

## Measurement Quality and Analytical Variation

### Do you use analytical results to make decisions and judgements?

As an accredited laboratory, we closely manage the quality of the measurements we supply to you. We understand the results you receive from us may help in the management of your business. Understanding the analytical variation in our testing will help you make better decisions. Hill Labs is able to provide you with information about the variation associated with your testing, via additional reporting.

### What is Analytical Variation?

We hope that this doesn't surprise you but if we carry out ten analyses on the same sample we will not get ten identical results. The results produced will vary slightly each time due to slight variations in testing conditions, such as equipment, the sub-sample, the technicians carrying out the test, or the testing environment. In the laboratory, we call this "Uncertainty of Measurement" or "UoM" for short.

We have regular controls to measure the UoM for a test and we actively try to remove as much variation as best we can. Variation in any analytical process will however never be zero. Please note that our uncertainty estimates do not include variation due to steps outside of the laboratory's control, such as sampling by the customer.

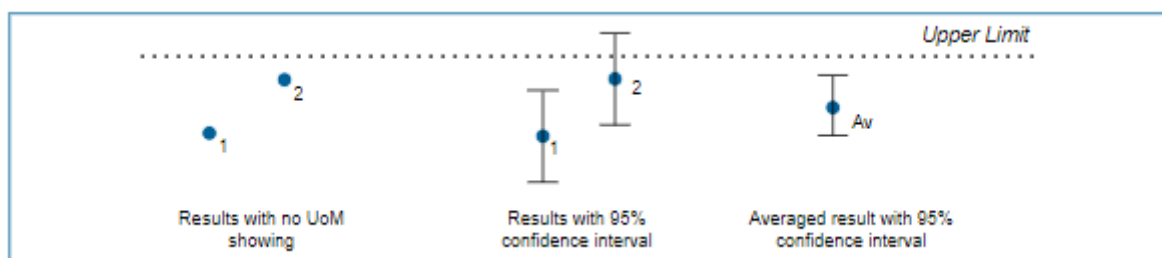
### Why is Analytical Variation Important?

A common reason for testing is to ensure limiting values are not exceeded. Without knowing the UoM, decisions may seem simple. These decisions may however be incorrect, and lead to undesired outcomes. The analytical method's capability needs to be well matched to the purpose of the testing and the relevant limit or critical value. Providing us with full information about any limits your result is likely to be compared against, will ensure the best testing methodology is chosen for your sample(s).

The example below illustrates this. With no UoM shown, it seems that both result 1 and 2 are below the limit and therefore meet requirements. A decision to release product or continue a current process might seem reasonable. However, each result represents just a single estimate of the true value in the sample. Given analytical variation exists, and because UoM information is not included, there is no indicator of how confident we can be regarding these decisions.

Including the UoM with the results allows us to make a better decision. The 95% confidence intervals give us 95% certainty that the true value is somewhere within that interval. Also at that confidence level, any result within the interval is essentially equivalent. If we report result 1, there is now greater than 95% confidence that the samples passes.

If we report result 2 however, we cannot say it passes within 95% confidence and that there is an increased possibility that the true result could fail, as the top of the 95% confidence interval crosses the limit. This increases the risk of accepting the pass decision, as any reanalysis of the same sample could result in a different conclusion, with potentially drastically different consequences. Re-sampling or reanalysis may be required to achieve a clearer understanding. Calculating an average result will result in a better estimate of the true value and have a reduced UoM.



We hope the above example illustrates the importance of UoM in the decision making process.

Our optional UoM reports provide you with an estimate of UoM that allows better decisions to be made, thereby reducing your risk. This is especially important where results are close to the required limit. Variation in repeating a test in such cases may show some results as being acceptable compared to the limit and some not. The uncertainty estimate allows for an assessment of where the result is truly likely to lie.

## When is UoM Reported?

In New Zealand, IANZ accredited laboratories must be able to provide UoM information when the customer asks for it. In some cases, such as testing for Drinking water, the reporting of UoM is a mandatory requirement. Such requirements are likely to become more common in the future.

Hill Labs routinely provides a standard report type by default. Where testing is conducted against a standard, specification, or compliance limit, the report may show whether a result passes / fails, is in / out of tolerance, is compliant / non-compliant, etc. In these cases, the report will also include a description of how the pass/fail is determined, unless the related standards or specifications require the use of specific rules. These are known as decision rules. The Hill Labs standard approach is to treat all values as fixed, with no consideration of UoM. Alternative decision rules can be applied as agreed with the customer.

If UoM information is required, a separate UoM report can be requested. The UoM report will be the default report in cases when providing UoM is a mandatory requirement.

## How will UoM be reported?

The result and its associated uncertainty is reported in the following way:

Your result:  $4.87 \pm 0.65 \text{ g/m}^3$  (95% confidence level)

In this example, we can be 95% sure the true result lies somewhere in the range 4.22 and 5.52 g/m<sup>3</sup>. Stated another way, if we repeat the test 100 times, we would expect that on average 95 of the results obtained would fall between those values. Our default is to report a level of confidence of 95%. Other confidence levels are available on request.

The uncertainty reported with a result is an estimate based on routine laboratory performance on typical sample matrices.

## UoM Calculations and Confidence Levels

The accepted method for combining uncertainties is to use standard uncertainties (the equivalent of one standard deviation, approximately 68% confidence level). For reporting, this standard uncertainty is multiplied by an appropriate coverage factor to give the required level of confidence. A coverage factor of 2 is used to give approximately 95% confidence, and a coverage factor of 3 is used for 99% confidence.

If you wish to use our uncertainty estimates in your own calculations, you will first need to divide them by the supplied coverage factor.

## Our aim is to make your job easier

If you have any further questions about this, please don't hesitate to contact one of our Client Services Managers. We are eager to understand your testing needs and ensure that they are met consistently, so that your decisions are easier and more meaningful. We hope you are satisfied with the additional information available to you and find it useful when making decisions.

