PART III

CALCULATIONS

2026 CT CEU s for Electricians

APPENDIX "B" Calculations Based on the 2023 NEC

Time to open your code books!!!

Floor area calculation 220.5(C) Question

Calculate the floor area to determine the proper square footage to be used for the load calculations.

Structure size is Length: 40 feet 6 inches= 40.5 feet Width: 50 feet 6 inches= 50.5 feet or 2091sq feet
Garage is 18.6 by 16.6 or 323 sq feet
Open porch Length: 24 feet O inches= 24.0 feet.
Width: 19 feet O inches= 19.0 feet

A. 2,045.25 square feet
B. 1,275 square feet
C. 1,729.85 square feet
D. 1,589.25 square feet

Solution:

Section 220.5(C) Length: 40 feet 6 inches= 40.5 feet Width: 50 feet 6 inches= 50.5 feet 40.5 ft x 50.5 ft = 2,045.25 square feet

Not Included is the Open Porch Length: 24 feet O inches= 24.0 feet Width: 19 feet O inches= 19.0 feet 24 ft x 19 ft= 456.0 square feet

Calculated floor area Total outside dimension - not included 2,045.25 ft2 - 456.0 ft2 1,589.25 square feet

Answer D. 1,589.25 square feet

- Load calculation for Electric Vehicle Supply Equipment 220.57

Question 1

A multi-unit dwelling complex has 4 electric vehicle charging stations, each rated at 6.8 kW (240V, single-phase) from the nameplate.

What is the minimum calculated load (in kilowatts) that must be considered for the feeder calculation serving the EV charging stations?

A. 27.2 kW

B. 34.0 kW

C. 36.1 kW

D. 28.8 Kw

Solution:
Section 220.57
The EVSE load shall be calculated at either 7200 watts (volt-amperes) or the nameplate rating of the equipment, whichever is higher.
7.2 kW x 4 = 28.8 kW

Answer:
D. 28.8 kW

Question 2

What is the minimum branch circuit size for a Level II EVSE with a 32-ampere current
rating?

A. 32 A
B. 35 A
C. 40 A
D. 55 A

Solution:
Sections 625.42 and 210.19(A)(1) EVSE are considered a continuous load so the branch circuit must be rated at 125% of the continuous load.
32 A × 1.25 = 40 A minimum OCPD

Answer: C. 40 A

Question 3

What is the minimum size XHHW-2 copper conductor permitted to supply a Level II
EVSE that has a 30-ampere current rating, assuming 75° terminations?

A. 12 AWG
B. 10 AWG
C. 8 AWG
D. 6 AWG

Sections 625.42 and 210.19(A)(1) EVSE are considered a continuous load so the branch circuit must be rated at 125% of the continuous load.
30 A × 1.25 = 37.5 A
Table 310.16
While XHHW-2 has a temperature rating of 90° C the conductor must be rated at 75° because of the terminations.
XHHW-2 = 8 AWG is rated for 50 A at 75° C.

Answer: C. 8 AWG

- **Problems using a temperature correction factor to cables, conductors in raceways**

Question 1

What is the ampacity of a 4 THHN conductor terminated to an 80-ampere circuit breaker
that is marked for 60°C/75°C terminations?

A. 70 A
B. 85 A
C. 80 A
D. 95 A

Solution:
Table 310.16
THHN Conductors have a 90°C rating
Section 110.14(C)(1)(a)(3)
The circuit breaker terminations are marked 60°C/75°C so you use the 75°C column of Table 310.16 to determine the ampacity of the 4 THHN conductors.

Answer: B. 85 A

Question 2

What is the ampacity of the 4 THHN conductors when terminated to the 80-ampere
circuit breaker when only marked for 60°C terminations?

A. 70 A
B. 85 A
C. 80 A
D. 95 A

Solution:
Table 310.16
THHN Conductors have a 90°C rating
Section 110.14(C)(1)(a)(1)
The circuit breaker terminations are marked 60°C so you use the 60°C column of Table 310.16 to determine the ampacity of the 4 THHN conductors.

Answer: A. 70 A

Question 3
Determine the ampacity of three 8 AWG THWN copper conductors installed in EMT in an ambient temperature of 40°C. All the conductors are current-carrying conductors. Calculate to the nearest ampere.
A. 35 A
B. 40 A
C. 44 A
D. 50 A

Solution:
Note 1:
Table 310.15(B) shall be referenced for ampacity correction factors where the ambient temperature is other than 30°C (86°F).
Table 310.16
8 AWG THWN = 50 A
Ambient Temperature Correction Based on 30°C (86°F)
Table 310.15(B)(1)(1), 75°C col.
THWN copper at 40°C = 0.88
50 A × 0.88 = 44 A

Answer: C. 44 A

Question 4

A 3-conductor 8 AWG copper plus an equipment grounding conductor Type MC cable is installed in an area with an ambient temperature of 96°F. The conductors within the cable assembly have THHN insulation, and all three conductors are considered current-carrying conductors. Determine the ampacity of the current-carrying conductors in this application. Calculate to the nearest ampere.
A. 35 A
B. 40 A
C. 45 A
D. 50 A

Solution:
Table 310.16
8 AWG THHN = 55 A
Table 310.15(B)(1)(1), 90°C col.
THHN copper at 96°F = 0.91
55 A × 0.91 = 50.05 A

Answer: 50 A

- Temperature Limitations of Equipment

Question 1

A 6 AWG THWN copper conductor is connected to a circuit breaker with termination temperature limitation marked (not to exceed) 60°C. What is the ampacity of the 6 AWG THWN copper conductor now that it is connected to this circuit breaker?

A. 50 A
B. 55 A
C. 65 A
D. 75 A

Solution:

Table 310.14(1)
Table 310.16
6 AWG THWN = 65 A
Section 110.14(C)(1)(a)(2) Limited by circuit breaker to 60°C
110.14(C)(1)(a)(2) applies
Circuit breaker terminations = 60°C
Table 310.16 Ampacity
THWN ampacity at 75°C is not permitted
Use ampacity of 6 AWG copper at 60°C
6 AWG THWN copper limited to 60°C ampacity = 55 A

Answer: 55 A

Eight 6 AWG THWN copper current-carrying conductors are installed to replace existing wiring within an existing single rigid metal conduit. The area of installation has an ambient temperature of 30°C. The new eight 6 AWG THWN conductors are connected to existing 50-ampere 2-pole circuit breakers with a marked terminal temperature rating of 60°C. What is the ampacity of the conductors, and is this an acceptable installation?
A. 45.5 A
B. 52.5 A
C. 55 A
D. 75 A

Solution:

Section 110.14(C)(1)
Table 310.14(1)
Table 310.16 Ampacity
6 AWG THWN at 75°C = 65 A
Table 310.15(C)(1) Adjustment Factors
8 current-carrying conductors = 70%
65 A × 0.70 = 45.5 A
6 AWG in 60°C column = 55 A
Ampacity = 45.5 A does not exceed the 60°C value but it is not large enough for the 50 A OCP so it is not permitted.

Answer: 45.5 A

Eight 6 AWG THWN copper current-carrying conductors are installed to replace existing wiring within an existing single rigid metal conduit. The area of installation has an ambient temperature of 30°C. The new eight 6 AWG THWN conductors are connected to existing 50-ampere 2-pole circuit breakers with a marked terminal temperature rating of 60°C. What is the ampacity of the conductors, and is this an acceptable installation?

A. 45.5 A
B. 52.5 A
C. 55 A
D. 75 A

Solution:
Section 110.14(C)(1)
Table 310.14(1)
Table 310.16 Ampacity
6 AWG THWN at 75°C = 65 A
Table 310.15(C)(1) Adjustment Factors
8 current-carrying conductors = 70%
65 A × 0.70 = 45.5 A
6 AWG in 60°C column = 55 A
Ampacity = 45.5 A does not exceed the 60°C value but it is not large enough for the 50 A OCP so it is not permitted.

Answer: 45.5 A

Question 3

Eight 6 AWG THHN copper current-carrying conductors are installed to replace existing wiring within an existing single rigid metal conduit. The area of installation has an ambient temperature of 30°C. The new eight 6 AWG THHN conductors are connected to existing 50-ampere 2-pole circuit breakers with a marked terminal temperature rating of 60°C. What is the ampacity of the conductors, and is this an acceptable installation?

E. 45.5 A
F. 52.5 A
G. 55 A
H. 75 A

Solution:

Section 110.14(C)(1)
Table 310.14(1)
Table 310.16 Ampacity
6 AWG THHN at 90°C = 75 A
Table 310.15(C)(1) Adjustment Factors
8 current-carrying conductors = 70%
75 A × 0.70 = 52.5 A
6 AWG in 60°C column = 55 A
Ampacity = 52.5 A does not exceed the 60°C value so it is permitted.

Answer: 52.5 A

• Continuous loads and branch circuit 210.20

Question 1

What is the minimum standard branch circuit size required for a 208-volt, single-phase, 8-kW continuous load, assuming terminations are rated for 75°C?

A. 40 A
B. 45 A
C. 50 A
D. 60 A

Solution:

Section 210.20(A)
Load = 8,000
208
Load = 38.46 A
Continuous load adjustment = Load x 125%
CL = 38.46 x 1.25
CL = 48.08 A
Table 240.6(A)
Next standard breaker size = 50A

Answer: C. 50 A is the next standard breaker size

Question 2
A 277-volt, single-phase circuit supplies a 6-kW continuous load and an 8 kW noncontinuous load.

1. What is the minimum standard size inverse-time circuit breaker (with terminations dual rated and marked at 60°C/75°C?
A. 45 A
B. 50 A
C. 60 A
D. 70 A

2. Determine the minimum size XHHW-2 copper circuit conductors for this branch circuit.

A. 6 AWG
B. 4 AWG
C. 2 AWG
D. 1 AWG

Solution Part 1 OCPD Size:

Calculation 1

Continuous Load (CL)

CL = 6,000

277

CL = 21.7 A

Calculation 2

Noncontinuous Load (NCL)

NCL = 8,000

277

NCL = 28.9 A

Calculation 3

Section 210.20(A)

Minimum standard size inverse-time circuit breaker

Min. OCPD = (CL x 125%) + NCL

Min. OCPD = (21.7 x 125) + 28.9

Min. OCPD = 56 A

Table 240.6(A)

Next standard size rating is 60 A

Answer: C. 60 A circuit breaker rated 60°C/75°C

Solution Part 2 Conductor Size:

210.19(A)
Min. Ampacity = (CL x 125%) + NCL
Min. Ampacity = (21.7 x 125) + 28.9
Min. Ampacity = 56 A
Section 110.14(C)(1)(a)(3)

90°C rated conductors connected to a circuit breaker rated 60°C/75°C
Table 310.16 Ampacity using 75°C
6 AWG XHHW-2 at 75°C is good for 65 A and can be protected by the 60A OCPD

Answer: A. 6 AWG XHHW-2

• Continuous loads and feeders 215.3

Question 1
A 3-phase, 4-wire feeder supplies a continuous load of 75 amperes and a noncontinuous load of 75 amperes to a second-floor equipment distribution switchboard.

Determining the minimum ampacity for this feeder, select the proper AWG XHHW-2 copper conductor size. The terminals of the circuit breaker and switchboard are rated 75°C.

A. 1/0 AWG
B. 2/0 AWG
C. 3/0 AWG
D. 4/0 AWG

Solution:

215.2(A)(1) Minimum Rating and Size
Min. Ampacity = (CL x 125%) + NCL
Min. Ampacity = (75 x 125) + 75
Min. Ampacity = 168.75 A
Section 110.14(C)(1)(a)(3)
XHHW-2 Conductors are rated for 90°C but the terminals are rated for 75°C.
Table 310.16 Ampacity using 75°C
2/0 AWG XHHW-2 at 75°C is good for 175A

Answer: B. 2/0 AWG XHHW-2

Question 2

A feeder supplies a continuous load of 100 amperes and a noncontinuous load of 35 amperes.
1. What is the minimum standard rating of time-delay fuses used for the feeder overcurrent protection?
A. 150 A
B. 175 A
C. 200 A
D. 225 A
2. What size THWN copper conductors are needed?
A. 1 AWG
B. 1/0 AWG
C. 2/0 AWG
D. 3/0 AWG

Solution:

Calculation 1

Section 215.3 OCPD selection
Min. OCPD = (CL x 125%) + NCL
Min. OCPD = (100 x 125%) + 35
Min. OCPD = 160 A
Table 240.6(A)
Next standard size rating is 175 A
Answer: B. 175 A time-delay fuse

Calculation 2

Section 215.2(A)(1) Minimum Rating and Size
Table 310.16
2/0 AWG THWN has an ampacity of 175 A and has adequate ampacity for 160 A load

Answer: C. 2/0 AWG THWN

• Table 300.5(A) Minimum Cover Requirements

Question 1

A homeowner would like to add a 120/240-volt four circuit panel for lights and
receptacles to a shed located 75 feet from the house. They have an extra bundle of
EMT and wire from a previous project and want to use that instead of buying new
conduit. What is the minimum burial depth for the EMT?

A. EMT is not permitted for direct burial
B. 12 inches
C. 18 inches
D. 24 inches

Solution:

Table 300.5(A)
Column 3 for One and two family dwellings

Answer is C. 18 inches

Question 2

You are installing a 24-volt lighting circuit for an outdoor decorative fountain in a landscaped public area. The power source is a listed Class 2 power supply, and the lighting circuit is limited to not more than 30 volts**.** The circuit is run underground using Type UF cable with GFCI protection and overcurrent protection not exceeding 20 amperes.

A. 6 inches

B. 12 inches

C. 18 inches

D. 24 inches

Solution:

Table 300.5(A)

Table 300.5(A), Note 2, low-voltage circuits (≤30V) with GFCI and ≤20A protection may be buried at 6 inches using direct burial cable such as UF.

Answer: A. 6 inches

• Adding conductors to an existing box 314

Question 1

What is the maximum number of 14 AWG conductors that can be added and pulled through the 4 x 1 ½ square box?

A. 4
B. 6
C. 8
D. 10

Solution:

Table 314.16(A)
Volume of a 4 × 1 ½ square box = 21 in.3
Table 314.16(B)(1)
Existing 12 AWG = 2.25 in.3
Total occupied space is 4 conductors: 4 x 2.25 cubic inches = 9
Unoccupied space: 21 – 9 = 12 in.3
Table 314.16(B)(1)
14 AWG = 2 in.3 with 12 cubic inches remaining
Number of conductors = 12 / 2

Answer: B. 6 additional 14 AWG conductors

Question 1

Determine the maximum number of additional 12 AWG conductors that can be added and added and spliced in a 12 in. × 12 in. × 4 in. junction box when it already contains 12 spliced 12 AWG conductors.

A. 244 additional conductors
B. 256 additional conductors
C. 286 additional conductors
D. 290 additional conductors

Solution:

Step 1: Determine the Junction Box Volume
12 in. × 12 in. × 4 in.
Volume = 576 cubic inches
Step 2: Volume Allowance per Conductor
Table 314.16(B)
12 AWG = 2.25 cubic inches
Step 3: Volume Used by Existing Conductors
12 – 12 AWG Spliced conductors x 2.25 cubic inches = 27 cubic inches
Step 4: Remaining Box Volume
576 cu in − 27 cu in = 549 cubic inches remaining
Step 5: Determine How Many Additional Spliced Conductors Can be Added
Each spliced conductor = 1 box fill unit = 2.25 cu in

549 / 2.25
= 244 additional conductors
Answer: A. 244 additional conductors

- Maximum number of conductors spliced in a conduit body 314.16(C)

Question 1

Determine the maximum number of 6 AWG THW conductors that can be spliced in a 2-inch EMT conduit body that is marked with a volume allowance of 82 cubic inches.?

A. 8
B. 10
C. 14
D. 16

Solution:

Section 314.16(C)
Table 314.16(B)(1)
Step 1: Volume Allowance Required per Conductor
6 AWG = 5 in.3
Step 2: Calculate the Maximum Number of Spliced 6 AWG Conductors
82 /16.4
= 5
Answer: 16 Conductors

Question 2

A Type T conduit body is used as a junction box installation. It has a volume marked as 20.0 cubic inches. What is the maximum number of 12 AWG THHN conductors that may be spliced inside this conduit body.

A. 6
B. 8
C. 9
D. 10

Solution:

Section 314.16(C)
Table 314.16(B)(1)
Step 1: Volume Allowance Required per Conductor
12 AWG = 2.25 in.3
Step 2: Calculate the Maximum Number of Spliced 12 AWG Conductors
20/8.8
= 2.25

Answer: B. 8 Conductors

- Voltage drop examples

Question 1

Calculate the voltage drop on a single-phase circuit with 32 amperes of load, 320 feet from the load to the panelboard, and served by 8 AWG copper THHN conductors.

A. 13 V
B. 14 V
C. 15 V
D. 16 V

Solution:

Where:
K = 12.9 for copper or 21.2 for aluminum
I = 32 A
D = 320 ft
CM = Circular mils of the conductor
Chapter 9, Table 8

$Vd = 2 \times K \times I \times D / CM$
$Vd = 2 \times 12.9 \times 32 \times 320 / 16{,}510$

8 AWG copper = 16,510 CM
$Vd = 2 \times K \times I \times D / CM$
$Vd = 2 \times 12.9 \times 32 \times 320 / 16{,}510$

$Vd = 263{,}424 / 16510$

$Vd = 15.95\ V$

Answer: D. 16 V

Question 2

A 480-volt branch circuit is to be installed with three 1/0 AWG THWN copper conductors serving a 140-ampere, 3-phase load. Determine the maximum length of the conductors, with the voltage drop not exceeding 3%

.

A. 460 feet
B. 477 feet
C. 493 feet
D. 502 feet

Solution:

210.19 Informational Note
Vd = V Supply x 3%
Vd = 480 x 0.03
Vd = 14.4 V
Chapter 9 Table 8

1/0 AWG = 105,600 cmil

L = CM × Vd / 1.73 x K x I

L = 105,600 × 14.4 / 1.73 x 2.9 x 140
L = 477 feet

Answer: B. 477 feet

AND NOW IT IS TIME FOR CHAPTERS 1- 3 OF YOUR 2023 CODE CHANGES