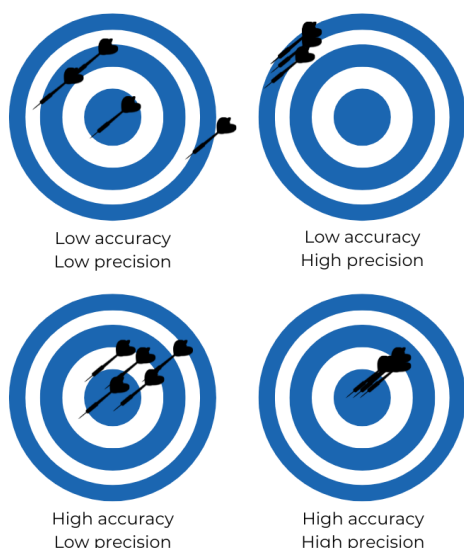# Accuracy and Precision

Version 1, Feb 2024

What is the difference between accuracy and precision?

Accuracy can be defined as how close a measured value is to the actual 'true' value.

Precision can be defined as how close measured values are to each other.

It is possible for results to be accurate without being precise and vice versa.

Figure 1 Bullseyes showing the levels of accuracy and precision

How can we improve the accuracy and precision of our data?

We can improve accuracy and precision by use of calibrated instruments (see our guide on Lab Equipment Calibration), conducting routine maintenance, increasing the number of measurements and significant figures must also be recorded correctly and consistently.

The "human factor" must also be considered, the variation in technique between personnel may result in differences in measurement. This is why it is important to ensure that training and standard operating procedures are kept up to date in order to maximise accuracy and precision.

Calibration is the most imperative to ensuring that data and measurements are accurate, the frequency in which equipment

It is also important to make sure that the equipment that is being used is designed and calibrated to operate within the range that is being measure/dispensed.

Certain systems may be prone to drift over time, HPLC drift may be indicative of column failure. If system drift is noticed maintenance must be performed as soon as possible.

How do we calculate accuracy and precision?

$$Accuracy = \frac{(True\ value - Measured\ value)}{True\ Value} \times 100$$

$$Precision = \frac{Standard\ Deviation}{Mean} \times 100$$

Accuracy and precision in analytical method development

In analytical method development accuracy is the value which expresses the closeness of agreement between the conventional true value that is accepted or an accepted reference value and the actual value found.

In analytical method development precision is the closeness of agreement between multiple measurements of the same sample which are obtained under specific conditions. Precision may also be expressed as repeatability.