

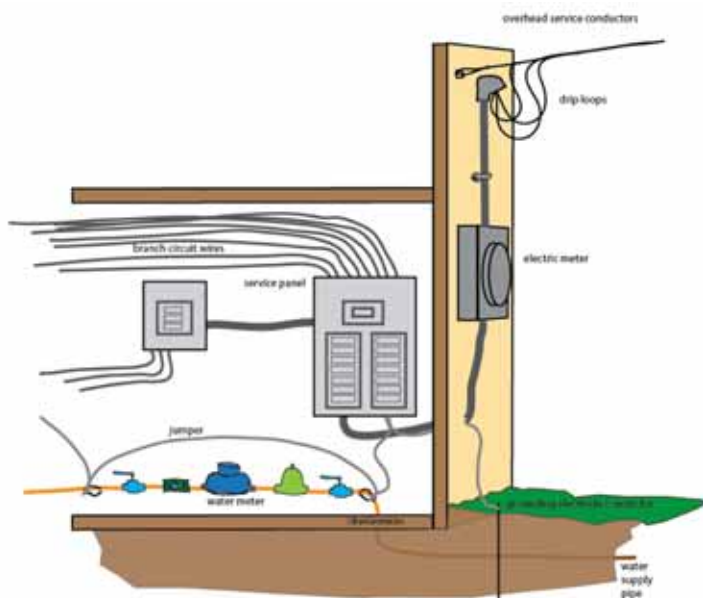
# What Every Homeowner Should Know About the Electrical System in Their Home

By Ben Gromicko

Primary components are the service entry, service panel, and branch circuits. In unaltered buildings built since about 1940, the electrical system is likely to be intact and safe, although it may not provide the capacity required for the use of the building. Electrical capacity can be easily increased by bringing additional capacity in from the street and adding a larger service panel between the service entry and the existing panel. Existing circuits can continue to use the existing panel and new circuits can be fed through the new panel.

The electrical systems of residential buildings built prior to about 1940 may require overhaul or replacement, depending on the

condition of the electrical system. Parts of these older systems may function adequately.



## 8.1 Service Entry

**Service.** Service is a term used to describe the conductors and equipment for delivering electricity from the utility company to the wiring system of the building served. Only one is typically installed for a dwelling. A minimum of 100-amp service is needed for a single residential dwelling unit.

**Service panel.** It is typically referred to as the “panelboard” or “main electric panel.” The first point of disconnect for the conductors from the utility company is at the “main panel.”

**Overhead wires.** Overhead wires from the street should be greater than 10 feet above the ground, not in contact with tree branches or other obstacles, and not reachable from nearby windows or other accessible areas. The wires should be securely attached to the building and have drip loops where they enter the weatherhead. Wires should not be located over swimming pools.

**Electric meter.** The electric meter and its base should be weatherproof and securely fastened. Advise the utility company of any problems with the meter.

**Service entrance conductor.** The insulation of the service entrance conductor should be completely intact. If the main service panel is located inside the building, the conductor’s passage through the wall should be sealed against moisture.

## 8.2 Main Electrical Service Panel (Breaker Box)

The main electrical service panel is the distribution center for electric service within the building. The primary function of the breakers or fuses (overcurrent protection devices) is to protect the house wiring from overloads.

All service panels must have covers or dead fronts. All openings should be closed.

**Main disconnect.** A means of disconnect for service must be located either outside or inside the dwelling unit nearest the point of entrance of the service conductors. No more than six hand movements or no more than six circuit breakers may be used to disconnect all service. Typically a main disconnect switch is required by the local authority. The main disconnect should be clearly marked to identify it as the service disconnect.

**Condition and location.** Water marks or rust on a service panel mounted inside the building may indicate water infiltration along the path of the service entrance conductor. Service panels mounted outdoors should be watertight. The service panel should have a workable space in front of it. The service panel should not be located inside a bathroom, over the stairs, or inside a clothes closet.

**Amperage rating.** The amperage rating of the main disconnect should not be less than 60-amps. It should be labeled or identified 100-amps or greater.

The ampacity of the service entry conductor may be determined by a building inspector by noting the markings (if any) on the conductor cable and finding the rating. If the service entry conductor is in a conduit, there may be markings on the conductor wires as they emerge from the conduit into the service panel. The ampere rating may be found on the service panel or service disconnect switch.

**Grounding.** A building inspector may be able to confirm that the service panel is properly grounded. Its grounding conductor should run to an exterior grounding electrode or be clamped to the metal water service inlet pipe between the exterior wall and the water meter.

Grounding electrode is a device that makes an electrical connection to the earth. A grounding electrode can be rebar in a footer, a metal underground water supply pipe within 10 feet of contact with the earth and a **grounding rod**.



**GFCI.** A GFCI (ground fault circuit interrupter) outlet is a device that adds a greater level of safety by reducing the risk of electric shock. Most building codes now require that GFCI protection be provided in wet locations such as the following: all kitchen counter receptacles; all bathroom receptacles;

all exterior receptacles; receptacles in laundry and utility rooms; receptacles next to wet bar sinks; all garage and unfinished basement receptacles, except receptacles that are not readily accessible or single receptacles for appliances that are not easily moved; receptacles near a pool, spa, or hot tub and; light fixtures near water.

**Downstream.** A GFCI outlet may be wired in a branch circuit, which means other outlets and electrical devices may share the same circuit and breaker. When a properly wired GFCI trips, the other devices downstream from it will also lose power.

**If you have an outlet that doesn't work,** and the breaker is not tripped, look for a GFCI outlet that may have tripped. The non-working outlet may be downstream from a GFCI device. The “dead” outlets may not be located near the GFCI outlet; they may be several rooms away or even on a different floor.

GFCI outlets should be tested periodically - at least once a year. All GFCI devices have test buttons.

**AFCI.** All 15-amp and 20-amp 120-volt circuits for dining rooms, living rooms, bedrooms, sunrooms, closets, hallways, or similar areas must be AFCI protected. An arc fault circuit interrupter (AFCI) is a circuit breaker designed to prevent fires by detecting non-working electrical arcs and disconnect power before the arc starts a fire. The AFCI should distinguish between a working arc that may occur in the brushes of a vacuum sweeper, light switch, or other household devices and a non-working

arc that can occur, for instance, in a lamp cord that has a broken conductor in the cord from overuse. Arc faults in a home are one of the leading causes for household fires.

AFCIs resemble a GFCI (Ground-Fault Circuit Interrupter) in that they both have a test button, though it is important to distinguish between the two. GFCIs are designed to protect against electrical shock, while AFCIs are primarily designed to protect against fire.

**Overcurrent protection.** A breaker or fuse is referred to as an overcurrent protection device. It is recommended that a homeowner should turn all circuit breakers on and off manually and make sure they are in functional condition.

The rating of the fuse or circuit breaker for each branch circuit may be checked by a building inspector or electrician. The amperage of the fuse or circuit breaker should not exceed the capacity of the wiring in the branch circuit it protects. Most household circuits use #14 copper wire, which should have 15-amp protection. There may be one or more circuits with #12 copper wire, which should have 20-amp protection. Large appliances, such as electric water heaters and central air conditioners, may require 30-amp service, which is normally supplied by #10 copper wire. If there were an electric range, it would require a 40-amp or 50-amp service with #6 copper wire.

**Identification.** Each circuit should be clearly and specifically identified as to its purpose. No two circuits should be labeled the same. No circuit should be

identified in a way that may be subject to change with occupancy. For example, no breaker should be labeled “Ben’s room.”

### 8.3 Branch Circuits

The oldest wiring system that may still be acceptable, and one still found fairly often in houses built before 1930, is “**knob and tube.**” This system utilizes porcelain insulators (knobs) for running wires through unobstructed spaces, and porcelain tubes for running wires through building components such as studs and joists. Knob and tube wiring should be replaced during rehabilitation; but if it is properly installed, needs no modification, has adequate capacity, is properly grounded, has no failed insulation, and is otherwise in good condition, it can be an acceptable wiring system and is still allowed in many localities. Check with local building code officials. Also check the terms and conditions of the **home insurance policy** to see if “knob and tube” wiring is excluded. The greatest problem with such wiring is its insulation, which turns dry and brittle with age and often falls off on contact, leaving the wire exposed. Knob and tube wiring is known to have caused house fires.

Approved wire types include:

- NM (non-metallic) cable, often called by the trade name “Romex”, a plastic covered-cable for use in dry locations (older NM cable may be cloth covered).
- NMC, similar to NM but rated for damp locations.

- UF (underground feeder), a plastic-covered waterproof cable for use underground.
- AC (armored cable), also called BX, a flexible metal-covered cable.
- MC (metal-clad cable), a flexible metal-covered cable with a green insulated ground conductor.
- EMT (electrical metallic tubing), also called “thinwall,” a metal conduit through which the wires are run in areas where maximum protection is required.

**Aluminum wire.** Aluminum wire was used in residential buildings primarily during the 1960s and early 1970s, and is a potential fire hazard.

According to the U.S. Consumer Product Safety Commission, fires and even deaths have been caused by the use of aluminum wiring in residential homes. Problems due to expansion and arcing at the connections can cause overheating between the wire and the devices, or at wire splices. The connections can become hot enough to start a fire.

Aluminum wire should be attached only to approved devices (marked “CO-ALR” or “CU-AL”) or with connectors.



Problems with aluminum wiring occur at connections, so feel cover plates for heat, smell for a distinctive odor in the vicinity of outlets and switches, and look for sparks and arcing in switches or outlets and for flickering lights. Whenever possible, aluminum wire and its devices should be replaced with copper wire and devices

appropriate for copper. It is difficult to find aluminum branch wiring in a home during a visual inspection. For a thorough investigation, an electrician should be hired.



**Smoke Detectors.** After moving in, consider replacing all of the smoke/fire detectors in the entire house. The building should have functioning smoke detectors. Detectors should be wired to a power source and also should contain a battery. Smoke detectors do not last forever. Replace detectors according to manufacturer’s recommendations. Test the detectors regularly.

**Replace batteries when you change your clocks for daylight savings time changes.**

#### 8.4 Inspection Standards

The inspector is required to inspect the service panel and overcurrent devices, but is not required to operate or reset overcurrent devices. During a home inspection, a representative number of switches, receptacles, lighting fixtures,

and AFCI-protected receptacles are inspected - not each and every one.

The inspector shall report the presence of solid conductor aluminum branch circuit wiring ONLY if it is readily visible. The measurement of the amperage or voltage of the electrical service is not required by the SOP. Exterior accent wiring is not part of a home inspection.

