LINEAR INTERPOLATION

There are occasions when an inspector may need to interpolate values between two known values. This is common when assessing percentage tolerances, or applying various correction factors to a measured quantity. While not difficult to calculate, it is important that the interpolated value be determined carefully and correctly.

The formula for linear interpolation is:

$$B_{mid} = [(B_{upper} - B_{lower})(A_{mid} - A_{lower})] / (A_{upper} - A_{lower}) + B_{lower}$$

Where:

A_{upper} = Upper Known Value
A_{lower} = Lower Known Value
B_{upper} = Upper Corresponding Value
B_{lower} = Lower Corresponding Value
A_{mid} = Mid Known Value
B_{mid} = Mid Unknown Corresponding Value

The concept may be best described by example:

Example:

Assume you are taking a temperature measurement with a certified thermometer.

The thermometer is accompanied with a calibration certificate which lists 'Indicated' and 'True' temperatures. The temperature that you observe (26.50 °C) falls between two adjacent indicated values (20.00 °C & 30.00 °C) on the calibration certificate. How do you find the corresponding 'True' temperature?

Interpolation of the Observed Temperature Value

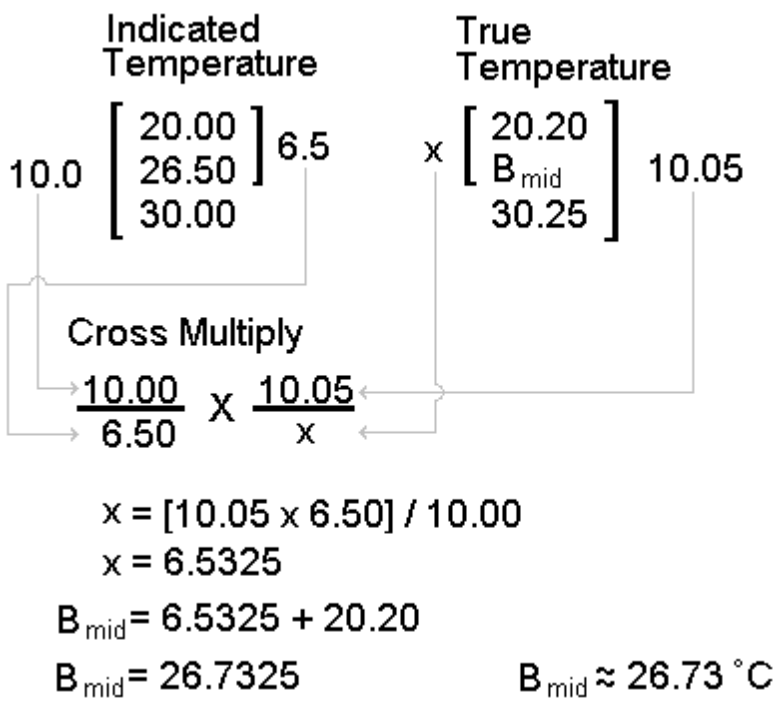
Indicated Temperature	True Temperature
20.00 °C (A_{lower})	20.20 °C (B_{lower})
26.50 °C (A_{mid})	B_{mid}
30.00 °C (A_{upper})	30.25 °C (B_{upper})

What is the true temperature for an indicated temperature of 26.5 °C?

B_{mid} = [(30.25 - 20.20) (26.50 - 20.0)] / (30.00 - 20.00) + 20.20
B_{mid} = [(10.05)(6.50) / 10.00] + 20.20
B_{mid} = [65.325 / 10.00] + 20.20
B_{mid} = [6.5325] + 20.20
B_{mid} = 26.7325 B_{mid}. **26.73 °C**

This formula is useful for setting up a spreadsheet or a small program in a laptop, programmable calculator or PDA. If the interpolation must be calculated manually, the following simplified explanation may make it clearer.

Using a simplified approach:



LINEAR EXTRAPOLATION

Either of these two approaches may also be used for linear extrapolation (finding a value not contained within, but rather larger or smaller than the data set), although extreme care must be taken to ensure that the extrapolated value is in fact representative and valid.