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Hot Rods: Three Methods for Measuring the Expansion Coefficients of Metals

This experiment was designed to test different methods to measure the coefficient of linear expansion with easily available items. Expansion coefficients are important in our lives. Engineers specifically have to be aware of expansion properties of materials especially when they are building bridges which could buckle, shrink and, collapse under extreme temperatures. It was hypothesized that the most efficient method for measuring the expansion coefficient of copper, aluminum, and brass, would be vertical water bath (method 3). Three methods were used in the experiment. In the horizontal steam heating steam was passed through three pipes which were placed over a dial on styrofoam. The insulated horizontal steam heating method was almost the same except the pipe was wrapped in styrofoam and had a second thermometer. The final method was conducted with the pipe vertically supported in a water bath. The angle of deflection was measured photographically and measuring deflection using Pages software. Using the circumference of the needle in the dial the expansion coefficient of expansion was calculated using the formula, calculated coefficient of linear expansion (α) = calculated change of length (ΔL) / (initial length of pipe (L_i) [change in temperature ($t_f - t_i$)]). The average calculated variance for horizontal steam heating (method 1) was 52.3%. The average calculated variance for insulated horizontal steam heating (method 2) was 51.4%. Finally, the average calculated variance for vertical water bath (method 3) was 89.9%. This proved that insulated steam heating (method 2) was the most accurate method.