Thermal Expansion

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Thermal Expansion

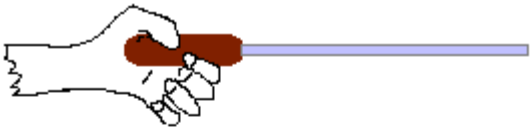
You probably already know that objects tend to expand when heated – in other words, their dimensions increase. This property of solids and liquids is called thermal expansion. For example, thermal expansion refers to water's characteristic tendency to expand when heated. Unlike air, which can be compressed, water grows in volume when it is heated, and must be accommodated.

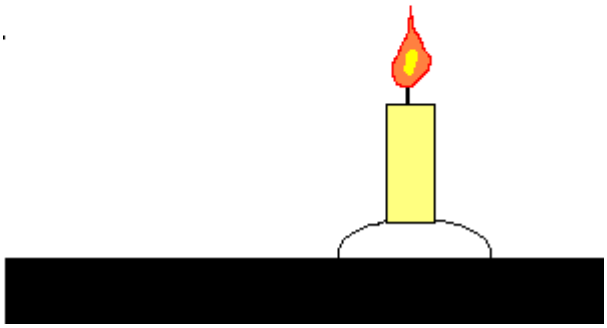
What is Thermal expansion

At a given temperature, inter-molecular distances are definite. When a body is heated, its molecules vibrate more energetically against the action of inter-molecular forces, causing the molecules to be increasingly displaced. Since the average distance between the molecules increases, the dimension of the body also increases. Consequently, the body expands. Materials that contract with increasing temperatures are rare; this effect is limited in size, and only occurs within limited temperature ranges. A material's coefficient of thermal expansion is its degree of expansion divided by a change in temperature, and generally varies with temperature.

Example

A laminated bar made from two different metals and fastened in a wooden handle is placed over a flame. The different thermal expansion rates cause the bar to bend.





Objects undergo changes in dimension when they are heated. This change in length or area or volume is called "Thermal Expansion."

Types of Thermal expansion

There are three types of thermal expansion:

(1) Linear Expansion

A material’s linear thermal expansion coefficient relates the change of a material's linear dimensions to a change in temperature. It is the fractional change in length per degree of temperature change. Ignoring pressure, we may write:

$$\alpha_L = \frac{1}{L}\frac{dL}{dT}$$

where L is the linear dimension (e.g. length) and dL / dT is the rate of change of that linear dimension per unit change in temperature.

(2) Area Expansion

A material’s area thermal expansion coefficient relates change in the material's area dimensions to a change in temperature. It is the fractional change in area per degree of temperature change. Ignoring pressure, we may write:

$$\alpha_L = \frac{1}{L}\frac{dL}{dT}$$

where A is some area of interest on the object, and dA / dT is the rate of change of that area per unit change in temperature

(3) Volumetric Expansion

For a solid, we can ignore the effects of pressure on the material, and the volumetric thermal expansion coefficient can be written :

$$\alpha_V = \frac{1}{V}\frac{dV}{dT}$$

where V is the volume of the material, and dV / dT is the rate of change of that volume with temperature.

This means that the volume of a material changes by some fixed fractional amount.

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Reference links

- http://www.en.wikipedia.org/wiki/Temperature
- http://www.en.wikipedia.org/wiki/volume
- http://www.en.wikipedia.org/wiki/pressure
- http:// www.daviddarling.info/encyclopedia/L/linear_expansion.html

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