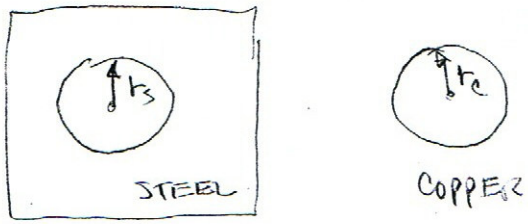
LINEAR THERMAL EXPANSION

STARTING AT ROOM TEMP ($\sim 20^\circ C$)

a.) If Cu $\rightarrow 275^\circ C$ WILL IT FIT THROUGH THE WHOLE

b.) WHAT IF BOTH ARE AT $275^\circ C$



$r_s = 2.005$ cm $r_c = 1.998$ cm

$T_0 = 15^\circ C$

$\Delta = r_s - r_c = 2.005 - 1.998$

$= 0.007$ cm.

$\alpha_s = 12 \times 10^{-6}\ ^\circ C^{-1}$

$\alpha_{Cu} = 17 \times 10^{-6}\ ^\circ C^{-1}$

USING. $\Delta L = L_0 \alpha \Delta T$

STEEL ← FRACTIONAL CHANGE → COPPER

$\frac{\Delta r}{r_0} = \alpha_s (275 - 15)$

$= 12 \times 10^{-6} (260)$

$= 3.12 \times 10^{-3}$

$\frac{\Delta r}{r_0} = \alpha_{Cu} (275 - 15)$

$= 17 \times 10^{-6} (260)$

$= 4.420 \times 10^{-3}$

a.) FOR Cu — ONLY Cu HEATED

$1.998 \frac{\Delta r}{r_0} = 1.998 (4.420 \times 10^{-3})$

$\Delta r_{Cu} = 0.0088$ cm won't fit larger than $r_s - r_{Cu}$

b.) FOR STEEL: $r_s \cdot \frac{\Delta r}{r_0} = \Delta r_s$ (BOTH HEATED TO $275^\circ C$)

$2.005 (3.12 \times 10^{-3}) = 6.26 \times 10^{-3} = 0.0063 = \Delta r_s$

$\Delta = (r_s + \Delta r_s) - (r_c + \Delta r_c)$

$= (r_s - r_c) + (\Delta r_s - \Delta r_c)$

$= 0.0070 + (0.0063 - 0.0088)$

↑ AT $15^\circ C$

$= 0.0070 + (-0.0025)$

$\Delta = 0.0045 > 0$ Cu will FIT