

Thermolyne 47900 Furnace

Standard Operating Procedure

Faculty Supervisor: Prof. Robert White, Mechanical Engineering (x72210)

Safety Office: Peter Nowak x73246 (Just dial this directly on any campus phone.)

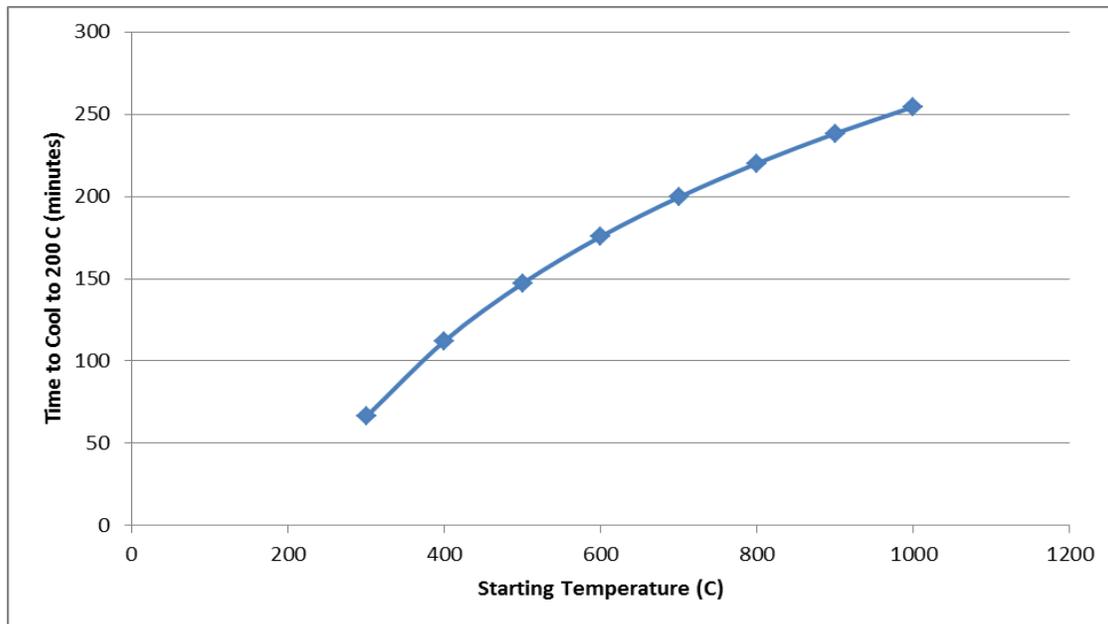
(617) 627-3246 (From off-campus or from a cell phone)

Tufts Emergency Medical Services are at x66911.

Revised: August 17, 2011

Warnings: *This tool uses high temperatures during operation. Do not open the furnace or remove any substrates until the oven and its contents have cooled sufficiently for safe handling. Do not open the oven until the temperature is below 200 C. Be sure you know what temperature your materials melt at before you put them in the furnace!!!*

The furnace operates to a maximum temperature of 1100 °C. The temperature ramp up rate is approximately 35 degrees per minute. The cool down time depends on the temperature that you are cooling from. The time to cool from various starting temperatures to 200 °C is estimated in the following plot. So, for example, to cool down from 600 C to 200 C takes approximately 175 minutes (3 hours). To cool from 1000 C to 200 C takes approximately 250 minutes (4 hours).



1.0 Material Requirements:

1.1 Equipment: tweezers, quartz boat, dummy wafers

1.2 Personal Protective Equipment: nitrile gloves, safety glasses

2.0 Procedure:

2.1 Setup

2.1.1 Load the substrate in the furnace.

2.1.2 A quartz boat is kept next to the furnace which can be used to hold a substrate vertically. There are also two bare wafers that can be loaded on either side of the substrate to isolate the sandwiched wafer from radiation. If using the quartz boat, be mindful of the positioning of the substrate on the quartz boat so that it does not come in contact with the thermocouple.

2.1.3 Close the oven door. There is an audible click when the door is closed completely.

2.1.4 If a nitrogen ambient atmosphere is required, open the nitrogen tank and adjust the flow valve to the appropriate rate. The flow valve is labeled in units of cubic feet per minute (CFM). A flow rate of 20 cubic feet per minute is suggested. However, it is not clear what should be used... if you go for higher flow rates you will have less oxygen in the chamber, but the nitrogen tank may run out too quickly. If the pressure in the tank falls below 200 psi, contact the lab manager to have the tank replaced. When running at 20 CFM, the tank drains at a rate of approximately 150

psi per hour. So, for example, if the tank starts at 1500 psi and you run at 20 CFM, you will drain the tank in 10 hours.

2.2 Operation

- 2.2.1 Turn on the main power by flipping the green switch on the front of the furnace.
- 2.2.2 After a five second boot, the display will show two numbers. The top green number is the actual temperature of the oven. The oven setpoint can be checked by pressing either the up or down button once.
- 2.2.3 Use the up and down arrows below the digital display to set the temperature setpoint.
- 2.2.4 The furnace will begin to ramp once the temperature has been adjusted.
- 2.2.5 An orange light is lit when the heating elements are engaged.

2.3 Shutdown

- 2.3.1 Once the process is complete, adjust the temperature setpoint so that the temperature is below room temperature. This will ensure that the heating elements will not engage.
- 2.3.2 Monitor the temperature as the furnace temperature decreases.
- 2.3.3 The substrates can be removed once a low temperature is reached. The cool down time will depend on the process temperature and may be much longer than the actual process time.
- 2.3.4 Once the furnace is cool, the substrate may be removed. Use the stainless steel pipe to move the quartz boat, if needed.
- 2.3.5 **Turn off the main power** to the furnace.
- 2.3.6 If nitrogen was used, **close the valve** to the nitrogen tank.

If at any time you feel a situation is dangerous, do not hesitate to call the safety office (x73246, Peter Nowak) the faculty supervisor/lab manager (x72210, Robert White), or Tufts Emergency Services (Police/Fire/Ambulance at x66911).

Report all accidents (injuries, major spills, fires) to the safety office at x73246 (Peter Nowak) and Prof. White at x72210. For emergencies, call Tufts Emergency Services at x66911.