

Explanation of Stray Voltage and Safe Installations

Getting Shocked on your Pool Deck? It is possible the shock is coming from stray voltage. This article contains a brief and simple explanation of stray voltage and equipotential bonding planes around swimming pools & spas, and their decks, in “ordinary” terms. This article also covers the changes to the National Electrical Code and how they affect the pool owner’s safety. At the end of the article, there is a link to download a testing procedure to determine if your pool is properly bonded. Unfortunately, if your pool was built without a proper equipotential bonding grid installed, the only option to correct it is to tear out the deck, install a proper steel or copper equipotential grid, and reinstall the deck.

Stray Voltage exists in the ground throughout the USA. Stray voltage emanates from multiple power sources, i.e. cut/nicked underground distribution lines, pad mount transformer or water heater leakage and faulty overhead to underground drops to name a few. Stray voltage travels along a path of least resistance and gravitates more quickly to wet/moist conductive areas. If a pond is on the property and stray voltage is present, it will enter the pond rather than the dry ground, just like a swimming pool. Fiberglass or Vinyl Liner Pools are constructed with pre-insulated non-metallic shells through which stray voltage cannot pass, and harmlessly continues on a path of least resistance. Whereby a concrete, (poured concrete, shotcrete, gunite, etc.) pool shell is conductive, the stray voltage will enter the pool just as it would a pond. However, because almost all concrete type shells are reinforced with rebar, the rebar cage creates an “Equipotential Bonding Plane” and helps to equalize, dissipate or minimize the voltage across the plane. Any individuals in the pool or on the deck become part of the equipotential plane helping to diminish the effects of the stray voltage. In most cases it will not even be felt by the persons. The deck around the pool exists to allow swimmers to enter and exit the pool without encountering dirt & mud. It is specifically designed to be a safe wet pedestrian surface. Wet concrete is more conductive than dry concrete, and therefore will attract concentrated stray voltage. In years past this was never an issue because builders placed rebar in the deck to prevent cracking. This rebar extended the equipotential bonding plane from the pool shell to the deck area and provided protection from stray voltage as well. Sometime prior to 2005, builders began using fiber reinforced concrete which is stronger than regular concrete and does not need rebar reinforcing. This saves about \$500/deck and works well, EXCEPT that by removing the rebar, the metallic grid creating the equipotential bonding plane is also removed, and the deck left unprotected from stray voltage. The potential for serious injury and death has been proven by national testing laboratories, US Coast Guard report, and a plethora of actual homeowner events, when a grid is not installed in the deck. (see NEETRAC Test, EPRI Test, ENEREX Report) Because of this new installation practice of eliminating rebar in decks, in 2005, the National Fire Protection Association (NFPA) changed the National Electrical Code (NEC®) and required a copper grid to be installed in the deck, if no rebar is used. The installed cost is about the same, but the copper grid is much faster than laying rebar and chairing it up to comply with the IBC, so it is fully encapsulated by the concrete. The copper grid also works to protect Paver decks and does not corrode in the sand. Both rebar and copper grids provide conclusive protection helping mitigate stray voltage. The Pool Lobby objected. They wanted to save costs and felt any grid was unnecessary, and therefore successfully had this requirement removed from the NEC® in 2008.

After a decade and half of disastrous results, the NEC® has been changed back to a safe level! TIA 1687 changes Article 680.26 of the 2023 NEC® to again require equipotential bonding grids from one of three options:

1 - Minimum Number 3 rebar tied in 12" x 12" squares, chaired up to be completely imbed in concrete. Poured concrete decks can be constructed with this method.

2 - 6x6-W2.0 x W2.0 steel mesh, chaired up to be completely embedded in concrete. Poured concrete decks can be constructed with this method.

3 - Copper Grid from #8 Solid AWG Wire welded in 12" squares. This does not have to be chaired up and embedded in concrete, it can lay on or in the dirt or concrete. All decks can be constructed with this method, including concrete, paver, and dirt/gravel surfaces.

If you are experiencing shocking on your pool deck, and it was constructed with only a single wire for equipotential protection, unfortunately the only way proven to resolve the issue and provide a safe environment has been to remove the existing deck and installing a proper equipotential bonding grid in a new deck. A paver deck can usually be rectified by removing the pavers, installing a copper bonding grid, and then reinstalling the pavers. Mostly an expense of labor plus a grid. However, removing a concrete deck and reinstalling with a bonding grid is much more extensive, and is a great motivation for installing a proper bonding grid when pool deck is first constructed.

Review the information on CMI's EquiBond copper equipotential bonding grid. This will ensure the pool and perimeter surface areas of the pool will be safe and provide years of worry-free enjoyment!

To download the Electric Power Research Institute's (EPRI) testing procedure to validate your pool is safe, [click here](#).