EECS 140 Laboratory Exercise 1
Soldering Practice

1. Objectives
   A. Introduction to EECS 140 laboratory
   B. Learn to check-out parts and tools from the EECS Shop
   C. Practice soldering, a key technique for connecting electronic circuits.

2. Discussion

   In this exercise you should become familiar with the EECS 140 laboratory and meet your lab instructor. You will learn how to check out tools and parts from the EECS Shop and you will practice soldering.

   Soldering is a key technique for connecting electronic circuits. Solder is a tin-lead alloy that melts at a relatively low temperature. The melted solder flows around the component wires or leads and then solidifies forming an electrical connection. A good solder connection conducts electricity well and resists corrosion.

   Soldering involves melting the tin-lead solder. In this exercise we will use a soldering iron to do this. While solder melts at a low temperature compared to iron or glass, the typical soldering iron tip is 400-750° F. At this temperature it can cause severe burns and damage tools, equipment, and clothing. Therefore, you must be careful as you work.

   To make a good solder joint you need four things:
   A. Clean leads on each component to be connected. Generally, in EECS 140 lab, component leads are sufficiently clean that no special action need be taken.
   B. A good mechanical connection. Solder is not that strong and is malleable, so you need a mechanical connection in addition to the solder (electrical) connection. Generally, the components and circuits you will assemble in EECS 140 are designed with adequate mechanical connections.
   C. Plenty of heat to warm the wires and melt the solder. Soldering involves heating the component leads and circuit board pads to a sufficient temperature that the solder melts and flows around the mechanical connection.

   Soldering is easier and a better connection is made with the soldering iron tip is clean and shiny. Soldering is easier because a clean tip transfers heat to the connection faster than a dirty tip. A better connection is made because there is less chance that crud gets into the connection.

3. Tools and Components
Check-out the following tools and components from the EECS Shop:

A. A pair of eye protectors
B. A hand-held soldering iron
C. A combined wire-cutter and wire-stripper
D. A long-nosed pliers
E. A soldering sponge
F. A soldering practice jig (wood block)
G. 9" of 14 gage wire
H. 18" of 20 gage hook-up wire
I. About 12" of solder

Some of this equipment is pictured in the following figures.

Figure 1 shows a soldering iron and a pair of eye protectors.
Figure 2 shows wire cutter/stripper and a pair of long-nosed pliers.

Figure 3 shows a soldering iron holder mounted to the lab bench and a sponge.

4. Tasks

Each person should carry out the following tasks. However, it suggested you work in pairs so that one person can read the instructions while the other person practices. You should completely read through each step before executing that step.

**Step 1 - Obtain tools and components from the EECS Shop**

Checkout the required tools and parts from the EECS Shop

**Step 2 - Set up the soldering iron**

Place the soldering iron in the holder mounted to the lab bench and plug the iron into a 110 VAC outlet. While the iron is heating (about 5 minutes) wet sponge and squeeze out the excess water. The sponge should be wet, not soaking, but not just damp.

**Step 3 - Set up the practice jig**

While the iron is heating, set up the practice jig. Take the length of 14 gage wire and, using the wire strippers, strip all the insulation from the wire. Bend the wire into a U-shape so that the ends of the wire will fit into the practice jig wooden block. The practice jig should look similar to that shown in Figure 4.
Step 4 – Cleaning and tinning the iron tip

Put on your eye protection. If you wear shatter-proof eye glasses, those are sufficient. Otherwise, you must wear eye protection whenever soldering. GTAs are instructed to deduct 10 percentage points from your lab score for each instance you are soldering without eye protection. On the third occurrence, you will earn a zero score for the lab exercise. It is mandatory that you wear eye protection while soldering.

Remove the iron from the holder by the handle and wipe the tip on the wet sponge. If the tip is properly tinned, it should appear shiny, silver in color, and the silver should cover the entire tip about 1/4 inch from the end. If the tip is not silver-colored take the solder and touch the end of the solder to the tip. The solder should melt and you should rub the solder around the tip. Don't feed too much solder or you will just get a glob at the end. If there are dull parts of the tip, rub solder over those parts. Once you've rubbed the solder around, clean the excess and spread the solder by wiping the tip on the sponge. You may have to do this two or three times.

When finished, replace the iron into the holder.
**Step 5 - Practicing soldering**

Cut about 3 inches from the 20 gage hook-up wire and strip about 3/4 inch of insulation from one end. Place the stripped end on the wire in the practice jig and wrap the hook-up wire around the 14 gage wire about 1 and 1/2 to 2 times. The wraps should be close together. This makes a mechanical connection and should look like the connection shown in Figure 5.

![Figure 5](image)

Figure 5 illustrates the 20 gage hook-up wire attached to the 14 gage practice jig wire.

Remove the iron from the holder by its handle and wipe the tip on the sponge. Then apply the tip to the side of the wrapped hook-up wire. Figure 6 illustrates applying the soldering iron to the connection.

![Figure 6](image)
Figure 6 shows applying the soldering iron to the connection. The iron tip should actually be closer to the connection at the corner of the hook-up wire and the jig wire (about a tip width to the left).

Allow the connection to heat for 5 to 8 seconds. After heating the connection, apply one end of the solder to the connection, not to the soldering iron tip. If the connection is sufficiently heated, the solder will melt and flow between the hook-up wire and the jig wire. If the solder does not flow right away, remove the solder and heat the connection for a few more seconds and try again. Apply sufficient solder to just fill the gaps between to two wires. You should still see the outline of the hook-up wire with solder around it. If solder drips from the connection, you've applied too much solder. If the connection looks like a blob, you've applied too much solder. Once the solder flows around the connection, remove the soldering iron from the connection, wipe the tip on the sponge, and replace the iron in the holder.

Allow the connection to cool for about 30 seconds. It is important not to move or jiggle the connection while the solder is cooling. If the connection is jiggled, the solder will not make a good electrical connection and you will have to re-heat the connection, remove the soldering iron, and hold the connection steady. Your solder connection should look shiny. If it has a dull appearance or rough looking appearance, you probably moved the connection while cooling or the connection was not sufficiently heated.

Set your practice jig aside to allow the connection to cool. Have your partner do Step 5 on their practice jig.

Repeat Step 5 six or seven times. Note that as you make more connections on the practice jig that you do not disturb previous connections. Practice applying the iron, heating the connection, applying solder, and removing the iron. This sequence does not have to be extremely fast, but the "smoother" (and quicker) the better.

If you need more hook-up wire or more 14 gage practice jig wire, just go to the shop and ask for it.

**Step 6 - Experiments**

On one of your connections, try pulling on the free end of the hook-up wire. You might be able to un-wrap the hook-up wire because, as mentioned above, solder is not that strong a mechanical connection.

**5. Laboratory Report**

You do not need to write a lab report for this exercise. However, the GTA will grade you on completing the exercise and following the instructions regarding eye protection.