

Answer on Question#37933 - Physics - Other

The brass bar and the aluminum bar in the drawing are each attached to an immovable wall. At 27.1 °C the air gap between the rods is 1.67×10^{-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

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

and the expansion of the brass

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

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

$$\Delta T = \frac{\Delta L_A + \Delta L_B}{\alpha_A L_A + \alpha_B L_B} = \frac{1.67 \times 10^{-3} \text{m}}{23 \times 10^{-6} \text{K}^{-1} \cdot 1 \text{m} + 19 \times 10^{-6} \text{K}^{-1} \cdot 2 \text{m}} = 27^\circ \text{C}$$

The desired temperature is then

$$T = 27.1^\circ \text{C} + 27^\circ \text{C} = 54.1^\circ \text{C}$$

Answer: the gap will be closed at temperature 54.1°C.

