A better soda can stove

Back in the early days of New France, a coureur des bois would spend a little fortune for his ultra light birch bark canoe. Space era materials now abound in consumer products. The modern backpacker will also find many opportunities to trade a large amount of money for light gears. Every gram count. Tents have carbon fiber frames, fork and spoon are merged into titanium sporks, white leds provide dependable light sources, Gore-Tex and microfiber enable light, warm, waterproof cloths. The outdoorsman value light gears. It's part of his nature. It's enough work to carry oneself over rough portage; who would want to carry a hard wood boat?

The modern outdoorsman have it easy. His expeditions won't make him rich, but he will find all his gears at the local store. However, money won't buy him the ultimate stove. The ultimate stove cost only 20 cents of supplies but one have to make it himself.

There are many light stoves available to the backpacker. Propane, white bas, hexamine, sterno, or just camp fire. One doesn't need to carry a lot to be able to cook in the wild. When the coolness of hi-tech settles down, backpackers agree that it pays to keep it

simple. The stove that packs the most bang per gram, that will never fail, is so simple that no one wants to sell it. It's the soda can stove.

The extreme simplicity can be deceptive. There are several variations on this basic theme and even if most serious backpackers agree that the soda can stove is the ultimate stove, the details of fabrication is the subject of heated debates. Should one use glue? Is it still zen if you have a threaded filler screw? Open flame or pressure jets? The Zen Stoves Website have detailed instructions for many of the dominant designs. Here I want to share how I adapted Robert Butler's Cobra Stove. My variation retains the Cobra's simplicity in design while allowing more refinement in construction to produce a good looking, reliable and safer stove. I call it the *Hannah Stove*. This is the design that I used with great success on the Kilauea and on the North Shore of Oahu.

While I was experimenting with early prototypes, it became evident that I wanted a pressure stove. Pressure stoves are more fuel efficient and they have fewer internal parts. I wanted something easy to build but most of all, I wanted a method that would yield consistent stoves. After learning the hard way, I decided that safety was to take precedence over those two requirements. Building a Hannah Stove will take you only one hour. Lets get started with the requirements.

At bare minimum, you will need

- 3 soda cans;
- 1 wood block;
- 2 wood screws;

- 1 box cutter (just the blade actually);
- 1 3mm drill bit (anything from 2mm to 5mm will do);
- 1 electric drill;
- 1 X-acto style knife;
- 2 sewing needle.

This is all what you need to get a functional stove.

To make your stove pretty you will also want to get

- fine waterproof sandpaper (600 or 1000 grit);
- polishing compound (yellow or green is best);
- buffing wheels.

This last list is for polishing. You could do it with steel wool but that's a lot more work. With basic polishing equipment you will have a shiny stove in no time. If you go for the shiny stove, remove the paint from two of the cans before you open them. Use the sandpaper for that. Be sure to smooth the bottom where there is not paint as well. Use plenty of water to prevent the sandpaper from clogging. Don't overdo it. You only need to clean about 5cm from the bottom of two the cans.

Now would be a good time to enjoy a glass or two of your favorite soft drink. You need to empty the two clean cans before you proceed.

Having a good time? So do I. Attach the box cutter blade on top of the wood block so that it protrudes a bit. You will use the wood block as a guide to achieve a neat cut on the can. This is a tricky part. The Hannah Stove doesn't use glue or sealant. That means that you need to fit the parts really tight. You can only do that if the cut is really clean and straight. You will probably need to use a spacer to adjust the blade height. Find something to put either under the wood block or under the can so the blade is about 2.5cm from the bottom of the can.

To get a real clean cut, you need to push the can firmly against the wood block but only slightly against the blade. Technically, the vector of your force should be almost orthogonal to the side of the block and at most 20 degree against the blade. You then just rotate the can until the blade passes through. This will take at least 20 turns. You budgeted one hour for the whole thing, right? The final cut should be really straight with almost no bumps toward the inside. Minor bumps can be dealt with. When the blade goes all the way through at one point, it might start to jam when you rotate. You should be able to separate the two ends by wiggling them gently without more cutting. I mean, really gently; no bumps.

Once you have cut the two cans, it's time to assemble your stove. The Hannah Stove is press fit. If you have peace of mind, you can just align the can bottoms and fit one right into the other. It is easier to do that if you enlarge one can bottom a bit. That's what the third soda can is for. This can should still be sealed. Select the can bottom with the less

inward bumps, this will be your stove bottom. You will ram the third can into it. The only way to take the third can out afterward it to use vapor pressure. Pour a few drops of water in your stove bottom and ram the third can in it. Of course, when I write *"ram"*, I mean *"really gently push downward"*. If it didn't get stuck there, you are all set. If it did, pour a few drops of methanol in a pan under the two jammed cans and set it ablaze. Both will just pop apart. That or the unopened can will explode. It doesn't happen often but for this eventuality you might consider replacing the unopened can with a can filled with plaster.

Some people claim that packing some absorbent material in your stove improves vapor pressure. Others say that it slows down the pre-heating. Both are completely missing the point. Ultimately, you want to use your stove in some unfriendly, and most likely, uneven terrain. The benchmarks you make in your kitchen are nice but they should not take precedence over real world usage. So, imagine that your stove tips, and I assure you that it will. You have a pressure stove and it will spit out its flaming fuel as fast as it can. Also, you are bound one day to forget to put back the refill cap. When you light up your pressure stove, the least that can happen is an internal explosion. This will spray flaming fuel all over the place. If you are unlucky, the stove will blow up, spraying flaming shrapnels instead. Packing might affect the performance of your stove, it might improve it or it might decrease it. But, this is not why the Hannah Stove uses packing. Packing is for safety.

The Cobra stove is clever with that regard. There is no refill hole on the Cobra. The refilling is done through the jets. The jets are small enough to prevent fire from entering the stove. This has two problems though. The first is that refilling the stove is really slow. You need to wait for the fuel to go through those really small jet holes. The other

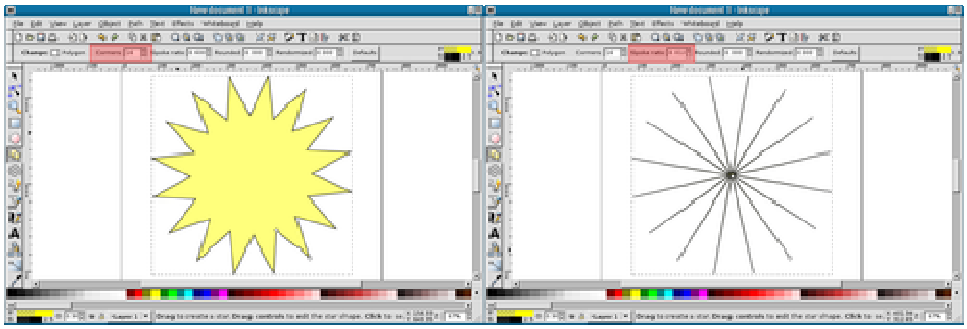
problem is that the stove is still vulnerable to tipping. Packing your stove with absorbent material solves all those problems. If the material is absorbent enough, tipping will only spill the excess fuel that is not retained by capilarity. The absorbent package will also block the filling hole from the vapor chamber. That way, you have a large hole for fast refill and if you forget the refill cap, the Hannah uses a coin instead of a screw, you don't blow anything. You just get a larger jet. This jet will be too large to be efficient and it will waste fuel but, that's the beauty of a simple design, you can simply throw in your coin cap while the stove is running to fix the problem.

So many words for a simple operation. To pack your stove, fill the bottom with noninflammable absorbent material. I use fiberglass insulation fiber. Perlite and vermiculite is also a good choice.

Before you lower the top of your stove over the bottom, drill the filling hole. If you don't, the air pressure might disassemble your stove before you are done, which is really frustrating. Start with 3mm, you can always enlarge later.

By now, if your favorite soft-drink is the same as mine, you should have peace of mind; you will need it for the next part. This can be really frustrating but if you followed all the instruction properly it will work, eventually. The top of your stove is a little bit smaller than the bottom. You need to lower it really straight into the bottom and to tap it gently until it fits mostly flush. To get it started, you can cut a section from the top a of can that you will use a guide. You need peace of mind while assembling any kind of zen stove, but especially while working on those that don't use sealant.

If you wreck one or both part, don't worry. You lost at most 20¢. Just cut another soda can and try again, with peace of mind and a stiff drink. When you finally get it, you can make the jets. The easiest way to have the jets aligned is to use a hole model. I made mine (SVG) with the star tool in Inkscape. I set the number of arms to the number of jets that I want and the inner radius to 0. The template section of the Zen Stoves website has several ready made hole models.



How many holes you want depend on the size of your needle. A lot of small holes gives best result. I use 24. Fix your hole model on top of the stove. Blu Tack works well for that. Cut a needle and fit it in the X-acto handle. To prevent the needle from breaking, cut it so that it protrudes at most a few millimeters. You can enlarge your holes later with a longer needle.

You are now ready for a test run. Your new Hannah stove needs pre heating before it can build the vapor pressure that will sustain the jets. All what you need to do is to pour a few drops of alcohol in a pan beneath the stove. Go ahead, pour 30ml of alcohol in the stove, a few drop in the pan, drop a coin over the filler hole, and set everything ablaze. Wear protective gears, too small jets will generate excessive internal pressure and can blow the stove up. Note that using a coin prevent massive pressure buildup. The coin just lift when pressure is to high. If your stove does a few backfire like explosions, it's the coin releasing the extra pressure.

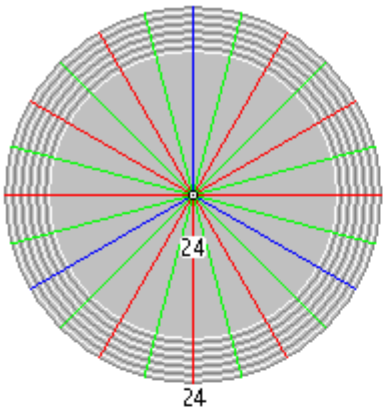
Don't worry about boiling anything yet. Just study the jets. If the jets are hissing and can't sustain a flame, they are too small. If the flame is more than 10cm high, the jets are too big. It is also possible that gas pressure is leaking from the seam where the two ends are joined. It might be that there is a big bump at that spot on either of the cans, that you removed too much material with the sandpaper on the top part or that you enlarged the bottom too much. It is easy to enlarge the holes but all the other problems will require that you cut two new cans.

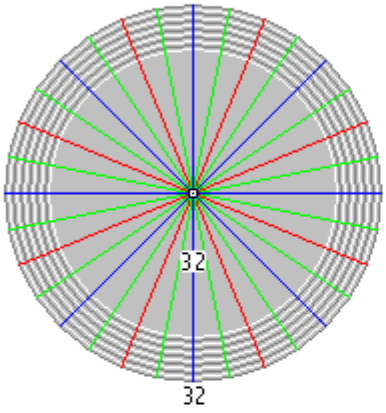
Once you are happy with your jets, you can see if they cook well. With 24 holes, I use a 5.5cm high mesh pot stand. Depending on your fuel type and your hole configuration, you will want to play with the pot stand height. Making a pot stand will be easy. You just need to cut a strip of steel mesh. Folding wire works just as well. The idea is to play more with the pot stand because it is easier to adjust that the jets. You new stove should bring 500ml of water to a rolling boil in 6 minutes with 30ml of ethanol.

Once your stove is finely tuned, you should give it a good shine. Aluminum is really easy to bring to a near mirror finish if you use the right tools. The idea is to level the scratch pattern and to progressively reduce the scratch size until you have something close to the wave length of visible light. Check this quick introduction by Caswell. Aluminum is a soft metal and your stove is really small. You can move quickly from one step to the next. With a little extra work, the technique you are going to use can bring a motorcycle frame to a mirror finish.

There are a many places where you can get your polishing compound. Jewellers supply stores have a large selection at competitive prices. For some reason, they don't like it when you tell them you want to polish soda cans. Find an interesting story to tell if you go see them. Wood working stores will also have some polishing compound. Not a large selection but you only need a medium one anyway. You can always fall back to Caswell. They have all what you could wish for. Grab a medium cut, either green, white or yellow and a buffing wheel. I also like to start with a fast cut; black or brown is perfect. You should already have smoothed your stove with 600 grit sandpaper. You might want to give it another pass to remove any scratches that that occurred while assembling. Rub the buffing wheel against the compound block then against your stove. Change the angle for each pass but try to keep it nearly perpendicular to the previous pass. Black compound gives an interesting finish but it is yellow that gives the real shine. To get a mirror finish, you need to smooth everything with 1000 grit sandpaper and to get down to red or blue compound, which I didn't do for this tutorial. When you use more than one compound, start with the fastest cut and progressively move to slower ones. Using more than one compound makes it shine faster but your tiny stove will shine soon enough even if you have only a medium cut.

You now have the ultimate stove. It is ultra light, good looking, dependable, safe, easy to use, efficient and you built it in only one hour, without fancy tools or measurements. Do not despair if it doesn't work well or doesn't look good the first time. It can take a few attempts to get it right.





Size	Inches	MM
50	.0700	1.778
51	.0670	1.702
52	.0635	1.512
53	.0595	1.511
54	.0550	1.397
55	.0520	1.312
56	.0465	1.181
57	.0430	1.092
58	.0420	1.067
59	.0410	1.041
60	.0400	1.016
61	.0390	0.990
62	.0380	0.965
63	.0370	0.940
64	.0360	0.914
65	.0350	0.889
66	.0330	0.838
67	.0320	0.813
68	.0310	.0787
69	.0293	0.743
70	.0280	0.712
71	.0260	0.660
72	.0250	0.635
73	.0240	0.610
74	.0225	0.572
75	.0210	0.533
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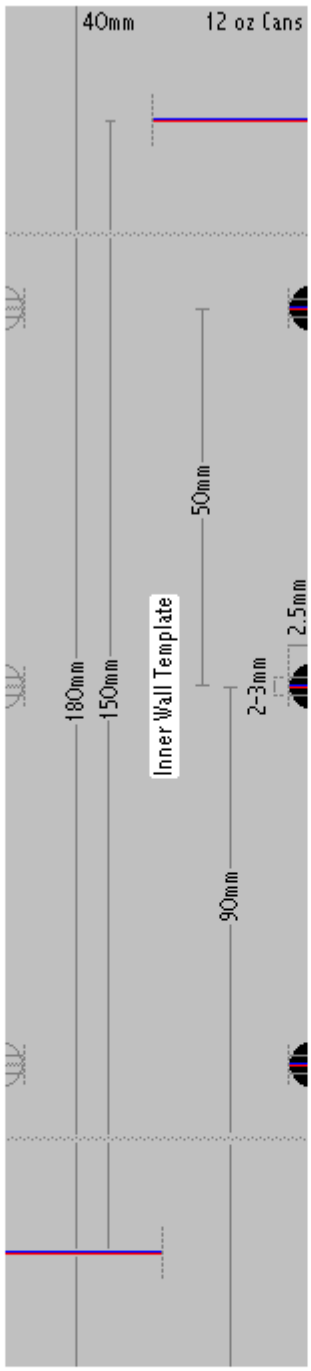

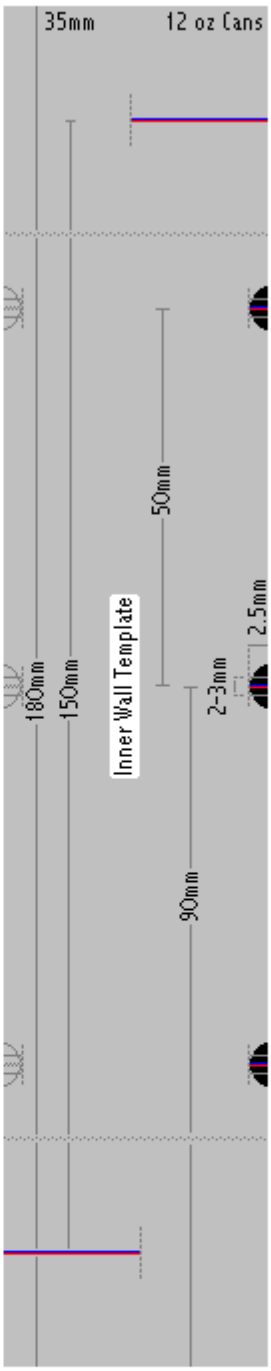

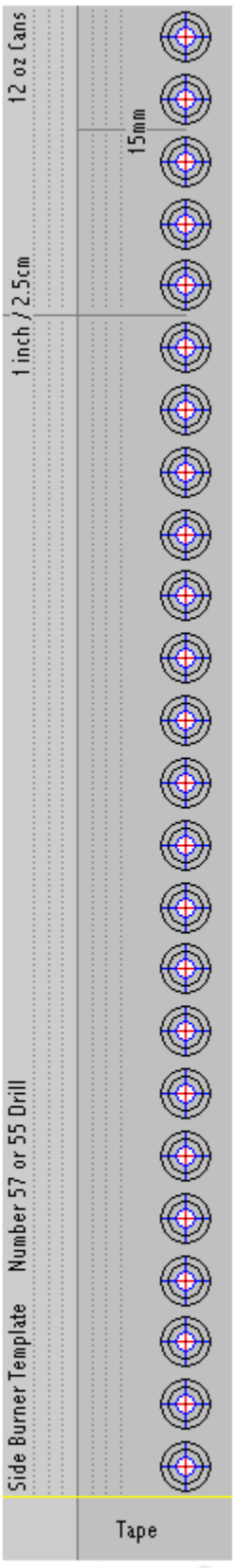

	Top	Base
Zen	30mm	20mm
Pepsi	20mm	25mm
Pepsi-G	20-24mm	27mm – 12oz Can 30mm – Irish Can
Photon	1.5 inch ~38mm	1.5 inch ~38mm
Tin Man	1.25 inch ~31mm	0.75 inch ~19mm