Sizing Outlet Boxes—Part 2

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Last month, we discussed how much is too much when it comes to properly sizing outlet boxes per National Electrical Code (NEC) guidelines. But providing adequate space for conductors, fittings, and devices gets a bit more complicated when the conductors vary in size. You should use the following steps to determine the size of the outlet box when the conductors are of different sizes.

Step 1: Determine the number and size of conductors and/or their equivalents in the box.

Step 2: Determine the volume of the conductor's equivalents, based on the values listed in Table 370-16(b).

Step 3: Select the outlet box size per Table 370-16(a).

Example No. 1:

Q. What size outlet box is required to accommodate three No. 10 conductors terminating on a 30A receptacle, two No. 12 conductors passing through, and two No. 12 conductors spliced?

(a) 4×1¼ sq (c) 4×2$^{1}/_{8}$ sq
(b) 4×1½ sq (d) any of these

A. The answer is (c), 4×2$^{1}/_{8}$ sq. Here are the calculation steps required to find the answer.

Step 1: First, determine the number and size of conductors and/or their equivalents (Fig. 1).

No. 10 Calculations—In addition to the three No. 10 conductors, you must also take into account the receptacle strap. The strap accounts for two additional conductors, thus yielding a total count of five. The bonding jumper does not count in your calculation.

No. 12 Calculations—You must account for the conductors that pass through the box as well as those that are spliced. Therefore, you have a total of four No. 12 conductors in your calculation (two passing through and two spliced).

Step 2: Determine the volume of the conductor's equivalents, based on the values listed in Table 370-16(b).

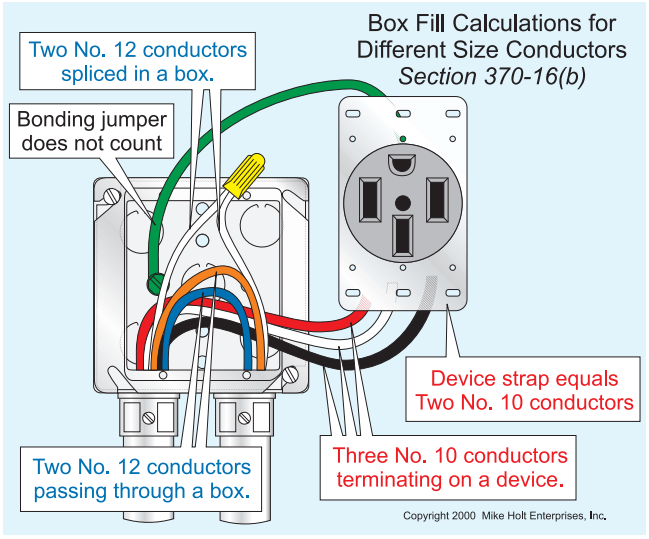

Fig. 1. *Box fill requirements when working with different size conductors.*

No. 10 = 2½ cu in. × five conductor volumes = 12½ cu in.

No. 12 = 2¼ cu in. × four conductor volumes = 9.0 cu in.

Total = 21½ cu in.

Step 3: Select the proper outlet box per Table 370-16(a).

A 4×1½ sq (21 cu in.) is too small, but a 4×2$^{1}/_{8}$ sq (30.3 cu in.) is just right.

What about sizing an outlet box for a domed fixture/paddle fan canopy? An equipment-grounding conductor, or not more than four fixture wires smaller than No. 14, or both, shall be permitted to be omitted from the calculations where they enter a box from a domed fixture or similar canopy and terminate within that box.

Example No. 2:

Q. A round 3×½ outlet box with cable clamps has a total volume of 8 cu in. Can you use this pancake box with a lighting fixture if it's supplied with 14/2 nonmetallic sheath cable, and the fixture has two No. 18 fixture wires and one ground wire?

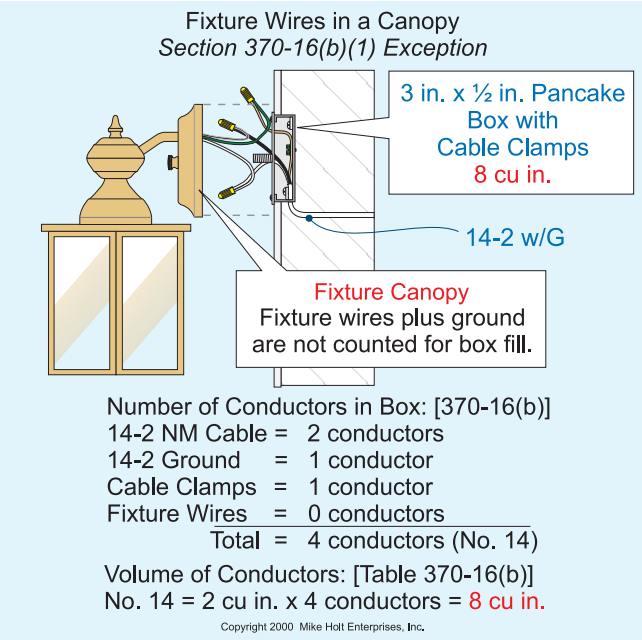

Fig. 2. *Box fill requirements when working with fixture wires in a canopy.*

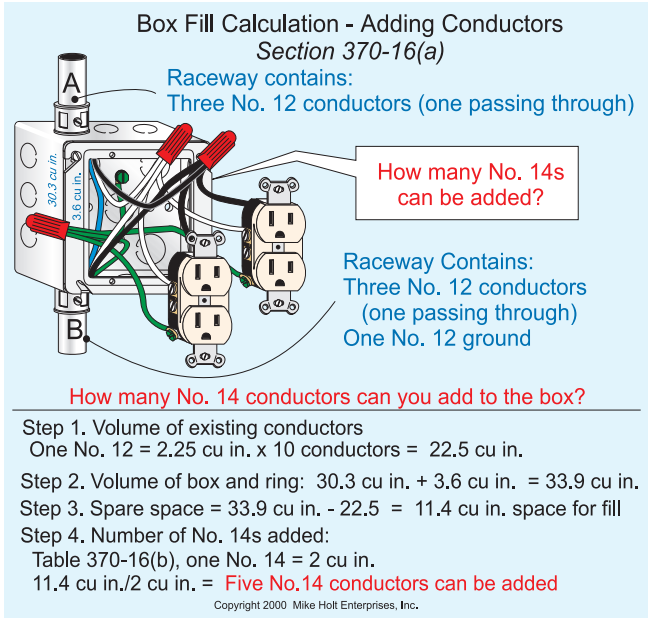

Fig. 3. *Box fill requirements when adding conductors to an existing box.*

(a) Yes (b) No

A. The answer is (a), Yes. Let's take a look at the steps necessary to find the answer.

Step 1: First, determine the number and size of conductors within the box (Fig. 2).

14/2 NM	Two No. 14 conductors
Box cable clamps	One No. 14 conductors
Ground wire	One No. 14 conductors
Total	Four No. 14 conductors

Step 2: Determine the total volume of the conductors and fittings per Table 370–16(b).

No. 14 = 2 cu in. × four conductors volumes = 8 cu in.

How about when you want to add conductors to an existing box? Here are the steps you should take in that situation.

Step 1: Determine the number and size of the existing conductors and/or their equivalents.

Step 2: Determine the volume of the existing conductors per Table 370-16(b).

Step 3: Determine the remaining space (total box volume–total existing conductor volume = space remaining) available in the box.

Step 4: Divide the space remaining by volume of one conductor to be added.

Example No. 3:

Q. How many No. 14 THHN conductors can you pull through an existing outlet box ($4 \times 2^{1}/_{8}$ sq) that has a plaster ring (marked 3.6 cu in.)? The outlet box contains two receptacles, five No. 12 THHN conductors and one No. 12 bare grounding conductor (Fig. 3).

(a) four conductors (c) six conductors
(b) five conductors (d) seven conductors

A. The answer is (b), five conductors. The steps required to find this answer are really pretty simple. Let's take a look.

Step 1: First, determine the number and size of the existing conductors.

Two Receptacles (2 yokes + 2 conductors)	Four No. 12 conductors
Five No. 12s	Five No. 12 conductors
One ground	One No. 12 conductor
Total	10 No. 12 conductors

Step 2: Next, determine the volume of the existing conductors per Table 370-16(b).

No. 12 conductor = 2.25 cu in. × 10 conductor volumes = 22.5 cu in.

Step 3: Then, determine the space remaining for the additional No. 14 conductors per Table 310-16(a).

Total space = 30.3 cu in. (box) + 3.6 cu in. (ring) = 33.9 cu in.

Remaining space = 33.9 cu in.–22.5 cu in. = 11.4 cu in.

Step 4: Now, determine the number of No. 14 conductors you can fit in the remaining space per Table 310-16(b).

No. 14 conductors added = 11.4 cu in. (remaining space) ÷ 2 cu in. (volume of one No. 14 conductor) = 5

Solution: You can add five No. 14 conductors to the existing box. EC&M