Appalachia-Science in the Public Interest
50 Lair St., Mt. Vernon, KY 40456

ASPI TECHNICAL SERIES TP 39

ELBOW TORCH WOOD STOVE

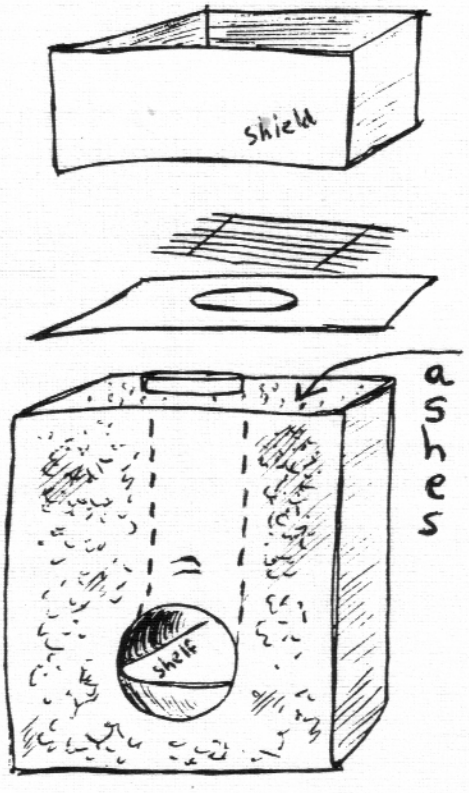
INTRODUCTION

In October, 1995, Mark Schimmoeller, an *ASPI* volunteer, traveled to Santa Barbara, Honduras, to begin a solar cooker project. It was cloudy upon his arrival, and the project shifted towards a simple, yet effective stove that burns twigs or small scraps of wood. Due to heavy deforestation, the cost of firewood rivals the cost of food, forcing many families in Honduras to eat only tortillas and not beans (Beans require much more cooking time). This stove proved quite helpful to families there. With a typical woodstove, a family in Santa Barbara uses one donkey load of firewood each week; with an elbow torch stove, ETS, this same load of wood lasts five weeks.

ASPI's philosophy is to use natural resources efficiently, regardless of how abundant the resources may be. Hence, the ETS ought to be utilized in the United States. For the fraction of this nation's population that cooks with wood outside, this stove can save a lot of time otherwise spent gathering wood that can now be left to decay and add humus to the ground. This stove can replace the outdoor grill, costing less and polluting less. A small ETS is ideal for camping trips, especially when a lot needs to be cooked with a small amount of wood. One practical approach is for campgrounds across the country to replace existing fire pits or grills with elbow torch stoves.

This stove expands on what is known as a "rocket stove," invented by Dr. Larry Winiarski while working at *Aprovecho Research Center* in Oregon. A stovepipe elbow is the crucial component of Larry's stove. Aprovecho has "rocket stove" plans, which show how to build the stove using an existing elbow or fashioning an elbow out of tin cans (which lasts about one month). This technical paper is a supplement to Aprovecho's, showing how to fashion an elbow using two flat pieces of thick stovepipe metal.

Essentially, the ETS consists of an elbow that is placed in some kind of outer structure and insulated with wood ashes, or some other low-mass insulation, such as pumice rock, vermiculite, or loosely crumpled aluminum foil. A fire is built in the lower end of the elbow and food is cooked on the top end. Since the elbow is insulated with a low-mass material (which doesn't rob the stove of heat) there's an excellent natural draft; the fire burns so hot (above 1100°F) that it almost completely combusts its fuel and is virtually smokeless.



The elbow torch stove functions according to these principles:

1. The insulated elbow creates a natural draft which keeps the fire burning hot.
2. The low-mass insulation encourages most of the heat to go directly to the cooking vessel.
3. A metal skirt around the cooking pot quickly heats the pot's sides as well as its bottom.
4. The elbow regulates air flow into the fire.
5. A shelf placed in the lower end of the elbow accelerates the draft and keeps sticks off the ashes.

BUILDING THE ELBOW

The elbow described here has a horizontal length of 14 in., a vertical length of 18 in., and a tube diameter of 7 in. This is the largest elbow that *ASPI* recommends building. The size of the elbow is important because it affects the flow of air into the fire. Too much air, or too little, will cause the fire to burn cooler and less efficiently. *ASPI* recommends that an elbow be made from either of the following two sizes: a large one like the one mentioned above, or a small one, useful for camping, with 4-inch diameter tubes, a horizontal length of 6 in., and a vertical length of 10 in.

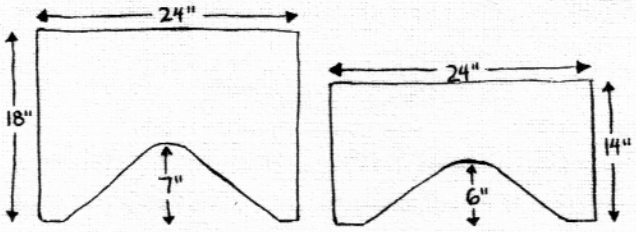


Diagram 1

To make a large elbow stove start with two pieces of thick stovepipe metal (that one can nonetheless bend), one piece 24 x 18 in. and one 24 x 14 in. The 18-inch piece will be the vertical tube and the 14-inch the horizontal. Rolling these pieces up along their 24 in. lengths makes tubes with diameters about 7 in. First, cut these two pieces as shown in *Diagram 1.*

The 14-inch piece, which will be the horizontal tube, needs to be cut 1 in. less (6 in. instead of 7 in.), to allow it to fit into the vertical tube. It's important to keep the extra metal cut out of the 18-inch piece. It will be needed later to make a shelf for the firewood.

Note: In making the small elbow stove, decrease the areas cut out of the tin sheets. To make 4-inch diameter tubes, shorten the lengths of the metal pieces to about 12 $^1/_2$ in. instead of 24 in. The widths should shorten to 6 in. and 10 in. The height of the areas cut from these pieces becomes 4 in. for the 10-inch piece and 3 in. for the 6-inch piece.

Once the cuts shown in *Diagram 1* are complete, flaps are made by bending the tin over along the widths of both pieces, as shown in *Diagram 2.* The smaller piece should have $^1/_2$ in. flaps. On the larger piece the flaps should be slightly smaller - about $^3/_8$ in. Wider flaps on the small piece produce a slightly smaller diameter, allowing it to fit easily into the vertical tube. The two flaps on each piece must be bent in opposite directions. They should make a gap wide enough for the tin being used.

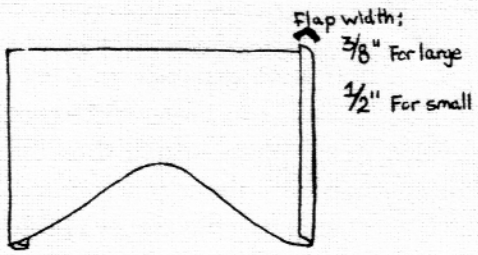


Diagram 2

The next step is to use a convenient metal tube (an old water pipe works well) for forming the tin pieces into pipe shapes. Place the metal tube close to and parallel with one of the flapped sides of the tin. Then bend the tin over the tube slightly. Then move the tube away from the flap a little and again bend the tin over slightly. Continue this bending process across the 24 in. length of the tin (at the midpoint the tin can be turned over and the bending process started from the other side) until a pipe is formed. Take time toward the end to work the metal so the tube is nicely round and the side flaps easily hook into each other. It's important that they easily hook together - this is just a matter of bending the metal correctly. Try giving a little extra bend to the flapped sides so they meet each other straight on and not at an angle.

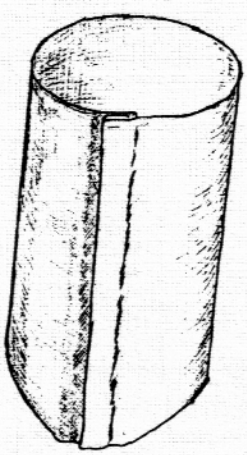


Diagram 3

Once the tin pipe is hooked together, slide it over the metal tube used earlier, with the joint of the stovepipe tube facing up. Grip one end of the joint with vicegrips, if available. Then start hammering at the other end, both against the folded part of the joint and directly on top of the joint. Remove the vice grips when the hammer reaches that end. When the joint is tight, use the other end of the hammer and crimp the joint as shown in *Diagram 3.*

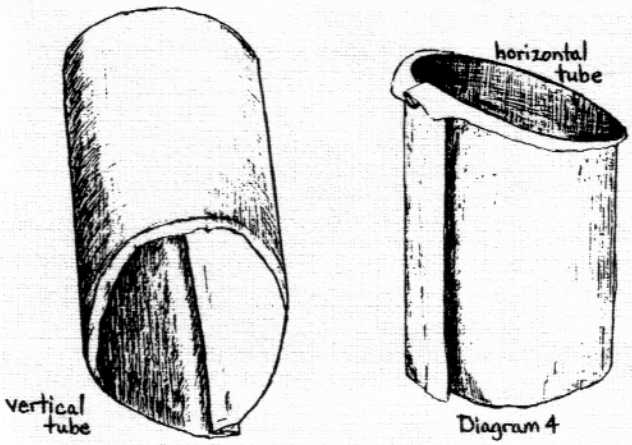


Diagram 4

Repeat this process with the other piece of tin. Now there are two tubes - notice how they will fit together to make a right angle elbow. The short tube is the horizontal section and the long tube is the vertical section. To join them, some bending is needed on both of their angled sides, as shown in *Diagram 4.* On the vertical tube use pliers to bend inward a $^3/_8$ in. flap along only the top third of the tube. On the horizontal tube bend outward a $^3/_8$ in. (or thereabouts) flap along the perimeter of the tube. However, increase the size of the flap (and the degree that it is folded) towards the bottom so that at the very bottom (where the joint is) the flap is about $^3/_4$ of an in. and bent back more than 90 degrees.

To join the tubes, fit the horizontal tube into the vertical. Before doing any hammering, take a look at how the tubes meet - more bending on the flaps may be needed. Sometimes pushing in the sides of the horizontal tube helps it to more cleanly meet with the vertical tube.

When ready, get the top part hooked together (the only part that will hook at this point) and then turn the elbow over so the top of the vertical tube is resting on the ground. Make sure the top of the elbow (the part being hooked together) is still in place. Then hammer the joint of the vertical elbow (it should be sticking out above the horizontal tube) so it folds over the joint of the horizontal tube. Fold over as little as possible so the elbow angle doesn't change too much. (The stove will still work fine if the elbow angle is slightly more than 90 degrees.)

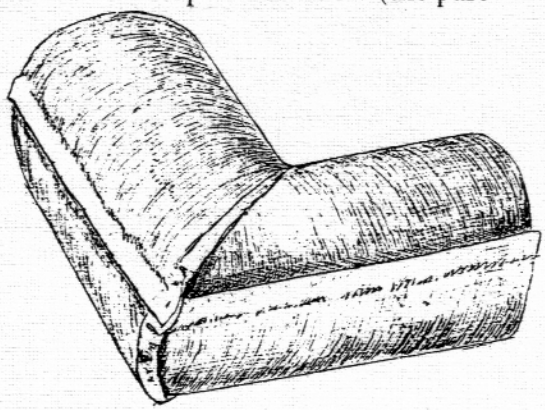


Diagram 5

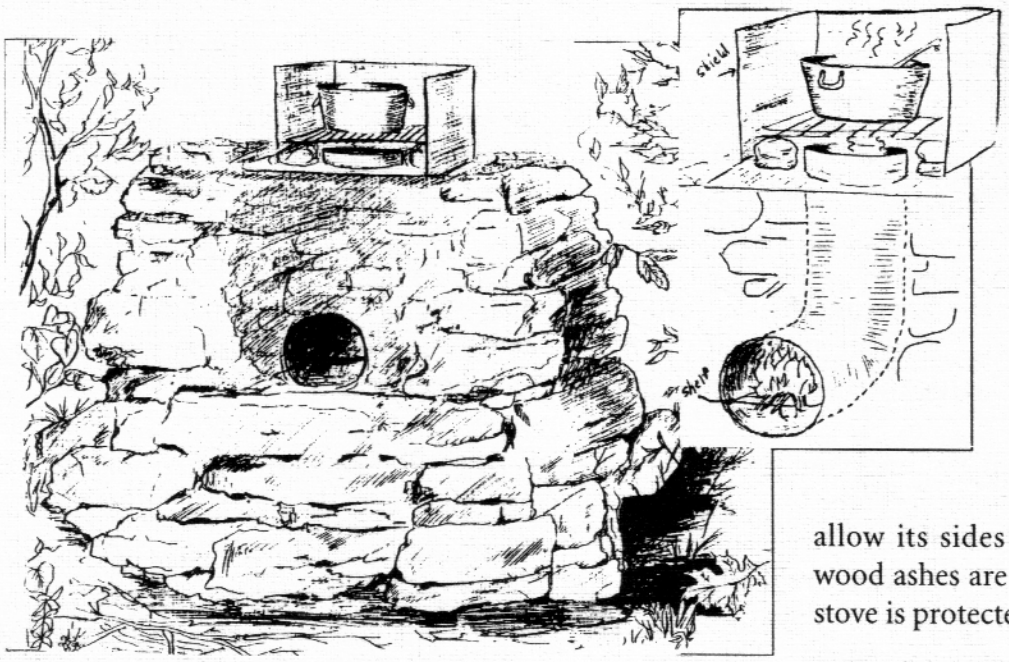
The two tubes should now be secured by bending the vertical tube over the horizontal as shown in *Diagram 5.* The horizontal tube may have to be hammered more deeply into the vertical tube so vertical tube is able to be folded over the horizontal tube.

COMPLETING THE STOVE

The hard part is finished. Now a decision needs to be made on what kind of outer container to put the elbow in. The possibilities are numerous- - metal, thick wood, bricks, or rocks. If a small elbow is made, it could be put into a 5 gallon metal drum. Even a cardboard box could be used for demonstration purposes, but this isn't recommended. What's important is to have a container big enough to allow for at least 2 in. of wood ashes (or other low-mass insulator) surrounding all sides of the elbow, even the bottom.

Look around and see what is available. It doesn't have to be perfect. An old metal trash can turned upside down makes a fine ETS, particularly with an elbow slightly smaller than the one described here. In this case, so that a lot of ashes are not used, fill the bottom of the can with rocks (or make a false bottom somehow) to a point 2 in. or more below the horizontal portion of the elbow. To get the rocks and ashes (and the elbow for that matter) into the can, the original bottom of the can (the top of the elbow torch stove) will have to be cut out - save this piece. Measure where the elbow needs to go, then cut a hole in the side of the can. Place the elbow through the hole, fill the rest of the can with ashes, then cut a hole in the top piece and work the top of the elbow through this piece.

Now a grill is needed to go across the top. An important thing to remember is to maintain a $1\frac{1}{2}$ in. air space (1 in. with a small ETS) between the cooking vessel and the elbow top. If the pot is put directly on top of the elbow, the fire won't have an adequate air flow.



Now take the curved piece that was cut out of the 18 x 24 in. sheet of tin and make two cuts in it so it will slide into the horizontal tube about a third up from the bottom; the width of this piece will be fewer than 7 in. This makes a shelf for the firewood, which is placed on top. Finally, make a tin shield at least on three sides (the same height as the cooking pot) that will surround the cooking pot and allow its sides to heat up more quickly. If wood ashes are used as insulation, be sure the stove is protected from rain.

To cook, place small pieces of wood on top of the shelf (in the lower tube) and light a fire. Push the wood into the fire as it burns. We think it's best to feed the fire so it stays within the elbow - if it shoots out above the vertical tube, it will smoke more. Happy cooking!

RESOURCES

Aprovecho Research Center
80574 Hazelton Road
Cottage Grove, Oregon
97424

For $7 Aprovecho will send their Capturing Heat booklet, which includes plans on how to build the "rocket stove" and other heat capturing devices, such as a haybox, two kinds of solar cookers, and a rocket oven.

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A resource and demonstration center, offering an array of appropriate technology technical papers.

Rafael Munoz,
a very poor, good-natured man who works with scrap tin in Santa Barbara, Honduras.

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