

TA INSTRUCTIONS FOR THE CONVECTIVE HEAT TRANSFER LAB

Ch En 385 – Knotts

Overview

- Students should spend about 1 hour in the lab. Part of this will be doing experiments, but make sure they are answering the analysis questions during waiting periods.
- You should have the apparatus set up to run at least 30 minutes prior to lab time in order for them to reach steady state by the time students arrive.
- Before operating the equipment alone, you should have passed it off with either Dr. Knotts, Will Davis, or Mike Beliveau.



Figure 2 WL 440 Apparatus setup for forced convection

General Instructions

1. Do the following to prepare for students.
 - a. Learn how to run the equipment and pass off your understanding with either Dr. Knotts, Mike Beliveau, or Will Davis.
 - b. Perform the experiments that the students will do.
2. You should have set up specific times (5 hours a week) for students to perform the experiments. You will be in the lab during these times.
3. You will setup the apparatus before each lab hour following the instructions below.
4. After students are finished with the lab, you will shut down the apparatus following the procedures below.
5. You can grade assignments when in the lab and not answering student questions; however, you should be closely monitoring the students.
 - a. Keep them on task.
 - b. Ask questions to deepen understanding.

Apparatus

The apparatus consists of a metal base with power and data connections with a chimney attached to it where the heater will be placed. For forced convection the heater will be inserted into the chimney, while for free convection the heater will be attached to the outside of the chimney. There are observation ports on two sides of the chimney with holes where a temperature probe may be inserted. At the top of the chimney is the fan which will power the air flow during forced convection.

Before the heater there is a thermocouple to test the air temperature coming in and after the heater is a thermocouple to test the air



Figure 1 Apparatus setup for free convection

temperature going out. For free convection we will use the first temperature as the ambient temperature. There is also a plastic rod inserted before the heater which, when inserted into the air stream generates turbulent flow. Since we are studying laminar air flow, the rod will be pulled out of the air stream.

Note: The apparatus will shut off automatically if the heater temperature exceeds 90°C.

To control the apparatus,

1. connect the USB cable from the apparatus to the computer that will be used.
2. Open the software: “WL440”.
3. Once it opens you will see it initialize and display the apparatus as well as values for the heating power output (P) and temperatures. If any of these does not display, restart the software, if the issue persists, check the USB connection and restart the computer.
4. If necessary, tare the measurements. This will reset all temperature readings to match T1 (ambient temperature).

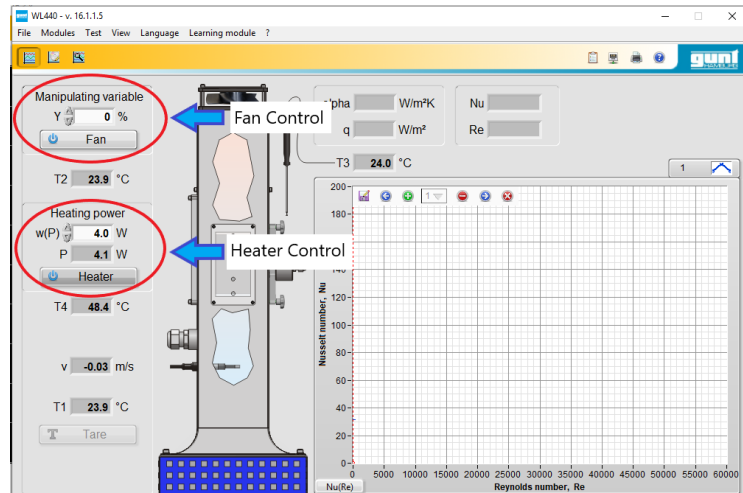


Figure 3 Location of Fan and Heater controls in the WL440 Interface

Set Up of the Starting Configuration

Do the following, **before students arrive**, if not already done.

1. At least 30 minutes before lab time, start each of the apparatuses. The cylinders will take the longest, so you will want to start them first.
2. Set the power output for the first cylinder to 5W, press the “Enter” key and click on the “Heater” button.
3. Set the fan for the first cylinder to 20%, press “Enter” and click on the “Fan” button.
4. Set the power output for the second cylinder to 5W.
5. Set the fan for the second cylinder to 90%.
6. Set the power output for the plate with forced convection to 5W.
7. Set the fan for the plate with forced convection to 20%.
8. Set the power output for the plate with free convection to 5W.

These should be allowed to reach steady state for the students to take their first data points.

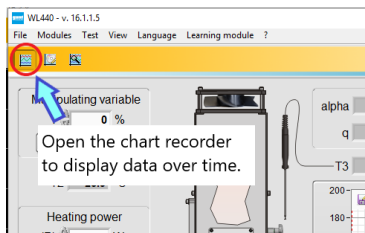


Figure 4 Where to open the chart recorder from the control interface

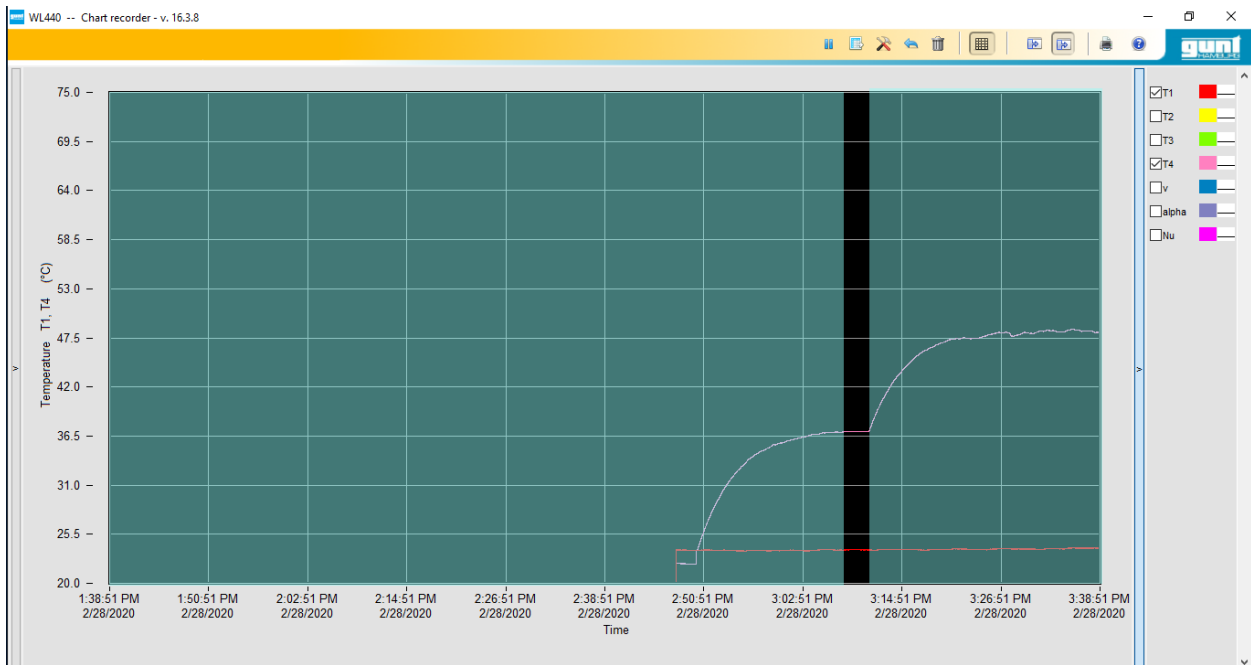


Figure 5 Chart recorder showing steady state in between two transitions

Lab Operation Procedures

1. Students will perform a few experiments with the apparatus setups given.
2. Once the students are finished taking their first data points, they will adjust the setpoints for the apparatus following the instructions in the worksheet.

Shutdown Procedures

1. Turn off power to the fan and heater.
2. Close the software.
3. Shutdown the computer.
4. Return the computer to its storage cabinet or to the lab manager for storage.

TAs will not have to prepare the apparatus for moving or long-term storage. This will be done by the lab manager or assistant lab manager.