
PHYSICS 126 EXPERIMENT NO. 3

THERMAL EXPANSION

In this experiment, the coefficients of linear expansion of copper and aluminum will be measured. When a metal rod of length l has its temperature changed by ΔT , its length changes by an amount Δl . For small changes in temperature, the fractional change in length is proportional to the temperature change. The proportionality constant, α , is the coefficient of linear expansion as shown in the equation below:

$$\frac{\Delta l}{l} = \alpha \cdot \Delta T$$

By measuring l , Δl , and ΔT , we will determine the coefficient of linear expansion, α .

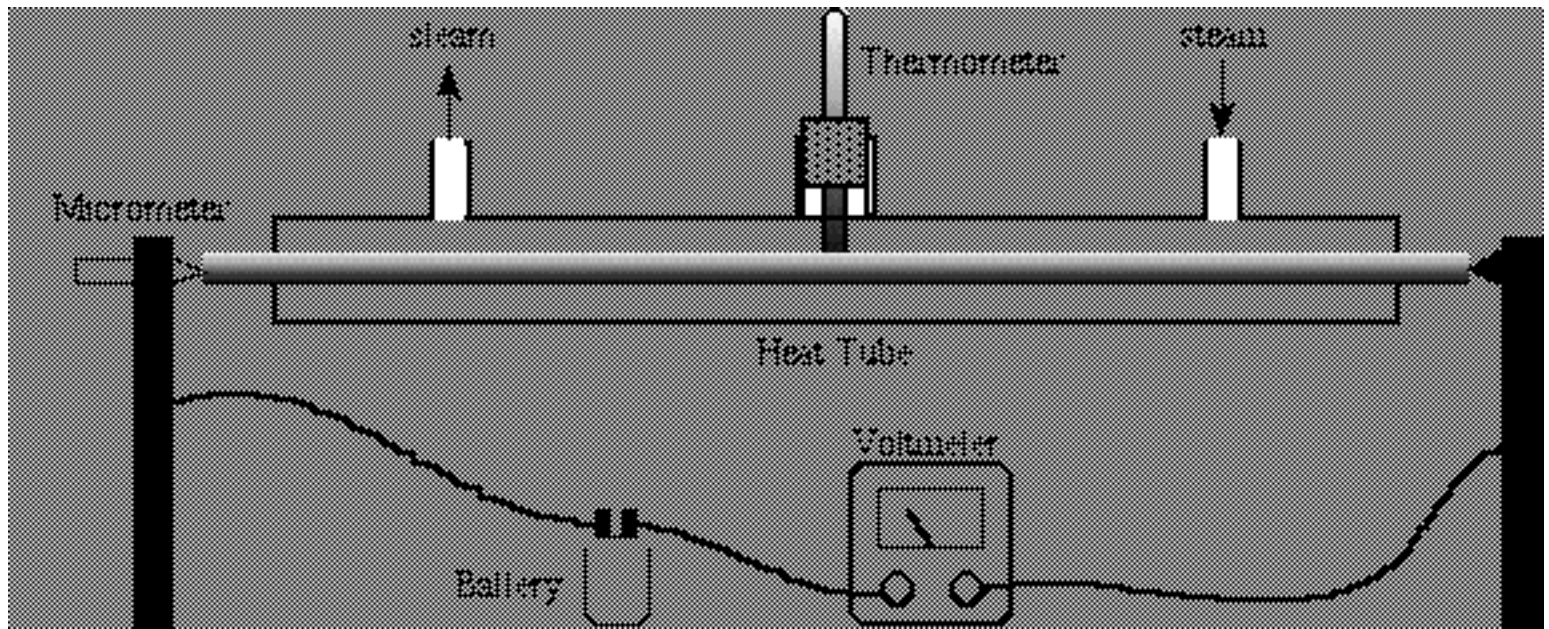
A. Equipment

Steam generator, thermometer, battery, voltmeter, “heat tube” with micrometer.

B. Method

A rod of either copper or aluminum rests inside a hollow metal tube (see figure below). The tube and rod start at room temperature. A steam generator can be used to fill the tube with steam and thereby

raise the temperature of the rod.



At each end of the rod is an electrical contact. If the circuit is complete, the voltmeter will read the voltage of the battery. If contact is broken, the voltmeter will read zero. One of the contacts to the rod is made through a small micrometer. By measuring the micrometer settings at which electrical contact is *just made* for a cool and hot rod, we can measure the change in length of the rod for a known temperature change.

C. Procedure

1. Your apparatus will either contain a copper or aluminum rod. Measure the length of the rod with a meter stick and the starting temperature.
2. Turn the micrometer screw gently back and forth while observing the voltmeter. Find the point at which contact is just barely made and record the micrometer setting.
3. Repeat step #2 several times so that the random error can be

estimated.

4. Back the micrometer screw well away from the end of the rod to allow for expansion while heating.

5. Pass steam through the “heat tube” and watch the temperature of the rod as it rises. Wait until the temperature reading has been stable for several minutes. Record the temperature.

6. Using the same procedure as above determine the new position of the end of the rod (and its uncertainty).

7. Calculate the coefficient of linear expansion of the rod.

Q1. Does your value of α agree within error with that in the textbook ?

8. Change places with another group and repeat the measurements on the other kind of metal rod.

Q2. Compare your result to the accepted value for α .