Mitigating Measurement Risk

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What does Uncertainty or Test Uncertainty Ratio (TUR) mean and how do they impact a measurement or product compliance? If a laboratory provides a measurement of 50 %RH with an uncertainty of ±0.78 %RH, a tolerance of ±1.25 %RH, and a TUR of 1.6:1, how can these numbers be broken down into useful information?

Let's examine measurement risk in simple terminology.

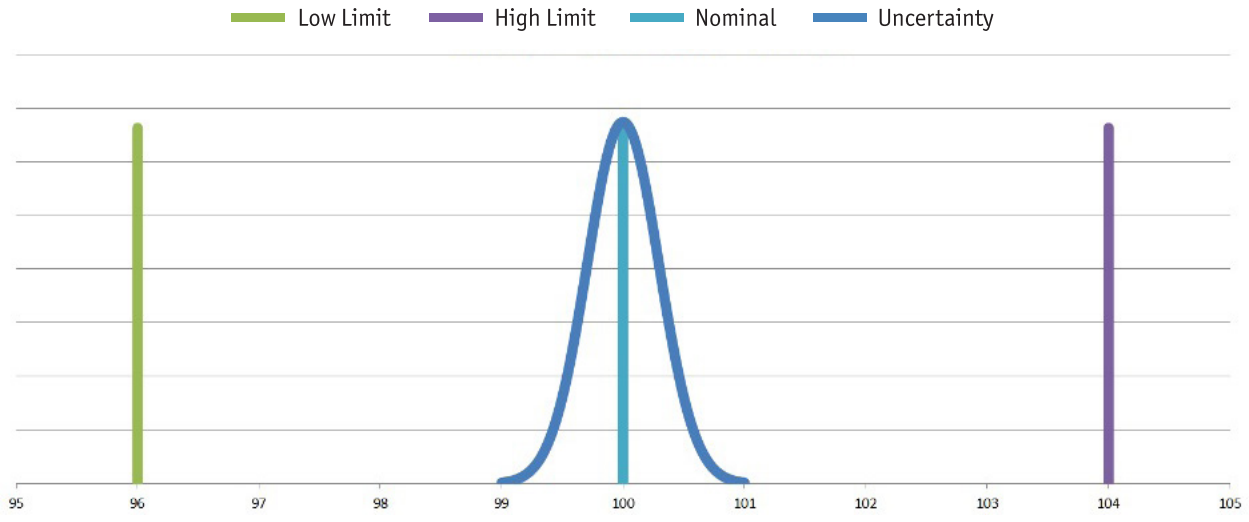
What is Measurement Uncertainty? In simple terms, Uncertainty is the range of values in which the true value lies; think of it as the possible error in the measurement.

Uncertainty is derived by statistical methods and is represented as a Gaussian distribution. If a device measures 100 psi and the Uncertainty (error) is ±1 psi, the true value is somewhere between 99 psi and 101 psi.

Test Uncertainty Ratio (TUR) is the ratio of the device accuracy to the Uncertainty (accuracy divided by Uncertainty). Using the above example, if the device has a tolerance of ±4 psi and the Uncertainty is ±1 psi, the TUR is 4:1.

The lower the TUR (closer the Uncertainty is to the tolerance) the higher the probability of false accept or false reject as evidenced in the following graphs.

GRAPH 1



Tolerance is ±4psi (96-104 psi). Uncertainty is ±1 psi (99-100 psi). Graph depicts the device measures 100 psi.

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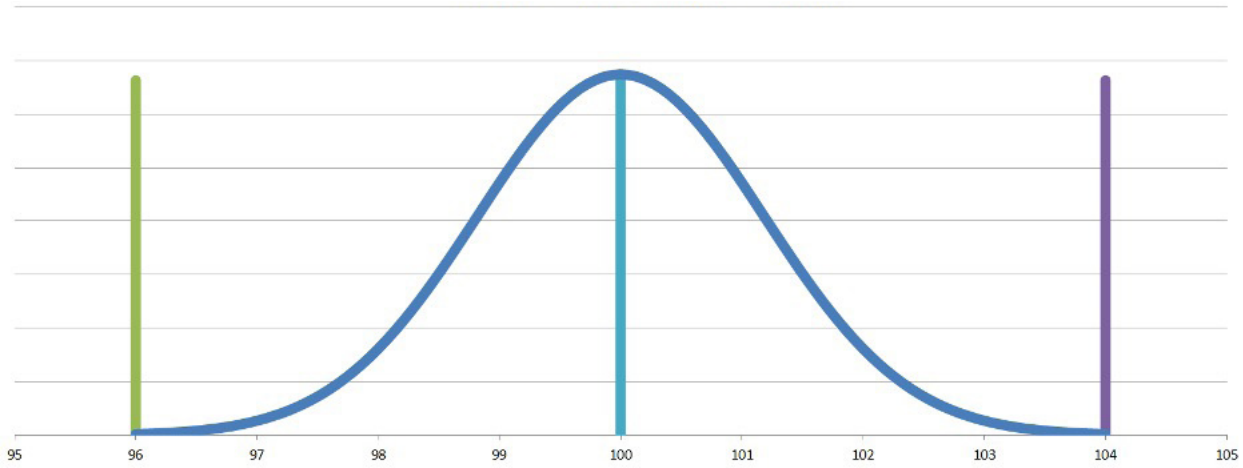
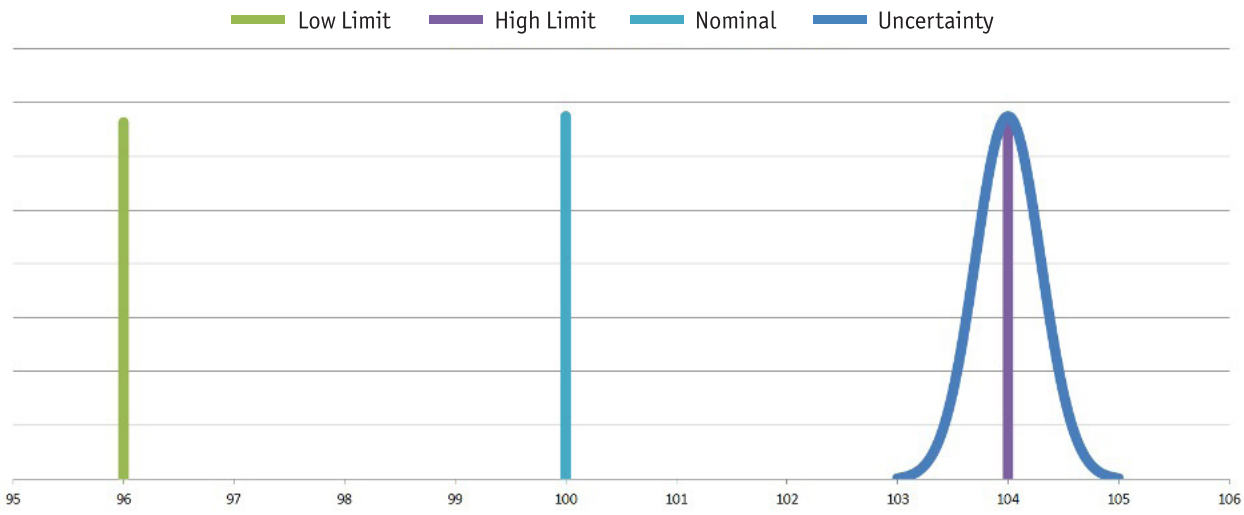
GRAPH 2



Tolerance is ±4 psi, Uncertainty is ±2 psi. TUR= 1:1. Graph depicts the device measures 100 psi.

The two previous graphs show the measurement at 100 psi (exactly nominal). But what happens if the measurement is at the ±4 psi limit?

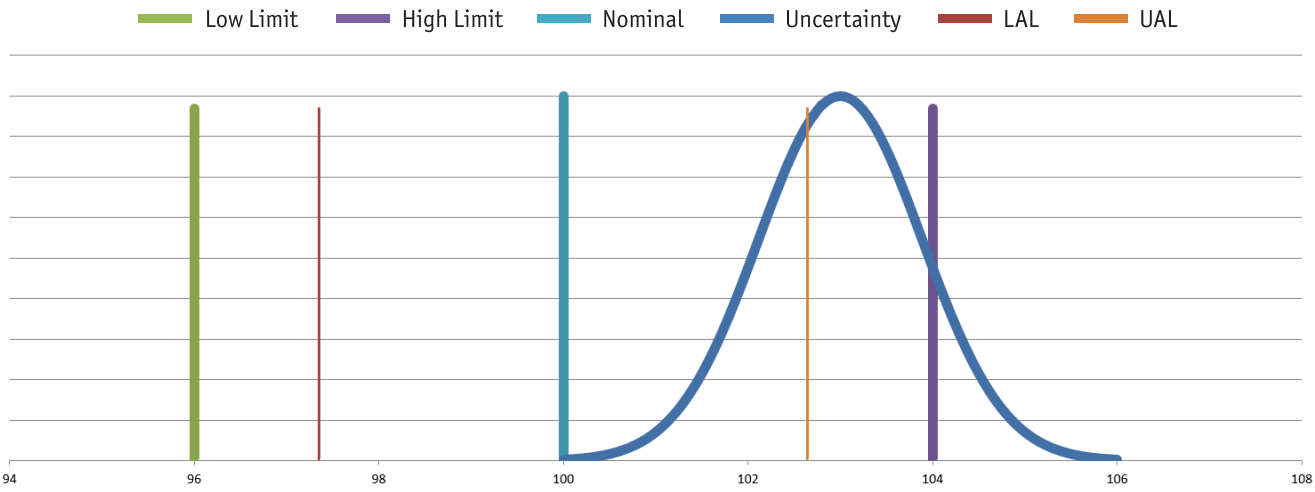
GRAPH 3



Tolerance is ±4 psi, Uncertainty is ±1 psi. TUR = 4:1. Graph depicts the device measures 104 psi

This graph shows the measurement at 104 psi, but half the distribution lies outside the 104 psi upper limit. In this scenario, there is a 50% probability of a false accept or a false reject. The device must be adjusted to bring the distribution within the upper and lower limits.

GRAPH 4



Tolerance is ±4 psi, Uncertainty is ±3 psi. TUR is 1.3:1. The graph depicts the device measures 103 psi and is above the RDS UAL. The device must be adjusted.

This device measures 103 psi. Using the Root Difference Squared (RDS) equation, the Upper Acceptance Limit (UAL) is 102.6 psi and poses measurement risk. The device must be adjusted to bring the distribution within the RDS limits.

To mitigate false accept or false reject, use risk-based Guardbanding. Adjust (where possible) your device to within a ±2% risk using the Root Difference Squared (RDS) Guardbanding method.

AL = acceptance limit
TL = tolerance limit
U = uncertainty

$$AL = \sqrt{TL^2 - U^2}$$

RDS Equation

The uncertainly of measurement must be taken into account when making a statement of conformity. Under ISO/IEC 17025:2017, metrology labs must define a decision rule as 'a rule that describes how measurement uncertainty will be accounted for when stating conformity with a specified requirement.' The decision rule is supplied or agreed upon, by the customer prior to calibration; see Enhanced Certificates options that follow.

References

International Laboratory Accreditation Cooperation (ILAC) G8:09/2019
National Voluntary Laboratory Accreditation Program (NVLAP)

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to maximize your equipment's capabilities, choose a metrology provider who uses Guardbanding and who is accredited to ISO 17025:2017. Masy offers the following calibration certificate options for your calibration needs.

Enhanced Masy BioServices Certificate offerings

Option 1: NVLAP accredited calibration with Guardbanding and false accept risk <2%. The certificate states conformity of Pass, Fail, Pass Indetermiant, or Fail Indeterminant and takes into account the uncertainty of the measurement. Your device (where possible) will be adjusted to mitigate false accept or false reject.

Option 2: NVLAP accredited calibration and uncertainty with no statement of conformity. Calibration certificates will not define Pass, Fail, Pass Indeterminant, or Fail Indeterminant. The customer will interpret the results.

Option 3: Commercial calibration without measurement uncertainty or accredited measurements. This is a basic calibration traceable to the International System of Units (SI).

CERTIFICATE LEVEL 1

NVLAP Accredited Calibration

In accordance with ILAC G8 methodologies

Includes Guardbanding and false accept risk ≤2%

Includes Measurement Uncertainties

Includes a statement of precision conformity (ie: Pass, Fail, Pass Indeterminate, Fail Indeterminate) taking into account the measurement uncertainties and the Test Uncertainty Ratio (TUR))

CERTIFICATE LEVEL 2

NVLAP Accredited Calibration

Includes measurement uncertainties with NO statement of conformity
(ie: Pass, Fail, Pass Indeterminate, Fail Indeterminate will **not** be designated on calibration certificate)

Includes all necessary data for the customer to interpret the calibration results

CERTIFICATE LEVEL 3

Commercial Calibration

Traceable to the SI through NIST

NOT ACCREDITED, does not include measurement uncertainties required for accredited calibration

Learn more at www.masy.com

ISO 17025:2017 Accredited

NVLAP CALIBRATION NVLAP LAB CODE 200904-0

ISO 9001:2015 CERTIFIED QUALITY MANAGEMENT SYSTEM