

VDI/VDE 3441

Position Scatter (P_s)

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:

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

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

Maximum Position Scatter ($P_{s,max}$)

The maximum value of all calculated position scatter values.

Position Deviation (P_a)

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)

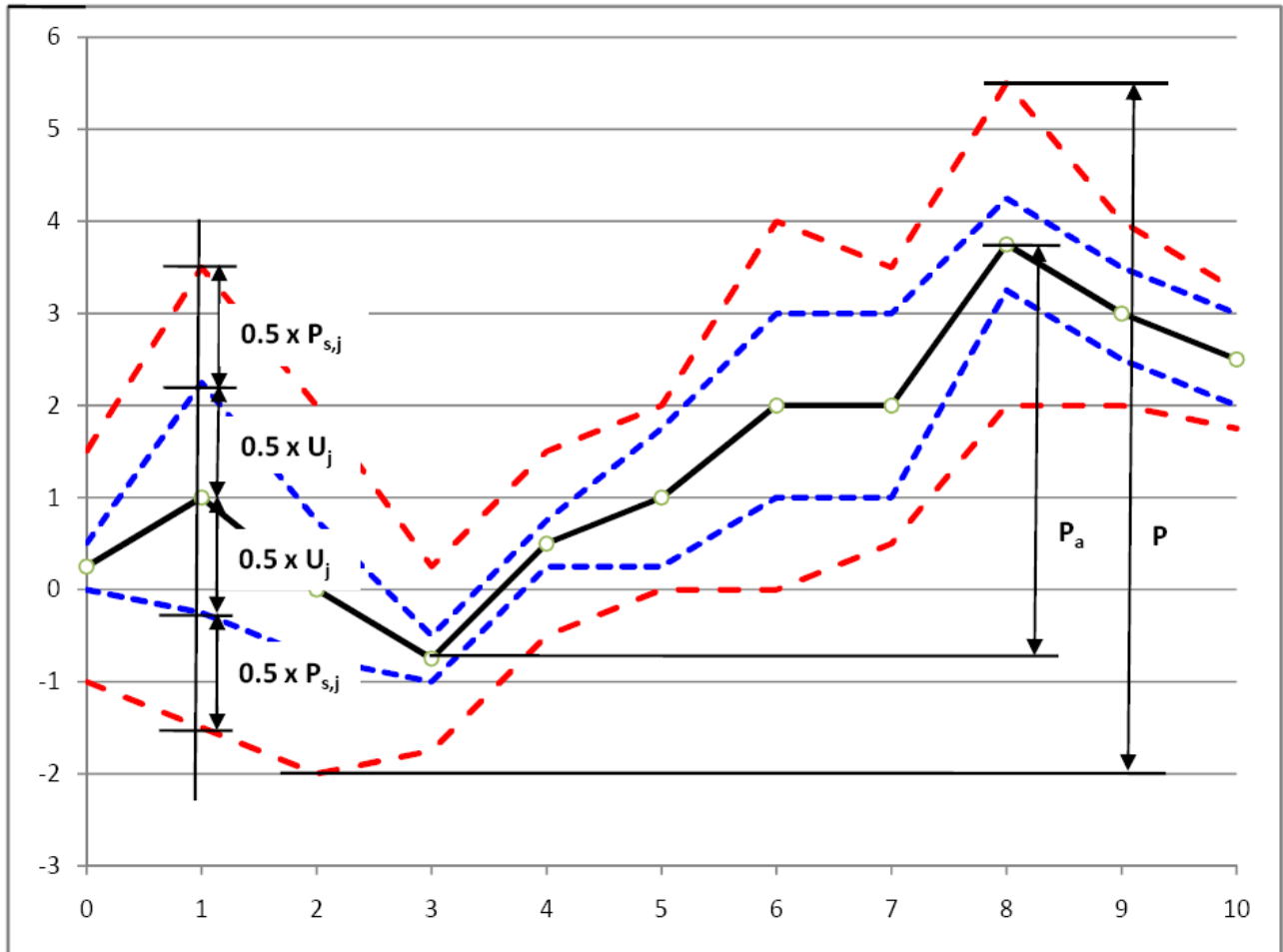
This is the overall deviation being calculated based for every position, average distinctive number:

- Position Deviation (P_a)
- Backlash (U)
- Position Scatter (P_s)

The uncertainty contains both random and systematic errors.

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

Graphical explanation



- = calculated averages of measurements in both directions
- - -** = boundaries of backlash
- - -** = boundaries of the statistically expected scatter