Annealing is a heat treatment that modifies a material to increase its ductility and to make it more workable. It involves heating a material to above its critical temperature, maintaining a suitable temperature, and then cooling. Annealing can induce ductility, soften material, relieve internal stresses, and refine the structure by making it homogeneous.

Normally annealing is carried out in a special atmosphere, such as N₂, Ar or with endothermic gas (a mixture of carbon monoxide, hydrogen gas, and nitrogen gas). Annealing is also done in forming gas, a mixture of hydrogen and nitrogen (NOTE: only MNTC staff performs this procedure).

**Loading Wafers**

a. Using the white thermal gloves on the metal rack remove the end cap from the tube furnace and place onto the designated ceramic plates.

b. Remove the annealing rod from rod tube 4 on the lower section of the metal rack.

c. Using the U-shape boat holder remove the wafer boat inside the tube furnace and place it boat holder. Place the boat holder onto the ceramic plates.

d. Replace the annealing rod into rod tube 4.

e. Place your samples into the wafer boat and retrieve the annealing rod from rod tube 4.

f. Raise the boat holder to the mouth of the tube furnace and push the quartz boat into center of the furnace with the annealing rod.

g. Replace the annealing rod into rod tube 4.

h. Place the end cap loosely onto the end of the tube furnace and do not push it on all of the way. These tubes and caps have a design error where the cap can become stuck due to heating and cooling of the both components.

**Program your thermal cycle with a ramp rate, dwell temperature, dwell time, and ramp down.**

1. Turn ON the furnace controller by activating the circuit breaker on the left side of the control panel.
   - Let the controller run thru the self-test
   - The controller will display a flashing AL1 and read the current temperature
   - Press the lower center and scroll to AL1
   - Press the 'SECRET' button located on the digits. A click should be heard. The controller will display CLR
• The Excess Temperature features will be cleared allowing the furnace controller to operate properly.
2. Open the door below the first row of buttons.
3. To make a ramp up and soak time program do the following.
4. Press and hold the far right scroll button. This will put you in the programming mode, allowing the program to be modified.
5. PR1 is the ramp rate. Press the up arrow key to modify this number.
6. PL1 is the operating temperature the furnace will reach. Use the up and down arrow keys to modify this value.
7. Pd1 is the dwell time or soak time of the furnace. The value is in hours. Set the time using the up and down arrow keys.
8. Move onto the next program to program a ramp down.
9. PR2 is the ramp rate. Press the up arrow key to modify this number.
10. PL2 is the operating temperature the furnace will ramp down to. Use the up and down arrow keys to modify this value.
11. Pd2 is the end time. Hold the down arrow key until the END is displayed. This will end the program.
12. Press the scroll key to display the amount of time left in the ramp program.
13. If the program is entered properly, wait for the program mode to exit.
14. Press the RUN/HOLD key to start the program running.
15. To modify a program while it is running, go into the program mode and cycle to the desired value.
16. Press the HOLD key. A dot should be blinking next to the value.
17. The value is now safe to modify using the up and down arrow keys.
18. When done modifying the program, press the HOLD key again.
19. Allow the program to exit and return to the normal operating mode.
Gas controls

1. Turn **ON** the N₂ valve for annealing furnace. Nitrogen should be set at 34 sccm on the flow meter (located on the wall by the Hydrogen generator). Do not adjust or change the N₂ flow rate!!!

![Nitrogen](image1.png)

2. Perform the annealing process for desired amount of time. Typical conditions are for 1 hour at 350°C.

3. Turn **OFF** the N₂ green valve on gas distribution rack.

Unloading wafers

a. Wait until the furnace cooled down to 100°C.

b. Using the white thermal gloves on the metal rack remove the end cap from the anneal tube furnace and place onto the ceramic plates.

c. Remove the annealing rod from rod tube 4 on the lower section of the metal rack.

d. Pull out wafer boat from the furnace using the u-shaped wafer boat holder and place the wafer boat only on the ceramic plates.

e. Replace rod back into the rod tube 4.

f. Turn **OFF** the furnace controller circuit breaker on the left side of the control panel.