

A machine tool is "calibrated" at 25° C, meaning that when commanded to move one inch at that temperature, it will move one inch. An aluminum part is then machined on a warm day, when the part and machine are both 92° F. The part is allowed to soak in the metrology lab – which is inexplicably kept at 18.5° C – overnight, and then measured on a CMM.

If the machine tool was programmed to make the part exactly 20" long, what will be the length measured on the CMM, and what will be the true "legal" length of the part?

Use the following coefficients of thermal expansion

- Machine tool scales:  $\alpha_M = 6.0 \text{ ppm/}^\circ\text{C}$
- Part:  $\alpha_P = 11.0 \text{ ppm/}^\circ\text{C}$
- CMM scales:  $\alpha_C = 5.5 \text{ ppm/}^\circ\text{C}$