Insulated Solar Electric Cookers
Construction Manual

Living Energy Farm, Updated, August, 2021
Alexis Zeigler

In the United States, our kitchens consume more energy than our farms. All over the world, low-income people suffer from chronic health problems caused by smoky wood cooking fires. At Living Energy Farm (LEF), we have pioneered a DC Microgrid that allows us to use solar energy in a manner that is cheaper and more efficient than the norm. Now, partnering with a solar cooking project based at Cal Poly in California, we are finding technologies that dramatically reduce the amount of energy needed for cooking in ordinary American homes. And this same technology can be scaled to provide very cheap, effective solar cookers suitable for use in communities that have little money.

What Is *NEW* In This Document

In that last six months of using ISECs at LEF, we have learned a lot. The cooks at LEF favor solar cookers that we call Roxies. The Roxies we built previously were made with rockwool board, tape, adhesive, and caulk. Sadly, the rockwool board isn't strong enough to stand up to regular use without reinforcement. We are now using Roxies made with sheet metal covered with rockwool. We have also changed our burner construction technique as the prior methods proved inadequately durable. All of that is outlined below.

The first few pages of this document give an overview of Insulated Solar Electric Cookers (ISECs), why they are important, what to expect in using them, and various options for building larger and smaller ISECs. **The reader should note that this document is not "the" manual for building ISECs.** The ISEC project is moving forward with collaborators all over the world. The Cal Poly researchers are trying to optimize ISEC efficiency and construction technique. Their material is linked from http://sharedcurriculum.peteschwartz.net/solar-electric-cooking/

The bulk of this document is made up of step-by-step instructions on how to build the ISECs and their component parts such as we have been building and using them at LEF. For the sake of clarity, we present each component part as a separate set of instructions.

Table Of Contents:

Introduction: Why Are ISECs Important, and What Are Your Choices?

Why Are These Solar Cookers Revolutionary?

"Normal" cooking involves using a lot of energy quickly, and very inefficiently. When you are cooking on a stove or in an oven, most of the heat is lost, not transferred to the food. The new cooking technology we are working with is called *Insulated* Solar Electric Cookers, or ISECs. These cookers are very efficient.

At LEF, we use solar power, and that makes us 100% energy self sufficient at the residential level. But unlike other off-grid projects, 90% of our electricity never goes through a battery. Rather, our solar electric panels send electricity straight to its useful destination. The Cal Poly team had the same idea, and ISECs use energy straight from solar panels. That makes the this way of using solar energy "radically inexpensive," to use the term coined by the Cal Poly research crew. At a practical level, *we have found ISECs to be more effective than any other solar cooking technology on the market.* There are many solar cookers available, but ISECs are the most convenient to use, and provide by far the most effective means of solar cooking in sub-optimal weather. And they are cheap to build!

What to Expect

This technology is new and changing quickly. This document will tell you how to build ISECs. A materials source list is at the end of this document.

The smaller ISECs function like a crock pot. All ISECs cook slowly, though the larger ones can cook somewhat more quickly. A 100 watt ISEC will cook 2 - 3 kg of food in winter or in partly cloudy weather, and more in sunnier weather. Larger ISECs will cook greater quantities of food. Slow cooking means less burned food, less carcinogenic substances in the food (which are created by very high temperatures), and more flavorful food. Slow cooking does involve changing the rhythm of cooking. Preparation is done ahead of time. ISECs could never replace all other cooking fuels in every climate, but they could do most of the cooking we need.

Safety

The reader should note that any device that can cook can also start a fire. At LEF, we build our cookers entirely out of non-flammable material, so the cooker itself cannot burn. But the reader should be aware that ISECs, like any cooking technology, carries some risk of fire and burns to the user. A more extensive discussion of fire risks is at the end of this document. We are pleased to share as much information as we have at our disposal, but **if you build your own ISEC, you proceed at your own risk.**

Community Scale Cooking

At LEF, we have built several biogas digesters, numerous solar cooking devices, as well as rocket stoves that use wood. Overall, a combination of biogas and ISECs seem to be the best approach to a cost effective, year-round, fully renewable approach to community scale cooking.The mix of biogas and ISECs is optimal because it allows cooking in any weather, is scalable to most any size, and can be adapted to most any climate. Biogas in a temperate climate is challenging because a biogas digester needs to stay very warm and cannot be indoors. And tending a biogas digester is like taking care of an animal -- you need to feed it every day, and pay some attention to it. That is easiest to do on a community scale.

The Value of Integrating Energy Systems

The original ISEC project developed at Cal Poly uses a 100 watt, 12 volt, well insulated cooker. The fact that they have proven that you can cook with only 100 watts is great! But such small power sources do not work in cloudy weather. We have found at LEF that our cooks always favor more powerful cookers. Our largest ISEC at LEF runs at 180 volts. It will cook quite well in cloudy weather.

The ISEC project aims to provide inexpensive cookers for low income families all over the world. At LEF, we are currently trying to expand our DC Microgrid in other locales. We have a project in Jamaica. In looking at what people need there, we are aiming to provide one power system for a family or small community that is a few hundred watts, powered with a nominal 24 or 48 volt photovoltaic (PV) daylight drive system. This should provide energy for cooking as well as pumping water, and running other DC appliances such as fans or a small fridge or washer. (We are putting together different packages of components at different power and price levels.) If 10 or 20 people can share a cooking facility, then it is possible to make much more effective cookers at higher voltages that work in cloudier weather, as well as providing other services, *at a similar per-capita cost*. The problem is, of course, that many low income communities do not have the up-front capital to build larger energy systems regardless of improved overall efficacy. The right balance of cost, efficiency, and scale is and will remain on ongoing question. Our hope here is to provide options.

ISECs Designs -- Your Options

The two types of cookers we have developed at LEF are bucket cookers and box cookers. The bucket cooker we call Perl is made with a 5 gallon bucket and perlite. The Cal Poly crew has expanded on this idea by using larger buckets with more insulation. For a small cooker, Perl works well. It is cheap and easy to build. It uses a stainless pot that can be removed from the cooker and can be any size up to about 6 quarts. The heat source is a homemade burner. It is also possible to build a bucket cooker can be built with wood ashes, though that’s not a great approach. Instructions follow.

Our favored cookers are Roxes -- box cookers made with rockwool sheet and sheet metal. Roxies can be built in many different sizes and insulation levels using rockwool and/or fiberglass. Naturally, larger ISECs or ISECs with thicker insulation levels cost more. Roxies can use pots that you already have in your kitchen.

I) Build Instructions -- Burner Wires

Get the Right Kind of Nichrome for Building Burners
If you look at an ordinary toaster in use, that wire the glows red is nickel chromium, or nichrome. It is a metal with high internal resistance. It is the most common form of material used to make electric heating elements. There are different kinds of nichrome, and it comes in many different sizes of wire or ribbon. You want wire, not ribbon, and you want a twenty-something gauge. Make sure you know the ohms (resistance) per inch/ foot/ meter, because that is how you will figure out how much nichrome to use in your burner. The Cal Poly folks use a 100 watt, nominal 12 volt photovoltaic (PV) panel to set up their ISECs. Most 12 volt panels have a “maximum power point,” denoted as PMAX on the back of the panel, at around 18 volts.

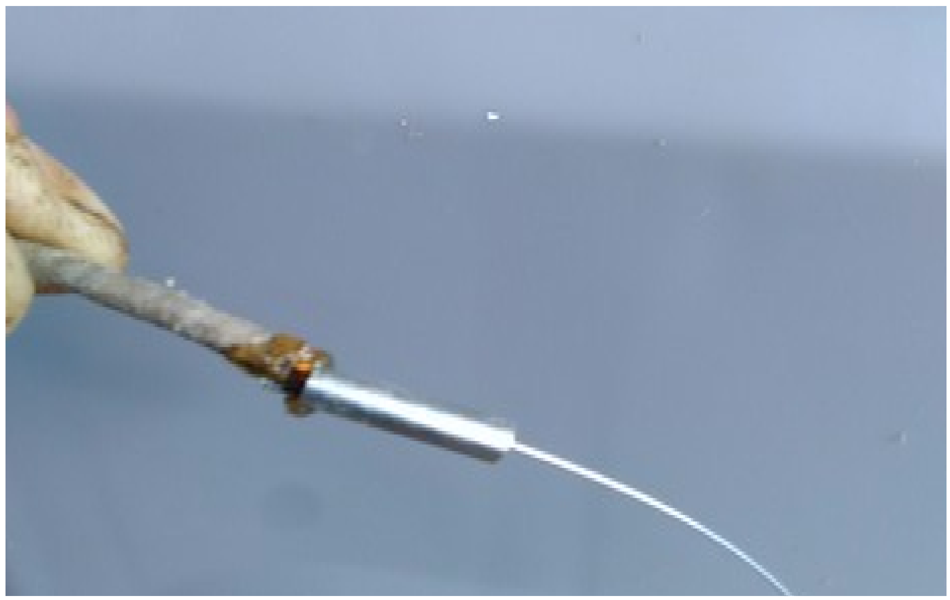
Calculating Nichrome Wire Length
For an 18 volt PMAX panel, you will need to cut a length of nichrome wire with 3 to 3.2 ohms resistance. The length of nichrome you need is easy to figure out if you know the resistance per length. We are using nichrome with 1.6 ohms per foot resistance. That means 2 feet gives us 3.2 ohms. Perfect. Alternately, you can use a electrical multimeter with a resistance scale. But beware, most cheap digital multimeters have inaccurate resistance scales. The voltage determines the length of the nichrome wire. The total wattage you use to power your burner does not matter as long as you are not using more than a few hundred watts. But beware, more wattage can create more of a fire hazard.

Nichrome Wire Length for Bigger ISECS
To set up different sized ISECs, figuring out how much nichrome to use is not difficult. To step up a burner for voltage higher than 18 PMAX, use the same ratio of resistance to the PMAX of the panel(s). At LEF, we have two panels with PMAX at 24 volts, and we put them in series to get 48 volts. We are using the same size nichrome wire (24 gauge) for bigger burners. The simplest way to find the length of wire for a higher voltage burner is a simple ratio. Thus 24 inches/ 18 volts = x inches/ 48 volts, and x solves to 64 inches. Or to use resistance to solve the equation, the math looks like 3.2 ohms / 18 volts = X ohms/ 48 volts, and X solves to 8.5 ohms. Then 8.5 ohms/ 1.6 ohms per foot = 5.3 feet, or about 64 inches. Beware that electricity above 48 volts starts to become a shock hazard.

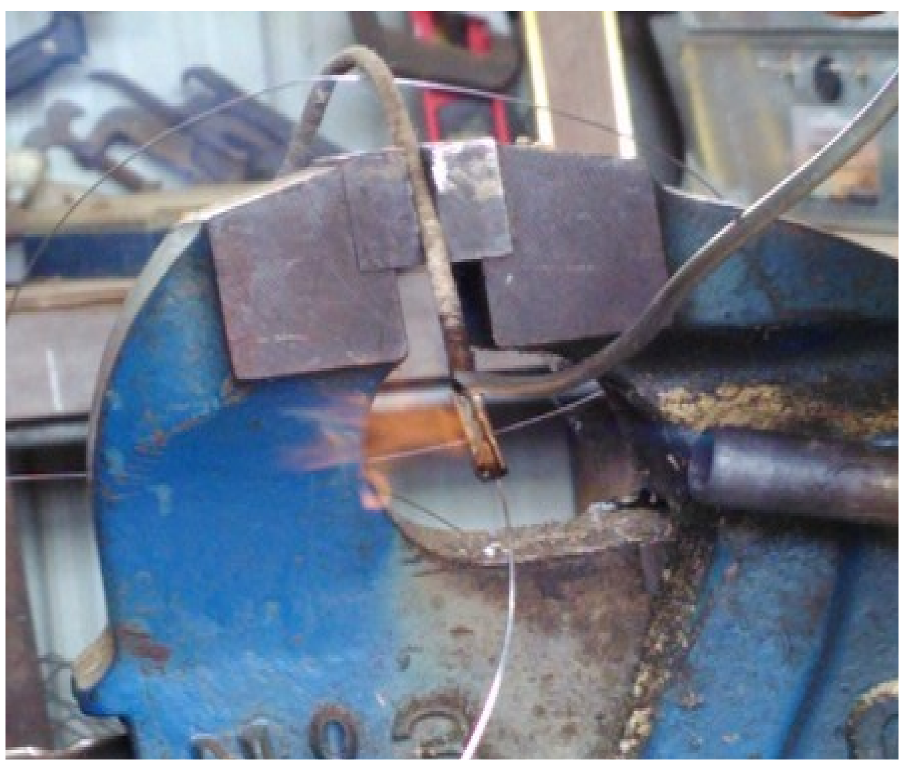
You will also need bare crimp connector couplings. These come in various sizes to accommodate different wire sizes. If you can’t find bare connectors, you can take the insulated connectors (as in the image) that are available in hardware and auto parts stores and remove the plastic from the outside of the coupling.

You will need to connect high-temperature copper wires to the nichrome wire. (We use 14 gauge copper on most of our cookers.) The high-temp wire is the same as that which is used to make ovens and toasters. We found that on our previous cookers, the cheap crimp connectors we were using did not stand up to high temperatures. Now we solder the connections between the copper and the nichrome. First, strip the copper wire and dip it in soldering flux.

Next, we slide the copper wire and the nichrome wire into a crimp coupling, making sure the nichrome overlaps the copper. Then crimp.



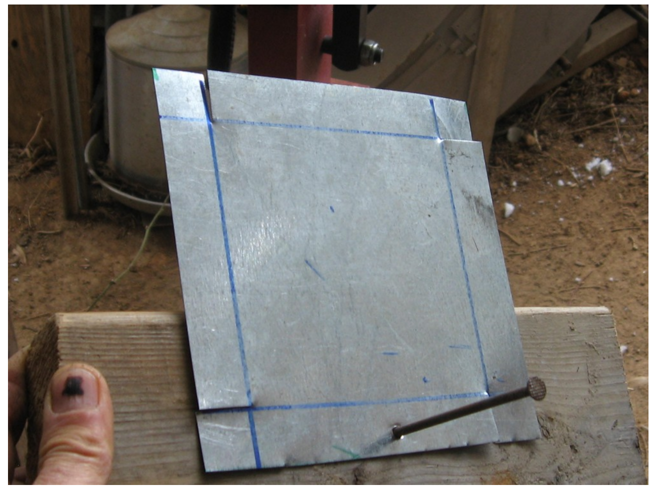
Then we solder with high temperature solder, NOT lead-based electronics solder. This photo shows a torch. An electric soldering gun is a bit easier to control.



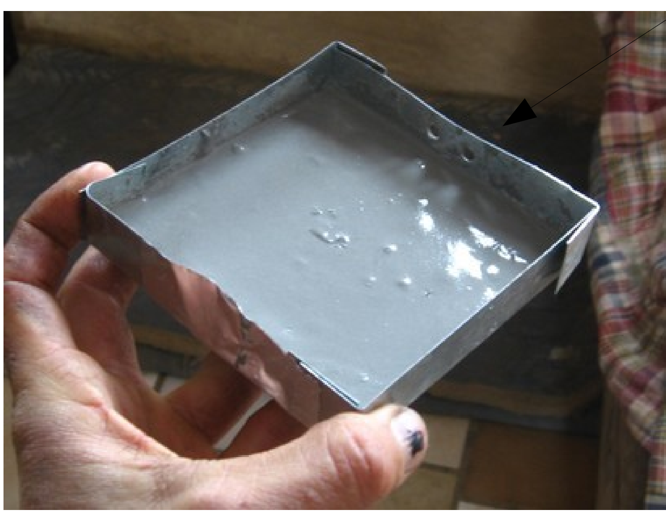
II) Build Instructions, Brick Burners

Most of our burners are homemade. To make a burner, you will need sheet metal and cement (either refractory cement or portland). Cut a rectangular piece of metal, and cut corners Punch 2 holes large enough for the high temperature wire. A metal punch is ideal (left photo), but a drill or a nail will work too (right photo). You can also make circular burners if you want.

Whitney no. 5 Jr hole punch, easily available used on ebay.



Put some cement in the bottom. Let it harden. These holes are where the wires pass through.



Brick Burner For Higher Powered Cookers

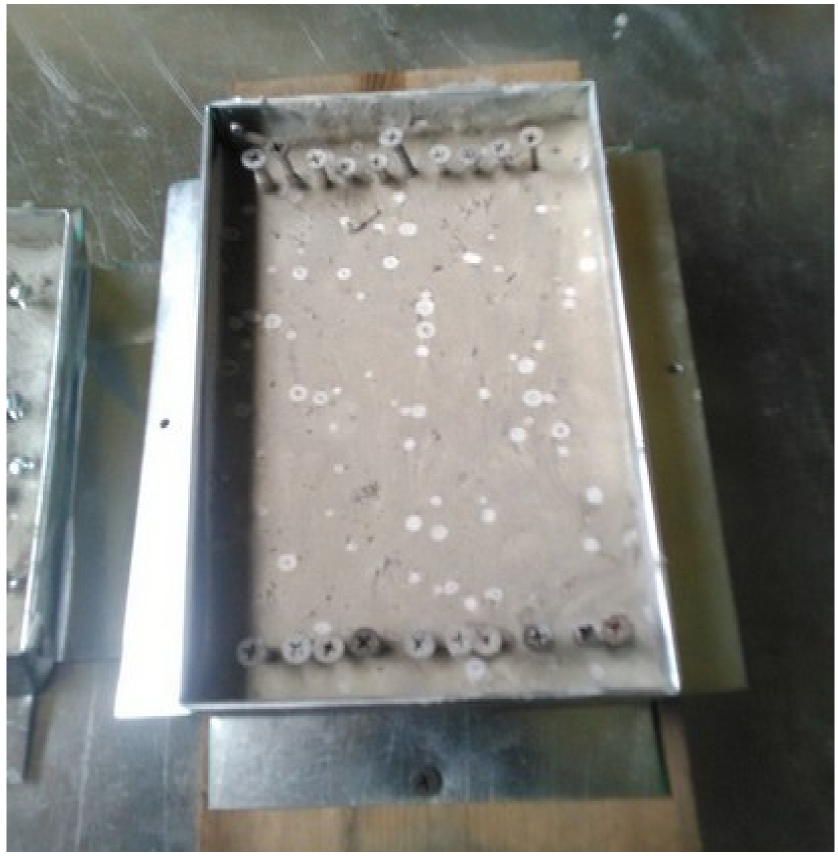
We are looking for faster methods for building brick burners, particularly for higher powered ISECS. Here is how you bend up some metal for that purpose. First you cut a flat piece of sheet metal. Notice the cuts and notches so the metal can fold.

We bend up the edges to form a trough, or U shaped channel.

Then two bends in the middle to make a T shaped piece of metal.

Then the T gets wrapped to form a tray without a bottom. This is so we can put it on a (temporary) piece of wood and drive screws to hold our nichrome wires in place.

We screw our tray down to a piece of wood, and put some refractory cement in the bottom. We run rows of screws at each end while the cement is still wet.



Once the first layer of cement has hardened, we string the nichrome wires between the screws, then lay enough cement and weights on top of them to hole them in place.

After the second layer of cement has hardened, we take out the screws and weights, and finish off with more cement. This burner has 64 inches of wire embedded in it for a high powered burner. You couldn't do that without the screws to help hold the wires in place. The wood has been removed.

This is a metal bottomed burner with 24 inches of wire for a 100 watt cooker.

The way these wires come right through the metal in this image is not ideal. See next page.

This material is high temperature wire sleeve. It helps protect wires. You can add it to high temperature wire to help protect the wires where they poke through the side of the burner. This sleeve protects the wire until it exits the cooker. If you add this sleeve to low temperature wire, it will *not* protect the insulation on that wire from melting.

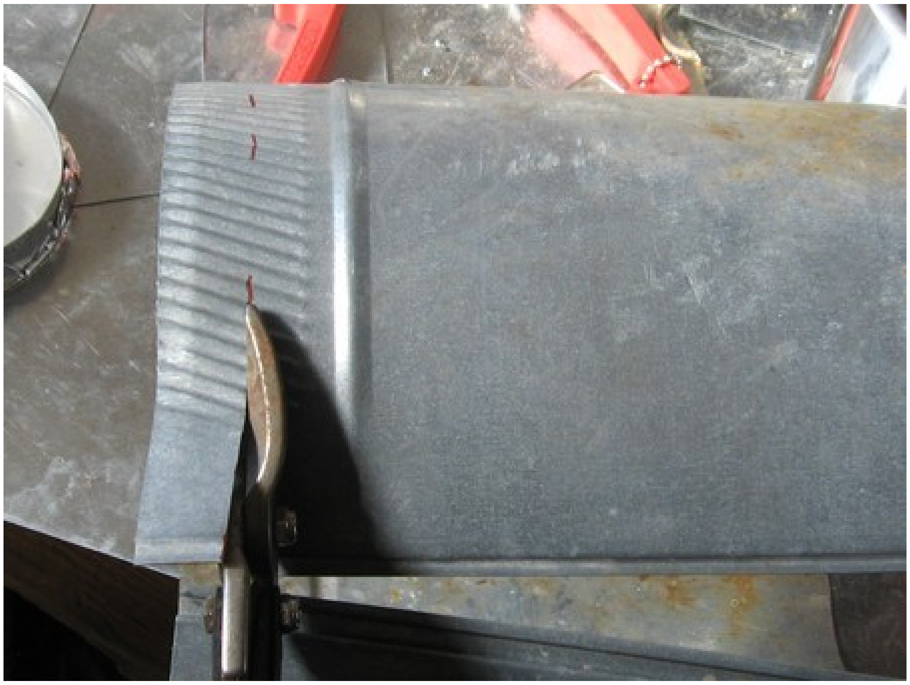
This is better – high temperature wire inside a high temperature sleeve to protect the wire from the edges of the metal. The sleeve should be continuous out the side of the cooker.

III) Build Instructions, Pot Tube For Perl

Measure the height of your pot, which is a tall, narrow pot. We have been using 3.5, 4.25, and 6 quart Bain Marie pots. Those are steam table drop-in pots. You are going to use a piece of metal to make a tube into which the pot can drop. Metal duct pipe works great because it already has a curved shape. But any metal will do -- scrap, roofing metal, anything you can bend with your hands. The width of rectangular metal needs to be a bit more than three times the diameter of your pot, and about 1.5 inches taller than the pot. The metal in the picture is 8 inch diameter duct.

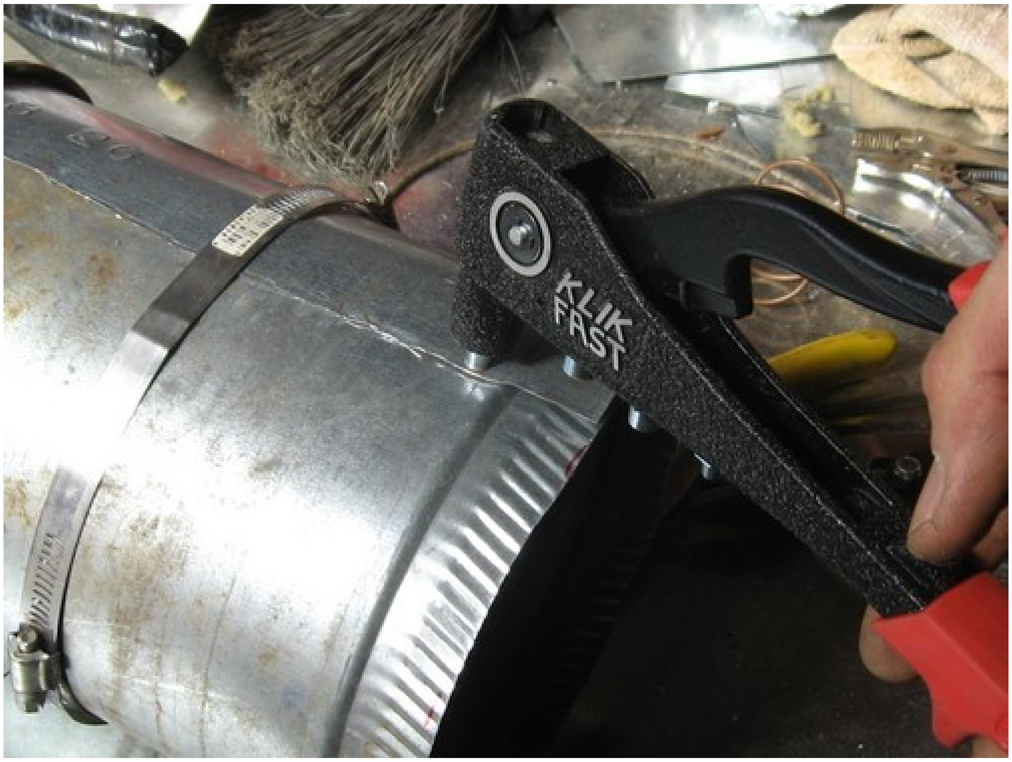
Take the metal and mark it about 1.5 inches longer than the height of the pot. In this case, my pot was about 7.25 inches, so I am marking at 8.5 inches.

Cut the metal. A good pair of shears (aka aviation shears) is desirable. With a hammer and a chisel, one can cut metal by placing it on a block of wood. That will give you a pretty rough cut though.



Wrap the metal around the pot to form a tube. You can hold the metal in place with a pipe clamp if you have a large one. A piece of wire will work too. You want the metal wrapped around the pot ***loosely***. The pot needs to slide in and out of the tube easily. You will be lifting the pot out often to cook (and pour out your soup!).

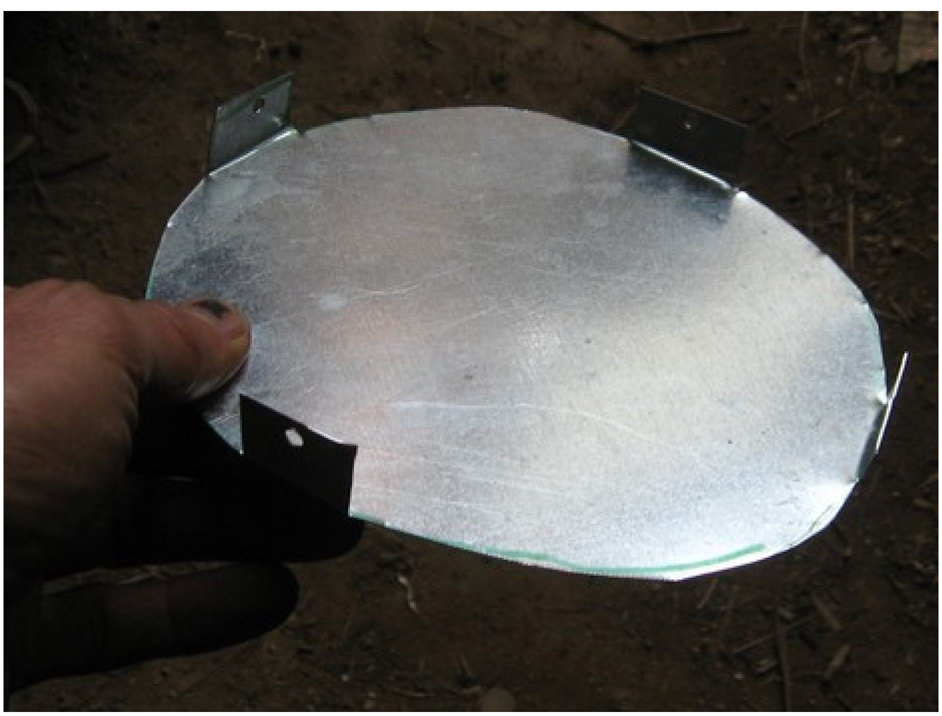
Fasten the metal at the bottom with a sheet metal screw or a pop rivet. Any shortish screw will do. (Drywall screws are not so good in metal.) For most screws, you would need to drill or punch a small hole to get the screw started. For pop rivets, you have to drill or punch a hole, and use a pop rivet tool. It does not matter much if the screw faces in or out, so long as it does not run into your pot.



Pull the pot out. Fasten the top end with a pop rivet or sheet metal screw. This screw or rivet MUST face outward or it will get in the way of your pot.

Poke some holes near the bottom of your tube. This is where the wires come out.

Mark and cut a circle of metal the same diameter as the tube, but with ears you can fold up. Minimum 4 ears, or bend up around the whole edge in sections if you want. You want to put holes in the ears for screws or pop rivets.



Set the bottom on the tube and fasten with screws or pop rivets.

This hole isn’t here.

Tape up the bottom with aluminum tape if you want.

Drop the burner into the tube, and feed the wires out the side of the tube.

IV) Build Instructions, Perl, an ISEC Made From Perlite

You can use foil or high temperature cloth at the top of the ISEC. Aluminum foil will form a thermal bridge and reduce efficiency somewhat. High temperature aramid cloth is better.

If you are going to use heat resistant cloth at the top of the ISEC, you will need to cut a doughnut shaped piece (a big ring with a hole in the middle). The outer ring of that doughnut will need to be about 2 inch wider in diameter than the top of the bucket. The inner hole of that doughnut shape will need to be 2 inches narrower than the tube.
Cut slits in the inner circle of the aramid so the material can fold down and the tube can fit through the hole in the middle of the aramid ring. If you are using foil, you will need to use multiple pieces. Tape the aramid or foil around the top of the outside of the tube with aluminum tape.

Aramid is a tightly woven fabric that will hold together when you cut slits in it. (It’s about $3.70 USD/ square foot if you buy a few hundred dollars worth.) Fiberglass welder’s blanket is a much more loosely woven material and will fall apart if you try cut slits in it, though it can be used in one large piece for the lid.

Drill small holes on the bottom of your bucket to let water out. Drill holes in the side at the level of the bottom of the pot tube as measured down from the top. Fill the bucket with perlite up to the level of the holes in the side, or slightly higher. There are different particulate sizes for perlite. The smaller stuff is probably best, but any will do.

Drop your tube for into the bucket, feeding the wires through the side of the bucket. Settle and pack the perlite some so the tube settles firmly and the top is the same level as the top of the bucket. Pull up the aramid or foil and cover the top of the tube with a bit of foil (to be removed shortly) so you can pour perlite to fill the rest of the bucket.

Remove the temporary foil over the top, then settle the perlite so it is a bit lower than the top of the bucket.

Pack some insulation around the top of the bucket. Rockwool (batt form, not board form) is best here, but fiberglass will do. Overfill it so it sticks up quite a bit. This needs to form a seal with the lid. Do NOT use flammable material.

Pull the aramid or foil down around the top of the bucket and tape it. It is okay to use duct tape here, as this area does not get so hot. Done! (Except for the lid....)

Steam Venting

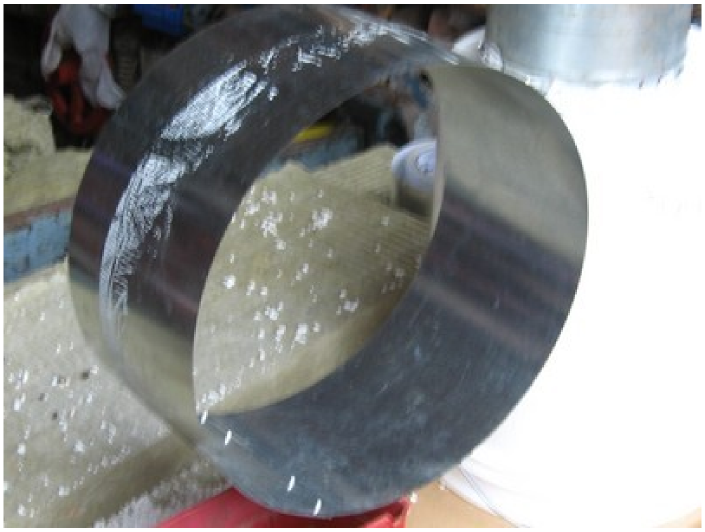
Steam Venting

Any cooking releases some steam, and one can expect moisture to accumulate in the insulation of an ISEC. Perlite will not degrade under wet conditions, and rockwool is more tolerate of moisture than fiberglass. If too much moisture builds up in the insulation, it will begin to defeat the insulation because you will have to heat up all that water while you are trying to cook your food. Particularly in the lid, there are likely to be moisture build-up issues. The Cal Poly crew has been working on this for a few years, working largely in southern California (where there is lots of sun). They use a steam tube vent through the lid. Perl could have a steam tube vent through the lid or immediately under it. The material that works for this purpose is high temperature silicon tubing. See resource list for what that is and where to get it.

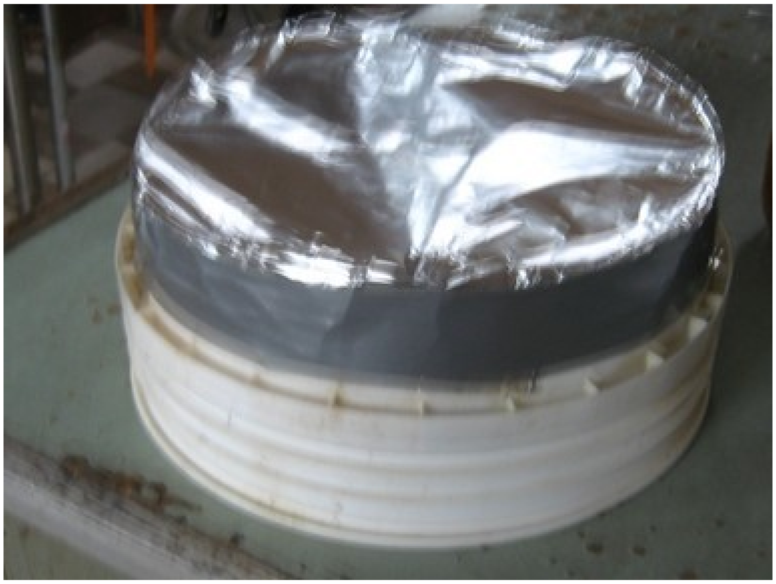
V) Build Instructions, Lid for Perl

A Lid for Perl

Perl ISEC will need a lid. You will need to make a ring as large or slightly larger than the top of the bucket. The ring needs to be about six inches tall. We use a metal strip. Alternately, you can cut the top six inches off of another bucket. If you have the metal, a strip is better because you can make a lid that is a little wider.



Cover one side of your lid with foil (cheap) or fiberglass welder's blanket (more expensive) or aramid (most expensive). Tape the outer edge of the foil or material around the lid ring.



If you are using fiberglass welder's blanket or aramid, put a layer of foil on the inside to function as a vapor barrier and reduce moisture entering your lid.

Fill your lid with rock wool (preferred) or fiberglass. Do not use flammable material.

Cover the other side with foil, fiberglass welder’s blanket or aramid. Tape around the edge. Your lid is complete.

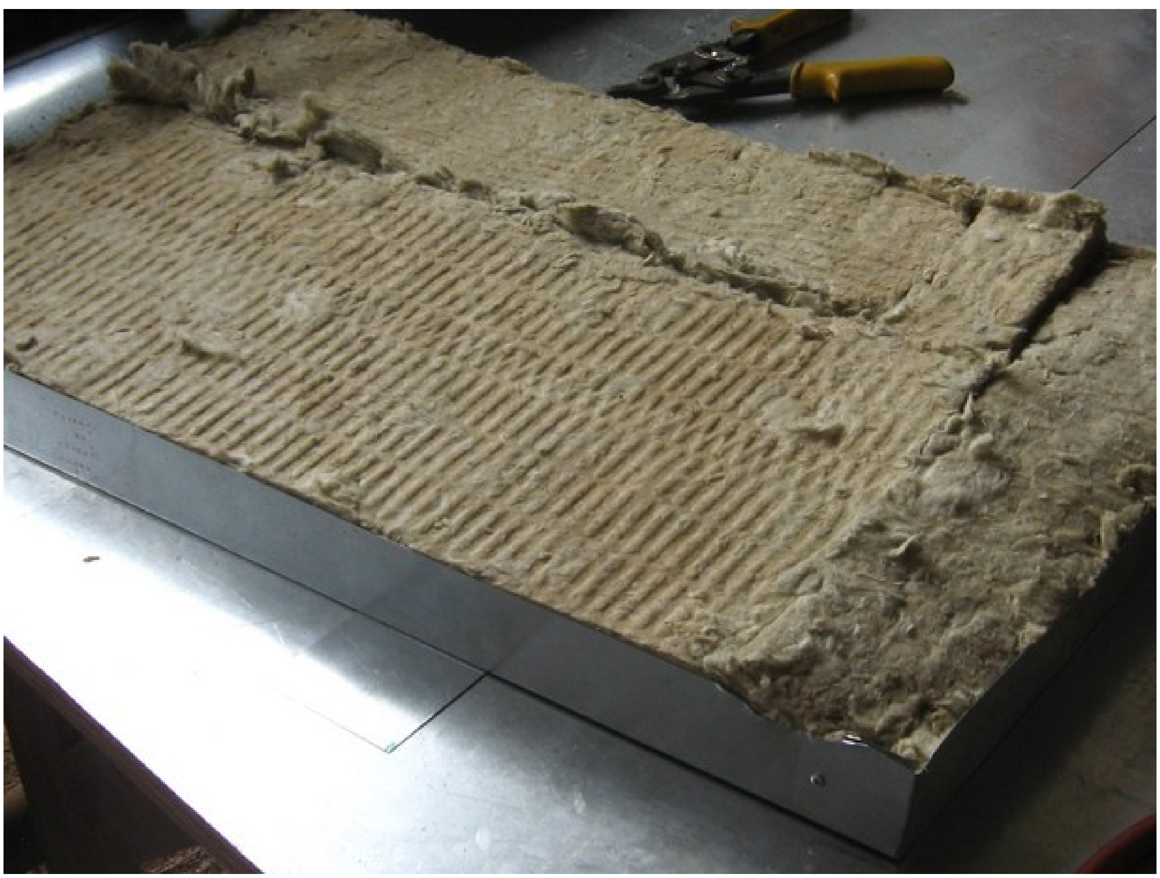
VI) Build Instructions, The Roxies

The Roxies, Larger ISECS

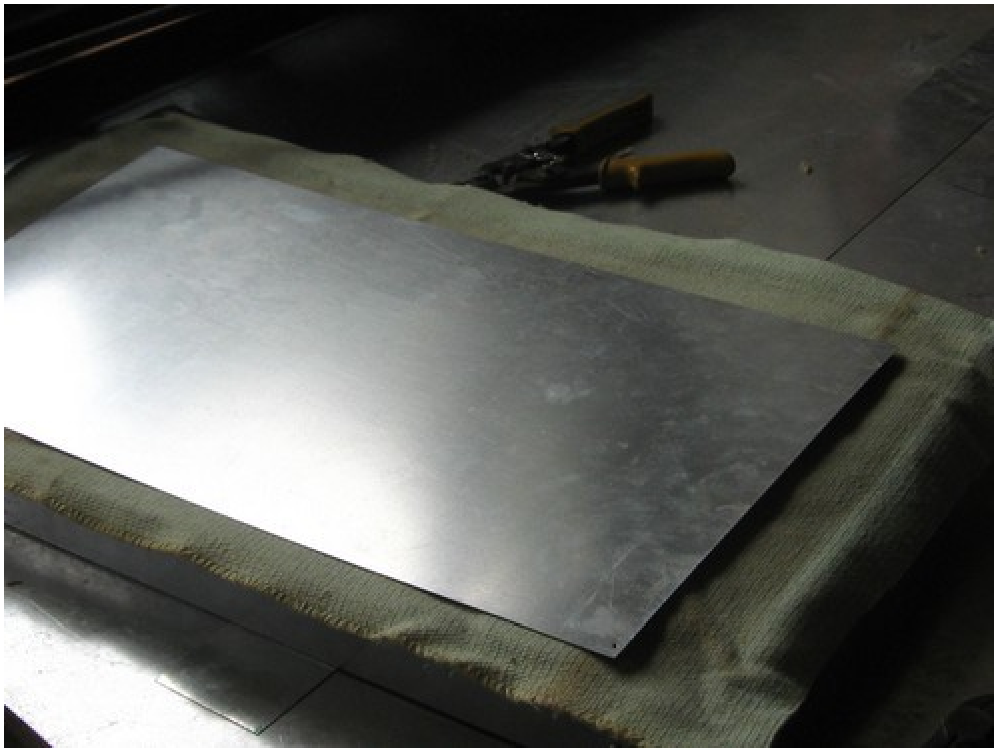
The “Roxies” refer to ISECs built with rockwool or fiberglass, with sheet steel to make an oven. The advantages of rockwool in either form is that is has much higher temperature tolerance, and does not fall apart when it gets damp. The disadvantages are that it is a little more expensive and hard to get. There are in theory several companies making rockwool sheets, but only one kind seems to be easily available, and that’s called Roxul. It comes in various thicknesses from 1 inch up to 4 inch. Roxul sheets are 2 foot by 4 foot. Don’t forget to account for overlapping corners. Mark your sheets with a marker. A kitchen knife will cut the Roxul.

Roxy 180 is our largest Roxy, made to run at 180 volts DC, dayight (direct) drive from our photovotaic panels. For this one, we made a metal base. The rockwool fits snugly into this base.

For the lid and the base, the rockwool is fitted into the metal.

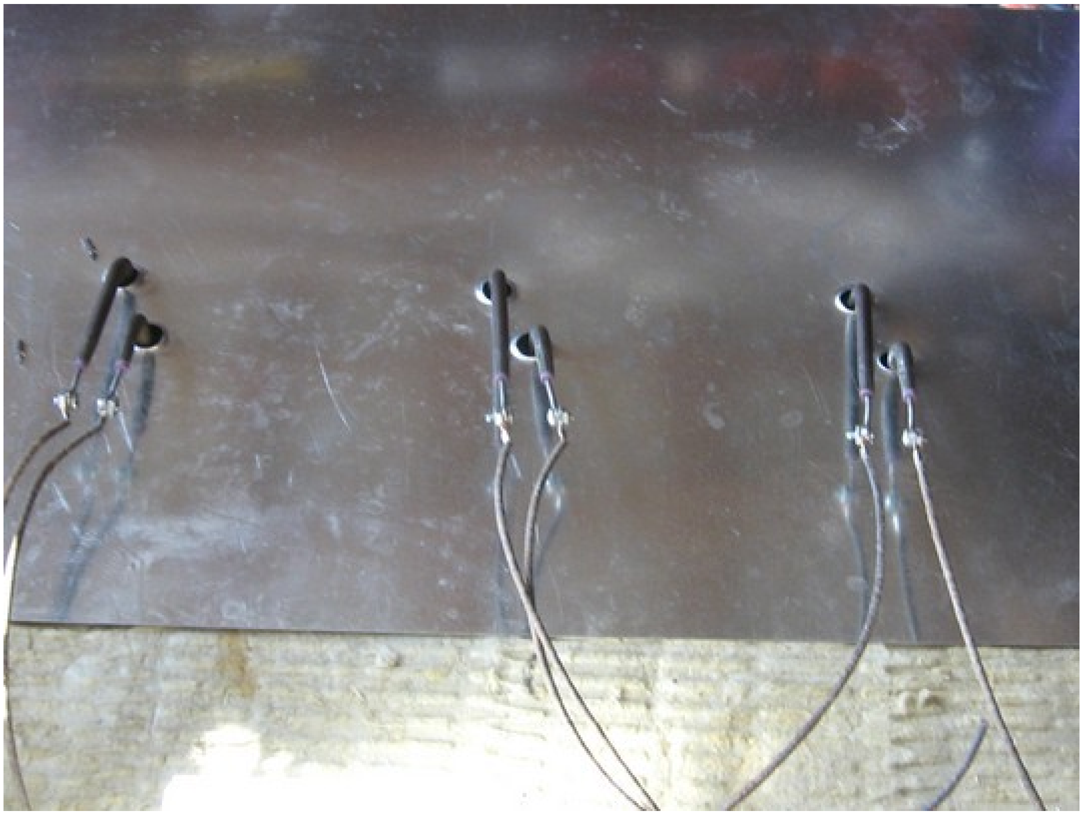


We covered the center of the base with sheet metal, and covered the edges with aramid to break the thermal bridge.



We cut a metal sheet to go on top of the Roxul. We poked holes so we could put the electrical connections safely under the metal. We are using three regular 240 volt stove burners. By using switches, we can use one, two, or three burners at a time. The lowest power setting puts all three burners in series, thus increasing resistance and giving us a cooker than can run alongside many other machines running simultaneously.

Wire are connected under the metal. Beware, high voltage DC electricity is dangerous in a similar fashion to high voltage AC power. `



All three burners. A large Roxy must have a thermostat or timer.

We put covers over the burners to avoid hot spots.

This is a real oven made to run at three different wattage levels (350, 700, and 1400 watts). It runs on 180 volt DC power. Ovens like this could be built to tie into the DC side of existing “grid-tie” solar racks. CAUTION: HIGH VOLTAGE DC POWER POSES A RISK OF SHOCK OR ELECTROCUTION. HIGH POWERED INSULATED OVENS POSE A FIRE HAZARD IF NOT BUILT AND USED PROPERLY. DO NOT WIRE THIS KIND OF OVEN IF YOU ARE NOT FAMILIAR WITH ELECTRICAL CODE AND SAFE WIRING PRACTICES. This oven MUST have some kind of thermal control – a thermostat and/ or timer. The top of the oven also can get hot depending on how much insulation is used. This oven will bake six loaves of bread. We made a rack to hold the trays.

We built our oven to sit on top of the base. Roxy 180 can run at 300 watts, 700 watts, or 1400 watts. This is a real oven that happens to be solar powered.

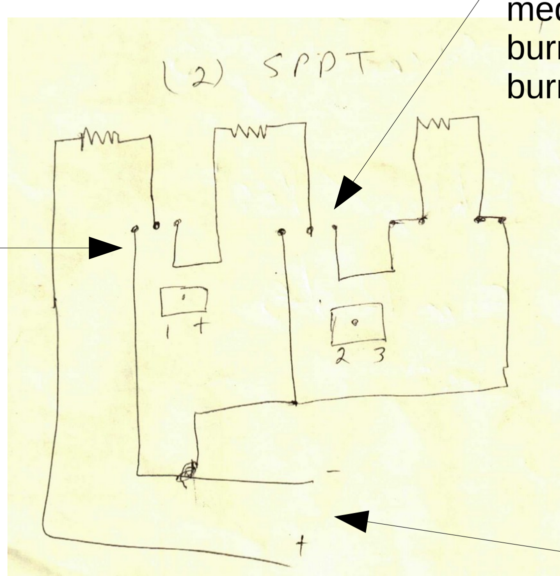
Rockwool on all sides, thicker on the top.

The same 180 volt oven with the lid on. The electrical box in front has both a timer and some switches. The whole top is covered with fire-proof welder’s blanket, which you can see on the sides.

Here is a simple schematic for how we used “double throw” switches so we can run the burners one, two, or three at a time. Because the burners are set in series, the lowest heat setting is when all three burners are engaged. This is a cheap and simple way to reduce power flow without any fancy electronics. The burners were eight dollars each.

Second switch toggles between medium (2 burners) or low (3 burners).

First switch toggles between high (one burner) or medium-low (2 or 3 burners).



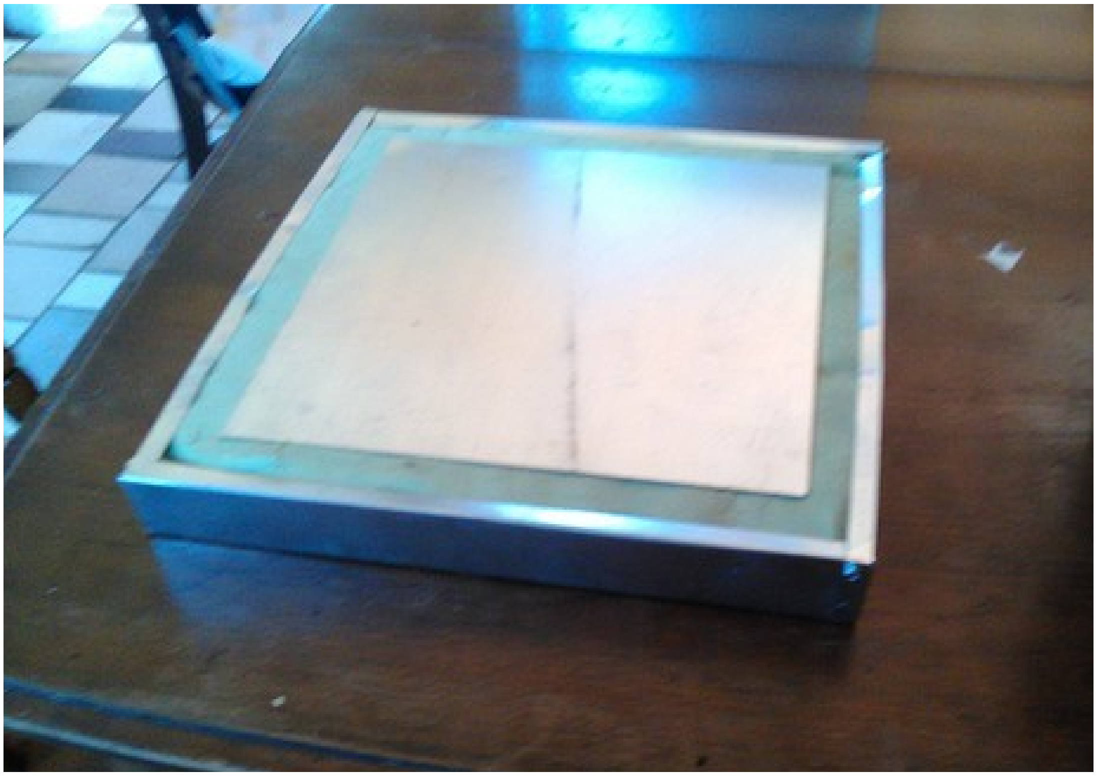
Timer connects here.

Roxy 48, 330 watt

Roxy 48 is a larger ISEC built with 2 inch Roxul. It is powered by a 48 volt, 330 watt radiant buner. The burner is made with 64 inches or 24 gauge nichrome wire. Roxy 48 cooks quite well. We control it with a spring wound timer. Finding a DC thermostat that would hold up for years of use is not easy. We can cook a batch of sweet potatoes or winter squash by 1 PM, and another batch for dinner.

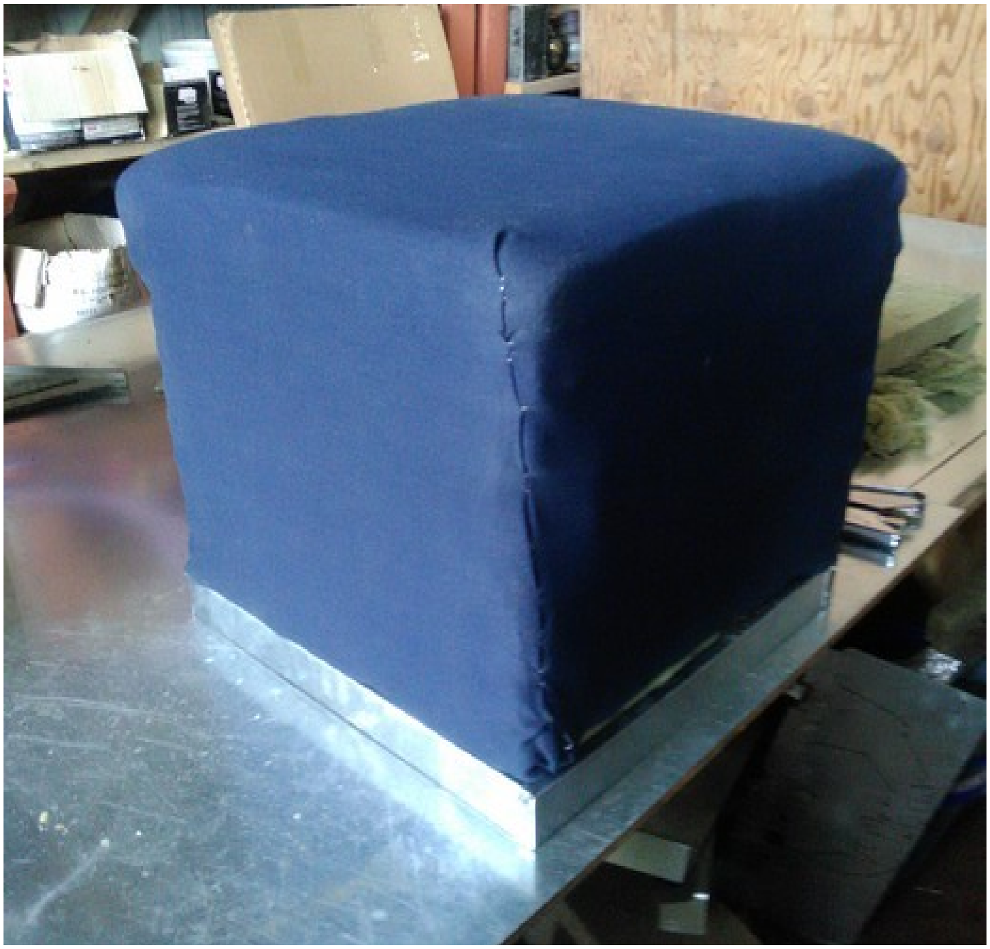
Roxy 48 base, showing some signs of wear after months of daily use.

Roxy 48 is covered with a welder’s blanket. It’s a bit floppy. See Blue Roxy below, which is a similar size but a more elegant build.



For our Jamaica project, we need Roxies that work well, are fast to build, and look good. We built a metal base insulated with rockwool, similar to Roxy 180. This one does not have the burner yet.

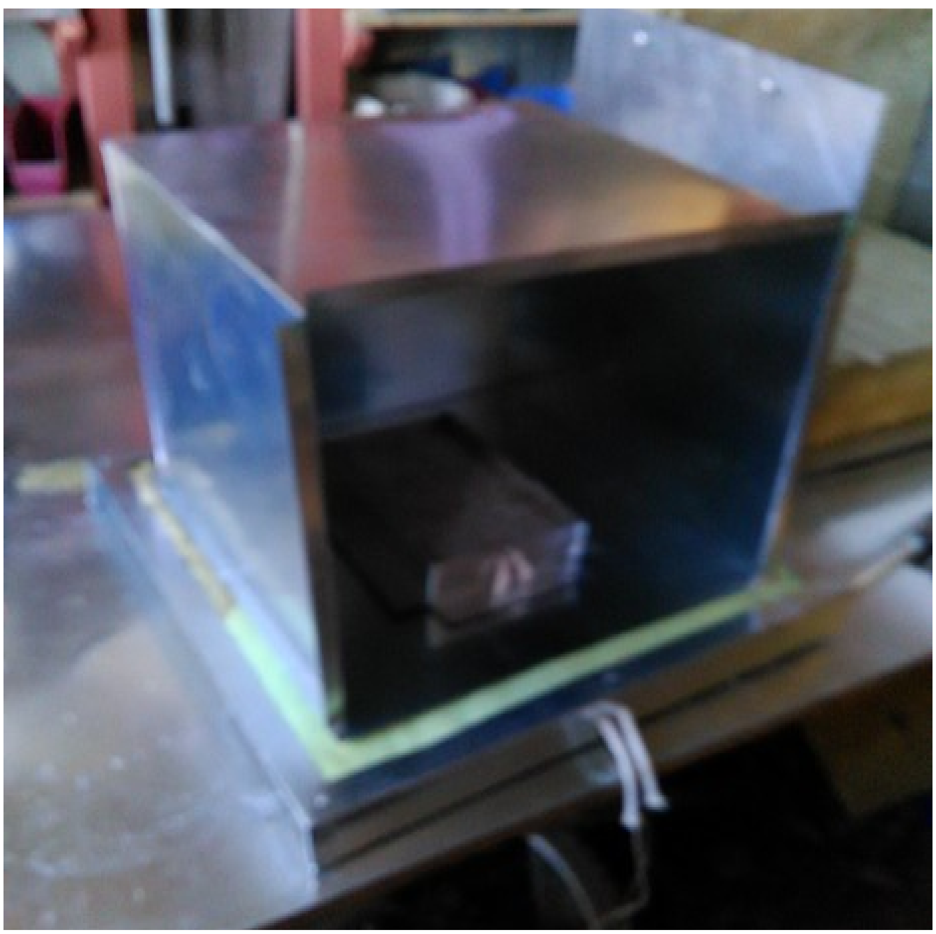
This is **Blue Roxy**, prototype for Jamaica. The outer covering is made with a thinner, tighter fitting aramid. It is moderately sized and light enough (12 lbs) to pick up without too much trouble. This one is easy to build -- we like it. The metal-to-fabric connection is a bit tricky. It involves a S-shaped bracket that pinches the fabric and the metal edge of the inner box.



Blue Roxy sitting upright. Nice cooker!

Roxy Metallica with a metal inner oven and an exterior metal covering.

Roxy Metallica sitting upright. It looks like a sturdy kitchen appliance. But it’s a bit heavy. The lid is about 17 pounds, which is heavy for some people to lift at counter height. It might work better sitting on the floor. The shiny metal covering will not look new for long. The galvanized cover will look messy before long.



This is the beginning of **Roxy Deluxe**, our nicest Roxy cooker. Metal interior box.

Metal outer shell for Roxy Deluxe.

Roxy Deluxe looks and functions very much like a “real” oven. It can be set up to run at a wide range of power levels. It has a door that is easily set in place.

Roxy Deluxe, closed up for cooking.

Roxy Deluxe is large enough for a large pot. The timer in front turns it off after the cooking is done. This is the fanciest solar cooker we have built.

Addendum: Tooling for Making Better ISECS

We started working on the ISEC project with an intent to make effective cookers as simply and cheaply as possible. The Perl cookers fit that bill. We also started using ISECs ourselves, setting up various sizes and tying them into the DC Microgrid at LEF. We made our first Roxy cookers based on a small, beat-up “haybox” cooker that we have. That haybox is just styrene covered in cardboard. It works great as a rice cooker. You just bring your rice (or grits or whatever) to a boil, drop it in the haybox, and not only do you save energy, your food never burns. It works great! Based on that idea, we taped up our first Roxy cookers with aluminum tape, and foil on rockwool board. But the rockwool is heavier, not so sturdy, and those cookers didn’t hold up. We have some metal working equipment on site, so we starting using that equipment to make metal-lined Roxy cookers. The metal-lined Roxies are far superior cookers. We use them now to cook with all the time, backed up by biogas.

Making metal boxes is easy and fast with proper tooling. The two large tools one needs are a shear and a brake. A shear is a big scissor. The 26 gauge galvanized duct metal sheet we use comes in 4 ft X 8 ft sheets, which means one needs a 52 inch shear. Unfortunately, those are expensive. The manual shears (as opposed to power shears) are variously called stomp shears, manual shears, or foot shear. The good quality ones can be obtained for about $2000 used. Northern Tool sells one new for about $1500. Shears show up on craigslist an ebay with regularity.

Sheet metal brakes are used to bend metal, and they come in various widths and qualities. The “box and pan” brakes have fingers that allow one to bend corners, which is helpful for making boxes. Harbor Freight sells an inexpensive three foot wide brake that is widely available new and used.

Our Niagara shear, old but very sturdy.

Box and pan brake, 4 feet wide.

Inexpensive Harbor Freight brake, 3 feet wide. It works fine for thin metal like we use on the Roxies. One can cut notches in the upper bar for making corners at particular distances (like a box and pan brake).

The fingers on a box and pan brake allow you to bend corners, to make metal boxes.

A manual shear is often called a stomp shear or foot shear because you stomp on the lever to cut metal.

Addendum, More On Fire Risks

ISECS should be built with materials that do not burn. We are very excited about Perl ISEC in particular as an inexpensive, very effective solar cooker that is easy to build. If there is any significant amount of water in a pot in Perl, or any 100 watt cooker, the water will keep it from getting too hot. We ran a Perl all day with no water at all in it. It got over 500 F inside. The aramid was blackened somewhat and smelled bad. But neither aramid, nor perlite, nor any other materials used in Perl, Ashley, or the Roxies will burn. The ISECs developed by the Cal Poly team use thermal switches and fuses on First ISEC and PCM ISEC. These are not strictly necessary on Perl or the Roxies, but the thermal switches and fuses are inexpensive and easy to install. Thermal switches that switch at 150 C or 180 C will not be activated in normal cooking. If the thermal switch is only activated very occasionally, it should last a long time. For our larger ISECs, we are using external timers. These are cheaper than thermostats that can handle DC current at higher amperages. ***It is easy to forget than an ISEC is plugged in!*** That creates a risk of overheating, particularly the day after you use it and the sun comes up again. It would be wise to use a thermal switch, thermal fuses, and/ or an external timer to prevent overheating. ***Make sure your ISEC is not still plugged in after you quit using it!***

Resource List

Buckets -- The primary reason we have pursued Ashely and Perl is the assumption that 5 gallon buckets are available. A number of hardware and lumber stores will sell 5 gallon buckets with their brand name on the side for cheap.

Perlite -- Perlite is widely available, but prices are variable. The cheapest prices are from commercial suppliers who provide materials for commercial nurseries. Perlite is sold in 4 cubic foot bags for about $35 - $40 per bag retail. One only needs about half a cubic foot per Perl cooker build. One supplier (for volume purchases) is https://www.7springsfarm.com/ On volume purchases, they are likely much cheaper than the big box stores or online.

High Temperature Wire -- Local electrical supply houses will have it, perhaps your local hardware store might sell it by the foot. The cheaper supply houses include zoro.com and globalindustrial.com. Others include grainger.com (owns zoro), mcmaster.com, mscdirect.com, as well as others. We also use ebay quite a bit. If you have heavy gauge wire around you can use it, but for short runs in the amperage needed for most ISECS, 14 - 16 gauge is fine.

Bain Marie Pots -- We have been buying from webstaurant.com, but beware, their shipping pricing is extortionate. They price their items low, and make their profit on inflated "shipping." We have not found a better source -- let us know if you do.

Metal Shears -- Brand name "aviation shears" are the best. Ideally, you want one straight cut shear and one "offset" for cutting round metal or stiff metal. See ebay item number 254126179593 (just search using the item number), 223463451369, and 203268145632.

Nichrome Wire -- We got ours from ebay, widely available through other sources. Ebay item number 281789675253

Fiberglass High Temperature Welder's Blanket -- See ebay item number 301902953193

Aramid -- See ebay item number 153528934391

High Temperature RTV Silicon -- see siliconedepot.com (volume pricing but high shipping costs), ebay item number 282934833088 or zoro.com

Thermal Switches -- We ordered a few of ebay item number number 273119630408 The Cal Poly crew uses Selco BM1−180A−000N. Hopefully, we can make the Selco switches available in the future.

Heavier Aluminum Foil -- ebay item 174416639430

High Temperature Ceramic Beads -- See ebay item 184551973592

Silicon Tubing, High Temperature (for steam venting) -- See ebay item 382868584977

Heavier Aluminum Foil -- ebay item 174416639430
High Temperature Ceramic Beads -- See ebay item 184551973592
Silicon Tubing, High Temperature (for steam venting) -- See ebay item 382868584977
Inexpensive Wire Stripper/ Crimper/ Cutter -- Ebay item number 192959194511
Duct Metal
Refractory Cement
Rockwool Batts
Roxul Rockwool Sheets
Aluminum Tape