



Wire Stripping and Crimping

Program: Electrician Technician

Course: EL110 Basic Safety

Objectives: In this lab you will learn how to properly strip wire and crimp terminal connectors on wires.

After completing this lab, you will be able to:

- Identify different types of wire terminations.
- Properly strip insulated wires
- Properly secure wire terminals onto stripped wires

Lab Equipment: N/A

Required Tools:

- Wire strippers/Crimpers
- Tape Measure

Materials:

- Wire terminals
 - splice, ring, male spade (bottom) splice, female spade
- Wire (Various types)

Safety (PPE):

- Safety glasses/goggles

Resources:

- Check Points for Correct Crimping.pdf

Required time: 120 Minutes.

Shop Maintenance:

- All work will cease 20 minutes prior to the end of class.
- All work areas must be cleaned.
- Tools and equipment must be cleaned and returned to the designated areas (cage, tool room, cabinets etc.)
- Any broken or missing tools must be reported immediately.
- Tools and equipment are students' responsibility.

Procedure:



How to Strip a Wire

Safe, durable electrical connections begin with clean, accurate wire stripping. Removing the outer layer of plastic without nicking the wires underneath is critical. If a wire does get nicked, the connection may break, or an electrical shortage may occur.

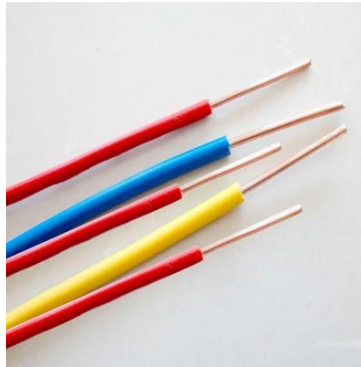


Figure 1 Properly Stripped Wires

The Tools:

Manual Wire Stripper

A simple manual wire stripper is a pair of opposing blades much like scissors. There are several notches of varying size. This allows the user to match the notch size to the wire size, which is very important for not damaging the wires. Depending on the manufacturer, there may be additional features that include a locking mechanism, an ergonomic handle, and the ability to cut screws.

Although a knife would also strip the wires, it may also damage the wire by nicking the metal or cutting into it. Using a knife to strip wire is also dangerous! The knife can easily slip and cause injuries.



Figure 2 Combination Wire Stripper and Crimper (left) and Wire Strippers with Ergonomic handle (right)

Stripping the Wire with Manual Wire Strippers By simply squeezing the handles of a manual wire stripper about 1/4" from the end of the wire or the desired length, using the correct notch on the tool, and then twisting it slightly, the insulation will be cut free.



Figure 3 Align wire with proper notch for wire gauge

Then by pulling the wire strippers towards the end of the wire, the insulation should slide right off the wire.



Figure 4 Remove approximately ¼" of insulation

Tips, Tricks, and Hints

It is important to match the size of wire to the correct notch in the stripper. If the notch is too large, the wire will not get stripped. If the notch is too small, there is a risk of damaging the wire. Using an undersized notch means the strippers will close too far, digging into the wire underneath. With stranded wire, the tool will cut off the outer ring of wires, decreasing the total diameter of wire and reduce the strength of the wire. A nick in solid core wire will severely reduce the strength and flexibility of the wire. The likelihood of the wire breaking upon being bent increases significantly.

How to Crimp an Electrical Connector

An electrical connector is a device for joining electrical circuits together using a mechanical assembly. The connection may be temporary or serve as a permanent electrical joint between two wires. There are hundreds of types of electrical connectors. Connectors may join two lengths of wire together or connect a wire to an electrical terminal.



Below are a few connector types. On the far, upper left, we have an insulated splice connector to connect two wire ends together. To the right, the forked connector (a.k.a. spade, or split ring) is useful for connecting wire to screw terminals by sliding the fork into a screw terminal's socket. Screws can be partially screwed in before installing the terminal. The ring terminals in the middle are also useful for connecting wire to screw terminals. While the ring terminal provides a more reliable connection, you would need to completely remove the screw before installing the terminal. On the far, upper right we have a male spade connector (a.k.a. blade). These can slide into the female spade connector (a.k.a. double crimp) that is shown on the bottom right. Depending on the design and application, these connectors can come in different flavors like flanged fork or locking ring terminal.



Figure 5 (top) splice, ring, ring, male spade (bottom) splice, female spade

These connectors can also come in different sizes and ratings. You will want to match the size of the connectors for a secure connection.

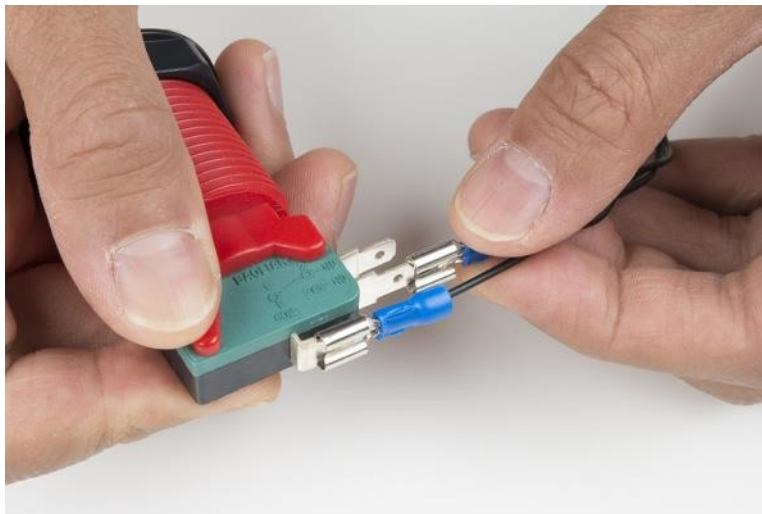


Figure 6 1/4" female spade connectors connecting to a microswitch's male spade terminals

What is a Crimp?



The word crimping in this context means to join two pieces of metal together by deforming one or both to hold the other. The deformity is called the crimp.



Figure 7 the metal has been deformed to pinch the wire and hold it in place

The Tools:

In order to crimp connectors onto a wire, a special tool is required for the crimp pin. There are several different styles of crimpers available depending on the crimp pin.

Manual Crimp Tool

Manual crimping tools can achieve nearly the same results, although it requires the user to be much more vigilant. This style of crimper is generally less sturdy. Attention must be given while crimping to ensure the jaws are lined up properly on the connector. Misalignment will cause a less than desirable crimped connection. Over time, wear and tear from normal usage can also cause the jaws to become separated and not close fully. Generally, squeezing it as hard as possible will be sufficient. The fancy wire stripper shown below can be used with quick disconnects. The tool can also be used to cut wire and strip wires/cables.



Figure 8 Manual Crimper for Insulated and Non-Insulated Spade Connectors

Warning! Pliers are not crimpers! Neither are hammers, vises, needle nose pliers or flat rocks. A good crimper when used correctly will make a cold weld between the wire and the barrel of the connector. If you were to cut a well-executed crimp in half, you would see a solid form of wire and connector. Using the wrong tool will not achieve a good crimp!



Figure 9 using the improper tool creates weak connections

Why is this level of perfection required? A poor crimp leaves air pockets between the wire and connector. Air pockets allow moisture to collect, moisture causes corrosion, corrosion causes resistance, and resistance causes heat, and may ultimately lead to failure.

Crimping a Quick Disconnect Connector

There are several arguments for and against using solid core wire with crimp connections. Many believe crimping to solid core wire creates a weak point in the wire, which can lead to breakage. There is also a greater chance for a crimp connection to come loose with solid core wire because the wire will not conform to the terminal as well. If you must use solid core wire, it is a good idea to solder the wire in place after you crimp it.

First, the correct size wire must be chosen for the terminal size, or vice versa. We'll assume that you are using stranded wire so that the wire conforms to the crimped connection. Next, strip the wire. The amount of exposed wire should be equal to the length of the metal barrel on the connector, usually around $\frac{1}{4}$ " or so. If the stripped wire fits up into the metal portion of the barrel with little or no free space, the connector is the right size.





Figure 10 length of wire stripped compared to terminal

The wire should then be inserted until the insulation on the wire touches the end of the barrel.



Figure 11 Good: The wire is sticking past the barrel just a little

The wire and terminal are then inserted into the crimper. The color of the terminal's insulation needs to be matched with the same color on the crimping tool. So, if the terminal's insulation is red, use the spot marked by the red dot on the crimpers. Alternatively, if the crimper does not have color markings, use the gauge markings on the side.

The terminal should be sitting horizontal with the barrel side up. The tool is then held perpendicular to the terminal and placed over the barrel, nearest to the ring (or other connection type). To finish the crimp, the tool is squeezed with considerable force. In general, it is almost impossible to 'over crimp' a connection.

After the crimp is completed, the wire and connector should still hold together after trying to pull them apart with great force. If the connection can be pulled apart, the crimp was not done correctly. It is better to have the crimp fail now, versus after it has been installed in its application.

Wire size	Military Requirements
22	15 lb
20	19 lb
18	38 lb
16	50 lb
14	70 lb
12	110 lb
10	150 lb

Figure 12 military spec chart for crimped connections



Tip: Depending on the application, two wires can be crimped together in a single crimp connector. You'll need to ensure that the combined wire diameter is able to fit in the crimp connection and the crimp connector is able to handle the amperage of the project.

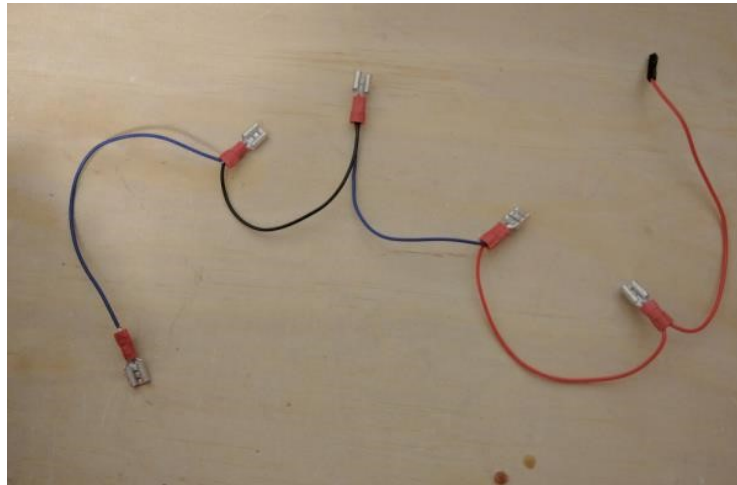


Figure 13 two wires crimped with female spade headers for the middle connections

Wire Stripping:

1. Students will measure and cut lengths of wire to be used.
2. Students will use wire strippers to strip each end of their wires.

Wire Crimping:

1. Students will gather the necessary terminal connectors. (Spade, fork, ring, etc.)
2. Students will now Crimp the connectors to their stripped wire ends.