

Position Scatter (Ps)

Due to circumstantial errors a bandwidth can be determined statistically. It can be stated with a certain reliability (in this case $\pm 3s$) that all the circumstantial errors are within this bandwidth.

The following is valid on every individual position x_j :

$$s_j \uparrow = \sqrt{\frac{\sum_{i=1}^n (x_{ij} \uparrow - \bar{x}_j \uparrow)^2}{n-1}}$$

$$s_j \downarrow = \sqrt{\frac{\sum_{i=1}^n (x_{ij} \downarrow - \bar{x}_j \downarrow)^2}{n-1}}$$

The average standard deviation:

$$\bar{s}_j = \frac{s_j \uparrow + s_j \downarrow}{2}$$

The position scatter on position x_j is defined as: $P_{s_j} = 6 \cdot \bar{s}_j$

Maximum Position Scatter (Ps,max)

The maximum value of all calculated position scatter values.

Position Deviation (Pa)

At all positions the difference between the maximum value and the minimum value of the averages, calculated from translations in both directions. The systematic error at each position x_j is:

$$\bar{\bar{x}}_j = \frac{\bar{x}_j \uparrow + \bar{x}_j \downarrow}{2}$$

And from that the Position Deviation can be calculated:

$$P_a = |\bar{\bar{x}}_{j,max} - \bar{\bar{x}}_{j,min}|$$

Backlash (U)

At every measured position the difference between the average of measurements moving in one direction and the average of measurements moving in the other direction (systematic error):

$$U_j = |\bar{x}_j \uparrow - \bar{x}_j \downarrow|$$

Maximum Backlash (U_{max})

The maximum value of all calculated backlashes.

Average Backlash (U_{mean})

The average value of all calculated backlashes.

Positioning Uncertainty (P)

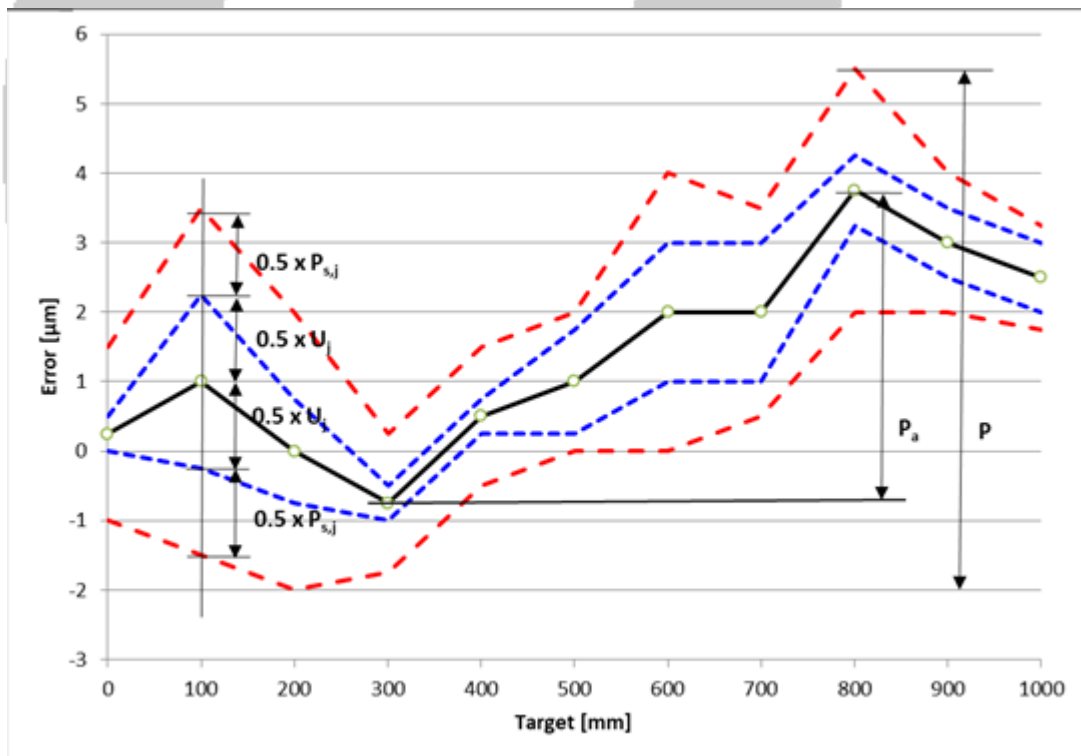
This is the overall deviation being calculated based for every position, average distinctive number:

- Position Deviation (Pa)
- Backlash (U)
- Position Scatter (Ps)

The uncertainty contains both random and systematic errors.

$$P = [\bar{x}_j + \frac{1}{2} \cdot (U_j + P_{s,j})]_{max} - [\bar{x}_j - \frac{1}{2} \cdot (U_j + P_{s,j})]_{min}$$

Graphical explanation



- Calculated averages of measurements in both directions
- - - Boundaries of backlash
- - - Boundaries of statistically expected scatter