

Automotive Wiring 101

The right tools and parts can go a long way towards elevating your wiring work from sketchy to semi-pro

We've all been there: that moment when you get your first good look at the tangled wad of wires, fuse holders, quick-splices and half-unstuck electrical tape that somebody has hidden out of sight to get their new <insert electrical part here> up and running quickly. They excused their sloppy work because they were "just going to test it out real quick," but it's still there – never revisited or completed properly – waiting for the perfectly inopportune moment to blow a fuse, melt a wire, or bring the whole car to a stop. It's in that moment when you most appreciate the value of a proper wiring install; this article aims to give you some of the basic tools to wire, rewire, and repair wiring like a pro.

Just like most other work on your car, the single most important ingredient for success on a wiring job is having the right tools and knowing how to use them properly. For most wiring work, the list of tools is pretty basic and you can equip yourself very well for about a hundred bucks. Here is my minimum recommended tool set for high-quality wiring work:

- Ratcheting Crimper with Multiple Jaw Inserts
- Basic Cutter/Wire Stripper
- Soldering Torch & Solder

Ratcheting crimpers are different than the non-ratcheting variety in that they force you to fully crimp the terminal before they will release so you always know you got a good crimp. What's more, there are many different types of terminals commonly found in automotive wiring and in order to have the right tips for each kind, you'll want interchangeable ends. I highly recommend the **S&G Tool Aid 18920 Ratcheting Terminal Crimping Kit** available from a number of online retailers. It's got a good quality ratchet, 5 different sets of crimping tips and although it may not be the fastest, it's a great tool to put high-quality crimps on nearly anything you'll run in to while working on a vehicle.

For wire strippers, avoid the "automatic" type of strippers unless you are doing a whole lot of wiring and want to step up to spend good money on high-end ones. The cheapo tools at your local home improvement store will strip wire, but they often don't do a very clean job and – more importantly – they can cause damage to the insulation that's left on the wire during stripping. Instead, go for the simple single-action types and keep them clean and sharp. I'm never without my **Gardner Bender GESP-70** strippers – they have provided many years and many thousands of wire ends cut and stripped and work as well today as the day I bought them.

For soldering, I prefer just about any generic propane torch (the miniature ones are nice but not necessarily a requirement) for their consistent heating rate and ability to get big – like 10AWG – wire and terminals hot quickly. Just about any 60/40 (that's 60% tin, 40% lead) rosin-core solder will work



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well for automotive use. Always make sure when soldering that you heat the conductor and the terminal, and then add the solder. A “cold” solder joint where the solder melts before the other pieces are hot enough is very likely to cause problems down the road and very hard to spot with the naked eye (well – until it falls apart).

I’ve seen a fair amount of debate over the years on forums about whether or not it’s proper to solder electrical connections on cars. The simple fact is that it depends completely on the terminal that is being used – some terminals are designed to be soldered, many are designed to be crimped. The important thing to pay attention to is using the right tool to install the terminal you’re working with. Keep in mind that there are VERY few soldered electrical terminal connections on your vehicle from the factory – the OEM’s know that using proper crimpers with proper terminals is extremely reliable and robust.

So now you have the right tools; the next critical factor in ensuring a good wiring job is to use high-quality components. The good news about wire is that most anything you’ll get – say in a kit – is workable even if it’s not the best quality available. There are, however, other common “kit” components that I strongly recommend against using: namely pre-wired relay sockets or fuse holders and the “quick-splice” types of connectors. I know there are many thousands of them out in the wild that are “working just fine,” but I’ve seen them fail more than once and there’s just no reason to take those short cuts. Instead of using pre-wired fuse/relay sockets, buy a “relay socket kit” or a “fuse holder kit” that lets you crimp terminals on your own wire and assemble the socket.

Somewhat better than the quick-splice connectors (so long as you have the right crimping tool) are the Nylon-Insulated connectors you can get at your local auto parts store. The thing I don’t like about these is that the Nylon insulation gets squashed to bits when you crimp them, and because the insulation covers the terminal you cannot visually check every crimp. Slightly better are the terminals that have heat-shrink clear tubing pre-attached, but they run the same risk of damaging the heat-shrink during crimping.

The best way to get perfect, consistent, and trouble-free terminal connections is to use non-insulated terminals with double-wall heat-shrink to cover them after crimping. Double-wall heat-shrink (as opposed to the cheapo single-wall at your local auto parts store) has a layer of hot-melt adhesive on the inside of the tube. As you heat it, the adhesive softens and the tubing glues itself onto the joint as it shrinks. It’s much more durable than single-wall and it usually has a higher shrink ratio (3:1) compared to single-wall which is typically 2:1. While on the subject of heat-shrink tubing, another more advanced addition to your electrical toolkit would be a nice heat gun. I use a **DeWalt D26960 LCD Heat Gun** for all my heat-shrink production work because I can set the temperature and get perfect, fast shrinking with no overheating every time, but any heat gun will be than a lighter or other open flame.

So, you’ve used the right tools to put the right products together and build/install your wiring – great! Now, don’t skimp on the last step – use some wiring loom to cover, organize, and protect your work. For most non-engine-bay wiring, the inexpensive molded split loom will work fine. For higher-

temperature resistance, there are high-temp split loom products that also work great. Woven loom is nice but requires more planning and can be a little harder to work with. Regardless of the type of loom, though, I recommend using **3M Scotch Super 33 Vinyl Tape**. I have tried many other tapes but always come back to this stuff because it works every time, and once I install it, I never have to think about it again. Also note that you do not need to tape the wires together before you loom them, nor do you need to tape the whole length of the loom. Install the loom over the wires, add a wrap or two of tape at the ends and any junctions, and you're all set. And finally, use some zip-ties to secure the loomed wire in place so that it doesn't move around.

Where can you get all these high-quality products I'm talking about? As an automotive enthusiast and budding semi-pro wiring guru, Del City (www.delcity.net) should be at the top of your Internet Favorites list. They carry good quality products at very fair prices and are great to deal with. I buy nearly all of my production wire and loom from them as well as a number of connectors and terminals. Plan ahead a little bit, order some extra pieces and you can get your stuff shipped for free as well!

There are many more advanced aspects of automotive wiring which are important and will (may?) be covered in future articles. Having the right tools and the right parts, however, are the first and most important steps to improving your electrical work both in appearance and function.



Figure 1: With this small set of good tools you can accomplish a lot!

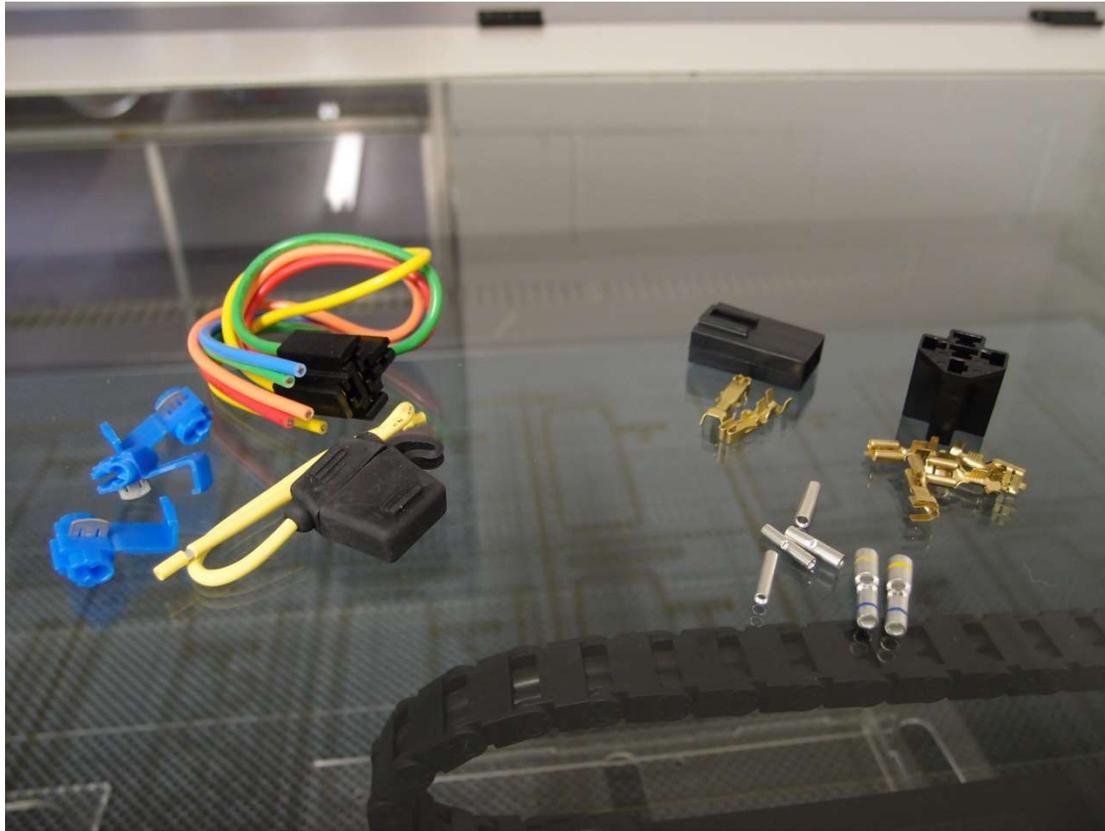


Figure 2: Avoid the junk on the left, use the stuff on the right instead.

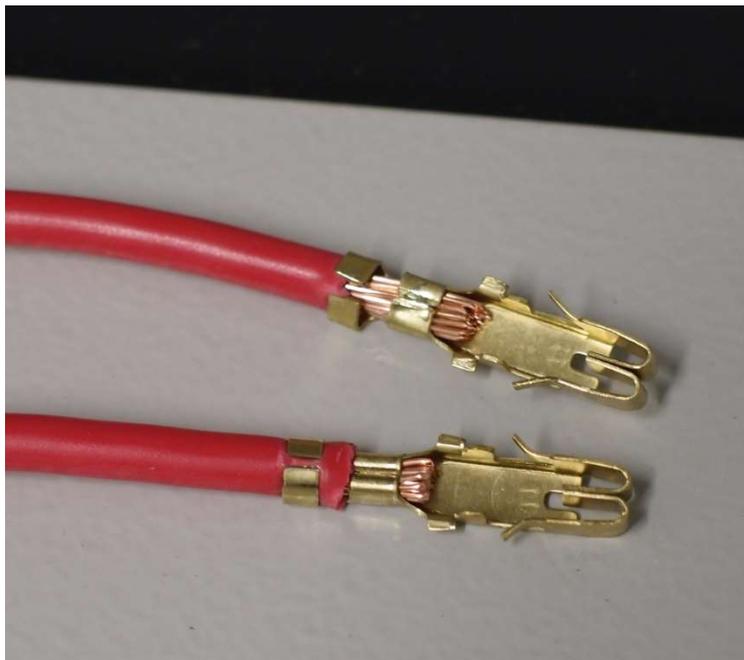


Figure 3: A bad crimp (TOP) has too much insulation stripped, poorly crimped wire holders and the insulation holders are smashing the little bit of insulation they are touching. The crimp on the bottom is 100% reliable.



Figure 4: A proper soldered joint is first crimped (TOP), then soldered with good flow (MIDDLE), then protected with double-wall heat-shrink tubing (BOTTOM).