



Board of Building Standards

ELECTRICAL SAFETY INSPECTOR ADVISORY COMMITTEE REQUEST FOR RECOMMENDATIONS

DATE: DECEMBER 10, 2021
TIME: 12:00 PM
LOCATION: NO MEETING THIS MONTH

Call to Order

Personnel Certification Applications

P-1 Farmer, Michael - ESI
Cert ID: 8726
Current Certifications: None
Staff Notes: Appears to meet requirements for certification
ESIAC Recommendations:
Committee Recommendation:

Continuing Education Applications for Review

ER-1 Generators and the 2020 NEC (Matthews Electrical Services)
All certifications except PI, NRIUI, RMI, and RIUI (4 hours)
Staff Notes:
ESIAC Recommendation:
Committee Recommendation:

ER-2 Grounding and Bonding Part 2: Beyond the Basics (Matthews Electrical Services)
BO, MPE, EPE, FPPE, BI, ESI, RBO, RPE, RBI (4 hours)
Staff Notes:
ESIAC Recommendation:
Committee Recommendation:

ER-3 Health Care Facilities, Fault Currents, Common Defects (IAEI)
All certifications except IU and plumbing (6 hours)
Staff Notes:
ESIAC Recommendation:
Committee Recommendation:

Old Business

New Business

Adjourn

File Attachments for Item:

P-1 Farmer, Michael - ESI

Cert ID: 8726

Current Certifications: None

Staff Notes: Appears to meet requirements for certification

ESIAC Recommendations:

Committee Recommendation:

Farmer

Michael

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				

Farmer

Michael

Last Name

First Name

BBS Certification ID

SECTION 3: EMPLOYMENT/EDUCATION

Formal Education	Date Graduated
Avon High School	1986
Related Vocational or Technical Training	Years' Experience
International Brotherhood of Electrical Workers Local 129 Apprenticeship	4
U.S. Military construction experience (MOS or other designation):	Years' Experience
Place of Employment:	Years' Employed
IBEW Local 129	26

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)

Farmer

Michael

Last Name

First Name

BBS Certification ID

SECTION 6: ELECTRICAL SAFETY INSPECTOR (ESI) - SPECIFIC EXPERIENCE QUALIFICATIONSApplicants 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 one 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 <u>AND</u> Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From _ To _ (MM/YY)
<i>Example:</i> Children's Hospital, Toledo Structural steel work on addition	Horner Steel and Trade 125 Anytown Street My City, OH, 45454 (419)555-1212	July 2013-May 2014 (10 months)
Total Experience on This Page (In Months):		

Board of Building Standards

Application for Interim Certification, Building Department Personnel

Farmer**Michael***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)
Republic Steel, Lorain, Ohio # 3 Blast Furnace Rebuild Installed and terminated 13.8 KV Feeder from WQC to new substation. Construct new substation with step down transformers and motor control centers to operate blast furnace equipment. Perform all grounding (mechanical & exothermic) and bonding required by code. Installed PVC coated rigid galvanized conduit and fiberglass cable tray for power and control wiring. Conduits and tray fill were calculated per code requirements. Installed and terminated 250 Volt DC Feeders to operate Skip Car motors. Performed standby for start up of the Blast Furnace	Henry J Kaiser Pittsburgh, PA.	04/92 to 11/92
Total Experience on This Page (In Months):		7

Board of Building Standards

Application for Interim Certification, Building Department Personnel

Farmer**Michael***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)
Industrial Plastics New 800A 480V 3 Phase 4 Wire Distribution Panel and Equipment - ForemanCoordinate work with other trades to install parallel 4" EMT Conduits, supports and properly sized junction boxes from 4000A 480V main service in back of building to a location in the front of the building to service new equipment. Install 4 - 500 MCM and 1/0 Ground per conduit and terminate. Install new perimeter grounding and connect to new equipment and building steel. Install Schedule 40 PVC conduits sized per wire fill for new equipment and transition to GRC conduit above finished floor.	Higgins Electric 620 Sugar Lane Elyria, Ohio 44035	06/93 to 08/93
BF Goodrich Building 471 New Estane Line - Foreman Responsible for the installation and coordination of a new line in a Class 1 Division 1 environment. Responsible for the ordering of proper explosion proof materials and over seeing the installation of GRC conduit, fittings, seal-offs, junction boxes, explosion proof flex, and wiring from MCC to new equipment and motors in the field. Installed control wiring from operator booth to locations in the field.		09/93 to 02/94
EMH Hospital 2nd Floor Surgery Remodel Work included installing a new 800A 480V 3 Phase 4 Wire Emergency Power Feed for a new distribution panel to supply 277V lighting and emergency power via a step down transformer for 208/120V power. Install branch circuits for normal and emergency power. Install 277V lighting and emergency lighting. Install new operating lights and equipment in each room.		03/94 to 09/94
Total Experience on This Page (In Months):		14

Board of Building Standards

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List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
North Ridgeville High School Addition Install Sch 40 PVC underground for new service, distribution panels and branch circuits in various spots of building. Work with masons to install panel tubs and conduit stubs in block walls using EMT and compression couplings. Relocate framing to accommodate electrical panel and equipment. Install ground system and bond at the main service. Install service entrance conductors and terminate. Install wire for branch circuits following code for conduit fill and derating of conductors as required. Installed conduit and wire for 277V indoor, outdoor and emergency lighting. Install switches and outlets. Install Fire Alarm System including conduit, wire and mounting devices and panels. Test Fire Alarm for proper operation. Work with other trades to coordinate all this work.	Higgins Electric 620 Sugar Lane Elyria, Ohio 44035	09/94 to 12/95
Total Experience on This Page (In Months):		16

Board of Building Standards**Farmer***Last Name*

Application for Interim Certification, Building Department Personnel

Michael*First Name**BBS Certification ID*

List Each Construction Project <u>AND</u> Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From _ To _ (MM/YY)
Lorain Ford Plant Expansion Fabricated structural supports for electrical equipment and conduits mounted in the field. Installed cable tray, grounding jumpers and 480V armored cable feeds for buss duct. Install buss duct, buss plugs and armored cable to various Motor Control Centers to feed conveyors and equipment. Promoted to Foreman to oversee the electrical installation of the finish conveyor system. This included coordinating work with multiple trades, ordering the proper materials and attending progress meetings. The electrical portion of this project was a combination of cable tray, GRC conduit, fittings, junction boxes, disconnects, SO and SJO Cords used for proximity switches and solenoids. The motors for the conveyor were all 480V 3 phase and controlled by the motor starters located in the MCC with properly sized overloads. The control wiring was all 120V and feed from the inputs inside the MCC.	Lake Erie Electric 25730 First Street Westlake, Ohio 44145 (440) 835-5688	01/96 to 02/97
Total Experience on This Page (In Months):		14

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List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
Owens Corning Medina New Shingle Production Line Installed GRC conduit and all the necessary supports, fittings and junction boxes to complete a pathway for the wiring needed to power and control the system including safety stops. Install PVC coated flexible conduit and fittings to motors. Fabricated supports for electrical equipment and conduit supports. Worked with Iron Workers to set electrical structures on roof and wire them up. The voltages for this project consisted of 277/480V 3 phase 4 wire for equipment and 120/208V 3 phase 4 wire for control and general duty power.	Lake Erie Electric 25730 First Street Westlake, Ohio 44145 (440) 835-5688	03/97 to 07/97
Total Experience on This Page (In Months):		5

Board of Building Standards

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List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From _ To _ (MM/YY)
Offices & Distribution Warehouse Cleveland, Ohio Foreman Responsible for the coordination and installation of the complete electrical system for this project including the fire alarm system and communications. Review drawings and order materials to ensure proper conduit sizes, supports and junction boxes based off circuit groupings and wire fill. Attend weekly project meetings and coordinate work with the other trades. Contact building department to discuss local requirements and inspections for the project. The project included the installation of Schedule 40 PVC conduit for the underground, EMT conduit for the office area, and Galvanized Rigid Conduit for the warehouse area. Flexible metallic conduit and liquid tight were used for the proper equipment pathways. The wiring included service entrance conductors, sub panel feeds, branch circuits and lighting feeds. The lighting for this project was 277V. Light fixtures in office were installed in drop ceiling using hurricane clips and tying the 4 corners of each fixture to building steel. The light fixtures in the warehouse where 400W Metal Halide with a cord cap for disconnecting means and a cable attached to the bar joist for safety. This building required a fire pump that was fed directly from the transformer to a disconnect.	South Shore Electric 589 Ternes Avenue Elyria, Ohio 44035 (440) 366-6289	08/97 to 05/98
Total Experience on This Page (In Months):		10

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List Each Construction Project <u>AND</u> Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
US Steel - Lorain, Ohio #3 Bar Mill 13.8KV Re-Conductor Project I was temporarily removed from South Shore Electric by our Business Manager to perform structural fabrication and installation for this project because I had certification in structural welding (vertical up & overhead). Project consisted of the installation of new structural towers and foundations, including grounding, addition of structural supports to existing towers and buildings to provide an over head pathway from Clinton Sub Station addition to the new electrical equipment located in #3 Bar Mill. Install switchgear and connect via buss tie in for all conductors and grounds inside Clinton Sub. Install ground wire, lighting arrestors, messenger, hang rollers and rig corners to install ungrounded Hendrix Cable. Remove rollers and replace with Hendrix Cable supports. Complete 15KV terminations, perform Megger test to check insulation and Hipot test to check for leakage before energizing equipment.	Higgins Electric 620 Sugar Lane Elyria, Ohio 44035	06/98 to 02/99
Total Experience on This Page (In Months):		8

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List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
Church on The Rise - New Westlake, Ohio Foreman Responsible for the layout and installation of the temporary power, electrical system, fire alarm system and sound system. Responsible for scheduling inspections, weekly job meetings, and trade coordination. Sch 40 PVC conduit and fittings were used for underground applications. EMT and set screw fittings were used for all work above grade. Installed all necessary junction boxes and provided grounding as required by code. Installed service equipment and sub panels as shown on plans. Grounding was completed by the use of the copper water main and a supplemental ground rod. bonding was provided at main service. Installed all branch wiring for power and lighting. Lighting was installed as required by the Authority having jurisdiction. Install all electrical devices and check for operation. Install wiring in conduit pathway for FA System. Terminate and mount pull stations, horn - strobes, smoke detectors, duct detectors, and heat detectors. Provided pull strings in conduit pathway for sound system.	South Shore Electric 589 Ternes Avenue Elyria, Ohio 44035 (440) 366-6289	02/99 to 01/00
Total Experience on This Page (In Months):		11

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List Each Construction Project <u>AND</u> Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From _ To _ (MM/YY)
Firelands Hospital, Sandusky, OH 4 Story Addition Responsible for the installation of the conduit system and wire for a new 800A 480V 3 phase 4 wire distribution panel to supply power to the new chillers for this addition. The conduit was routed from the penthouse to the first floor of the addition. Completed floor and wall penetrations where needed and provided fire stop or caulk for each. The conduit system was EMT with compression fittings. Junction boxes were sized and install as needed per code. Install new Chiller Panel and terminate. Installed conduit and wire from new panel to chillers. Installed temperature control system and worked with company for start up of the complete system.	Brady Electric 1721 Hancock Street Sandusky, OH 44870	01/00 to 08/00
Total Experience on This Page (In Months):		7

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List Each Construction Project <u>AND</u> Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
Business Agent / Assistant NJATC Training Coordinator Responsible for assisting the Business Manager in providing training for our apprentices and continuing education for our journeymen. Classes included NEC code updates, conduit bending, fiber optic, solar, PLC Logic, high voltage terminations and splices. Meet with local building departments to discuss issues or deficiencies they were experiencing with inspections so we could provide additional training. Job site visits were performed, as well surveys to help us develop our training programs.	IBEW Local 129 6100 S Broadway Suite 201 Lorain, OH 44053 (440) 233-7156	07/00 to 01/05
Total Experience on This Page (In Months):		53

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Farmer**Michael***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)
Project Manager / Partner Responsible for the commercial and residential bidding, project management, service work, ordering of materials and securing proper permits and inspections for all projects. Work included Avon Lake Animal Clinic addition, EMH Hospital (Office remodels, New Generator, New Computer Room, and service work), CenturyLink Main Office remodel and generator replacement, Old Navy, Manco Duck Tape office remodel and many service clients. Our residential work included wiring new homes and additions, service changes and service work. All work was performed to current codes at that time.	Custom Electric 8185 Pyle South Amherst Road South Amherst, OH 44001	01/05 to 03/07
Total Experience on This Page (In Months):		

Board of Building Standards

Application for Interim Certification, Building Department Personnel

Farmer**Michael***Last Name**First Name**BBS Certification ID*

List Each Construction Project <u>AND</u> Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
Vice President of Operations. Responsible for the day to day operations of the company during this time period as well as securing all required permits. The projects during this time period where Certain Teed Shingle Factory in Sandusky, Ohio. We were responsible for the installation of a new 480V feeder from existing switchgear to a location approximately 2000' away. The work included fabricating supports, junction boxes, fittings and expansion fittings for the new GRC conduits. Cables and grounding bushings were installed and terminated for a finished product. Tri-County Medical Offices in Elyria, Ohio. We were awarded the contract to provide complete electrical service, fire alarm and sound system pathway for this project. This project included 277V lighting and emergency lighting, 120V general power and 120V emergency power. The electrical system was a mixture of EMT conduits and applicable fittings and MC Cable and fittings for small branch circuit drops and lighting whips. All work was installed according to code and passed all inspections.	Higgins Electric 620 Sugar Lane Elyria, OH 44035	04/07 to 10/07
Total Experience on This Page (In Months):		6

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Application for Interim Certification, Building Department Personnel

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List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
Purchased Higgins Electric 03/07. Project Manger Perry Middle School, Perry, OH Carry over project from Higgins Electric that was handed to me to finish. We had subcontracted the Tele / Data work for this project to Andy Dever. This work included installing all the data cabling, from various IT rooms not exceeding 320'. We were responsible for the the IT equipment installation and testing of it along with all the cabling. We installed the equipment ladder racks but all cable tray was installed by others. First Merit Bank, Avon, OH. Was the responsible person for bidding and securing this project. Applying and receiving all required permits. Attend weekly project meetings and coordinate work with all trades. Support the electricians by providing current information and suppling needed materials. The project included a new electrical service, lighting, branch circuits, fire alarm and security system. The conduit system consisted of SCH 40 PVC and fittings for underground work. EMT and MC Cable were used for above ground work. All fittings and junction boxes were UL approved.	Lake Erie Electric 7495 Industrial Parkway Lorain, OH 44053 (440) 989-8200	03/07 to 10/08
Total Experience on This Page (In Months):		19

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Application for Interim Certification, Building Department Personnel

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List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
Walmart - Lorain, Ohio Responsible for the installation of the automotive center in this store. Coordinated work and scheduled inspections as required. Worked included 480V sub panel feed, step down transformer and 120/208V general duty power panel. All service work was installed per code including bonding the transformer to building steel. The lighting was 277V and the equipment was 120/208V, 3 phase 4 wire. We installed the conduits, wire and terminations for this project.	South Shore Electric 589 Ternes Avenue Elyria, Ohio 44035 (440) 366-6289	06/10 to 01/11
Flavorseal - Avon, Ohio New Electric Heat Printer Installed new equipment from Germany that prints labels on the food package bags. Installed a new 800A feed from existing switch gear. Install feds and terminate on both ends. Ground equipment via rebar and building steel. Translate and install wiring from MCC to equipment and terminate. Check for operation. Use the 10' tap rule to install outlets per owner on equipment by installing fuse blocks and transformers in MCC to operate needed auxiliary equipment.		01/011 to 04/11
Total Experience on This Page (In Months):		9

Farmer

Michael

Last Name

First Name

BBS Certification ID

List Each Construction Project <u>AND</u> Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From _ To _ (MM/YY)
Freeman Manufacturing Avon, Ohio Miscellaneous Projects Customer purchased used tank heater to melt wax for different applications. Equipment had no drawings and was installed per customers specifications. I had to mount equipment and control panel, provide new 480V service and size the control transformer to operate the new controls. Install GRC conduits on conveyor and mount control devices for operation. Bond conveyor at splice points. Install all new wiring and terminate for operation. Installed 3 new sub panels in various areas of the plant provided by the owner for new equipment. Installed new conduits sized according to wire size determined by over-current protection. Installed all supports, fittings and junction boxes as required. The installation of bonded expansion fittings was required on all 3 runs. Install cables and terminate as required by code.	South Shore Electric 589 Ternes Avenue Elyria, Ohio 44035 (440) 366-6289	04/11 to 10/11
Total Experience on This Page (In Months):		7

Board of Building Standards

Application for Interim Certification, Building Department Personnel

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List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
Flavorseal - Avon, OH Spice Room Addition Foreman Coordinate interior build out which included the addition of a new 480V Sub Panel from existing MDP, step-down transformer, and 120/208V 3 phase 4 wire sub panel for miscellaneous equipment drops. The new area was completed using freezer panels. All electric and fire alarm work was installed above this area in EMT and set screw fittings. All penetrations through the ceiling required the use of stainless steel conduit, coupling, cord grip connector and SO cord with twist-lock connectors and plugs that met the food industry requirements. All penetrations were fire caulked and sealed. New 277V LED vapor-tight lighting was installed throughout the project. I also coordinated the replacement of the existing 300KW generator with a 750 KW generator to provide enough power to support the entire building. We installed additional conduits and changed out the service entrance rated transfer switch to accommodate the new future service for this building. All conduits, junction boxes and fittings were installed to code and inspected.	South Shore Electric 589 Ternes Avenue Elyria, Ohio 44035 (440) 366-6289	10/11 to 9/12
Total Experience on This Page (In Months):		12

Board of Building Standards

Application for Interim Certification, Building Department Personnel

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List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
Director of Public Service Plans for and directs the engineering, construction, inspection, and maintenance of City streets, sidewalks, bridges, water systems, buildings, cemetery, and other municipal infrastructures, facilities or property. Attend meetings to discuss issues and solve problems. Inspect and approve all facilities with in the right of way, including traffic signals. Develop and maintain effective working relationships with other public utilities. Understand, interpret, and apply laws and regulations to specific situations and communicate clearly.	City of Avon 36080 Chester Road Avon, Ohio 44011 (440) 937-7800	09.12 to present
Total Experience on This Page (In Months):		108

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List Each Construction Project AND Specific Type of Work Performed	Name of Employer, Contact, Address, Telephone Number	Project Time: From_ To _ (MM/YY)
NJATC Instructor I was the 3rd year apprenticeship instructor for nine years. Classes were held after work on Tuesdays and Thursday from October until the beginning of April for 4 hours. The 3rd year class consisted of the fundamentals of electronics and how they operate different from AC , Article 250 Grounding & Bonding, Transformers, Motors, Impedance calculations and Ohms Law. This was a five year apprenticeship program. I also attended the week long training program provided by our NJATC in Nashville, Tennessee. School requirements were 160 hours of classroom instruction per year.	IBEW Local 129 6100 S Broadway Lorain, OH 44053 (440) 233-7156	10/96 to 01/05
Total Experience on This Page (In Months):		9 months

Board of Building Standards

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Farmer

Michael

Last Name

First Name

BBS Certification ID

SECTION 8: PERSONAL HISTORY

1. Have you ever been convicted of any felony, or any crime involving 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:

Michael W. Farmer

Subscribed and duly sworn before me according to law, by the above named applicant this

day 22 of November in the year 2021 at Avon, County of Lorain and State of Ohio.

Notary Public:

Rose Frances Seighman



Rose Frances Seighman

NOTARY PUBLIC
STATE OF OHIO

My Commission Expires
August 2, 2025



2019

CITY OF SANDUSKY, OHIO

Department of Community Development

Division of Building Inspection

This license or registration shall be in force for the period beginning on January 02, 2019
and ending on the last day of December 2019.

This license or registration has been issued and shall be renewable in accordance with the Ordinances of the
City of Sandusky, Ohio. Failure to comply shall constitute a forfeiture or suspension of this registration.

MICHAEL W FARMER

3400 WILLIAMS CT
AVON OH 44011

CT001651

Registration Number

JOURNEYMAN ELECTRICIAN

Trade

No Apprentice, Journeyman or Contractor shall lend his Registration to others.

Director of Public Works

01/02/2019

Chief Building Official

City of Sandusky

Department of Community Development

Division of Building Inspection

2019

License/Registration #: CT001651

JOURNEYMAN ELECTRICIAN

Issued to: MICHAEL W FARMER

Renewal notices are sent out as a courtesy at the end of each year.

It is the license/registration holder's responsibility to renew their license at the end of each year.

If you have any changes to your name, address, phone or company, please notify the office listed below:

Division of Building Inspection
222 Meigs Street
Sandusky, OH 44870

Office: 419-627-5940
E-Mail: dleslie@ci.sandusky.oh.us
www.ci.sandusky.oh.us

Fee Receipt

License/Registration #: CT001651

JOURNEYMAN

Received from:
MICHAEL W FARMER

City of Sandusky

Department of Community Development

Division of Building Inspection

Date Paid 01/02/2019

How Paid Check

Ck # 1467

Fee \$25.00

Receipt # RN-0193272

Account 110-4090-46411

Received by: DSL

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
MICHAEL W FARMER**

54.47.1207

Expiration Date: 01/02/2022

Signature

Michael W. Farmer
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**

MICHAEL W FARMER

MICHAEL W FARMER
is duly registered and is entitled to the practice in the State of
Ohio. License categories are for Servicing, Testing, Repairing,
and Installing.
Fire Alarms / Detection

OSHA

600208279



U.S. Department of Labor
Occupational Safety and Health Administration

Michael W. Farmer

has successfully completed a 30-hour Occupational Safety and Health
Training Course in

Construction Safety & Health

Joyce Furblong
(Trainer)

11/28/07
(Date)

OSHA recommends Outreach Training courses as an orientation to occupational safety and health for workers. Participation is voluntary. Workers must receive additional training on specific hazards of their job. This course completion card does not expire.

For further information see our web site at www.osha.gov/outreach.html

File Attachments for Item:

ER-1 Generators and the 2020 NEC (Matthews Electrical Services)

All certifications except PI, NRIUI, RMI, and RIUI (4 hours)

Staff Notes:

ESIAC Recommendation:

Committee Recommendation:

Course Description and Objectives

Generators are a critical part of our lives. We depend on them to keep the lights on and for other important operations when the utility power goes down. However, improper design and use of generator systems can lead to disastrous and even fatal results.

The objective of this 4-hour course is to provide the end-user with the NEC and other requirements to install a safe and code-compliant generator installation.

This course will cover generator safety requirements, portable and standby generators, transfer switches, separately derived systems, grounding and bonding of generator systems and more.

As part of this course, the differences between Emergency Systems, Legally Required Standby Systems and Optional Standby Systems will be covered.

A design example of a home standby generator installation will be included to reinforce the main topics covered.

Generator Course Outline

1. Generator Code References
 - a. Article 100 Definitions
 - i. Separately Derived System
 - ii. Switch, Transfer
 - b. Article 445 Generators
 - c. Article 250
 - i. Section 250.30 information note 1
 - ii. Section 250.34 (A) Portable Generators
 - iii. Section 250.34(B) Vehicle-Mounted and Trailer-Mounted Generators
 - iv. Section 250.34(C) Grounded Conductor Bonding
 - v. Section 250.35 Permanently Installed Generators
 - d. Article 685 Interconnected Electrical Systems
 - e. Article 700 Emergency Systems
 - f. Article 701 Legally Required Standby Systems
 - g. Article 702 Optional Standby Systems
 - h. Article 705 Interconnection Electrical Power Production
 - i. Article 708 Critical Operations Power Systems (COPS)

Other references:

- a. NEMA Motors and Generators MG-1
 - b. UL 2200 Standard for Stationary Engine Generator Assemblies
 - c. NFPA 37 Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines
2. Generator Safety
 - a. Proper location
 - b. Fuel concerns
 - c. Shock, arc flash, GFCIs etc.
 3. Types of Generators and Generator systems
 4. Grounding and Bonding of Generators
 - a. Separately Derived Systems
 5. Exercise: Sizing, Specifying and Designing a Code-Compliant Home Standby Generation Installation
 6. Wrap-up
 - a. Questions and Answers
 - b. Code credit applicability and certificates



CRITERIA FOR SUBMITTING CONTINUING EDUCATION COURSES FOR BOARD OF BUILDING STANDARDS CERTIFICATIONS

The Ohio Board of Building Standards approves Continuing Education Courses for building department personnel. The courses may be used for the attainment of goals that are connected with technical and professional development as they relate to enforcing and interpreting the Ohio State Building Codes. Board approval is granted only on course instruction pertaining to OBC, OMC, OPC, and RCO requirements and such other content areas directly related to the responsibilities of the certification for which credit is being requested.

Instructors: Anyone or any organization promoting an approved course, is required to make full and accurate disclosure regarding course title, course approval number, number of credit hours, certifications for which the BBS has approved the class, and fees in promotion materials and advertising. ***The Board does not grant retroactive approval. It is recommended that courses be submitted for approval well in advance of any scheduling of classes and advertising.*** Advertising shall not disclose improper approval information to the public.

Course sponsors/co-sponsors: provide participants a certificate of completion containing the following information: name of participant, title of approved courses, BBS approval #, BBS approved certifications, date of the continuing education program, number of approved credit hours awarded and signature of authorized sponsor or instructor.

Anyone or any organization administering an approved course shall provide the Board with advanced written information on scheduling of the course(s) (date and place) and provide to the Board a legible list of participants who completed the course with the name of course, date, and location.

Participants: Must attend the complete course as presented by the instructor to receive credit hours approved by the Board. No partial credit shall be given to any participant who failed to complete the entire course as approved. The sponsor/co-sponsor or instructor shall formulate a method to verify the individual's attendance and completion of the course.

Board approval: Remains in effect through the calendar year of approval. The course may be renewed administratively by sponsor application in subsequent years so long as it references current codes and standards. Upon the Board's adoption of a new edition of the codes, course sponsors must update their course and submit to the Board for approval. The Board does not grant retroactive approval for courses presented prior to approval date.

Facility/training area: Shall be capable of comfortably and safely seating at least the number of attendees with writing surfaces for each attendee; accessible to/and usable for people with disabilities; sized and provided with audio/visual equipment adequate so that each attendee can see the instructor(s) and overhead screen and hear the content of the training programs; illuminated for writing and that the content on an overhead screen can be seen easily by all attendees; non-smoking in the training room; sound controlled so that outside noise will not interfere with the training.

APPLICATION

FOR Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.



Board of Building Standards

6606 Tussing Road, P.O. Box 4009

Reynoldsburg, Ohio 43068-9009

(614) 644-2613 Fax: (614) 644-3147

dic.bbs@com.state.oh.us

www.com.state.oh.us/dic/dicbbs.htm

COURSE SUBMITTER:

Course Submitter: Henry Matthews

(Contact Name)

Organization: Matthews Electrical Services

(Organization/Company)

Address: 1203 McKinley Place

(Include Room Number, Suite, etc.)

City: Fostoria

State: Ohio

Zip: 44830

E-Mail: hpmatthews66@att.net

Telephone: 419-575-3488

Fax: _____

Course Sponsor: _____

COURSE INFORMATION:

Course Title: Generators and the NEC - Webinar

New Course Submittal: ☒

Update Course: ☐

Prior Approval Number: _____

Purpose and Objective: This course will review the contents and requirements of article 445 in the NEC - Generators. It will cover topics such as definitions, grounding and bonding of generators, overcurrent protection, GFCI requirements, generator safety, paralleling of generators and others. We will review basic generator theory and history. We will also review the concept of separately derived systems and how to ground and bond the system according. The role of the transfer switch will also be discussed.

Number of Instructional Contact Hours that can be obtained upon completion: 4

If Multi-Session, Number of Instructional Contact Hours Per Session: _____

Program Applicable for the Following Participants:

Building Official ☒

Master Plans Examiner ☒

Building Inspector ☒

Fire Protection Inspector ☒

Mechanical Inspector ☒

Building Plans Exam. ☒

Plumbing Inspector ☐

Plumbing Plans Exam. ☒

Non-Res IU Inspector ☐

Electrical Plans Exam. ☒

Mechanical Plans Exam. ☒

Fire Protect. Plans Exam. ☒

Res Building Official ☒

Res Plans Examiner ☒

Res Building Inspector ☒

Res Mechanical Inspector ☐

Res IU Inspector ☐

Electrical Safety Inspectors ☒

Location of ESI Course: www.matthewselectrical.net via www.zoom.com

Date(s) of ESI Course(s): 12-11-21 and others

SUBMITTAL CHECKLIST: Make Sure all of the Following Information is Submitted:

Check
Off

Course Submitter:	Name of contact person and their certification numbers, organization, address, fax, phone	X
	Organization sponsoring or requesting the program (if any)	
Course Title:	Name of course (related to content)	X
Purpose/Objective:	Describe purpose and how course will improve competency of certification(s) listed	X
Contact Hours:	Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	X
Participants:	Check off each certification for which credit is requested (for which course relates to certification)	X
Content of Program:	Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered	X
Course Materials:	Collated workbooks, handouts, hard copy or electronic versions of program is available	X
Instructor(s) Info.:	Resume of professional/educational qualifications & teaching/training experience/BBS certifications	X
Test Materials:	National Electrical Code	X
Completed Application:		X

NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.

Generators

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

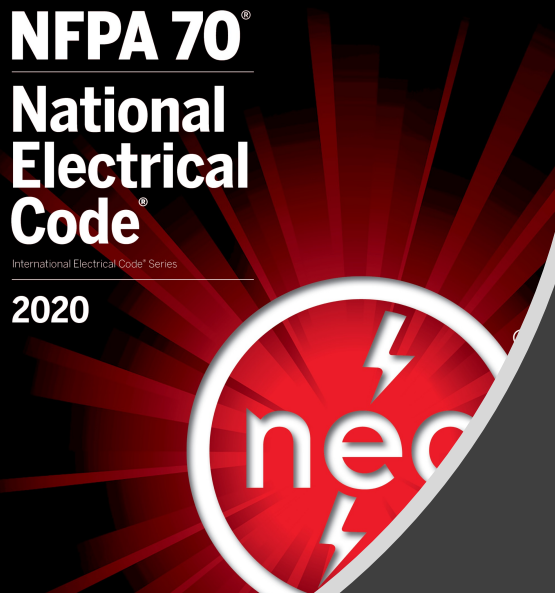


MATTHEWS ELECTRICAL SERVICES

The 2020 NEC has not been adopted in Ohio. PRESENTED FOR INFORMATIONAL PURPOSES ONLY

1

1



NFPA 70®

National
Electrical
Code®

International Electrical Code® Series

2020

Generators

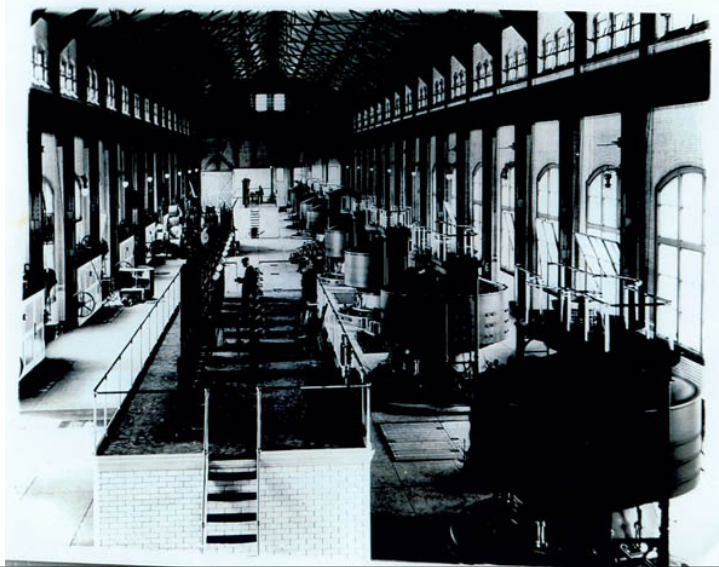
NEC Article: 445

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2

2

Niagara Falls power Co. 1895
The first major hydro-electric power plant in
the world
Adams Station, power house #1



3

3



The 2020 NEC has not been adopted in Ohio. PRESENTED FOR INFORMATIONAL PURPOSES ONLY

4

4



5

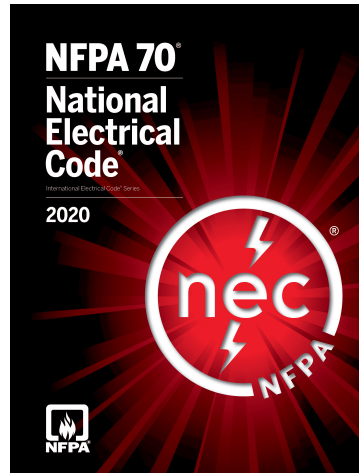
A Minion character from the Despicable Me franchise is shown from the chest up. It is wearing a red fire helmet with a silver bell and a silver megaphone. The Minion has its mouth open as if shouting into the megaphone.

Roll Call!

The 2020 NEC has not been adopted in Ohio. PRESENTED FOR
INFORMATIONAL PURPOSES ONLY

6

Generators Article 445



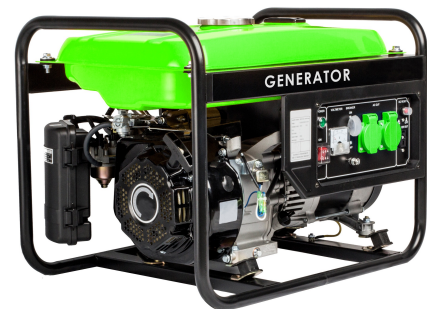
The 2020 NEC has not been adopted in Ohio. PRESENTED FOR INFORMATIONAL PURPOSES ONLY

7

7

Course Description and Objectives

- Generators are a critical part of our lives. We depend on them to keep the lights on and for other important operations when the utility power goes down. However, improper design and use of generator systems can lead to disastrous and even fatal results.
- The objective of this 4-hour course is to provide the end-user with the NEC and other requirements to install a safe and code-compliant generator installation.
- This course will cover generator safety requirements, portable and standby generators, transfer switches, separately derived systems, grounding and bonding of generator systems and more.
- A design example of a home standby generator installation will be included to reinforce the main topics covered



8

Agenda

- Generator types
 - Portable
 - Standby
 - Vehicle mounted
- Definitions
 - Separately derived system
- Applicable standards and codes
- Generator Safety
- NEC applicable articles:
- Overcurrent and overvoltage protection
- Conductor sizing
- Grounding and bonding
- Transfer switches
- Other considerations
 - Layout, placement, ventilation
 - Generators in parallel
- Maintenance
- Residential design and installation example
 - Load estimate and generator sizing
 - Surge loads

9

10

GENERATOR SAFETY

USE BACKUP POWER SAFELY

When used properly, portable and standby generators are a great option to provide backup power during brownouts or blackouts. Learn how to use generators safely with the following tips:

GENERATORS

Location

- 20 ft**
Always keep generators at least **20 feet away** from your home
- Never operate a generator in an **enclosed space**
- Make sure the generator has **3-4 feet** of clear space above and on all sides for proper ventilation
- Keep generators **away** from doors, windows, and vents
- Always **direct exhaust away** from your home

Use

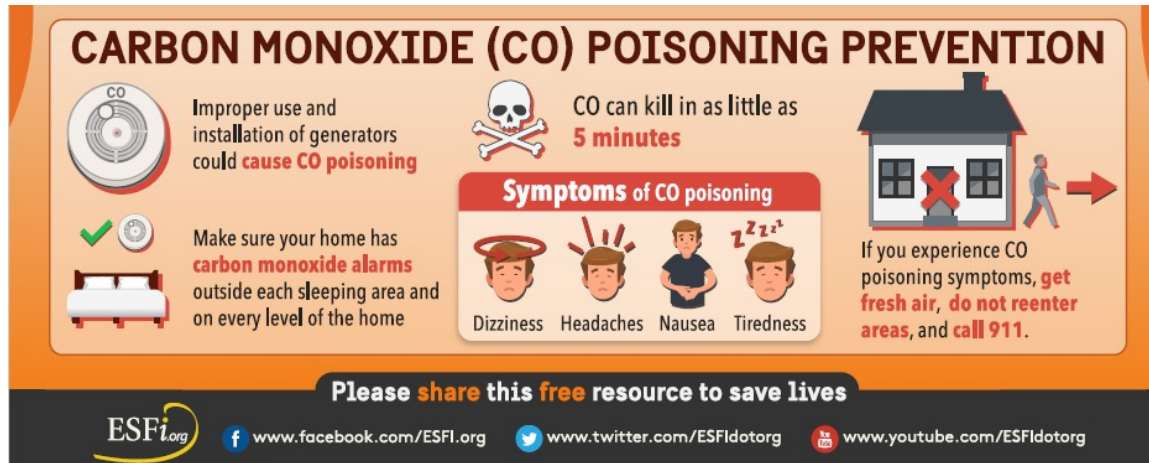
- Always use **grounded cords** and inspect cords for damage prior to use
- Use the **proper cord** for the wattage being used
- Always use **GFCI protection**
- Make sure to start / stop generators when **no electrical loads** are connected
- Keep generators **dry, do not operate when wet**, and refuel when cool
- Do not overload** generators
- Do not plug a generator directly into your home, connect items being powered **directly to the generator**

TRANSFER SWITCHES

Transfer switches, whether manual or automatic, allow you to choose between **utility power** or **backup generator power**

Transfer switches are the only way to **safely power** your home's electrical system

Using a transfer switch **prevents backfeeding**. This occurs when your generator becomes a power source for the **surrounding area** and can damage your home, your neighbor's homes, and injure workers trying to restore power



11

Generator Basics

- Generator Definition (Britannica Encyclopedia)
 - Also called dynamo
 - Any machine that converts mechanical energy to electricity
- Electric Motor Definition (Britannica Encyclopedia)
 - Any class of devices that convert electrical energy to mechanical energy, usually by employing electromagnetic phenomena

12

Emergency and Standby Power

- Resources
 - 2020 NEC
 - 2012 International Building Code
 - NFPA 101 Life Safety Code
 - NFPA 99, Health Care Facilities Code
 - NFPA 5000 Building Construction and Safety Code
- Determine which one applies to your jurisdiction

13

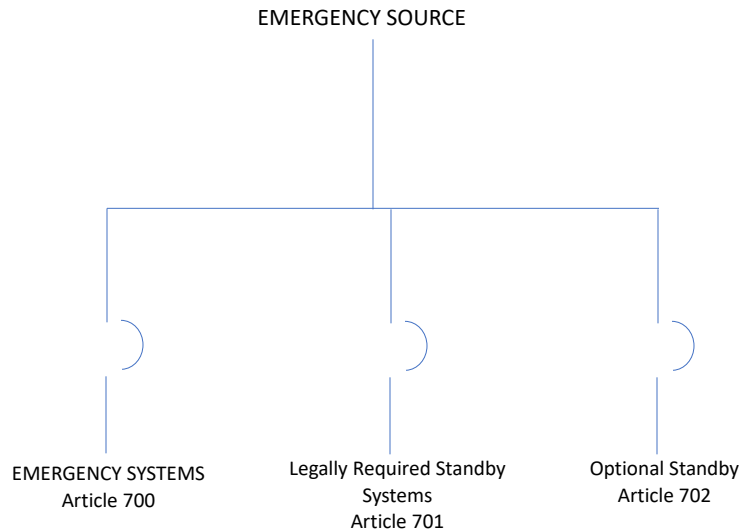
Emergency and Standby Power

- Types of systems (NEC)
 - Emergency Systems (Article 700)*
 - Legally Required Systems (Article 701)*
 - Optional Standby Systems (Article 702)

***Legally required by municipal, state, federal or other codes**

14

Emergency Source Wiring (700.10(B))



15

Definitions

• NEC 700.2

- Emergency systems – Emergency Power shall automatically supply power within the required application (illumination, exit signs, smoke ventilation systems, fire alarms, elevators, fire pumps, PA systems, critical industrial processes etc.) in no less than 10 seconds
- Legally Required Systems – required to automatically supply power to selected loads, other than those classified as emergency, during an event of loss of normal power. Power shall be restoring in no less than 60 seconds
 - Examples: heating and refrigeration, communications systems, sewage disposal, smoke ventilation systems and industrial processes that could create hazards or interfere with fire rescue operations if normal power was interrupted.

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Definitions

- NEC 700.2
 - Emergency systems
 - Those systems legally required and classed as emergency by the municipal, state, federal, or other codes, or by any governmental agency having jurisdiction.
 - These systems are intended to automatically supply illumination, power, or both, to designated areas and equipment in the event of failure of the normal supply or in the event of accident to elements of a system intended to supply, distribute, and control power and illumination essential for safety to human life.

17

Definitions (Emergency Systems – continued)

- NEC 700.2
 - Informational note:
 - *Emergency systems are generally installed in places of assembly where artificial illumination is required for safe exiting and for panic control in buildings subject to occupancy by large numbers of persons, such as hotels, theaters, sports arenas, health care facilities, and similar institutions.*
 - *Emergency systems may also provide power for such functions as ventilation where essential to maintain life, fire detection and alarm systems, elevators, fire pumps, public safety communications systems, industrial processes where current interruption would produce serious life safety or health hazards, and similar functions.*

18

Definitions

- IBC:
 - Emergency Power – A power system that automatically provides secondary power within 10 seconds after primary power is lost
 - Standby Power – A power system that supplies secondary power within 60 seconds once primary power is lost

19

Definitions

- NEC 701.2
 - **Legally Required Standby Systems:**
 - Those systems required and so classed as legally required standby systems by municipal, state, federal, or other codes or by any governmental agency having jurisdiction.
 - These systems are intended to automatically supply power to the selected loads (other than those classed as emergency systems) in the event of failure of the normal source.
 - *Informational note: Legally required standby systems are typically installed to serve loads, such as heating and refrigeration systems, sewage disposal, lighting systems, and industrial processes, that when stopped during any interruption of the normal electrical supply, could create hazards or hamper rescue or fire-fighting operations.*

20

Definitions

- NEC 702.2
 - **Optional Standby Systems:**
 - Those systems intended to supply power to public or private facilities or property where life safety does not depend on the performance of the system.
 - These systems are intended to supply on-site generated or stored power to selected loads either automatically or manually.
 - *Informational note: Optional standby systems are typically installed to provide an alternate source of electric power for such facilities as industrial and commercial buildings, farms, and residences and to serve loads such as heating and refrigeration systems, data processing and communication systems, industrial processes that, when stopped during any power outage, could cause discomfort, serious interruption of the process, damage to the product or process, or the like.*

21

Definitions

- **Service:** The conductors and equipment connecting the servicing utility to the wiring system of the premises served
- **Separately Derived System:** An electrical source, other than a utility, having no direct connection(s) to circuit conductors of any other electrical source other than those established by grounding and bonding connections.
- **Transfer switch:** An automatic or non-automatic device for transferring one or more load conductor connections from one power source to another.
- **Power Production Equipment** (new for 2020 NEC): Electrical generating equipment supplied by any other source other than a utility service, ut to the source system disconnecting means.
 - Examples: generators, solar PV systems and fuel cell systems

22

Generator Sizing

- Concerns:
 - Overloading
 - Engine speed drops and voltage and frequency become unstable
 - Causes amperage to surge
 - Generator trips offline or shuts down to prevent damage to itself
 - Underloading
 - Wet stacking: unburned fuel escapes into the exhaust side of the engine
 - Engine performance decreases and damage can occur
 - Ideal: 70-85% of the machine's rated capacity (Generac)

23

Types of Loads

- Continuous loads
- Surge loads: motors, pumps, compressors etc.
- Intermittent loads
- Drills, power tools, blenders

24

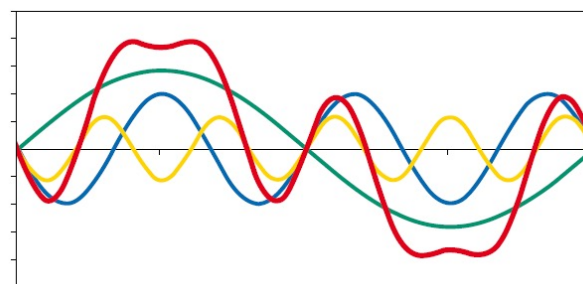
Types of Loads

- Resistive
- Inductive
 - Motors
 - Pumps
 - Refrigerators
 - Furnace
- Non-linear loads: create harmonics that can damage generators
 - May require harmonic filters or upsizing generator
 - Variable Frequency Drives (VFDs)
 - UPS
 - Switching power supplies

25

Harmonics

- Multiples of the fundamental baseline frequency of 60 Hz
- For example:
 - 2nd harmonic = 120 Hz
 - 3rd harmonic = 180 Hz
 - 4th harmonic = 240 Hz
 - 5th harmonic = 300 Hz
- See IEEE 519 for more details
 - Recommended Practice and Requirements for Harmonic Control in Electric Power Systems



Caption:

- nonsinusoidal waveform
- first harmonic (fundamental)
- third harmonic
- fifth harmonic

26

NEC Article 445

- 445.6 Listing: Stationary generators 600 volts and less shall be listed
- 445.10 Location: Generators shall be of a type suitable for the locations in which they are installed. They shall also meet the requirements for motors in 430.14
 - 430.14
 - Ventilation and maintenance – shall be located so that adequate ventilation is provided and so that maintenance such as lubrication of bearing and replacing of brushes, can be readily accomplished
 - Open motors (or generators) that have commutators or collector rings shall be located or protected so that sparks cannot reach adjacent combustible material

27

445.11 Marking

- Each generator shall be provided with a nameplate giving the
 - manufacturer's name
 - the rated frequency,
 - the number of phases if ac,
 - the rating in kilowatts or kilovolt-amperes,
 - the power factor,
 - the normal volts and amperes corresponding to the rating,
 - and the rated ambient temperature

28

445.11 Marking

- Marking shall be provided by the manufacturer to indicate whether or not the generator neutral is bonded to its frame.
- Where the bonding is modified in the field, additional marking shall be required to indicate whether the neutral is bonded to the frame.

29

445.12 Overcurrent Protection

- (A) Constant Voltage Generators shall be protected from overload by inherent design, circuit breakers, fuses, protective relays, or other identified overcurrent protective means suitable for the conditions of use.

30

445.13 Ampacity of Conductors

- (A) General: The ampacity of the conductors from the generator output terminals to the first distribution device(s) containing overcurrent protection shall not be less than 115 percent of the nameplate current rating of the generator.
- It shall be permitted to size the neutral conductors in accordance with 220.61.
- Conductors that must **carry ground fault currents** shall not be smaller than the minimum required size of the largest conductor.
 - Henry's note: This is the equipment grounding conductor (EGC) which is usually sized per NEC table 250.122

Exception: Where the design and operation of the generator prevent overloading, the ampacity of the conductors shall not be less than 100 percent of the nameplate current rating of the generator.

31

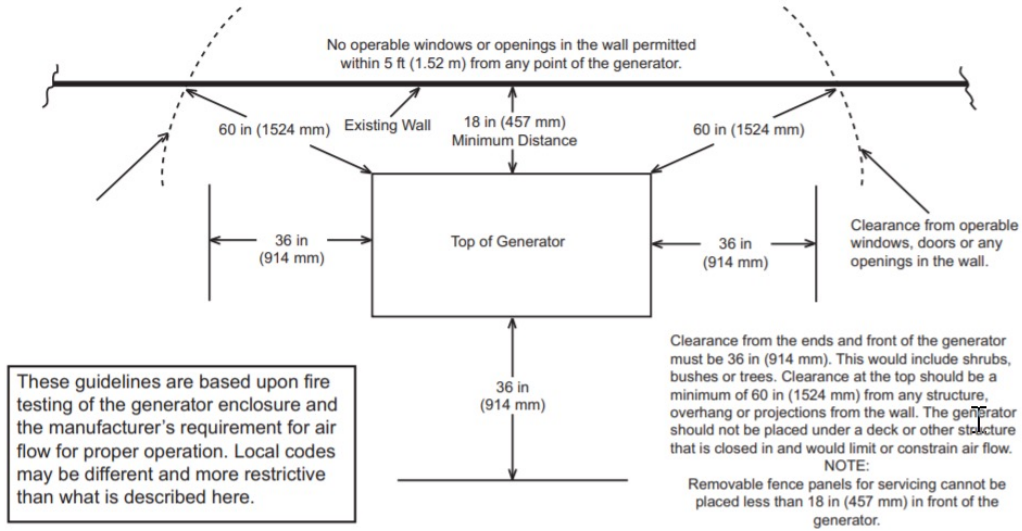
IEEE 142 – 2007

Grounding of Industrial and Commercial Power Systems

32

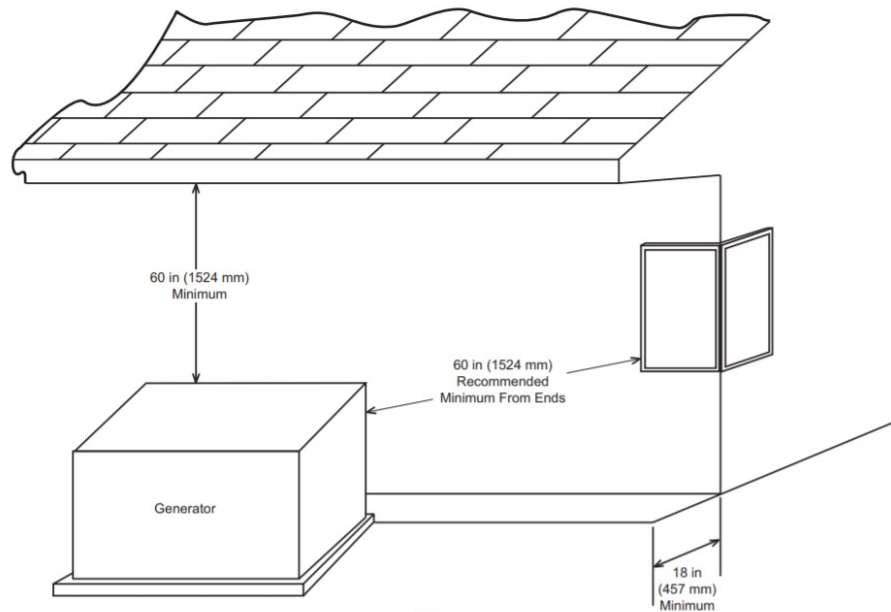
3.1 SITE SELECTION

From Generac Guardian series installation manual



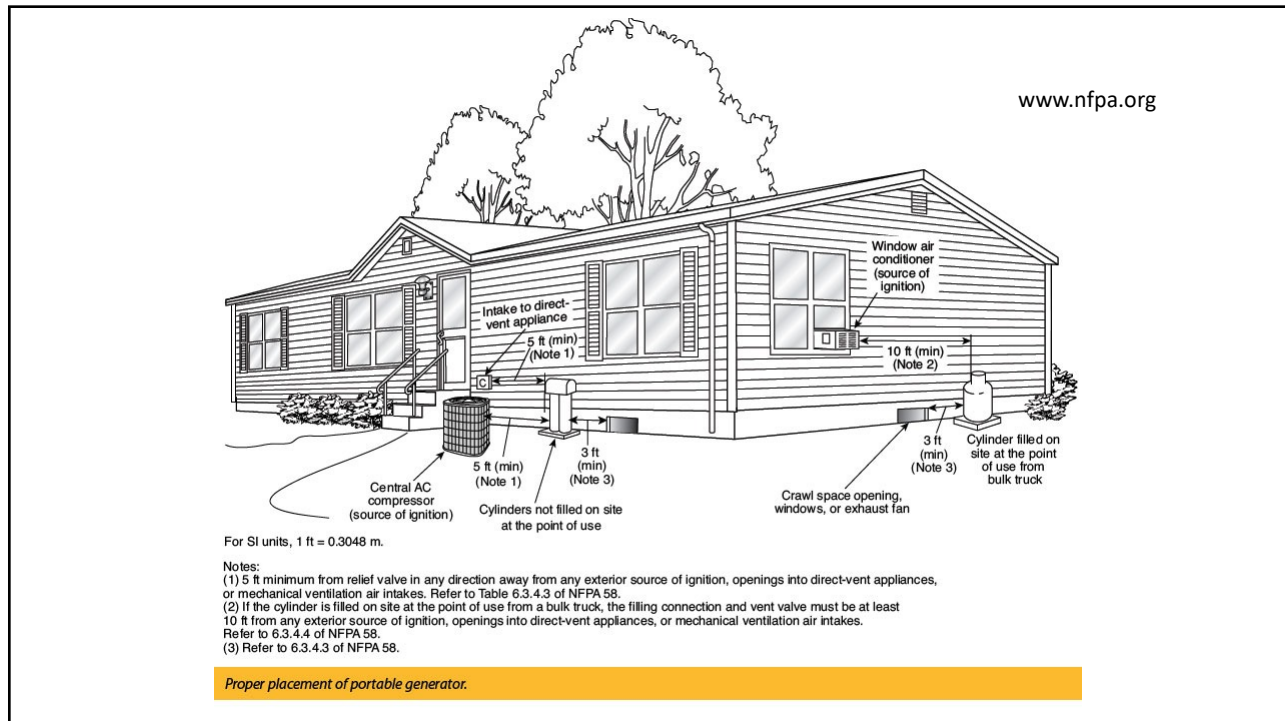
33

From Generac Guardian series installation manual



NOTE:
The generator can be placed under decks or structures as long as all clearances are met and local building codes are followed.

34



35

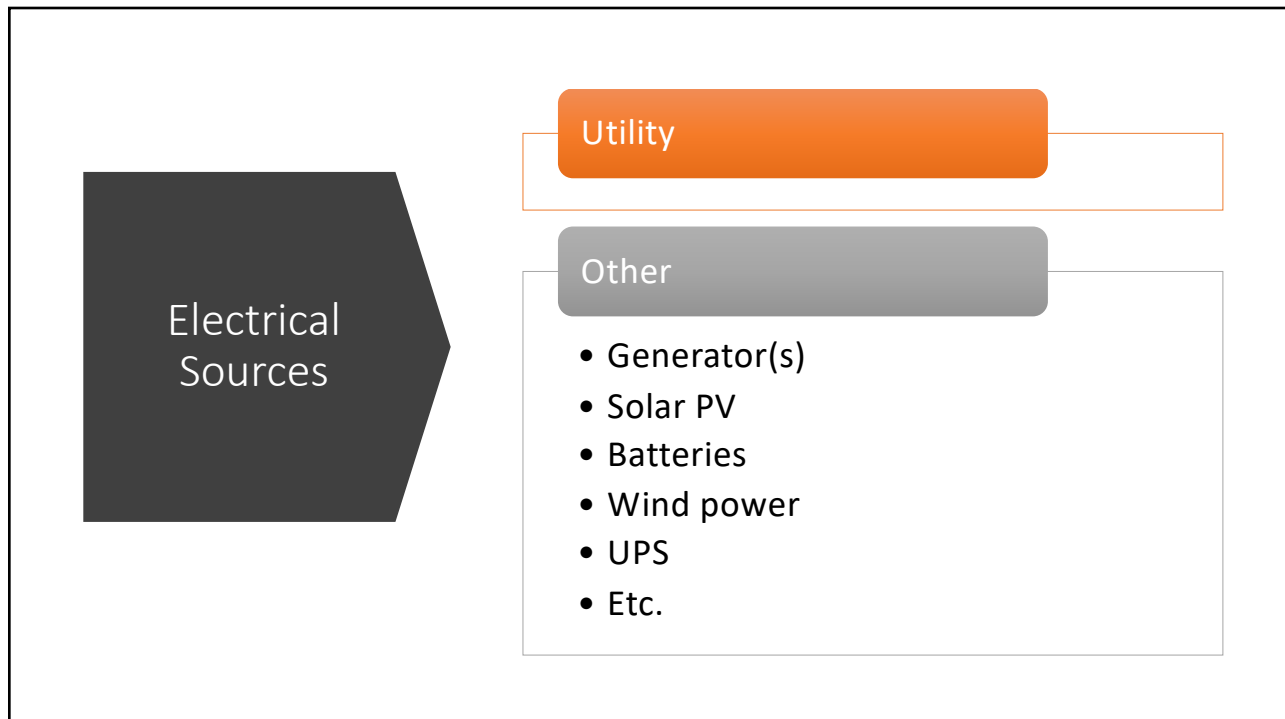
Extension cords

- Article 590 Temporary Installations

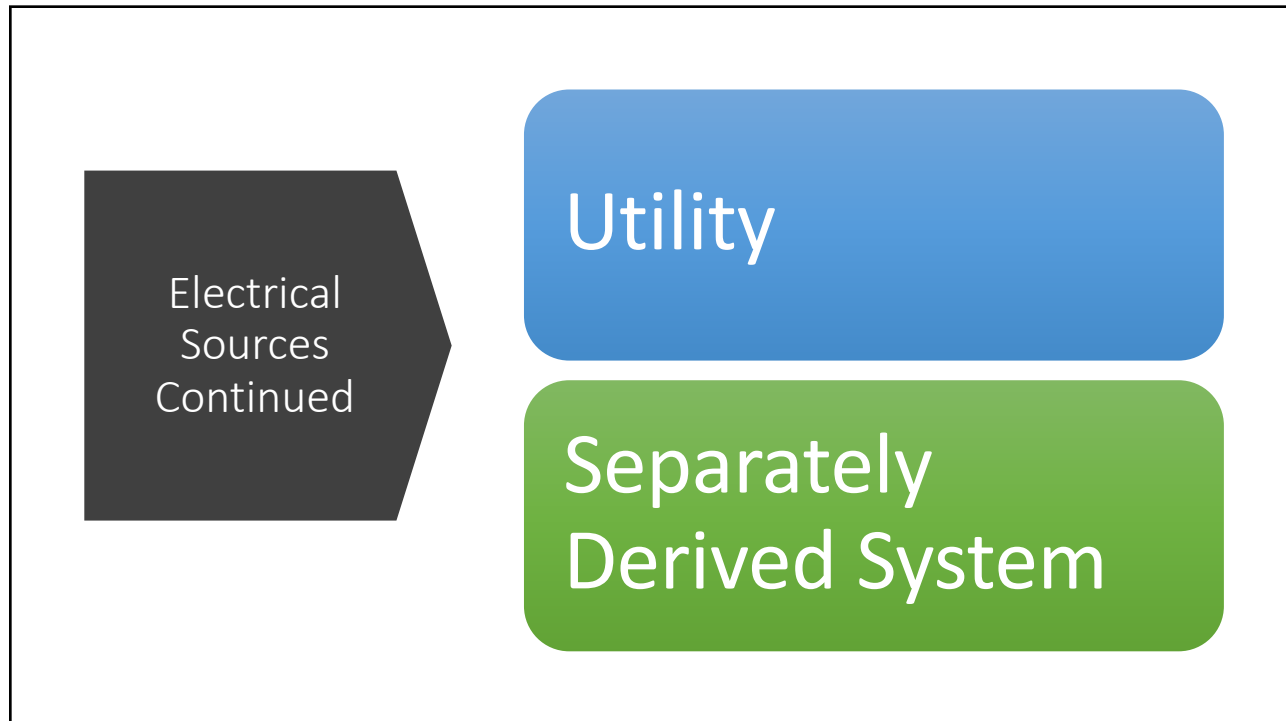
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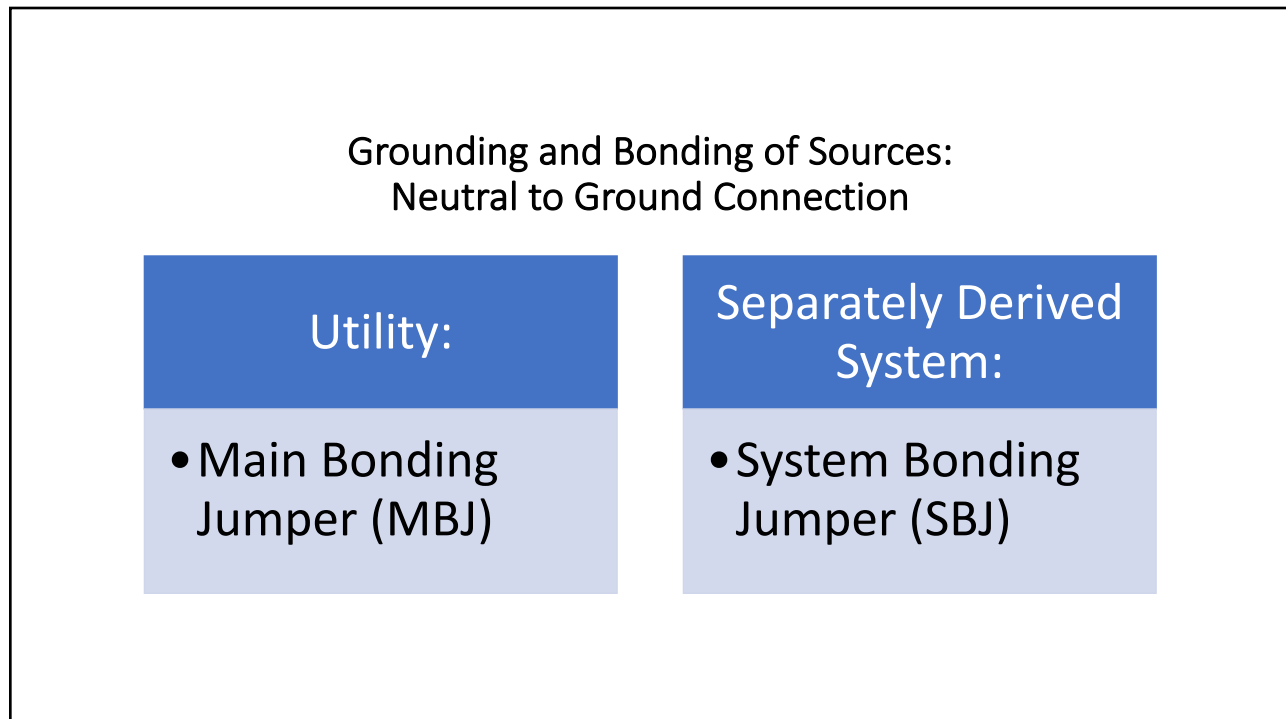
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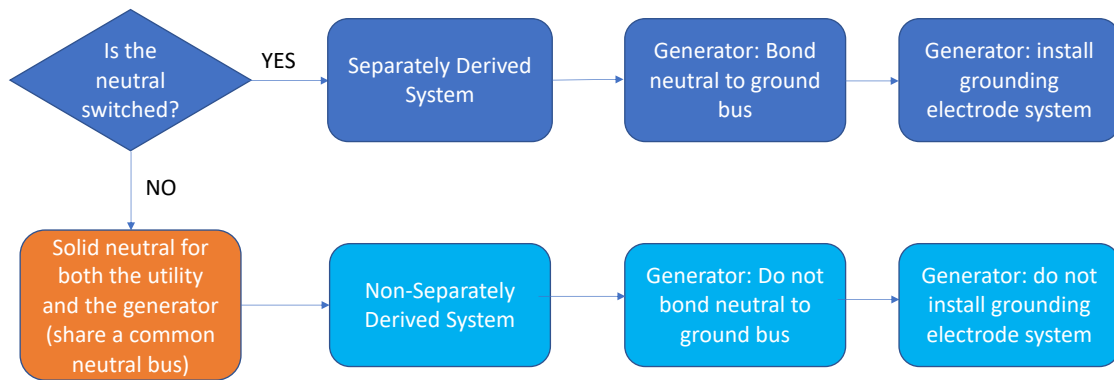
39



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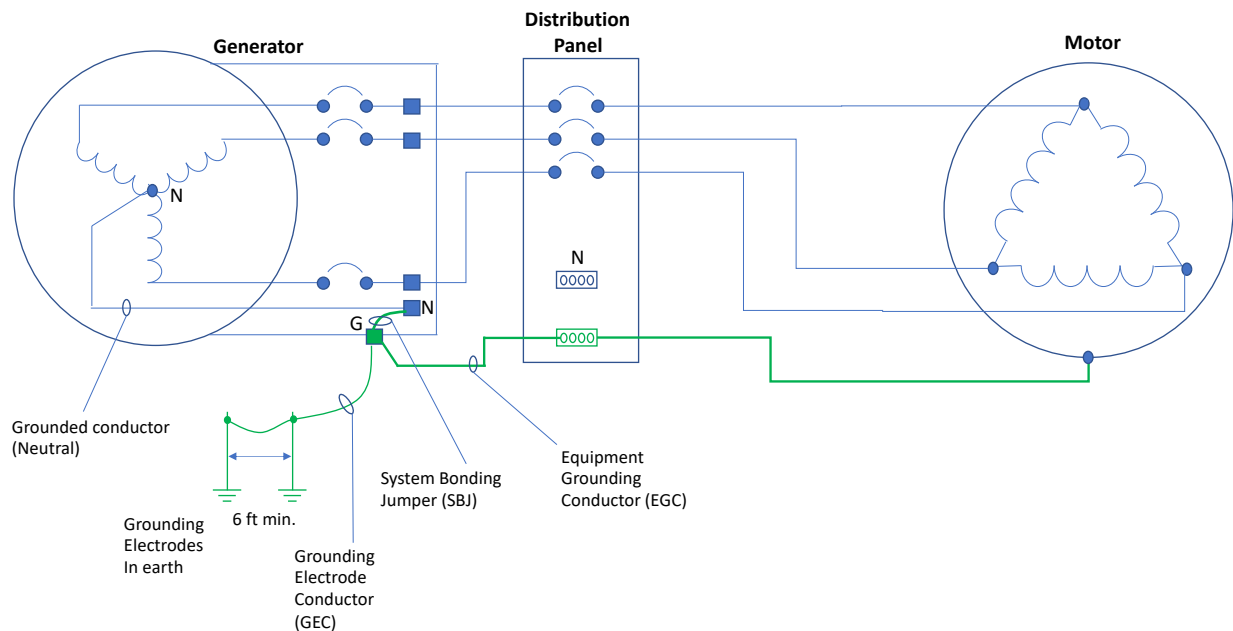
How Do You Tell With a Generator System?

- Look at the transfer switch



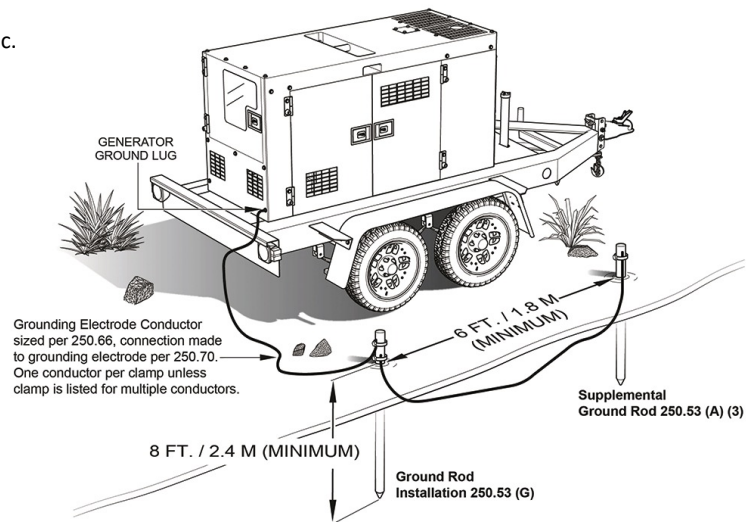
41

Generator as Separately Derived System



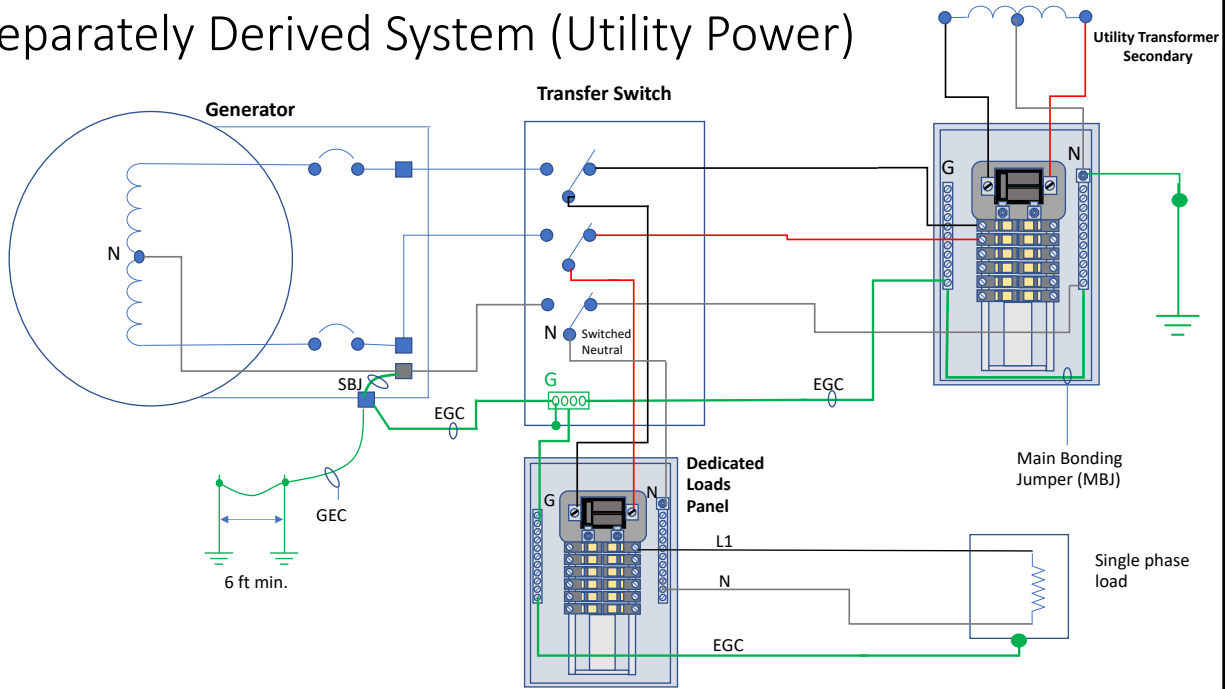
42

From Multiquip, Inc.



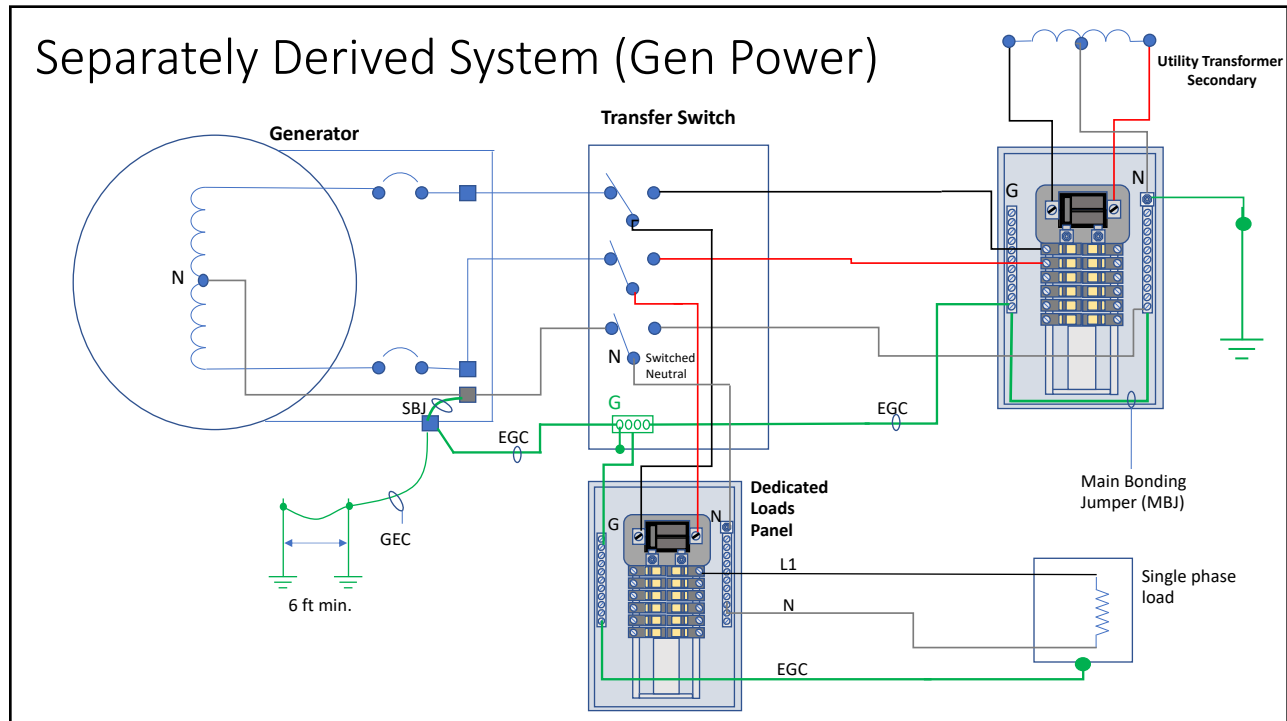
43

Separately Derived System (Utility Power)



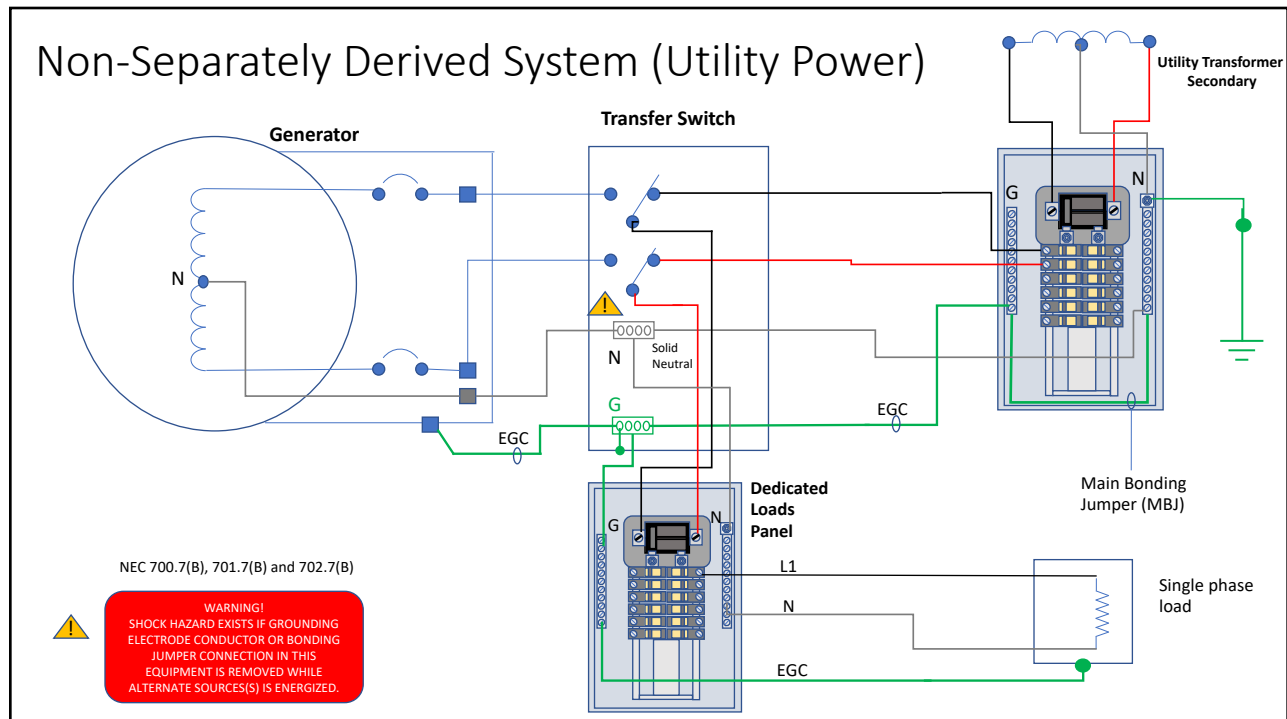
44

Separately Derived System (Gen Power)



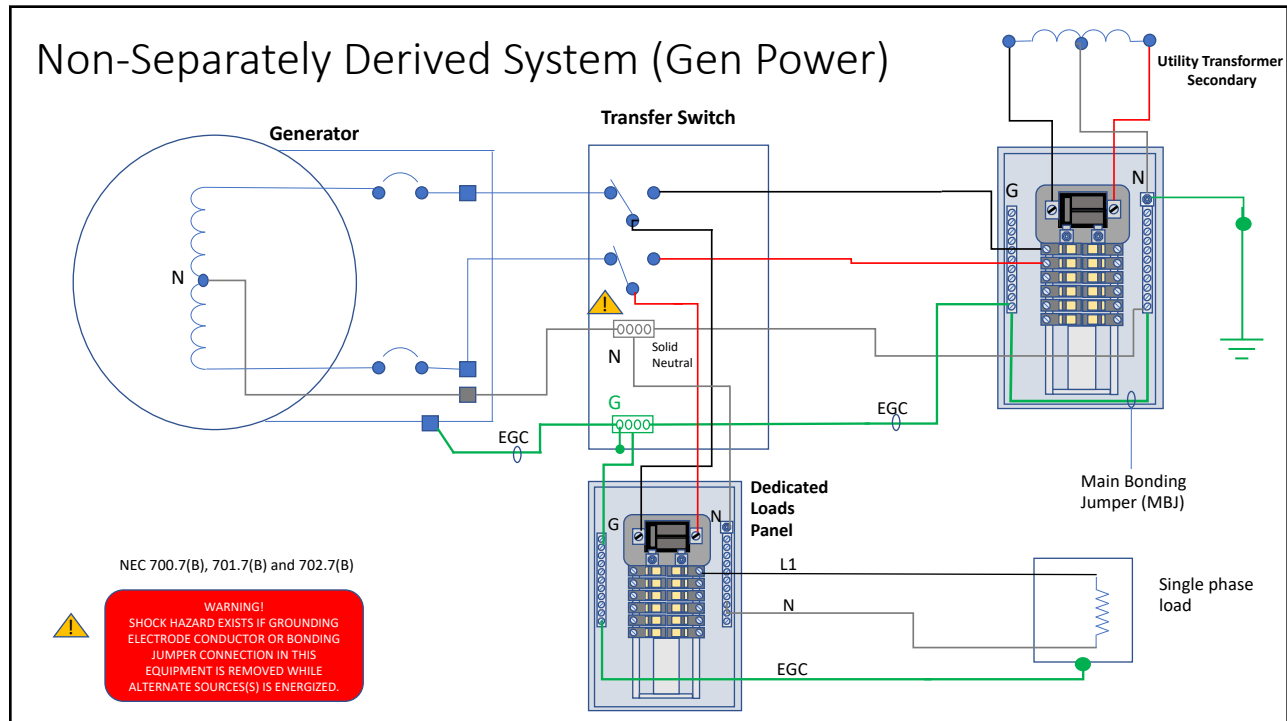
45

Non-Separately Derived System (Utility Power)



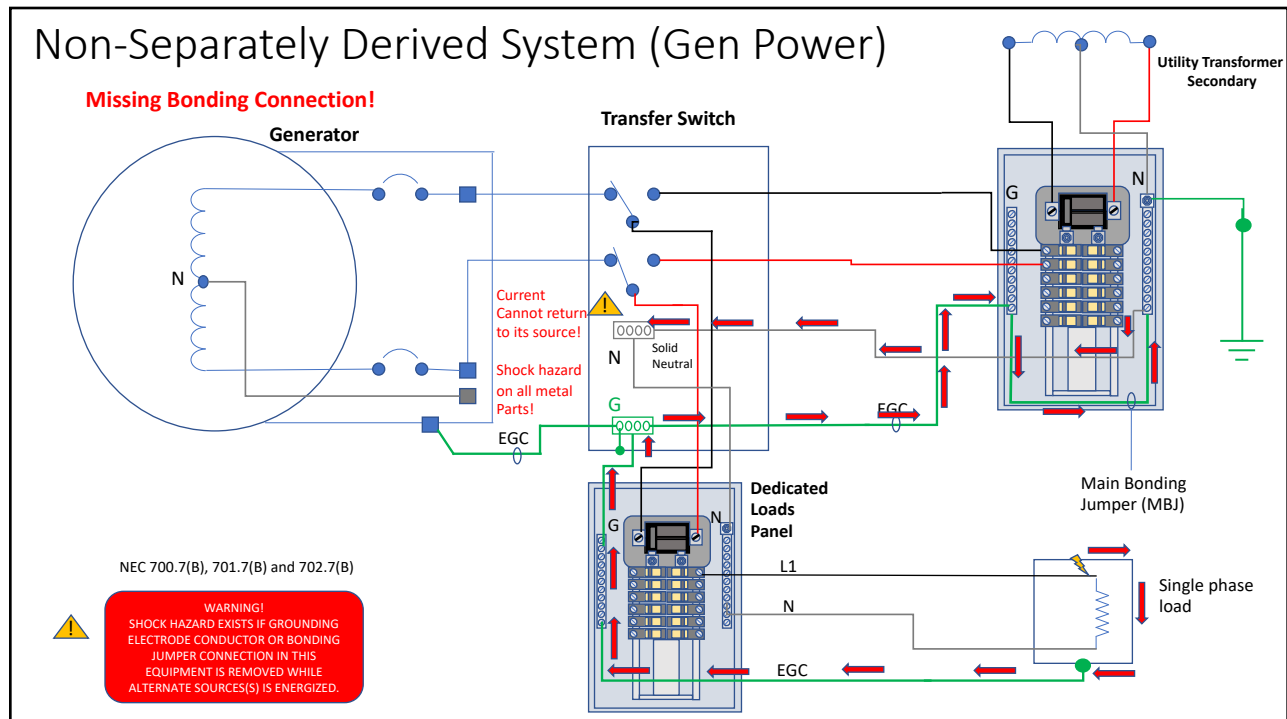
46

Non-Separately Derived System (Gen Power)



47

Non-Separately Derived System (Gen Power)



48

Other Labeling Requirements

For Portable Generators

- 702.7(C) Signs for Generator Power Inlet
- Where a power inlet is used for a temporary connection to a portable generator, a warning sign shall be placed near the inlet to indicate the type of derived system that the system is capable of based on the wiring of the transfer equipment. The sign shall display one of the following warnings:

49

WARNING!

FOR CONNECTION OF A SEPARATELY DERIVED
(BONDED NEUTRAL) SYSTEM ONLY

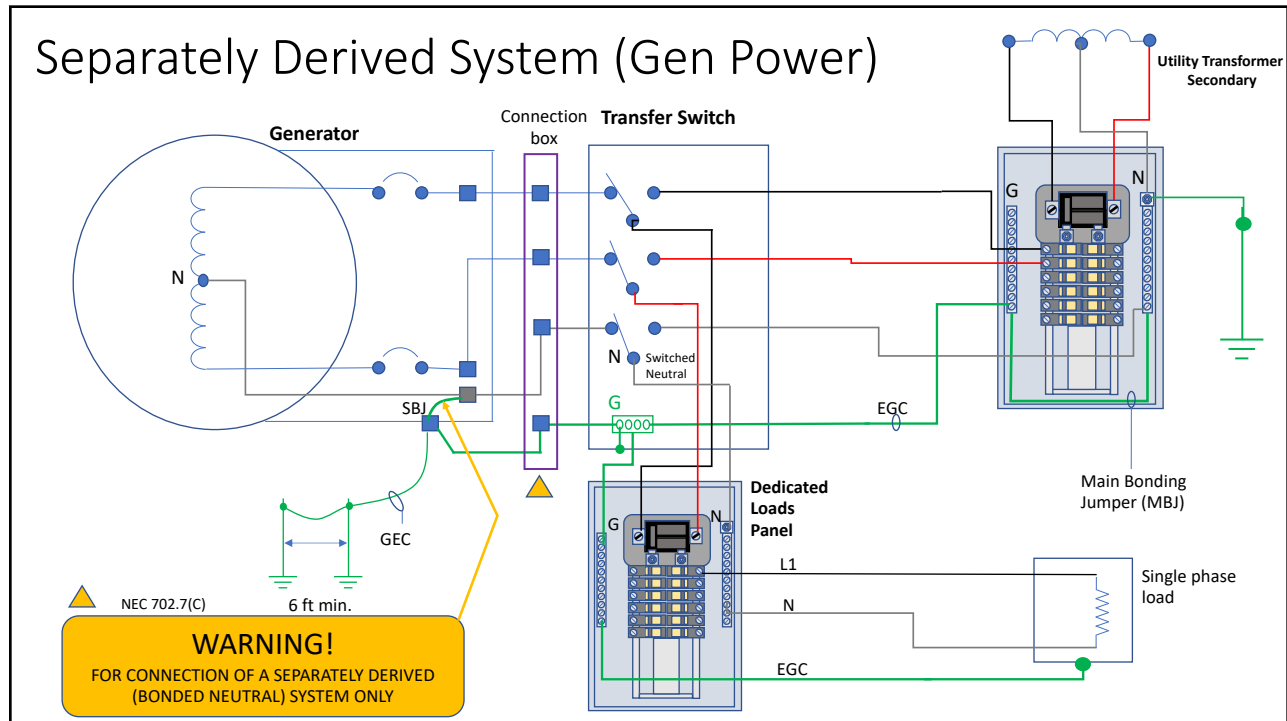
OR

WARNING!

FOR CONNECTION OF A NON-SEPARATELY DERIVED
(FLOATING NEUTRAL) SYSTEM ONLY

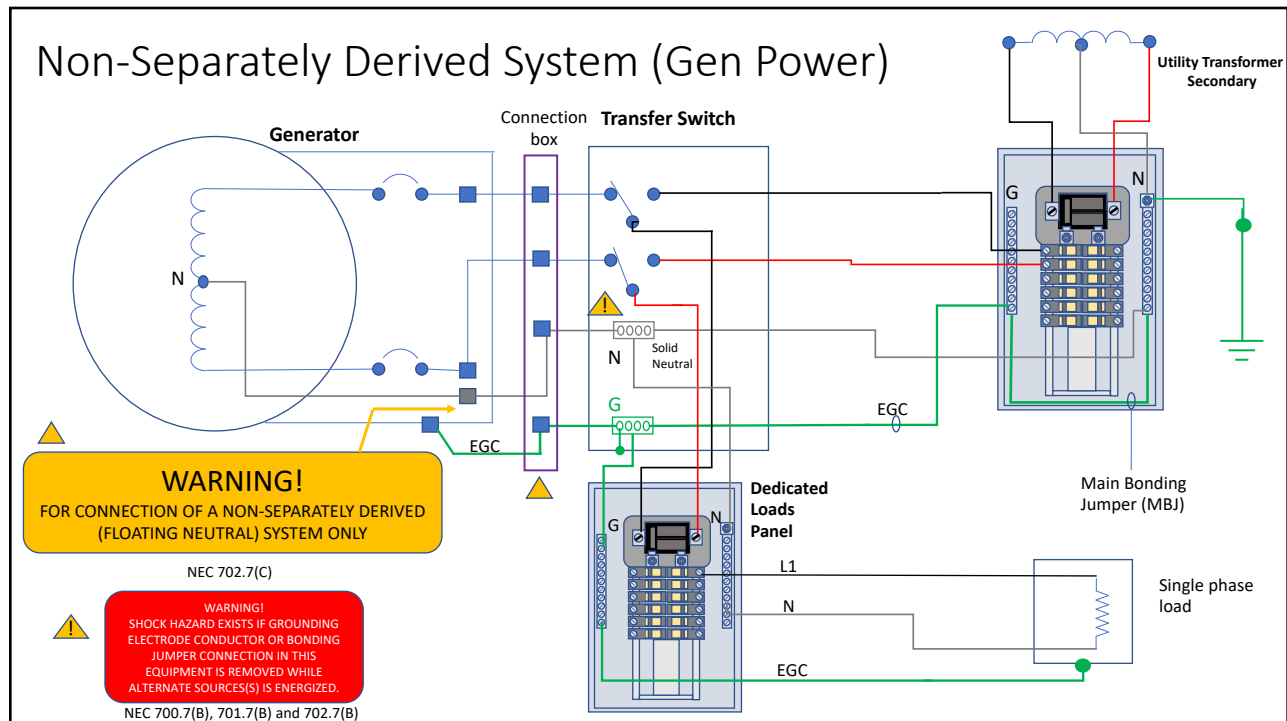
50

Separately Derived System (Gen Power)

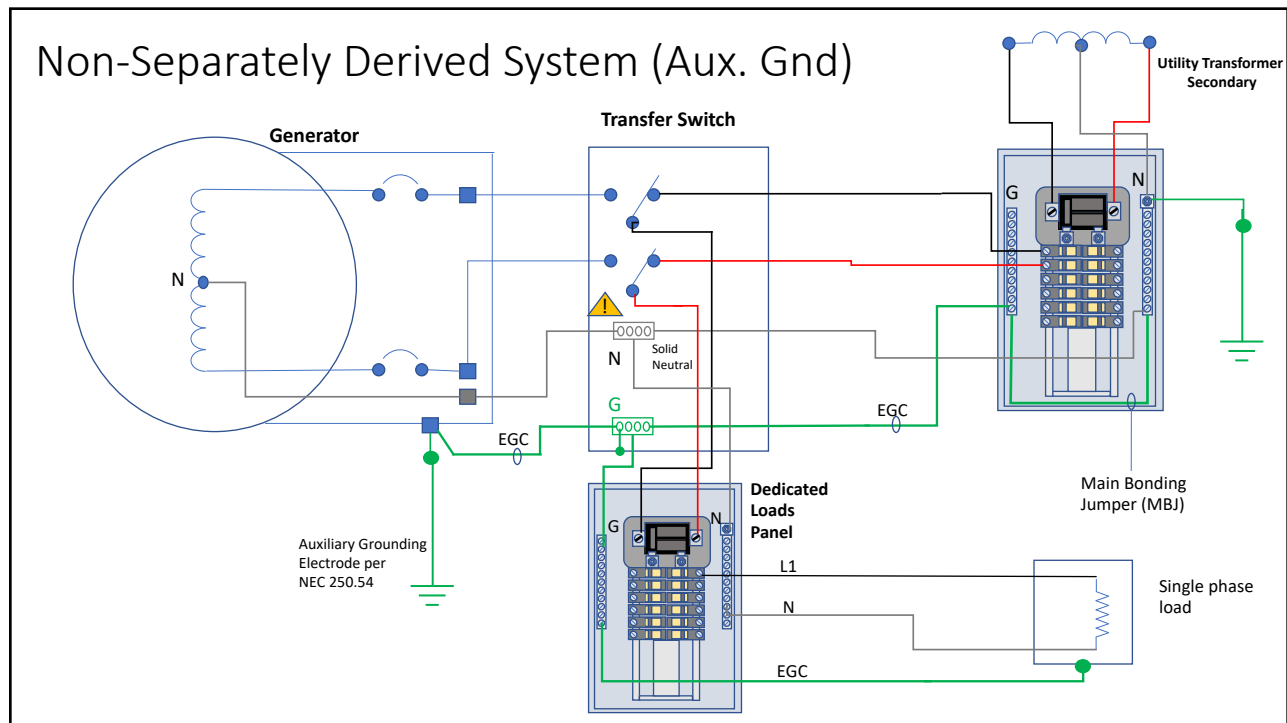


51

Non-Separately Derived System (Gen Power)



52



53

NEC 250.54 Auxiliary Grounding Electrode

- One or more grounding electrodes shall be permitted to be connected to the equipment grounding conductors specified in 250.118 and shall not be required to comply with the electrode bonding requirements of 250.50 or 250.53(C) or the resistance requirements of 250.53(A)(2) Exception, but the earth shall not be used as an effective ground-fault current path as specified in 250.4(A)(5) and 250.4(B)(4)

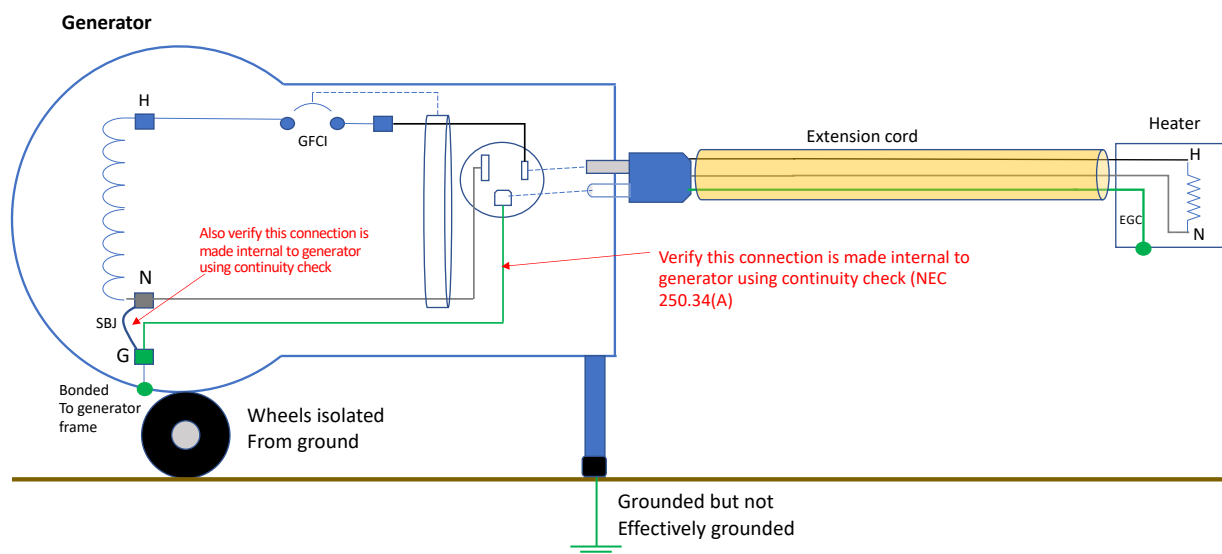
54

Small Portable Generator Grounding/Bonding NEC 250.34(A)

- The frame of a portable generator shall not be required to be connected to a grounding electrode as defined in 250.52 for a system supplied by the generator under both of the following conditions
 1. The generator supplies only equipment mounted on the generator, cord-and-plug-connected equipment through receptacles mounted on the generator, or both
 2. The normally non-current-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles are connected to the generator frame.

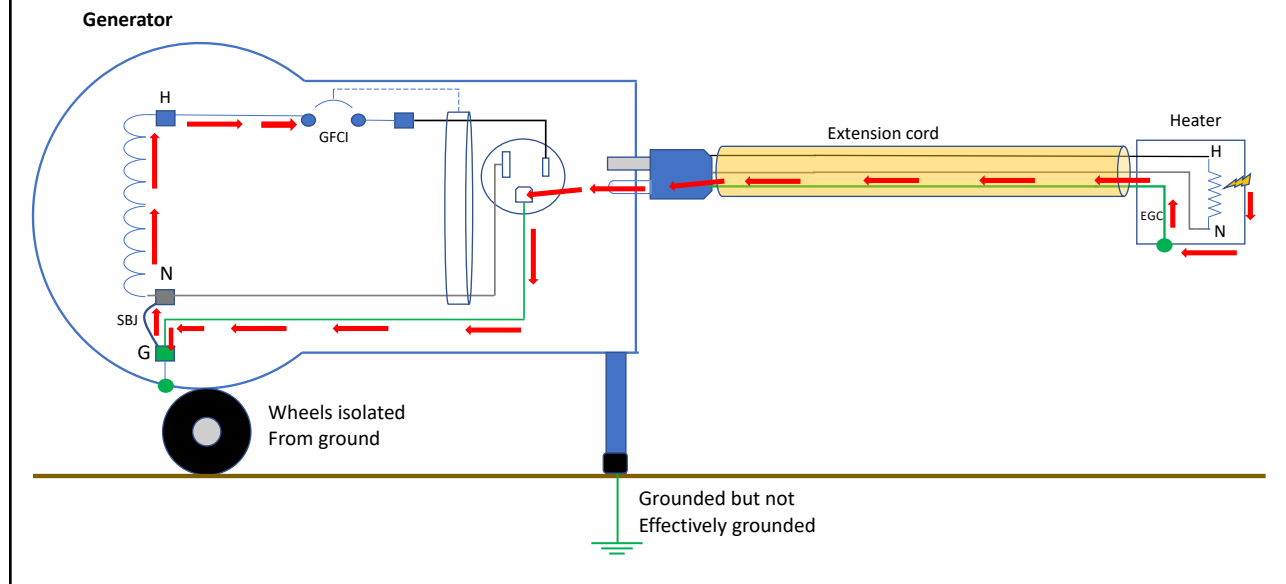
55

Portable Generator



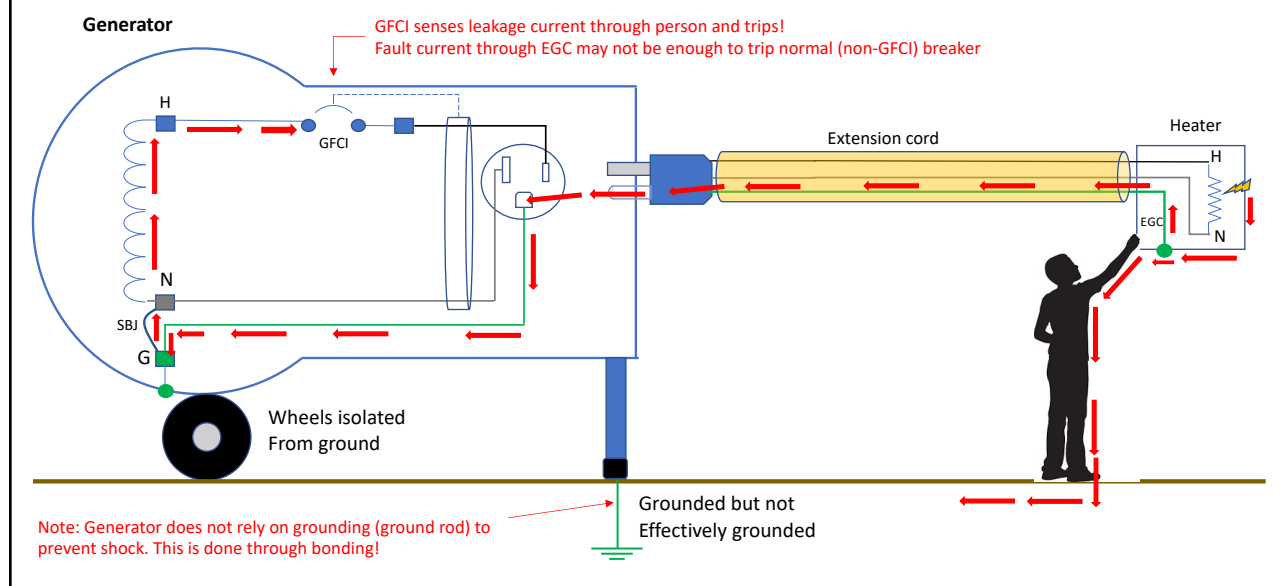
56

Portable Generator with fault in equipment



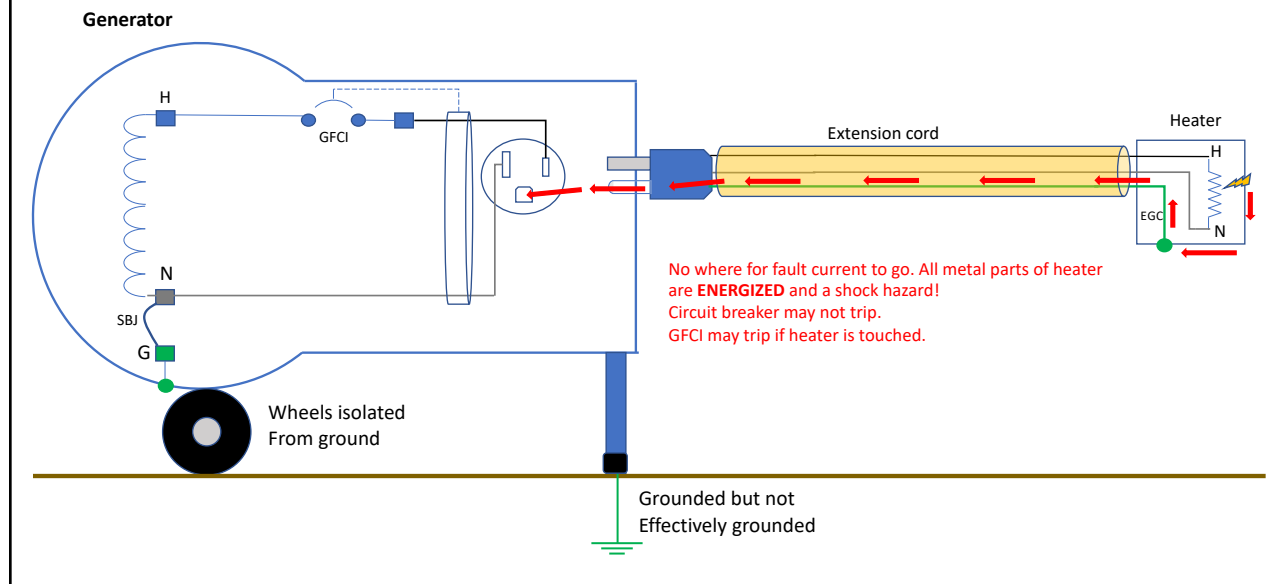
57

Portable Generator with fault in equipment and someone touches equipment frame



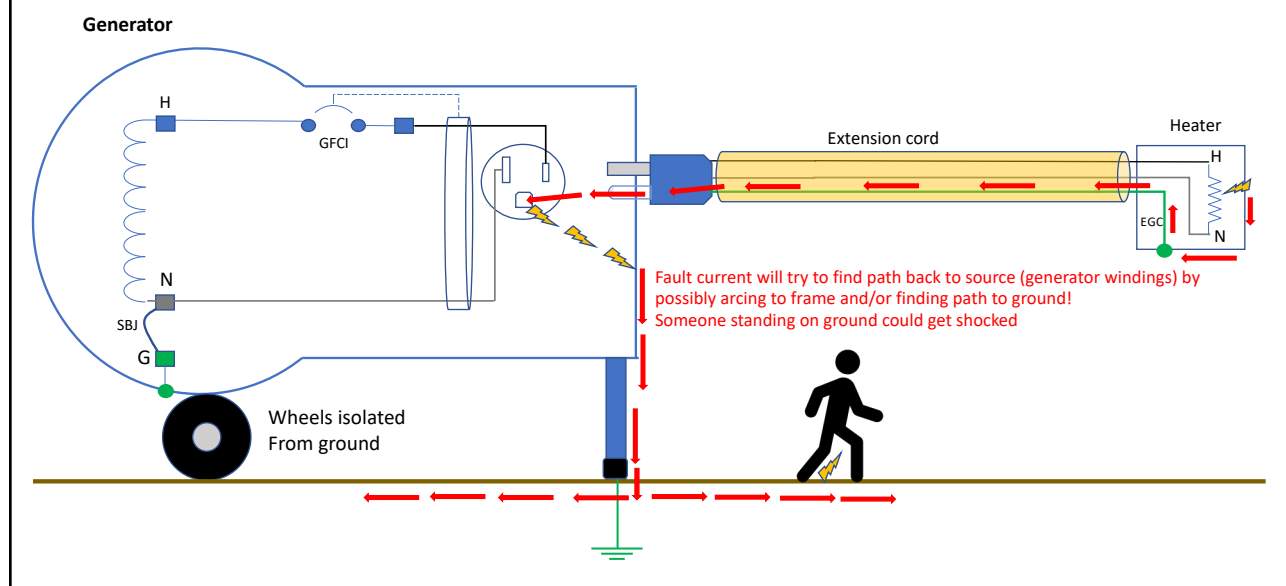
58

Portable Generator without receptacle bonded to frame



59

Portable Generator without receptacle bonded to frame

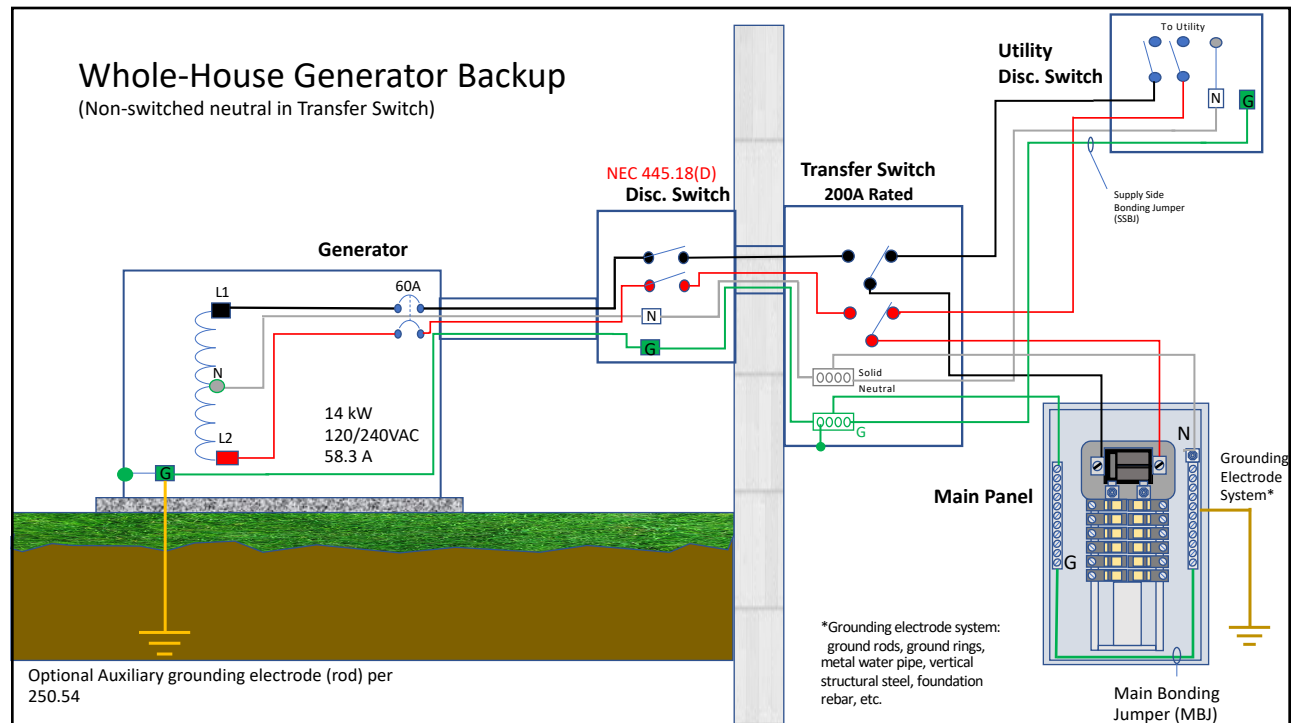


60

Sizing Example

- Standby generator
- 16 kW Continuous Power
- 120/240V split phase output
- Transfer switch has solid neutral connection for generator
 - No neutral switch
 - Not a separately derived system

61



62

Calculations

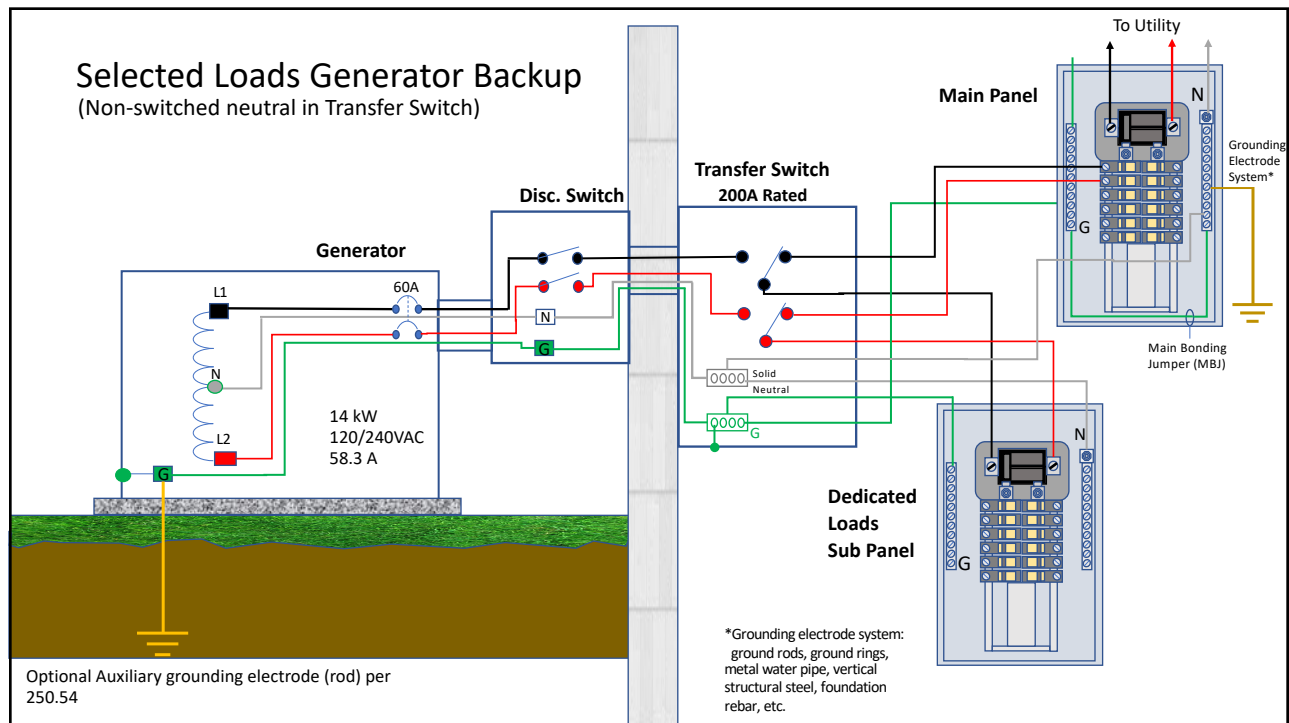
- Wire type: THWN
- **Conductor Sizing:**
 - Generator Full Load Amps (FLA): 58.3
 - Multiply FLA x 1.15 per 445.13: $58.3 \times 1.15 = 67 \text{ A}$
 - Use Table 310.16 using 75 deg C column
 - # 6 good for 65 amps ❌
 - # 4 good for 85 amps ✅
 - Check: Will 60 amp circuit breaker on the generator protect the #4 wire? **Yes!**

63

Calculations

- **Overcurrent Protection:**
 - 60 Amp circuit breaker included in generator
 - Ok per 445.12(A)
 - “Constant-voltage generators, except ac generator exciters, shall be protected from overload by inherent design, circuit breakers, fuses, protective relays, or other identified overcurrent protective means suitable for the conditions of use.”

64



65

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

- Type of change: New
- 2020 NEC: requires an emergency shutdown device to be located outside all one- and two-family dwelling units at a readily accessible location
 - Not required cord-and-plug-connected portable generators.
- This emergency shutdown device was deemed necessary for fire service and other first responders to secure on-site power sources during emergencies such as a house fire.

FOR INFORMATIONAL PURPOSES ONLY. NOT CURRENT CODE IN OHIO

66

66



FOR INFORMATIONAL PURPOSES ONLY. NOT CURRENT CODE IN OHIO

67

67

Design Example

- House prone to power outages in summer due to storms
- Summer temps can exceed 90 degrees F on most days
- Duration of outages usually last from 2 to 24 hours
- Homeowner only wants to back up certain loads, not whole house
- Electrical service is 120/240V, 200 amps
- Backup to loads shall be automatic
- Not all appliances and lights will be on during outage, only those necessary
- Homeowner does not plan to cook anything during outage
- Homeowner does not plan to do any clothes washing/drying during outage
- Homeowner wants air conditioner to run during outages
- Natural gas is supplied to the house for heating

68

Appliance Consumption Table

Appliance	Watts	Appliance	Watts	Appliance	Watts
Kitchen		Living Room		Tools	
Blender	500	Bluray Player	15	Band Saw – 14"	1100
Can Opener	150	Cable Box	35	Belt Sander – 3"	1000
Coffee Machine	1000	DVD Player	15	Chain Saw – 12"	1100
Dishwasher	1200-1500	TV – LCD	150	Circular Saw – 7-1/4"	900
Espresso Machine	800	TV – Plasma	200	Circular Saw 8-1/4"	1400
Freezer – Upright – 15 cu. ft.	1240 Wh/Day**	Satellite Dish	25	Disc Sander – 9"	1200
Freezer – Chest – 15 cu. ft.	1080 Wh/Day**	Stereo Receiver	450	Drill – 1/4"	250
Fridge – 20 cu. ft. (AC)	1411 Wh/day**	Video Game Console	150	Drill – 1/2"	750
Fridge -16 cu. ft. (AC)	1200 Wh/day**	Lights		Drill – 1"	1000
Garbage Disposal	450	CFL Bulb – 40 Watt Equivalent	11	Hedge Trimmer	450
Kettle – Electric	1200	CFL Bulb – 60 Watt Equivalent	18	Weed Eater	500
Microwave	1000	CFL Bulb – 75 Watt Equivalent	20	Misc.	
Oven – Electric	1200	CFL Bulb – 100 Watt Equivalent	30	Clock Radio	7

69

Appliance	Watts	Appliance	Watts	Appliance	Watts
Toaster	850	Compact Fluorescent 20 Watt	22	Curling Iron	150
Toaster Oven	1200	Compact Fluorescent 25 Watt	28	Dehumidifier	280
Stand Mixer	300	Halogen – 40 Watt	40	Electric Shaver	15
Heating/Cooling		Incandescent 50 Watt	50	Electric Blanket	200
Box Fan	200	Incandescent 100 Watt	100	Hair Dryer	1500
Ceiling Fan	120	LED Bulb – 40 Watt Equivalent	10	Humidifier	200
Central Air Conditioner – 24,000 BTU NA	3800	LED Bulb – 60 Watt Equivalent	13	Radiotelephone – Receive	5
Central Air Conditioner – 10,000 BTU NA	3250	LED Bulb – 75 watt equivalent	18	Radiotelephone – Transmit	75
Furnace Fan Blower	800	LED Bulb – 100 Watt Equivalent	23	Sewing Machine	100
Space Heater NA	1500	Office		Vacuum	1000
Tankless Water Heater – Electric	18000	Desktop Computer (Standard)	200	Note: TVs, Computers, and other devices left plugged in but not turned on still draw power.	
Water Heater – Electric	4500	Desktop Computer (Gaming)	500		
Window Air Conditioner 10,000 BTU NA	900	Laptop	100	**To estimate the number of hours that a refrigerator actually operates at its maximum wattage, divide the total time the refrigerator is plugged in by three. Refrigerators, although turned "on" all the time, actually cycle on and off as needed to maintain interior temperatures.	
Window Air Conditioner 12,000 BTU NA	3250	LCD Monitor	100		
Well Pump – 1/3 THP	750	Modem	7		

70

Appliance	Watts	Appliance	Watts
Laundry		Paper Shredder	150
Clothes Dryer – Electric	3000	Printer	100
Clothes Dryer – Gas	1800	Router	7
Clothes Washer	800	Smart Phone – Recharge	6
Iron	1200	Tablet – Recharge	8

71



14 kW Generator

14RCAL with Automatic Transfer Switch and OnCue Plus

★★★★★ (0) [Write a review](#)

Starting at \$4490.00* MSRP

Model Number 14RCAL

Fuel Type LPG, Natural Gas

Phase Single Phase or Three Phase

ATS Included

Remote Monitoring Included

*Starting price in US dollars. Does not include installation or accessories or costs to export outside the US.

[FIND A DEALER](#)
[GET A QUOTE](#)

[REQUIRED COMPONENTS](#)
[FINANCING INFORMATION](#)

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FEATURES	SPECS	REQUIRED COMPONENTS	ACCESSORIES
Model		14RCAL	
Rated kW LP		14 kW	
Rated kW NG		12 kW	
Amps LP		58 amps	
Amps NG		50 amps	
Peak Motor Starting kVA @240 V		33 kVa	
Alternator Note		All information shown is for 1 Phase 60 Hz generator with the largest alternator option available.	
Displacement		725 cm ³ (44 cu. in.)	
Horsepower		NG 20.5 HP, LP 23.6 HP	
Enclosure Material		Aluminum	
Sound Output During Weekly Exercise		63 dB(A)	
Sound Output During Full-speed Operation		67 dB(A)	
Response Time		10 seconds	
Warranty		Premium five-year limited warranty	
Country of Origin		US	
Certifications/Listings		UL 2200,CSA,EPA,cUL	
Automatic Transfer Switch Included		Included	
Remote Monitoring Available		Included	
Off Grid / Utility Backup		Off Grid,Utility Backup	

Henry Peter Matthews, PE, CPE, CESCO, PVA

Home Address

1203 McKinley Place
Fostoria, Ohio 44830
Email: hpmatthews@matthewselectrical.net
Home Phone: 419-701-7707
Cell Phone: 419-575-3488

Work Address

Marathon Petroleum Company
539 South Main Street
Findlay, Ohio 45840
Email: hpmatthews@marathonpetroleum.com
Office phone: 419-421-3423
Cell phone: 419-957-2110

Work Experience

- | | |
|---|-----------------------|
| Marathon Petroleum Company, LP; Findlay, Ohio | June 2006 – Present |
| <ul style="list-style-type: none">• Advanced Senior Engineer/Electrical Specialist• Electrical Engineering Supervisor – Terminal Engineering• Project Engineer – Major Projects• Electrical Designer – Retail Division | |
| Cooper Standard Automotive, Bowling Green, Ohio | July 1993 – June 2006 |
| <ul style="list-style-type: none">• Plant Engineering Manager• Plant Electrical Engineer | |
| Toledo Engineering Company (consultant); Toledo, Ohio | June 1989 – July 1993 |
| <ul style="list-style-type: none">• Electrical Drafter | |

Education

- | | |
|--|--------------|
| Bowling Green State University; Bowling Green, Ohio
Masters of Business Administration | Aug 2003 |
| Pennsylvania State University; University Park, PA
BS Electrical Engineering | Dec 1989 |
| Solar Energy International, Paonia, Colorado
Solar PV Training | Sept 2021 |
| Owens Community College; Findlay, Ohio
Certificate: Introductory Welding | April 2017 |
| Penn Foster Career School
Certificate: Plumbing | July 2010 |
| Penn Foster Career School
Certificate: Electrician | October 2004 |

Certifications

Professional Engineer (PE): OH, MI, IN, KY, IL, WI
Photovoltaic Associate (PVA) by NABCEP
Certified Electrical Safety Compliance Professional (CESCP), NFPA
Certified Plant Engineer (CPE): Association for Facility Engineers
Building Operator Certification (BOC): Northwest Energy Efficiency Council

Licenses	Ohio Electrical Contractor , Ohio Department of Commerce, License # 46972 Ohio Training Agency , Ohio Construction Industry Licensing Board, Agency #48714 Ohio Training Agency , Ohio Board of Building Standards
Special Training	Solar Energy International (SEI) , Paonia, Colorado • Solar Electric and Design and Installation Course, April 2021, 60 hours • PV Systems Fundamentals (Battery-Based), June 2021, 40 hours • Advanced PV System Design and the NEC, June-July 2021, 60 hours • Comparing Battery Technologies, July 2021, 10 hours • Tools and Techniques for Operations and Maintenance of PV Systems, 9/21, 40 HR
Affiliations	Institute of Electrical and Electronics Engineers (IEEE) – Senior Member International Association of Electrical Inspectors (IAEI) NFPA Section Member for Architects, Engineers and Building Officials Illumination Engineering Society of North America (IESNA) API RP 545 former Co-Chair , American Petroleum Institute, Lightning Protection for Above Ground Storage Tanks (2017- 2018)
Business Ownership	Matthews Electrical Services, Owner Designer Cuts Hair Salon, LLC; Co-owner

Biography

Henry has worked in the electrical, power, electronics, instrumentation, controls and communication fields for over 30 years. He earned his Bachelor of Science degree in Electrical Engineering from Penn State University in 1989. Henry worked as a consultant for Toledo Engineering Company in Toledo, Ohio as a drafter and field technician.

In 1993 he started working for Cooper Standard Automotive Company in Bowling Green, Ohio in 1993 as a Plant Electrical Engineer. He was then promoted to Plant Engineering Manager in 2000. During this time, he earned his Professional Engineering License in Ohio.

In 2003, Henry earned his MBA at Bowling Green State University.

In 2006, Henry joined Marathon Petroleum Company in Findlay, Ohio. He then went on to obtain his Professional Engineers license in Electrical Engineering for Michigan, Indiana, Illinois, West Virginia, Kentucky, Minnesota and Wisconsin. During his tenure at Marathon, Henry has had several roles including Electrical Design Engineer, Project Engineer and Electrical Supervisor. He is currently an Advanced Senior Engineer where he writes electrical standards for the company and conducts a community of practice for all the company's electrical engineers and safety professionals.

During his time at Cooper Standard Automotive and Marathon Petroleum, Henry developed a passion for teaching, learning and applying Electrical Construction Codes. At Cooper, he trained the entire non-electrical maintenance staff to perform basic electrical tasks.

At Marathon, Henry works with the Learning and Development Department to conduct multiple training sessions for new hires and seasoned engineers on various topics including Electrical Safety, Grounding and Bonding, Hazardous Area Location, Electrical Inspection, Motors, Lightning protection Static Electricity Mitigation, Reading and Understanding Electrical Diagrams, Programmable Logic Controllers and more.

Henry also works very closely with the Talent Acquisition Teams and visits numerous college campuses to deliver presentations on Engineering, Career Development, Networking and other topics.

Henry recently served as the Co-chair of the API Recommended Practice 545 Task Group for Lightning Mitigation for Above Ground Storage Tanks. In this role, he works with engineers, scientists and manufacturers from all over the world to evaluate the impacts of lightning and static electricity on metal above ground storage tanks.

His passion for teaching and Electrical Safety has motivated him to earn the Certified Electrical Safety Compliance Professional Certification (CESCP) from NFPA. He also regularly attends numerous electrical and safety conferences and training sessions conducted by NFPA, IEEE, API.

Previously, Henry was the President of the Fostoria, Ohio area Toastmasters team.

Henry is also a member of the International Association of Electrical Inspectors.

Henry also owns two small businesses:

Matthews Electrical Services - that performs mainly limited residential and small commercial electrical services and conducts training for licensed electricians in the state of Ohio.

Designer Cuts Hair Salon, LLC – Henry co-owns the beauty salon with his wife.

File Attachments for Item:

ER-2 Grounding and Bonding Part 2: Beyond the Basics (Matthews Electrical Services)

BO, MPE, EPE, FPPE, BI, ESI, RBO, RPE, RBI (4 hours)

Staff Notes:

ESIAC Recommendation:

Committee Recommendation:

Grounding and Bonding Part II Webinar – Beyond the Basics

Course Outline

1. Objective: To cover more advanced Grounding and Bonding applications and relating them to applicable NEC grounding and bonding requirements.
2. Structure
 - a. Duration: 4 hour
 - b. Format
 - i. Webinar
 1. Register at www.matthewselectrical.net
 2. Webinar conducted at www.zoom.com
 - c. Resources
 - i. 2020 National Electrical Code
 1. Article 250 Grounding and Bonding
 2. Article 445 Generators
 3. Article 690 Solar Photovoltaic Systems
 4. Other applicable NEC sections
 - ii. 2021 NFPA 70E Electrical Safety in the Workplace
 - iii. NFPA 77
 - iv. NFPA 780
 - v. IEEE 80 and IEEE 142
 - vi. PowerPoint Slides Developed by Matthews Electrical Services
 - vii. Solar Energy International material
 - viii. IAEI.org website and publications including Soares Book on Grounding and Bonding
 - ix. NFPA website
 - x. Electrical Safety Foundation International website and publications
 - xi. Various equipment manufacturers published material
3. Curriculum: Grounding and Bonding
 - a. Review of Grounding and Bonding basic concepts
 - b. Proper grounding and bonding for personnel safety and equipment reliability
 - c. Review of GFCI and GFPE operating principles
 - d. System grounding: Utility vs. Separately Derived Systems
 - e. Preventing objectionable current flow
 - f. Resistance Grounding Systems
 - g. Grounding and Bonding of Remote Buildings
 - h. Grounding and Bonding of Generator systems and the role of the transfer switch
 - i. Grounding and Bonding of Solar PV systems
 - j. Lightning protection basics
 - k. Static Electricity Mitigation



CRITERIA FOR SUBMITTING CONTINUING EDUCATION COURSES FOR BOARD OF BUILDING STANDARDS CERTIFICATIONS

The Ohio Board of Building Standards approves Continuing Education Courses for building department personnel. The courses may be used for the attainment of goals that are connected with technical and professional development as they relate to enforcing and interpreting the Ohio State Building Codes. Board approval is granted only on course instruction pertaining to OBC, OMC, OPC, and RCO requirements and such other content areas directly related to the responsibilities of the certification for which credit is being requested.

Instructors: Anyone or any organization promoting an approved course, is required to make full and accurate disclosure regarding course title, course approval number, number of credit hours, certifications for which the BBS has approved the class, and fees in promotion materials and advertising. ***The Board does not grant retroactive approval. It is recommended that courses be submitted for approval well in advance of any scheduling of classes and advertising.*** Advertising shall not disclose improper approval information to the public.

Course sponsors/co-sponsors: provide participants a certificate of completion containing the following information: name of participant, title of approved courses, BBS approval #, BBS approved certifications, date of the continuing education program, number of approved credit hours awarded and signature of authorized sponsor or instructor.

Anyone or any organization administering an approved course shall provide the Board with advanced written information on scheduling of the course(s) (date and place) and provide to the Board a legible list of participants who completed the course with the name of course, date, and location.

Participants: Must attend the complete course as presented by the instructor to receive credit hours approved by the Board. No partial credit shall be given to any participant who failed to complete the entire course as approved. The sponsor/co-sponsor or instructor shall formulate a method to verify the individual's attendance and completion of the course.

Board approval: Remains in effect through the calendar year of approval. The course may be renewed administratively by sponsor application in subsequent years so long as it references current codes and standards. Upon the Board's adoption of a new edition of the codes, course sponsors must update their course and submit to the Board for approval. The Board does not grant retroactive approval for courses presented prior to approval date.

Facility/training area: Shall be capable of comfortably and safely seating at least the number of attendees with writing surfaces for each attendee; accessible to/and usable for people with disabilities; sized and provided with audio/visual equipment adequate so that each attendee can see the instructor(s) and overhead screen and hear the content of the training programs; illuminated for writing and that the content on an overhead screen can be seen easily by all attendees; non-smoking in the training room; sound controlled so that outside noise will not interfere with the training.

APPLICATION

FOR Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.



Board of Building Standards

6606 Tussing Road, P.O. Box 4009

Reynoldsburg, Ohio 43068-9009

(614) 644-2613 Fax: (614) 644-3147

dic.bbs@com.state.oh.us

www.com.state.oh.us/dic/dicbbs.htm

COURSE SUBMITTER:

Course Submitter: Henry Matthews

(Contact Name)

Organization: Matthews Electrical Services

(Organization/Company)

Address: 1203 McKinley Place

(Include Room Number, Suite, etc.)

City: Fostoria

State: Ohio

Zip: 44830

E-Mail: hpmatthews66@att.net

Telephone: 419-575-3488

Fax: _____

Course Sponsor: _____

COURSE INFORMATION:

Course Title: Grounding and Bonding Part II Webinar - Beyond the Basics

New Course Submittal: ☒

Update Course: ☐

Prior Approval Number: _____

Purpose and Objective: This course will expand upon the basic grounding and bonding principles and requirements covered in Grounding and Bonding (Part 1).

This course will cover more in-depth grounding and bonding topics such as system grounding, resistance grounding, separately derived systems, grounding and bonding of generator systems, Solar PV systems and remote buildings. We will also discuss how grounding and bonding helps mitigate static electricity and is a key component of lightning protection systems.

Number of Instructional Contact Hours that can be obtained upon completion: 4

If Multi-Session, Number of Instructional Contact Hours Per Session: _____

Program Applicable for the Following Participants:

Building Official ☒

Master Plans Examiner ☒

Building Inspector ☒

Fire Protection Inspector ☐

Mechanical Inspector ☐

Building Plans Exam. ☐

Plumbing Inspector ☐

Plumbing Plans Exam. ☐

Non-Res IU Inspector ☐

Electrical Plans Exam. ☒

Mechanical Plans Exam. ☐

Fire Protect. Plans Exam. ☒

Res Building Official ☒

Res Plans Examiner ☒

Res Building Inspector ☒

Res Mechanical Inspector ☐

Res IU Inspector ☐

Electrical Safety Inspectors ☒

Location of ESI Course: www.matthewselectrical.net via www.zoom.com

Date(s) of ESI Course(s): 12-18-21

SUBMITTAL CHECKLIST: Make Sure all of the Following Information is Submitted:

Check
Off

Course Submitter:	Name of contact person and their certification numbers, organization, address, fax, phone	X
	Organization sponsoring or requesting the program (if any)	
Course Title:	Name of course (related to content)	X
Purpose/Objective:	Describe purpose and how course will improve competency of certification(s) listed	X
Contact Hours:	Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	X
Participants:	Check off each certification for which credit is requested (for which course relates to certification)	X
Content of Program:	Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered	X
Course Materials:	Collated workbooks, handouts, hard copy or electronic versions of program is available	X
Instructor(s) Info.:	Resume of professional/educational qualifications & teaching/training experience/BBS certifications	X
Test Materials:	Quizzes will be conducted inside the Zoom Webinar	X
Completed Application:		X

NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.



MATTHEWS ELECTRICAL SERVICE

Grounding and Bonding Webinar Part II

Matthews Electrical Services

Ohio Training Agency #48714

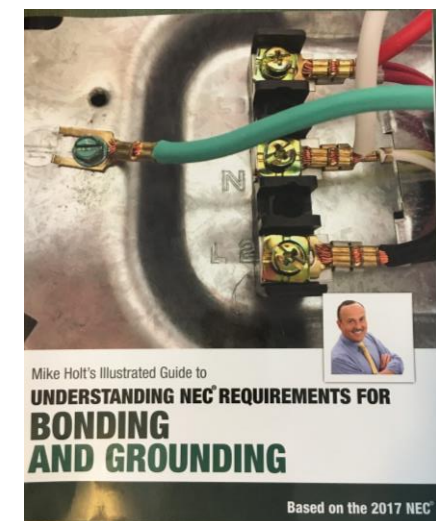
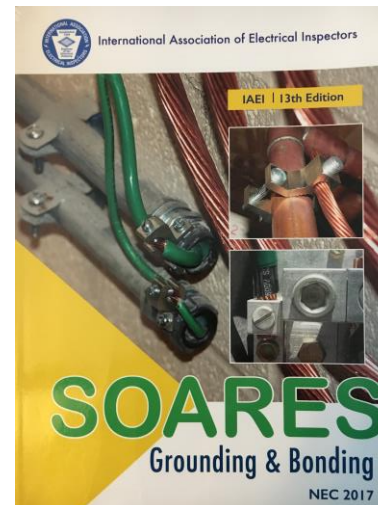
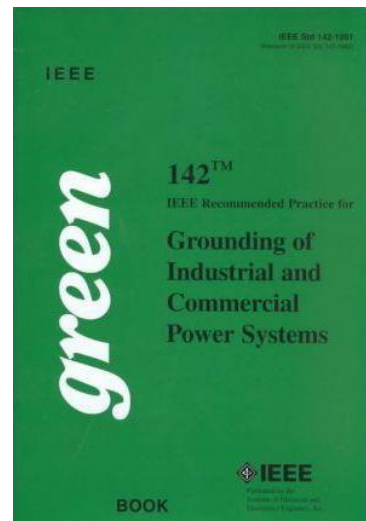
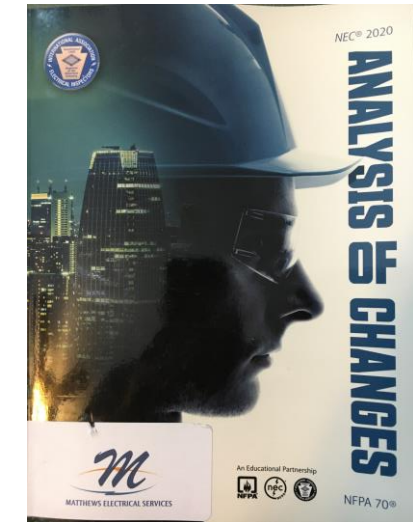
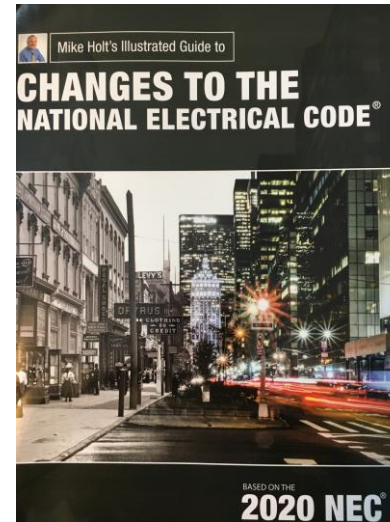
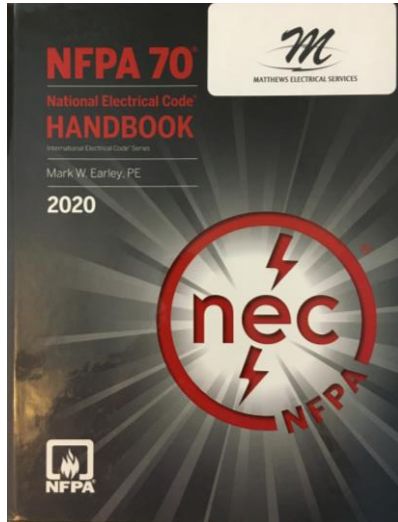
Henry Matthews, PE, CPE, CESP





WELCOME!

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





Keys to Understanding Grounding and Bonding

- Grounding and Bonding is one of the most confusing topics in the NEC
- Simplified by understanding:
 - Grounding
 - Bonding
 - Theory of current flow
 - Effective Ground Fault Current Path



Why Do We Ground and Bond? Review

Rule #1

- Electric current always wants to return to its **source** – not ground
 - Exception: Lightning

Rule #2

- Electric current will take any and all available paths to get back to its source
 - Includes:
 - Earth
 - Water
 - People
 - Metallic objects
 - Airs
 - Concrete
 - Wood
 - Pets
 - You get the picture...

Rule #3

- Most of the current (returning back to its source) will take the path of least resistance (impedance)

Goal #1

- **Bonding** creates an intentional low impedance (resistance) path for current to return to the source
- AKA: Low Impedance Effective Ground Fault Path

Three Methods

- The Neutral (Grounding Conductor): Normal Current Return Path
- Equipment Grounding Conductor: Intentional Abnormal Current (Ground Fault) Return Path
- The Earth: Unintentional Current (Ground Fault) Path - aka stray currents

Why Do We Ground and Bond?

- Grounding

- Divert lightning to ground
- Establish voltage reference
- Minimize elevated voltages
- Stabilize voltages
- Relax static charges
- Noise reduction (electronics)

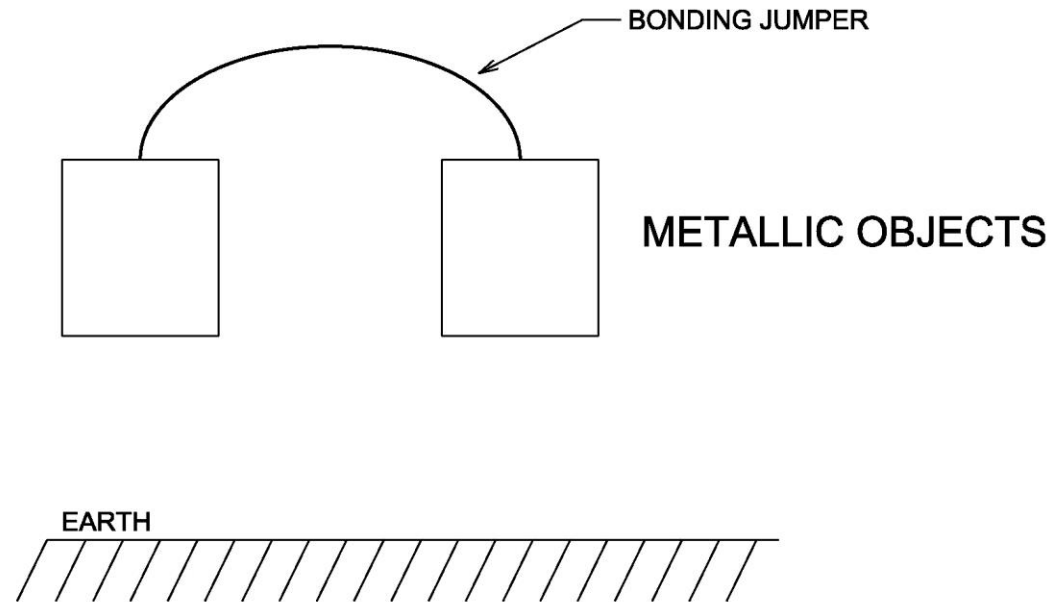


- Bonding

- Equalize voltages (no current flow)
- Create equipotential planes
- Create effective ground fault path
- Prevent static electricity buildup
- Help minimize step and touch potential

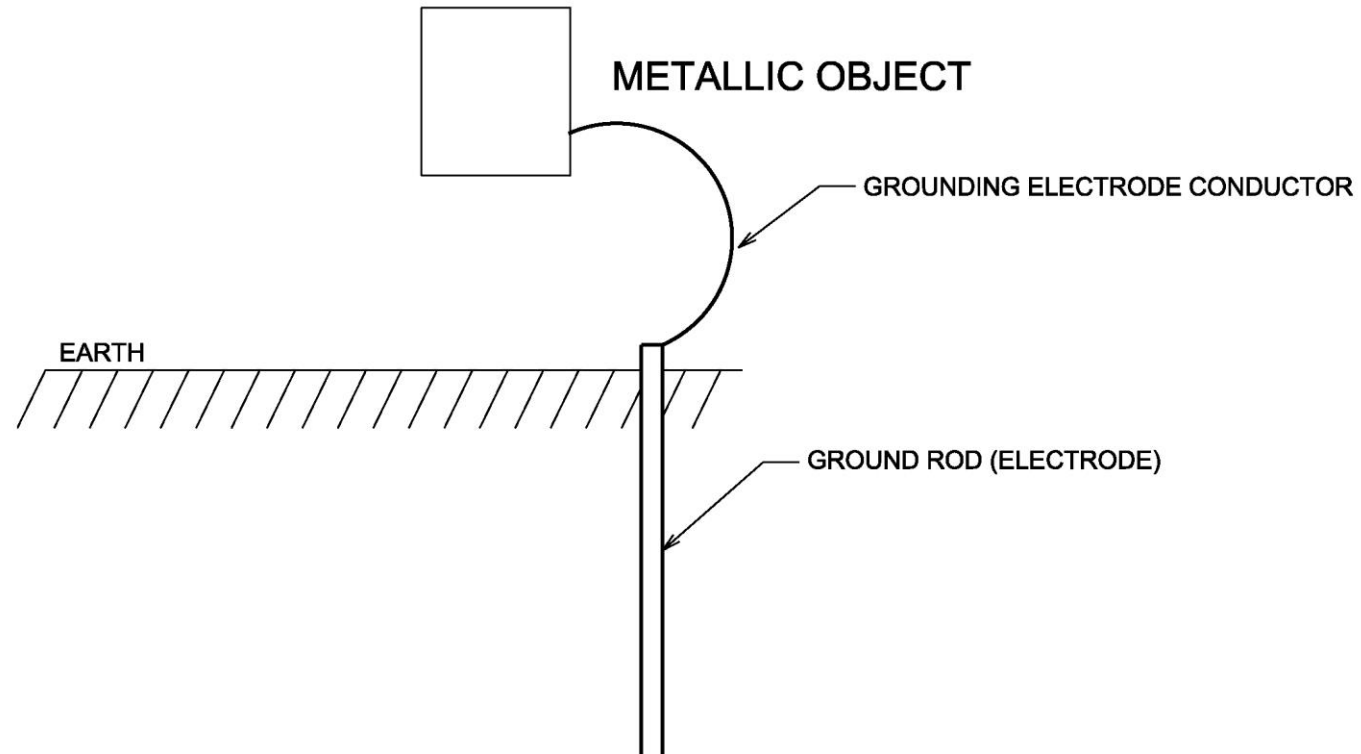


BONDING



- Both objects are at same voltage (equi-potential), but not necessarily 0 volts
- No current flow between bonded objects

GROUNDING



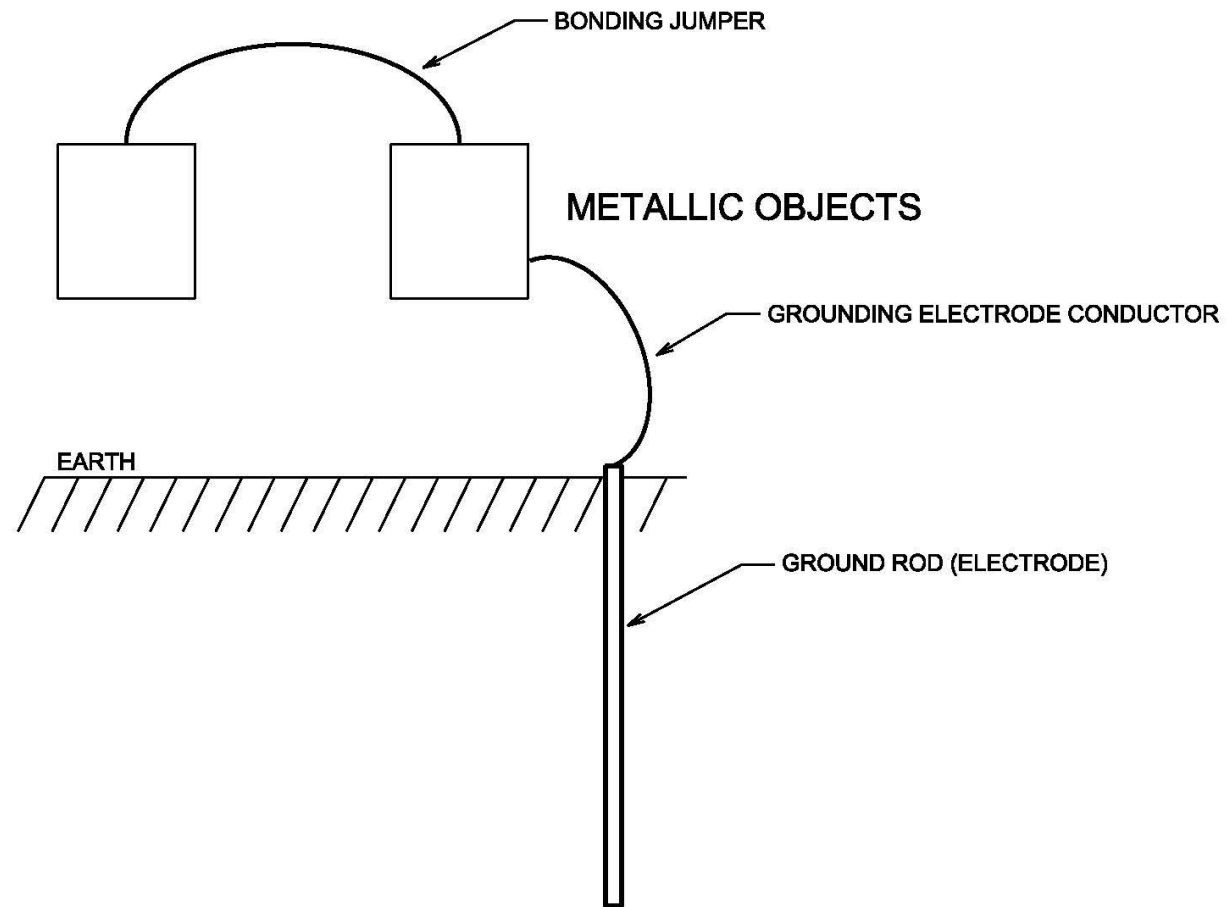
Object is now at 0 volts (ground reference)



Things that are inherently grounded*

- *perform ground resistance tests to be certain
- Some codes require additional grounding

BONDING AND GROUNDING



Both objects are now at 0 volts

Types of Grounding

- System Grounding [250.4(A)(1)]
 - ...shall be connected to the earth in a manner that will limit the voltage imposed by lightning, line surges, or unintentional contact with higher-voltage lines and that will stabilize the voltage to earth during normal operation
- Electrical Equipment Grounding [250.4(A)(2)]
 - Normally non-current-carrying conductive materials enclosing electrical conductors or equipment, or forming part of such equipment, shall be connected to earth so as to limit the voltage to ground on these materials
 - *Examples: conduit, electrical enclosures, electrical devices and fittings, equipment enclosures, transformer cases, motor cases etc.*

Bonding

- Bonding of electrical equipment [250.4(A)(3)]
 - Normally non-current carrying conductive materials enclosing electrical conductors or equipment, or forming part of such equipment, shall be connected together and to the electrical supply source in a manner that establishes an effective ground fault path.
- Bonding of Electrically Conductive Materials and Other Equipment [250.4(A)(4)]
 - Normally non-current-carrying electrically conductive materials that are likely to become energized shall be connected together and to the electrical supply source in a manner that establishes an effective ground-fault current path

Effective Ground-Fault Current Path!

[250.4(A)(5)]

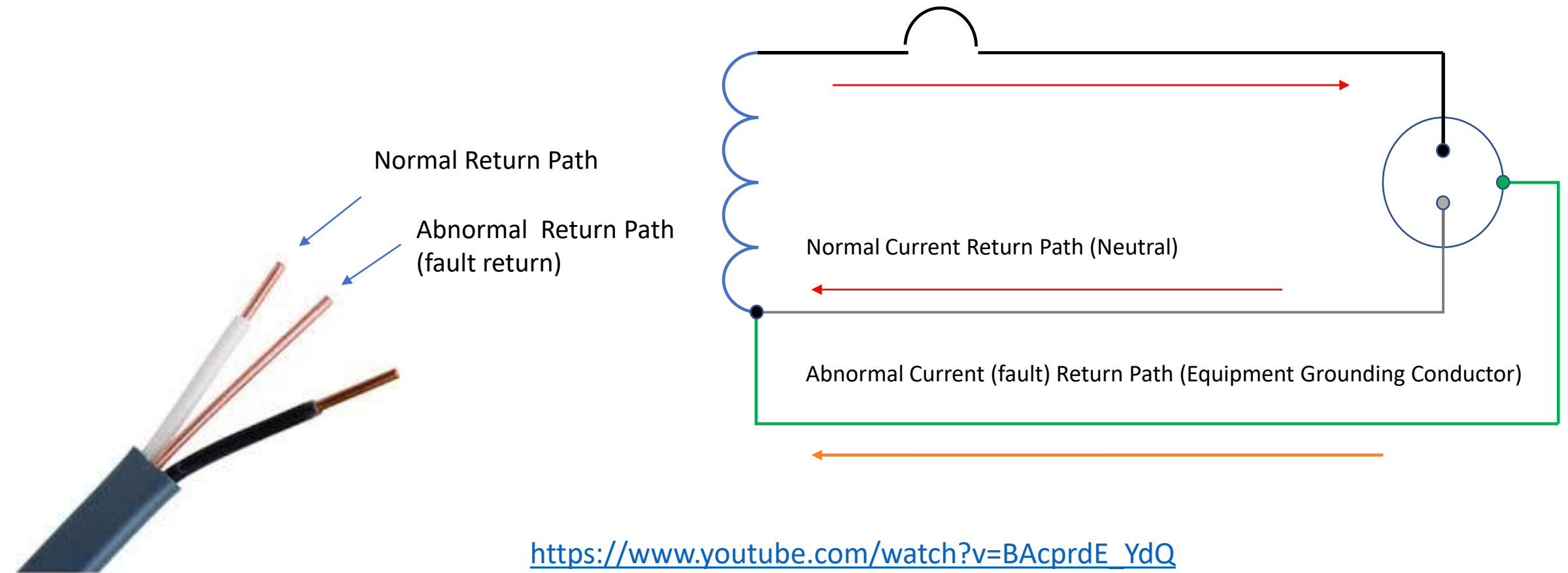


Effective Ground-Fault Current Path!

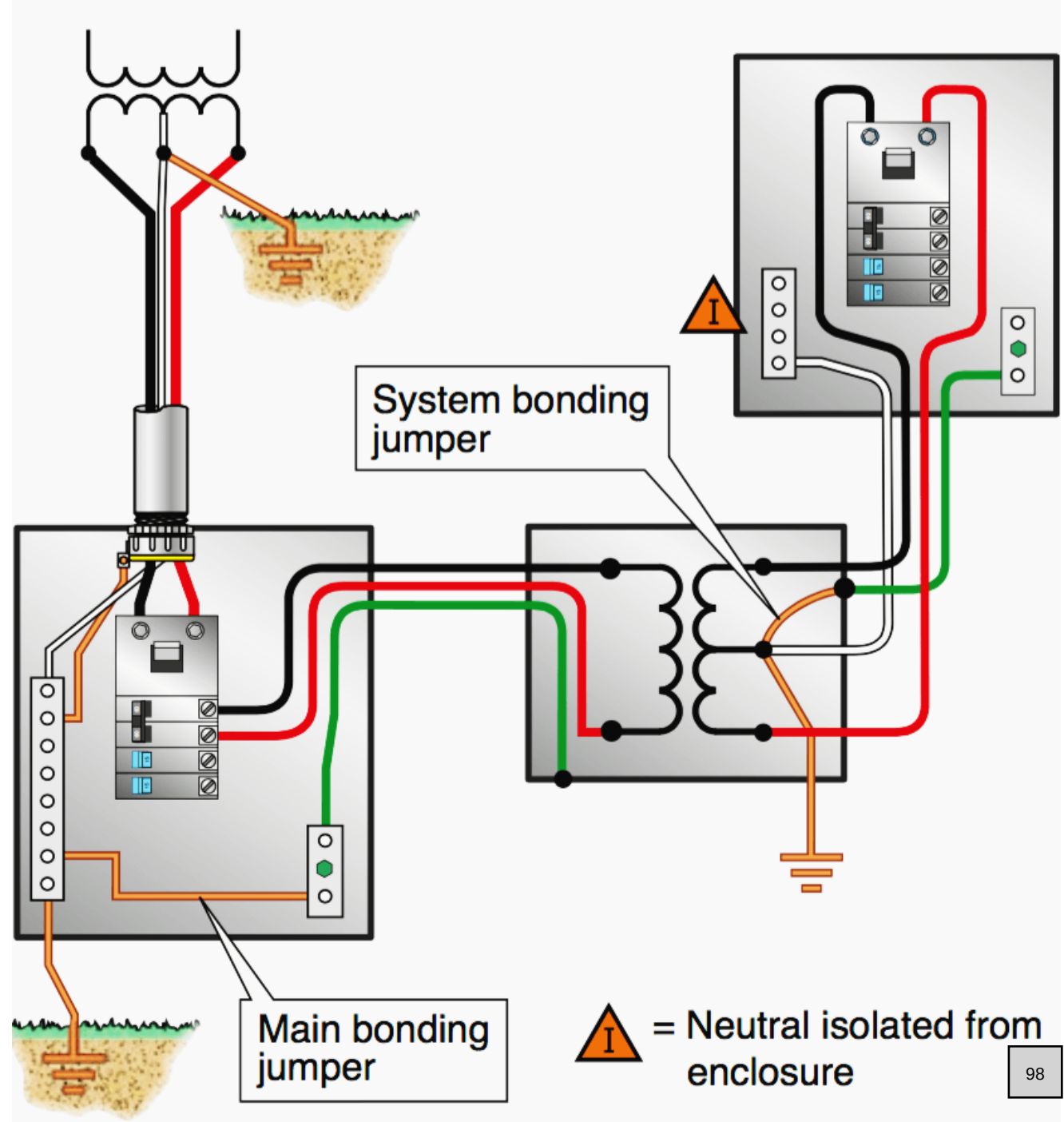
[250.4(A)(5)]

- Electrical equipment and wiring and other electrically conductive material likely to become energized shall be installed in a manner that creates a low-impedance circuit facilitating the operation of the overcurrent device (*circuit breaker, fuse e.g.*) or ground detector for high-impedance grounded systems.
- It shall be capable of safely carrying the maximum ground fault current likely to be imposed on it from any point on the wiring system where a ground fault may occur to the electrical supply source.
- The earth shall not be considered as an effective ground fault current path.

Current Return Paths

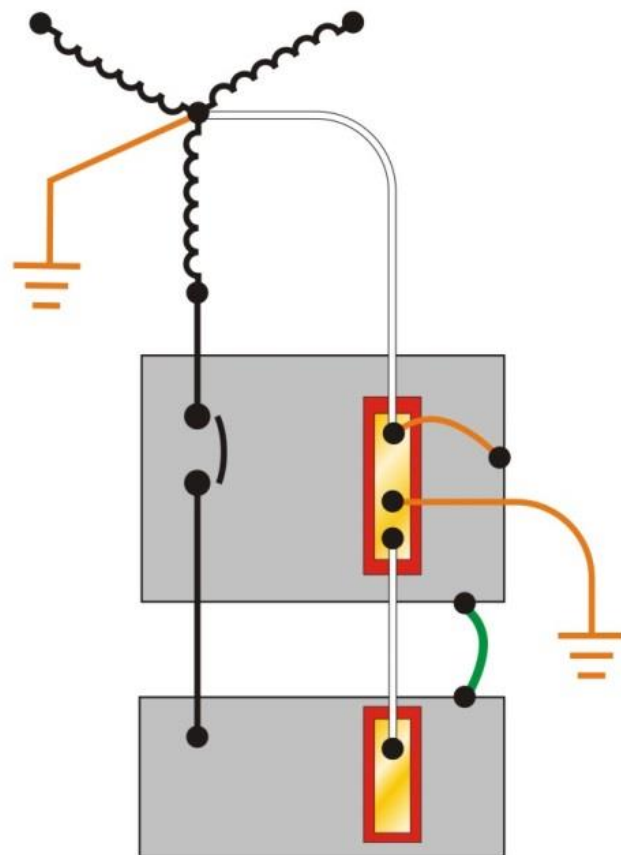


Utility Service vs. Separately Derived System

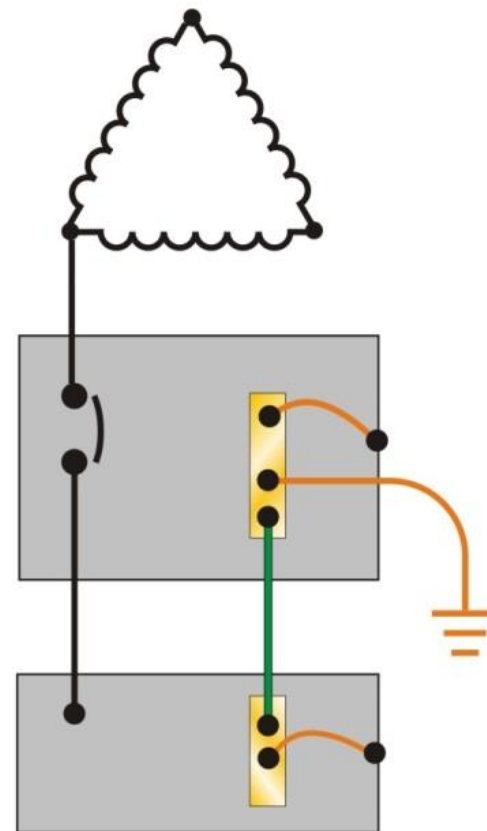


NEC 250.4(A) and (B)

Part A - Grounded System



Part B - Ungrounded System

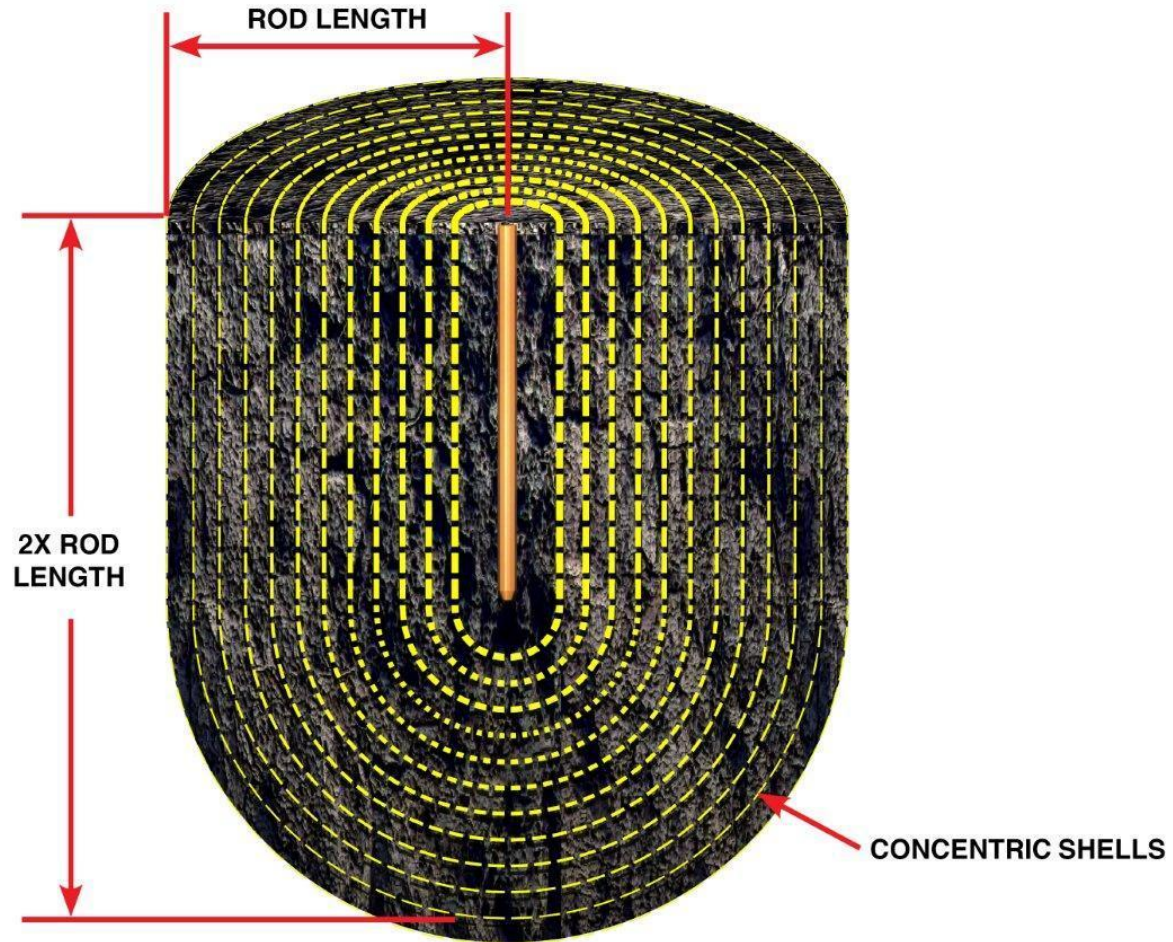


The performance requirements of the fault-current paths for each system are provided in each part

The Conductors of the Grounding System

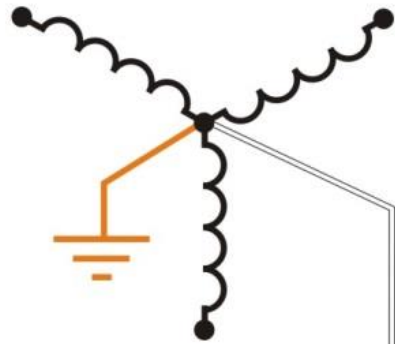
- Main Bonding Jumper (MBJ)
- Grounded Conductor (neutral)
- Grounding Electrode Conductor (GEC)
- Supply Side Bonding Jumper (SSBJ)
- System Bonding Jumper (SBJ): for separately derived systems
- Equipment Grounding Conductor (EGC)
- Bonding Conductors (Jumpers)

What is the Sphere of Influence?



<https://www.youtube.com/watch?v=lqQStcKz-eY>

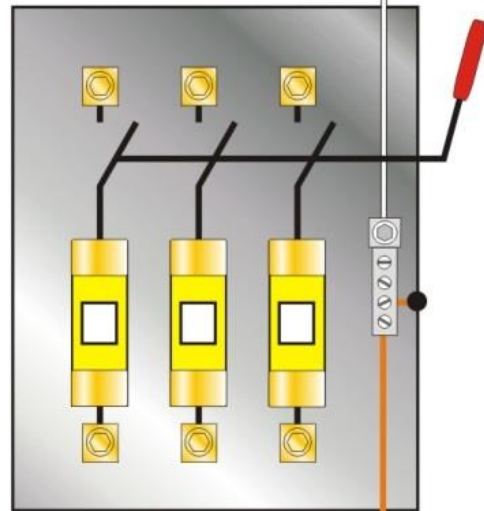
Functions of Grounding Electrode



Grounding Electrode - A conducting object through which a direct connection to earth is established.

1. Connects the electrical system to earth
2. Connects electrical equipment to earth
3. Attempts to maintain equipment at the earth voltage potential

Little effect in clearing ground faults
(not its function)



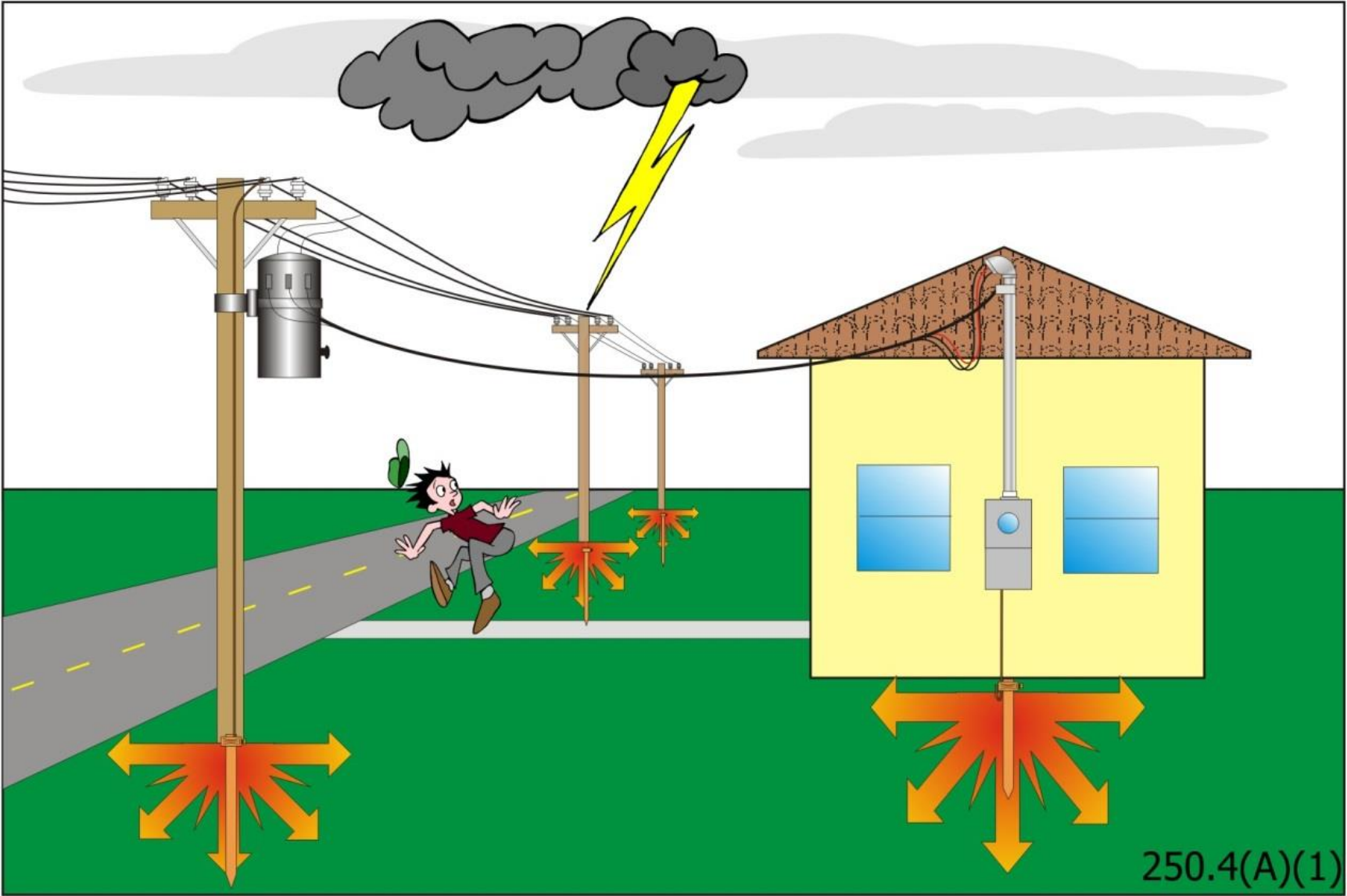
Note: All conductors not shown



Grounding electrode conductor

Grounding electrode system

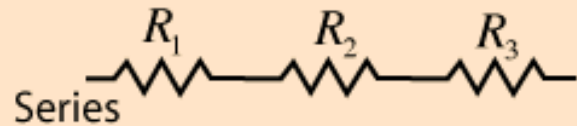
Dissipation of Over-Voltages



Why Do We Put Ground Rods in Parallel?

Resistor Combinations

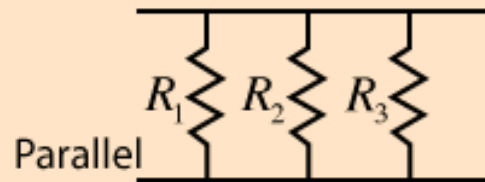
The combination rules for any number of [resistors](#) in series or parallel can be derived with the use of [Ohm's Law](#), the [voltage law](#), and the [current law](#).



$$R_{equivalent} = R_1 + R_2 + R_3 + \dots$$

$$R_{equivalent} = \frac{V}{I} = \frac{V_1 + V_2 + V_3 + \dots}{I} = \frac{V_1}{I_1} + \frac{V_2}{I_2} + \frac{V_3}{I_3} + \dots = R_1 + R_2 + R_3 + \dots$$

Series key idea: The current is the same in each resistor by the current law.



$$\frac{1}{R_{equivalent}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$$

To lower resistance, add ground rods (electrodes) in parallel

Ground Rods and Electrical Resistance

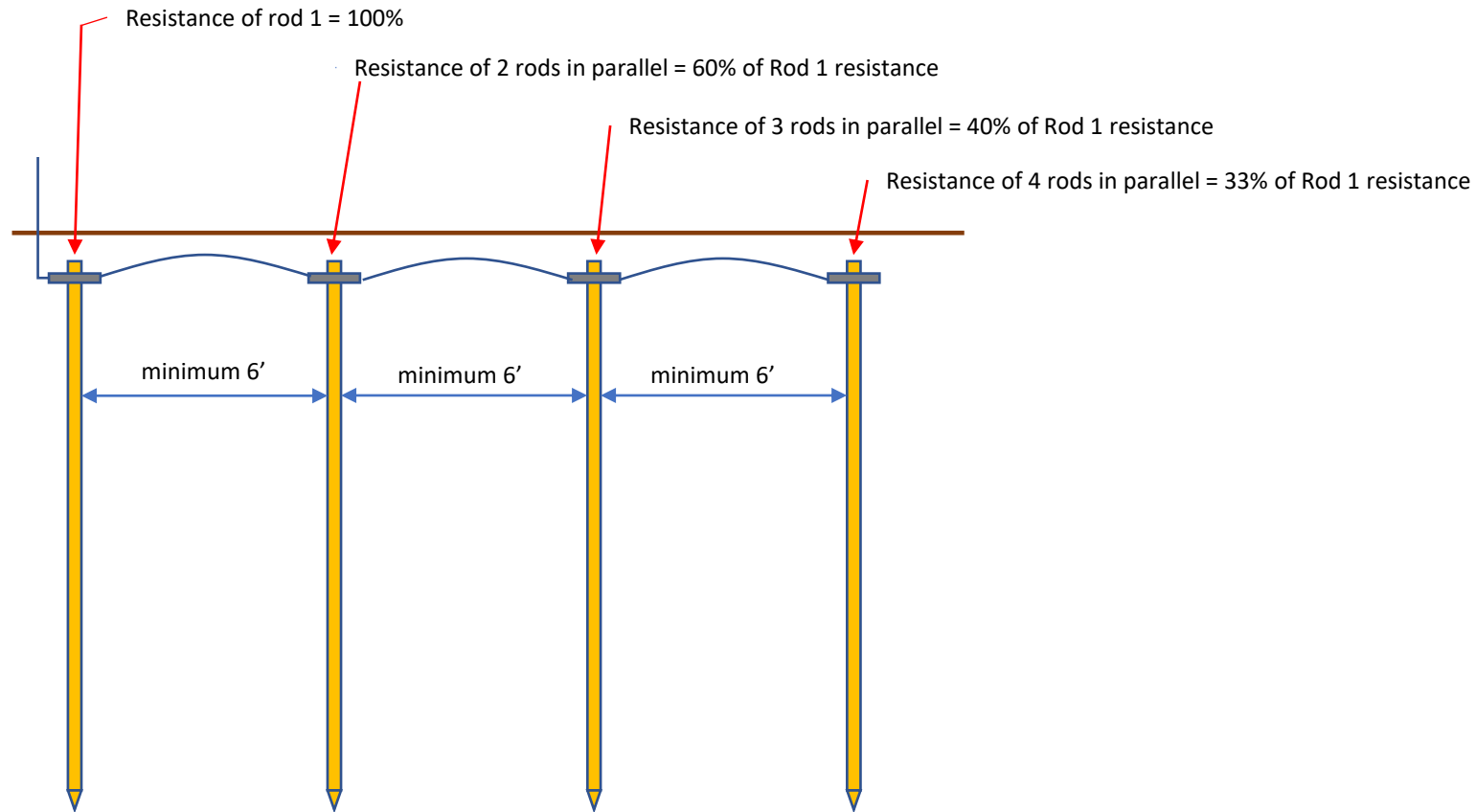
Example:

Rod 1 = 60 ohms

Rods 1&2 = 36 ohms

Rods 1,2,&3 = 24 ohms

Rods 1,2,3&4 = 19.8 ohms



Equipotential Bonding

- Also known as:
 - Chassis grounding, equipment grounding, instrumentation ground and safety ground
- Used for:
 - In-ground swimming pools, data-communication centers, electrical substations, dairy farms, anti-corrosion systems etc.
- Objective: To create a grounding plane that minimizes step and touch potential where regardless of where a person steps or what he/she touches, the voltage is the same. Shock mitigation.

<https://www.youtube.com/watch?v=wyOILpoR39A&t=1s>

20 mins

Equipotential Grounding Grid

- Primarily bare, solid #8 copper wire
- 1-ft grid, Must extend at least 3 ft past the water's edge
- All other objects within 5 ft of the pool shall have a grounding conductor bonded to the grid
- All metallic objects shall be bonded together, to the grid and to the concrete rebar
- Entire area where people are engaged in swimming or could be wet shall have all metallic objects bonded together regardless of distance.
- Recommended to extend equipotential grid to all concrete areas regardless of distance.



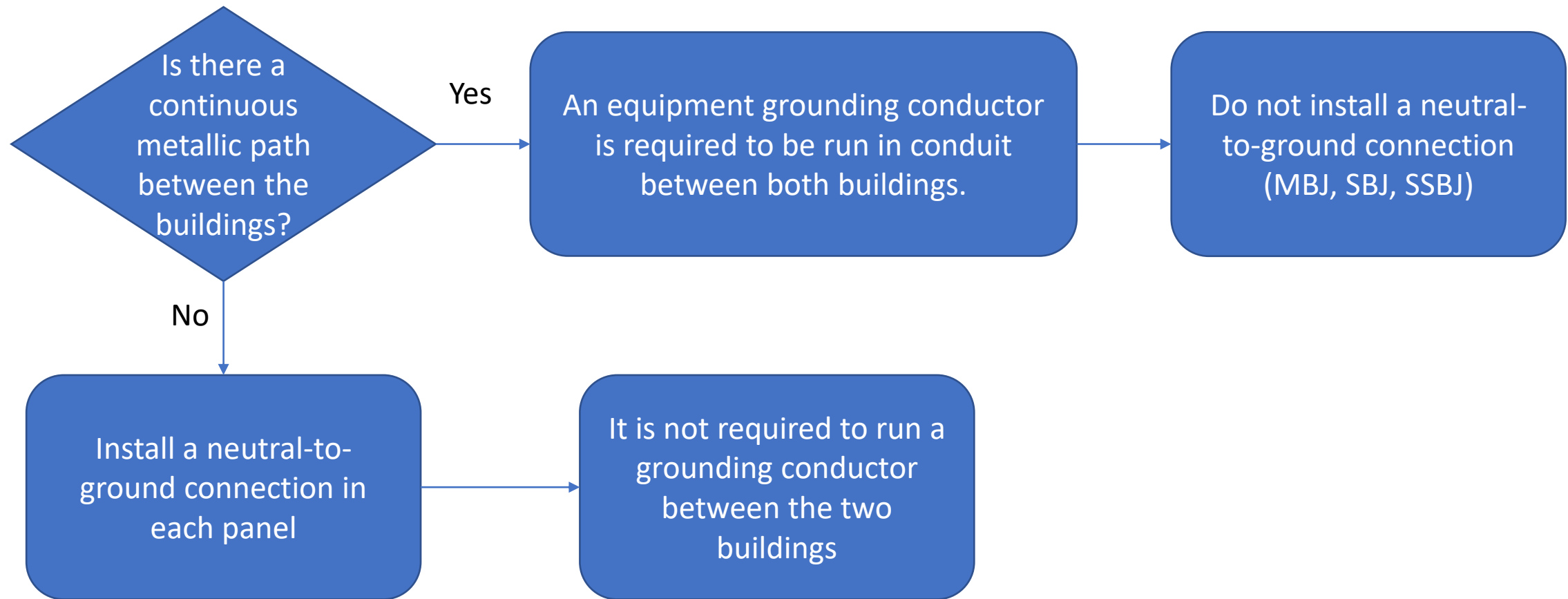
Pool Equipment and Items Requiring Grounding

- Lighting assemblies, including in-water lighting
- The pool water itself! At least 9 in² must be in contact with conductive surface
- All electrical equipment within 5 ft horizontally of the pool
- Conductive equipment within 12' vertically of the pool including diving boards
- Motors, filters and other electrical recirculation equipment
- Metallic fittings
- Junction boxes, transformers, power supply enclosures
- GFCIs
- Panelboards
- Note: some low-voltage, listed, in-pool luminaires may not require a grounding conductor. VERIFY PROPER INSTALLATION WITH MANUFACTURER INSTRUCTIONS, THE AHJ AND THE NEC!

Hot tubs, Hydromassage Tubs (680.40)

- Equipotential bonding isn't required if
 - The spa or hot tub is listed, labeled and identified as a self-contained spa or hot tub for aboveground use
 - The spa or hot tub isn't identified as suitable for indoor use
 - The spa or hot tub is located on or above grade
 - The top rim of the spa or hot tub is at least 28 in. above a perimeter surface located within 30 in. from the spa or hot tub.

Grounding Between Multiple Buildings Fed from Single Building Panel



Metallic path can be conduit, water pipe, gas pipes, rebar in concrete, grounding conductor, communications wiring, Fencing, building structures etc.

Grounding Between Multiple Buildings Fed from Single Building Panel

- All buildings must have a grounding electrode installed, whether they are isolated or not.
- Exception: If the remote building has only one circuit breaker or fuse, then a grounding electrode is not required.
- However, an equipment grounding conductor run in conduit from the main panel is required
- A ground rod is still a good idea in this case

Grounding Electrode Required

- For each building(s) or structure(s) served by one or more feeders or branch circuits, a **grounding electrode system** meeting the requirements of Part III of Article 250 must be used or installed
- The grounding electrode(s) must be connected in a manner specified in 250.32(B) or (C)
- Where no grounding electrode(s) are present from the construction of the building or structure, a grounding electrode system as specified in Part III of Article 250 (*specifically 250.50*) must be installed and used
- See 250.32(A)

Grounding Electrode Requirements

- Grounding electrodes at additional buildings or structures must be **bonded together** to form a grounding electrode system
- Where no grounding electrodes are present at the building or structure, one or more of the grounding electrodes specified in 250.52(A)(4) through (A)(8) must be installed and used
- Rod, pipe, and plate electrodes to comply with 250.53(A)(1) through (A)(3)
- See 250.50

Grounding Electrode Requirements

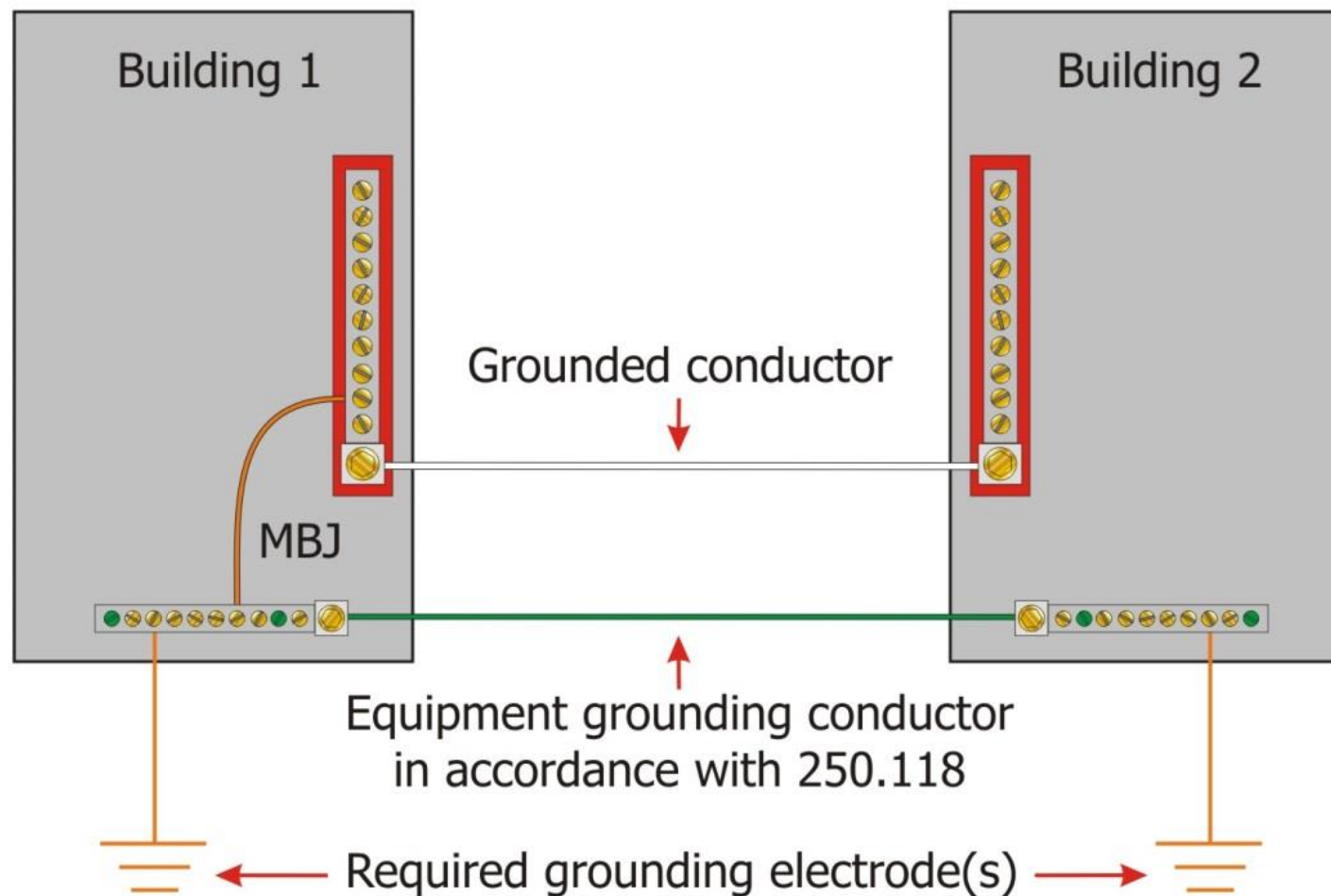
(cont.)

250.32(A) Exception:

- A grounding electrode shall not be required where only a single branch circuit, including a multiwire branch circuit, supplies the building or structure and the branch circuit includes an equipment grounding conductor for grounding the normally non–current-carrying metal parts of equipment.*

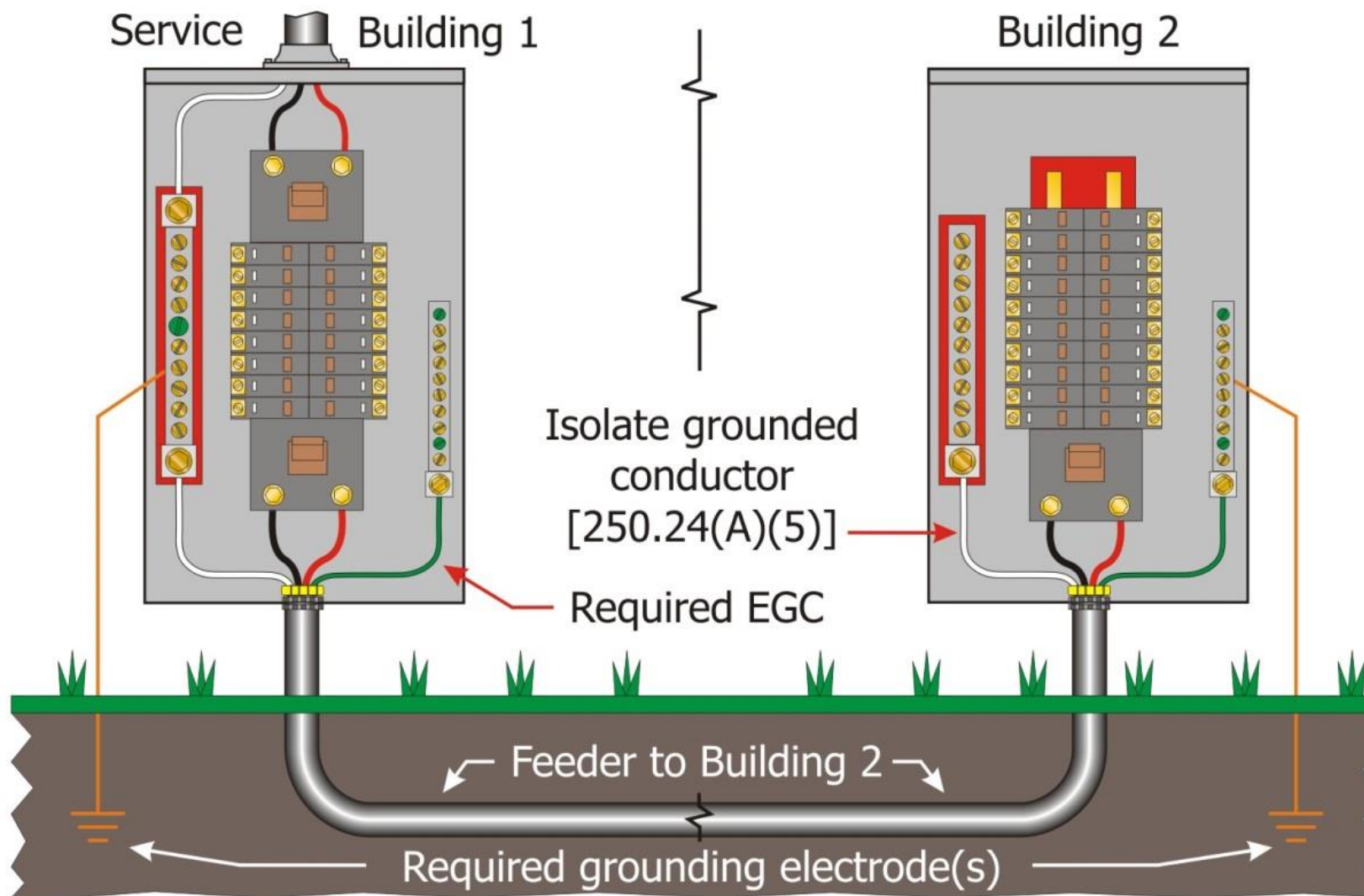
Grounding and Bonding at Seperate Building or Structure

Grounding at separate building or structure using the required equipment grounding conductor [250.32(B)(1)]



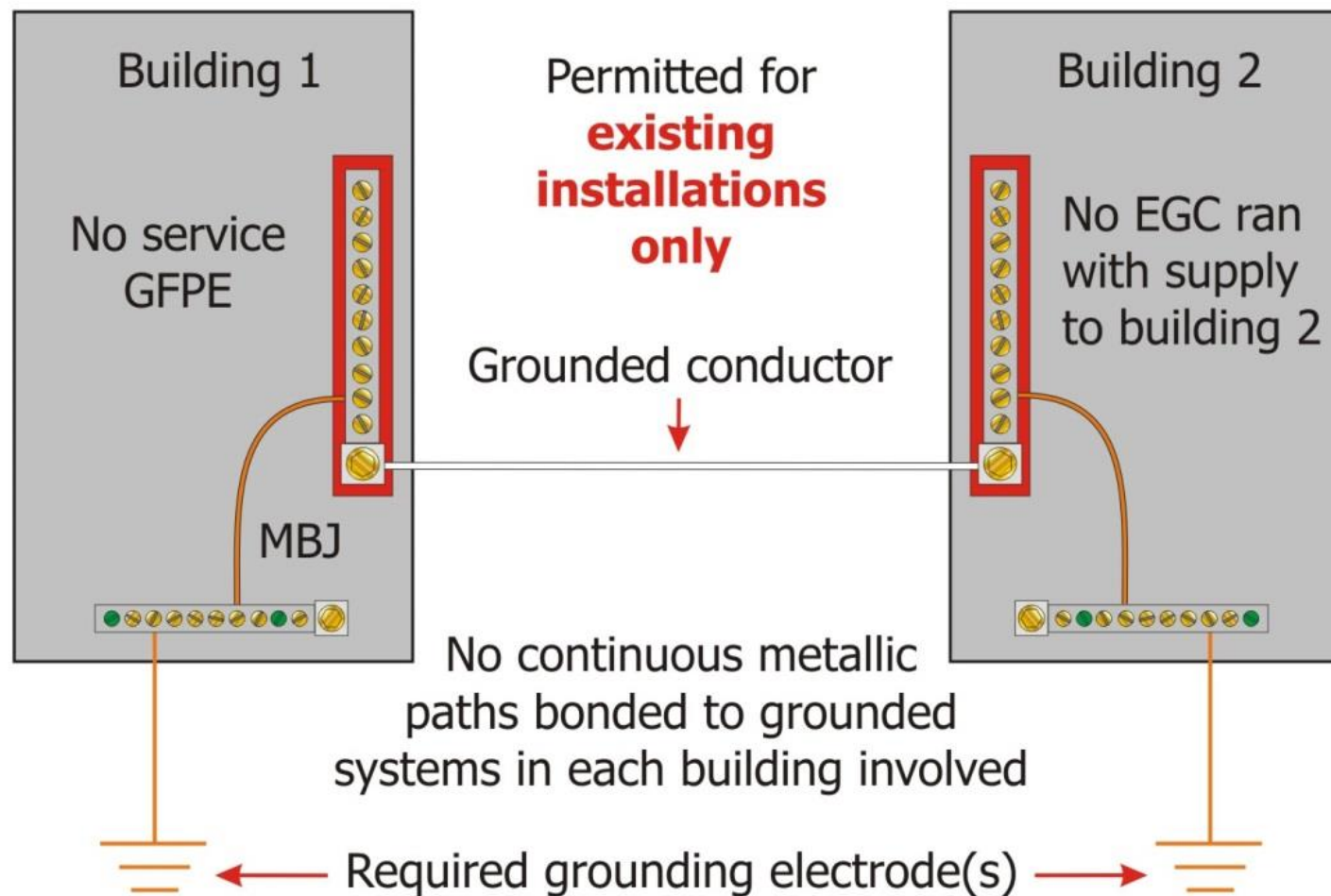
Grounding and Bonding at Seperate Building or Structure

Grounding and bonding at separate building or structure using required equipment grounding conductor [250.32(B)(1)]



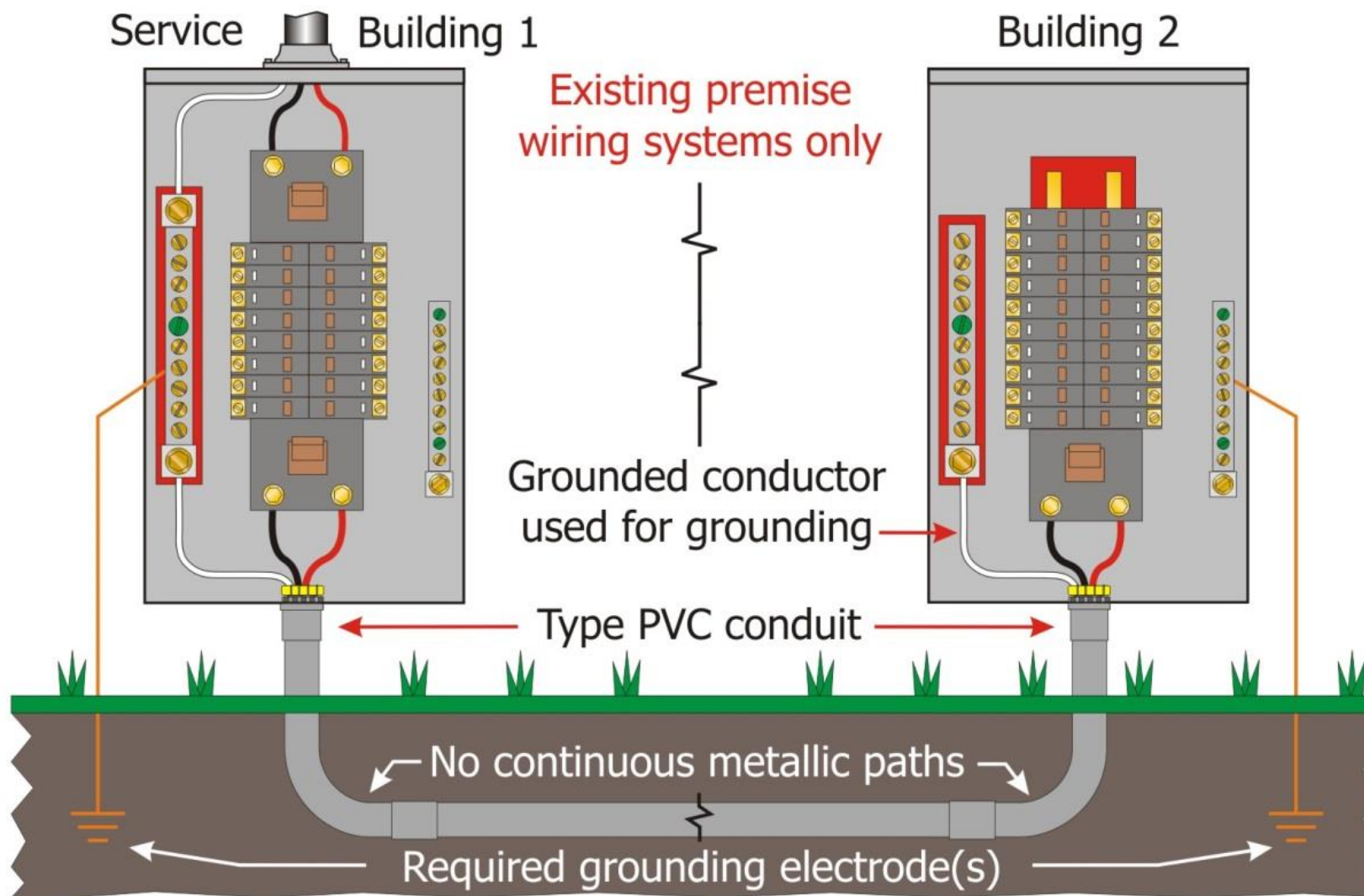
Grounding and Bonding at Seperate Building or Structure

Grounding at separate building or structure using the grounded circuit conductor [250.32(B)(1) *Exception No. 1*]



Grounding and Bonding at Seperate Building or Structure

Grounding and bonding at separate building or structure using grounded circuit conductor [250.32(B)(1) Exception No. 1]

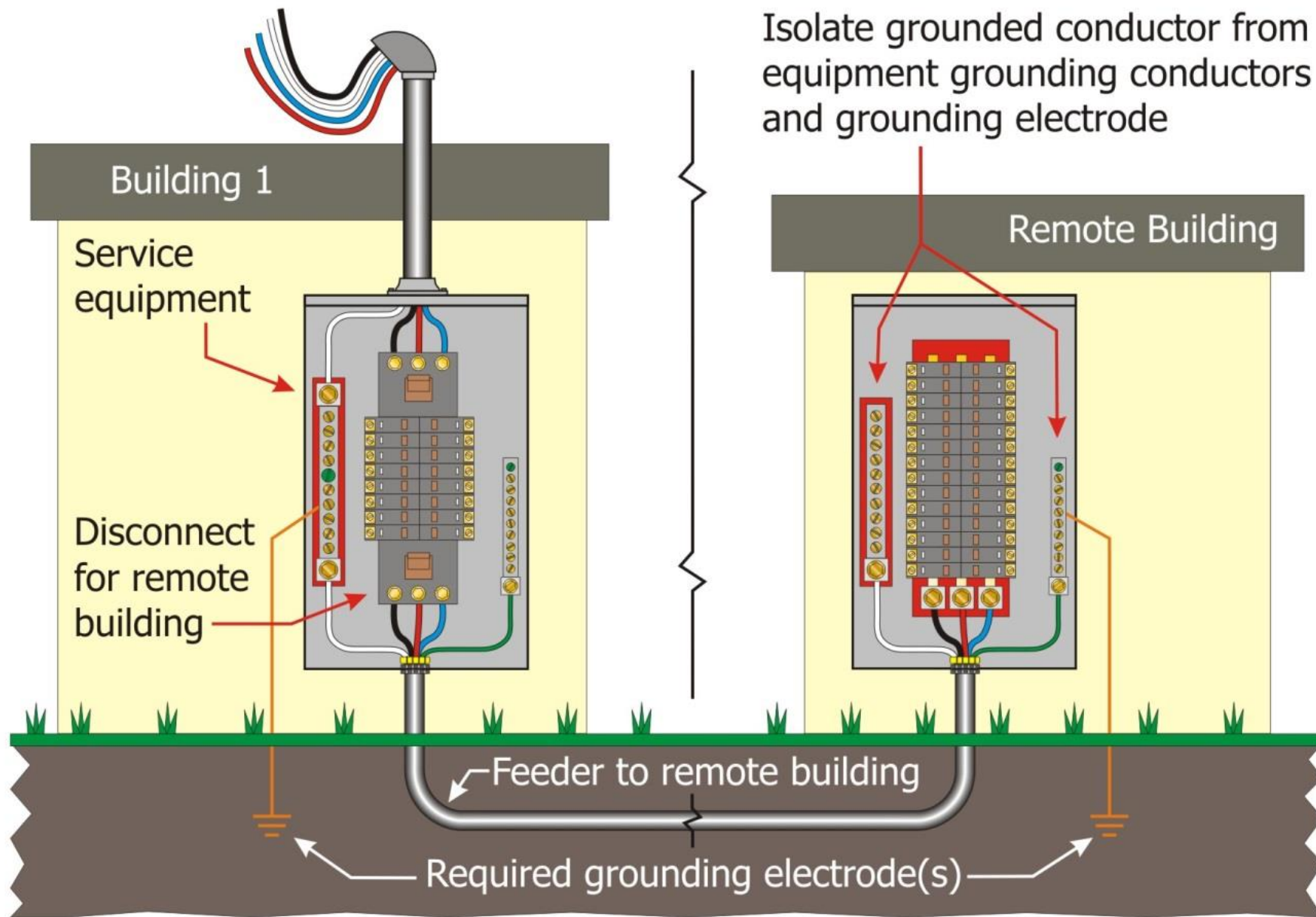


Disconnecting Means for Separate Building or Structure on the Same Premises

- Special rules have been provided for large capacity, multibuilding industrial installations under single management *[see 250.32(D)]*
- These occupancies have trained and qualified personnel and have established procedures for safe switching of electrical feeders or branch circuits
- As a result, the disconnecting means are permitted to be at other locations on the premises rather than at the building served as generally required by 225.32



Remote Disconnect Permitted

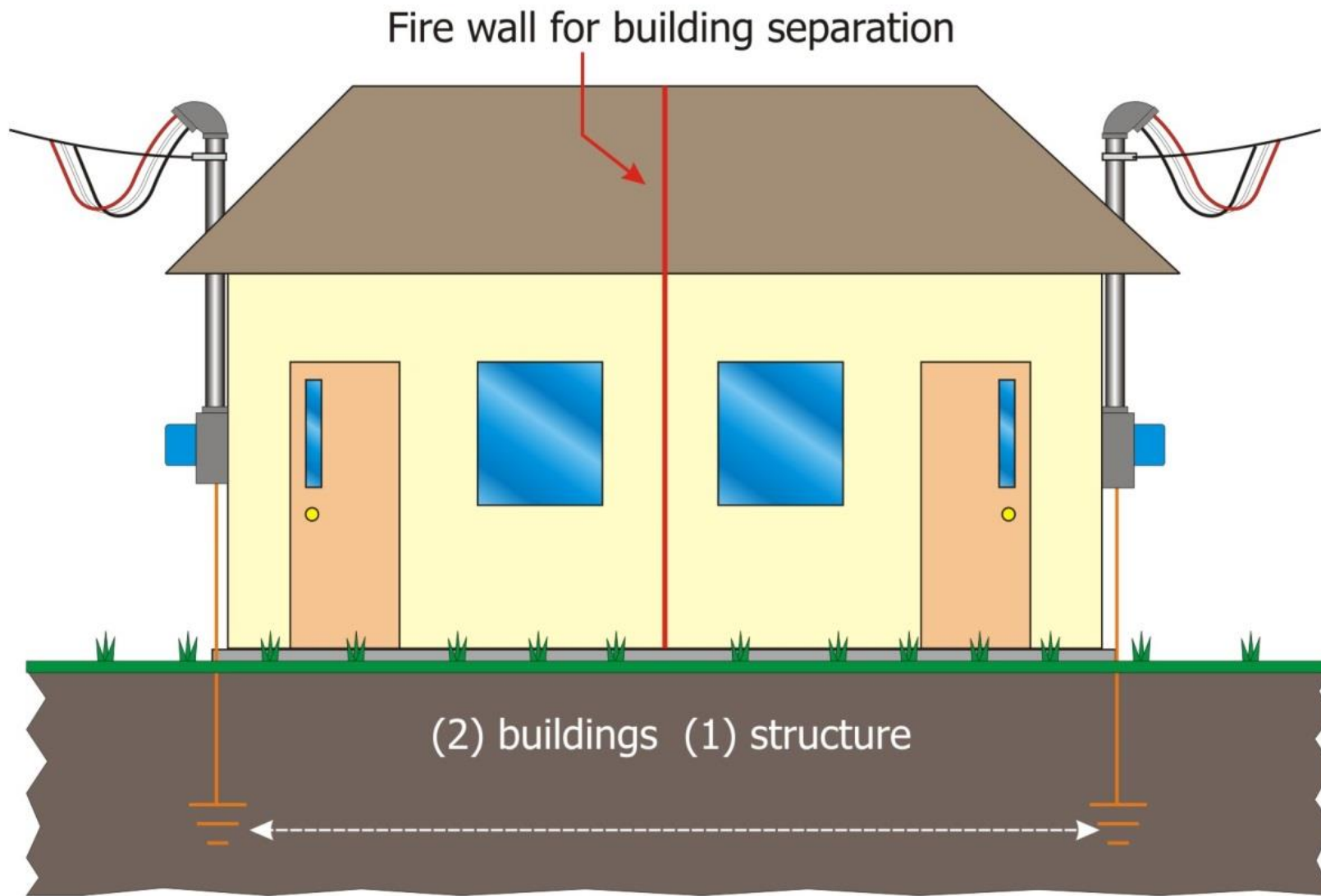


Copyright © IAEI 2014

Note: Buildings under single management

[250.32(D)]

Two Buildings on a Common Foundation



Bonding grounding electrodes together
permitted but not required [250.58]

Henry Peter Matthews, PE, CPE, CESCO, PVA

Home Address

1203 McKinley Place

Fostoria, Ohio 44830

Email: hpmatthews@matthewselectrical.net

Home Phone: 419-701-7707

Cell Phone: 419-575-3488

Work Address

Marathon Petroleum Company

539 South Main Street

Findlay, Ohio 45840

Email: hpmatthews@marathonpetroleum.com

Office phone: 419-421-3423

Cell phone: 419-957-2110

Work Experience

Marathon Petroleum Company, LP; Findlay, Ohio	June 2006 – Present
• Advanced Senior Engineer/Electrical Specialist • Electrical Engineering Supervisor – Terminal Engineering • Project Engineer – Major Projects • Electrical Designer – Retail Division	
Cooper Standard Automotive, Bowling Green, Ohio	July 1993 – June 2006
• Plant Engineering Manager • Plant Electrical Engineer	
Toledo Engineering Company (consultant); Toledo, Ohio	June 1989 – July 1993
• Electrical Drafter	

Education

Bowling Green State University; Bowling Green, Ohio Masters of Business Administration	Aug 2003
Pennsylvania State University; University Park, PA BS Electrical Engineering	Dec 1989
Solar Energy International, Paonia, Colorado Solar PV Training	Sept 2021
Owens Community College; Findlay, Ohio Certificate: Introductory Welding	April 2017
Penn Foster Career School Certificate: Plumbing	July 2010
Penn Foster Career School Certificate: Electrician	October 2004

Certifications

Professional Engineer (PE): OH, MI, IN, KY, IL, WI
Photovoltaic Associate (PVA) by NABCEP
Certified Electrical Safety Compliance Professional (CESCP), NFPA
Certified Plant Engineer (CPE): Association for Facility Engineers
Building Operator Certification (BOC): Northwest Energy Efficiency Council

Licenses	Ohio Electrical Contractor , Ohio Department of Commerce, License # 46972 Ohio Training Agency , Ohio Construction Industry Licensing Board, Agency #48714 Ohio Training Agency , Ohio Board of Building Standards
Special Training	Solar Energy International (SEI) , Paonia, Colorado • Solar Electric and Design and Installation Course, April 2021, 60 hours • PV Systems Fundamentals (Battery-Based), June 2021, 40 hours • Advanced PV System Design and the NEC, June-July 2021, 60 hours • Comparing Battery Technologies, July 2021, 10 hours • Tools and Techniques for Operations and Maintenance of PV Systems, 9/21, 40 HR
Affiliations	Institute of Electrical and Electronics Engineers (IEEE) – Senior Member International Association of Electrical Inspectors (IAEI) NFPA Section Member for Architects, Engineers and Building Officials Illumination Engineering Society of North America (IESNA) API RP 545 former Co-Chair , American Petroleum Institute, Lightning Protection for Above Ground Storage Tanks (2017- 2018)
Business Ownership	Matthews Electrical Services, Owner Designer Cuts Hair Salon, LLC; Co-owner

Biography

Henry has worked in the electrical, power, electronics, instrumentation, controls and communication fields for over 30 years. He earned his Bachelor of Science degree in Electrical Engineering from Penn State University in 1989. Henry worked as a consultant for Toledo Engineering Company in Toledo, Ohio as a drafter and field technician.

In 1993 he started working for Cooper Standard Automotive Company in Bowling Green, Ohio in 1993 as a Plant Electrical Engineer. He was then promoted to Plant Engineering Manager in 2000. During this time, he earned his Professional Engineering License in Ohio.

In 2003, Henry earned his MBA at Bowling Green State University.

In 2006, Henry joined Marathon Petroleum Company in Findlay, Ohio. He then went on to obtain his Professional Engineers license in Electrical Engineering for Michigan, Indiana, Illinois, West Virginia, Kentucky, Minnesota and Wisconsin. During his tenure at Marathon, Henry has had several roles including Electrical Design Engineer, Project Engineer and Electrical Supervisor. He is currently an Advanced Senior Engineer where he writes electrical standards for the company and conducts a community of practice for all the company's electrical engineers and safety professionals.

During his time at Cooper Standard Automotive and Marathon Petroleum, Henry developed a passion for teaching, learning and applying Electrical Construction Codes. At Cooper, he trained the entire non-electrical maintenance staff to perform basic electrical tasks.

At Marathon, Henry works with the Learning and Development Department to conduct multiple training sessions for new hires and seasoned engineers on various topics including Electrical Safety, Grounding and Bonding, Hazardous Area Location, Electrical Inspection, Motors, Lightning protection Static Electricity Mitigation, Reading and Understanding Electrical Diagrams, Programmable Logic Controllers and more.

Henry also works very closely with the Talent Acquisition Teams and visits numerous college campuses to deliver presentations on Engineering, Career Development, Networking and other topics.

Henry recently served as the Co-chair of the API Recommended Practice 545 Task Group for Lightning Mitigation for Above Ground Storage Tanks. In this role, he works with engineers, scientists and manufacturers from all over the world to evaluate the impacts of lightning and static electricity on metal above ground storage tanks.

His passion for teaching and Electrical Safety has motivated him to earn the Certified Electrical Safety Compliance Professional Certification (CESCP) from NFPA. He also regularly attends numerous electrical and safety conferences and training sessions conducted by NFPA, IEEE, API.

Previously, Henry was the President of the Fostoria, Ohio area Toastmasters team.

Henry is also a member of the International Association of Electrical Inspectors.

Henry also owns two small businesses:

Matthews Electrical Services - that performs mainly limited residential and small commercial electrical services and conducts training for licensed electricians in the state of Ohio.

Designer Cuts Hair Salon, LLC – Henry co-owns the beauty salon with his wife.

File Attachments for Item:

ER-3 Health Care Facilities, Fault Currents, Common Defects (IAEI)

All certifications except IU and plumbing (6 hours)

Staff Notes:

ESIAC Recommendation:

Committee Recommendation:

APPLICATION

FOR Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.



Board of Building Standards

6606 Tussing Road, P.O. Box 4009

Reynoldsburg, Ohio 43068-9009

(614) 644-2613 Fax: (614) 644-3147

dic.bbs@com.state.oh.us

www.com.state.oh.us/dic/dicbbs.htm

COURSE SUBMITTER:

Course Submitter: Lorenzo Adam
(Contact Name)
Organization: Ohio Chapter IAEI
(Organization/Company)
Address: 27 Penbrooke Ct
(Include Room Number, Suite, etc.)
City: Monroe State: Ohio Zip: 45050
E-Mail: ladam@masonoh.org
Telephone: 513-229-8520 Fax: _____
Course Sponsor: Ohio Chapter IAEI

COURSE INFORMATION:

Course Title: Health Care Facilities / Fault Currents / Common Defects

New Course Submittal: ☒ Update Course: ☐ Prior Approval Number: _____

Purpose and Objective: To provide attendees with an overview and explanation of the subjects presented and to provide a level of uniformity among inspectors, contractors, professional designers and jurisdictions

Instructors: Various IAEI members

Number of Instructional Contact Hours that can be obtained upon completion: 6 hours

If Multi-Session, Number of Instructional Contact Hours Per Session: _____

Program Applicable for the Following Participants:

Building Official ☒	Master Plans Examiner ☒	Building Inspector ☒	Fire Protection Inspector ☒	Mechanical Inspector ☒
	Building Plans Exam. ☒			Plumbing Inspector ☐
	Plumbing Plans Exam. ☐			Non-Res IU Inspector ☐
	Electrical Plans Exam. ☒			
	Mechanical Plans Exam. ☒			
	Fire Protect. Plans Exam. ☒			

Res Building Official ☒	Res Plans Examiner ☒	Res Building Inspector ☒	Res Mechanical Inspector ☒	Res IU Inspector ☐
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Electrical Safety Inspectors ☒
Location of ESI Course: Fairfield, Ohio Date(s) of ESI Course(s): Februaury 5, 2022

SUBMITTAL CHECKLIST: Make Sure all of the Following Information is Submitted:

Check
Off

Course Submitter:	Name of contact person and their certification numbers, organization, address, fax, phone	
	Organization sponsoring or requesting the program (if any)	
Course Title:	Name of course (related to content)	
Purpose/Objective:	Describe purpose and how course will improve competency of certification(s) listed	
Contact Hours:	Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	
Participants:	Check off each certification for which credit is requested (for which course relates to certification)	
Content of Program:	Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered	
Course Materials:	Collated workbooks, handouts, hard copy or electronic versions of program is available	
Instructor(s) Info.:	Resume of professional/educational qualifications & teaching/training experience/BBS certifications	
Test Materials:		
Completed Application:		

NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.

Agenda

NEC Analysis of Changes February 5th 2022

Topic: See outlines for more details on these topics.

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

7:30 am to 8:00 am	Registration	
8:00 am to 9:00 am	Non- Hospital Health Care	1.00 h
9:00 am to 9:30 am	Break	
9:30 am to 10:30 am	Non-Hospital Health Care	1.00 h
10:30 am to 10:45 am	Break	
10:45 am to 12:00 m	Fault Current	1.25 h
12:00 pm to 1:00 pm	Break for lunch	
1:00 pm to 1:45 pm	Fault Current	0.75 h
1:45 pm to 2:30 pm	Common Electrical Defects	0.75 h
2:30 pm to 2:45 pm	Break	
2:45 pm to 4:00 pm	Common Electrical Defects	1.25 h
4:00 pm	Certificates Distributed	
Total		6.00 h

Course Outline for Jointly Sponsored Seminar Series February 5, 2022

Non-Hospital Health Care Facilities

All health care facilities addressed by the code are routed towards hospitals, but the misunderstanding comes when it is not a hospital. Ambulatory services, outpatient services, medical offices, dental offices and the likes, nursing homes and assisted living facilities.

The code requirements for these facilities differ from those for hospitals. We will be discussing wiring methods and how it affects which facility you are operating under.

- Definitions Art. 100
- Requirements:
 - o Art. 517
 - General Part I
 - Wiring and Protection Part II

Fault Current Calculations and Misunderstanding Practices

Short circuit current rating is a requirement in all services. It states that no electrical service shall be rated less than what is capable of withstanding when it comes to fault. The importance of this subject is crucial to understanding the seriousness of a fault, not only it could affect the health of the personnel but also the loss of the infrastructure, including production time loss and lack of readily available materials.

- Definitions Art. 100
- Requirements:
 - o Art 110.9 / Interrupting Rating
 - o Art. 110.10 / Circuit Impedance, Short Circuit Current Rating
 - o Art. 110.24 / Available Fault Current
 - o Art. 230 / Services
 - o Art. 240.86 / Series Rating

Common Electrical Defects

Common electrical defects and violations are commonly found in the field. Common violations is where the consistency among inspectors and compliance among contractors would have an impact in all jurisdictions, the myth where one jurisdiction requires something while another requires exactly the opposite would tend to disappear, thus bringing the level of consistency of the NEC to uniformity. Common defects will help Inspectors, Building Officials and Contractors understand the violations that will occur during the inspection process and how to relate such violation to the respective Building Officials, according to **Section 113 in 2017 Ohio Building Code and Section 109 in 2019 RCO.**

- Various articles will be discussed throughout this topic as violations and defects changes from project to project.
- The presentation will focus on:
 - o Plan Review Deficiencies
 - o Field Deficiencies

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 ESI's 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 NFPA 70 as the standard to comply with electrical installations

INSTRUCTOR QUALIFICATIONS

Lorenzo M. Adam

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

Address: 27 Penbrooke Ct., Monroe, Ohio 45050

Gaylord K. Poe

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

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

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

Caty Robinson

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

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

Peter M. Baldauf

Peter has been in the electrical industry for over 15 years. He began his electrical career working through a trade school in Dayton, Ohio. After graduation, he enrolled in the Associated Builders and Contractors State certified electrical apprenticeship program. Peter attended the program for the full four years and upon completion of the program, he relocated to Tacoma, Washington. 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.

Address: 3600 Shroyer Road, Kettering, OH 45429

Daniel Dewayne Jenkins

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

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

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

Address: 3600 Shroyer Road, Kettering, OH 45429

Rick Lecher

Rick has been in the electrical industry for 31 years. He received his Certification # 1671 from the State of Ohio in 1998. Rick has been employed by Inspection Bureau, Inc. (IBI) for 5 years as an Electrical Safety Inspector. Rick is currently inspecting in IBI's C-2 and R-1 territories. Rick is also an Electrical Plan Examiner for IBI.

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

Jointly Sponsored Seminar Series 2022
Presented by GCEA and Southwest Division IAEI

Facility

The facility is conveniently located in Fairfield, about 1 mile west from I-75 off Route 4. Classes are held at the **Receptions 5975 Boymel Drive, Fairfield, Ohio**. The room occupancy is good for 300 students comfortably with tables and chairs. There are provisions for audio-visual equipment (screen, microphone and speakers). Restrooms are located nearby the room for females and males. Refreshments are served during the class; attendees have access to vending machines as well as water. Duration of the instruction is 6.00 hours. 8:00am – 4:00pm. on February 5th 2022.

Course Materials

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



“Who’s Fault is it?”

2017 NEC Requirements

Prepared by:
Dewayne Jenkins

Definitions

- **Circuit Breaker.**
- A device designed to open and close a circuit by nonautomatic means and to open the circuit automatically on a predetermined overcurrent without damage to itself when properly applied within its rating.



Definitions

- **Fuse.**
- An overcurrent protective device with a circuit-opening fusible part that is heated and severed by the passage of overcurrent through it.



Definitions

- **Interrupting Rating.**
- The highest current at rated voltage that a device is intended to interrupt under standard test conditions.

Definitions

- **Overcurrent.**
- Any current in excess of the rated current of equipment or the ampacity of a conductor. It may result from overload, short circuit, or ground fault.
- **FPN:** A current in excess of rating may be accommodated by certain equipment and conductors for a given set of conditions. Therefore, the rules for overcurrent protection are specific for particular situations.

Definitions

- **Overload.** Operation of equipment in excess of normal, full-load rating, or of a conductor in excess of rated ampacity that, when it persists for a sufficient length of time, would cause damage or dangerous overheating. **A fault, such as a short circuit or ground fault, is not an overload.**

Definitions

- **Qualified Person.** One who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training on the hazards involved.
- **FPN:** Refer to NFPA 70E, Standard for Electrical Safety in the Workplace, for electrical safety training requirements.

Unqualified person?



**One method of becoming familiar
with the hazards involved**



Gene Pool Thinned!!!



Qualified Person



Definitions

- Excerpt from NFPA 70-E – commentary following the definition of "Qualified Person"
- 110.6 Training Requirements.
- (A) Safety Training. The training requirements contained in this section shall apply to employees who face a risk of electrical hazard that is not reduced to a safe level by the electrical installation requirements of Chapter 4 [of NFPA 70E]. **Such employees shall be trained to understand the specific hazards associated with electrical energy.** They shall be trained in safety-related work practices and procedural requirements as necessary to provide protection from the electrical hazards associated with their respective job or task assignments. Employees shall be trained to identify and understand the relationship between electrical hazards and possible injury.

110.9 – Interrupting Rating

- Equipment intended to interrupt current at fault levels shall have an interrupting rating sufficient for the nominal circuit voltage and the current that is available at the line terminals of the equipment.
Equipment intended to interrupt current at other than fault levels shall have an interrupting rating at nominal circuit voltage sufficient for the current that must be interrupted.

110.10 Circuit Impedance and Other Characteristics.

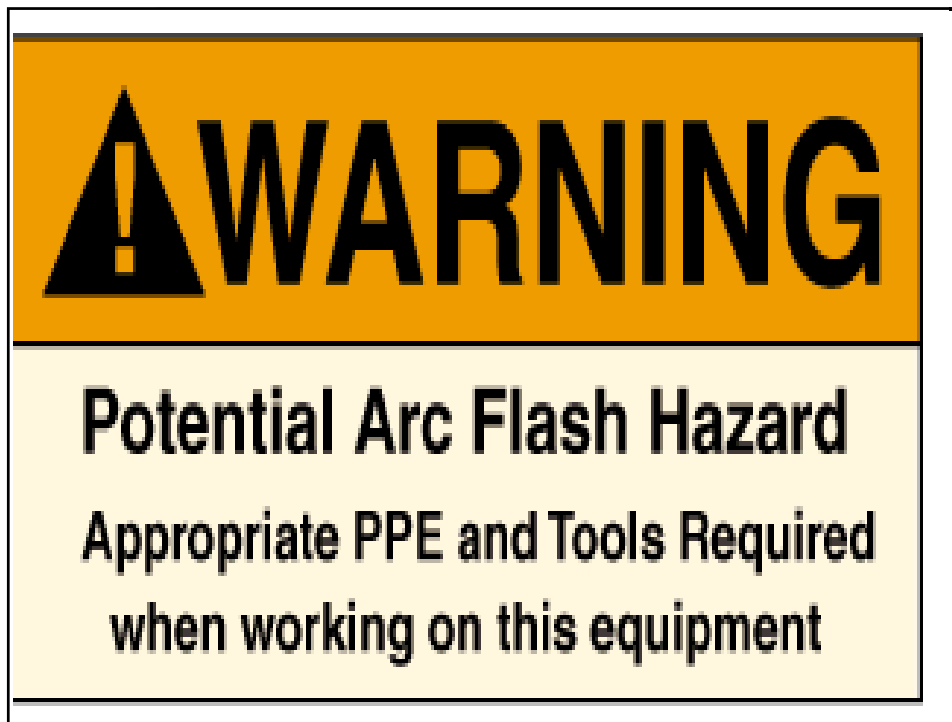
- **110.10 Circuit Impedance and Other Characteristics**
- The overcurrent protective devices, the total impedance, the component short-circuit current ratings, and other characteristics of the circuit to be protected shall be selected and coordinated to permit the circuit-protective devices used to clear a fault to do so without **extensive damage** to the electrical components of the circuit. This fault shall be assumed to be either between two or more of the circuit conductors or between any circuit conductor and the grounding conductor or enclosing metal raceway. Listed products applied in accordance with their listing shall be considered to meet the requirements of this section.
- *Evidence of Extensive Damage is determined under test conditions. Equipment applied in a circuit within the ratings of the equipment should not sustain extensive damage under fault conditions*

Short Circuit



110.16 Flash Protection

- **110.16 Flash Protection**
- Electrical equipment, **such as** switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers, that are in **other than dwelling occupancies**, and are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential electric arc flash hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.



110.22

- **110.22 Identification of Disconnecting Means**
- Each disconnecting means shall be legibly marked to indicate its purpose unless located and arranged so the purpose is evident. **The marking shall be of sufficient durability to withstand the environment involved.**
- Where circuit breakers or fuses are applied in compliance with the series combination ratings marked on the equipment by the manufacturer, the equipment enclosure(s) shall be legibly marked in the field to indicate the equipment has been applied with a series combination rating. The marking shall be readily visible and state the following:
 - CAUTION — SERIES COMBINATION SYSTEM
RATED _____ AMPERES. IDENTIFIED
REPLACEMENT COMPONENTS REQUIRED.

408.4 Circuit Directory or Circuit Identification.

- Every circuit and circuit modification shall be legibly identified as to its clear, evident, and specific purpose or use. The identification shall include sufficient detail to allow each circuit to be distinguished from all others. **Spare positions that contain unused overcurrent devices or switches shall be described accordingly.** The identification shall be included in a circuit directory that is located on the face or inside of the panel door in the case of a panelboard, and located at each switch on a switchboard. **No circuit shall be described in a manner that depends on transient conditions of occupancy.**

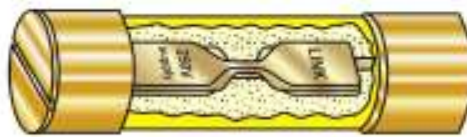
240.60 (C)

- **(C) Marking:**
 - Fuses shall be plainly marked, either by printing on the fuse barrel or by a label attached to the barrel showing the following:
 - (1) Ampere rating
 - (2) Voltage rating
 - (3) Interrupting rating where other than 10,000 amperes
 - (4) Current limiting where applicable
 - (5) The name or trademark of the manufacturer
 - The interrupting rating shall not be required to be marked on fuses used for supplementary protection.

240.60(D) Renewable Fuses

Class H fuses

Interrupting rating 10,000 amperes (maximum)



Class H cartridge fuses of the renewable type only permitted for use as replacements in existing installations where there is no evidence of overfusing or tampering



240.83 Marking

- **(C) Interrupting Rating**
- Every circuit breaker having an interrupting rating other than 5000 amperes shall have its interrupting rating shown on the circuit breaker. The interrupting rating shall not be required to be marked on circuit breakers used for supplementary protection.



240.83 Marking

- **(E) Voltage Marking**
- Circuit breakers shall be marked with a voltage rating not less than the nominal system voltage that is indicative of their capability to interrupt fault currents between phases or phase to ground.

240.85 Applications

- A circuit breaker with a straight voltage rating, such as 240V or 480V, shall be permitted to be applied in a circuit in which the nominal voltage between any two conductors does not exceed the circuit breaker's voltage rating. A two-pole circuit breaker shall not be used for protecting a 3-phase, corner-grounded delta circuit unless the circuit breaker is marked 1–3 to indicate such suitability.

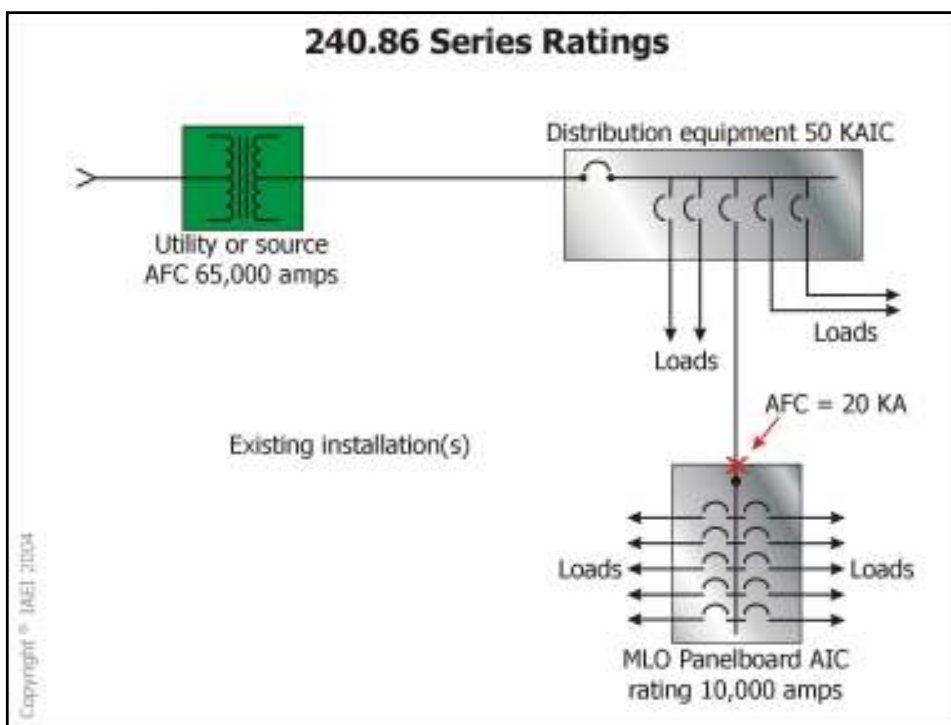
240.85 Applications

- A circuit breaker with a slash rating, such as 120/240V or 480Y/277V, shall be permitted to be applied in a solidly grounded circuit where the nominal voltage of any conductor to ground does not exceed the lower of the two values of the circuit breaker's voltage rating and the nominal voltage between any two conductors does not exceed the higher value of the circuit breaker's voltage rating.
- **FPN:** Proper application of molded case circuit breakers on 3-phase systems, other than solidly grounded wye, particularly on corner grounded delta systems, considers the circuit breakers' individual pole-interrupting capability.

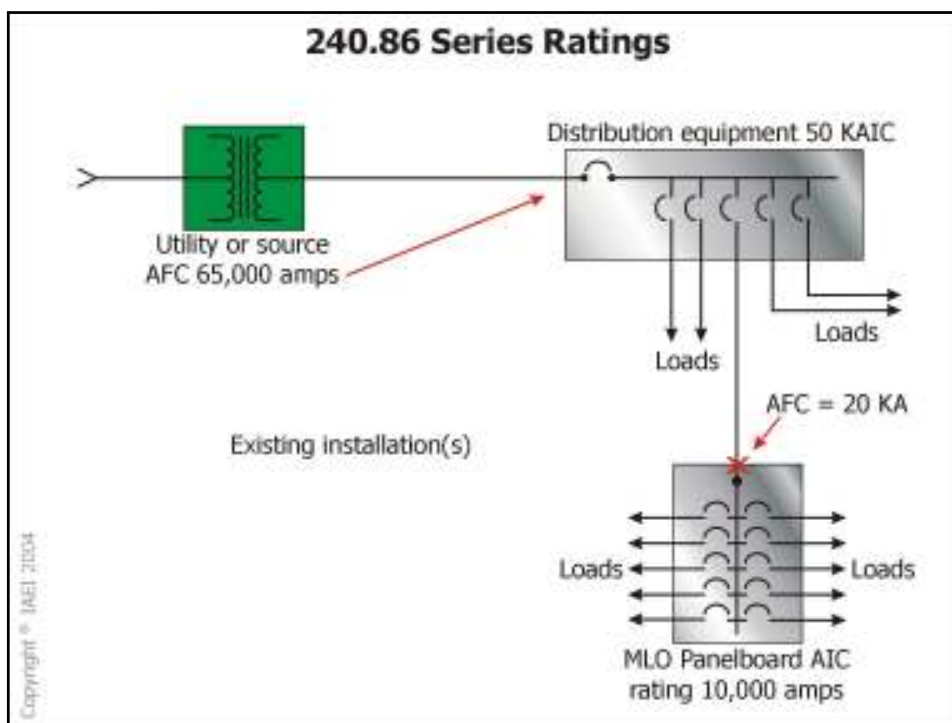
240.85 Applications

- A circuit breaker marked 480Y/277V is not intended for use on a 480-volt system with up to 480 volts to ground, such as a 480-volt circuit derived from a corner-grounded, delta-connected system. A circuit breaker marked either 480V or 600V should be used on such a system. In like manner, a circuit breaker marked 120/240V is not intended for use on a delta-connected 240-volt circuit. A 240-volt, 480-volt, or 600-volt circuit breaker should be used on such a circuit. The slash (/) between the lower and higher voltage ratings in the marking indicates that the circuit breaker has been tested for use on a circuit with the higher voltage between phases and with the lower voltage to ground.

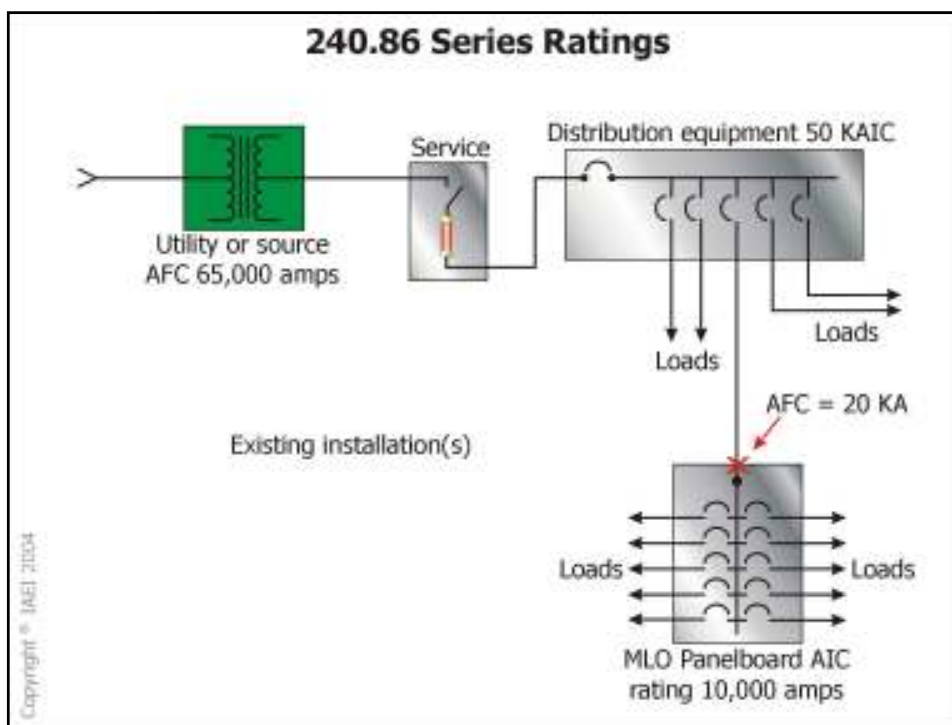
240.86 Series Ratings



240.86 Series Ratings



240.86 Series Ratings

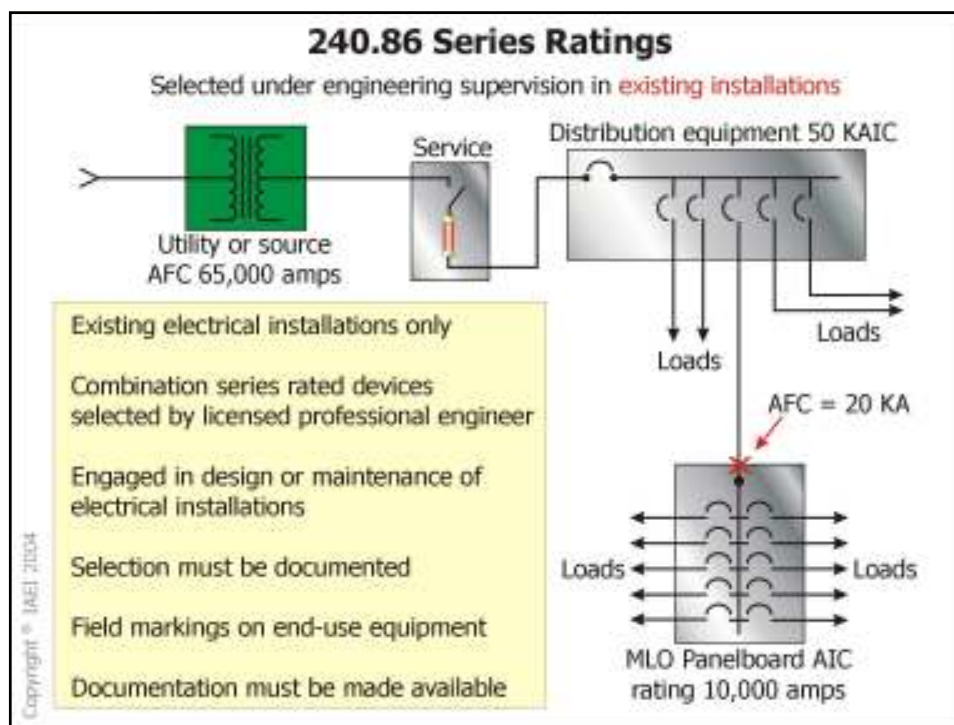
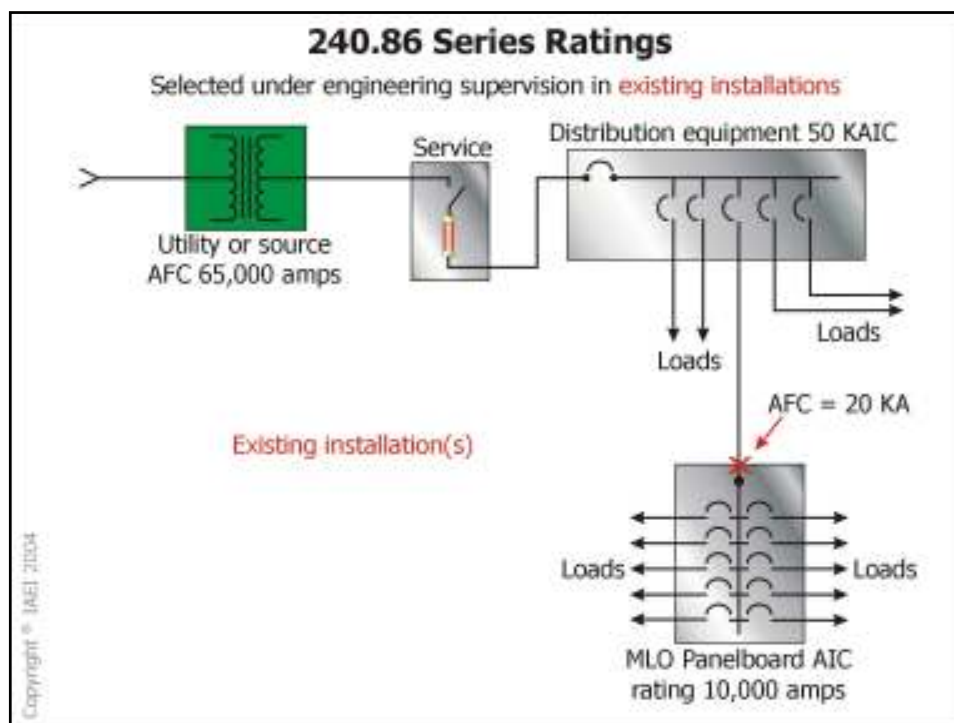


Current Limiting Fuses



Unlimited Current Fuses





240.86 Series Ratings

- A series rated system is a combination of circuit breakers or a combination of fuses and circuit breakers that can be applied at available short-circuit levels above the interrupting rating of the load-side circuit breakers but not above that of the main or line-side device. Series rated systems can consist of fuses that protect circuit breakers or of circuit breakers that protect circuit breakers. The arrangement of protective components in a series rated system can be as specified in 240.86(A) for engineered systems applied to existing installations or in 240.86(B) for tested combinations that can be applied in any new or existing installation.

240.86 Series Ratings

- (A) **Selected Under Engineering Supervision in Existing Installations:** The series rated combination devices shall be selected by a licensed professional engineer **engaged primarily in the design or maintenance of electrical installations**. The selection shall be documented and stamped by the professional engineer. This documentation shall be available to those authorized to design, install, inspect, maintain, and operate the system. This series combination rating, including identification of the upstream device, shall be field marked on the end use equipment.

240.86 Series Ratings

- Compatibility with series rated systems will in all likelihood be limited to circuit breakers that (1) remain closed during the first 1/2 cycle of a fault and (2) have an interrupting rating that is not less than the let-through current of an upstream protective device (such as a current-limiting fuse). In those cases where the opening of a circuit breaker, under any level of fault current, begins in less than 1/2 cycle, the use of a field engineered series rated system will in all likelihood be contrary to acceptable application practices specified by the circuit breaker manufacturer. Where there is any doubt over the proper application of existing downstream circuit breakers with new upstream overcurrent protective devices, the manufacturers of the existing circuit breakers and the new upstream overcurrent protective devices must be consulted.

Component Protection Utilizing Fuses

- The two parameters IRMS and IP must be compared to the equipment's withstand rating. The rule is simple: if the RMS and peak let-through value of the fuses are less than the equipment withstand rating, the equipment will be protected. This philosophy holds true for various static components, such as wire and cable, busway, and motor starters. This basic protection requirement is mandated by NEC section 110.10. It will also be true for non-current limiting circuit breakers when their opening time is greater than one-half cycle.



Component Protection Utilizing Fuses

- In the past, as long as the fuse let-through values were less than the breakers interrupting rating, the system was considered sound. THIS METHOD HAS A SOLID HISTORY OF SUCCESSFUL APPLICATIONS. **However, due to changes in circuit breaker design, the method may not always work with today's circuit breakers. Selecting a current-limiting fuse to protect a downstream molded case circuit breaker has now become an increasingly more complex problem (emphasis added).**



Component Protection Utilizing Fuses

- Simply put, if the total clearing energy of a quicker acting molded case circuit breaker (a breaker that exhibits dynamic impedance) is less than the melting energy of a larger upstream fuse, the molded case circuit breaker will interrupt the full value of the system fault without the benefit of the fuse's current-limiting effect. This situation can have CATASTROPHIC effects on the circuit breaker as it tries to interrupt faults beyond its interrupting capacity. **Currently, there is no available engineering method to predict protection of these faster breakers (emphasis added).**
- (Source: Cooper / Bussmann "SPD electrical protection handbook". Copyright 1999 by Cooper Bussmann)

AIC Rating of equipment

- In general, protective devices are required to have an interrupting rating equal to the available fault current (NEC 110.9). However, under most circumstances, the use of current limiting fuses to protect devices with inadequate interrupting ratings meets this requirement. This eliminates the need to install more expensive fully rated devices. The most common use is protecting molded case circuit breakers (MCB's).

AIC Rating of equipment

- There are three ways of selecting current-limiting fuses for this purpose:
 1. Using circuit breaker manufacturer's UL (or other NRTL) listed series ratings for their panelboard with fuses.



AIC Rating of equipment

2. Reference to Underwriters Laboratories, Inc. (UL) Recognized Component Directory (the “Yellow Book”), including any supplements. The Recognized Component Directory lists manufacturers that have obtained a UL listing of their circuit breakers when tested in series with current-limiting fuses. Unless the complete equipment assembly has obtained a UL listing and is labeled for series rating with a stated maximum available fault current, the component series ratings do not qualify such equipment for use on an available fault current higher than the interrupting rating of the lowest rated breaker.



AIC Rating of equipment

3. The “Engineered” method using peak let-through charts or software. For many years, an “engineered” method (known as the up-over-and-down method) of using current-limiting fuses has been used to successfully protect breakers with inadequate interrupting ratings. However, circa 1975, new designs of fast acting breakers began to appear. These breakers employ a “blow-apart” contact design that actually uses the repulsion energy of the fault current. The result was that current limiting fuses were not always able to protect these breakers from damage.

AIC Rating of equipment

- The interaction of the current-limiting fuse and these fast breakers cannot be mathematically modeled to analytically determine a predictable outcome. Thus the only safe course for the industry was to require documented testing of each combination of breaker and fuse prior to application.
- Today, when the downstream disconnect or overcurrent protection devices are molded case circuit breakers, you cannot arbitrarily use the current limiting effect of fuses to lower the RMS fault current value to a level below the breaker's AIC rating. **You must either use listed series combinations of fuse/breaker or use fully rated fuses or breakers.**

Selective Coordination

- Definition:
- **Coordination(Selective).**
Localization of an overcurrent condition to restrict outages to the circuit or equipment affected, accomplished by the choice of overcurrent protective devices and their ratings or settings.

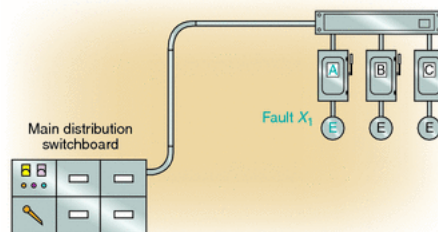
Selective Coordination

The NEC has mandatory selective coordination requirements for the following systems:

- Elevators – Article 620: 620.62
- Emergency Systems- Article 700: 700.27
- Legally Required Standby Systems- Article 701: 701.18
- Critical Operations Power Systems- Article 708: 708.54
- Healthcare - Article 517: 517.26 Required for Essential Electrical Systems

Selective Coordination

Below is an example of the requirement found in 620.62. The basic idea is to localize a fault condition to the affected machinery or apparatus so that the rest of the equipment connected to a feeder remains unaffected.



Selective Coordination

Selective coordination would be a necessity for egress lighting and other emergency systems where large groups of people gather and are faced with an emergency situation. 700.27 requires this type of protection.



Selective Coordination

517.26 requires compliance with article 700 for selective coordination for essential electrical systems within health care facilities.



Trouble

- The following pictures are examples of serious problems arising from poor planning and/or design







Construction Site



The End

•Thank you

Welcome from SW Division IAEI



The “Doctor” is in. Health Care Facilities Article 517

Presented by:

Pete Baldauf

Based on the 2017 NEC





517.1 Scope

- ▶ The provisions of this article shall apply to electrical construction and installation criteria in health care facilities that provide services to human beings.
- ▶ The requirements in Parts II and III not only apply to single-function buildings but are also intended to be individually applied to their respective forms of occupancy within a multifunction building (e.g., a doctor's examining room located within a limited care facility would be required to meet the provisions of 517.10).

517.1 Scope

- ▶ The requirements of Article 517 are intended to apply to all types of health care facilities. The requirements for each type of health care facility are nevertheless intended to be applied in a very specific manner. Application example: In a suite of doctors' offices within an office building, a doctor's business office would be treated as an ordinary occupancy and would be required to meet only the applicable portions of other parts of this Code. However, the examining rooms attached to the doctor's business office would be required to meet the provisions of Part II and 517.45 in Article 517.

Services to Human Beings



Not Veterinarian Clinics



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.



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517.2 Definitions: Health Care Facilities

- ▶ Definition of “Health Care Facility” was revised to include “**mobile enclosures**”
- ▶ 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 for 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]

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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 location.

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	General Care (Category 2) Space: - Inpatient bedrooms - Dialysis rooms - In vitro fertilization rooms - Procedural rooms - Similar rooms
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	Support (Category 4) Space: - Anesthesia work rooms - Sterile supply - Laboratories - Morgues - Waiting rooms - Utility rooms - Lounges

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Patient Care Vicinity

- ▶ A space, within a location intended for the examination and treatment of patients, extending 1.8 meters or six feet beyond the normal location of the patient bed, chair, table, treadmill, or other device that supports the patient during examination and treatment and extending vertically 2.3 meters or seven foot six inches above the floor.



2017 NEC Code Sections

- ▶ We will review just some of the important related code sections to Health Care Facilities.
- ▶ This presentation is not intended to provide a comprehensive understanding or analysis of Article 517.

210.8(B)(5), Ex. No. 2 to(5) GFCI – Sinks

- ▶ Receptacles located around sinks at a dentist's or doctor's office or clinic do require GFCI protection
 - **(B) Other Than Dwelling Units** – All single-phase receptacles rated 150 volts to ground or less, 50 amps or less and three-phase 100 amps or less installed in the locations specified in (1) through (10) shall have ground-fault circuit-interrupter protection for personnel
 - **(5) Sinks** — where receptacles are installed within 1.8 m (6 ft) from the top inside edge of the bowl of the sink
 - **Exception No 2 to (5):** For receptacles located in patient bed locations of general care or critical care areas of health care facilities other than those covered under 210.8(B)(1) (*Bathrooms*), GFCI protection shall not be required





Part II. Wiring and Protection

- ▶ 517.10 Applicability
- ▶ (A) Applicability. Part II shall apply to patient care space of all health care facilities.
- ▶ (B) Not Covered. Part II shall not apply to the following:
 - ▶ (1) Business offices, corridors, waiting rooms, and the like in clinics, medical or dental offices, and outpatient facilities.
 - ▶ (2) Areas of nursing homes and limited care facilities wired in accordance with Chapters 1 through 4 of this Code where these areas are used exclusively as patient sleeping rooms.

406.12 Tamper-Resistant Receptacles

- ▶ All 15- and 20- ampere, 125- and 250- volt receptacles in the areas specified in 406.12(1) through (7) shall be listed tamper-resistant receptacles.
- ▶ (5) Business offices, corridors, waiting rooms and the like in clinics, medical and dental offices and outpatient facilities.

Purpose

- ▶ 517.11 General Installation – Construction Criteria.
- ▶ The purpose of this article is to specify the installation criteria and wiring methods that minimize electrical hazards by the maintenance of adequately low potential differences only between exposed conductive surfaces that are likely to become energized and could become in contact by a patient.

517.13 Grounding of Receptacles and Fixed Electrical Equipment in Patient Care Spaces

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

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

- ▶ General: The following to be directly connected to the insulated copper equipment grounding conductor that is clearly identified its entire length by green insulation and installed with the branch circuit conductors in the wiring methods specified in 517.13(A).
 - ▶ (1) The grounding terminals of all receptacles other than isolated ground receptacles.
 - ▶ (2) Metal outlet boxes, metal device boxes, or metal enclosures.
 - ▶ (3) All non-current-carrying conductive surfaces of fixed electrical equipment likely to become energized that are subject to personal contact, operating at over 100 volts.

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

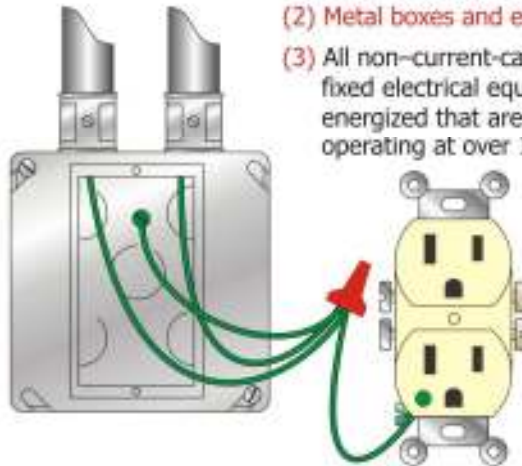
- ▶ Exceptions to 517.13(B) (1) General.
 - ▶ (1) For other than isolated ground receptacles, an insulated equipment bonding jumper that directly connects to the equipment grounding conductor is permitted to connect the box and the receptacle(s) to the equipment grounding conductor. Isolated ground receptacles shall be connected in accordance with 517.16
 - ▶ (2) Metal faceplates are permitted to be connected by the means of the securing screws to a grounded receptacle.
 - ▶ (3) Luminaires more than 7-1/2 feet above the floor and switches located outside of the patient vicinity shall be permitted to be connected to an equipment ground path complying with 517.13(A) or (B).
- ▶ (2) Sizing. Use table 250.122 to size equipment grounding and bonding jumpers.

517.13(B) Grounding of Receptacles (Patient Care Areas of Health Care Facilities)



The following shall be **directly** connected to an insulated copper EGC that is installed with the branch-circuit conductors in the wiring methods as provided in 517.13(A)

- (1) The grounding terminals of all receptacles
- (2) Metal boxes and enclosures containing receptacles
- (3) All non-current-carrying conductive surfaces of fixed electrical equipment likely to become energized that are subject to personal contact, operating at over 100 volts



- 517.13(B) rearranged for clarity and usability
- Metal box required to be directly connected to the insulated copper EGC required for grounding at patient care areas

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Panelboard Bonding 517.14

- ▶ The equipment grounding terminal buses of the normal and essential branch-circuit panelboards serving the same individual patient vicinity shall be bonded together with an insulated continuous copper conductor not smaller than 10 AWG.
- ▶ Where two or more panelboards serve the same patient vicinity or by separate transfer switches), they shall be bonded together.
- ▶ This 10 AWG insulated copper conductor shall be continuous from panel to panel but shall be permitted to be broken in order to terminate on the ground bus in each panel.

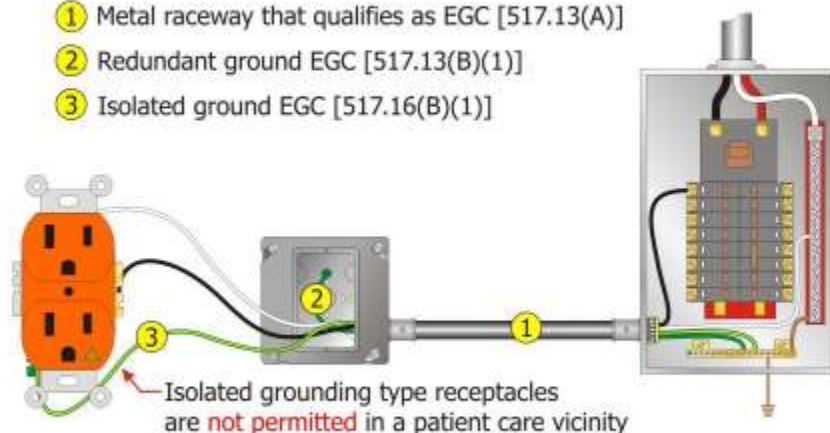
517.16 Use of Isolated Ground Receptacles

- ▶ 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)] with a color designation of **green with one of more yellow stripes**.*

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)]



The prohibition 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)**



517.18(A) Patient Bed Location (General Care Areas)

- All receptacles or the cover plate supplied from the **critical branch** required to have a **distinctive color or marking** so as to be readily identifiable.
- Marking is also to indicate the panelboard and branch circuit number supplying them.
- This change is a continuation to align Article 517 with NFPA 99 (*Health Care Facilities Code*).
- The term “emergency system” was removed from Article 517 to once again be consistent with NFPA 99.
- Removes confusion with these circuits in health care facilities with those circuits described in Article 700 for “Emergency Systems.”

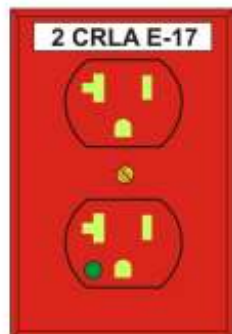
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517.18(A) Patient Bed Location (General Care)

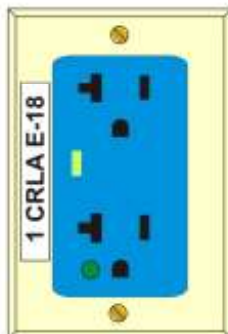


Cover plates for the receptacles or the electrical receptacles themselves are required to have a **distinctive color or marking** so as to be readily identifiable as being supplied from the **critical branch**

Covers or receptacles must also indicate the panelboard and branch circuit number supplying them



Receptacle and cover plate



Receptacle only



Cover plate only

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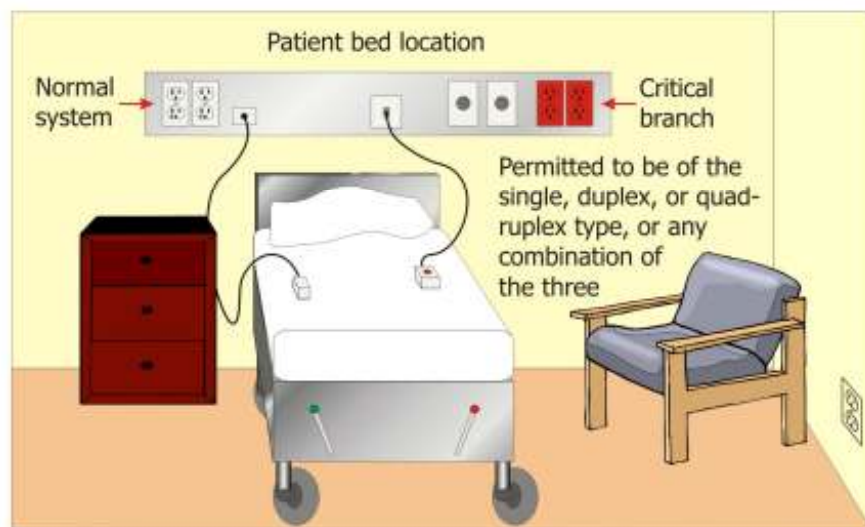
517.18(B) Patient Bed Location Receptacles (General Care Areas)

- The minimum number of receptacles required for general care area patient bed locations of health care facilities was **increased from four to eight receptacles**.
- Aligns the NEC with NFPA 99 (*Health Care Facilities Code*).
- NFPA 99 Section 6.3.2.2.6.2 requires each patient bed location in general care areas, where considered a Category 2 application, to be provided with a minimum of **eight receptacles**.
- Category 2 is facility systems in which failure of such equipment is likely to cause minor injury to patients or caregivers.

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517.18(B) Patient Bed Location Receptacles

The minimum number of receptacles required for general care area patient bed locations of health care facilities was **increased from four to eight receptacles**



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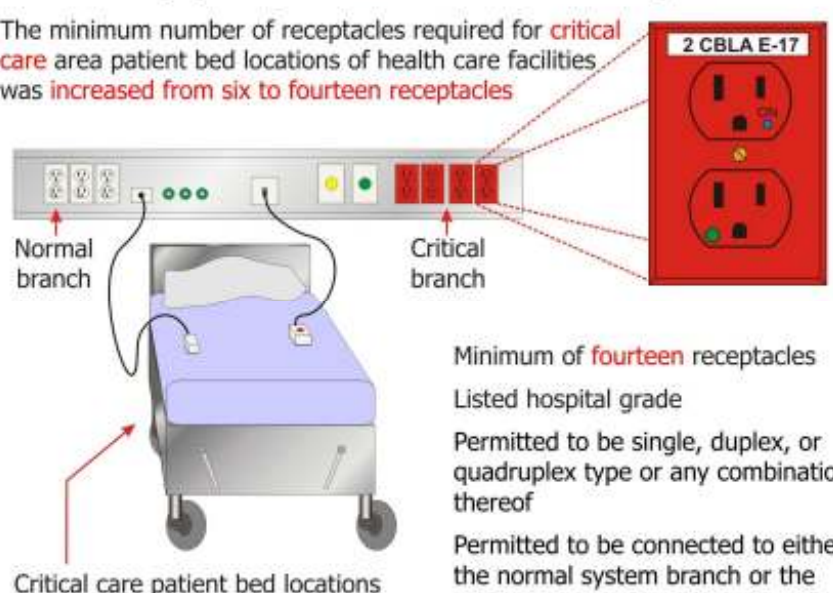
517.19(B) Patient Bed Location Receptacles (Critical Care Areas)

- The minimum number of receptacles required for **critical care** area patient bed locations of health care facilities was **increased from six to fourteen receptacles**.
- The systems required to supply at least one of these receptacles was changed from the emergency system to the **critical branch** as the term “emergency system” has been removed for Article 517.
- NFPA 99 Section 6.3.2.2.6.2 requires each patient bed location in critical care areas, where considered a Category 1 application, to be provided with a minimum of fourteen receptacles.
- Category 1 covers facility systems in which failure of such equipment or system is likely to cause major injury or death of patients or caregivers.

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517.19(B) Patient Bed Location Receptacles

The minimum number of receptacles required for **critical care** area patient bed locations of health care facilities was **increased from six to fourteen receptacles**



Normal branch

Critical branch

2 CBLA E-17

Minimum of **fourteen** receptacles

Listed hospital grade

Permitted to be single, duplex, or quadruplex type or any combination thereof

Permitted to be connected to either the normal system branch or the **critical branch**

Critical care patient bed locations

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517.19(C) Operating Room Receptacles

- New 517.19(C) was added requiring a minimum number of **thirty-six receptacles** in an operating room of health care facilities.
- At least **twelve of the thirty-six receptacles** required to be connected to either the normal system branch or the critical branch circuit supplied by a different transfer switch than the other receptacles at the same location.
- These receptacles are permitted to be of the single or duplex types or a combination of both.
- All receptacles shall be listed hospital grade and so identified.
- NFPA 99 Section 6.3.2.2.6.2 requires each operating room to be provided with a minimum of thirty-six receptacles.

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517.19(C) Operating Room Receptacles

New 517.19(C) was added requiring a minimum number of **thirty-six receptacles** in an operating room of a health care facilities



At least **twelve of the thirty-six receptacles** required to be connected to either the normal system branch or the critical branch circuit supplied by a different transfer switch than the other receptacles at the same location

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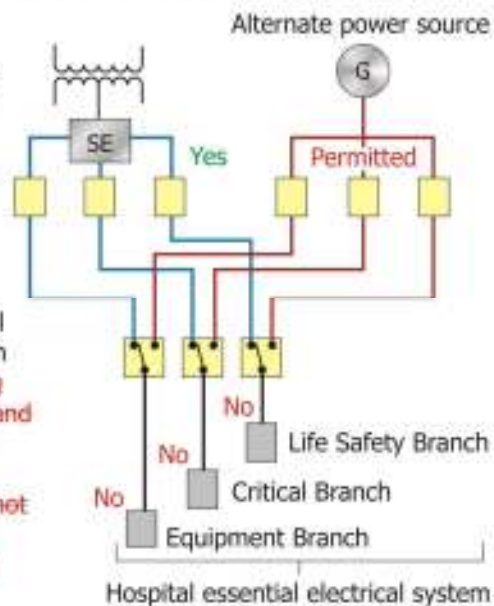


517.17(B) Feeder GFP (Health Care Facilities)

Where ground-fault protection is provided as specified by 230.95 or 215.10, an additional step of GFP is required in all next level feeder disconnecting means downstream toward the load

Additional levels of GFP shall not be installed as follows:

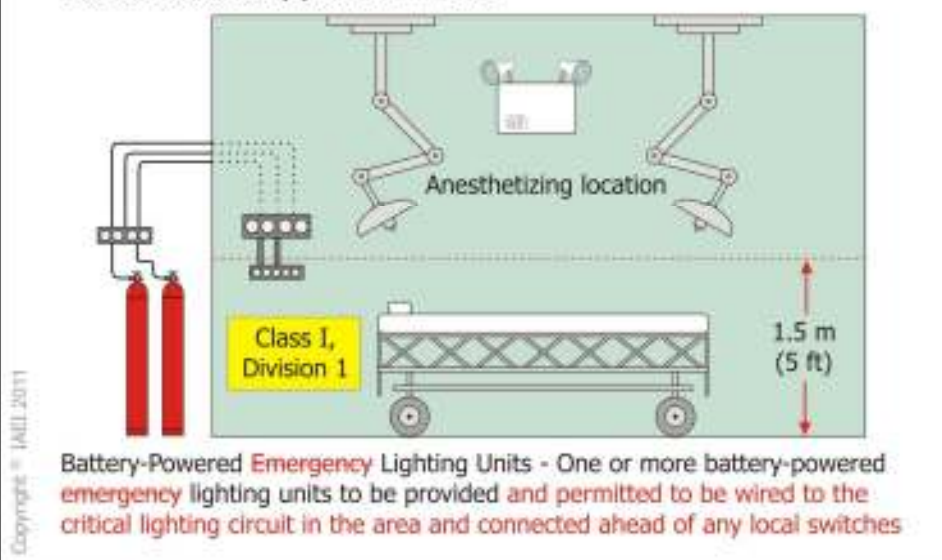
- (1) On the load side of an essential electrical system transfer switch
- (2) Between the on-site generating unit(s) described in 517.35(B) and the essential electrical system transfer switch(es)
- (3) On electrical systems that are not solidly grounded wye systems (greater than 150 volts to 600 volts phase-to-phase)





517.63(A) Battery-Powered Lighting Units

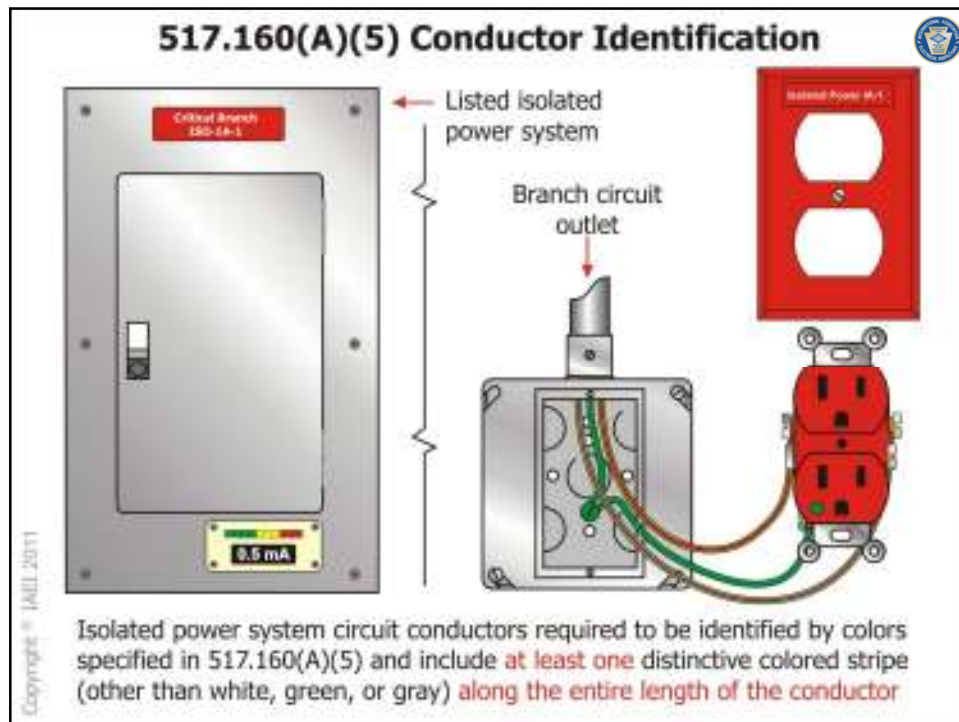
Battery-powered lighting units in anesthetizing locations are permitted to be connected to the critical lighting circuits and the word "emergency" and the reference to 700.12(F) were eliminated





Battery-Powered Lighting Units

- ▶ Individual unit equipment for backup illumination consisting of the following
 1. Rechargeable battery
 2. Battery-charging means
 3. Provisions for one or more lamps mounted on the equipment, or with terminals for remote lamps, or both
 4. Relaying device arranged to energize the lamps automatically upon failure of the supply to the unit equipment.



Questions and Answers

■ Let's review

Question #1

- ❑ Do I have to install “health care type MC/AC Cable” when I’m wiring exam rooms in a doctor’s office?

Answer #1

- NO necessarily, complete metal raceway systems such as EMT conduit & wire is the preferred method. Listed metallic cable assemblies & fittings are permitted methods.
- Listed MC or AC Type that qualify with 250.118
- Remember the exceptions 517.13(B)

Question # 2

- Is it necessary for all receptacles in a health care facility to have “redundant grounding” required by 517.13?

Answer #2

- 517.13 not only requires patient care space receptacles to be redundantly grounded, but all branch circuits serving patient care spaces.
- Note: exceptions 517.13 (B) 1 & 2
- The focus is patient care spaces and not other areas such as offices & corridors.

Question #3

- Where can I find the definition of redundant grounding in the NEC?

Answer #3

- You are not going to find the definition of redundant grounding in the NEC.
- This is a two part safe wiring scheme to minimize electrical hazards for patients who receive care in these facility spaces.

Question #4

- Do switches for general lighting need to have “redundant grounding” if they are in a patient care space?

Answer #4

- Yes, refer to 517.13(A) & (B) – All branch circuits serving patient care spaces, including switches require redundant grounding. Terms are key here!
- See 517.13(B) exception No. 3 – May apply here.
- Switches located outside the patient vicinity (six feet) may choose 517.13 (A) or (B) as a compliant option.

Question #5

- Would lighting fixtures (luminaries) in a patient care area require “redundant grounding”?

Answer #5

- Yes, again refer to 517.13(A), All branch circuits serving patient care spaces.
- Again, terms are key here.
- See 517.13(B) exception No. 3 – May apply here.
- Luminaires located outside the patient vicinity (7'6" above the floor) may choose 517.13 (A) or (B) as a compliant option.

Question #6

- Would the NEC permit ½" flex to be ran between device boxes for receptacles in a patient care area?

Answer #6

- Yes, refer to 250.118 - Normally general care spaces
- Maximum length is 6 feet in the same ground fault current path.
- Does not exceed 1-1/4" in trade size
- Must have fittings listed for grounding
- For circuits 20 amps or less
- Not installed for flexibility

Question #7

- Would it be permitted to run PVC in a slab to feed receptacles in a patient care space?

Answer #7

- Absolutely Not, again see 517.13(A) – Metal Raceways!
- Code change in 2005 allowed the use of PVC conduit in the slab for panel feeders and branch circuits not serving the patient care spaces. See 517.30(C)(3)(2)
- Definitely not branch circuits serving patient care spaces.

Question #8

- Are the requirements of Article 517 applicable to Veterinarian clinics?

Answer #8

- No, 517 does not apply to Vet clinics, only facilities for human beings.
- See 517.1 Scope

Question #9

- Who is responsible for the determination of the level of proposed patient care spaces within a facility?

Answer #9

- See definitions. 517.2 – Governing Body
- The person or persons who have the overall legal responsibility for the operation of a health care facility.

Question #10

- Do the quantity requirements for receptacles at patient bed locations (517.18 & 517.19) apply at general care space exam rooms?

Answer #10

- No, See 517.18(A) Exception No. 2
- Does not apply to patient bed locations in clinics, medical & dental offices and outpatient facilities meeting the requirements 517.10(B)(2).
- 517.19 applies to critical care areas

Question #11

- Do the requirements for receptacles at patient bed locations (517.19) apply to procedure rooms?

Answer #11

- Maybe, it would ultimately depend on the type of procedure being completed and whether or not the failure of the equipment or a system is likely to cause major injury or death of patients, staff, or visitors.
- Simple procedure rooms fall under the definition of general care spaces in definitions and would potentially only cause minor injury.

Question #12

- Are receptacles located in an exam room of a patient care space required to be of the “hospital grade” type?

Hospital Grade Receptacles?



Answer #12

- No, again see 517.18(A) exception No. 2
- Does not apply to clinic, medical & dental offices and outpatient facilities.

Question #13

- How do I comply with the redundant grounding requirements when I'm installing isolated ground receptacles in a patient care areas?

Answer #13

- They can only be installed “outside the patient vicinity”. Not permitted otherwise.
- They must meet all requirements 517.13 (A) & (B) when installed in patient care spaces and provide an insulated equipment grounding conductor with green insulation with one or more yellow stripes for the entire length per 517.16

Question #14

- Do all receptacles located in pediatric exam rooms have to be tamper proof?
- What about other areas within the facility?

Answer #14

- Yes, but not tamper proof type. Tamper resistant receptacles or tamper resistant covers shall be provided for in patient care areas.
- It not only applies to exam rooms, but rooms, bathrooms, playrooms and activity rooms. See 517.18(C)
- Other areas within clinics, medical and dental offices and outpatient facilities have to meet the requirements of 406.12

Question #15

- Can nonmetallic sheathed cable (romex) be used in areas other than patient care areas within a facility?

Answer #15

- Yes, first refer to 517.12 which allows the wiring methods in chapter 3.
- Caution should be taken when choosing the NM Cable method (romex).
- Refer to 334.10(3) – Must be “concealed” within a 15-minute thermal barrier.
- 334.12 (2) is not permitted above dropped ceilings.

Thank You!



COMMON DEFECTS PART X

RICK LECHER – CATY ROBINSON – LORENZO ADAM

1

SECTION 104 OBC 2017

104.2.1.3 Inspections. *If the plans for the erection, construction, repair, alteration, relocating, or equipment of a building are subject to inspection by the building official, under section 108, the building official shall cause to be made such inspections, investigations, and determinations as are necessary to determine whether or not the work which has been performed and the installations which have been made are in conformity with the approved construction documents.*

2

SECTION 108 OBC 2017

108.1 General. *After construction documents have been approved, construction or work may proceed in accordance with the approved documents. Construction or work for which an approval is required shall be subject to inspection. It shall be the duty of the owner or the owner's duly authorized representative to notify the building department when work is ready for inspection. Access to and means for inspection of such work shall be provided for any inspections that are required by this code.*

3

SECTION 104 OBC 2017

104.2.3.3 Electrical safety inspector. *An electrical safety inspector is responsible to determine electrical systems compliance with approved construction documents in accordance with section 108.*

4

SECTION 108 OBC 2017

108.6 Inspections, observation of violations, unsafe conditions, or serious hazards. When an inspector from the department having jurisdiction finds that any work in connection with the location, erection, construction, repair, alteration, moving, or equipment of a building is contrary to the approved construction documents for the same, the building inspector shall proceed as required in either section 108.6.1 or 108.7.

5

SECTION 108 OBC 2017

108.6.1 Communication process for work contrary to approved construction documents.

1. Communicate the nature of the differences to the owner or the owner's on-site representative and offer the following options:

- 1.1** The owner will bring the item of noncompliance into compliance,
- 1.2** The owner will revise the drawings and resubmit to the department,
- 1.3** The items of noncompliance will not be brought into compliance and will be referred to the building official as indicated in item 4 below.

6

SECTION 108 OBC 2017

2. The owner or the owner's on-site representative shall indicate which option (item 1 above) will be exercised

3. Notations on the on-site inspection record and in the inspector's log shall be made. The notations shall include the inspector's name, the date of the inspection, the type of inspection, the observed items of noncompliance, the option chosen by the owner or the owner's on-site representative, the name of the person communicated with, and the estimated dates of compliance and follow-up inspections, if applicable.

7

SECTION 108 OBC 2017

4. If the owner or the owner's on-site representative indicates that the work will not be brought into compliance with the approved construction documents, the inspector shall submit a report to the building official for the final determination of noncompliance in accordance with section 108.7.

8

SECTION 108 OBC 2017

108.6.2 Observation of violations not shown on plans. *If an inspector, in the course of performing the assigned or requested inspections, observes a code violation that was either shown incorrectly or not adequately addressed or detailed in the approved construction documents, the inspector shall communicate the finding to the building official so that the building official can make a determination of whether the code violation is of such significance to warrant communicating the finding to the owner or the owner's representative as a recommended change.*

9

APPROVED
THE CITY OF MASON BLDG. DEPT.
513.229.8520

ADDRESS _____
DATE _____ INSPECTOR _____

FOOTING _____ SLAB _____
FRAMING _____ ELECTRIC _____
INSULATION _____ DRIVE APPROACH _____
SIDEWALK _____ MASONRY _____
FIRE PROTECTION _____ FINAL _____

Approval Date _____ Inspector _____

NOT APPROVED
MASON BUILDING DEPARTMENT
229-8520

THE FOLLOWING ITEMS DO
NOT MEET THE BUILDING CODE

DO NOT REMOVE THIS NOTICE
FROM THE JOB SITE

Inspector _____

10

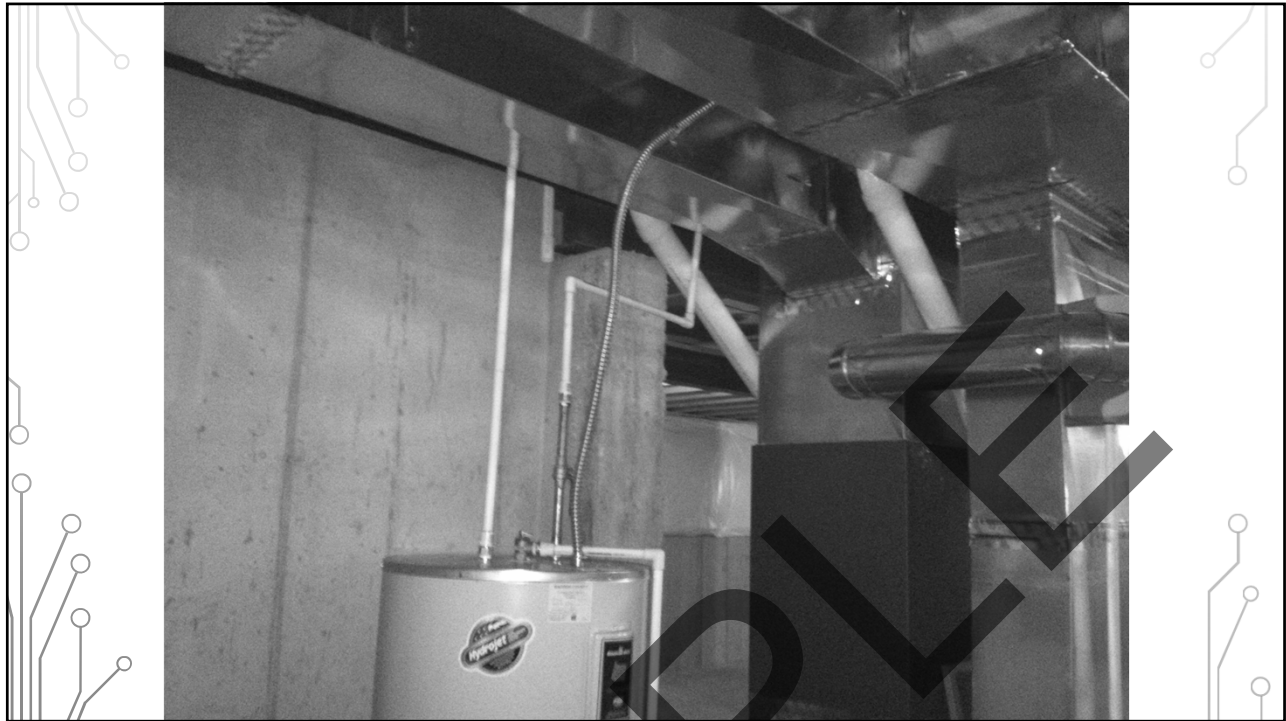
SECTION 108 OBC 2017

108.7 Building official determination of noncompliance. *The building official shall evaluate the inspector's report and render a final determination as to whether the items of non-compliance are to be communicated to the owner in the form of an adjudication order complying with section 109. The building official shall also determine whether any approvals are possible.*

11



12



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