ACCURACY, BIAS, PRECISION AND CONFIDENCE LIMITS

INTRODUCTION

The terms: 'accuracy', 'bias', 'precision' and 'confidence limits' are often confused. They each describe measurement errors, but they have distinct meanings.

ACCURACY AND BIAS

If we were to make numerous measurements of the same property of a material, and calculate the average of the results, and then compare this average with the "true" value, we would have an estimate of the accuracy of the measurement.

The difference between our average and the "true" value is sometimes called the bias of the measurement. It is a systematic effect and gives an indication of the extent to which the measurement system is out of calibration.

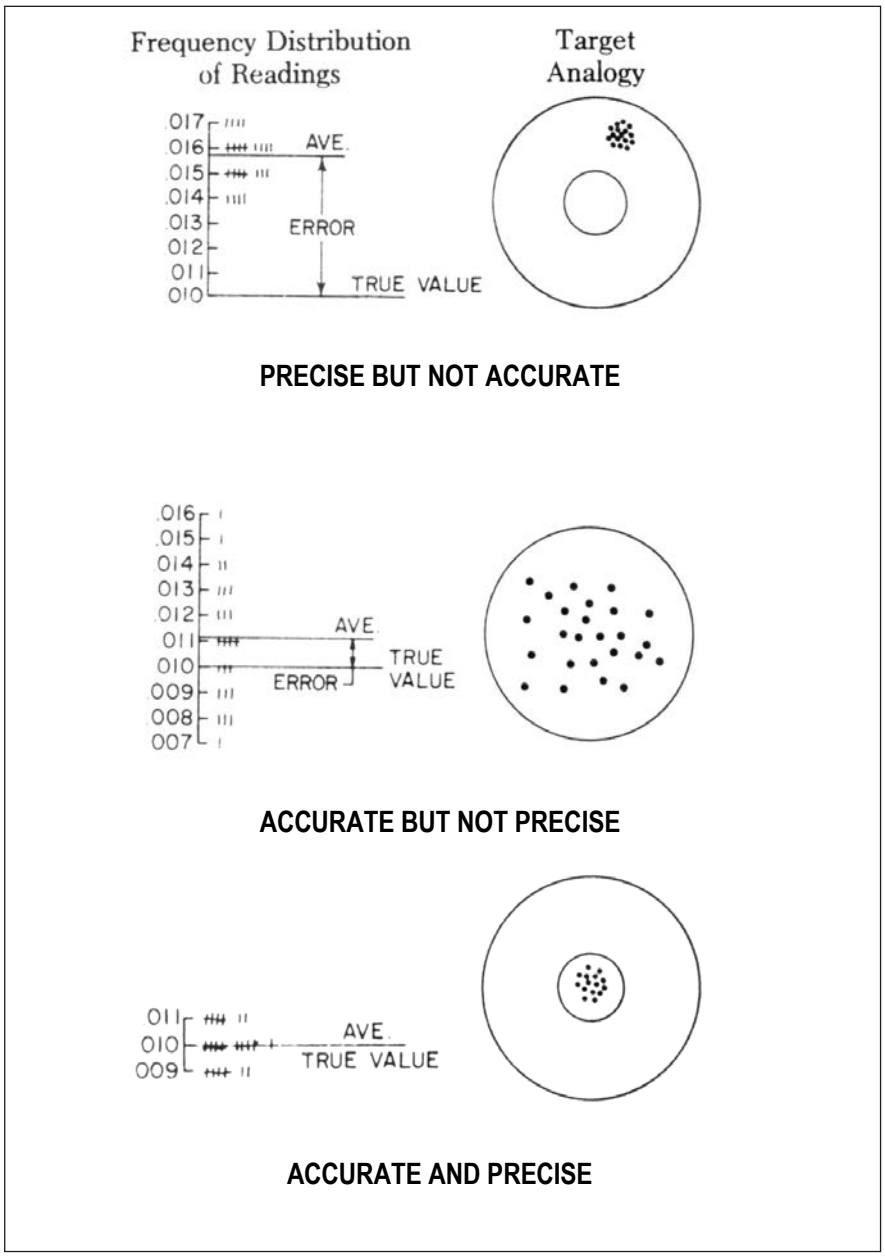
PRECISION

Irrespective of the accuracy of a measurement system, there is a low probability that two results from that system will be completely identical, even on the same sample. This variability can be due to a variety of causes, but for any measurement system in statistical control, the inherent dispersion of the results is itself reproducible and measurable. Precision is usually measured with respect to the standard deviation of repeat measurements. In wool testing, usually the largest component of variance is in sampling.

CONFIDENCE LIMITS

For a measurement system under statistical control, with a known precision, we can predict the likelihood that repeat measurements will fall outside a specific set of boundaries.

For wool testing, the term that is commonly used for these boundaries is the 95% confidence limits (95% CL). These are the limits above and below the average result within which repeat measurements are expected to fall 95% of the time. In general terms the 95% confidence limits are equal to twice the standard deviation of repeat measurements.



MAXIMUM PROBABLE DIFFERENCES

When two measurements are made on the same lot and are then compared, there is uncertainty associated with each one, and the difference between them is therefore affected by the precision of both measurements. IWTO defines the maximum probable difference (MPD) as the difference within which 2 measurements characterising the same lot are expected to fall 95% of the time. In practice, the MPD is equal to 1.414 times the 95% CL for the measurement.

DETERMINING ACCURACY IN WOOL TESTING

Wool is a very inhomogeneous material. It is almost impossible to know the "true" value of any parameter relating to a lot of wool. Test methods and IWTO Regulations assume that wool measurements are always accurate, and indeed all laboratories strive for this situation. However, the reality is that a wool laboratory can only assess its accuracy by reference to other laboratories, and must use the assumption that the average of a number of such independent comparisons will be the best estimate of the "true" result. Hence professional laboratories participate in routine interlaboratory trials in addition to monitoring their results against 'standard' samples.

PRECISION DETERMINATION IN WOOL TESTING

The determination of precision for most wool test methods is carried out in accordance with standard statistical practices. When a test method is drafted, at least one (but usually more) interlaboratory trials are carried out, in which a number of participants use the standard method on blind replicates of a range of samples. Statistical analyses of these trials allows estimation of the variability both between and within laboratories, which are then used to calculate the 95% CL and MPD values. These values are published in most test methods. For wool they often vary with the level of the property being measured.

Laboratories are able to monitor their performance against these precision values by carrying out replicate testing both within their laboratory, and in interlaboratory trials.

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