



Large Rural Mailbox Annealer or Annealer Management for Jacks*

Wallace Venable

Emeritus Associate Professor, Mechanical & Aerospace Engineering, Box
6106, West Virginia University, Morgantown, WV 26506-6106, USA

wvenable@wvu.edu

I didn't think this up. I started with a page from Fred Birkhill's lampworking class notes, and he, in turn, got the idea from a friend. I later found it in Dudley Giberson's book (which should be at the core of any glass equipment builder's library) and he credits Labino. My own contributions relate to cheap temperature measurement and control. The total cost runs to about \$125.



I lined the sides and back of the mailbox with 2 layers of frax insulation, and put one layer on the door. The door insulation is held in place with a scrap of metal grid and wire loops through the door.

The mechanical part of the project generally follows the advice of Henry Halem and Dudley Giberson. Use caution, apply rigidizer, etc., etc. etc.

You will only need about 20 square feet of fiber, but I bought a full box of 2600° frax to get a good price. The 2300°F insulation is fine for an annealer, but by buying the higher temperature material, I have the option to use the rest of the box in other projects, such as a glory hole.

Heating Elements

Fred's drawing showed a heating element which looked like a water heater element. I asked Fred if water heater elements worked and he said he didn't know.

Replacement elements for electrical water heaters are readily available in "home stores" at very modest prices. I decided to do an experimental evaluation of them as potential elements for glass kilns and annealers. These have a number of potential advantages beyond low cost and ready availability. First, they are easily mounted with a few bolts. Second, the tubular construction allows them to be grounded, so that there is no exposed electrical circuitry within the box.

These elements are intended to be cooled by direct contact with the water. As I expected, a 110 volt - 1500 watt element lasted only about five minutes in air when connected to power.

Power consumption in an electrical circuit varies with the square of the applied voltage. We

* In many trades, a Master is a worker who is so highly specialized he can only do one thing - period. As I see it, a Jack is a Renaissance Man of the craft world. It is the Jacks who can take methods developed in one area and apply them in another. On the whole, Jacks have a tradition of sharing techniques, and of teaching "outsiders." Masters, on the other hand, have a tradition of protecting secrets, and forming guilds of exclusion. Jacks are often concerned with "good enough," while Masters focus on "the best." This applies to tools and equipment, as well as techniques and results.

© 2002 by Wallace Venable This document may be freely copied for personal use, free distribution, or inclusion in class notes on the condition that the entire work is distributed unaltered. The illustrations may be used for the preparation of slides or transparencies. All other use is reserved.

would therefore expect that the power produced on 120 volts to be one fourth of the 240 volt rating. This is, in fact, true, as my tests showed. I found that 3600 and 4500 watt 240 volt elements will work in free air. When I installed the 3600 watt element in my box with 1 inch of insulation, I got a temperature of about 500°F. Replacing that one with a 4500 watt one, I got 750°F. By adding a second inch of insulation to the walls, I got the temperature up to 950°F. Unfortunately, at 950° the element sagged under its own weight, and the metal surface oxidized rapidly and destructively. Our lumber yard offers elements which are guaranteed against burn-out, but these cost about \$40, so I terminated this series of experiments.

I ordered a nice 120 volt 1200 watt element from Joppa Glass, and installed it using Dudley's mullite rod and donut system. Using the controls described below, maximum temperature is about 1100°F. It appears that the controls do not allow full voltage to reach the coil, but the system is well matched as it is.

Power Control

Traditionally, simple electric kilns and annealers are controlled with an "infinite heat switch." These have a simple bi-metallic conductor which turns off the power when it gets hot, then cools and turns power on again. They are moderate in price, but the on-off cycle is minutes in length and results in repeated heating a cooling of everything. This isn't desirable from a glass standpoint, and cuts element life.

I decided to experiment with standard dimmer switches.

In our local Lowes, I found 120 volt dimmer switches in 3 basic ratings.

- A 300 watt dimmer built into an extension cord, and intended for table lamps. I bought one of these to use control my stained glass soldering iron. It works well for that. Price - about \$7.00
- A variety of 600 watt dimmers for installation in a wall switch box. Price - about \$6.00
- A 1000 watt dimmer for installation in a wall switch box. Price - about \$40.00

Obviously the first choice for a controller for this project should be the 1000 watt model, but I decided to investigate the \$6.00 one first.

The apparent external difference between the 600 and 1000 watt models is that the later has a finned "heat sink" mounted on the outside of the box, beneath the decorative cover plate. The 600 watt model has only a thin metal front to dissipate heat.

The wattage limits of the dimmer will be based on the possibility of overheating the unit. For residential use, the manufacturers of the units must assume a worst case scenario in which the switch is mounted in a plastic box, and covered with a plastic decorative plate. By putting the unit in a metal box, using a metal cover, and mounting it out where air can circulate around it, we can increase its capacity. There is no analytical way to determine how much of an increase we can make, so I resorted to experimentation.

I installed a 600 watt dimmer in square junction box spliced into the middle of a heavy duty extension cord. Controlling 120 volts, it ran a "1350 watt" electric heater at highest setting. The face plate got "hot" to the touch, but I encountered no problems. The measured current was about 9 amps, in stead of the expected 11 amps, so power controlled was only 1080 watts. I plan to study dimmer outputs with an oscilloscope, but I haven't gotten to that yet.



For the annealer, I mounted a steel electrical box on the mailbox, and used a steel switch face plate. The box and face plate act as a heat sink. The face plate stays cool enough for a glass worker to keep a hand on - probably below 115°F.

I added a sheet metal bracket above the electrical box to hold the temperature display.

Temperature Measurement

I'm measuring annealer temperature with a simple Type-K thermocouple and a cheap digital multimeter. To conserve the battery, I only turn it on when measurements are being made. This system is described in my handout ***Kiln Temperature Measurement for Jacks, or How to Make a \$20 Digital Pyrometer***. You can find that on the web site listed at the end of this piece.

Major Parts and rough price estimates:

- Large rural mailbox (Lowe's #92636) \$19.83
- Fiber insulation - 2600°F - 1 inch \$25.00
- Element: Joppa Glass E-120-10-205 (120 volts = 1200 watts) \$30.00
- Ceramic rods 2 - 15" and donuts - 6 Joppa Glass \$25.00
- Metal single switch plate (Lowe's #72450) \$0.94
- Metal square junction box (Lowe's #72460) \$1.04
- Dimmer switch - 600 watt (Lowe's #70775) \$5.17
- Type-K thermocouple - \$7.00 - Sundance Art Glass Center, <http://www.artglass1.com>
- 7-Function Multitester - Cen-Tech Item 30756 - lists at \$9.99 - only \$4.95 on sale. Harbor Freight Tools, <http://www.harborfreight.com>
- Junction block - Radio Shack Cat.No. 274-656 2 for \$1.69

Reference: *A Glassblower's Companion* by Dudley Giberson, \$35.00 plus shipping, Joppa Glass <http://www.joppaglass.com/index.html>

My other projects related to glass working are described on my RMI Studio web pages at <http://www.cemr.wvu.edu/~venable/rmi/>

CAUTION: These documents are simply descriptions of what I have done. They are not sets of plans or recommendations. Use these ideas at your own risk.