Solder Wire

Description
This Activity Plan is designed as one among many through which students will rotate in small groups. The students will be given some theory, and the instructor will demonstrate the proper procedure of joining two wires together using soldering techniques. The ability to join wires together using sound soldering techniques is an essential skill for an automotive technician.

Lesson Outcomes
The student will be able to:

• Join electrical wires together using a filler material
• Demonstrate competent soldering techniques
• Understand basic soldering terminology
• Understand why good soldering techniques are vital to being an automotive service technician

Assumptions
Before doing so themselves, students will have been given some theory and the instructor will have demonstrated the proper procedure of joining two wires together using soldering techniques.

Terminology
Cleaning sponge: a sponge used to clean the end of the soldering iron in order to allow the iron to function properly.

Electrical wire: wire that is designed to easily conduct electricity.

Needle-nose pliers: a style of pliers with a long, narrow end, designed to get into tight areas.

Safety glasses: glasses specially designed to protect the eyes in a workplace setting.

Solder: the metal-based filler material used to join wires together.

Soldering iron: a tool used to melt the solder.

Soldering iron holder: a tool used to support the soldering iron when not in use.

Wire cutters: a type of plier that is designed to cut electrical wire.

Wire gauge: the thickness of wire.

Wire strippers: a tool use to strip a wire of its insulation so that it can be soldered.
Estimated Time
30–45 minutes

Recommended Number of Students
20, based on the BC Technology Educators’ Best Practice Guide, 1–2 students per station

Facilities
Automotive or industrial education shop

Tools
• Cleaning sponge
• Heat gun for Activity 6: Heat Shrink (optional)
• Needle-nose pliers
• Safety glasses
• Solder
• Soldering iron
• Soldering iron holder
• Wire strippers/crimpers
• Wire cutters

![Figure 1—Heavy duty automatic wire stripper](image)

Materials
Electrical wire in the 18–22 gauge category (1 foot per student)

Optional Materials
• Electrical tape for Activity 5: Tape a Wire (optional)
• Heat shrink tube for Activity 6: Heat Shrink (optional)
• Electrical components such as resistors, capacitors, transistors, circuit boards or others. These would typically be found in an electronics class.
• Splice connector
• Butt connector
• Terminal connectors
Resources

How to Solder—Intro/Joining Stranded Wires—Part 1
www.youtube.com/watch?v=Q9G9gaokqvM

How to Solder: The Basics
www.youtube.com/watch?v=BxeDkcAa4Fs

How to Solder Wires Together (Sort of)—Eric the Car Guy
www.youtube.com/watch?v=L61LJcz7H6g

Video of Heat Shrink Tube Before and After

Heat Shrink Tubing Frequently Asked Questions—Allied Wire & Cable (AWC)
Activity 1: Join Two Wires Using Solder

1. Plug in the soldering iron and let it heat up for a few minutes.
2. Cut the electrical wire into two 6" long pieces.

Note: If you are going to do Activity 6, Heat Shrink, then students could slide a piece of heat shrink tube over one of the wires at this time. This would more realistically reflect the fact that the heat shrink tube would have to be inserted onto a wire before making the solder connection, since the other ends of each wire would most likely be connected to other parts.

3. If the soldering iron is new, then “tin” the soldering iron. “Tinning” is applying a small amount of solder directly to the soldering iron tip.
4. Clean the tip of the soldering iron with a wet sponge.
5. Cut a small 4” piece of solder off of the main solder roll.
6. With the wire strippers, strip off approximately ½” of insulation from two separate wires.
7. If the wire you are using is composed of many fine strands of wire, then spread the finer strands apart on two separate pieces of wire.
8. Proceed to carefully intertwine the fine strands together. This technique attempts to make the two bare ends into one. It should not take a long time.
9. If the wire you are using is a solid piece of wire, simply twist the two ends together as neatly as you can.
10. Place the hot tip of the soldering iron on one side of the joined wires.
11. With the needle-nose pliers, hold a small piece of solder onto the opposite side of the joined wires.
12. After a few seconds the solder will begin to melt into the wire. You don’t want the tip of the soldering iron to melt the solder—rather you want the hot wire to melt the solder.
13. Once a small amount of solder has melted, remove both the soldering iron and the solder.
14. Let the joined wires cool for a few seconds.
15. The soldering process is now complete.
16. Lightly try to pull the joint apart; it should stay attached even under moderate strain.
17. Optional: If electronic components such as resistors, capacitors, transistors, circuit boards or others are available, they could be also be soldered, although this is typically done in an electronics classroom.
Activity 2: Install Splice Connector (Optional)

1. Cut 3" from one end of the previously soldered wire.
2. Use a splice connector (sometimes called a *Scotch lock*) to connect the short wire you just cut off the other wire. Use pliers to push the metal spade connector into the wires. The attachment point should be approximately 2" in from the end of the long side of the wire.

![Figure 2—Quick splice connector, connecting wires together](image)

3. With pliers, squeeze the metal tab down into the wires.
4. Close the plastic tab over the connector. Make sure it clicks into place.

Activity 3: Install Butt Connector (Optional)

1. Cut the wire in a different spot.
2. Strip ½" insulation of each end.
3. Insert each end of the wire into the butt connector.
4. Using the wire crimpers, crimp the butt connector near each end to connect the wires.
   
   **Note:** Most crimpers will have three different crimp areas depending on the gauge of wire you are using. These different sizes are designated by three colours: red, blue or yellow. Most connectors are colour-coded to the wire gauge, red, blue or yellow. Simply match up the colour of the connector to the coloured area on the crimpler.

![Figure 3—Solderless parallel butt connector](image)
Activity 4: Install Male and Female Terminal Connectors (Optional)

1. Cut the wire in a different spot.
2. Strip $\frac{1}{2}$" insulation of each end.
3. Insert one wire end into the female terminal and crimp it using the wire crimp tool.
4. Insert the other wire end into the male terminal and crimp it using the wire crimp tool.
5. Join the male and female terminals together.

![Figure 4—Solderless female and male disconnect](image)

Evaluation Guidelines

Soldering Rubric (see next page)
<table>
<thead>
<tr>
<th>Criteria</th>
<th>Poor</th>
<th>Below Standard</th>
<th>Satisfactory</th>
<th>Good</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Has the soldering iron tip been properly cleaned?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Have the wires been properly stripped?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Has the wire been twisted together properly before the soldering procedure?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Has the solder properly melted and sunk into the wire as opposed to simply sitting on top of it?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Are the Scotch lock and butt connectors secured properly?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Is the solder joint strong and unable to be pulled apart?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

**Total:** /30
Note: The next two activities should only be done once the solder joint has been marked. If you wish to do both activities, you will need to have two soldered joints.

Activity 5: Tape a Wire

After having the solder joint inspected and marked complete the following.

1. Get a roll of electrical tape.
2. Unravel approximately 2” of tape.
3. Begin to wrap the solder joint by looping the tape securely once around the insulation of the wire, right beside the soldered joint.

4. Continue to wrap the solder joint by angling the tape roll slightly. Keep tension on the tape roll so it wraps tightly. The tape should overlap itself by approximately half the width of the tape.

5. When the solder joint is covered, finish the taping job by ending on the wire insulation on the other side, wrapping it completely around once. It should end approximately 1 tape width away from the soldered joint. Remember to hold tension on the tape roll. **Note:** On this final loop of taping the tape roll should be straight, so there is no half width overlapping.

![Figure 5—Wrap the solder joint by looping the tape securely.](image-url)
Figure 6—Finish by ending on the wire insulation on the other side.

6. Cut the tape with scissors or a utility knife. Smooth over the cut end onto the wire.
Activity 6: Heat Shrink

After having the solder joint inspected and marked complete the following.

1. Cut the wire approximately 3” away from the solder joint.

2. Cut a small piece of heat shrink tube to just cover and extend past the soldered joint. Assuming that the solder joint is about an inch long, the heat shrink tube should be approximately 1.5” long.

3. Centre the heat shrink tube over the solder joint.

4. Evenly apply heat from a heat gun over the tube until it shrinks and fits tightly over the wire. **Caution:** Heat guns and the hot air they produce can be extremely hot and burn.

Figure 7—Applying heat shrink to a soldered joint