

## **Instructions for Building the MIDGE (Modified Inverted Downdraft Gasifier Experiment)**

### **Materials:**

- 55 oz Bush Beans can, or similar.
- 16 oz tomato can, or similar.
- Large tuna can (12oz), or other can, that will fit snugly, in or around the large can.
- 4 each, 10(treads per inch) x 2 inch (length) sheet metal screws.
- 2 Coat hangers or similar stiff wire (pot holder option 1)
- 4 each, 10 x 1 inch sheet metal screws (pot holder option 2)

### **Tools:**

- Hand can opener...the kind that punches a triangular hole in the top of a can.
- Tin snips for cutting the tuna can.
- A nail (3d) or equivalent hole punch.
- Punch or drill for 1/4" holes in the side of a can (I use a single hole paper punch; under a buck any place that sells stationary).
- Wire cutters ( for pot holder option 1)
- Sharpie marker or similar.
- Gloves to prevent being cut by sheet metal.

### **Construction Directions.....**





#### **A. Make the stove parts:**

- 1) Wash the empty cans, and remove the labels.
- 2) 550Z can modifications (Cowling).
  - a. Around the bottom (unopened end), use the can opener to punch five equally spaced holes into the side. Set the can aside.
- 3) 16 OZ can modifications (Burner)
  - a. Turn the can upside down and punch as many holes as you can with a 3d nail. It needs to look like a sieve when you are done.
  - b. Using the can opener, punch at least four equally spaced holes into the side at the bottom. You should end up with one at 12, 3, 6, 9 O'clock positions.
  - c. Around the top (open end), make about 16,  $\frac{1}{4}$  inch (or about the size a paper punch makes) equidistant holes around the circumference. Set the can aside.
- 4) Internal burner stand.
  - a. Measure the height of the burner. Take this measurement and measure from the top of the cowling and mark that point on the cowling. This is the level where 4 each, 2 inch sheet metal screws will be screwed through the cowling wall, into the center of the cowling.

5) Tuna Can modifications (Stove Cap).

- a. Turn the tuna can upside down. Place the burner in the center of the tuna can bottom and trace a circle onto the tuna can. Cut out a hole in the tuna can bottom, a little smaller than the circle you drew.

**B. Construction of the stove**



- 1) Place the burner into the Cowling and center it on the 4 screws.
- 2) Invert the tuna can, and press it into the outer until it rests on the burner.

**C. Options**

1. **Insulate the outside of the cowling**, leaving the air holes at the sides open and unobstructed.
  - a. Although the stove will perform smoke free without the insulation, a bluer flame (cleaner combustion) will result when the stove is insulated. (The insulation helps retain the heat of the secondary air). The only restriction here is the insulation of your choosing needs to be able to take significant heat.

## 2. Windscreen

- a. A windscreen helps keep the heat from the stove focused under the pot. Most any non flammable material will do. I use a disposable cookie sheet, trimmed and bent into a semi circle for my stove.

## 3. Potholders (option 1). Potholder option 1 below works the best, but makes the stove harder to disassemble.

- a. Make three of the following: Mark a piece of coat hanger wire 2 inches from the end. Place this mark over the edge of your bench and bend. Remove from the bench and continue to bend it 180 degrees. Use pliers if needed.
- b. From the bend you just made, mark (the long end of the wire) at 1 inch. Bend the wire at that mark, 180 degrees the opposite way.
- c. Measure 3 inches from the second bend (on the long end), and trim the wire at this mark.
- d. If you bent it correctly, it should look like a flattened out S with a long tail.
- e. Place one every 120° with the 3 inch leg inside the can. Then push the cap in until it seats on the burner. This might take a little shoving.

## 4. Potholders (option 2) Although this option is simpler for construction, it will leave a gap between the cap and the burner that kind of defeats the semi sealed secondary air cap; but I have used it, and can get a 25 minute burn, boiling 2 cups of water for about 15 minutes of that time.

- a. Take 4 each, 10(treads per inch) x 1-inch (long) sheet metal screws and drive them through the cap from the inside at 12, 3, 6, 9 o'clock positions.

## 5. Fuel

- a. Any dry wood product that is no thicker than a number 2 pencil (the kind you used in school) will work. My lengths are usually between 1 and 2 inches. Tap the bottom of the stove on the ground, bench, etc. to settle the fuel as you fill. Fill up to the secondary air holes in the burner.

i. Fuel ideas; 1x2 inch limber cut down, Twigs, wood pellets

## 6. Lighting

- a. I use 1-inch triangles of the thin campfire starters ("strike a fire" is one brand name). You should get many triangles from one starter. Place the fire starter in the center of the fuel and bury it with a little more fuel. Sprinkle lamp oil all over the top of the fuel and light the starter.

- b. The fire will grow a little slowly at first, and then will propagate to a full burn. If everything is built correctly, gasification will be observed almost immediately and you will start seeing and hearing the gas light then relight as gas pockets build up. When the stove gets to temperature, the secondary air at the top of the burner will mix with the gas and can be seen as flames emanating from the secondary air holes in the burner section. All things being equal, there should be a significant amount of blue flame at this point.
- c. Your burn times will be 12-15 minutes without a pot on top, and up to 25 minutes with a pot on top.

### 7. A word of caution.

- a. You are dealing with fire and gas. Be careful please.
- b. Because this is not a 100% efficient woodgas burner, there will be CO<sub>2</sub> emitted when the stove is burning the remaining charcoal (after the flame has gone out). Low levels of tar and soot are produced during the burn that will blacken a pan but will probably not do much else in the way of harm (assumption on my part).
- c. The cowling gets **hot!!** Take care handling this stove during burns, and immediately after the flame extinguishes. The cowling shouldn't char what it's sitting on, but may melt plastic etc. Place on a surface that can take heat.



**Closing note:** How well does this stove gasify?

One of the worst smells I can think of is smoldering cigarette butts. If you want to prove to yourself how well this little device gasifies, fill it full of old cigarette butts, add a little lamp oil and light it off. There should be very little smell, if any at all.

Be careful and enjoy stretching the boundaries of gasification.



MIDGE WoodGas Stove



## MIDGE Modification for Primary Air Control

### The Parts



On the far right is a plain tapered can. In the middle is a tapered can with holes cut to be a burner, fit inside a straight can to show the height that is just a little less than the cowling. The cowling shows at the bottom a piece of steel tubing -electrical conduit- sticking out a little. This tubing goes across the whole stove, going through holes in the bottom of an assembly like the two cans in the middle. Also seen is the bolt and washer placed in the tubing, this just sits there and can be pushed in to close off the air. Another one would be on the other side.



This picture is from the top and shows the straight can held in the middle of the cowling by the tubing going across. The burner has been removed. You can see the tubing on one side. It isn't visible on the other side in this picture, but it is there. The oblong shape in the middle is actually a hole in the tubing. The white material is sealing the tubing to the can. I did not have a neat method for cutting a smooth round hole in the cans for putting the tubing in, I merely cut slits with a razor knife and bent them back to make a rough hole that was tight on the tubing. The leakage of air around the tubing on the cowling makes no difference, but the tubing needs to be sealed to the straight sided can.

The inside diameter of the tubing is 0.62 inches

Hopefully it is plain that air comes in the tubing from the sides, goes into the straight sided can through this oblong hole, (I made two angled cuts with a hacksaw) and rises up to the tapered burner jammed into the straight sided can.



And here is the stove all put together, except the other bolt and washer valve, is not there. Lots of different kinds of valve should work.

Good luck!

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## Couple of change to the MIDGE

The intent of this modification was to address the concern that there are hot ashes to deal with when performing multiple burns. So far this configuration will burn at least 4-5 loads without requiring an ash dump. That's over an hour of cooking time! All modifications are simply experimental, but the results so far are promising that these are performance improvements. I have burned larger diameter sticks and there is less tar production.

The interruption in cooking is minimal if multiple fuel loads are immediately available. At burn out, shake the unit a little and the ash and coal will drop into the ash holder. Drop in fresh fuel and relight the top. The coals should be far enough away from the fresh fuel not to ignite it from the bottom. Secondly, the hot coals will provide additional preheated air and aid the buoyancy effects for the secondary air.

I'd like to see some of the group give it a try to see results from various points of view. As always, take care around fire, and always burn on a non-flammable surface. I accept no liability for burning down anything with this stove.

Keep on stoving!

CHRIS



Looking from the bottom (top is unchanged), both bottoms have been cut out and ¼ inch hardware cloth has been shaped and inserted in the base of the burner. The church key tabs made from the can opener, on the cowling, have been bent down 180°. These rest on the rim of the ash holder (right), which provides a stable base for the stove.



Ash holder is an additional tuna can, the same size as the burner cap. Lug nut choice was arbitrary. It's what I had lying around the shop.



On top of the lug nuts I place the punctured bottom of the cowling I removed previously.



Apologies for the cocked unit, I was obviously rushing; It does actually seat level. This is what it looks like assembled....



.... and looking down into the stove.