Harger Uni-Shot Exothermic Ground Connection Welding Kits

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In 2017, I installed a perimeter ground system around the outside of my station, using several ground rods bonded together with heavy wire and mechanical clamps. The ground rod for my ac service, telephone/DSL service, and the single-point ground panel (SPGP) for feed lines are all bonded together through this system. Last fall, I upgraded to welded connections.

Why Welded Connections

With the growing awareness of amateurs about the need for solid ground systems, many are deciding that one lonely ground rod outside the station window isn't enough. To get the job done right, hams are working with new techniques, materials, and tools.

Most of us aren't that familiar with the techniques or materials used for heavy-duty ground connections and conductors. Digging and drilling are involved. Wires are thicker. Clamps and terminals are much bigger. That unfamiliarity can lead to poor or unreliable connections, especially those exposed to the weather and soil for a long time.

Connections between a ground electrode (usually a ground rod) and grounding conductors (heavy copper wires) are usually in direct contact with the soil, so corrosion and moisture damage are a constant problem. The connection might have to carry very high current without damage. Connections have to be mechanically strong, so that they aren't accidentally cut or torn loose by digging or soil motion.

Mechanical clamps, usually type-G ("acorn") or the two-part type-J, are often used to make connections between the heavy ground conductor and the ground rod, and I originally used acorn clamps, as shown in Figure 5. The clamp relies on compression to create a secure metal-to-metal contact. Some types of clamps are rated for direct burial. Even so, repeated thermal cycling and mechanical stress can cause the connection to loosen gradually, requiring inspection of the connection every so often. Wouldn't it be nice if a connection would never loosen or corrode?

Figure 5 — A ground rod and acorn clamp securing stranded #6 AWG ground wire. This is typical of clamped connections that are replaced and upgraded by the welded Uni-Shot connections.

Exothermic Welding

The answer is to weld the wire to the ground rod. Copper can be difficult to weld, but a special technique called *exothermic welding*, using thermite, works well. Thermite gives off tremendous amounts of heat when it burns. Mixed with copper powder in a ceramic crucible, a pool of molten metal is created — hot enough to partially melt the ground wires and rod. The result is a solid, welded connection.

Electricians use exothermic welding all the time. (So do railroads — **www.youtube.com/watch?v=rNjosF789X4**.) As a result, there are many products available. The most common are single-use kits for ½- or ⅝-inch ground rods and two, three, or four ground wires at sizes starting at #8 AWG. While more expensive than a bronze clamp, connections made with thermite welding are secure and can be buried or covered without needing to be inspected in the future.

Kits are available wholesale from local electrical supply distributors and in smaller quantities from ham distributors. The kits I evaluated were supplied by KF7P Metalwerks (**www.kf7p.com/KF7P/HargerUniShot.html**).

Ordering Kits

On the order page, there are a number of different kit configurations. It's important to get the right model. The Harger Uni-Shot kits are designed for ⅝-inch-diameter ground rods, and you need to know the number and size of wires to be connected. The ⅝-inch kits can be used with ½-inch ground rods if you use mold sealer, as described below. My ground rods are ½-inch diameter, and all ground wires are #6 stranded AWG. I needed eight two-wire kits and two three-wire kits. You should order at least one spare, particularly if you haven't used the kits before.

I also ordered the flint igniter tool to light the ignition powder and some

Bottom Line

Using an exothermic welding kit rather than a mechanical clamp results in a secure ground connection that won't loosen or deteriorate over time.

Figure 6 — The Uni-Shot in action with mold sealer around the ground rod and both wire sleeves. Clamping pliers support the crucible so it is vertical.

Figure 7 — The final welded connection. An additional ground conductor is clamped to the rod. This connection will not be buried.

mold sealer for around the holes in the crucible. You can use fireworks sparklers to ignite the kit, but a sparking tool is more convenient. Mold sealer is clay putty that prevents the molten metal from leaking around the ground rod and the wires so that everything inside is completely heated. Mold sealer will help keep you from having to rework a connection. The mold sealer costs about the same as a kit, so if it saves you from wasting one kit, it's worth it. The pound of sealer is enough for dozens of connections.

Using the Kit

The kits come with a fairly complete instruction sheet intended for use by electricians. The instructions and drawings are complete but terse. Read them completely, and carefully identify each part of the kit. Watch the video provided by KF7P Metalwerks at **www.kf7p.com/KF7P/HargerUniShot.html**. The segment of thermite igniting is not sped up — it happens in a couple of seconds.

I made a mistake the first time, either letting the powder leak out by not assembling the kit correctly, or I didn't have the ground rod aligned correctly. Treating the first one as a practice opportunity, I didn't have any trouble thereafter.

The welded connection shouldn't be hammered, so the ground rod must be driven in to its final position. If you're going to bury it, the top of the rod should be below ground level before you weld the connection. The ground rod's top will probably need to be filed or ground down to fit through the hole in the bottom of the crucible. A coarse file or portable grinder will do the job. (I used a file and that turned out to be the hardest part of the project.) Use a steel brush to clean the rod and the ground wires of any dirt and oxidation.

It is a good idea to practice inserting the wires into the sleeves and getting the crucible set up in a stable position on the ground rod. Note how the sleeves fit in the mold, and be sure the flared end is on the outside of the crucible. Using clamping pliers as a support is a good idea; heavy ground wires are stiff and can pull the crucible out of position. The wires should touch in the middle of the mold. Pack some mold sealer around the ground rod and all wire sleeves on the outside of the crucible.

Be sure that you put the ceramic insert and steel disc in the mold before the thermite powder. If you don't, the molten mass will pool below the wires, and the weld will be incomplete. Removing the powder once in the mold is pretty much impossible, and you won't be able to use that kit.

Be sure you know which portion of the powder tube has the thermite (the clear end) and which has the much finer starting powder (the orange end). They can't be mixed (or separated). Tap the powder tube before you open it to be sure the powder is not packed into a lump from shipping. Having the powders in separate compartments of the powder tube is helpful.

Pour in the thermite, put on the cap, then pour the starting powder into the cap's hole. Leave a little bit around the hole to catch the spark. If it's a windy day, block the wind or the fine-grained starting powder can blow away.

Put on safety glasses and heavy gloves before lighting the powder. It is tempting, but don't look at the molten mixture after ignition. Light the starting powder and in a few seconds, the thermite mixture will have turned into molten weld material. Let the mold cool for at least 10 minutes before touching it. Figure 6 shows the Uni-Shot kit just after ignition.

To remove the mold, tap it with a hammer and break it into pieces. You should see a round button of solid metal on top of the ground rod with the ground wires coming out of it (see Figure 7).

Except for the cooling period and breaking off the mold, the whole process takes about 5 minutes per connection. More time will be required if the wires or ground rod are dirty or corroded. I was able to update the whole ground system in a few hours.

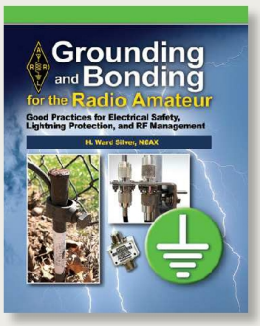
I am glad I did change the connections to welds, because I found that a couple of the clamps I had originally installed had loosened. That was probably the installer's fault (me), but it's typical that hams won't have a lot of experience with installing ground systems. The extra expense compared to a clamp is a few dollars per connection and well worth not having to worry about the connections loosening up or corroding over time.

Now that I am more familiar with the kits, I will be using them from the start. They are the right tool for the job and in lightning country, knowing my ground system is secure is a good feeling.

Manufacturer: Harger, 301 Ziegler Dr., Grayslake, IL 60030; **www.harger.com**. Distributed by KF7P Metalwerks (**www.kf7p.com**). Kits priced from $10.95 to $14.95; mold sealer, $15.95; flint igniter tool, $10.95.

Grounding and Bonding for the Radio Amateur

Learning the Terms



If you aren't familiar with the how and why of amateur station ground systems, you can read up on the subject. *The ARRL Handbook* covers the topic in the Safety chapter, and there are a number of articles in the ARRL website's Technology section (**www.arrl.org/safety**). Ward Silver's, N0AX, recent book *Grounding and Bonding for the Radio Amateur* (**www.arrl.org/shop/Grounding-and-Bonding-for-the-Radio-Amateur**), covers this and related subjects in detail and will explain unfamiliar jargon and abbreviations, like SPGP.

W4OP Magnetic Loop Antenna with Remote Tuning

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In a previous review, I discussed my experiences with the original manually tuned W4OP Loop sold by LNR Precision.[1] Since then, a new upgrade has been added to the product line incorporating a remote tuning function. Like the original W4OP Loop, the new version covers 40 through 10 meters (6-meter coverage is optional) and is rated at 15 W. This review will compare the new version to the original.

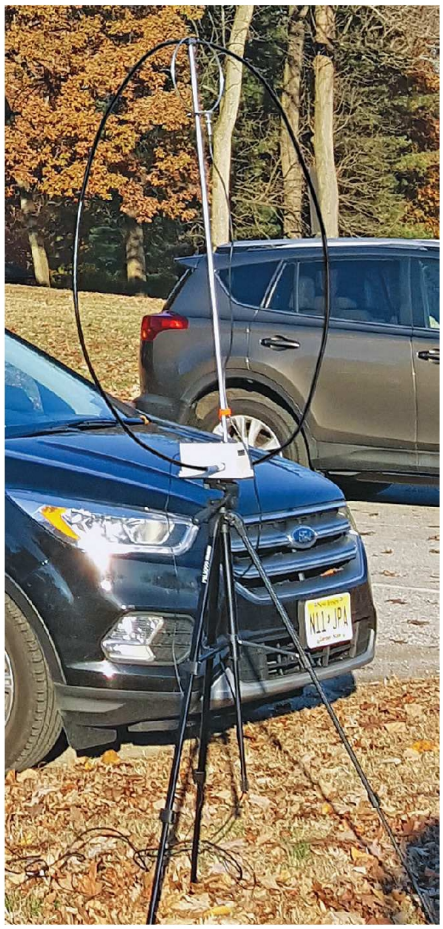
A Small Footprint

Magnetic loops can be quite handy for use in locations where typical dipoles, long wires, or vertical antennas are not practical. These locations include portable ham operations and home stations where these larger antennas are not allowed, making a small loop antenna quite attractive. The additional capability to remotely tune the antenna adds to its convenience.

The same basic design of the original loop has been retained in the updated product. The loop itself is made of a length of semi-rigid coaxial cable fashioned into a 4-foot-diameter circle and connected to a tuning unit via PL-259 connectors. The loop is held in place by an aluminum support mast attached to the tuning unit. A smaller coupling loop is mounted on the top of the support mast near the main loop. The coaxial feed line attaches to this coupling loop and

Bottom Line

The latest version of the W4OP Loop from LNR Precision adds the convenience of remote tuning from the operating position to the popular and effective manually tuned version. It's a good choice for those who operate portable in areas without access to antenna supports or for a home station when larger antennas are not possible.



[1]J. Everhart, N2CX, "W4OP Magnetic Loop Antenna," Product Review, *QST*, Oct. 2017, pp. 61 – 63.