The Connecticut General Statues and Regulations and 2017 NEC Changes Chapters 4-5 for Unlimited Licensees

Instructor Introduction

Morning Class Schedule: 4 hours

- General Statues and Regulations, Ratio of Apprentices
- Connecticut State Building Code
- Safety
- 2017 NEC Changes
- Calculations
- Final Q&A

1

- This course is worth 4 hours of continuing education for Unlimited Licensees. (E1, E2, E9)
- You will be emailed a copy of your certificate within 2 business days.

Questions? Concerns?
Call the office at 1-800-443-5233

2

Section 332b - Hiring ratios for apprentices, journeymen and contractors

Lower ratios of licensees to apprentices compared to previous law

Apprentices	Licensees (now)
3	3
4	6
6	12
8	18
10	24

(Ratio continues at 3 licensees to 1 apprentice)

3

Section 30-332-15a - Employment of Apprentices

Apprentices:

May perform work *only* in the presence and under the direct supervision of a licensed contractor or journeyman

Direct Supervision:

Is defined as under the guidance of and within sight and/or hearing of the licensed person

Violation:

May result in disciplinary action, including loss of license by contractor who obtains the permit for the work

4

Section 332-15a (f) - How to register an apprentice

- An apprentice may not perform any work covered by Chapter 393 of the General statutes prior to registration
- The contractor must contact the department of labor to request registration of the apprentice.
- An Electrician apprentice can be registered as an E-2 and then must receive 8000 total hours of training in multiple types of electrical work. Four years (minimum) of on-the-Job training is required.

5

Section 20-332-16 - Prohibited Acts, Records, Lettering

Prohibited acts subject to disciplinary action include:
Working beyond the limitations of one's license or operating under a name other than the one on his license without first informing the licensure board.

Records:
Licensed contractors must keep records of all employees, to be shown to the Commissioner (or his/her agent) upon request.

Lettering:
State license numbers must be displayed on all commercial vehicles in letters at least one inch high and legible.

6

Section 20-335 - License Fee, Continuing Ed. Requirements, Expiration & Renewal

Initial License Application Fee: Journeyman $90.00, Contractor $150.00

Annual License Renewal Fee: Journeyman $120.00, Contractor $150.00

Continuing Education Requirements:

The required annual continuing education for all license categories is **4 hours.**

Expired licenses:

Licenses can be renewed up to one month after date of expiration with no penalty. Failure to renew license within two years after expiration requires re-application and payment of associated fees.

7

Section 20-338a - Work required to be performed by licensed persons

All work for which a building permit is required must be performed by a licensed contractor or journeyman. (Or a properly supervised and trained apprentice)

8

Section 20-338b - Building permit applications; Who may sign

- The contractor may sign the permit application personally.
- He or she may delegate this to an employee, subcontractor or other agent provided.
- A *dated* letter on *the contractor's letterhead* must be provided to the building official authorizing the agent to sign the permit application. The letter must include:
  - Name of municipality where work is to be performed
  - Job name or description
  - Starting date for the job
  - Name of both the contractor and the agent
  - The license numbers of all involved

9

Section 20-338c - Work not to commence until permit is obtained

No licensed contractor may begin work for which a license is required, prior to obtaining all necessary permits from the local AHJ.

- Different permits may be required by general statute (state law) and by local ordinance.
- The state mandates building permit requirements.
- Local government may require additional permits, for example:
  - Occupancy Permits for work being done in the public right of way.
  - Alarm permits, sign permits, zoning permits etc.
- Each municipality may have its own unique regulations

10

Section 20-340 - Exemptions from Licensing Requirements

- Persons employed by any federal, state or municipal agency
- Employees of any public service company or corporate affiliate
- Industrial maintenance firms
- Work performed on Single Family Residences occupied by the owner
- Employees of licensed solar contractors
- Stage and theatrical companies, carnivals, circuses, etc.

11

Section 20-341 - Penalties for Violations

Offenses covered by this section include:

- Work performed without a license
- Advertising to do work for which one is not licensed
- Employing a person who does not hold the appropriate license (or apprentice permit)
- Working under an expired license or apprentice permit;

Penalties may include:

  - Criminal charges. (class B misdemeanor)
  - Civil penalties of up to $3000.00 per violation.

12

Public Act No. 17-76 & Ratio Relief Form

Public Act No. 17-76 – repeals and replaces Sec 20-332b

Two important changes to laws:

- Apprenticeship ratio relief form
- Lower ratios of licensees to apprentices compared to previous law – *examples below*

Apprentices	Licensees (before)	Licensees (now)
3	5	3
4	8	6
6	14	12
8	20	18
10	26	24

(Ratio continues at 3 licensees to 1 apprentice)

13

Connecticut State Building Codes

The 2018 Connecticut State Building Code is based on the following model codes:

- The 2015 ICC codes and references:
- The ICC A117.1-2009 (accessibility) standard
- National Electrical Code (2017 NFPA 70)
- The 2018 State codes applies to projects with permit applications
- Amendments to the model codes can be found from this link: https://portal.ct.gov/-/media/DAS/Office-of-State-Building-Inspector/2018-CT-State-Building-Code---Effective-10-01-18.pdf?la=en

14

Safe Operating Rules and Procedures

Wear Personal Protective Equipment as needed for hazards identified.

Lift correctly. Lift with your legs not your back. Lift only objects that can be done safely.

Smoke in only designated areas.

Report all injuries. This is important, because the injury might prove to be serious later!

Inspect all ladders and scaffolding before use.

Always follow your companies LOTO program.

Correct and report all unsafe conditions.

Identify all hazards and mitigate as necessary.

15

Electrical

All electrical work shall comply with the current National Electrical Code adopted at the time of installation.

Job sites shall be provided with GFCI protection for personnel. This protection shall comply with OSHA, NEC and NFPA 70E current standards. In lieu, of GFCI protection an assured equipment grounding conductor program is permissible.

It is the responsibility of the company owner to guarantee no contact with energized conductors or parts. All employees will be notified where energized parts are located. Barriers shall be provided to notify personnel of the minimum approach distance as specified by OSHA, the NEC and NFPA 70E.

The tags for LOTO shall be visible and legible.

16

Lockout/Tagout Procedures

Before any maintenance, construction, demolition, tie-in, inspection or servicing of equipment (electrical, mechanical steam or other) that requires entrance into or close contact with machinery, equipment, power sources or line breaking, the power shall be disconnected and locked out.

Lock out at the source, not control devices.

All energy sources shall be rendered inoperative, pneumatics, hydraulics, moving equipment, etc.

Locks and Tags will be removed only by the person directly responsible for the safe operation of the equipment.

17

Aerial Lifts

Aerial lifts include the following: Extensible and articulating boom platforms, vertical towers, aerial ladders, or any combination thereof!

Lift controls shall be tested everyday prior to use.

You must be authorized to operate an aerial lift.

Do not attach your fall protection to adjacent structures. A body belt must be worn and the lanyard attached to the lift.

Brakes shall be locked when outriggers are used on a solid flat surface, wheel chocks, shall be in place

Do not move the truck when the boom is extended. Controls for the boom shall be both upper and lower.

The insulation value of the bucket shall have integrity.

18

2017 NEC Changes Chapter 4

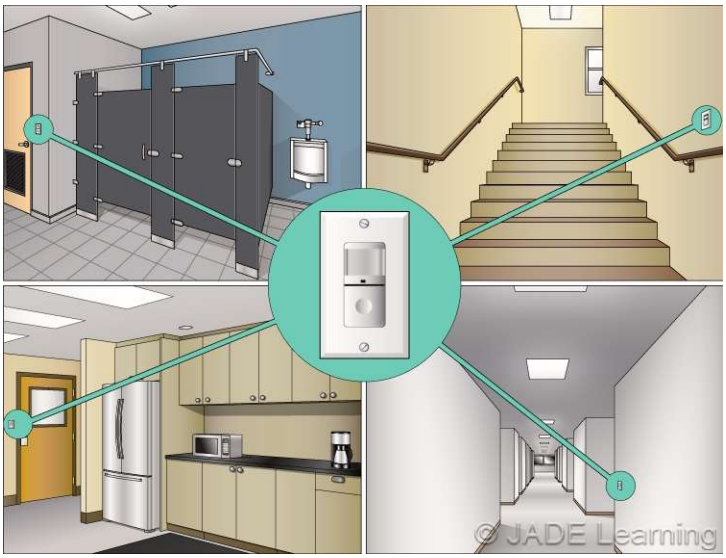
19

400.10 & 400.12 - Flexible Cords and Cables – Uses Permitted and Uses Not Permitted

A flexible cord is permitted to be located above a suspended or dropped ceiling if it is contained within an enclosure for use in Other Spaces Used for Environmental Air.

20

404.2(C) Switches Controlling Lighting Loads.

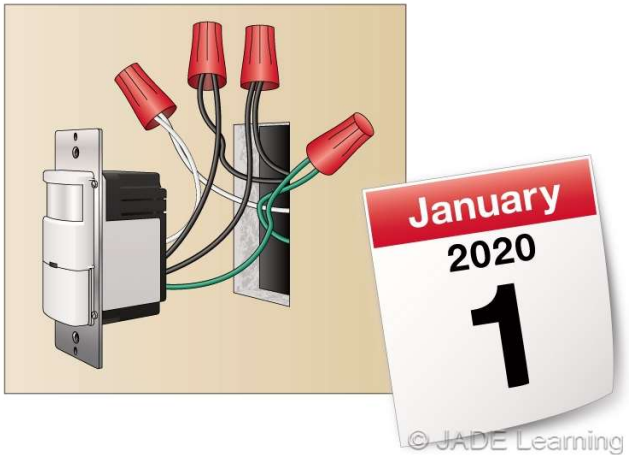


The grounded conductor must be installed at switch locations in bathrooms, hallways, stairways and rooms suitable for human occupancy.

21

404.22 - Electronic Lighting Control Switches

After January 1, 2020 an equipment grounding conductor cannot be used to power the electronic light switch.



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Connecticut 2017 NEC Changes for Unlimited Licensees

406.2 - Definitions - Outlet Box Hood

An outlet box hood is a housing shield intended to fit over a faceplate for flush-mounted wiring devices, or an integral component of an outlet box or of a faceplate for flush-mounted wiring devices.

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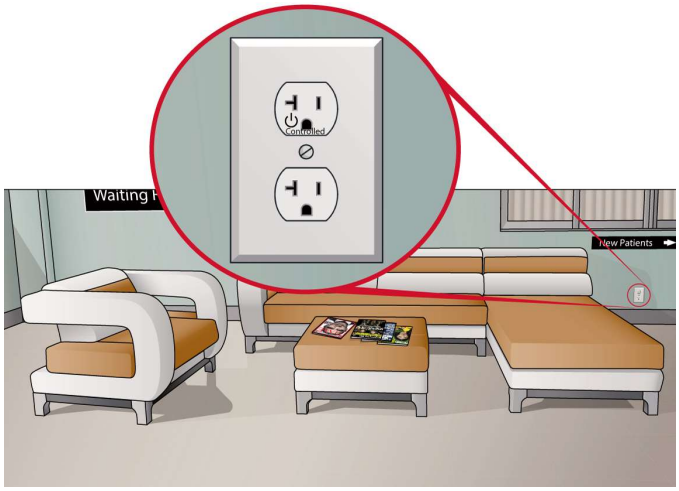
Connecticut 2017 NEC Changes for Unlimited Licensees

406.3(E) - Receptacle Rating and Type - Controlled Receptacle Marking

Receptacles that are controlled by an energy management system must be marked with the power symbol and the word "controlled."



24

406.3(F) - Receptacle Rating and Type - Receptacle with USB Charger

Receptacles with built in USB chargers must be listed.

25

406.4(D)(2) - General Installation Requirements - Replacements Non-Grounding-Type Receptacles

Not all non-grounding type receptacles can be replaced with a GFCI receptacle.

Some manufacturers require an equipment ground for their equipment or appliance.

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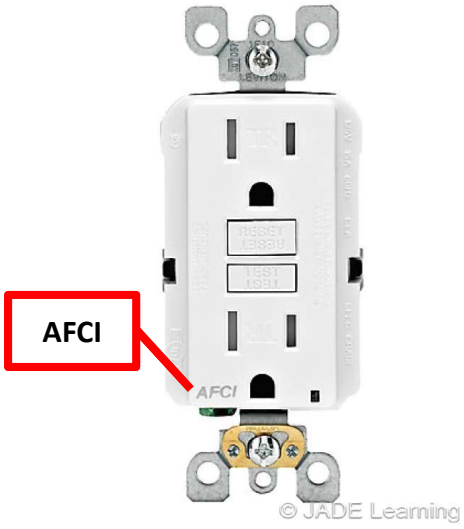
Connecticut 2017 NEC Changes for Unlimited Licensees

406.4(D)(4) General Installation Requirements - Replacements - AFCI Protection



Replacing a non-grounding type receptacle with another non-grounding type receptacle in an area that requires AFCI protection is not permitted.

JADE Top 20

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Connecticut 2017 NEC Changes for Unlimited Licensees

406.4(D)(5) - General Installation Requirements – Replacements - Tamper-Resistant Receptacles

A non-grounding receptacle is permitted to replace a non-grounding receptacle without providing tamper-resistant protection.

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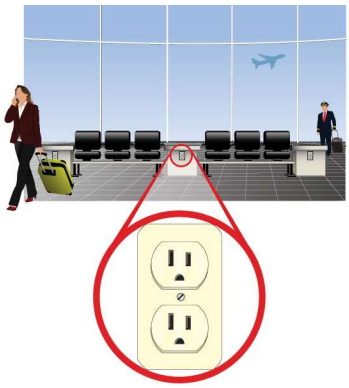
406.5(E), (F), (G), (H) - Receptacle Mounting - Receptacles in Countertops, Work Surfaces, Orientation, in Seating Areas

Receptacles listed for installation in countertops may be installed in work surfaces. Receptacles that are listed for installation in work surfaces only cannot be installed in countertops.

Listed for Countertop Applicatons



Listed for Work Surface Applicatons Only

406.6(D) - Receptacle Faceplates - Receptacle Faceplate with Integral Night Light and/or USB Charger.

Receptacle cover plates that incorporate a night light and/or a USB connector must be listed.

406.9(B)(1) - Wet Locations - Receptacles of 15 and 20 Amperes in a Wet Location

Receptacles in wet locations do not require an extra duty hood where the enclosure is identified for outdoor use without an outlet hood.

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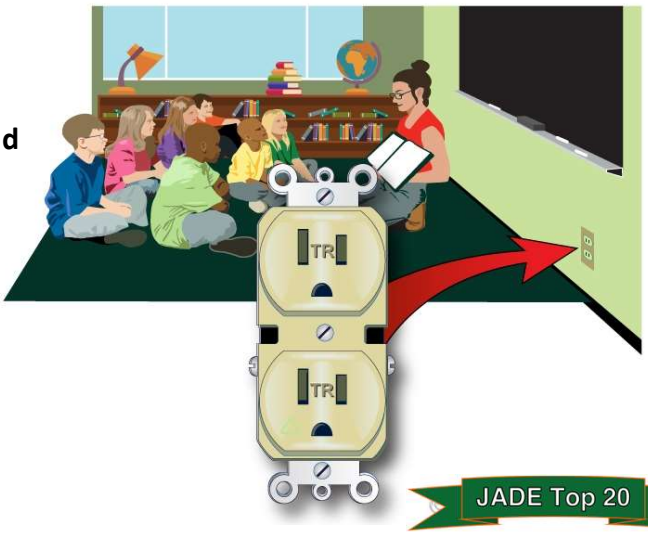
406.12 - Tamper-Resistant Receptacles

Also required in:

- **Preschools and elementary schools**
- **Business offices, corridors and waiting rooms in medical facilities**
- **Places of awaiting transportation**
- **Gymnasiums**
- **Skating rinks**
- **Auditoriums**
- **Dormitories.**



JADE Top 20

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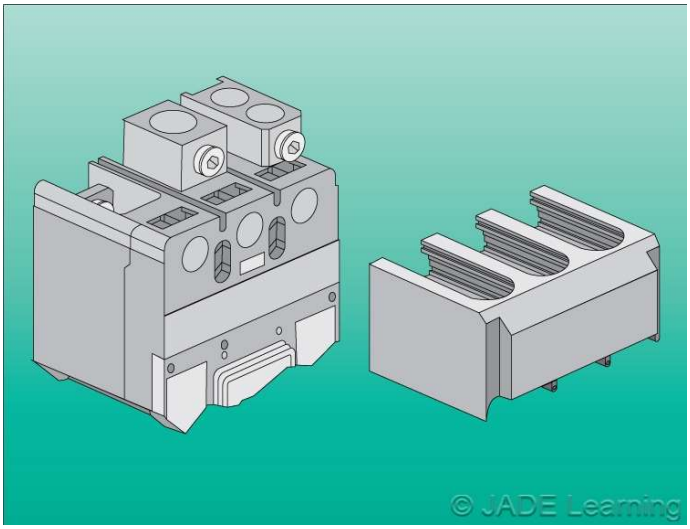
408.3(A)(2) - Service Panelboards, Switchboards, and Switchgear

Barriers are required, which will prevent accidental contact with busbars while servicing load terminations.



33

408.4(B) - Field Identification Required – Source of Supply

The label must be:

- **Permanent**
- **Durable**
- **Not handwritten.**

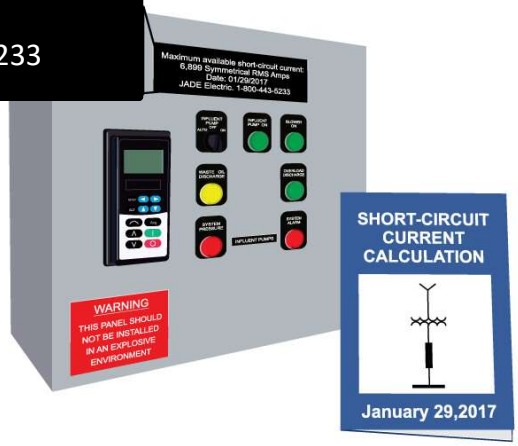
Supply Located in MDP1 Main Equipment Room

34

409.22 - Industrial Control Panels: Short-Circuit Current Rating

Maximum Available short-circuit current:
6,899 Symmetrical RMS Amps
Date: 01/29/2017
JADE Electric: 1-800-443-5233

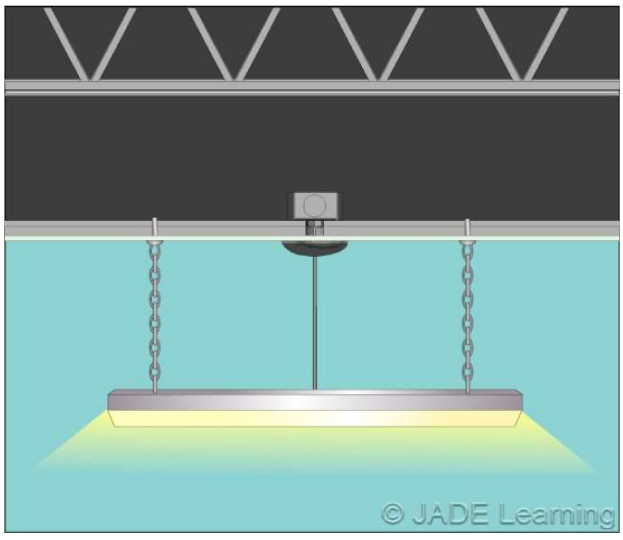
A record of the available short-circuit current and the date of the calculation must be kept.



35

410.62(C) Cord-Connected Electric-Discharge and LED Luminaires.

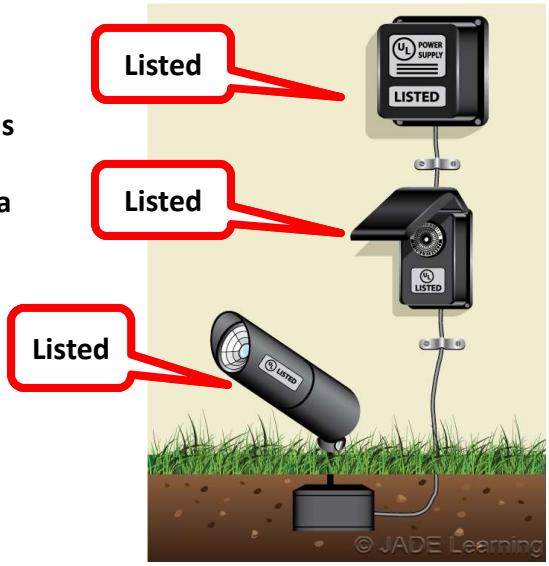
A luminaire can be cord-and-plug connected using a grounding-type attachment plug. The luminaire must be located directly below the lighting outlet, and the cord must be visible for its entire length.



36

Article 411 - Low-Voltage Lighting

Low voltage lighting systems using insulated conductors do not need to be listed as a complete system as long as each component is listed.



37

422.5 Appliances - GFCI Protection for Personnel

Single- or 3-phase appliances rated 250 volts or less, and 60 amperes or less, must have GFCI protection for personnel.

38

422.6 – Appliances: Listing Required

All appliances operating at 50 volts or more shall be listed.

39

422.16(B)(2) - Built-in Dishwashers & Trash Compactors

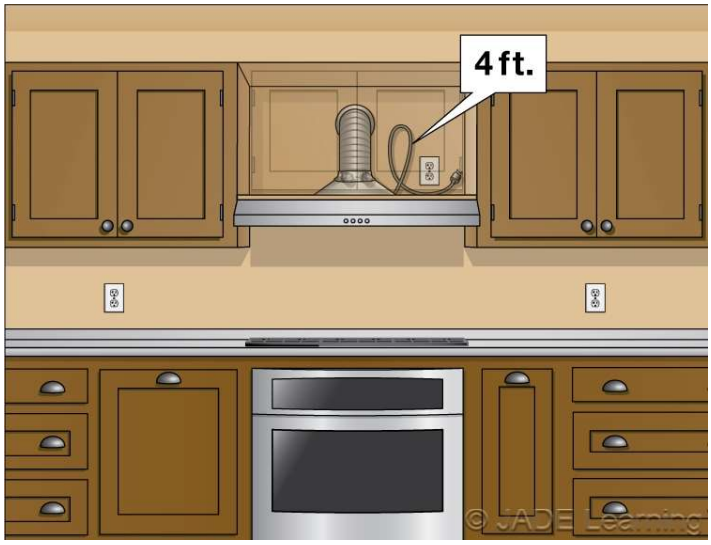
A receptacle for the dishwasher is no longer permitted to be installed behind the dishwasher. The receptacle must be accessible.

40

Connecticut 2017 NEC Changes for Unlimited Licensees

422.16(B)(4) - Flexible Cords: Range Hoods

The maximum length of the cord for a range hood has been increased to 4 feet.



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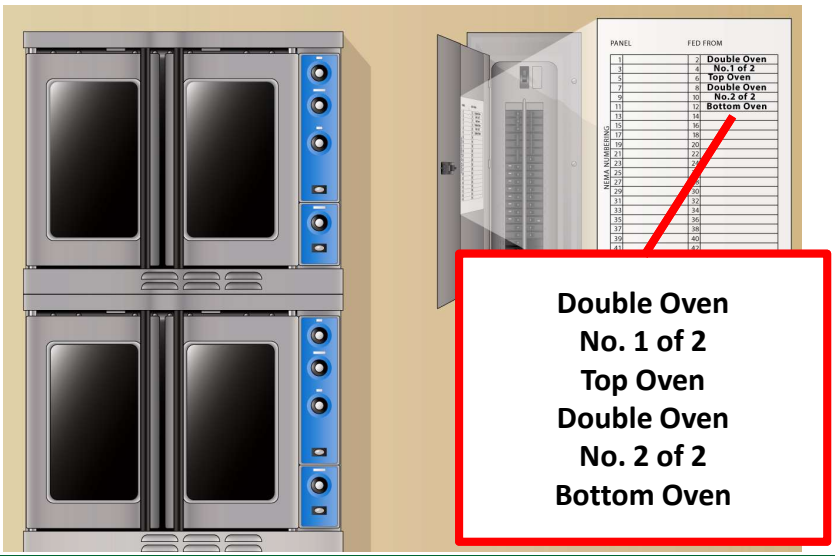
Connecticut 2017 NEC Changes for Unlimited Licensees

422.30 – Appliances: Disconnecting Means - General

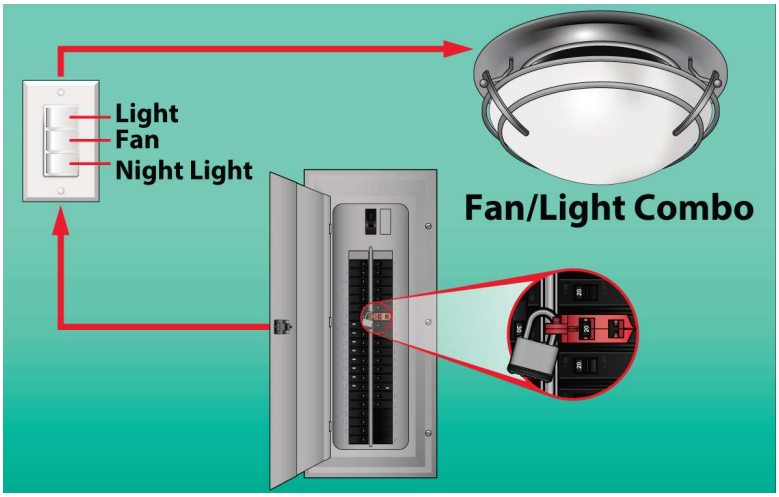


The disconnecting means for an appliance supplied by more than one branch circuit must be grouped and identified as the multiple disconnecting means for the appliance.

42

422.31(A) - Disconnection of Permanently Connected Appliances: Rated at Not over 300 Volt-Amperes or 1/8 Horsepower

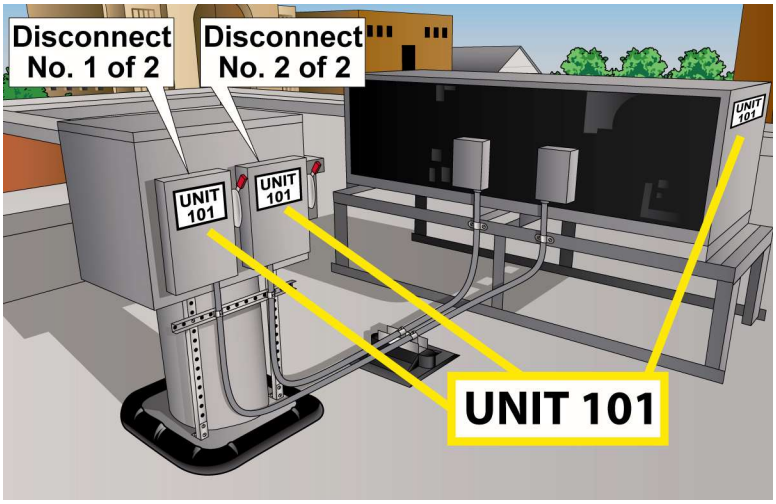
The disconnecting means for appliances that are rated not more than 300 volt-amperes or 1/8 HP must be within sight of the appliance or have a lockout device on the circuit breaker.



43

424.19 - Control and Protection of Fixed Electric Space-Heating Equipment: Disconnecting Means

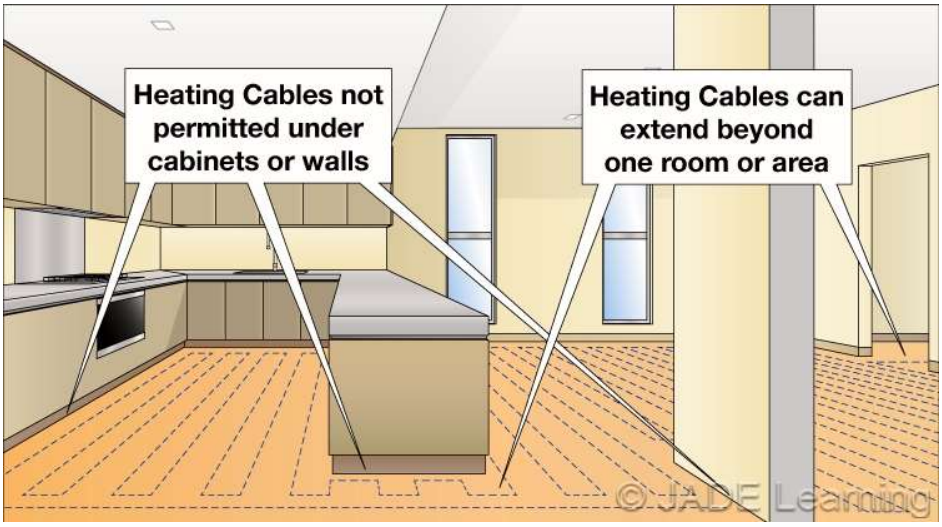
Multiple disconnects for heating equipment must be grouped and identified as being a part of multiple disconnecting means.



44

424.38 - Electric Space-Heating Cables - Area Restrictions

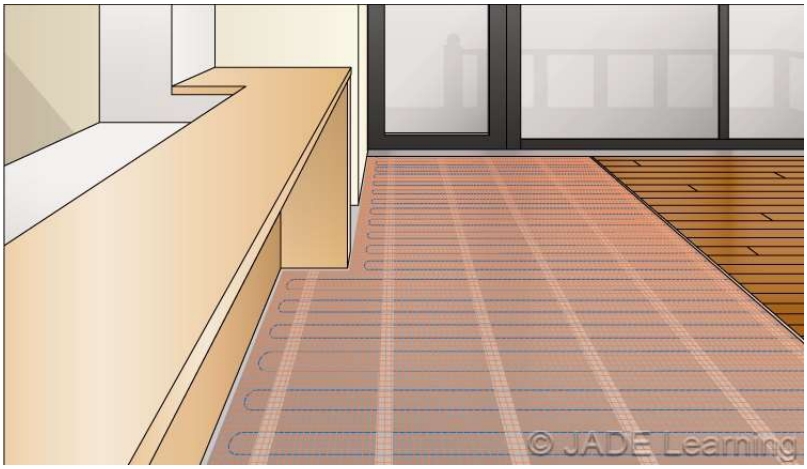
Heating cables are now permitted to extend beyond one room or area.



45

424.45 - Electric Space-Heating Cables: Installation of Cables Under Floor Coverings

Electric space-heating cables can be installed below ceramic tile, hardwood, vinyl floor coverings or even carpet if installed according to the manufacturer's instructions and identified as suitable for use under the floor covering.



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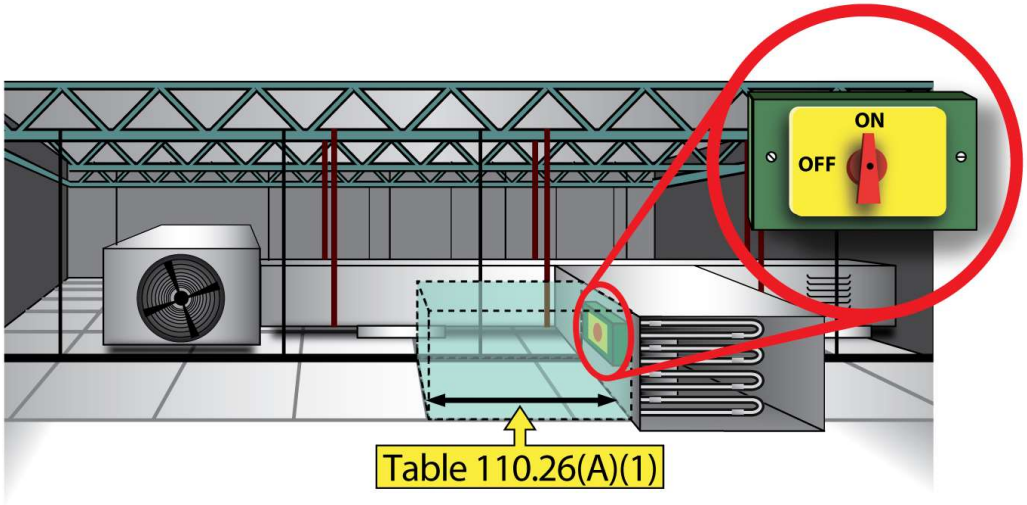
424.66 - Duct Heaters - Installation

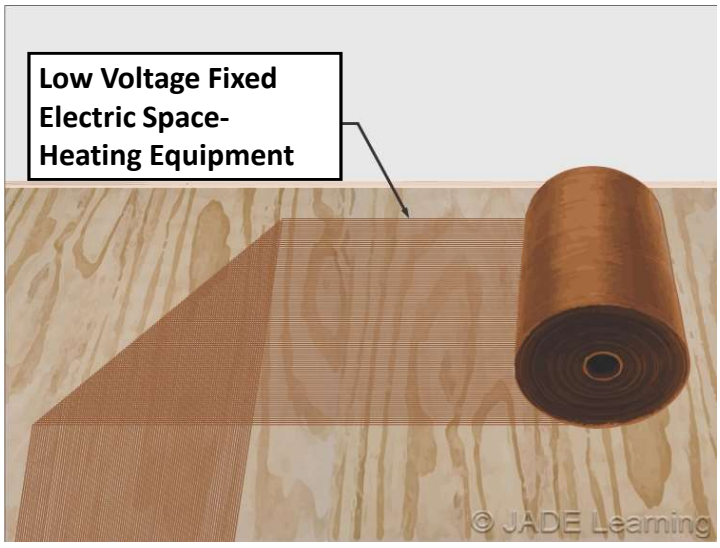
Duct heaters require working space in areas with limited access.



47

424 - Part X: Low-Voltage Fixed Electric Space-Heating Equipment.

Low-voltage fixed electric space-heating equipment must be listed as a complete system and installed in accordance with the manufacturer's installation instructions.



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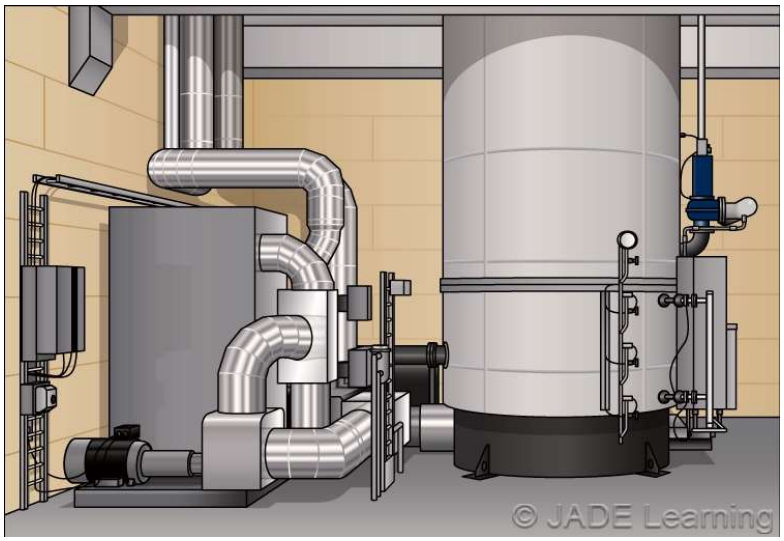
Article 425 Fixed Resistance and Electrode Industrial Process Heating Equipment

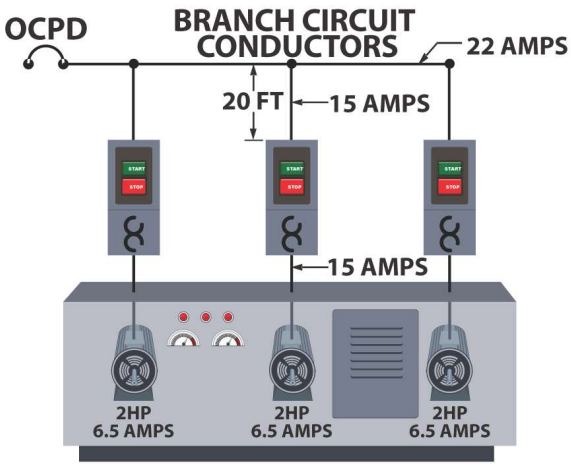


Article 425 covers fixed industrial process heating equipment that uses resistance or electrode heating technology.

430.53(D)(4) Several Motors or Loads on One Branch Circuit. Single Motor Taps.

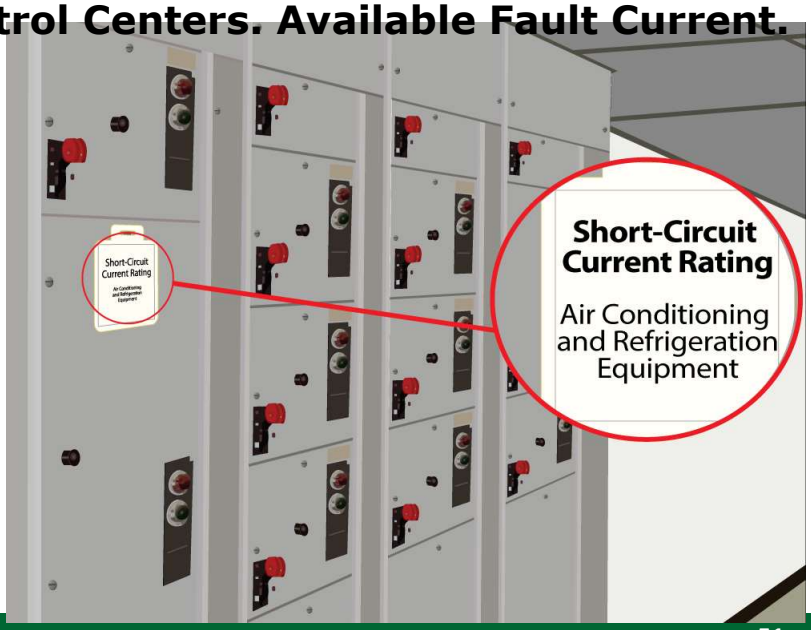
20 amps.

The tap conductors must be at least 1/3 the ampacity of the branch circuit conductors or the same size as the conductors from the manual motor starter to the motor, whichever is larger.



430.99 Motor Control Centers. Available Fault Current.

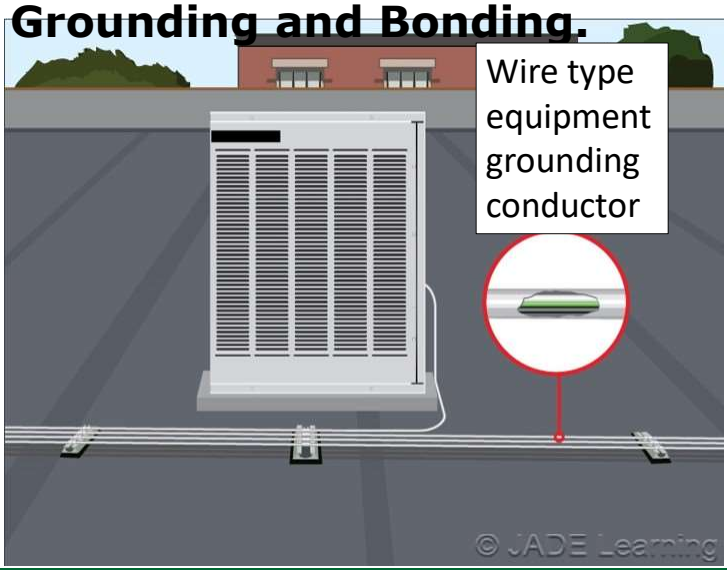
The available short-circuit current must be made available to those authorized to inspect the installation.



51

440.9 Air-Conditioning and Refrigerating Equipment. Grounding and Bonding.

A wire type equipment grounding conductor must be installed in metallic raceways that are installed outdoors on a roof and that use non-threaded fittings.



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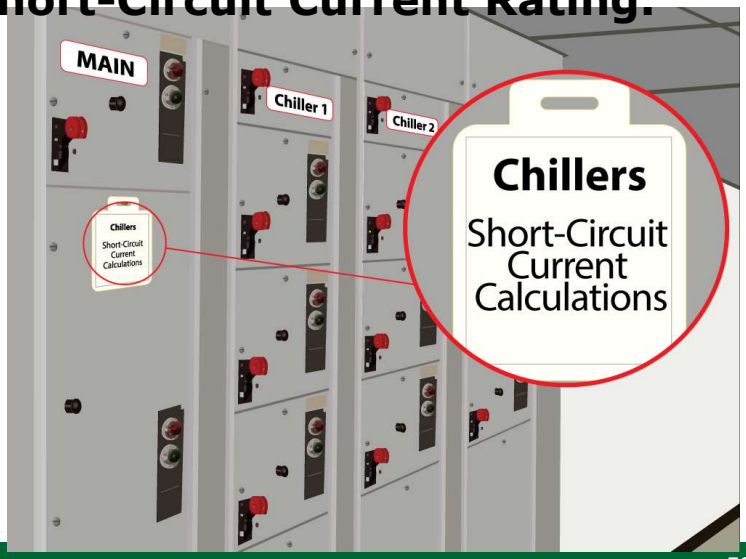
440.10 Air-Conditioning and Refrigerating Equipment. Short-Circuit Current Rating.

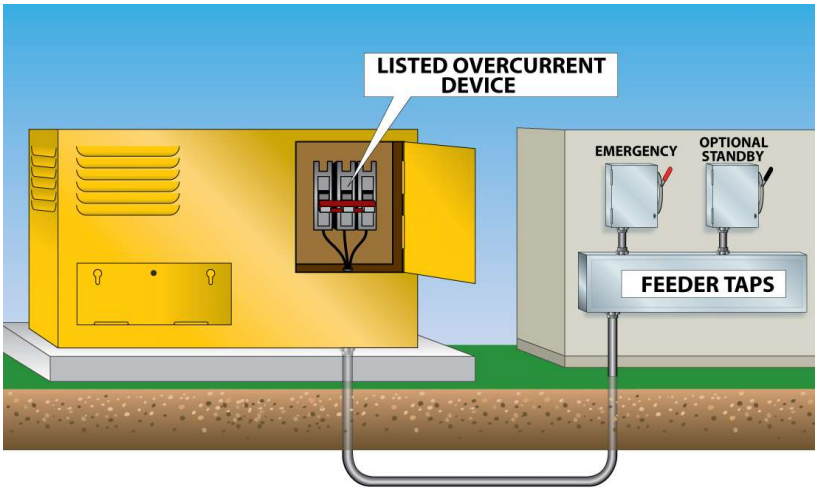
The available short-circuit current and the date the calculation was performed shall be documented and made available to those authorized to inspect the installation.



53

445.13(B) – Generators - Ampacity of Conductors: Overcurrent Protection Provided

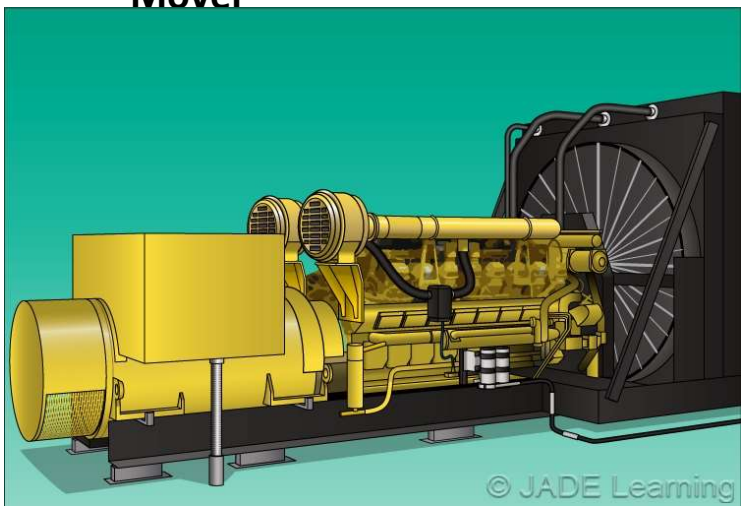
If a stationary generator rated 15 kW or more is equipped with a listed overcurrent device, taps to the generator feeder can be made on the load side of a listed overcurrent device.



54

445.18(A), (B) – Generators: Disconnecting Means, Shutdown of Prime Mover

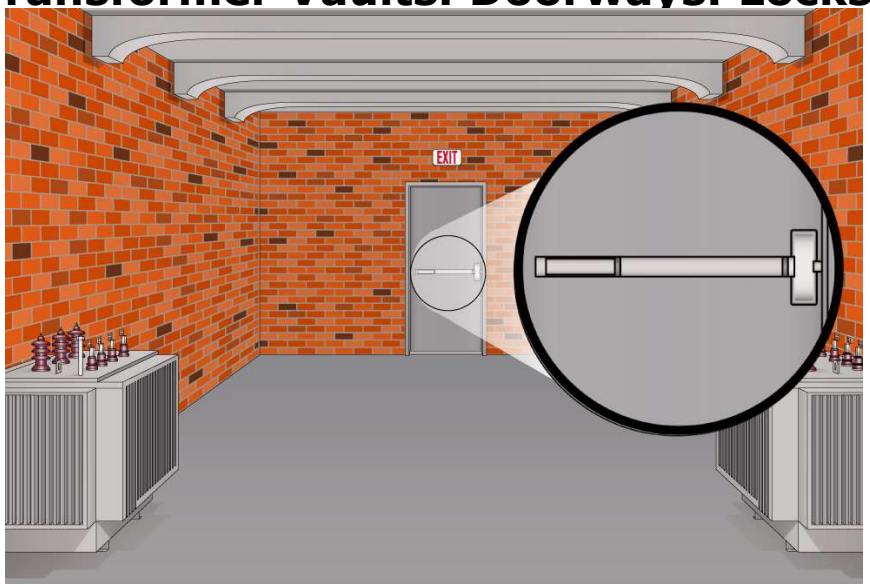
A disconnecting means must be provided for the generator and the prime mover. The disconnecting means must disable start circuits so the generator cannot restart without a manual reset.



55

450.43(C) Transformer Vaults. Doorways. Locks.

Personnel doors are required to open in the direction of egress and be equipped with listed panic hardware.



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480.3 - Storage Batteries - Equipment

Storage batteries must be listed.

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2017 NEC Changes Chapter 5

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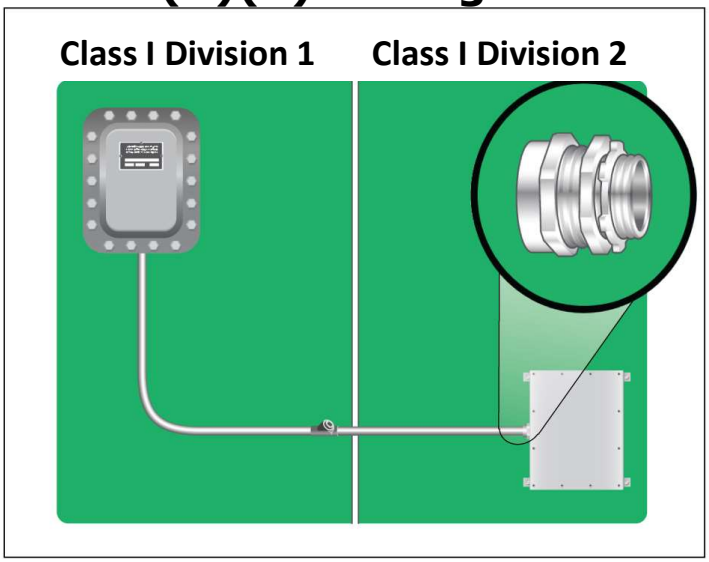
500.2 Special Occupancies. Definitions - Relocated.

Article 500 Definitions	Article 100 Definitions As Applied to Hazardous (Classified) Locations
Combustible Dust	Combustible Dust
Combustible Gas Detection System	Combustible Gas Detection System
Control Drawing	Control Drawing
Dust - Ignition Proof	Dust - Ignition Proof
Dusttight	Dusttight
Hermetically Sealed	Hermetically Sealed
Nonincendive Circuit	Nonincendive Circuit
Nonincendive Field Wiring Apparatus	Nonincendive Field Wiring Apparatus
Oil Immersion	Oil Immersion
Purged and Pressurized	Purged and Pressurized
Unclassified Locations	Unclassified Locations

A number of definitions were moved from Article 500 to Article 100.

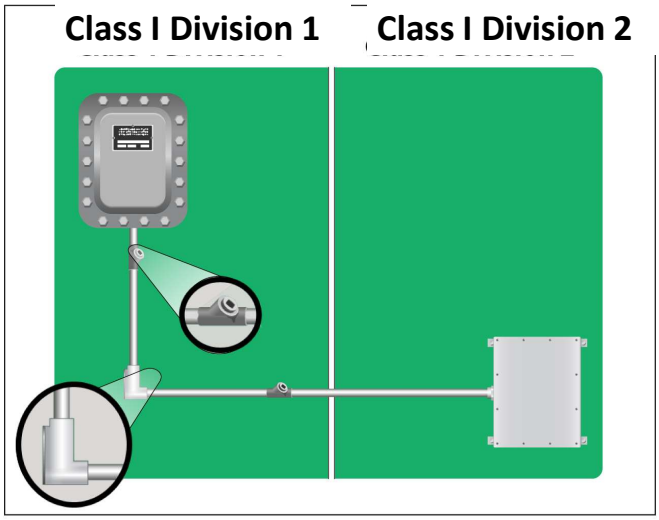
501.10(B)(1) Wiring Methods. Class I, Division 2.



Threadless fittings for rigid metal conduit and intermediate metal conduit can be used in Class I, Division 2 locations.

501.15(A)(1) Sealing and Drainage. Conduit Seals, Class I, Division 1. Entering Enclosures.

Conduit bodies cannot be used between the explosionproof enclosure and the conduit seal.



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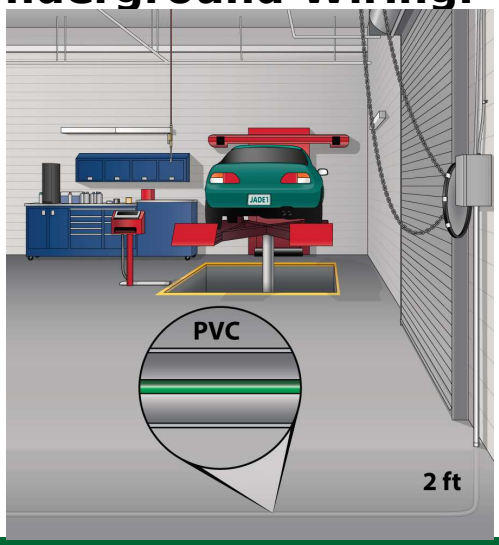
511.8 Commercial Garages, Repair and Storage. Underground Wiring.

Where PVC is used, a wire-type equipment grounding conductor is required.

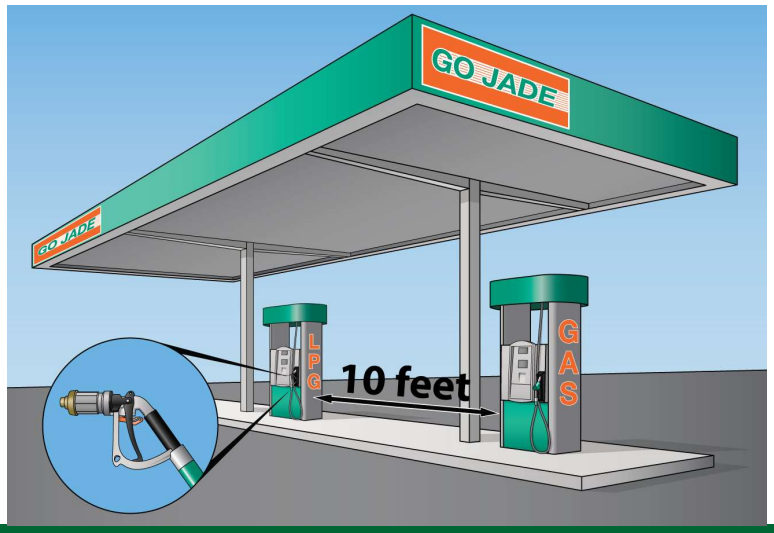


62

514.3(B)(2) Motor Fuel Dispensing Facilities. Classified Locations.

- Compressed Natural Gas
- Liquefied Natural Gas
- Liquefied Petroleum Gas

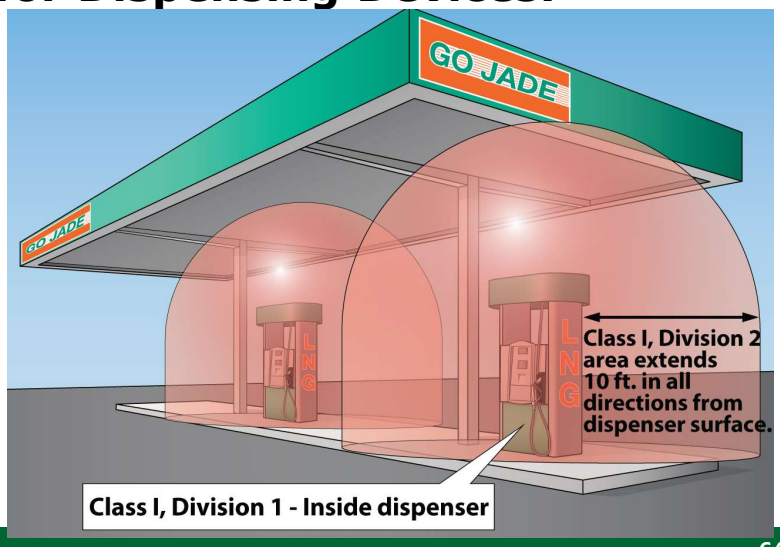
The minimum required distance between LPG dispensers and Class I liquid dispensers is now 10 feet.



63

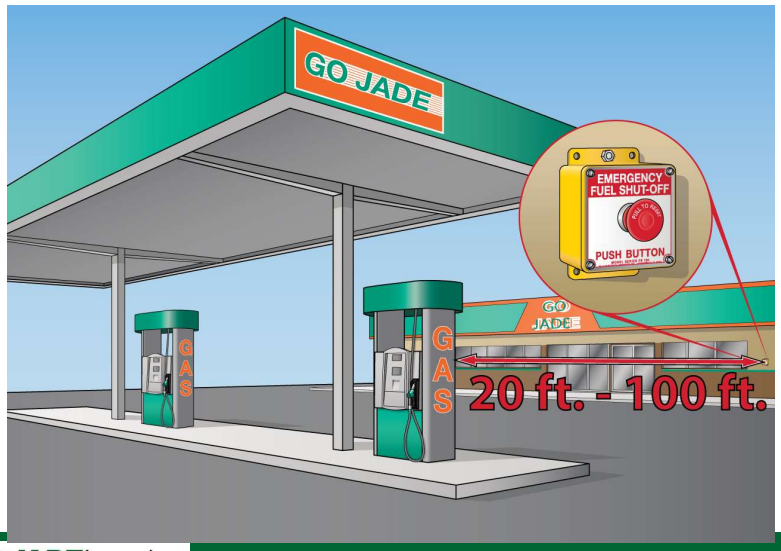
Table 514.3(B)(2) Electrical Equipment Classified Areas for Dispensing Devices.

- Class I, Division 1: The area inside a LNG dispenser.
- Class I, Division 2: The area extending 10 feet in all directions from the LNG dispenser.



64

514.11 Motor Fuel Dispensing Facilities. Circuit Disconnects.

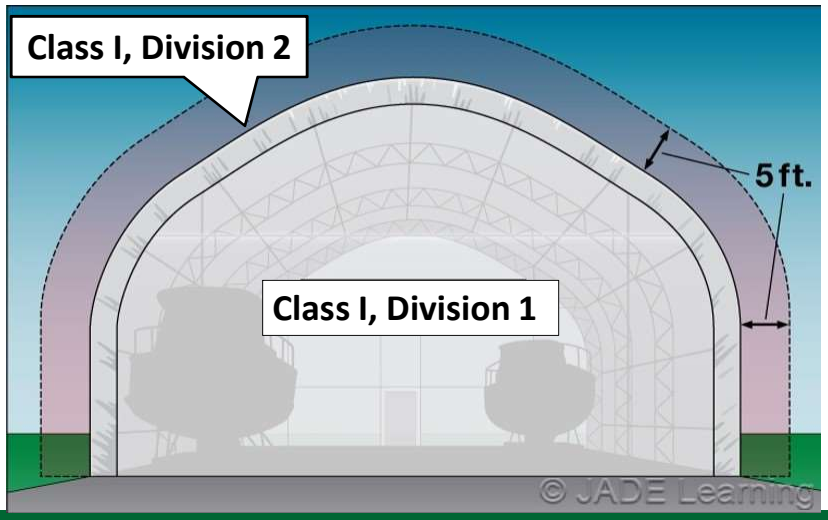


- Emergency disconnects not less 20 feet and not more than 100 feet away.
- All circuits must be disconnected.

65

516 Spray Application, Dipping, Coating, and Printing Processes Using Flammable or Combustible Materials.

- Class I, Division 1 : The area inside a membrane enclosure.
- Class I, Division 2 : The area extending 5 feet outside the membrane area.



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Connecticut 2017 NEC Changes for Unlimited Licensees

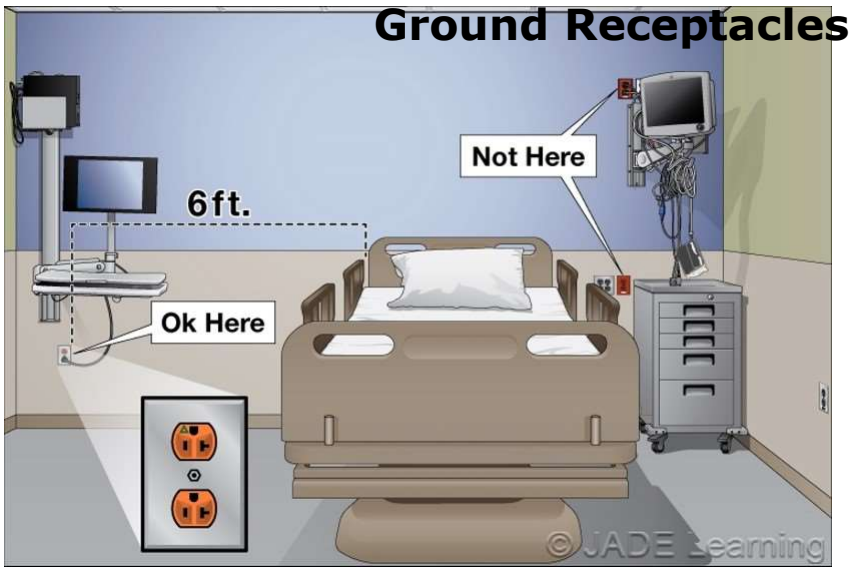
517.2 Health Care Facilities. Definitions.

There is a new definition of a medical and dental office.

67

Connecticut 2017 NEC Changes for Unlimited Licensees

517.16 Health Care Facilities. Use of Isolated Ground Receptacles.

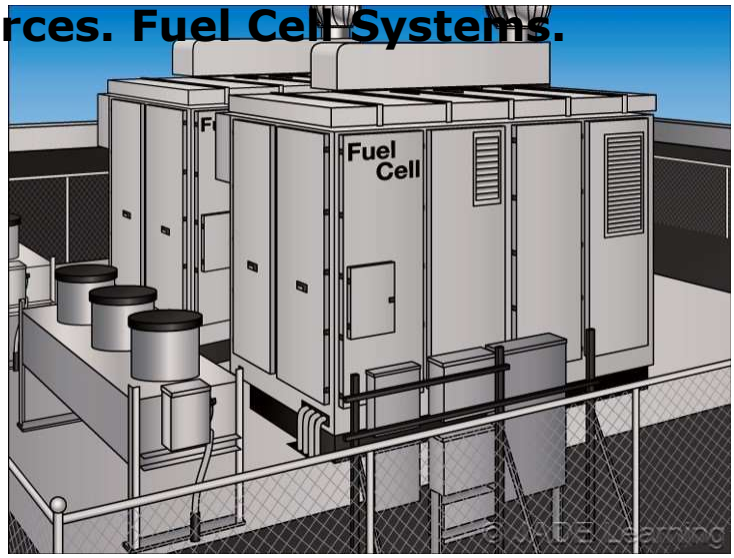


An isolated ground receptacle cannot be installed in the patient care vicinity.

68

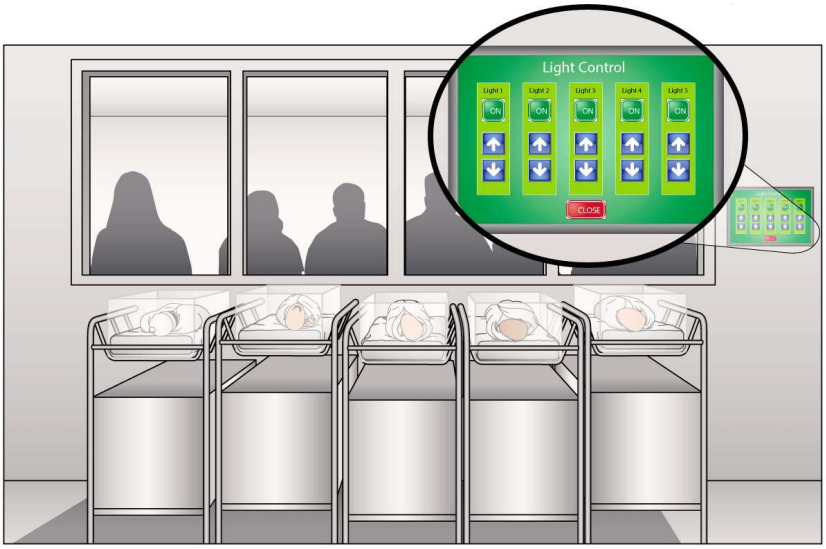
517.30(B)(2) Health Care Facilities. Types of Power Sources. Fuel Cell Systems.

Fuel cells can be used as an emergency source of power for essential electrical systems in hospitals and other health care facilities.



69

517.34(B) Health Care Facilities. Critical Branch.

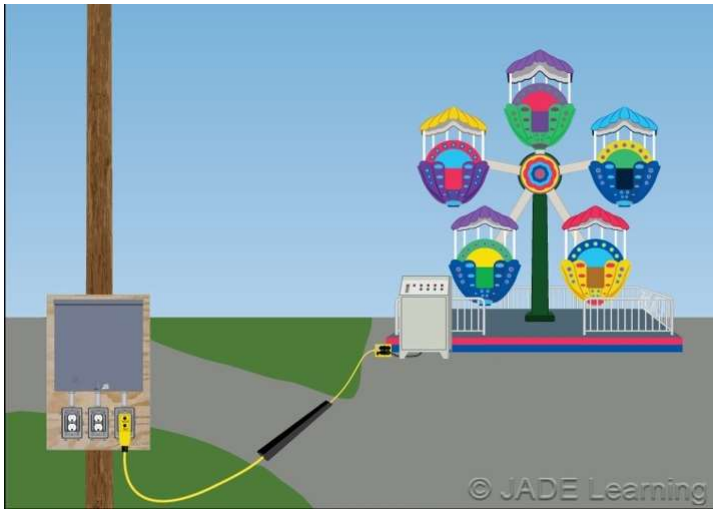


Task lighting on the critical branch of the essential electrical system, such as in an infant nursery, can be controlled by switches or other devices like keypads.

70

525.23(D) Carnivals, Circuses, Fairs. GFCI Protection. Receptacles Supplied by Portable Cords.

GFCI receptacles that are supplied by flexible cord must be listed for portable use.



71

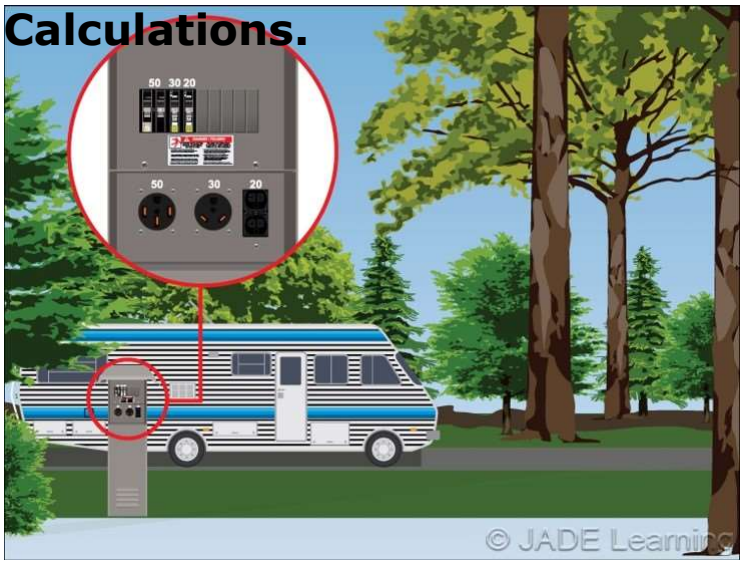
551.71 Recreational Vehicle Parks. Type Receptacles Provided.

- Every RV site with electric power requires at least 1 GFCI protected 20-ampere 125-volt receptacle.
- 70% of RV sites require a single 30-ampere 125-volt receptacle.
- 40% of new RV sites require a single 50-ampere 125/250-volt receptacle.

72

551.73(A) RV Parks. Calculated Load. Basis of Calculations.

When calculating the load for an entire RV Park, the load per type of receptacle is multiplied by the number of receptacles before the demand factors are applied.



73

JADE Top 20

555.1 Marinas, Boatyards, and Commercial and Noncommercial Docking Facilities. Scope.

Article 555 now covers docking facilities at:

- one-family dwellings
- two-family dwellings
- multifamily dwellings
- residential condominiums

74

555.3 Marinas, Boatyards, and Commercial and Noncommercial Docking Facilities. Ground-Fault Protection.

Overcurrent protective devices that supply marinas, boatyards, and commercial and noncommercial docking facilities must now have ground-fault protection not exceeding 30 mA.

75

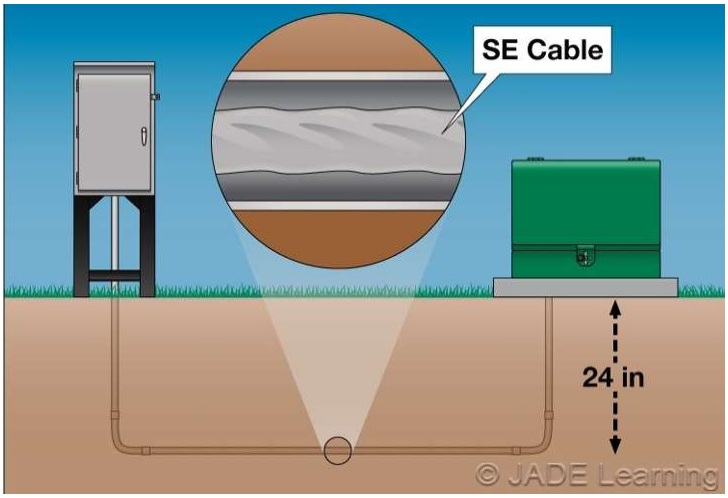
555.24 Marinas, Boatyards, and Commercial and Noncommercial Docking Facilities. Signage.

Signs around a marina or docking facility must warn swimmers that there is a potential shock hazard from electrical currents in the water.

76

590.4(B),(C),(G) Temporary Installations. General. Feeders, Branch Circuits, Splices.

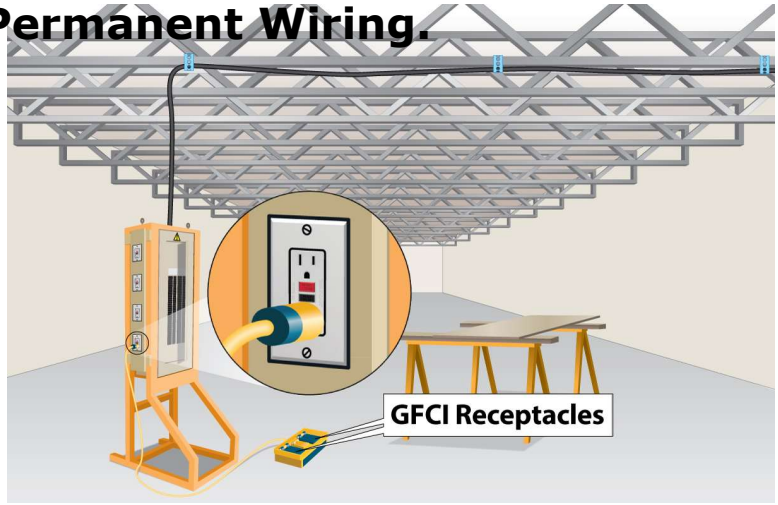
In temporary installations SE cable can be installed in a raceway underground.



77

590.6(A)(1) GFCI Protection for Personnel. Receptacle Outlets. Receptacle Outlets Not Part of Permanent Wiring.

Listed portable cord sets can be used to provide GFCI protection in temporary installations.



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Practical Exercises

79

Calculate branch circuit size and overcurrent protection fixed electric heat

When sizing branch-circuit conductors for fixed electric space-heating equipment, you must consider these to be a continuous load. The branch-circuit conductors and overcurrent devices for fixed electric space-heating equipment must have an ampacity not less than 125% of the total heating load.

What size conductor and overcurrent device with 75°C terminals is required for a 10kW, 240V fixed electric space heater that has a 3A blower motor?

Step 1. Determine the total load.

I = VA ÷ E

I = 10,000VA ÷ 240V = 41.67A

I = 41.67A + 3A = 44.67A, round up to 45A

80

Calculate branch circuit size and overcurrent protection fixed electric heat

Step 2. Size the conductors at 125% of the load [110.14(C), 210.19(A)(1)].

Conductor = 45A × 1.25 = 56A

A 6 AWG conductor is rated 65A at 75°C

Step 3. Size the overcurrent device at 125% of the load [210.20(A), 240.4(B) and 240.6(A)].

Overcurrent device = 45A × 1.25 = 56A

Choose the next standard size up, which is 60A [240.4(B)]

6 Conductor from the 75 degree column with 60A overcurrent protection

81

Calculate branch circuit size, overcurrent protection, and GFCI protection for electric de-icing and snow melting equipment

426.4 Continuous Load. Fixed outdoor electric deicing and snow-melting equipment shall be considered a continuous load.

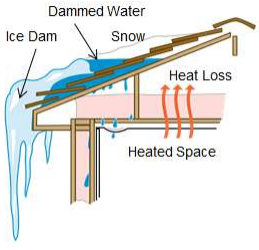
Our snow melting cable is 120V and 100 foot long. The wattage is 8watts/ft.

Step 1. Determine the total load.

I = VA ÷ E

I = 800 Watts ÷ 120V = 6.66A

I = 6.66 Amps, round up to 7A



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Connecticut 2017 NEC Changes for Unlimited Licensees

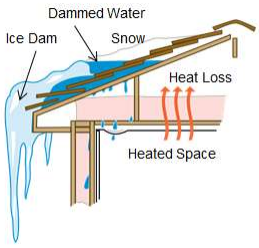
Calculate branch circuit size, overcurrent protection, and GFCI protection for electric de-icing and snow melting equipment

Step 2. Size the conductors at 125% of the load [110.14(C), 210.19(A)(1)].

Conductor = 7A × 1.25 = 8.75A

A 14 AWG conductor is rated 15A at 60°C

Step 3. Size the overcurrent device at 125% of the load [210.20(A), 240.4(B) and 240.6(A)]



Overcurrent device = 7A × 1.25 = 8.75A

Choose the next standard size up, which is 15A [240.4(B)]

14 Conductor from the 60 degree column with 15A overcurrent protection

Connecticut 2017 NEC Changes for Unlimited Licensees

Calculate branch circuit size, overcurrent protection, motor overload device size, and thermal protection for at least 3 different types of motors, voltages, and phases

ACME MOTOR made in USA

HP	20	Hz	60	SF	1.0
Volts	460	Ph	3	Frame	286U
FLA	24.5	Design	B	Enc	TEFC
RPM	1760	Code Ltr	G	Ins Class	F
Duty	Cont	Amb	65°C	FL Eff	90.2
Catalog Number: AEM2334-4				PF	86

Calculate branch circuit size, overcurrent protection, motor overload device size, and thermal protection for at least 3 different types of motors, voltages, and phases

- 430.6 (A) (1)

  (1) Table Values. Other than for motors built for low speeds (less than 1200 RPM) or high torques, and for multispeed motors, the values given in Table 430.247, Table 430.248, Table 430.249, and Table 430.250 shall be used to determine the ampacity of conductors or ampere ratings of switches, branch-circuit short-circuit and ground-fault protection, instead of the actual current rating marked on the motor nameplate.

85

Calculate branch circuit size, overcurrent protection, motor overload device size, and thermal protection for at least 3 different types of motors, voltages, and phases

- Table 430.250 states that a 20HP, 3 phase 460 volt motor will draw _____ amps full load current.
- How many amps did the nameplate say? _____
- Section 430.22 tells us we now have to

  _____ .
- We must now go to Table 310.15(B)16 and find a conductor with insulation of THWN that can carry our motor load, the size is _____.

The 60 degree column must be used because of the rating of our terminals.

86

Calculate branch circuit size, overcurrent protection, motor overload device size, and thermal protection for at least 3 different types of motors, voltages, and phases

- Table 430.52 will provide information about the proper size of time delay fuses we need. We had a full load current of 27 amps according to Table 430.250. We must increase this number by what percent _____.
- The calculated number is _____ amps.
- Now we must look at 240.6 and locate the appropriate overcurrent device in accordance with 430.52 (C) (1) Exc. #1. The size of the fuses are _____ ?

87

Calculate branch circuit size, overcurrent protection, motor overload device size, and thermal protection for at least 3 different types of motors, voltages, and phases

- Let's begin with 430.32 (A) (1)
  - A separate overload device that is responsive to motor current. This device shall be selected to trip or shall be rated at no more than the following percent of the motor nameplate full load current rating:
- Our motor had a FLA on the nameplate of 24.5 amps. The service factor of our motor was 1.0, based on this, our overloads will be _____% of 24.5.
- Which will result in a heater size of _____.

88

Calculate branch circuit size, overcurrent protection, motor overload device size, and thermal protection for at least 3 different types of motors, voltages, and phases

The last calculation was a 3 phase motor, let's try a single phase motor. Our overcurrent protection will be a molded case circuit breaker.

89

Calculate branch circuit size, overcurrent protection, motor overload device size, and thermal protection for at least 3 different types of motors, voltages, and phases

- 430.6 (A) (1)

  (1) Table Values. Other than for motors built for low speeds (less than 1200 RPM) or high torques, and for multispeed motors, the values given in Table 430.247, Table 430.248, Table 430.249, and Table 430.250 shall be used to determine the ampacity of conductors or ampere ratings of switches, branch-circuit short-circuit and ground-fault protection, instead of the actual current rating marked on the motor nameplate.

90

Calculate branch circuit size, overcurrent protection, motor overload device size, and thermal protection for at least 3 different types of motors, voltages, and phases

- Table 430.248 states that a 5HP, single phase 230 volt motor will draw _____ amps full load current.
- How many amps did the nameplate say? _____
- Section 430.22 tells us we now have to _____ .
- We must now go to Table 310.15(B)16 and find a conductor with insulation of THWN that can carry our motor load, the size is _____.

All terminals are rated at 75 degrees Celsius.

91

Calculate branch circuit size, overcurrent protection, motor overload device size, and thermal protection for at least 3 different types of motors, voltages, and phases

- Table 430.52 will provide information about the proper size of molded case breaker we need. We had a full load current of 28 amps according to Table 430.248. We must increase this number by what percent _____.
- The calculated number is _____ amps.
- Now we must look at 240.6 and locate the appropriate overcurrent device in accordance with 430.52 (C) (1) Exc. #1. The size of the molded case circuit breaker will be _____

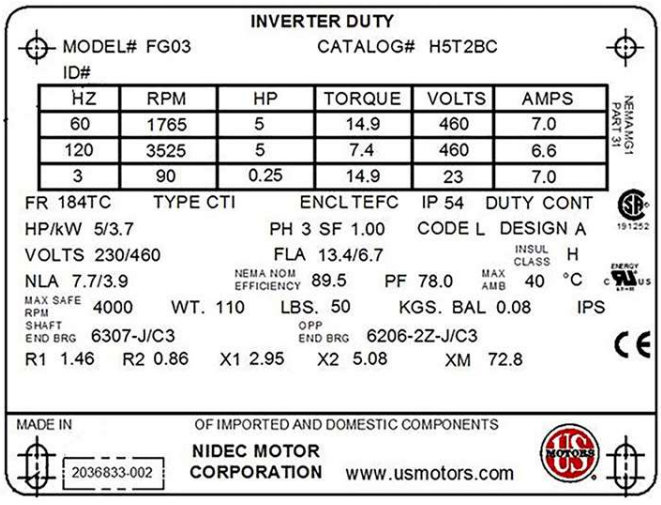
92

Calculate branch circuit size, overcurrent protection, motor overload device size, and thermal protection for at least 3 different types of motors, voltages, and phases

- Let's begin with 430.32 (A) (1)
  - A separate overload device that is responsive to motor current. This device shall be selected to trip or shall be rated at no more than the following percent of the motor nameplate full load current rating:
- Our motor had a FLA on the nameplate of 20.6 amps. The service factor of our motor was 1.15, based on this, our overloads will be _____% of 20.6.
- Which will result in a heater size of _____.

93

Calculate branch circuit size, overcurrent protection, motor overload device size, and thermal protection for at least 3 different types of motors, voltages, and phases



This motor will be controlled by a VFD

94

Calculate branch circuit size, overcurrent protection, motor overload device size, and thermal protection for at least 3 different types of motors, voltages, and phases

- 430.6 (A) (1)

  (1) Table Values. Other than for motors built for low speeds (less than 1200 RPM) or high torques, and for multispeed motors, the values given in Table 430.247, Table 430.248, Table 430.249, and Table 430.250 shall be used to determine the ampacity of conductors or ampere ratings of switches, branch-circuit short-circuit and ground-fault protection, instead of the actual current rating marked on the motor nameplate.

95

Calculate branch circuit size, overcurrent protection, motor overload device size, and thermal protection for at least 3 different types of motors, voltages, and phases

- Table 430.250 states that a 5HP, 3 phase 460 volt motor will draw _____ amps full load current.
- How many amps did the nameplate say? _____
- Section 430.22 tells us we now have to _____ .
- We must now go to Table 310.15(B)16 and find a conductor with insulation of THWN that can carry our motor load, the size is _____.

96

Calculate branch circuit size, overcurrent protection, motor overload device size, and thermal protection for at least 3 different types of motors, voltages, and phases

- Table 430.52 will provide information about the proper size of molded case breaker we need. We had a full load current of 7.6 amps according to Table 430.250. We must increase this number by what percent _____.
- The calculated number is _____ amps.
- Now we must look at 240.6 and locate the appropriate overcurrent device in accordance with 430.52 (C) (1) Exc. #1. The size of the breaker is _____ ?

97

Calculate branch circuit size and overcurrent protection for air conditioning and refrigerating equipment

Compressor Data Company Nameplate

MODEL Y	VAC	HZ	PH	RLA	LRA	FLA
Compressor	230	60	1	20.6	95	---
Outdoor Fan Motor 1/2 hp	230	60	1	---	---	1.2

Branch Circuit Selection Current	34.3 amperes	
Minimum Circuit Ampacity	27.0 amperes	
Maximum Fuse or HACR type Breaker	45 amperes	
Operating Voltage Range	197 min.	253 max.

98

Calculate branch circuit size and overcurrent protection for air conditioning and refrigerating equipment

The branch circuit conductor size can be sized as a minimum circuit conductor size by using the MCA [minimum circuit ampacity].This name plate says the ampacity must equal or exceed 27 amps. Look in Table 310-16 in the 60 degree column as required in 110-14 for conductors smaller than a 1 AWG conductor regardless of the insulation on that conductor. The minimum branch circuit conductor size for this name plate is 10 AWG copper branch circuit conductor size.

99

Calculate branch circuit size and overcurrent protection for air conditioning and refrigerating equipment

Overcurrent Protection

The maximum overcurrent protection is determined by the manufacturer and is usually marked “maximum fuse or HACR type breaker”

If the maximum fuse or HACR type breaker size in amps [maximum overcurrent protection] is not found on the nameplate, it may be determined as follows; RLA OR BCSC whichever is greater x 175%]

OR if that overcurrent device size won't carry the load without tripping then you may calculate as a maximum [RLA x 225%] but only if required for the equipment to work reliably without the overcurrent device tripping.

This breaker or fuse is used only for short circuit protection

100

Calculate transformer size, primary/secondary feeder size, and overcurrent protection for primary/secondary

Our load will be a lighting load in a commercial building. The voltage at each light is 120 V. The ampacity of this continuous load is 85 Amps.

Sizing the Transformer: 85 times 1.25 = 106.25 Amps We need a transformer that can deliver this amount of amps continuously.

Calculating KVA we must take 106.25 times 208 times 1.732 which equals 38,277.2 KVA divided by 1000

Since transformers are sized in KVA the next higher size would be chosen
Standard sizes for three-phase transformers:
3, 6, 9, 15, 30, 45, 75, 112.5, 150, 225, 300, 500, 750 and 1,000 (KVA)

101

Calculate transformer size, primary/secondary feeder size, and overcurrent protection for primary/secondary

Since we now know the size of the transformer we can calculate our required conductor sizes.

Step 1. Determine Transformer Current Ratings: Determine the primary and secondary current rating of the transformers:

	Primary Current	Secondary Current
45 kVA	45,000 VA/(480 x 1.732) = 54A	45,000 VA/(208 x 1.732) = 125A

Step 2. Primary Protection [450.3]: The primary winding of transformers shall be protected against overcurrent in accordance with the percentages listed in Table 450.3 and all applicable notes. Where 125 percent of the primary current does not correspond to a standard rating of a fuse or nonadjustable circuit breaker as listed in 240.6(A), the next higher rating can be used [Note 1].

45 kVA	54A x 1.25 = 68A, next size up 70A

102

Calculate transformer size, primary/secondary feeder size, and overcurrent protection for primary/secondary

Step 3. Size Primary Conductor: Feeder conductors supplying continuous loads shall be sized no less than 125 percent of the continuous loads based on the conductor ampacities as listed in Table 310.15(B)(16), before any ampacity adjustment in accordance with the terminal temperature rating [110.14(C) and 215.2(A)(1)].

45 kVA 54A x 1.25 = 68A, 4 AWG rated 85A at 75°C, Table 310.15(B)(16)

Step 4. Size Secondary Conductor All based on 45 KVA we would take 45000 divided by 208 times 1.732 = 125 Amps Continuous load 125 times 1.25 = 156.25 Table 310.15(B)(16) states that at 75 degrees C a 1 gauge conductor may be used.

Step 5. Size Secondary Overcurrent Protection When the secondary current is 9 amps or more the overcurrent protection for the secondary will be a maximum of 125% of 125 amps which is the secondary current = 125 times 1.25 = 156.25. We are allowed to round up according to 240.6 which results in a circuit breaker size of 175 Amp.

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Questions?

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