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## How to Solder

Basic soldering is a skill that's easy to learn and not too hard to master. It just takes practice.

There is a huge range of soldered joints out there, from tiny chip resistors on circuit boards to large UHF connectors. There is also a large variety of irons, tips and solder to choose from, and it certainly does help to have the right tool for the job.

Although we will focus on the middle range of connector and cable size in this tutorial (using audio cable and connectors as examples), the theory can be applied to a solder joint of any size.

Good luck, and remember....good soldering takes practice!



## Soldering Tools

The only tools that are essential to solder are a soldering iron and some solder. There are, however, lots of soldering accessories available.

Different soldering jobs will need different tools and different temperatures too. For circuit board work you will need a fine tip, a lower temperature and finer grade solder. You may also want to use a magnifying glass. Audio connectors such as XLR's will require a larger tip, higher temperature and thicker solder. Clamps and holders are also handy when soldering audio cables.

## Soldering Irons

There are several things to consider when choosing a soldering iron.

- Wattage
- adjustable or fixed temperature
- power source (electric or gas)
- portable or bench use



I do not recommend soldering guns, as these have no temperature control and can get too hot. This can result in damage to circuit boards, melt cable insulation, and even damage connectors.

### *Wattage*

It is important to realize that higher wattage does not necessarily mean a hotter soldering iron. Higher wattage irons just have more power available to cope with bigger joints. A low wattage iron may not keep its temperature on a big joint, as it can lose heat faster than it can reheat itself. Therefore, smaller joints such as circuit boards require a lesser wattage iron - around 15-30 watts will be fine. Audio connectors need something bigger - I recommend 40 watts at least.

## Temperature

There are a lot of cheap, low watt irons with no temperature control available. Most of these are fine for basic soldering, but if you are going to be doing a lot you may want to consider a variable temperature soldering iron. Some of these simply have a boost button on the handle, which is useful with larger joints; others have a thermostatic control so you can vary the heat of the tip.



If you have a temperature controlled iron you should start at about 315-345°C (600-650°F). You may want to increase this however - I prefer about 700-750°F. Use a temperature that will allow you to complete a joint in 1 to 3 seconds.

## Power

Most soldering irons are mains powered - either 110/230v AC, or benchtop soldering stations which transform down to low voltage DC. Also available are battery and gas powered. These are great for the toolbox, but you'll want a plug in one for your bench. Gas soldering irons lose their heat in windy outside conditions more easily than a good high wattage mains powered iron.



## Portability

Cheaper soldering irons will need to plug into the mains. This is fine a lot of the time, but if there is no mains socket around, you will need another solution. Gas and battery soldering irons are the answer here. They are totally portable and can be taken and used almost anywhere. They may not be as efficient at heating as a good high wattage iron, but they can get you out of a lot of hassle at times.

If you have a bench setup, you should consider using a soldering station. These usually have a soldering iron and desoldering iron with heatproof stands, variable heat, and a place for a cleaning pad. A good solder station will be reliable, accurate with its temperature, and with a range of tips handy it can perform any soldering task you attempt with it.



## Solder

The most commonly used type of solder is rosin core. The rosin is flux, which cleans as you solder. The other type of solder is acid core and unless you are experienced at soldering, you should stick to rosin core solder. Acid core solder can be tricky, and better avoided for the beginner.

Rosin core solder comes in three main types - 50/50, 60/40 and 63/37. These numbers represent the amount of tin and lead present in the solder, as shown below.



Solder Type	% Tin	% Lead	Melting Temp (°F)
50/50	50	50	425
60/40	60	40	371
63/37	63	37	361

Any general purpose rosin core solder will be fine.

## Soldering Accessories

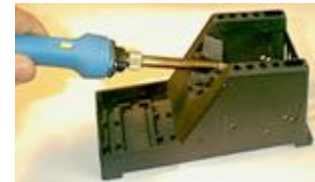
### Soldering Iron Tips

Try to use the right size tip whenever you can. Smaller wires and circuit boards require small fine tips, and mic cable onto an XLR would need a larger tip. You can get pointed tips, or flat tipped ones (sometimes called 'spade tips'). If you have a solder station with a desolderer, you will also want a range of desoldering tips and cleaners.



### Soldering Iron Stands

These are handy to use if you are doing several or more joints. It is a heat resistant cradle for your iron to sit in, so you don't have to lie it down on the bench while it is hot. It really is essential if you are planning to do a lot of bench soldering as it is only a matter of time before you burn something (probably your elbow resting on the hot tip) if you don't use one.



### Clamps

I strongly recommend clamps of some sort. Trying to hold your soldering iron, the solder, and the wire is tricky enough, but when you have to hold the connector as well it is almost impossible. There are adjustable clamps that can be manipulated to hold both the connector and the wire in place so you still have two free hands to apply the heat and the solder. These are cheap items, and I know mine have paid for themselves many times over.



### Magnifying glass

If you are doing work on PCBs (printed circuit boards) you may need to get a magnifying glass. This will help you see the tracks on the PCB, and unless you have exceptional sight, small chip resistors are pretty difficult to solder on without a magnifying glass. Once again, they are not expensive, and some clamps come with one that can mount on the clamp stand.



### Solder Wick

Solder wick is a mesh that you lay on a joint and heat. When it heats up it also melts the solder which is drawn out of the joint. It is usually used for cleaning up solder from tracks on a circuit board, but you will need a solder sucker to clean out the holes in the circuit board. Place the wick on the solder you want to remove then put your soldering iron on top of the wick. The wick will heat up, then the solder will melt and flow away from the joint and into wick.



### Solder Suckers

If you don't have a solder station with desolderer, and you work on PCB's, you are going to need one of these before too long. They are spring loaded and suck the melted solder out of the joint. They are a bit tricky to use, as you have to melt the solder with your iron, then quickly position the solder sucker over the melted solder and release the spring to suck up the solder. I find solder wick to be easier to use and more effective.



## Fume Extractors

Solder fumes are poisonous. A fume extractor will suck the fumes (smoke) into itself and filter it. An absolute must for your health if you are setting up a soldering bench.



## Preparation

### Step 1: Preparation

If you are preparing the cable for a connector, I strongly suggest you put any connector parts on now (the screw on part of an XLR, or casing of a 1/4" jack for example). Get into the habit of sliding these on before you start on the cable, or else you can bet it won't be long before you finish soldering your connector only to discover you forgot to put the connector casing on, and have to start all over again.



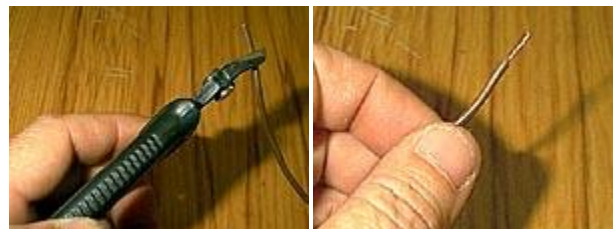
Once you have all the connector parts on that you need, you will need to strip your cable. This means removing the insulation from the end of the wire and exposing the copper core. You can either use a wire stripper, side cutters, or a knife to do this.

The obvious tool to choose to strip a wire would be.....a wire stripper. There are many types of wire stripper, and most of them work the same. You simply put the wire in, and squeeze it and pull the end bit off. It will cut to a preset depth, and if you have chosen the right depth it will cut the insulation off perfectly. It is possible to choose the wrong depth and cut too deeply, or too shallow, but they are very easy to use.



On the other hand, some people (myself included) prefer to use a knife or side cutters. I use side cutters for small cable and a Stanley knife for bigger cables...and although I have a couple of wire strippers, I haven't used them for years. This may seem odd, but I've got my side cutters and knife with me anyway, and they do the job fine.

If you are using side cutters (as shown here), position them about 10mm (1/2 inch) from the end, and gently squeeze the cutters into the insulation to pierce it, but not far enough to cut the copper strands of the core. Open the cutters slightly so you can turn the wire and pierce the rest of the insulation. You may have to do this a few times to cut through all of the insulation, but it is better to cut too shallow and have to turn and cut again rather than cut the core and have to start again. Now you should be able to slide the insulation off with your cutters, or pull it off with your fingers. This may sound a tedious method, but in no time at all you will be able to do it in two cuts and a flick of the cutters.



I won't explain how I use a knife to do larger cable, as I'd hate someone to slice a finger or thumb open following my instructions. Using a sharp blade like that certainly does have its risks, so stick with wire cutters or side cutters if you are at all unsure.

If your connector has been used before, make sure you remove any remnants of wire and solder from the contacts. Do this by putting the tip of your soldering iron into the hole and flicking the solder out when it has melted. *Common Sense Alert!* Please be careful when you flick melted solder...flick it away from you.

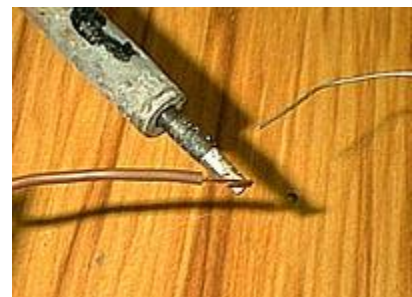


## Tinning

### Step 2: Tinning

Whatever it is you are soldering, you should 'tin' both contacts before you attempt to solder them. This coats or fills the wires or connector contacts with solder so you can easily melt them together.

To tin a wire, apply the tip of your iron to the wire for a second or two, then apply the solder to the wire. The solder should flow freely onto the wire and coat it (if it's stranded wire the solder should flow into it, and fill the wire). You may need to snip the end off afterwards, particularly if you have put a little too much solder on and it has formed a little ball at the end of the wire.



Be careful not to overheat the wire, as the insulation will start to melt. On cheaper cable the insulation can 'shrink back' if heated too much, and expose more copper core than you intended. You can cut the wire back after you have tinned it, but it's best simply not to overheat it.

The larger the copper core, the longer it will take to heat up enough to draw the solder in, so use a higher temperature soldering iron for larger cables if you can.

To tin a contact on an audio XLR connector, hold the iron on the outside of the contact for a second or two, and then apply the solder into the cavity of the contact. Once again, the solder should flow freely and fill the contact. Connectors such as jacks have contacts that are just holes in a flat part of the connector. To tin these you put your iron on it, and apply the solder to where the iron is touching. The solder should flow and cover the hole.

Once you have tinned both parts, you are ready to solder them together.



# Soldering

## Step 3: Soldering

This step can often be the easiest when soldering audio cables.

You simply need to place your soldering iron onto the contact to melt the solder.

When the solder in the contact melts, slide the wire into the contact.

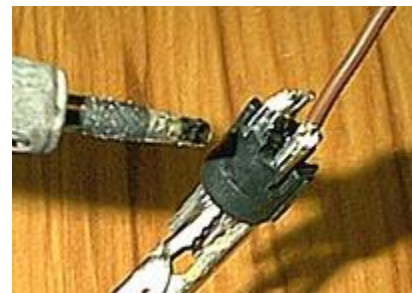
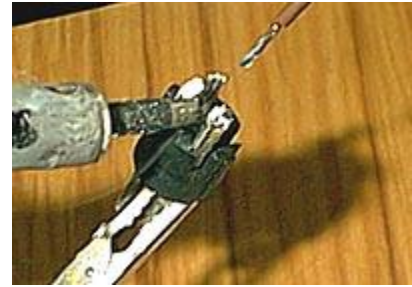
Remove the iron and hold the wire still while the solder solidifies again.

You will see the solder 'set' as it goes hard.

This should all take around 1-3 seconds.

- A good solder joint will be smooth and shiny.
- If the joint is dull and crinkly, the wire probably moved during soldering.
- If you have taken too long it will have solder spikes.

If it does not go so well, you may find the insulation has melted, or there is too much stripped wire showing. If this is the case, you should desolder the joint and start again.



## Cleaning Your Soldering Iron

You should clean your tip after each use. There are many cleaning solutions and the cheapest (and some say best) is a damp sponge. Just rub the soldering iron tip on it after each solder.

Another option is to use tip cleaner. This comes in a little pot that you push the tip into. This works well if your tip hasn't been cleaned for a while. It does create a lot of smoke, so it is better not to let the tip get so dirty that you need to use tip cleaner.



Some solder stations come with a little pad at the base of the holder. If you have one of these, you should get into the habit of wiping the tip on the pad each time you apply solder with it.



If you need to clean solder off a circuit board, solder wick is what you need. You place the wick on the joint or track you want to clean up, and apply your soldering iron on top. The solder melts and is drawn into the wick. If there is a lot of solder the wick will fill up, so gently pull the wick through the joint and your iron, and the solder will flow into it as it passes.



## Tips and Tricks

1. Melted solder flows *towards* heat.
2. Most beginning solderers tend to use too much solder and heat the joint for too long.
3. Don't move the joint until the solder has cooled.
4. Keep your iron tip clean.
5. Use the proper type of iron and tip size.

### *Troubleshooting*

If either of the parts you are soldering is dirty or greasy, the solder won't take (or 'stick') to it. Desolder the joint and clean the parts before trying again.

Another reason the solder won't take is that it may not be the right sort of metal. For example you cannot solder aluminum with lead/tin solder.

If the joint has been moved during soldering, it may look grainy or dull. It may also look like this if the joint was not heated properly while soldering.

If the joint was overheated the solder will have formed a spike and there will be burnt flux residue.