ARTICLE **215** FEEDERS

Introduction to Article 215–Feeders

Article 215 contains the general requirements for feeder conductors which extend between a service disconnect, transformer, generator, PV system output circuit, or other power-supply source and the branch-circuit overcurrent protective device. Feeders have specific requirement permissions that differ from branch circuits making the proper identification of feeders critical. Some of these rules are outside of the scope of this material, however we do cover the following topics in this article:

- Scope
- Feeder Rating and Size
- Overcurrent Protection
- Equipment Grounding Conductor

215.2 Conductor Sizing

(A) General. Feeder conductors must be sized to have an ampacity not less than the largest of the calculations contained in 215.2(1) or (2). Figure 215-4



(1) Without Conductor Ampacity Correction/Adjustment. Feeder conductors must be sized to have an ampacity of not less than 125 percent of the continuous loads, plus 100 percent of the noncontinuous loads, based on the temperature rating of equipment in accordance with 110.14(C)(1) and Table 310.16, prior to conductor ampacity correction and/or adjustment. ▶Figure 215–5





Example 1

Question: What size conductors are required for a 100A continuous load and 100A noncontinuous load where the equipment is rated for 75°C conductor? ► Figure 215–6





Step 1: Determine the minimum conductor ampacity.

Minimum Conductor Ampacity = (100A × 125%) x 100A Minimum Conductor Ampacity = 225A

Step 2: Determine the conductor size.

4/0 AWG THWN-2, rated 230A [Table 310.16, 75°C column]

Answer: (d) 4/0 AWG

Example 2

Question: What size conductors are required for a 180A continuous load where the equipment is rated for 75°C conductor? Figure 215-7

(a) 1/0 AWG (b) 2/0 AWG (c) 3/0 AWG (d) 4/0 AWG

Solution:

Step 1: Determine the minimum conductor ampacity.

Minimum Conductor Ampacity = 180A × 125% Minimum Conductor Ampacity = 225A

Step 2: Determine the conductor size.

4/0 AWG THWN-2, rated 230A [Table 310.16, 75°C column]

Answer: (d) 4/0 AWG



Ex 2: Conductors that terminate to pressure connectors in separate enclosures or wireways at both ends in accordance with 110.14(C)(2) can have an ampacity of 100 percent of all loads based on the 90°C column of Table 310.16. Figure 215–8



Figure 215-8

Example

Question: What size AWG, THWN-2 feeder conductors rated 90°C are required between power distribution blocks rated 90°C for a circuit supplying a 180A continuous load where the circuit overcurrent protection is 225A? ▶ Figure 215–9

(a) 1/0 AWG (b) 2/0 AWG (c) 3/0 AWG (d) 4/0 AWG





Solution:

Step 1: Determine the minimum conductor ampacity.

When terminals of separately installed connectors at each end of a conductor are rated at least 90°C, the feeder conductor between the 90°C rated connectors can be sized to no less than 100 percent of the 180A continuous load based on the 90°C column of Table 310.16 [215.2(A)(1) Ex 2].

Minimum Conductor Ampacity = 2/0 AWG THWN-2, rated 195A at 90°C.

Step 2: Determine the conductor size.

The feeder conductors must be sized so they are protected by a 225A circuit breaker in accordance with 240.4.

2/0 AWG THWN-2 rated 195A at 90°C is not permitted to be protected by a 225A circuit breaker.

3/0 AWG THWN-2 rated 225A at 90°C is permitted to be protected by a 225A circuit breaker.

Answer: (c) 3/0 AWG

Ex 3: Neutral conductors are permitted to have an ampacity of 100 percent of the continuous and noncontinuous loads. Figure 215–10



Figure 215–10

Example

Question: What size neutral conductor rated 90°C is required for a 125A continuous neutral load where the equipment is rated for 75°C conductor? ► Figure 215–11

a) 1 AWG	(b) 2 AWG	(c) 3 AWG	(d) 4 AWG
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Solution:

Step 1: The neutral conductor is sized to the 125A continuous load at 100 percent [215.2(A)(1) Ex 3].

Step 2: Size the conductors in accordance with 110.14(*C*)(1)(*b*)(2) and Table 310.16.

1 AWG has an ampacity of 130A [Table 310.16, 75°C column].



Ex: If the assembly, including the overcurrent devices protecting the feeder, is listed for operation at 100 percent of its rating, the ampacity of the conductors can be sized at 100 percent of the continuous load plus the noncontinuous load.

(2) With Conductor Ampacity Correction/Adjustment. Conductors must be sized to have an ampacity of not less than 100 percent of the total load after conductor ampacity correction and/or adjustment in accordance with Table 310.15(B)(1)(1) and Table 310.15(C)(1). Figure 215–12



▶ Figure 215–12

Example

Question: What size conductors rated 90°C are required for four current-carrying conductors supplying a 180A continuous load in an ambient temperature of 100°F where the equipment is rated for 75°C conductor?

(a) 4/0 AWG (b) 300 kcmil (c) 500 kcmil (d) 600 kcmil

Note: According to 215.2(A), the feeder conductor size is determined by the larger of 215.2(A)(1) or (2).

Solution:

Step 1: The circuit conductors must have an ampacity of 180A after conductor ampacity temperature correction [Table 310.15(B)(1)(1)] and adjustment [Table 310.15(C)(1)], based on the conductor's insulation rating of 90°C. One way to find the conductor size is to determine the conductor ampacity required to supply a 180A continuous load at 100 percent after correction and adjustment.

Conductor Ampacity at 90°C = Continuous Load at 100%/ (Correction × Adjustment)

Continuous Load = 180A

Correction [Table 310.15(B)(1)(1)] = 91% (100°F ambient temperature with 90°C Conductor)

Adjustment [Table 310.15(C)(1)] = 80% (four current-carrying conductors)

Conductor Ampacity at 90°C Column = 180A/(91% × 80%) Conductor Ampacity at 90°C Column = 180A/73% Conductor Ampacity at 90°C Column = 247A

Step 2: Select the conductors from the 90°C column of Table 310.16 [110.14(C)(1)(b)(2)]. ▶ Figure 215–13



Figure 215–13

4/0 AWG THWN-2 is suitable because it has an ampacity of 260A at 90°C before any correction and adjustment.

Note: According to 215.2(A), the feeder conductor size is determined by the larger of 215.2(A)(1) or (2). In this case, based on the conditions specified in this example, 4/0 AWG is the minimum size. Figure 215–14

Answer: (a) 4/0 AWG



Note 2: The *NEC* recommends that feeder conductors be sized to prevent a voltage drop of not more than 3 percent. In addition, it recommends that the total voltage drop on both feeders and branch circuits should not exceed 5 percent.

(B) Neutral Conductor Size. The neutral conductor must be sized to carry the maximum unbalanced load in accordance with 220.61, but must not be smaller than the equipment grounding conductor in accordance with 250.122. Figure 215–15



Figure 215-15

► Example

Question: What size neutral conductor is required for a feeder consisting of 3/0 AWG phase conductors and one neutral conductor protected by a 200A overcurrent protective device when the unbalanced load is 30A and the equipment is rated for 75°C conductor? Figure 215–16



Figure 215–16

Solution:

Section 220.61 and Table 310.16 permits 10 AWG neutral conductor rated 30A at 75°C [110.14(C)(1) and Table 310.16] to carry the 30A unbalanced load, but must not be smaller than the 6 AWG equipment grounding conductor in accordance with 250.122.

Answer: (c) 6 AWG