CORRECTION PLOT

(Revised: 23 Feb 2006)

Principle:

The usual form of a calibration curve is the direct calibration curve, where the input x is plotted on the abscissa against the measured output y on the ordinate. However, such curves are not very useful when the differences between the true and indicated values are extremely small.

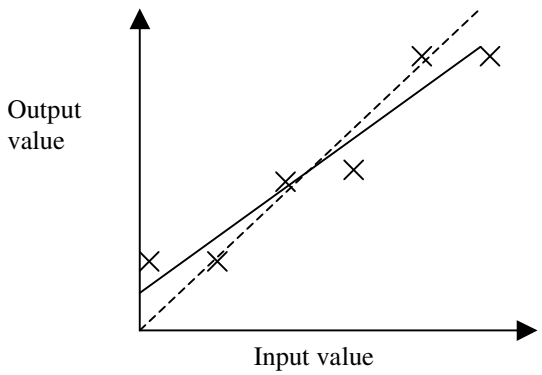
In such situations, alternative forms of the calibration curve, viz the deviation / systematic error plot or the correction plot are convenient. During the measurement of an unknown quantity, we obtain the output value from the instrument. For this output value, the corresponding correction can be readily determined from the correction plot. By adding this correction to the observed output value, the best estimate of the true input value can be calculated.

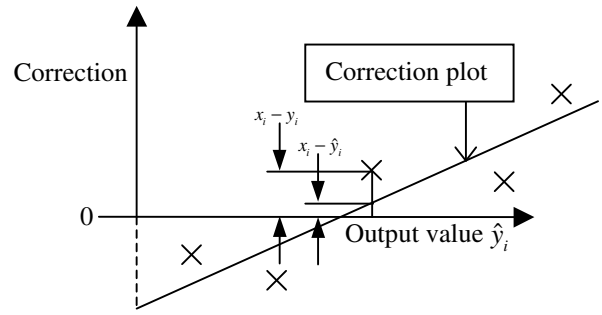
Definitions[1]:

1. **Error** (of measurement): Result of a measurement minus a true value of the measurand.
2. **Systematic error**: Mean that would result from an infinite number of measurements of the same measurand carried out under repeatability conditions minus a true value of the measurand.
3. **Correction:** Value added algebraically to the uncorrected result of a measurement to compensate for systematic error. (Hence the correction is equal to the negative of the estimated systematic error).

Procedure:

Let x_i be the input values and y_i the output values. Then the total error at a point i, $e_i = y_i - x_i$. Let $\hat{y}$ be the estimated values obtained by regression. The estimated systematic error at the point is $\hat{y}_i - x_i$. The correction at the point is $x_i - \hat{y}_i$. The plot of Correction vs Output value, is the required correction plot. This will be a straight line, when linear regression is used to determine the estimated values. Also mark the points $x_i - y_i$, and examine the position of these points with respect to the correction line. These should form a random pattern, or there should not be any run.





Reference:

1. BIPM, IEC, et al, "Guide to the expression of uncertainty in measurement", 1995.

Note:

The equation to the correction plot line is given by

$$x_i - \hat{y}_i = \frac{\hat{y}_i - a_0}{a_1} - \hat{y}_i = \frac{-a_0}{a_1} + \hat{y}_i \left(\frac{1}{a_1} - 1 \right)$$

Example:

Input x	Output y	Estimated Value $\hat{y}$	Residual $y - \hat{y}$	Total Error e=y-x	Correction $x - \hat{y}$	x-y
10	12	13	-1	2	-3	-2
10	14	13	1	4	-3	-4
20	23	25	-2	3	-5	-3
20	27	25	2	7	-5	-7
30	36	37	-1	6	-7	-6
30	38	37	1	8	-7	-8