NGB
total weighing solutions

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

N.G. Brown & Associates Pty Ltd ABN 97 004 919 738
p 03 9753 4499 l f 03 9753 4299 l e office@ngbrown.com.au l a 31 Jellico Drive, Scoresby, Vic, 3179

What is uncertainty of measurement?

The first thing you should understand about metrology is that no measurement is exact or certain. If I was to show you a bolt and ask how long it is just by looking at it you might say, “It’s about 100 mm”. The use of the word about implies there is some uncertainty in your estimate.

Even the best measurements have uncertainty; a measurement is in fact always an estimate, a laboratory might make a much better estimate than the one you can make just by looking at something, but no measurement can ever tell you the exact value ever. In metrology we must always consider the uncertainty when making a measurement. The “give or take 5mm” in the above diagram is the uncertainty of the measurement estimation.

Confidence in Measurements

Related to uncertainty is the concept of confidence. Thinking again about the bolt and estimating the length, we might say “it is about 100mm give or take 5mm and I am 95% sure of my estimation”. We are assigning an uncertainty (+/-5mm) and a level of confidence (95%) to our measurement estimation. This helps the user evaluate the quality of our measurement. If it was said that the 95% confidence is not acceptable and you need to be more confident you could change your estimate to 100mm +/-10mm and say you are now much more confident (perhaps to 99%) because it is easy to estimate to within +/-10mm. So to be more confident you need to increase the uncertainty. A lawyer may then ask if you can be 100% confident as a jury wants to be sure your measurement is correct. Unfortunately no measurement can ever have a 100% confidence level so the jury will always have some doubt about any measurement and will need to consider the statistics.

It is an industry standard to provide a measurement result with an uncertainty at a confidence level of 95%. For the bolt example this means that there is still a chance the bolt length may exceed 105mm but it is small. 95% means there is a 1 in 20 chance it will exceed the 100mm +/-5mm range. In metrology we must be very clear about the level of our uncertainty at a given confidence level. We can carry out an uncertainty evaluation which includes analysis and experiments to determine the uncertainty of a measurement. If we measure your 5kg weight as 5000.005g with an uncertainty of +/-3.0mg we are saying there is a 95% chance the weight value is within the range of 5000.002g to 5000.008g. There is also a 5% chance it is outside this range but that is how a 95% confidence level works.