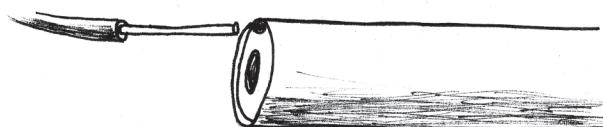


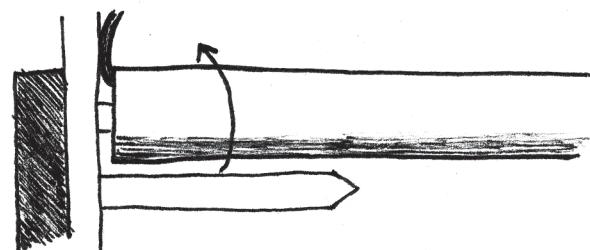
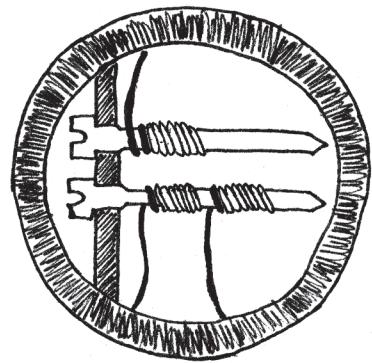
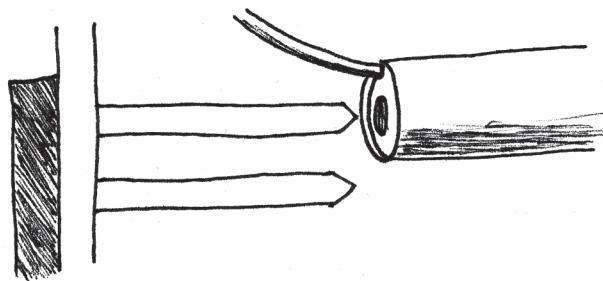


Wire Wrap is Still Useful

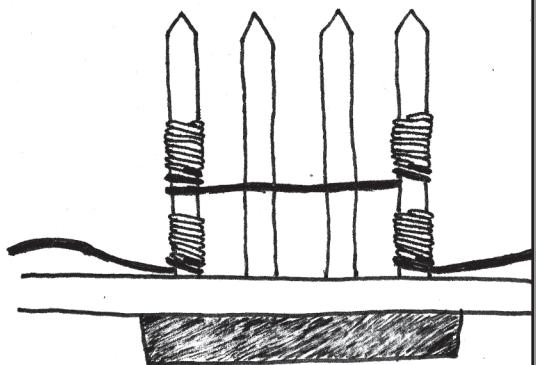
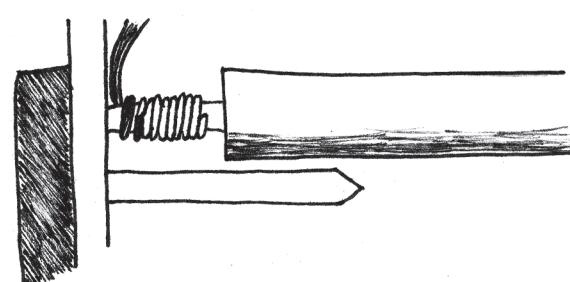
It is also easy and fun



By: Nicholas C Lewis
(based on Soldering Is Easy
by Mitch Altman, Andie Nordgren,
Jeff Keyzer)



Distribute widely!

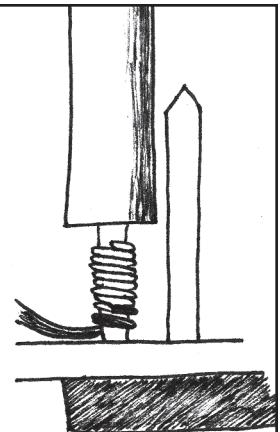


Wire wrap was once very common for prototyping circuits. It is much more reliable than solder-less breadboards, and can be easier and cheaper than having PCBs made.

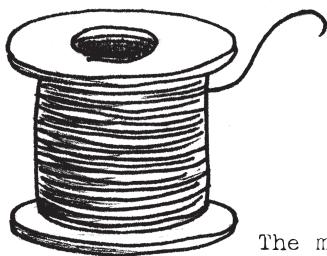
While surface mount technology and lower cost PCB manufacturing has reduced its use it can still be a very useful technique.

During the wrapping process, a wire is pulled around a terminal by use of a wrapping tool.

After the wrapping operation and the connection is stabilized the compression between wire and terminal corners is from 50,000 psi (35Kg/mm²) to 100,000 psi (70 Kg/mm²).



A solid, round wire is used for wire wrap connections. The wires range from 0.25 mm - 1.0 mm diameter (AWG 30 - AWG 18) and are connected with hand-held tools. The typical insulation materials are: PVC, Kynar, Milene, Teflon, and Tefzel.

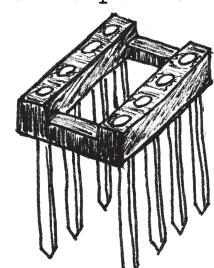


The most common wire for circuit board work is AWG 30 with Kynar insulation.

These are wire wrap terminals.



Some are designed to solder to components



And others are for components to push into.

This is a Wire Wrap tool.

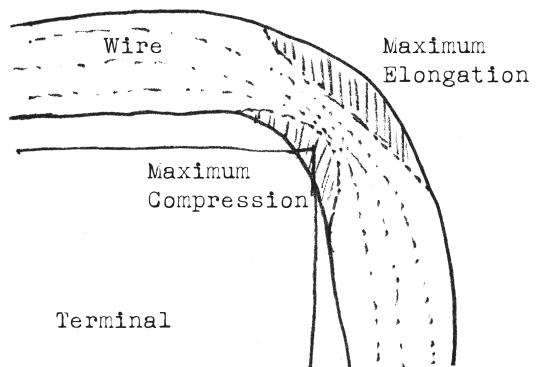


The tool wraps the solid round wire tightly around the edged terminal under mechanical tension.

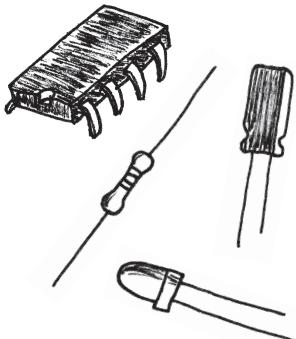
There are three different sorts of wrapping bits: Modified, Standard, and C.S.W. (cut, strip, wrap) bits.

The most common of these is the modified bit.

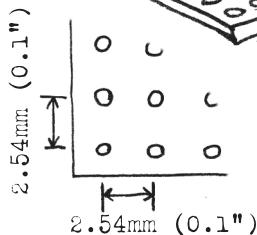
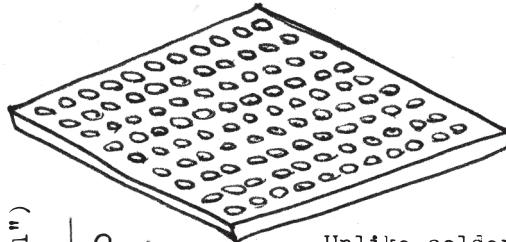
When used properly together these three things create a corrosion-safe and gas-tight connection on the sharp corners of the terminal.



Electronic circuits are made by connecting electronic parts together.



There are many ways to connect electronic parts together.



Unlike soldering parts to a printed circuit board, wire wrap generally involves placing components together on perforated fiberglass board (perf board).

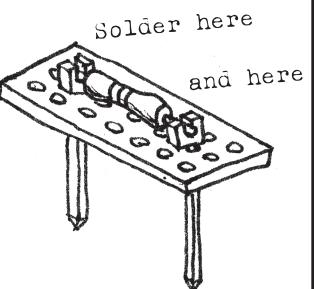
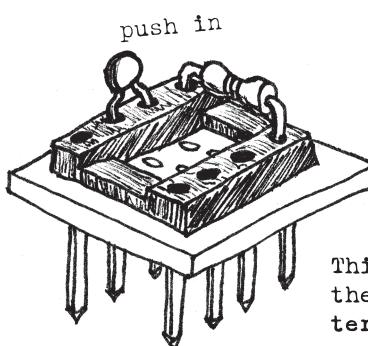
All the parts have wires, called leads, sticking out of them.



Most of these leads are round.



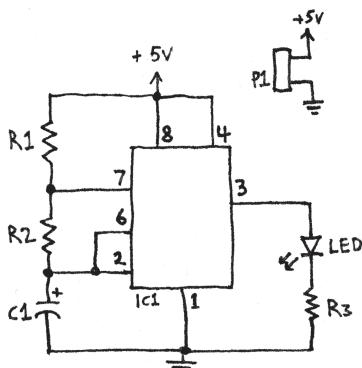
Round leads will not work for wire wrapping as corners are required for strong connections.



Other leads are rectangular but are too short (such as on ICs).

This is why we need the wire wrap terminals and sockets.

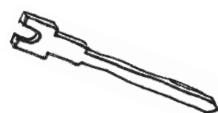
When wire wrapping you must follow your schematic as your perf board does not connect anything.



Before you start wiring go over your schematic carefully as this is the road map you will follow.

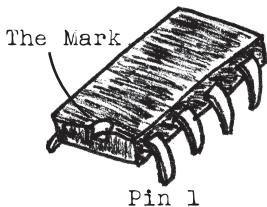
Think about the colors of wire you want to use and where each component is going to go.

After detailed review of your schematic you need to decide what kind of terminals you are going to use.



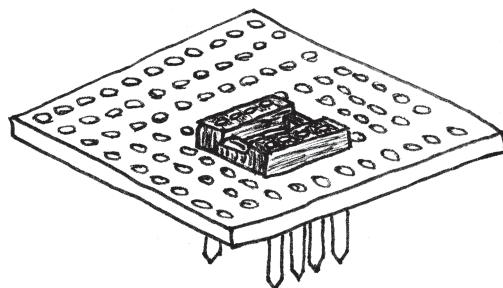
This depends on what components you are using and whether you want to solder parts or just press them in.

Lets start with an Integrated Circuit (IC).



ICs have many pins and a mark that indicates where pin #1 is located.

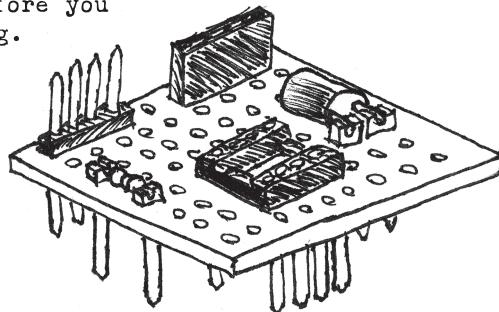
To place the IC we begin by placing an IC socket in the perf board.



You can glue the socket (super glue works well) to the perf board to help hold it in place while wrapping.

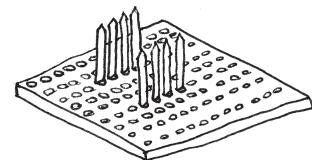
If your board has copper pads around the holes you can tack solder a few terminals.

It is good to place most of the components before you start wrapping.



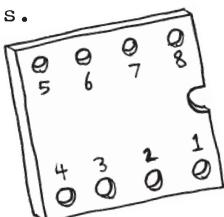
Try components in a variety of positions to determine the best layout to simplify the wire routing. Experiment before wiring since changes are much easier to make at this time.

Then you turn the board over so you can connect the wires.



If any of the terminals try to fall out just push them back in or secure them with glue/solder.

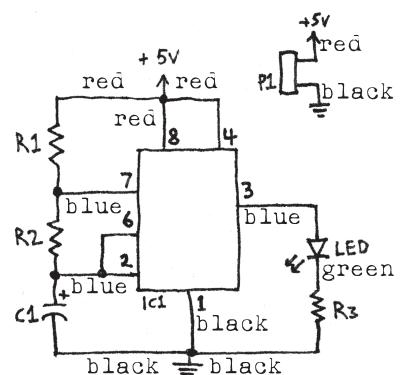
Before you start wrapping you can place an ID marker over the pins of the IC sockets.



These help you find the pin number without counting. The notch on the ID marker should line up with the notch on the socket.

Choose a color scheme for the wires so that they are easy to trace later when debugging.

Red is commonly used for positive voltage lines (Vcc) and black for ground lines. It is good to reserve red and black for these purposes.



Using the same color for every connection makes it hard to trace wires and troubleshoot.

In this example blue is used for the signal lines from IC1 and green is used for the "extra" wire between the LED and R3.

Before making a connection you must strip about 25mm (1") of insulation from one end of the wire.

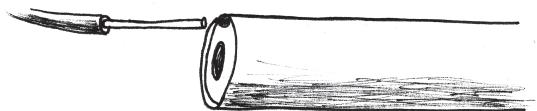


This length will provide a good number of wraps around the terminal.

Most wire wrap tools include a basic wire stripper.

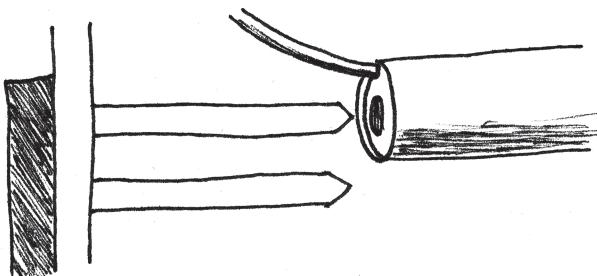


Slip the wire into the small hole at the side of the tool.



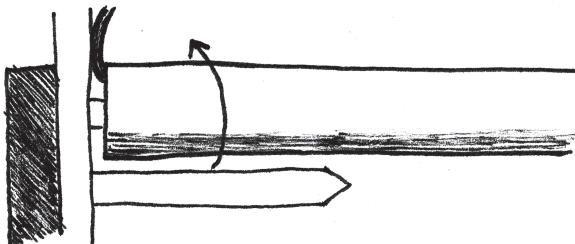
Be sure to slip the wire in far enough. With a standard bit the insulation should rest on the inner face and with a modified bit the insulation should slip inside a small distance.

Then slide the center hole of the tool over the terminal.



Be sure that the wire is in the side hole and the terminal is in the center hole.

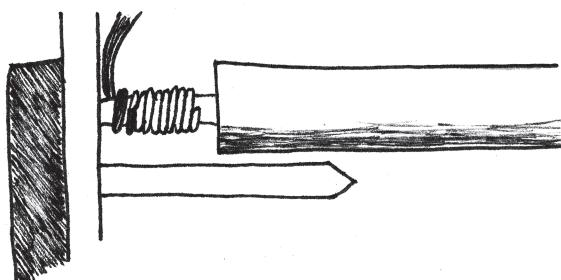
While holding the wire start turning the tool clockwise to make the wrapped connection.



Hold on to the insulated portion of the wire to stop excess insulated wire from wrapping around the terminal. Pinching it against the board works well. Always rotate the tool in the same direction.

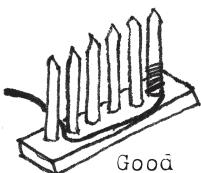
Do not push too hard or pull backwards on the tool while turning or you will either overlap the turns or leave gaps.

Keep rotating until all of the stripped wire is on the terminal and the tool comes off freely. This should result in approximately 6 to 12 wraps around the pin.

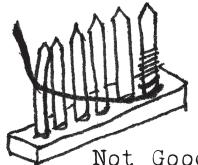


Then pull the tool off the terminal, and take a look at your perfect wire wrap!

Now route the wire to the other end of the connection, cut it to length (include the 25mm (1") you are about to strip), and strip the end. Then you are ready for your next wire wrap connection.



Good



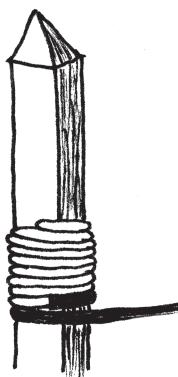
Not Good

Provide clearance around other terminals to avoid bending the terminals and/or damaging the wire.

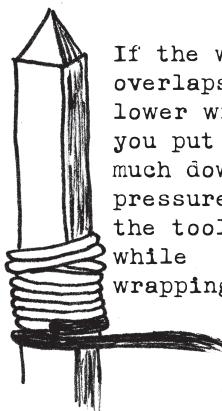
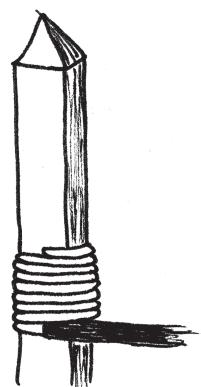
It is better to make the wire a little long, if it gets too short you'll have start over.

A good wire wrap connection has 6-12 even wraps and insulation that comes all the way to the terminal.

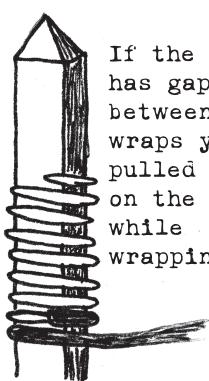
Good "modified" connection
(insulation around 3+ corners)



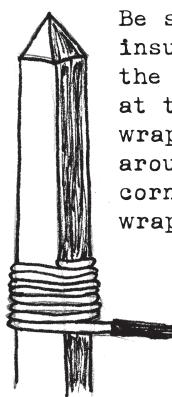
Good "standard" connection
(insulation just to terminal)



If the wire overlaps lower wraps you put too much down pressure on the tool while wrapping.

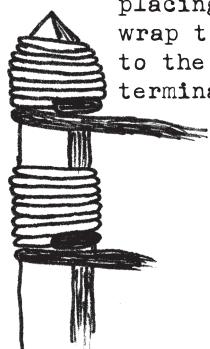


If the wire has gaps between wraps you pulled up on the tool while wrapping.

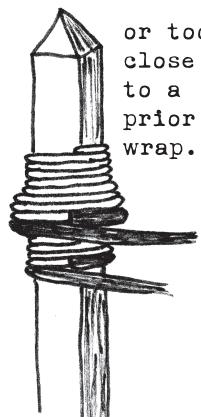


Be sure that the insulated portion of the wire starts right at the pin (standard wrap), or is wrapped around at least 3 corners (modified wrap).

If there is uninsulated wire extending from the terminal it may short to another terminal.

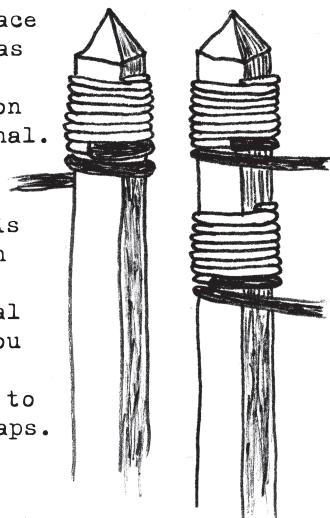


You should avoid placing the wrap too close to the tip of a terminal



or too close to a prior wrap.

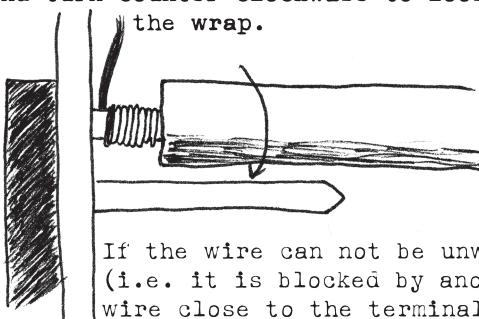
Always place the wrap as low as possible on the terminal.



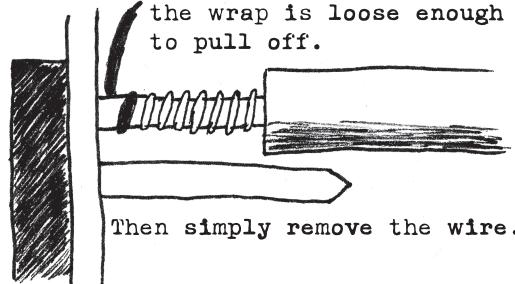
If it is high on the terminal than you lose places to put wraps.

All of these conditions are fixable.
If you have any of them just remove the wrap and start again.

To remove a wrapped wire: insert the tool over the wrapped terminal and turn counter clockwise to loosen the wrap.



Continue to turn until the wrap is loose enough to pull off.

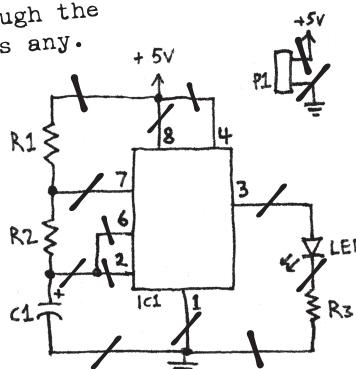


Then simply remove the wire.

If the wire can not be unwrapped (i.e. it is blocked by another wrap) then you can also just cut the wire close to the terminal and leave the wrap.

Be organized as you work through the connections so you do not miss any.

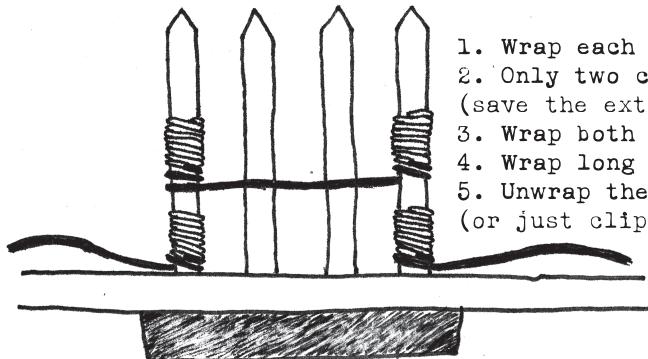
Sometimes it works best to use one color at a time. Other times it is easier if you make the connections in a logical order, such as in the path that the electricity follows, or to make connections one component at a time.



Check off each connection on your schematic diagram as you go.

When you think you are done double-check every connection.

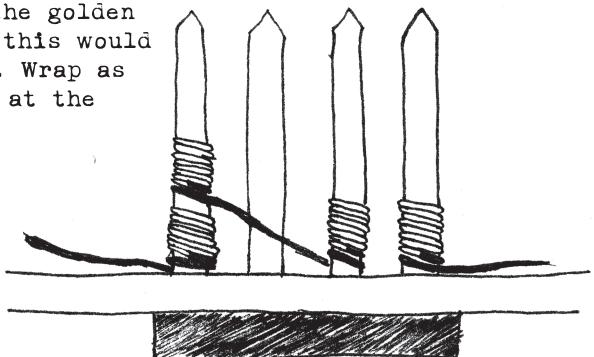
The Golden Rules of Wire Wrapping



1. Wrap each connection as low as possible.
2. Only two connections on one terminal.
(save the extra space for repairs and changes)
3. Wrap both ends of a wire at the same level.
4. Wrap long wires first.
5. Unwrap the wire to remove a connection.
(or just clip off the wire and leave the wrap)

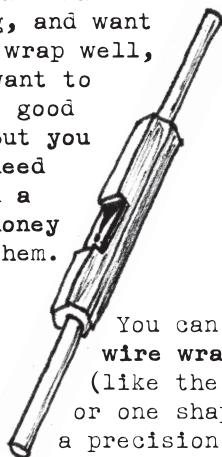
Do not reuse unwrapped wire.

Sometimes you must violate one of the golden rules. The most common reason for this would be where the rules contradict (i.e. Wrap as low as possible vs. wrap both ends at the same level).



If that is the case follow the rules in order and if a later rule is broken it is OK.

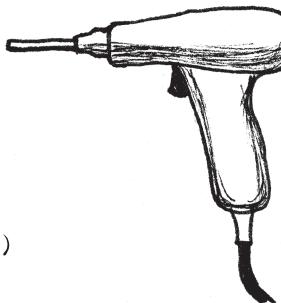
If you like wire wrapping, and want to wire wrap well, you'll want to buy some good tools. But you do not need to spend a lot of money to get them.



You can buy a decent wire wrap tool (like the one shown, or one shaped like a precision screw driver) for about US\$30.

If you really want to go all out, or if you think you will be doing a lot of wire wrapping,

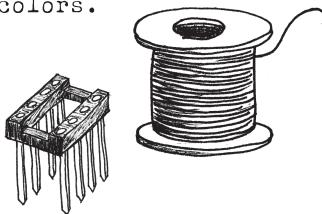
you can buy a decent manual wire wrap gun for about US\$150,



or an electric wire wrap gun for about US\$400.

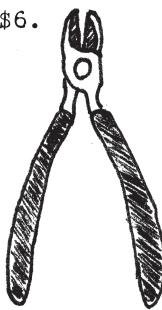
You can sometimes find bargains on these at surplus stores.

Buy a 100ft roll of wire wrap AWG30 wire for about US\$10. You should get several spools in different colors.



You will also need wire wrap sockets (US\$2-3ea) and/or solder terminals (US\$10 for 100).

Then you'll need wire cutters, for another US\$6.



You might also want a soldering iron (about US\$30),



long nose pliers (about US\$6),



wire strippers (about US\$10),



and safety glasses (as low as US\$2).

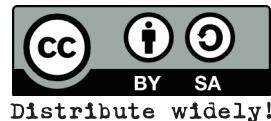
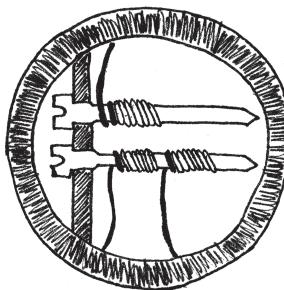


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Narration and Artwork by Nicholas C Lewis <http://NicholasCLewis.com>

Translate it, use it, spread it, color it, teach with it! <http://NerdCreationLab.com/WireWrapComic>

Based on "Soldering is Easy" by Mitch Altman, Andie Nordgren, & Jeff Keyzer <http://mightyohm.com/soldercomic>



This comic was made to support



Wrapduino
a wire wrap
Arduino clone

by Nicholas C Lewis
of NerdCreationLab.com

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