

Equipotential Bonding Validation Procedure

The following measurements provide a useful way to determine the adequacy of the equipotential bonding at an in-ground swimming pool. The measurements also provide a way to understand what specific bonding connections are suspect or questionable, based on the measurement result versus the expected results described in the comments section of the table. The measurements are going to be slightly different at every pool depending on the design and the construction materials, but the procedure is universally useful for equipotential bonding assessments. For additional insight visit <https://strayvoltage.epri.com/Resources.aspx>

1. Required hardware:

- One True RMS AC multi-meter
- One two foot (or longer) conductive metal grounding electrode – (preferably copper or steel)
- One wire lead (at least 50ft long) and at least 14 gauge insulated wire
- One bucket with salted water to wet various test points
- Two stainless steel or copper (plates or bars) with contact surface area of at least 50 square inches. Example: 24” long by 2.5” wide or any other dimensional combo of at least 50 in. sq.)
- One 20K ohm load resistor applied across the test leads where specified.

Note: The 20K load resistor - built into a double banana jack test lead accessory - is not easy to find but can be easily fabricated by the user. A 3Kohm Fluke SV225 is a suitable replacement to eliminate static voltage and can be found on-line.

2. Identify a suitable “earth reference point” (at least twenty feet away) from the pool deck area and (at least twenty feet away) from the circulating equipment and drive the conductive metal electrode to a depth of one foot or deeper into the earth. This reference point will be used for many of the voltage benchmarking measurements. If the soil is dry, it is useful to pour a few gallons of pool water onto the soil where the metal electrode is placed.
3. Conduct each measurement twice. Once with the load resistor and again without the load resistor These are recorded as the (load resistor or V_R measurement) and the (open-circuit or V_{oc} measurement). Measuring both ways should reduce the chance of any measurement errors caused by (static charge or phantom) voltage readings.

Notes: It is normal and expected that the readings with the load resistor across the meter leads will be at least several tenths of a volt lower than the same readings without the load resistor. As an example, a 4.2 volt reading without the load resistor may become a 3.8 Volts reading with the load resistor. The readings with the load resistor are used for eliminating static voltages but should not be used for calculating expected exposure and perceptible shock currents. For more information on calculating shock and exposure currents refer to <https://strayvoltage.epri.com> for the appropriate procedure A 20K load resistor measurement will be important in determining whether voltage differences are present between pool water and pool walking surfaces.

4. Procedure: Set the meter for AC Volts and (record in the data sheet) the following measurements:
 - a) The free air measurement with the test leads not connected to any surfaces
 - b) The measurement with the test leads solidly connected to one another
 - c) The measurement with one lead connected to a suspected energized surface and the other lead in open air

For the remaining items, record the measurement both with and without the load resistor

- d) Between the remote earth reference point and the bonding lug on the circulating pump
- e) Between the remote earth reference point and the water bond mechanism
- f) Between the remote earth reference point and the pool water at four equally spaced locations around the perimeter of the pool
- g) Between the remote earth reference point and the walking surface at four equally spaced locations around the perimeter of the pool
- h) Between the pool water and the pool deck at points within the human reach and contact areas of the deck and the coping around the water’s edge
- i) Repeat the previous measurement near any bonded light niches ladders or handrails

A useful way to document the readings is by using a hand drawn sketch of the pool area and logging the readings on the sketch. Alternatively, a table such as the following can be used where the voltage readings are rounded to the nearest tenth of a volt (for example 3.1V instead of 3.079V)

Date:	Time:	Tested By:	Address:
Measurement Mode	V_{oc} Open Circuit V	V_R Load Resistor	Notes Comments and Observations * Record load resistor Kohm value here:
Meter Leads in Open Air			These pre-measurement tests help the investigator define the meter noise floor and provide an understanding of how the meter is going to respond to different bonded versus unbonded measurements. A zero Vac reading is generally unattainable.
Meter Leads Connected Together			
One test lead connected to an energized surface and the other in open air			
Pump Lug to Remote Earth Reference			Expected reading during summer is between one and 15 Vac
Water bond to Remote Earth Reference			Expected reading similar to but could be a bit lower than the pump bonding lug V
Pool water point a to remote earth reference			Expected reading during summer is between one and 15 Vac
Pool water point b to remote earth reference			All water to earth points should be similar within a few tenths V
Pool water point c to remote earth reference			All water to earth points should be similar within a few tenths V
Pool water point d to remote earth reference			All water to earth points should be similar within a few tenths V
Pool Deck point a to remote earth reference			All deck to earth points above grid should be similar within a few tenths V
Pool Deck point b to remote earth reference			All deck to earth points above grid should be similar within a few tenths V
Pool Deck point c to remote earth reference			All deck to earth points above grid should be similar within a few tenths V
Pool Deck point d to remote earth reference			All deck to earth points above grid should be similar within a few tenths V
Water to Coping			Expected AC voltage reading with load resistor is a few tenths volts Desired reading with load resistor is less than 0.5Vac
Water to Deck at 1ft			Expected AC voltage reading with load resistor is a few tenths volts. Desired reading with load resistor is less than 0.5Vac
Water to Deck at 2ft			Expected AC voltage reading with load resistor is a few tenths volts. Desired reading with load resistor is less than 0.5Vac
Water to Deck at 5ft			Expected AC voltage reading with load resistor is similar – but a bit lower than the water to remote earth reading