

## ISEC Assembly

### For ISEC Cooker with Phase Change Thermal Storage

The link below leads to an instruction video, which is not a necessary accompaniment but can deliver clarifying visuals.

<https://www.youtube.com/watch?v=MEaCE7GpcNA&feature=youtu.be>

### Assembly Summary

One pot is cut in a way that allows another pot to slide into it completely. A chain of diodes and a thermal switch are glued to the bottom of the cut pot and soldered together in series, along with lead wires. A shield is then attached to the bottom of the nest. The main cookpot is glued to a smaller spot with a connecting ring, sealing a chamber between them that is filled with the phase change material. The cooker is placed into an insulated container and connected to a solar panel.

### Materials Needed

- 2 identical pots (aluminum is best for ease of cutting)
- One pot that is smaller than the other two and a lid for it
- 17 flat, square diodes (BYV10X-600P)
- Thermal switch rated for 10A and at least 150 °C
- Hi-temperature epoxy (we use J.B. Weld)
- About 2m of Wire (Maximum 14 AWG)
- A container for the cooker and insulation
- Insulation (Clothes, Blankets work fine, fiberglass can get messy)
- Alligator Clips
- “Shielding” medium
  - Options for this are elaborated on in the Shielding section
- Erythritol
- Sheet metal

### Tools needed

- Hand Saw
- Soldering iron and Sn-Ag 96%-4% solder
- Needle Nose Pliers
- Scissors or Metal Sheers

## Nest Assembly

Designate one of the identical pots to be the **nest** pot (which gets heated up by the diodes) and one to be the **cook** pot (which holds the food). The cook pot will slide into the nest pot and will get heated up by the nest pot.

1. Saw off the top couple inches or so of the nest pot, enough to remove the handles. This should leave you with a shorter pot and a metal ring with the handles attached. Discard the metal ring.
  - This is so the cook pot can slide into the nest pot without its handles interfering
2. Saw 4 vertical slits into the nest, equally spaced, sawing all the way down to the base
  - This improves the ability of the cook pot to fit snugly into the nest, improving thermal connection (very important)
3. Mix the J.B. Weld. Place the nest face down and begin gluing the diodes to the bottom of the nest. If you are using a different diode than listed above, this process will differ.
  - Brush the back of the diode (the flat side) with JB Weld and push it down hard onto the bottom of the nest, maximizing thermal connection between the diode and the pot (very important)
  - Make sure to place them close enough together so that the diode leads can be wrapped to the leads of the adjacent diodes, chaining them together.
4. Glue the thermal switch onto the bottom of the pot, in a position so that one of the thermal switch leads can attach to one of the diode leads on the end of the diode chain.
5. Let the epoxy cure (harden). This can be vastly accelerated with heat.
6. Once the epoxy cures, wrap the diode leads to the adjacent diodes to form a chain and solder them together. Solder one of the thermal switch leads to the end of the chain.
  - Make sure that no leads or solder is close to touching the pot; this would cause a short-circuit
7. Prepare the lead wires. Cut 2 lengths of wire and cut the wire housing at the ends to expose the wire threads for connection.
  - These 2 lead wires should be fairly long (.5 m to 1 m) so that they can come out of the insulation container holding the cooker and connect to the solar panel leads.
8. Solder one wire lead to the remaining thermal switch lead and one wire lead to the remaining end of the diode chain.
9. Make sure to note which wire is the positive lead and which is the negative.
  - When the diode is laying on its flat side with the leads pointing south, the eastern lead is the positive lead and the western is the negative. Thus, if you had a chain of diodes laying like this all together, the eastern side of the chain would be the positive side.
10. Attach alligator clips to the ends of the wire leads.

**Nest Complete!**

## Shielding

The diodes get very hot and risk burning the insulation. Also, the soldered leads can be fragile. We recommend shielding the bottom of the nest in some way. The shield could be permanently attached or not.

We have used a metal plate filled with sand. The nest is placed onto the sand, cushioning the circuit. We have also poured concrete into a metal plate and placed the nest onto it (with the cookpot inside it so the nest shape is appropriate when the concrete dries). Do not seal a plate to the bottom with just air, as the sealed air pressure would increase with heat. Do not use a material that will melt.

## Note about Cookpot handles

Metal handles on the cookpot can lead to heat loss if not well insulated. For instance, if the cooker is in a bucket and the pot is well insulated, but the handles extend and touch the sides of the bucket, there will be significant heat loss and thus less powerful cooking. Also, the handles will get very hot if they are metal.

We recommend sawing off metal handles and screwing on wooden handles (or attaching wooden handles in any other adequate way). However, if you can insulate the handles appropriately and have oven mitts for handling the pot, the original metal handles are fine.

## Phase Change Assembly

The smaller pot will be placed inside the cookpot.

1. Cut a ring of sheet metal with scissors or shears that is the exact thickness to connect the top of the small pot to the top of the larger pot.
2. Use JB Weld to connect the small pot to the inner part of the ring. Allow to cure.
3. Meanwhile, start the erythritol melting process. Fill the cookpot with enough erythritol so that the inner chamber will be mostly filled.
  - o Note that erythritol expands as it melts
4. Melt the erythritol. Erythritol melts at 120 °C. This can be done a couple ways:
  - o Place the cookpot filled with erythritol on the hot plate
  - o Or, use ISEC to melt it. Follow the ISEC Usage instructions in the next section

**Use EXTREME CAUTION when handling the molten erythritol. It will stick to your skin and cause much more severe burns than most substances. Take as many precautions as possible. Clear the area of all tripping hazards. Wear gloves, long sleeves, pants, protective eyewear, and closed-toed shoes.**

5. Once melted, apply JB Weld to the bottom of the sheet metal ring that is currently attached to the smaller pot.

6. With the pot of molten erythritol in a convenient location, place the smaller pot into the pool of molten erythritol. Place something to weigh it down so that the tops of the two pots are level and the sheet metal ring connects them.
  - o Make sure everything is positioned so that the JB Weld will seal the outer part of the ring of sheet metal to the cookpot. Be wary of erythritol spilling over if you added too much
7. Wait for JB Weld to cure and erythritol to cool down and solidify.

### **ISEC Usage**

Place the cooker (shield, nest, cookpot w/ phase change, and lid) into the container. Make sure it is well insulated and that the lead wires come through the insulation and out of the container.

Attach the positive lead wire to the positive solar panel terminal and the negative lead wire to the negative solar panel terminal to commence heating. Allow phase change time to heat up and melt; this time varies based on sunlight, but should only be a few hours.

Once the phase change has melted (guess based on time or test it out by throwing something in the cooker), put your food into the cookpot, put the lid back on, and reinsulate. Feel free to check on the food, but know that heat will escape when you do, so be swift.

When the food is finished cooking, take the phase change cookpot out with oven mitts and pour the cooked food into a container.

**CAUTION:** When pouring the food out of the cookpot, be wary of leaking molten erythritol. The chamber should be sealed, but in particular on first use of a new pot, one should watch out for this.

**End**