Linear Expansion of Materials

As the temperature of a material increases, it begins to expand. For instance, a metal rod or beam will increase its length by an amount ΔL. The value of ΔL depends on the original length (L_o) at the original temperature (T_o), the temperature to which it is heated (T) and the coefficient of linear expansion (α). The equation relating these variables is shown in **Figure 1**. The amount of expansion depends upon the material; each material has its own unique coefficient of linear expansion. Coefficients for a variety of materials are shown in **Table 1**. Note that the left column includes metals and metal alloys and the right column includes non-metals.

Figure 1

$$\Delta L = \alpha \cdot L_o \cdot (T - T_o)$$

Table 1

Material	α (m/°C/m)	Material	α (m/°C/m)
Copper	$5.1 \cdot 10^{-5}$	Wood	$5.0 \cdot 10^{-6}$
Steel	$1.3 \cdot 10^{-5}$	Polyethylene	$2.0 \cdot 10^{-4}$
Aluminum	$2.2 \cdot 10^{-5}$	Polystyrene	$7.0 \cdot 10^{-5}$
Brass	$1.9 \cdot 10^{-5}$	Polyvinyl chloride	$5.0 \cdot 10^{-5}$

The expansion of a rod or beam in one dimension as described by **Figure 1** is known as **linear expansion**. Linear expansion causes the length of a rod or beam to change with temperature. **Figure 2** shows how the length of a beam varies as a function of temperature for four different materials.

Figure 2