# UNIT **5**

## RACEWAY AND BOX CALCULATIONS

### **Introduction to Unit 5—Raceway and Box Calculations**

Anyone who's ever pulled wire into a raceway probably understands the reason to have limits on the wire fill for raceways. Trying to pull too many conductors into a raceway can damage conductor insulation due to the friction and abrasion doing so causes. We've all heard the joke about tying a wire-pulling rope onto the hitch of the service truck and putting it in four-wheel drive.

Chapter 9, Table 1 in the *NEC* provides limits for wire fill in terms of the maximum percentage(s) of a raceway's interior cross-sectional area. This unit explains those limits and provides instruction regarding the use of the associated tables in Chapter 9 to calculate conductor fill. How to use the tables in Annex C when the conductors in the raceway are the same size (total cross-sectional area including insulation) is also covered.

Conductor intolerance results from disregarding the limits on the radius of bends required for making transitions to and from a wireway, and the number of conductors and splices allowed.

The *Code* also provides a limit to the number of conductors allowed in outlet boxes, based on Table 314.16(A). This limit is often joked about as being the "maximum number of conductors that can be installed in the outlet box while using the persuasion of your hammer handle." In this unit, you'll learn how to properly calculate the maximum number of conductors and "conductor equivalents" to be installed in an outlet box.

Be sure to read and study this material thoroughly and frequently so your understanding of what the *NEC* means by "conductor equivalents" and "conductor fill" becomes second nature.

An explanation of the sizing requirements of 314.28(A)(1) and (2) for larger pull boxes, and junction boxes which enclose conductors 4 AWG and larger, rounds out the information provided here in Unit 5.

#### 5.8 Conductor Jamming– Chapter 9, Table 1, Note 2

Chapter 9, Table 1, Note 2 (Informational Note 2)—Jamming: When three conductors are pulled into a raceway, they'll occasionally try to flatten out. When the inside diameter of a raceway is between 2.80 and 3.20 times the diameter of a conductor, conductor jamming can occur. ▶Figure 5–38



diameter of a conductor, conductor jamming can occur.

Figure 5–38

(b) No

#### **Example**

(a) Yes

**Question:** According to Annex C, Table C.1, three 500 kcmil THHN conductors can be installed in 2½ EMT. Will this installation have the possibility of jamming? **Figure 5–39** 





#### Solution:

Trade Size 2½ EMT has a diameter of 2.731 in. [Chapter 9, Table 4] and 500 kcmil THHN has a diameter of 0.949 in. [Chapter 9, Table 5].

The ratio of the raceway diameter as compared to the conductor diameter is 2.731 in./0.949 in.

The ratio of the raceway diameter as compared to the conductor diameter is 2.87 times.

Answer: (a) Yes