Biotech Laboratories
AIR FOOD WATER ENVIRONMENTAL TESTING

Measurement of Uncertainty

Introduction
Every measurement is subject to some degree of uncertainty. Measurement uncertainties can come from a variety of sources and usually a combination of more than one. Such uncertainties can be estimated using statistical analysis of a set of measurements.
All NATA accredited laboratories are required to determine the measurement of uncertainty (MU) for applicable analyses. Analyses such as presence/absence testing (eg Salmonella/Listeria in 25 grams, E. coli/Faecal coliforms in swabs) are exempt from MU determinations. ISO/IEC 170251, the standard to which all NATA accredited laboratories must adhere, requires calibration and testing laboratories to have and apply procedures to estimate the uncertainty of their measurements. Furthermore, Section 5.10.3 of the standard states test reports shall include information regarding MU when a customer instructs the laboratory to provide the information, when it is relevant to the validity or application of test results, or when it affects compliance to a specification limit. Basically, the uncertainty of measurement is the doubt that exists about the result of any measurement. It is different for each laboratory and within the laboratory it is a different value for each type of analysis.

What affects the measurement of uncertainty for a particular analysis?
Below are examples of that which can affect the final measurement or result:

- the measuring instrument – built in errors or inaccuracy, age of the instrument(s)
- the item being tested – whether it is stable or constantly changing
- the analysis process – the number of weighing, pipetting steps required
- imported uncertainties - instrument calibration
- operator skill – experience, workload, time of day etc
- sampling issues – bacteria are not evenly distributed through a food or water matrix or in the environment
- the laboratory environment – room temperature, air pressure and humidity

How is it calculated?
In general, to calculate the uncertainty of a measurement, you must identify the sources of uncertainty in the measurement. The degree of the uncertainty from each source must be estimated. Finally the individual uncertainties are combined to give an overall figure.

In the field of microbiology it is standard to estimate the level of the uncertainty for factors such as stability of the sample and sampling issues. It has been decided that it is acceptable to evaluate all the sources of uncertainty at once for each analysis within laboratory.

This is performed by different laboratory staff simultaneously process the same sample for the analysis being investigated and the final result is recorded for each sample. This is then repeated by laboratory staff on a different sample and so on until at least 10 sets of samples have been processed for that particular analysis. Variables such as the time of day the samples are processed, workload and the other sources of variation are incorporated into the testing regime. A statistical analysis is then performed to determine the MU for that analysis.

How is it reported?
Biotech Laboratories will report MU as a range appearing in brackets either under the result (on dedicated Legionella and Plate count reports) or beside the result. For example:

Plate Count: 230,000 (MU Range: 170,000 to 310,000) CFU/gram

When will Biotech Laboratories report the measurement of uncertainty?
As stated above, ISO//IEC 170251 requires that all laboratories must report the MU when it affects compliance to a specification limit. NATA has advised that all Legionella and Plate Count results from water cooled air-conditioning systems must have the MU reported when the MU range is relevant to the validity or application of test results. In this case AS3666 has specified action requirements based on Legionella levels. Whereas it is only necessary to list the MU when the range covers one of these limits, we report MU levels for all Plate Count and all Legionella positive results.

Biotech Laboratories will report the MU range for results for sample types such as, drinking/potable water, primary and secondary contact recreational water, pool and spa water, irrigation water and food, if it is specifically requested by a client, or the client advises that it will impact on a regulatory requirement/guideline.

How do I interpret the measurement of uncertainty range results?
Regulatory guidelines such as AS366, Australian Drinking Water Guidelines, Food Standards Code and other documents either make no mention of MU or do not specifically state how a measurement of uncertainty result it should be interpreted.

Take the case of a result of 80 with a MU range of 58 to 110.
If the acceptable limit is 100 – Is this a pass or a fail? The reported result is 80 which is a pass, but the MU upper level is 110 which is a fail.
If the acceptable limit is 60 - Is this a pass or a fail? The reported result is 80 which is a fail, but the MU lower level is 58 which is a pass.

Arguments can be made for using the MU range as a best or worst case scenario. In fact in some countries, the complete opposite view has been taken. At present, Australian authorities have not stipulated how to interpret MU ranges and have indicated only they may need to be considered when interpreting results.

Until the applicable standards and guidelines are reissued with a clear statement on how a MU range is to be interpreted, the interpretation of the report should be based on the actual analysis results, not on the MU range if it is reported.

It must also be remembered that the interpretive reporting of our results, ie ticks or crosses on reports, are based on the actual result, not the reported MU range.

For further information please contact Biotech Laboratories.