More Power To You!

Haven't started using Anderson Powerpole connectors for your dc connections yet? This article will show you how to install them properly. Even if you have been using Powerpoles for years, you may learn a few new tricks.

Del Schier, K1UHF

This article gives a general overview of Anderson Powerpole connectors, along with tips and tricks for using them.[1] Powerpoles were adopted as a standard power connector by many ARES and RACES groups so that stations could be set up quickly during an emergency. Amateur Radio operators across the US and in the UK use the same connectors in a standardized configuration. Many manufacturers have developed dc power panels that use Powerpole connectors. Most Amateur Radio dealers sell Powerpole connectors and power panels.

Until the Powerpole standard developed, hams used dozens of different ways of connecting 12 V circuits. Twisted and taped, wire nuts, banana plugs, binding posts and Molex plugs — you name it. Most of these connections have serious disadvantages, including shorts and reversed polarity, or they are simply difficult to connect and disconnect. Imagine if every 120 V ac appliance, lamp or toaster had different plugs and sockets, or came with bare wires.

Good connectors can actually have less loss than the wire they are connecting! Anderson Powerpoles in the size used by Amateur Radio operators have a contact resistance as low as 100 μΩ, or 0.0001 Ω! This is the same resistance as only 0.6 inches of 12 gauge wire.

Figure 2 — Here are several sizes of Powerpole connector assemblies. We use the smaller ones rated for cool running at 45 A continuous with 10 gauge wire. The big ones are rated for 250 A, continuous.

Standardizing on one type of connector for all of your radios and power sources makes things much more convenient. Powerpoles are polarized, color keyed, genderless, insulated and hot swappable. They do not wear out with thousands of connect and disconnect cycles. They are simple to install or remove and can be installed with a soldering iron or crimp tool. In the ARES/RACES genderless configuration they may be used to connect a power supply to a battery for charging, and with the same genderless arrangement connect either the battery or power supply to a radio or other load.

Unlike other connectors, Powerpoles may be assembled in several different configurations, making it impossible to plug the wrong things together. An example would be to make it impossible to accidentally plug a 12 V circuit into a 24 V one. Figure 1 shows a variety of Powerpole connectors assembled into mating configurations.

A good connector should not lose contact tension with use. Powerpoles use a stainless steel spring to hold the silver-plated copper contacts firmly together. Some connectors depend upon soft copper that eventually

[1]For more information about Anderson Powerpole connectors visit **www.andersonpower.com**.

Figure 1 — Notice how these various examples mate. At the top left is a pair of connector bodies in the genderless ARES and RACES configuration.

Figure 3 — On the left are 45 A contacts; notice the open ends that must be crimped. The standard 30 A size in the center or the smaller 15 A size on the right may be crimped or soldered.

From March 2006 QST © ARRL

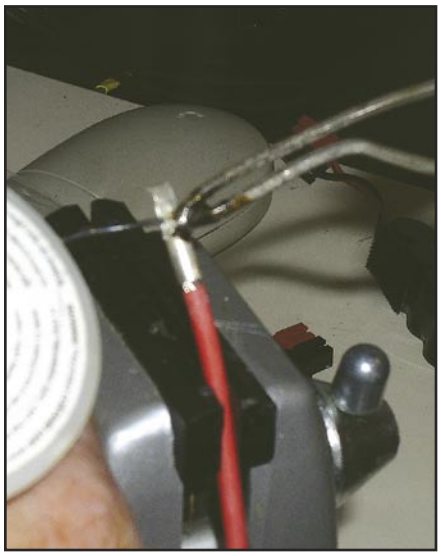

Figure 4 — To solder a Powerpole connector, place the tip of your soldering iron against the body, right at the end of the wire inside the connector. Melt a small amount of solder so it flows through the small hole in the connector and is drawn into the wire.

spreads apart and becomes loose and intermittent.

Contact Sizes

Anderson Power Products, the manufacturer of Powerpoles, makes hundreds of different connectors, with ratings of up to 1000 A. The Powerpoles that Amateur Radio operators need are Anderson #1327 PP15/45 housings with three different contact choices. The three contact sizes, 15, 30 and 45 A, are rated according to the wire size they will accept. The part numbers for the contacts are #1332, 15 A for 16 to 20 gauge wire; #1331, 30 A for 12 to 16 gauge wire and #261G2, 45 A for 10 to 14 gauge wire. Figure 2 shows several sizes of Powerpole connector assemblies.

An Anderson engineer told me that 30 A connectors would not fail in sustained use until over 200 A, and I believe it. The actual rating for a Powerpole connector is for a 30°C temperature rise at 30 A. For example a 45 A contact using 10 gauge wire over long periods will get only 30°C higher than the ambient temperature with 45 A of current. This temperature rise spec is according to the National Electrical Code for building wiring and is more of a wire gauge rating than a connector rating. The automotive industry standard is much higher with a 100°C rise at the rated current allowed. Powerpole insulated housings use a high temperature plastic, UL94 V-0, with the connector design allowing for air to flow through the connector.

Choose the contact size that fits the wire you plan to use. A 100 W HF transceiver normally comes with a 12 gauge power cord and that will fit properly in a 30 A Powerpole contact.

The 30 A (12 to 14 gauge) size of Powerpole contacts fit in the same housings that the 15 and 45 A contacts do, and the assembled connectors mate no matter which contacts are used. The only real difference between the contacts is the size of wire that they accept. The 15 A contacts are designed for 16 to 20 gauge wire, but I often will use smaller wire by doubling the wire over two or three times. With 10 gauge wire, you must use the 45 A contacts, which should be crimped since that size cannot easily be soldered. Figure 3 shows a pair of Powerpole bodies with 15, 30 and 45 A connectors.

When you are ready to put contacts on your wires do not worry about the housings; they go on later. With other types of connectors you may have to remember to assemble them in the proper order; otherwise you will be sorry.

To Solder, or Not To Solder?

Tip: Before soldering or crimping contacts on the wire, you may wish to rotate the contacts so that you will not have to twist the wires later to align the contacts to the housings. This is especially important with two-conductor heavy-gauge wire. If you orient the contacts so they will be turned correctly to slip into the connector bodies, it will make *that* part of the job much easier.

As with most aspects of Amateur Radio, you must do things properly, and with the right tools. Soldering is an art. If you are not experienced with soldering, crimping is the way to go. Nevertheless, I will explain the basics of soldering.

To properly solder any electrical connection you must use solder designed for this purpose. *Do not use acid-flux plumbing solder!* Any good electronics-grade solder should be fine. The type of solder with water-based flux should be thoroughly washed with water after soldering. Use the proper soldering iron — one that provides the right heat — one with a ⅛ inch to ¼ inch tip and from 40 to 125 W. The thermal mass (size) of the tip has as much to do with the heat transfer as the heating power of the element. The right iron should cause the solder to flow nicely into the joint within about 3 to 5 seconds. It is important to have the tip clean and shiny, with a fresh coating of solder, commonly called "tinning."

Strip the wire back 5⁄16 inch. That is just enough for the wire to fully fit into the contact wire recess. Try not to nick the wire or leave any stray strands outside the contact. Unless you have three hands, put the wire in a small bench vise with the stripped end and contact up, as shown in Figure 4. Put the iron tip on the contact at the point where the end of the wire is, and flow just a bit of solder between the tip and the contact.

Wetting this junction causes better thermal conduction and allows the parts to heat together. Within a few seconds you should see the solder start to flow. At this moment add only enough additional solder to flow into the inside of the contact and the core of the wire. It is important not to put so much solder in that it flows into the wire insulation. Running solder down too far will cause a stress point that may cause the wire to break with repeated flexing. Once you have completed the joint, inspect it. Figure 5 shows examples of good and poor soldering jobs.

Crimp Tools and Other Pliers

It is interesting to note that FAA aircraft maintenance standards recommend crimped connections, not soldered. The reasons stated by the FAA are that crimped connections are less prone to vibration and flexing failures and crimps may be done properly by unskilled mechanics. Crimping Powerpole contacts is much faster and easier, but it must be done with the correct tool. Anderson makes tools to do two of the three sizes of connectors for about $190 each. West Mountain Radio has a tool that does all three sizes of contacts, called the PWRcrimp, for about $50. MFJ, Powerwerx and several other companies sell a variety of crimp tools. Some of those tools are similar to the PWRcrimp and others are more like pliers to squeeze the contact. Before buying a crimp tool, make sure it will properly handle all of the contact sizes you want to use. The less-expensive crimp tools may squash the terminal so that it won't fit properly into the connector body. If you have

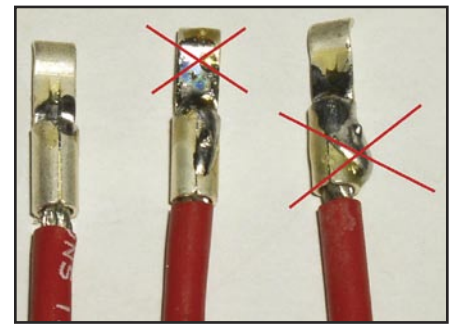

Figure 5 — There should not be any solder on the outside of the housing, as shown on the right. If so, you will find it *impossible* to insert the contact into the plastic connector housing. It is important that you *do not* have *any* solder on the flat contact surface near the "spoon" area, as shown in the middle example. Solder on the contact surface will destroy the performance of the connector! If you have a blob of solder on the outside of the contact body you may file or scrape it off. If solder is on the contact-mating surface re-do the connection with a new contact.

Figure 6 — The author's daughter doing a nice job of crimping Powerpoles using a PWRcrimp tool.

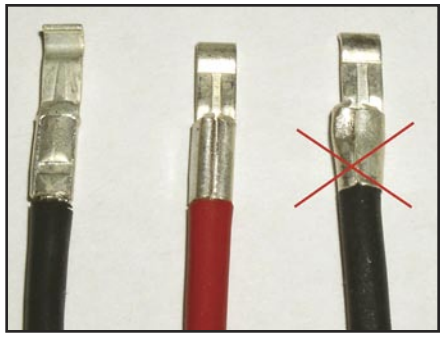

Figure 7 — Shown on the left are top and bottom views of a crimp done with a crimping tool. To the right is one done with the wrong tool, one designed for an uninsulated crimp terminal.

to force the contact into the body it may not mate with another Powerpole with the full retention force. A poorly done crimp will be weaker, have higher resistance and be subject to failure because of internal corrosion.

If your crimp tool came with instructions, follow them. To crimp a contact with a tool designed specifically for Anderson connectors, put the contact on the wire with the contact seam up and insert it fully into the appropriate die for that size contact. Put it fully into the tool's contact positioner stop. If the tool is designed for Anderson connectors it will have a ratchet release to ensure a proper crimp. Squeeze the tool just until it releases. Properly crimped with the proper tool, you will have an aerospace-quality connection with lower resistance and higher reliability than the best solder job. See Figure 6. Figure 7 shows examples of properly crimped connectors as well as one crimped with the wrong tool. Notice the bulge on the side of the improperly crimped connector. That connector will not slide into an Anderson Powerpole connector body.

Before doing the final assembly of the connectors it is important to inspect the contact installation. Do not skip this step! For soldered contacts, make sure there is no solder on the outside of the contact body or on the contact surface. For crimped connections be certain that the contact was properly aligned in the tool during the crimp. Also make sure that the contact tab is perfectly straight and was not bent up or down by comparing it to an unused contact. If the tabs are bent down toward the spring they will not have full spring pressure. If they are bent up away from the spring they will release from the spring and slide back in the housing. In that case the connector will not work.

After inspection, rotate the wire, with the contact installed, so that the flat "spoon" end of the contact is down, toward and parallel to the stainless steel spring inside the connector body. Push the assembly in until it clicks. With heavy wire you should be able to push directly on the wire to insert the contact into the housing. With smaller wire you may have to push on the back of the contact with a small screwdriver. If you have difficulty pushing the contact in, or it doesn't click, something is wrong. Either you have a blob of solder on the contact, you have bent the contact or the contact is not rotated correctly with respect to the housing. Once you have properly assembled the connector, the wire and contact should "float" slightly inside the housing and cannot be pulled out with your bare hands.

Dovetailing the Connector Bodies

Decide on how to assemble the connector bodies. The Amateur Radio ARES and RACES convention for 12 V connections is to orient the connector bodies "tongue top, red right" as you look at the open front end of the bodies. You may wish to use other arrangements for other voltages or special control circuits.

The housings are cleverly held together with small dovetail joints. Look at them closely and you will see how they assemble and work. The housings slide together. Do not try to snap them together or apart. It is important that the dovetails are fully mated and flush. If not, the finished Powerpoles will not connect properly. To make pairs permanent, use a small drop of superglue. Only glue the bodies after you are certain that they are the way you want them forever. I never permanently glue my housings; normally they are fine. Some people use roll pins to lock the connector pairs together. Anderson does not recommend roll pins. They supply spiral pins, or for critical applications, glue. The roll pins will fall out, and knowing Murphy, they will fall right into your expensive radio, causing smoke.

Mating pairs of connectors connect with three to five pounds of retaining force and are vibration proof. If you trip over a wire, the Powerpole connector will disconnect and save your radio from hitting the floor.

Unlike other connectors, Powerpoles may be disassembled without cutting the wire or unsoldering. This is handy for slipping the wire through a small hole with only the contacts on the end. The contact, with the wire attached may be removed from the housing by prying the end of the contact up over the flat retaining spring with a small screwdriver and pulling the wire out. You can slide assembled housings apart, but they can be stubborn, or impossible if you have glued them. If they are stubborn place the bottom edge of the appropriate housing against a solid object and tap the other one in the direction that it slides down. Twisting them slightly before sliding helps, but do not try to snap them apart or you will damage the dovetail.

Figure 8 — Anderson Powerpoles rigged as an automotive ATC/ATO fuse holder. See the text for an explanation of how to make this fuse holder.

A trick that I have used with Powerpoles is to make a fuse holder that will accept automotive ATC/ATO fuses. Be warned. It is a good idea to install a fuse physically located at a connection to a large battery! To make a fuse holder you will need two pair of housings, and one pair of contacts. Cut the small rectangular piece, the one with the Anderson "A" trademark on it, from one pair of housings and glue those pieces inside of the other housings, as shown in Figure 8. Then slide the Powerpole bodies together side by side and insert your fuse.

Once you install Powerpoles on each and every piece of 12 V equipment, plugging things in and out will be as easy as your lamp or toaster. You will find how convenient they are and how well they perform. More power to you!

Del Schier, K1UHF, was first licensed in 1961 and holds an Amateur Extra class license. Del operates from the top of West Mountain in Ridgefield, Connecticut and is active on all bands, from 1.8 MHz to 10 GHz, including 2 meter EME. He says his favorite band is 10 GHz. The designer of the RIGblaster and RIGrunner products, he works at West Mountain Radio. He also enjoys flying radio control electric and glider models. You can contact him at 126 Old West Mountain Rd, Ridgefield, CT 06877 or at **k1uhf@arrl.net**.