HOMEOWNER REPAIR GUIDE

BURYING ELECTRICAL WIRING

For garages, landscape lighting and other exterior uses

Buried wiring can be the answer to garage wires that hang too low across your back yard, as well as a way to add post lights, landscape lighting, and the convenience of exterior receptacles. Underground wiring will not be damaged by weather, wind, tree limbs or the occasional delivery truck, but – to protect children and pets from the wiring (and vice versa) – it should be buried properly.

CALL BEFORE YOU DIG

Ohio law requires that, before beginning ANY digging project, you contact the Ohio Utilities Protection Service (www.oups.org), 1-800-362-2764. You must call at least 48 hours in advance, but no more than 10 working days (excluding weekends and legal holidays), so they can mark where the underground utilities lie on your property. Mark the path where you plan to dig with white spray paint or white flag stakes prior to their visit. It is not unusual for natural gas pipes or other utilities to be near the surface.

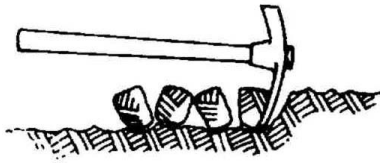
By assessing current needs and future use, you can determine how many circuits to include, whether to use conduit or cable, and how heavy an amperage load to plan. Check with your community's electrical inspector for any recent changes in local rules, and obtain an **electrical permit** for this project.

DIGGING THE TRENCH

Burying 120 volt electrical wiring is really not difficult; digging the trench is the hard part. Try to have as straight a path as possible from the house to the end of the trench. Be aware of the upcoming weather, as you want to dig in relatively dry soil on a fairly pleasant day. If the ground is wet, muddy, or frozen, it makes for a miserable time. A short trench (20 feet or less) can be dug in a day using hand tools, but longer trenches may call for a rented **trenching machine** to speed things up. The trench does not need to be any wider than the conduit you are burying. When digging by hand, a **mattock** is used to chop into the soil, a **digging bar** to hack roots and break rocks, and a **trenching shovel** to clear the trench. These hand tools will still be needed to clean out the trench even if you use a machine. If you place the excavated soil upon a plastic tarp that you've laid alongside the trench, you'll save the grass underneath.



Mattock, digging bar, and trenching shovel



Chopping into the soil with a mattock

If the path of your trench goes underneath a walk or driveway, you may be able to drive an iron pipe to create a passage underneath it, rather than cutting out the asphalt or concrete *(see illustrations)*. Large tree roots can be chopped out (although if too many roots are compromised, the tree may suffer), or it may be possible to route the wires under or through the root mass.

CONDUIT OR DIRECT-BURIAL CABLE?

The depth of the trench will be determined by the wiring method you use. In most cases, you'll probably use **conduit** (a hollow tube through which you run individual wires). However, if you only need a power supply (without wires to control lights from inside the house), you can use a **direct burial cable**, placed in the soil without conduit. Known as **UF** for "underground feeder," the cable has a heavier plastic sheathing than the **Romex™** used inside the house.

As with installing indoor wiring, there are some rules to follow. Most of the rules involve protection of the wiring from damage.

WIRING METHOD	REQUIREMENTS
UF direct-burial cable	The **NEC** (National Electrical Code) requires that UF cable be placed in a trench at least 24 inches deep. In most communities, you will have to leave the trench open until the inspector arrives to approve the depth. *If you are using UF wiring, lay 2"x6" treated lumber planks a couple of inches over the wire as the trench is being refilled* to prevent a shovel from piercing the wiring at a later date. Anywhere UF cable is exposed above the soil, it must be protected with conduit. All connections and splices should be done in weatherproof boxes above the soil, to keep water from getting into the connections and causing a short.
Conduit	On the other hand, if you use conduit, the trench needs to be only 18 inches below the surface. Another advantage is that the conduit can carry several wires – wires to control garage lights from switches inside the house, as well as the power supply wires.

CHOOSING CONDUIT

Not all types of conduit can be buried in the soil:

CONDUIT	SUITABILITY FOR BURIAL
EMT (Electrical Metallic Tubing) and flexible "Raintite"	Not considered suitable for burial.
Aluminum Rigid	Will corrode away in certain soils, such as clay, or in moist areas.
Galvanized steel Rigid	Requires special tools for making cuts and threading the pipe.
PVC (PolyVinyl Chloride)	The choice for most do-it-yourselfers. With PVC, you'll need only a hacksaw to cut and a utility knife to deburr it. As with other PVC projects, you simply glue pre-formed 90° or 45° ells (elbows) and fittings to the tubing using cleaner and PVC cement, as needed.



PVC fitting



PVC conduit

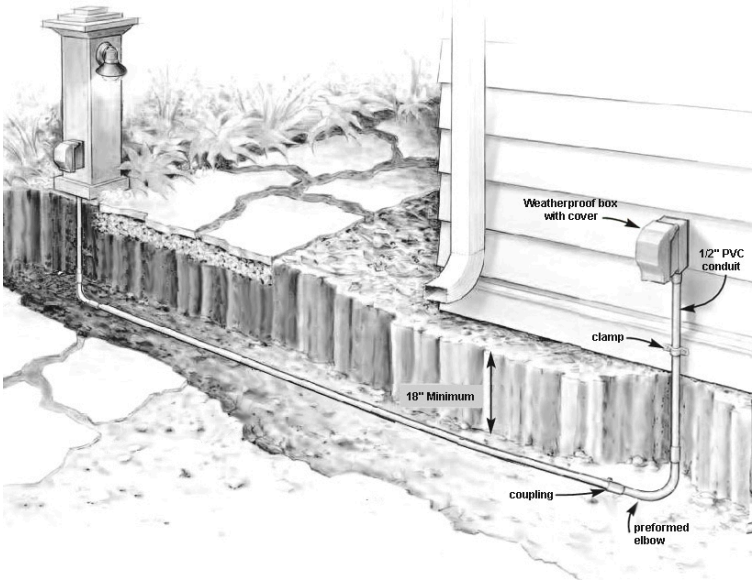
Code specifies that **Schedule 40 PVC** can be used underground, where the conduit passes through the house, or where it passes inside a lamppost. A thicker-walled PVC conduit (called **Schedule 80**) is required where the conduit is exposed *above grade* (above the soil) on the side of the house and/or garage. While most of the retail building supply companies sell Schedule 40 PVC, they usually do not carry Schedule 80. You will need to locate an electrical supply house to purchase Schedule 80.

KEEP LOW-VOLTAGE WIRES SEPARATE

Code also requires that **no** low-voltage wires be placed in conduit with 120/240-volt circuits. That means that low-voltage wires for garage door controls, intercoms, alarm systems, TV cables, low-volt landscape lighting, or telephone wires must be in their own conduit (or directly buried), although they can be laid in the same trench next to the higher-voltage conduit.

WIRE SIZE AND VOLTAGE DROP

In addition to the basic code requirements, the wires and conduit you use will be determined by the distance between the service panel and the appliances to be powered. Long wire runs can result in a drop in voltage. Let's imagine that you want to build a wood project out in your yard or in a garage workshop, using a 12-amp circular saw. Even if you have a 20-amp circuit (which would normally use 12 gauge wire), because the wires are running 50 feet or more, the voltage can decrease – causing the garage lights to dim significantly *(a brown-out)* and your saw to run hot and erratically. To prevent voltage drops, use the next larger size cable (10/2 UF with ground, or 10/3 with ground for two circuits). If machines with higher current demands are to be used, consider running an even larger size cable. In addition, if you are running several circuits to your garage, you might also install a sub-panel to control them.



Buried PVC conduit run from the house wall to a lamppost (18" minimum depth)

OUTDOOR CIRCUITS AND GFCI PROTECTION

Outdoor lighting and outlets should be on their own circuits, independent of any indoor wiring. That way, if the hedge trimmer trips the breaker, the ice cream in the freezer won't melt. In addition, **Ground Fault Circuit Interrupter** (GFCI) protection for all outdoor receptacles is required by the NEC – accomplished with an individual GFCI receptacle in each outlet box or with a GFCI breaker mounted in the service panel that protects the entire

circuit. (Any electrical equipment operated outdoors should have GFCI protection to keep you from being accidentally electrocuted.)

> **TIP: MAP YOUR WIRING**
>
> As you progress with your project, take photos and draw a map to document where the wiring lies, to keep with your house records. When it comes time to do a new digging job, it will help to know where the hidden wiring should be.

ILLUSTRATIONS

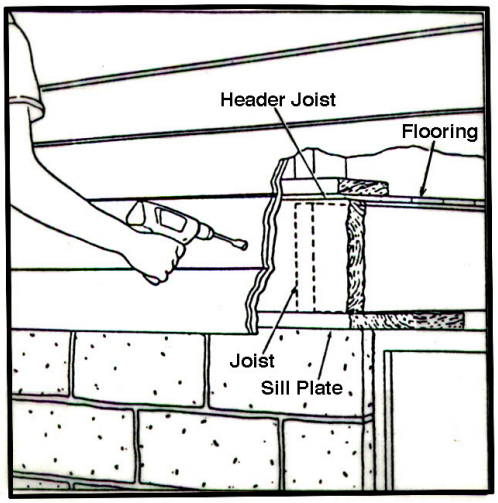


Illustration 1: Locate the point for the wiring to pass through the wall. Try to be 3-or-so inches away from a joist, in order to have room to mount a junction box inside the house. Use a 1/4" drill for the starter hole; it's much easier to fill with wood putty if you find it's not in the right spot. Then, use a 7/8" paddle bit to bore through the wall. If the wall is masonry, use a 7/8" masonry drill (available in a 12” length). You'll find it’s usually easier to drill in at a mortar joint than into a brick.

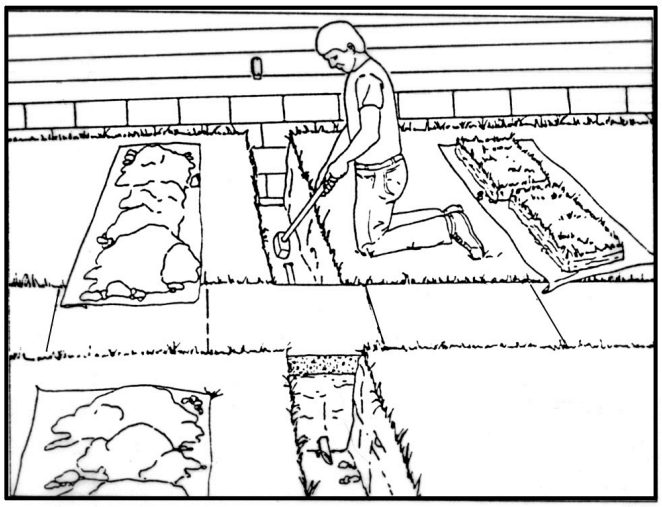


Illustration 2: To pass the wiring under a sidewalk block or a large tree root, drive a length of iron pipe through the soil with a sledge hammer. You will be able to pull the wiring or push the conduit through the hole after removing the pipe.

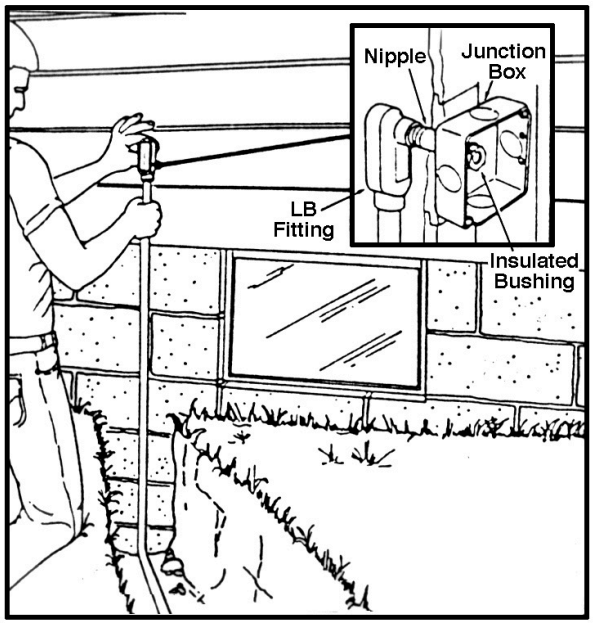


Illustration 3: A junction box is required wherever there is a change in types of wiring. Install one inside the house and one in the garage. Caulk around the LB fitting to prevent rain or insects from entering the siding.

MAXIMUM CONDUCTORS IN RIGID PVC CONDUIT, SCHEDULE 80

Maximum number of conductors and fixture wires (wire type letters THHN, THWN, THWN-2) by trade size of conduit, in inches:

WIRE SIZE (GAUGE)	½"	¾"	1"	1¼"	1½"
14	9	17	28	51	70
12	6	12	20	37	51
10	4	7	13	23	32
8	2	4	7	13	18
6	1	3	5	9	13
4	1	1	3	6	8

Home Repair Resource center

Home Repair Resource Center empowers homeowners to maintain their homes for sustainable and diverse communities.

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