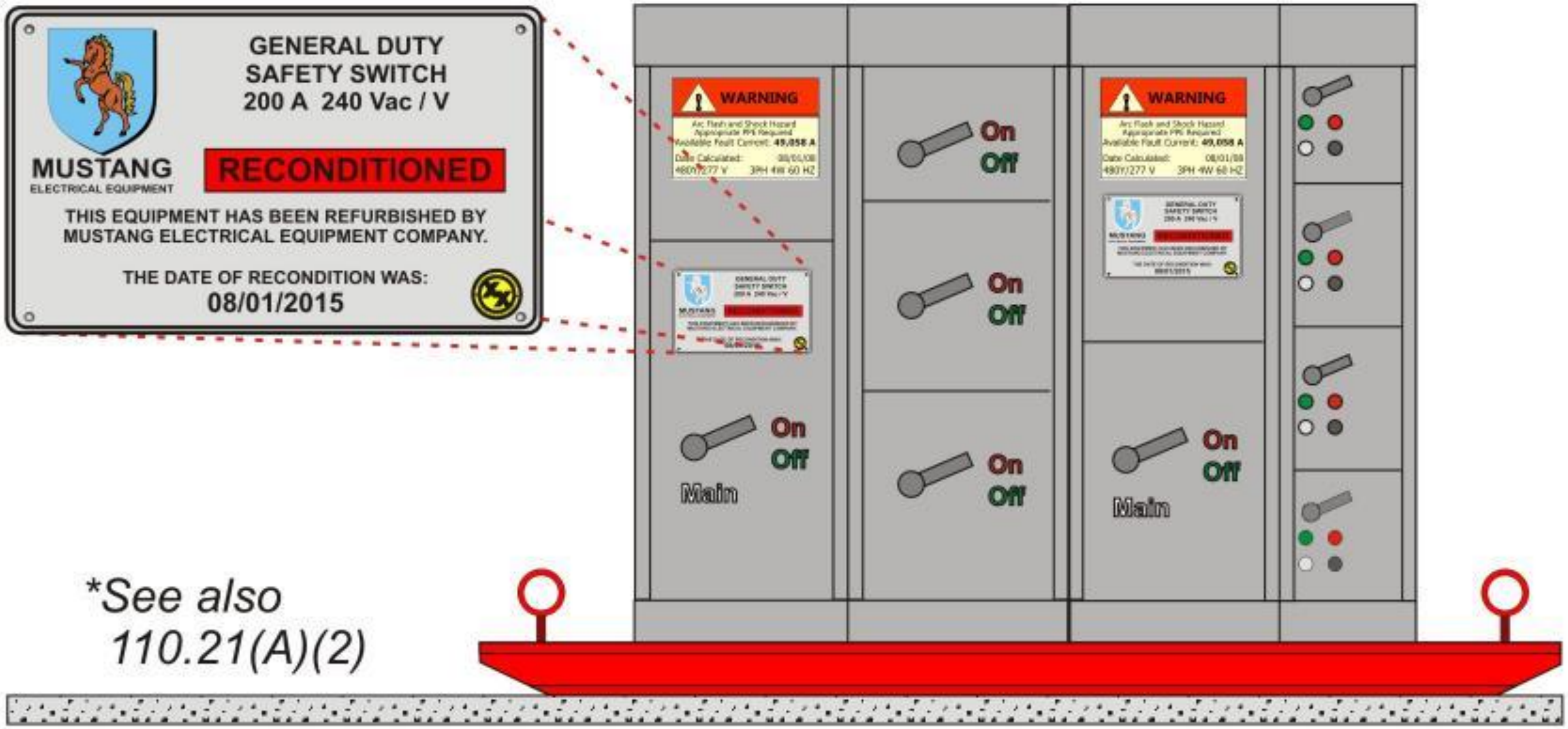
Receptacle. A contact device installed at the outlet for the connection of an attachment plug, or for the direct connection of electrical utilization equipment designed to mate with the corresponding contact device. A single receptacle is a single contact device with no other contact device on the same yoke. A multiple receptacle is two or more contact devices on the same yoke.

110.3(A)(1), Informational Note No. 1
Examination of Equipment

- New I-Note added indicating equipment may be new, **reconditioned**, **refurbished** or **remanufactured**
- "Examination" judgement was presumed to be reserved for "new" equipment
- Reconditioned, refurbished and remanufactured electrical equipment is now widely used in all types of industry to replace, upgrade or further the life cycle of existing equipment
- In some cases, the existing electrical equipment is no longer being produced or the manufacturer is no longer in business
- New **110.21(A)(2)** provides additional guidance for refurbished, reconditioned, or remanufactured equipment **markings and nameplate requirements**

110.3(A)(1) I-Note No. 1 Examination

In judging equipment, considerations of such things as suitability for installation and use in conformity with the *NEC* shall be part of the evaluation process



**See also 110.21(A)(2)*

Informational Note No. 1: Equipment may be new, reconditioned, refurbished, or remanufactured

110.3(C) Listing (Product Certification)

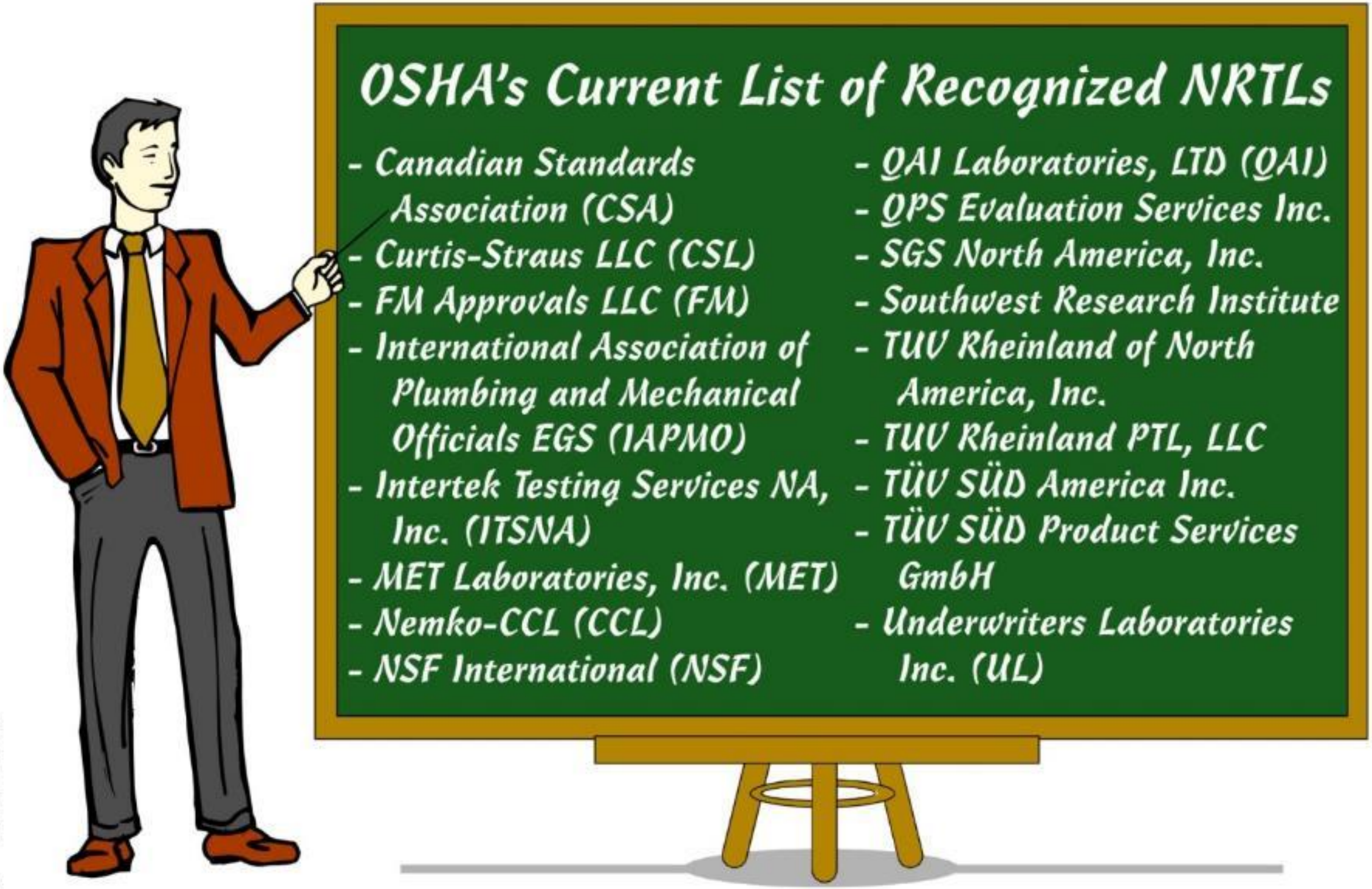
- New **110.3(C)** added requiring the listing process be executed by a **qualified third-party electrical testing laboratory** and that the product testing and certification process be in accordance with **appropriate product standards**
- New text and Informational Note provides clarification concerning requirements for **listing (product certification)**
- AHJ depends on listing requirements and product certification as the most common basis for approvals of electrical installations in accordance with the *NEC*
- I-Note points to **OSHA** website which provides a list of **nationally recognized testing laboratories (NRTL)** that meet or exceed OSHA criteria

110.3(C) Listing (Product Certification) *(cont.)*

- **(C) Listing.** Product testing, evaluation, and listing *(product certification)* shall be performed by **recognized qualified electrical testing laboratories** and shall be in accordance with applicable product standards recognized as achieving equivalent and effective safety for equipment installed to comply with this *Code.*

- **Informational Note:** The Occupational Safety and Health Administration ***(OSHA)*** recognizes **qualified electrical testing laboratories** that perform evaluations, testing, and certification of certain products to ensure that they meet the requirements of both the construction and general industry OSHA electrical standards. If the **listing *(product certification)*** is done under a qualified electrical testing laboratory program, this listing mark signifies that the tested and certified product complies with the requirements of one or more appropriate product safety test standards.

110.3(C) Listing and Informational Note



OSHA's Current List of Recognized NRTLs

- Canadian Standards Association (CSA)
- Curtis-Straus LLC (CSL)
- FM Approvals LLC (FM)
- International Association of Plumbing and Mechanical Officials EGS (IAPMO)
- Intertek Testing Services NA, Inc. (ITSNA)
- MET Laboratories, Inc. (MET)
- Nemko-CCL (CCL)
- NSF International (NSF)
- QAI Laboratories, LTD (QAI)
- QPS Evaluation Services Inc.
- SGS North America, Inc.
- Southwest Research Institute
- TUV Rheinland of North America, Inc.
- TUV Rheinland PTL, LLC
- TÜV SÜD America Inc.
- TÜV SÜD Product Services GmbH
- Underwriters Laboratories Inc. (UL)

Product testing, evaluation, and listing to be performed by recognized qualified electrical testing laboratories and must comply with applicable product standards

110.14(D)
Electrical Connections - Installations

- New requirements added for the use of **tightening torque tools** where torqueing is indicated

- Previous I-Note at parent text of 110.14 has been deleted and replaced with enforceable *Code* text at **new 110.14(D)**

- Tightening torque tools now required where torqueing is specified on the equipment or in **manufacturer installation instructions**

- Where a tightening torque is indicated as a numeric value on equipment or in manufacturer installation instructions, **calibrated torque tool shall be used to achieve the indicated torque value** *(unless manufacturer installation instructions provide for an* ***alternative method*** *of achieving the required torque)*

110.14(D) Electrical Connection Torque Tools

Where a tightening torque is indicated as a numeric value on equipment or in installation instructions provided by the manufacturer, a calibrated torque tool is generally required to be used to achieve the indicated torque value

110.16(B)
Service Equipment Arc-Flash Hazard Warning

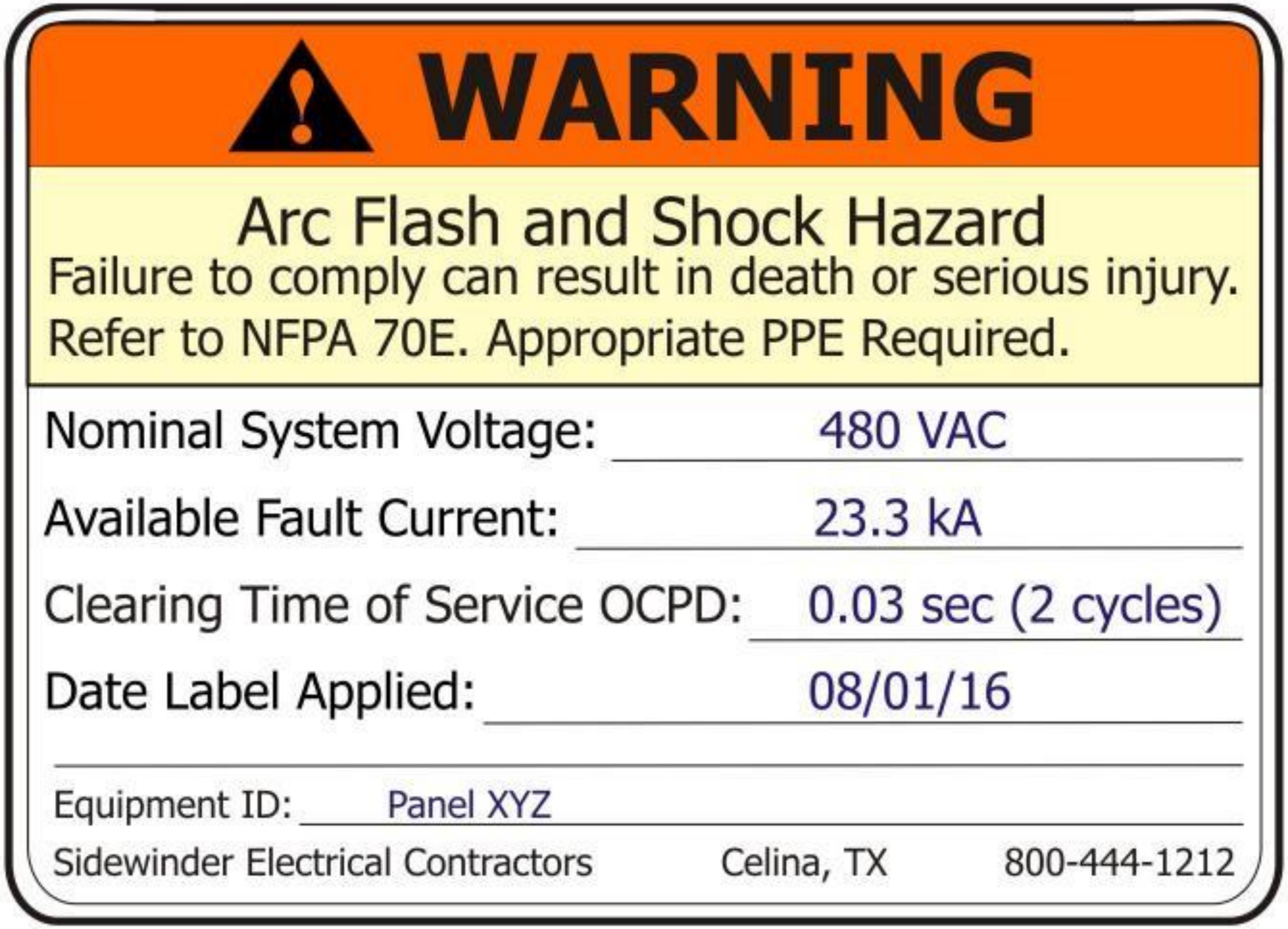
- New **110.16(B)** was added requiring **non-dwelling unit service equipment** rated **1200 amperes or more** to be labeled with the normal system voltage, available fault current, clearing times, and date the label was applied
- Basic arc-flash warning label of 110.16 expanded to require additional information for non-dwelling unit service equipment
- Information needed to determine such things as the incident energy, minimum arc rating of clothing and personal protective equipment (PPE), and working distance from NFPA 70E
- Date the label was applied is necessary as the posted available fault current will fluctuate and can be affected by events beyond the control of the property owner

110.16(B) *(cont.)*
Service Equipment Arc-Flash Hazard Warning

- Non-dwelling unit service equipment rated 1200 amperes or more required be permanently field or factory labeled with:
  - Normal system voltage
  - Available fault current
  - Clearing times
  - Date the label was applied
- Exception: Service equipment labeling shall not be required if an arc-flash label is applied in accordance with acceptable industry practice *(see NFPA 70E 2015 Standard for Electrical Safety in the Workplace)*
- **Note: The following slides illustrate what this label could look like**

110.16(B) Arc-Flash Hazard Warning Label

In other than dwelling units, in addition to the requirements in 110.16(A), a permanent label shall be field or factory applied to service equipment rated 1200 amperes or more



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

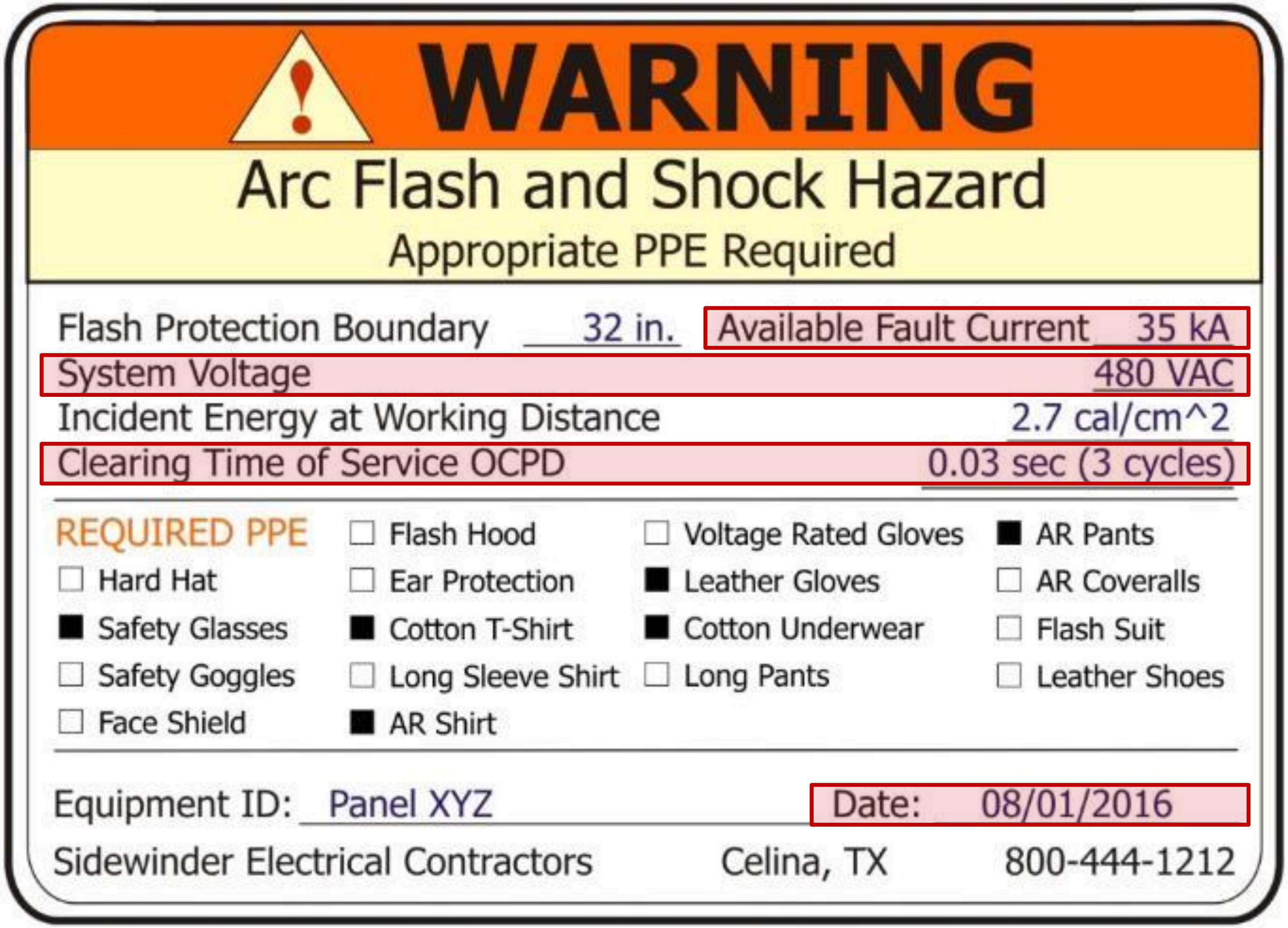
Equipment ID: Panel XYZ

Sidewinder Electrical Contractors Celina, TX 800-444-1212

Exception: Label not required if arc flash label is applied in accordance with "acceptable industry practice" (NFPA 70E)

110.16(B) Arc-Flash Hazard Warning Label

In other than dwelling units, in addition to the requirements in 110.16(A), a permanent label shall be field or factory applied to service equipment rated 1200 amperes or more



WARNING

Arc Flash and Shock Hazard

Appropriate PPE Required

Flash Protection Boundary 32 in. Available Fault Current 35 kA
System Voltage 480 VAC
Incident Energy at Working Distance 2.7 cal/cm^2
Clearing Time of Service OCPD 0.03 sec (3 cycles)

REQUIRED PPE
- ☐ Hard Hat
- ■ Safety Glasses
- ☐ Safety Goggles
- ☐ Face Shield
- ☐ Flash Hood
- ☐ Ear Protection
- ■ Cotton T-Shirt
- ☐ Long Sleeve Shirt
- ■ AR Shirt
- ☐ Voltage Rated Gloves
- ■ Leather Gloves
- ■ Cotton Underwear
- ☐ Long Pants
- ■ AR Pants
- ☐ AR Coveralls
- ☐ Flash Suit
- ☐ Leather Shoes

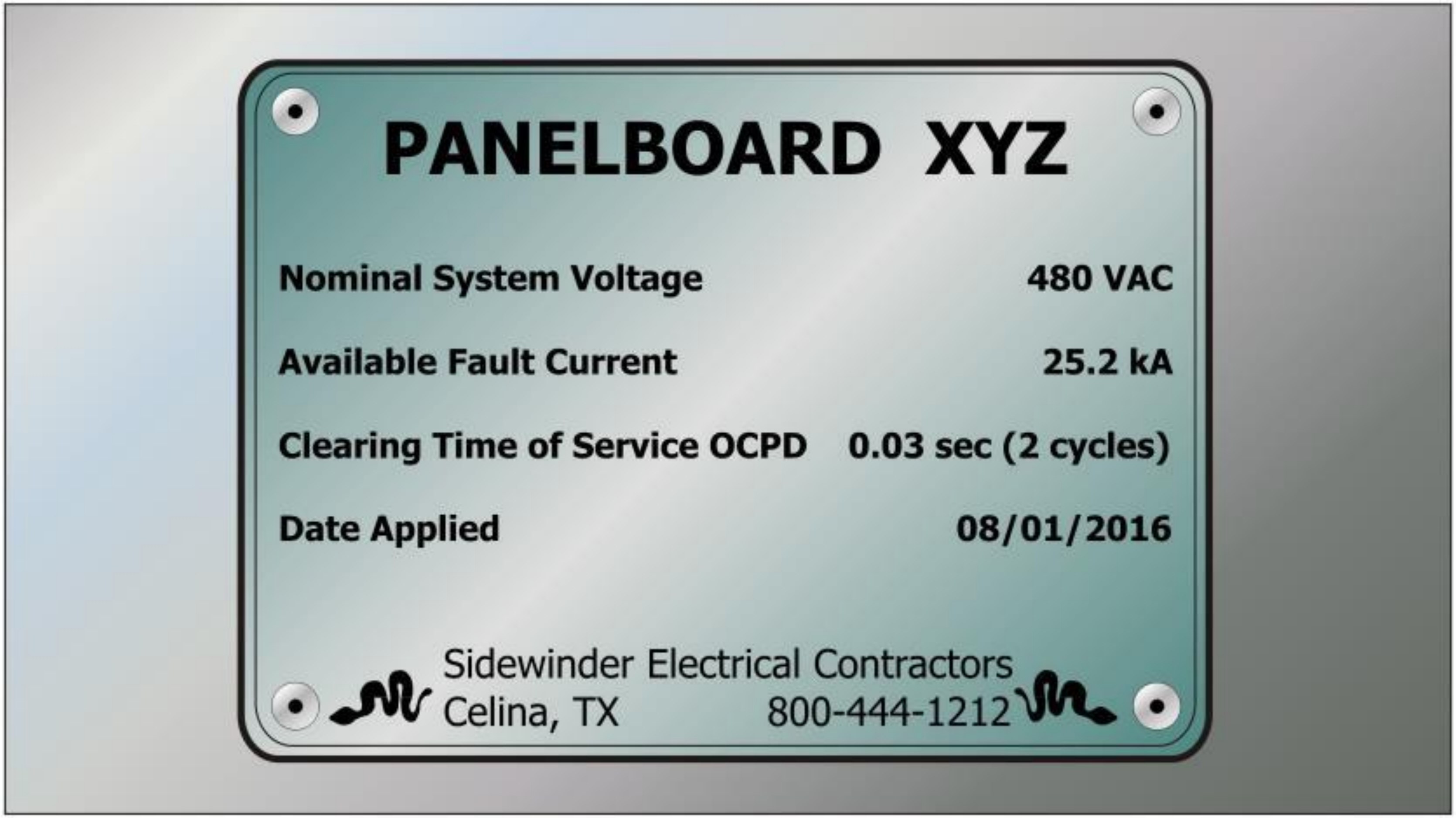
Equipment ID: Panel XYZ Date: 08/01/2016

Sidewinder Electrical Contractors Celina, TX 800-444-1212

Exception: Label not required if arc flash label is applied in accordance with "acceptable industry practice" (NFPA 70E)

110.16(B) Arc-Flash Hazard Warning Label

In other than dwelling units, in addition to the requirements in 110.16(A), a permanent label shall be field or factory applied to service equipment rated 1200 amperes or more



PANELBOARD XYZ

Nominal System Voltage	**480 VAC**
Available Fault Current	**25.2 kA**
Clearing Time of Service OCPD	**0.03 sec (2 cycles)**
Date Applied	**08/01/2016**

Sidewinder Electrical Contractors
Celina, TX 800-444-1212

Exception: Label not required if arc flash label is applied in accordance with "acceptable industry practice" (NFPA 70E)

SQUARE D®

GENERAL DUTY SAFETY SWITCH
INTERRUPTOR DE SEGURIDAD DE SERVICIO GENERAL
200 A
240 Vac / V~

⚠ DANGER / PELIGRO

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH
PELIGRO DE DESCARGA ELÉCTRICA, EXPLOSIÓN O DESTELLO POR ARQUEO

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E.
- This equipment must only be installed and serviced by qualified electrical personnel.
- Never operate energized switch with door open. Keep door fastened.
- Turn off switch before removing or installing fuses or making load side connections.
- Always use a properly rated voltage sensing device at all line and load fuse clips to confirm switch is off.
- Turn off power supplying switch before doing any other work on or inside switch.
- Do not use renewable link fuses in fused switches.

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

- Utilice equipo de protección personal (EPP) apropiado y siga las prácticas de seguridad eléctrica establecidas por su Compañía (consulte la norma NFPA 70E).
- Solamente el personal eléctrico especializado deberá instalar y prestar servicio de mantenimiento a este equipo.
- Nunca haga funcionar el interruptor con la puerta abierta cuando esté energizado. Mantenga la puerta asegurada.
- Desenergice el interruptor antes de extraer o instalar fusibles o de hacer conexiones en el lado de carga.
- Siempre utilice un dispositivo de tensión nominal adecuado en los clips para fusibles de los lados de carga y línea para confirmar la desenergización del interruptor.
- Desenergice el interruptor antes de realizar cualquier otro trabajo en el interruptor.
- No utilice fusibles de cinta renovables en los interruptores de fusible.

El incumplimiento de estas precauciones podrá causar la muerte o lesiones serias.

To lock out switch, place padlock hasp through hole in lockplate and above handle.

40275-957-02

Para bloquear el interruptor, la aldaba del candado debe pasar por el agujero en la placa de inmovilización y por encima de la manija.

SERVICE DISCONNECT

110.21(A)(2) Equipment Markings - Reconditioned Equipment

- New **110.21(A)(2)** added to require **refurbished, reconditioned, or remanufactured equipment** to be marked with the **name, trademark, and other descriptive marking** of the organization responsible for reconditioning the electrical equipment
- New rules added to provide **traceability** and other additional information to manufacturers, owners, installers, and AHJs related to reconditioned equipment
- The **date of the reconditioning** must also be established on the nameplate or marking
- AHJ should never rely solely on equipment's original listing as basis of approval of reconditioned electrical equipment

110.21(A)(2) Equipment Markings - Reconditioned Equipment *(cont.)*

- **Reconditioned Equipment.** Reconditioned equipment shall be marked with the name, trademark, or other descriptive marking by which the organization responsible for reconditioning the electrical equipment can be identified, along with the date of the reconditioning. Reconditioned equipment shall be identified as “reconditioned” and approval of the reconditioned equipment shall not be based solely on the equipment’s original listing.
- ***Exception:*** *In industrial occupancies, where conditions of maintenance and supervision ensure that only qualified persons service the equipment, the markings indicated in 110.21(A)(2) shall not be required.*
- **Informational Note:** Industry standards are available for application of reconditioned and refurbished equipment. Normal servicing of equipment that remains within a facility should not be considered reconditioning or refurbishing.

110.21(A)(2) Reconditioned Equipment

MUSTANG
ELECTRICAL EQUIPMENT

GENERAL DUTY
SAFETY SWITCH
200 A 240 Vac / V

RECONDITIONED

THIS EQUIPMENT HAS BEEN REFURBISHED BY
MUSTANG ELECTRICAL EQUIPMENT COMPANY.

THE DATE OF RECONDITION WAS:
08/01/2015

Typical marking requirements for reconditioned electrical equipment in accordance with 110.21(A)(2)

110.26(A)(4)
Limited Access Working Space

- New requirements added in Article 110 concerning working space for equipment located in a space with **limited access** *(above suspended ceiling, crawl spaces, etc.)*

- Previous 424.66(B) limited access working space requirements was relocated to **110.26(A)(4)** to **broaden this requirement** to more than just duct heaters

- Limited access working space requirements at **crawl spaces** were added to this requirement as well

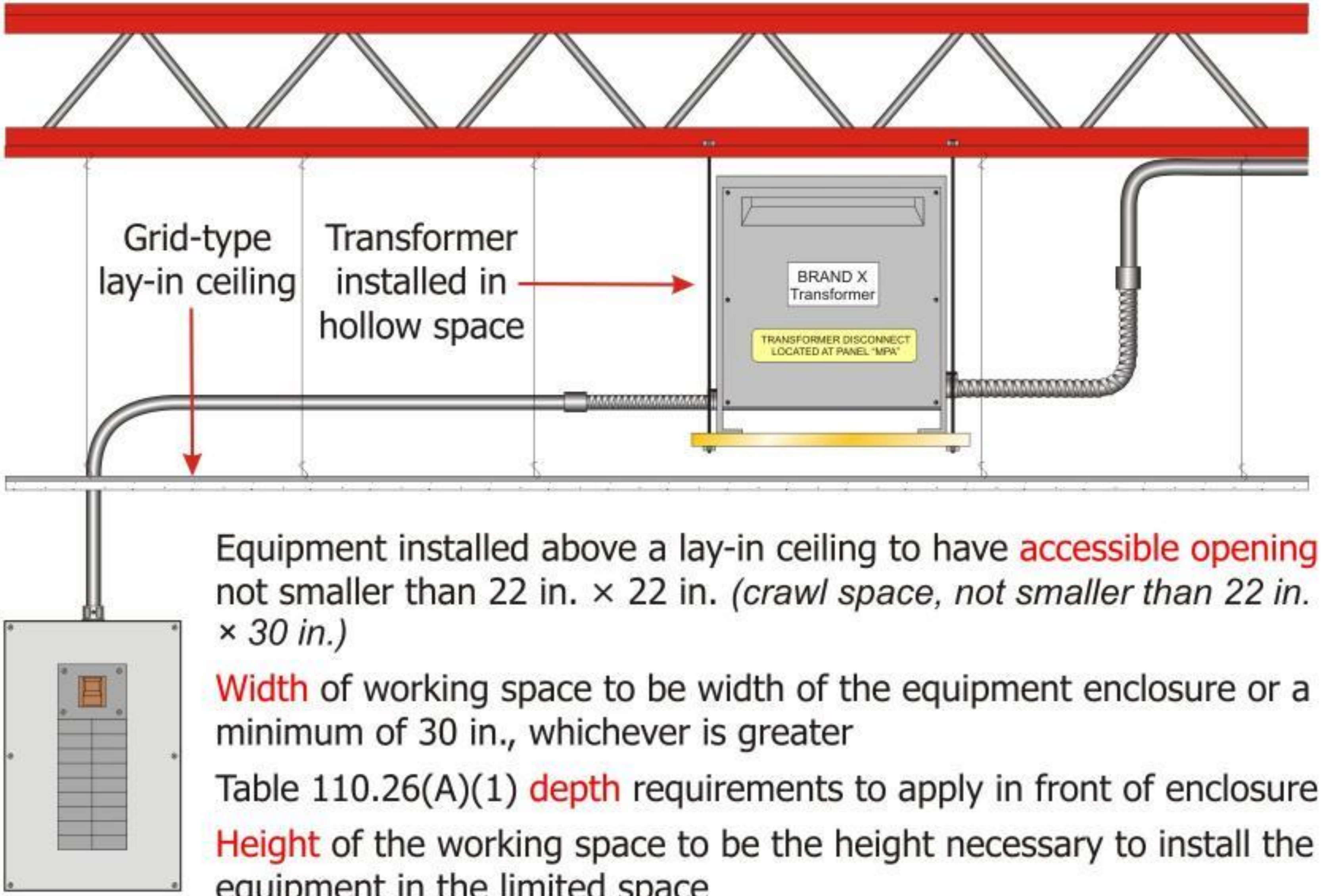
- Strict compliance with 110.26(A)(1), (A)(2) and (A)(3) in ceiling spaces and crawl spaces is not feasible and in some cases, not possible

110.26(A)(4)
Limited Access Working Space *(cont.)*

- The *NEC* Correlating Committee appointed a ***Working Space Task Group*** to review requirements for working space of electrical equipment that is often installed in spaces with **limited access** such as transformers, motors, air-handling equipment, etc.

- Working space requirements for equipment *(with limited access or not)* that are **likely to require examination, adjustment, servicing, or maintenance while energized** are general requirements for all electrical equipment

110.26(A)(4) Limited Access Working Space



Equipment installed above a lay-in ceiling to have accessible opening not smaller than 22 in. × 22 in. *(crawl space, not smaller than 22 in. × 30 in.)*

Width of working space to be width of the equipment enclosure or a minimum of 30 in., whichever is greater

Table 110.26(A)(1) depth requirements to apply in front of enclosure

Height of the working space to be the height necessary to install the equipment in the limited space

Horizontal ceiling structural member/access panel permitted in spac

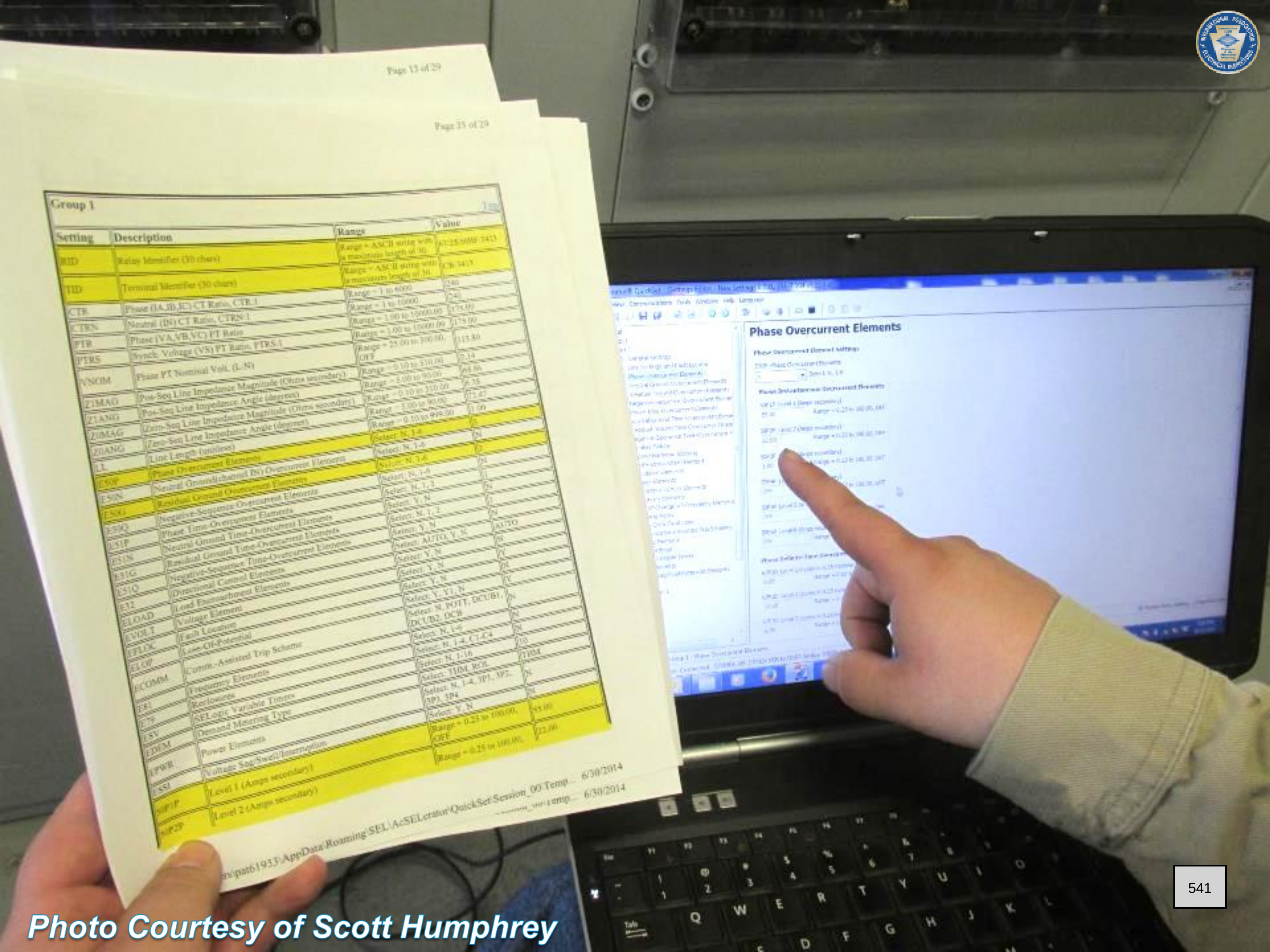
110.26(A)(4) Limited Access required above a lay-in suspended ceiling

110.26(A)(4) Limited Access required in crawl spaces

110.41(A) and (B) Inspections and Tests - Pre-energization and Operating Tests/Reports

- New requirements added at **110.41** for **pre-energization testing** and **reporting** of electrical equipment (over 1000 volts) upon request by the AHJ
- Being located in Article 110, this will apply to all equipment rated over 1000 volts regardless of its location
- Ensures that these electrical systems perform to their design specifications and a record verifying the proper settings and test data would be available to the AHJ, installers, operators, testers, and maintainers after the equipment is put into service
- Similar to 225.56 for outdoor feeders and branch circuits greater than 1000 volts

Photo Courtesy of Shermco Industries



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Group 1 Top

Setting	Description	Range	Value
RID	Relay Identifier (30 chars)	Range = ASCII string with a maximum length of 30.	67/25/50BF 3413
TID	Terminal Identifier (30 chars)	Range = ASCII string with a maximum length of 30.	CB 3413
CTR	Phase (IA,IB,IC) CT Ratio, CTR:1	Range = 1 to 6000	240
CTRN	Neutral (IN) CT Ratio, CTRN:1	Range = 1 to 10000	240
PTR	Phase (VA,VB,VC) PT Ratio	Range = 1.00 to 10000.00	175.00
PTRS	Synch. Voltage (VS) PT Ratio, PTRS:1	Range = 1.00 to 10000.00	175.00
VNOM	Phase PT Nominal Volt. (L-N)	Range = 25.00 to 300.00, OFF	115.80
Z1MAG	Pos-Seq Line Impedance Magnitude (Ohms secondary)	Range = 0.10 to 510.00	2.14
Z1ANG	Pos-Seq Line Impedance Angle (degrees)	Range = 5.00 to 90.00	68.86
Z0MAG	Zero-Seq Line Impedance Magnitude (Ohms secondary)	Range = 0.10 to 510.00	6.25
Z0ANG	Zero-Seq Line Impedance Angle (degrees)	Range = 5.00 to 90.00	72.47
LL	Line Length (unitless)	Range = 0.10 to 999.00	1.00
E50P	Phase Overcurrent Elements	Select: N, 1-6	3
E50N	Neutral Ground(channel IN) Overcurrent Elements	Select: N, 1-6	N
E50G	Residual Ground Overcurrent Elements	Select: N, 1-6	3
E50Q	Negative-Sequence Overcurrent Elements	Select: N, 1-6	N
E51P	Phase Time-Overcurrent Elements	Select: N, 1, 2	1
E51N	Neutral Ground Time-Overcurrent Elements	Select: Y, N	N
E51G	Residual Ground Time-Overcurrent Elements	Select: N, 1, 2	1
E51Q	Negative-Sequence Time-Overcurrent Elements	Select: Y, N	N
E32	Directional Control Elements	Select: AUTO, Y, N	AUTO
ELOAD	Load Encroachment Elements	Select: Y, N	N
EVOLT	Voltage Element	Select: Y, N	Y
EFLOC	Fault Location	Select: Y, N	N
ELOP	Loss-Of-Potential	Select: Y, Y1, N	Y
ECOMM	Comm.-Assisted Trip Scheme	Select: N, POTT, DCUB1, DCUB2, DCB	N
E81	Frequency Elements	Select: N, 1-6	N
E79	Reclosures	Select: N, 1-4, C1-C4	N
ESV	SELogic Variable Timers	Select: N, 1-16	10
EDEM	Demand Metering Type	Select: THM, ROL	THM
EPWR	Power Elements	Select: N, 1-4, 3P1, 3P2, 3P3, 3P4	N
ESSI	Voltage Sag/Swell/Interruption	Select: Y, N	N
50P1P	Level 1 (Amps secondary)	Range = 0.25 to 100.00, OFF	55.00
50P2P	Level 2 (Amps secondary)	Range = 0.25 to 100.00,	22.00

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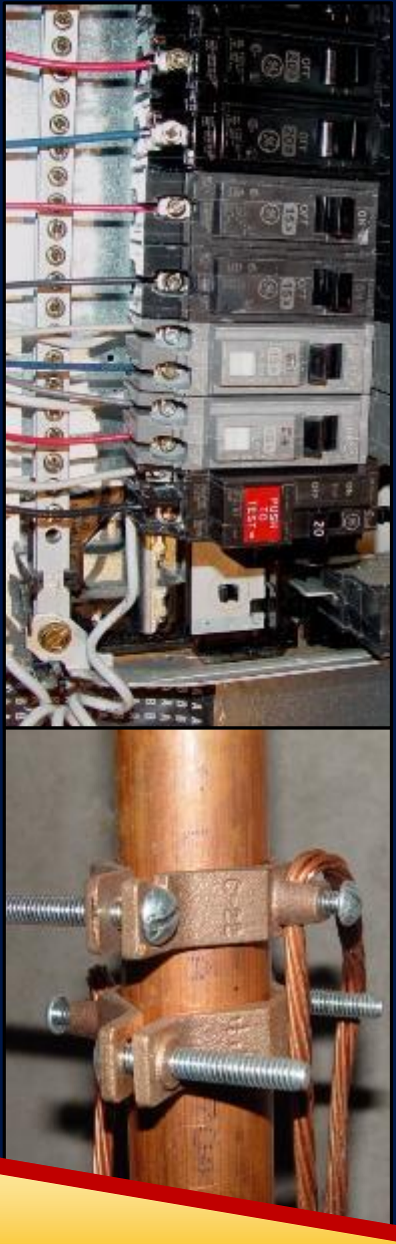
Photo Courtesy of Scott Humphrey



Chapter Two Wiring and Protection

210.5(C)(1), Exception
Identification of Ungrounded Conductors

- New exception added for **relief from identifying** each ungrounded conductor for **existing installations** where a voltage system(s) already exists and a different voltage system is being added

- Numerous existing and older systems exist that are supplied by more than one nominal voltage system installed prior to the adoption of the 2005 *NEC [when 210.5(C) was first mandated]*

- A new requirement was also added concerning the **durability** and makeup of the labels involved

210.5(C)(1), Exception
Identification of Ungrounded Conductors *(cont.)*

- New exception also included labeling requirements for these older existing unidentified installations requiring a label at each voltage system distribution equipment point

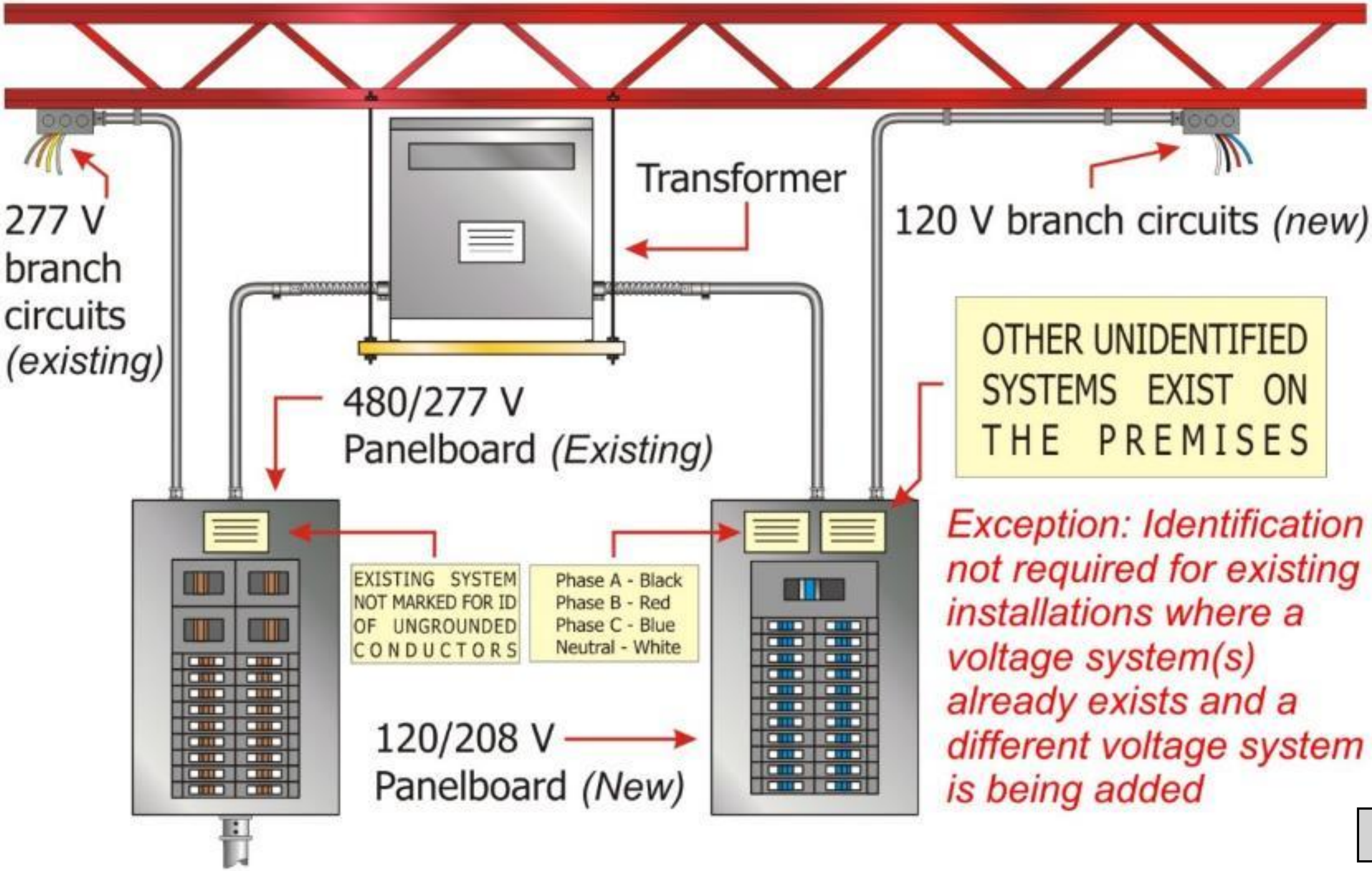
- Must identify that **only the newer added voltage system(s)** have been marked or identified at each termination, connection, and splice point

- The new system label(s) will be required to include the words "**Other Unidentified Systems Exist on the Premises**"

- Labels required by 210.5(C)(1)(b) to be “**sufficiently durable**” and able to withstand the environment in which it is installed

210.5(C)(1), Ex. ID of Ungrounded Conductors

Where premises wiring systems have more than one nominal voltage system, each ungrounded branch circuit conductor shall be identified by phase or line and system at all termination, connection, and splice points



277 V branch circuits *(existing)*

Transformer

120 V branch circuits *(new)*

480/277 V Panelboard *(Existing)*

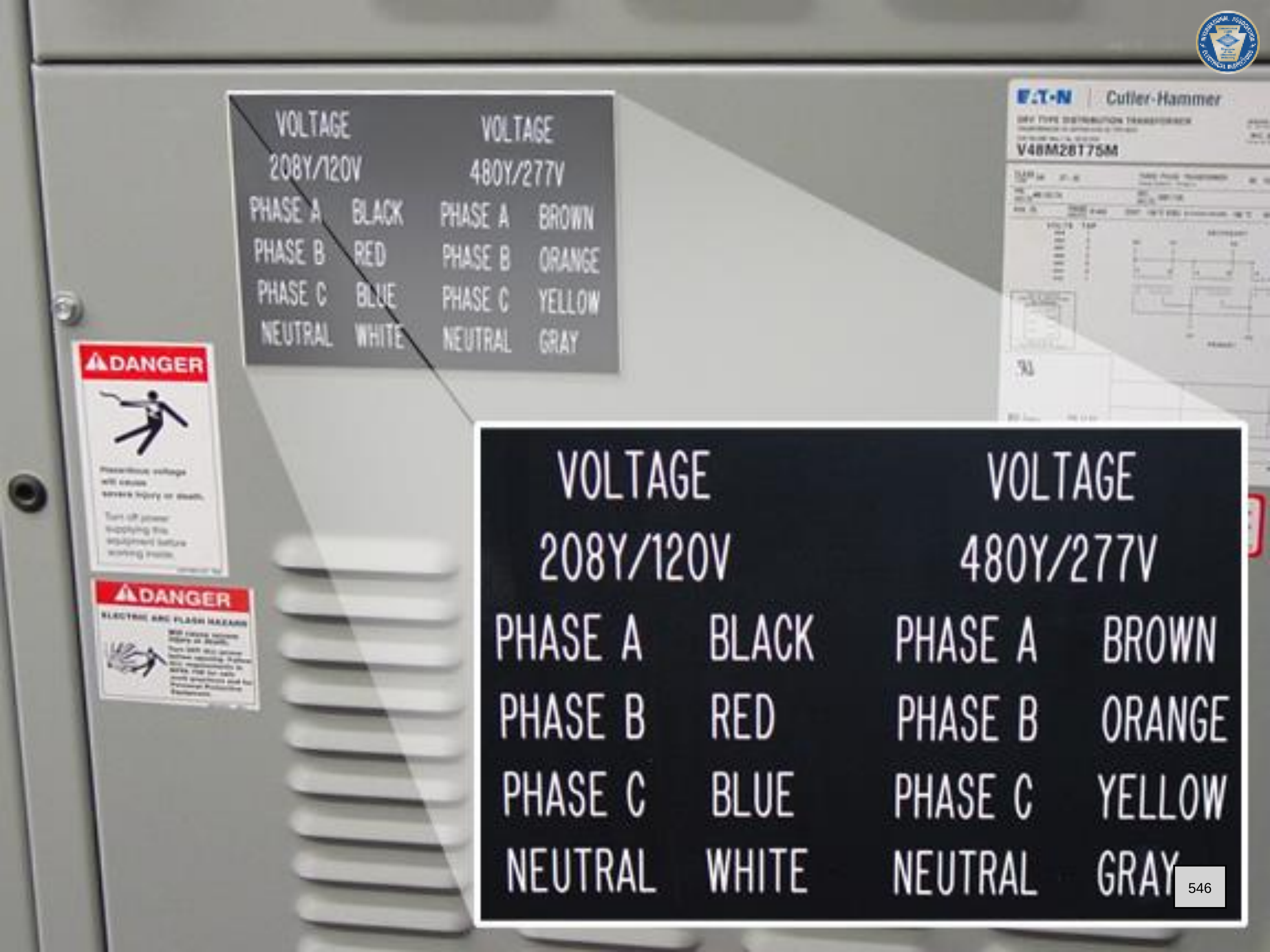
OTHER UNIDENTIFIED SYSTEMS EXIST ON THE PREMISES

EXISTING SYSTEM NOT MARKED FOR ID OF UNGROUNDED CONDUCTORS

Phase A - Black
Phase B - Red
Phase C - Blue
Neutral - White

120/208 V Panelboard *(New)*

Exception: Identification not required for existing installations where a voltage system(s) already exists and a different voltage system is being added



VOLTAGE 208Y/120V		VOLTAGE 480Y/277V	
PHASE A	BLACK	PHASE A	BROWN
PHASE B	RED	PHASE B	ORANGE
PHASE C	BLUE	PHASE C	YELLOW
NEUTRAL	WHITE	NEUTRAL	GRAY

210.8 GFCI Protection - Measurements

- New language added to clarify how measurements are to be determined for GFCI receptacle *(added at parent text of 210.8)*

- Measurements from receptacles to objects *(such as a sink)* that would qualify for GFCI protection should be measured as the "**shortest path**" a cord of an appliance connected to a receptacle would take **without piercing a floor, wall, ceiling, or fixed barrier, or passing through a door, doorway, or window**

- Similar to existing text at **680.22(A)(5)** for receptacle measurements around permanently installed swimming pools

210.8
GFCI Protection - Measurements *(cont.)*

- Eliminates the need for GFCI protection for receptacles installed inside a cabinet *(under a sink)* as the measurement to the sink would constitute "**penetrating a cabinet door**" in order to achieve this measurement
- Compliments revisions at **210.8(A)(7)** *(dwelling units)* and **210.8(B)(5)** *(non-dwelling units)*

210.8 Measurements for GFCI Protection

GFCI protection shall be provided as required in 210.8(A) through (E) and installed in a readily accessible location

Note: This illustration could be an office break room or a dwelling unit kitchen

Outlet for disposer

Outlet for refrigerator not within 1.8 m (6 ft) of sink and does not serve countertop

When determining distance from receptacles, distance shall be measured as the “shortest path” the cord of an appliance connected to the receptacle would follow without piercing a floor, wall, ceiling, or fixed barrier, or passin through a door, doorway, or window

210.8(A)(7)
GFCI Protection at Dwelling Unit Sinks

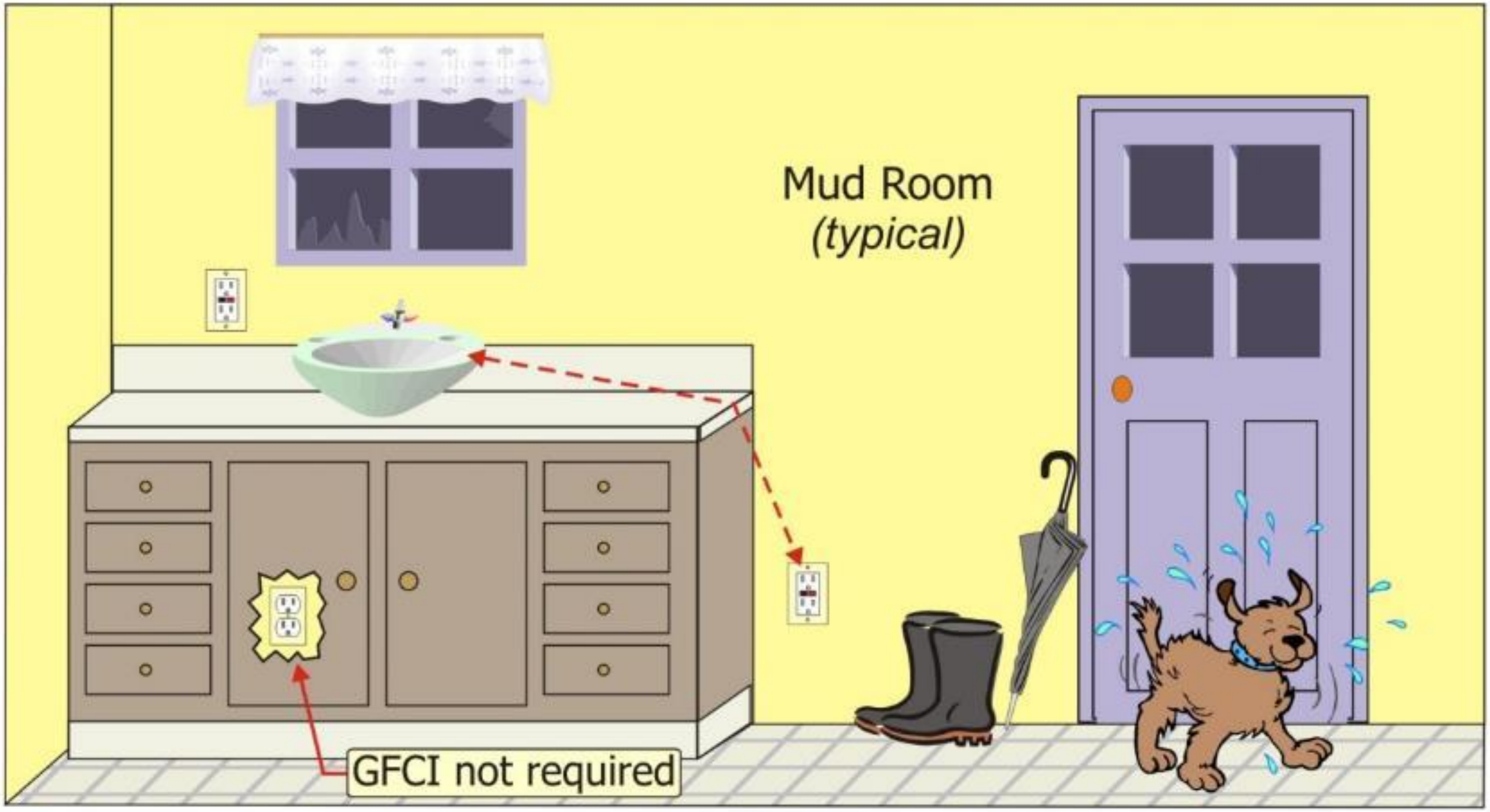
- Dwelling unit sink measurements revised for determining which receptacles require GFCI protection
- All 125-volt, single-phase, 15- and 20-ampere receptacles installed within 1.8 m (6 ft) of the “**top inside edge of the bowl**” of any dwelling unit sink *(including the kitchen sink)* require GFCI protection without the measurement piercing a floor, wall, ceiling, or fixed barrier, or passing through a door, doorway, or window
- Revision makes it clear that the measurement from the receptacle to the sink ends or begins at the “**top inside edge of the bowl**” of the sink rather than the “outside edge” of the sink *(outside edge of a sink is three dimensional)*

210.8(A)(7) *(cont.)*
GFCI Protection at Dwelling Unit Sinks

- This revision, along with addition to parent text of 210.8 will eliminate the necessity for GFCI protection for receptacles installed inside a cabinet *(such as a receptacle for the garbage disposer)* as the measurement to the sink would constitute "penetrating a cabinet door" in order to achieve this required 1.8 m (6 ft) measurement

- This same revision occurred at **210.8(B)(5)** for GFCI protection and measurements at a **non-dwelling unit sink**

210.8(A)(7) GFCI Protection at Sinks



GFCI required for all 125-volt, single-phase, 15- and 20-ampere receptacles installed within 1.8 m (6 ft) from the top inside edge of a dwelling unit sink *(laundry, utility, mud room, kitchen, wet bar, etc.)* without the measurement piercing a floor, wall, ceiling, or fixed barrier, or passing through a door, doorway, or window

Note: Same requirement at 210.8(B)(5) for non-dwelling unit sinks

210.8(B)
GFCI Protection at Other Than Dwelling Units

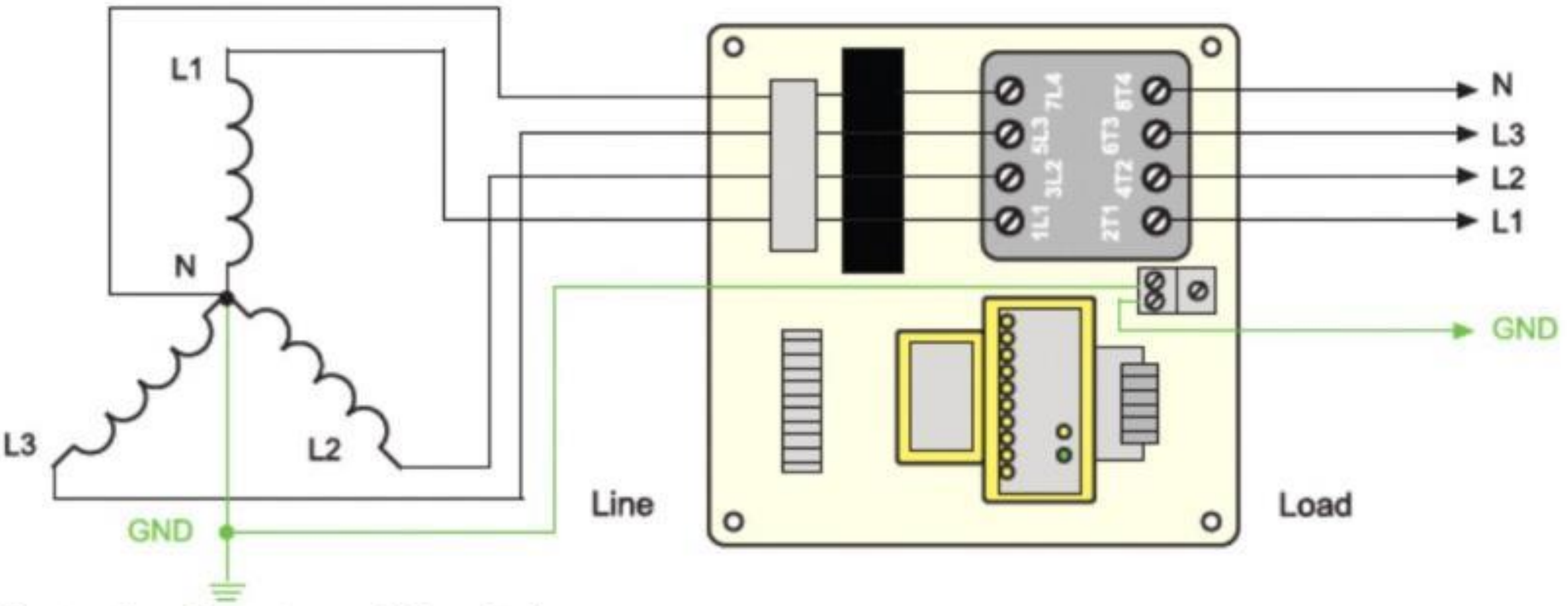
- GFCI requirements for receptacles at commercial/industrial applications have been expanded to recognize ground faults other than 15 and 20 ampere, 125 volt applications only
- Expansion includes “Other Than Dwelling Unit” receptacles for:
  - All **single-phase** receptacles rated **150 volts to ground** or less, **50 amperes** or less
  - All **three-phase** receptacles rated **150 volts to ground** or less, **100 amperes** or less
- These GFCI requirements still include coverage of 125-volt, single-phase, 15- and 20-ampere receptacles

210.8(B) *(cont.)*
GFCI Protection at Other Than Dwelling Units

- Class A GFCI devices *(4 to 6 mA)* cannot be used where the electrical equipment employs 480 or 600 volts or is a three-phase system
- Dangers and shock hazards of electrocution exist for these applications as well
- Shock hazards are not limited to 15 and 20 ampere, 125 volt receptacle alone at commercial/industrial applications
- Class C, D and E GFCI devices operate at **20 mA** or less to prevent fibrillation and require an equipment grounding conductor (EGC) in the protected circuit with an internal means within the device to **monitor EGC continuity**

210.8(B) Three-Phase GFCI Protection

Three-Phase, Four-Wire Configurations (L1, L2, L3, N)



(Illustration Courtesy of Bender)

(Other Than Dwelling Units) All single-phase receptacles rated 150 volts to ground or less, 50 amperes or less; and three-phase receptacles rated 150 volts to ground or less, 100 amperes or less, installed in specified locations shall have ground-fault circuit-interrupter protection for personnel

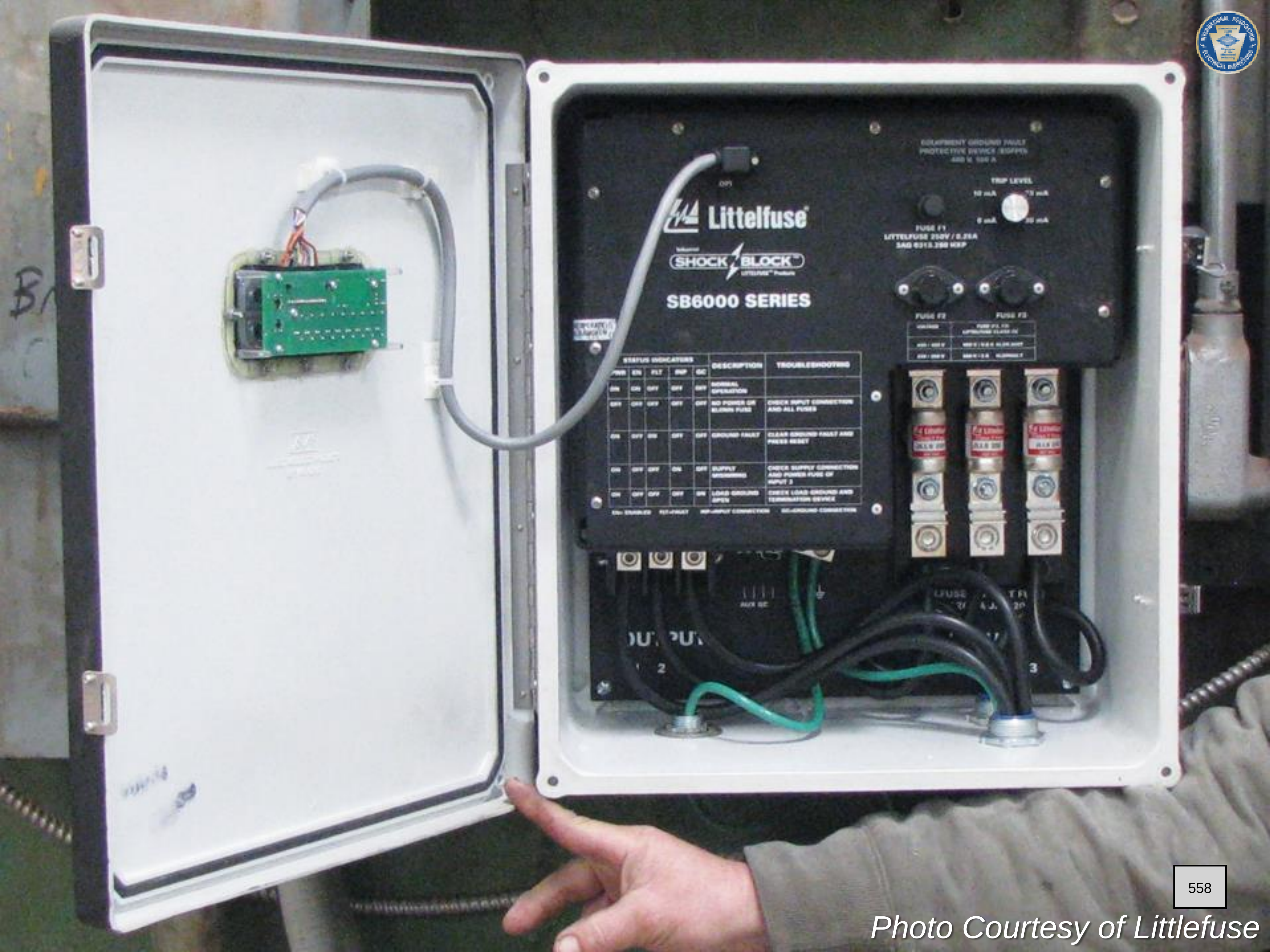


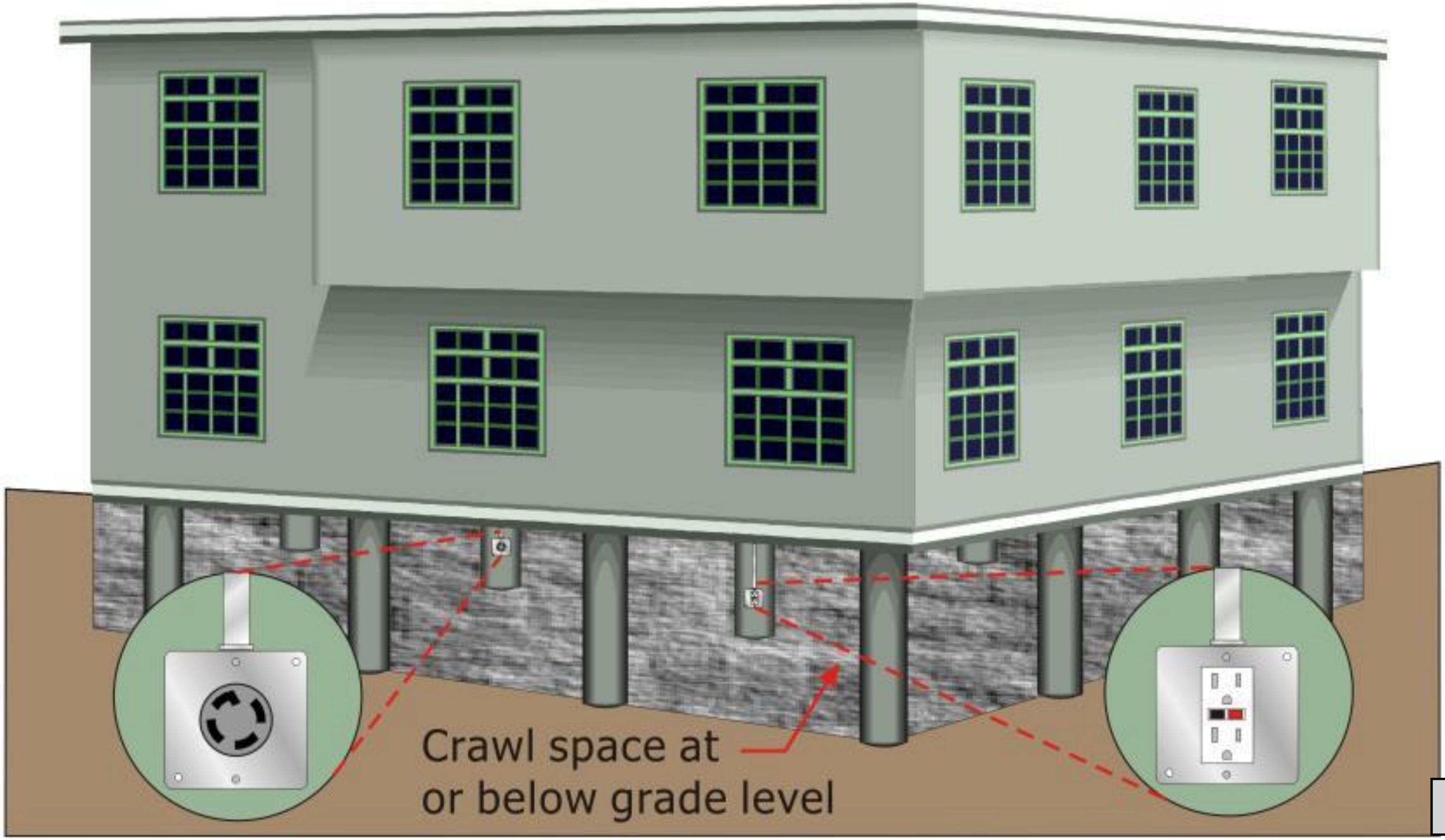
Photo Courtesy of Littlefuse

210.8(B)(9) GFCI Protection for Non-Dwelling Unit Crawl Spaces

- GFCI protection added for non-dwelling unit crawl spaces
- GFCI required for all **single-phase** receptacles rated **150 volts to ground** or less, **50 amperes** or less and **three-phase** receptacles rated **150 volts to ground** or less, **100 amperes or less**
- Similar requirements found at **210.8(A)(4)** for dwelling units
- Non-dwelling unit crawl space GFCI requirement not limited to 125-volt receptacles
- Death rate from shock hazards in crawl spaces higher than injury rate (86.7%)

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



210.8(B)(10) GFCI Protection - Non-Dwelling Unit Unfinished Basements

- GFCI protection for receptacles installed in **unfinished basements** has been expanded to include **non-dwelling unit** (commercial/industrial)
- Revisions to the parent text at 210.8(B) has expanded the receptacles involved to those that are **single-phase** rated **150 volts to ground** or less, **50 amperes or less** and **three-phase** receptacles rated **150 volts to ground** or less, **100 amperes or less**
- Similar requirements found at **210.8(A)(5)** for dwelling units
- Same shock hazards exist in an unfinished basement of a commercial building as they do in dwelling units

Unfinished non-dwelling unit basement

210.8(E) GFCI Protection - Crawl Space Lighting Outlets

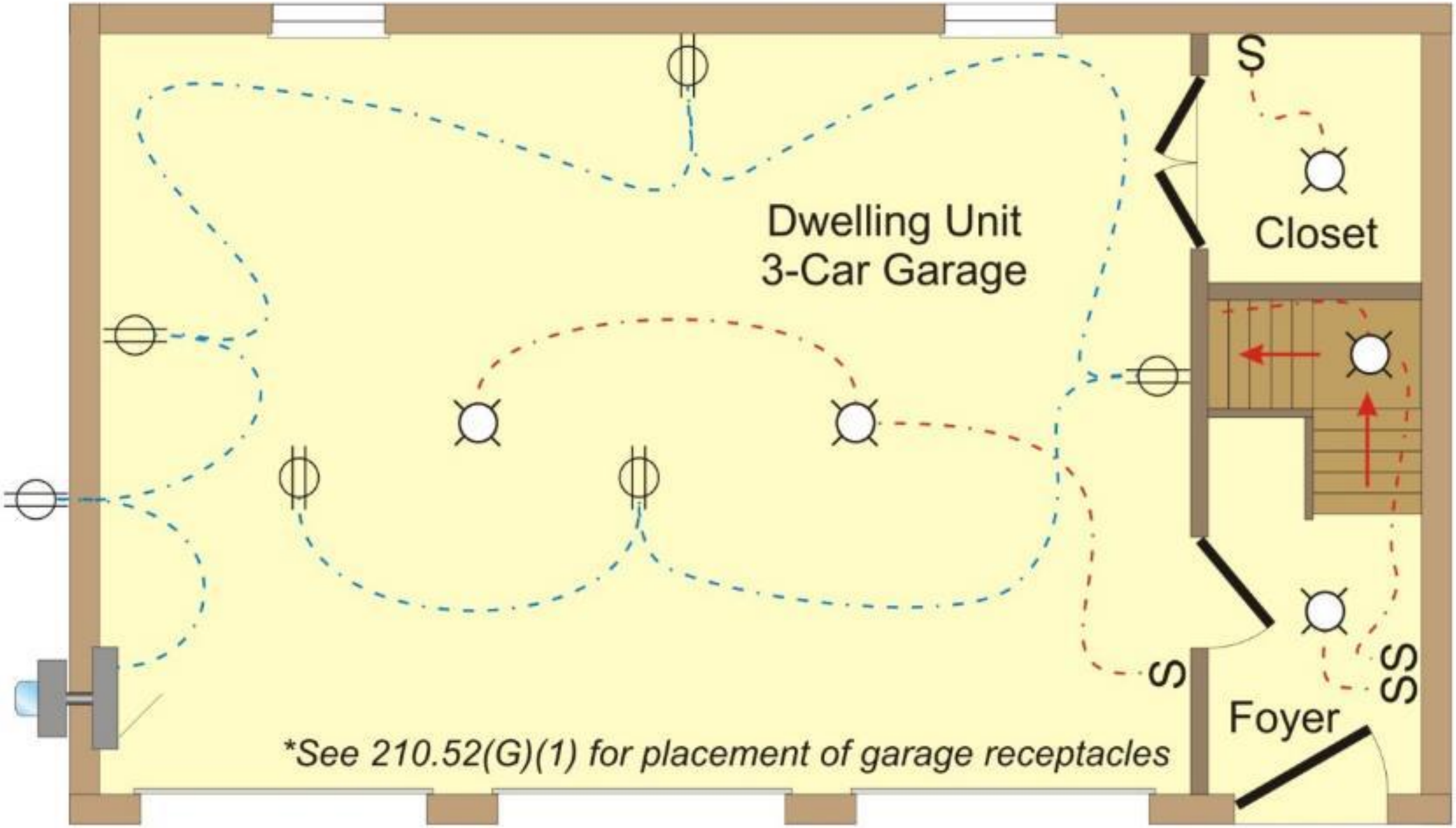
- GFCI protection is now required for **lighting outlets** not exceeding 120 volts in **crawl spaces** where the space is at or below grade level
- Applies to **all crawl spaces**, dwelling unit and non-dwelling units alike
- This new GFCI requirement for lighting outlets was predicated on a fatality of a worker in a crawl space *(broken incandescent light bulb of a keyless lampholder)*
- Numerous open-bulb keyless or pullchain lampholders installed in crawl spaces and are constantly being damaged

Lighting outlets in crawl spaces require GFCI protection

210.11(C)(4) Garage Branch Circuits

- New requirement added for minimum rated 120 volt, **20 ampere** branch circuit for dwelling unit garage receptacles
- Garage receptacle outlet branch circuit **prohibited from serving other outlets** *(see exception)*
- Exception for readily accessible receptacles located **outdoors**
- 15 ampere rated branch circuit in the modern dwelling unit garage is typically not sufficient for appliance and tools rated at 12 to 16 amperes
- Lighting outlets in the dwelling unit garage required to be supplied by general lighting circuits

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



**See 210.52(G)(1) for placement of garage receptacles*

At least one 120-volt, 20-ampere branch circuit shall be installed to supply receptacle outlets in dwelling unit garages (no other outlets)

Exception permits supply of readily accessible outdoor receptacle outlets

210.12(C) AFCI Protection for Guest Rooms and Guest Suites

- New provisions added requiring **AFCI protection** for **guest rooms** and **guest suites** of hotels and motels
- All 120-volt, single-phase, 15- and 20-ampere branch circuits supplying outlets and devices installed in guest rooms and guest suites of hotels and motels require AFCI protection
- Previous *Code* called for AFCI Protection if “permanent provisions for cooking” were present *(see 210.18, now 210.17)*
- Same AFCI protection deserved while occupying a hotel room as afforded at a dwelling unit
- AFCI protection plays an important role in protecting property and the lives of personnel

210.12(C) AFCI Protection for Guest Rooms and Guest Suites of Hotels and Motels

All 120-volt, single-phase, 15- and 20-ampere branch circuits supplying outlets and devices installed in guest rooms and guest suites of hotels and motels shall be provided with AFCI protection

~~210.17~~ 625.40

Electric Vehicle Branch Circuit

- The requirement for an **individual branch circuit** for **electric vehicle outlets** has been relocated from 210.17 to 625.40
- Previous requirement for a “separate” branch circuit was changed to an “individual” branch circuit *(separate branch circuit not defined anywhere in the Code)*
- Each individual circuit for an EV outlet shall have no other outlets
- There is still no requirement for an outlet to be installed specifically for the purpose of charging of an electric vehicle
- Ensures EV charging can be completed safely and effectively without overloading an existing branch circuit


PLUG – IN VEHICLE ONLY
Offered By:
The City of West Palm Beach
Office of Sustainability
Rethinking Paradise for a Green City
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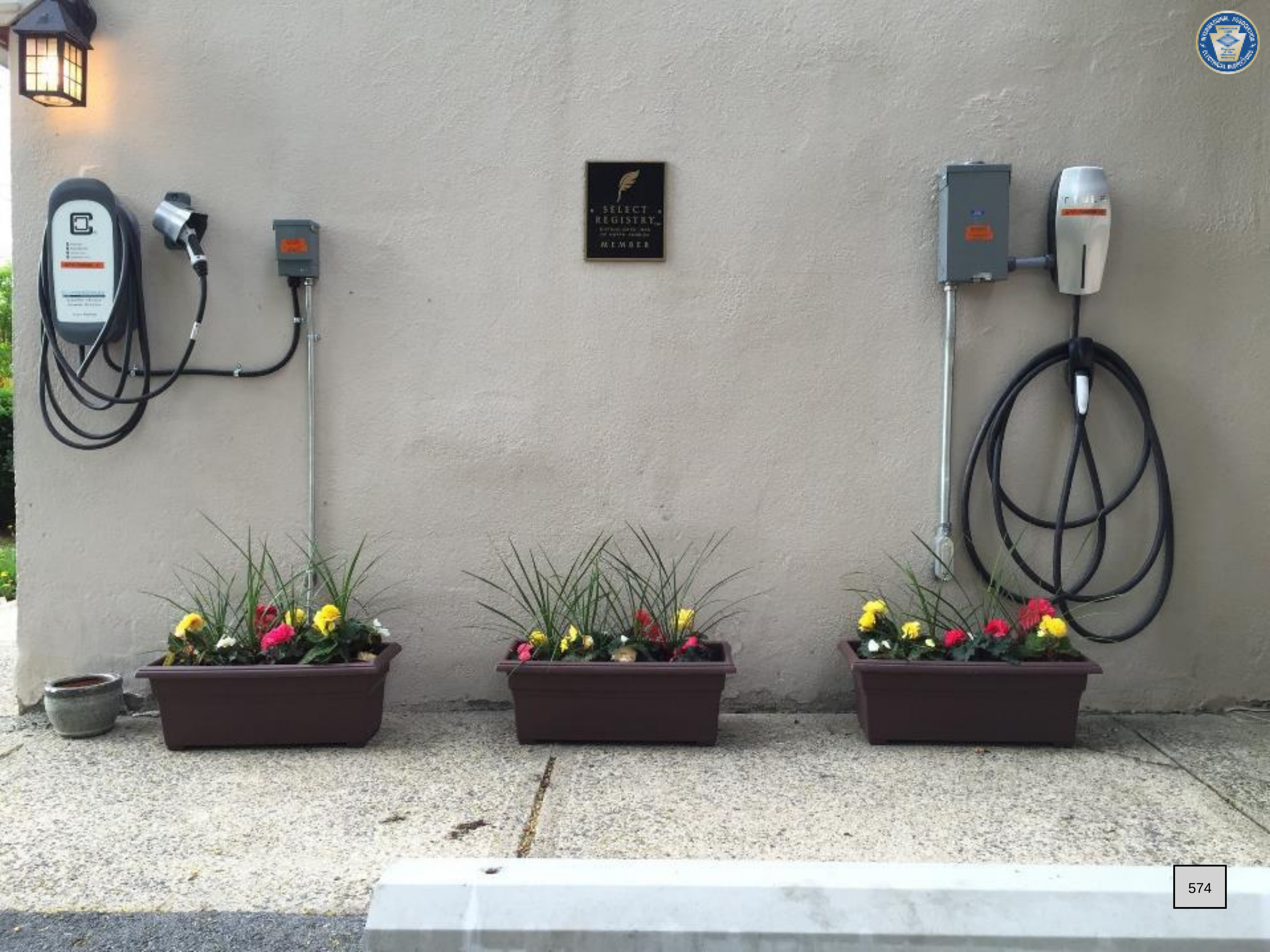
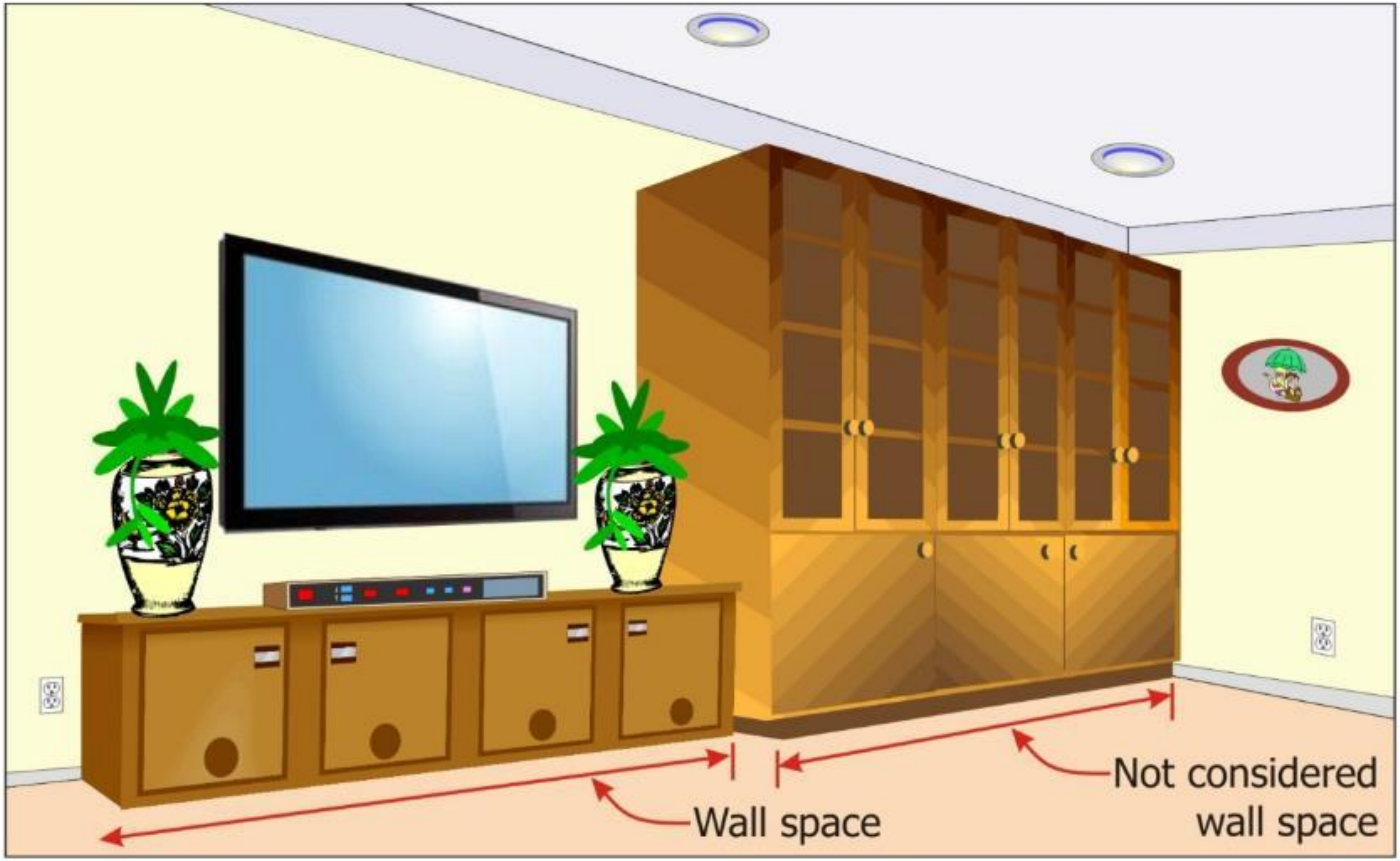
Rethinking Paradise for a Green City
GING STATION
VEHICLE
RECHARGING STATION
ELECTRIC VEHICLE


SELECT
REGISTRY
MEMBER

210.52(A)(2)(1) Receptacle Wall Space

- Fixed cabinets **“that do not have countertops or similar work surfaces”** were added as an item that will constitute a **break in a wall space** for receptacle spacing reasons at dwelling units
- Separates “fixed cabinets” such as kitchen pantry-type cabinets *(but not limited to kitchen cabinets)* that do not have countertops or similar work surfaces from short desk-type cabinets with countertops that are clearly intended as work surfaces
- This change will ensure that receptacle outlets are required and installed for such things as laptop computers, printers, televisions, etc.

210.52(A)(2)(1) Receptacle Wall Space

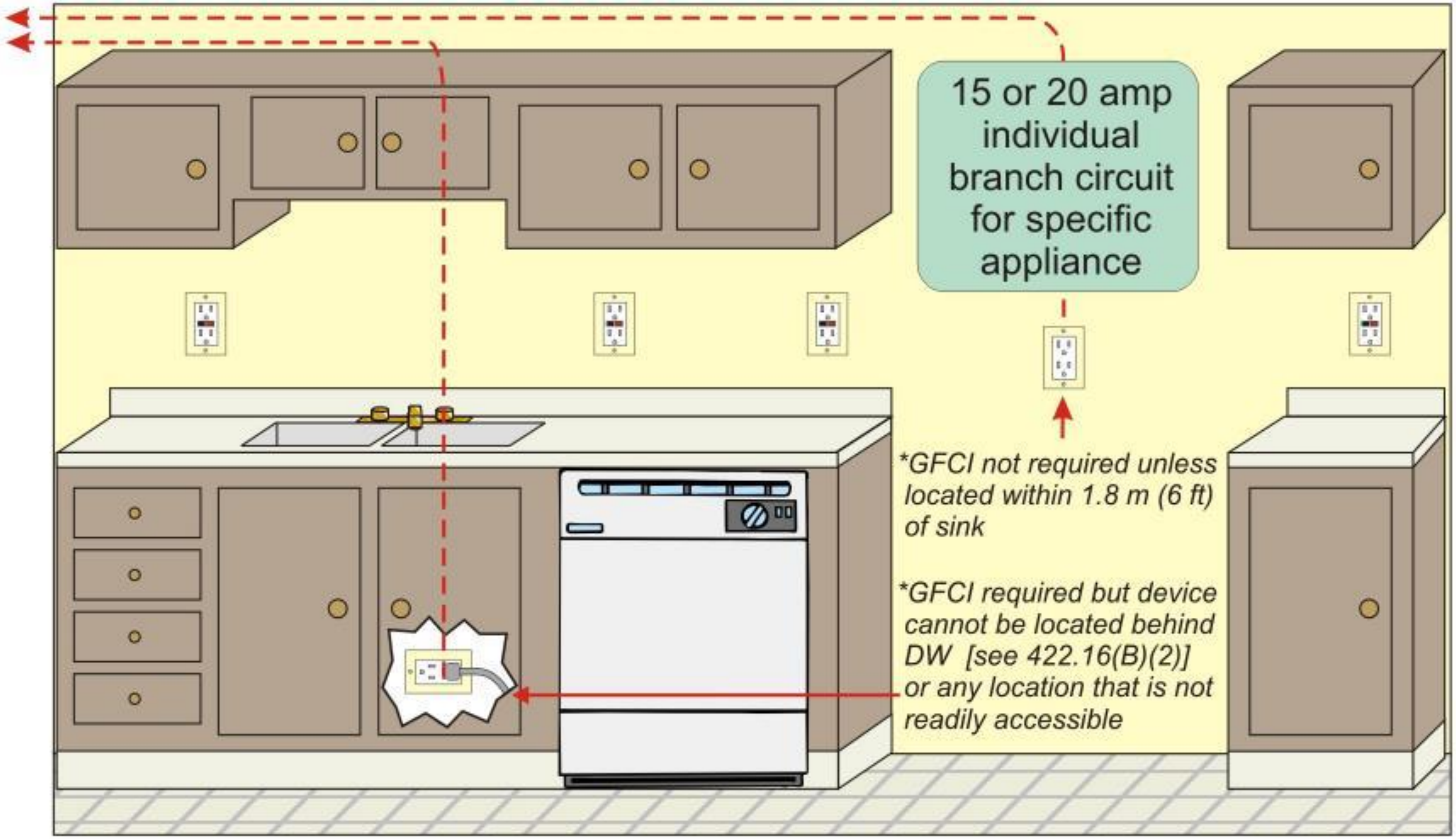


Any space 600 mm (2 ft) or more in width and unbroken along the floor line by doorways and similar openings, fireplaces, and fixed cabinets that do not have countertops or similar work surfaces

210.52(B)(1) Ex. No. 2
~~Refrigerator~~ Appliance Branch Circuit

- Any dwelling unit **kitchen appliance** is now permitted *(by the exception)* to be supplied by an individual branch circuit rated **15 amperes or greater**
- 210.52(B)(1) requires receptacle outlet serving the **refrigeration equipment** be supplied from one of the 20-ampere rated small-appliance branch circuits
- Previous exception allowed refrigerator to be supplied by an individual branch circuit rated 15 amperes or greater *(why just refrigerator?)*
- Revised exception will now allow an individual branch circuit 15 amperes or greater for kitchen appliances such as **garbage disposal**, **dishwasher**, or permanently installed **microwave**

210.52(B)(1) Ex. No 2 Appliance Branch Circuit



15 or 20 amp individual branch circuit for specific appliance

**GFCI not required unless located within 1.8 m (6 ft) of sink*

**GFCI required but device cannot be located behind DW [see 422.16(B)(2)] or any location that is not readily accessible*

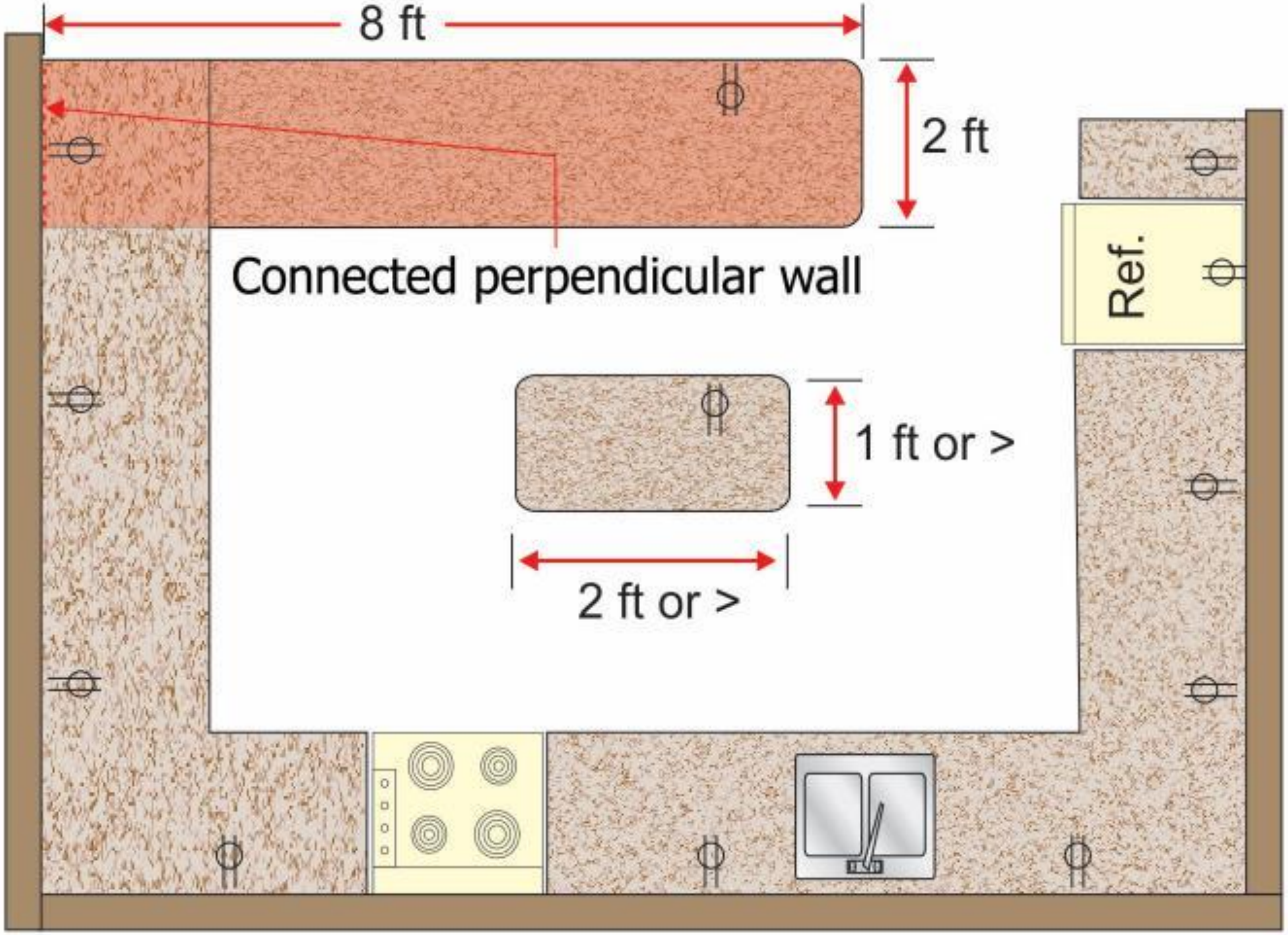
Refrigeration equipment generally required to be served by one of the two or more 20-ampere small-appliance branch circuits

The receptacle outlet for any specific appliance is permitted to be supplied from an individual branch circuit rated 15 amperes or greater

210.52(C)(3) Peninsula Countertop Space

- At least one receptacle outlet is required **at each peninsular countertop long dimension space** with a long dimension of 600 mm (24 in.) or greater and a short dimension of 300 mm (12 in.) or greater
- This measurement must now be taken from the "**connected perpendicular wall**"
- Previously when measured from the **connecting edge** rather than the wall, at least one receptacle outlet was located somewhere at or on the peninsular countertop itself

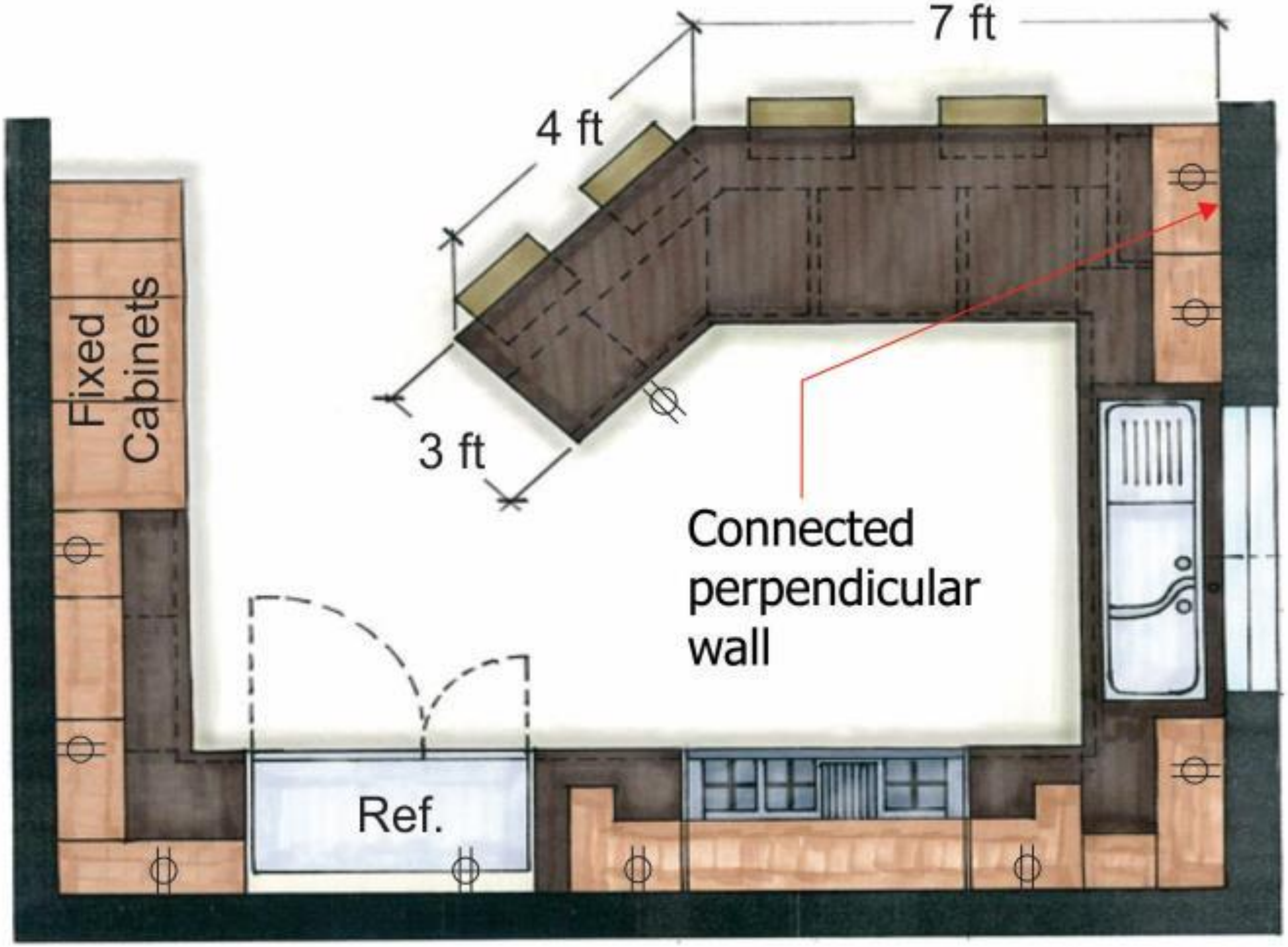
210.52(C)(3) Peninsular Countertop Spaces



At least one receptacle outlet to be installed at each peninsular countertop long dimension space with a long dimension of 600 mm (24 in.) or greater and a short dimension of 300 mm (12 in.) or greater

Measurements to be measured from the "connected perpendicular wall"

210.52(C)(3) Peninsular Countertop Spaces



Connected perpendicular wall

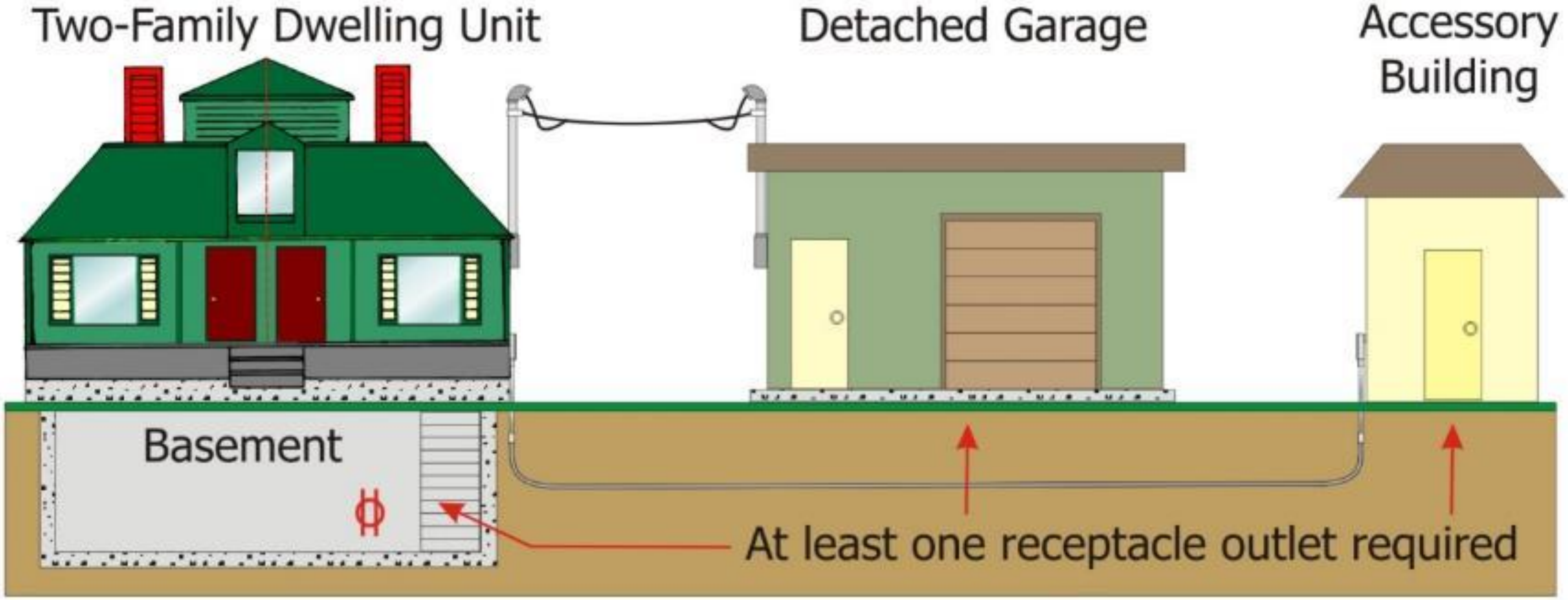
At least one receptacle outlet to be installed at each peninsular countertop long dimension space with a long dimension of 600 mm (24 in.) or greater and a short dimension of 300 mm (12 in.) or greater

Measurements to be measured from the "connected perpendicular wall"

210.52(G) Receptacles for Basements, Garages, and Accessory Buildings

- Receptacle requirements for dwelling unit garages, basements, and accessory buildings expanded to **two-family dwellings** *(not just one-family dwellings)*
- **At least one receptacle outlet** is required to be installed in each attached garage and detached garage with electric power, each separate unfinished portion of a basement, and each accessory building with electric power
- Same level of electrical safety has been extended to two-family dwellings as it has been for one-family dwellings *(potential of a hazard the same at both)*
- Helps elimination of resorting to running extension cords as a substitute for permanent wiring in these specified areas if no receptacle outlet were present

210.52(G) Receptacle for Basements, Garages, and Accessory Buildings



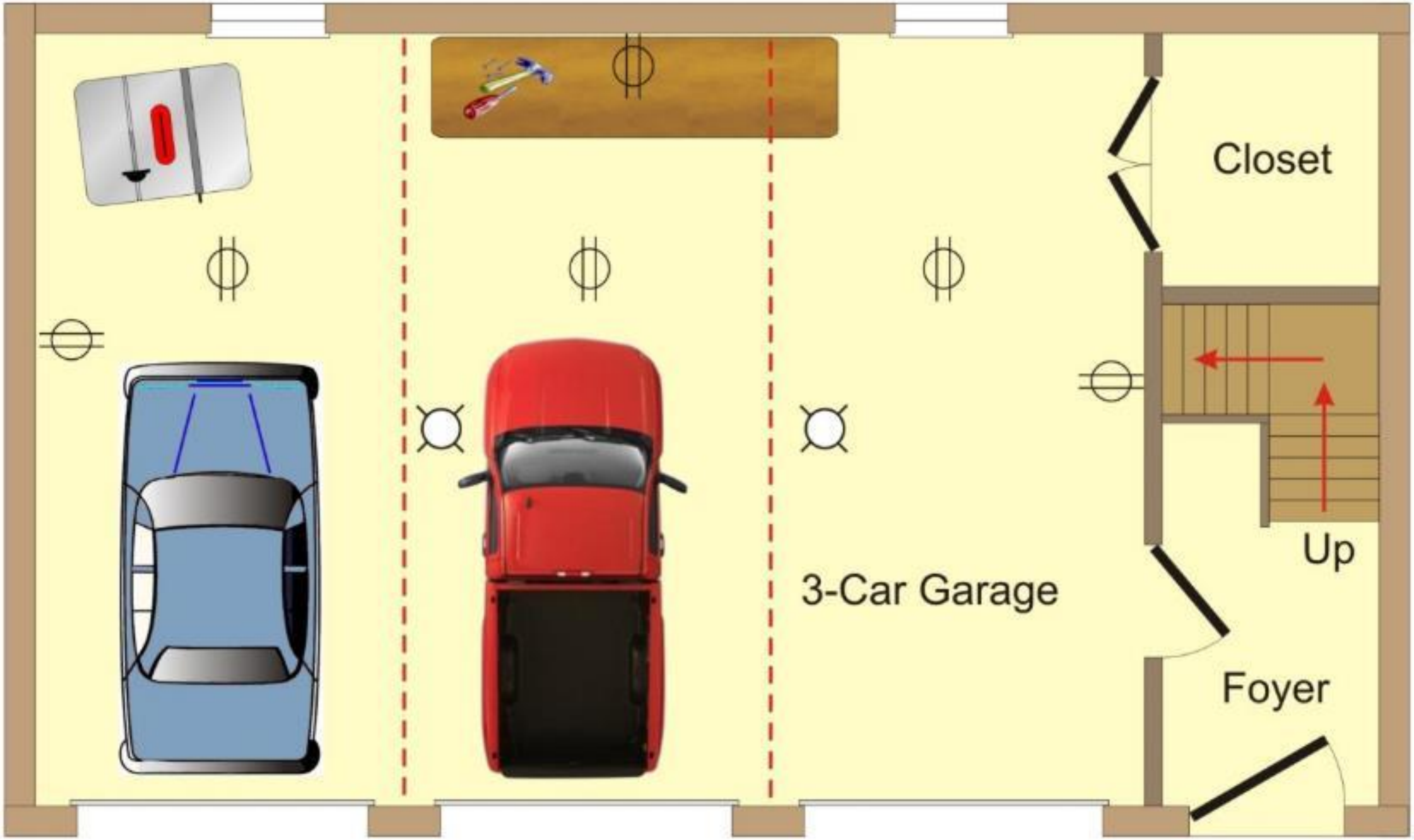
At one- and two-family dwellings, at least one 125-volt, 15- or 20-ampere receptacle outlet, in addition to those for specific equipment, shall be installed in areas specified below:

- Attached garages and in each detached garage with electric power
- Accessory buildings with electric power
- Unfinished basements - each seperate portion of the basement

210.52(G)(1) Dwelling Unit Garages

- At least one receptacle outlet is required to be installed "**in each vehicle bay**" and not more than **1.7 m (5½ ft)** above the floor
- Applies to each attached garage and in each detached garage with electric power
- Branch circuit supplying these receptacle(s) **cannot serve outlets outside of the garage** *(with the exception of readily accessible receptacles located outdoors)*
- Helps address increased activities within a modern day dwelling unit garages *[such as the possibility of the existence of electric vehicle (EV) charging equipment]*

210.52(G)(1) Dwelling Unit Garages



In each attached garage and in each detached garage with electric power, at least one receptacle outlet is required to be installed "in each vehicle bay and not more than 1.7 m (5½ ft) above the floor"

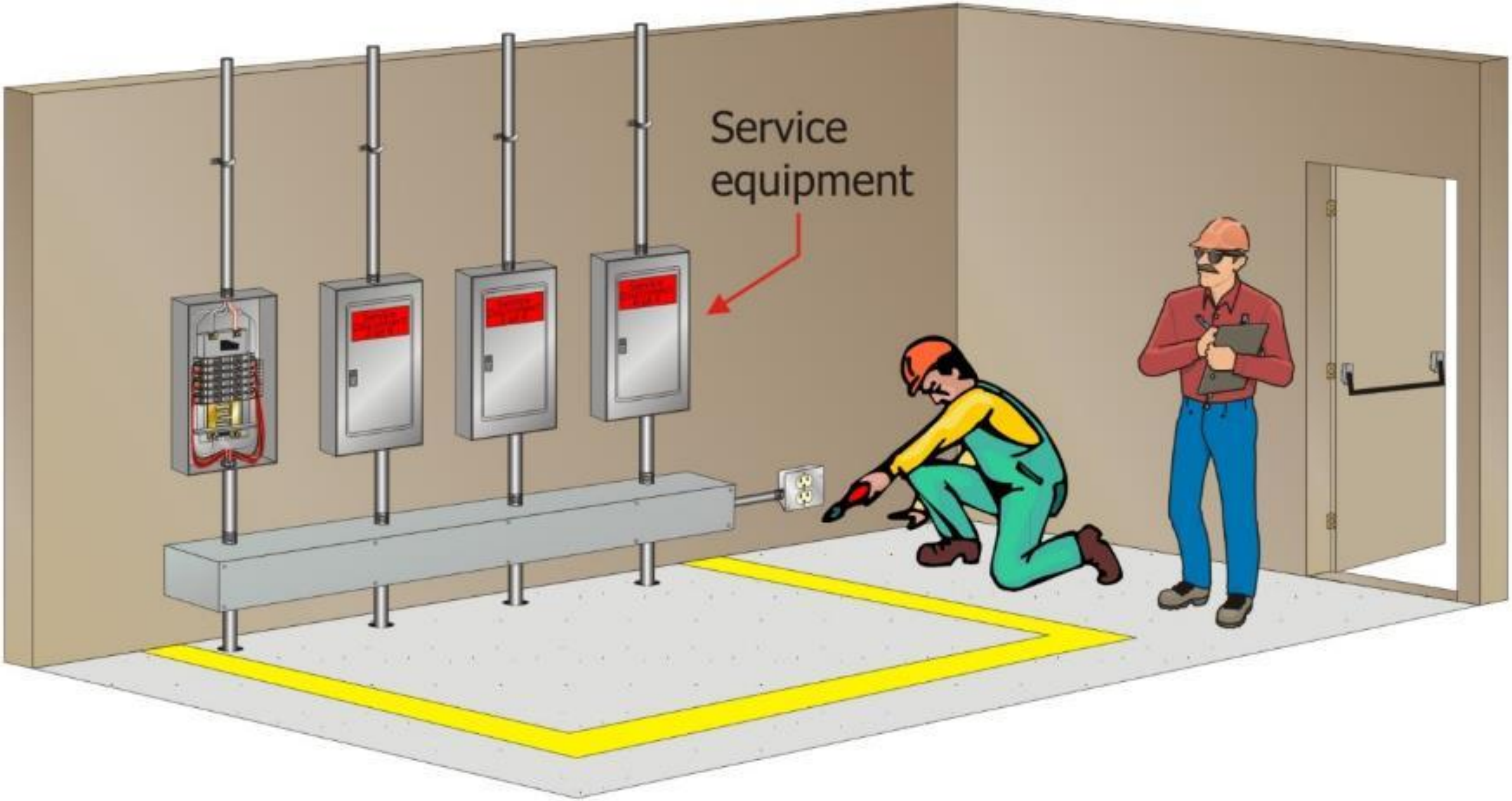
Note: *See 210.11(C)(4) for garage branch circuit requirements*


1
2
3
4

210.64 Electric Service Areas

- At least one 125-volt, single-phase, 15- or 20-ampere-rated receptacle outlet is still required to be installed at the electrical service equipment
- Maximum distance required receptacle outlet(s) can be located from the electrical service has been shortened to **7.5 m (25 ft)** and limited to **indoor service equipment only**
- This required receptacle outlet(s) is now required to be installed in an accessible location and **must be located within the same room or area** as the service equipment
- Does not apply to one- and two-family dwellings
- **New exception** added exempting services dedicated to equipment covered in **Articles 675 and 682** when the service voltage is **greater than 120 volts to ground**

210.64 Receptacle at Electrical Service Areas



At least one 125-volt, single-phase, 15- or 20-ampere-rated receptacle outlet shall be installed in an accessible location within 7.5 m (25 ft) of all indoor electrical service equipment and located within the same room or area as the service equipment *(other than one- and two-family dwellings)*

Exception added for service areas covered in Articles 675 and 682

210.64 Receptacle at Electrical Service Areas

Article 682 Natural and Artificially Made Bodies of Water

Article 675 Electrically Driven or Controlled Irrigation Machines

At least one 125-volt, single-phase, 15- or 20-ampere-rated receptacle outlet shall be installed in an accessible location within 7.5 m (25 ft) of all indoor electrical service equipment and located within the same room or area

Exception added for services dedicated to equipment covered in Articles 675 and 682 when the service voltage is greater than 120 volts to ground

210.70(C) Lighting Outlets Required (All Occupancies)

- Lighting outlet requirements for storage or equipment spaces added for **non-dwelling unit utility rooms and basements**
- Title changed from “Other Than Dwelling Units” to “**All Occupancies**”
- Revised to mirror *Code* text at 210.70(A)(3) for dwelling units
- This lighting outlet requirement for storage or equipment spaces now applies to both dwelling and non-dwelling unit locations such as:
  - attics
  - underfloor spaces
  - utility rooms and
  - basements

210.70(C) Lighting Outlet(s) All Occupancies

At non-dwelling unit attics, underfloor spaces, utility rooms, and basements, at least one lighting outlet containing a switch or controlled by a wall switch must be installed where these spaces are used for storage or contain equipment requiring servicing *[See 210.70(A)(3) for dwelling units]*

At least one switch to be located at the "usual point of entry" to space with lighting outlet(s) located "at or near the equipment requiring servicing"

210.71 Receptacles for Meeting Rooms

- New provisions added for **receptacle outlets placement** and **wall spacing requirements** in **non-dwelling unit meeting rooms** such as found at hotels and convention centers
  - *Examples of rooms that are **not** meeting rooms include auditoriums, schoolrooms, and coffee shops*
- No previous *Code* requirement to provide receptacle outlets in meeting rooms of commercial or non-dwelling occupancies
- 125-volt, 15- or 20-ampere receptacle outlets installed in meeting rooms were due in part to building owners and designers recognize the need for access to electrical power for a multitude of different types of portable equipment

210.71 Meeting Rooms *(cont.)*

- 210.71(A) General
  - Each meeting room of **not more than 93 m2 (1000 ft^2)** in other than dwelling units shall have outlets for nonlocking-type, 125-volt, 15- or 20-ampere receptacles
  - Outlets to be installed in accordance with **210.71(B)** *(see next slide)*
  - Where a room or space is provided with **movable partition(s)**, each room size shall be determined with the partition in the position that results in the **smallest size meeting room**

210.71 Meeting Rooms *(cont.)*

- 210.71(B) Receptacle Outlets Required
  - Total number of receptacle outlets, including floor outlets and receptacle outlets in fixed furniture, shall not be less than as determined by **210.71(B)(1) and (2)** *(see next slide)*
  - These receptacle outlets shall be permitted to be located as determined by the designer or building owner

210.71 Meeting Rooms *(cont.)*

- 210.71(B) Receptacle Outlets Required *(cont.)*
  - (1) Receptacle Outlets in Fixed Walls
    - Receptacle outlets shall be installed in accordance with **210.52(A)(1) through (A)(4)**
  - (2) Floor Receptacle Outlets
    - Meeting rooms that are at least 3.7 m **(12 ft) wide** and that has a floor area of at least 20 m^2 **(215 ft^2)** shall have at least **one receptacle outlet located in the floor** at a distance not less than 1.8 m **(6 ft)** from any fixed wall for each 20 m^2 (215 ft^2) or major portion of floor space


ANALYSIS OF CHANGES – 2014 NEC
INTERNATIONAL ASSOCIATION
ELECTRICAL INSPECTORS

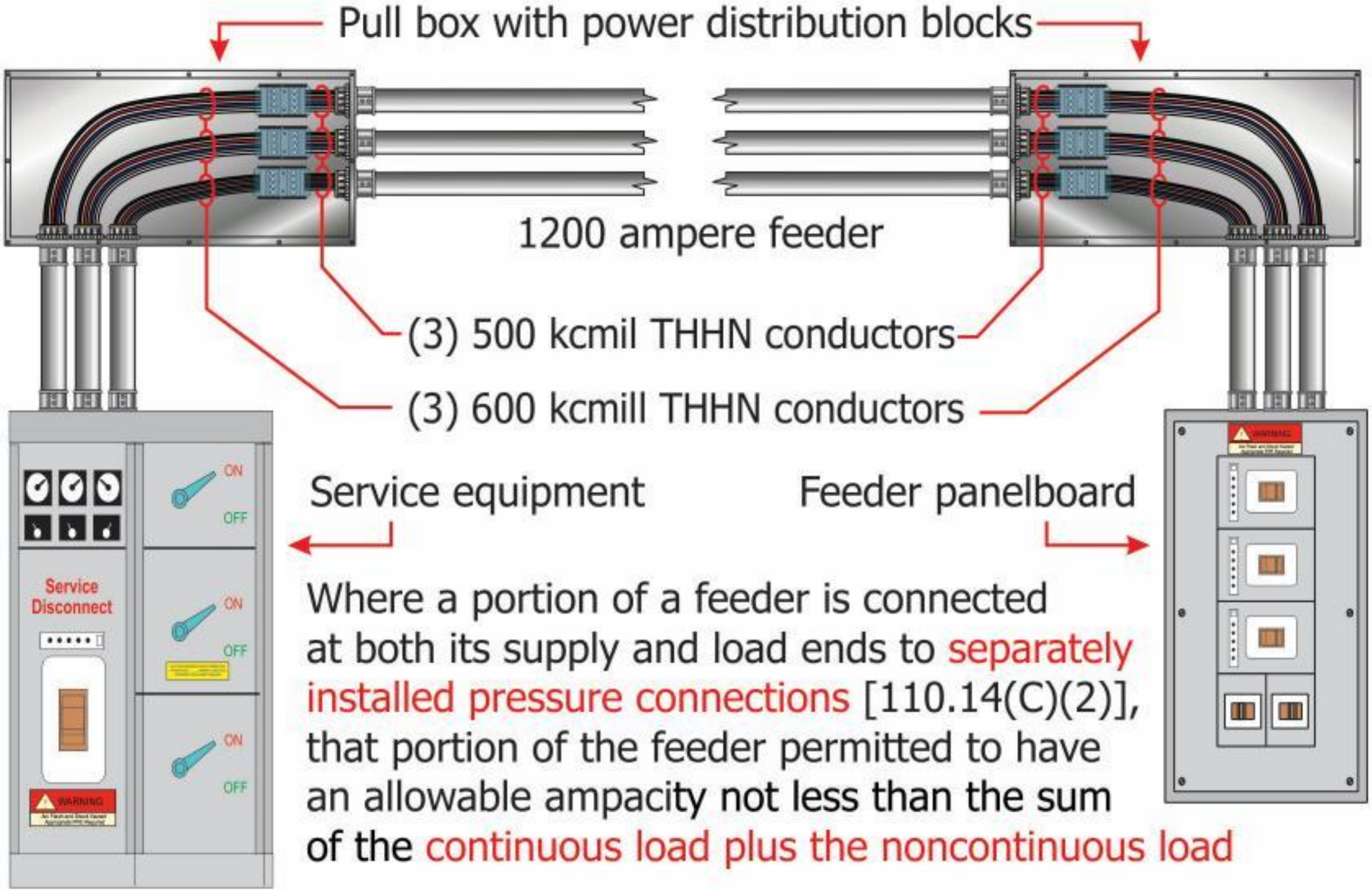
215.2(A)(1)(a) Ex. No. 2
Feeder Rating and Size

- **New exception** added that allows a portion of a feeder that is connected at both its supply and load ends to **separately installed pressure connections** to have an allowable ampacity **not less than the sum of the continuous load plus the noncontinuous load** *(rather than the noncontinuous load plus 125 percent of the continuous load)*

- The previous exceptions that appeared after 215.2(A)(1)(b) have been relocated to appear after 215.2(A)(1)(a)

- Makes it clear that these exceptions apply to the main rule that feeder conductors must have an allowable ampacity of not less than the noncontinuous load plus 125 percent of the continuous load

215.2(A)(1)(a) Ex. No. 2 Feeder Rating and Size



Pull box with power distribution blocks

1200 ampere feeder

(3) 500 kcmil THHN conductors

(3) 600 kcmill THHN conductors

Service equipment

Feeder panelboard

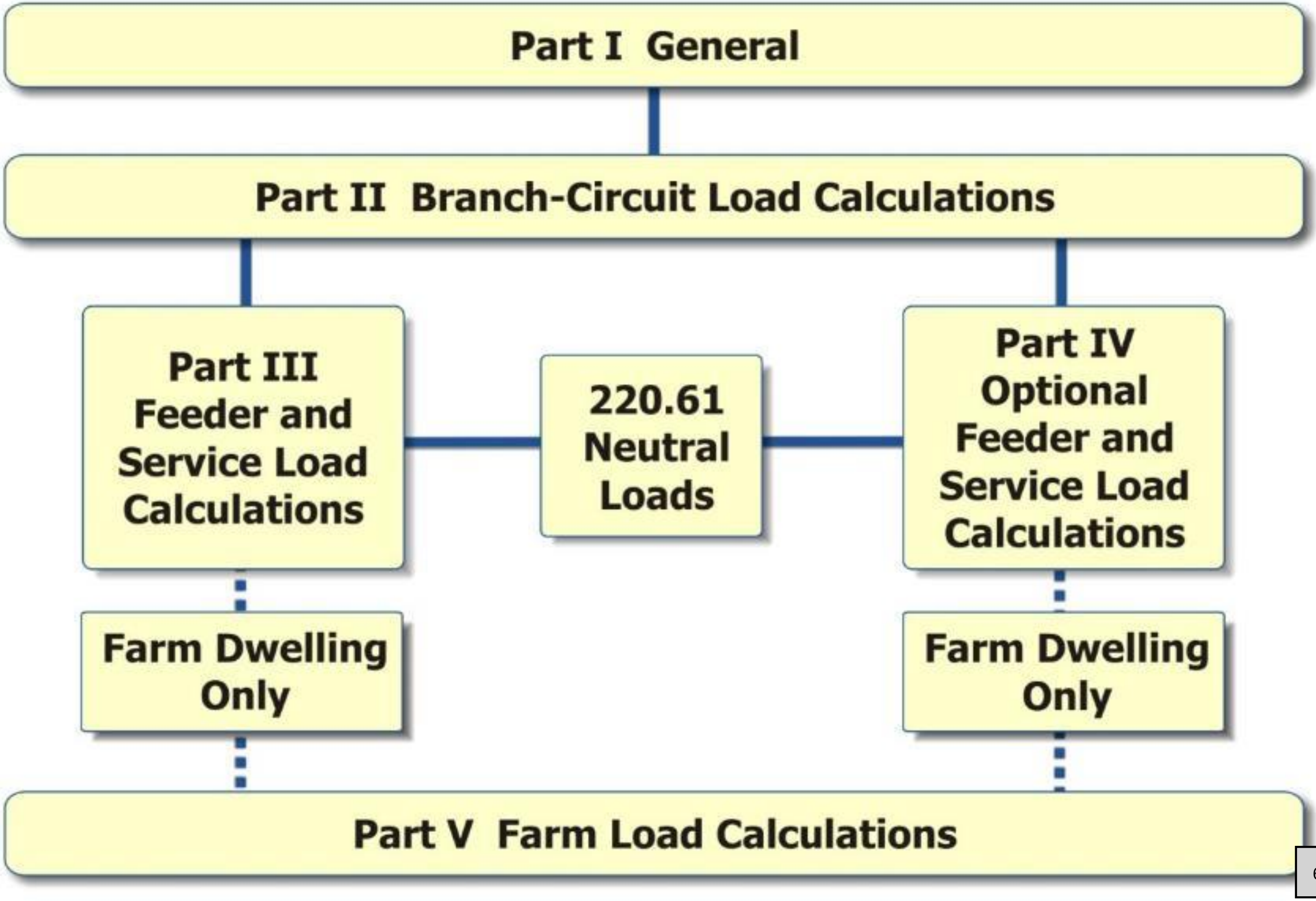
Where a portion of a feeder is connected at both its supply and load ends to separately installed pressure connections [110.14(C)(2)], that portion of the feeder permitted to have an allowable ampacity not less than the sum of the continuous load plus the noncontinuous load

No portion of a feeder installed under the provisions of this exception shall extend into an enclosure containing either the feeder supply or the feeder load terminations, as covered in 110.14(C)(1)

Article 220 and 220.1 Branch-Circuit, Feeder, and Service Load Calculations

- Title and Scope of Article 220 were revised to enhance clarity of what is covered by Article 220
- The word **“Load”** was added to the title of the article and the word **“loads”** was added a couple of times in the scope
- Revisions make it clear that the place for calculating loads is Article 220
- Place for determining branch circuit and feeder conductor sizes are Articles 210 and 215

Article 220 Branch-Circuit, Feeder, and Service Load Calculations



Part I General

Part II Branch-Circuit Load Calculations

Part III Feeder and Service Load Calculations

220.61 Neutral Loads

Part IV Optional Feeder and Service Load Calculations

Farm Dwelling Only

Farm Dwelling Only

Part V Farm Load Calculations

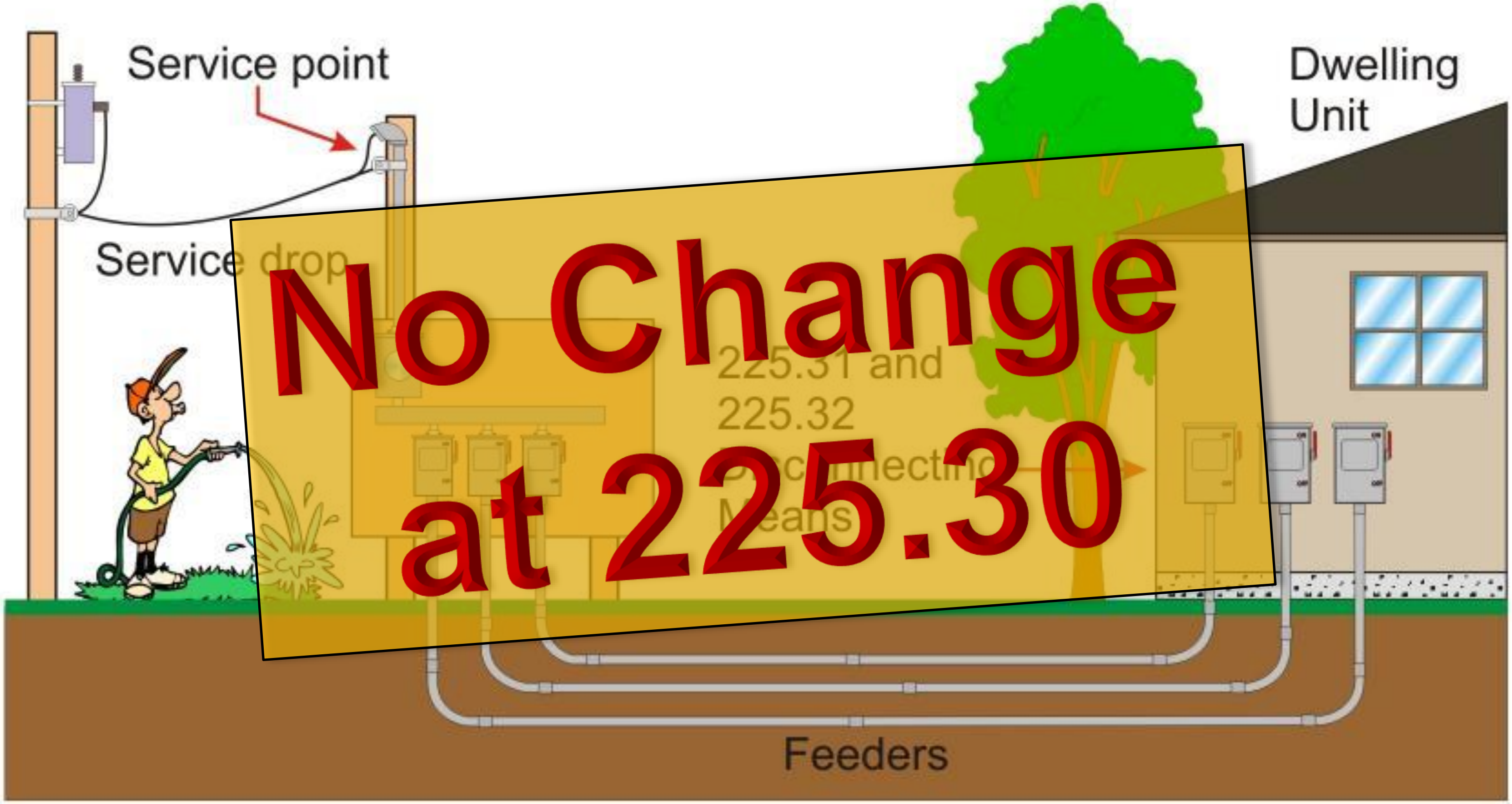
225.30(F) Number of Supplies (Feeders)

- **Multiple feeders** are now allowed to enter a one- or two-family dwelling under certain restrictions including that the feeder disconnects at the building served **must be grouped**
- **This 2017 *NEC* change was overturned as it did not pass written ballot resulting from Certified Amending Motion (CAM) 70-3**
- **This failed ballot resulted in returning the *Code* language at 225.30 to the 2014 *NEC Code* language**

No Change at 225.30

225.30(F) Number of Supplies (Feeders)

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



No Change at 225.30

Multiple feeders are now allowed to enter a one- or two-family dwellings under certain restrictions that include the feeder disconnects at the building served must be grouped

230.24(B)(5) Vertical Clearance for Overhead Service Conductors

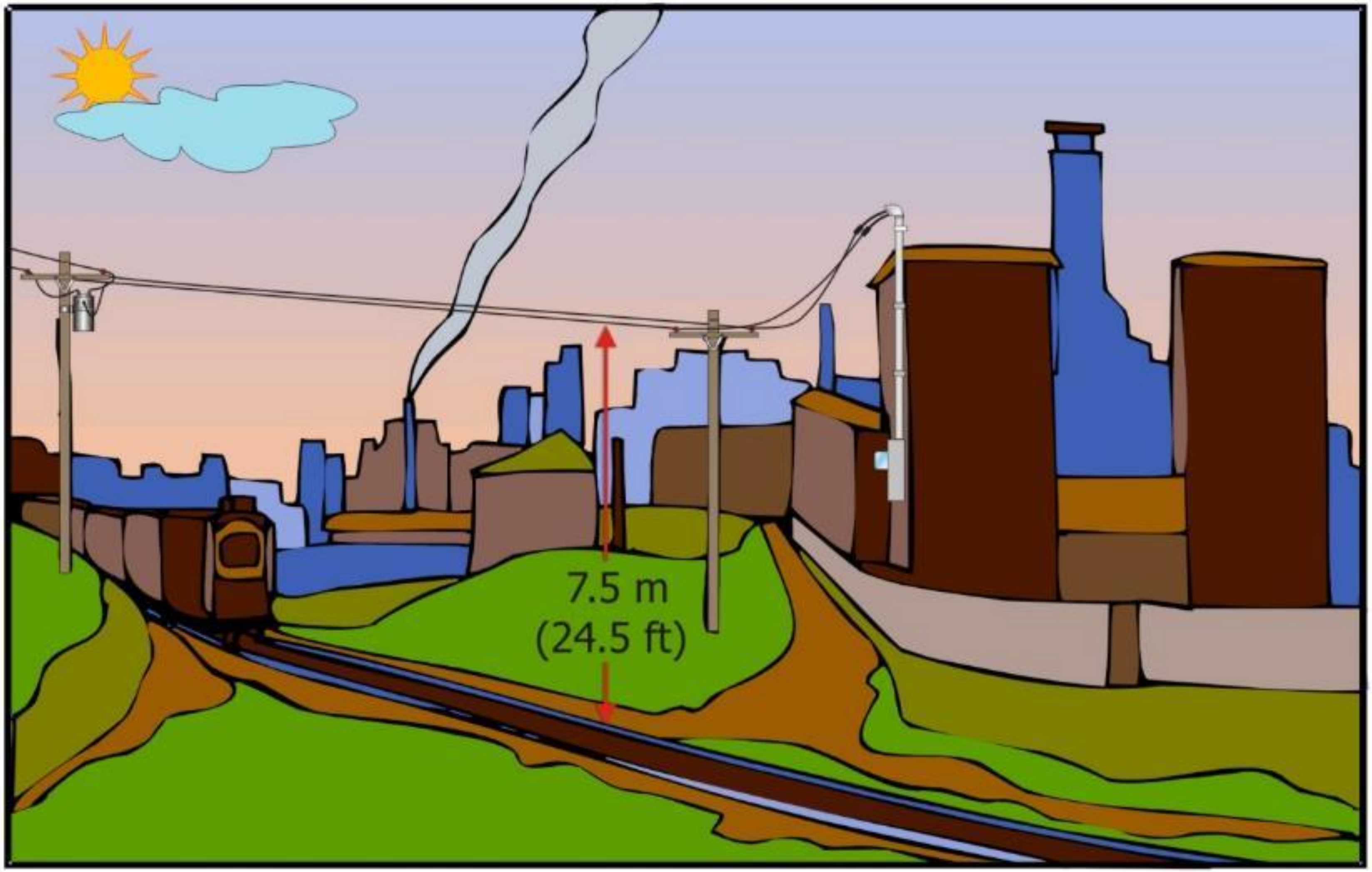
- New vertical clearance of **7.5 m (24.5 ft)** added for overhead service conductors installed **over railroad tracks**

- Coordinates with the same requirement for outside overhead branch circuits and feeders in Article 225 *(see 225.18)*

- Vertical clearance requirements for overhead service conductors should be at least equal to the same requirements for outside overhead branch circuits and feeders

- 7.5 m (24.5 ft) clearance requirement is derived from and matches vertical clearance requirements found in ANSI Standard C2, ***National Electrical Safety Code (NESC)***

230.24(B)(5) Clearance for Overhead Service Conductors



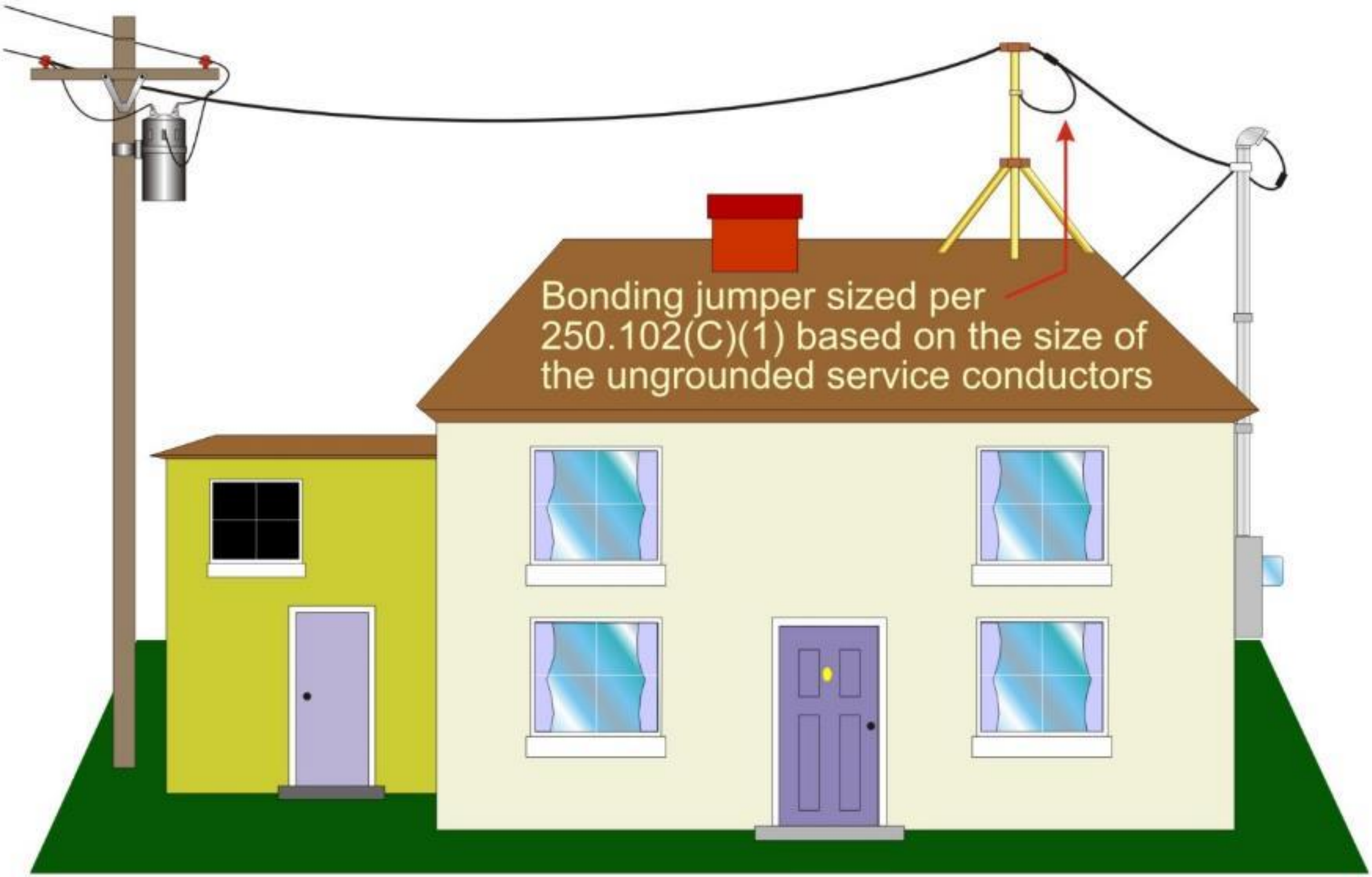
Overhead service conductors (not over 600 volts) shall have a minimum clearance from track rails of a railroad of not less than 7.5 m (24.5 ft)


SRCX
4017
BNSF
408120

230.29 Supports Over Buildings

- **Metal support structures** that support overhead service conductors installed over a roof are now **required to be bonded** to the grounded overhead service conductor
- These metal structures, sometimes referred to as a "**roof jack**" in the field, should be adequately bonded to limit a potential shock hazard
- The bonding jumper used to accomplish this bonding is to be sized per the requirements of **250.102** and **Table 250.102(C)(1)**
- This is based on the size of the ungrounded service conductors
- Similar to bonding requirements for bonding of ferrous metallic raceways used to chase or enclose a grounding electrode conductor *[see 250.64(E)]*

230.29 Supports Over Buildings



Bonding jumper sized per 250.102(C)(1) based on the size of the ungrounded service conductors

Metal support structures supporting overhead service conductors passing over a roof required to be bonded to grounded overhead service conducto

Table 240.6(A) Standard Ampere Rating

- Standard ampere ratings for fuses and inverse time circuit breakers have been revised to be included in a **list format** located at **new Table 240.6(A)**
- Revision to "list format" style has a long precedence in the *NEC*
- Converting a long list of items that were previously in long sentences or paragraphs to a "list format" is one way to accomplish this goal
- This change makes the *Code* more "user friendly"

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)

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			

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 ratings shall be permitted

240.67 Arc Energy Reduction

- New arc energy reduction requirements have been added for **fuses rated 1200 amperes or higher**
- Benefits of an **arc energy reduction** requirement that reduces incident energy for circuit breakers rated 1200 amperes and greater have been recognized and implemented by the requirements at **240.87**
- Arc energy reduction is designed to limit the arc-flash energy to which an electrical worker or maintenance personnel could be exposed
- Applies when working on the load side of an overcurrent devices rated or can be adjusted to **1200 amperes or higher**

240.67 Arc Energy Reduction *(cont.)*

- The **incident energy** in an arcing event is directly proportional to the time frame for such an event
- Installation requirements of **240.87 for circuit breakers** and these new requirements at **240.67 for fuses** provide a means to reduce the level of incident energy
- This has a future effective date of **January 1, 2020**

240.67 Arc Energy Reduction

Where fuses rated 1200 amperes or higher are installed, 240.67(A) and (B) shall apply

This requirement shall become effective January 1, 2020

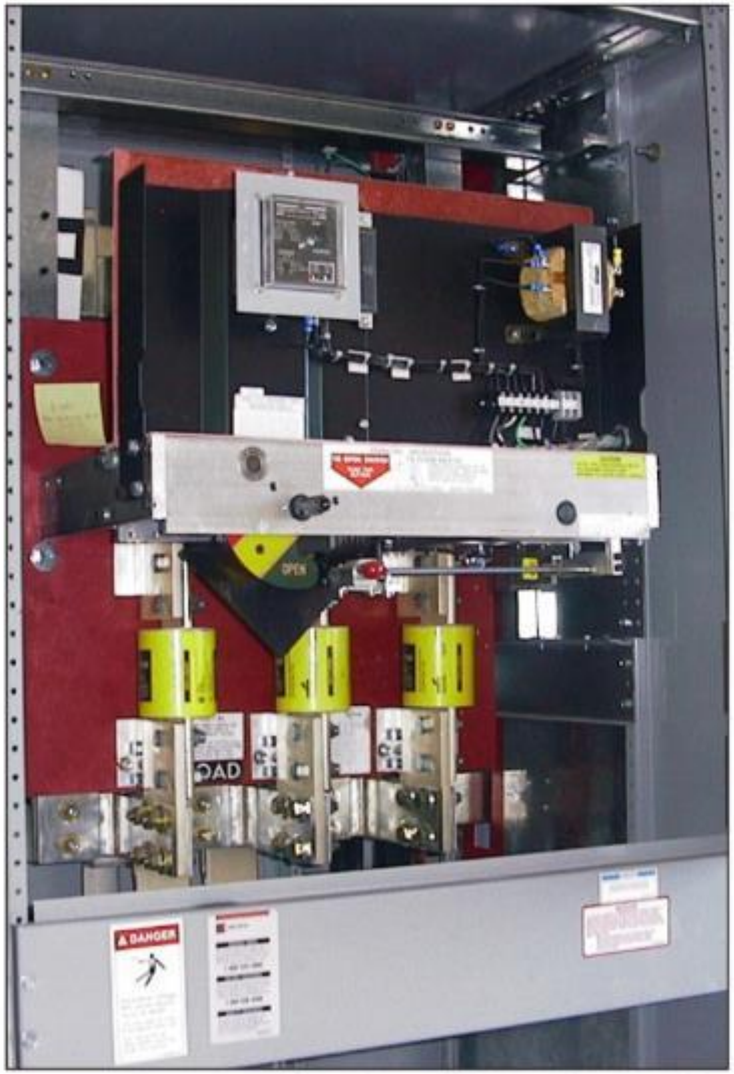
A fuse shall have a clearing time of 0.07 seconds or less at the available arcing current, or one of the following shall be provided:

(1) Differential relaying

(2) Energy-reducing maintenance switching with local status indicator

(3) Energy-reducing active arc flash mitigation system

(4) An approved equivalent means

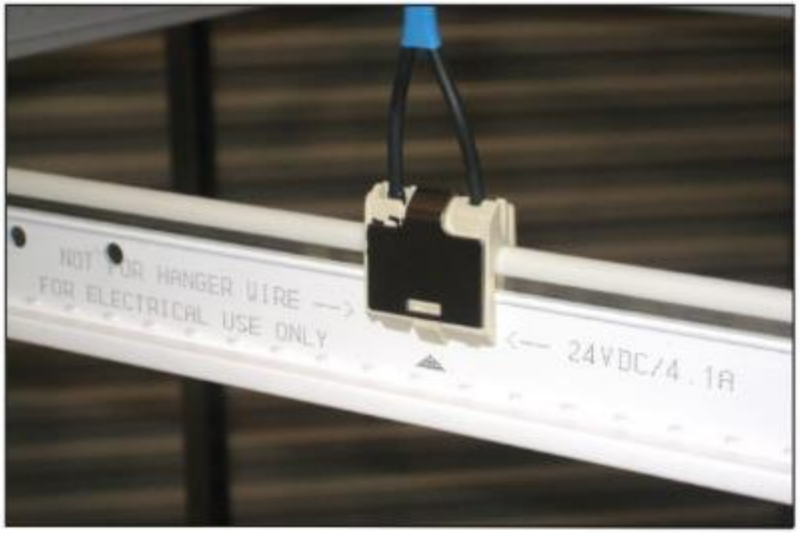


Courtesy of Eaton Corporation

250.22 Circuits Not to Be Grounded

- Class 2 load side circuits for **suspended ceiling low-voltage power grid distribution systems** were added to the list of circuits not to be grounded
- Natural step as Article 393 stipulates that the “Class 2 load side circuits for suspended ceiling low-voltage power grid distribution systems **shall not be grounded**” *[see 393.60(B)]*
- Supply side of these Class 2 power sources are to be grounded by connection to an EGC *[see 393.60(A)]*
- The ungrounded nature of the load side of this low-voltage system helps ensure safety similar to other identified low-voltage systems not to be grounded at 250.22

250.22 Circuits Not to Be Grounded



The following circuits shall not be grounded:

(1) Circuits for electric cranes operating over combustible fibers in Class III locations, as provided in 503.155

(2) Circuits in health care facilities as provided in 517.61 and 517.160

(3) Circuits for equipment within electrolytic cell working zone as provided in Article 668

(4) Secondary circuits of lighting systems as provided in 411.6(A)

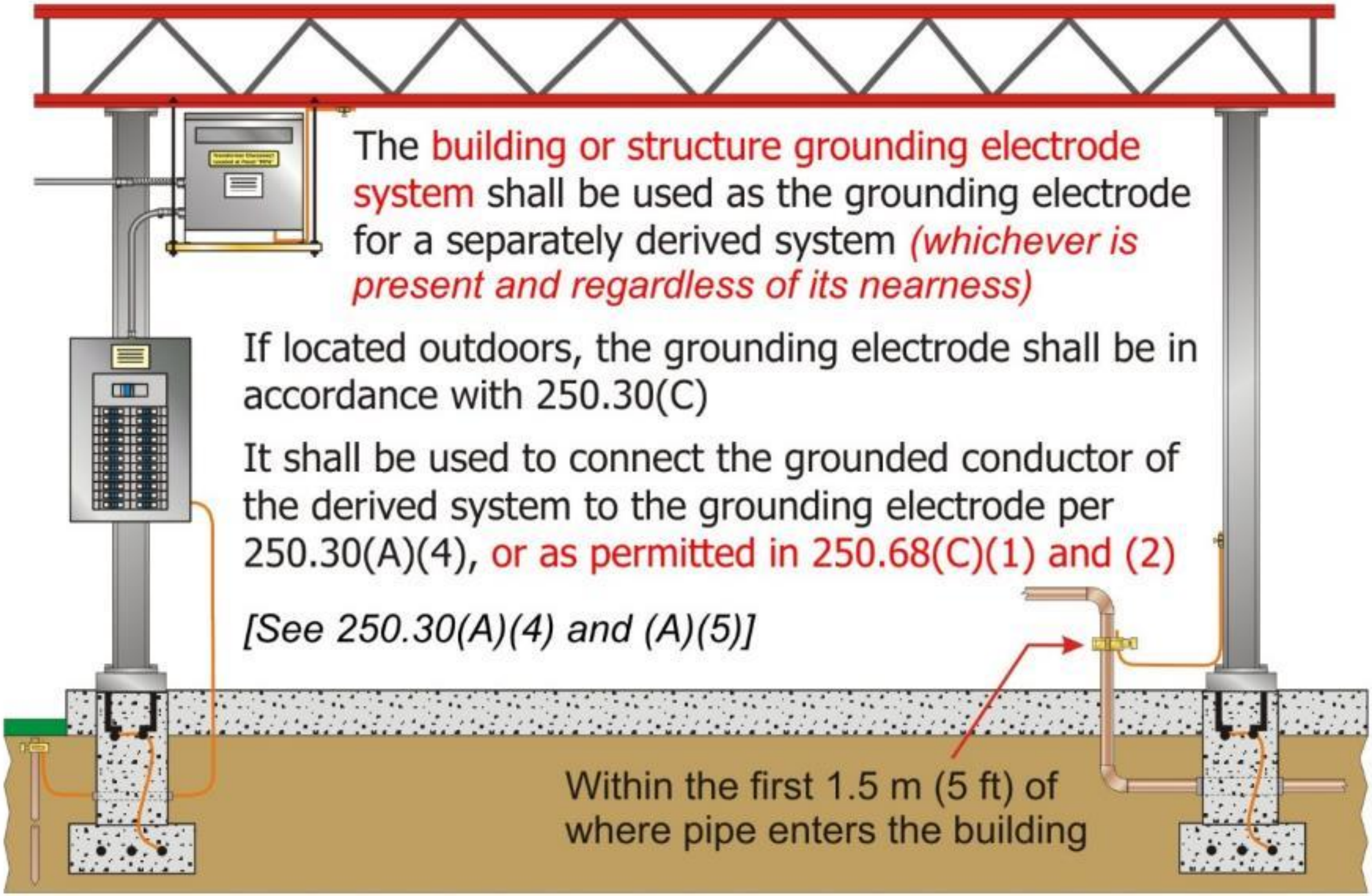
(5) Secondary circuits of lighting systems as provided in 680.23(A)(2)

(6) Class 2 load side circuits for suspended ceiling low-voltage power grid distribution systems as provided in 393.60(B)

250.30(A)(4) and (5)
Grounding Separately Derived Systems

- **Metal water piping** or **building steel** used as the first options of a grounding electrode system for a separately derived system have been removed
- **Any** of the building or structure grounding electrode(s) that are **present** can now be used as the grounding electrode(s) for a separately derived system
- The grounding electrode(s) used for the separately derived system do not have to be located near the grounding electrode conductor connection
- The **metal water piping** and the **structural metal frame** as covered in **250.68(C)(1) and (2)** have been recognized as conductors to extend the grounding electrode connection at 250.30(A)(5)

250.30(A) Grounding Separately Derived Systems



The building or structure grounding electrode system shall be used as the grounding electrode for a separately derived system *(whichever is present and regardless of its nearness)*

If located outdoors, the grounding electrode shall be in accordance with 250.30(C)

It shall be used to connect the grounded conductor of the derived system to the grounding electrode per 250.30(A)(4), or as permitted in 250.68(C)(1) and (2)

[See 250.30(A)(4) and (A)(5)]

Within the first 1.5 m (5 ft) of where pipe enters the building

Structural metal frame of a building or concrete-encased electrodes permitted as a bonding conductor to interconnect electrodes or as GEC

250.30(A)(6)(a)
Common GE Conductor

- A **metal water pipe** *[complying with 250.68(C)(1)]* was added to the allowable methods for a common grounding electrode conductor for multiple separately derived systems
- Building or structure employing multiple separately derived systems permits a **common grounding electrode conductor** to be utilized for connection of the grounded conductor of the separately derived systems to the grounding electrode(s)
- For metal water pipe to qualify as a common grounding electrode conductor, connection must be made to an **interior metal water pipe** that is electrically continuous with a metal underground water pipe electrode and made within the **first 1.52 m (5 ft)** from the point of entrance to the building *(with industrial exception) [see 250.68(C)(1)]*

250.30(A)(6)(a)
Common GE Conductor *(cont.)*

- Revisions were also made to the provisions of a **metal structural frame of a building or structure** qualifying as a common grounding electrode conductor for multiple separately derived systems
- Revised by adding the word "**structural**" to the reference to give a better description to this method
- *Code* reference of **250.52(A)(2)** was changed to **250.68(C)(2)**
- **250.52(A)(2)** pertains to the conditions a metal structural framing member must meet in order to qualify as a grounding electrode
- **250.68(C)(2)** relates to a metal structural frame of a building or structure being used as a conductor to interconnect electrodes that are part of the grounding electrode system

250.30(A)(6)(a) Common GE Conductor

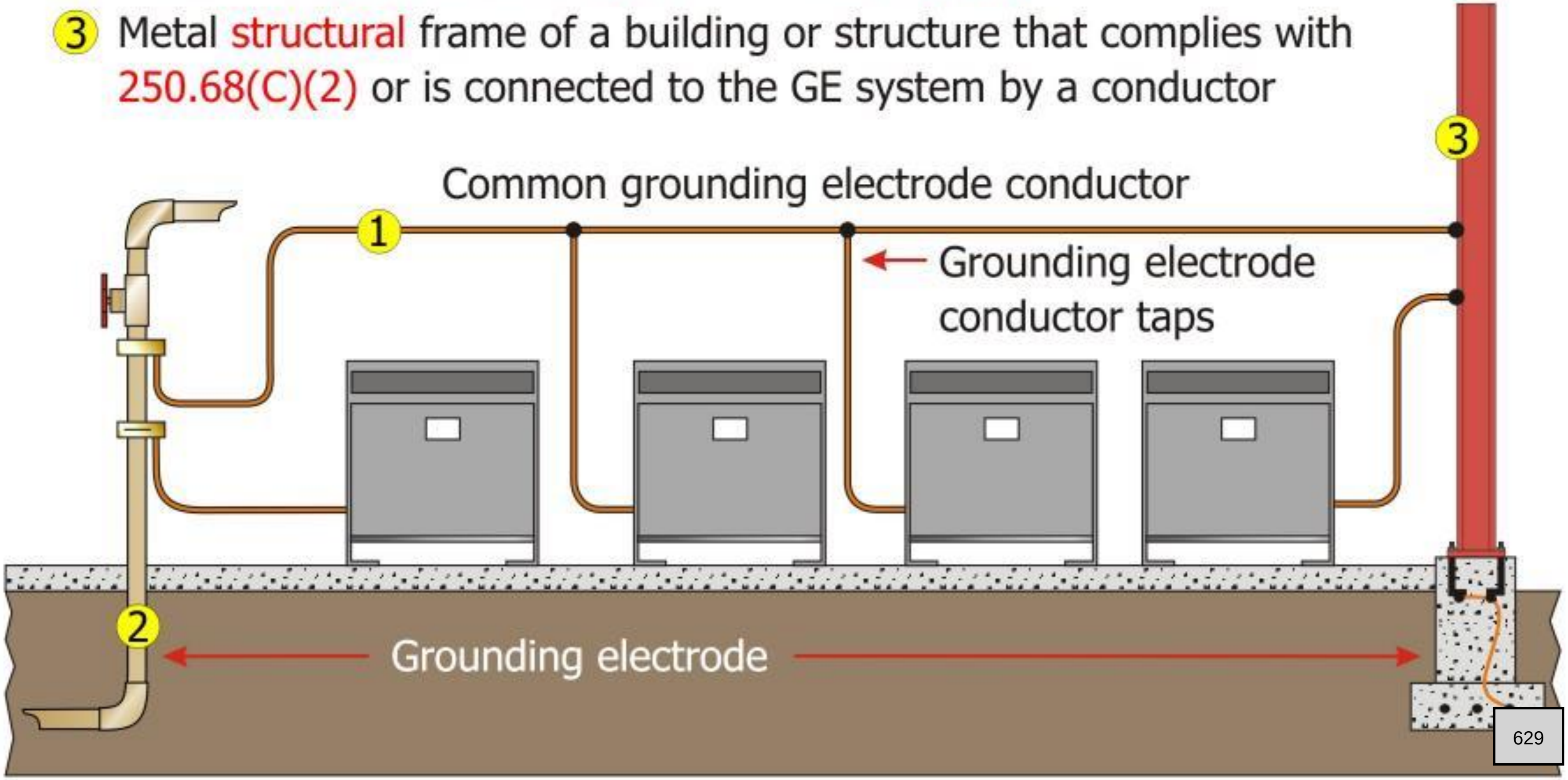
A common grounding electrode conductor for multiple separately derived systems shall be permitted

Common grounding electrode conductor permitted to be one of the following:

① Wire-type conductor (3/0 AWG copper or 250 kcmil aluminum minimum)

② Metal water pipe that complies with 250.68(C)(1) *[first 1.52 m (5 ft), etc.]*

③ Metal structural frame of a building or structure that complies with 250.68(C)(2) or is connected to the GE system by a conductor



250.52(A)(2)
Metal In-Ground Support Structure

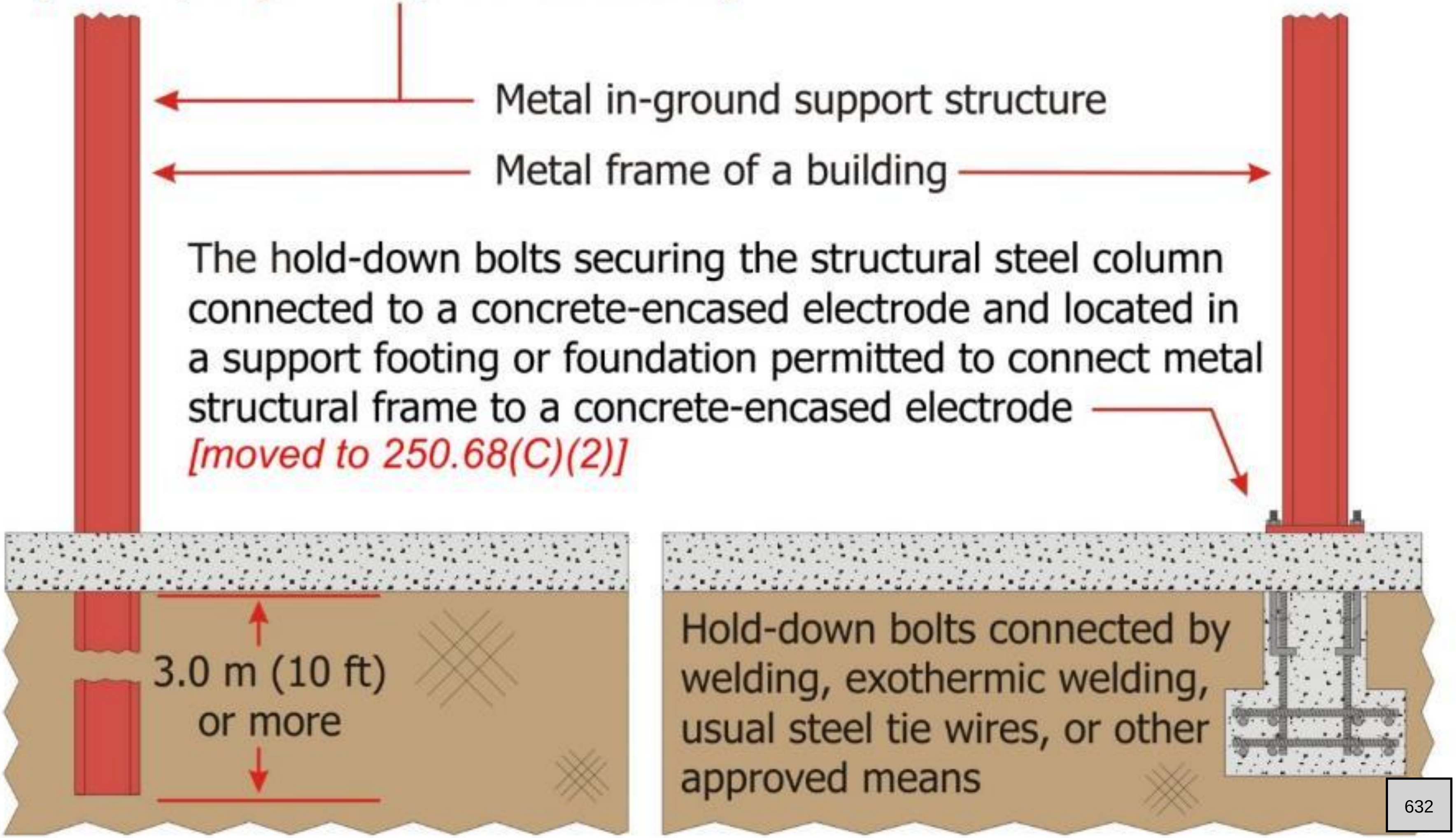
- The title of 250.52(A)(2) was changed from "~~**Metal Frame of a Building**~~" to "**Metal In-Ground Support Structure**"
- New title is more in line with the definition of a grounding electrode in Article 100 *(conducting object through which a direct connection to earth is established)*
- Only one item *(the metal support)* remains that would qualify as a "metal in-ground support structure" grounding electrode
- To qualify as an in-ground support structure, must be:
  - In direct contact with the earth vertically **3.0 m (10 ft) or more** *(with or without concrete encasement)*

250.52(A)(2)
Metal In-Ground Support Structure *(cont.)*

- Previous condition of a **metal structural member connected to a concrete-encased electrode** through the hold-down bolts, etc. qualifying as a grounding electrode has not been deleted
- **Relocated to 250.68(C)(2)** *(Grounding Electrode Connections)* as it is no longer appropriate for 250.52(A)(2) *(Electrodes Permitted for Grounding)*
- Adds clarity to 250.68(C)(2) and should be preserved as a permitted connection method

250.52(A)(2) Metal In-Ground Support Structures

One or more structural metal in-ground support structure(s) in direct contact with the earth vertically for 3.0 m (10 ft) or more *(with or without concrete encasement)* qualifies as a grounding electrode *(if multiple are present, only one required to be used)*



Metal in-ground support structure

Metal frame of a building

The hold-down bolts securing the structural steel column connected to a concrete-encased electrode and located in a support footing or foundation permitted to connect metal structural frame to a concrete-encased electrode *[moved to 250.68(C)(2)]*

3.0 m (10 ft) or more

Hold-down bolts connected by welding, exothermic welding, usual steel tie wires, or other approved means

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

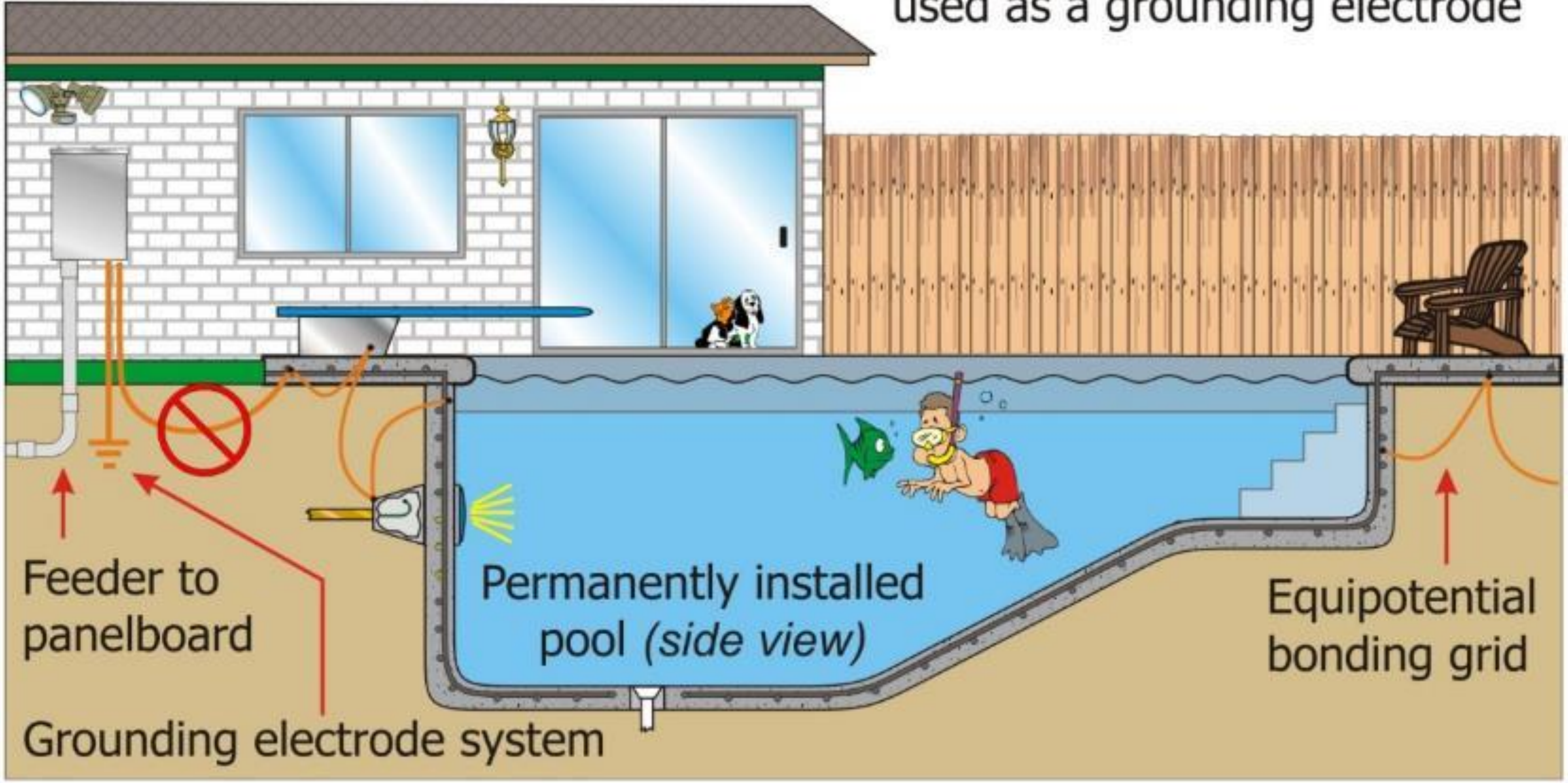
- Third item added to the list of objects that are **prohibited** from being used as a grounding electrode at 250.52(B)
- The structures and structural reinforcing steel of an **in-ground swimming pool** as described in 680.26(B)(1) and (B)(2) are now **prohibited from being used as a grounding electrode**
- Important clarification to point out the difference between grounding and bonding
- Equipotential bonding requirements of 680.26 are to reduce voltage gradients *(difference of voltage potential between two conducting objects)*, not to create a grounding electrode system for a building or structure

250.52(B)(3) Swimming Pools Not Permitted for Use as Grounding Electrodes *(cont.)*

- Third item added to the list of objects that are **prohibited** from being used as a grounding electrode at 250.52(B) *(cont.)*
- Items that shall not be used as a grounding electrode include:
  - Underground gas piping systems
  - An aluminum electrode
  - **Structures and structural reinforcing steel of an in-ground swimming pool**

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



Feeder to panelboard

Permanently installed pool *(side view)*

Equipotential bonding grid

Grounding electrode system

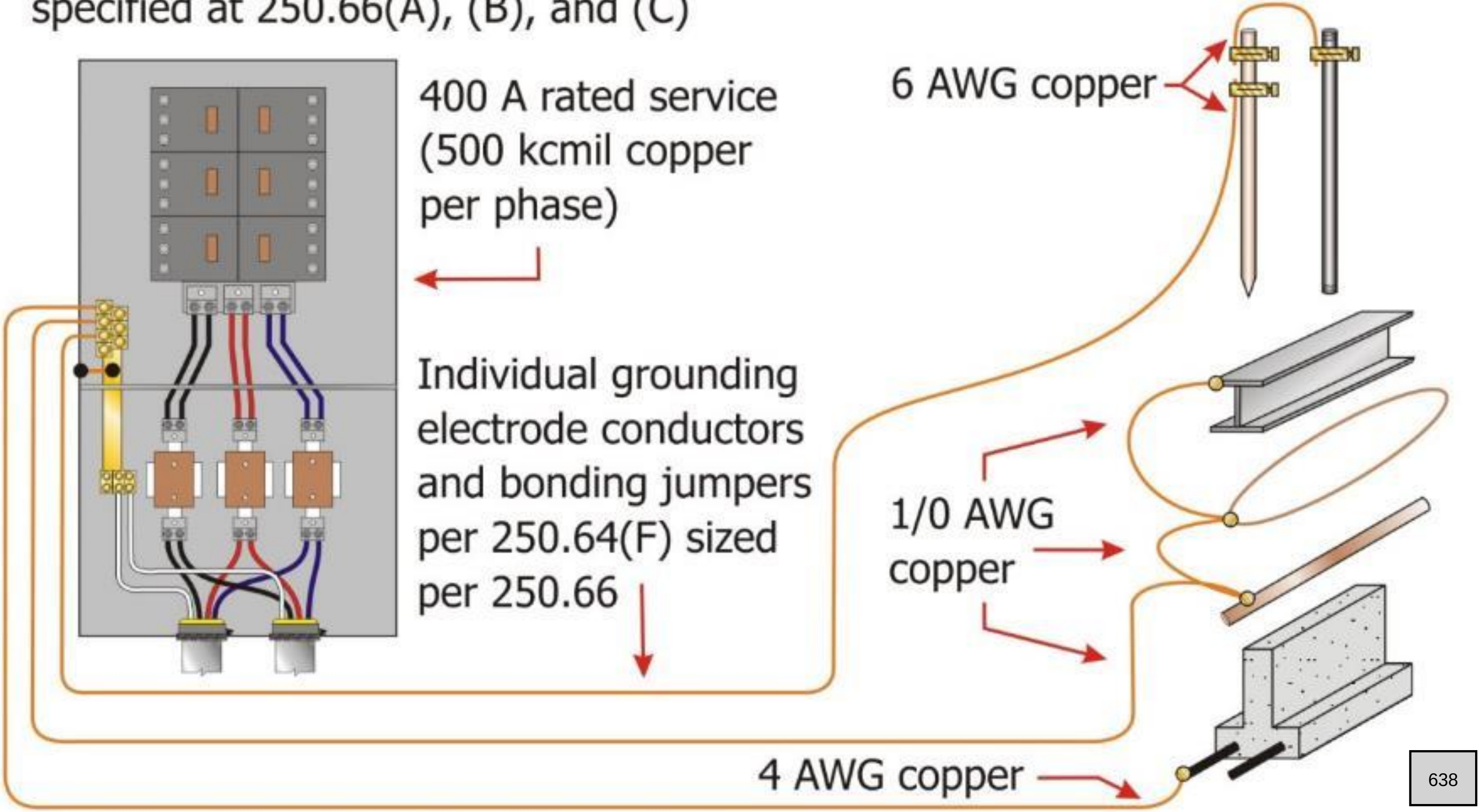
The provisions of 680.26 for equipotential bonding are to reduce voltage gradients *(difference of voltage potential between two conducting objects)*, not to establish a grounding electrode system for a building or structure

250.66(A), (B) and (C) Sizing of GECs

- The term **“sole connection”** was completely removed from 250.66(A), (B), and (C)
- New text makes it clear that the action of **“daisy chaining”** grounding electrodes with properly sized bonding jumpers to form a grounding electrode system is an acceptable practice…
- as long as any downstream grounding electrode would not require a larger grounding electrode conductor or bonding jumper
- The term **"or bonding jumper"** was added to each subdivision to use the correct terminology when “daisy chaining” occurs past the first grounding electrode in the chain of multiple electrodes

250.66(A), (B) and (C) Sizing of GECs

If the grounding electrode conductor or bonding jumper connected to the electrodes described at 250.66(A), (B), and (C) does not extend on to other types of electrodes that require a larger size conductor, the grounding electrode conductor(s) shall not be required to be larger than the sizes specified at 250.66(A), (B), and (C)

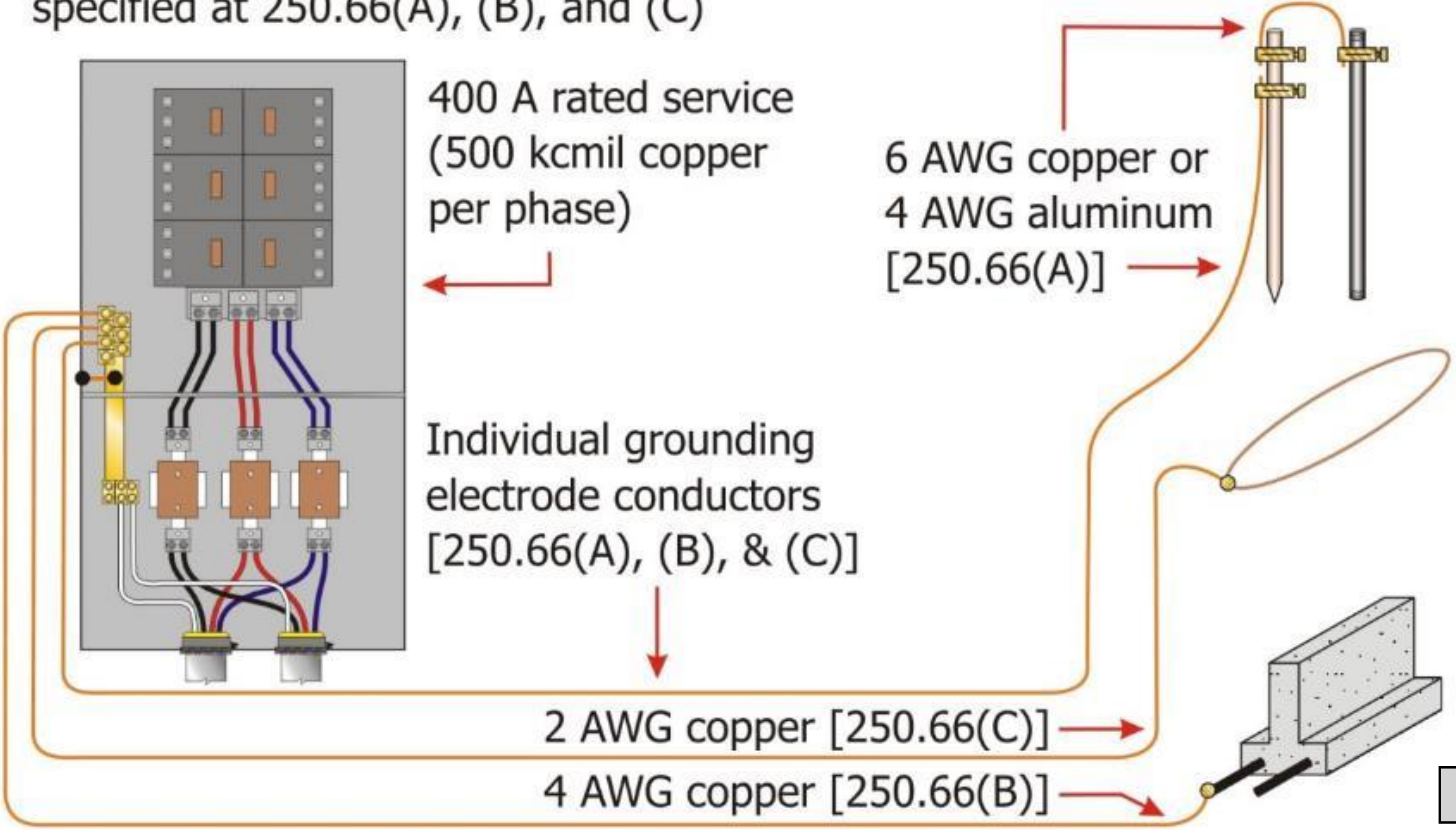


400 A rated service (500 kcmil copper per phase)

Individual grounding electrode conductors and bonding jumpers per 250.64(F) sized per 250.66

250.66(A), (B) and (C) Sizing of GECs

If the grounding electrode conductor or bonding jumper connected to the electrodes described at 250.66(A), (B), and (C) does not extend on to other types of electrodes that require a larger size conductor, the grounding electrode conductor(s) shall not be required to be larger than the sizes specified at 250.66(A), (B), and (C)



400 A rated service (500 kcmil copper per phase)

6 AWG copper or 4 AWG aluminum [250.66(A)]

Individual grounding electrode conductors [250.66(A), (B), & (C)]

2 AWG copper [250.66(C)]

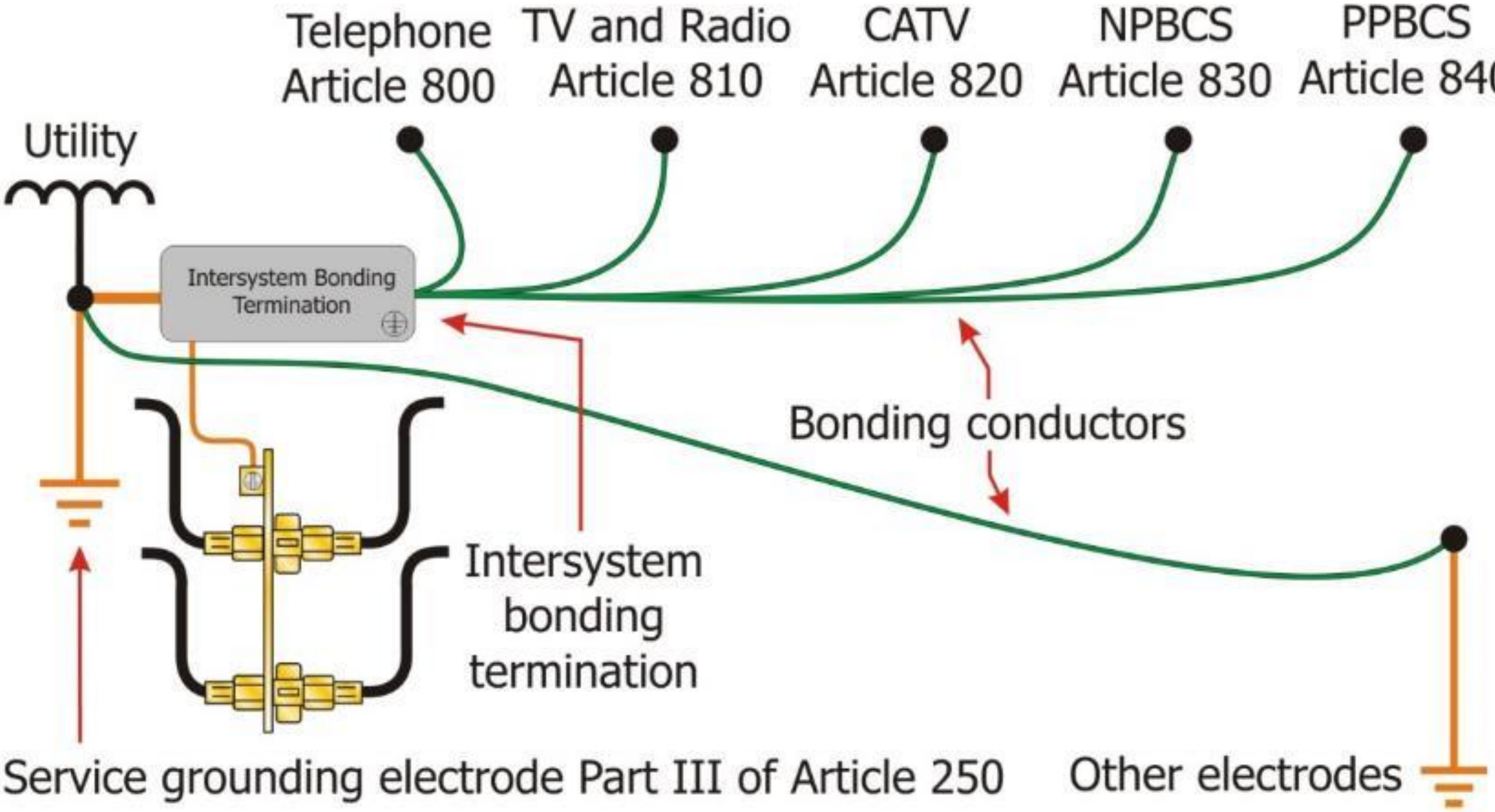
4 AWG copper [250.66(B)]

250.94(A) and (B)
Bonding for Communication Systems

- The title of the section was changed from "Bonding for ~~Other~~ Systems" to "Bonding for **Communication** Systems"
- Existing text for the intersystem bonding termination was placed under **250.94(A)** and titled, "**The Intersystem Bonding Termination Device**"
- New **250.94(B)** titled, "**Other Means**" added permitting intersystem bonding connections to an **aluminum or copper busbar** that will accommodate at least three terminations for communication systems as well as "**other connections**"
- A new exception was added for both 250.94(A) and (B) offering relief from an intersystem bonding connection means "where communications systems are not likely to be used"

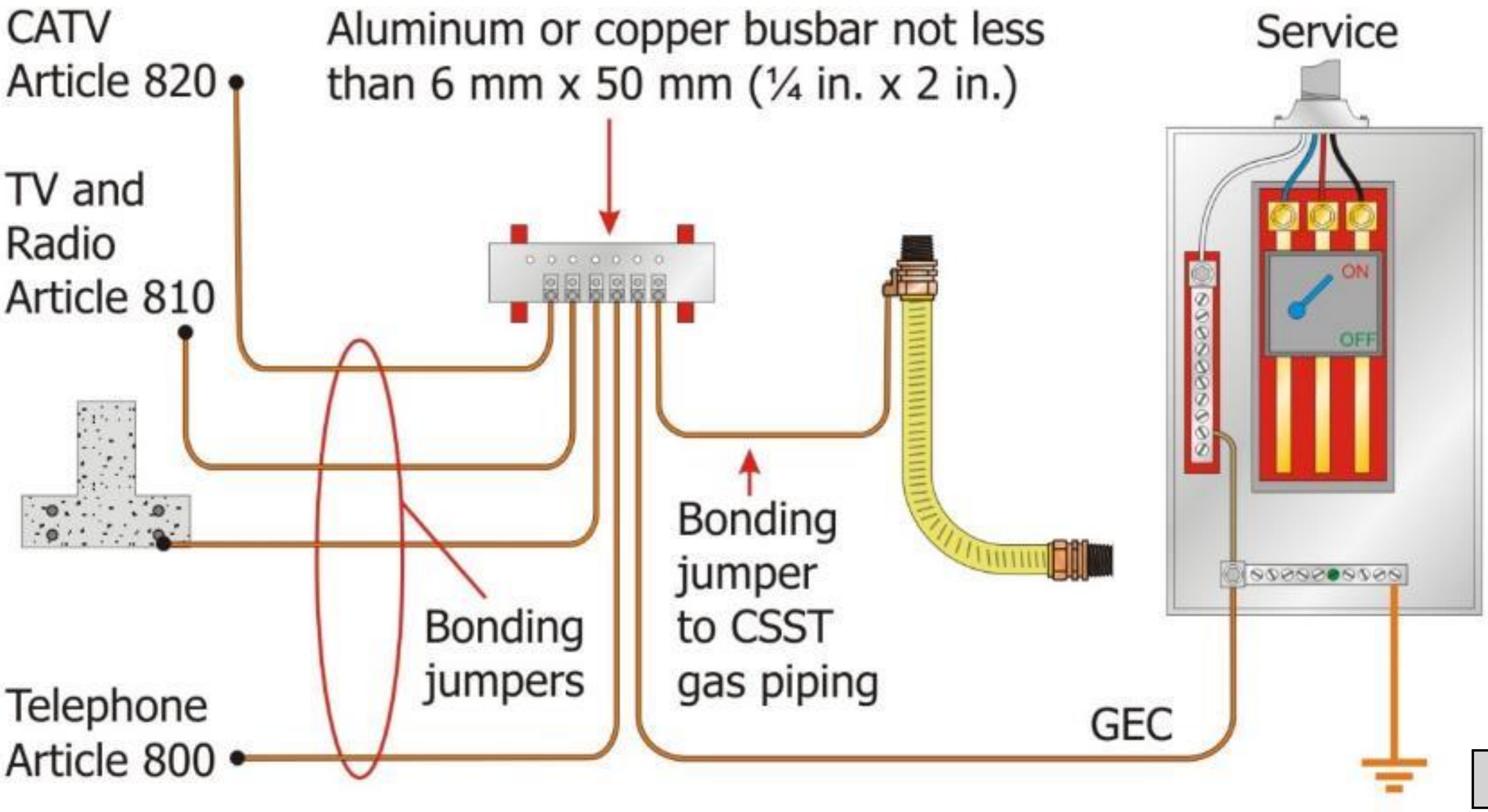
Bonding for ~~Other~~ Communication Systems

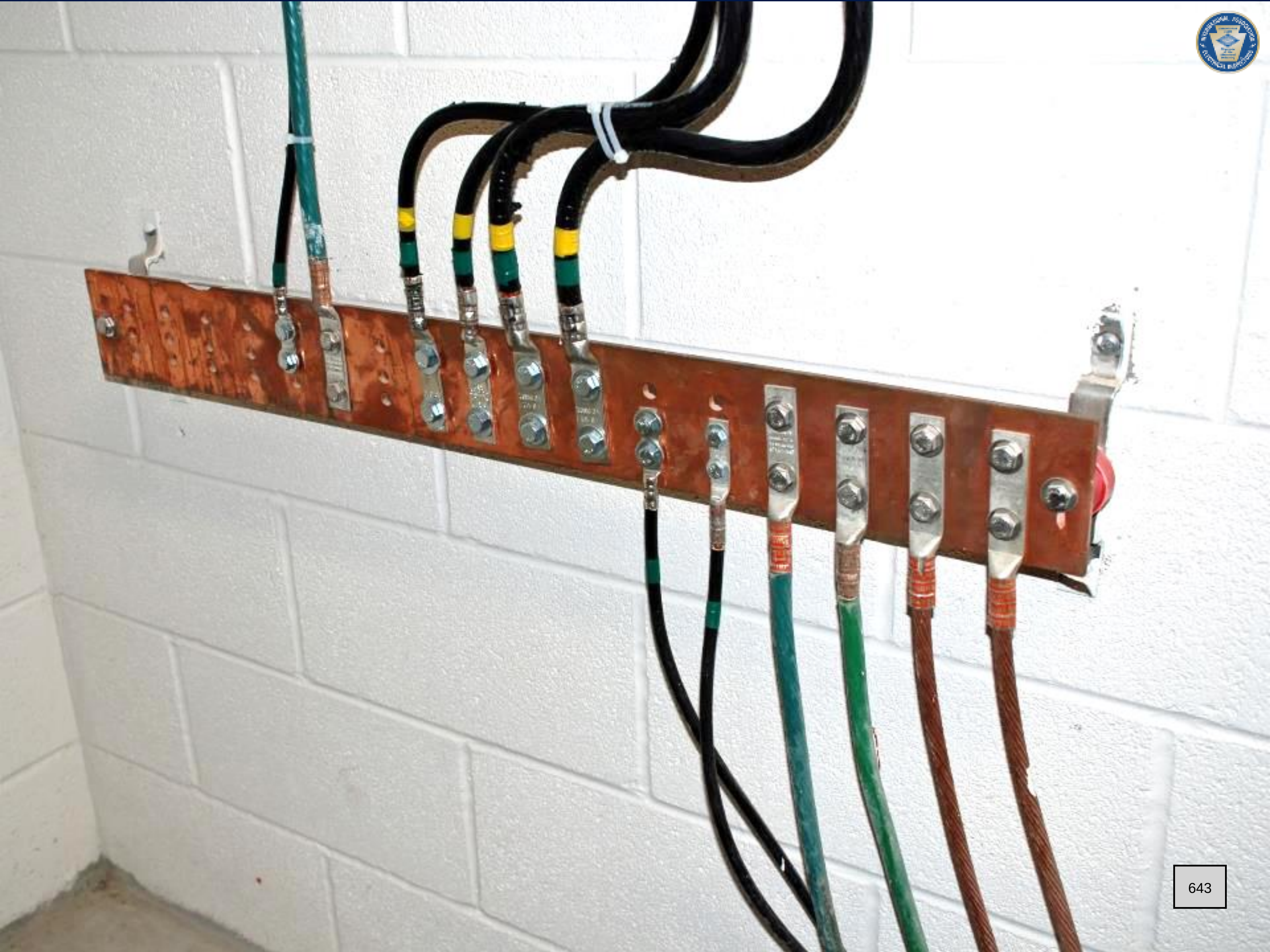
250.94(A) The Intersystem Bonding Termination Device. An intersystem bonding termination (IBT) for connecting intersystem bonding conductors shall be provided external to enclosures at the service equipment or metering equipment enclosure and at the disconnecting means for any additional buildings or structures.

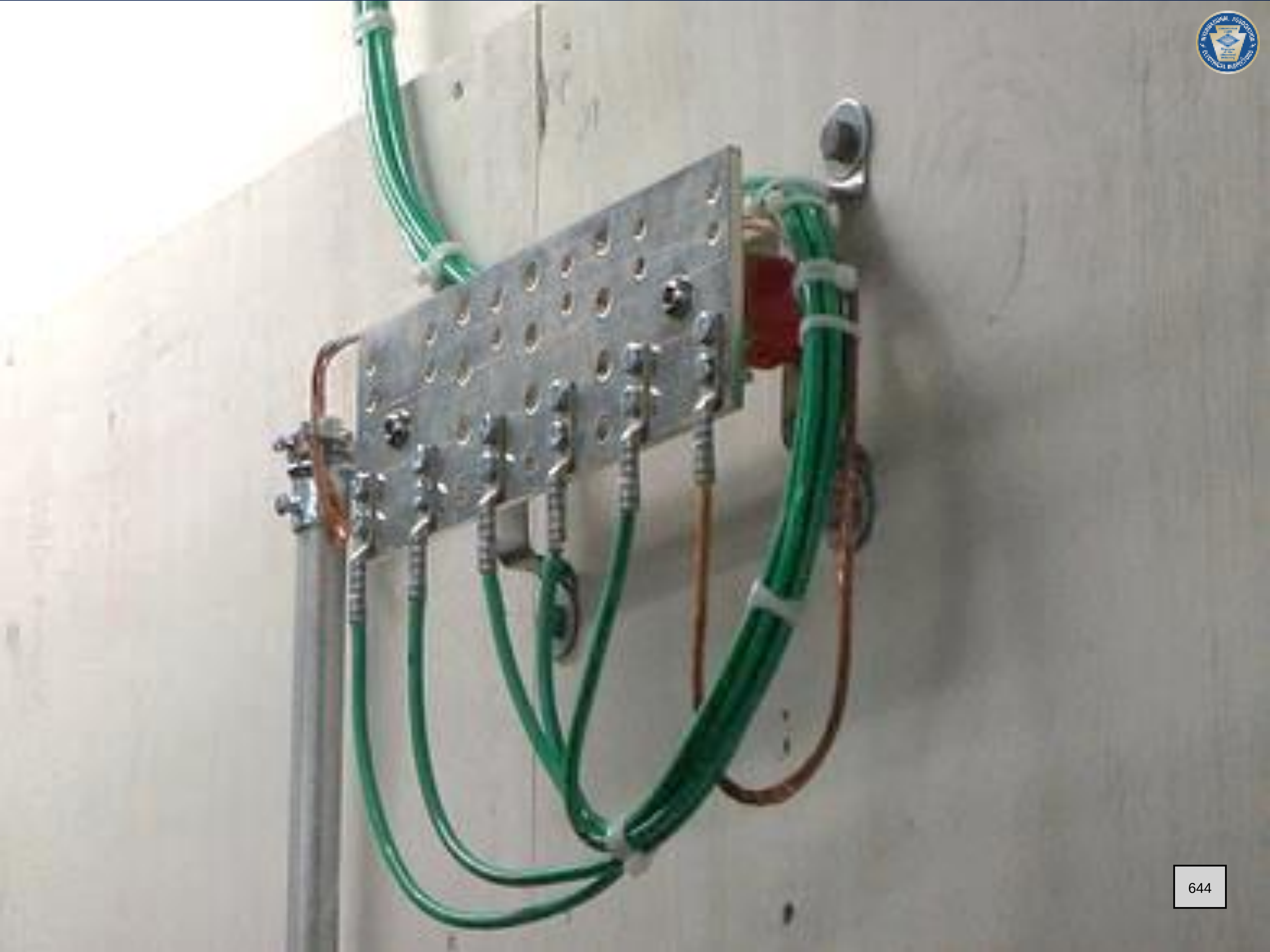


Bonding for ~~Other~~ Communication Systems

250.94(B) Other Means. Connections to an aluminum or copper busbar not less than 6 mm thick × 50 mm wide (¼ in. thick × 2 in. wide) and of sufficient length to accommodate at least three terminations for communication systems in addition to other connections.







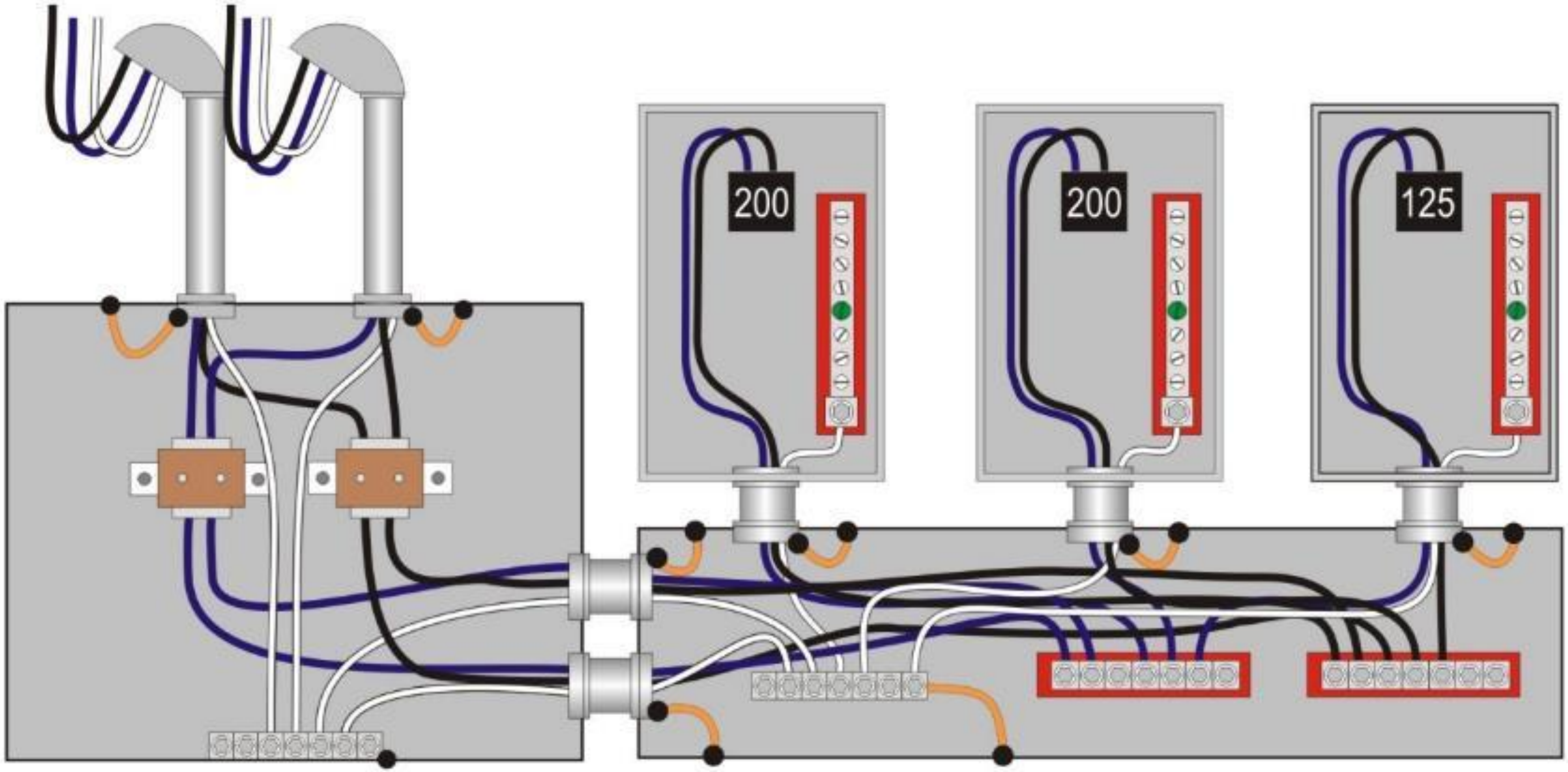
250.102 Grounded Conductor Bonding Conductors and Jumpers

- For proper sizing of a **grounded conductor**, **main bonding jumper**, **system bonding jumper**, or a **supply-side bonding jumper** for an alternating-current (ac) systems, provisions of 250.102 and Table 205.102(C)(1) must be utilized
- The term "**Grounded Conductor**" was added to the title of 250.102 to more accurately reflect what the section addresses
- Change harmonizes the title with the content of the section

250.102 Grounded Conductor Bonding Conductors and Jumpers *(cont.)*

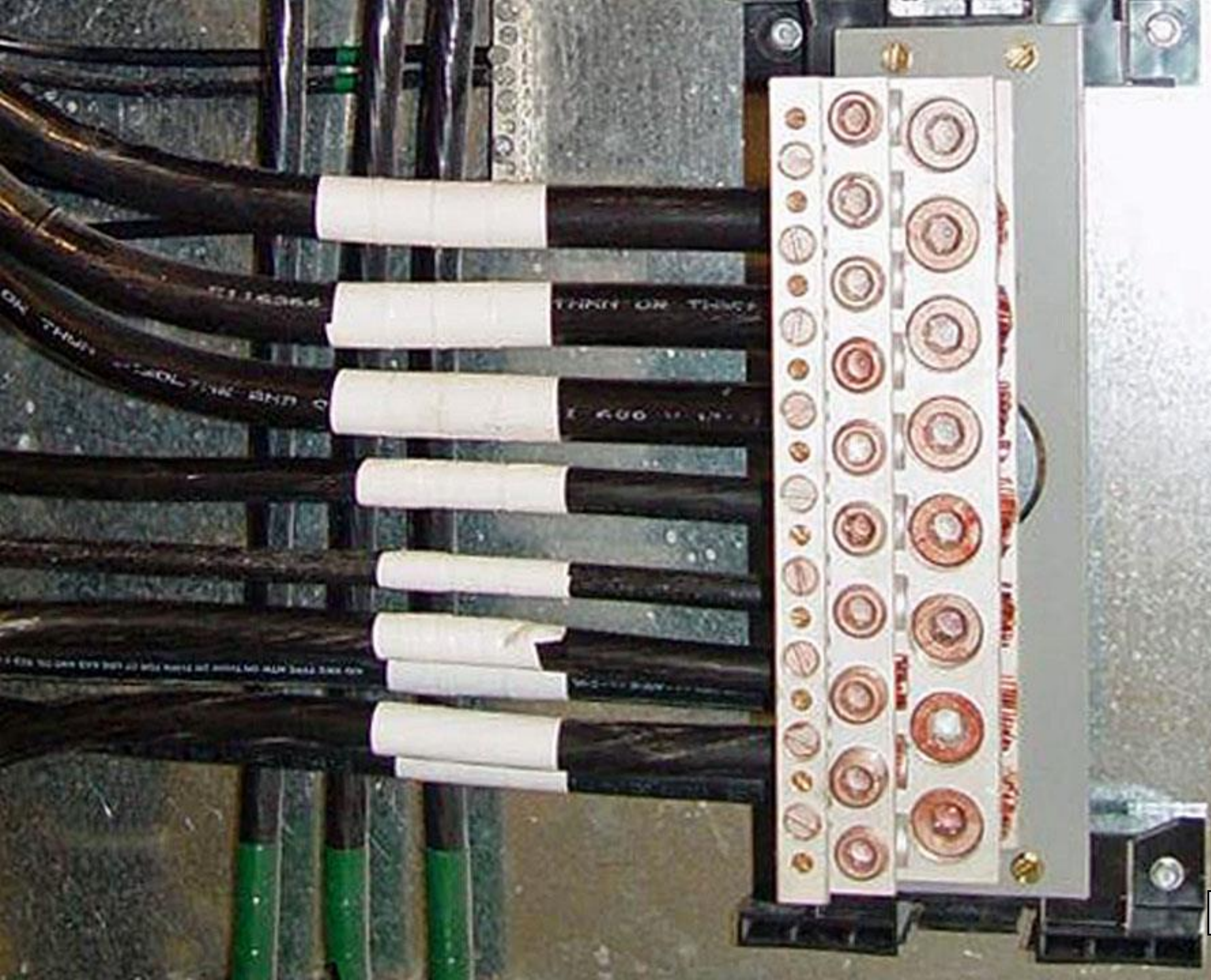
- The term "**Aluminum and copper-clad aluminum**" added to the choices of material acceptable for bonding jumpers
- Title of 250.102(C)(2) has been revised from "Size for Parallel Conductor Installations in Two or More Raceways" to "**Size for Parallel Conductor Installations in Two or More Raceways or Cables**"
- This will help avoid any misperception as a cable is not the same as a raceway

250.102 Grounded Conductor, Bonding Conductors and Jumpers



Grounded conductors, bonding conductors, and bonding jumpers of copper, aluminum, copper-clad aluminum, or other corrosion-resistant material are to be sized in accordance with 250.102 and Table 250.102(C)(1)

Supply-side bonding jumpers installed in parallel in two or more raceways or cables to comply with 250.102(C)(2)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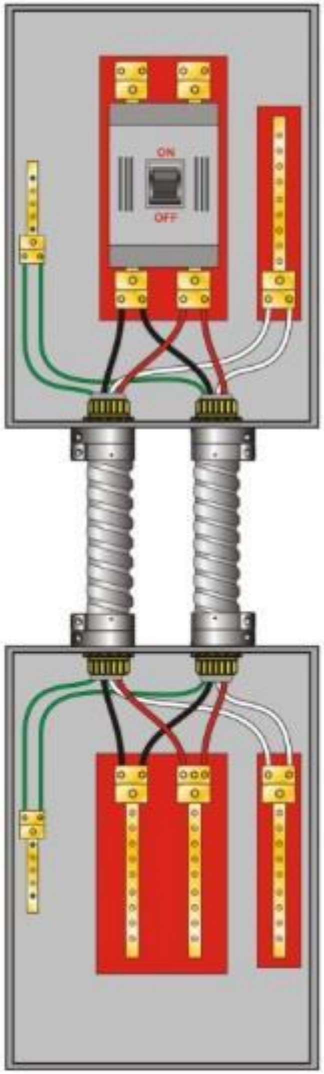
THHN OR

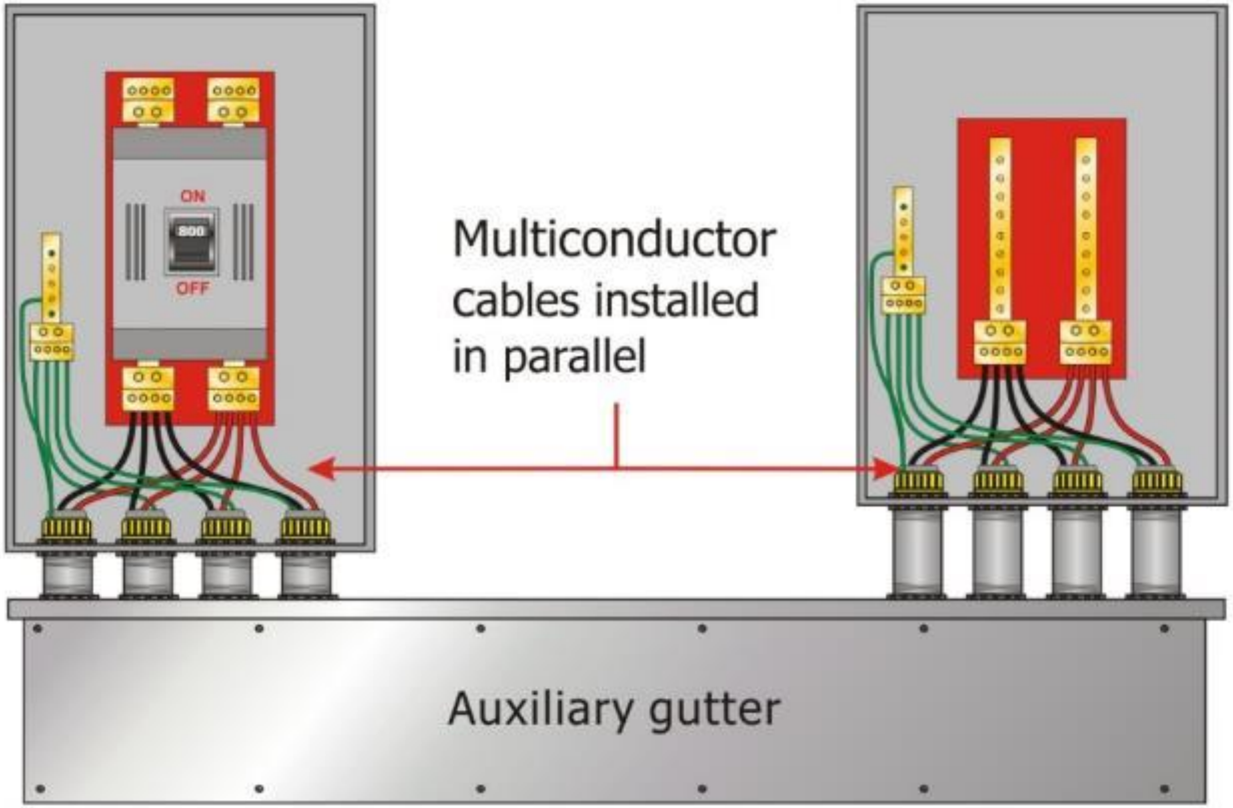
250.122(F) EGCs Installed in Parallel

- Revision and new text added to clarify how to size and install equipment grounding conductors when installed in parallel in single or multiple raceways, multiconductor cable, auxiliary gutter, or cable tray
- Expanded to cover equipment grounding conductors installed as part of a **multiconductor cable** as well as when installed in **auxiliary gutters**
- Previous single, long paragraph has been expanded into two separate second level subdivisions
  - 250.122(F)(1) Conductor Installations in Raceways, Auxiliary Gutters, or Cable Trays
  - 250.122(F)(2) Multiconductor Cables

250.122(F) EGCs Installed in Parallel

Rules for equipment grounding conductors installed in parallel in single or multiple raceways or cables and in cable tray, have been expanded to cover EGCs installed in auxiliary gutters and as part of a multiconductor cable





Multiconductor cables installed in parallel

If multiconductor cables are installed in parallel in the same raceway, auxiliary gutter, or cable tray, a single EGC is permitted in combination with the EGCs provided within the multiconductor cables *(must be connected together)*

250.148 Continuity and Attachment of EGC to Boxes

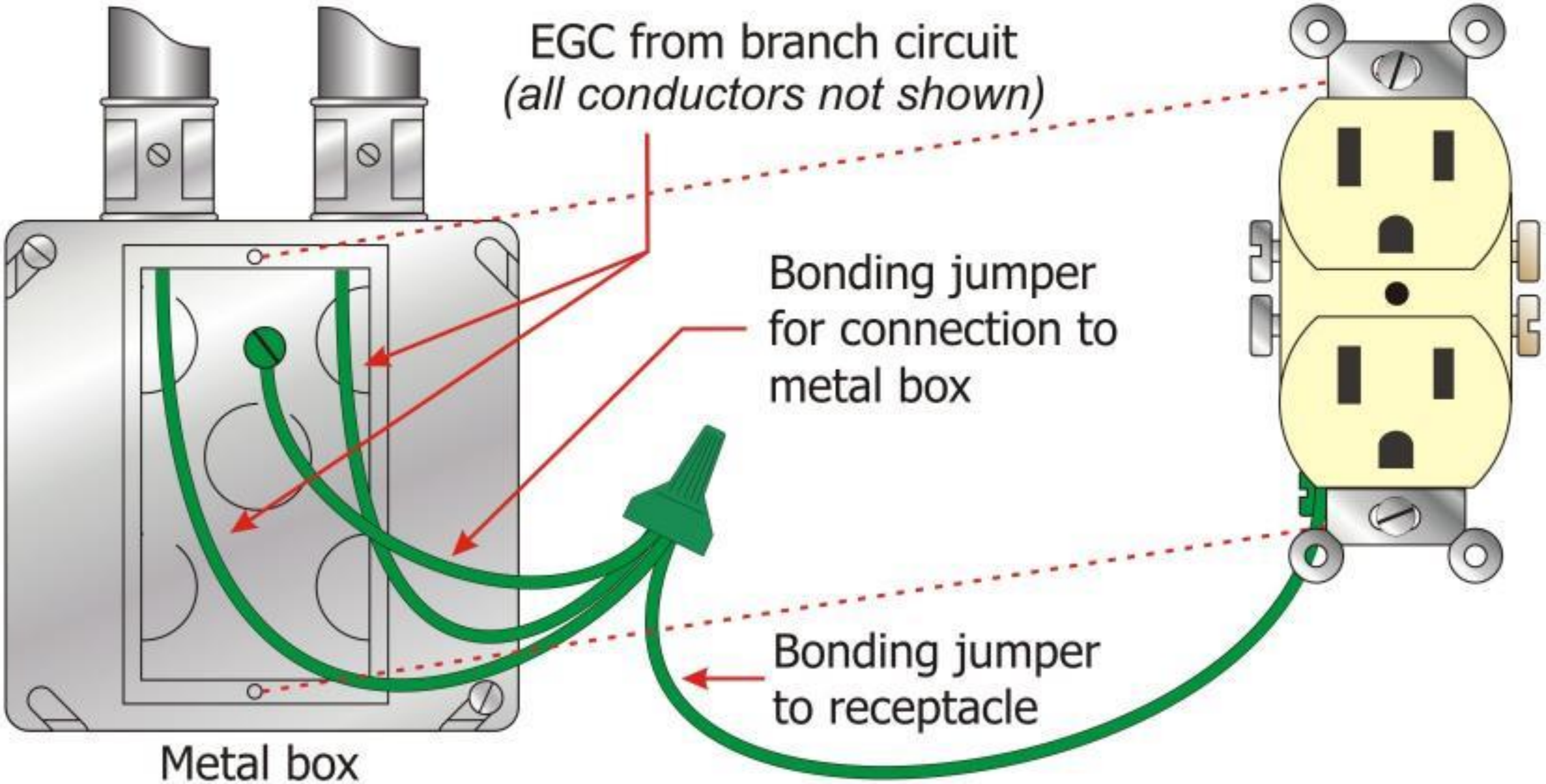
- Revision clarified that **all equipment grounding conductors** associated with any and all circuits in the box must be connected together and to the box *(not just EGCs of each associated circuit)*

- Existing exception gives relief to EGCs of an **isolated ground circuit** *(isolated ground receptacle not required to be connected to the other EGCs or to the box)*

- Reference to **250.8** *(Connection of Grounding and Bonding Equipment)* was also added to this section to provide guidance on terminating an EGC or bonding jumper to a metal box or enclosure

250.148 Continuity and Attachment of EGC to Boxes

If circuit conductors are spliced within a box, or terminated on equipment within or supported by a box, all equipment grounding conductor(s) (EGC) associated with any of those circuit conductors shall be connected within the box or to the box with devices suitable for the use


EGC from branch circuit

(all conductors not shown)

Bonding jumper for connection to metal box

Bonding jumper to receptacle

Metal box

See exception for isolated ground receptacles at 250.146(D)

250.187(B) Identification and Insulation of Impedance Grounded Neutral Systems

- Neutral conductor for an **impedance grounded neutral systems** *(over 1000 volts)* must be identified and insulated to the **maximum neutral voltage** rather than the same insulation as the phase conductors

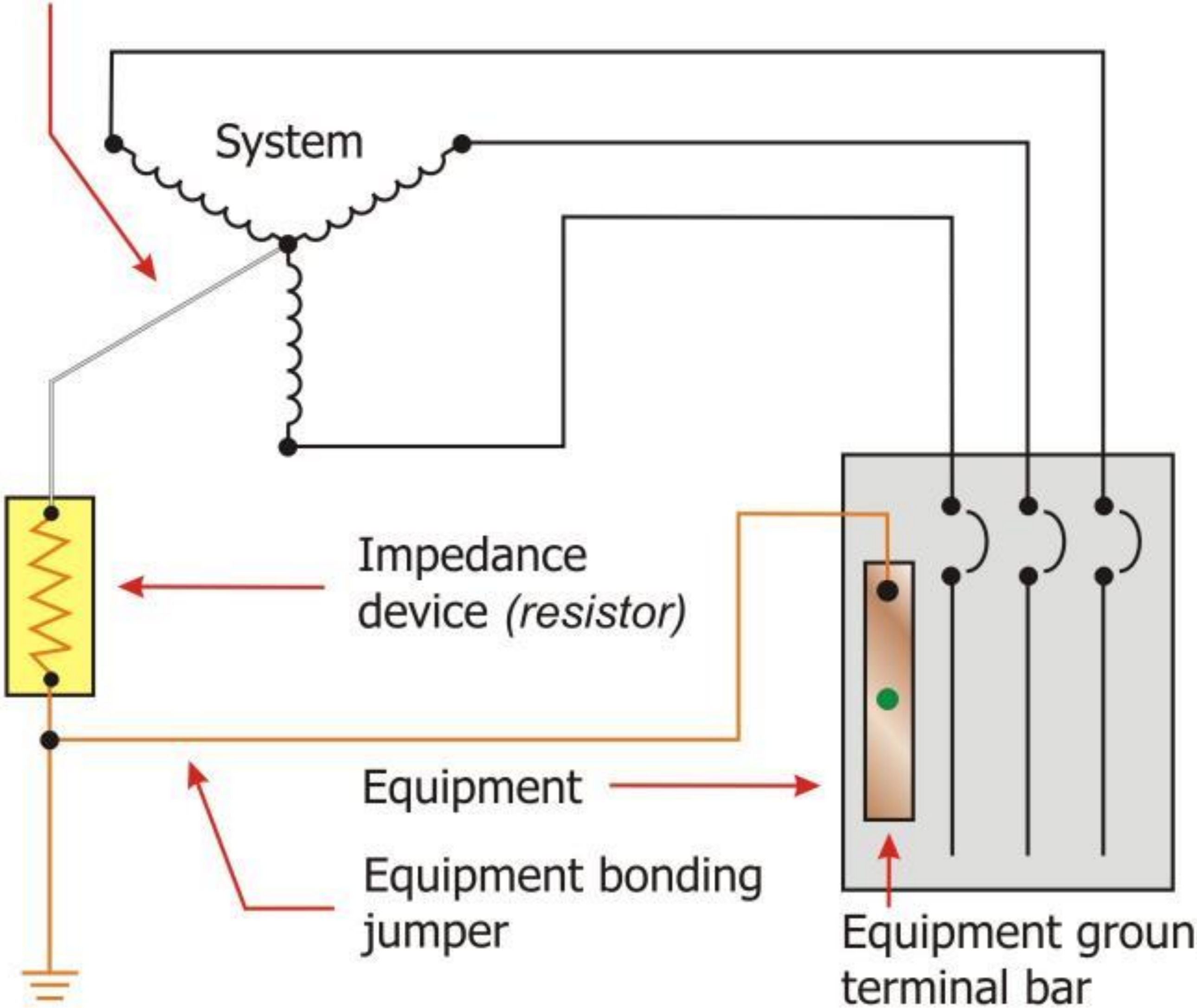
- Maximum voltage on the neutral conductor in a three-phase impedance grounded neutral system is **57.7%** of the phase-to-phase voltage, or 2400 volts for a 4160-volt system

- No hazard or disadvantage from a different insulation rating on the neutral conductor

- Revisions also reformatted 250.187 into a list format to provide clearer statement for enforcement and improves clarity

250.187 Impedance Grounded Neutral Systems

Neutral conductor for an impedance grounded neutral systems over 1000 volts must be insulated to the maximum neutral voltage rather than the same insulation as the phase conductors



System

Impedance device *(resistor)*

Equipment

Equipment bonding jumper

Equipment grounding terminal bar

Chapter Three
Wiring Methods
And Materials

Table 300.5 Minimum Cover Requirements

- Two **new footnotes** were added to Table 300.5 allowing lesser depths for **listed low-voltage lighting system** and for pool, spa, and fountain lighting where part of a listed low-voltage lighting system
- Removes conflicts between manufacturing instructions that require their secondary wiring to be installed at **lesser depths than Table 300.5**
- In some instances, these conductors are to be buried at **less than 150 mm (6 in.)** to conform to the manufacturers installation instructions
- Resolves a conflict between the product standard UL 1838 *[and 110.3(B)]* and Table 300.5

Table 300.5 Minimum Cover Requirements

Minimum Cover Requirements, 0 to 1000 Volts, Nominal, Burial to Millimeters (Inches)

	Type of Wiring Method or Circuit									
	Column (1) Direct-Buried Cables or Conductors		Column (2) Rigid Metal Conduit or Intermediate Metal Conduit		Column (3) Nonmetallic Raceways Listed for Direct Burial (No Concrete Encasement)		Column (4) Residential BC (120 Volts or Less, GFCI, Max. OCPD of 20 Amperes)		Column (5) Irrigation and Landscape Ltg (30 Volts Max., Type UF or Other Identified Cable or Raceway	
Location of Wiring Method or Circuit	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.
All locations not specified below	600	24	150	6	450	18	300	12	150[a, b]	6[a, b]
In trench below 50 mm (2 in.) thick concrete or equivalent	450	18	150	6	300	12	150	6	150	6
Under a building *(see NEC text)*	0	0	0	0	0	0	0	0	0	0
Under min.102 mm (4 in.) thick concrete exterior slab with no vehicular traffic [slab extending not less than 152 mm (6 in.)]	450	18	100	4	100	4	150 *(direct burial)* 100 *(in raceway)*	6 4	150 *(direct burial)* 100 *(in raceway)*	6 4
Under streets, highways, roads, alleys, driveways, parking lots	600	24	600	24	600	24	600	24	600	24
One- and two-family dwelling driveways/parking areas, (dwelling-related purposes only)	450	18	450	18	450	18	300	12	450	18
In or under airport runways	450	18	450	18	450	18	450	18	450	18

Reproduction of NEC Table 300.5 (in part)(see next slide for Footnotes and Notes to table)

Table 300.5 Minimum Cover Requirements

Minimum Cover Requirements, 0 to 1000 Volts, Nominal, Burial to Millimeters (Inches)

[a] A lesser depth shall be permitted where specified in the installation instructions of a listed low-voltage lighting system.

[b] A depth of 150 mm (6 in.) shall be permitted for pool, spa, and fountain lighting, installed in a nonmetallic raceway, limited to not more than 30 volts where part of a listed low-voltage lighting system.

Notes:

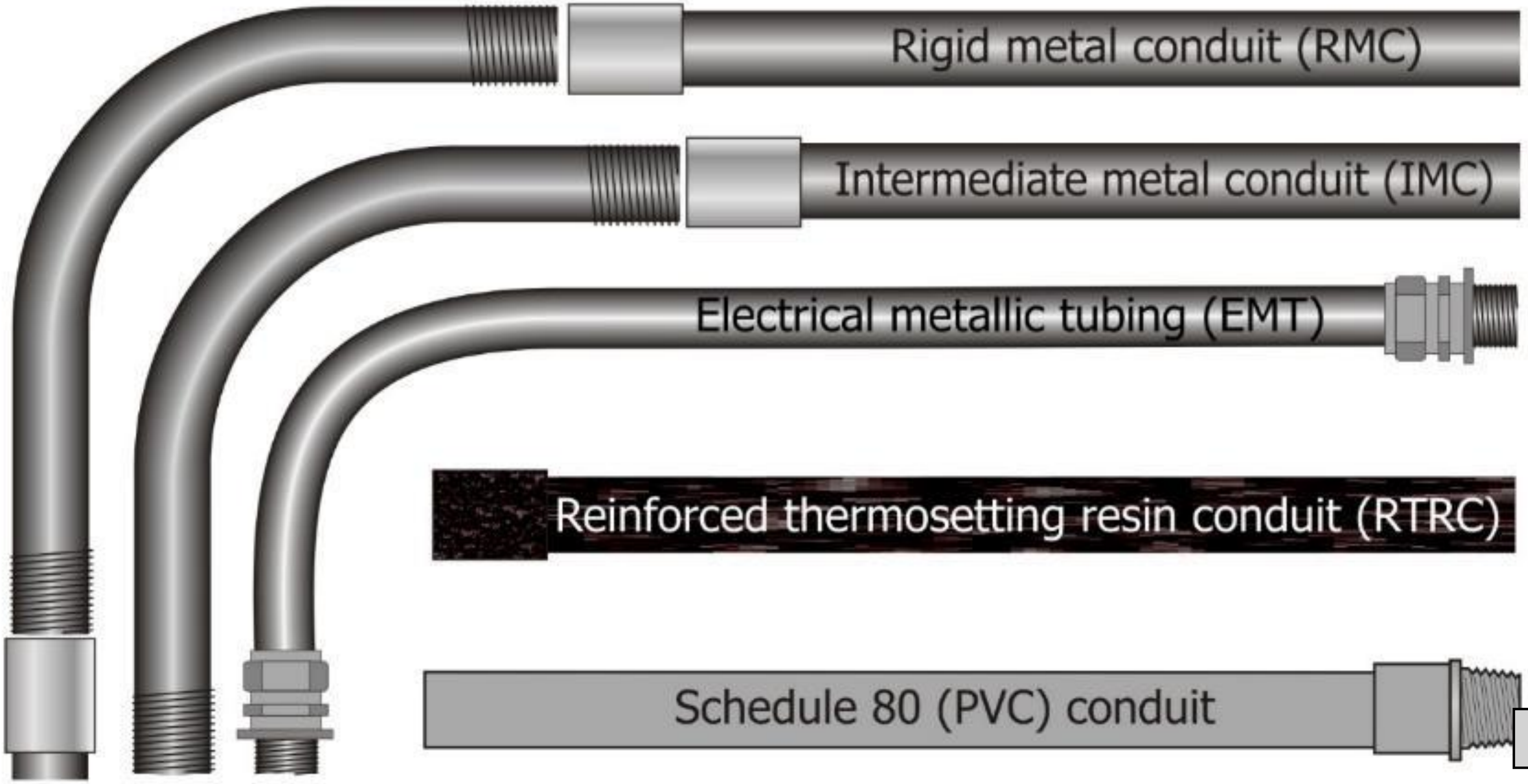
1. Cover is defined as the shortest distance in ~~millimeters~~ mm (~~inches~~ in.) measured between a point on the top surface of any direct-buried conductor, cable, conduit, or other raceway and the top surface of finished grade, concrete, or similar cover.
2. Raceways approved for burial only where concrete encased shall require concrete envelope not less than 50 mm (2 in.) thick.
3. Lesser depths shall be permitted where cables and conductors rise for terminations or splices or where access is otherwise required.
4. Where one of the wiring method types listed in Columns 1 through 3 is used for one of the circuit types in Columns 4 and 5, the shallowest depth of burial shall be permitted.
5. Where solid rock prevents compliance with the cover depths specified in this table, the wiring shall be installed in a metal raceway, or a nonmetallic raceway permitted for direct burial. The raceways shall be covered by a minimum of 50 mm (2 in.) of concrete extending down to rock.

300.5(D)(4)
Protection from Physical Damage

- **Electrical metallic tubing *(EMT)*** was added to the list of acceptable wiring method that can be used to provide protection from physical damage for conductors installed underground and subject to physical damage
- EMT is permitted to be installed in concrete, in direct contact with the earth, or in areas subject to severe corrosive influences **where protected by corrosion protection and approved as suitable for the condition**
- Corrosion protection is a requirement for listed EMT per UL 797 *(Electrical Metallic Tubing - Steel)* and in accordance with 300.6

300.5(D)(4) Protection from Physical Damage

Where direct-buried conductors and cables are installed in enclosures or raceways and are subject to physical damage, electrical metallic tubing (EMT), rigid metal conduit (RMC), intermediate metal conduit (IMC), reinforced thermosetting resin conduit (RTRC) (Type RTRC-XW), Schedule 80 rigid polyvinyl chloride (PVC) conduit, or equivalent is allowed to be used to provide protection from physical damage

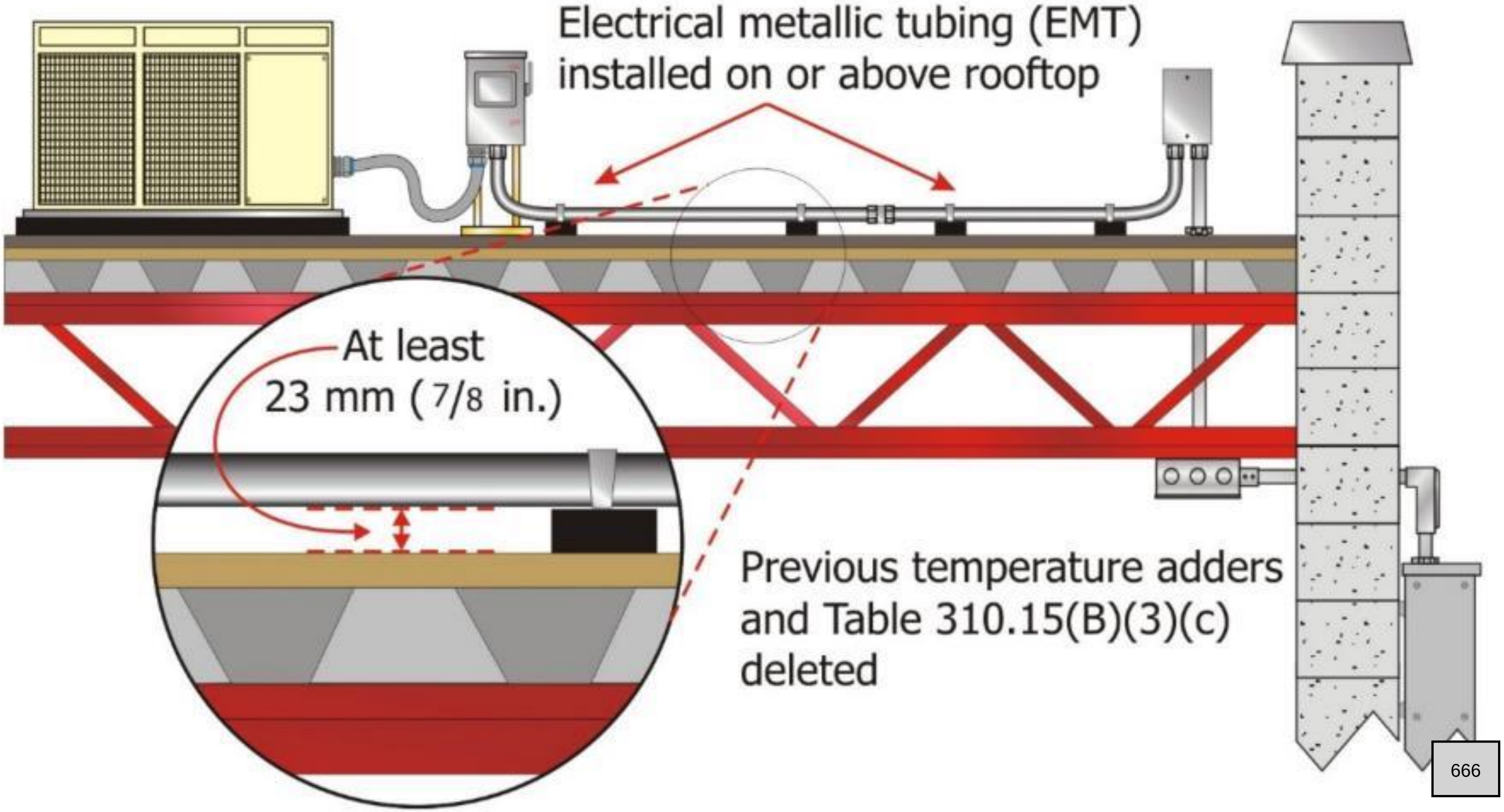


310.15(B)(3)(c)
Raceways and Cables on Rooftops

- Previous **Table 310.15(B)(3)(c)** was **deleted** and replaced with new text added at 310.15(B)(3)(c)
- Raceways and cables not in direct contact with the rooftop surface no longer require **rooftop temperature adder**
- New text requires a temperature adder of **33°C (60°F)** only when a raceway or cable is installed **directly on or less than 23 mm (⅞ in.)** above a rooftop
- Allows for the use of “shallow type unistrut” that is of the ⅞ in. size as well as other commonly installed listed raceway supports of larger sizes
- Pre-existing allowable ampacity and temperature correction factors adequately size the conductors to ensure that the conductors operate within a comfortable safety zone

310.15(B)(3)(c) Raceways and Cables on Rooftops

Where raceways or cables are exposed to direct sunlight on or above rooftops, they shall be installed 23 mm (7/8 in.) above the roof or be subject to a rooftop temperature adder of 33°C (60°F) *(see exception for Type XHHW-2 conductors)*



Electrical metallic tubing (EMT) installed on or above rooftop

At least 23 mm (7/8 in.)

Previous temperature adders and Table 310.15(B)(3)(c) deleted

310.15(B)(7) Single-Phase Dwelling Unit Services and Feeders

- The provisions for sizing dwelling unit service *(and main power feeder)* was expanded to single-phase, **208Y/120-volt systems** as well as single-phase, 120/240-volt systems
- Explanatory language added to address the permitted application of correction or adjustment factors required by **310.15(B)(2)(a)** ***(Temperature Correction Factors)*** or **310.15(B)(3)(a)** ***(More Than Three Current-Carrying Conductors)*** applied to the ampacity associated with the temperature rating of the conductors
- New informational note added with direction to **240.6(A)** for service ratings based on **standard ampacity ratings** for application of 310.15(B)(7)
- Previous **Table 310.15(B)(7)** *(removed in 2014 cycle)* was added back into the *Code (see* ***Example D7*** *of Informational Annex D)*

310.15(B)(7) 120/240 Volt or 208Y/120 Volt, Single-Phase Dwelling Services and Feeders

Single-phase, 120/240-volt services or feeders (100 - 400 ampere) and single-phase, 208Y/120-volt feeders (100 - 400 ampere), supplying the entire dwelling unit load permitted to have an ampacity not less than 83% of the service or feeder rating

Correction or adjustment factors required by 310.15(B)(2) or (3) permitted to be applied to the ampacity associated with the temperature rating of these conductors

Service/feeder ratings addressed by this section are based on the standard ampacity ratings from 240.6(A)


6675 MEDITERRANEAN
SERVICE DISCONNECT
BLDG 3 34 UNITS
1200 AMP MAIN 120/208V 3PH
A-BLK B-RED C-BLUE
FED FROM 750 KVA XFMR

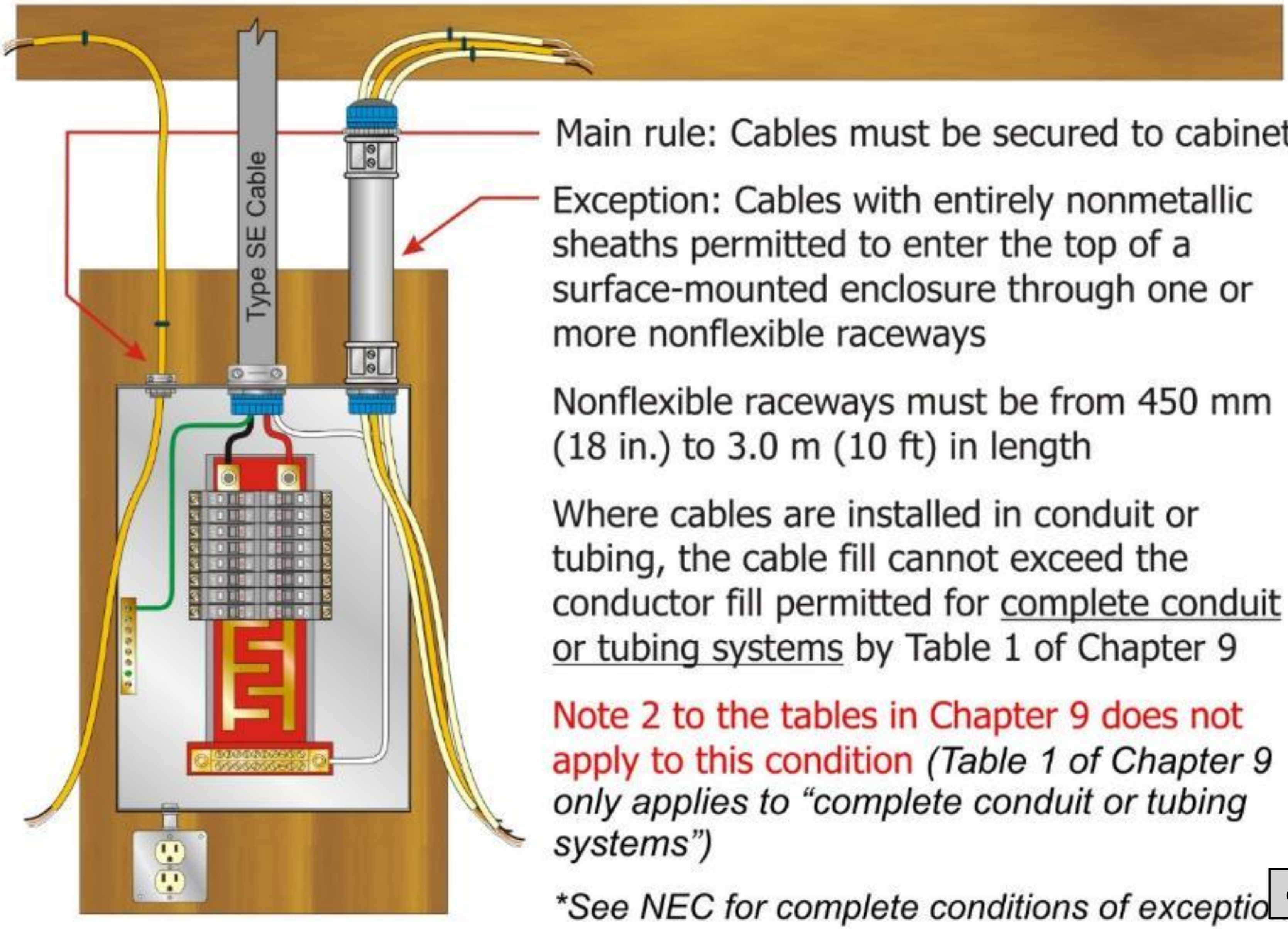
312.5(C), Ex., Item (g) Cable Raceway

- New sentence added to Item (g) indicating that **Note 2 to the tables in Chapter 9 does not apply** to a “sleeve” of conduit or tubing required by 312.5(C), Exception

- In order to meet this exception, cables with entirely nonmetallic sheaths permitted to enter the top of a surface-mounted enclosure through one or more nonflexible raceways not less than 450 mm (18 in.) and not more than **3.0 m (10 ft)** in length

- This limited length of raceway is required to be restricted on conductor fill to the limits of **Chapter 9, Table 1** *(53% of the cross-sectional area of the conduit or tubing for one conductor, 31% for two conductors, and 40% for over 2 conductors)*

312.5(C), Ex., Item (g) Cable Raceway



Main rule: Cables must be secured to cabinet

Exception: Cables with entirely nonmetallic sheaths permitted to enter the top of a surface-mounted enclosure through one or more nonflexible raceways

Nonflexible raceways must be from 450 mm (18 in.) to 3.0 m (10 ft) in length

Where cables are installed in conduit or tubing, the cable fill cannot exceed the conductor fill permitted for complete conduit or tubing systems by Table 1 of Chapter 9

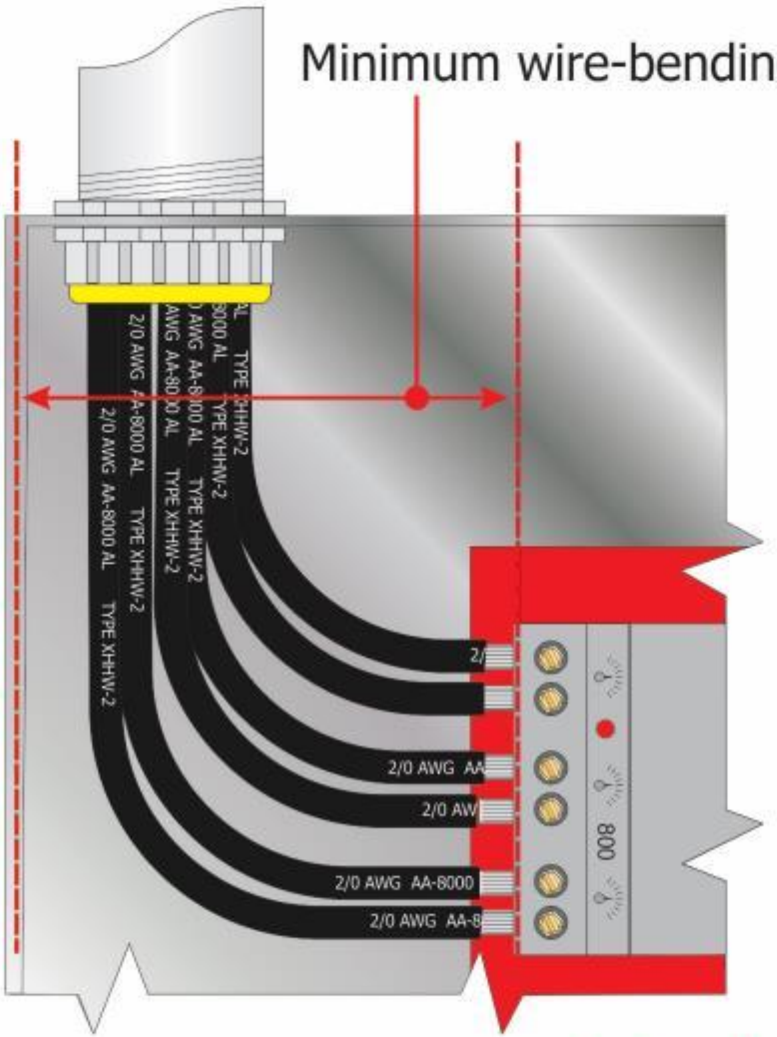
Note 2 to the tables in Chapter 9 does not apply to this condition *(Table 1 of Chapter 9 only applies to "complete conduit or tubing systems")*

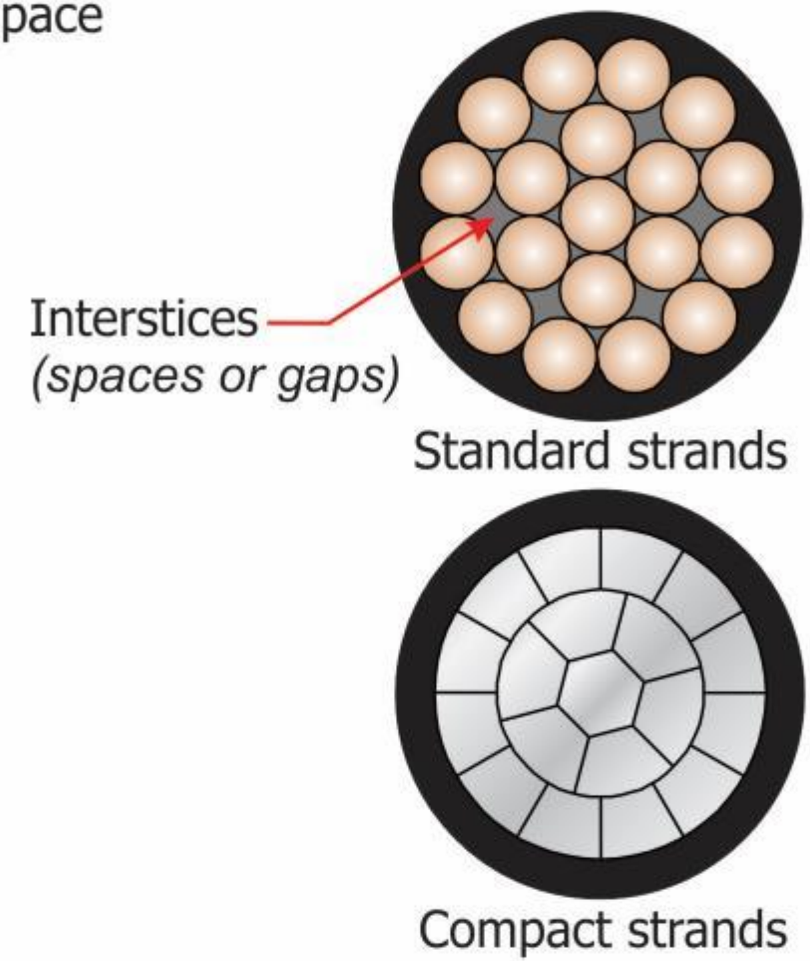
**See NEC for complete conditions of exceptio*

Table 312.6(A) Minimum Wire-Bending Space at Terminals and Minimum Width of Wiring Gutters

- New column was added to Table 312.6(A) addressing wire-bending space for **compact stranded AA-8000 aluminum alloy conductors** for consistency
- Requirements for wire-bending space at terminals and the use of Table 312.6(A) or Table 312.6(B) remained the same
- Need for consistency between Table 312.6(A) and (B)
- Dimensions added for aluminum conductors are consistent with minimum safety standards
- Provides a useful correlation with comparable material in Table 312.6(B)

Table 312.6(A) Minimum Wire-Bending Space at Terminals and Minimum Width of Wiring Gutters





A new column for compact stranded AA-8000 aluminum conductors has been added to Table 312.6(A) for minimum wire-bending space at termina

Table 312.6(A) Minimum Wire-Bending Space at Terminals and Minimum Width of Wiring Gutters

Wire Size (AWG or kcmil)		Wires per Terminal									
		1		2		3		4		5	
All Other Conductors	**Compact Stranded AA-8000 Aluminum Alloy Conductors (see Note 2)**	**mm**	**in.**	**mm**	**in.**	**mm**	**in.**	**mm**	**in.**	**mm**	**in.**
14-10	12-8	Not Specified		—	—	—	—	—	—	—	—
8-6	6-4	38.1	1½	—	—	—	—	—	—	—	—
4-3	2-1	50.8	2	—	—	—	—	—	—	—	—
2	1/0	63.5	2½	—	—	—	—	—	—	—	—
1	2/0	76.2	3	—	—	—	—	—	—	—	—
1/0-2/0	3/0-4/0	88.9	3½	127	5	178	7	—	—	—	—
3/0-4/0	250-300	102	4	152	6	203	8	—	—	—	—
250	350	114	4½	152	6	230	8	254	10	—	—
300-350	400-500	127	5	203	8	254	10	305	12	—	—
400-500	600-750	152	6	203	8	254	10	305	12	356	14
600-700	800-1000	203	8	254	10	305	12	356	14	406	16
750-900	—	203	8	305	12	356	14	406	16	457	18
1000-1250	—	254	10	—	—	—	—	—	—	—	—
1500-2000	—	305	12	—	—	—	—	—	—	—	—

Note 1: Bending space at terminals shall be measured in a straight line from the end of the lug or wire connector *(in the direction that the wire leaves the terminal)* to the wall, barrier, or obstruction.

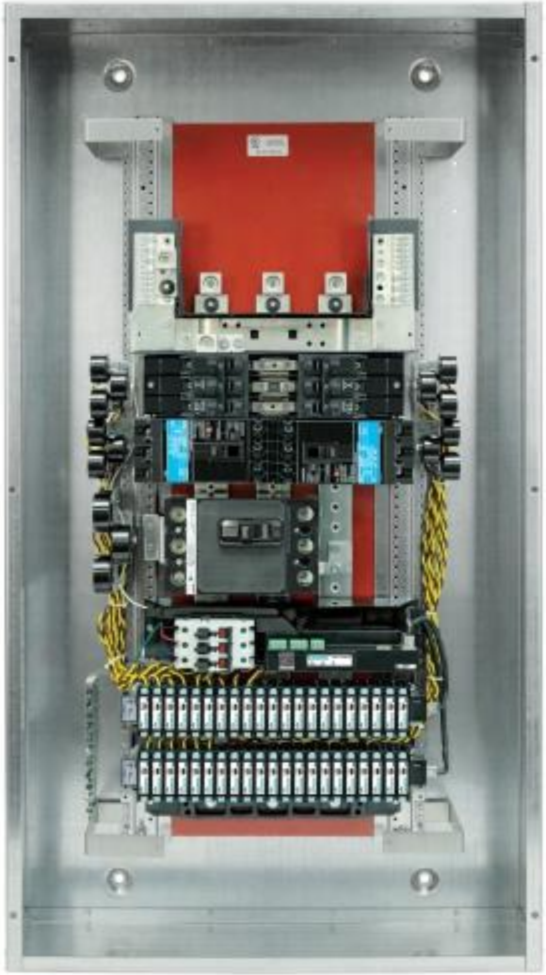
Note 2: This column shall be permitted to be used to determine the minimum wire-bending space for compact stranded aluminum conductors in sizes up to 1000 kcmil and manufactured using AA-8000 series electrical grad aluminum alloy conductor material in accordance with 310.106(B). The minimum width of the wire gutter spac shall be determined using the all other conductors value in this table.

312.8(B) Power Monitoring Equipment

- New language was added to allow **power monitoring equipment** within the wiring space of enclosures for switches or overcurrent devices with specific conditions
- This equipment is now required to be **listed for the application** when installed in the free spaces of cabinets and cutout boxes
- Satisfies a demand from the electrical industry for installation of such listed power monitoring equipment for measuring, monitoring, and controlling circuits as part of load monitoring or energy management system

312.8(B) Switch and Overcurrent Device Enclosures With Power Monitoring Equipment

Power monitoring equipment is now required to be listed for the application when installed in free spaces of cabinets and cutout boxes



Courtesy of Siemens

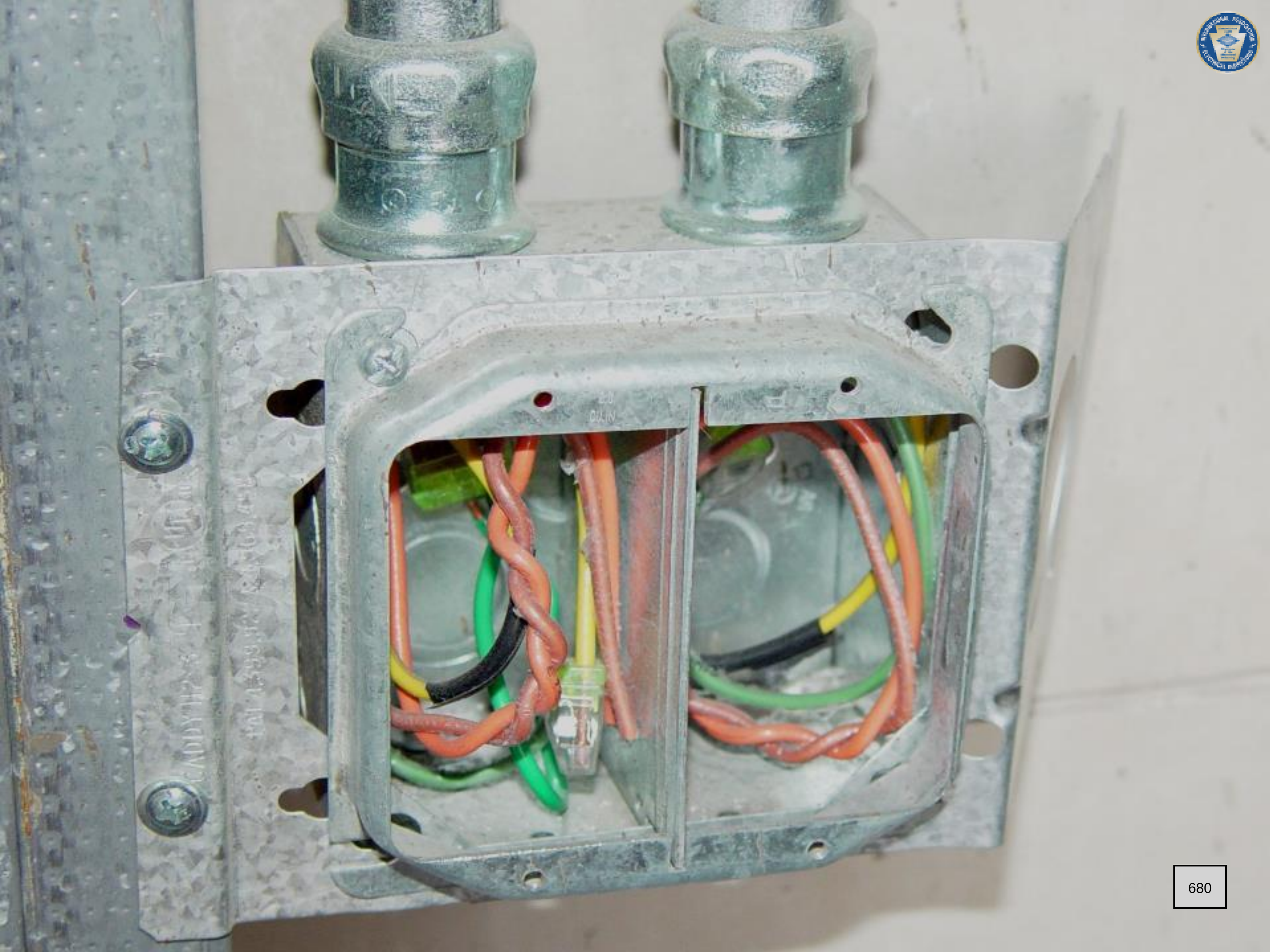
Power Monitoring Equipment - The wiring space of enclosures for switches or overcurrent devices permitted to contain power monitoring equipment where all of the following conditions are met:

(1) Identified as field installable accessory as part of the listed equipment, or is listed kit evaluated for field installation in switch or overcurrent device enclosures

(2) Total area of all conductors, splices, taps, and equipment at any cross section of the wiring space does not exceed 75 percent of the cross-sectional area of that space

314.16(A) and (B) Box Fill Calculations

- The volume or space that is occupied by an **internal barrier** in a box or enclosure has been added to the items addressed for performing a box fill calculation
- **Nonmetallic box barriers** are generally provided with its volume markings, but **metal barriers** for metal boxes are not currently marked with their volume consumption
- New added sentence at 314.16(B) will also make it clear that **each space** within a box installed with an interior barrier will need to be **calculated separately**
- Each barrier (if not marked) shall be considered to take up:
  - 8.2 cm^3 **(½ in.^3) if metal**
  - 16.4 cm^3 **(1 in.^3) if nonmetallic**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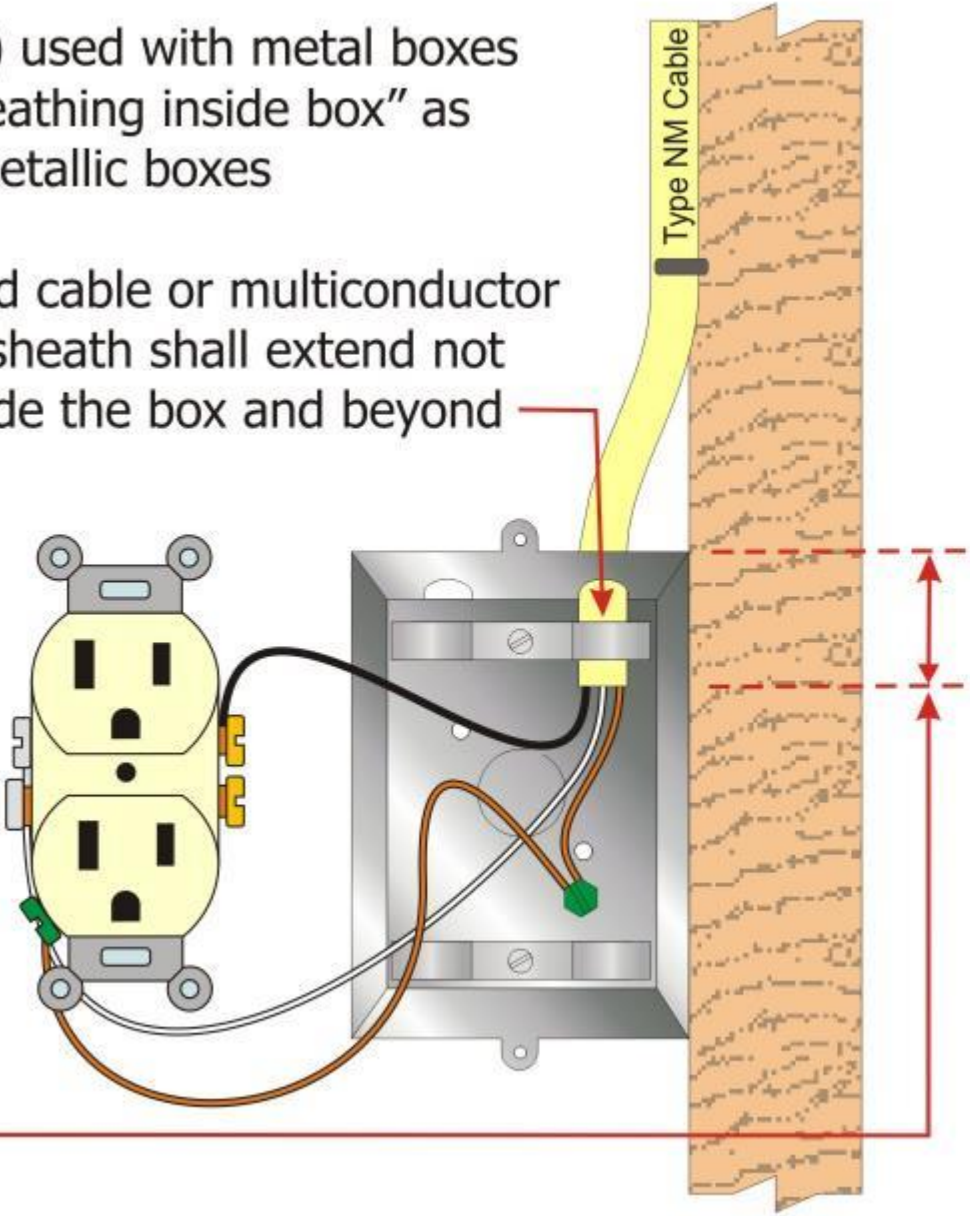
314.17(B) Cable Entering Metal Box

- The outside sheath of Type NM or Type UF cable used with **metal box** must now extend not less than **6 mm (¼ in.)** inside the box and beyond any cable clamp
- Same as currently required for nonmetallic boxes
- Same protection for cables and their associated conductors is needed when entering a metal box or conduit body as well
- Assures that cable clamp of a metal box will not be tightened down upon an exposed insulated conductor of a Type NM or Type UF cable

314.17(B) Type NM Cable Entering Metal Boxes

Type NM cable (or Type UF) used with metal boxes now requires the same "sheathing inside box" as currently required for nonmetallic boxes

Where nonmetallic-sheathed cable or multiconductor Type UF cable is used, the sheath shall extend not less than 6 mm (¼ in.) inside the box and beyond any cable clamp



Minimum 6 mm (¼ in.)

314.27(E)
Separable Attachment Fittings

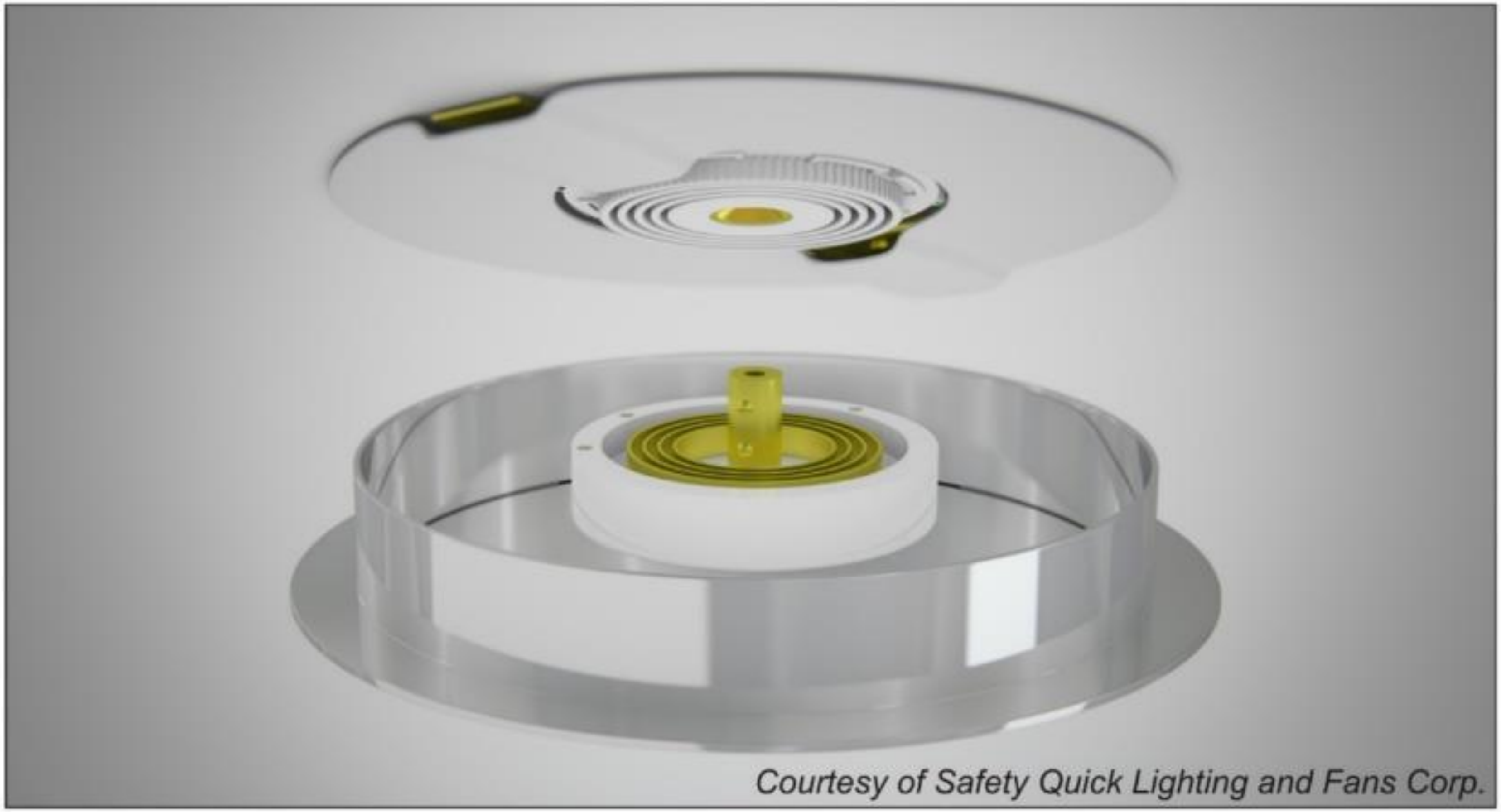
- Outlet boxes now permitted to support **listed locking support and mounting receptacles** used in combination with **compatible attachment fittings** for supporting a luminaire, lampholder, or ceiling suspended (paddle) fan
- Listed locking support and mounting receptacles are **an option** for mounting *(not a requirement)*
- Recognizes new listed technology designed to power and support luminaires and or ceiling suspended *(paddle)* fans
- Listed product provides a secure mounting mechanism and will facilitate interchange of luminaires and ceiling suspended *(paddle)* fans in a safe and efficient manner

314.27(E)
Separable Attachment Fittings *(cont.)*

- New provision for **listed locking support and mounting receptacles** for luminaires coincides with the revised definition of a "**receptacle**" in Article 100
- **Receptacle.** A contact device installed at the outlet for the connection of an attachment plug, **or for the direct connection of electrical utilization equipment designed to mate with the corresponding contact device**. A single receptacle is a single contact device with no other contact device on the same yoke. A multiple receptacle is two or more contact devices on the same yoke.
- Similar *Code* language was added at **422.18** for support of ceiling-suspended (paddle) fans

314.27(E) Separable Attachment Fittings

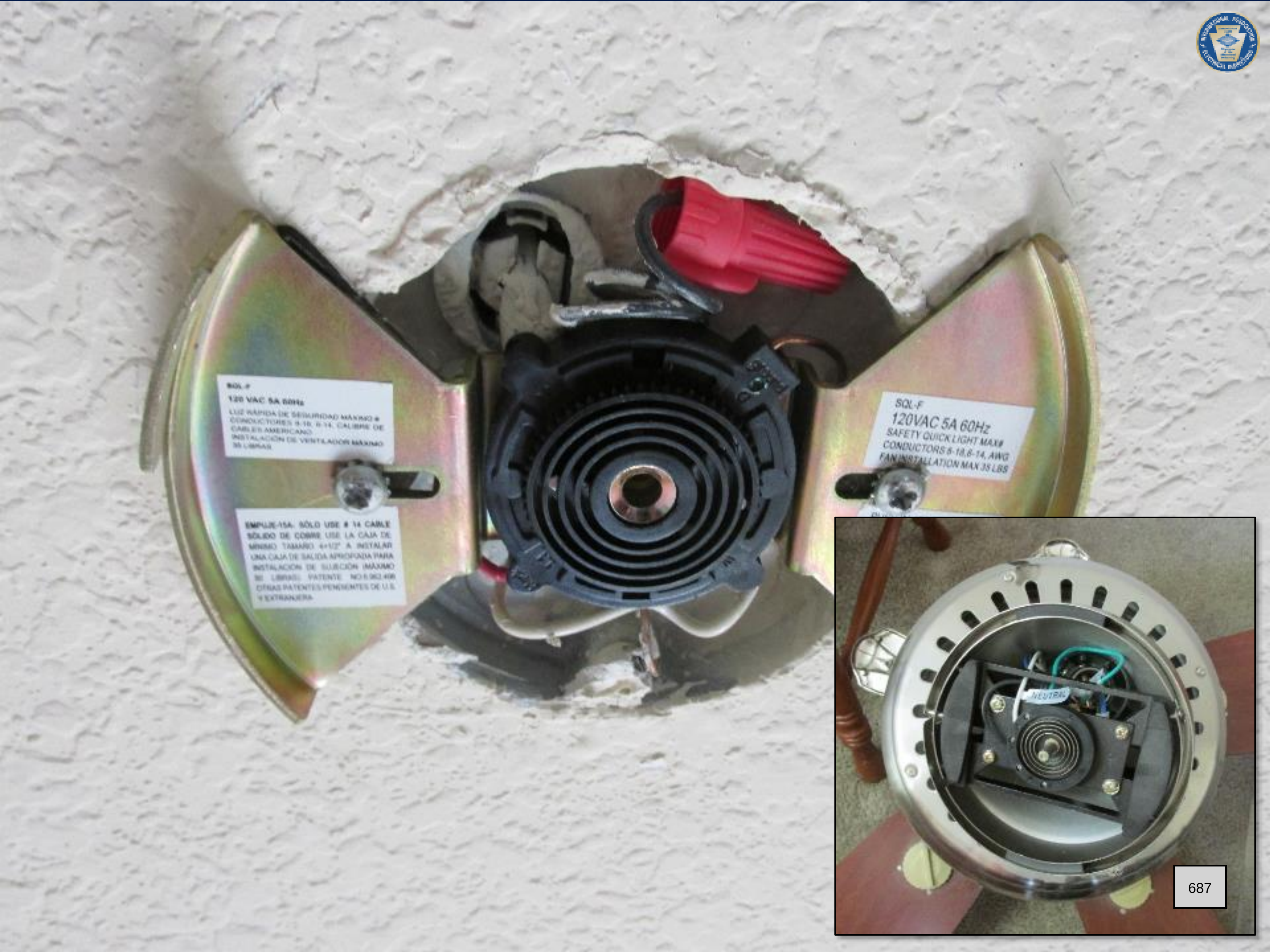
Outlet boxes permitted to support listed locking support and mounting receptacles used in combination with compatible attachment fittings



Courtesy of Safety Quick Lighting and Fans Corp.

Separable attachment fittings must be identified for the support of equipment within the weight and mounting orientation limits of the listing

Supporting receptacle installed within a box must be included in box fill calculati


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

320.6 Listing Requirements

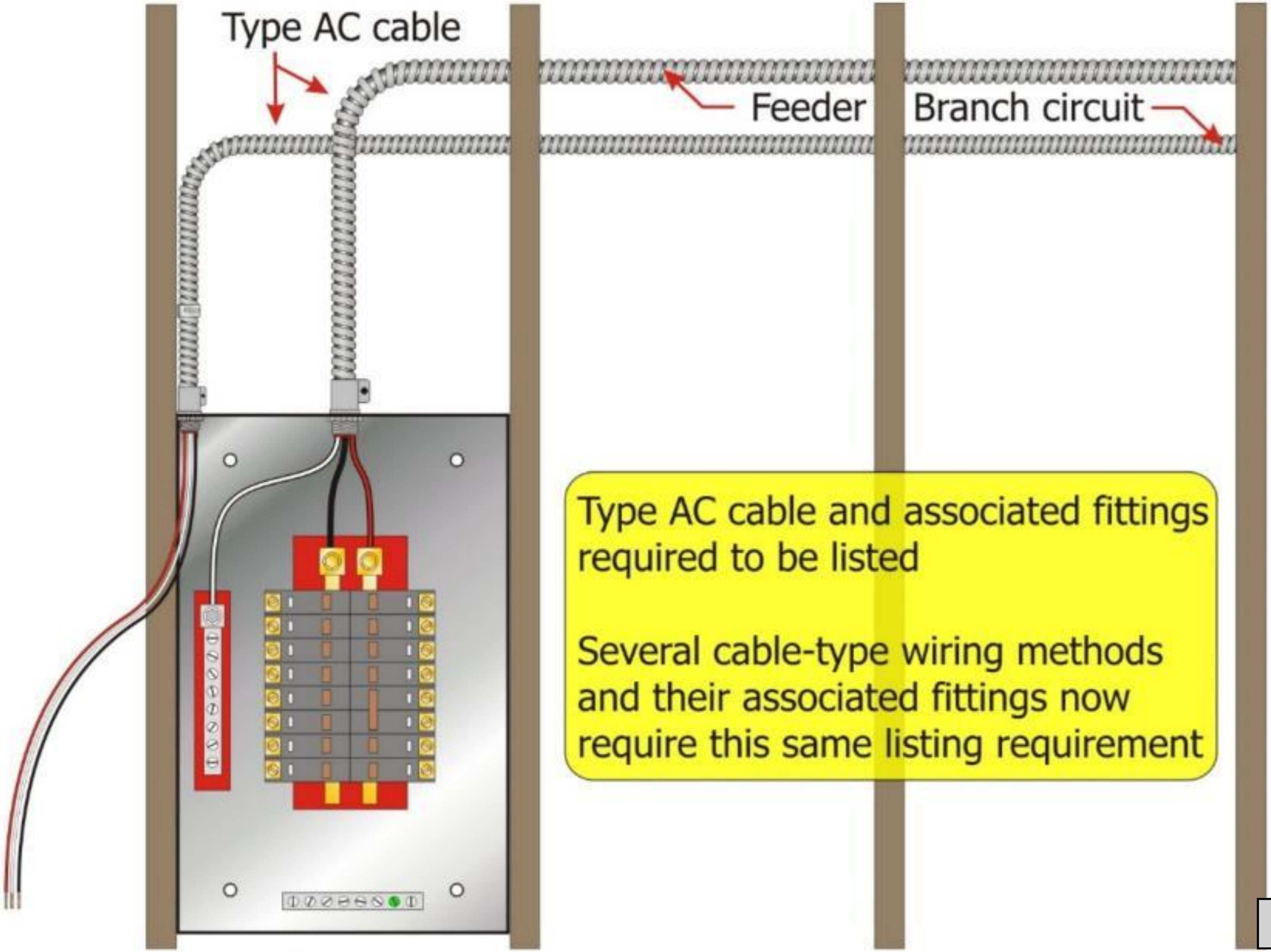
- New listing requirements were added in a number of the cable-type wiring method articles that will require the **wiring method *(cable)* and associated fittings** to be **listed**

- Must be listed for use with each other

- A non-listed cable-type wiring method may not function correctly with listed termination fittings

- This will ensure that the cable installed in the field has been evaluated to the appropriate product standard and listed for use in accordance with *NEC* regulations

320.6 Listing Requirements



Type AC cable and associated fittings required to be listed

Several cable-type wiring methods and their associated fittings now require this same listing requirement

320.6 Listing Requirements

- The same requirement that the wiring method (cable) and associated fittings be listed occurred at the following locations:

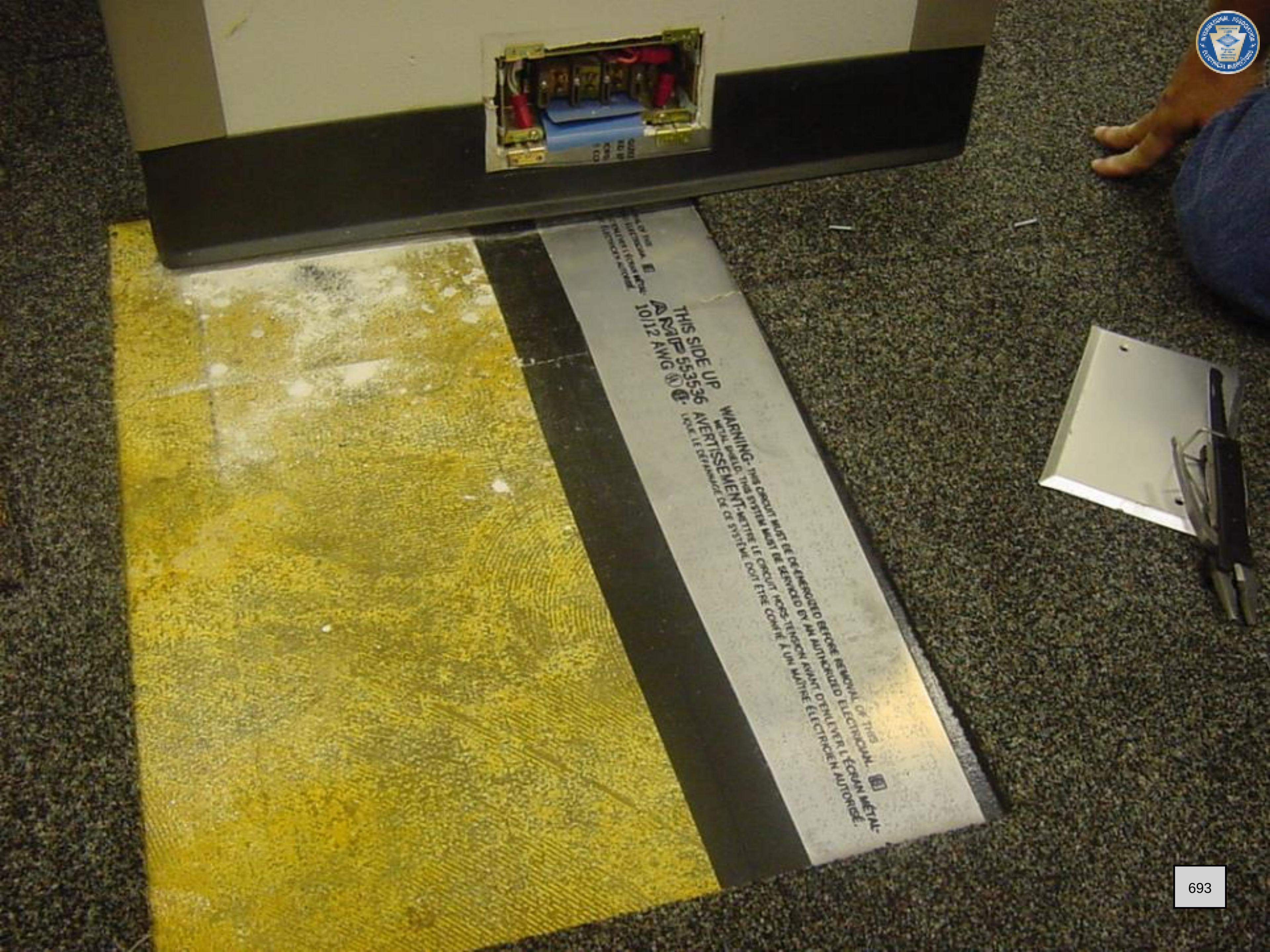
320.6	Type AC cable	FR 1808	PI 1332
322.6	Type FC cable	FR 1801	PI 1334
328.6	Type MV cable	FR 1814	PI 1336
330.6	Type MC cable	FR 1816	PI 1337
332.6	Type MI cable	FR 1806	PI 1338
334.6	Type NM cable	FR 1824	PI 886
336.6	Type TC cable	FR 1833	PI 1339
338.6	Type SE cable	FR 1827	PI 1341
340.6	Type UF cable	FR 1829	PI 887

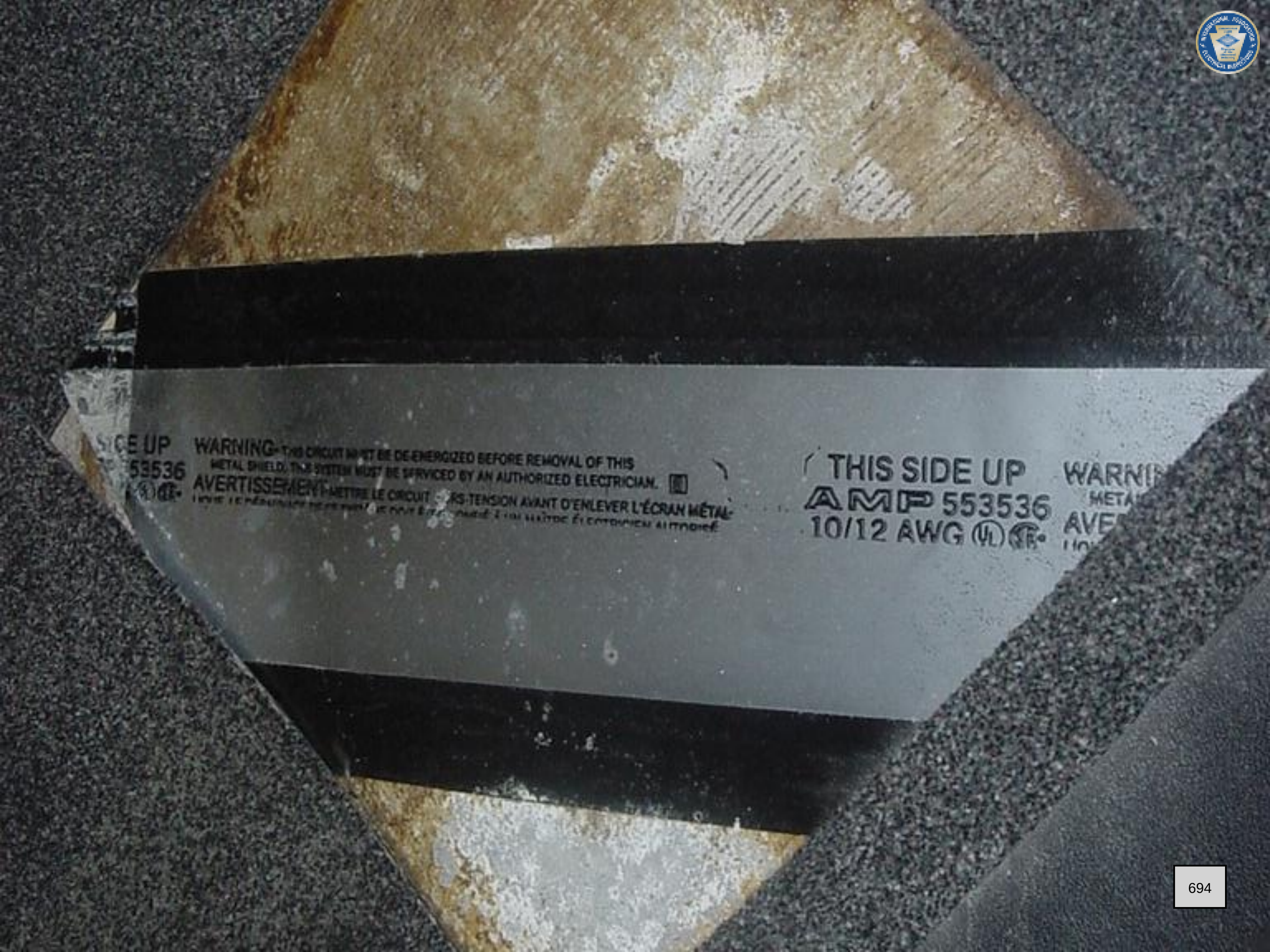
324.12(5) Uses Not Permitted Flat Conductor Cable: Type FCC

- Type FCC cable will now be permitted in **administrative office areas of hospitals and school buildings**
- Type FCC cable systems are still prohibited:
  - in outdoor or in wet locations
  - where subject to corrosive vapors
  - in any hazardous *(classified)* location
  - in school and hospital buildings *(non-administrative areas)* or
  - in residential buildings
- Type FCC cable systems is safe and reliable when installed and maintained in accordance their product specifications

324.12(5) Uses Not Permitted
Flat Conductor Cable: Type FCC *(cont.)*

- Certain areas in a school building, hospitals and emergency care centers do not present safety risks that would deter the use of **Type FFC cable** such as administration offices
- Today's modern workspace environments often requires flexibility in the design of these spaces often resulting in **open room environments** with little to no access to the building's perimeter wall receptacle outlets


THIS SIDE UP
AMP 553536
10/12 AWG
WARNING- THIS CIRCUIT MUST BE DE-ENERGIZED BEFORE REMOVAL OF THIS METAL SHIELD. THIS SYSTEM MUST BE SERVICED BY AN AUTHORIZED ELECTRICIAN.
AVERTISSEMENT- METTRE LE CIRCUIT HORS-TENSION AVANT D'ENLEVER L'ÉCRAN MÉTALLIQUE. LE DÉPANNAGE DE CE SYSTÈME DOIT ÊTRE CONFIÉ À UN MAÎTRE ÉLECTRICIEN AUTORISÉ.


SIDE UP
53536
WARNING- THIS CIRCUIT MUST BE DE-ENERGIZED BEFORE REMOVAL OF THIS METAL SHIELD. THE SYSTEM MUST BE SERVICED BY AN AUTHORIZED ELECTRICIAN.
AVERTISSEMENT- METTRE LE CIRCUIT HORS-TENSION AVANT D'ENLEVER L'ÉCRAN MÉTAL-
THIS SIDE UP
AMP 553536
10/12 AWG
WARNI
METAL
AVE

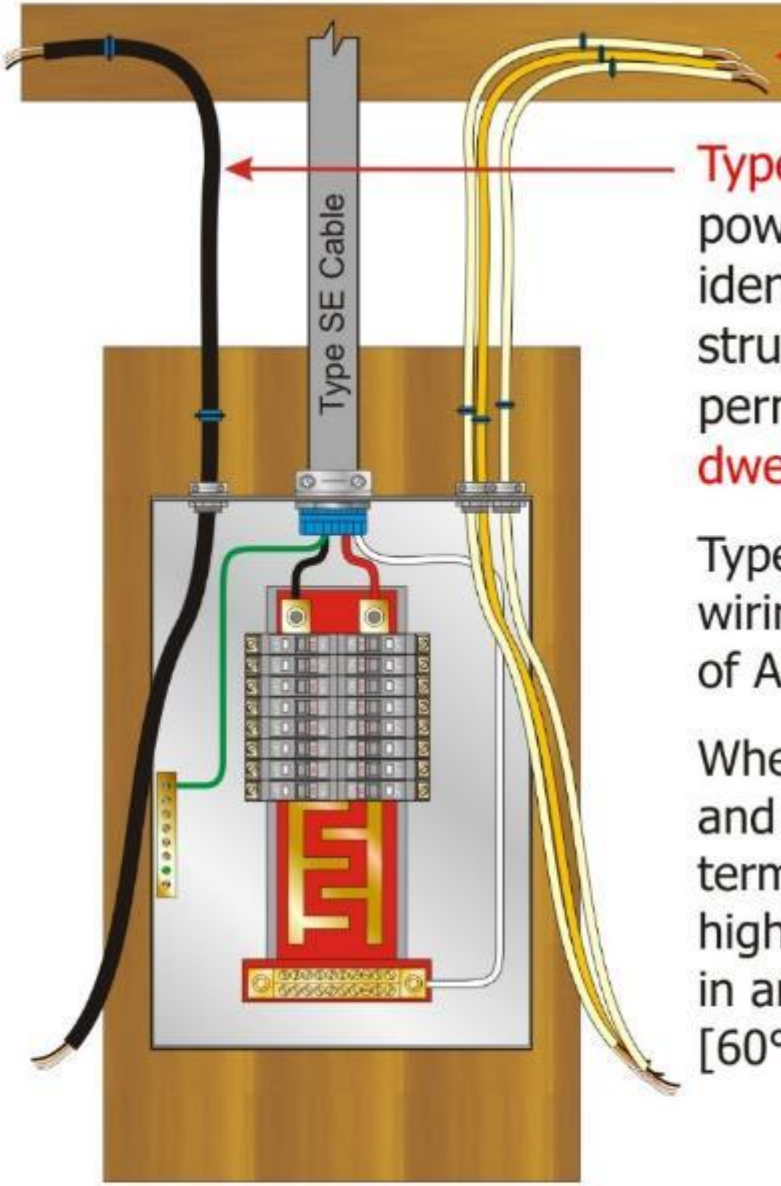
336.10(9) Power and Control Tray Cable: Type TC

- **Type TC-ER** cable with a designation of "**JP**" will now be allowed exposed without a raceway at **dwelling units**
- There are now 9 different list items under "Uses Permitted" for Type TC cable
- Type TC-ER cable containing both power and control conductors that is identified for pulling through structural members to be installed in **one- and two-family dwelling units**
- The "**-ER**" suffix stands for "**Exposed Run**"
- The "**-JP**" suffix stands for "**Joist Pull**"

336.10(9) Power and Control Tray Cable: Type TC *(cont.)*

- Type TC-ER cable meets or exceeds:
  - Construction specifications for nonmetallic-sheathed cable (Type NM cable)
  - UL product standard crush and impact ratings for Type NM cable and Type SE and SER cable
  - UL crush and impact tests for Type MC cable
- This type of cable has gained popularity when installing a standby power generator at a dwelling unit
- By allowing Type TC-ER cable to be installed exposed in a dwelling unit, the installer can secure the cable to the lower side of joists in unfinished basements or crawl spaces without installing a raceway for the cable

336.10(9) Uses Permitted for Type TC Cable



Type TC-ER cable containing both power and control conductors identified for pulling through structural members (JP) now permitted in one- and two-family dwelling units

Type TC-ER cable used as interior wiring must be installed per Part II of Article 334

Where used to connect a generator and associated equipment having terminals rated 75°C (167°F) or higher, the cable shall not be limited in ampacity by 334.80 or 340.80 [60°C (140°F)]

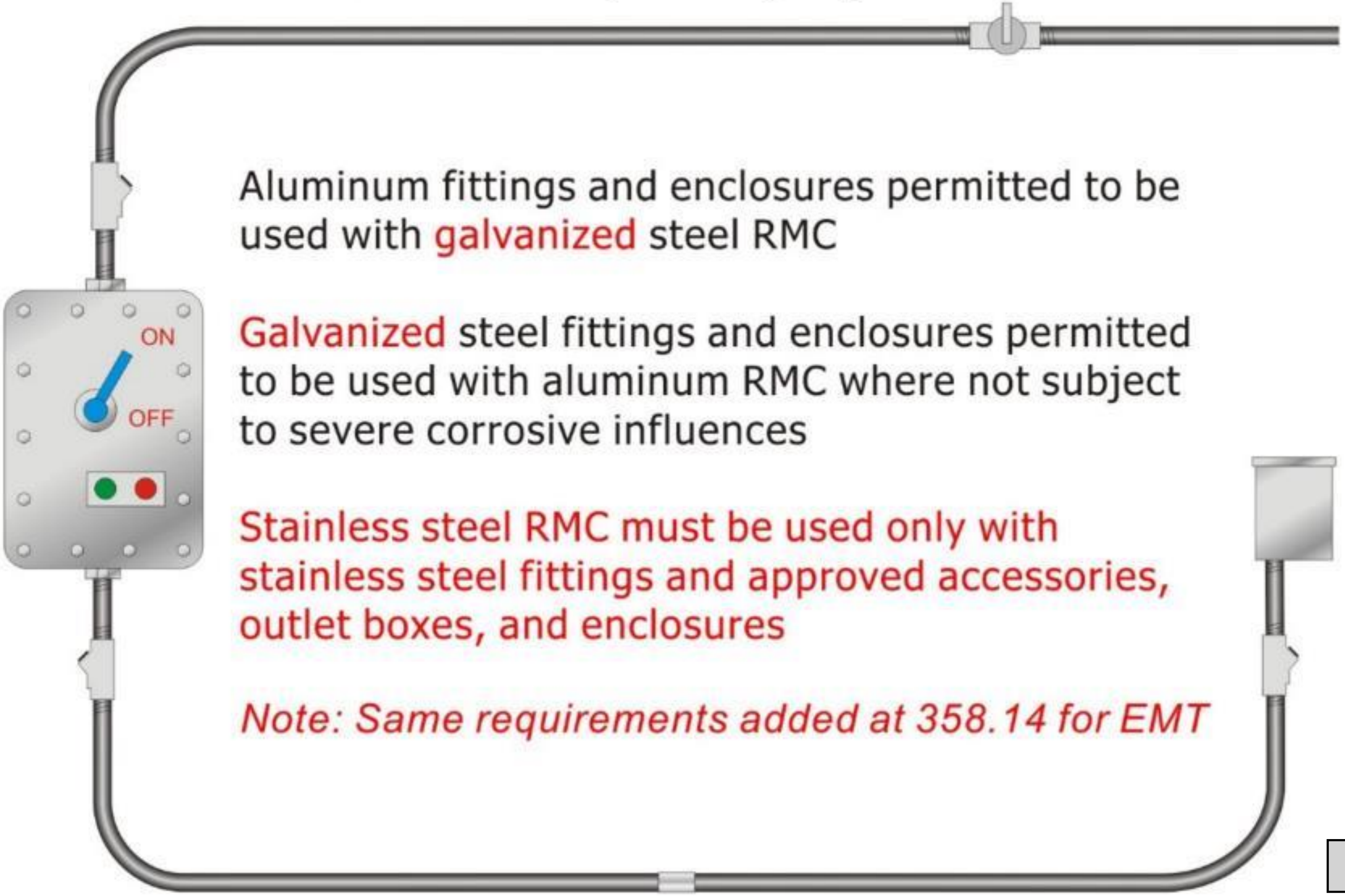
Cable illustration courtesy of Southwire

344.14 Dissimilar Metals: Type RMC

- **Stainless steel RMC** can only be used with stainless steel fittings, approved accessories, stainless steel outlet boxes, and stainless steel enclosures
- Revisions clarify the acceptable fittings that can be used with different types of RMC, based on **galvanic compatibility**
- A galvanic action or corrosion is an electrochemical process in which one metal corrodes preferentially to another when both metals are in electrical contact *(in the presence of an electrolyte)*
- Stainless steel RMC used with aluminum or galvanized fittings, accessories, outlet boxes and enclosures could result in a galvanic action and leading to corrosion of the stainless steel

344.14 Dissimilar Metals: Type RMC

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



Aluminum fittings and enclosures permitted to be used with galvanized steel RMC

Galvanized steel fittings and enclosures permitted to be used with aluminum RMC where not subject to severe corrosive influences

Stainless steel RMC must be used only with stainless steel fittings and approved accessories, outlet boxes, and enclosures

Note: Same requirements added at 358.14 for EMT

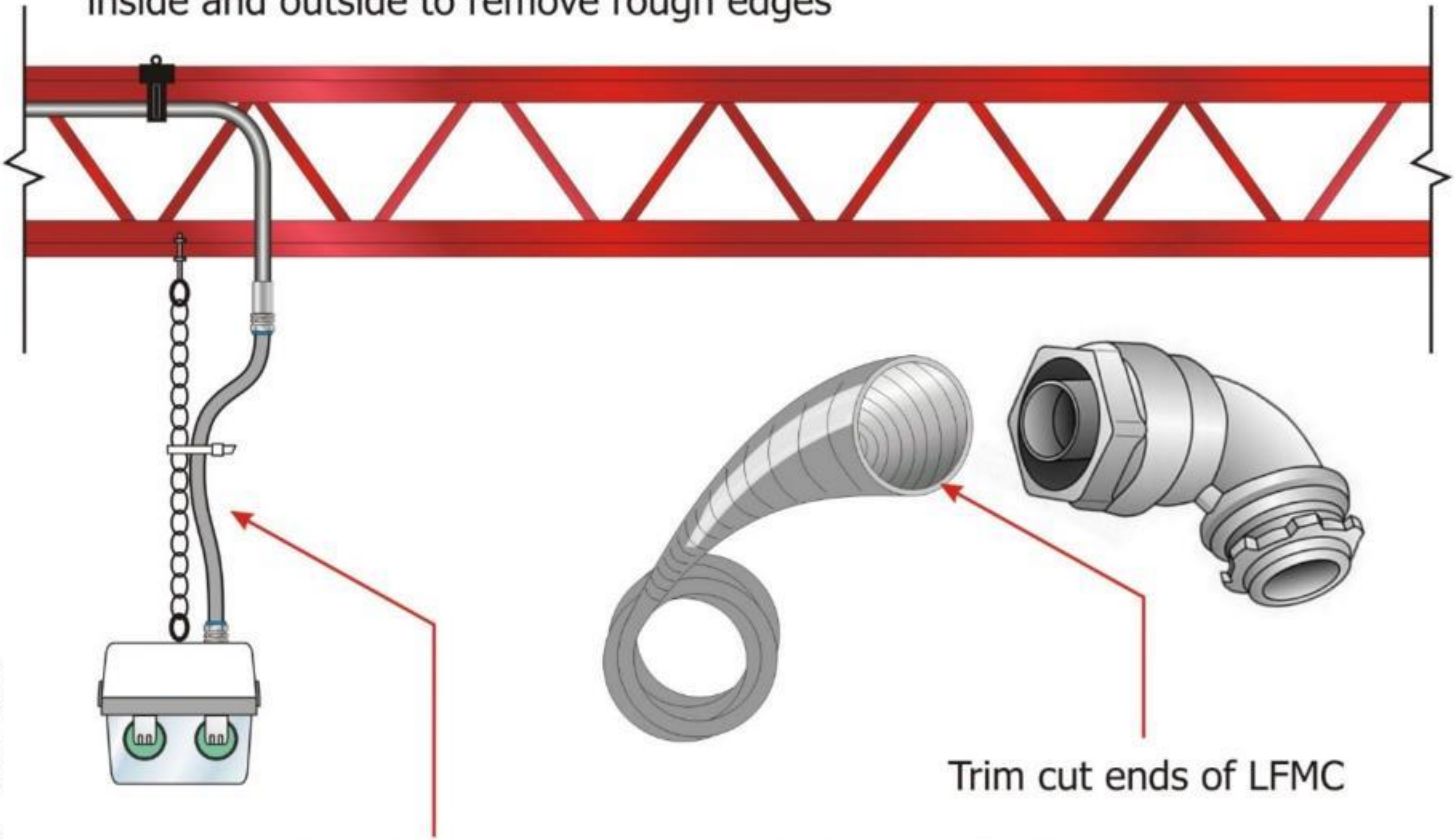
Stainless Steel
Rigid RMC

350.28 Trimming of LFMC

- New language added requiring cut ends of liquidtight flexible metal conduit *(Type LFMC)* to be **trimmed inside and outside** to remove rough edges
- Proper trimming of Type LFMC is necessary as to allow the proper installation of the steel grounding ferrule
- Important to maintain ground continuity of the steel sheath of Type LFMC
- Trimming of the cut ends should be done to prevent chafing of pulled conductors
- Provides consistency between Article 350 and Article 356 (LFNC) and other *NEC* articles for trimming and reaming

350.28 Trimming of LFMC

All cut ends of liquidtight flexible metal conduit (LFMC) shall be trimmed inside and outside to remove rough edges



Trim cut ends of LFMC

Liquidtight flexible metal conduit installed where flexibility is necessary after installation


03MAR16

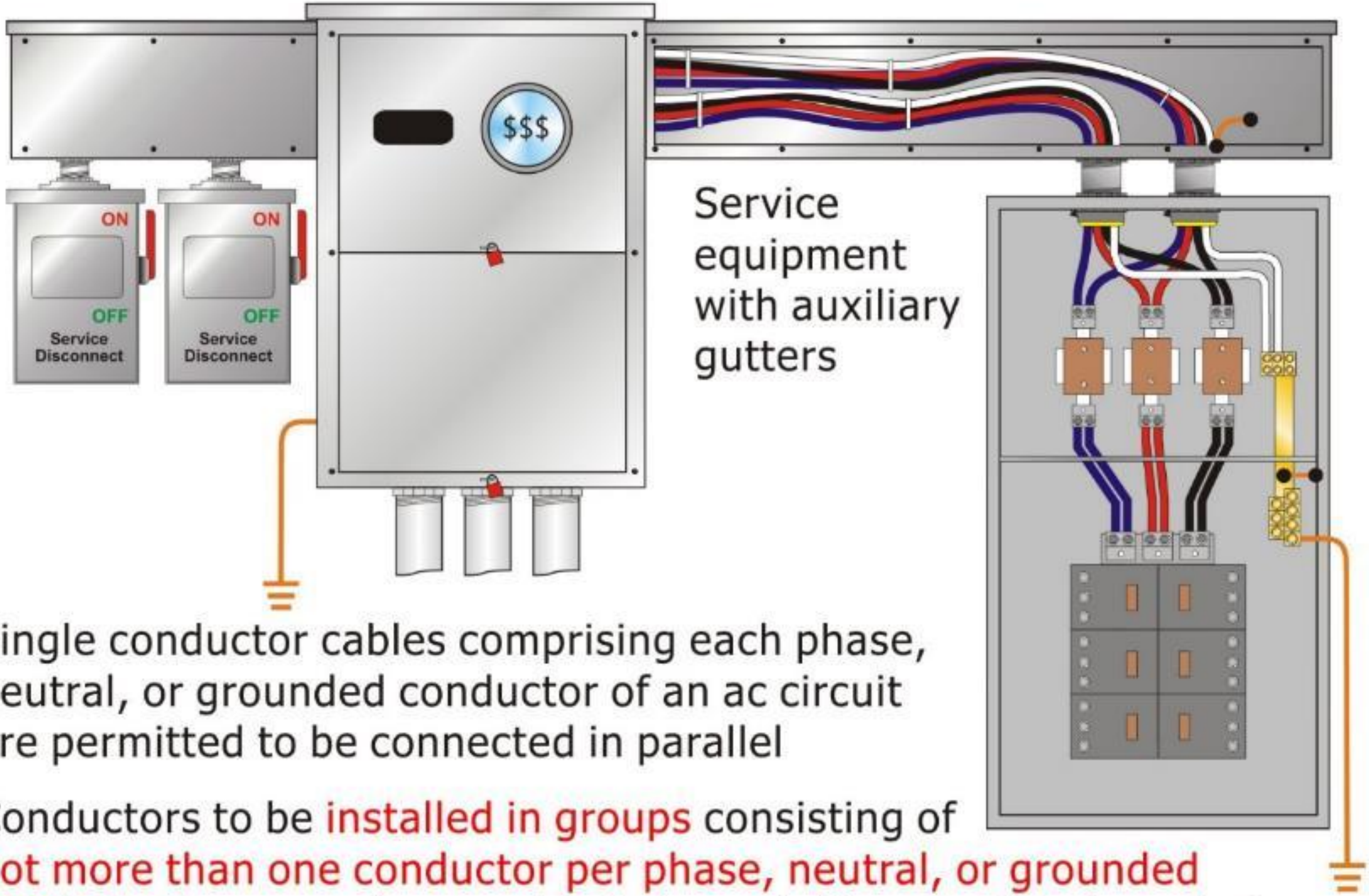
358.10 Uses Permitted – Type EMT

- The "Uses Permitted" for EMT has been revised for consistency with other steel conduit articles *(Type IMC and RMC)*
- Some requirements or "uses" for EMT were moved from 358.12 *(Uses Not Permitted)* and reworded using positive language
- Provisions for stainless steel EMT were also added
- Clarification of the use of galvanized steel, stainless steel, and aluminum EMT in corrosive environments and concrete
- If supplementary corrosion protection is required or desired, it can be provided by a factory-applied PVC coating, paint approved for the purpose, or tape wraps approved for the application

366.20
Parallel Conductors In Auxiliary Gutters

- Language added to address how to install **conductors in parallel in an auxiliary gutter**
- An auxiliary gutter is designed for conductors to be laid or set in place after the enclosures have been installed as a complete system
- Documented failures of paralleled conductors have occurred when these conductors were installed in wireways and auxiliary gutters and were **not grouped together**
- Leads to overheating and insulation breakdown due to the **induction process**
- Primary concerns when installing conductors in parallel are ensuring that each conductor in the paralleled set has the **same electrical characteristics** as the others in the same set

366.20 Parallel Conductors in Auxiliary Gutters



Service equipment with auxiliary gutters

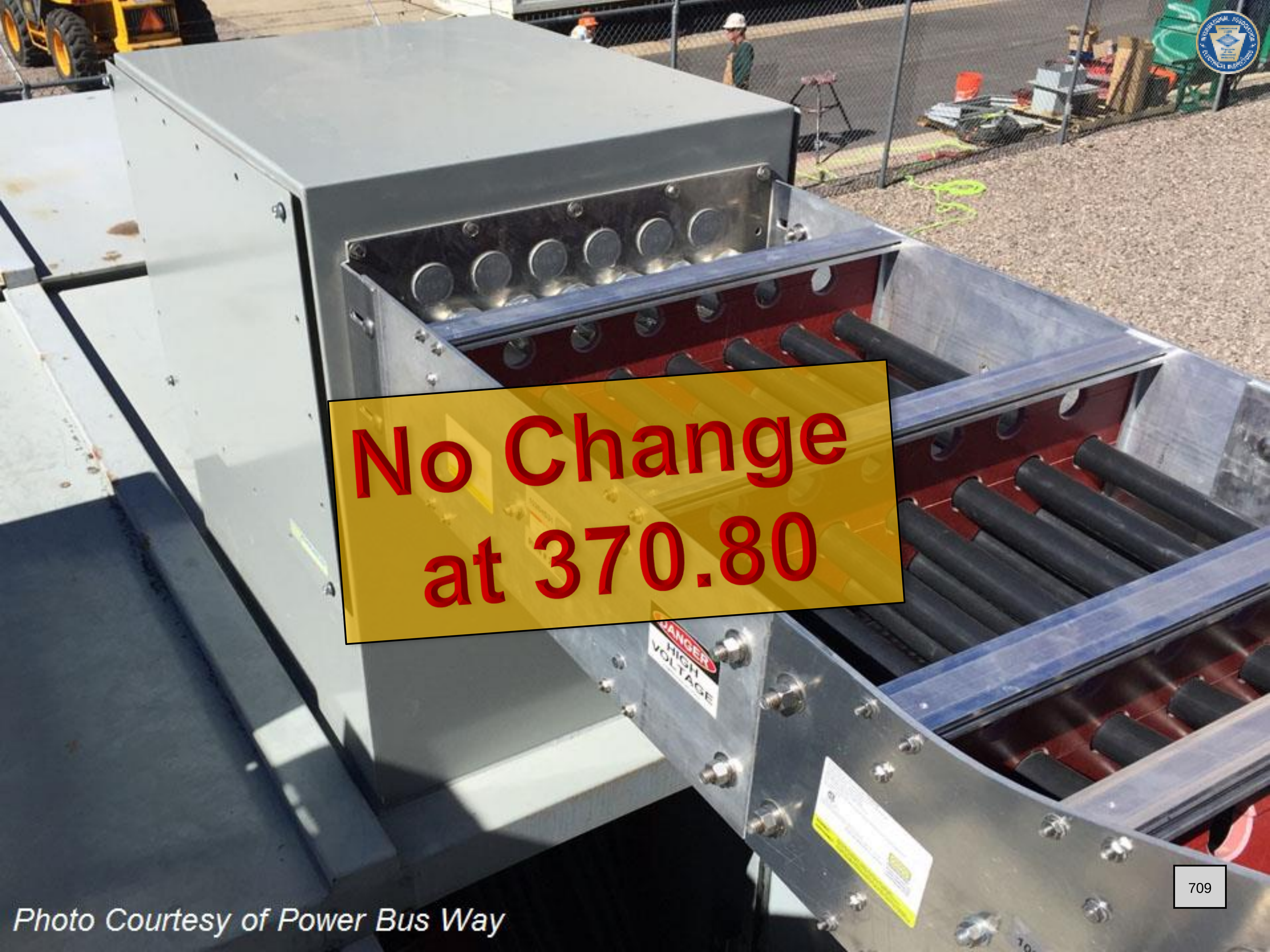
Single conductor cables comprising each phase, neutral, or grounded conductor of an ac circuit are permitted to be connected in parallel

Conductors to be installed in groups consisting of not more than one conductor per phase, neutral, or grounded conductor to prevent current imbalance in the paralleled conductors due to inductive reactance

370.80 Cablebus-Ampacity of Conductors

- Additional information was proposed to be added to provide clarity for the allowable ampacities for cables installed in cablebus assemblies (Article 370) and aligns ampacities with cable tray installations (Article 392)
- **This 2017 *NEC* change was overturned by the NFPA Standards Council at its August 3-4, 2016 meeting *(see Standards Council Agenda Item 16-8-3-f)***
- **Standards Council decision on CAM 70-13 and Second Revision 2110 returned the *Code* language at 370.80 to the 2014 *NEC Code* language**

No Change at 370.80



No Change at 370.80

Photo Courtesy of Power Bus Way

Chapter Four
Equipment for General Use

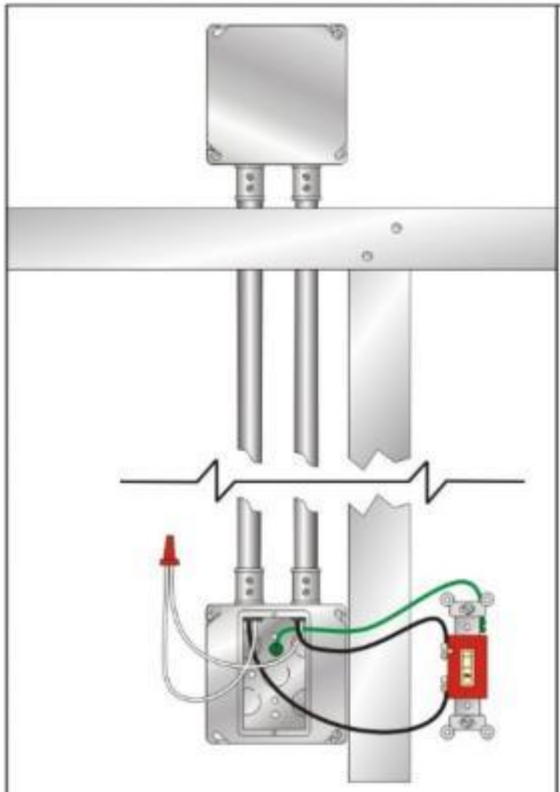
404.2(C)
Grounded Conductor at Switch Locations

- The previous seven “conditions” in which a grounded conductor was not required to be installed at lighting switch locations has been revised and reduced to only **five “conditions”**
- Previous condition **(4) and (5) moved** from these conditions to the parent text of 404.2(C) and reworded into positive language
- Enforceable language was added to require the grounded conductor to be **connected and used** by the switching device rather than simply be “present” at the switch enclosure
- Exception added to **exclude replacement or retrofit switches** installed in locations prior to local adoption of 404.2(C) where the grounded conductor cannot be extended without removing finish materials
- New exception also puts a limit to the number of electronic lighting control switches on a branch circuit **(5)** or feeder **(25)**

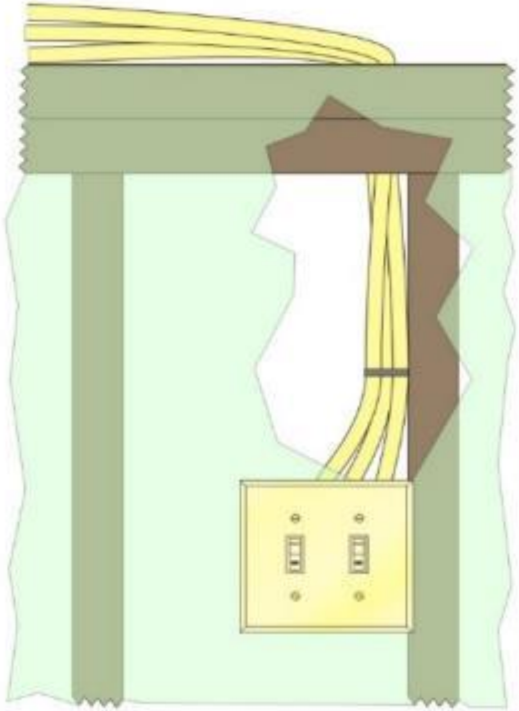
404.2(C) Grounded Conductor at Switch Locations

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:



Raceway system large enough for all contained conductors



Accessible for the installation of additional cable without removing finish materials

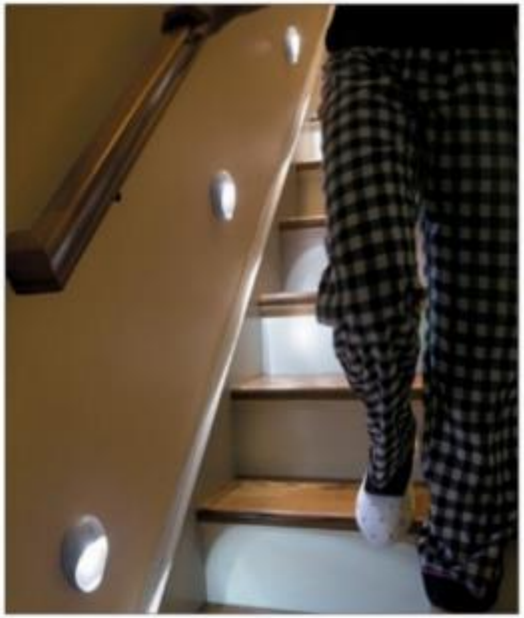
(Courtesy of Leviton/Cheetah USA)

Snap switches with integral enclosures comply with 300.15(E)

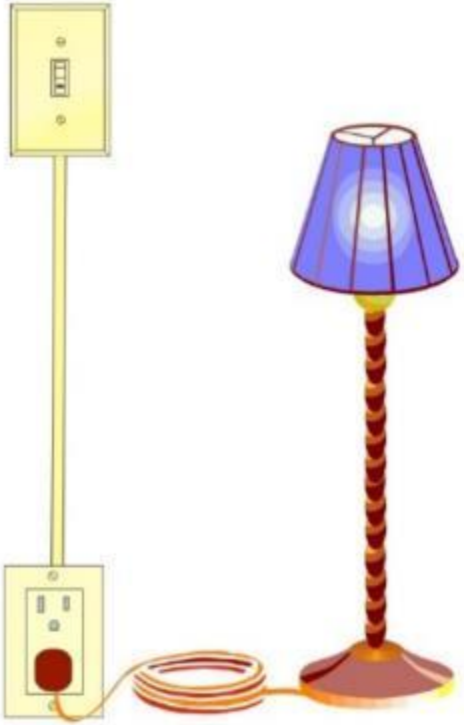
404.2(C) Grounded Conductor at Switch Locations

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 lighting in the area is controlled by automatic means *(such as a motion sensor)*



Where a switch controls a receptacle load

Switch for non-habitation type room or occupancies as defined by applicable building code

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

404.22

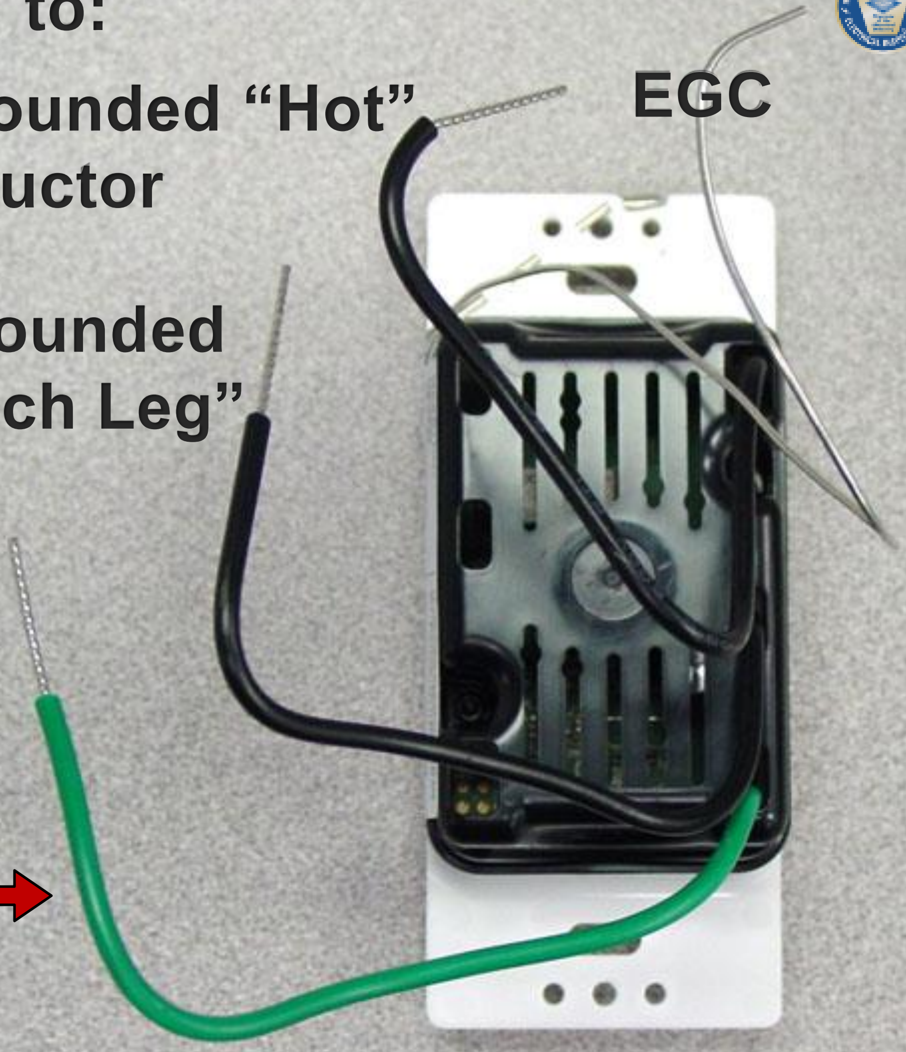
Electronic Lighting Control Switches

- New provisions added for "Electronic Lighting Controlled Switches" **prohibiting current** on the **equipment grounding conductor** with a future effective date
- In conjunction with revisions to 404.2(C), electronic lighting control switching devices to be listed and **"shall not introduce current on the equipment grounding conductor during normal operation"**
- Currently, readily-available existing listed electronic lighting control switching devices requiring EGC to be used as grounded conductor per the **manufacturer's instructions**
- This probation on introducing current on the EGC requirement has a future effective date on **January 1, 2020**

404.22
Electronic Lighting Control Switches *(cont.)*

- One of the main reasons to prohibit a grounded conductor from being connected to equipment grounding conductor(s) is to **eliminate circulating currents** from being introduced into the equipment grounding conductor path
- New language will require insulated grounded supply conductor to be **installed and used** with the proper listed electronic device
- **New exception** will recognize **retrofit** installation or **replacement** situation in existing situations where the grounded conductor is not installed

Connection to:



Ungrounded "Hot" Conductor

EGC

Ungrounded "Switch Leg"

Grounded Conductor (if present), EGC if Grounded Conductor is Not Present

406.2 Definition: Outlet Box Hood

- Definition for the term "**outlet box hood**" was added at 406.2
- Outlet box hoods commonly referred to in the field as "in-use" covers or "bubble" covers
- All outlet box hood covers should be required to be listed for use in a wet location when installed in a wet location
- Relied upon to provide environmental protection for enclosed devices such as GFCI receptacle outlet devices
- **Nonmetallic** outlet box hoods are typically constructed of UV resistant polycarbonate while the **metal enclosures** are typically made of powder-coated cast zinc

406.2 Definition: Outlet Box Hood

A housing shield intended to fit over a faceplate for flush-mounted wiring devices, or an integral component of an outlet box or of a faceplate for flush-mounted wiring devices.

The hood does not serve to complete the electrical enclosure; it reduces the risk of water coming in contact with electrical components within the hood, such as attachment plugs, current taps, surge protective devices, direct plug-in transformer units, or wiring devices.


EXTRA DUTY
LIFT
OPEN


EXTRA DUTY


EXTRA DUTY
WET LOCATIONS WHEN COVER CLOSED
reddot

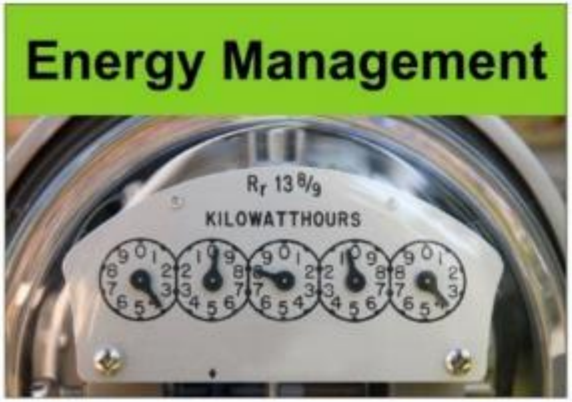

TAYMAC

406.3(E) Controlled Receptacle Marking

- The word “**Controlled**” is now required to be placed on the controlled receptacle along with the previous symbol
- The word “**Controlled**” was also added to Figure 406.3(E)
- The controlled receptacle symbol and the word “**Controlled**” are **to be placed on the controlled receptacle face** *(not the faceplate or cover)* and remain visible after installation
- This will assure that the end user of this receptacle knows that it is being controlled and **could become de-energized**
- This removes any misunderstanding due to a “symbol” on the receptacle that might not be understood by the end user

406.3(E) Controlled Receptacle Marking

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



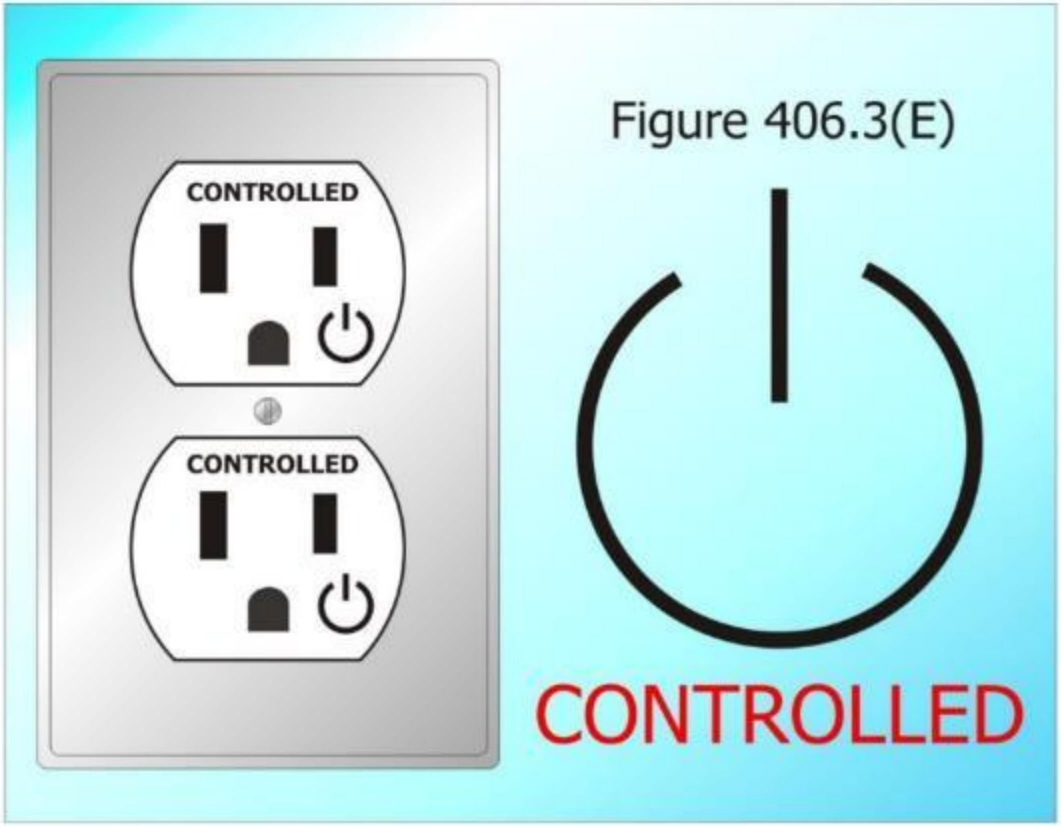


Figure 406.3(E)

For receptacles controlled by an automatic control device, the marking shall be located on the receptacle face and visible after installation

406.3(F) Receptacle with USB Charger

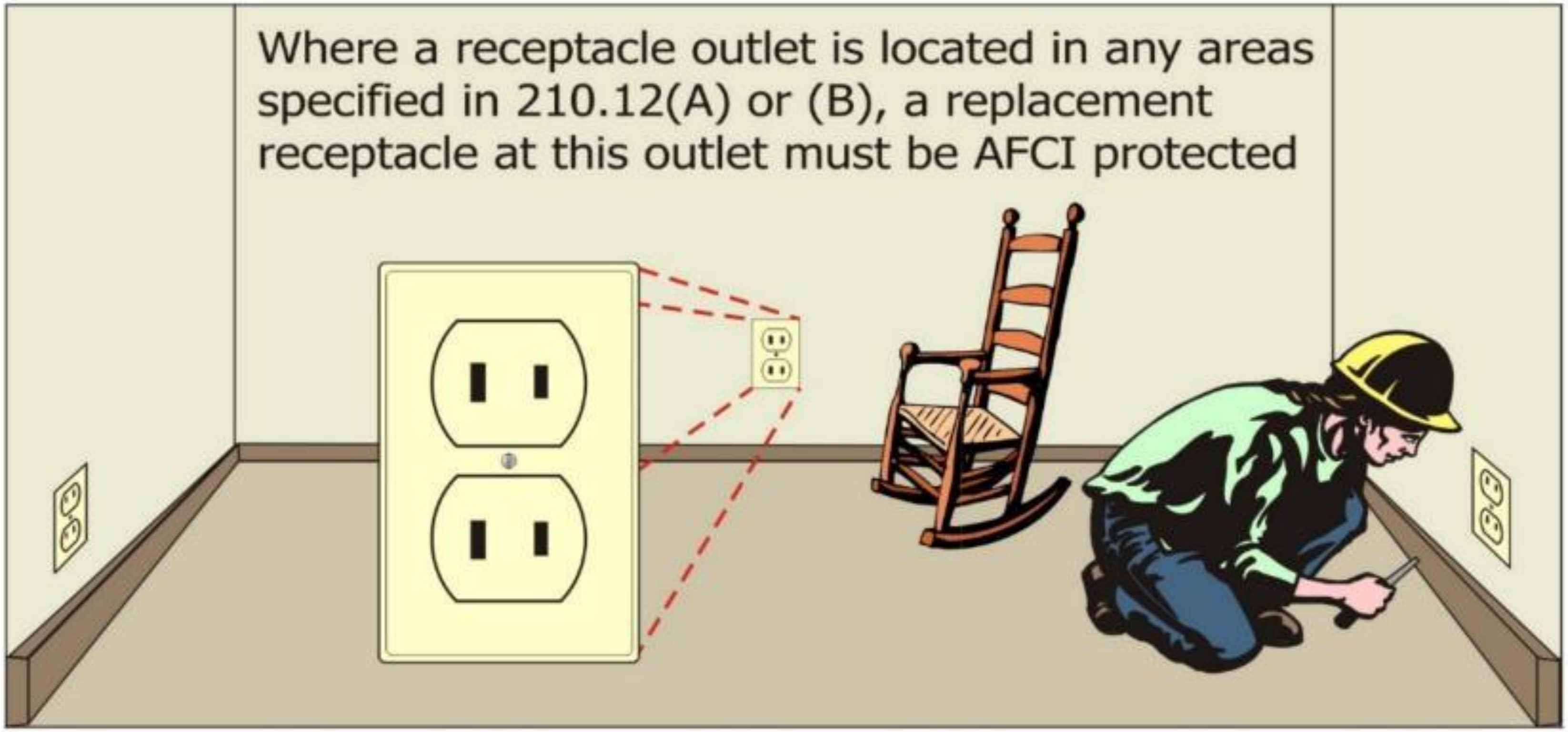
- New provisions added pertaining to 125-volt 15- or 20-ampere receptacle that additionally provides Class 2 power in the form of a **USB outlet and charger**
- New provisions require these devices to be **listed** and constructed such that the Class 2 circuitry is **integral with the receptacle**
- **Universal Serial Bus *(USB)*** is an industry standard that defines the cables, connectors and communications protocols used in a bus for connection, communication, and power supply between computers and electronic devices
- Some Class 2 power supply and Class 2 output connector(s) are intended to be secured and directly connected to a duplex receptacle *(not integral with the receptacle)*


SAMSUNG

406.4(D)(4), Ex. No. 1 and Ex. No. 2
AFCI for Replacement of Existing Receptacles

- Two new exceptions were added for AFCI requirements for replacement of existing receptacles
- First new exception recognizes applications where an existing two-wire receptacle is replaced and no equipment grounding conductor can be installed *(existing two-wire system)*
- Second new exception stipulates that the exception to 210.12(B) **does not apply** when replacing existing receptacles
- Exception to 210.12(B) permits existing branch circuit conductors to be modified or extended up to 1.8 m (6 ft) without AFCI protection where no additional outlets or devices are installed

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



Where a receptacle outlet is located in any areas specified in 210.12(A) or (B), a replacement receptacle at this outlet must be AFCI protected

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

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

Where a receptacle outlet is located in any areas specified in 210.12(A) or (B), a replacement receptacle at this outlet must be AFCI protected

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

[210.12(B), Ex.: AFCI protection not required where the extension of the existing conductors is not more than 1.8 m (6 ft.) and does not include any additional outlets or devices]

406.4(D)(5) Tamper-Resistant Receptacles for Replacements

- Tamper-resistant receptacles required for replacement receptacles “**except where a non-grounding receptacle is replaced with another non-grounding receptacle**”
- Listed tamper-resistant receptacles are generally required to be provided where receptacles are replaced at receptacle outlets that are required to be tamper-resistant elsewhere in the *Code*
- Listed tamper-resistant receptacles are **not manufactured or available** in a nongrounding, two-prong receptacle style
- 406.4(D)(2)(a) permits a non-grounding-type receptacle as a replacement for another non-grounding-type receptacle

406.4(D)(5) Receptacle Replacement Tamper-Resistant Receptacles

Listed tamper-resistant receptacles are required for replacement receptacles where a receptacle outlet is required to be tamper-resistant elsewhere in the *Code* "except where a non-grounding receptacle is replaced with another non-grounding receptacle"

406.6(D) Receptacle Faceplate *(Cover Plates)* with Integral Night Light and/or USB Charger

- New requirements were added pertaining to receptacle faceplates with **integral night lights and/or USB chargers**
- These faceplates must be **listed** and constructed such that the night light and/or Class 2 circuitry is "**integral with the flush device cover plate**"
- Plug-in night light/covers that is not "integral with the flush device cover plate," but simply designed to be plugged directly into a receptacle outlet presents a problem
- The ease in removing these night light-type covers from the receptacle outlet increases its safety hazard

406.6(D) Receptacle Faceplate (Cover Plates) with Integral Night Light and/or USB Charger

Receptacle faceplates shall be installed so as to completely cover the opening and seat against the mounting surface

Courtesy of SnapPower

A flush device cover plate that additionally provides a night light and/or Class 2 output connector(s) shall be listed

The night light and/or Class 2 circuitry must be integral with the flush device cover plate

Courtesy of SnapPower

406.9(B)(1) Extra-Duty Outlet Box Hoods

- Other listed products, enclosures, or assemblies providing weatherproof protection that do not utilize an outlet box hood **need not be marked “extra duty”**
- These power outlets *(other listed products)* typically locate a receptacle behind a hinged steel cover, which is not an outlet box hood, and need not be identified as "extra duty"
- This has caused some **confusion over the lack of "extra duty" identification** on these types of listed assemblies
- This change provides needed clarity and eliminates confusion within the electrical industry

406.9(B)(1) Extra-Duty Outlet Box Hoods

An outlet box hood installed at an enclosure for 15 and 20 amperes, 125 and 250 volt receptacles in a wet location to provide weatherproof protection whether or not an attachment plug cap is inserted or not must be listed and identified as “extra duty”

Must be Marked “Extra Duty”

“Extra Duty” Not Required

Other listed products, enclosures, or assemblies providing weatherproof protection that do not utilize an outlet box hood need not be marked “extra duty”

406.12 Tamper-Resistant Receptacles

- Requirements for tamper-resistant *(TR)* receptacles **expanded** to locations **where small children are likely to congregate** and have ready access to energized receptacle outlets
- TR receptacles expanded to **250 volt receptacles** as well as 125 volt receptacles
- Receptacles rated at 250 volts are commonly used for air-conditioning and heating units in dwelling units, guest rooms and guest suites of hotels and motels as well as other locations
- TR receptacle requirements expanded to other dwelling unit areas such as **mobile and manufactured homes**
- Reorganized to put the areas that require TR receptacles into a **list format**

406.12
Tamper-Resistant Receptacles *(cont.)*

- Requirements for tamper-resistant *(TR)* receptacles **expanded** to locations **where small children are likely to congregate**:
  - Dwelling units (210.52)
  - **Mobile and manufactured homes (550.13)**
  - Guest rooms and guest suites of hotels and motels
  - Child care facilities
  - **Preschools and elementary education facilities**
  - **Medical and dental waiting rooms**
  - **Places of assembly occupancies (518.2)**
  - **Dormitories**

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

(4) Preschools/elementary educational facilities; (5) Waiting rooms, etc. in medical/dental offices; (6) Places of waiting-transportation, gymnasiums, etc.; (7) Dormitories

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

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:
(4) Preschools and elementary education facilities

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: (5) Business offices, corridors, waiting rooms and the like in clinics, medical and dental offices and outpatient facilities

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: (6) Subset of assembly occupancies described in 518.2 to include places of waiting for transportation, gymnasiums, skating rinks, and auditoriums

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: (7) Dormitories

406.15

Dimmer-Controlled Receptacles *(Deleted)*

- Dimmer-controlled receptacle provisions have been **deleted**
- Section sought to correct incompatibilities between certain types of dimmer and certain cord-and-plug connected loads
- Such incompatibilities are currently dealt with in the **listing of specific load types** and the **listing of specific dimmer types**
- During the last *Code* revision cycle, new rules were added at 406.15 permitting certain receptacles to be controlled by a dimmer under specific conditions
- In conjunction with 404.15(E), dimmer switches are generally not permitted to control receptacle outlets
- Use of the term "nonstandard configuration" in previous *Code* was not defined with regard to plug/receptacle combinations

408.3(A)(2)
Barriers at Service Panelboards

- New requirements added for **barriers** to be placed in all **service panelboards** such that no uninsulated, ungrounded service busbar or service terminal be exposed to inadvertent contact by persons
- Identified as a safety concern by installers and proponents of electrical safety in the workplace
- An **exception** was also added eliminating the barriers at panelboards installed to comply with the requirements of **408.36, Ex. No. 1, 2, and 3**
- Exceptions to 408.36 address the "**six means of disconnect**" rules and the old "**split-bus**" panelboards that could be present

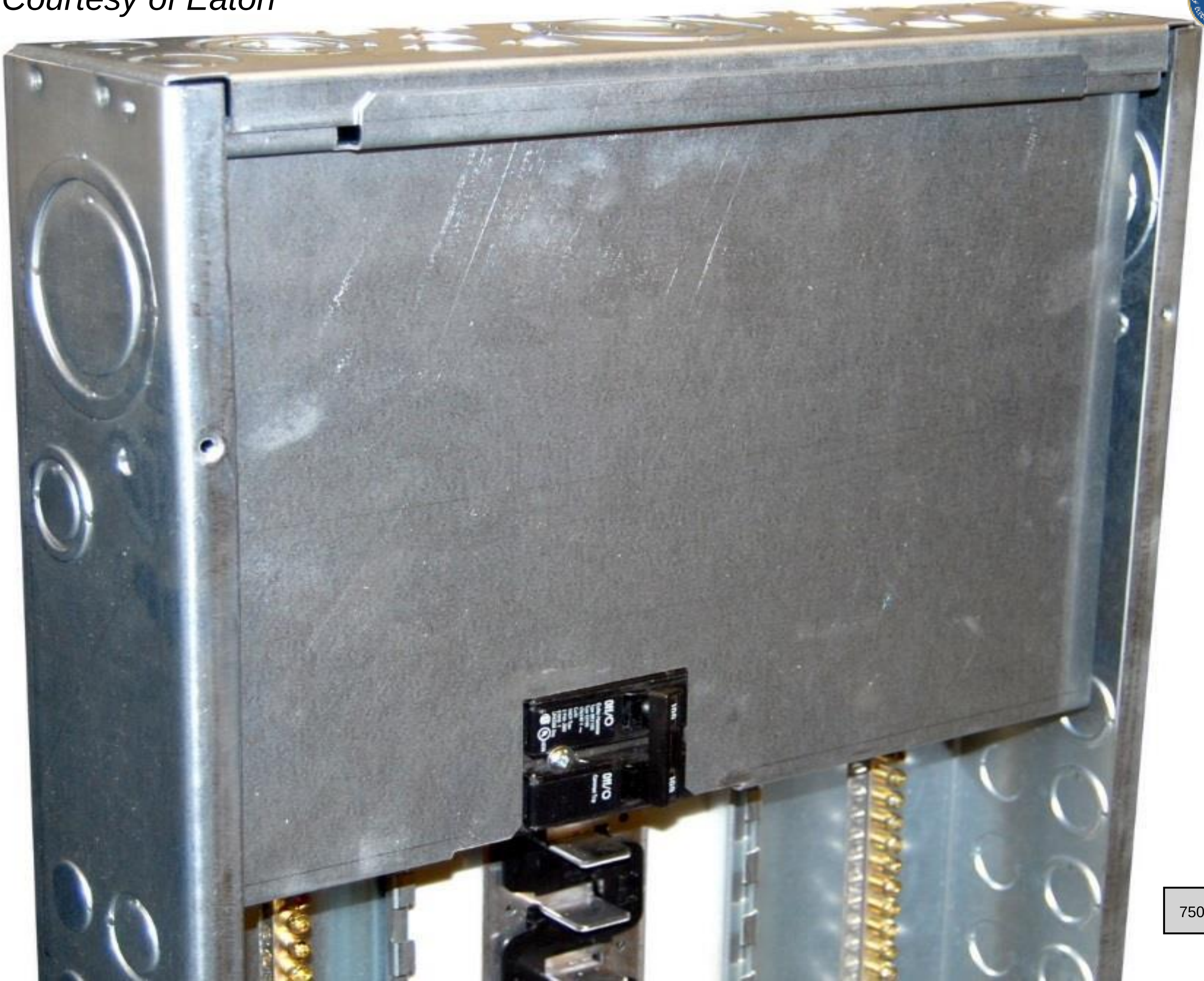
408.3(A)(2) Barriers at Service Panelboards

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

Courtesy of Schneider Electric

Exception: *This requirement shall not apply to service panelboards with provisions for more than one service disconnect within a single enclosure as permitted in 408.36, Exceptions No. 1, 2, and 3*

Courtesy of Eaton



409.22(B) Short-Circuit Current Rating

- New requirements added for documentation of **available short-circuit current** at **industrial control panels**
- This information shall also include the **date the short-circuit current calculation was performed**
- Enforcement community has experienced difficult time enforcing proper short-circuit current ratings of industrial control panels
- New requirement provides much needed information to aid the electrical inspector *(AHJ)* when enforcing 409.22(A) which will ensure that the industrial control panel complies with its established short-circuit current rating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ENCLOSED INDUSTRIAL CONTROL PANEL
No. CJ - 964990
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MULTI-CRAFT CONTRACTORS, INC
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50 Amps Max 5 Hp Max
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Incoming Power Torque Value:35 in.lbs.
Grnd Lug:35 in.lbs.
Use Copper Wire 60 degree C.
Minimum Wire Size 16 Awg

Other Locations for Short-Circuit Current Rating Documentation

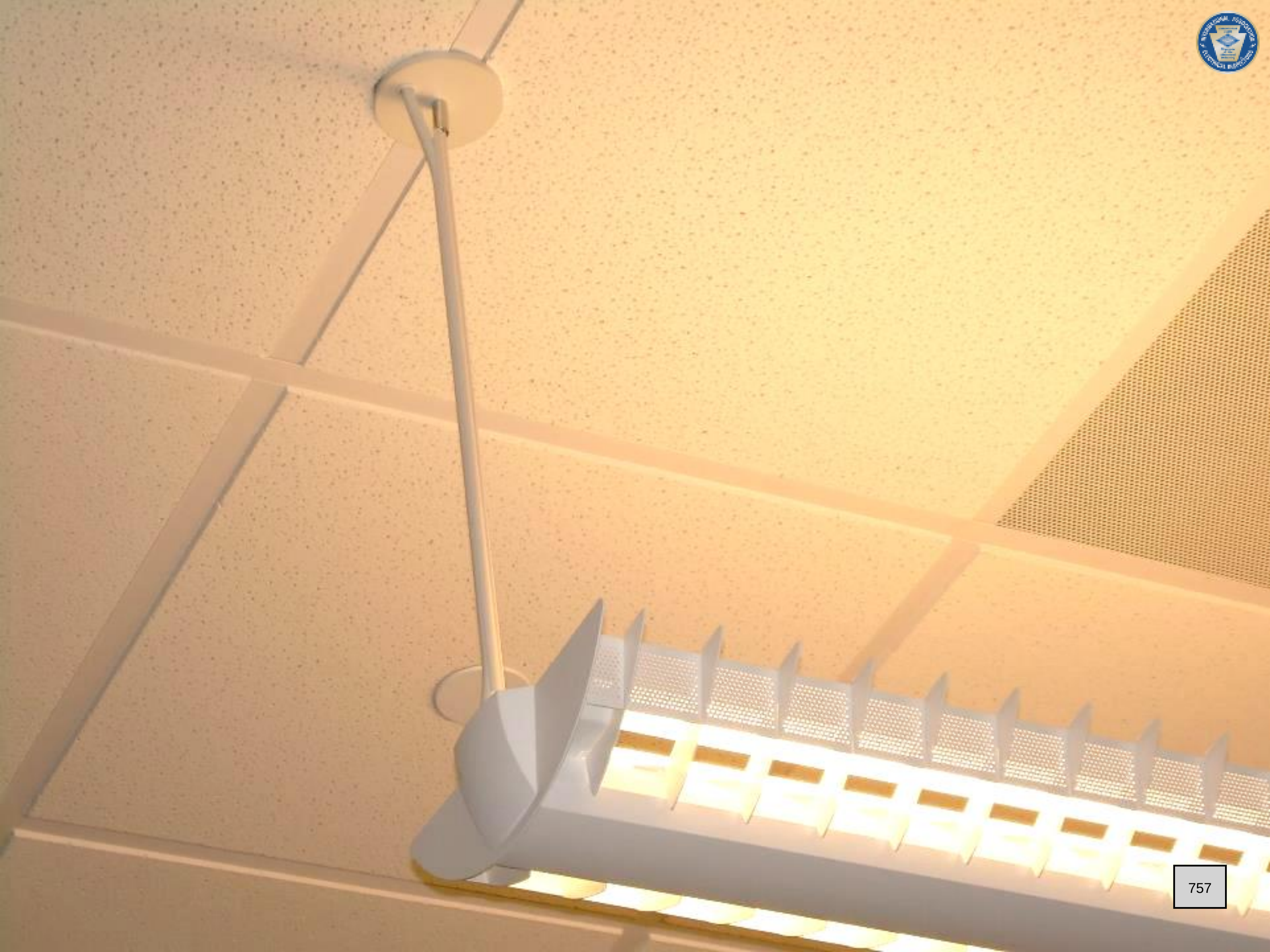
- Available short-circuit current documentation was added for other things such as:
  - Motor control centers
  - Air conditioning equipment
  - Elevators control panels
  - Industrial machinery
  - Emergency system transfer equipment for:
    - Emergency systems
    - Legally required standby systems
    - Optional standby systems
    - Critical operations power systems (COPS)

410.62(C)(1) Cord-Connected Installation of Lampholders and Luminaires

- Re-organization occurred to the requirements for cord-connected lampholders and luminaires of the electric-discharge and LED type
- New layout much easier to follow and comprehend
- Previous language at 410.62(C)(1) was one long sentence that was extremely difficult to follow
- New re-organized text provides improved clarity while retaining the core intent of these cord-connected requirements

410.62(C)(1) Cord-Connected (cont.)
Installation of Lampholders and Luminaires

- Electric-discharge and LED luminaires permitted to be cord connected when the following conditions apply:
  - Luminaire is located directly below the outlet or busway
  - Flexible cord is visible for entire length outside the luminaire
  - Not subject to strain or physical damage
  - Terminated with one of the following methods:
    - Grounding-type attachment plug cap or busway plug
    - Part of a listed assembly incorporating a manufactured wiring system connector in accordance with 604.100(C)
    - Luminaire assembly with a strain relief and canopy having a maximum 150 mm (6 in.) long section of raceway for attachment to an outlet box above a suspended ceiling



Article 411 Low-Voltage Lighting

- Article 411 was re-organized and renamed
- Title changed from "~~Lighting Systems Operating at 30 Volts or Less and Lighting Equipment Connected to Class 2 Power Sources~~" to simply "**Low-Voltage Lighting**"
- Limitations of 411.3(A) and (B) for low-voltage lighting systems operating at **30 volts or less** and the limitations of Class 2 low-voltage lighting systems conforming to *NEC* Chapter 9, Table 11(A) or Table 11(B) was **removed**
- Low-voltage lighting systems addressed by Article 411 are now basically limited by the maximum rating of **25 amperes for the output circuits** of the power supply under all load conditions

422.2 Definition: Vending Machine

- Previous definition of “**Vending Machine**” has been **deleted**
- What constituted a vending machine?
- Vending machine are still required to be **GFCI** protected, but the requirement has been **re-located to 422.5(A)(5)**
- All appliances operating at 50 volts or more are now required be listed *(see new 422.6)*
- In determining what constitutes a vending machine, the user of the *Code* needs to rely on the **listing and the product standards** for vending machines
- Revision to require all appliances to be listed eliminates the need for a definition of vending machine


Dr Pepper
Est. 1885
WESTERN FAMILY
Cola
Root Beer
diet Cola
Coca-Cola
pepsi


PIZZA gio
by giorgio pompei
REAL ITALIAN PIZZA
HOT AND CRISP, STRAIGHT OUT OF THE OVEN
READY IN LESS THAN 3 MINUTES
CHOOSE FROM TWO AUTHENTIC, ARTISAN 11" PIZZAS
MARGHERITA
HOT SALAMI
PIZZA gio
by giorgio pompei
REAL ITALIAN PIZZA
HOT & CRISP, STRAIGHT OUT OF THE OVEN
Ready, sliced and served in a box in less than 3 minutes.


CARVANA
CARVANA

422.5 GFCI Protection for Appliances

- Ground-Fault Circuit-Interrupter **(GFCI) requirements** throughout Article 422 related to personnel hazards from specific equipment moved to a **single location** in Article 422
- New 422.5(B) was also added allowing **five options** for the **location and type of GFCI protective device** provided in order to deliver GFCI protection to specific appliances listed at 422.5(A)
- Collecting these specific GFCI requirements into one central location will increase clarity and usability
- Based on the voltage limitation of the product standard for GFCIs (UL 943), the "**250 volts or less**" value was initiated at 422.5
- Multiple GFCI protective devices permitted but not be requirec

422.5 GFCI Protection for Appliances *(cont.)*

- 422.5(A) General
  - Appliances identified in 422.5(A)(1) through (5) rated **250 volts or less** and **60 amperes or less**, single- or 3-phase, shall be provided with GFCI protection for personnel
  - Multiple GFCI protective devices shall be permitted but shall not be required
    - (1) Automotive vacuum machines provided for public use
    - (2) Drinking ~~fountains~~ water coolers
    - (3) High-pressure spray washing machines — cord-and-plug-connected
    - (4) Tire inflation machines provided for public use
    - (5) Vending machines

422.5 GFCI Protection for Appliances *(cont.)*

- 422.5(B) Type
  - The GFCI shall be readily accessible, listed, and located in one or more of the following locations:
    - (1) Within the branch circuit overcurrent device
    - (2) A device or outlet within the supply circuit
    - (3) An integral part of the attachment plug
    - (4) Within the supply cord not more than 300 mm (12 in.) from the attachment plug
    - (5) Factory installed within the appliance

422.5 GFCI Protection for Appliances

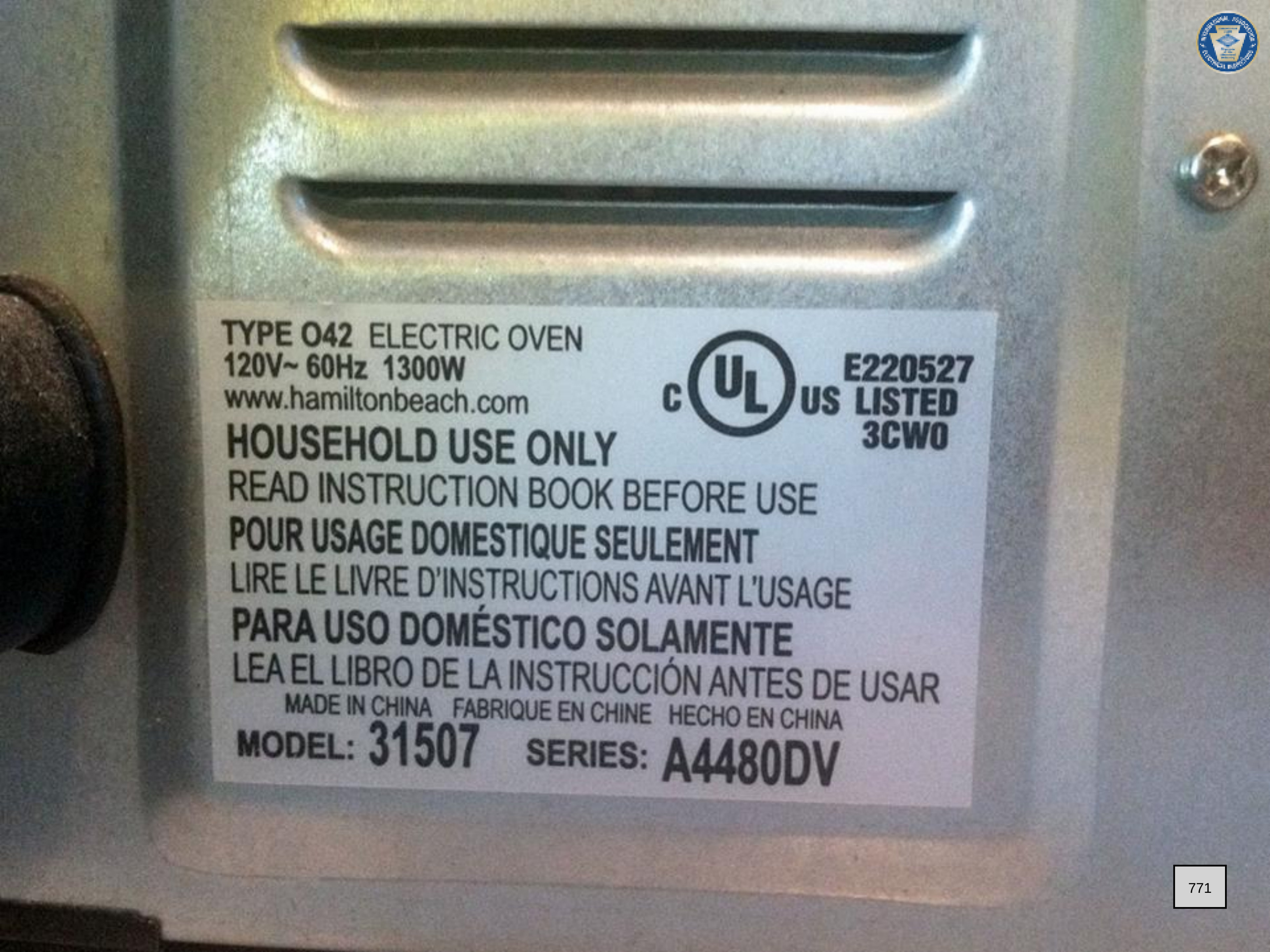
GFCI requirements for Appliances *(250 volts or less and 60 amperes or less, single- or 3-phase)* have been moved to one location in Article 422

(Multiple GFCI devices permitted but not be required)

(1) Automotive vacuum machines; (2) Drinking water coolers; (3) High-pressure spray washing machines *(cord-and-plug-connected)*; (4) Tire inflation machines; (5) Vending machines

422.6 Listing Required *(Appliances)*

- New section has been added to Article 422 requiring all appliances operating at **50 volts or more** must be **listed**
- All appliances should be listed to help determine the proper classification of the equipment and to ensure application of proper product standard installation requirements
- Listing requirement for appliances helps ensure equipment is installed and used in accordance with any instructions included in the listing or labeling of that particular piece of equipment *[see 110.3(B)]*
- Relying *NEC* definitions and industry terms or product marketing information can and often does result in misinterpretation and misapplication of requirements for appliances



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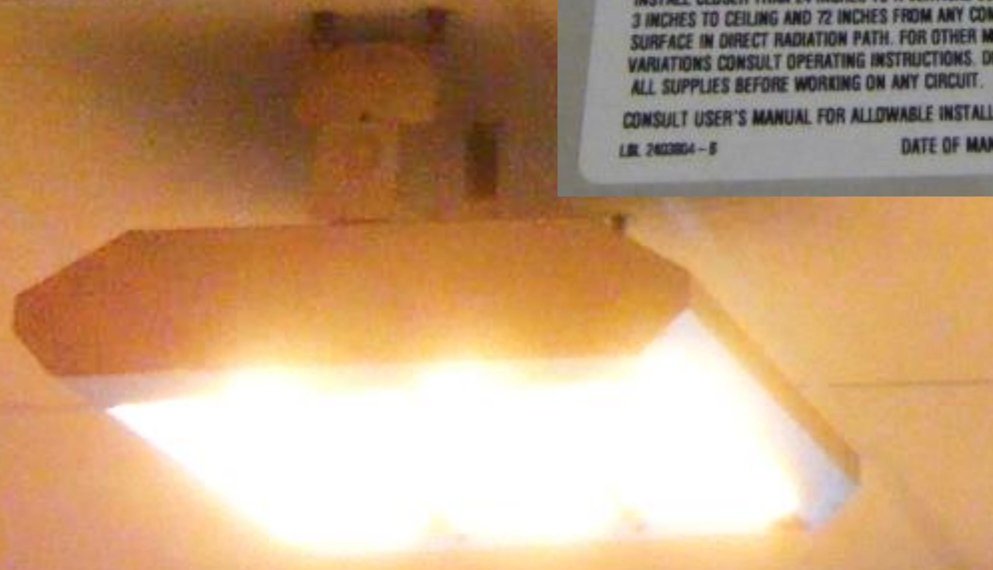
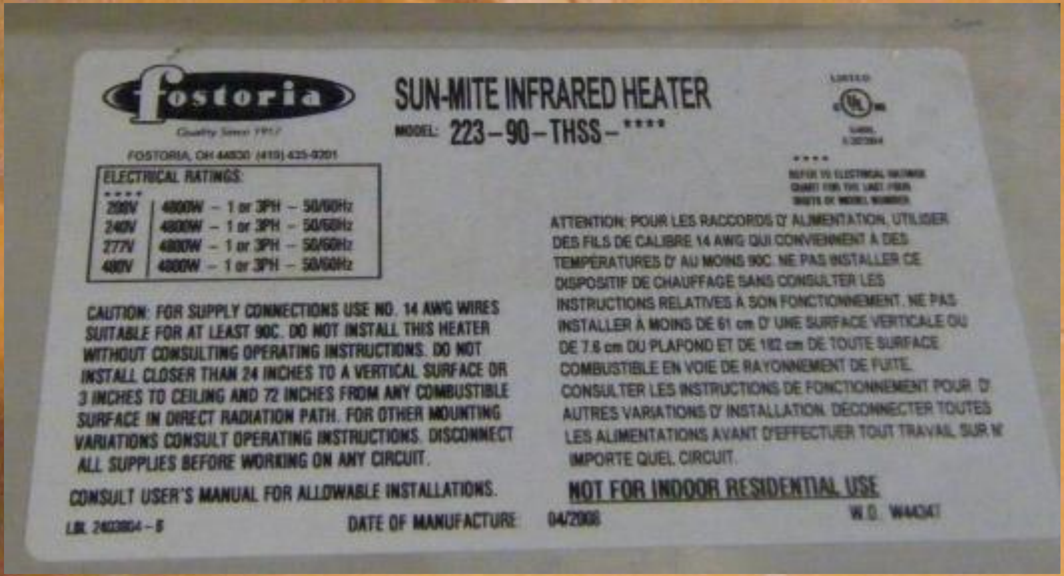
READ INSTRUCTION BOOK BEFORE USE
POUR USAGE DOMESTIQUE SEULEMENT
LIRE LE LIVRE D'INSTRUCTIONS AVANT L'USAGE
PARA USO DOMÉSTICO SOLAMENTE
LEA EL LIBRO DE LA INSTRUCCIÓN ANTES DE USAR
MADE IN CHINA FABRIQUE EN CHINE HECHO EN CHINA
MODEL: 31507 SERIES: A4480DV

422.14
Infrared Lamp Industrial Heating Appliances

- Rules for industrial infrared lamp heating appliances has been **deleted** from Article 422 and **relocated** in new Article 425 "**Fixed Resistance and Electrode Industrial Process Heating Equipment**" *(see new 425.14)*
- Creation of new Article 425 called for gathering of existing *NEC* requirements covering industrial heating equipment and relocating that information to its new home in Article 425
- Relocation brings requirements for commercial and industrial fixed resistance and process heating equipment into its own article while improving clarity and usability of the *NEC*
- Heating lamps are part of a larger group of commercial/industrial heating equipment that deserves its own article





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Quality Since 1917

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SUN-MITE INFRARED HEATER

MODEL: 223–90–THSS–****

LISTED

ELECTRICAL RATINGS:

****	
208V	4800W – 1 or 3PH – 50/60Hz
240V	4800W – 1 or 3PH – 50/60Hz
277V	4800W – 1 or 3PH – 50/60Hz
480V	4800W – 1 or 3PH – 50/60Hz

****
REFER TO ELECTRICAL RATINGS CHART FOR THE LAST FOUR DIGITS OF MODEL NUMBER

CAUTION: FOR SUPPLY CONNECTIONS USE NO. 14 AWG WIRES SUITABLE FOR AT LEAST 90C. DO NOT INSTALL THIS HEATER WITHOUT CONSULTING OPERATING INSTRUCTIONS. DO NOT INSTALL CLOSER THAN 24 INCHES TO A VERTICAL SURFACE OR 3 INCHES TO CEILING AND 72 INCHES FROM ANY COMBUSTIBLE SURFACE IN DIRECT RADIATION PATH. FOR OTHER MOUNTING VARIATIONS CONSULT OPERATING INSTRUCTIONS. DISCONNECT ALL SUPPLIES BEFORE WORKING ON ANY CIRCUIT.

ATTENTION: POUR LES RACCORDS D' ALIMENTATION, UTILISER DES FILS DE CALIBRE 14 AWG QUI CONVIENNENT À DES TEMPÉRATURES D' AU MOINS 90C. NE PAS INSTALLER CE DISPOSITIF DE CHAUFFAGE SANS CONSULTER LES INSTRUCTIONS RELATIVES À SON FONCTIONNEMENT. NE PAS INSTALLER À MOINS DE 61 cm D' UNE SURFACE VERTICALE OU DE 7.6 cm DU PLAFOND ET DE 182 cm DE TOUTE SURFACE COMBUSTIBLE EN VOIE DE RAYONNEMENT DE FUITE. CONSULTER LES INSTRUCTIONS DE FONCTIONNEMENT POUR D' AUTRES VARIATIONS D' INSTALLATION. DÉCONNECTER TOUTES LES ALIMENTATIONS AVANT D'EFFECTUER TOUT TRAVAIL SUR N' IMPORTE QUEL CIRCUIT.

CONSULT USER'S MANUAL FOR ALLOWABLE INSTALLATIONS.

NOT FOR INDOOR RESIDENTIAL USE

LBL 2403804 – B

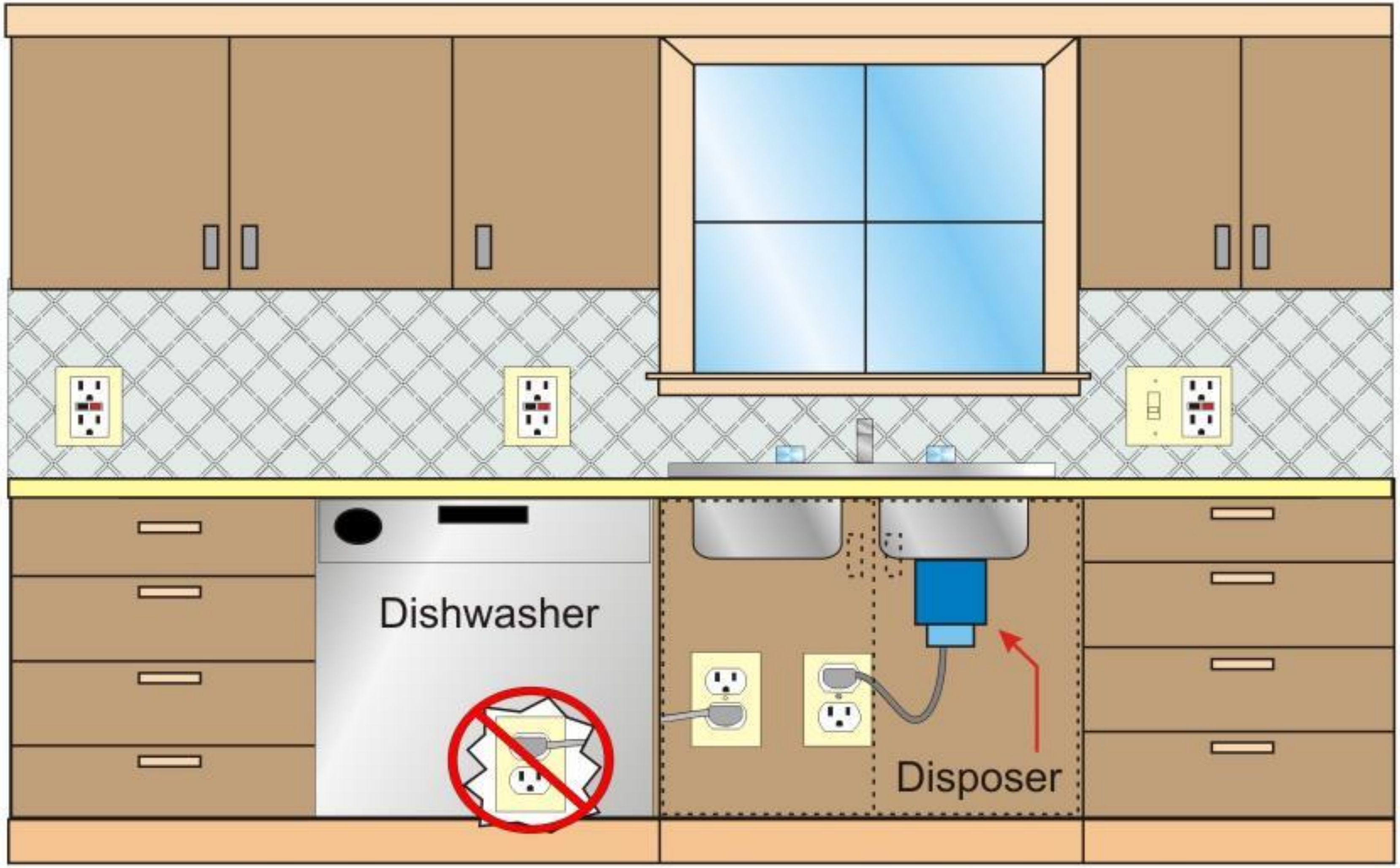
DATE OF MANUFACTURE 04/2006

W.O. W44347

422.16(B)(2) Built-In Dishwashers

- Cord-and-plug-connected built-in dishwashers are now only allowed to have the receptacle outlet located in the **space adjacent to the space occupied by the dishwasher**
- The maximum length of a cord for a built-in dishwasher was extended from the previous maximum length of 1.2 m (4 ft) to **2.0 m (6.5 ft)** measured from the face of the attachment plug to the plane of the rear of the appliance
- Other requirements for dishwashers and trash compactors remain the same as the 2014 *NEC*
- Change occurred to align 422.16(B)(2) with the product standard for household dishwashers, **UL 749**

422.16(B)(2) Built-In Dishwashers



Receptacle outlet for cord-and-plug connected built-in dishwasher required to be located in the space adjacent to the space containing the dishwasher only with the length of a cord for a built-in dishwasher lengthened from 1.2 m (4 ft) to 2.0 m (6½ ft)

422.16(B)(4) Range Hoods

- The maximum length of a flexible cord for a cord-and-plug-connected range hood has been increased from 900 mm (36 in.) to **1.2 m (4 ft)**

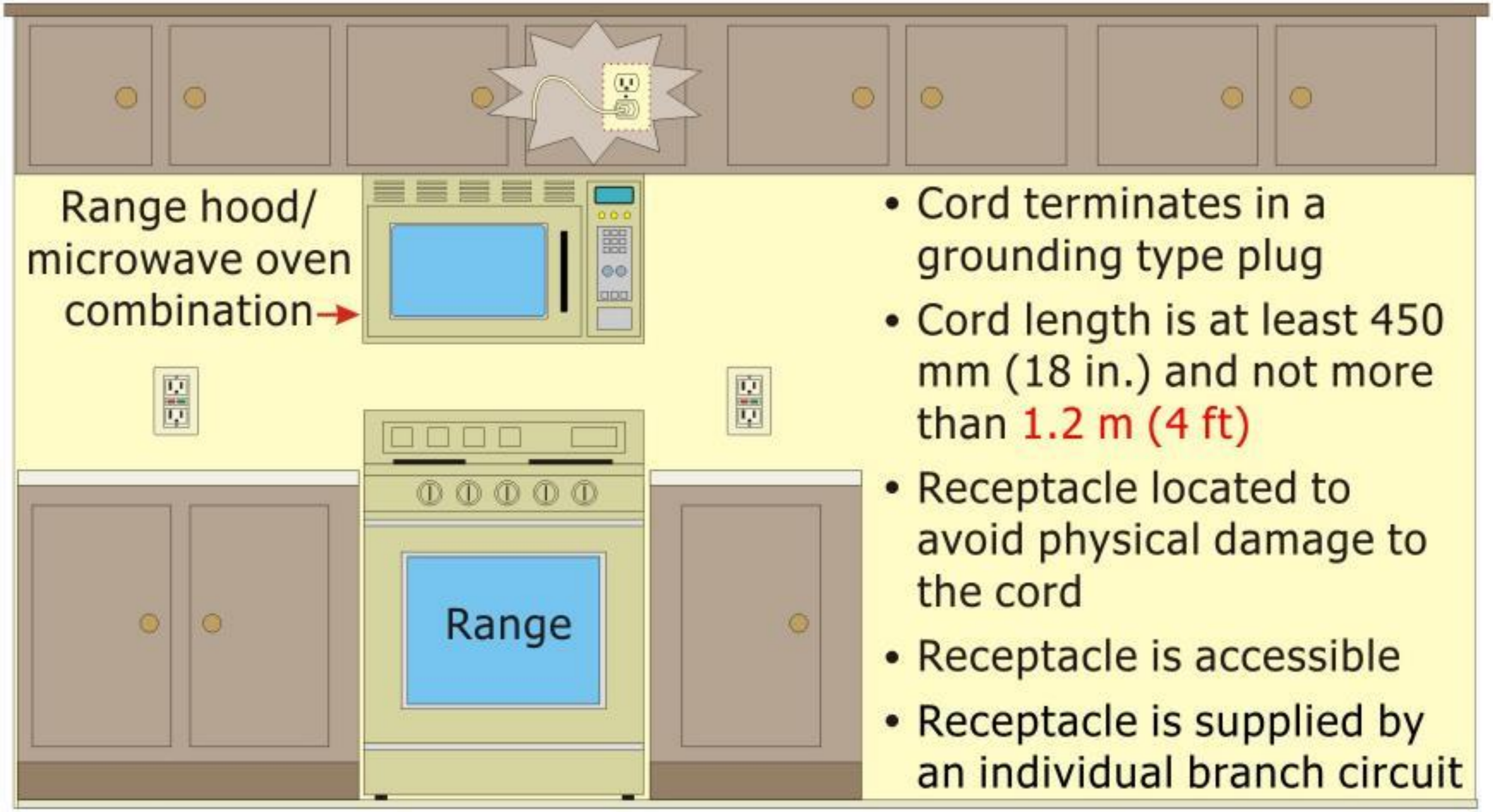
- With some of the designs of the newer range hoods, the previous maximum length of 900 mm (36 in.) was simply **not sufficient**

- Putting undue stress and strain on the cord in order to reach the mating receptacle outlet

- The height *(top to bottom)* of some of the newer **chimney-type range hoods** is a concern for cord length as well

422.16(B)(4) Range Hoods

Range hoods permitted to be cord-and-plug connected where identified on installation instructions by manufacturer and meets the following:



- Cord terminates in a grounding type plug
- Cord length is at least 450 mm (18 in.) and not more than 1.2 m (4 ft)
- Receptacle located to avoid physical damage to the cord
- Receptacle is accessible
- Receptacle is supplied by an individual branch circuit

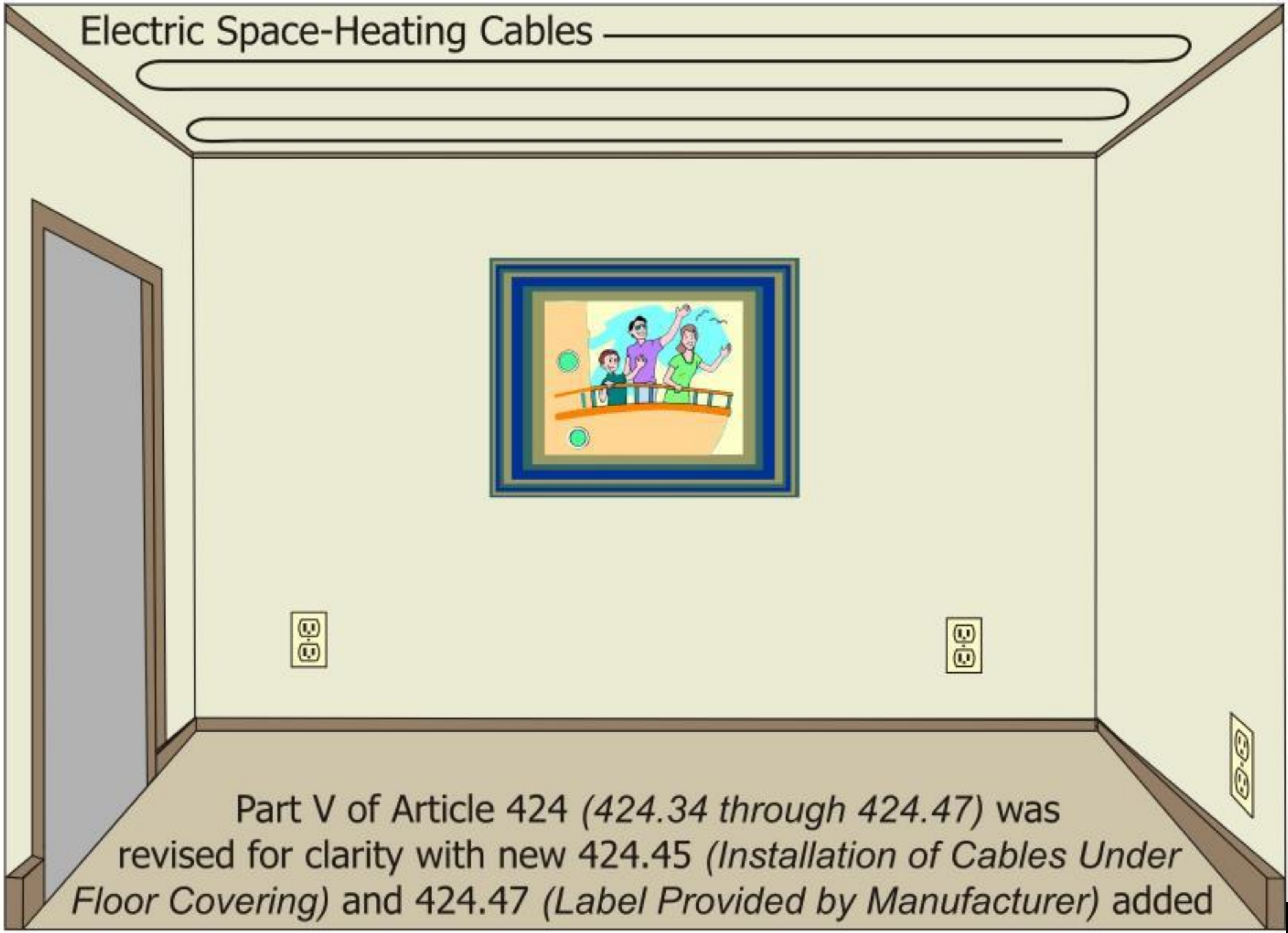
Length of cord for cord-and-plug connected range hoods increased from 900 mm (36 in.) to 1.2 m (4 ft)


Kenmore
SYRUP
Smartfood

Article 424 Part V:
Electric Space-Heating Cables

- Part V of Article 424 was **revised** for simpler interpretation and application
- Two new sections were added to Part V of Article 424 ***(424.45 and 424.47)*** address proper installations of cables under floor coverings and labels provided by the manufacturer
- Previous edition of the *Code* did not properly address these added items in Part V of Article 424
- The previous requirements for **color coding of heating cable** leads was deleted as it was inconsistent with other heating products covered by Article 424

Article 424 Part V: Electric Space-Heating Cables



Electric Space-Heating Cables

Part V of Article 424 *(424.34 through 424.47)* was revised for clarity with new 424.45 *(Installation of Cables Under Floor Covering)* and 424.47 *(Label Provided by Manufacturer)* added

424.45
Heating Cables Under Floor Coverings

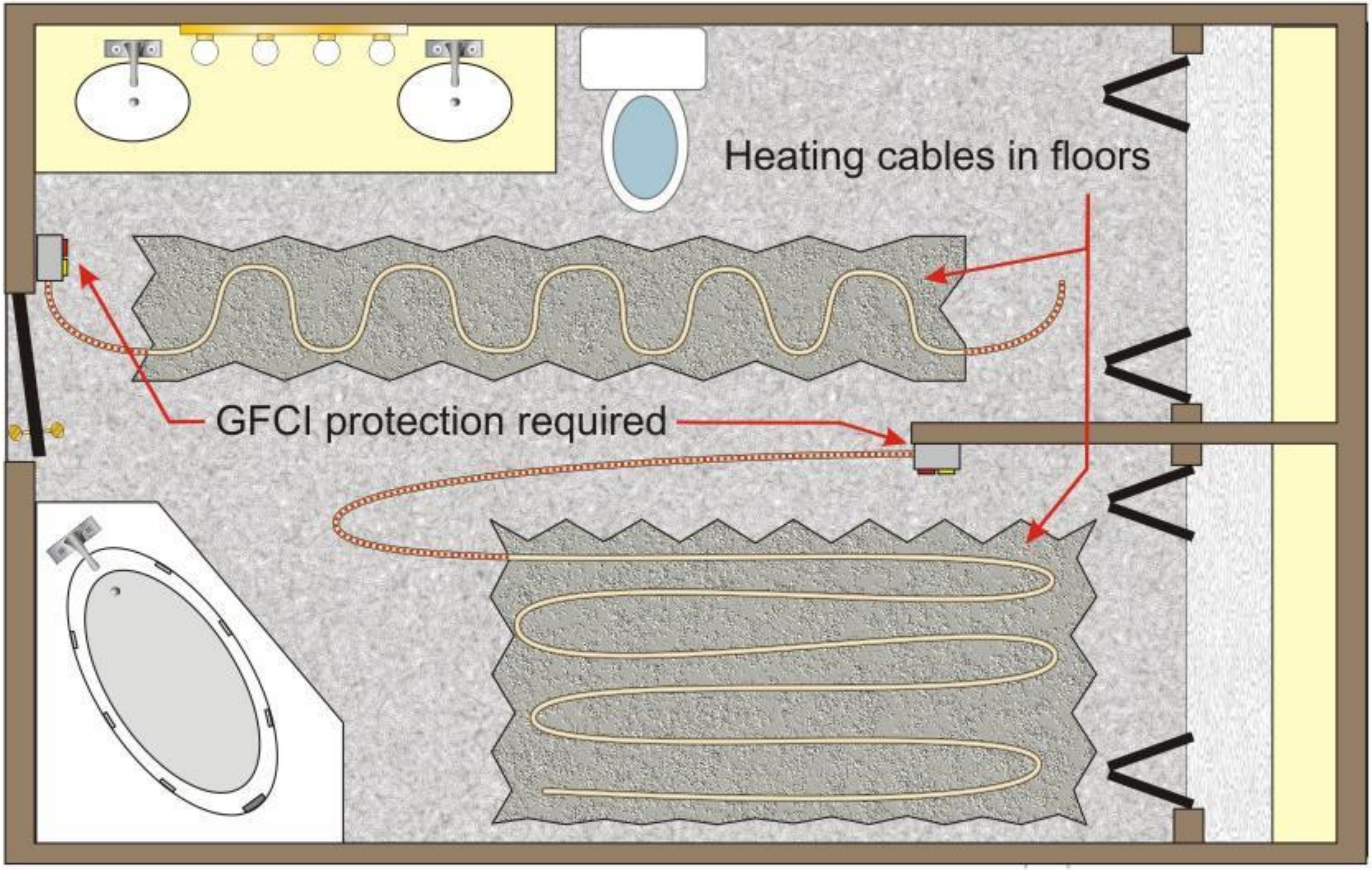
- New requirements added for the installation of **heating cables installed under floor coverings**

- Not new to the electrical industry, but installation requirements for these under flooring heating cables are **new for Article 424**

- Heating cables and heating panels have become very similar in terms of installation and use

- Previously the *Code* did not specifically mention under floor coverings for heating cables, which left some users of the *Code* unclear if heating cables installed under floor covering was permitted or not permitted

424.45 Heating Cables Under Floor Coverings



New requirements added in Part V of Article 424 giving specific instruction for the installation of heating cables installed under floor coverings

424.47

Electric Space-Heating Cable Label

- New provisions added for manufacturers of electric space-heating cables to provide **marking labels** to be affixed to panelboards identify which branch circuits supply the circuits to those space-heating installations

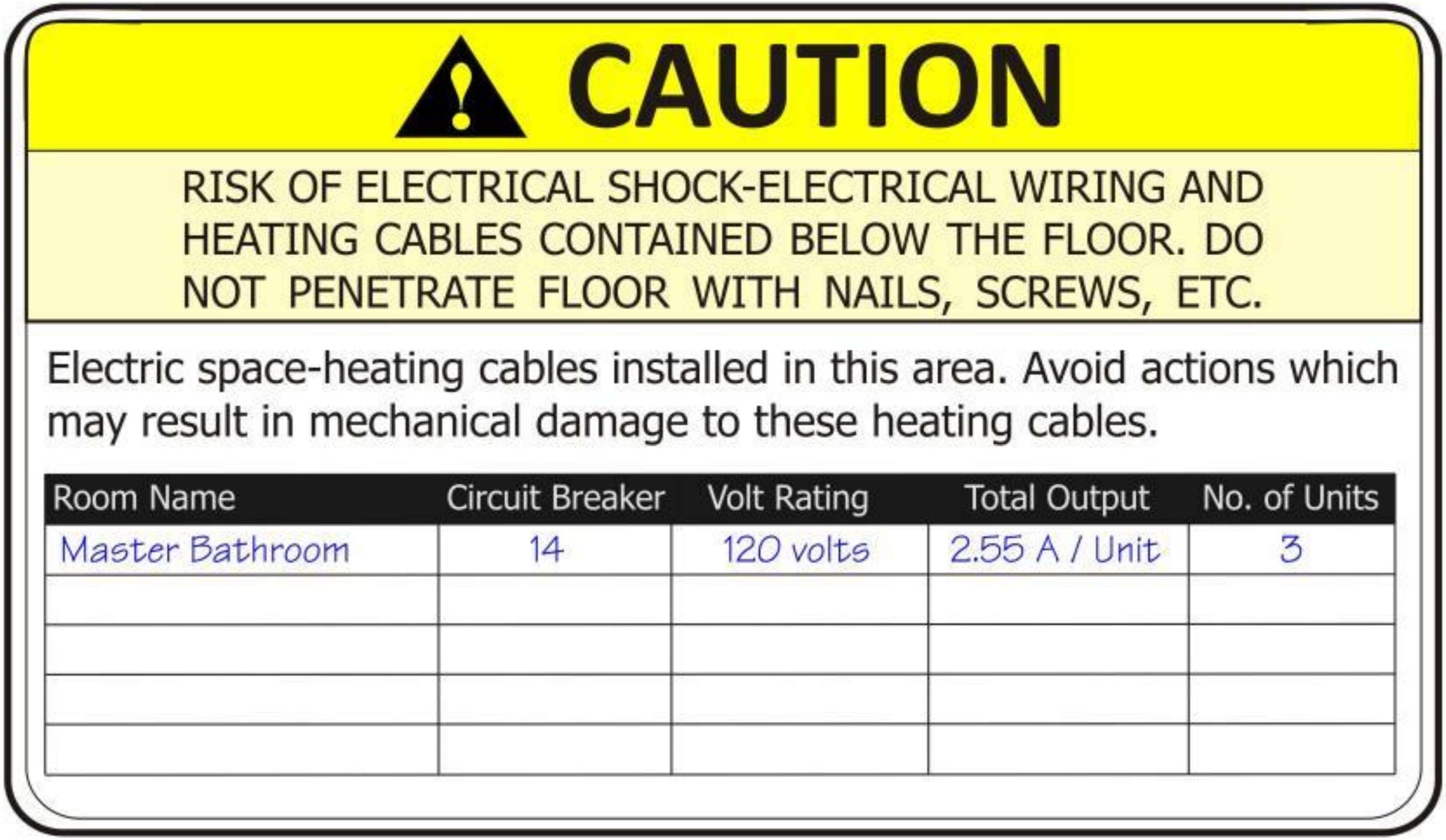
- Labels must also give the installer instructions to apply these labels to the supply panelboard

- Labeling **not required** if the electric space-heating cable installations are “**visible and distinguishable after installation**”

- Label to be applied to panelboard and filled out by installer

424.47 Label Provided by Manufacturer

Manufacturers of electric space-heating cables to provide marking labels that indicate electric space-heating cables present and instructions that the labels be affixed to panelboards identifying branch circuits supply heating cables



CAUTION

RISK OF ELECTRICAL SHOCK-ELECTRICAL WIRING AND HEATING CABLES CONTAINED BELOW THE FLOOR. DO NOT PENETRATE FLOOR WITH NAILS, SCREWS, ETC.

Electric space-heating cables installed in this area. Avoid actions which may result in mechanical damage to these heating cables.

Room Name	Circuit Breaker	Volt Rating	Total Output	No. of Units
Master Bathroom	14	120 volts	2.55 A / Unit	3

If the electric space-heating cable installations are visible and distinguishable after installation, labels not required to be provided and affixed to panelboards

Article 424 Part X Low-Voltage Fixed Electric Space-Heating Equipment

- A new **Part X** was added to Article 424 for **low-voltage fixed electric space-heating equipment**

- Previous editions of the *NEC* did not exclude these low voltage heating products, but did not address provisions for low voltage heating cables or heating panel products

- Without these new requirements, a “low-voltage” piece of equipment would have to meet all the same requirements as 120 volt or 240 volt rated equipment

- New requirements in Part X of Article 424 are very similar to provisions already in place in the *NEC* in Article 411 for low-voltage lighting systems

Article 424 Part X Low-Voltage Fixed Electric Space-Heating Equipment *(cont.)*

- For low-voltage fixed electric space-heating equipment addressed in Part X of Article 424, the rated output is limited to **25 amperes**, **30 volts (42.4 volts peak) ac**, or **60 volts dc** under all load conditions
- The **30-volt ac** and **60-volt dc** levels correlate with accepted levels considered by many to be a threshold of reduction in risk of electric shock
- Also aligns with the voltage levels for Class 2 ac and Class 2 dc voltage levels in **Chapter 9, Tables 11(A) and 11(B)**
- **25 ampere maximum output** current added to limit secondary current levels to levels associated with most low-voltage fixed electric space-heating equipment

Article 425 Fixed Resistance and Electrode Industrial Process Heating Equipment

- New Article 425 **Fixed Resistance and Electrode Industrial Process Heating Equipment** incorporated into the 2017 *NEC*
- In previous editions, the *NEC* did not adequately address requirements for industrial process heating equipment
- Previous 422.14 *(appliances with infrared heat lamps)* was relocated to new Article 425 *(see 425.14)*
- New article will provide clear requirements for installation and enforcement for such as working space, listing requirements, marking of equipment, overcurrent protection, protection from physical damage, installation in damp or wet locations, and spacing from combustible materials

Article 425 Fixed Resistance and Electrode Industrial Process Heating Equipment *(cont.)*

- New Article 425 "**Fixed Resistance and Electrode Industrial Process Heating Equipment**" will apply to such things as:
  - Boilers
  - Electrode boilers
  - Duct heaters
  - Strip heaters
  - Immersion heaters
  - Process air heaters
  - Other approved fixed electric equipment used for industrial process heating

426.32 Impedance Heating Voltage Limitations

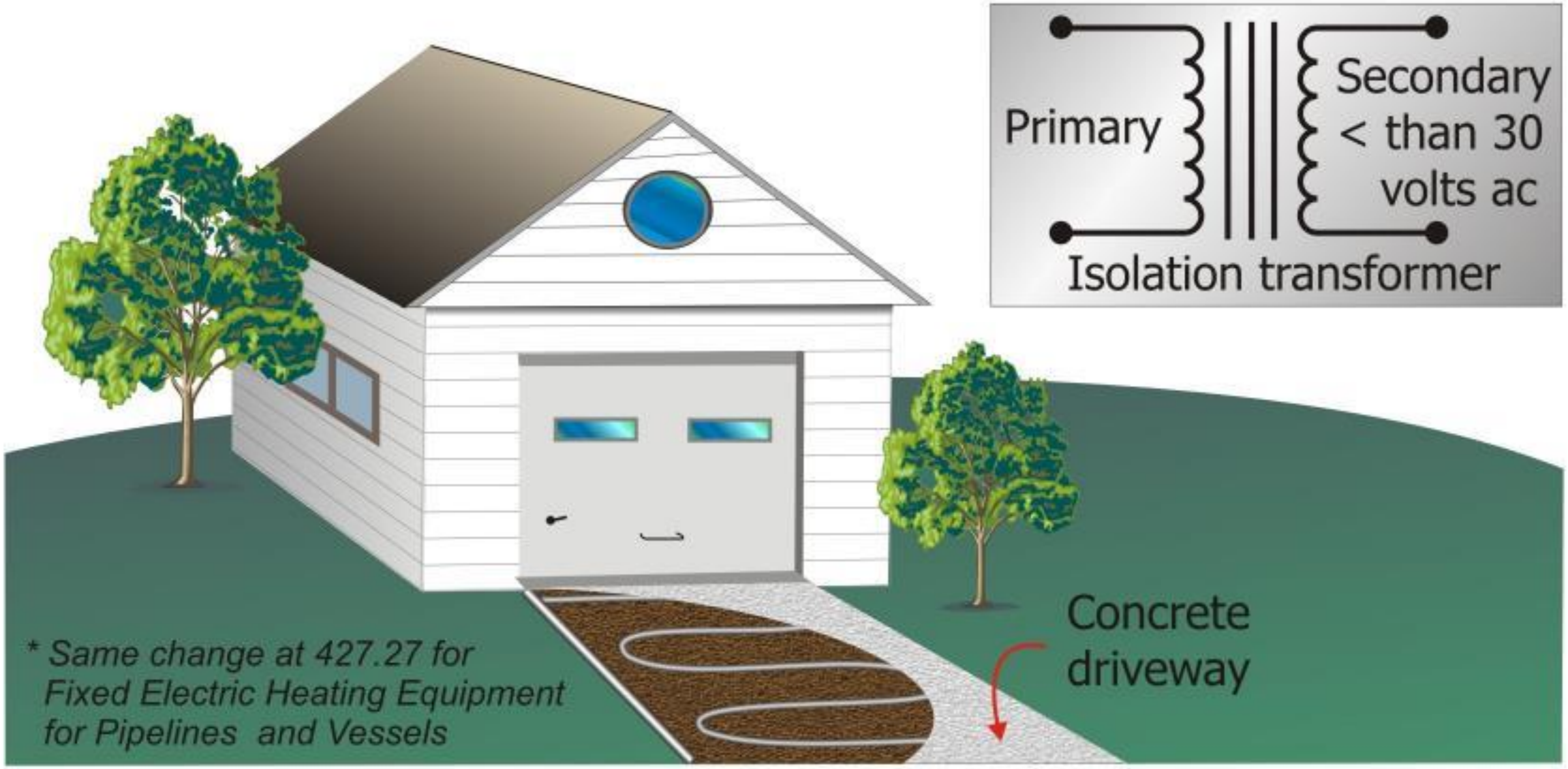
Fixed Outdoor Electric Deicing and Snow-Melting Equipment

- Allowance for voltage output greater than **30 volts ac** if an **impedance heating system** for fixed outdoor electric deicing and snow-melting equipment is provided with **Class A GFCI** protection has been **deleted**
- Secondary winding of an isolation transformer connected to an impedance heating elements cannot have an output voltage greater than 30 volts ac
- Higher operating current levels of electrical Impedance heating systems not compatible with Class A type GFCI protective device
- An impedance heating system cannot be designed to have a leakage under 5 mA *(making Class A GFCI protection obsolete)*
- Same revision occurred at **427.27** for impedance heating system for fixed electric heating equipment for pipelines and vessels

426.32 Impedance Heating Voltage Limitation

Fixed Outdoor Electric Deicing and Snow Melting Equipment

Secondary winding of an isolation transformer connected to the impedance heating elements shall not have an output voltage greater than 30 volts ac



** Same change at 427.27 for Fixed Electric Heating Equipment for Pipelines and Vessels*

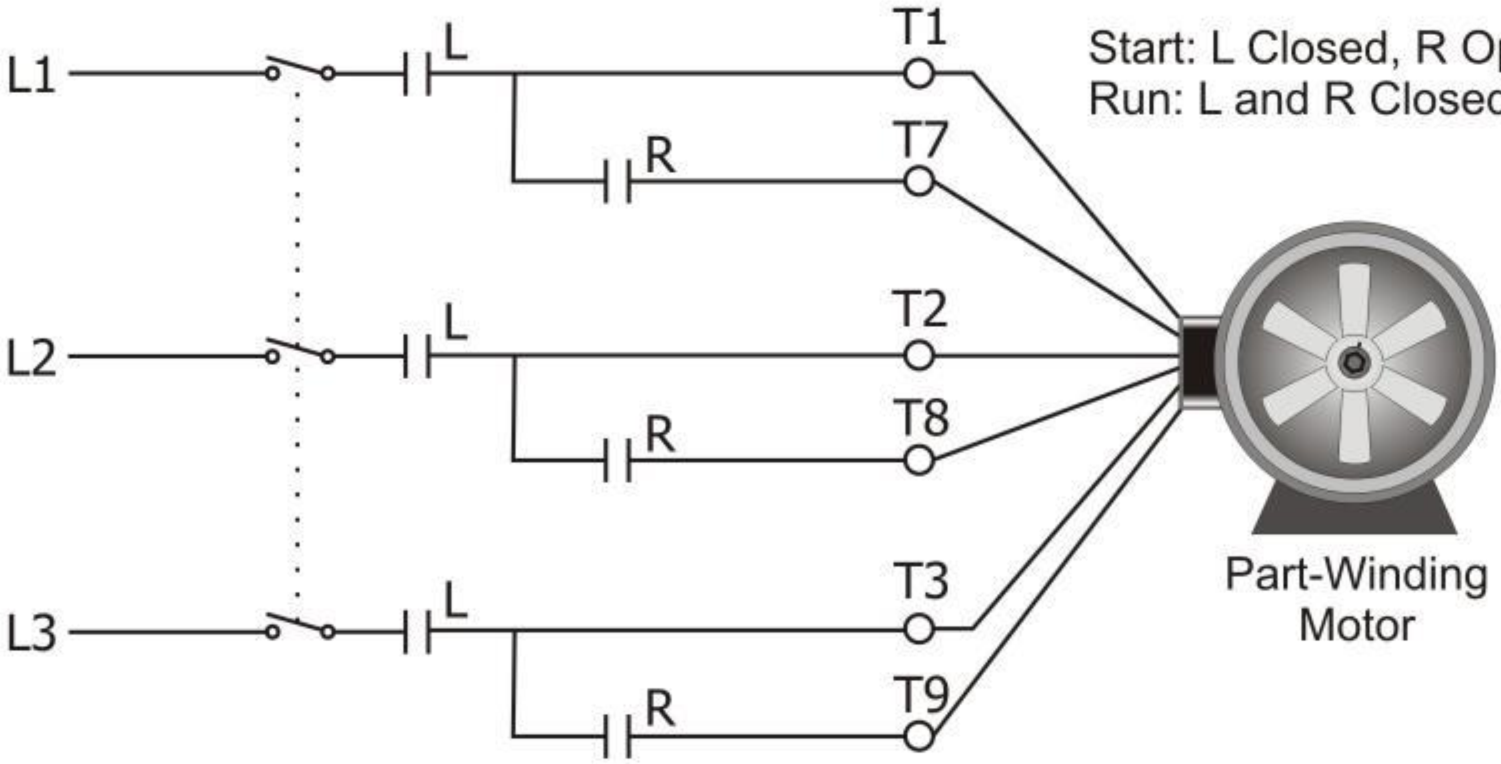
The allowance for voltage output greater than 30 volts ac if an impedance heating system for fixed outdoor electric deicing and snow-melting equipment is provided with Class A GFCI protection has been deleted

430.2 Definition: Part-Winding Motors

- The definition of a **part-winding motor** was moved from 430.4 to its proper location at 430.2
- The first paragraph of previous 430.4 seemed to be the very definition of a part-winding motor
- A part-winding or soft start motor is any system that is used to reduce inrush current, as well as strain on electrical circuits that supply power to motors
- Inrush current is the initial surge of current into the windings when the motor is started

430.2 Definitions: Part-Winding Motors

Part-Winding Motors. A part-winding start induction or synchronous motor is one that is arranged for starting by first energizing part of its primary (armature) winding and, subsequently, energizing the remainder of this winding in one or more steps. A standard part-winding start induction motor is arranged so that one-half of its primary winding can be energized initially, and, subsequently, the remaining half can be energized, both halves then carrying equal current. A hermetic refrigerant compressor motor shall not be considered a standard part-winding start induction motor.



Start: L Closed, R Open
Run: L and R Closed

Part-Winding
Motor

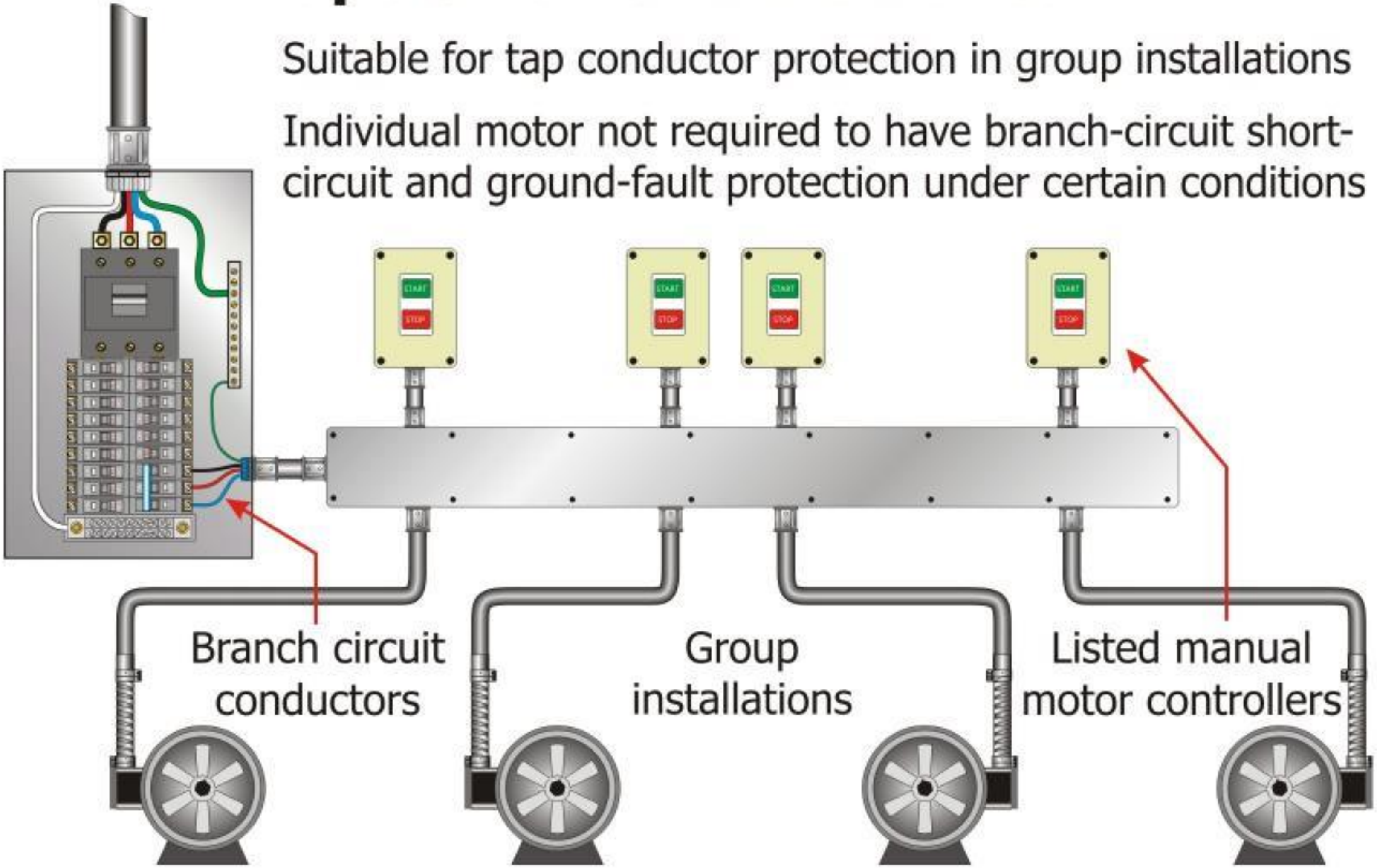
430.53(D)(4)
Single Motor Taps on One Branch Circuit

- New tap rule for single motor allows **7.5 m (25 ft) taps** with the same conditions as is allowed in other areas of the *NEC*
- The ampacity cannot be less than **one-third** that of the branch-circuit conductors
- Previous provisions allowed these taps to have an ampacity not less than one-tenth the rating or setting of the branch-circuit short-circuit and ground-fault protective device with the maximum length of 3 m (10 ft)
- 7.5 m (25 ft) tap allowance for single motor taps is a natural progression for the *NEC*

430.53(D)(4) Single Motor Taps on One Branch Circuit

Suitable for tap conductor protection in group installations

Individual motor not required to have branch-circuit short-circuit and ground-fault protection under certain conditions



Branch circuit conductors

Group installations

Listed manual motor controllers

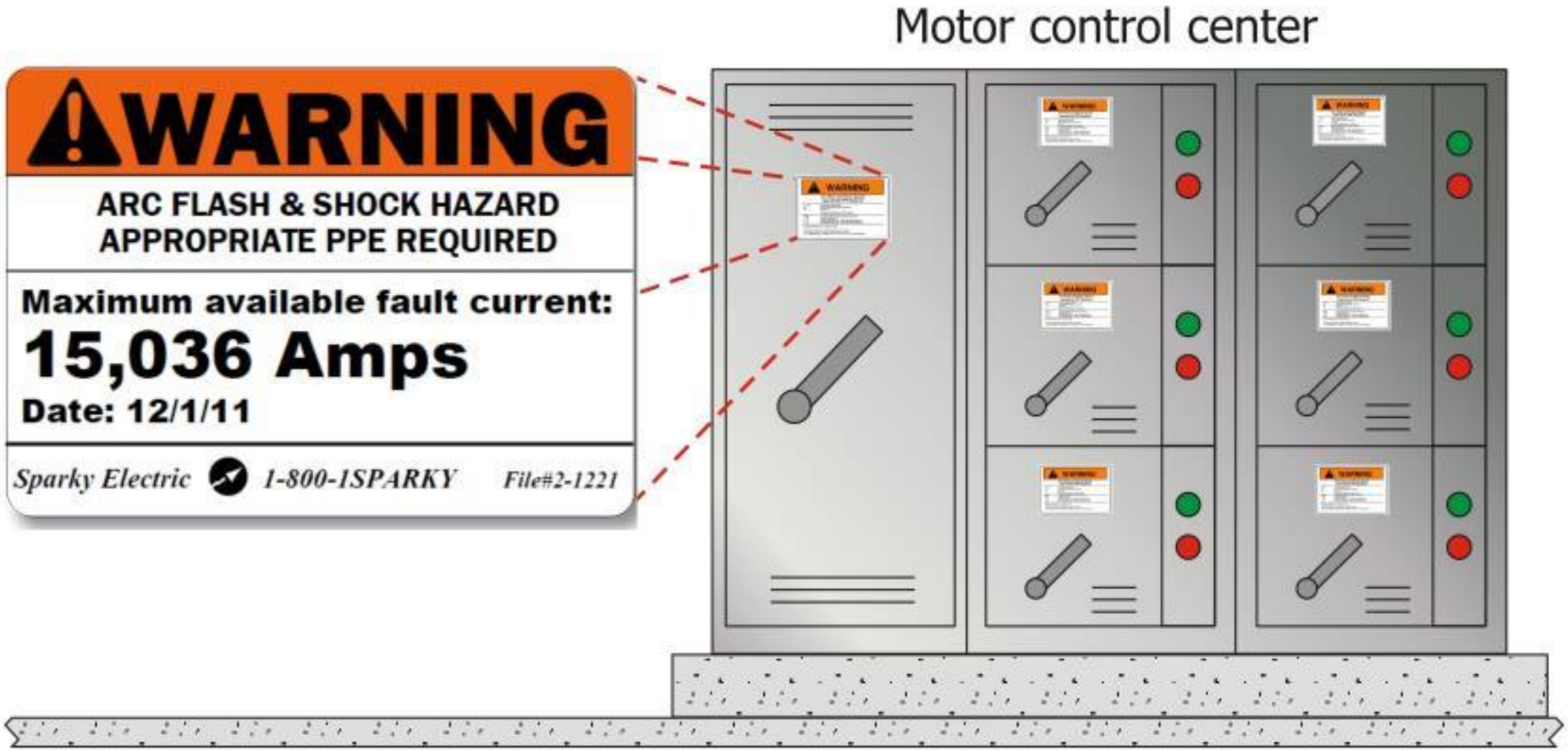
New 430.53(D)(4) increases the maximum length of the conductors of any tap supplying a single motor to 7.5 m (25 ft) when the ampacity is not less than one-third that of the branch-circuit conductors

430.99 Available Fault Current for Motor Control Centers

- New requirements added for **available short circuit current** at motor control center and the **date** the short circuit current calculation was performed
- **Documentation** also required to be made available to those authorized to inspect the installation of the motor control center
- Documentation shall include:
  - Available short circuit current *(fault current)* at the motor control center
  - Date the short circuit current calculation was performed
- This documentation can reduce liability *(for contractors, inspectors, and manufacturers)* by identifying equipment was originally installed with the correct short-circuit current rating

430.99 Available Fault Current for Motor Control Centers

The available short circuit current at the motor control center and the date the short circuit current calculation was performed shall be documented and made available to those authorized to inspect the installation



⚠WARNING

ARC FLASH & SHOCK HAZARD
APPROPRIATE PPE REQUIRED

Maximum available fault current:
15,036 Amps
Date: 12/1/11

Sparky Electric *1-800-1SPARKY* *File#2-1221*

New requirements added for available short circuit current at motor control centers and the date the short circuit current calculation was performed

Available Fault Current for Equipment

The available short circuit current required at equipment listed below and the date the short circuit current calculation was performed shall be documented and made available to those authorized to inspect the installation

NEC Section	Equipment	FR	SR	PI	PC
409.22(B)	Industrial Control Panels	FR 3002	SR 3003, SCR 1	PI 4421, PI 4733	PC 1800, PC 409
430.99	Motor Control Centers	FR 3016		PI 4437, PI 4712	
440.10	AC Equipment	FR 3006	SR 3005	PI 4432, PI 4438, PI 4697, PI 4729	PC 1808
620.51(D)(2)	Elevator Control Panels	FR 3393	SR 3334		
670.5	Industrial Machinery	FR 3336	SR 3336	PI 4709, PI 4427	PC 1301

Same available short circuit current documentation and the date the short circuit current calculation was performed was added at the above locations

440.9 Grounding and Bonding of Rooftop A/C Equipment

- The outdoor portions of metallic raceway systems that use **non-threaded fittings** are now required to contain a **wire-type equipment grounding conductor** *(EGC)*

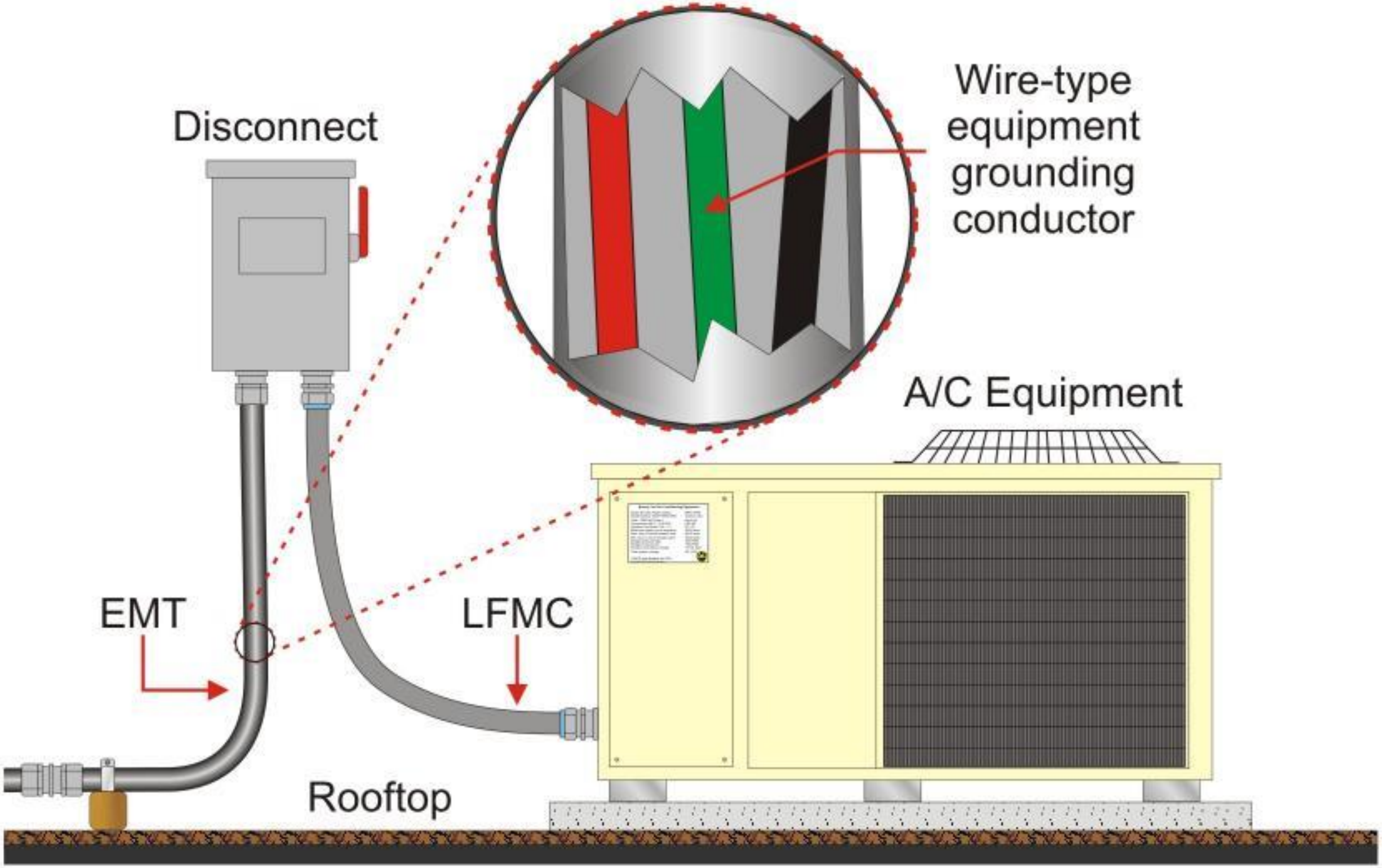
- Applies when installed outdoors on a roof to supply multimotor and combination-load equipment

- When installed on a rooftop to supply such things as rooftop HVAC equipment, some metallic raceway systems installations become compromised from activities such as snow removal or roof repair/replacement

440.9 Grounding and Bonding of Rooftop A/C Equipment *(cont.)*

- Concerns have been raised regarding metallic raceway systems and their ability to maintain their continuity as their own equipment grounding conductor *(EGC)*
- Metallic raceway systems on rooftops being subject to movement and damage that can result in separation of their non-threaded conduit or tubing fittings

440.9 Grounding and Bonding-Rooftop Equipment



Where multimotor and combination-load equipment is installed outdoors on a roof, an equipment grounding conductor of the wire type shall be installed in outdoor portions of metallic raceway systems that use non-threaded fittings


1
2
3
4
5
6
7
1

440.65

Protection Devices for Room A/C Units

- **Heat detecting circuit interrupter (HDCI)** was added to a list of devices for protection of single-phase room air conditioners
- HDCI technology is intended for use in dehumidifiers, room air conditioners and other refrigeration equipment
- Incorporates the functionality of a leakage current detector interrupter (LCDI), and is intended to interrupt power to the protected device when an overheating condition occurs
- HDCI devices have a maximum rating of 40 amperes and are intended for use on circuits rated 250 volts (ac) maximum

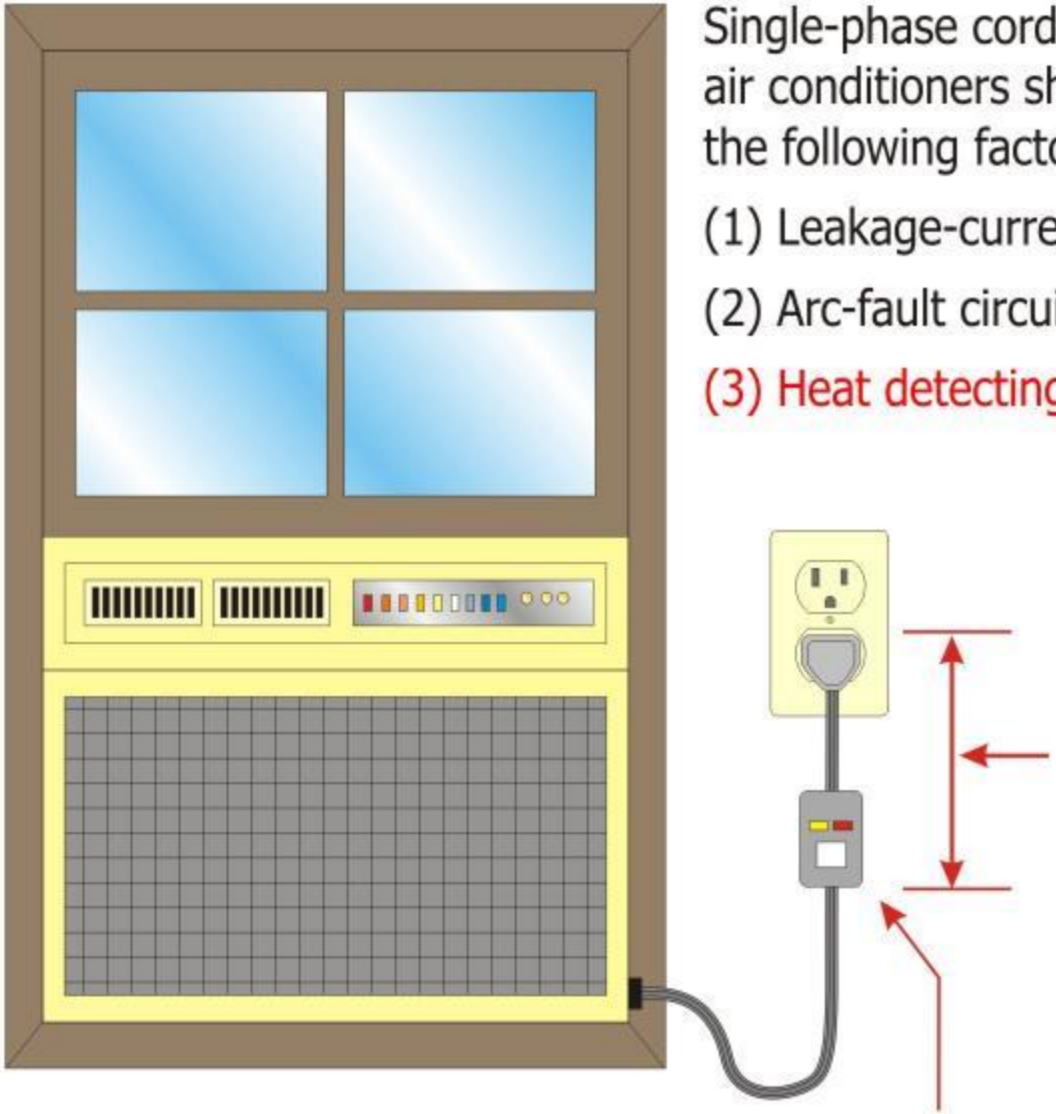
440.65 Protection Devices for Room AC Units

Single-phase cord- and plug-connected room air conditioners shall be provided with one of the following factory-installed devices:

(1) Leakage-current detector-interrupter (LCDI)

(2) Arc-fault circuit interrupter (AFCI)

(3) Heat detecting circuit interrupter (HDCI)



LCDI, AFCI, or HDCI to be located within 300 mm (12 in.) of attachment plug

The protection device shall be an integral part of the attachment plug or be located in the power supply cord within 300 mm (12 in.) of the attachment plug

445.11 Nameplate Marking for Generators

- Nameplate marking requirements for generators have been **revised** and put into a **list format**
- **“Impedance” was replaced with “reactance”** as “impedance” was in conflict with the nationally recognized standard *(IEEE 115)* used to obtain subtransient, transient, synchronous, and zero sequence values for an alternator *(generator)*
- Inverter-based generators rated more than 15 kW are now also required to be marked with the **maximum short-circuit current** to verify proper overcurrent protection
- Manufacture’s marking provision required to indicate if the generator neutral is **bonded to the generator frame**
- Revised information will assist the AHJ in determining compliance with **445.13** *(ampacity of conductors for generators)*

UNBALANCED LOAD CAPABILITY-25%

GENERATOR SET DATA

MADE IN USA

MODEL 0051910

SERIAL 4307416

TYPE CODE SG030-A163.0V18HBYYC

ENGINE NO. 0E8336

RATED KW 30

RATED KVA 30

UPSIZE ALT.KW 40

VOLTS 120/240

AMPS 125

PHASE 1

POWER FACTOR 1.0

HERTZ 60

ALT. R.P.M. 1800

ENG. R.P.M. 1800

PROD. DATE 11/10/05

GENERAC POWER SYSTEMS, INC.
WAUKESHA, WI

CLASS H ROTOR H STATOR WINDING INSULATION AT 40°C AMBIENT

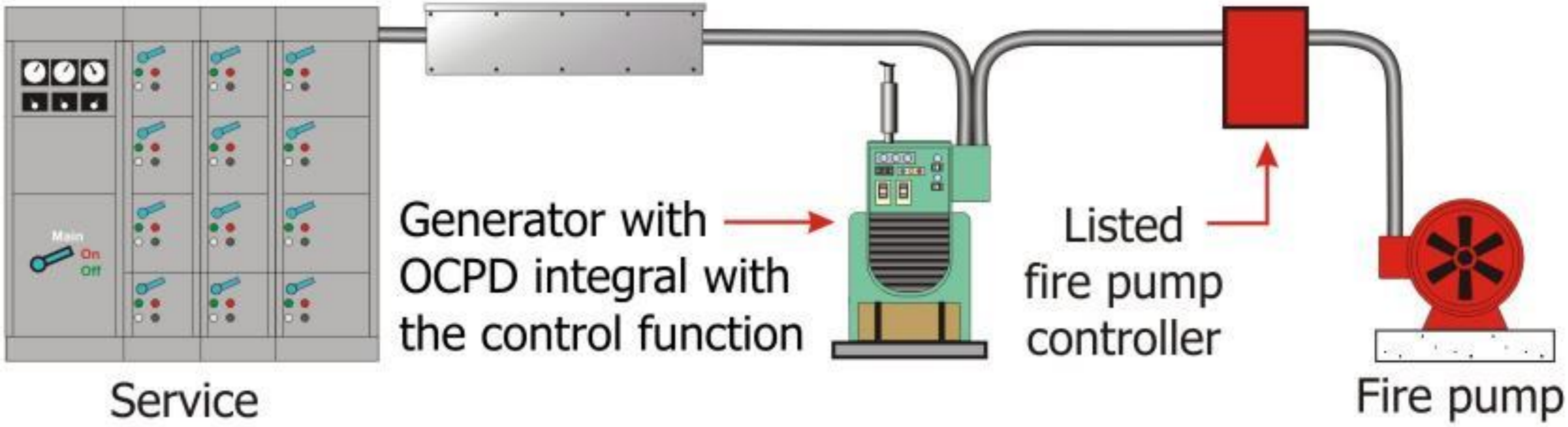
445.13(B) Generator OCPD Provided

- New requirement added to clarify **feeder taps** can be used if generator is equipped with an overcurrent relay or other overcurrent protective device
- Feeder tap rules of **240.21(B)** can be used
- New revision can be applied unless the tapped conductors are for portable generators rated 15 kW or less where field wiring connection terminals are not accessible
- This change should reduce confusion among some users of the *Code* about the conditions under which tap conductors for generators are acceptable

445.13(B) Generator OCPD Provided

Ampacity of conductors between a generator and the first overcurrent protection device cannot be less than 115% of the nameplate current rating on the generator nameplate

An exception permits these conductors to have an ampacity of not less than 100% of the generators nameplate current rating if the generator is designed to operate to prevent overloading *[see 445.13(A) and exception]*



Feeder tap rules of 240.21(B) can be used if the generator or generator set is equipped with an overcurrent relay or other overcurrent device

Tapped conductors are not allowed for portable generators rated 15 kW or less where field wiring connection terminals are not accessible

445.18 Generator Disconnecting Means and Shutdown of Prime Mover

- Generator disconnecting means requirements have been reorganized with added provisions for:
    - Disconnecting means
    - Shut down of the prime mover
    - Generators installed in parallel
- Generator is typically the combination of an electrical generator and an engine *(prime mover)* mounted together to form a single piece of equipment or a “gen-set”
- Lack of information and regulations for a “**prime mover**” was addressed for the 2017 *NEC* with the addition of 445.18(B) titled, “**Shutdown of Prime Mover**”

445.18 Generator Disconnecting Means and Shutdown of Prime Mover *(cont.)*

- Additional requirements were necessary to provide a remote shutdown means in the event of an emergency
- New shutdown means for the prime mover is needed to prevent the generator set from unexpectedly starting and running while the generator is shut down for such things as undergoing service
- New 445.18(C) was also added titled “**Generators Installed in Parallel**”
- Clarifies where generators are installed in parallel it is not necessary to provide a disconnecting means at each generator and at the paralleling equipment as long as the generator is capable of isolating the generator output terminals from the paralleling equipment


Cummins
Onan
GenSet
PROTOTYPE TEST
PTS
SUPPORTED
HOT
⚠WARNING
Hazardous Voltage
Generator with automatic
control will start
Rotating Parts

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

- **Listed cord sets** are now permitted to be used to incorporate ground-fault circuit-interrupter *(GFCI)* protection for portable generators manufactured or rebuilt prior to Jan 1, 2015
- GFCI requirements have been separated into two different categories for these generators:
  - **Unbonded** *(floating neutral)* generators and
  - **Bonded** neutral generators
- Unbonded *(floating neutral)* generators require GFCI protection at all 125-volt, 15 and 20 ampere receptacles, but only where both 125-volt and 125/250-volt receptacles exist on the generator

445.20 GFCI Protection for Receptacles on 15-KW or Smaller Portable Generators *(cont.)*

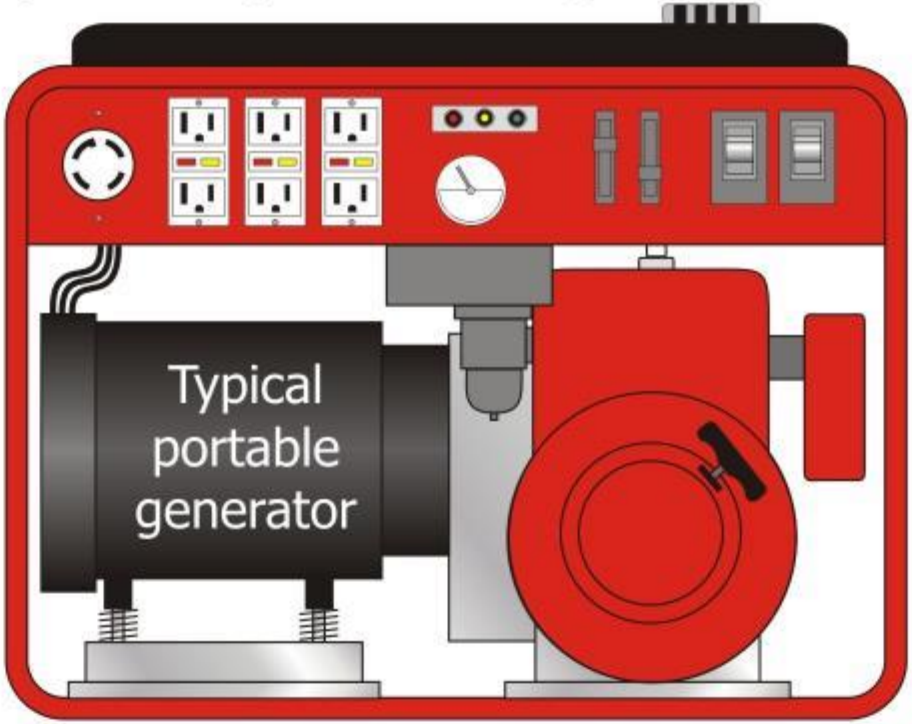
- An exception for unbonded *(floating neutral)* generators eliminates GFCI protection where the 125-volt receptacle outlets(s) is interlocked such that it is not available for use when any 125/250-volt receptacle(s) is in use
- New 445.20(B) requires all 125-volt, 15 and 20 ampere receptacles on bonded neutral generators to be provided with GFCI protection
- An exception to 445.20(A) and (B) permits GFCI protection in the form of listed cord sets or devices incorporating listed GFCI protection if the generator was manufactured or remanufactured prior to January 1, 2015

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

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)

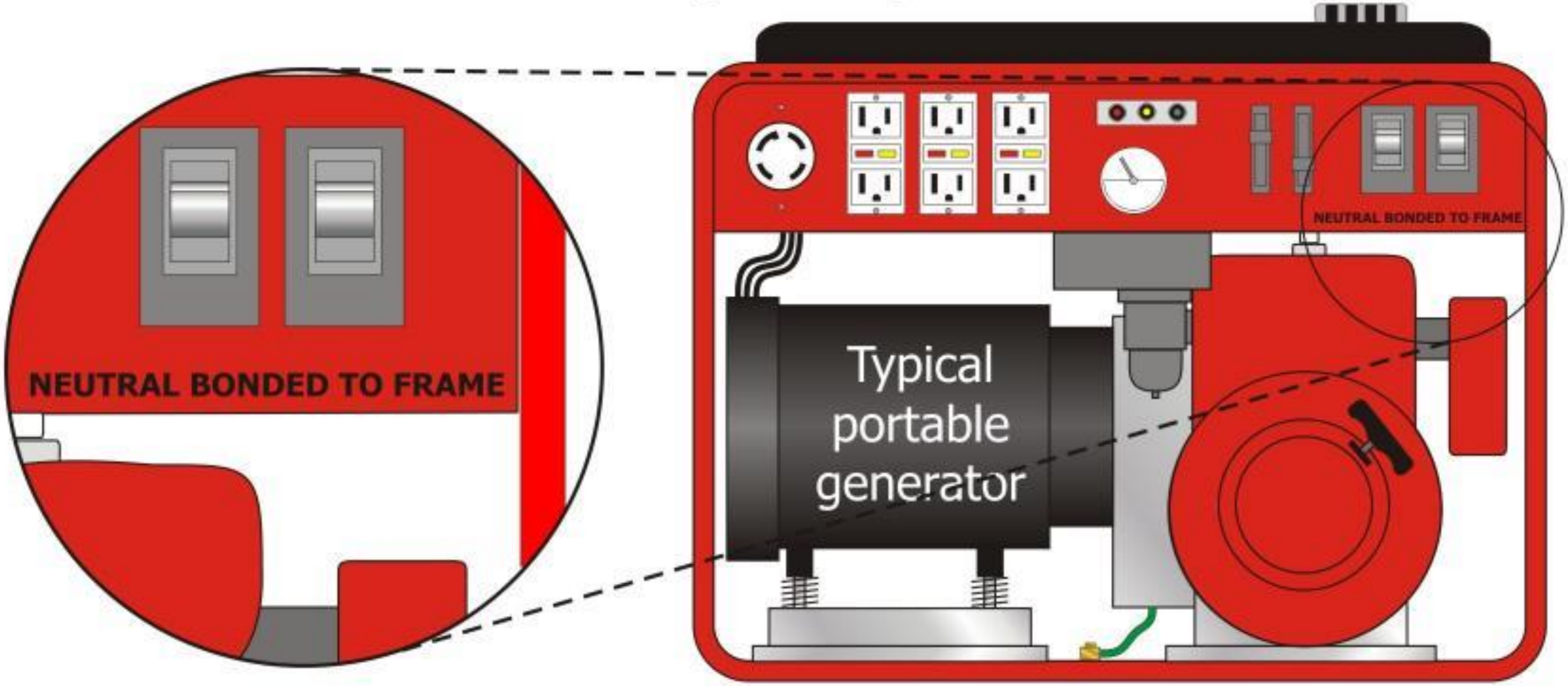


If the generator was manufactured or remanufactured prior to January 1, 2015, listed cord sets or devices incorporating listed GFCI protection for personnel identified for portable use shall be permitted

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

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(B): Bonded neutral generators to be provided with GFCI protection on all 125-volt and 15- and 20-ampere receptacle outlets



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

Photo Courtesy of Generac

480.3 Equipment *(Storage Batteries)*

- New requirement were added at 480.3 that will require **storage batteries** and **battery management equipment** to be **listed** *(other than **lead-acid batteries**)*
- Recognizes the need for a National Recognized Testing Laboratory *(NRTL)* evaluation of storage batteries and battery management equipment by a third-party testing laboratory
- Through the use of new technologies, energy density for storage batteries has significantly increased and continues to increase
- Lithium-ion battery energy density has been increasing at approximately 10 percent annually

Analysis of Changes – 2017 *NEC*

Training Presentation By:

International Association of Electrical Inspectors