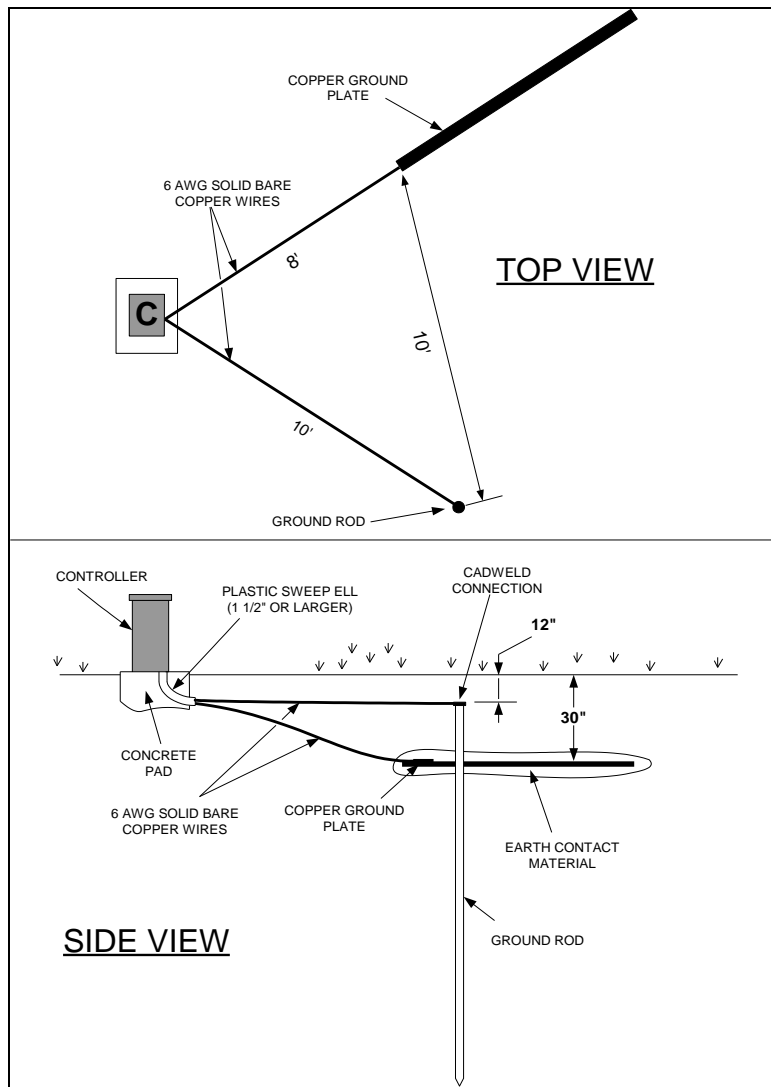


RECOMMENDED SPECIFICATIONS FOR IRRIGATION SYSTEMS

It is the responsibility of the installer to connect all electronic irrigation equipment for which he is responsible to earth ground in accordance with Article 250 of the National Electrical Code (NEC.) Grounding, bonding, and shielding components will include the items described in the following paragraphs, at a minimum.

EARTH GROUNDING

Use grounding electrodes that are UL listed or manufactured to meet the minimum requirements of Article 250-52 of the 2002 edition of the NEC. At the very minimum, the grounding circuit will include a copper clad steel ground rod, a solid copper ground plate and 100 pounds of PowerSet® earth contact material, as defined below and per the following detail. This detail is the minimum requirement for supplementary grounding of any electronic equipment. Other details, for a multitude of field situations, are available from the American Society of Irrigation Consultants, ASIC Guideline 100-2002 (www.asic.org, "Design Guides".)



Ground rods are to have a minimum diameter of 5/8" and a minimum length of 10 feet. These are to be driven into the ground in a vertical position or an oblique angle not to exceed 45 degrees at a location 10 feet from the electronic equipment, the ground plate, or the wires and cables connected to said equipment, as shown in the detail above. The rod is to be stamped with the UL logo [Paige Electric part number 182007.] A 6 AWG solid bare copper wire (about 12 feet long) shall be connected to the ground rod by the installer using a Cadweld GR1161G

"One-Shot" welding kit [Paige Electric part number 1820037.] This wire shall be connected to the electronic equipment ground lug as shown in the detail above.

The copper grounding plate assemblies [Paige Electric part number 182199L] must meet the minimum requirements of Article 250-52(d) of the 1999 NEC. They are to be made of a copper alloy intended for grounding applications and will have minimum dimensions of 4" x 96" x 0.0625". A 25-foot continuous length (no splices allowed unless using exothermic welding process) of 6 AWG solid bare copper wire is to be attached to the plate by the manufacturer using an approved welding process. This wire is to be connected to the electronic equipment ground lug as shown in the detail of page 1. The ground plate is to be installed to a minimum depth of 30", or below the frost line if it is lower than 30", at a location 8 feet from the electronic equipment and underground wires and cables. Two 50-pound bags of PowerSet® [Paige Electric part number 1820058] earth contact material must be spread so that it surrounds the copper plate evenly along its length within a 6" wide trench. Salts, fertilizers, bentonite clay, cement, coke, carbon, and other chemicals are not to be used to improve soil conductivity because these materials are corrosive and will cause the copper electrodes to erode and become less effective with time.

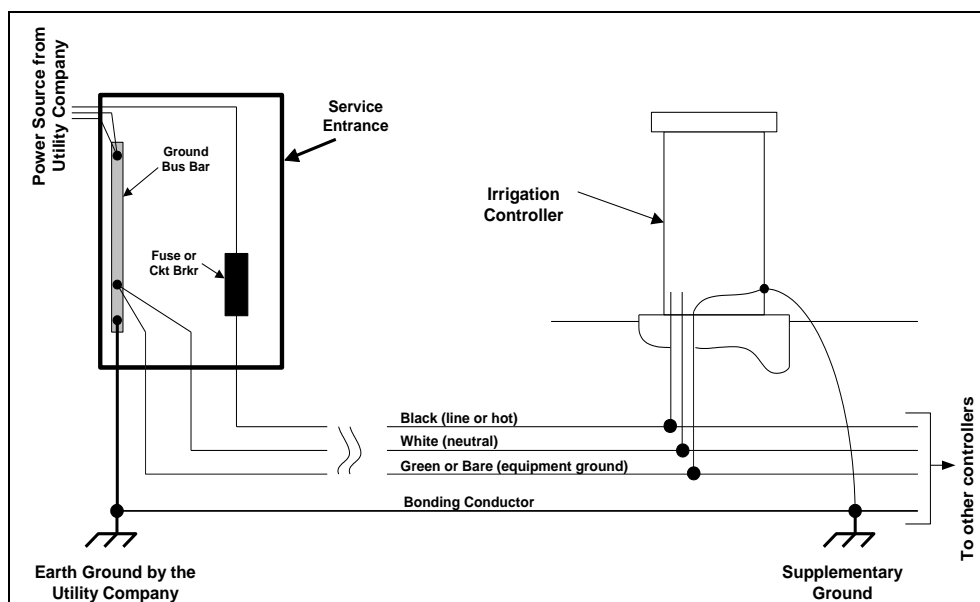
Install all grounding circuit components in straight lines. When necessary to make bends, do not make sharp turns. To prevent the electrode-discharged energy from re-entering the underground wires and cables, all electrodes shall be installed away from said wires and cables. The spacing between any two electrodes shall be as shown in the detail of page 1, so that they don't compete for the same soil.

The earth-to-ground resistance of this circuit is to be measured using a Megger®, or other similar instrument, and the reading is to be no more than 10 ohms. If the resistance is more than 10 ohms, additional ground plates and PowerSet® are to be installed in the direction of an irrigated area at a distance of 10', 12', 14', etc. It is required that the soil surrounding copper electrodes be kept at a minimum moisture level of 15% at all times by dedicating an irrigation station at each controller location. The irrigated area should include a circle with a 10-foot radius around the ground rod and a rectangle measuring 1-foot X 24-feet around the plate.

All underground circuit connections are to be made using an exothermic welding process by utilizing products such as the Cadweld "One-Shot" kits. Solder shall not be allowed to make connections. In order to ensure proper ignition of the "One-Shot", the Cadweld T-320 igniter must be utilized [Paige Electric part number 1820040.] The 6 AWG bare copper wires are to be installed in as straight a line as possible, and if it is necessary to make a turn or a bend it shall be done in a sweeping curve with a minimum radius of 8" and a minimum included angle of 90°. Mechanical clamps shall be permitted temporarily during the resistance test process, but are to be replaced with Cadweld "One-Shot" kits immediately thereafter.

BONDING

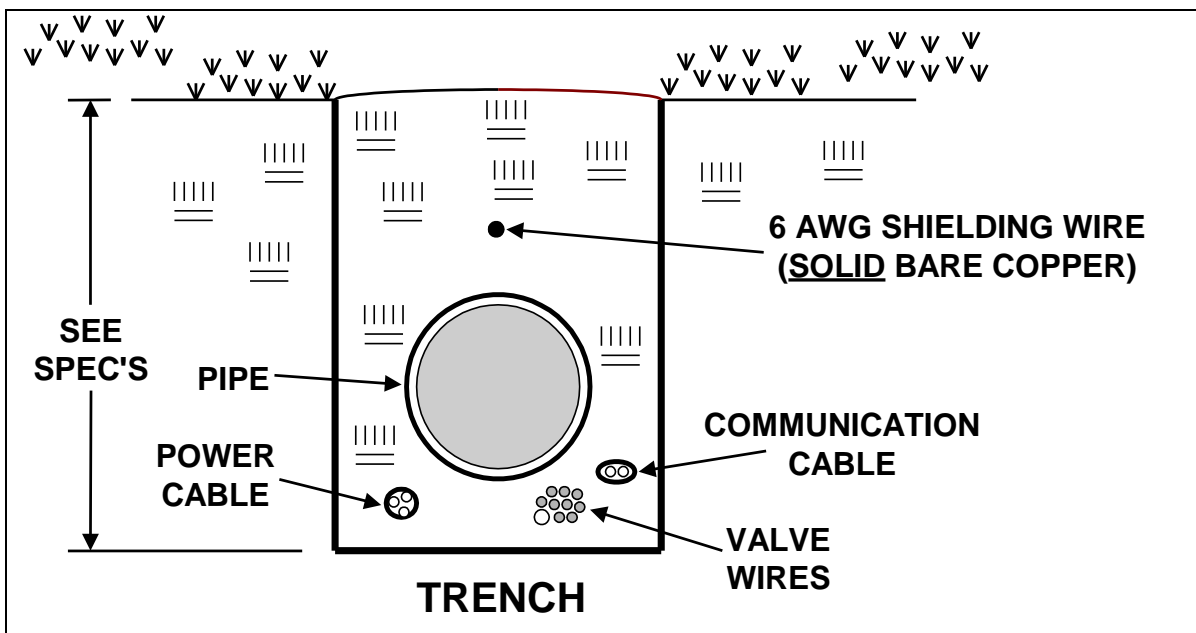
The above grounding circuit is referred-to as "supplementary grounding" in the NEC. And for safety reasons, the NEC requires that all supplementary grounds be "bonded" to each other and to the service entrance ground (power source) as shown below. This is also "recommended practice" of IEEE Standard 1100-1999. Note that this is in addition to the equipment ground, which is commonly referred-to as "the green wire." The Black, White and Green wires must always be kept together in a trench/conduit/tray/etc.



The bonding conductors are to be 6 AWG solid bare copper unless the system power conductors are larger than 1/0 AWG, in which case they are to be 4 AWG solid bare copper. All splices to the bonding conductors shall be made using a Cadweld "One-Shot" kit as shown in the details below. [Paige Electric part number 1820074.]

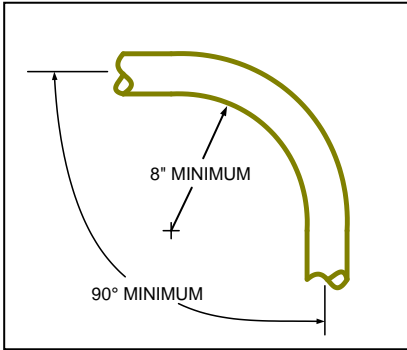
SHIELDING

The bonding conductors are to be installed in such a way so that they also act as shielding conductors. This becomes a network of solid bare copper wire over all the main bundles of other wires and cables as shown in the detail on page 4.



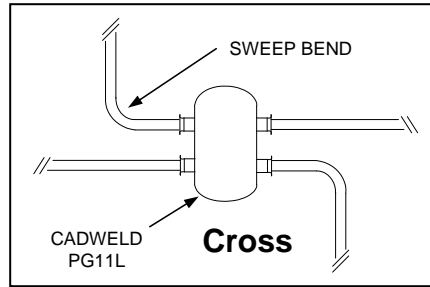
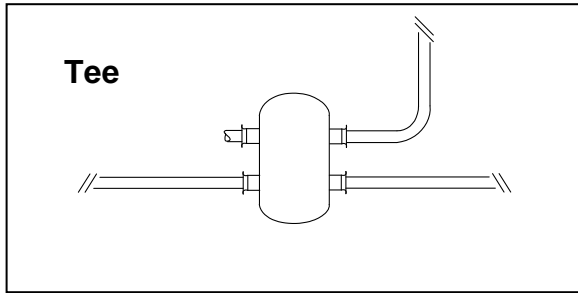
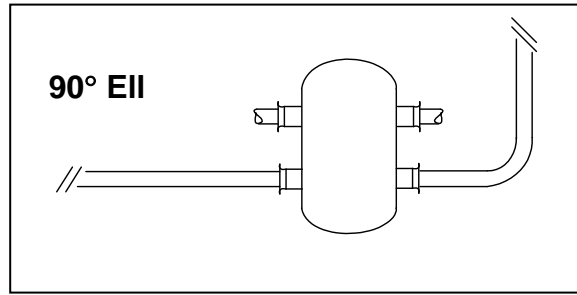
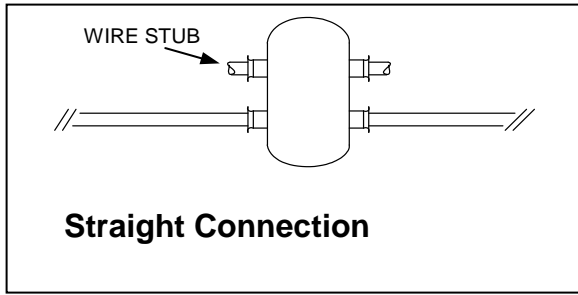
The bare copper wire is to be installed as close to the surface as possible, yet being sufficiently below the ground level as to prevent damage from maintenance equipment such as aerators. And it must be placed above all other valve/power/communication wires and cables, per detail, and installed in all trenches as shown on the electrical plan drawings. It is not necessary to install this conductor over short wire runs (less than 150 feet) away from the main wire bundles. The conductor is laid in as straight a line as possible, and when necessary to make bends, do so in a sweeping motion using the following detail as a guideline.

Note: When connecting bare copper wires to the ground lug of electronic equipment, feed it through a dedicated 1 1/2" plastic sweep ell to automatically meet the requirements of the "sweep bend" shown here.



The shield network is to be connected to the service entrance earth ground, to all electronic equipment ground lugs, and all equipment supplementary grounding electrodes. One such network is necessary for each power source. Do not interconnect the equipment ground wires from different power sources.

When joining bare copper wires, do so using an ERICO PG11L "One-Shot" kit as shown in the details below. [Paige Electric part number 1820074.]



WIRES AND CABLES

Power wiring (120 VAC or 240 VAC):

All power cables are type Tray Cable; they are to be UL listed for direct burial, and rated at 600 volts. The cable shall include three conductors, which are to be colored or numbered as 1, 2, and 3, and shall be color-coded (using 3M #35 Vinyl Electrical Color Coding Tape) to code and electrical industry standards. The size of the "hot" and "common" conductors are to be as shown on the irrigation plans, and the size of the "ground" conductor as required by the National Electrical Code, or larger. The inner copper conductors shall be insulated with high dielectric PVC and Nylon. The outer jacket will be black PVC and is to be sunlight resistant. [Paige Electric Co., LP specification number P7266D for 10 AWG and smaller and specification number P7267D for 8 AWG and larger.]

Control Valve Wiring (24 volt AC, nominal):

Wires connecting the remote control valves to the irrigation controller are single conductors, type PE. Its construction incorporates a solid copper conductor and polyethylene (PE) insulation with a minimum thickness of 0.045 inches. The wires shall be UL listed for direct burial in irrigation systems and be rated at a minimum of 30 VAC. Wire sizes and colors are defined in the irrigation plans and other specifications. [Paige Electric Co., LP specification number P7079D.]

FOR ASSISTANCE, PLEASE CONTACT PAIGE ELECTRIC AT THE LOCATIONS BELOW, OR ONE OF ITS DISTRIBUTORS.

LOCATION	PHONE	FAX
1160 Springfield Rd, Union, NJ 07083	(800) 327-2443	(908) 687-2722
14538 So. Garfield Ave., Paramount, CA 90723	(800) 228-7137	(562) 633-9532
2683 W. Lake Van Ness Cir. , Fresno, CA 93711	(559) 431-2346	(559) 431-2574
www.paigewire.com		

Disclaimer: Paige Electric has made every effort to ensure that the information and recommendations contained within are correct. However, neither Paige Electric nor any of its employees warrants nor accepts any liability for the use of this information. National and local electrical codes should always be followed. Wiring, grounding, shielding, and bonding irrigation system components often require competent engineering judgement on a case-by-case basis. Competent engineering assistance should be sought from firms specializing in this field.