Aprovecho Research Center
Cottage Grove, Oregon
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"Bucket" Rocket Stove Construction Using 310 Stainless Elbow Kits

SUMMARY

The Learning Process

On 27 September 2005, I spent a full day at Aprovecho learning to fabricate the can-based rocket stoves generally referred to as "bucket stoves." Damon Ogle of Aprovecho is not only extremely knowledgeable and masterful with tools in-hand, but also a patient and thorough teacher. If I can be taught to assemble these stoves with good instruction, anyone can.

I do not consider myself to be at all experienced, skilled, or adept at the kind of work required to produce a bucket stove from the basic components; and yet, with instruction, I can now easily make these one of these stoves in less than an hour. In a setting where multiple stoves are being assembled from standardized components, the use of jigs and templates in trained hands could certainly reduce this time to something on the order of twenty minutes.

310 Stainless Elbow Kits

The core of any rocket stove, literally and figuratively, is the "elbow", a combustion chamber consisting of the fuel magazine and the riser. We worked with prefabricated elbow components made of 310 stainless steel. Damon's ingenious design is an attractive engineering solution, combining durability with ease of mass prefabrication, reasonably efficient nesting of the pieces for somewhat efficient shipping, and extremely easy on-site assembly and incorporation into the stove-body.

Unlike soft steel or regular stainless, the 310 stainless is heat resistant to temperatures to 1100° C and will therefore be expected to maintain its integrity for long periods of time. By comparison, rockets built of other metals tend to burn through or wear out after a few weeks of use. Another sound alternative material, ceramic tile known as baldosas in Guatemala, is quite durable, but requires special skill to manufacture to appropriate dimensions and thicknesses. Lightweight insulative bricks are also a viable option for combustion chambers. Baldosas and insulative bricks are less expensive than 310 steel, but they are heavier and more susceptible to damage during transport.

The stove I made had a combustion chamber diameter of four inches (cross-sectional area of approximately 12.5 square inches), but Damon also had a five-inch version of the elbow kit prefabricated.

The 310 stainless may be somewhat difficult to obtain. Damon ordered a 24 gauge sheet from the East coast. It was not cheap: around $300 for a 4 x 10 sheet, which will produce approximately 15-1/2 elbows for stoves. The parts can be mass-produced using laser cutting and customized configuring of standard metal-working tools.

Ease of Assembly

The elbow components are assembled in seconds. The magazine snaps together without so much as hand tools. The folded seam of the riser is tamped closed with a hammer. The fuel-

feed shelf is secured to the magazine by two pop-rivets, but this can also be done with a couple sheet-metal screws. Once the magazine and riser are placed within the completed stove-body-canister, they are joined by simply bending metal tabs with finger-pressure.

The fashioning of the 20-liter (5 gallon) can to house the elbow was done with tape measure, pen, tin snips, channel lock pliers, ball-peen hammer, and file (used for its squared shape to hammer into the corners of the magazine aperture, not to file with).

The skirt component, a 6-inch by 36-inch (give or take) strip of light sheet metal, simply requires drilling and pop-riveting (or sheet metal screws) to create a cylinder of correct size for the intended pot. For example, a 10-inch diameter pot would require a 10 ¾ inch diameter skirt leaving a 3/8 inch gap between the outside of the pot and the inside of the skirt. The width of the gap is critical for proper heat transfer to the pot.

Materials

(1) 310 stainless steel elbow kit
(1) 20-liter (5 gallon) metal can
(1) 6-inch x 36-inch (plus or minus) strip of light-gauge sheet metal
(5) small pop-rivets or sheet metal screws
(15-liters) insulation, such as wood ash or vermiculite

Tools Required

tape measure
pen or marker
tin snips
channel lock pliers
ball-peen hammer
file
pop-rivet gun and drill with 1/8-inch bit
or
screwdriver and small punch

ILLUSTRATED STEP-BY-STEP ASSEMBLY INSTRUCTIONS

The 310 stainless components for the combustion chamber nest pretty well, making for more efficient packing and shipping. These are the riser pieces.

Note that these components are slightly unfinished: the top end (facing down in this photo), have not been cut or crimped to create the pot support structure. In building this stove, I hand-nipped and hand-crimped the upper edge of the riser tube, the finished product of which is depicted in later photos. Ordinarily, the cutting and crimping would be done in the pre-fabrication process, along with all the other cuts and folds.

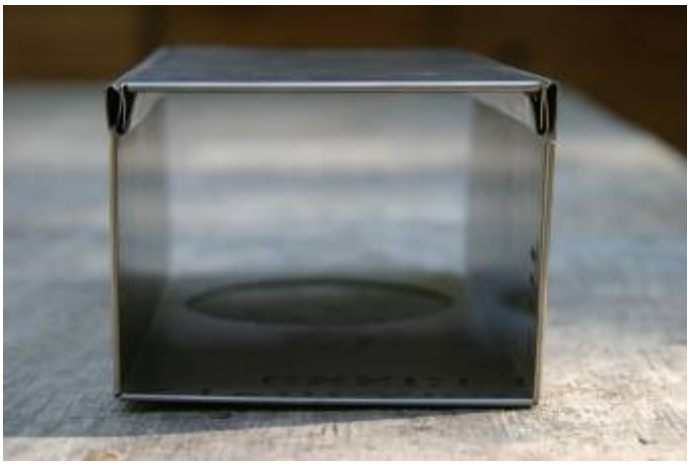
This is larger of the three pieces that make up the fuel magazine section of the combustion chamber.

The riser section will fit into the circular opening, depicted in this photo, when the combustion chamber is assembled in the canister.

The edge of the larger piece of the fuel magazine is bent to accept the bottom piece.

The edge of the bottom piece has been crimped to snap into the fold of the larger piece.

The fitting together of the top and bottom pieces of the fuel magazine.



The pieces snapped together.

The end cap for the fuel magazine section of the combustion chamber.

Fitting the end cap onto the fuel magazine.

The end cap in place.

The corners of the fuel magazine are bent inward to retain the end cap. The resulting three-piece structure is quite rigid.

The folded edges of the riser component are interlocked and pounded into a closed seam with a ball peen hammer.

Using the now-formed riser tube as a template, trace the location of its future placement in the center of the can.

Next, trace another circle just inside the first. This inner circle will define the cut line.

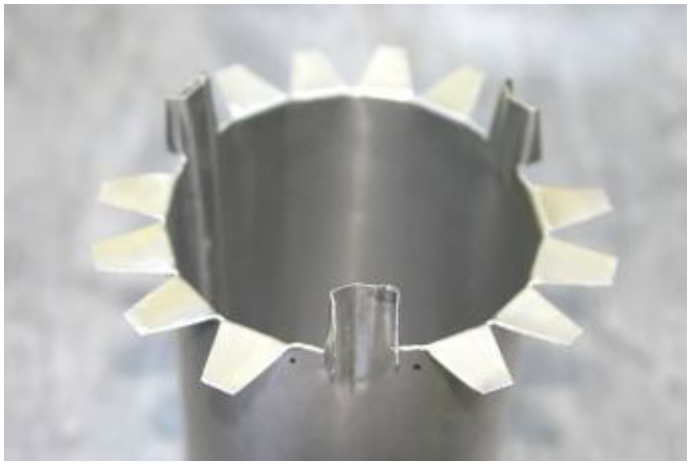
Using tin snips, cut out the inner circle.

Using a very square-ended pliers (like a channel lock), carefully fold down the metal (approximately 10 degrees) precisely at the outer circle. This causes the metal to bend exactly along that line when struck with a ball-peen hammer.

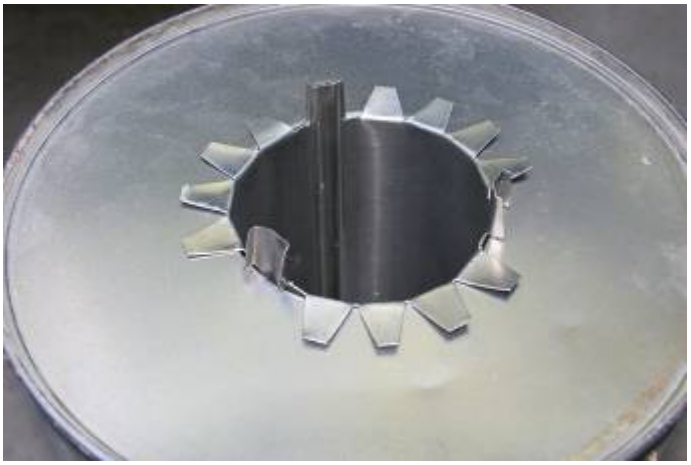
Bending down the annulus for the riser placement, using the ball-end of the ball-peen hammer.

The tabs at the upper end of the riser piece are folded down to create the structures that will hold the riser onto the top of the stove body (can). The three crimped tabs, which will serve as the pot supports, are bent outward for additional mechanical strength.

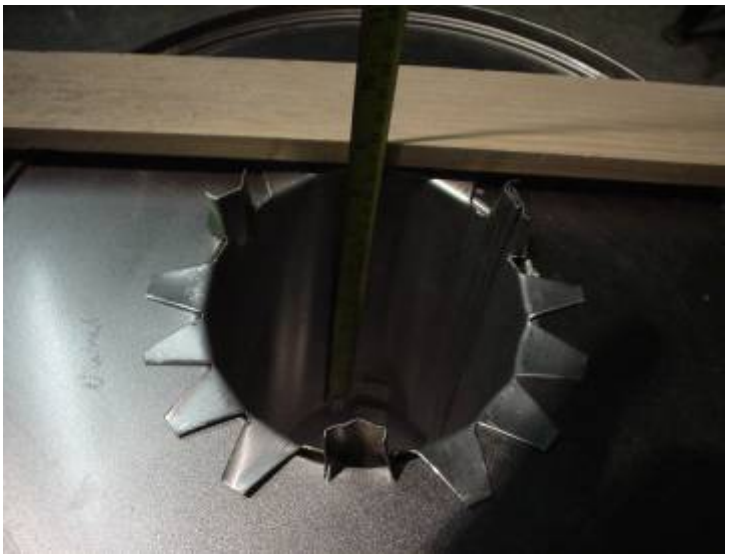
These features will be prefabricated into the riser tube configuration. In this instance, however, the metal shop had not cut or crimped the piece, and I preformed these operations with hand-tools.



Detail of the cuts and folds on the top end of the riser.



The riser fits snugly into the hole.



Using a straight edge across the top rim of the can, measure vertically to the bottom of the riser tube.

With this measurement, and using the fuel magazine as a template, trace the location of the magazine placement on the side of the can. The magazine should open on the opposite side of the can from the location of the spout-and-plug, on what is now the bottom of the stove body.

As with the opening on the top of the stove body, a second rectangle is drawn inside the fuel magazine placement mark. This second line will be the cut line.

As before, use tin snips to cut out the rectangular area as marked. Then, fold the edge at the placement mark, and bend back the metal by striking with the ball-peen hammer.

Since the hammer edge is round, but we need square corners to accommodate the fuel magazine, I used a hard, rectangular object to form them. For example, pound on the side of a heavy metal file set against the corner to square-up the bend.

Lift the riser piece part-way out of its hole (so the fuel magazine can clear the tabs), and insert the fuel magazine into the side opening. Then, drop the riser onto the fuel magazine. Holding the two components tightly together, bend the fastening tabs (by hand) under the top edge of the fuel magazine to secure the structure.

The combustion chamber is now in place within the stove body.

Fit the fuel feed shelf into the magazine, positioning it so that the inner edge aligns with the circumference perimeter of the riser. Affix the shelf with pop-rivets on either side, as shown.

Using the spout on what is now the bottom of the can, fill the stove body with insulation. Wood ash is an excellent insulation material. I used vermiculite.

Assemble the pot-skirt by measuring and cutting thin galvanized sheet into a properly sized strip, and fastening with three pop rivets. It is important to achieve the proper “Gap D” between the pot wall and the skirt so as to maintain the same cross-sectional area throughout the stove, from magazine opening, through the riser, and around the pot.

Voila!