

THE MAKER'S ULTIMATE TOOLS

The tools we use — or wish we could get our hands on. By Saul Griffith

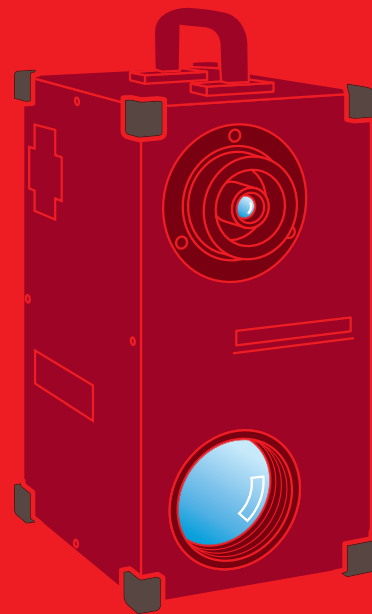
Here's what would go into an extremely expensive ideal toolbox for someone who wants to be able to make pretty much anything, from ultimate fighting robots to hybrid go-karts, and even play around with microelectromechanical systems. You can and will make do without these, but in a perfect world, where the streets are paved with socket wrenches, these five tools would be in your basement. For the complete list, turn to page 46. For an ultimate tools narrative, go to makezine.com/03/ultimate.



3D Printer, \$25,000

zcorp.com/products/printers.asp

This makes surprisingly beautiful parts; just don't expect them to be robust. It's the fastest way to go from computer model to physical part. My pick of the bunch is Z Corp's printer — it's the cheapest and fastest. Neat fact: They're used to print replacement body parts.

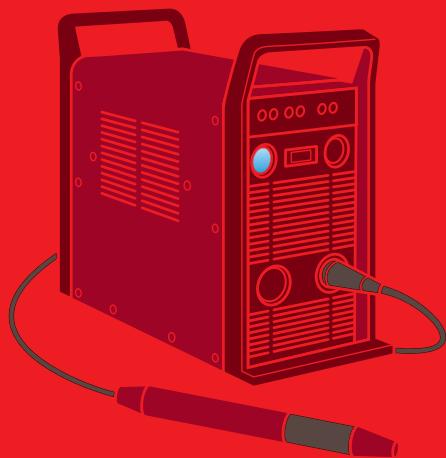


3D Scanner, \$30,000

kmpi.konicaminolta.us/vivid/default.asp

These machines are still quite expensive, and accuracy depends on how much you spend and the size of the object you are scanning. They're used a lot these days for restoration of antiquities and sculptures as well as assisting in surgery.

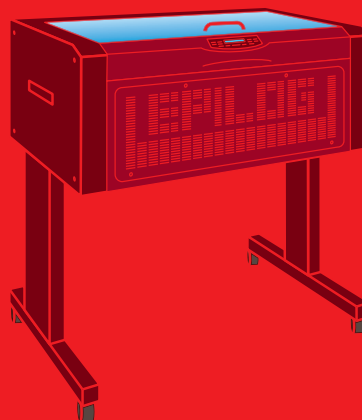
Illustrations by Nik Schulz



Plasma Cutter, \$10,000

toolking.com/hobart/view.asp?id=4276

It's more difficult to use than a laser cutter, but there's a big advantage: it cuts metal or anything that conducts electricity. Think of it as a robotic oxy torch. You can be up and running for about 10K. Make your own parts for that car restoration project or build custom aluminum chandeliers. Poor maker's alternative: An oxy torch and a very steady hand or a high-quality bandsaw and lots of patience.



Laser Cutter, \$19,900

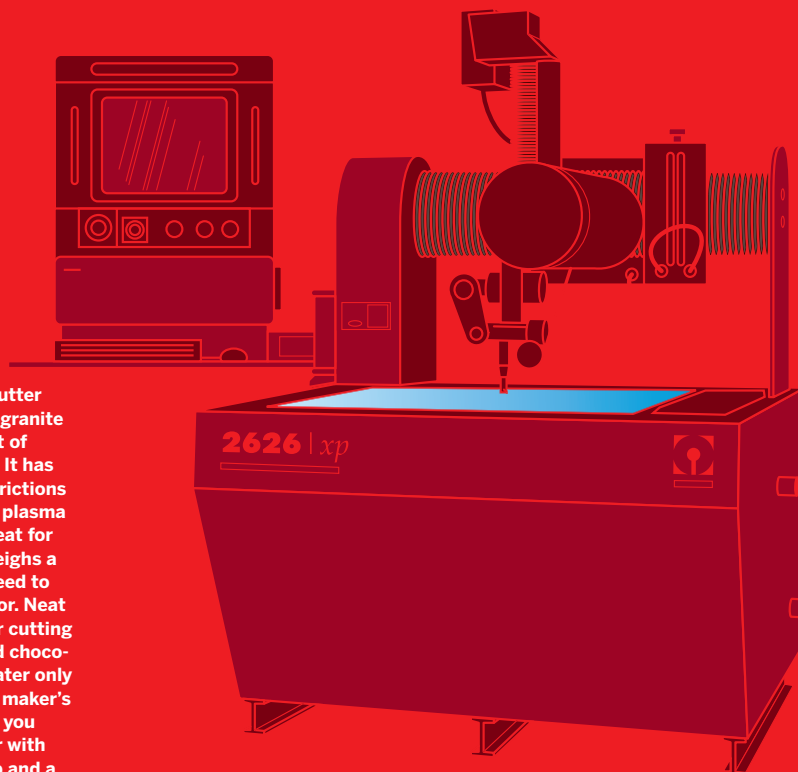
epiloglaser.com/mini2412.htm

CAD-driven high-powered lasers cut plastic, paper, and wood in thicknesses up to about $\frac{3}{8}$ inch with very high precision. For kicks, you can write your name on toast or etch your face on an eggplant. They're also good for cutting rubber stamps. Poor maker's alternative: Print the patterns with your inkjet printer and cut them out with a scroll saw. Not as accurate or as fast, but a workable workaround.

Water Jet, \$100,000

omax.com

This rich man's plasma cutter cuts through 8 inches of granite with a barely subsonic jet of abrasive grit-filled water. It has none of the material restrictions of the laser cutter or the plasma cutter (though it isn't great for wood). The water tank weighs a ton (literally), so you'll need to reinforce your garage floor. Neat fact: Used extensively for cutting up chicken carcasses and chocolate bars (though with water only — no abrasive grit). Poor maker's alternative: Rumor has it you can do something similar with a washing machine pump and a hypodermic needle.



Make: 45

THE ULTIMATE TOOL BUYING GUIDE

A complete list of tools you need to make almost anything.

If a genie were to grant me my wish for a shed full of tools, this is what I'd ask for. Think of it as an extremely biased guide to outfitting yourself with the ultimate shop for launching your own space program.

- Necessity
- Priority
- Extremely useful
- Surprisingly useful
- Infrequent but handy
- Can do without, better with
- You didn't know it was so lovely

Tool Name	McMaster #	\$ Budget	\$ Deluxe
Hand Tools			
Box Knife	3814a11	1	10
Precision Blade	35435a11	1	10
	38995a71		
	35515a12		
Claw Hammer	6484a21	10	50
Ball Peen Hammer	6481a31	10	50
Blacksmith's Hammer (Heavy Weight)	6462a24	10	80
Rubber Mallet	5917a8	10	40
Miter Box	4201a11	15	45
Hacksaw	4086a34	5	25
Tight Spot Hacksaw	4060a16	2	5
Hole Punch Tool	3461a22	40	150
Center Punches and Chisel Set	3506a76	25	120
Metric and Imperial Socket Sets	7290a24	30	1200
	5757a35		
	5582a11		
Torque Wrench	85555a221	50	300
Hex Key Sets, Imperial and Metric	5541a31	2	80
	5215a24		
	7162a13		
	5215a12		
Torx Key Set	6959a85	2	40
Mini-Hex Drivers	52975a21	2	40
	7270a59		
Combination Wrenches, Metric and Inch	5314a62	25	800
	5304a73		
	5314a25		
	5772a53		
Vise Grip Long Nose Locking Pliers	7136a19	2	50
Needlenose Pliers, Small and Large	5451a12	2	35
Bull Nose Pliers, Small and Large		2	35
Vise Grip, Large	7136a15	5	60

Tool Name	McMaster #	\$ Budget	\$ Deluxe
Vise Grip, Med Curved	5172a17	5	45
Adjustable Wrenches	5385a12	3	40
	5385a15		
Crow Bar / Ripping Bar	5990a2	2	30
Tube Cutter	2706a1	15	80
Glass Cutter	3867a16	2	25
Bolt / Chain Cutter	3771a15	50	150
Sheet Metal Snips	3585a13	10	40
	3908a11		
	3902a9		
Finishing Saw	4012a1	10	30
Coping Saw	4099a1	4	10
	6917a11		
Hole Saw Kit	4008a71	25	120
Pull Saw	4058a52	10	20
Metric / Inch Tap and Die	2726a66	40	1200
Drill Sets	28115a77	5	1200
	31555a55		
	31555a56		
	31555a57		
	8802a11		
	8802a12		
8802a13			
Deburring Taper	3018a4	5	80
Deburring Tools	4253a16	2	25
	4289a36		
Drill Stops	8959a16	2	10
Vise	5344a31	10	1500
Clamps	5165a25	2	45
Quick-Grips	51755a7	15	50
Jaw Puller	6293k12	50	180
Files	8176a12	2	100
	8194a12		
Hydraulic Floor Jack		25	200
Block And Tackle / Lifting Winch		50	500
Screwdrivers, Flat and Phillips	8551a31	1	90

Tool Name	McMaster #	\$ Budget	\$ Deluxe
Jeweller's Screwdrivers	52985a21 52985a23	10	40
Propane Burner		10	50
Heat Gun		50	250

Power Tools

18V Electric Drill	29835a16	25	300
Band Saw	4164a12	250	5000
Reciprocating Saw (Sawzall)	4011a25	120	250
Sliding Compound Miter Saw	3001a21	200	600
Tilting Table Saw	27925a12	300	2000
Drill Press	28865a31	100	2500
Plunge Router	36485a11	100	300
Manual Lathe	8941a12	500	5000
Mig Welder	7899a28	200	1500
Stroboscope	1177t92	25	250
Adjustable Hot Plate	33255k61	50	800
Dremel	4344a42 4370a5	50	150
Angle Grinder	4395a16	50	250
Bench Grinder	20535A654	75	300
Belt Sander	4892a21	100	200
Disc / Belt Sander	46245a49	250	1500
Bridgeport Mill		500	15000
Heisseschneider Hot Knife		50	200
Sewing Machine		25	2500
Air Compressor	4364k3	200	2500
Spot Blaster	31195k11 3210k11	50	500
Vacuum Pump		100	1000+
Oxy / Acetylene Torch	7754a12	250	1500
Plasma Torch		600	3000

Computer Controlled Tools

Inkjet Printer		25	250
Large-Format Printer		900	25000
Nc Mill		2500	120000
Nc Lathe		5000	150000
Laser Cutter (Co2)		12000	50000
Plasma Cutter		3000	20000
Wire / Sink EDM		100000	250000
Water Jet		80000	150000
3D Printer (Z Corp, FDM, STL)		25000	250000
Plotter / Cutter (Roland)		1000	25000

Electronics Tools

Wire Stripper		2	80
Pliers Set	5323a49	10	120
Work Holder And Magnifier	5007a14	5	100
Multimeter		75	250
Temp-Control Solder Station		150	1000

Tool Name	McMaster #	\$ Budget	\$ Deluxe
Hot Air Tool for Point Reflow / Desoldering		30	500
Bench Power Supply, Multi-Output		150	500
Toaster Oven, Adjustable Time / Temp		40	60
Microscope (See Safety / Measurement / Visualization)			
Oscilloscope		500	5000
Micro-tweezer Sets		2	100
Pick-n-Place		3000	25000

Fetish Tools

Optics Bench		1000	400000
Mask Writer		50000	1000000
Mini-jector		4000	50000
Thermoformer		1000	20000
ESEM		25000	500000
3D Scanner		5000	100000
Excimer Laser Cutter		100000	1000000
PCR			100000
Micropipettes		20	2000
Spin Coater		500	25000
High Temp / Vacuum Oven		2000	30000
Chemistry Hoods and Glass Equipment		2000	1000000
Ultrasonic Welder		5000	25000
Tube Bender		1000	40000
Tanks for Anodizing, Etching		25	2500
Kiln		500	5000
Anvil		250	1000
Crucible		20	2500
Thin Film Evaporator / Sputterer		5000	100000

Safety, Measurement, and Visualization

Safety Goggles	2404t21	1	10
Ear Muffs	9205T6	2	30
Micrometer	2054a75	5	300
Caliper	8647a44	5	500
Head-Mounted Magnifier	1490t3 1509t14	5	120
Feeler Gauges	2070a7	1	25
Spirit Level	2169a4 2169a1	5	50
Tape Measure	19805a74	1	25
Adjustable Stereomicroscope	10705t64	500	25000
Hot Gloves		5	100
Work Gloves		1	40
Welding Mask		15	100