



Bill Crutchfield, Founder and CEO

# Speaker installation guide for new construction

We've developed this in-wall, in-ceiling, and on-wall speaker installation guide to help you pre-wire your new home and install the speakers after construction. Need more help? Our comprehensive and caring tech support is free with most orders. Please let us know if there's anything else we can do.

*Bill Crutchfield*

Installing your own in-wall, in-ceiling, or on-wall speakers can be a great way to save money, and still get a good-looking system that blends attractively into your décor. This guide includes detailed information to help you pre-wire your new home, and install your own speakers after construction.

## Before you get started

Make sure that you have a thorough understanding of local building and fire codes. You should be able to obtain a copy from your local government office. Also read and follow the safety guidelines below and those in the owner's manual.

### Can you do it yourself?

Have you ever installed phone lines, TV cable, security, or other low-voltage wiring in a new home? If so, then you probably already have the skills and tools you'll need to install wiring for an in-wall, in-ceiling, or on-wall speaker system. In most locales, a homeowner is allowed to install his or her own low-voltage wiring. However, each state has its own code, as do some cities and counties, so check with your local building inspector to be sure.

If you don't have much wiring experience, make sure you read this guide thoroughly to get an idea of the steps and work involved. Also, be sure you're experienced in the safe use of power drills, hand tools, and ladders. The pre-wiring process will go more smoothly with two people, so make sure you have a helper for some of the more labor-intensive parts. If you'd prefer not to pull the wire yourself, or don't have the proper tools, hire a professional to pre-wire your home. You can still save money later by installing the speakers yourself.

### Safety tips

- Be sure to use wire that meets local building and fire code. Use UL-rated wire labeled CL2 or CL3 for in-wall installations.
- Follow the safety procedures set in place by your builder, including those relating to use and storage of extension cords and power tools. Some sites may require a hard hat or other protective clothing. Remember, you're working on a construction site, so exercise caution.
- If you drill through a fire block or firebreak, patch it with comparable material.
- When working on a ladder:
  - ◆ Place your ladder in a stable position close to where you're working. Don't reach.
  - ◆ Always have one hand on the ladder.
  - ◆ Face the ladder when ascending or descending.
  - ◆ Don't carry heavy items up the ladder that could cause you to lose your balance and fall.
- Before connecting your speakers, be sure to unplug your receiver.

### Will your builder let you work on the site?

Don't assume that it will be OK with your builder for you to work on "your" construction site. If you don't have any experience working on a construction site or with low-voltage wiring, your builder might not want to risk potential delays. What if your work is inspected and found unacceptable? All of the other subcontractors will be delayed while you fix your work. Also, some builders may have insurance policies that prohibit unlicensed or uninsured subcontractors from working on sites they supervise.



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## Need More Help?

**Tech support is free with most orders. You can contact our Tech Support staff 16 hours a day (8 a.m.-midnight, Eastern Time), seven days a week. Their phone number is printed on your invoice.**

Crutchfield provides information intended to simplify your installation. Because tools, products, materials, techniques, and local codes and regulations vary and change, Crutchfield assumes no liability for omissions, errors, or the outcome of any project. Always exercise caution, and follow all applicable regulations and codes. Consult a licensed professional if you have any doubts about our information.

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Speak sincerely to your builder about your determination to do a good job. Many custom builders and a few tract-home builders will allow a home owner to do the work, provided you guarantee you will not delay or interfere with other contractors.

## Your role on the construction site

The construction schedule puts your A/V installations in a narrow time frame. In the early stages of house construction, weather can delay a project. Likewise, circumstances may make the schedule go faster than planned. Keep in close touch with your builder to avoid unpleasant surprises.

House construction proceeds in stages. Here's how we think you should schedule your work around the builder's tasks (your steps are shown in bold):

1. Foundation
2. Framing and roof
3. Plumbing
4. Electrical
5. **A/V pre-wiring**
6. Drywall installation
7. Trim installation
8. Floor installation
9. **In-wall/in-ceiling speaker grille and frame installation (if you want the grilles painted)**
10. Paint
11. Final electric and plumbing
12. **Install in-wall/in-ceiling speakers, controls and wall plates**
13. Final inspection (all holes, boxes, and brackets must be closed)
14. Move-in
15. **Install on-wall speakers; final A/V component hookup**

You want to install all A/V wires after the electrician has finished pulling AC wires. This is critical, because you have to avoid the electrical wires as much as possible. After the AC power wires are run, the electrician may still be on-site for a day or two installing switches and terminating. If your builder is on a tight schedule, you may have to work while the electrician is still on-site. Sometimes your builder may be able to delay the next stage until the following week, giving you the weekend to work.

## Working successfully with other trades on the site

You will find the subcontractors on the job site much more cooperative if you follow some simple guidelines while you are on their turf. Remember, they are making their living by completing their work on schedule.

- Try to work in rooms and areas where no other work is going on.
- Keep your tools, ladders, and extension cords organized and neat.
- Don't borrow tools from subcontractors.
- Clean up after yourself. Bring a broom and dustpan to sweep up any wood shavings and debris you create.

## Who can you hire to do the work?

If for any reason you can't do the pre-wiring yourself, you'll need to hire someone else to do the work. Before you hire anyone, you need to have a well-documented wire plan, including the type and length of wire needed for each run, the proposed locations of speakers and components, as well as the necessary brackets and wall plates. If you haven't written anything down, it will be harder to find someone to do the work for you.

Next, speak to your general contractor or builder. Many builders will insist that you use the electrical or security contractor scheduled to do the other pre-wiring work on your home. If not, you can shop around.

If you want to be in charge, then you may have to agree to:

1. Assume responsibility for the correctness of the wire plan. This probably doesn't seem like a big deal for a single-room stereo or

home theater setup, but if you're wiring speakers to multiple rooms, along with devices like a volume control, or an IR sensor so you can control the source components in your main room remotely, things can get more complicated.

2. Provide copies of the wiring plan to the workers.
3. Walk through the site with the workers and discuss and approve the project before and after the work is done.
4. Provide all materials (J-boxes, brackets, wire, fasteners) for the job.
5. Pay the subcontractor an hourly rate for the workers involved (prices will vary by locale).

Should you want the subcontractor to assume more responsibility (you would like your plans checked, or you would like them to supply the right wire, etc.) you should hire a contractor with experience doing A/V installations. A good qualification is that the company is a member of the Custom Electronic Design and Installation Association (CEDIA). You can get referrals to CEDIA members from [www.cedia.org](http://www.cedia.org). You should expect a CEDIA member to charge for design services, as well as the installation labor. Some CEDIA firms won't install a system unless they design it from scratch and sell you the components. Some are willing to help a do-it-yourselfer.

## Preparation and planning

### Choosing the right speaker wire

The type of speaker wire you use will depend on where you're going to route the wire and how far the signal will have to travel to get from your receiver or amplifier to the speaker. You'll need UL-rated speaker wire labeled CL2 or CL3 to run wire inside your walls. The Underwriters Laboratory (UL) looks at heat generated from current flowing through wire, how quickly the cable will catch and spread fire when exposed to flame, and the wire's susceptibility to damage from external stresses. Also, be sure to check your local building and fire code and buy wire accordingly.

The gauge, or thickness, of your speaker wire should depend on how far the wire has to travel from the receiver to the speaker. The lower the American Wire Gauge (AWG) number, the thicker the wire. Significant power losses can occur over long runs, resulting in lower performance. While this probably won't be a problem in most single-room setups, it could be an issue for multi-room systems. Use the chart below as a guideline for wire gauge selection.

Distance from speaker to amplifier	Gauge
Less than 80 feet	16
80 to 200 feet	14
More than 200 feet	12

You can choose speaker cable with two or four conductors (see photo on page 3). Two-conductor cable is all you need to wire one speaker. Four-conductor wire is mostly used in multi-room applications with volume controls. For example: If you're going to run wire from a receiver in your living room to a pair of speakers with a volume control in your dining room, you would use four-conductor wire from the receiver to the volume control, and two-conductor wire from the volume control to each speaker.

You may see in-wall speaker cable identified in short hand that indicates its gauge and its number of conductors. For example:

16/2 is 16-gauge wire with 2 conductors

14/4 is 14-gauge wire with 4 conductors

As you're planning your speaker wire routes, also consider what other kinds of wire you might like to install. For example, Cat-5 cable can be used to create a whole-house computer network, and is also necessary for

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most IR (infrared) control systems. IR systems allow you to control your CD player, receiver, etc. from another room — a definite plus for multi-room systems.

## Speaker placement

Generally, you'll want to have chosen your speaker locations before your purchase. But if you're still in the process of deciding where to put your in-wall, in-ceiling, or on-wall speakers, or if you want some detailed placement tips, check out [crutchfield.com/inwallplacement](http://crutchfield.com/inwallplacement)

## Planning the wire route

Once you've chosen your speaker locations, you need to figure out how to run the wire. Because wire costs money, you'll want each wire run to be as direct as possible. However, in order to avoid AC power wires, or keep from drilling holes through every stud all the way around your room, you'll probably have to compromise. The trick is to minimize your work, not your wire length.

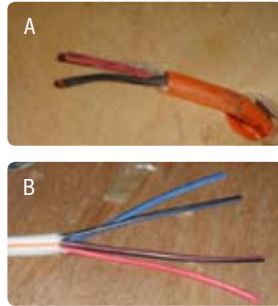
Although it may seem like wasting wire, your attic, basement, or crawlspace can provide you with great wire pathways, where you don't have to drill, you simply hang your wire in clamps and brackets. Plan to use these spaces as much as possible, even if it means a much longer length of wire. The time you save not drilling studs and joists can more than compensate for the longer wire runs.

Also see "The rules of routing wire" on page 4 for additional guidance as you plan your wire routes.

## Making sure you have enough wire

After planning where you're going to route your wire, calculate how much you'll need. The key to estimating wire runs is to work your way from point to point carefully, without overlooking anything. If you're working from plans, use a scale ruler. Better yet, walk through the construction site, pacing off each run and thinking through where the wire will have to turn a corner or go up or down a wall. Convert your paces to feet and keep a record of each run. Here are five keys to estimating wire:

1. Careful inspection: Make a note of which direction ceiling joists run and where other structural obstacles might lie.
2. Pace off the entire route: Don't guess, pace off *everything*. Estimate small runs first and double-check yourself for consistency.
3. Measure the ceiling height: Don't guess at the ceiling height, measure it. If you "eyeball" a vaulted ceiling, you're asking for trouble.
4. Allow 4 to 6 feet for wire termination: If you intend to install speakers and volume controls by yourself, allow plenty of extra wire so you can set the device on a ladder or floor while you hook it up. Consider leaving even more wire for an in-ceiling speaker installation, so you can wire your speakers while standing on the floor (instead of precariously balanced on a ladder).
5. Allow 10 to 15 percent extra for insurance: Your planned wire route might be thrown off by something the plumber or electrician did. To be safe, buy a minimum of 10 percent more wire than you think you need. Professionals use a 20 percent fudge factor, but that's easy for pros to justify, since they can use the excess wire on their next job.



Two conductor wire (A) is used when running wire directly to a speaker, while 4-conductor wire (B) is often used for runs to volume controls.

Here's an example of how to calculate a wire run from a receiver to the right in-ceiling surround speaker:

### Receiver to right surround speaker, 2-conductor wire

- Slack for speaker installation:..... 6 feet
- Horizontal run across ceiling to wall: ..... 9 feet
- Vertical run down wall to wall plate:..... 6 feet
- Wall plate to receiver: ..... 4 feet
- Subtotal: ..... 25 feet
- + 15% fudge factor: ..... 4 feet
- Total: ..... 29 feet

The same technique should be applied to multi-room audio systems. Depending on your setup, this process might be a bit more involved. Here's an example of a wire run in a one-story home, from a receiver in the family room to a volume control and speakers in the home office.

### Volume control to receiver, 4-conductor wire

- Slack for volume control installation: ..... 4 feet
- Vertical run from volume control to ceiling: ..... 4 feet
- Ceiling to first cable hook in the attic: ..... 4 feet
- Length of attic run: ..... 40 feet
- Last cable hook in the attic to ceiling: ..... 4 feet
- Ceiling to wall plate behind receiver: ..... 7 feet
- Wall plate to receiver: ..... 5 feet
- Subtotal: ..... 68 feet
- + 15% fudge factor: ..... 10 feet
- Total: ..... 78 feet

### Speakers to volume control, 2-conductor wire

- Left speaker:
- Slack for speaker installation: ..... 6 feet
  - Horizontal run across ceiling to wall: ..... 4 feet
  - Vertical run inside the wall: ..... 4 feet
  - Horizontal run to volume control: ..... 8 feet
  - Slack for volume control installation: ..... 4 feet
  - Subtotal: ..... 26 feet
  - + 15% fudge factor: ..... 4 feet
  - Total: ..... 30 feet

- Right speaker:
- Slack for speaker installation: ..... 6 feet
  - Horizontal run across ceiling to wall: ..... 12 feet
  - Vertical run inside the wall: ..... 4 feet
  - Horizontal run to volume control: ..... 8 feet
  - Slack for volume control installation: ..... 4 feet
  - Subtotal: ..... 34 feet
  - 15% fudge factor: ..... 5 feet
  - Total: ..... 39 feet

So for this room you would buy 78 feet of 4-conductor speaker wire and 69 feet of 2-conductor wire.

Many professional installers simply take the longest speaker run (in this case, 39 feet) and use that for both speakers — or for all 5, 6, or 7 speakers in a home theater setup. Why? If the signal travels the same distance to each speaker, it will arrive at each speaker at the same time, which gives you perfectly timed, in-sync audio. However, for relatively small variances in length, most people probably won't be able to hear the difference. Plus, using the longest run for all speakers in a home theater setup could add quite a bit to your wire costs, and leave you with many extra feet of wire to dress and hide inside the wall. For optimum performance, equal lengths of wire are ideal, but you'll have to decide if that makes sense for you.

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## Tools you'll need

Hand tools:

- Hammer
- Tape measure
- Small level
- Linesman pliers
- Wire cutter/strippers (for the wire gauges you'll be working with)
- Laser level or chalk line



Some of the tools you'll need to pre-wire your home include: (A) a power drill; (B) a hammer; (C) measuring tape; and (D) a level.

## Drills and bits:

Count on using a ½" or larger electric drill. You'll need a set of spade bits from ¼" to 1½". Professional installers use auger and hole-saw bits because they make the job easier. Since these bits are expensive, think twice about purchasing them for one-time use.

If you don't have a battery-powered drill, you'll need grounded extension cords of sufficient length to reach from the contractor-supplied central electrical supply to anywhere you want to drill. You shouldn't join four 25-foot cords to make a 100-foot cord. The wasted power may lower the voltage to a point that your drill could be damaged permanently.

## Additional supplies:

- Bring step ladders and extension ladders of sufficient height to reach every wiring location in your home. You'll also need eye protection, good boots, knee pads, gloves, and protective clothing. Some job sites require a hard hat.
- Wire labels — Included free with your speakers. In the box, you'll see Crutchfield CableLabels™ — four pages of clearly identified, color-coded labels for your speakers and other A/V gear. Label both ends of each wire before you start pulling, or before cutting another wire. For more information, or to order additional sets, see [crutchfield.com/CableLabels](http://crutchfield.com/CableLabels)
- Electrical tape
- Wire ties and attachments — Wire must be supported every 4½ feet and within 1 foot of a junction box. Wire ties and wire-tie clamps are recommended because the staples electricians use for regular AC wiring may damage low-voltage cables if they're nailed down too tightly.
- Nail plates — Whenever you drill a hole ¼" or less from the surface of any wooden part of your house (a stud, joist, plate, block, or brace), or notch any wooden part, you must protect the cable with a nail plate. The nail plate prevents a nail from ever piercing the cable.

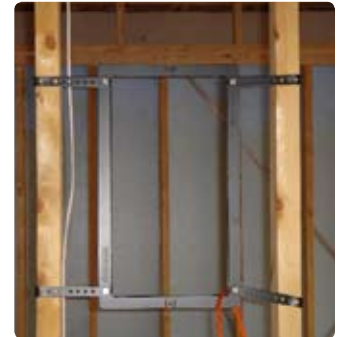


Use nail plates if you notch studs or joists, to prevent your speaker cable from being damaged in the future.

- J-boxes — "J-boxes" or junction boxes are used to mount volume controls and other in-wall devices, such as infrared sensors. Look for a J-box that's deep enough to fit your in-wall devices (usually 2¾").
- Backless brackets (also known as P-rings) — When you're simply terminating wires at a wall plate for speakers, you don't need the structural strength of a wall box. Backless brackets provide the minimum structure you need for a wall plate.
- Optional "hole-saving" brackets — Brackets for in-wall and in-ceiling speakers can be installed in the pre-wire or rough-in stage. These brackets save a lot of time, since the drywaller will cut holes for the brackets before hanging the drywall (as they do for light switches, electrical sockets, etc.). You may have to order these separately — they aren't included with, or available for, all in-wall and in-ceiling speakers.



Backless brackets provide the minimum structure you'll need to attach a wall plate. If you're installing one to run speaker wires to your receiver, mount it at the same height as AC outlets for a clean, uniform look. If you're installing one for an IR sensor or volume control, mount it at the same height as light switches.



Hole-saving (or "rough-in") brackets tell the drywaller to cut a hole for the speaker (just like he/she would for electrical outlets and lighting fixtures). This makes your job much easier later on, since it takes the guesswork out of finding your speaker location and wire after the drywall's up.

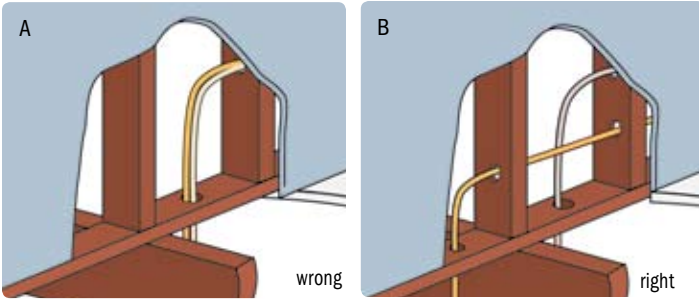
## The rules of routing wire

### How close can you get to AC power wires?

AC wires produce an intense field of electromagnetic interference about 4 feet in diameter. If the A/V wires are run directly adjacent to the AC wires for a significant distance, this interference can generate hum in your speakers. Here are the best ways to keep your system's performance clean:

1. If AC and low-voltage wires cross, keep them at 90-degree angles.
2. Don't install your wires beside AC power lines for more than 5 feet. When you have to run your wire beside an AC line, keep it a *minimum* of 1 foot away from the power line throughout the entire run; keep it 2-3 feet away if possible.
3. Never use the same hole to feed both AC wire and speaker wire.

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(A) Running speaker wire with power cable results in poor speaker performance. (B) For good speaker performance: If speaker cable and power cable run parallel, keep them a minimum of 12" apart, 2-3 feet if possible. If they intersect, keep them at 90-degree angles.

### Will other low-voltage wire interfere with audio and video?

No, you can safely run audio and video in the same bundle as security, phone, control, and any other low-voltage wire — provided you're sure that no other subcontractor is planning to use that hole for their run.

### What are the rules for drilling holes into the structure?

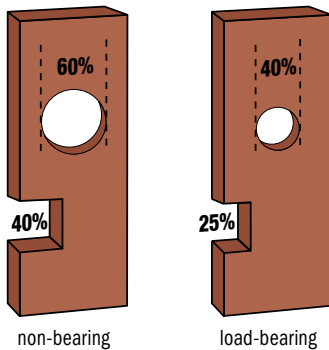
Wood-frame houses are not all built the same way, but it's typical to see 2" x 4" wall studs, 2" x 10" floor joists and 2" x 6" (or larger) ceiling joists. Typically, these are spaced 16 inches apart, center to center. In some new homes, spacing for joists may be 24 inches, center to center. The architect sizes the wooden structural members to compensate for holes accommodating wires and pipes.

You should make yourself familiar with the terms used to describe the structure of your house. When you have any doubts about whether you should drill here or there, ask your builder for advice. Local building and fire codes incorporate the general principles we're going to talk about, but some cities, counties and states restrict and amend these principles because of the risk of earthquakes, hurricanes, snowfall, or tornadoes. You should be able to get a copy of your building and fire code from your local government office.

Studs that support joists are called "bearing" or "load-bearing," and are often (though not exclusively) found in exterior walls. A non-bearing stud is typically found in some interior walls that divide one room from another. Non-bearing stud walls are your preferred wire routes, since they can have larger holes drilled into them.

Here are some general rules:

- **Studs** — Drill holes in the center of each stud to better avoid nails. If you notch a stud, use a nail plate. In a non-bearing wall, hole diameter can be up to 60 percent of the stud width, and notch depth can be up to 40 percent. In a load-bearing wall, holes can't exceed 40 percent and notches can't exceed 25 percent.



In non-bearing walls (left) hole diameter can be up to 60% of the stud width, and notch depth can be up to 40%. In a load-bearing wall (right) holes can't exceed 40% and notches can't exceed 25%.



(A) Load-bearing walls intersect directly with the floor above. You'll see the wall run continuously up to the ceiling. (B) Non-bearing walls don't intersect directly with the floor above. In this image, there's enough room for a heating duct to run between the wall and the ceiling.

- **Joists** — Keep all holes centered vertically in the joist. Don't allow a hole to be drilled within 2" of the top or bottom of the joist. The extreme ends and the middle third of the span of the joist carry the load, so avoid making holes there if possible. You are limited to a hole that is a third of the measured depth of the joist. A 2" x 6" joist actually measures 5½" deep, so you can drill a 1¾" hole. You can drill multiple holes rather than one very large hole when many wires need to go one way. Engineered roof and floor trusses or wooden "I" beams often have open "web" space for wiring so that you don't need to make holes. Consult your builder for maximum hole sizes, if you need to drill. Generally, for such "TJI" (or "truss-joist") trusses, smaller holes are allowed near the ends, and larger holes are allowed near the middle.
- **"Glue lams" or headers** — You cannot make any holes in laminated support beams (glue lams) or headers (the supports over doors, windows, or arches). Your wire routes must avoid these structural members at all costs, even if it means a large detour.
- **For your wires to pull easily**, the diameter of a hole should be about twice as big as the total diameter of all the wires you plan to pull through it. Since hole sizes are limited, you may have to plan your wire routes to use multiple holes. We recommend that you limit your hole size to 1½", to accommodate a ¾" bundle of cables.



Glue lams are laminated support beams consisting of many thin pieces of wood glued together. You cannot drill or notch these beams.

### What if your house is steel framed?

Steel framing is usually found in commercial structures. It normally makes wiring go faster, since steel frames and joists often have large pre-made openings for wire.

You can buy a punch to make more openings. All holes must be in the center of any steel member and cannot be any closer than 1½" to another hole. Holes can be larger than wood framing. However, punching limits you to a fairly small hole size. If you must make new holes, ask your builder to approve a maximum hole size.

The edges of pre-made or punched openings can be very sharp. You'll need plastic grommets from an electrical supply house to fit inside the openings to protect the wire.

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## Now that you know the rules, let's look at pre-wiring your house, step-by-step

1. Bring all your tools, parts and wire into a room that's not occupied by other workers. If you're installing speakers in a single room that other people are working in, you should wait for them to finish if you can't easily work around them. Try to set up near a hallway or entrance. That makes it easier to measure out your lengths of wire, and tape them into a bundle to pull them all at once if necessary.
2. Using a large, bright felt pen or crayon, walk through your room or house and mark all of the speaker, bracket and box locations according to your wiring plan. It's important to be thorough and systematic with this step, particularly if you're installing a multi-room system. Start with the most distant room and work your way back "home," to where your main audio/video system will live.
3. You and your helper can split up and start drilling holes and installing boxes and brackets. Drilling can be tiring, so if you have lots of holes to drill, switch from one task to the other periodically.

When you have a long run of holes to drill through studs or joists, use a laser level or snap a chalk line against the face of the studs or joists to line up your holes perfectly. As you drill, work backward so that you can always see the holes you just made. Lined-up holes make pulling wire much easier. Always drill in the center of the stud or joist and at least 1/4" away from the edge.

Volume controls are usually located 44-48" off the floor. They will look best if you measure and match the height of your wall switches. Don't attach low-voltage boxes to light switch boxes. Wall plates are typically aligned with the AC wall receptacles (12-18" off the floor).

4. Installing hole-saving brackets for in-wall and in-ceiling speakers saves work later and allows you to position the speakers relative to door and window frames and lights. Using a laser level or snapping a chalk line from light fixtures helps you align ceiling speakers with lights.
5. Now it's time to measure, cut, label, and pull the wire.
  - Start with the longest runs first, while you're fresh. As you tire, the wire runs will get shorter and easier. On the other hand, if you're unsure about estimating wire lengths, start with the short runs first. As you gain confidence, start pulling the longer runs.
  - Measure your wire run by pacing it. Count each floor-to-ceiling run as four paces. Allow at least three extra paces at speaker ends, two extra paces at volume controls or wall plates. Total your paces.
  - Pace off the distance from your spools (or coils) of wire and place a marker (you may have to walk out into the yard on long runs). Pull one wire from a spool to the marker, and then cut. Label each end of the wire for source and destination before pulling it, or before cutting another wire.
  - Don't try to pull wire right off the spool. It will not save time.
  - To pull more than one wire through a hole at once, first bundle the wires with electrical tape at the leading end. Stagger the ends, so that the bundle gets progressively thicker.
  - Don't pull too hard. Stretching the center conductor and/or dielectric can damage your wires. Carefully move the wire bundle to the starting point for your run. Have your helper keep the wire from getting hung up as you move it. Feed the wire through the holes and pull it to your destination. Whenever the wire binds, stop pulling, find the point of friction, and ask your helper to ease the wire past that point as you continue pulling.
  - Don't kink the cables or attempt to make your corners tight. Cable should not be bent sharply. Kinks or tight turns can change the electrical characteristics of the cable and negatively affect performance.

- When running wire in a basement or attic crawlspace, don't just lay the cable on joists. Fix cable brackets or hooks every 4½ feet.
6. Once the wire has been pulled, you must dress it. Support the wire once every 4½ feet with a wire tie or clamp, and within 1 foot of a J-box or P-ring. At each J-box or P-ring, dress at least 4 feet of speaker wire. It's better to use wire ties or clamps rather than wire staples, since wire staples are more likely to compress the dielectric and ruin the performance of your wire. Wire ties should not be over-tightened. It's important that nothing you do changes the shape of the wire.



Don't bend the cable; instead, create a smooth, gradual curve. Plastic wire ties should be snug, but not tight enough to pinch the cable.



Dress at least 4 feet of speaker wire in a loop at each J-box or P-ring location, securing it with wire ties.

Once you get the wire to the location for your in-wall, in-ceiling, or on-wall speaker, dress 6 feet of speaker wire in a loop. If you're using a hole-saving bracket, secure the wire loop just behind it, in an easily accessible location.

If you're not using a hole-saving bracket, secure the loop between the studs or joists using a wire tie or clamp. Another option is to cut a strip of thin plastic (such as a garbage bag) and tack that up to the studs or joists. Dress your wire as usual, and then punch a hole in the center of the plastic. Pull a couple of inches of the end of the dressed wire through the hole. When you're trying to find your wire later, it will be closer to the actual speaker location, and easier to find. The drywall will cover up your wire, so photograph or measure the location so that you can find the wire after the drywall is up.



If you're not using a hole-saving bracket, another option is to cut a strip of plastic and tack it up to the studs or joists. Dress 6 feet of wire and secure it above the strip of plastic. Then poke a hole in the middle of the plastic, and pull through a short length of wire.

7. Affix a nail plate to any stud or joist with a wire closer than 1/4" from the face of the stud or joist.
8. Wrap the ends of each wire with plastic bags and tape to prevent moisture from entering wires. Wire can rot from paint and plaster moisture. Make sure labels are protected.
9. Inspect every room twice. Drywall installers will cover up everything you've done, so take pictures of any concealed wiring and make careful notes. Clean up each room, check that you have everything you came with, and head home for a well-deserved rest.

Once you've completed the wiring, you may still need to make up to three separate installation visits to your new home over the next few weeks.

# Speaker installation guide for new construction

## Painting and installation

### Speaker grille and frame installation for painting

If you would like to have any of your in-wall and in-ceiling speaker frames and grilles painted, be sure to schedule a trip to install them before the painters begin work at your home. With some speakers you must install the speaker and the frames and grilles; with others you can simply install the frame and grille, keeping the expensive speaker portion safely at home until the house is finished.

Discuss painting the speakers with your painter and your builder. Place the grilles for each room's speakers in that room with notes attached identifying the grilles as speaker grilles to be painted. Plan to return to the site as soon as the grilles are all painted to install the grilles into the frames. Don't expect the grilles to stay clean and unscratched if you leave them lying around the construction site. Install them as soon as you can. Since the grilles simply friction-fit into the frames, it's typically a quick visit with a ladder and no tools.

If you're going to paint the speaker grilles yourself, here are some tips:

1. If your speakers are already installed, remove the grille from the speaker. They must be painted separately with paint that's been thinned. Only use thinners recommended by the paint manufacturer.
2. Clean surfaces with a damp cloth before masking.
3. Protect the speaker drivers. The woofer and tweeter cannot be painted. You must mask them off. Some speakers come with paint masks in the box. If not, use paper and masking tape to create your own mask. Mask off the entire baffle (the area behind the grille). Don't use tape directly on the drivers.
4. If you're painting an on-wall speaker and bracket, mask off the speaker wire connections, and any threaded parts on the speaker and the bracket.
5. Use a primer for best paint adhesion.
6. It's best to apply the paint in several light coats, and spraying the paint on will work better than using a paint brush. When you paint the grilles, use thinner paint and take care not to clog the holes of the grille.
7. Wait until paint is completely dry before removing any masking.



Many speakers come with paint masks to protect the drivers.

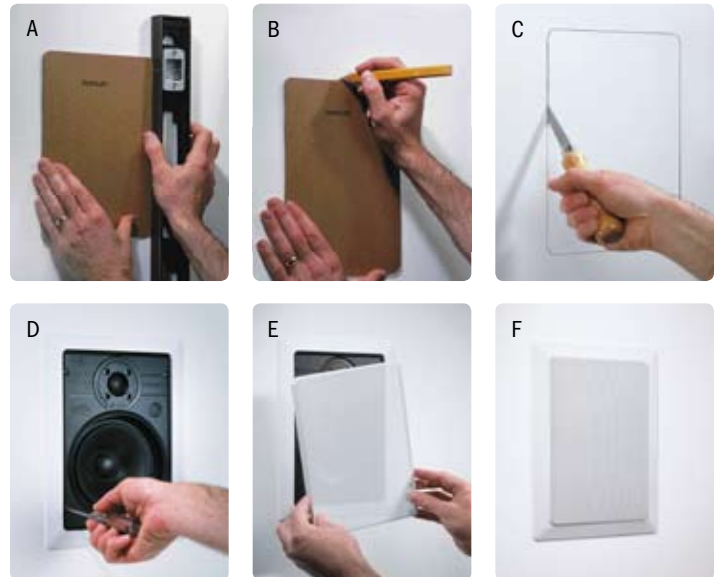
### Covering all holes before final inspection

Your last visit before you move into your new home is to install all of the in-wall and in-ceiling speakers, volume controls, infrared sensors and wall plates in your system. All of the holes in your home must be covered for your builder to get final approval for you to move in.

### Installing your speakers

#### Installing in-wall/in-ceiling speakers

- Tools you'll need (if you didn't use a hole-saving bracket): a drywall saw; a utility knife; wire strippers (for the gauge of wire you're working with); a Phillips screwdriver and/or drill (check the owner's manual); masking tape; a pencil; a level; a chalk line or laser level (especially for in-ceiling speakers); measuring tape; and a scribe (for circular speakers).



Installing in-wall or in-ceiling speakers in your finished home: First, find each speaker's pre-wired location referencing your previous measurements and photos. Next, check for obstructions using your stud finder. Drill a small test hole, and probe the area behind it using a sturdy wire, making sure the area's clear before cutting. To install the speaker: **A.** Level the template. **B.** Trace the template. **C.** Cut the drywall out in one piece. Pull out your dressed loop of speaker wire. **D.** After you connect the wires to the speaker, screw the speaker and frame into the wall, but not too tightly or the grille won't fit properly. **E.** Gently place the grille into the frame. **F.** Enjoy the finished product.

The basic idea behind all in-wall and in-ceiling speakers is that the speaker is held in place by sandwiching the drywall. A frame around the speaker conceals the cutout in the drywall and presses against the front of the wall. Behind the wall, the speaker has either a set of flip-out "dog ear" brackets or a bracket that screws into the frame. You should read and follow the manufacturer's instructions precisely. Here are some tips that may help (if they don't conflict with your speaker installation manual):

- Put some insulation in the wall cavity before you install the speaker. The insulation will improve the sound. Put the same amount of insulation in each speaker cavity. Don't pack it tightly in one and loosely in another.
- Check for any tone controls on the speaker. If the speaker is within a foot of a corner, set the bass controls to the "minus" or "cut" position. If the room is very "live," without rugs or a lot of upholstered furniture to absorb sound, set the treble control to the "minus" or "cut" position.
- Don't over-tighten the screws. If you over-tighten the screws, the speaker frame may bend, or the drywall may crack. If you're using a powered screwdriver, set the torque setting on low. Let the powered screwdriver do most of the work, then do the final tightening by hand.
- If the speaker has any tone controls or has a pivoting tweeter, leave the grille off until you can listen to the speaker. Once you have adjusted the speaker, install the grille.
- Be careful handling the grilles. If they get bent, it's very difficult to use them. Grilles friction-fit into the installed speakers. Do not use excessive force to install them. If the grille does not slip in, try loosening the mounting screws before resorting to muscle to install them. Work a little in at a time, starting at one corner and gradually moving around the speaker.

# Speaker installation guide for new construction

## *Installing on-wall speakers*

- Tools you'll need: a utility knife; wire strippers (for the gauge of wire you're working with); a Phillips screwdriver and/or drill (check the owner's manual); a pencil; a level; and a tape measure.

On-wall speaker brackets need to be drilled directly into a stud, or possibly drilled into the wall using wall anchors. Reference the measurements and/or photographs that you took prior to drywall installation to locate your speaker wire, as well as the spot where you want to install your on-wall speaker.

Start by drilling a pilot hole and exploring the space behind the wall using a piece of sturdy wire (such as a bent coat hanger). Check for any obstructions. When you've confirmed that the area behind the wall is clear, cut a small hole to retrieve your in-wall wire. Cut the drywall on an inward slant so that it'll be easier to patch when you're done. Hopefully, your detailed measurements and photographs pay off, and it's as simple as reaching into the wall and pulling out the wire. But finding your in-wall wire isn't always that straightforward, and you may have to cut another hole to reach it. Be prepared to patch and repair your drywall.

Next, you'll need a hole for your wire. Since the speaker wire will be coming out of the wall directly behind the on-wall speaker, this hole will most likely be concealed by the bracket. For this reason, many people choose not to mount a wall plate. You'll just need a hole large enough to pass your speaker wire without pinching it.

Finally, it's time to attach the bracket to the wall, wire your speaker, and attach your speaker to the bracket. This process can vary slightly between mounting brackets, so be sure to follow the installation instructions in the owner's manual.

