Measurements Reported Out of Context

Change is in the wind for the definition of traceability

The interesting thing about evolution is that change is inevitable, yet we are so resistant to change. Those who are closest to a particular change event are typically evenly divided: about half embrace the change and the other half fight it every step of the way. In the end, change happens regardless of how each of us chooses to deal with it.

So it goes with the evolution of technology. Throughout history, a very slow evolution has taken place as can be seen of mankind's attempts to invent products or develop services that make life easier and which provide an improved quality of life. It's been a precarious balance between design concepts, available materials, the tools used to develop these designs, and our ability to accurately measure; all of which are necessary to turn each concept into reality. As one of these integral components improves, challenges arise for the others. The reason it has taken thousands of years to reach today's technological realities is largely due to resistance to change which usually stems from a lack of understanding the reason for the change. Ultimately, it slows us down from reaching our desired goals. Today in the U.S., we are once again stalled in making progress with the relatively recent realization that a stated measurement is incomplete without a measurement uncertainty (MU) being reported as an integral part of the measurement.

Before we get over our head in uncertainties, let's step back and look at a simpler concept. Surely you have seen instances where someone reports a numeric value and fails to include the unit of measure. Often when this happens, the unit of measure is implied because the reported value is usually associated within the context of the topic of discussion. For example, when watching a weather report in any U.S. city, the regional map shows numbers for many locations but states no associated unit of measure. The same goes for Relative Humidity and wind speed values. That's because everybody knows that in the U.S. it's a given that temperature values are always °F (Fahrenheit), wind values are in MPH (and usually the Meteorologist says "miles per hour"), and humidity is always in units of percent (actually % RH). This practice of leaving off units of measure is, unfortunately, commonly accepted. This is less of an issue when the reported values are well within the context of the subject. However, people get lazy about including units of measure and there are many examples where assumptions were made that everyone understood the context within which the numbers were stated. This can lead to mistakes, some of which can have costly and embarrassing results. Sometimes errors occur even when the unit of measure was clearly stated. Case in point: the NASA-JPL Mars Climate Orbiter which, on September 23,

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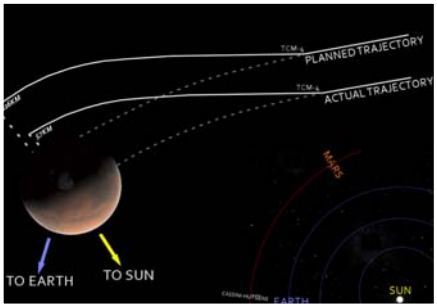
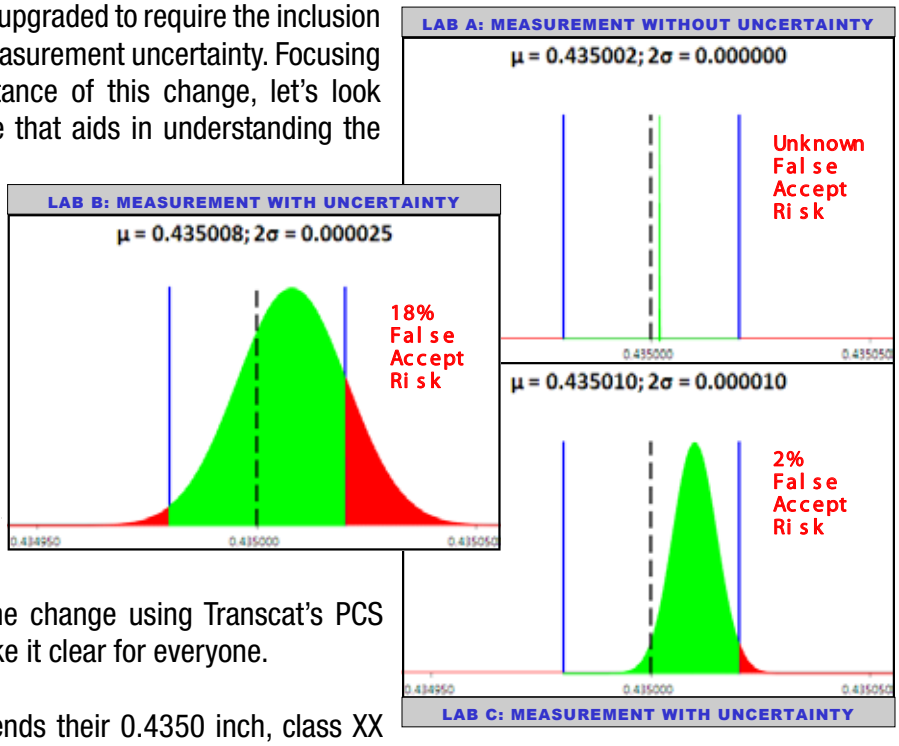


1999, was sent erroneous steering commands that caused it to enter a lower altitude than it could handle and the atmospheric stress caused it to disintegrate; a 193 million dollar mistake! Part of the egregious error was due to incorrect conversion between English and metric units, known as the "metric mixup". In this case, the units were known and still a tragic mistake happened. Clearly, if the unit of measure is left off altogether, it is a recipe for disaster! As for calibration, most Metrologists know that units of measure must be reported with the measurand (instrument's value). Surprisingly, some calibration reports do not include the unit of measure. Your quality personnel should be all over that one!

What is meant by the 'full context of a measurement'?

The definition of traceablility has been refined to refer more specifically to Metrological Traceability since the term 'traceability' can apply to many different things. This definition has also been upgraded to require the inclusion of a stated measurement uncertainty. Focusing on the importance of this change, let's look at an example that aids in understanding the reasons for the change using Transcat's PCS feature to make it clear for everyone.



A company sends their 0.4350 inch, class XX ring gage (tolerance = ±0.000 020 inch) to three labs. The values reported were: Lab A 0.435 002 inch; Lab B 0.435 008 inch; Lab C: 0.435 010 inch. While all readings were within tolerance, if this were the only information upon which to base a decision, it would appear that Lab A had the most favorable result and that Lab C may have something wrong

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with their measurement. However, taking each lab's uncertainty into account provides the full context within which a decision can be made regarding the quality of the measurement. Lab A is not accredited and only reported the value of the ring gage. Labs B and C are ISO 17025 accredited and reported an uncertainty with their measurements. The illustrations show how the uncertainty (or lack thereof) compares to the tolerance limits. Since Lab A does not estimate their measurement uncertainty, the gage owner does not know how this lab's reading compares to the tolerance limits (or to the other labs). A measurement result without an uncertainty is a measurement reported out of context which provides no means to understand its qualitative value. However, using the full context of the measurement, which includes uncertainty, it is clear that Lab C provides the greatest confidence in reporting the value of the ring gage to the client. Visit our website, www.transcat.com, for more technical resources including traceability.

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