Measurement Decision Risk Analysis Frequently Asked Questions

Integrated Sciences Group answers frequently asked questions relating to measurement decision risk analysis. The answers are intended to provide clarification and dispel common misconceptions. If you have any questions or comments regarding any of our risk analysis FAQ topics or would like us to answer additional questions, please contact us at tech@isgmax.com.

Question	Answer
What is measurement decision risk?	The risk that accompanies decisions made on the basis of measurement results.
Why should I compute measurement decision risk?	Measurement decision risk is typically expressed as false accept risk or false reject risk. False accept and false reject risks are the principal metrics by which the quality of a test or calibration process can be evaluated. In addition to providing quality metrics, risks constitute variables that relate to both the cost of testing and calibration and the cost of deploying or shipping nonconforming end items.
What is false accept risk?	There are two definitions of false accept risk: Unconditional false accept risk is the probability that an equipment parameter or attribute will be both out-of-tolerance and perceived as being in-tolerance during calibration or testing. Conditional false accept risk is the probability that an accepted parameter or attribute will be out-of-tolerance during calibration or testing. The consequences of high false accept risk include possible negative outcomes relating to the accuracies of calibration systems and test systems and to the performance of end items.
What is false reject risk?	The probability that in-tolerance parameters will be rejected. It is another measure of the quality of calibration or testing. The consequences of high false reject risk include increased costs due to unnecessary adjustment, repair and re-test, as well as shortened calibration intervals and unnecessary out-of-tolerance reports or other administrative reaction.
How do I compute measurement decision risk?	There are three principal alternatives: the *classical method* found in much of the measurement decision risk literature;

Measurement Decision Risk Analysis Frequently Asked Questions

	the *Bayesian method* applicable to controlling measurement decision risk in response to the real-time results of testing or calibration; and the *confidence level method* that serves as a pseudo risk control tool to be used in the absence of information needed to estimate the bias uncertainty of the unit under test.
How do I choose between alternatives to find the best methodology for my company/dept/lab?	
What is the difference between a test accuracy ratio (TAR) and a test uncertainty ratio (TUR)?	The definition of TAR has evolved somewhat. It began as the "ratio of the tolerance limits of a unit under test (UUT) attribute to the tolerance limits of a measurement reference." Other definitions have emerged over the years, most of which replace the measurement reference tolerance limits with some variation of the uncertainty in the measurement process. Until recently, "TUR" has usually just been another way of saying "TAR." In 2006, TUR was given an "official" definition in ANSI/NCSL Z540.3: "The ratio of the span of the UUT tolerance limits to twice the expanded uncertainty of the calibration process." A caveat was added saying that this definition is valid only for symmetrical two-sided UUT tolerance limits.
Are measurement decision risks under control if the TUR is sufficient (i.e., TUR $\geq$ 4)?	No. The in-tolerance probability of the UUT attribute is a major contributor to measurement decision risk. TUR does not take this probability into account and is, therefore, often an unreliable and misleading decision metric.
What are guardband limits?	Guardband limits are test limits that are set inside or outside tolerance limits by some amount needed to reduce either false accept or false reject risk, respectively.
Can test guardbands be determined from measurement process uncertainty using simple algorithms?	A major factor in setting test guardbands is the a priori in-tolerance probability of the UUT. Other factors are MTE and UUT error distributions, MTE in-tolerance probability, measurement process uncertainty, and MTE and UUT tolerance limits.

Measurement Decision Risk Analysis Frequently Asked Questions

What is a guardband multiplier?	Guardbands are usually specified in terms of a guardband multiplier. For example, if the guardband multiplier is 0.9, the test guardband limits are set at 90% of the tolerance or "performance" limits.
Is measurement decision risk constant over the MTE calibration interval?	Measurement decision risk is, in part, a function of the MTE attribute's in-tolerance probability. Since this probability varies over the calibration interval, decision risk depends on the time elapsed since MTE calibration and on the MTE bias uncertainty growth rate.
What are acceptable levels of measurement decision risk?	The level of acceptable false accept or false reject risk primarily depends on the criticality of the decision. For example, an extremely small level of false accept risk is required for monitoring the core temperature of a nuclear reactor, Conversely, a much higher false accept risk is necessary for using a bathroom scale to decide your weight. An optimal level of risk can be determined by minimizing the sum of the cost of potential negative consequences of a given risk level and the cost of attaining it. ANSI/NCSL Z540.3 requires that the unconditional false accept risk accompanying all calibrations be no greater than 2%.