A Technique for Putting a PL259 on a Piece of Coax

A basic question: Should you solder “or” crimp PL259 connectors, or any other connectors, onto coax?

It's a good question to start off the discussion and the answer centers on “what you prefer”! Why do one or the other?

Soldering wires together requires heating solder to its melting point (a relatively low temperature compared with that required to melt the wires being joined) and letting it flow over, under and around the components you are wishing to join. When the solder cools and solidifies, the components are held in place by the solder. Soldering does not make the connection moisture proof and compared with a crimped connection, it is not very strong.

Crimping, on the other hand, is a mechanical connection made under pressure; the tool that applies the pressure is a specially designed “crimping tool”. Typically a connector (a “ferrule” in our discussion here) is shaped such that it completely surrounds the parts being joined. With the ferrule in place, a crimping tool is used to apply enough pressure on the ferrule and wires to create a very tight bond keeping the connector and it’s contents together. The resultant connection is a stronger, tighter, and an electrically better (less resistance) connection than a soldered connection.

Note: Pliers alone will not provide the necessary pressure to achieve the benefits that a designated crimping tool will provide. Most crimping tools are designed to require more than one squeeze of the handles to apply the needed amount of pressure on the ferrule and the enclosed wires being joined. In addition the crimping tool is designed to automatically release when the desired “crimp” has been applied.

My preference is to crimp whenever it is possible and practical to do it! I prefer crimping because it is a stronger

connection, there is no third conductor involved (solder), lower resistance because a crimped connection has more surface contact between the coax and the connector, and it is much easier to crimp than solder. Soldering has its place, just not in this project!

A "Technique" for Preparing the Cable End and Crimping a PL259 onto a Piece of Coax.

This isn't a set of instructions but rather a paper presenting a technique for preparing the coax and installing a crimp-on PL259. Much of what is written here centers on preparing the coax, so it applies to "solder-on" connectors as well. That said, I prefer to crimp-on the connector so only crimping is discussed.

If you don't have your own technique for preparing the coax and installing a crimp-on PL259, try the following as it does work even though it isn't the fastest or the only way to prepare the coax. There are many techniques out there for putting a connector onto coax, this just happens to be mine. Consider this "technique" as a beginning for you to create your own technique for putting a PL259 on a piece of coax.

As you might rightly presume, I prefer to use crimp on connectors. Crimping creates a tight contact interface between the wire and the PL259 that, under normal conditions, should not come loose over time. It also creates that bond around the circumference of the Coax.

If, after trying other methods, you decide to use this method, you will need to buy, or borrow, a crimping tool and possibly additional dies. The tool and dies will last for the entire time you are in ham radio, as well as the ham who inherits your station, and the one after that…! If you buy additional dies for different size coax, be sure they were made to work with your crimp tool.

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Important Note: When you you have a crimp-on PL259 in this paper, I want you to hold the ferrule in position on the bottom of the body of the PL259. Notice three things, the first is the length of the ferrule compared to that of the bottom part of the connector. The ferrule is longer than the bottom of the connector so when crimped in place the ferrule will not only very tightly compress the electrical connection between the braid and the connector (our goal), but it will also seal around the outside cover of the coax creating a physical barrier to keep out dust and possibly liquids from entering the connector and causing problems. Additional protection against liquids contaminating the connector can be created by using heat shrink, preferably the kind with heat-activated glue on its inside surface, to protect against liquids from contaminating the connector.

With that said, when installing the connector on a piece of coax, my first step is to slide onto the coax some heat-shrink, the screw-on "nut" part of the PL-259 connector if it is separate from the body of the connector, and the ferrule part of the crimp-on connector. If you forget to preposition these parts, comfort yourself in that I know for a fact you are not the first, nor will you be the last to forget to put these pieces on the cable before its too late!

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If you have never paid attention to how coax is put together, a generic coax cable has a center conductor (typically stranded wire, but possibly a single wire) surrounded by a dielectric which itself is surrounded by a braided conductor (or possibly a foil covering, or both) and all that is inside the outside cover which is typically hard to cut through. "Direct Burial" coax is quite hard to cut through! I mention it here because the goal is to put a connector on this cable without shorting the center conductor to the braided shield and to keep the connector from coming apart at any point in the future.

The primary tools you will need are a razor-sharp knife, a small pair of pointed wire cutters, or a pair of sharp pointed scissors for cutting the braid, a regular pair of wire cutters, and of course a crimping tool with the appropriate dies for the task at hand.

Preparing the Coax for the PL259:

There are several designated “tools” available for preparing the coax for the connector, the ads for which claim to make preparation of the cable a snap. I tried a couple of them and have “not” found one that really works smoothly, so my choice is to use a sharp razor knife to prepare the end of the coax. It takes a bit longer and requires a little practice, and it also works!

Before getting into the preparation of the coax for the PL259, here are a few words about how I cut the layers of the cable.

Ground rule: do not attempt to cut through any portion of the coax with one swipe of the blade. Rather, in a controlled manner, plan to carefully cut it by making more than one pass as you cut your way through each layer. Be aware that some coax is designed for direct burial and the associated abuse it can get. The outside cover of direct burial coax is tough to cut through! Be careful!

Begin my making your initial cut into but not through the outside covering of the coax. Following that initial cut, and while slightly bending the coax to open the cut so you can see what is going on, make a second, and subsequent cuts. Do this until you have cut through the external material covering the braid. The concept here is to control the cut rather than just slice through the coax.

While we want the outside cover of the coax to be tough material, when it comes to preparing it for the PL259, its toughness is/can be a challenge. I say this because just under the tough outside cover is the braid typically made up of woven “hair thin” copper wires. And as you might guess, these braided wires are easily damaged; it takes very little to cut them because they are thin wires and sitting on a hard surface, the insulation between the braid and the center conductor.

The fact is the braid is “the” other conductor in the coax so you need to preserve it while and after cutting and removing the outside cover of the coax. If you cut a couple strands of the wire making up the braid, doing so won’t “seriously” compromise your end goal. Just leave the cut wires

of the braid in place and go on to the next step. That said, if there is a major portion of the braid cut, I suggest you cut off your first try and start over again.

Once I have successfully cut around the circumference of the outside coax cover, I then use the same technique to cut along the length of the coax cover I plan to remove. And, when that is completed, I peel off, not pull off, the cover exposing the braided layer. I've found that pealing the cover from the braid doesn't pull apart the braid as much as pulling the cover off the end of the coax. Note: While not true for all brands and sizes of coax, in some cases, during the manufacturing process, the braid is imprinted on the inside of the outer cover. If you pull the cover off the end of that cable, you run the risk of damaging the braid as you pull the cover off. Pealing it off tends to minimizes this.

Again, it's not that a cut wire or two of the braid will ruin the coax at that point but the effect of the shielding at that point will be decreased and therefore somewhat compromised by the lack of continuity in the braid.

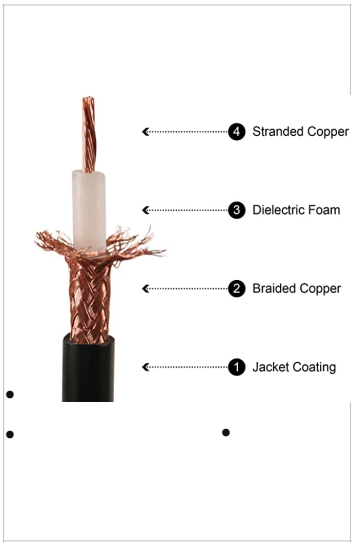
Note: Before you proceed from here, and if you haven't done so yet, be sure you have put a couple inches of heat shrink, the outer "nut" part of the PL259, and the ferrule part of the PL259, on the cable. For now, slide them down the coax out of your way.

The first task is to determine how much of the outside cover you should remove. Since the center conductor will be the longest part of the coax that will need to be exposed, and we want to be certain it extends a little beyond the end of the center pin of the connector, use the PL259 (<u>without</u> the ferrule on it) as your measuring tool. To do this, place the connector next to the coax such that, when all is prepared and you are ready to put the connector on the coax, there will be about a 1/4 inch or so of center conductor extending through and beyond the tip of the center pin of the connector. When positioned where you want it, mark the coax with tape, or something else you can see on the black outer cover, and remove the outside cover of the coax. (If needed, refer to the comments made at the beginning of this paper about how to cut and remove the coax outer cover.)

Note: by design, when the ferrule is positioned for crimping, it needs to be positioned against the bottom of the body of the PL259 covering all of the braid that's covering the bottom part of the connector as well as some of the outside covering of the coax.

The second task is to fit the coax to the PL259 connector.

Before proceeding with the preparation, let me describe the desired "fit". When the PL259 is ready to be crimped onto the coax, the PL259 will be seated against the inner insulation (separating the braid and the center conductor, #'s 3 and 4 in the picture below), the center conductor (#4) will extend out the center pin of the connector, and the braid (#2) will completely cover the bottom pin of the PL259. With the above accomplished, the ferrule, (which I hope you already put on the coax) will need to be positioned against the bottom of the connector, covering the braid at the bottom of the connector **<u>and</u>** some of the outside cover of the coax (#1). You do not want to see any braid showing at either end of the ferrule before or after crimping.



Before going further, double check that enough of the outside covering of the coax has been removed to allow the center conductor to extend beyond the tip of the center pin of the PL259 when the PL259 is ready to be crimped. To do this, again position the PL259 against the coax such that the bottom tip of the PL259 is at the point on the coax where the cover ends and the exposed braid begins. If the coax center conductor extends beyond the end of the connector, all is well to proceed. If it does

not, then an additional, probably short, length of the cover, and the center insulation needs to be removed. Again, the lengths of the cover and center insulation that need to be removed will be the additional length needed for the center conductor to extend beyond the tip of the connector when you are ready to crimp the ferrule and crimp or solder the center pin. The last step of the installation will be to cut off the excess tip of the connector.

With enough braid now exposed, the next step is to determine where to and then cut the braid and the center insulation. To determine where to make the cut, again place the connector against the coax with the bottom tip of the connector next to the end of the coax cover. Note on the braid where the bottom pin of the connector connects to the main body of the PL259. It is at that point the braid and the center insulation will need to be cut. With a sharpie or some other method, mark on the braid where the bottom pin is connected to the main body of the PL259.

Read on before you start cutting.

When the center insulation is cut, where it ends will determine how far onto the coax the PL259 can go. A proper fit is for the PL259 to be seated against that center insulation, while the braid "covers" the bottom part of the connector, and the center conductor extends through and out the tip of the center pin on the PL259. *I keep repeating this because after crimping the ferrule, if you can't crimp (or solder) the center conductor, you will need to start over again from the beginning and will have wasted the connector!*

Now that you have determined where to cut the braid and center insulation, here is how I do it. I suggest using a pair of sharp pointed scissors or small sharp wire cutters for cutting the braid and a sharp razor knife for the insulation. The braid is normally made of very fine wire so it will be easy to cut. Using scissors should not damage the scissors.

Starting with the braid, the best approach I've found is to carefully pull/slide the braid down the insulation such that it expands the weave. I then cut the braid around the coax at of slightly long of my mark. (It will/can be trimmed soon.)

After you have “cut” the braid, keep it pulled back/down the coax so that it will be out of the way allowing you to have access to the center insulation. The point where you want to cut the insulation will be where you marked it a minute ago. If you have not marked where to cut, put the connector against the coax again with the bottom tip next to the outside cover of the coax, and mark it again.

With the braid now cut to length, or a bit long for where it will eventually fit, the next step is to remove the center insulation exposing the center conductor. Because the center conductor might be a bit long for removing in one piece, consider removing it in two or three pieces. In addition to removing the insulation and creating a “base” against which the PL259 will rest when installed, the idea here is to maintain the integrity of the center conductor of course.

This is pretty much straight forward but there are a couple cautions you might want to be aware of. The first, is that if the center conductor is stranded wire, you want to be careful to not cut any strands and, if possible, to not even nick the wire when removing the insulation. By all means, don’t shorten the center conductor! It’s a little late to have to go back to the beginning and again prepare the coax for the PL259.

Two other comments are appropriate for this point in the process. The objective of each is to prevent a possible short created by the center conductor touching anything to do with the braid conductor on the inside of the PL259.

The first applies if the center conductor is stranded. Twist the center conductor as tightly as you can without braking any strands. The second is to straighten it so that there will be no bends/kinks in the center conduct. The purpose of each of these actions is to prevent a short between the center conductor and any internal part of the connector. Except for having to possibly trim the braid, you are now ready to put it all together. So, read on…

When installed, the center conductor and its insulation will be threaded through the bottom part of the connector and the braid will be positioned over that bottom part of the connector. When first put on the connector, if the braid is too long with the PL259 seated against the center insulation, you will need to eyeball the amount to trim from the braid, remove the

connector, and trim the braid. Your objective is for the braid to cover the outside of the bottom part of the connector when it is seated on the coax. A little long is not acceptable but a little short is ok. Also, after trimming the braid, be sure you have found and removed all the little pieces of wire you just trimmed from the coax.

Again, double check the length of the center insulation as it determines the length of the center conductor; it is the stop against which the PL259 will sit when fully on the coax.

Expanding the braid as described above does not damage the braid. But, expanding it to the point that a permanent bend/kink in the braided wires is developed could damage it in that it might be harder to put the ferrule over it and up against the bottom of the body of the PL259. There is no work around for this condition but to try to ease the ferrule in place for crimping.

If you find the center conductor is not long enough when the PL259 is in place and seated against the insulation surrounding the center conductor, you will need to remove a bit more of the outside cover of the coax and a corresponding amount of the center insulation. The correct length of the center conductor is reached when the PL259 is put on the end of the cable, is seated against the insulation that surrounds the center conductor, and the center conductor extends beyond the end of the center pin of the connector. It doesn't need to extend very far beyond the end of the center pin but it does need to be long enough that it can be crimped onto the center pin or soldered in place (which is done depends on the connector you are installing).

Again, the goal when fitting the braid is for it to cover the bottom part of the connector and, when the ferrule is up and in place for crimping, there are no wires visible that might cause a short. So, if it is necessary to trim the braid, do so such that the braid "covers" only the bottom part of the PL259.

Final Assembly:

1. If the braid has been trimmed, the first step is to be positive that all the trimmings are removed from the coax and the connector so as to avoid a short when first used.

2. Fit the PL259 onto the coax such that the connector is sitting against the center insulation, the center conductor is through and visible beyond the tip of the center pin of the connector, and the braid fits around the bottom part of the connector.

3. Bring up the ferrule and position it so that it covers the bottom of the connector, the braid, and is snug against the bottom of the body of the PL259. There should be no visible braid wires showing. Also, the bottom end of the ferrule should be covering some of the outside covering of the coax. If all these are in place, using the special crimping tool with the die that fits the ferrule diameter, crimp the ferrule around the connector, the braid, and the outside cover of the coax. This should take about 3, possibly 4, cycles of the tools handles. The crimp tool will automatically release when the desired crimp pressure has been applied. Do not manually release the tool.

4. At the tip of the center pin, use the crimp tool and the correct die (typically a small part of the die at the tip of the tool where the pin fits.) and crimp it using the same application of the tool as you did with the ferrule.

If the pl259 you are installing is one with the open pin for soldering, then solder the pin and center conductor, using only enough solder to secure the center conductor to the tip of the pin. You might consider position the PL259 so the tip is pointing down while you solder it. This way the solder will not run down the center pin towards the main body of the connector.

(**Note:** I have read, but not experienced myself, that there are poorly made PL259's on the market that allowed excessive molten solder to flow through the center pin and into the body of the connector settling such that it created a short between the center pin and the braid at some point inside the connector. As you can imagine this might/will cause a short and damage to the rig. This potential problem is a good reason to use crimp-on connectors requiring the center pin to be crimped not soldered.)

5). The cable is ready to go **BUT**, before you connect any equipment with this cable, run a continuity check from end to end and pin to shield of each connector. I know, if you do only one end, you are doing the whole cable and its other connector, but…. I hope this has been a useful read and I'm open to feedback if its offered.