

# Tools:

**A guide for those who use screwdrivers as hammers and hammers as screwdrivers!**

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*Downloaded from TRCY, The Robotics Club of Yahoo: <http://members.tripod.com/RoBoJRR>*

Most folks would consider it a waste that I am taking the time to write a tutorial on common tools. Critics would say, "If they don't know to use tools then they don't need to be building anything." But I know lots of young robot builders who are out there that have lot of wonderful ideas but don't know how to use or choose the right tools for there projects. I was lucky enough to learn about tools at an early age from my Grandfather, so in this guide I'll present a few tools I feel every robot builder should have and understand how to use. I hope you find it informative.

A very common first question I should address is, "where can I buy tools?" If you live in the United States then you are pretty lucky, take a look in your phone book and look under *hardware*, this will give you a few listings. You should find listings for stores such as Sears, Lowe's, and Home Depot. Many department stores in America such as, Meijer's, Target and especially Wal-Mart carry a wide variety of good tools at competitive prices. Many of the local, family owned hardware stores would charge you as much as double what the items would cost at major store chains. The reason is the smaller stores can't handle the bulk buys, so it costs them more to sell things to you.

When buying tools you need to realize that some tools cost more because they are name brand models. For instance in the American store chain called Sears you'll mostly find Craftsman brand tools. Most Craftsman brand tool carries a lifetime warranty. That means if the tool breaks in your lifetime, Sears will replace it free of charge. But how many times do tools break? In my experience the answer is not often.

This, however, does not mean you should buy the cheapest tools you can find. For instance in America you'll find the store chain called Big-Lots. Big-Lots carries very cheap tools that often will not hold up over time. One possible plus side to stores like Big-Lots is that they carry "factory refurbished" power tools. Refurbished means that something was wrong at one point with the tool and the factory has fixed it and is reselling it. However, they can't sell these as totally new items, so the price is slashed and a big label saying "factory refurbished" is stamped on the box. If you are serious about working on robots then you need good tools and power tools is an area where I believe you should not be cheap! But, if you are young and desire to own your own tools then refurbished tools can be a great way to pick up power tools like cordless drills and jigsaws.

For shopping online or though mail order you'll find a detailed list of catalog companies under the TRCY [Reference Area](#). You should request free mail order catalogs from the companies listed there.

As you read through the tools listed here I'll give you suggestions on weather or not you can buy a cheap model or if you should spend a little bit more and make sure you get a good tool that will last you a long time.

If you have a problem with the information provided here or have a question please leave a posting on The Robotics Club of Yahoo (TRCY) [message boards](#) explaining the issue in detail or drop me a line at [Weyoun7@aol.com](mailto:Weyoun7@aol.com). I should also point out that this list is geared for readers living in the United States of America. I have compiled a list of robotic parts and tool suppliers with the help of the international members of TRCY and you can find this list by clicking [here](#). This international list of suppliers was created because I know how hard it can be for builders living out side to the US to find parts and tools, but other than the information provided there I am not able to give you further instructions if you live outside the US.



The first tool we'll look at is the "All-in-1, 6 way driver." No toolbox or workshop should be without one of these! They cost around \$5 or less and are well worth it!

The picture to the far left shows the driver in one piece, the other picture shows the six driver ends of the screwdriver. You'll get two Phillips head bits, two flat head bits and two hex drivers, which are the different sized ends of the metal shaft that houses the other driver bits. Phillips heads are the screwdriver heads that look like X's.

The two hex drivers fit over screws that have octagon shaped heads, sort of like bolts. You'll find screws like this in computer cases. 6-in-1's are great for working on computers; cause you only need the one tool!

Screwdrivers should only be used as screwdrivers! Don't use the handles to hammer on things. In certain cases you can hammer on older, heavy-duty drivers to cause rusted bolts or screws to come loose. Take care of your tools, use them properly and they'll last you a long time!

Pictured to the right are two basic hammers you should have in your toolbox. The first is a general claw hammer. It's called a claw hammer because of the claw on the back of the head; this can be used to pry nails out of wood. A hammer like this comes in handy when you need to force a tight fit of a motor shaft onto a wheel.

The other hammer is a rubber mallet. This is a must have hammer because it allows you to hammer out dents on aluminum sheeting. A rubber mallet is used for hammering when you need to be careful not to damage the object you are working on.



This is a ratcheting screwdriver. You can stick in any normal screwdriver bit into this ratchet and in fact this Craftsman tool comes with a set of driver bits. Cost was \$10 from Sears and was well worth it. I have not seen another tool like it and it fits into the smallest places. It really comes in handy when you have a small case for protecting your robot's controller and you need to drive a screw from the inside of the case.



Our next tools are pliers! You can get a cheap set of pliers just about anywhere, but I recommend you get a good set. It might cost you around \$20 for a set of six. Now some people would disagree with me, but I know cheap pliers will break, so in my opinion it's better to buy a good set that will last, maybe even Craftsman brand. I want to point out you do not need to buy a set, most stores sell them individually too and you can buy them as you need them for a couple of dollars at a time. Often in the long run it is cheaper to buy a set of 5 or more.

There are four basic pairs of pliers that you'll need for working on most robotic projects. The first pair in the upper left corner is a pair of wire cutters. These are great for cutting all types of wire, even thick aluminum wire. They are also perfect for cutting the stop tab off of gears when modifying servos for full rotation.

In the lower left is a pair of needle nose pliers. These are great for grabbing hold of tiny objects, like very small shafts that hold gears in place.

The pairs to the right are normal gripping pliers. These would be used to bend metal bars or shafts, bend aluminum, pull nails, loosen or tighten bolts and many other common tasks. The pair with the red handles is meant for heavier duty jobs.



This is a universal wrench manufactured by Popular Mechanics. It's cheap and very well made. It'll fit just about any sized nut or bolt. You'll find many variations of the adjustable universal wrench, I happen to like this make and model.

I like this tool because you can adjust it on the spot without switching sockets on a ratcheted wrench.

You'd need a wrench like this if you were going to be working on larger robots. For instance if you wanted to create a lawn mowing robot, you'd probably need a wrench like this to tighten bolts that would hold you motors in place.

Cost is around \$6 or less. Now some wrenches are made for serious work and can cost a lot more than \$6.

Now we come to wire strippers. This has to be the tool I use the most often. I used to use my teeth to strip wire, which is not a good thing to do! For one you don't know most wires have been and two it's a good way to ruin your front teeth or even chock!



So get a good pair of wire strippers. The pair on the far right is the best wire stripper I have ever owned. I picked them up at a computer show for \$1. If you see them for \$10 get them! They are very much worth the price. All you do is stick your wire in the mouth, and squeeze the handle. This grabs the wire, holds it in place and strips the plastic coating off to whatever length you want. The worst thing about them is I don't seem this type at many stores.

The middle pair has to be the worst wire stripper I have ever seen. They are meant for grimping on wire connectors. It'll strip wire too, but more times that not you'll end up cutting the wire you are trying to strip. You can get a pair like this in a kit of wire connectors for about \$10.

The pair to the left is not half bad, but they can be expensive. They work like the pair to the far right, except you must match up the size of the wire to the correct groove before you can strip. This pair is very common and cost is around \$15



Our next item is wire nuts. Wires nuts are used to cap off and connect wires that have been twisted together by hand. This is much better than using electrical tape to cover the bare ends of connected wires. Wires nuts come in all different sizes, bigger nuts are for thicker wires.

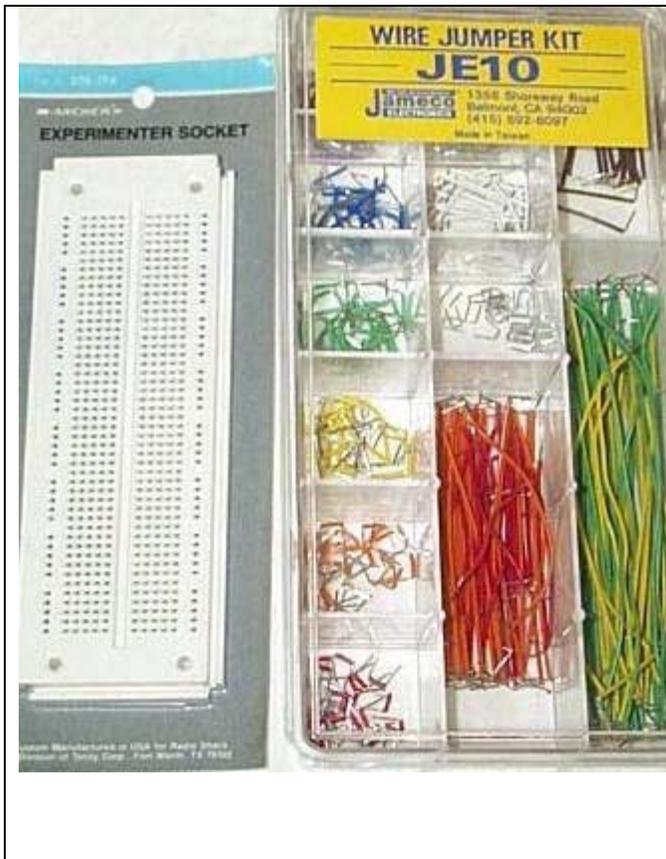
They are easy to use: after you twist your stripped wires together by hand you stick a wire nut on them and twist the nut a few times. Twist it to many times and you can snap thinner wire in half. Give the wires a slight tug to make sure the nut is secure and you are done. This also makes it easy to re-wire your work! Best place to pick up wires nuts is at a local major retailer of hardware, such as Home Depot and buy them by the box. Wire nuts are reusable so a box will last you a while.



This is a wire clip. It's nothing more than a length of wire with two alligator clips on the ends. The clips have a plastic cover over them to prevent them from touching wires or components that they are not clipped onto.

The end towards the left of the picture has been removed to show the metal alligator clip on the inside of the cover.

You can buy wire clips by the pack with 6 or more in each pack, cost is under \$3 and they come in an assortment of colors. You must have a pack of these for experimenting! You can pick them up at any Radio Shack or just about any catalog company.



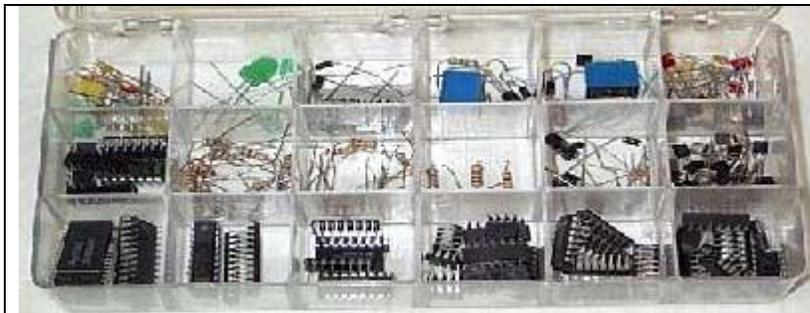
Breadboard and wire jumpers are an experimenter's best friends! The breadboard is a solder less socket board. This is the \$11 version from Radio Shack, though I want to point out you can buy cheaper ones from [Jameco](#) and [B&G Micro](#).

On the under side of the board are rows of copper strips, when you stick components or wires in the different rows you make connects by pushing the pins through the socket until they touch the copper backing.

The two long rows on the ends are two continuous strips which are most often used to connected common tie points such as the positive and negative power lines of a circuit.

All the other strips run parallel to the short end of the board. There is a break in the middle of the strips, which is indicated by the center groove. Each row of pins on the right and left of the groove has their own copper strip on the bottom of the board.

The jumper wire as pictured is a boxed set from Jameco, cost is around \$10 and comes with several different lengths of wire which were made for use in solder less breadboards. It's important to note that there is such a breadboard that does need soldering. It's a printer circuit board with strips and pinholes with the same layout as solder less breadboards. Cost of these is about \$2.



A storage box for all your electronics goodies is handy to have.

I organize my IC's or Integrated Circuit chips into separate bins according to their functions. So that all op-amps are in the same bin.

I don't store my chips like these in static resistant foam, but it would be a good idea to do so. Most IC's are packed in static resistant foam to begin with anyway so finding it should not be a problem. I also put a label on the top of my components box so I know what parts are in which bins inside the container. I recommend you do the same, at least for the storage of your IC's and transistors. [Click here](#) if you are not familiar with basic electronics components and would like to learn more.



Tape: can there be anything better than tape?

Tape is very important when creating your own projects. You can use tape to hold things together to see how something will work before you permanently attach something together.

But it's important you pick the right tape for the right job!

We'll start with the handy man's secret weapon, Duct Tape! It's pronounced Duct Tape, not Duck Tape, even though that's what most people end up calling it. It's called duct tape because it was and is used to tape together air ducting in the construction of homes and so forth. It's a very strong tape and can be used to hold together heavy objects. The Duct Tape is the gray roll.

The off white colored roll of tape is masking tape and most often used when painting to cover areas of something that you would not want painted, thus it would be masked and they is why it's called masking tape. It's good for temporarily holding smaller object together or for holding components in place when soldering or holding objects together to let glue dry between them.

The black roll is my personal favorite, electrical tape. It does not conduct but it is used to cover exposed ends of wires that have been twisted together. I find this tape to be perfect for holding things together, even for long periods of time. It's much better than masking tape, and easier for smaller things that duct tape. You can often buy a pack of ten rolls for \$5 at hardware stores such as Lowe's.

The shiny tape is aluminum tape is a bit on the expensive side. It's used as a fix for patching or seeming together aluminum sheeting. This tape is conductive and very sticky. A roll of this will last you a while and comes in handy for jerry rigging things like touch sensors.

The blue tape is actually double-sided tape. The blue is a layer of removable plastic stripping, which separates the tape so it does not stick to it's self. This tape is VERY sticky and is perfect for mounting servos to robotics platforms. The down side is it is hard to come by, I have not seen it in many stores, so you'll have to ask around to find a good sized roll of this. The plus side is a big roll will last you a while. A good place to check for this is a hobby store or the hobby section of a Wal-Mart.



Something else very good for holding things is a clamp. You can use clamps for a variety of different jobs, such as holding wood down to a table while you are cutting it. Holding wood or plastic together and in straight alignment for drilling.

I picked this set up at a Big-Lots for a couple of dollars. In my opinion you can go cheap on clamps. There's not much too a clamp, you keep them oiled and they'll last you a lifetime.

These clamps are pretty smaller for larger jobs get bigger clamps. One model to look for is the quick grip as pictured below:



This is what you want for holding wood in place while you are cutting it! Cost is around \$11



I said before you if keep a clamp oiled it'll last a lifetime, right? Well what sort of oil am I talking about? WD-40, oil your tools with moving parts every so often and you'll protect them and keep them work right. Application is pretty easy, just spray a dab on the tool, let it sit a few minutes and dry the excess off with a paper towel. For the usage on my tool I oil them once a year.

The other can pictured there in the upper right corner is a can of compressed air. You can pick this up at most computer stores and is used to dust off computer keyboard and so forth. Cost is about \$7 per can and well worth it! Canned air is great for dusting off circuit boards, insides of electronics cases, etc...



The above tool is a square. It's a short 6" inch metal ruler with a slide on it that has a flat edge. If you want to make sure you cut straight lines on wood or anything else then you need a good square. The basic idea is you back the flat edge of the slide against the object you want to cut then slide the ruler up and make your marks on the wood or metal with a pencil or score it with a knife. This square has a level inside the handle of the slide. They make cheap plastic versions of the square with no moving parts that are just as good as this one and cost is just 2 or 3 dollars. This level is a rather good one, however and cost a bit more than the plastic ones.



Our next tools are both tin snips. These are used for cutting aluminum sheeting. Aluminum sheeting is a cheap way to give your robot that all metal look when in fact that frame underneath is all light weight wood.

You must have tin snips if you plan to work with aluminum sheeting. Nothing else will cut it properly!

Cost is about \$10 more or less. There is not much of a need for them unless you are going to work with aluminum or other metal materials.

You'll want to wear good leather padded gloves when working with metal. It's a good idea to use glove when cutting wood as well to protect your hands from splinters.



How do you make a hole? The answer is with big drill bits! This is a set of hole making drill bits from 3/8" of an inch up to 1" inch wide. You can use them to make holes in wood or plastic.

Don't try to use them to drill holes in metal; you need metal drilling bits for metal. These are wood drill bits.

This set I pick up at Wal-Mart for under \$10. There's no better way to make holes in things.

It is possible to make bigger holes with bigger bits. I've seen connector heads that make holes up to 3" across. The bigger they are the more expensive the bits become though.



These are miscellaneous small tools that should be in every toolbox! The top item is a utility knife. You can break its blade off as you use it and it become dull. You can pick these up for about .50 cents just about anywhere. These are perfect for cutting tape!

Below it is a pair of tweezers. You need pair like these to pick up small electronic components. In the middle is a small level, which is perfect to see how far off center your little robot is.

At the bottom is a wire wrap tool and wire wrap striper. This tool wraps very thin wire around circuit components to make circuit board like connections. The plus side with wire wrap is it is easier to fix something if you wire something incorrectly. The tool cost about \$10 and is VERY handy for smaller robots.

The other tools are used to insert or extract IC's from circuit board sockets. There are great tools and very cheap to pick up and Radio Shack. These little tools are great if you are having problems keeping the pins on your IC's from bending.



This is basic soldering equipment. I recommend that if you are serious about robotics you think about getting an adjustable soldering station. Cost for just an item is about \$40 from [Jameco](http://www.jameco.com). I realize this might be more than the casual tinkerer wants to shell out so picked here is a cheap soldering iron you can get at Radio Shack or just about any where else. You half to be careful when soldering with a cheap iron like this, because you get what you pay for. The iron will get very hot and often so will the cheap handle on units like this. The tips will often break and sometimes the iron does not include a proper tip for electronics work. You want a tip with a small, very sharp point at the end.

The tool in the lower right corner is a pair of helping hands. Cost is around \$10 and it's an invaluable tool for objects while soldering!

The blue tube next to the iron is a solder sucker. It's only a couple of dollars and even a cheap one like this last you a long time. It acts like a plunger to push air out of a tube, you stick the open end of the tube next to your hot solder you want to get ride of, you hit a trigger and everything next to the opening is sucked away. The tube come apart in the middle and you can clean out the solder that has built up on the inside.

The tube pictured above contains solder flux. Sometimes heavy-duty connectors on switches need a little more oomph to hold the solder, that's when you use flux. The round object is a spool of solder. Solder comes in different sizes, you want a thin solder for solder electronics work.



Now we get to the mother of all electronics tools, the Multimeter! Multimeter live up to their name, they allow you to monitor multiple electronics readings with one tool.

You can measure DC and AC voltage readings. Measure current. Measure resistance of a resistor or other components. You can test diodes, check transistors and test capacitors all from the single Multimeter.

But not all Multimeters are made equally. There are meter that give digital reads, like the one pictured to the left and there are ones that give analog readings, which moves a needle to point to the correct reading the meter is getting.

This Multimeter manufactured by TERMA cost about \$60. This might be a bit much for some builder to spend on a tool and so fortunately cheaper versions are available. Most hardware stores carry Multimeters and you can find analog meters for as low as \$12 and digital for as low as \$20.

Take a look at the meter below. I bought this one from [B&G Micro](#) for only \$12 it functions as reliably as my TERMA meter. You'll often find better prices on meter with catalog companies than you will with local stores. One good catalog to look at for meters is MCM (phone #1-800-543-4330).

