Linear Heat Conduction Module Procedure

Objective: Determine the thermal conductivity (k, )

1. Prepare DAQ
   1. Connect Arduino microcontroller to the PC (an UNO can be mounted to the bottom of the project base
   2. Open Serial Studio (will save data from Arduino as a .csv)
   3. Load LHCM.json in Serial Studio
   4. Ensure thermocouples are connected to MCP9601 thermocouple amplifiers
   5. Upload LHCM\_v4.ino to the microcontroller
   6. Verify that there are no I2C address conflicts, and that all thermocouples are correctly displaying reasonable room temperatures to the serial monitor  
      (It is important to verify that the serial monitor within the Arduino IDE is disabled for serial communication between the microcontroller and Serial Studio)
2. Prepare Ice Bath
   1. Fill red picnic cooler with ice by loading ice in from ice machine in the front of the room   
      (Ice machine is often disabled. A quick fix is to remove the top panel with a screwdriver, turn on the cleaning cycle and turn ice making mode back on)
   2. Make sure there is room to submerge pump
      1. If not, use secondary bucket to remove some ice
3. Calibrate Thermocouples
   1. Place thermocouple in ice bath and ensure thermocouples read 0°C within ±0.5°C and do not fluctuate for more than 5 minutes.
4. Test Cooling Loop
   1. Turn on pump by turning the 30 minute timer on
      1. Ensure outlet pipe is facing top of picnic cooler
      2. Make sure there are no leaks or spills
   2. Check inlet and outlet temps with handheld thermometer
      1. Ice bath temp should not exceed 2°C
      2. Outlet temp should be as close as possible to ice bath temp. (about ≤ 1°C)
   3. Listen to pump, is there enough water in the ice bath?
5. Build the conduction tower.

Remember to: add thermal paste to top of each module as each module is stacked  
Note: it helps to insert thermocouples to sample module before adding thermal paste to ensure alignment

* 1. Stack from bottom to top modules in the following order:
     1. Cooling loop module
     2. 60mm tall bottom conduction path   
        (holes 7.5mm from the top face).
     3. 30mm tall material sample module.
     4. 60mm tall top conduction path module   
        (holes 7.5mm from the bottom face)
     5. Heater module
  2. Optional: Cover conduction tower with PVC insulation sleeve
  3. Wire thermocouples from MCP9601 amplifiers to the conduction tower
     1. The amplifier with direct wire from the ADDR to GND pins is “Thermocouple A”, typically corresponding with the top most chip. This can be changed if desired, but care must be taken to ensure the order is kept track of.
  4. Check if the heater is inserted to the tower. If not, insert it to the top module.
     1. (If the PVC sleeve is used, put insertion heater through red PVC cover)

1. Turn on Extech PID Controller
   1. Ensure the internal thermocouple reads room temperature.
   2. Ensure the set point (in green) is set to 200°C
2. Make sure the microcontroller is connected to the computer and Serial Studio is running
3. Turn on insertion heater using the switch on the variac. Observe the temperature read out on the PID controller increasing.
4. During experiment
   1. Periodically check and note the input power on the watt-meter, ice bath temperature, outlet temperature, and thermocouple temps. Be wary of large fluctuations
   2. Periodically check to make sure the 30 min pump timer has not stopped the sump pump.