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ELECTRICAL SYSTEM GROUNDING ISSUES

Grounding is an important part in all electrical construction projects. In a home, grounding provides a safe pathway for electricity that could cause a shock hazard to residents. There are two basic purposes for the grounding pathway: system grounding and equipment grounding.

System Grounding

The earth is part of the electrical generation system. Electricity flows from the generation plant to your home via power lines and returns to the plant through the earth. The overhead utility pole wires are "hot." The "neutral" or return flow runs from the neutral buss bar in your service panel (through a connection to something buried in the earth – usually the water supply pipe) to a buried electrode at the utility pole where the step-down transformer is mounted. Practically speaking, this means that your water service pipe system (which travels in the soil to the house) is used to help carry away the residual electricity from your home after it has been used in light fixtures and appliances. Another function of system grounding is to route lightning and high voltages from the service entrance wires to the earth to minimize damage to the house.

Since the 1990's, the **National Electric Code** (NEC or Code) has required that two grounding paths be installed *whenever you replace or upgrade your main service panel.* In many communities (including Cleveland Heights), the electrical inspector wants to see a connection to the metal water supply line on the street side of the water meter, plus two exterior "made" grounding electrodes. The most common method specified by Code is to drive 8-foot long, 5/8-inch diameter copper-plated or galvanized iron rods into the soil. In areas where the bedrock is close to the surface, the rods can be driven in at no more than a 45-degree angle. An alternative approach is to excavate a trench 30 inches deep and lay the rods horizontally. The grounding rods are connected to the service panel by a continuous length of copper wire.

When the electrical system in older homes has not been updated, the cold water pipe system may still be the only ground. In order for it to serve this purpose, it must have a complete metal-to-metal connection throughout its entire length. If the metal path is interrupted, then the electricity will stop flowing at that point and become a possible shock hazard to you.

Often, water meters (water filter and conditioner housings, too,) are made of plastic or have **dielectric** or insulated unions to join to the water line. Without a **bonding jumper** *(see Illustration 1),* the electricity may stop at these units, rather than being safely carried back to the earth. A bonding jumper provides a bridge around the meter to allow electricity safe passage out of the house. Construction of a bonding jumper is simple; you'll need a piece of 4-gauge copper wire about two feet long and two bronze grounding clamps. Fasten a clamp on the pipe about 6" or so on either side of the meter, and then attach the ground wire under the screw on each clamp. pipe is painted or heavily corroded, first scrape or sand off the corrosion to ensure a good metal-to-metal connection.

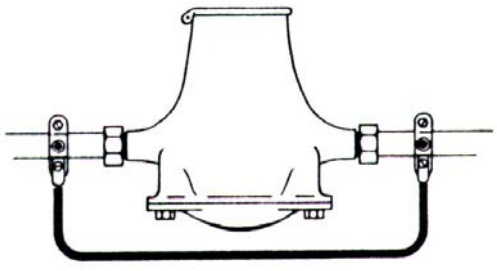

Illustration 1: Bonding jumper

Of course, many plumbing systems have been modernized since they were originally built, causing interruptions in the metal path designed to serve as a ground for the electrical system.

(continued)

If you have plastic pipe, fittings, or insulated unions (which separates two dissimilar metal pipes, such as copper and iron, to limit corrosion problems) anywhere else in your cold water pipe system, you should consider installing a new ground wire (must be continuous, with no splices) from the neutral buss bar in the service panel to the cold water pipe on the street side of the meter.

Equipment Grounding

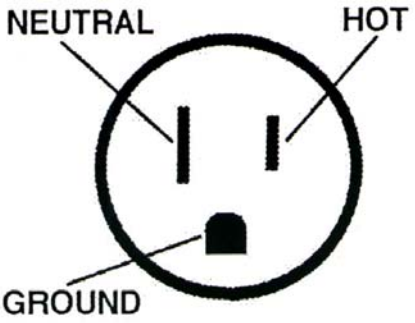

Illustration 2: Polarized receptacle

Equipment grounding provides the grounding path throughout the house. Electricity will seek the easiest path to the earth. Your body is an excellent electrical conductor; if you make contact with energized equipment, you'll become part of the circuit. Faulty equipment wiring is a major cause of electrocution at home.

Some of the outlets in your home have three openings: for a hot (black wire), a neutral (white wire) and a ground (green or bare wire, *see Illustration 2.)* Many appliances with metal housings have a three-prong plug. A green (or bare) wire is attached to the frame or housing to provide a grounding path to the round prong on the plug *(see Illustration 3).* If a hot wire shorts out against the grounded housing, the circuit breaker or fuse will disconnect the circuit to prevent the housing from becoming energized.

You should never install a three-prong outlet onto a two-wire circuit where there is no ground wire (unless it is a **Ground-Fault Circuit Interrupter** – *see separate handout.)* Ungrounded three-prong outlets are commonly cited as violations; you can replace them with a two-prong outlet, run a ground wire from the service panel to the outlet *(see below),* or replace it with a GFCI.

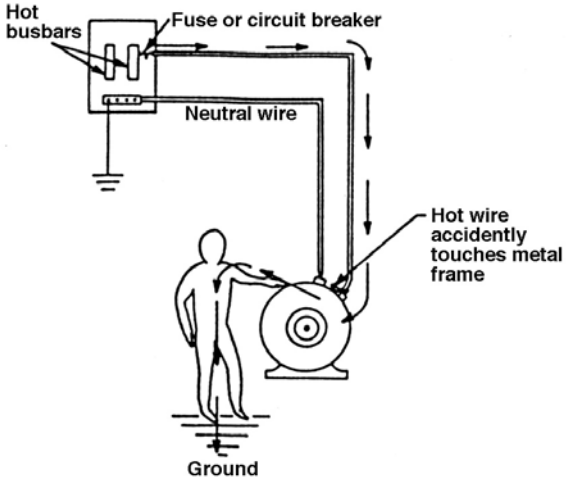

Illustration 3-A: Ungrounded metal appliance housing poses a shock hazard.

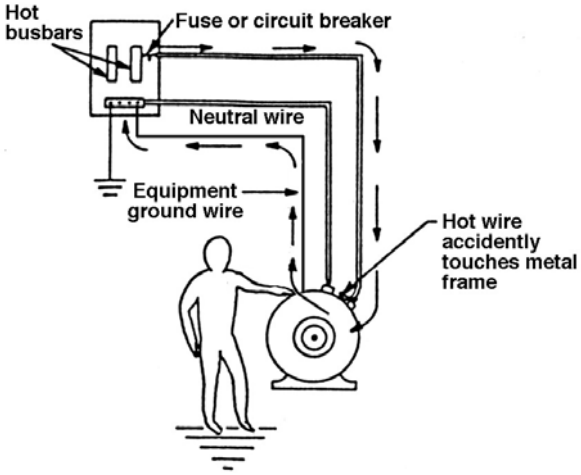

Illustration 3-B: Equipment grounding wire offers a "least-resistance" path to ground.

A common grounding issue in older homes concerns ground "taps" or connections from the ground prong opening on a wall outlet to the nearest cold water pipe (such as under the kitchen sink). At one time these connections were legal; however, because so many insulated or plastic devices are being installed in water lines – breaking the ground connection – the NEC now requires that all ground wires eventually connect to the grounded neutral buss bar in the main service panel.

New Work

All new electrical circuits must be grounded – including all metal workboxes and exposed metal parts on fixtures, switches and appliances. All new receptacle circuits in living, dining rooms, hallways and bedrooms must be protected with **Arc Fault Circuit Interrupters** (AFCI). Even if old two-wire (knob-and-tube) circuits are being connected to new wires, the junction boxes must be grounded. If you have any questions about the rules, contact your city's electrical inspector prior to starting your job, as the rules change periodically (every three years). Since most electrical projects require a permit, you'll want to get it right the first time, rather than redoing work.