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Embrace the philosophy of improvisational fabrication and really personalize your office cubicle. Kaden Harris—the unconventional mind behind Eccentric Genius (www.eccentricgenius.ca)—takes aspiring and die-hard makers into a highly entertaining parallel universe of surreal workplace-oriented projects that combine a wide spectrum of basic shop techniques, alternative material sourcing, and lateral design paths. From scale model Greco-Roman projectile launchers to mood-enhancing audiovisual effects, each project offers a different set of challenges, skills, maker lore, and bad puns.

Far more than a collection of project “how-tos,” Eccentric Cubicle offers oblique industrial design and fabrication philosophies, sardonic social commentary, and enthusiastic encouragement for Makers to adapt, modify, and hack their way through the builds.

Enhance your workshop skill set and bring character and life to your office desktop with Eccentric Cubicle!

Kaden Harris is the product of an unorthodox career path, an overused library card, an oblique imagination, and wonderful parents who never discouraged even his most absurd interests. A native of Paisley, Ontario (pop. 550), he escaped at the earliest opportunity for his education, and then entered the workforce...repeatedly. Kaden has worked as a graphic designer, as “The Banker” in the production engineering department of an electronics company, and as an effluent cook on the graveyard shift at Toronto’s main sewage treatment plant, about which the less said, the better. He’s also been a ceramicist, a glass cutter, a chef, a loughgard, a drummer in rock bands, and a scrapyard grunt. He’s a ceramicist, a glass cutter, a chef, a loughgard, a drummer in rock bands, and a scrapyard grunt.

He’s always built things, generally improvising them out of whatever was at hand. On the ragged edge between art and craftsmanship, he builds odd things that do stuff...or no, he builds things that do stuff...or no...that’s not it...um...er...OK...he builds things that do stuff oddly.
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Eccentric Cubicle

Kaden Harris
Eccentric Cubicle
by Kaden Harris

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Introduction: The Philosophy of Improvisational Fabrication

A Maker’s life is rarely fully funded, with an unlimited budget, a state-of-the-art shop facility, and a team of brilliant young assistants poised to spring into action and help bring a creative vision into reality. In terms of toolage, raw materials, and skillset/knowledge base, “work with what ya got” is pretty much standard-issue methodology for [insert really high percentage here] of us. Whether this situation ultimately proves to be limiting or liberating depends entirely on your attitude towards “comfort zones, working outside of.”

Now, I’ve never met an out-of-the blue creative impulse that didn’t warrant at least two sketches, a few Google inquiries and a cursory rummage through the parts bins. Before I know it, it’s 6:00 the next morning, and I’m waist-deep in technology I know almost nothing about, watching the coffee distill, wondering “what the Hell was I thinking?” and counting down the minutes until the scrap yards open their gates.

Comfort zone? What comfort zone?

Over time, this seat-of-the-pants approach to Making coalesced into something that’s almost definable, and definitely learnable: The Philosophy of Improvisational Fabrication. Common sense from a Maker perspective, it’s based on the following pillars.

The 5 “F”s:
Cliché alert: it’s one of those cutesy, alliterative lists self-help books are so fond of.
Live with it.

Figure out what you’re building
What’s it supposed to do, and how’s it supposed to do it?
Parse your project down to the basic mechanisms required to make it work. Pay attention to how these subassemblies act and interact. Get a comfortable understanding of the factors at play, the physics involved, and the Aristotelian “total is greater than the sum of the parts” factor. There’ll be a number of different approaches available for each component mechanism: never be afraid to consider a Plan B . . . or C.

Critical components become apparent as you go, which helps when you’re sourcing parts, and you’ll suss out the control points you’ll need to consider when doing your U.I.

My experience has been that breaking anything down to its contextual basic components is the single most valuable technique for getting a tangible understanding of what you’re dealing with. Of course, once you’ve gained that understanding, feel free to improvise with wild abandon. Not much different from playing jazz or writing code, when you think about it.

Forage for parts
Improvisational fabrication works best with a rich and varied array of raw material. Repurpose components from scrap yards, thrift shops and dumpsters. eBay is your friend. The design (both industrial and visual) of your project will coalesce around the aesthetic of one or two of the...
components you source, which makes a “big picture” view of the mechanism essential. When this occurs, hit the drawing board/CAD app and start dealing with specifics. Your parts list will shuffle itself into three categories: parts you’ve found and repurposed, parts you have to buy, and parts you have to fabricate from scratch.

You now have a firm grasp of the task ahead.

Cool.

If you have any blanks in the skill set required to deal realistically with the job at hand, now would be the time to learn stuff. This learning may lead to the discovery of blanks in your tool set, at which point the financial realities of pursuing Plan A may spur heightened enthusiasm for Plan B — so be prepared.

Fabricate the damned thing
Projects define themselves as a series of subassemblies. Consider the sequence of these events carefully, both from an efficiency standpoint and from an assembly standpoint. Wherever possible, make disassembly as easy as assembly. It is a foregone conclusion that you’ll be taking the project apart repeatedly.

There is a logical order to do things in, which may or may not be the most apparent build path. Take your time, and ponder where needed.

Despite your best intentions, there’s a strong possibility that some particularly clever aspect of your design is not gonna work, and you’ll be troubleshooting/redesigning on the fly. This is a character-building experience which will expand your vocabulary of colourful pejoratives and have you rummaging through your parts bins at 3:30 a.m. looking for a 10-32 lefthand thread brass thumbwheel.

Think while building, pay attention, and be patient.

Fine-tune the mechanisms and aesthetics
A well-thought-out design, accurately built to realistic tolerances, will work, plain and simple. How well it works usually depends for the most part on a few crucial measurements lying well to the right of the decimal point. Identifying these tuning points, and implementing workable methods of adjusting these factors, are part of the industrial design “big picture” you should always be cognizant of. Successful improvisation deals with these issues at every stage of the build.

Finishing and detailing a smoothly functioning mechanism is always fun. The personality of the project should be pretty tangible by that point, which makes customizing and accessorizing less of an ordeal, and more of an obsession. Once again, having the will to adapt is essential. The Great Cosmic Random presents unexpected options much more frequently than most people care to acknowledge. When they become apparent to you, embrace them with confidence and enthusiasm.

Field test the finished device
Use what you build. A lot. Pay attention to how it functions, how it handles the strains of operation, and how easy it is to use. If you’re lucky, you’ll be able to patch any problem areas before long-term damage occurs; at the very least, you’ll learn what not to do on Rev 2.0.

Get someone else to use it, and pay attention to how they interact with what you’ve built. If they have issues, deal with them. You’re gonna be hearing, “Whooooa . . . is that ever cool! Can I try it?” more often than you ever imagined. Don’t disappoint the masses!

You might want to keep Plans B and C handy, in case a radical rework or two are needed. And when you’re well and truly satisfied with your work, a celebratory cocktail is appropriate.

What a Bunch of Tools
About ten years ago, I built a very formidable four-poster bed using only a Swiss Army knife and a rock.

I am not making this up.

Fortunately, the décor style I was building for was a wiggy “H.P. Lovecraft meets the Addams Family” kinda theme. (Like it could be anything else with this honkin’ big chain-draped monstrosity of a bed sitting dead center.) It looked better than it sounds.

Events such as that make a fella truly appreciate tools. Lots and lots of tools.

Tool collections start small and grow as needed. Depending on the fabrication techniques you choose to explore, they can grow at a disconcerting rate. I’m a meat ‘n’ spuds classic tool guy for the most part, and I’ll bodge a tool together rather than buy something if it’s feasible . . . but that’s me.

I assume you have basic handyman/car maintenance tools: screwdrivers, locking pliers, hammers, tape measure, soldering iron, adjustable wrench, and maybe a set of sockets and box wrenches. That sort of stuff.

A well-equipped home workshop? Well, it’d help a lot, but it’s not essential to start out with.

Here’s what I personally view as essential tools. Your definition of “essential” will vary; your disposable income will still disappear like blinis in Gdansk.
Saws
Let’s talk about saws first. There are about 8 billion different kinds of them, and at some point in your Maker career, you’re going to wish you owned each and every one of them.

I’ve built my toolset by buying to need: I needed to mill stock out of bigger chunks of wood. If you personally feel motivated enough to do that with a handsaw, I salute you, and when you’re in town, the walnut martinis are on me. Me. I bought a table saw. Or “rescued” a table saw, actually, having come across the legendary Rockwell Beaver alone, unloved and abandoned in the lane behind a soon-to-be demolished Italian restaurant of dubious repute. Table saws are the undisputed king of the shop: loud, dangerous, and effective: everything a power tool should be.

That lets me mill stock, do compound miter cuts with pretty good accuracy, and make sawdust with alarming efficiency. They’re very hackable tools, and can be jigged and modded for countless other tasks. There exists a thriving aftermarket accessories sector, with countless manufacturers offering miraculous-sounding bolt-on geegaws, gizmos, and all-important doodads in exchange for the contents of your bank account. I recently retired the Rockwell and got a new table saw of Asian origin that has a sliding miter table built in instead of the traditional slot-and-insert thingie most similar toolage has. This innovation has apparently caused quite the hullabaloo in the traditional woodworking community, with many Grandpa Simpson types loudly predicting the end of the world as we know it.

Get over it . . . it’s a saw.

I bought one near the bottom of the manufacturers’ line, just to see what all the fuss was about. It’s okay, actually. The build quality of the saw is horrendous in general, but it’s accurate, and the sliding table is really quite versatile. Out of the box it’s more useful than a regular table saw, but nothing you can’t jig together in half an hour on a standard machine.

I needed precise miter cuts: I snagged a German-made frame-maker’s mitering saw at a thrift shop for $12.99. Not a whole lot of frills: stock clamping, end stop, front and rear depth stops, and preset stops in the mitering gauge at the usual angles. It does what it says on the packet — no muss, no fuss. Highly recommended, even if you have a good table saw, just for the finesse factor inherent in doing it by hand.

I needed to cut doweling off flush with surfaces; I bought a Kugihiiki, which is a Japanese flush-cutting handsaw. The teeth on the flexible blade are kerfed in one direction only, which protects the surface you’re flush-cutting from damage. The saw cuts on both the push and the pull strokes so it practically melts through wood. Nothing short of miraculous, actually. You need one, if only to impress visitors.

I needed to cut metal; I bought large and small hacksaw frames, and keep ’em filled with the best blades I can afford. That’s the thing about hacksaws: the frame just holds the blade in place. Love the blade, not the frame, as it were. Now, I know a lot of you are thinking: “What’s he on about with hacksaws? I possess the mystical Dremel, king of all of tools! Materials of all ilk bow before my mighty cutting power.”

Uh huh . . . well, knock yourself out, Mr. Weensy Abrasive Disk. Send us a postcard when you finish cutting up that 1” x 1” copper bus bar.

I’ve had the same handsaws for years, and frankly, none of them are any good. A traditional 22” carpenter’s handsaw can do a lot of things reasonably well, but nothing exceptionally well — except make sawdust. They do that with impressive coverage. Your standard miter saw is good for 45-, 60-, and 90-degree cuts, and a 45-degree bevel if you’re lucky — none of which will be particularly precise. You need to have both, but don’t break the bank on them. Better to invest your tool-buyin’ dollar on more specifically purposed equipment.

Saw wise, buy what you need.

Here’s the rest of the Daily Tools. Some are run-of-the mill, some specialty, some homemade.

All invaluable.

Cutting Holes
Drills You’re gonna need an electric drill. A drill press would be nice, but isn’t really essential. I’ve never been satisfied with any of those clamp-ya-drill-into-this-gizmo-and-voilà-instant-drill-press thingies on the market, although your results may vary. Given a choice between cordless convenience and the consistent torque and speed provided by a corded tool, I’d opt for something with a cord.

The drill press is absolutely the unsung hero of the workshop. I seriously overuse mine. I’ve bodged together jigs to turn it into a lathe, router, and thickness sander; a bunch of stuff nature never intended for the poor thing. I’m drawing up a poor-man’s CNC (computer numeric control) sliding vise for it, even though there’s no real chance that I’ll ever have the time to build it. Commercially available drill presses range from dirt cheap to OMFG expensive. You can
shop according to your own budget, but I strongly suggest actually getting your hands on any model that you’re considering buying. You need to feel for yourself exactly how solid the mechanism is (or isn’t). On Planet Drill Press, “solid” beats “bells ’n’ whistles” every single time.

**Bits**
If you haven’t invested in a reasonably good-quality set of bits, from at least \( \frac{3}{8} \)” to \( \frac{1}{32} \)”, now is the time to do so. You’re a Maker. Makers make holes. Get a set of Forstner bits, too; they’ll let you drill smooth-walled, flat-bottomed, large-diameter holes in wood. Yes, this is important. Hole saws in various diameters are good to have around, in that they make both large-diameter holes and large-diameter circular plugs, which can easily turn into wheels, pulleys, or cogs. This is a marked improvement over spade bits, which make large-diameter holes and prodigious amounts of wood shavings. Spade bits win on depth of hole however. Buy what you need, and buy reasonable quality, bearing in mind that they’re gonna go dull eventually.

There’s a strong tendency to treat drill bits as disposable toolage, as sharp drills are essential, and putting a fresh edge on a bit by hand is an entirely arcane skill, well beyond the ken of we mortals. If you find yourself drilling a lot of holes in a lot of materials, then take a close look at the Drill Doctor, a semi-automated bit-sharpening machine that does what it says on the package. You will toast the inventor of this machine with high-quality hooch each and every time it saves you a run to the hardware store on a snowy afternoon because your \( \frac{5}{16} \)” bit is too dull to bore cheese. Not an essential tool, but an exceptionally useful one to the busy, forward-thinking, and frugal drillfella. It may take a while, but it will save you money eventually, and really, it’s a pleasure to know you’re always working with a sharp bit. [Figure 01.01]

**Cutting fluid**
The juice that facilitates working with metal. Lubricant, coolant, general-purpose metalworking mojo in a bottle. Hardcore alloy artists can get unrealistically passionate about this stuff, for some reason. A friend of mine has different formulas on hand for a bewildering variety of metal/tool/tool speed combinations. Me, I keep a can of WD-40 parked by the drill press and apply as needed. (I’m gonna hear about this, I can just tell.)

**Tap and die set**
Sounds like a punk version of Riverdance, no? We’re talking thread cutting here. “Turn a piece of brass rod into a bolt” thread cutting. “Drill a hole and cut threads into it” thread cutting. Makin’ nuts and bolts, dammit. Very useful tools indeed.

The basic set pictured covers metric and most SAE sizes up to \( \frac{3}{4} \)” and set me back about a hundred bucks. I’ve added a set of jewelers’ sizes to it, and a few nonstandard types (left-hand threads, mostly), as well as stocking up on the smaller-diameter taps that see the most use and are most prone to dulling and breakage. [Figure 01.02]

**Cutting Other Stuff**

**Model-maker’s chisel set**
Buy the best quality set you can afford, and guard it jealously.
Razor knife Spend the extra money to get a high-quality one with a solid blade-locking mechanism and an ergonomic handle, and don’t be afraid to refresh your cutting edge. Use in conjunction with the following item.

Self-healing cutting mat Don’t argue — just buy a nice big one and use it. Improves cut accuracy, and saves your blades. Really impresses visitors too, for some reason.

Jack plane, and planes in general Man, do tools have the coolest names, or what? Smoothes out wood surfaces, and reduces dimension subtly. Get a modest-sized one to start out, and plan on messing up a lot of wood until you become one with the tool. It’s a worthwhile investment over time. Also worth getting is a pair of miniatures: I actually use mine more than any full-sized plane in the house. You can find them on the ‘Bay dirt-cheap: cutesy little block and chisel planes, about 1/8th regular size. If you keep the blades sharp, they’re invaluable. [Figure 01.03]

Pipe cutter Damn straight, Bunkie. We’re cuttin’ pipe! Well, tubing actually. Either way, the thing about pipe is that it doesn’t stretch. It doesn’t take kindly to compression either: any fabrication involving long metal cylinders is . . . or . . . dimensionally unforgiving. It’s gotta be the right length. You could use your hacksaw and miter box, then true up your dimensions and dress your edges with emery cloth, needle files, the Leveler (you’ll learn about this shortly) and a set square, or you could use one of these while drinking a cocktail. [Figure 01.04] It’s your call.

Whetstone (and the skills to use it properly) Sharp tools are happy tools.

Measuring

Quilter’s measuring gauge Seek out a sewing supply store and be amazed at the variety of efficiently designed drawing and measuring tools. The needle and thread community know measuring. This 2” x 2” square of metal gives you accurate right angles and measurements from 1/8” to 2” in 1/8” intervals. [Figure 01.05]

12” carpenter’s square I soundly encourage a non-Euclidean approach to life. That said, a majority of mechanisms are generally more comfortable with a “right angles/straight lines” kinda thing. Use appropriately. [Figure 01.06]
Introduction

Set Square Accurately setting up your power tools helps achieve the aforementioned “right angles/straight lines” environment.

Calipers Inside and outside. Transferring a measurement directly to the stock as a physical analog is inherently more accurate than the multiple format changes a dimension goes through when a ruler is involved. Get them at a swap meet from the same guy you buy your needle files from.

Protractor You can get away with using the one from your grade school math set, but use something more accurate if you can get one. All you’re really looking for is an accurate angle measurement to check your cuts against. About five years ago, I dug a very slick little laptop drafting table out of the dumpster behind a thrift shop. I use its protractor function in the shop for angle checking. Yes, there are better ways. No, I can’t see myself changing.

Compass For drawing circles — knowing where magnetic north is rarely important during the fabrication phase of a project.

French curves Before the advent of spline curve based digital drawing, the French curve was the go-to tool for
drawing smooth polyradial curves. Now, do not mistake me for a Luddite in any way, shape or form; I do 95% of my design work digitally. The other 5%, where I’m finessing the visual aesthetic and trying to make a curve work with the grain and texture of a specific material, I use a French curve. You’re a CAD uberuser with no pretension towards artsy-fartsy nonsense? You don’t need it. [[Figure 01.07]]

But if you had one, you’d use it, because it’s handy.

**Sticky Stuff**

**Wood glue** Real wood glue, dammit. Not that minty fresh white stuff preschoolers eat.

**Double-faced tape** The regular stuff and the foam-backed stuff.

**Thread adhesive** Think “chemical lock washer.” I use the semi-permanent stuff from Loc-Tite. It’s pink, and smells ghastly, but it does exactly what it is intended to do, which makes it easy to overlook the hideous odour.

Well, almost easy.

**Aerosol stencil adhesive** This is amazingly useful stuff. I use a no-name dollar store brand that sets up to about the consistency and tackiness of the adhesive on a sticky note. It adheres solidly enough to hold two flat surfaces tight during fairly rough handling, and it’s easy to remove with minimum residue.

**Aerosol contact cement** Stencil adhesive’s tough-ass brother who was in the Marines. Make adhesive sanding discs, veneer with impunity, stick stuff together with child-like enthusiasm. Glue hairless animals to the wall.

**Abrasives**

**Sandpaper** 60, 100, 150, 400 and 600 grit. For hand sanding, making your own sanding pads is the only rational approach. I really like the dense plastic foam they extrude those pool noodle thingies out of — you can carve it easily to whatever profile you need using knives, hot wires, or power sanders, then use aerosol stencil adhesive to glue on the abrasive surface of your choice.

As an aside, I recently came into a supply of the most intimidating sandpaper ever produced. It’s labeled as 40 grit, which is a grossly conservative assessment of its coarseness. Imagine the roughest gravel road you ever found yourself lost on. Now laminate it onto a sheet of paper with brick-red resin, and that is a close approximation of the awesome abrasive might that is contained on these sheets. I’m using it with extreme caution.

**Emery cloth/paper** 80, 150, 400, 600, and 1500 grit. Proper cloth for the coarser grits, wet and dry paper for the finer ones.

Manicurists’ emery boards are also pretty handy to have handy for quick surface touchups and localized special attention, but be aware that all emery boards are not created equal. Brave the cosmetics section of your local pharmacy and engage the salesperson in meaningful technical discourse regarding the abrasive qualities of their emery board selection. I’m serious.

**Steel wool** Medium, fine, and extra fine.

**A dead-flat sanding surface** You probably don’t have one of these, but if you had a can of aerosol stencil adhesive and the abrasive paper of your choice, all you’d need would be a really flat surface. Marble cutting boards are okay, although I’ve seen some that were a little convex. Personally, I use a piece of 5/16” mirror, with the theory being that any...
imperfections in flatness will show up as distortions in the reflections . . . yeah, right.

Seriously, it’s a worthwhile tool to build. Use the lightest possible coating of stencil adhesive on your abrasive paper, and a sheet of glass to press it completely flat onto your official surface. The stencil glue makes it easy to change abrasives. You can do thickness sanding by hand with 50 grit (there’s a certain Neanderthal pleasure in making that much sawdust manually), and put a mirror finish on brass plate with 15 micron polishing paper. I use mine a lot to true up miter cuts and get nice flat surfaces after glue-ups. I call it “the Leveler.”

Sanders You need a $\frac{1}{3}$-sheet pad sander to flatten and smooth out wood surfaces. That’s all there is to it. You might also consider one of those cute little detail Sanders, but I gotta confess that I have yet to see one of these things from any manufacturer that was really well designed. It’s like the guys who did the I.D. on them (yeah, all of ‘em, every single one) thought the term “woodworking tool” was a colloquialism for “sex toy.” Sheesh. Ergonomic and industrial design issues aside, they’re really quite useful. [Figure 01.08]

Belt/disk bench sander Personally, I prefer a sanding belt running in the vertical plane. My little Delta 1” belt/5” disk model cost about 80 bucks at Canadian Tire. The cool thing about this wee beastie is the ability to remove the back plate from the belt path, leaving you with an amazingly useful flexible sanding surface. Curves can coexist with right angles and straight lines, and this tool lets you approach forming curves in a very controlled freestyle manner. The stick-on abrasive discs are invariably optimistically priced by the retailer. See: Sandpaper, Aerosol contact cement, Razor knife, and Compass, and make your own. [Figure 01.09]

Bench grinder Removing large amounts of metal? Buffing up a high gloss? Save time: get one of these; collect every overachieving wheel, pad, and brush you can find for it; and spend the time you save foraging for components.

Dremel Oh, alright . . . if you have to. But build a foot pedal speed controller for it, wouldja? (Conveniently, there is a how-to on the subject contained in this very book. See Chapter 9.)

Needle files I paid 10 bucks per set at a swap meet. Ten different profiles in a set, and they’re made to cut with the edges as well as the face surface. They are exceptionally useful tools. Jewelry makers use them to finesse intricate gold castings, and they’re the gunsmiths’ tool of choice for filing a hair trigger. Each file in the set has a different profile: various radii, assorted acute angles, flat, cylindrical . . . you get the idea. It’s a well-thought-out collection of shapes for finely detailing metalwork. Think of a Dremel grinding bit as a being a chainsaw; these are scalpels. [Figure 01.10]

Hold ‘ems Jigs Jigs are our friends — there is no better way of ensuring accurate, repeatable assembly glue-ups, cuts, and hole positioning than by using a jig, and the real joy comes from the fact that they are so damned easy to make. (And see the nano-project at the end of Chapter 2 for instructions for making an endlessly adjustable one of your own.)

Clamps You will reach a point where you absolutely cannot have enough clamps. Collect multiple styles and sizes, but at the very least have four 18” bar clamps, four 6” C clamps, and a drawer full of those black-and-orange clothespin-style ones. [Figure 01.11]
Figure 01.10: Jewelers’ needle files: the Maker’s secret weapon for fine-tuning a mechanism.

Figure 01.11: The clamp food chain illustrated

Figure 01.12: My secret vises
Dressmakers' elastic  Once again, the needle-and-thread contingent comes through with an amazingly useful product (even if we are repurposing a tad). I found this stuff at the local sewing supply shop in widths from 1/2" to about 4", priced at around three bucks for a hundred-foot roll. Picture a near-endless piece of elastic waistband from industrial strength boxers and you've got it. Clamping an irregularly shaped glue-up? Need even pressure applied all the way around? This stuff is the answer. Wrap the WIP (work in progress) in question in this stuff, from every direction, and wait for nature to run its course on the glue consistency. I find 1" and 3" widths to be the handiest.

Numerous vises  Bench vise, drill press vise, woodworking vise, tilting vise, jewelers' vise — you can never have too many ways to hold your work solidly in position while you do stuff to it. I'm a bench vise traditionalist, for the most part. Gimme “Strong Like Bull” over “Gosh, Aren’t I Clever and Versatile” any day of the week. That said, I have an unseemly number of vises in the shop.

Use whatever you like, but use something. You'll need to make some wooden or leather covers for the jaws if you don't have something appropriate already, to protect the surface of whatever slab of expensive wood/metal that ends up clamped in them from getting chewed up. If I catch you going out and paying for jaw covers, expect an interesting late-night visit from tool ninjas. [Figure 01.12]

Other  A couple more.

Propane torch  Just yer basic propane torch, with a tin of plumbers paste flux and a spool of joint solder. [Figure 01.13]

Rubber mallet  Our old friend, the blunt instrument.

The Right Stuff . . .

A big factor in Improvisational Fabrication is material selection: the right stuff for the task at hand, as it were. Knowing material properties and being able to adapt both your design and fabrication techniques to make effective use of the materials at hand are two of those essential skills that make a Maker. Most of the lore involved is common sense, tempered by a strong sense of compromise. It'd be nice to be able to use advanced carbon fiber and nanomaterial technology on every project. Realistically, you're gonna use whatever you can find on sale, dig out of a dumpster, or find in a shoebox in the attic. Here are some useful thumbnail guides to material selection. No, they are not overwhelmingly comprehensive. Yes, they are useful.

MDF (Medium-density fiberboard)

- **Advantages:** Cheap, available, easy to work with.
- **Disadvantages:** Not particularly strong, not particularly water-resistant. Ugly as sin.
- **Uses:** Big, flat surfaces; jigs.

Plywood

- **Advantages:** Ubiquitous. Comes in lots of flavours, grades, and thicknesses. Generally quite flat.
- **Disadvantages:** None, really — as long as you remember that it's plywood and treat it as such. Which means it ain't pretty, has challenging end grain issues, and delaminates at the least appropriate times.
- **Uses:** Big flat surfaces of varying thickness where end grain is not an issue.

*Softwood* (Basic 2’ x 4’, for example)

- **Advantages:** Cheap, available, easy to work with.
- **Disadvantages:** Soft: the surface damages easily, and long
lengths are prone to warping. Appearance varies, but can turn into a “50s rec room” knotty pine horror with alarming ease. 

**Uses:** Framing, internal support structure, jigs and fixtures, test cuts.

**Hardwood** (Maple, birch, oak, walnut, countless other species)  
**Advantages:** Hard, resilient, Looks like real wood because it is. Comes in a mind-blowing array of colours, grain structures and resiliency.  
**Disadvantages:** Expensive, tougher to work with than softwood. Proper finishing can be a righteous pain in the ass.  
**Uses:** Personally, just about everywhere. Maple is my go-to material for a lot of stress-bearing components, and I’m not just saying that because I’m Canadian.

**Brass**  
**Advantages:** Easy to work with, resilient, widely available in an inspirational variety of form factors. Learning how to look at plumbing fittings and not see “just plumbing fittings” is absolutely epiphanous. Thermally and electrically conductive. Buffs up all pretty like.  
**Disadvantages:** Soft.¹ Tarnishes at an appalling rate.² Won’t hold an edge.  
**Uses:** Mechanism components. Moderate load structural components. Connectors.

**Copper**  
**Advantages:** Thermally and electrically conductive, easy to work with. Ubiquitous in a variety of form factors, most usefully pipes, tubes and sheets. Solders easily.  
**Disadvantages:** Soft. Really, really soft. Tarnishes easily. Becoming ridiculously expensive. Won’t hold an edge.  
**Uses:** Moving electrons, heat, fluid or gas. Ornamental cladding. Big shiny cylinders that aren’t PVC drainpipe.

**Aluminum**  
**Advantages:** Lightweight, easy to work with, strong alloys readily available. Cast and extruded components widespread in countless form factors. Inexpensive. Thermally and electrically conductive. Can be melted and cast easily. Polishes to a mirror finish. Ubiquitous. Weldable.  
**Disadvantages:** Some alloys have brittleness issues; cast pieces in particular can shatter under impact. Corrodes easily and unattractively. Not easy to weld. Won’t hold an edge.  
**Uses:** Just about everything. It’s a versatile material to begin with, and the enormous range of preformed shapes you encounter at scrap yards makes it damned inspirational.

**Stainless steel**  
**Advantages:** Strong, corrosion resistant, most alloys are nonmagnetic. Weldable. Holds an edge while still being readily sharpenable.  
**Disadvantages:** Difficult to work with. It’s a tough but prissy metal: a challenge to weld, discolors under excessive heat, beats the shit out of your tools. Requires skill and finesse to do it justice.  
**Uses:** Limited from a general-purpose fabrication standpoint. Use where its particular material properties are needed, or if you find a component preformed that will repurpose easily. Generally a pain in the ass.

**Other ferrous metals**  
Reg’lar folks’ steel and iron. Magnets stick to it, rusts like crazy, about a bazillion different alloys of varying provenance and properties. Iron is the metal that changed civilization: tough, versatile, universal. Not an easy material to work with any precision without Spending Money On Tools.® I use it where needed for strength.

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¹ Not “soft like softwood,” but “soft compared to other metals.” I generally do not recommend using brass rod as an axle or pivot point in a high-load situation due to the extreme risk of it bending. Harness the inherent softness of brass constructively by using it as bushing material to separate harder metals from the delicate fiber of wood. A properly sized and polished bushing is nearly as effective as a bearing race in terms of reducing friction.

² There’s a reason that brass musical instruments are heavily lacquered, and this is it. Hours of elbow grease expenditure lapping and buffing brasswork up to a near gilded gloss disappear before your eyes as the powers of oxidation exert themselves and turn the damned thing green overnight. This is crazymakin’ in the extreme, which means that having a good brass polish close to hand is essential. Personally, I use “Flitz,” which is this weird blue goop in a tube. It’s of Teutonic origin, so local availability may be problematic, but it’s well worth seeking out.