Linear Expansion

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Linear Expansion

Linear expansion is a one-dimensional change in length due to variation in temperature; it is the change in the length of a material for a unit

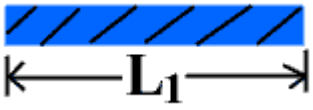
change in temperature. Most substances expand when heated and contract when cooled. Expansion and contraction of materials must be considered when designing large structures, when using tape or chain to measure distances for land surveys, when designing molds for casting hot material, and in other engineering applications when large dimensional changes due to temperature are expected.

What is linear expansion?

Linear expansion is the expansion in the length of solid bodies caused by heating. It is the increase of a planar dimension of a material, measured by the linear elongation of a sample, e.g., in the form of a beam, which is exposed to two given temperatures.

Factors on which Linear Expansion depends

Consider a metallic bar of length "L1" at temperature "T1" k. Let the bar be heated to "T2" k.



Experiments show that linear expansion depends on two factors:

1. The increase in the length of a solid bar is directly proportional to its original length

$$\Delta L \propto L_1 \quad \text{---------- (1)}$$

2. The increase in the length is directly proportional to the change in temperature.

$$\Delta L \propto \Delta T \quad \text{---------- (2)}$$

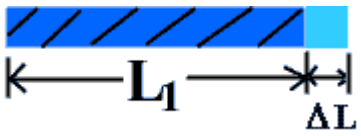
From eq. (1) and (2)

$$\Delta L \propto L_1 \Delta T$$

.....

OR we can write as

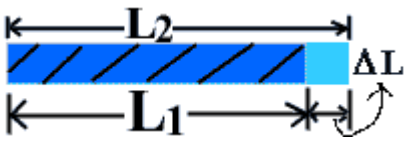
$$\Delta L = \alpha L_1 \Delta T$$



.....

Where ?= Coefficient of linear expansion of solid.

Therefore



From figure:

$L_2 = L_1 + ?\ L$ .....

Putting the value of**? L**

$L_2 = L_1 + ?L_1\ ?T$.....

$L_2 = L_1$ (1+ ? ?T).....

$L_2 = L_1$?{1+ (T2 - T1)}.....

Where [?T= T2 - T1]

COEFFICIENT OF LINEAR EXPANSION

A coefficient of linear expansion is a characteristic property of solid materials and is defined as an "increase in length per unit of original length per Kelvin rise in temperature .” This coefficient is denoted by "?"(alpha). The value of ? is constant for a given material but is different for different materials. It is independent of the mass & dimensions of a body. A material’s coefficient of linear expansion depends on the nature of the material.

UNIT OF ?: 1/K or K^{-1}

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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/Solid
- http:// www.daviddarling.info/encyclopedia/L/linear_expansion.html

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