Answer on Question#37950 - Physics - Other

The brass bar and the aluminum bar in the drawing are each attached to an immovable wall. At 21.9 °C the air gap between the rods is 1.55 x 10-3 m. At what temperature will the gap be closed?

Solution:

$\Delta L = \alpha L_0 \Delta T$ gives for the expansion of the aluminum

$$\Delta L_A = \alpha_A L_A \Delta T \qquad (1)$$

and the expansion of the brass

$$\Delta L_B = \alpha_B L_B \Delta T \qquad (2)$$

Taking the coefficients of thermal expansion for aluminum ($\alpha_A = 23 \times 10^{-6} K^{-1}$) and brass ($\alpha_B = 19 \times 10^{-6} K^{-1}$) adding Equations (1) and (2), and solving for ΔT give:

$$\Delta T = \frac{\Delta L_A + \Delta L_B}{\alpha_A L_A + \alpha_B L_B} = \frac{1.55 \times 10^{-3} m}{23 \times 10^{-6} K^{-1} \cdot 1m + 19 \times 10^{-6} K^{-1} \cdot 2m} = 25.4°C$$

The desired temperature is then

$$T = 21.9°C + 25.4°C = 47.3°C$$

Answer: the gap will be closed at temperature $47.3°C$.