

SHIPSHAPE

# Subpanel Install

A neatly wired electrical panel is safer and easier to troubleshoot

BY CJ NIELSEN

**W**hen I was called to fix a wire that a builder had accidentally cut while repairing a deck outside of San Francisco, I could tell right away the home had some problems. The house was decades old and still beautiful on the outside, but somebody—possibly a former owner—had spliced numerous new lines into the original wiring to add lights and outlets (including some on the deck), hence the unprotected wire cut by the deck-repair crew.

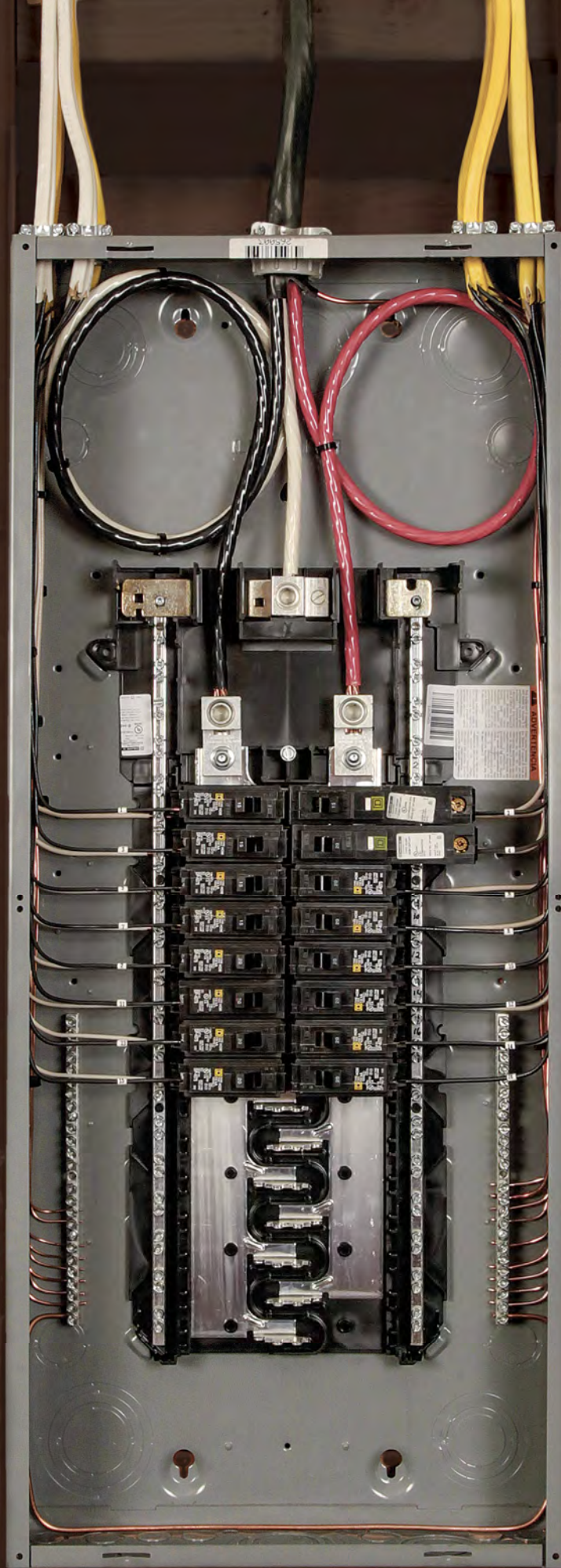
To top it off, the original load center (often called a panel) didn't have enough breaker spaces to safely supply all of the outlets, switches, and appliances in the house. So in addition to repairing and replacing many of the circuits running to the old panel, I installed a new subpanel to run new circuits to roughly half of the home.

Subpanels are common add-ons in homes. When someone wants to turn their garage or basement into a workshop, I often recommend that they add a subpanel to accommodate the breakers for their new tools. The same goes for a large addition and many other accessory buildings.

Electrical panels aren't something a homeowner looks at every day, and when they do see them, it's usually because something blew. But just because they aren't often seen doesn't mean they shouldn't look nice.

The load center is the heart of the electrical system. If planned correctly, labeled, and neatly installed, it should provide years of trouble-free service; and if something does go wrong, it'll be easy to troubleshoot or trace problems. And of course, a neatly wired panel also serves as a great signature for the electrician wiring the project. □

CJ Nielsen is an electrician in Northern California.  
Photos by Matthew Millham.





# WIRED IN

All of the cables are labeled as they're pulled to the load center so that they can be wired to the appropriate breakers. Load centers are commonly arranged with odd numbers on the left and even numbers on the right, and it makes sense to run the cables so they land on the side of the box they'll enter. I pull enough cable for each circuit so that it reaches below the bottom of the load center by about half the height of the box. This extra wire provides flexibility to

accommodate minor changes. When feeding cables into the box, take time to work out all of the kinks and twists, strip them carefully to avoid nicking the conductors, and tackle the cables one at a time so you don't mix up labels. It's crucial to keep the neutral and ground wires paired for arc-fault breakers, and following the same guidelines for regular breakers can make it easier to track down problems in the future. To stay organized, I work one side of the box at a time.



**Tap and pull.** To remove the metal knockouts, tap them down with needle-nose pliers, and then pull them out from the bottom.



**Work back to front.** Box connectors secure cables and protect them from the knockouts' sharp edges. Start from the back; otherwise, the front cables will block access to the rear connector's set screws. Feed the cables in two at a time, and use cable stackers to keep them organized.



**Erase the memory.** The subfeed cable in particular is stiff and has a "memory," or tendency to return to its original shape, which can strain connections if it's not worked out. Take your time to get it as straight as possible before tightening the connector's set screws.



**One cable at a time.** Carefully slice the outer plastic sheathing using a utility knife with a fresh blade, starting about an inch down from the box connectors. Keep tension on the cable as you slice, and stop just above the label on the sheathing.



**Save the label.** Clip off the label and set it aside, then peel the sheathing and paper off the wires, and use diagonal cutters to cleanly cut them from the wires.



**Reuse the label.** Slip the label over the ends of the neutral and hot wires, bend the ends over, and secure the wires' tips under the label to hold it in place.



# LAND THE GROUNDS

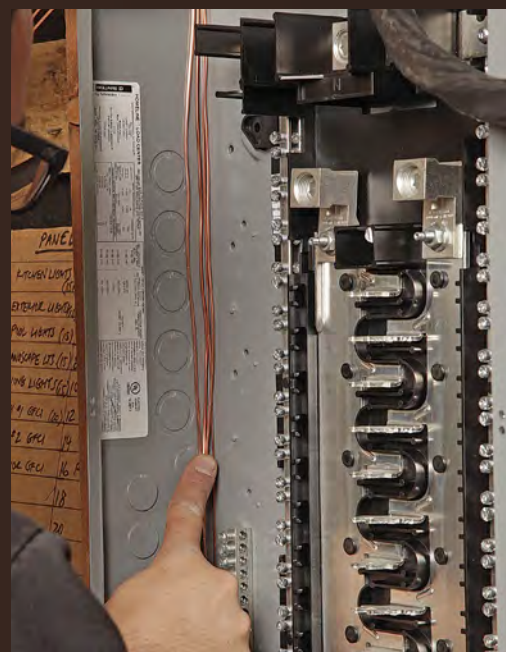


See a video of this process at [FineHomebuilding.com/magazine](http://FineHomebuilding.com/magazine)

After all the wires are stripped of their sheathing, separate the paired neutrals and hots from the loose grounds. Take your time to untangle everything so the grounds can be neatly pushed into the back corners of the box. I tighten all connections with a screwdriver to start, and after everything is wired in the right place, I go back with a torque driver to make sure everything is properly torqued to meet the load-center manufacturer's requirements and local code. To strip the subfeed, lightly score a line starting about an inch below the connector down to the end of the cable. Cut all the way through at the end, then pull the sheathing away from the cables; it should split on the scored line. Use diagonal cutters to clip the sheathing free at the top.



**Two is better than one.** Most panels come with one ground bus bar. To keep things neat, I install a second—one for each side of the box.



**Starting from the top.** Use a finger to push the grounds, one at a time, into the back corner, and run your finger down each wire to straighten it out.

# LAND THE SUBFEED

It's always a good idea to leave some extra subfeed cable in the box—electricians call this excess "service loops"—to make future repairs easier. Take time to make the service loops neat and work out the cables' memory so that they go into the lugs easily. Cables that are forced into the lugs are more likely to loosen over time, which could result in a fire.



**Don't stress the subfeeds.** After connecting the neutral feed, move on to the hot-feed cables. Loop each cable once so its end goes square into its lug. Line the cable up with the lug to determine where to trim it, then cut at that mark with diagonal cutters.



**Strip an inch.** Use a utility knife to score a line around the insulation of each feed cable.







# LAND NEUTRALS, INSTALL

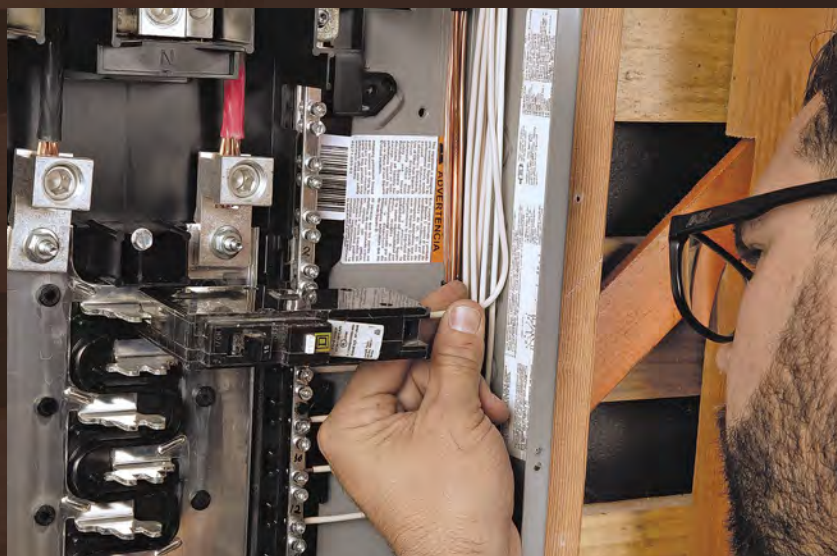
After landing all of the neutral wires, install the breakers, and then land the hot wires. I go through the circuits systematically, working down one side and then down the other. For each space, I identify the correct neutral/hot pair, separate out the neutral, and make sure the label stays on the hot.



**Neutrals come next.** Land the neutrals in order from top to bottom. Push the wire to the back corner of the box, run your finger down it until you're even with the space on the neutral bus where it's going to land, hold your finger on the wire as a bending point, and bend a soft 90° with your other hand.



**Cut, strip, tighten.** Use wire strippers to cut off the excess, strip about 1/2 in. of insulation from the end, and insert the wire into the neutral bus bar just far enough that a little copper shows out the other side. You can always cut the wire a little long and nip it back. Zip-tie the neutrals together on either side of the box.



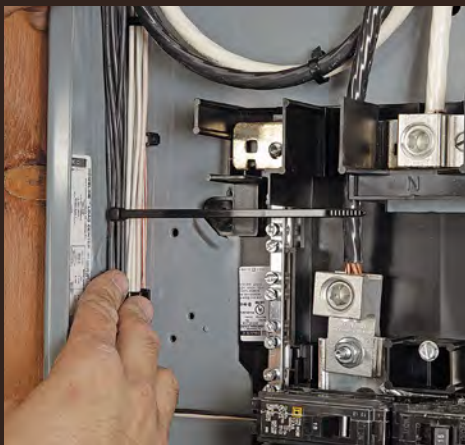
**Special consideration.** Neutrals connect directly to arc-fault circuit interrupter (or AFCI) breakers. I typically install AFCIs as I'm landing the neutrals, rather than with the rest of the breakers.



# BREAKERS, LAND HOTS



**Install the breakers.** With the breakers snapped into place, bend the hots, strip out 1/2 in. of insulation, and connect the hots to each, tightening the set screws.



**Last straps.** Secure all of the hot wires on either side of the box with zip ties to keep the conductors together.



**Label the hots.** Although the temporary labels have been removed, I label the hots more permanently so the next person who opens the panel can easily identify which circuit is which.



**Test it out.** After everything is properly tightened, flip on the breakers to verify that the installation went according to plan.