

# **Measurement Risk Analysis Methods As Applied to Guard Bands**

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## **Abstract**

Measurement risk analysis provides a probability description of the possible results of a calibration scenario. Under a basic calibration testing scenario, the measurement from a Test Instrument (TI) is compared with the measurement from a Unit Under Test (UUT). If the difference between these measurements is greater than some required tolerance, the UUT is declared to be out of tolerance (OOT). The usual result of this OOT declaration is that the UUT is adjusted in some fashion so that the tested measurement is no longer OOT.

Since the TI makes measurements with error, there is a probability that the decision made through this testing process could be in error. Specifically, the TI could find the UUT to be in tolerance when it is in fact OOT. This is generally referred to as a False Accept. The probability of a False Accept is found using the multivariable integrals specified by measurement risk analysis methods.

Guard Banding provides a method for making False Accepts less likely. The process involves choosing a tighter testing tolerance, known as the Guard Band. If the difference between the UUT measurement and the TI measurement is outside the Guard Band, the UUT is adjusted even if it is inside the required tolerance.

A downside to the Guard Band methodology is that it increases the likelihood of a False Reject. This means that the UUT is observed by the TI to be OOT when in fact it is in tolerance. As a result, an unnecessary adjustment is performed on the UUT with its associated costs.

This paper expands measurement risk analysis methods to allow for the Guard Band test scenario. These methods allow the choice of a Guard Band on the basis of the resulting False Accept and False Reject probabilities. In addition, this paper compares the mathematical approach to choosing Guard Bands with other methods.