
**Manual to Lab 6: PHY2048C.**

**Florida State University**

**Thermal Expansion Experiment**

## About labs in this class

The labs in this class will have general instructions, and many things need to be figured out by the students. I will be answering any specific questions the students may have without completely giving away the key to the puzzle. **Answer the questions and record your measurements in your lab notebook and then submit the notebook at the end of the activity.**

## About this lab

In this lab, you will determine the coefficient of thermal expansion of various apparatus. For this, you will use the steam generator, which can be set to different temperatures. The different temperatures correspond to the settings as specified in Table 1. Figure 1 shows the different materials you will be measuring the thermal expansion for. The formula for thermal expansion in three dimensions, taken from your textbook, is:

### LINEAR THERMAL EXPANSION

According to experiments, the dependence of thermal expansion on temperature, substance, and original initial length is summarized in the equation

$$\frac{dL}{dT} = \alpha L \qquad (1.1)$$

where $\frac{dL}{dT}$ is the instantaneous change in length per temperature, $L$ is the length, and $\alpha$ is the **coefficient of linear expansion**, a material property that varies slightly with temperature. As $\alpha$ is nearly constant and also very small, for practical purposes, we use the linear approximation:

$$\Delta L = \alpha L \Delta T \qquad (1.2)$$

where $\Delta L$ is the change in length and $\Delta T$ is the change in temperature.

**Activity 1.** Measure the thermal expansion coefficient, $\alpha$, for all 5 materials. Be careful not to burn yourself! Measure the lengths with the micrometer without touching the material directly. Pass a string through the holes of the cylinders to draw the materials in and out of the water.

**Question 1.** Identify sources of systematic error in this experiment.

**Activity 2:** Exchange your sample with another group's sample and measure the expansion coefficients of all materials again. At the end, each group should have measured the coefficients of all materials.

| Setting | Approx. Temperature (°C) |
|---|---|
| 1 | 50 |
| 2 | 55 |
| 3 | 60 |
| 4 | 65 |
| 5 | 70 |
| 6 | 75 |
| 7 | 80 |
| 8 | 85 |
| 9 | 90 |

*Table 1: Steam Generator Settings.*


Figure 1: (2) Stainless Steel. (3) Brass. (4) Aluminum. (5) Zinc. (6) Copper

You are provided all the tools to measure the thermal expansion of the different materials.

**Question 2.** Compare your results with the expansion coefficient in your book. What is the fractional discrepancy between the tabulated values and yours?

**Question 3.** In a dry country with big seasonal and night-day thermal gradients (so, not Panama), what would be the best material for building the structure of a bridge.

**Question 4.** Follow up: In Panama, where the thermal gradient is not as big, do you think there is a better material than this?