Conduit Fill

"Maximum Conduit Fill" is the maximum number of cables or conductors that can be installed in a single conduit. Limits on conduit fill are set by the National Electrical Code (NEC). These limits were created to prevent mechanical damage to cables during installation as well as overheating of cables in service.

How is Conduit Fill Determined?

Conduit fill is determined by adding together the cross-sectional areas of all cables to be installed in a conduit. This total cable area is then compared with the cross-sectional area available in the conduit. The NEC specifies that for three or more cables in a conduit, the total cross-sectional area of the cables must not exceed **40%** of the available area in the conduit. For one or two conductors in a conduit, the maximums are 53% and 31%, respectively. Determining the maximum allowable conduit fill for a specific installation either requires reference to a table *or* a mathematical calculation.

The (Relatively) Easy Way

Conduit fill tables are located in Appendix "C" of the 1996 NEC. In the NEC, there are 82 fun-filled pages of tables that give the maximum number of conductors that can be put in various types of electrical conduit. Below is a quick reference guide to those tables. Individual tables are required for each conduit type because the inside diameter (ID) varies slightly from type to type.

Conduit Type	NEC Tables
Electrical Metallic Tubing (EMT)	C1, C1A
Electrical Nonmetallic Tubing	C2, C2A
Flexible Metallic Conduit	C3, C3A
Intermediate Metallic Conduit	C4, C4A
Liquidtight Flexible Nonmetallic Conduit (Type B)	C5, C5A
Liquidtight Flexible Nonmetallic Conduit (Type A)	C6, C6A
Liquidtight Flexible Metallic Conduit	C7, C7A
Rigid Metallic Conduit	C8, C8A
Rigid PVC Conduit, Schedule 80	C9, C9A
Rigid PVC Conduit, Schedule 40 and HDPE Conduit	C10, C10A
Type A, Rigid PVC Conduit	C11, C11A
Type EB, PVC Conduit	C12, C12A

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The Hard Way

If you can't find a table that fits the specific cable and conduit type in question, you will have to resort to getting conduit fill information the hard way. Naturally, you remember from your school days that the area of a circle is "pi times the radius squared" ($\pi \times r^2$). OK, so you *don't* remember! But since pi is the Greek letter π which represents the constant 3.14, and the radius of a circle is always half its diameter, you're all set to play Einstein. Just look up the overall diameter (in inches) of each cable in Anixter's catalog, divide by 2 to obtain the radius, multiply the radius by itself, i.e., square the number, then multiply that result by 3.14 and, eureka, you have the area of each cable. Add the areas of all cables together and you now have the total cross-sectional cable area in square inches. We're half way there!

Next, calculate the internal cross-sectional area of the conduit in a similar fashion. To do this, obtain the inside diameter (ID) of the conduit (again in inches) in which the cables will be installed. Divide by 2 to obtain the radius, square the radius, multiply the result by 3.14 and, eureka again, you have the total cross-sectional area of the conduit itself.

It is now a simple process to divide the total cable area by the conduit area and multiply by 100 to convert it to a percentage. If the number is 40% or less, you will make the NEC inspector very happy.

However, if the conduit fill works out to greater than 40%, and the cable is installed anyway, you will make the electrical inspector very unhappy. You might also make someone very poor when the inspector insists that the situation be corrected before he or she will approve the installation.

Oh, by the way, if both the above methods fail, you can always contact Anixter Engineering and Technical Support for assistance.

Additional information on conduit fill is also available in Anixter's 1996 *Wire & Cable Technical Information Handbook* starting on page 108 and in Chapter 9 of the 1996 NEC beginning on page 879.

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