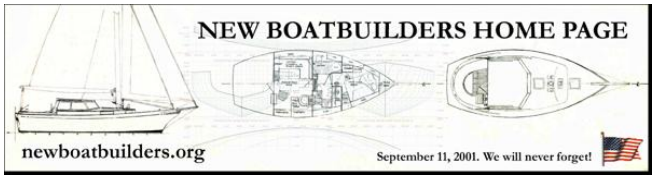


**NEW BOATBUILDERS HOME PAGE**

# Grounding. Our connection to the earth.

Let's talk a little more about grounding. It seems to be easily misunderstood; what it is and why it is so important.

Somewhere on this earth is the source of the electrical power you are using right now. It may be a power station, or a dam, or the battery in your laptop. Whatever it may be, it follows some simple rules. The flow of electrons wants to complete the circuit, flowing from the source, out to where you use it, and then back to the source. This is true of both AC and DC.

Compare this to water. All the water you see around you originates in the oceans. It evaporates and is taken up into the sky as water vapor. It rains or snows and the water falls back to the earth. It then flows downhill and eventually ends up back in the ocean, where the cycle is repeated.

Electricity is much the same. Every circuit has at least two wires. Electrons flow out through one and back through the other completing the circuit. So what is that third wire for? It is there because electricity always seeks a path back to its source. Just as water flows downhill, electricity always seeks the path of least resistance back to its source. If there is not a low resistance path, such as a wire, it looks for other paths. It there are none, nothing happens. But if there is one, such as you, it flows through you.

Suppose something goes wrong. Say there is a wire in your appliance that is rubbing against the case, and eventually chaffs through the insulation on the wire. Now you have bare wire touching the metal case. Then you accidentally touch the case. The electricity sees you as the path of least resistance and you get a huge shock as the current flows through you back to the earth. If it flows through your heart it kills.

But what if you attach a third wire to the metal case, run that wire outside and attach it to a rod driven into the ground? Back at the power station there is another rod in the ground connected to the generator at one of the two wires carrying the current. So when the wire in the appliance touches the case the electricity sees the third wire as the path of least resistance. The current flows back to the power station, and not through you.

So, all over the world power sources are connected to ground, and appliances are connected to ground through a grounding rod and a third wire. In many places this is referred to as earth, and earthing the system because it literally flows through the earth.

Now suppose you bring the two power wires aboard a boat. If there is a fault the electricity is still going to look for any easy path back to ground. If you touch an electrified appliance, that path becomes you,

and the water in which you are sitting. The danger to you is obvious. What about someone in the water? The current flows through the water and sets up a current field surrounding the source. Anyone touching (or in) the water feels the current. If any metal on the boat is in contact with the water then it is also energized. If you touch it, you get a shock. If it is AC current the person in the water suffers muscle paralysis and drowns.

To prevent this we bring the third wire (the green grounding wire) aboard. But if we connect to anything on board that is in contact with the water, then, when a fault occurs, we have the same problem. Current flows through the water. We want it to go through the wire. So we connect the wire at the boat's ground, and we do not connect it to the neutral wire anywhere on the boat. This way, if there is a fault the current flows back through the grounding wire, which is the path of least resistance. The green wire is also connected to the metal case of any AC electrical appliance on the boat. If a fault occurs in the appliance then the current returns to ground.

But suppose we put a transformer between the power from shore and the system on the boat? Now the green wire is no longer connected to the green wire ashore. To make that connection we connect it to the neutral wire at the transformer, on the boat side of the transformer. The transformer is the source of power, not the shore side generator so we connect the green (grounding) and white (neutral) at the source of power. The same is true if the source of power is a generator on the boat, or an inverter on the boat. The green and white wires are always connected at the source of power. For generators the connection between the green and white is inside the generator. They do not have to be connected externally. Inverters may have an internal connection but they may not. You need to follow the installation manual to connect it correctly. But, regardless, it becomes the source of power when you are running an appliance off the inverter, so they must be connected.

Bonding is NOT grounding. To prevent galvanic corrosion due to dissimilar metals in contact with the water, they need to be connected together. Some experts believe this should not be done on wood boats. Two dissimilar metals in an electrolyte (water) form a battery. But by connecting them we neutralize this. Metal fittings are connected to bring all of them to exactly the same electrical potential, zero. Then no current flows between them and no corrosion occurs. The bonding wire is connected to the grounding point on the boat. But this is not part of the electrical system, and current should never flow in the bonding wire. If current is flowing in the bonding wire then something is wrong. Do not confuse this with grounding.

So grounding is important for safety. It protects people from shock hazard. It is important to make sure it is installed correctly.