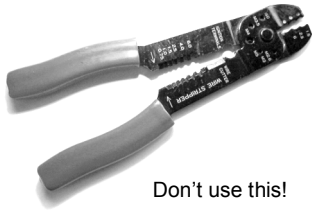


Make Professional Quality Wiring Harnesses

Almost any electronic project involves a wiring harness of some kind. If you are connecting two or more wires from point A to point B, you have a wiring harness on your hands - an important (and often overlooked) part of your project. In applications where grease, vibration, and moisture are constantly attacking your wiring, a well-made wiring harness can save you the frustration of a short circuit or broken connection when you're miles away from your workbench.

Tools:

A lot of hobby wiring involves brightly colored plastic insulated crimp terminals. These terminals were likely installed with a cheap crimper like the one shown here. This style of crimper usually makes very poor crimps and can cause some serious reliability problems. Usually one strong pull will yank the wire right out of the terminal! This tool is for emergency repairs only.



Don't use this!

To make a quality wiring harness, you're going to need a few special tools. Some of these can be found at your local hardware or auto parts store. The rest can be found online at stores such as Waytek, Inc. (waytekwire.com).

- A pair of wire strippers (\$7, Waytek #467)
- An open barrel crimp tool (\$21, Waytek #419)
- A non-insulated terminal crimper (\$47, T&B WT111M, Waytek #456)



Thomas & Betts WT111M

- A heat gun (\$70, Craftsman #11801 or similar)
- A multimeter with continuity test beeper
- Pin release tools for any special connectors you are using. Often a set of small screwdrivers will do the trick.

Materials:

The materials you need will depend on your harness. Here are some general guidelines. All of these materials are available online at Waytek or Digikey (www.digikey.com) or locally at Jameco (www.jameco.com) and HSC Electronic Supply (www.halted.com).

Wire – Stranded, sized to carry the current you need. 18 gauge is cheap and can carry 3-5 Amps. Waytek carries GXL automotive wire that resists moisture, grease, oil, and solvents, but if the wire is protected by heat shrink this is not necessary. Multiple colors will help troubleshooting later.

Sheathing – This protects the wire and keeps the bundle together. Polyolefin heat shrink tubing comes in rolls and seals out chemicals and moisture. Some types have glue that melts over splices for a better seal. Heat shrink makes it difficult to modify the harness, and is better for finished designs. Another option is plastic corrugated loom, which isn't sealed from the environment but wires can be added and removed easily. Expandable mesh sleeving has good abrasion resistance and comes in varieties with high temperature ratings (good around exhaust parts).

Crimp terminals – My favorite are the open barrel type with strain relief like Waytek #31073 shown here. These can be crimped with the #419 tool. You can also use standard insulated connectors if you pull off the colored insulation and use a good crimping tool like the WT111M, then cover with heat shrink. For more than one wire, there are many multi-pin connectors available at Digikey. I like the AMP MATE-N-LOK series (*ex. Digikey A14296-ND*) which is cheap, has optional moisture seals (*Digikey A25396-ND/A25403-ND*) and a variety of pins. Weather-Pack connectors are also sealed and available at some auto parts stores such as NAPA.



Template - All but the simplest designs will require you to make a template. This is a drawing of the harness, to scale, on a large sheet of paper. This template is a map that will become your work surface and will also give you a guide to the length, connectors, and routing of each wire. Take your time and get this right before you start building the harness. Mount the template on plywood and use screw-in eyelets and twist or zip-ties to secure the wires as you build.

Techniques:

Once you have your template ready, the build process is pretty simple. Here are the basic steps:

1. Cut each wire to length and strip the ends.
2. Crimp a terminal on each end. Tug on each terminal to ensure there is no movement of the wire.
3. Repeat steps 1&2 for each wire, securing it to the template as it would be in the finished harness.
4. Test continuity of all wires and verify routing.
5. Install heat shrink or loom, moving from the "small" end of the harness to the "big" end. For heat shrink, 1" overlap between sections will help keep moisture out and keep the harness from coming apart.
6. Check continuity of each wire. For multi-pin connectors, make sure you know which terminal needs to go where in the housing, they can be a pain to remove if you screw up.
7. Install connector housings. You're done!

By the way, for quick and dirty jobs, insulated terminals can be made to work. Using the right size terminal for the wire is really critical: yellow for 10-12 gauge wire, blue for 14-16, red for 18-22. A ratcheting crimper with wide jaws helps. Harbor Freight Tools (harborfreight.com) sells a cheap one - \$15, PN93977.

One note about crimping vs. soldering – There is much debate about which is better. Crimping is faster and easier once you have the right tools. Most OEM harnesses are crimped. Soldering can work too if you provide strain relief and don't let the solder flow up the wire.

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