

# How to Build and Use a 55-gallon drum light-bulb-powered oven

## Materials for an oven powered by four 100-Watt bulbs:

One 55-gallon drum, cut in half  
Eight 8x2x16" concrete paving bricks  
Three 1-meter lengths of heavy-gage, insulated lamp wire  
Three light bulb sockets with push-through switch  
Three plugs that will accommodate the heavy gage lamp wire  
One twin light bulb socket that can screw into a single light bulb socket.  
Thermometer [ $>105$  C]  
Two (12"x2"x15') rolls of aluminum-backed fiberglass duct insulation (R factor = 6)  
Aluminum tape (2" x 40 yds) rated to withstand 105°C (221°F)  
Four 100-watt light bulbs  
Miscellaneous nuts & bolts

## Procedure: (see Figures 1 and 2 for reference)

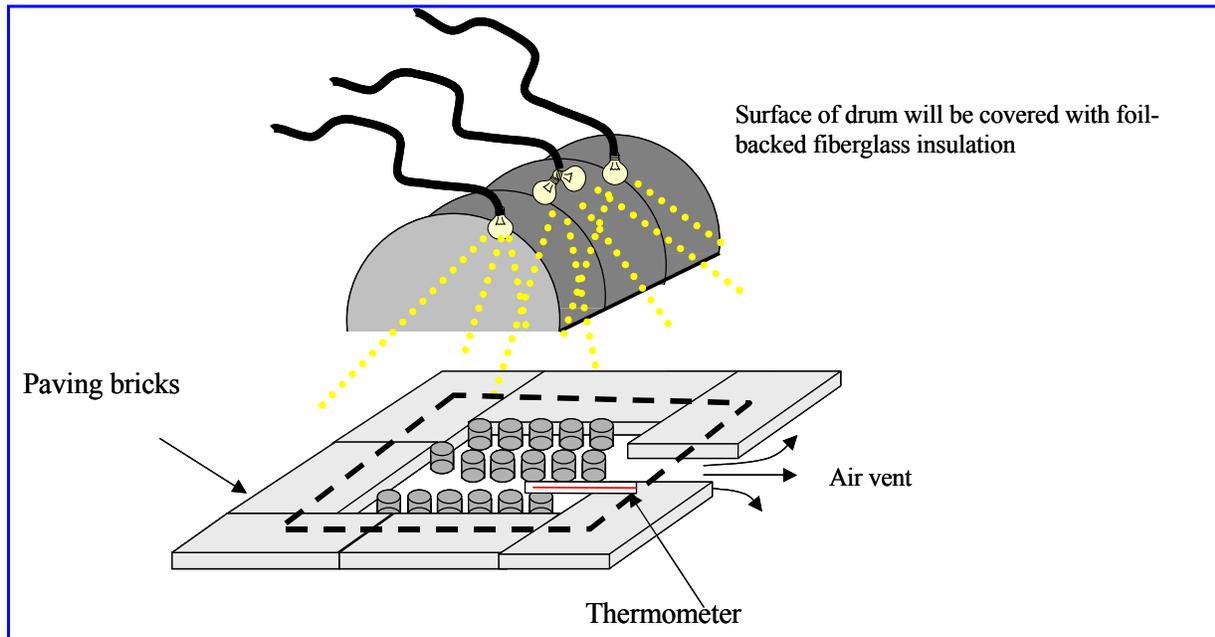
1. Cut a 55-gallon drum in half lengthwise. We hired a machinist who used a jig saw with a fine blade (32-tooth). Smooth the cut edges with a metal file.
2. Take one of the drum halves and seat it so that all cut edges are on the ground (or lab bench). Drill three evenly-spaced holes in the top of the drum. The diameter of the holes is determined by the diameter of the light bulb sockets, which will fit in the holes. Smooth the rough edges with a metal file.
3. Following the manufacturer's instructions, connect each 1-meter length of the heavy-gage insulated lamp wire with a light bulb socket at one end and a plug on the other end.
4. Attach each light bulb socket to the 55-gal drum by seating it in one of the three holes. We used a strip of aluminum bolted to the drum to firmly secure the light bulb sockets. (See Figure 4)
5. Cover the drum with the aluminum-backed fiberglass duct insulation. We attached ours lengthwise along the axis of the drum, and then cut custom-fitted pieces for the half-circle ends. Use the aluminum tape to secure the insulation to itself and to the drum.
6. Screw the twin light bulb socket into the middle light bulb socket, and install all four 100-Watt bulbs

## Use:

Plug in the oven and turn on the bulbs. Place the thermometer such that the sensor tip is centrally located beneath the center light bulbs. It may take approximately 24 hrs to reach a steady-state temperature. Once you are confident the oven temperature has reached a steady state, you can adjust the temperature by moving the cement brick to increase or decrease the air-flow gap in the front of the oven. The ideal target temperatures lie between 100-110°C (212-230°F). Do not use the oven until you have established that the temperature lies steadily between this range. Using the oven when it exceeds or falls below this range may yield erroneous results. Figure 3 shows a plot of our light-bulb oven's temperature over time. This data was collected with two 200-Watt bulbs.

Prior to loading your soil samples in the oven, be certain that you have labeled each sample with a unique I.D. number/name, and have recorded the wet weight. Load the oven with your wet soil samples and continue to monitor the temperature every couple of hours, as convenient. The oven temperature is likely to drop when the room-temperature soil samples are loaded, and it will take some time before the oven temperature reaches the ideal temperature range again. Leave your samples in the oven for a minimum of 24 hrs once the temperature reaches a minimum of 100°C (212°F). If your samples are particularly wet, and/or if the oven is loaded especially heavily with moist soil samples, it may take longer than 24 hours to completely dry your samples.

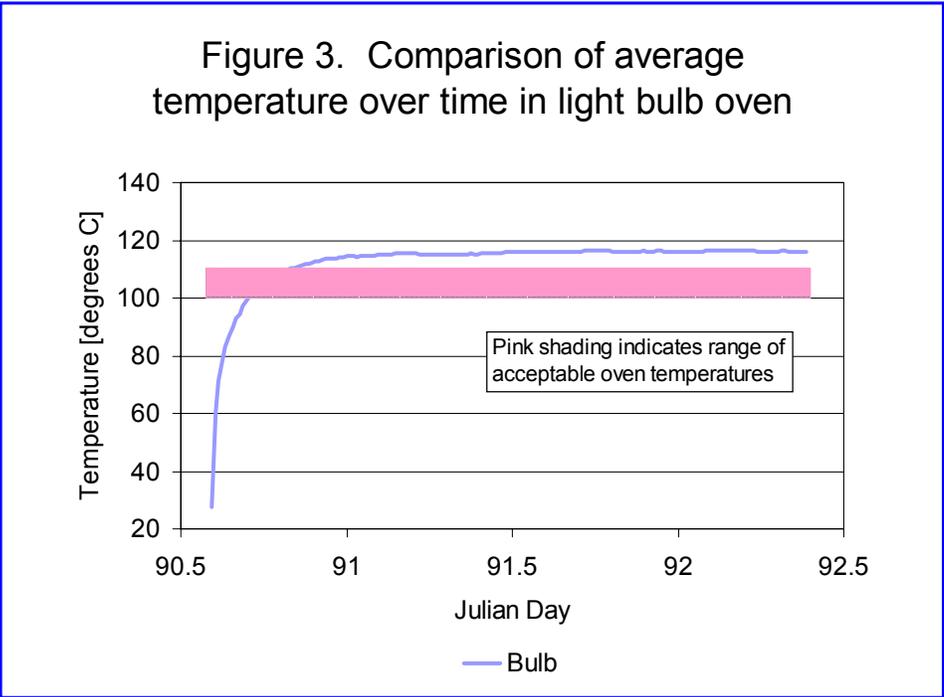
Once your soil samples are dry, record the dry weights and calculate the soil moisture according to the GLOBE Soil Moisture Protocol. Remember to unplug the oven if you do not plan to use it again within 24 hours.



**Figure 1** Schematic of 55-gallon drum, light-bulb powered oven



**Figure 2** The 55-gallon drum light bulb oven prototype during testing phase.



**Figure 3** Light bulb oven temperature over time (preliminary data).



**Figure 4.** Bracket used to secure light bulb socket to the 55-gallon drum