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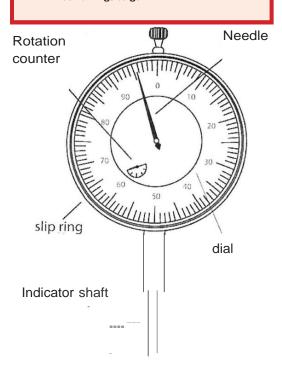
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Linear Expansion Apparatus #1206

Warning:

- Not a toy; use only in a laboratory or educational setting.
- Choking Hazard- small parts
- California Proposition 65
 Warning: This product can expose you to chemicals including nickel which is known to the State of California to cause cancer, birth defects, or other reproductive harm. For more information go to www.P65Warnings.ca.gov.





Introduction

This apparatus will allow you to determine the coefficient of expansion of three different types of material. In order to perform the experiments, you will need the linear expansion apparatus and an outside steam supply from a steam generator or similar device.

How to Read the Dial Indicator

The dial indicator is an extreme precision device used to measure minute amounts of movement. Depending on the style of the indicator, this can be either in thousandths of an inch (.001 in.) or in millimeters (.01 mm). The indicator shaft runs through the center of the unit and translates even the tiniest movement to the dial on the face. This movement is amplified many times so that you can better see the relative movement.

Each line on the dial represents one thousandth of an inch (.001) or one tenth of a millimeter (.01), again depending on the style of your indicator. The needle can make several rotations around the dial and these rotations are counted and indicated usually by a second smaller dial on some indicators.

For use in the linear expansion device, the needle will not travel that far but keep in mind that on an inch scale, one revolution will equal one hundred thousandths of an inch (.100) or on a metric scale one millimeter (1.0).

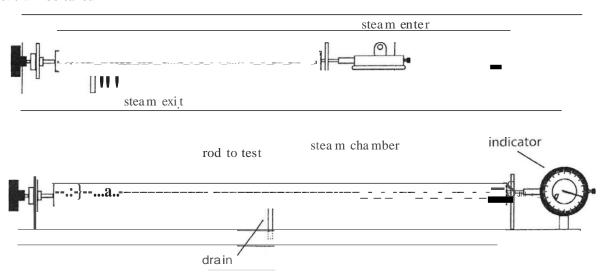
Also, on the outer section of the dial will be a slip ring. The ring will rotate the entire dial so that once you have the indicator set at your starting position, the ring and dial can be rotated to align the needle and the zero on the dial.

Setting Up the Unit

Place one of the 3/16 rods (brass, steel, or copper) into the unit as shown. Make sure that the ends of the rod are flush or slightly protruding past the ends of the stopper. Place the steam chamber in the base and press the test rod up against the threaded stop.

Attach the dial indicator by removing the nut over the attachment post and by placing the movable shaft of the indicator into the rubber stopper on the "steam enter" side of the steam chamber. Secure the indicator with the nut and make sure that the indicator shaft is touching the rod to be tested. Turn the slip ring on the indicator so that the needle is aligned with the "O" mark. At this point, note the length of the rod as indicated before applying heat is called "LI". Write this down.

Place a centigrade thermometer into the vertical stopper as shown. Next attach a rubber hose from one of the steam chambers ferruled connectors to your source of steam. Make a written note of the temperature from the thermometer. This measurement will be called "T1".



Determining Coefficient of Expansion

Now turn on the steam source and watch the thermometer. Allow the steam to flow for about three minutes and record the dial reading. Record this as "L2". Shut off the steam source. Note the thermometer and note this temperature at "T2". The amount of temperature change can be determined by subtracting "T1" from "T2". This gives you an answer that will be called "T3". The amount of expansion can be found by subtracting "L1" from "L2". This will give you "L3". Take "L3", the total expansion, and divide it by "T3", the total temperature change, to determine how much the rod expanded for every centigrade of temperature increase. Call this "TL". Finally, take the "TL" and divide it by the beginning length of the rod in centimeters. This will give you the coefficient of expansion. This is a constant number by which you can multiply the length of any rod or bar to determine the amount of expansion per degree of heat applied. This number only applies to items made from the same material as the test sample.

The coefficient of expansion per centigrade are:

Brass- .0000189 Steel- .00000633 Copper- .0000167