Electrical Level 3

Conductor Selection and Calculations 26302-14

Objectives

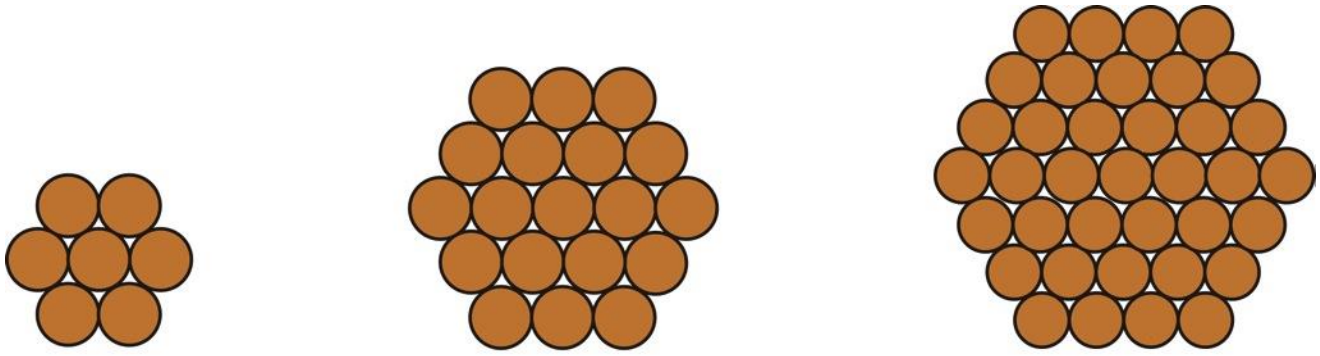
When trainees have completed this lesson, they should be able to do the following:

1. Select electrical conductors for specific applications.
2. Calculate voltage drop in both single-phase and three-phase applications.
3. Apply *National Electrical Code*® (*NEC*®) regulations governing conductors to a specific application.
4. Calculate and apply *NEC*® tap rules to a specific application.
5. Size conductors for the load.
6. Derate conductors for fill, temperature, and voltage drop.
7. Select conductors for various temperature ranges and atmospheres.

This is a knowledge-based module; there are no Performance Tasks.

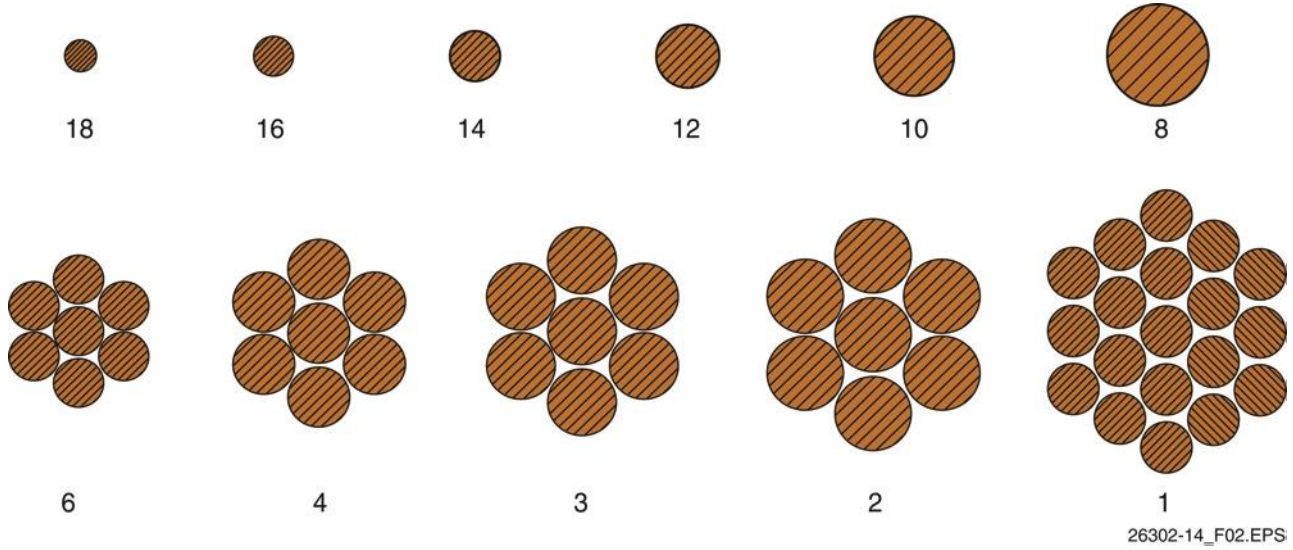
Introduction

- Per ***NEC Section 310.106(C)***, all conductors No. 8 AWG and larger must be stranded when installed in a raceway.
- Stranded wire is more flexible. The number of strands may vary widely depending on size. The American Wire Gauge (AWG) is used to identify wire sizes up to 4/0.



Comparison of Various Wire Sizes

- AWG wire sizes run in reverse order for smaller wires: for example, No. 18 AWG is smaller than No. 1 AWG.
- Wires larger than No. 1 AWG are designated 1/0, 2/0, 3/0, and 4/0, and run consecutively.
- Wires larger than 4/0 are measured in circular mils.

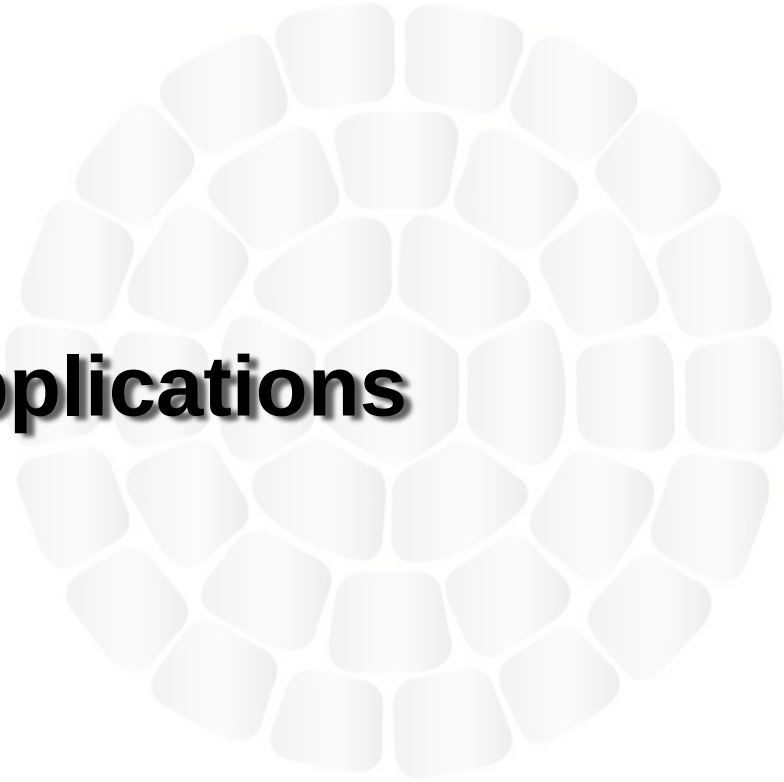


Next Session…

Compact Conductors

- Compact conductors have been compressed to reduce the air space between the strands.
- This reduces the overall diameter of the cable and can be useful when increasing the service or feeder ampacity of the cable in existing conduit.

Conductor Applications



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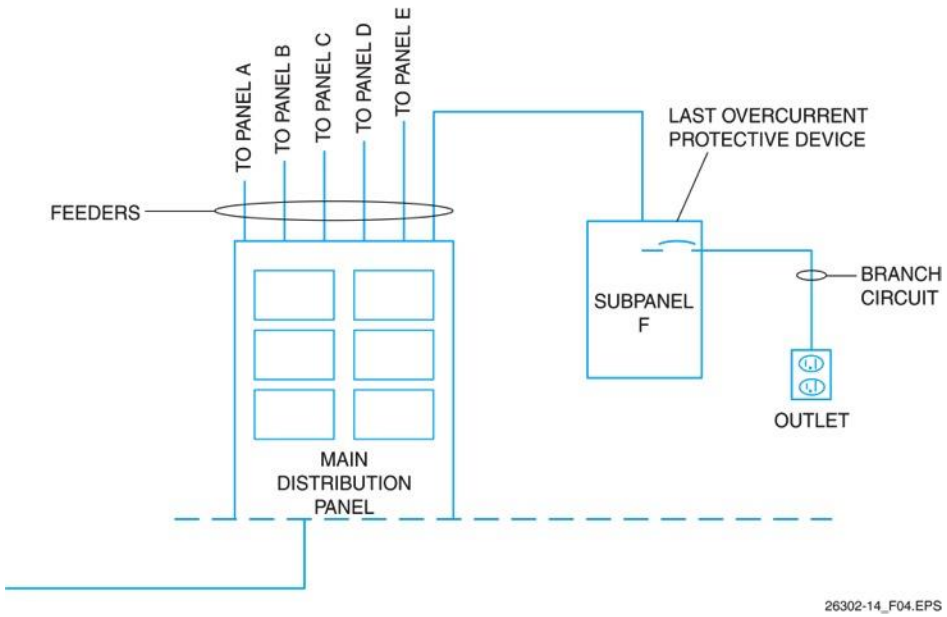
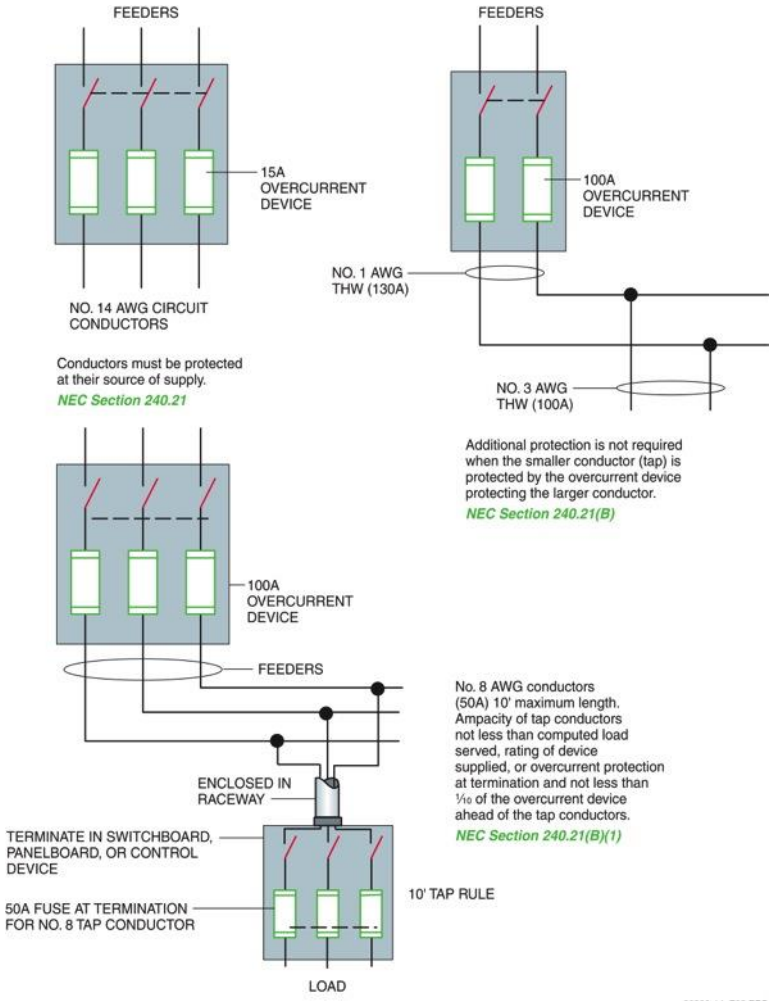
Conductor Applications



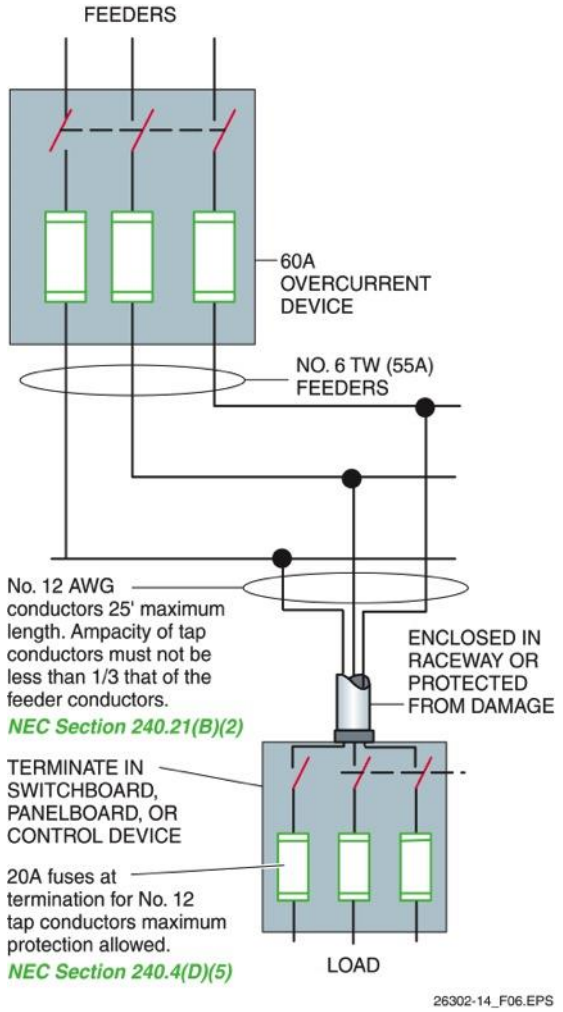
- Feeders are defined as the circuit conductors between the service equipment (or other power supply source) and the final branch circuit overcurrent device.
- A branch circuit is defined as the circuit conductors between the final overcurrent device protecting the circuit and the outlet(s).

Location of Overcurrent Protection in Circuits



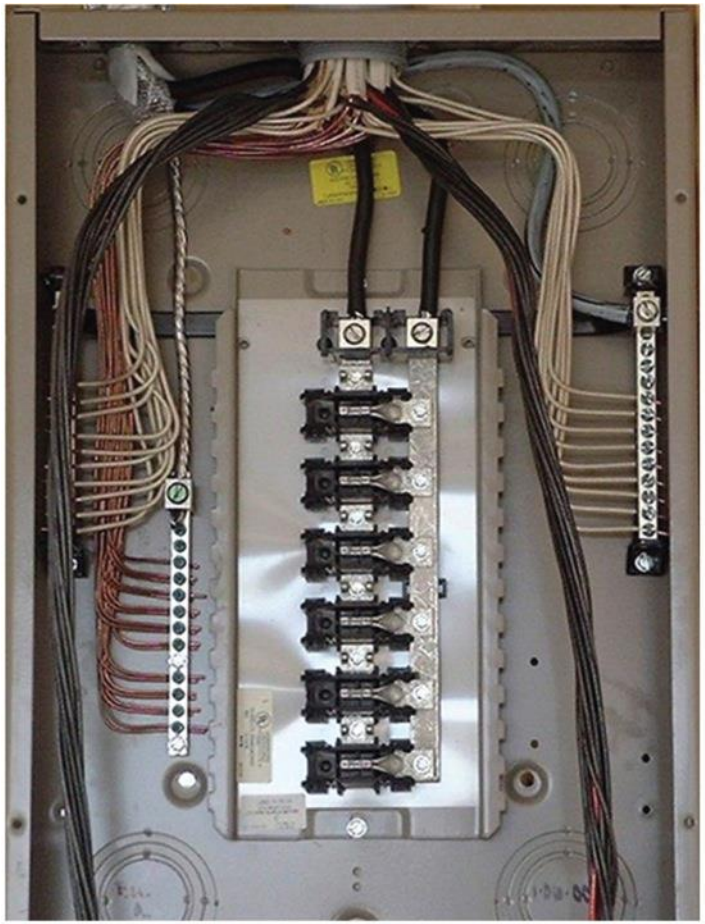
NEC® 25' Tap Rule

- In general, the ampacity of a circuit conductor must not be less than that of the maximum load served.
- The rating of the branch circuit overcurrent device determines the branch circuit rating.
- Conductor ampacities may be derated for temperature and/or three or more conductors in a raceway.



Think About It – Conductor Identification

Can you identify the ungrounded feeder conductors, the grounded feeder conductor, and the grounding feeder conductor in this picture?



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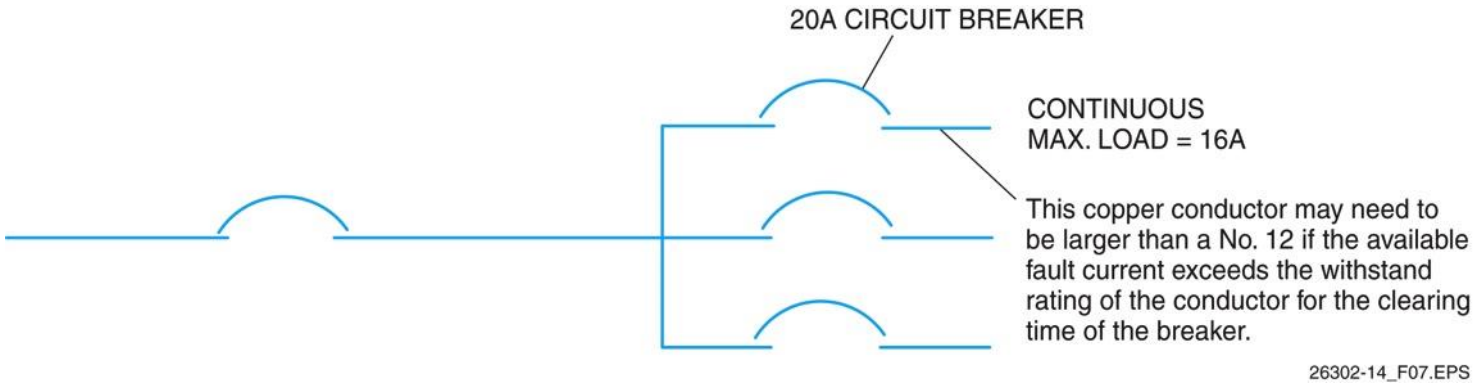
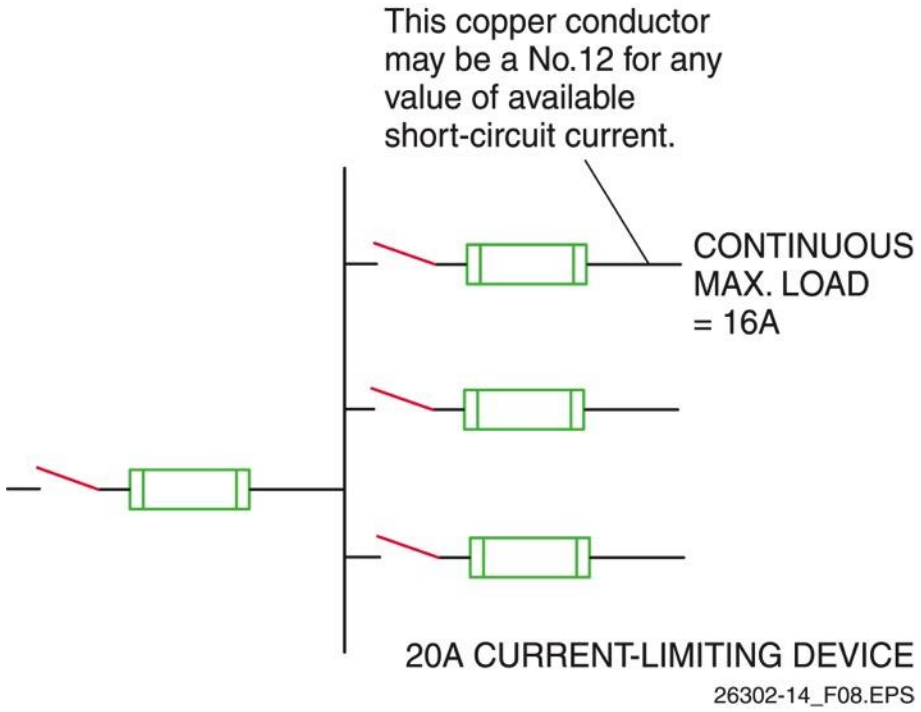
Conductor Protection



- Physical protection of conductors involves the proper installation of conduit, boxes, fittings, and terminations.
- Electrical protection is provided by overcurrent protective devices. When a noncurrent-limiting device is used for short circuit protection, the conductor's short circuit withstand rating must be selected based on the device's ability to protect the circuit.

Current-Limiting Device

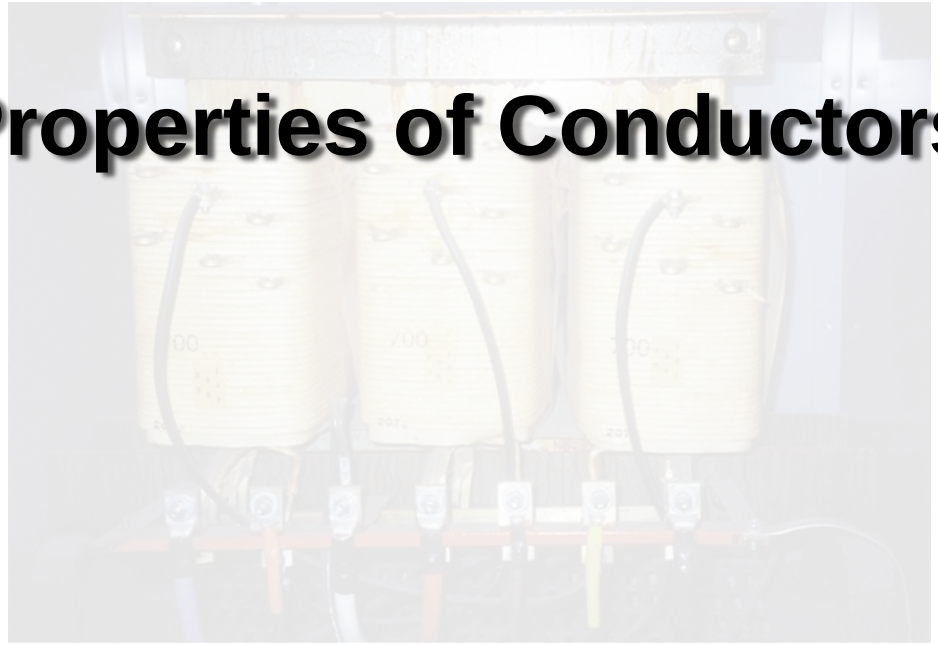
- A current-limiting device limits the short circuit current and eliminates the need for oversized ampacity conductors.
- Some circuits use a circuit breaker as a disconnecting means and general overcurrent protection along with supplemental current-limiting devices at specific points in the circuit.



Next Session…

Think About It – Location of Overcurrent Protection

Is overcurrent protection required for the secondary conductors at the transformer terminals shown here?



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Properties of Conductors

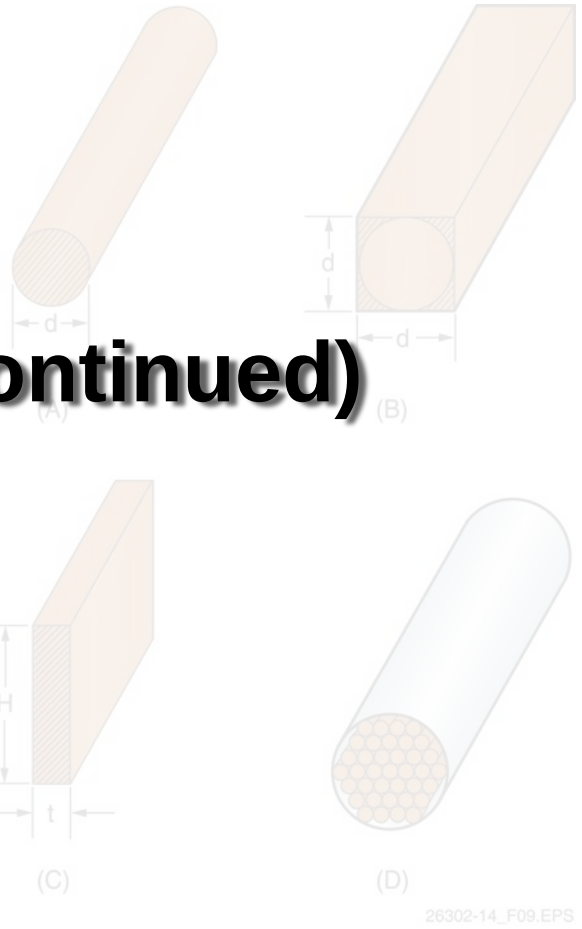
Next Session…

- ***NEC Table 310.15(B)(16)*** is used to find the maximum current-carrying capacity of a conductor.
- ***NEC Table 310.15(B)(3)(a)*** is used to adjust the value from ***NEC Table 310.15(B)(16)*** when there are more than three conductors in a raceway.

Voltage Drop

Next Session…Voltage Drop

- Conductors should be sized so that the voltage drop does not exceed 3% for power, heating, and lighting loads, and 5% for conductors, feeders, and branch circuits.
- Mils represent wire sizes in thousandths of an inch. A square mil has a larger area than a circular mil. Divide square mils by 0.7854 to convert to circular mils.



Voltage Drop (Continued)

Think About It – Voltage Drops

This parking lot fixture has three 1,000W lamps, is 300' from the panel, uses No. 12 wire, and is supplied by a 20A, 208V circuit. The fixture manufacturer specifies a maximum voltage drop of 3%. Does this circuit adequately support this load?

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Next Session…

Tables for Calculating Voltage Drop in Low-Voltage (24V) Wiring

Reference tables are available to avoid having to make voltage drop calculations in low-voltage circuits.

Wrap Up

	Length of Circuit (One Way in Feet)											
AWG Wire Size	25	50	75	100	125	150	175	200	225	250	275	300
20	29	14	10	7.2	5.8	4.8	4.1	3.8	3.2	2.9	2.8	2.4
18	58	29	19	14	11	9.6	8.2	7.2	6.4	5.8	5.2	4.8
16	86	43	29	22	17	14	12	11	9.6	8.7	7.8	7.2
14	133	67	44	33	27	22	19	17	15	13	12	11

Wrap Up

3-2-1

3 – Write 3 important things learned during class

2 – Write 2 questions you have about the material

1 – Write 1 thought you had about the material

Next Session…

MODULE EXAM

Review the complete module to prepare for the module exam. Complete the Module Review as a study aid.