Knowledge Domain: Electrical Simple
Unit: Connections
Skill: Soldering
(Teach this skill following 'Desoldering')

Tools and Parts Required:
1) **Soldering Iron**
2) **Soldering Iron Stand**
3) **Solder**
4) **Damp Sponge**
5) **Sand Paper (optional)**
6) **Pliers**
7) **Wire strippers**
8) **Heat Sink or Alligator Clips**
9) **Solid wire**
10) **Stranded wire**
11) **PCB (printed circuit board)**
   *(Use the empty circuit board from the 'Desoldering' skill)*

Introduction

Soldering is a method to make electrical connections. Repair broken electrical connections by soldering. A broken electrical connection may cause a machine to break or malfunction. Soldering is a simple fix to repair the machine.

Sometimes you may want to build a circuit to replace a broken part. Solder will allow you to build a circuit and substitute parts.

Example

Below is a picture of a resistor being soldered into a printed circuit board (PCB).
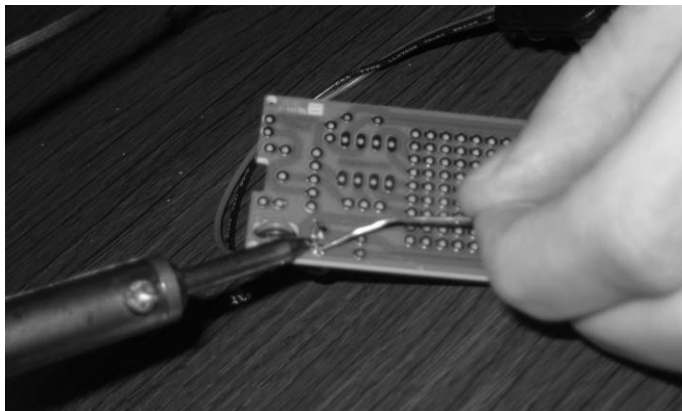
Identification and Diagnosis

Solder is used to make electrical connections. Two wires can be connected using a small blob of solder. Electrical components can be added to circuits using soldering.

Do not use solder to make or repair mechanical connections.

Procedure

Soldering irons melt solder. To solder a connection you must transfer melted solder to the wire connection.

1. Plug in the soldering iron.
2. Set it on a stand so the table or work surface does not burn. A large wrench will substitute for a stand.


3. If the tip of the iron is dirty, use the damp sponge or sandpaper to remove dirt and debris. You may clean the tip with a damp sponge even when the iron is hot.
4. Coat the tip of the iron with a thin layer of solder. This process is tinning. Tinning helps heat transfer from the iron to the wire connection.

There are three main types of joints you will solder: (1) solid wire, (2) stranded wire, and (3) soldering to a PCB.

Soldering solid wire

1. Use wire strippers to expose the ends of two solid core wires.
2. Form one wire into a loop.
3. Thread the second wire through the loop.
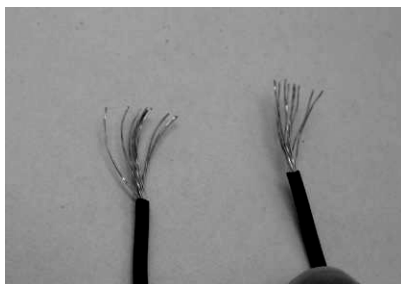4. Bend the second wire to make two connected loops.
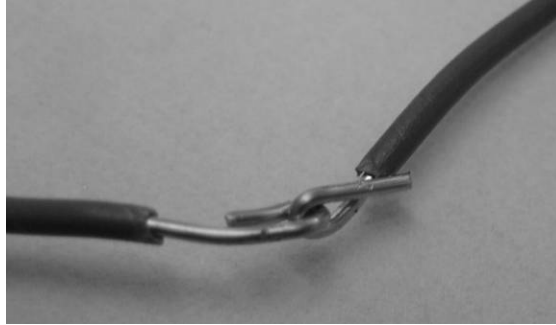
5. Place the tip of the soldering iron on the back of the joint to heat the wires.
6. Quickly touch the solder to the hot joint. The solder will melt into the joint. You may need to practice this a few times.
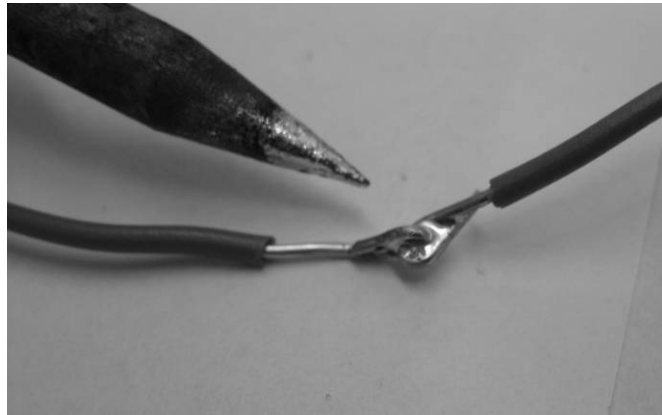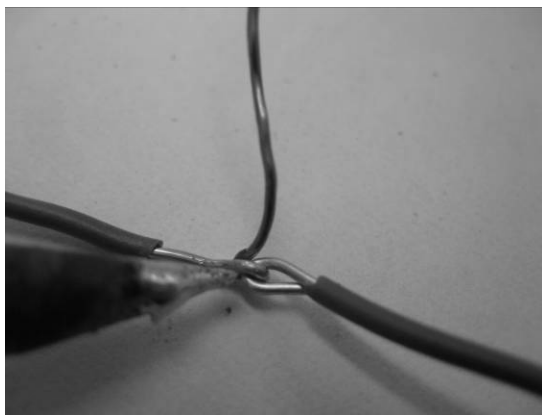

Soldering stranded wire

1. Strip the ends of two stranded wires.
2. Spread the individual strands of wire apart.
3. Place the two wires together and twist tightly.

4. Place the tip of the soldering iron on the back of the joint to heat the wires.
5. Quickly touch the solder to the hot joint. The solder will melt into the spaces between the strands. If it does not melt into the joint, remove any excess solder and try again.
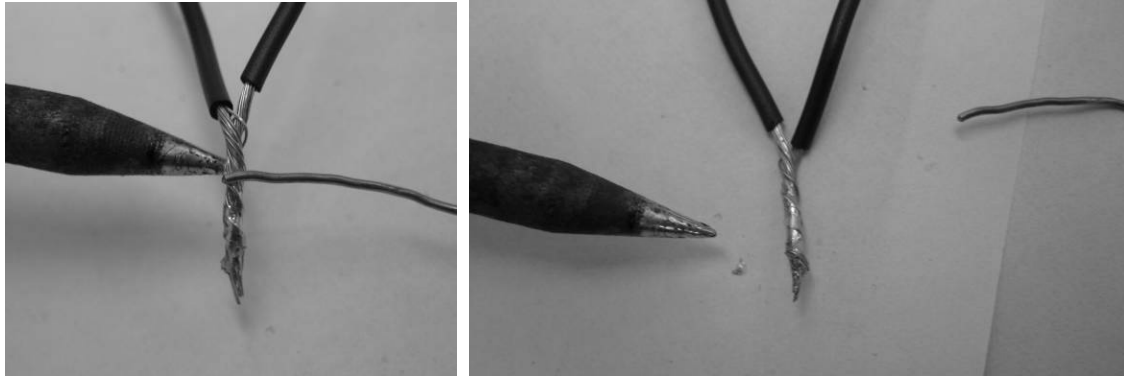
Soldering to PCB

1. Excess heat can damage some electrical components. If you are using electrical components, use a heat sink. Place the heat sink between the joint you are soldering and the component itself. Heat sinks are metal pieces with large surface area that dissipate excess heat. An alligator clip makes a good heat sink. Always use heat sinks to protect the components.
2. A printed circuit board should already have a small layer of tinning present. Place the stripped end of a solid wire through a hole in the board.
3. Use the soldering iron to heat the wire.
4. Feed solder into the joint. The solder should be sucked into the hole in the PCB. This may take practice. Remove excess solder and try again if necessary.
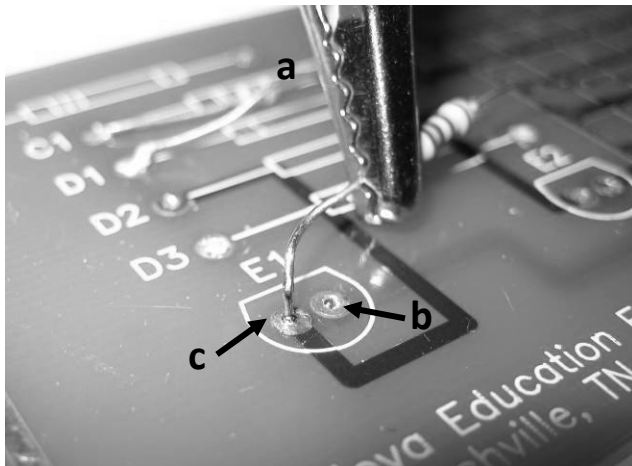

Photo of resistor being soldered to PCB: (a) Heat sink, (b) tinning in and around hole, (c) soldered joint

General Tips

- When soldering any joints, do not leave the iron on the joint for more than 5-10 seconds. Overheating the joint can damage the circuit.
- Do not brush melted solder onto a joint. This will not make a good connection. When done correctly, the joint will suck the solder in.
- When you finish soldering a joint, use a continuity tester to verify the electrical connection.

Exercise

Part 1

1. Cut two (2) pieces of solid-core wire, 10-15 cm in length. Strip 2 cm from each end and solder the two wires together.
2. Cut two (2) pieces of stranded wire, 10-15 cm in length. Strip 2 cm from each end and solder the two wires together.

Solid-core wire   Stranded wire
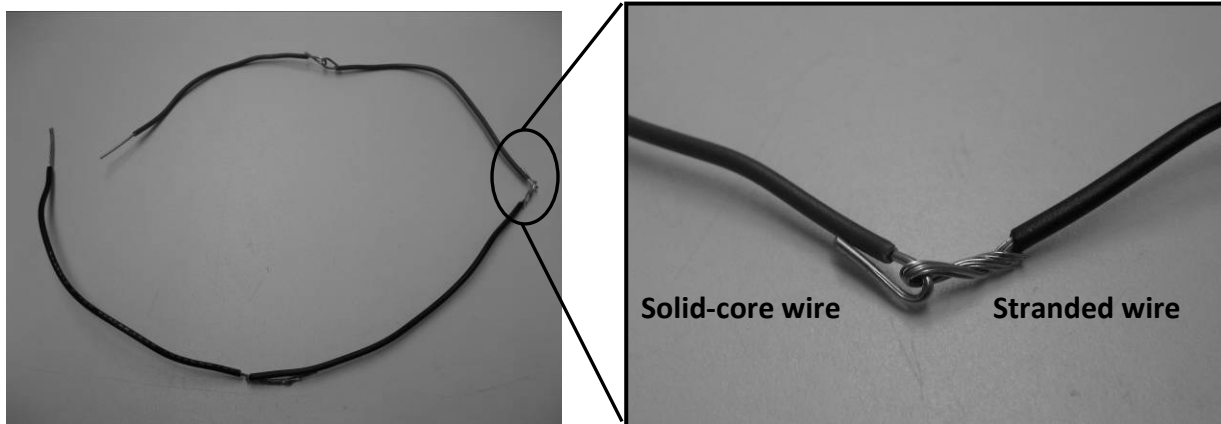
3. Join the soldered solid core wire with the soldered stranded wire to form a loop. When soldering stranded wire to solid wire, follow the solid-core wire technique.
4. Your instructor may have you practice using heat shrink tubing and electrical tape. Prepare heat shrink tubing before soldering.

Part 2

6. Use the PCB you emptied in the 'Desoldering.' lab. Solder two resistors in parallel onto the board. Use a continuity tester to check your work.

Your instructor must verify your work before you continue.

Preventative Maintenance and Calibration

- The soldering iron works best when the tip is clean and not oxidized. Oxidized metal appears dull, dark, and dirty. Tin the tip of the iron when not in use to prevent oxidation of the tip.
- Excess heat can damage some electrical components. Always use heat sinks to protect the components. Sometimes you may be unsure about using the heat sinks. Use heat sinks to be safe.
- Soldering makes electrical connections. Soldering does not create strong mechanical connections. Insure the wires are well connected before soldering.
- Excess solder can lead to bad electrical connections. Avoid using large amounts of solder on a joint.
- Always calibrate every medical device before returning it to use.