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10 Cool Tools

by Jessika Toothman

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10 Cool Tools

Long before humans qualified as Homo sapiens, they'd been using tools. As [time](#) went on, the tools they created became more and more advanced. Nowadays, the tools of the trade, like those used to make prototypes of fantastic and innovative new products, are so complex and cool, you and I will probably never own them. We won't need to. But for people inventing cutting-edge products, these tools are a must.



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A revolving waterslide created by Discovery Channel's "Prototype This!" team could save a lot of time walking up stairs at the water park.

One interesting prototype created with the tools we'll read about on the following pages is the revolving circular waterslide pictured above. The team members on [Discovery's](#) show "Prototype This!" also attempted to create a 6x6 all terrain runner and robots that box. The "Prototype This!" team comprises five scientists and engineers with different fields of expertise such as animatronics, mechanical engineering and electronics. Together they work to create wild futuristic prototypes in a short timeframe.

Unlike the tools collecting cobwebs in the corner of your garage, these high-tech tools are what's needed to push the bounds of human innovation and create amazing new potential products. On the following pages, we'll take a look at some of the types of tools used on "Prototype This!" and explore the interesting functions they perform.

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Cool Space Tools

Watch this NASA video to learn more about the specialized tools that astronauts use in spaceflight. You can't just run to Home Depot and buy space tools. Each is specially built so that astronauts can use them with their space suits. (August 14)



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ZPrinter 450 3-D Printer

Regular 2-D [printers](#) have become ubiquitous products in the modern age. Three-dimensional printers, on the other hand, are still able to turn some heads. Whether you're an architect or an artist, an educator or a product designer, a 3-D printer might be exactly what you're looking for.



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The ZPrinter 450 can build a 3D model of your prototype in just a matter of hours.

In some ways, the technology is similar to 2-D printing because it uses software to break down 3-D models into 2-D layers -- or **cross sections** -- of the desired prototype. There are a variety of methods to accomplish 3-D printing, but it's generally done in layers. For example, in one method, layers of fine powder are deposited onto the blossoming prototype, followed in turn by a layer of liquid binder. Once an object has been printed, it can be coated with sealant to strengthen it. Also, many of the machine's components are similar to those in regular printers, but that's where the technologies diverge.

For one thing, compared to 2-D printers, 3-D printers are slow. Sure, some are faster than others -- the Z Corporation makes one of the speedier ones on the market -- but even it only builds an inch or two an hour (depending on the size and shape of what is being printed). Their ZPrinter 450 lays down layers between .0035 and .0040 inches thick (.089 to .102 millimeters), and it can build prototypes that are 8 inches by 10 inches by 8 inches in size (20 by 25 by 20 centimeters). The Z Corporation has another model, the Spectrum Z510, which can build slightly larger prototypes with greater resolution and at about the same speed as the 450. The ZPrinter rings up at about \$45,000 and the Spectrum Z510 at about \$73,000 [source: [Prototype Magazine](#), [Prototype Magazine](#)].

Despite potential drawbacks -- including the hefty price tag -- the possibilities of a 3-D ZPrinter are interesting to contemplate. You could print relief maps of the ocean floor, prototype products for pitch meetings, model human hearts for research or create architectural models to give construction workers a better visual picture of the design plans. And the best part -- it's all in color.

Different materials can be used in the printing process to create different characteristics in the finished products; they can be made more rubbery for example. Depending on the company, a range of techniques and materials can be utilized which impact the characteristics of the finished product. For instance, some make stronger prototypes, some offer more colorful results, others greater precision.

On the next page, let's take a closer look at the cutting-edge software that makes 3-D printing possible.

SolidWorks 3-D CAD Software

To print a 3-D prototype, the first thing you need is a 3-D model. Using special software, it's possible to make virtual designs which can be fed into a 3-D

[printer](#) and presto -- you have a desktop visual of your product.

CAD ([computer](#)-aided design) software was first pioneered in the early 1960s, and it became popular on the commercial scene in the 1970s. Since then, an enormous field of engineers and designers of all sorts have made use of the technology to design everything from [airplane](#) engines to the kitchen sink.

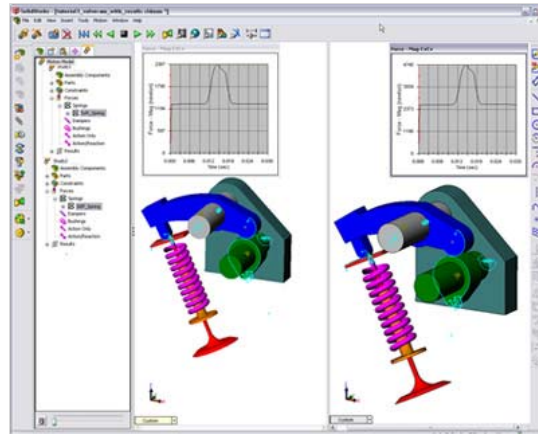


Photo Courtesy of [SolidWorks](#)

This popular software makes all kinds of design applications easier to accomplish. As pictured above, for example, it can help by simultaneously comparing different design alternatives.

SolidWorks is one company that makes top-of-the-line mechanical CAD software, with a variety of tools and functions to design, manipulate, compile, correlate and evaluate prospective products. SolidWorks software enables users to transform 2-D to 3-D, use a variety of tools to swiftly and efficiently develop their design, simulate the assembly and operation of the prototype, compare and share their finished product, and much more.

While using the SolidWorks software, it's possible to not only manipulate 2-D images and create professional drawings ready for the production line, but also to make detailed 3-D image maps. These can be sent to 3-D printers, and you could have a prototype of your design in a matter of minutes (or hours depending on the size).

One example of an application of the SolidWorks 3-D CAD software was created by the MAKO Surgical Group. They designed and built the MAKO Tactile Guidance System -- a robotic arm that assists surgeons perform less invasive, more successful [surgeries](#). The machine not only helps control the surgeon's movement, it can also let them know where it's safe and appropriate to cut. The SolidWorks software proved useful not only for part design, but also for mapping the virtual space the surgeons navigate.

The guys on "Prototype This!" aren't making surgical equipment with their tools, but read about another tool they're using to make their own unique prototypes.

Fluke Multimeter

If you work with electronics and electrical systems, chances are very good you've heard about -- and likely own -- a multimeter. But to give the rest of us a little background, a multimeter is a handy device that's able to measure a wide range of parameters in the world of all things electrical. For example, they can usually measure connectivity, frequency, current, resistance, volts, amps, ohms, temperature and more.

This can be handy in numerous situations: testing whether an electrical current exists, discovering the value of a resistor or checking the charge in a battery. Actions like these can help determine malfunctions, solve a number of problems and be very important as safety precautions.

Let's look a little closer at one popular brand of multimeter -- Fluke. Fluke makes several multimeters with a range of capabilities suitable for a variety of users. Advanced ones have large, well-lit digital displays which can be used to view data trends through graphs and charts. This can be particularly useful if you're having trouble tracking down an intermittent electrical problem. Other models are more straightforward for simpler applications. Newer Fluke multimeters often have large memory capacities and longer running [battery](#) time, making them a good choice for situations that call for ongoing monitoring. Many are beefed up to be safe under heavy industrial conditions, and they can be essential for troubleshooting and problem-solving in hazardous environments such as plants, factories and other engineering facilities.

Whether fixing a conveyor system, building a [robot](#) or testing a fuse, a multimeter might be just what you need to get the job done safely and effectively. On the next page, we'll examine a similar tool with other important functions.

Infiniium DSA91304A High Performance Oscilloscope

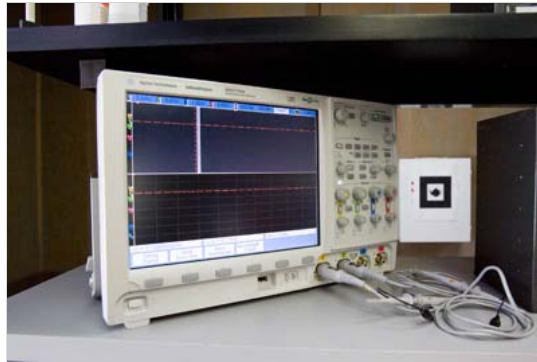
[Oscilloscopes](#) are a lot like multimeters, but in most cases, they're much more powerful and take measurements and analysis to the next level. One important distinction, too, is that oscilloscopes focus solely on [electrical signals](#), and when we say focus, we mean it. They actually let a user view the signals he or she is monitoring.

An important tool to have on hand for designing and testing anything dealing with electronics and electrical systems, oscilloscopes are used by people across a large cross-section of industry. You might find one in an aerospace-defense testing facility, another in an [automotive](#) factory or still another in any number of research labs. An oscilloscope can display the wave pattern of an electrical signal, and this allows someone to analyze whether or not it's the appropriate pattern and strength



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This Fluke multimeter is used by the cast of Discovery's new show "Prototype This!"



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This oscilloscope isn't currently in use, but if it was you'd be able to see a wave fluctuating across its screen.

Agilent Technologies is one company that makes oscilloscopes. Its top-of-the-line models cost upwards of \$100,000, but many are more affordable [source: [Agilent Technologies](#)]. Let's take a closer look at what some of these fancier oscilloscopes can accomplish.

The \$115,000 Infiniium DSA91304A High Performance Oscilloscope, for example, measures several aspects of electrical waves in a 13 gigahertz bandwidth range. It's capable of providing measurements to a high degree of accuracy, and performing several mathematical functions on the results in order to manipulate and study them. It has four channels that can be used to view and compare four separate signals. You can watch your waves come in at a maximum rate of 40 giga-samples a second, providing great detail and accuracy. The Infiniium also has a very large amount of memory, so you can record high-quality sample signals and play them back for comparison and study.

Now that we've looked at some cool tools for design and testing, let's move onto the factory floor.

VersaLASER VLS6.60

[Laser](#) engraving machines (also known as laser etching machines, laser cutters and a variety of other similar names which describe their various functions) have been gaining in popularity, both for the precision clarity of the results and the speed at which they operate. In the process, a laser beam is programmed to create a design on a range of possible materials. Those materials can be organic, like paper, stone, wood, rubber and leather, or they can be plastic or metal. Lasers create a nicely polished edge as they vaporize or cut controlled portions of the material in your designated pattern.

Lasers engravers can be called upon for cutting, engraving, scribing, drilling, marking and other related modeling techniques. They can be used for pretty much anything you can think of that's etched or imprinted, whether it's a picture frame, trophy, printed circuit board, jewelry, you name it. Laser cutters can also be handy in industrial settings, either for mass production, prototype production or anything in between.

One laser cutter, the VersaLASER VLS3.50, can shape, etch, scribe and cut objects in a workspace 24 by 12 inches in size (about 61 by 31 centimeters). This diverse and incredibly precise machine weighs in at 110 to 123 pounds (50 to 56 kilograms) and needs a [computer](#) all to itself to run, operating on either Windows XP or [Windows Vista](#). It requires an exhaust system, and while the laser engraver isn't that expensive to run, it is expensive to acquire. The VersaLASER also has a cylindrical axis to create an all-around effect.

A basic way to understand laser engravers is to look at how similar they are to printers. Only instead of working by adding a material to a surface, they create details by taking it away. Let's look at a machine with a somewhat similar function on the next page.

PCNC 1100 Mill

A CNC machine -- that stands for [Computer](#) Numerical Control -- is a type of computerized workshop device that replaces more conventional workshop machines. CNCs are able to perform many common shop jobs such as drilling, milling and turning -- and they do it all by themselves, making the shape that you define.

CNC machines are computer-programmed to perform all the tasks a human would have had to do on a manual machine, as well as many tasks that humans simply aren't able to do. Whether it's cutting a sinuous curve into a heavy steel plate, or engraving a miniature image on the back of a gold watch, CNC's can do it faster and with greater accuracy than any other type of machine. Moving on a number of linear and rotary axes, most CNCs can perform a variety of complex tasks -- the more axes, the more versatile the tasks and the more complex the shape that it's possible to cut.



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This VersaLASER VLS3.50 can zip through laser cutting projects needed by the team on "Prototype This!"



Photo Courtesy of [Tormach](#)

The Tormach PCNC 1100 Mill is the perfect fit for many work areas -- from industrial settings to basement workshops.

One CNC in particular, the Tormach PCNC 1100 Mill (that's personal computer numerical control), stands as a leader in the field and can be just the thing you need whether you're an engineer, an entrepreneur or a hobbyist. The machine can cut through anything, from wood and plastic up to and including steel, iron, titanium and chromium alloys -- and shape them into whatever final 3D product you're looking for. The PCNCs 1.5 [horsepower](#) spindle rotates at speeds between 100 and 5,000 RPMs.

Want the complete package? The PCNC and all its accompanying gadgets will set you back about \$16,000 [source: [Tormach](#)]. But that price does include a long list of accessories; the PCNC 1100 Mill itself costs \$7,480, and you can mix and match your extras. And it's not as expensive as it could be; during the design process, the people at Tormach worked to keep this personal CNC affordable, as well as easy to use.

Read about another type of tool that can be found in the "Prototype This!" toolbox on the next page.

PS-900 Soldering System

When two metal surfaces need to be joined together and they can't be melted, you'll be reaching for your trusty soldering iron. Soldering makes use of the fact that different metals have different melting points -- using a metal alloy with a lower melting point than the two you're joining does the trick.

Soldering can be tricky, though. Getting just the right amount of heat and solder onto your project can be challenging, especially if you're using a solder that needs a lot of heat like some of the lead-free ones. Then there's the wetting and the fluxes and the danger that you haven't formed a strong enough bond between what you're trying to connect. There's a lot to consider in good soldering.



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When not in use, this soldering iron can go into sleep mode.

Because of all this, many companies develop technologies to make the process go more smoothly. One example is OK International, a company that develops and sells tools for electronics assembly equipment, like their PS-900 Soldering Station.

The PS-900 uses SmartHeat Technology to provide extremely steady levels of heat throughout the soldering process -- that is, until you set it in the handy auto-sleep workstand. Lead-free alloys work great with the PS-900. Depending on what you're using to solder, and what you're soldering on, the company offers different tips to get the best match. This soldering system can also be used with other OK International products like their fume extraction systems, fluid dispensers and other related tools.

We've seen what happens when things heat up; let's cool them off a bit on the next page.

C370A-NC Vertical Column Circular Cold Saw

A cold saw is a special kind of [circular saw](#) that uses a coolant system during the cutting process. This helps decrease sparks, dust and grit while cooling the saw, which assists in producing a smoother cut and increases blade life. Powerful rigid vises of different sorts are common, and these hold the

materials being cut in a vibration-free grip, another big factor contributing to precision cutting and long-lasting blades.

Cold saws are particularly suitable for cutting narrow tubes and small bars -- and for producing exact **miters** (cuts at angles -- like the 45 degree angle cuts on the pieces of a doorframe). They use special saw blades, called high speed steel or HSS blades, which are less heat-resistant and can cut at faster speeds.



Photo Courtesy of [Kalamazoo Machine Tool](#)
This cold saw can really get the job done.

Let's take a closer look at one of these machines made by Kalamazoo Machine Tool. Its C370A-NC vertical column cold saw is one serious saw. The vertical column body design makes it extremely stable and vibration-free. The NC at the end of its name means this saw is fully programmable to automatically store all the parameters needed to complete up to 100 jobs.

The saw, weighing 1,875 pounds (about 850.5 kilograms), uses circular 12.5 to 14.5 inch (32 to 37 centimeters) high speed steel blades which can be set to spin at speeds between 13 and 76 revolutions per minute, which you would want to adjust depending on what you're cutting.

Now that we've cut everything into pieces, let's check out a cool tool on the next page that can help put everything back together again. And this next tool isn't like the little soldering system we read about on the last page that's perfect for intricate work -- this hot air machine is for the big jobs.

Invision 456MP MIG Welder

MIG welding (that stands for metal inert gas) is accomplished by feeding a wire through the contact tip of a welding gun. A shield of gas, also delivered through the tip, surrounds the contact area -- protecting the electrode wire and keeping any contamination out of the weld and keeping it clean. The feeding wire is melted when it's energized with [electricity](#) and forms the weld puddle.

MIG welding is also known as GMAW (gas metal arc welding -- nowadays it can actually have some semi-inert gases like carbon dioxide in it too -- although the term MIG remains popular). The advantages to MIG-style welding is that it saves time, there's not a lot of clean-up, there's less waste and, probably most importantly, you get a really good weld.

The Invision 456 MIG Welder is a good example of this technology, and at a base price of about \$10,000 for the MIGRunner Package deal, it better be [source: [Miller](#)]. Complete with a carrying cart for easier mobility, the Invision can definitely be used for heavy manufacturing and pretty much anything else.

Invision's advanced S-74D wire feeder is designed to improve the look of the tricky first portion of the weld and it has a trigger hold (kind of like a car's [cruise control](#)) for long welds. The wire feeder can also store up to four welding programs to save time and allow the welder control over every step of the process. It can hold a 60 pound (27 kilogram) coil of wire so you don't need to keep stopping all the time to reload it.

We've got quite a bit of heavy equipment and materials on our hands now -- 60 pound coils of wire? That's going to take up some space. Find out about a cool tool that can be used to haul all this stuff around the workshop on the next page.

Sidewinder ATX-3000

Most forklifts, and vehicles in general, are not the easiest things in the world to maneuver. This is because the wheels only roll forwards and backwards -- there's no lateral movement. So if your goal is to move somewhere off to your right or left -- say to that better parking space a few slots down that just opened up -- and you want to end up pointed in the same direction when you get there, you need to turn, go either forward or backward, and turn again. In a [car](#), this isn't that big of a deal, but when it comes to vehicles like forklifts, it can be another story.

Forklifts often carry large, bulky and very heavy objects that can be difficult to load and challenging to maneuver (especially through doorways and other narrow places). All that turning and maneuvering at safe, but very slow speeds can also suck up a great deal of time. And that's what makes this last tool so cool -- its wheels are designed to let it travel in any and every direction.



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You can see the gas canister on the cart behind this Miller welder, that's one of the key components of MIG welding.



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Ever find a spot to parallel park but you just can't squeeze? In the Sidewinder you would have been fine.

The special wheel design was invented by Bengt Ilon of [Sweden](#) in the 1970s. It works because its wheels are comprised of a circular set of rollers arranged at angles along the wheel. This, in effect, gives the wheels something similar to the functional shape of a sphere (like the [ball bearings](#) in rolling chairs) and vastly increases the range of motion available. Want to go sideways? How about diagonally backward with a twist at the end? Whatever you want, any direction of motion is now possible.

These fancy wheels have started appearing on different commercial products, including the Airtrax Sidewinder ATX-3000. This forklift is operated with two joysticks and can rotate in a full circle while remaining in one place -- no donuts here. It can also drive over anything up to 3 inches high. A big advantage of the Sidewinder is that a warehouse could be filled with more items because less room needs to be devoted to driving maneuvers, all of which can also be accomplished more rapidly.

To find out more about the world of high-tech tools and other interesting facts, follow the links on the next page.

Lots More Information

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