

MEETS 2008  
NATIONAL ELECTRICAL CODE  
680.26(C)

POOL  
& SPA

NEWS

hanley wood



**GROUND BAR**

**ELECTRICAL PANEL**

**SER PA**

**GROUND**

**#12 Wire Minimum**

**#12 Wire Minimum**



**FILTER**

**PUMP MOTOR**

**J-BOX**

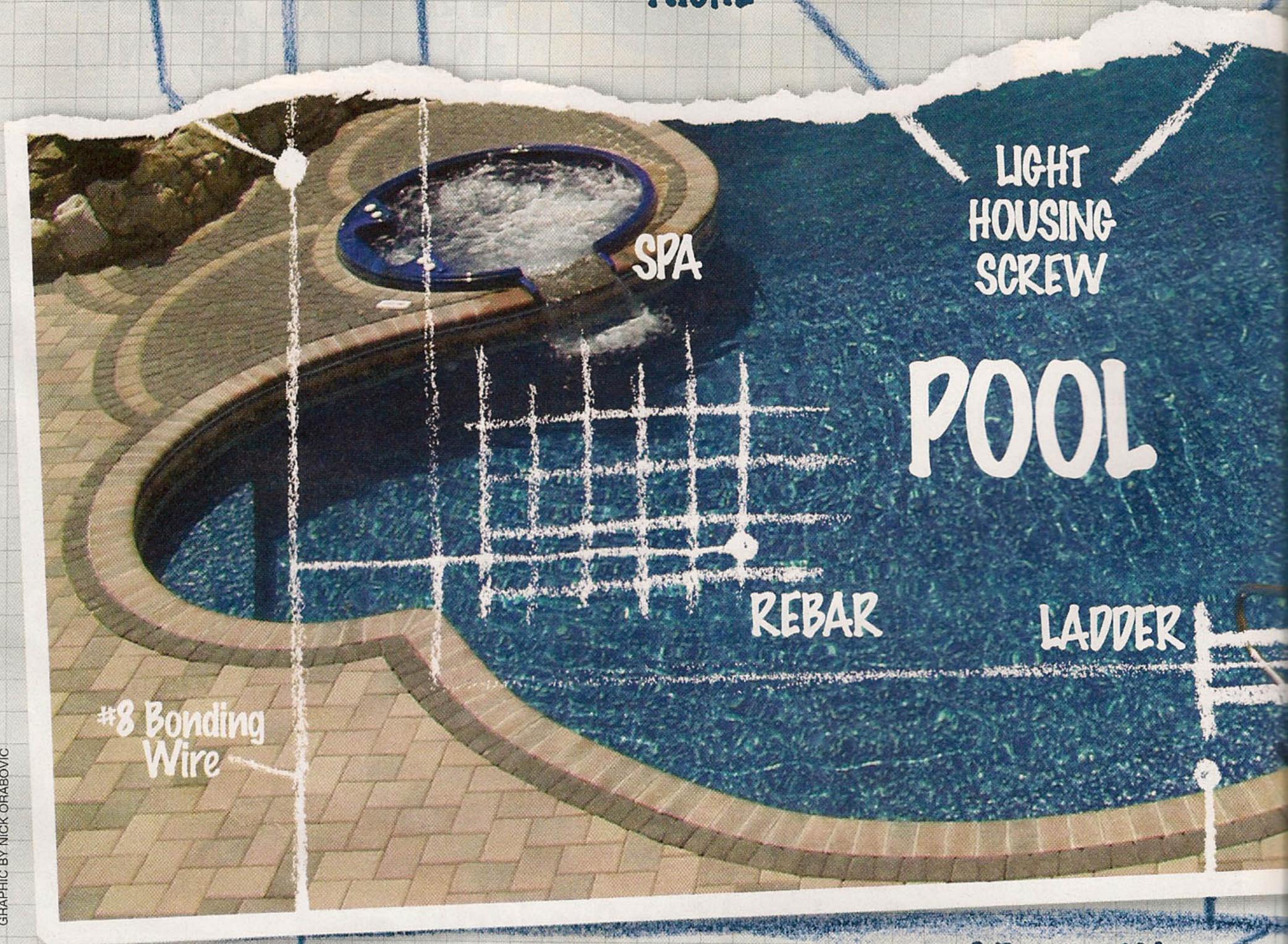
**Light Cable Ground Lead**

**Conduit or #8 Ground Wire**

**#8 Bonding Wire**

**Light Cable Ground Lead**

**NICHE**



**SPA**

**LIGHT HOUSING SCREW**

**POOL**

**REBAR**

**LADDER**

**#8 Bonding Wire**

**#8 Bonding Wire**

# On the Grid

Electricians and engineers list some common mistakes in grounding and bonding pools.

**By Rebecca Robledo** Grounding and bonding can be one of the most confusing parts of pool construction.

So when pool professional and licensed electrician Alan Brotz brings on a new crew member, his first message is very clear: Know your stuff.

"I tell all my guys there is no more important wire on a pool or spa wiring system than a ground wire and a bond wire," says the owner/president of Swim Systems Inc. in Oviedo, Fla. "The grounding and bonding around a pool are more critical than in any other application in a home, because of the conductivity of water."

This message applies to pool contractors. Even if local codes require that a licensed electrician handle this critical stage of construction, it's valuable to know how bonding and grounding should be done.

Here are six common mistakes made by both pool professionals and electricians while grounding and bonding pools, and some guidelines on how to avoid them.

## Mistake #1: Confusing the two

Many pool professionals don't know the difference between grounding and bonding, while others use the terms interchangeably. Even some electricians make this mistake, Brotz says.

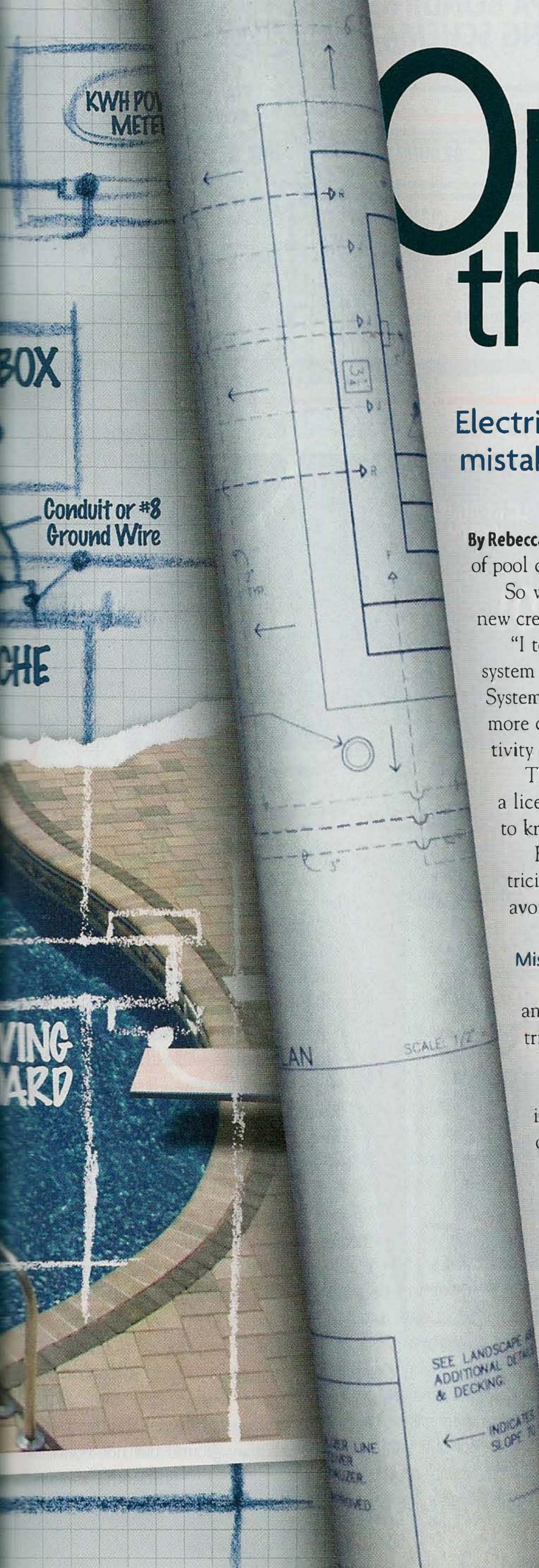
But the two are quite different.

*Grounding* is a process meant to protect people against a possible fault in the electrical system. Basically, it means to electrically attach a piece of equipment to earth ground, which is at the lowest "electrical potential," mostly referred to as 0 Volt potential. If there's a fault, or short, the circuit breaker will trip and turn off the equipment.

To ground a piece of equipment, installers must run a properly sized wire from the equipment, through the same conduit as the current-carrying conductors and to the circuit breaker panel. Finally, the wire attaches to the ground bus bar in the circuit breaker panel.

*Bonding*, on the other hand, electrically ties all specified metallic elements together to minimize the differences in voltage. (In these discussions, voltage is also referred to as potential.) The pump, motor, ladder, even the water nowadays, are bonded.

"If there's a difference in potential, that creates a foundation for current flow," Brotz says. "If the current can flow between two pieces of equipment, then it's just waiting for somebody to come along and be the conductor."



# POOL AND SPA BONDING AND GROUNDING SCHEMATIC

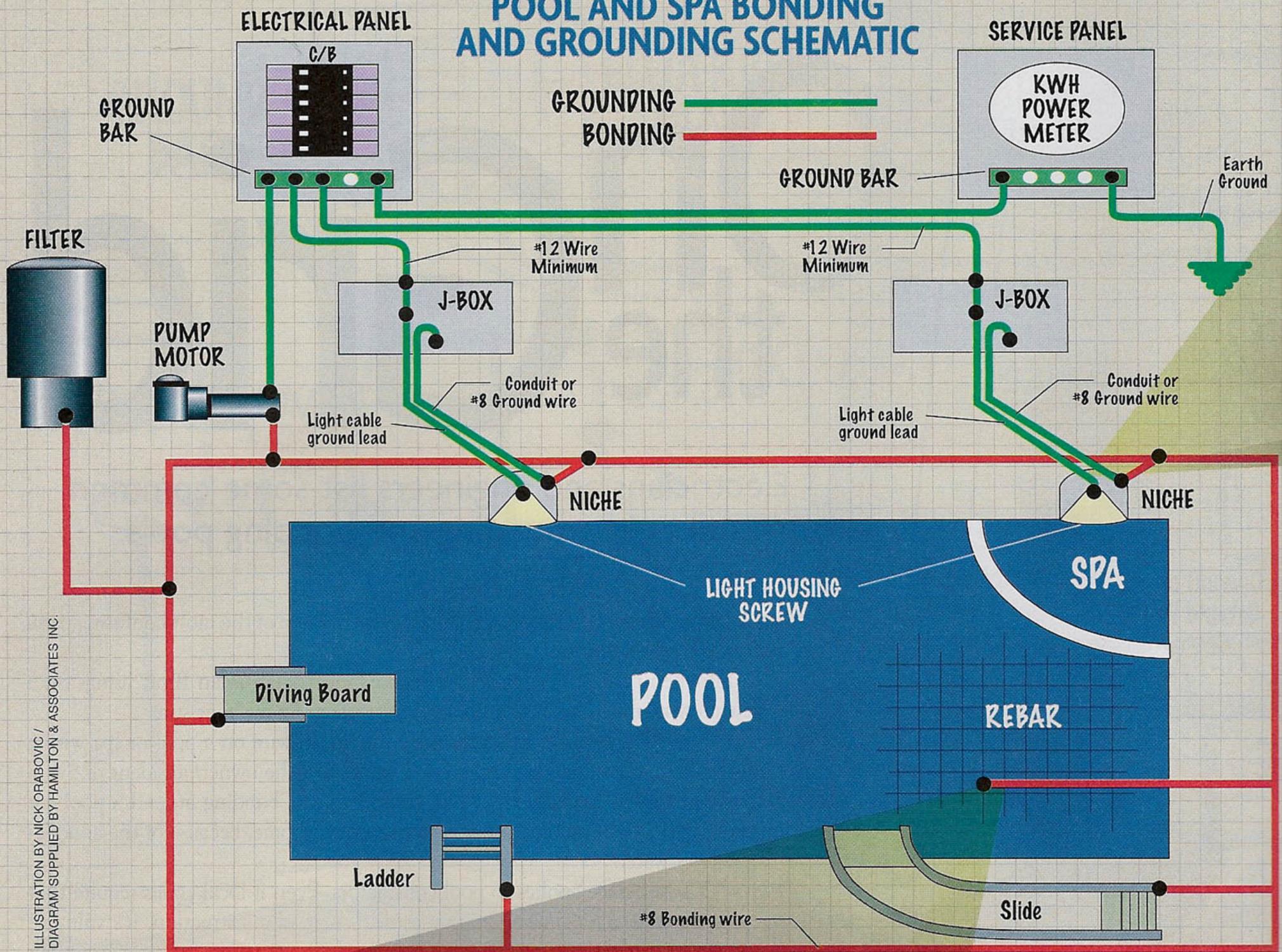
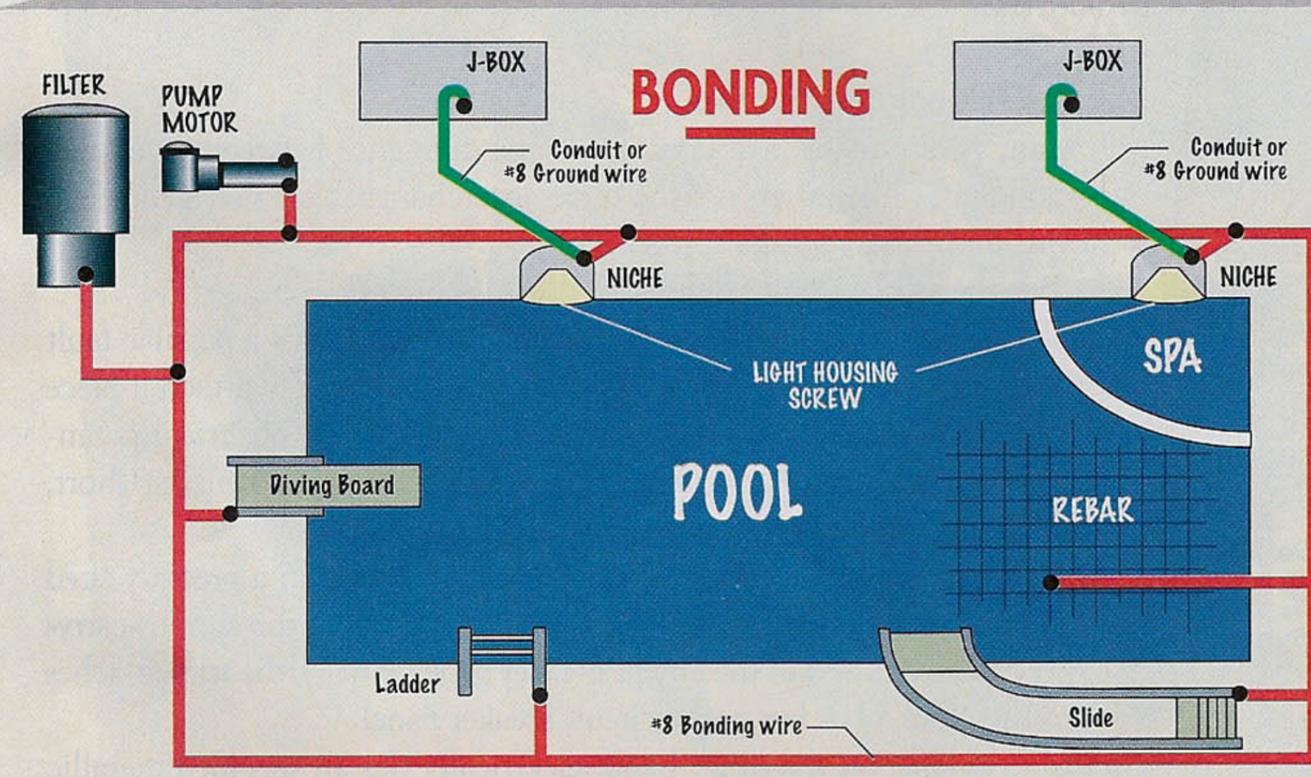


ILLUSTRATION BY NICK DRABOVIC / DIAGRAM SUPPLIED BY HAMILTON & ASSOCIATES INC.



Red bonds together: Bonding minimizes the differences in potential, or voltage, between metallic components around the pool to reduce shock hazards. Anything metallic within 5 feet of the inside pool wall (including the rebar and conductive deck materials) should be tied to the bonding grid. (Note: The wires running from the light niche and terminating at the junction box are technically grounds and therefore green. However, they also serve as bond wires.)

THE DIAGRAMS ARE MEANT TO DEMONSTRATE BASIC PRINCIPLES. THEY ARE NOT MEANT AS DESIGN GUIDES. THEY ARE NOT ALL-INCLUSIVE. CONSULT THE APPROPRIATE EDITION OF THE NEC AND LOCAL CODES.

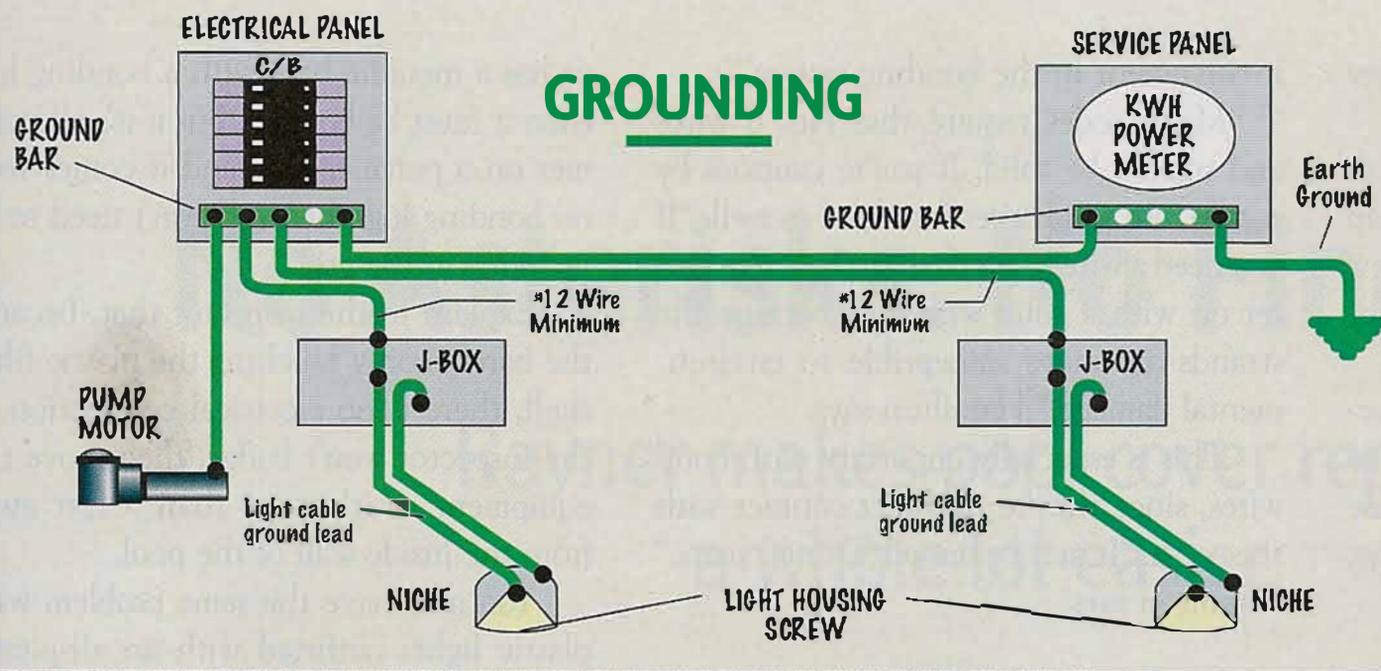
Brotz gives the example of a pump and heat pump sitting next to each other, with neither bonded. "If there was a fault in the system, either in the pump or heat pump, it's possible for either piece of equipment to become energized with a voltage other than 0 volts," he says. "If somebody were to come up and touch the pump, then they become the conductor between the two and get shocked or electrocuted."

To bond the system, a No. 8 wire runs from one metallic element to the next, connecting to pieces of equipment on a provided bonding lug and, thus, creating an electrical bonding grid. The wire runs through the earth, not inside a conduit.

## Mistake #2: Neglecting to ground and bond thoroughly

Because of confusion between the two terms, some professionals may ground but not bond, or vice versa.

Other installers take care to do this with all



Green grounds: All electrical equipment associated with the pool must be grounded. Ground wires run through the same conduit as the current-carrying conductors and to the circuit breaker panel. If there's a fault, the circuit breaker will trip and turn off the equipment.

Otherwise, you risk current straying, if the potential between two components is different.

#### Mistake #4: Using the wrong connectors

When hooking up the bonding and grounding wires to a piece of equipment, you want the best connection possible to ensure that any current that needs to move has a clear path.

That's why tying or wrapping the wire around a bolt or other metallic component on the equipment won't do the trick. "It doesn't insure any sort of reasonable electrical contact, particularly over time," Hamilton says.

Instead, use clamps or lugs rated for the specific wire size and application. For instance, when connecting the wire to the pool's rebar grid, you must use clamps that are UL approved for concrete encasement. If they're going in the ground, the tag should indicate that they are approved for direct burial. These clamps are usually made of brass and copper. The screw should be made of stainless steel or brass. You don't want plated steel anywhere near these applications, or they will rust and eventually fail.

"As to ones that are not required within concrete, then they're going to be standard electrical fittings like you would get at an electric supply house," Hamilton says.

Make sure the connectors are listed for the type of wire you're using, whether it's stranded or solid. Electrician and pool professional David Durkin often sees stake-ons, but connectors and terminals used with solid wire. "They will become loose after a while, because it's supposed to mesh in, and you can't mesh into a solid wire," says the owner of D&M Electric in Antioch, Calif.

Conversely, you can't wrap stranded wire around a screw. "It keeps pushing out strands, and it's

the pool equipment, but then forget about less obvious things like fences or ladders.

To be clear, anything metallic within 5 feet of the water (meaning the inside wall of the pool), must be bonded. This includes the back of the light niche, ladders (both ladder pockets), diving board stands, lifeguard stands, handrails, junction boxes, pool shells and deck, if they're made of conductive material. There are exceptions: Any small isolated parts of less than 4 inches in any dimension and extending less than 1 inch into the structure, such as rope hangers.

The pool's rebar must also be bonded, as well as any reinforcing steel under the deck within 3 feet of the inside of the pool wall. If there is no reinforcing steel in the deck, at least one bare No. 8 (or larger) buried wire may be used, if installed in accordance with code requirements.

Generally speaking, all electrical equipment associated with the pool must be grounded.

#### Mistake #3: Grounding and bonding to earth

Some professionals believe that grounding can be done by driving an 8-foot ground rod into the earth and hooking the grounding wire to it. "That will not conduct fault current to trip the circuit breaker," Brotz says. Some may believe this sends any stray current to the earth, but that's not the purpose of grounding.

Any defective piece of

equipment will remain energized. "Then when somebody comes up and touches it, it's, 'Good night, nurse,'" Brotz says. "That ground rod will do absolutely nothing."

Some will even try using the earth as part of the bonding conductor. "In other words, you bond the pool together, drive a ground rod; bond the pad together, drive a ground rod. But you don't run a wire in between," says E.P. Hamilton III, Ph.D., P.E., an electrical engineer and president of Hamilton & Associates in Pflugerville, Texas. If you do this, the system isn't bonded, because everything must be

#### Bonding the water

The newest addition to the National Electrical Code, made in the 2008 version, requires builders to bond the water to the equipotential bonding grid of the pool. This is fairly controversial. Some believe this addition necessary to ensure that the water doesn't have a different potential than the equipment and pool structure. Others believe there is no hazard if the pool is completely insulated and electrically isolated through traditional grounding and bonding. The National Electrical Code panel continues to discuss this matter as it prepares the 2011 NEC.

While some have found the new requirement confusing, it is actually straightforward. In many cases it doesn't require doing anything different. Simply use a metallic element of 9 square inches or more that comes into contact with the water. Any item or combination of items already required to be bonded and in contact with the water meets this requirement – as long as they add up to 9 square inches of space combined.

A metal ladder would be one example. Attach it to the bonding grid with your No. 8 wire and appropriate connectors, as required by the NEC. If you're using the ladder, do this with both pockets, just as you would do anyway to meet the code.

Some inspectors claim that the 9 inches of metal to bond the water is required *in addition* to ladders and the like. However, Hamilton says, if you already include these elements and they add up to 9 inches or more, no extra step is necessary.

But bonding to water is an absolute requirement under the 2008 edition of the NEC, so if you aren't currently designing the pool with a metallic ladder, handrails or light with a metallic niche, you'll need to add something with at least 9 square inches of metallic surface area. — R.R.

not a good connection," Durkin says. "They should be using terminals."

If you do want to make the connection by wrapping solid wire around a screw, wrap it clockwise, he adds. "When the screw tightens, it sucks the wire instead of pushing it out."

When you have to pot certain connections, such as those inside a light niche, use potting kits made for that purpose. Don't use things such as bath tub caulk, Hamilton says.

#### Mistake #5: Using the wrong wires

Watch where you use insulated wire. Particularly on the equipotential grid under the deck, uninsulated wire is mandated by code. Some electricians prefer this variety on the whole bonding grid to maximize contact with all relevant pieces of equipment, the water, earth and all conducting surfaces in contact with the bond wire.

There is one place where you must use an insulated wire: "If you have a non-metallic conduit going from the light niche up to the junction box, you have to pull an insulated No. 8 green wire through there," Hamilton says. "But even that's more of a ground wire, even though it does have some

involvement in the bonding system."

Many codes require that No. 8 wires and smaller be solid. If you're cautious by nature, use solid wires for No. 6 as well. "If you need a wire that's that small, you're better off with a solid wire, just because the strands are more susceptible to environmental damage," Hamilton says.

This is especially important with bond wires, since they're in direct contact with the earth. "It may be buried 50 or 60 years," Hamilton says.

#### Mistake #6: Believing that plastic or fiberglass elements need bonding

This mistake is generally not made by professionals, but rather by inspectors. Many of them, for instance, see the metal tension band on a plastic or fiberglass filter and insist that it be bonded.

"Don't do anything to the tension band on that filter," Hamilton says. "That creates a substantial safety hazard...if you do anything to the tension band. You're affecting its mechanical integrity and ability to hold the filter together over time and under pressure."

If that filter comes with a bonding lug,

or has a metallic base with a bonding lug, then it must be bonded. But if it's all polymer on a polymer base and it comes with no bonding lug, then it doesn't need to be included in the grid.

Explain to the inspector that, because the band is only touching the plastic filter shell, there is no electrical connection. If the inspector won't budge, then move the equipment so it's more than 5 feet away from the inside wall of the pool.

You may have the same problem with plastic lights outfitted with an all-plastic niche. Show the inspector that UL has listed it to go ungrounded.

Take a slightly different path when installing double-insulated pumps, Hamilton says. Though you can't bond them now, code requires that you run a bonding wire to it anyway. You won't make the connection to the pump, but you must connect the bond wire to the ground wire in the junction box serving the pump. The code requires this so that if the double-insulated pump is replaced with a pump that isn't double-insulated, then there's a place to bond it without tearing up the pool area. ■

## POOLBOND

WATER BONDING



- EASY TO INSTALL •
- NON CORROSIVE •

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