

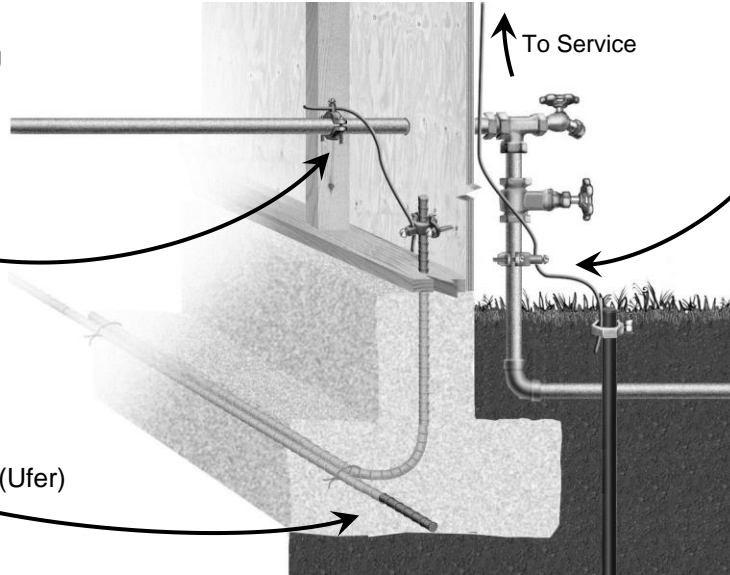


CALIFORNIA ELECTRICAL CODE GROUNDING ELECTRODE SYSTEMS

Bond all available electrodes together to form the Grounding Electrode System [CEC 250.50]

Water piping can be used to bond different electrodes only within the first 5 ft. of water piping into the building. [CEC 250.68(C)(1)]

Concrete-encased electrode (Ufer) (250.52A3)



Metal underground water piping with 10 ft. or more in contact with earth must be part of the grounding electrode system and must be supplemented by at least one other type of electrode. [CEC 250.52(A)(1), 250.53(D)(2)]

- A concrete-encased electrode (Ufer) is required when new footings are created in direct contact with soil. [CEC 250.50]. It shall be a minimum of 20 linear feet of #4 or larger rebar, or a bare 4 AWG copper wire in the foundation footing. Pieces of rebar can be spliced with the usual steel tie wires to obtain the required 20 feet. Rebar that is normally present as part of the footing design can be used as the Ufer. [CEC 250.52(A)(3)] The connection to the Ufer must be accessible; a piece of rebar is typically used with a blank cover plate installed on a mud ring at the clamp location. [CEC 250.68(A)]
- Clamps to copper water tubing must be listed for same. Bonding jumpers must be installed around unions, regulators, or filters on the incoming line [CEC 250.53(D)(1)]. Metal water piping must always be supplemented with one or more other electrodes. [CEC 250.53(D)(2)].
- Ground rods must be driven their full depth [CEC 250.53(A)(4)], though when the grounding electrode conductor requires protection, a slight amount of the rod can stick out above the ground surface.
- Bonding conductors and grounding electrode conductors are sized based upon the service conductor size. The minimum size is 8 AWG. Grounding electrode conductors ending at a Ufer never need be larger than 4 AWG [CEC 250.66(B)], and those ending at ground rods never need be larger than 6AWG [CEC 250.66(A)]. Water pipe conductors are sized as follows:

<u>Copper Service Entrance Size</u>	<u>Aluminum Service Entrance Size</u>	<u>Grounding Electrode Conductor Size</u>
≤ 2 AWG	≤ 1/0	8 AWG
1 or 1/0	2/0 or 3/0	6
2/0 or 3/0	4/0 or 250 kcmil	4
4/0 – 350 kcmil	> 250 – 500 kcmil	2
> 350 – 600 kcmil	> 500– 900 kcmil	1/0

- 8 AWG grounding electrode conductors always require protection [CEC 250.64(B)]. 6 AWG conductors do not require protection where closely following the building surface and not exposed to physical damage. 4 AWG conductors and larger require protection when exposed to physical damage.
- Protection for the grounding electrode conductor can be schedule 80 PVC conduit. If the protection is metal tubing, it must be bonded at each end. Bonding at the panel cannot be with ordinary locknuts [CEC 250.64(G)]. Grounding type locknuts can be used when no concentric knockouts remain; bond bushings are required with remaining concentrics or reducing washers. Bonding at the electrode is with a clamp made for the purpose that connects either to the electrode or to the conductor.
- The conductor from the service equipment to the grounding electrode system must be installed in a single piece without splices (except splices made with irreversible connections or exothermic welding) [CEC 250.64(C)]. Bonding conductors that connect the different parts of the grounding electrode system can be separate wires.