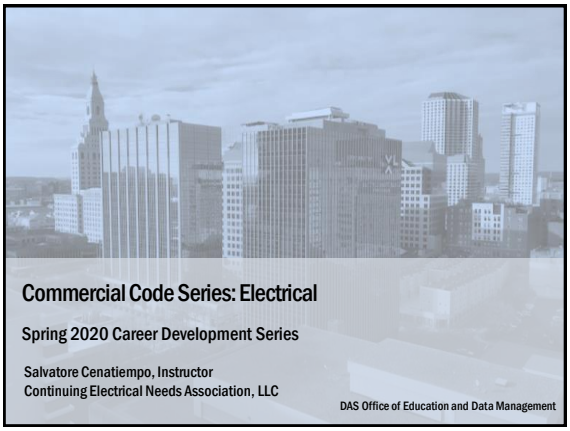
2020 Connecticut State Building and Fire Codes

Find the most current schedule at https://portal.ct.gov/DASCodeChange

Completed: 2020 Amendments Drafted and Code Change Proposals Received

- 11/13/19 Committees/Work Groups Review
- 12/11/19 Final Drafts Developed
- 1/8/20 Drafts Reviewed
- 2/16/20 Codes and Standards Drafts Approval
- 2/29/20 Public Comment Period
- 5/31/20 Legislative Review/Approval
- 10/1/20 Code Takes Effect



Commercial Code Series: Electrical

Spring 2020 Career Development Series

Salvatore Cenatiempo, Instructor
Continuing Electrical Needs Association, LLC

DAS Office of Education and Data Management

Course Objectives: Plan Review

At the conclusion of this plan review section, participants should be able to:

- Determine the level and detail of electrical plans, schematics, calculations and submittals needed to evaluate and approve the electrical portion of the building permit application.
- Evaluate for compliance the submitted materials including minimum service load and dwelling unit loads calculations, electrical systems, equipment and components for commercial building including the use of the NEC, code sections, tables and diagrams.
- Determine the listing and labeling of electrical materials, components, devices, fixtures and equipment, along with approved agency (ies).
- Develop a step by step electrical inspection checklist for the proposed dwelling and commercial units.
- Evaluate generator systems design schematics for building integration, circuit sizing and current, connections and disconnects, converters, ground fault and overcurrent protection, voltage and mounting requirements.
- Develop a step by step electrical inspection checklist for the proposed generator.

3

Course Objectives: Inspections

At the conclusion of this inspection section, participants should be able to:

- Prepare and execute an electrical inspection checklist for commercial mixed use building from service entrance to outlet including Inspect and evaluate bonding and grounding components for compliance.
- Determine compliance of mounting systems used for electrical equipment and components, notching and boring of structural members and derating of wiring bundles.
- Inspect and evaluate secondary power supplies from generator for interconnections to primary building electrical supply including controllers, transfer switching and disconnects.

4

NFPA 70
2017

IBC
2015

IECC
2015

ICC A117-1
2009

CT Amendments
2018

COMMERCIAL ELECTRICAL INSPECTION CHECKLISTS

The following checklist provides assistance in determining an Electrical code review and inspection checklist for low rise commercial buildings with mixed use occupancies. Use groups R-2, A, B located in 1 single structure based on the approval of the 2018 CT state building code. References are based on the NEC 2017, IBC 2015, IECC 2015 and the A117.1 2009 and the 2018 CT supplement publications. Please use your personal code publications when using our checklist. * *Note: These items included in the checklist are non-inclusive and are to serve as a guide or basis for inspection.*

Thank you CENA LLC.

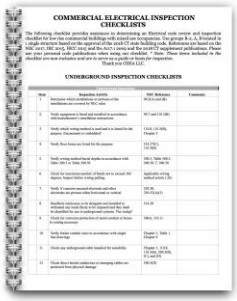
Checklist plan review

Objective

Ascertain plans for any code violations

time4cena.com

Electrical Checklist



COMMERCIAL ELECTRICAL INSPECTION CHECKLISTS

UNDERGROUND INSPECTION CHECKLISTS

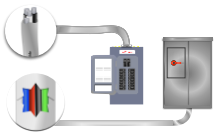
Checklists

- ✓ Plan Review for approval
- ✓ Onsite inspection checklist
- ✓ Services
- ✓ Sources
- ✓ Feeders
- ✓ Branch Circuits
- ✓ Listings

4 Parts

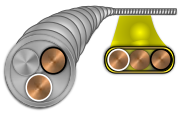
Services

Feeders

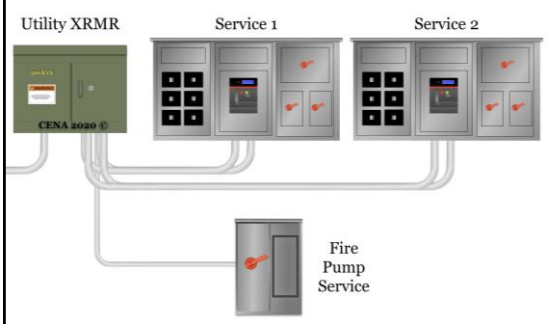


Sources

Branch Circuits



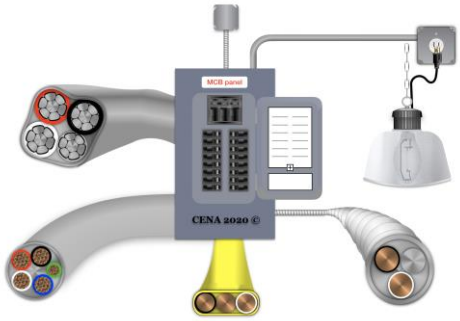
Services



Sources

Feeders

Branch Circuits



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WIC
Living
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Bedroom
9'2 x 7'4
Mech
WIC
Bath
Bedroom
14' x 10'6
W
D
Kitchen/Living
14'10 x 14'4
Mech


W
D
Bath
Kitchen/Living
18'1 x 15'8
Bedroom
12'7 x 10'
Balcony
15' x 6'
Mech


Kitchen
W
D
Bath
Bedroom
11' x 10'
Living
20'7 x 16'3
Bath
Bedroom
11'11 x 11'7
Mech
Mech


Kitchen
9'8 x 10'8
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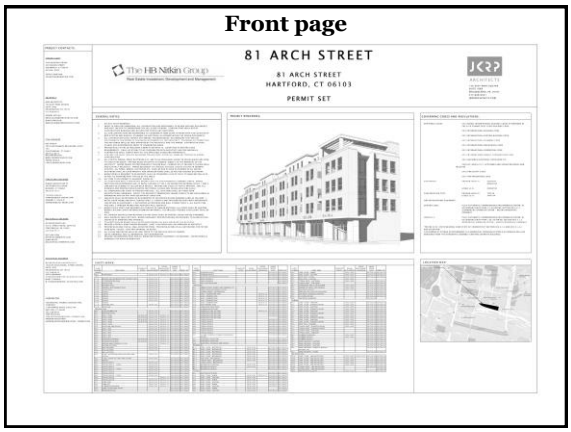
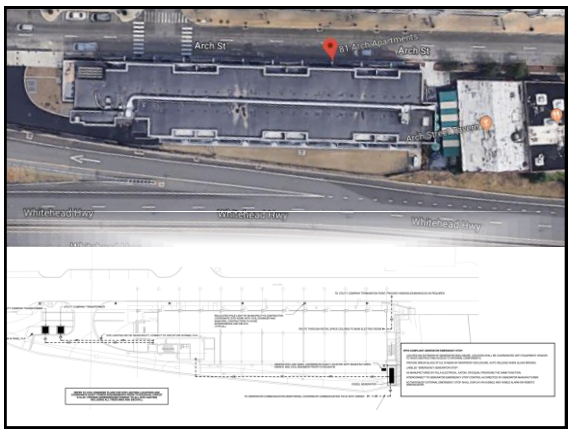
Bedroom
12'8 x 14'6
Mech

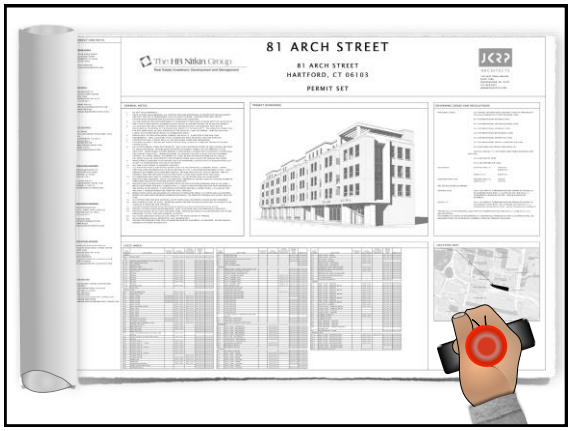
Front page


81 ARCH STREET
81 ARCH STREET
HARTFORD, CT 06103
PERMIT SET


Arch St
81 Arch Apartments
Arch St
Arch Street Tavern
Whitehead Hwy
Whitehead Hwy
Whitehead Hwy

UNDERGROUND INSPECTION CHECKLISTS

Underground Inspections			
Item	Inspection Activity	NEC Reference	Comments
1.	Determine which installations or portions of the installations are covered by NEC rules	90.2(A) and (B)	
2.	Verify equipment is listed and installed in accordance with manufacturer's installation instructions	90.7 and 110.3(B)	
3.	Verify which wiring method is used and it is listed for the purpose. Encasement or embedded!	110.8, 110.3(B), Chapter 3	
4.	Verify floor boxes are listed for the purpose	314.27(C), 110.3(B)	
5.	Verify wiring method burial depths in accordance with Table 300.5 or Table 300.50	300.5, Table 300.5, 300.50, T. 300.50	
6.	Check for maximum number of bends not to exceed 360 degrees. Inspect before wiring pulling.	Applicable wiring method article (.26)	
7.	Verify if concrete-encased electrode and other electrodes are present either horizontal or vertical	250.50, 250.52(A)(3)	
8.	Handhole enclosures to be designed and installed to withstand any loads likely to be imposed and they shall be identified for use in underground systems. Tier rating?	314.30	



Site Plan & Table 300.5

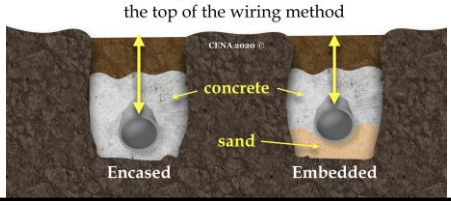
See notes located at the bottom

Table 300.5 Minimum Cover Requirements, 0 to 1000 Volts, Nominal, Burial in Millimeters (Inches)

Location of Wiring Method or Circuit	Type of Wiring Method or Circuit									
	Column 1 Direct Burial Cables or Conductors		Column 2 Rigid Metal Conduit or Intermediate Metal Conduit		Column 3 Nonmetallic Raceways Listed for Direct Burial Without Concrete Encasement or Other Approved Raceways		Column 4 Residential Branch Circuits Rated 120 Volts or Less with GFCI Protection and Maximum Overcurrent Protection of 20 Amperes		Column 5 Circuits for Control of Irrigation and Landscape Lighting Limited to Not More Than 30 Volts and Installed with Type UF or in Other Identified Cable or Raceway	
	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.
All locations not specified below	600	24	150	6	450	18	300	12	150[a][b]	6[a][b]
In trench below 50 mm (2 in.) thick concrete or equivalent	450	18	150	6	300	12	150	6	150	6
Under a building	0 (in raceway or Type MC or Type MI cable identified for direct burial)	0	0	0	0	0	0 (in raceway or Type MC or Type MI cable identified for direct burial)	0	0 (in raceway or Type MC or Type MI cable identified for direct burial)	0
Under minimum of 102 mm (4 in.) thick concrete exterior slab with no vehicular traffic and the slab extending not less than 152 mm (6 in.) beyond the underground installation	450	18	100	4	100	4	150 (direct burial) 100 (in raceway)	6 4	150 (direct burial) 100 (in raceway)	6 4
Under streets, highways, roads, alleys, driveways, and parking lots	600	24	600	24	600	24	600	24	600	24
One- and two-family dwelling driveways and outdoor parking areas, and used only for dwelling-related purposes	450	18	450	18	450	18	300	12	450	18
In or under airport runways, including adjacent areas where trespassing prohibited	450	18	450	18	450	18	450	18	450	18

Article 100 Definitions
Words stated specifically more than once are usually located in Article 100.

Burial depths are measured from the top of the wiring method

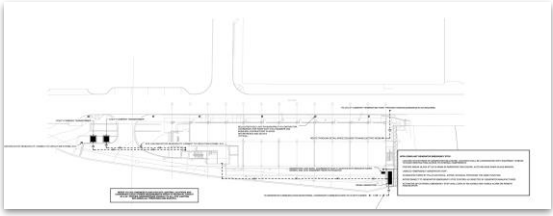


Article 100 Definitions
Words stated specifically more than once are usually located in Article 100.

Electrical terms used

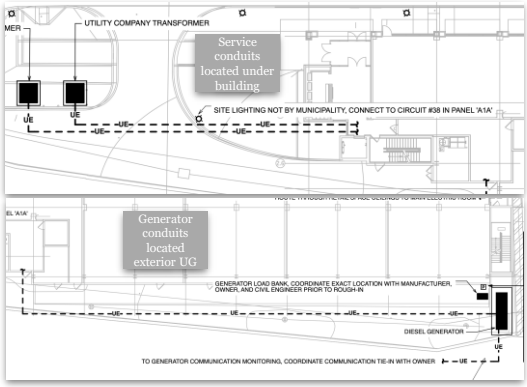
Encased **Embedded**

Site Plan Electrical

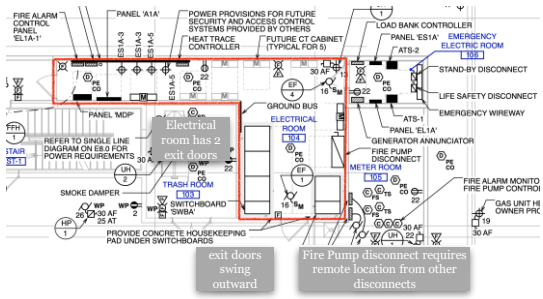


Verify all notes and materials

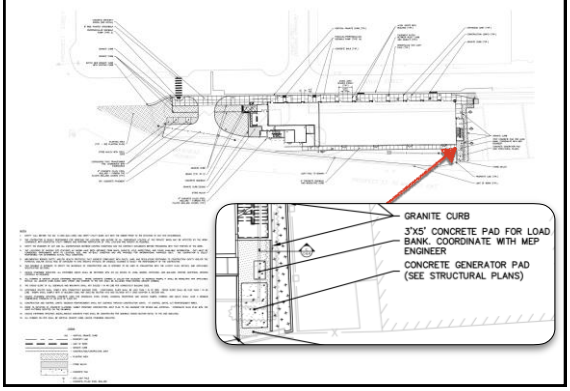
Site Plan Electrical



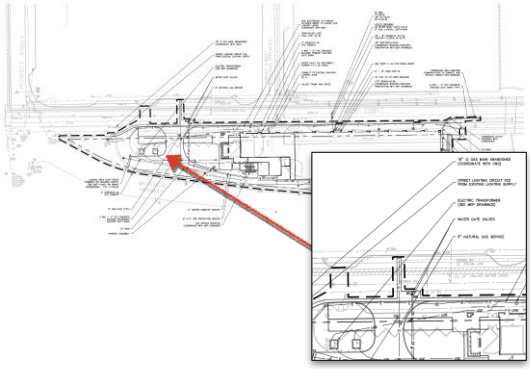
Site Plan Electrical



Site Plan Materials

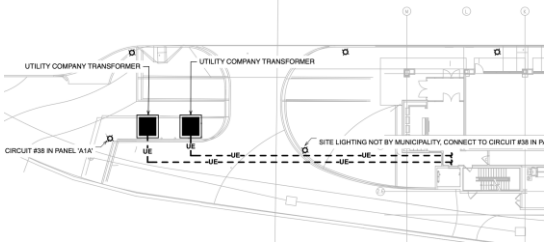


Site Plan Utilities



1 ELECTRICAL SITE PLAN

SCALE: 1" = 20' - 0"

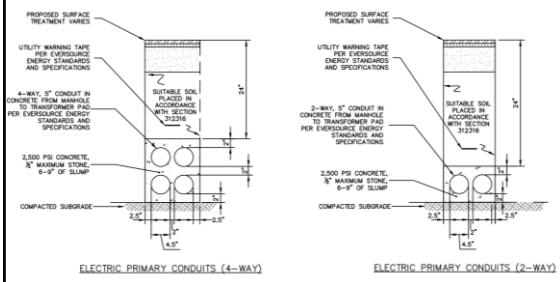


Electrical public utility notes

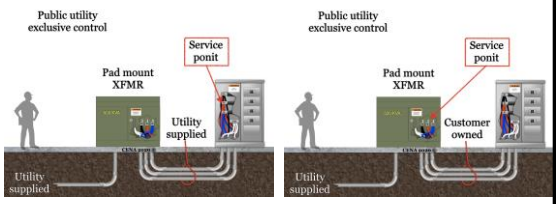
UTILITY SERVICE AND COORDINATION NOTES:

1. PROVIDE NEW MANHOLE, CONDUIT DUCTBANK, AND CONNECTION TO EXISTING MANHOLE AS REQUIRED BY UTILITY COMPANY.
2. REFER TO CIVIL ENGINEERING PLANS FOR LOCATIONS OF UTILITY MANHOLES AND ROUTING OF PRIMARY DUCTBANKS.
3. PROVIDE PULL CABLE IN EACH PRIMARY CONDUIT, SIZED AS DIRECTED BY UTILITY COMPANY.
4. PRIMARY SERVICE CABLES FURNISHED AND INSTALLED BY THE UTILITY COMPANY.
5. NEW MANHOLE SHALL BE PRECAST REINFORCED CONCRETE WITH 6'-0" x 14'-0" x 7'-0" INSIDE DIMENSIONS, AND SHALL MEET THE MATERIAL SPECIFICATIONS REQUIRED BY NORTHEAST UTILITIES (CL&P). GROUNDING SHALL BE INSTALLED PRIOR TO SETTING THE MANHOLE.
6. PRIMARY CONDUIT BANKS SHALL BE CONCRETE ENCASED AND INSTALLED AS REQUIRED BY THE APPLICABLE NORTHEAST UTILITIES DESIGN & APPLICATION STANDARDS.

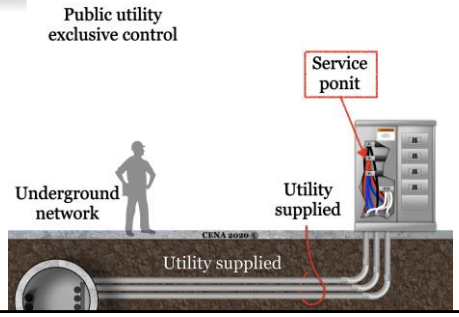
Site Plan Details



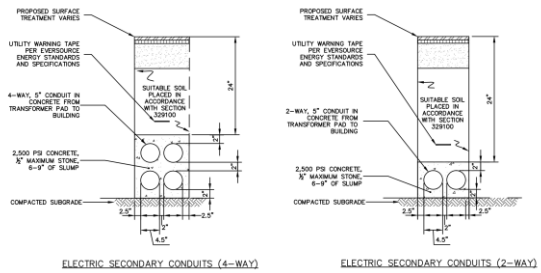
90.2 scope
Installations under the exclusive control of an electric utility where such installations, consist of service drops or service laterals, and associated metering are not covered under the NEC



Article 100 service point
The point of connection between the facilities of the serving utility and the premises wiring. Lateral underground conductors are not service conductors. Lateral conductors are under the exclusive control of the serving utility.



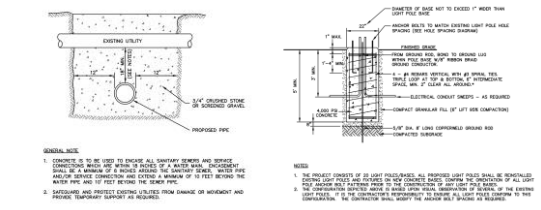
Site Plan Details



ELECTRIC SECONDARY CONDUITS (4-WAY)

ELECTRIC SECONDARY CONDUITS (2-WAY)

Site Plan Details



TYPICAL UTILITY CROSSING

SCALE: NONE

UTY-102-CT

LIGHT POLE BASE

SCALE: NONE

2017 NEC - 300.5(D)(3)

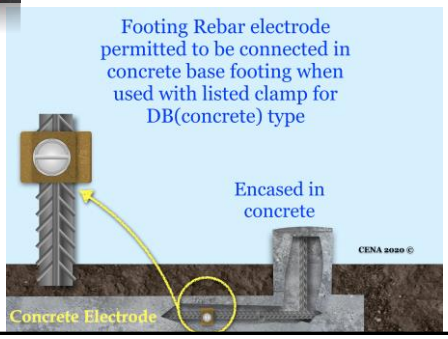
(3) Service Conductors. Underground service conductors that are not encased in concrete and that are buried 450 mm (18 in.) or more below grade shall have their location identified by a warning ribbon that is placed in the trench at least 300 mm (12 in.) above the underground installation.

2017 NEC - 300.5(F)

(F) Backfill. Backfill that contains large rocks, paving materials, cinders, large or sharply angular substances, or corrosive material shall not be placed in an excavation where materials may damage raceways, cables, conductors, or other substructures or prevent adequate compaction of fill or contribute to corrosion of raceways, cables, or other substructures.

Where necessary to prevent physical damage to the raceway, cable, or conductor, protection shall be provided in the form of granular or selected material, suitable running boards, suitable sleeves, or other approved means.

250.52(A)(3)
Footing Rebar electrodes require a connection in the base footing in concrete with a listed clamp to the 20 feet of rebar encased in concrete in direct connection to soil.

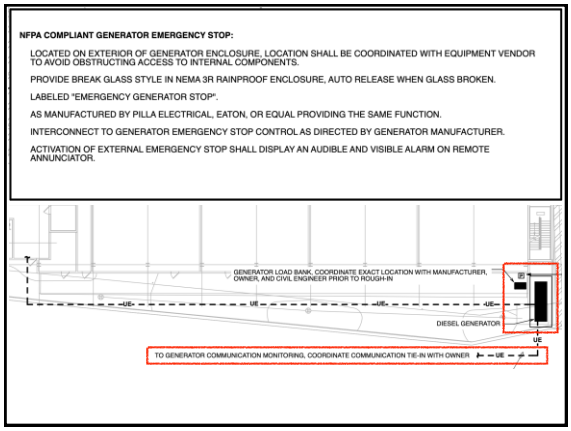


250.68(C)(3)
Footing Rebar electrodes require a connection in the base footing or to a stub up rebar located above the footing wall in a non corrosive location. Rebar buried in soil is a violation.

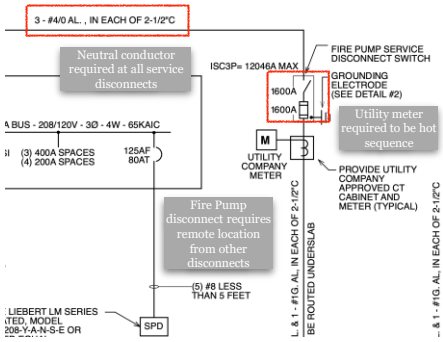
GENERAL INSPECTION CHECKLISTS

General Requirements

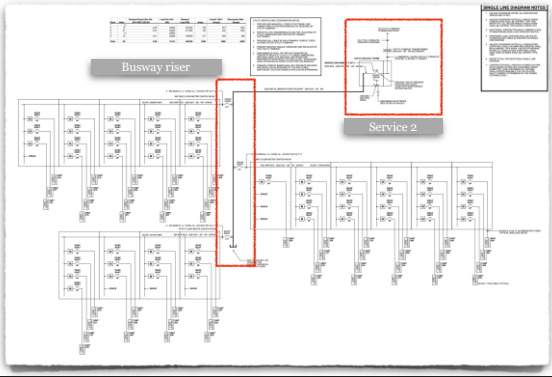
Item	Inspection Activity	NEC Reference	Comments
1.	Determine which installations or portions of the installations are covered by NEC rules	90.2(A) and (B)	
2.	Verify equipment is listed and installed in accordance with manufacturer's installation instructions and suitable for the location.	90.7, 110.3(B), 110.20, Table 110.20	
3.	Identify any special equipment or systems that require special approvals or evaluations	90.4, 90.7, 110.2, 110.3	
4.	Verify service and distribution equipment has sufficient interrupting ratings for AFC (available fault current) and system is fully rated	110.9, 110.10	
5.	Is service and distribution equipment being installed as a fully rated system or as a series combination rated system?	110.9, 110.10, 240.86	
6.	Check for electrical enclosures and boxes with unused openings. Verify closure of raceway and cable openings	110.12(A), 408.7	
7.	Verify equipment has not been contaminated by foreign materials or is not damaged	110.12(B)	
8.	Verify equipment is securely mounted and adequate ventilation and space for the equipment is provided	110.13	
9.	Check electrical splices and equipment terminations	110.14(A) and (B)	



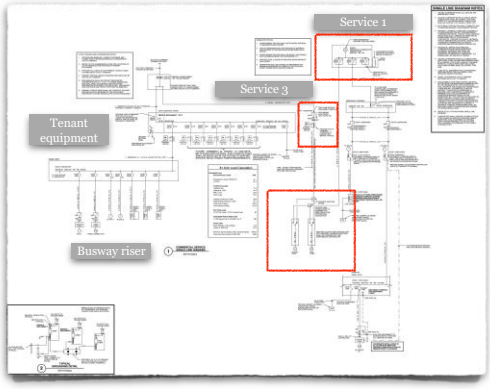
Electrical line Diagram Fire Pump



Electrical line Diagram Residential



Electrical line Diagram Commercial



Electrical apartment feeder notes

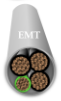
SINGLE LINE DIAGRAM NOTES

1. UNLESS OTHERWISE NOTED, ALL DEVICES AND SPACES ARE 3 POLE.
2. UNLESS OTHERWISE NOTED ALL ABOVE GRADE CONDUCTORS SHALL BE COPPER, TYPE THW, RATED 75°C. ALL BELOW GRADE CONDUCTORS SHALL BE COPPER, TYPE XHHW-2, RATED 75°C.
3. ELECTRICAL CONTRACTOR SHALL CONNECT LOAD TO MAINTAIN BALANCE LOAD IN METER CENTER
4. APARTMENT LOAD CENTERS SHALL BE FED BY ALUMINIUM SER CABLE AS INDICATE ON SINGLE LINE DIAGRAM
5. UNLESS OTHERWISE NOTED ALL CONDUCTORS SUPPLYING LOADS 100 AMPS AND GREATER SHALL BE ALUMINUM, TYPE XHHW. UNLESS OTHERWISE NOTED ALL CONDUCTORS SUPPLYING LOADS LESS THAN 100 AMPS SHALL BE COPPER, TYPE THW.
6. REFER TO E8.0 FOR ADDITIONAL SINGLE LINE DIAGRAM.
7. CONTRACTOR SHALL PROVIDE A POWER SYSTEM STUDY BASED ON SPECIFIC EQUIPMENT BEING SUBMITTED. FINAL EQUIPMENT AIC RATINGS SHALL EXCEED AVAILABLE THE CALCULATED FAULT CURRENT DETERMINED BY THE POWER SYSTEMS STUDY.

Conductor types

Copper grade Abovegrade - THW Belowgrade - XHHW-2

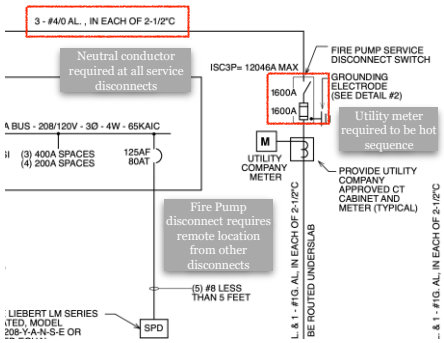
SER cable for apartment feeders 100A and larger



EMT with THW conductors

CENA 2020 ©

Electrical Service Fire Pump



695.3(A) Reliability source

The NFPA 20 2016 addition @ Annex provides definition of a reliably power source. Data from the local power Co and fire Marshall office will be needed for every Fire Pump installation in determining if the district power is reliable.

Annex A gives 4 points of reference to reliably power.

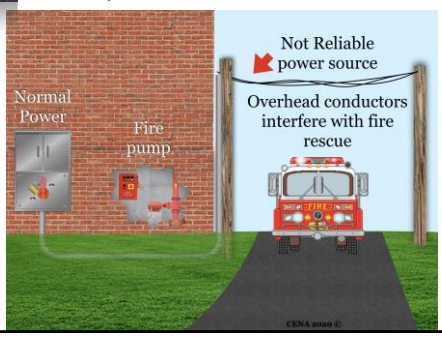
1. Power plant interruption more than 4 hour duration
2. No routine local community power outages.
3. No overhead power wires in the area of the protected building supplying it.
4. Normal source disconnects not meeting the location requirements of overcurrent and control functions.

Local community power CO data records indicating how many power outages in the pass year or more. How long each outage and reason why

Local Fire Marshall office records indicating request to interrupt power to property in the pass year or more. Time of day and frequency of requests.

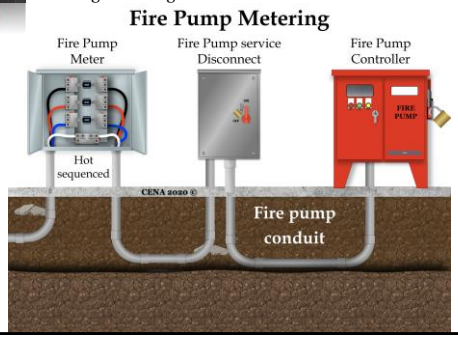
695.3 Reliable source

Over head power lines in close proximity to the building may require disconnection to the fire pump if local fire department decides they will interfere with fire rescue.



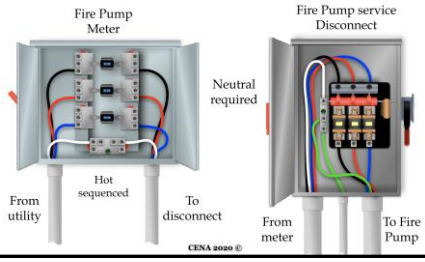
695.3 Reliable power

Utility suppliers require fire pumps to meet strict compliance. Check with your local utility if they require hot sequenced metering. Metering before service disconnect.

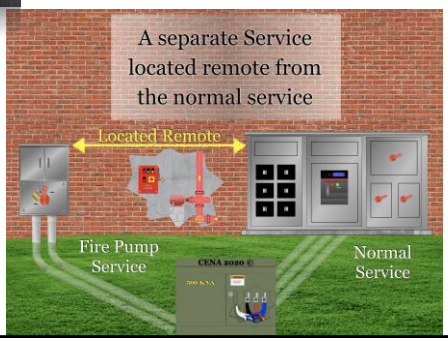


250.24(C)
All service disconnects require a **neutral** or **grounded** conductor brought to the enclosure and bonded to the enclosure. This provides a path for fault current back to the electrical source.

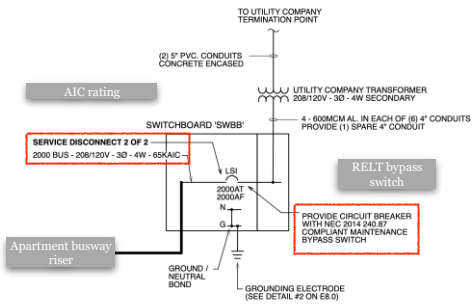
Fire Pump Service



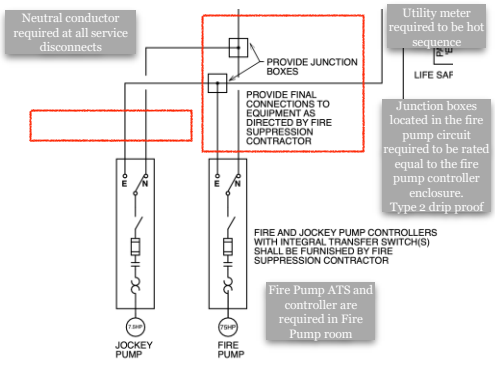
695.4(B)(3) - 230.2(A) - 230.72(B)
Fire Pump disconnects are required to be sufficiently remote from all other disconnects including any service disconnect.



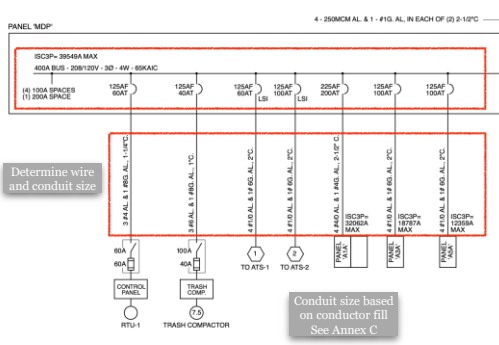
Electrical Service 2



Fire Pump Line diagram

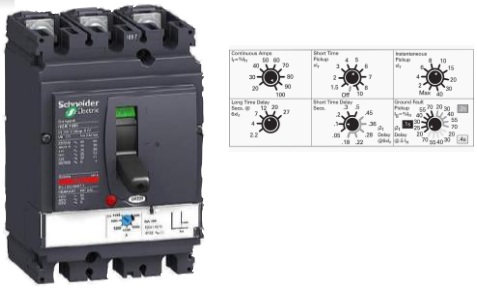


Fire Pump Line diagram

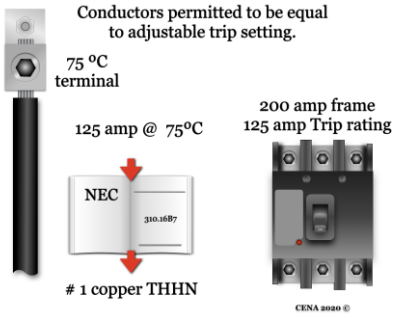


240.6(C)

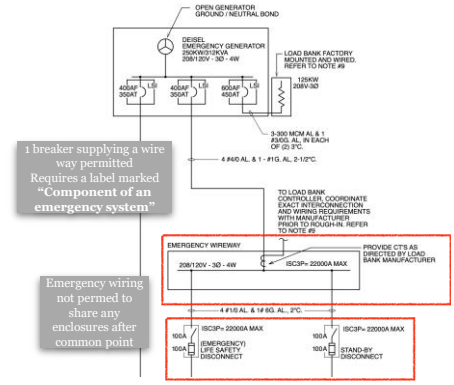
Circuit breakers that are equipped with a adjustable trip setting are permitted to protect conductors at the adjusted setting. Restricted access is required.



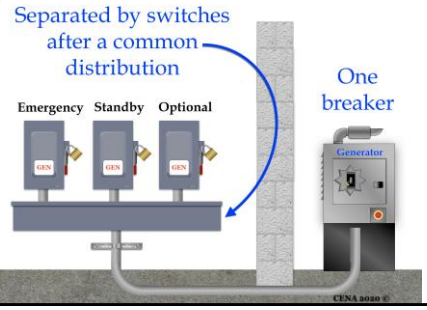
240.6(C)
Line diagrams will indicate AF and AT notes. These indicate **A**mperage **F**rame and **A**mperage **T**rip setting.



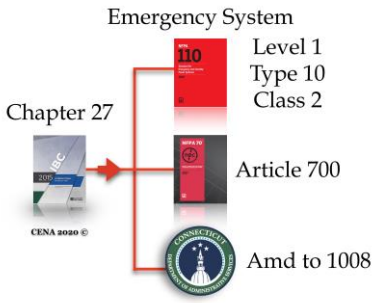
Fire Pump Line diagram



700.10
A common wireway is permitted for splicing emergency conductors and other conductors if located between the generator and the wireway. All switches for emergency require separate enclosures.

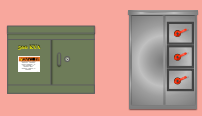


700.10
Emergency loads are selected by the 2015 IBC code in chapter 27. Documents must state which electrical loads are emergency and standby.



Services

The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.



Requirements

Commercial

Residential

Special equipment

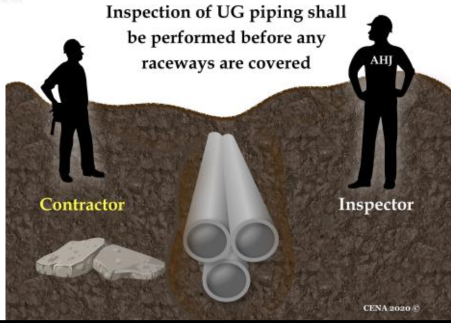
SERVICE INSPECTION CHECKLISTS

Service Inspections (cont.)

	Item	Inspection Activity	NEC Reference	Comments
	1.	Determine each building has one service or more as allowed by justified provisions	230.2	
	2.	Check that each service drop or lateral supplies one set of service conductors	230.40	
	3.	Verify that the service conductors are sized per minimum requirements, and large enough to serve the calculated load.	230.23(B, 230.31(B), 230.42	
	4.	Verify that service entrance conductors are listed or marked as being sunlight resistant or covered.	310.8(C)	
	5.	Verify clearances for overhead service drop conductors	230.24	
	6.	Verify the point of attachment is adequate	230.26, 230.27	
	7.	Verify that if the service mast is used to support the drop, it only supports the electrical service conductors and is adequate for this purpose.	230.28	
	8.	Verify depths for buried service lateral conductors	230.32, 230.49, 300.5, 300.50	

110.3.8.1

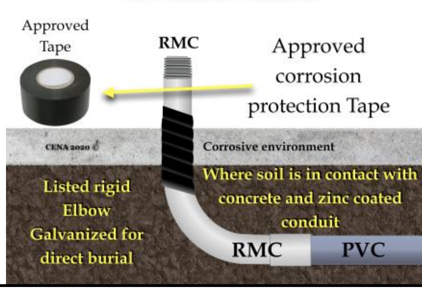
Electrical installation of underground piping and conductors after trenches are excavated and bedded and before backfill is put in place



358.10(B)(1) & 344.10(B)(1)

Zinc coated raceways exposed to soil and concrete pass from one material to the other will corrode. A bitumen or asphalt coating is approved to help prevent corrosion where the 2 materials come in contact with galvanized raceways.

Zinc coated conduits



81 Arch Load Calculation

	KVA
Calculated Load	
Noncontinuous Loads	
Receptacles Load at 180VA Per	10.1
at 100%	10.1
Continuous Loads	
Lighting Load	11.9
Lighting at 1.25%	14.8
Misc. Load	25.2
HVAC Load	58.7
Subtotal Continuous Loads	98.8
Subtotal Noncontinuous Loads	10.1
Total Load of Space	108.9
Total Demand (Amps)	301.6
Fire Pump Load	
75 HP Fire Pump / 7.5 HP Jockey Pump	80
Anticipated Future Retail Load	
11,400 square feet @ 25 Watts / sq. ft.	285
Total Loads	
Base Building + Future Retail	474
(Amps @ 208V 3Ø)	1313
Minimum Service Rating (125% demand) (Amps)	1640.8
Disconnect Size (Amps @ 208V 3Ø)	2000

SINGLE LINE DIAGRAM NOTES

1. UNLESS OTHERWISE NOTED, ALL DEVICES AND SPACES ARE 3 POLE.
2. UNLESS OTHERWISE NOTED ALL ABOVE GRADE CONDUCTORS SHALL BE COPPER, TYPE THW, RATED 75°C. ALL BELOW GRADE CONDUCTORS SHALL BE COPPER, TYPE XHHW-2, RATED 75°C.
3. ELECTRICAL CONTRACTOR SHALL CONNECT LOAD TO MAINTAIN BALANCE LOAD IN METER CENTER.
4. PROVIDE (1) NORMALLY OPEN AND (1) NORMALLY CLOSED AUXILARY CONTACT FOR EMERGENCY LOWERING PROVISION. CONTACT SHALL MONITOR DEVICE STATUS (I.E. TRIPPED OR OPEN) AND BE INTERCONNECTED TO THE ELEVATOR CONTROLLER. PROVIDE 2#12 IN 3/4"C. BETWEEN CIRCUIT BREAKER AND ELEVATOR CONTROLLERS. COORDINATE TERMINATION LOCATION IN CONTROLLERS WITH ELEVATOR CONTRACTOR.
5. PROVIDE ALL WIRING FOR SIGNALING/ COMMUNICATION BETWEEN GENERATOR, AUTOMATIC TRANSFER SWITCHES, AND EQUIPMENT REQUIRED FOR COMPLETE OPERATION OF EMERGENCY GENERATOR. ALL WIRING SHALL BE RUN IN 3/4" CONDUIT.
6. UNLESS OTHERWISE NOTED ALL CONDUCTORS SUPPLYING LOADS 100 AMPS AND GREATER SHALL BE ALUMINUM, TYPE XHHW. UNLESS OTHERWISE NOTED ALL CONDUCTORS SUPPLYING LOADS LESS THAN 100 AMPS SHALL BE COPPER, TYPE THW.
7. LUGS ON ALL EQUIPMENT SHALL BE PROPERLY SIZED AND RATED FOR THE CONDUCTORS SPECIFIED AND/OR PROVIDED.
8. VERIFY LOCATIONS OF UTILITY COMPANY METERING WITH UTILITY COMPANY.
9. AN AUTOMATIC LOAD STEP CONTROLLER SHALL BE PROVIDED FOR MAINTAINING A MINIMUM LOAD ON THE GENERATOR SET. THE CONTROLLER SHALL MONITOR THE CONNECTED DOWNSTREAM LOADS AND WILL AUTOMATICALLY ADD OR SUBTRACT LOAD STEPS IN RESPONSE TO BUILDING LOAD CHANGES AS TO MAINTAIN A MINIMUM LOAD LEVEL (DETERMINED BY GENERATOR MANUFACTURER) ON THE GENERATOR SET. THE CONTROLLER INCLUDES AN INITIAL TIME-DELAY CIRCUIT, AND AUTOMATIC TIME DELAYED LOAD STEP APPLICATION CIRCUIT. A REMOTE CONTACT CLOSURE IS REQUIRED FOR ACTIVATION AND TRANSFER OF CONTROL. A SEPARATE CURRENT TRANSFORMER SHALL BE SUPPLIED LOOSE FOR MOUNTING AND SENSING OF DOWNSTREAM LOADS.
10. REFER TO E8.1 FOR ADDITIONAL SINGLE LINE DIAGRAM.
11. CONTRACTOR SHALL PROVIDE A POWER SYSTEM STUDY BASED ON SPECIFIC EQUIPMENT BEING SUBMITTED. FINAL EQUIPMENT AIC RATINGS SHALL EXCEED AVAILABLE THE CALCULATED FAULT CURRENT DETERMINED BY THE POWER SYSTEMS STUDY.

DWELLING UNIT LOAD CALCULATIONS (NEC 2014-Section 220)

PROJECT: 81 Arch Street **DATE:** May 19, 2017

UNIT NO. 2 Bedroom Units Type B1, B2, B3, & B4

SQUARE FOOTAGE 1340

	LOAD(WATTS)	NEC SECTION
LIGHTING/RECEPT.	4020	Table 220.3A(3W/Sq. Ft.)
SMALL APPLIANCE	3000	220.16A
RANGE	8000	220.19
GAR. DISPOSAL	1000	
DISHWASHER	900	
DRYER	5000	220.18
WASHER	900	220.16B
HOT WATER HEATER	4500	
MOTOR	100	
AIR CONDITIONING	3328	
ELECTRIC HEAT	7072	
MISC.	1000	
TOTAL CONNECTED	35492	

DEMAND OPTION CALCULATION #2(NEC 220.30)			LOAD(WATTS)
AIR CONDITIONING/ELECTRIC HEAT	=	at largest of100% A/C or 65% Heat	4596.8
LTG/RECEPT,SMALL APPLIANCE, RANGE,GAR. DISPOSAL,MICROWAVE, DRYER,WASHER,HOT WATER HEATER, MOTOR	=	at 100% of first 10kVa 40% of remainder	10000 7368
TOTAL DEMAND			21965

105.6 Amperes @208V-1Ø

SITE ELECTRICAL NOTES

1. PLAN IS DIAGRAMMATIC ONLY. VERIFY EXACT LOCATIONS OF ALL EQUIPMENT AND SITE WORK WITH OWNER, ARCHITECT, AND CIVIL ENGINEER PRIOR TO COMMENCING WORK.
2. CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATION OF UNDERGROUND SERVICES WITH OTHER CONTRACTORS AND UTILITY COMPANIES.
3. EXACT ROUTING AND TERMINATION POINTS OF UNDERGROUND SERVICES SHALL BE VERIFIED WITH THE UTILITY COMPANY AND OTHER CONTRACTORS.
4. IN ADDITION TO THE LENGTH SHOWN, THE CONTRACTOR SHALL PROVIDE A UNIT PRICE PER 100'-0" OF RUN FOR SECONDARY ELECTRIC SERVICE CONDUITS, RELATED TRENCHING, AND BACKFILL.
5. IN ADDITION TO THE LENGTH SHOWN, THE CONTRACTOR SHALL PROVIDE A UNIT PRICE PER 100'-0" OF RUN FOR TELEPHONE SERVICE CONDUITS, RELATED TRENCHING, AND BACKFILL.
6. COORDINATE FINAL INTERCONNECTIONS TO EACH UTILITY COMPANY, PROVIDE ALL MATERIALS AND LABOR REQUIRED FOR SERVICE CONNECTIONS IN ACCORDANCE WITH EACH UTILITY (POWER AND COMMUNICATIONS) COMPANY SERVICE STANDARDS.
7. UNLESS OTHERWISE NOTED, UNDERGROUND ELECTRICAL AND COMMUNICATIONS CONDUITS SHALL BE 24" MINIMUM BELOW GRADE. UNDERGROUND CONDUITS SHALL BE SCHEDULE 40 PVC.

SERVICE INSPECTION CHECKLISTS

Service Inspections (cont.)

Item	Inspection Activity	NEC Reference	Comments
16.	If multiple service disconnects are used, verify no more than six and that they are grouped together	230.71, 230.72, 230.204, 230.205	
17.	Generally, service equipment must be readily accessible and installed so that the center grip of the operating handle, when in its highest position, is not more than 2.0 m (6 ft 7 in.) above the floor or working platform	240.24(A)	
18.	Check the service disconnect ratings. Amperage, voltage, Phase and AIC rating.	230.79, 230.80, 230.205, 110.9	
19.	Verify any equipment connected to the supply side of the service disconnect is permitted on supply side	230.82	
20.	Verify service disconnect identification	230.70(B) and (C)	
21.	Is equipment protected from physical damage?	110.27	
22.	Verify GFPE is provided where required for the service	230.95	
23.	If GFPE is present in the service equipment, verify performance testing completed prior to energizing	230.95(C)	

Table 310.15(B)(16)
The 75°C column is the most likely to be used since most electrical enclosures are listed for use with conductors at the terminal temperature of 75°C. Red columns below are 75°C

Temperature Rating of Conductor [See Table 310.104(A).]

Size AWG or kcmil	60°C (140°F)	75°C (167°F)	90°C (194°F)	60°C (140°F)	75°C (167°F)	90°C (194°F)	Size AWG or kcmil
	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, USE, ZW	Types TBS, SA, SIS, FEP, FEPB, MI, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, ZW-2	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, USE	Types TBS, SA, SIS, THHN, THHW, THW-2, THWN-2, RHH, RHW-2, USE-2, XHH, XHHW, XHHW-2, ZW-2	
	COPPER			ALUMINUM OR COPPER-CLAD ALUMINUM			
18**	—	—	14	—	—	—	—
16**	—	—	18	—	—	—	—
14**	15	20	25	—	—	—	—
12**	20	25	30	15	20	25	12**
10**	30	35	40	25	30	35	10**
8	40	50	55	35	40	45	8
6	55	65	75	40	50	55	6
4	70	85	95	55	65	75	4
3	85	100	115	65	75	85	3
2	95	115	130	75	90	100	2
1	110	130	145	85	100	115	1
1/0	125	150	170	100	120	135	1/0
2/0	145	175	195	115	135	150	2/0
3/0	165	200	225	130	155	175	3/0
4/0	195	230	260	150	180	205	4/0
250	215	255	290	170	205	230	250
300	240	285	320	195	230	260	300
350	260	310	350	210	250	280	350
400	280	335	380	225	270	305	400
500	320	380	430	260	310	350	500
600	350	420	475	285	340	385	600

Table 310.15(B)(16)
Service disconnecting means is required to deliver 100% of the total calculated load or more.

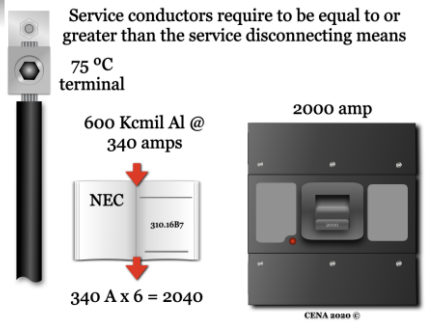
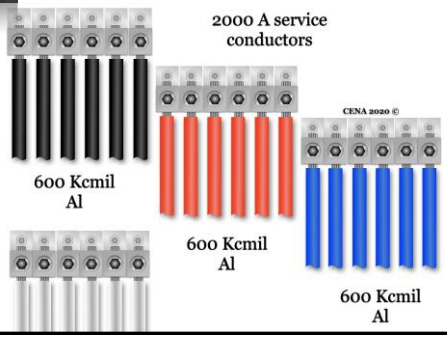


Table 310.15(B)(16)
Determine the load to be supplied, then each individual conductor rating multiplied by the amount necessary to supply the total load. See Article 220 for service load calculations.



Annex C standard and compact conductors
✻ stands for compact conductors used in the tables in Annex C.

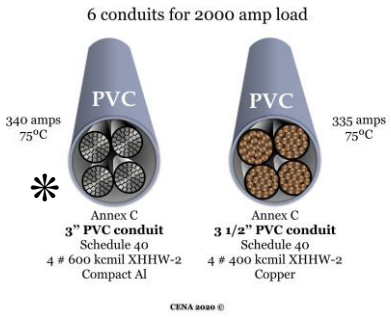


Table 250.66
Grounding Electrode Conductor sizing is taken from Table 250.66 based on the largest service conductor phase area. Paralleled phases must be totaled using all wires in that phase.

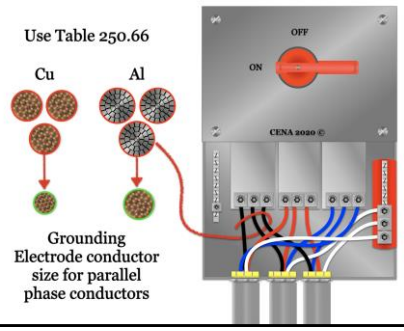


Table 310.15
There 3 steps to sizing conductors for installation of loads.

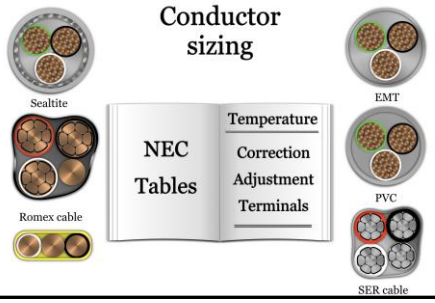


Table 310.15(B)(7)
Demand factor of 83% applies to 1ø 120/240V and 120/208V feeders 400 amp and less. Cable supplies entire load at dwelling unit. Dwelling load demand only.

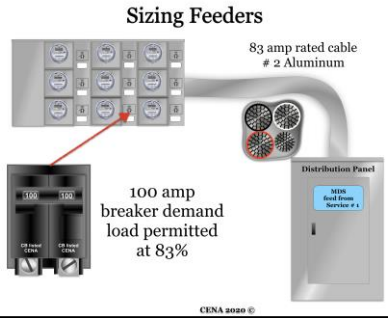
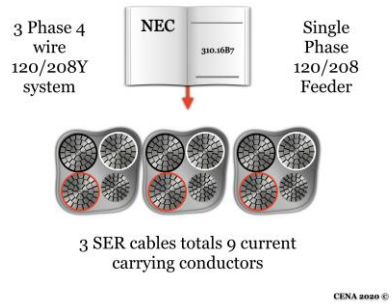


Table 310.15
There 3 steps to sizing conductors for installation of loads.



GENERAL INSPECTION CHECKLISTS

		General Requirements		
	10.	Check temperature ratings of terminations	110.14(C)	
	11.	Check for arc flash warning labels and locations of labels	110.16	
	12.	Check for minimum working spaces at electrical equipment. Verify working space is not used for storage	110.26(A), (B), (E), 110.34(A)	
	13.	Check the space above and below equipment for no foreign equipment *(Dedicated Equipment Space)*	110.26(F)	
	14.	Verify entrance and egress to work spaces. Any personal doors to or within 25 ft. of working space requires panic hardware and must open in the direction of egress.	110.26(C), 11026(C)(3), 110.33	
	15.	Verify illumination is provided for equipment	110.26(D), 110.34(D)	
	16.	Check for circuit directories, and identification of disconnecting means	110.22, 408.4	

2nd floor Electrical room

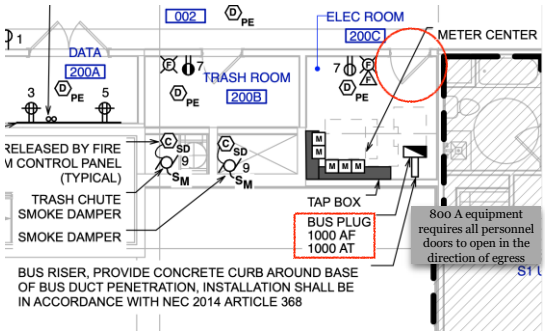


Table 110.26(A)(1)
Work depth space is based on voltage inside equipment measured from the front cover to opposite wall. Concrete or tile is considered grounded material

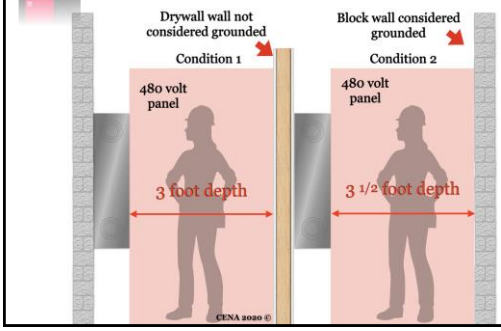


Table 110.26(A)(1)
Work depth conditions are based on live voltage on one side and nothing on the other side or both sides or one side live and the other conductive material (grounded).

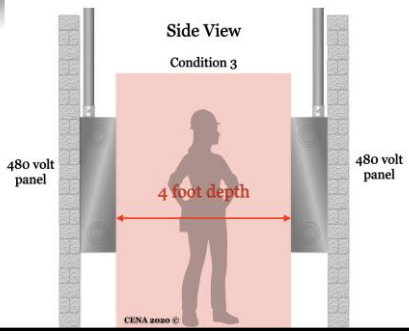


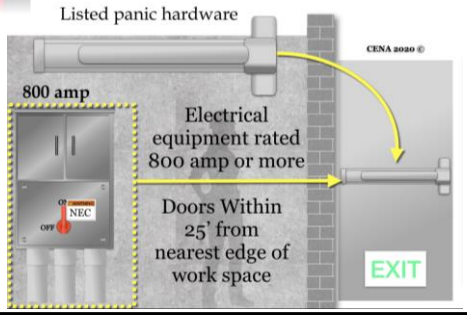
Table 110.26(A)(1)
Electrical equipment requires work space clearances when energized. Use voltage to ground rating and conditions to tabulate the proper minimum distance from enclosure covers.

Table 110.26(A)(1) Working Spaces

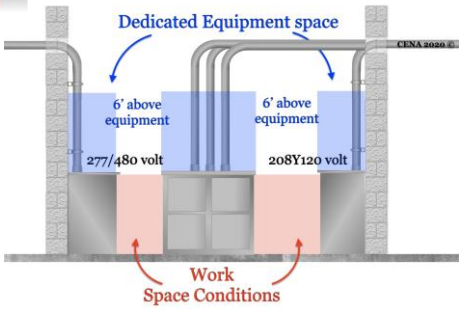
Nominal Voltage to Ground	Minimum Clear Distance		
	Condition 1	Condition 2	Condition 3
0–150	900 mm (3 ft)	900 mm (3 ft)	900 mm (3 ft)
151–600	900 mm (3 ft)	1.0 m (3 ft 6 in.)	1.2 m (4 ft)
601–1000	900 mm (3 ft)	1.2 m (4 ft)	1.5 m (5 ft)

Note: Where the conditions are as follows:
Condition 1 — Exposed live parts on one side of the working space and no live or grounded parts on the other side of the working space, or exposed live parts on both sides of the working space that are effectively guarded by insulating materials.
Condition 2 — Exposed live parts on one side of the working space and grounded parts on the other side of the working space. Concrete, brick, or tile walls shall be considered as grounded.
Condition 3 — Exposed live parts on both sides of the working space.

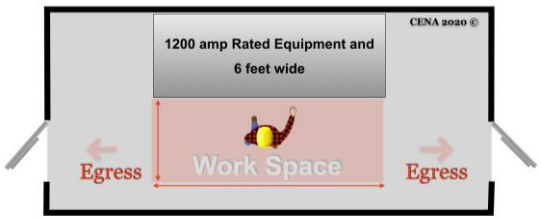
110.26(C)(3)
Electrical equipment rated 800 A and larger with OC devices requires panic hardware on all personnel doors within 25' measured from the nearest required work space.



110.26(E)(1)
Equipment Dedicated space is measured from the floor to a space of 6 feet above the equipment. No foreign equipment is permitted in that space. Applies to any equipment not communicating with that electrical enclosure.

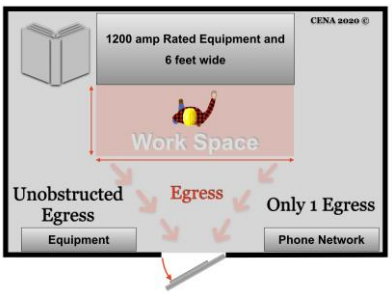


110.26(C)(2) 1200 amp equipment requirement
Egress on both sides of the work space 24" minimum.

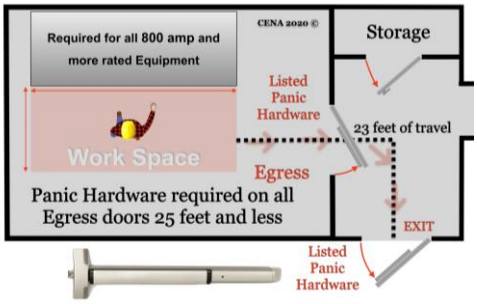


Large Equipment requires 2 Entrances and Egress

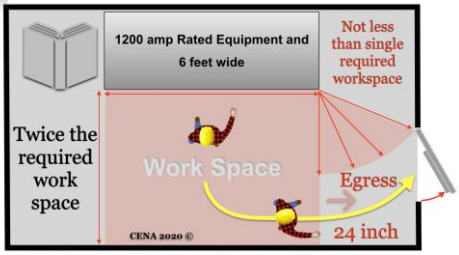
110.26(C)(2) 1200 amp equipment requirement
Unobstructed egress travel to exit the space requires only 1 door access 24" minimum.



110.26(C)(3)
Panic hardware is required on personnel doors measured 25' from the workspace of electrical equipment rated at 800 A or more.



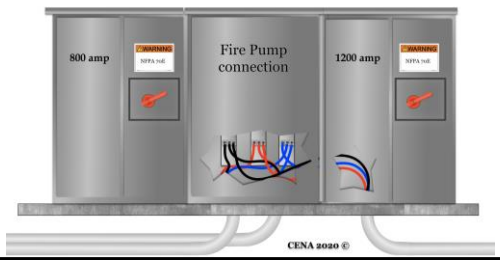
110.26(C)(2) Large Equipment
1200 A and greater and wider than 6' electrical equipment with 1 exit requires a double work clearance in front of equipment. The equipment requires a distance from the nearest door opening to be equal to the workspace in Table 110.26(A).



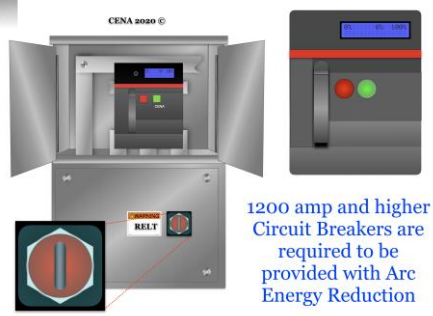
Path to and from equipment always must maintain 24 in access

408.3(A)(3)
Conductors entering or leaving a vertical switchboard section are not permitted to pass through another vertical section unless suitable barriers are installed.

Conductors **not permitted** to pass through adjacent vertical sections

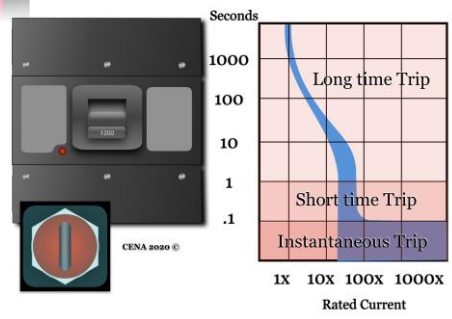


240.87
Energy reduction switch and operation listed for Arc flash reduction required with all 1200 A and larger circuit breakers. Trade name known as RELT switch.



1200 amp and higher Circuit Breakers are required to be provided with Arc Energy Reduction

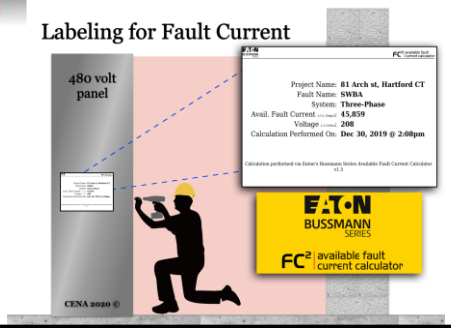
240.87
Energy reduction switch require current injection testing before energizing power. All manufactures instructions require this test to ensure proper safe Arc fault reduction clearing time.



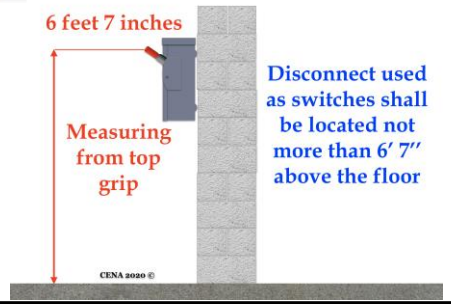
110.16(B) & 110.24(A) &(B)
Service disconnects 1200 A and larger require a field marked label stating the available fault current and clearing time of the overcurrent device with date.

Fault current Labeling

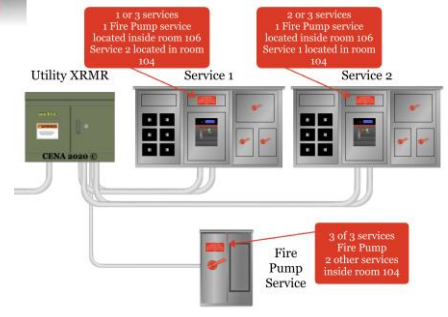
110.21(B) Labeling and Marking
Labels require durability to withstand the environment installed in. Weather condition can deteriorate important information. Caution should be taken in acceptance of labels.



404.8(A) Switches accessible
Switches used for disconnecting means for readily access require a height to the top handle of 6 feet 7 inches maximum.



230.2(E)
If more than 1 service disconnect supplies a building, each disconnect requires a corresponding plaque that clearly denotes all source disconnects and each shall state their locations.



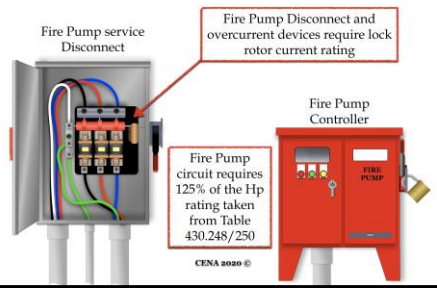
250.58
Regardless of how many systems and services, each structure or building can have only 1 electrode system.

250.58 Common Grounding Electrode. Where an ac system is connected to a grounding electrode in or at a building or structure, the same electrode shall be used to ground conductor enclosures and equipment in or on that building or structure. Where separate services, feeders, or branch circuits supply a building and are required to be connected to a grounding electrode(s), the same grounding electrode(s) shall be used.

Two or more grounding electrodes that are bonded together shall be considered as a single grounding electrode system in this sense.

695.4(B)(2) Circuit conductors
All conductors supplying power to a fire pump require a rating of 125% of the FLC from table 430.251 for 3ø supply.

Fire Pump Conductors



SERVICE GROUNDING INSPECTION CHECKLISTS

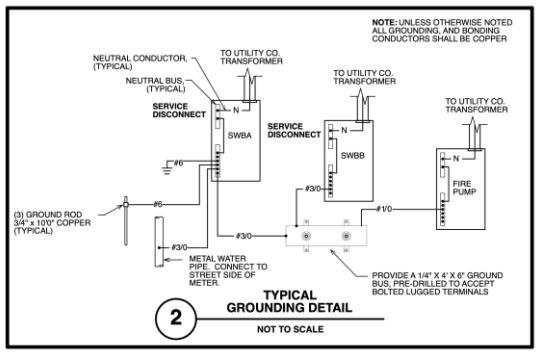
Service Grounding and Bonding			
Item	**Inspection Activity**	**NEC Reference**	**Comments**
1.	Verify grounding requirements or specifications of any engineered drawings	None, but may be a local rule or regulation	
2.	Verify the size of the service based on the plans or by the equipment labels	Based on the blueprints or load served 220.10, 230.42, 230.79	
3.	Determine all available grounding electrodes based on the construction and plans	250.50, 250.52(A)	
4.	Determine other electrodes required to be used and bonded to the grounding electrode system	250.52(A)(4) through (7)	
5.	Verify grounding electrode conductor(s) are properly sized	250.66, 250.64(F)	
6.	Verify that bonding jumpers connecting grounding electrodes together to form the grounding electrode system are sized properly	250.53(C)	
7.	Check that grounding electrode conductor(s) is installed without a splice	250.64(C), 250.64(F)	
8.	Verify grounding electrode conductor is securely fastened and protected from physical damage	250.64(B)	

Table 250-.66
Earth Electrodes conductors are sized to this table.

Table 250.66 Grounding Electrode Conductor for Alternating-Current Systems

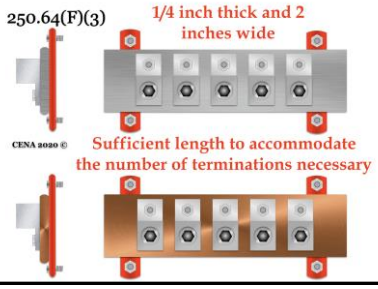
Size of Largest Ungrounded Conductor or Equivalent Area for Parallel Conductors [a] (AWG/kcmil)		Size of Grounded conductor or Bonding Jumper (AWG/kcmil)	
Copper	**Aluminum or Copper-Clad Aluminum**	**Copper**	**Aluminum or Copper-Clad Aluminum [b]**
2 or Smaller	1/0 or Smaller	8	6
1 or 1/0	2/0 or 3/0	6	4
2/0 or 3/0	4/0 or 250	4	2
Over 3/0 through 350	Over 250 through 500	2	1/0
Over 350 through 600	Over 500 through 900	1/0	3/0
Over 600 through 1100	Over 900 through 1750	2/0	4/0
Over 1100	Over 1750	3/0	250

[a] Notes 1 and 2 also a & b see addition text

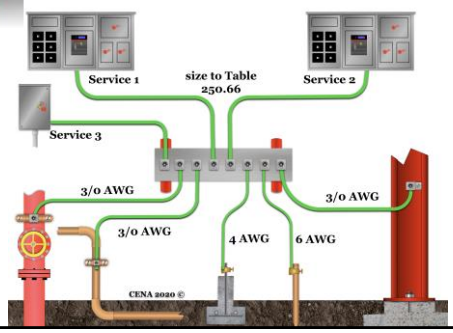


250.64(F)(3)
Grounding to a common point requires a approved plate of either copper or aluminum 1/4 inch thick and 2 inches wide. The length depends on the amount of terminals needed.

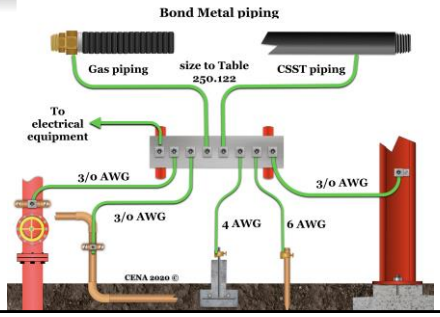
Aluminum / Copper Buss Bar



250.64(D)(1)
Grounding to a common point requires a approved plate of either copper or aluminum 1/4 inch thick and 2 inches wide. The length depends on the amount of terminals needed.



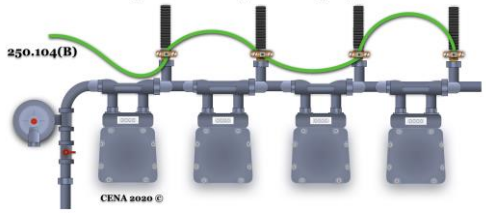
250.104(B) other metal piping
A bonding jumper connected to the common grounding busbar is required to ensure electrical continuity to all circuits that may energize any part of the metal gas piping system.



250.104(B) other metal piping

A bonding jumper is required to electrically connect the metal gas piping system to any of the 5 locations stated: Service neutral conductor, Equipment grounding conductor, service enclosure, grounding electrode conductor or any electrode used.

All Metal Gas piping systems require a wire type bonding jumper installed to each load side customer gas pipe. Connections requirements are the same as electrode conductor. Regardless of the type of metal gas pipe.



Sources

Power sources include, but are not limited to, interconnected or stand-alone batteries, solar photovoltaic systems, other distributed generation systems, or generators and separately derived transformers.

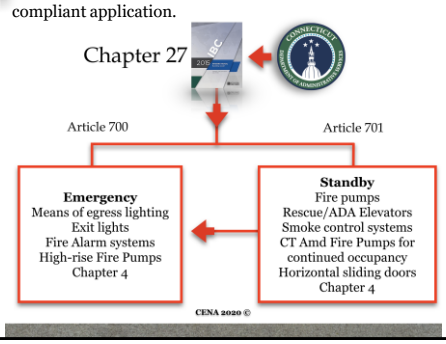
Transformers

Generators

Battery Storage

2702.1.6 Interchangeability

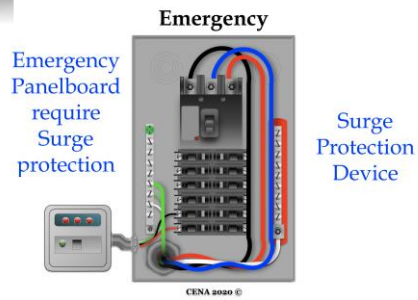
Standby systems are permitted to be installed on the emergency system if installed as emergency system. Level 1, Type 10 and Class 2 hours or more would be a minimum NFPA 110 compliant application.



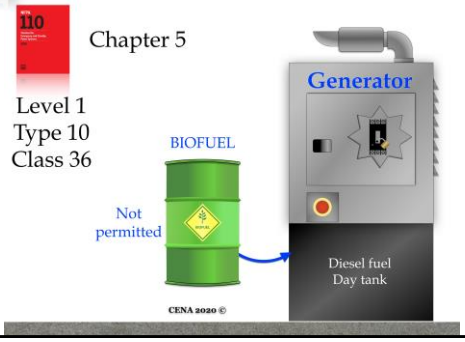
EMERGENCY SYSTEM INSPECTION CHECKLISTS

Emergency System Requirements			
Item	Inspection Activity	NEC Reference	Comments
1.	Establish that Article 700 applies to the type of occupancy and electrical system	Applicable building code or local code and Article 700	
2.	Review engineered drawings for specifications	Local Code(s) and 700.9(C)	
3.	Determine the emergency system source to be used based the drawings and at a minimum	700.12	
4.	Check equipment being used on emergency system for suitability	700.3, 110.3(A) and (B)	
5.	Verify connected emergency system load and capacity of the emergency system	700.5, 220.10, 215.2	
6.	Verify capacity meets load demand or load shedding is provided	700.5	
7.	If generator is the source, verify onsite fuel is provided (for minimum 2-hours operation)	700.12(B)(2)	
8.	Power sources are suitable for minimum 1-1/2 hours of operation and transfer is within 10 seconds. Level-Type-Class	700.12	
9.	Verify unit equipment is connected to the proper lighting circuits. Battery pack units	700.12(F)	
10.	Check for dimmer systems (listed for use in emergency systems) and ability upon power failure to illuminate selected emergency circuits	700.23	

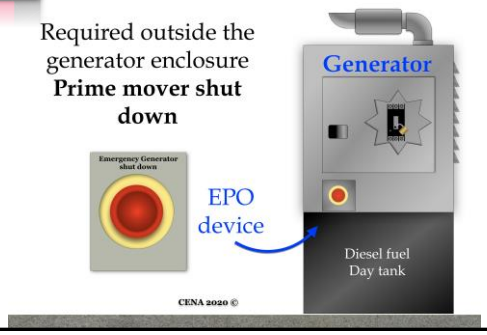
700.8 Surge protection
A listed SPD in required to be installed in or on all emergency systems switchboards and panelboards. Type 2 SPD would be acceptable.



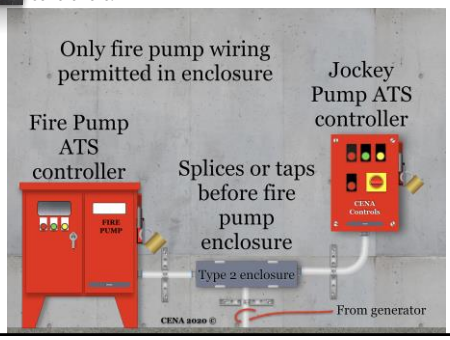
2702.2
All emergency systems are required to comply with the NFPA 110. See Section 5.1.1 for types of fuel permitted.



445.18
Comply with the NFPA 110. Section 5.6.5.6 remote manual stop station required to shut down the prime mover



695.6(E)
Fire Pumps controller and ATS are not permitted to supply any other loads including jockey pumps tapped from fire pump controllers.



250.58
Regardless of how many systems and services, each structure or building can have only 1 electrode system.

250.58 Common Grounding Electrode. Where an ac system is connected to a grounding electrode in or at a building or structure, the same electrode shall be used to ground conductor enclosures and equipment in or on that building or structure. Where separate services, feeders, or branch circuits supply a building and are required to be connected to a grounding electrode(s), the same grounding electrode(s) shall be used.

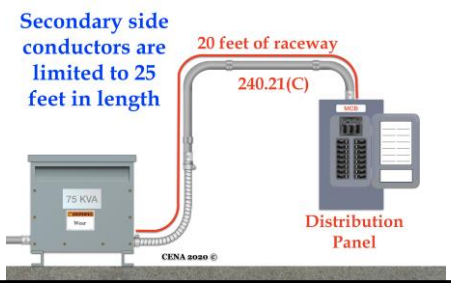
Two or more grounding electrodes that are bonded together shall be considered as a single grounding electrode system in this sense.

TRANSFORMERS INSPECTION CHECKLISTS

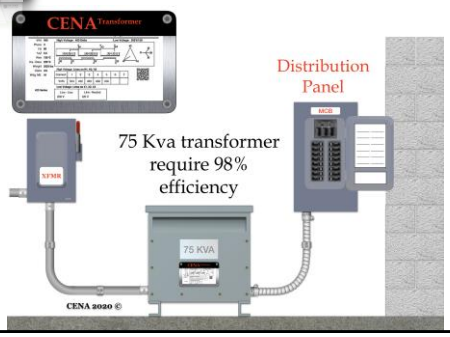
Transformer Inspections				
	Item	Inspection Activity	NEC Reference	Comments
	1.	Check wiring methods (usually conduit and flexible metal conduit) for support and suitability for the conditions.	Chapter 3 and Article 300, 300.11	
	2.	Verify the transformer installation covered by Article 450	450.1, 450.2, 90.2	
	3.	Verify overcurrent protection for over 600 volt transformers is in accordance with 450.3(A)	450.3, 450.3(A) and notes, Table 450.3(A)	
	4.	Verify overcurrent protection for transformers 600 volts or less is provided and properly sized	450.3, 450.3(B), Table 450.3(B)	
	5.	Verify conductor sizes on the primary and secondary	240.4, 310.15, 310.16	
	6.	Verify compliance with applicable secondary tap rules	240.21(B) and (C)	
	7.	Check overcurrent protection for protection of conductors	240.4, 240.6, 240.21(B) and (C), 240.100, 310.16	
	8.	Verify clearances and working space around transformer and specifically ventilating openings in accordance with markings	450.9, 110.3(B), 110.26	
	9.	Verify transformer is readily accessible or complies with the hollow space or exposed locations provisions	450.13	
	10.	Verify transformers installed indoors meet the separation requirements or fire resistant room requirements	450.21	

240.21(C)
Wire length from a XFMR to the first panel board is limited to 25 '. No splicing or tapping is permitted.

Transformers Secondary's



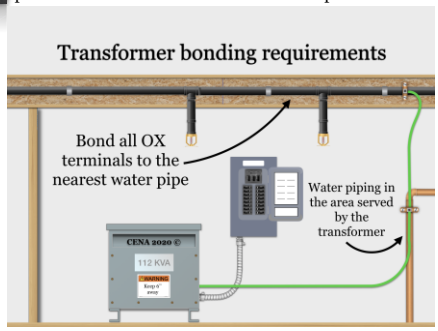
405.7 Table for Transformers efficiency
XFMR are required to be a minimum power efficiency based on Kva rating. Table C405.7 gives % values permitted.



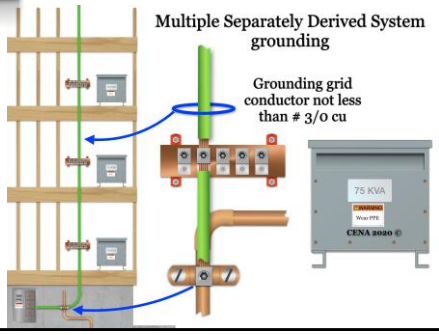
TRANSFORMERS GROUNDING INSPECTION CHECKLISTS

Separately Derived System Grounding and Bonding			
Item	**Inspection Activity**	**NEC Reference**	**Comments**
1.	Verify grounding requirements or specifications of any engineered drawings	None, but may be a local rule or regulation	
2.	Verify the size of the system based on the plans or by the equipment labels	Based on the blueprints or load served 220.10	
3.	Determine all available grounding electrodes based on the construction and plans	250.50, 250.52(A)	
4.	Determine which electrode(s) required to be used (as near as practicable and in the same area	250.30(A)(7)	
5.	Verify grounding electrode conductor(s) are properly sized	250.66, 250.30(A)(3)	
6.	Verify that system bonding jumper is connected and sized properly	250.30(A)(1), 250.28, 250.66	
7.	Check that grounding electrode conductor(s) is installed without a splice	250.64(C)	
8.	Verify grounding electrode conductor is securely fastened and protected from physical damage	250.64(B)	

250.104(D)(1)
Bonding jumper from the XFMR XO terminal to the nearest metal water piping system in the area where circuits are powered from the XFMR. There are 2 exceptions.



250.30(A)(6)
Grounding for more than 1 XFMR requires a common wire 3/0 cu minimum run to each XFMR continuously making contact to a copper or aluminum plate.



250.30(A)(6)

Grounding water piping systems is required from the first 5 feet on entry to a building. Wood frame buildings may have some nonmetallic water piping throughout but underground sprinkler systems will be metallic.

Feeders

All circuit conductors between the service equipment, the source of a separately derived system, or other power supply source and the final branch-circuit overcurrent device.

Requirements

Commercial

Residential

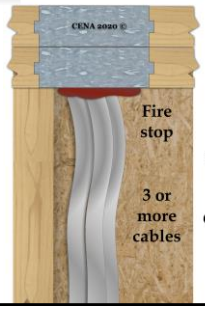
Common Equipment

FEEDER INSPECTION CHECKLISTS

Feeders				
	Item	Inspection Activity	NEC Reference	Comments
	1.	Are feeders sized to meet the loading requirements	215.2, 215.5, 220.40, 220.61	
	2.	Verify panel schedules for panelboard and distribution equipment ratings based on single line drawings	215.5, 215.2	
	3.	Check feeder wiring methods for suitability	Chapter 3 and 5	
	4.	Verify any feeder GFPE requirements have been met	215.10, 230.95, 240.13	
	5.	Check for feeder disconnects at separate buildings	Article 225, Part II, 225.32	
	6.	Verify separate building disconnects meet the location and grouping provisions of Article 225, Part II	Article 225, Part II	
	7.	Proper wiring methods used for outside feeders	225.10, 225.20 thru 225.22	
	8.	Verify wiring methods for feeders are continuous from enclosure to enclosure	300.10	
	9.	Verify size of feeder equipment grounding conductors	250.122	
	10.	Check for feeders that are installed as taps for meeting the restrictions for tap conductors	240.21, 240.4(E) and (F)	

334.10
Nonmetallic sheathed cables permitted in type R-2 buildings install within a 15 minute drywall construction. Type 3,4 and 5 construction.

338.10 and 334.80
SER cables passing through a bored hole sealed with fire caulk requires derating. SER cables follow the same application as romex cable with some exceptions.



Ampacity derating

SER cables passing through the same bored hole in framing members that are sealed with fire caulk must apply derating to all current carrying conductors.

310.15(B)(3)(a) Table
SER cables passing through a bored hole sealed with fire caulk requires derating.

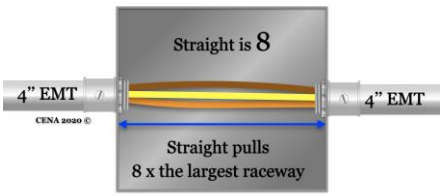
Table 310.15(B)(3)(a) Adjustment Factors for More Than Three Current-Carrying Conductors

Number of Conductors[1]	Percent of Values in Table 310.15(B)(16) Through Table 310.15(B)(19) as Adjusted for Ambient Temperature if Necessary
4–6	80
7–9	70
10–20	50
21–30	45
31–40	40
41 and above	35

338.10 & 334.10
SER cables permitted in type R-2 buildings install within a 15 minute drywall construction. Type 3,4 and 5 construction.

314.28(A)(1)
Sizing pull boxes for a straight pull is 8 x the largest raceway or cable. Distance can't be less than this value.

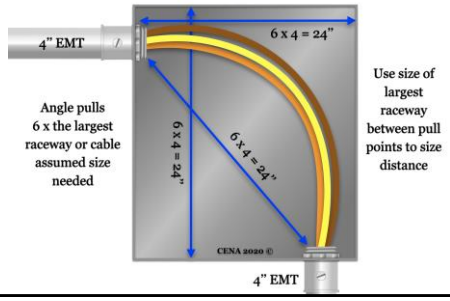
Straight Pull



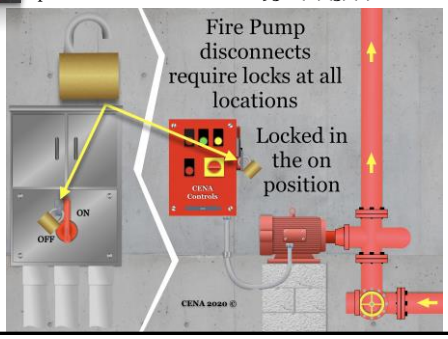
4 x 8 = 32" minimum distance

314.28(A)(2)
Sizing pull boxes for angle pulls is 6 x the largest raceway between pulling openings. Also each raceway x 6 for minimum distance from opposite wall of the entering raceway.

Angle Pull



695.4(B)(3)(e)(3)
Locking all disconnects used in a Fire Pump circuit ensures continuity and supervision of power to the fire pump. Other option are available at section **695.6(B)(3)(e).**



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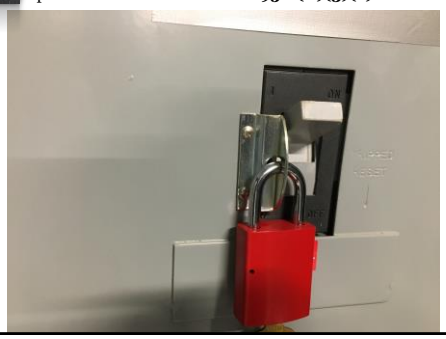
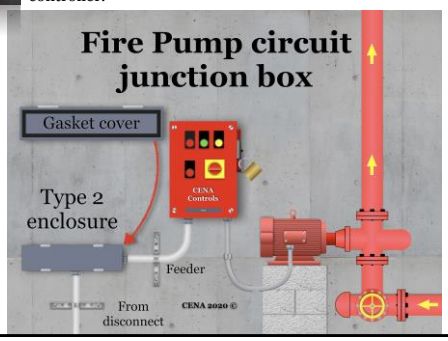
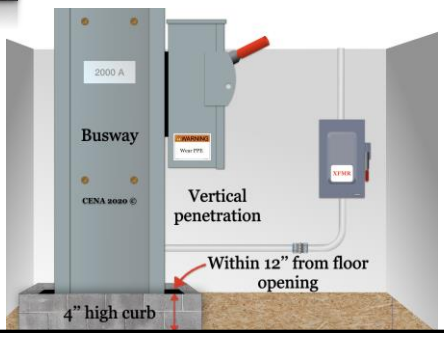


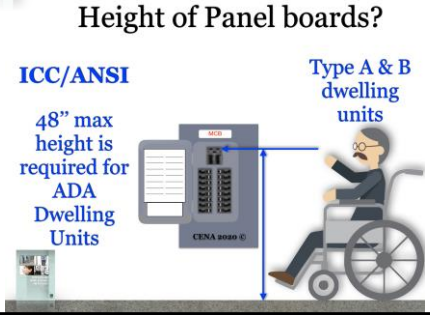
695.6(J)
Junction boxes installed in fire pump room require a seal tight enclosure. Type 2 listed enclosure are equal to a listed fire pump controller.



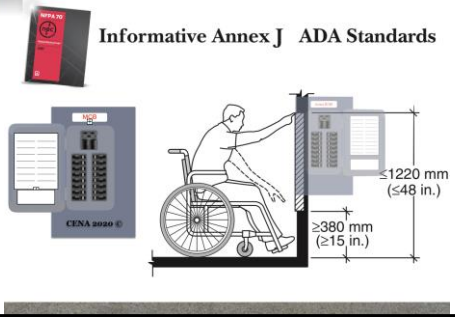
368.10(C)(2)
Busways penetrating 2 or more dry floors vertically require a 4" high curb within 12" of the floor opening on all sides to prevent liquids from accumulating through the floor.



1002.9 Operable Parts
Panelboard maximum height is 48" and minimum from the floor at 15". ADA requires all electrical circuit breakers to be reachable for accessible dwelling units. This includes both type A & B units.



Annex J.
Measurements for ADA reach for electrical components can be located in Annex J as a references for ADA compliance.



FEEDER INSPECTION CHECKLISTS

Feeders (cont.)			
Item	**Inspection Activity**	**NEC Reference**	**Comments**
16.	Verify that different means of identification for feeders where more than one nominal voltage system is used and the two systems occupy the same raceways or enclosures	215.12(A)	
17.	Verify that no overcurrent device is inserted in a feeder grounded conductor	240.22	
18.	Verify there are no grounding connections to a grounded conductor on the load side of the service disconnecting means	250.24(A)(5), 250.142(B)	
19.	Check for proper terminations of grounded (neutral) conductors on neutral terminal bus in panelboard (only one per terminal)	408.41	
20.	Verify parallel conductor installations meet all of the requirements for parallel conductors	310.4	
21.	Verify any required GFPE equipment is installed and has been performance tested prior to energizing	215.10, 240.13, 230.95(C), 517.17	

408.4(B)
All panel boards require affixed label printed on the cover indicating the location of upstream supply equipment. No handwritten markings permitted.

Labeling for Panelboards

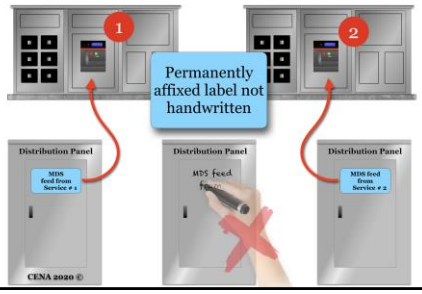


Table 250.122
Grounding conductor sizes are required to be no less than sizes in Table 250.122. All ground wire sizes are based on the upstream over-current device. This includes paralleled circuits.

Rating or Setting of Automatic Overcurrent Device in Circuit Ahead of Equipment, Conduit, etc., Not Exceeding (Amperes)	Size (AWG or kcmil)	
	Copper	Aluminum or Copper-Clad Aluminum*
15	14	12
20	12	10
60	10	8
100	8	6
200	6	4
300	4	2
400	3	1
500	2	1/0
600	1	2/0
800	1/0	3/0

Table 250.122
Grounding conductor sizes are required to be no less than sizes in Table 250.122. All ground wire sizes are based on the upstream over-current device. This includes paralleled circuits.

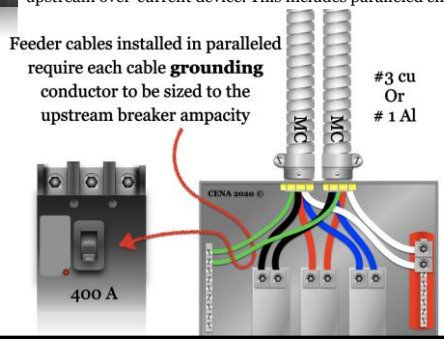


Table 250.96
Grounding conductors installed in metal raceways require sizing the same as if installed in PVC conduit.

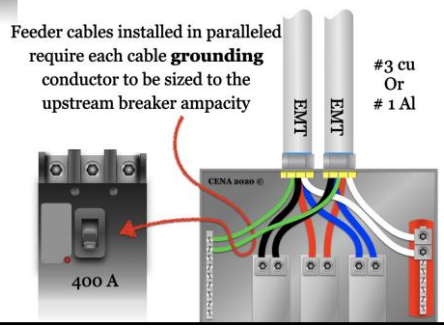
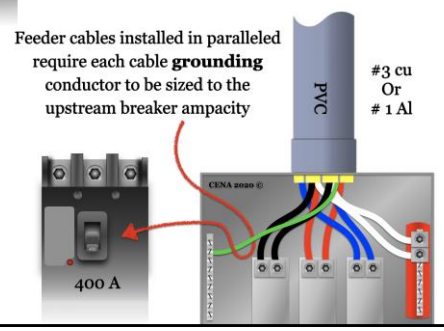


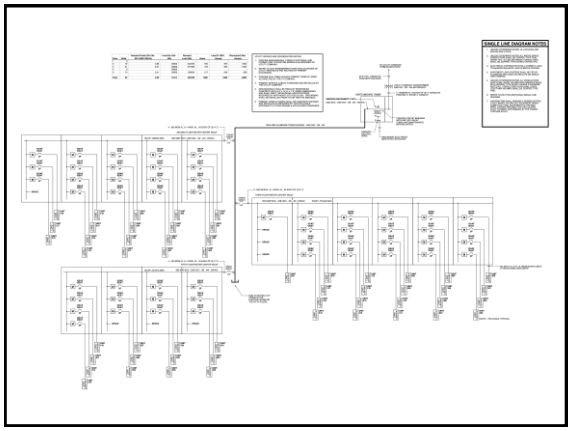
Table 250.122
Grounding conductors installed in metal raceways require sizing the same as if installed in PVC conduit.

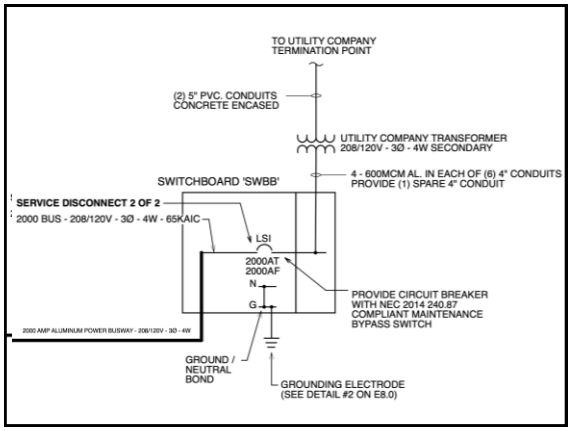


Lighting Circuits

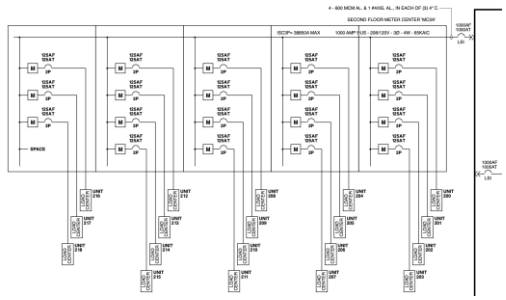
DRAWING NOTES

1. FIELD VERIFY LOCATION OF ALL WIRING DEVICES WITH ARCHITECT PRIOR TO ROUGH-IN.
2. FIELD VERIFY EXACT LOCATIONS OF ALL LIGHTING FIXTURES WITH ARCHITECT PRIOR TO ROUGH-IN.
3. UNLESS OTHERWISE NOTED ALL LIGHTING SHALL BE CIRCUITED TO PANEL 'A1A'.
4. UNLESS OTHERWISE NOTED ALL EMERGENCY LIGHTING AND EXIT SIGNS SHALL BE CIRCUITED TO PANEL 'EL1A'
5. EXIT SIGNS SHALL BE CONNECTED TO LINE SIDE OF LOCAL LIGHTING CONTROL.
6. UNLESS OTHERWISE NOTED ALL CORRIDOR AND STAIRWELL FIXTURES ARE NIGHT LIGHTS SHALL BE 24/7 OPERATION.
7. EMERGENCY LIGHTING CONTROL UNIT (ELCU) SHALL BE CONNECTED TO THE LOCAL LIGHTING ZONE WHERE INDICATED ON PLAN. CONSTANT NORMAL POWER, AND EMERGENCY CIRCUIT AND SHALL AUTOMATICALLY ILLUMINATE THE FIXTURE TO 100% OUTPUT UPON LOSS OF NORMAL POWER, SEE DETAIL #4 ON DRAWING E8.2.





Floor	Units	Demand Factor (Per the	Load Per Unit (VA)	Demand Load (VA)	Amps	Load @ 125% (Amps)	Disconnect Size (Amps)
1	0	-	-	-	-	-	-
2	19	0.38	35000	252700	700	875	1000
3	21	0.37	35000	271950	753	942	1000
4	0	-	35000		-	-	-
5	13	0.41	35000	186550	517	646	800
Total	53	0.25	35000	463750	1285	1606	2000



Elevators

Electrical requirements

ESS Level and Type

Conductors Ampere rating

2 hr rating

Disconnect Locations

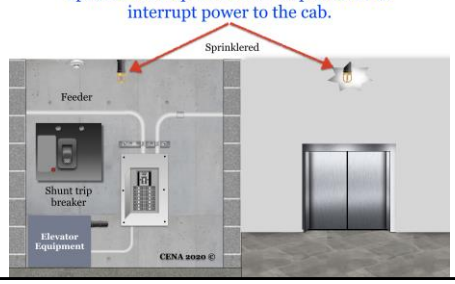
Cab & Control space Lighting

Receptacles

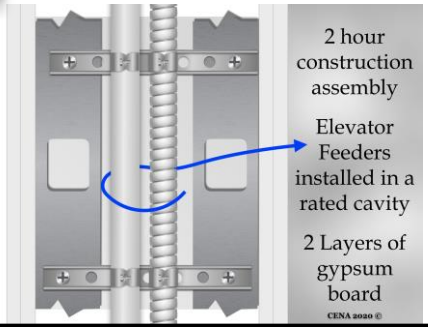
SPD's

3005.5 Machine room
Control equipment spaces and hoistways that are sprinklered require disconnection of power feeder to elevator equipment. Shunt trip breakers require manual reseting.

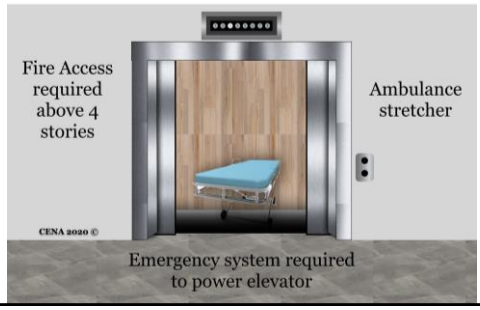
Elevators control spaces and hoist ways that are sprinklered require a shunt trip breaker to interrupt power to the cab.



700.10(D)(1)
2 hr rated wiring methods can be achieved several ways. Building construction fire assemblies is acceptable.

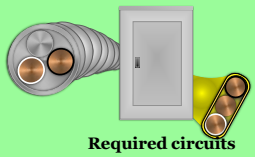


3002.4 Fire Department Emergency Access
When an elevator is required to be use to accommodate an ambulance stretcher in buildings more than 4 stories above grade plane, the shunt trip breaker powering the elevator equipment is prohibited.



Branch Circuits

The circuit conductors between the final over- current device protecting the circuit and the outlet(s)



Required circuits

Commercial

Residential

Commons areas

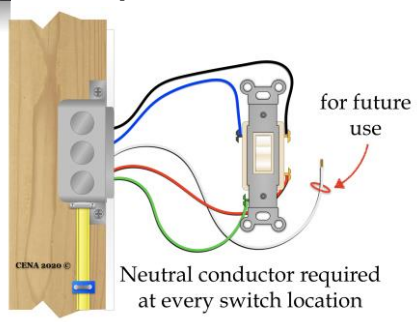
BRANCH CIRCUITS INSPECTION CHECKLISTS

Branch Circuit Electrical Inspections			
Item	Inspection Activity	NEC Reference	Comments
1.	Verify type of occupancy and wiring methods are suitable for that type of occupancy	Chapter(s) 3 and 5	
2.	Check for proper sizes of branch circuits	210.19, 310.16, 240.4(D)	
3.	Verify proper sizes for branch circuit overcurrent protection, overcurrent device rating and interrupting rating	210.20, 240.4, 408.30, 110.9, 110.10, 240.86	
4.	Check for individual and multiple outlet branch circuits ratings	210.3, 210.23	
5.	Verify the continuous loads and the noncontinuous loads and the circuit sizes	210.19, 210.20, 310.15	
6.	Verify the branch circuit loads do not exceed the maximum loads allowed	220.10 thru 220.14, 220.18	
7.	For motors and HVAC equipment verify the branch circuits meet the requirements in Article 430 and 440	240.14(C), 430.22, 430.24, 440.31 thru 440.35	
8.	Check that the loads on the circuit does not exceed the circuit rating	210.23	

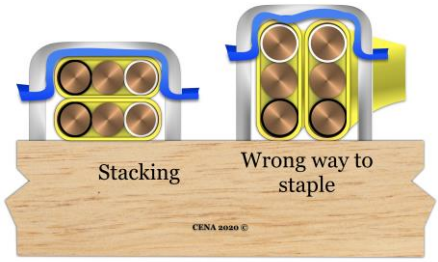
BRANCH CIRCUITS INSPECTION CHECKLISTS

Branch Circuit Electrical Inspections			
9.	Verify that the branch circuits are enough for the load served and the load is evenly distributed	210.11	
10.	Check that the branch circuits for specific loads meet the requirements of that particular article	210.2	
11.	Verify multiwire branch circuits for proper use and identification	210.4, 210.5	
12.	Verify simultaneous disconnects for all multiwire branch circuits	210.4(B)	
13.	Verify grouping of multiwire branch circuits in at least one location within the panelboard.	210.4(D)	
14.	Check for lighting and receptacles at mechanical equipment locations	210.63, 210.70(C)	
15.	Check for required location of outlets at show windows and signs	210.62, 600.5(A), 220.14(G) and (F)	

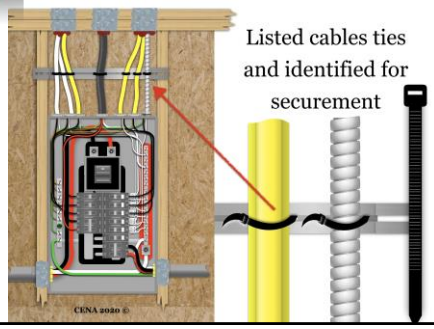
404.2(C)
All switch locations require a neutral conductor installed for future electronic devices. This will accommodate motion sensors installed or replaced in the future.



334.30 Securing
Non metallic cable requires approved staples for securement. Product listings provide instruction on the proper use of wire securement.

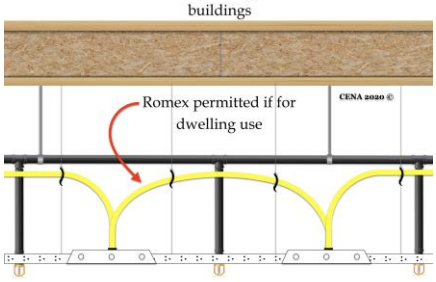


334.30 Securing
Non metallic cable secure with cable tie require listing for securement and support. Identified labels on the carton or bag.



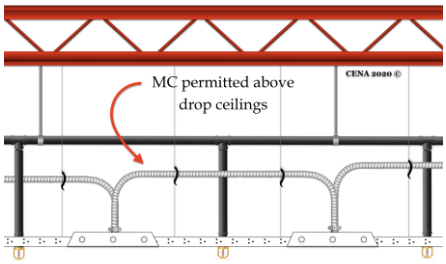
334.10(2)
Romex cable is permitted any where in Multi-family dwelling building(s) of type 5 construction. Type 5 construction protected and sprinklered throughout permits romex cable to be used in that portion of the building.

Romex above drop ceilings in Residential buildings

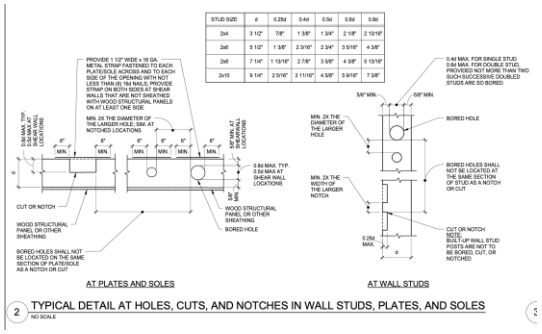


330.10
MC cable is permitted any where in building not subject to physical damage or corrosion. 120 volt to 600 volt rated UL listed for use as feeders and branch circuits.

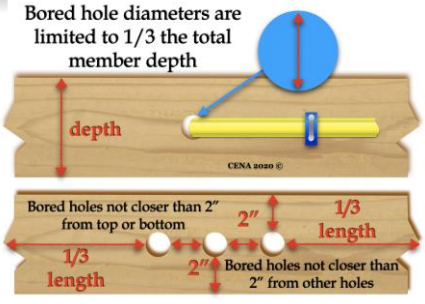
Other wiring methods used above drop ceilings in Commercial buildings



Front page

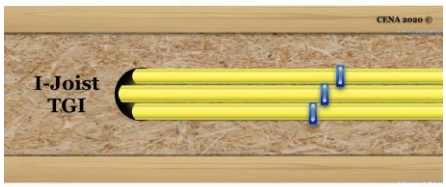


300.4
Drilling and notching is permitted for sawn lumber. Load bearing and non bearing studs have different allowances. Top plate notching is also addressed in the rules.



300.4
Engineered lumber requires the design professional involved to grant any permission if making penetrations in any engineered products.

Engineered lumber has instructions permitting cutting or boring

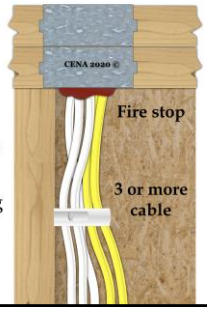


Engineered lumber is manufactured. Check with registered design on plans or manufacture recommendations

334.80 Ampacity
Romex cables requires derating if 3 or more cables pass through a bored hole in framing members with fire sealant. All conductors exceeding 3 required amperage adjustment.

Ampacity derating

Romex cables passing through the same bored hole in framing members that are sealed with fire caulk must apply derating to all current carrying conductors.



334.80 Ampacity
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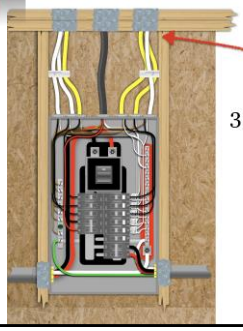
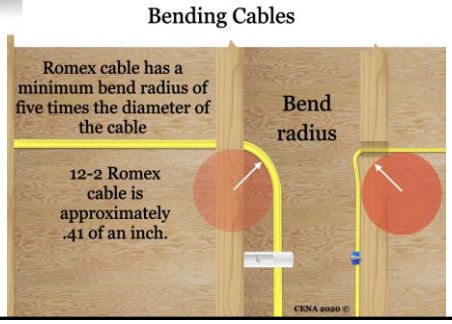


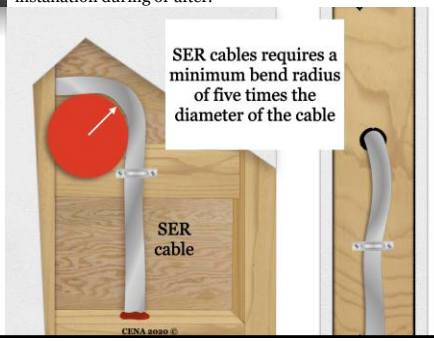
3 or more NM cables installed in fire sealants must be adjusted for Ampacity.

CENA 2020 ©

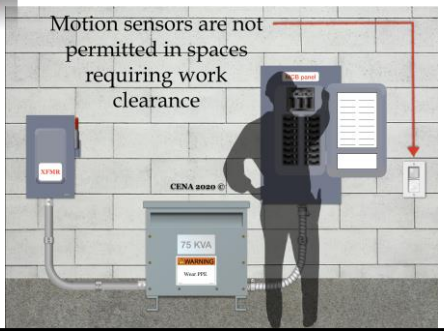
334.24 Bending Radius
Romex cables requires a radius curve of the inner edge of the cable not less than 5 times the diameter of the cable.This include during installation or after.



338.24 Bending Radius
SER cables requires a radius curve of the inner edge of the cable not less than 5 times the diameter of the cable. This includes installation during or after.



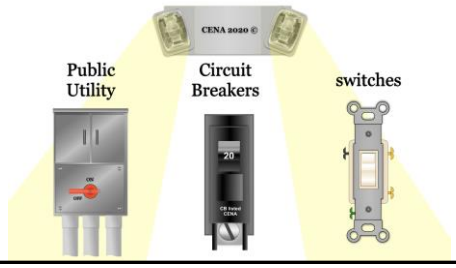
110.26(D)
Automatic controls of any type are not permitted to control lighting for work clearances at electrical equipment.



1008.3.6 Activation

Emergency lighting is required to illuminate the means of egress when an interruption of the normal lighting in the event of a public utility outage, circuit breaker or switches opened.

Interruption of normal power by any of these 3 possibilities require activation of emergency lighting



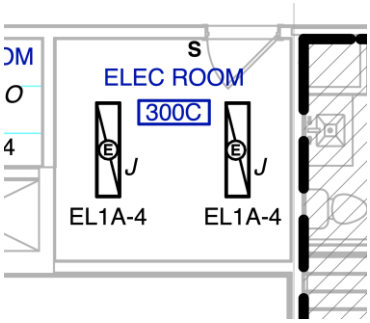
1008.3.3.(1)

Corridors require 2 lighting circuits, 1 from the normal and 1 from the emergency.

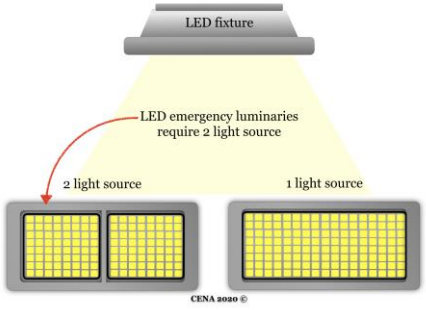
Emergency lighting systems shall be designed and installed so that the failure of any individual lighting element, such as the burning out of a lamp, cannot leave in total darkness any space that requires emergency illumination.

(B) System Reliability. Emergency lighting systems shall be designed and installed so that the failure of any illumination source cannot leave in total darkness any space that requires emergency illumination. Control devices in the emergency lighting system shall be listed for use in emergency systems. Listed unit equipment in accordance with 700.12(F) shall be considered as meeting the provisions of this section.

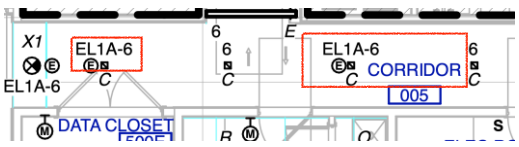
1008.3.3.(1)
Electrical rooms require emergency lighting. 2 circuits, normal and emergency with local switches bypassed.



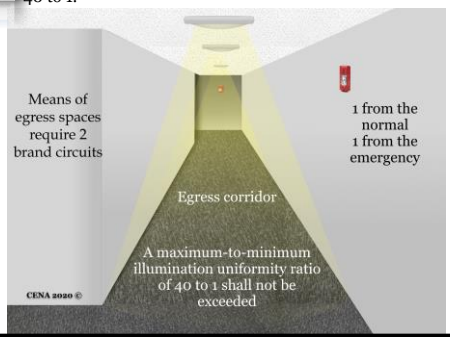
1008.2.3 Arrangement of Illumination
Required illumination requires arranged so that the failure of any single lamp does not result in an illumination level of less than 0.2 foot-candle at the floor level.



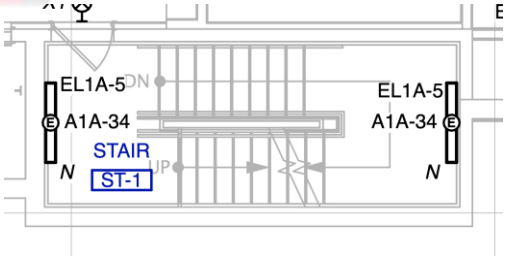
1008.3.3.(1)
Corridors require 2 lighting circuits, 1 from the normal and 1 from the emergency.



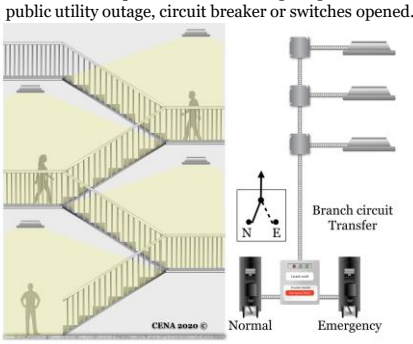
1008.3.5
Egress Corridors require 2 lighting circuits, 1 from the normal and 1 from the emergency with a uniform illumination ratio of 40 to 1.



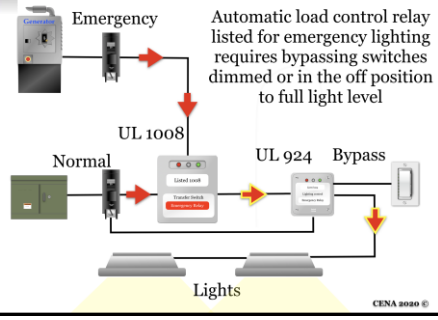
700.17
Areas requiring emergency means of egress lighting require 2 circuits from both the normal and emergency system. Stairways, corridors, and other passage ways require 2 circuits.



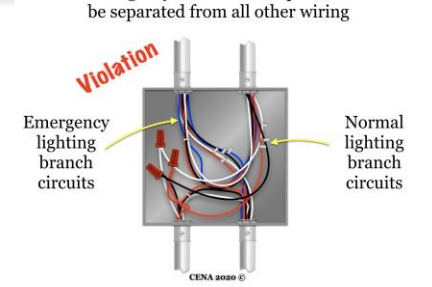
1008.3.6 Activation
Emergency lighting is required to illuminate the means of egress when an interruption of the normal lighting in the event of a public utility outage, circuit breaker or switches opened.



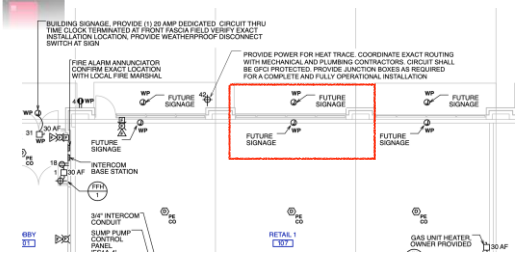
700.17
2 branch circuits are required for each space or area of means of egress. Both normal and emergency circuits are required to supply lighting fixtures if either is interrupted.



700.10(A)
Emergency circuits require separation from all other circuits. 2 emergency circuits from the same source are permitted together. Includes raceways, cables, boxes, etc.



600.5 Required sign circuits
Each front entry to a store requires at least one 20 amp 1200 watt rated branch circuit installed above the door entry.



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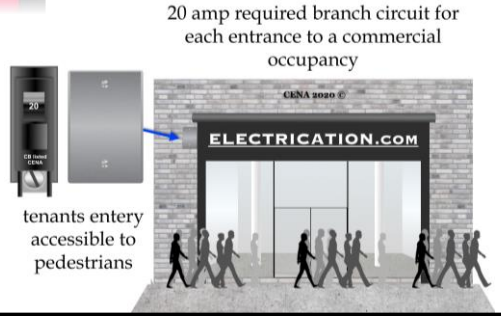
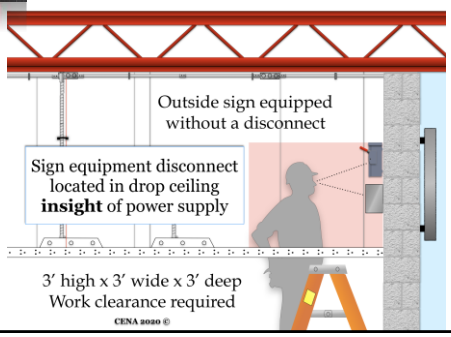
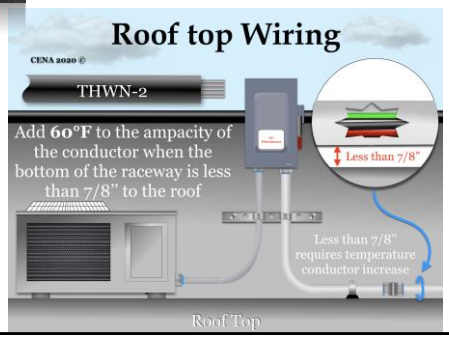


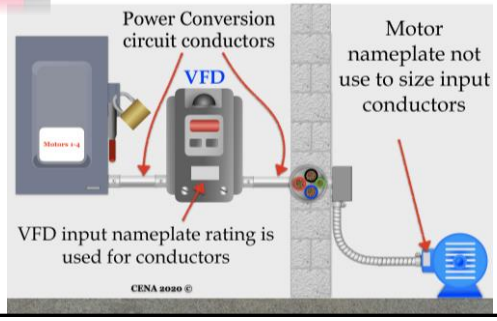
600.21(D) Required sign work clearance
Sign power supplies require a 3x3x3 work clearance when not in sign itself.



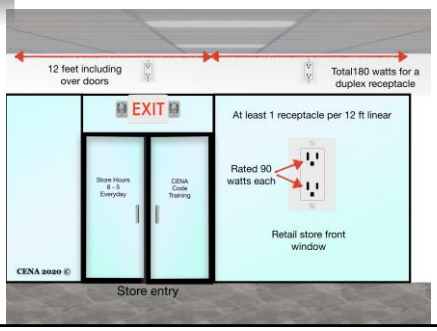
310.15(B)(3) Raceways expose to the sun
Raceways located on roofs within 7/8" require a temperature multiplier of 60°C added as a correction factor



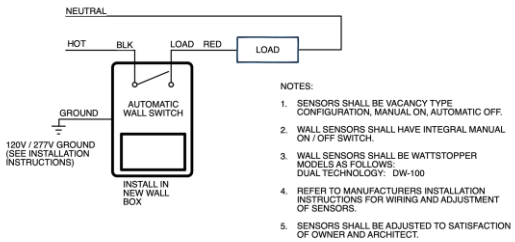
430.120(A)
Adjustable-speed drive system conductors shall have an ampacity not less than **125%** of the rated input current to the power conversion equipment.



210.62 & 220.43
Any windows used for displays reqiure receptacles located above windows within 18" and 1 for each 12' wide window including over doors.

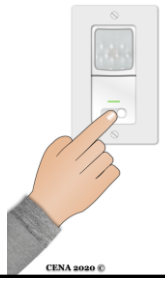


Equipment Details



C405 Lighting systems
Light fixtures require occupancy sensors in specific areas of commercial buildings. Applies to all areas except in dwelling units.

Occupancy Sensor Control



1. Classrooms/lecture/training rooms.
2. Conference/meeting/multipurpose rooms.
3. Copy/print rooms.
4. Lounges.
5. Employee lunch and break rooms.
6. Private offices.
7. Restrooms.
8. Storage rooms.
9. Janitorial closets.
10. Locker rooms.
11. Other spaces 300 square feet (28 m2) or less that are enclosed by floor-to-ceiling height partitions.
12. Warehouses

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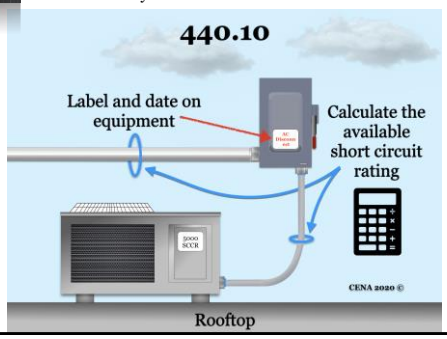
410.64(C)
A cord connected LED lighting fixture requires a plug and cord attachment to a receptacle for a connection. Hardwire cords are not permitted unless listed specifically from the manufacture.

440.10
Field marked SCCR value required to be placed where visible for determining the short circuit of the equipment. Dated and available for anyone in the future.



Use of OEDM Training Materials

Use of Office of Education and Data Management (OEDM) training materials must be approved in writing by the State of Connecticut, Department of Administrative Services' Office of Communications. In approving of such use, the State of Connecticut assumes no liability associated with such use, including, but not limited to, the user's dissemination of any inaccurate information or interpretation in connection with its use of these training materials. Use of the training materials is at the sole risk of the user, and the State's approval of the use does not constitute an endorsement of the user or its intended use.

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