

Audio Precision Calibration Services (APCS) is accredited as a calibration provider under ISO/IEC 17025:2017. One of the conditions of accreditation is that; if our calibration reports include pass/fail indications then we must explain the “rules” we use to make the pass/fail decision. The rule must include the measurement uncertainties used. In order to be complete, the rule needs to also identify, the use of guard bands, the coverage factor used, the source of the target specification, and the probability of a false acceptance situation.

We think that our choice to include the pass/fail notation makes interpretation of the test result easier and more efficient for our customers.

From ISO/IEC 17025:2017 the definition is

3,7 decision rule

rule that describes how measurement uncertainty is accounted for when stating conformity with a specified requirement.

APCS Explanatory Notes

The section on Explanatory notes on page 3 is taken from the from a typical APCS Calibration Report. The possible outcomes for each measurement fall into 3 categories PASS, UNCERTAIN, and FAIL.

Calibration Reports – 2 Types

APCS issues calibration reports under two different situations

- Situation 1- the product is new and is being initially shipped to the customer. In this case the customer receives one calibration report marked “AS SHIPPED” In this case all sections of the report will indicate **PASS**. Other outcomes are not allowed.
- Situation 2 - a unit has been returned from the field for calibration. In this case the customer will receive two calibration reports, the first report will cover the performance of the unit “AS RECEIVED” at the lab. In this case the results of each measurements can fall in one of the 3 possible categories; **PASS, Uncertain, Fail**. *In the event that the unit as received is not functional the As Received report will indicate the unit was NON-functional accordingly no measurement data is available.*
- Situation 2 (cont.) After the unit has been adjusted, updated and repaired as need the unit is calibrated again. This final report is marked “**AS SHIPPED**” In this case all sections of the report will indicate “**PASS**”. Other outcomes are not allowed.

PASS indications – what is considered

If we look at the cases where the outcome of the measurement is marked PASS – the following conditions are considered.

1. The test limits for the calibration report are taken directly from the product specification - which are available online in the **Installation Instructions and Specification** booklet for the model or model family.
2. The uncertainty of the reported measured value as established– APCS uncertainty considerations are a combination the uncertainty factors that affect the reported measured value- Measurement uncertainty is stated at a minimum confidence level of 95% following the recommendations in ISO/IEC 98-3 typically using a coverage factor of 2 except as appropriate (for example, in cases where an error source with a uniform distribution dominates).
3. The test limit (from the Specification) is reduced by including a guard bands consisting of the *95% expanded measurement uncertainty*.
4. The Reading value is less than the reduced test limit.
5. The probability or risk of false acceptance using this technique is *typically, <0.2%*

To summarize – the pass conditions are stated when the measured value using 95% uncertainty conditions does not exceed the product specification reduced by the 95% confidence guard band.

UNCERTAIN Indications – what is considered

The same Items 1, 2, 3, from above.

4. The Reading value is within the specified upper and lower limits, but it is close to one of the limits by an amount that is less than the 95% expanded measurement uncertainty.
5. The probability or risk of false acceptance is elevated **and could approach 50% if the Reading value equals the upper or lower specification limit**. The determination of the pass-fail condition is up to the customer and their policy for acceptance.

FAIL Indications

The Reading value is outside the specified upper or lower limits.

Explanatory notes to the last three columns of the calibration report

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"**MU**" - The column labeled "**MU**" lists the expanded measurement uncertainties derived from equipment specifications, repeatability data, and other significant sources. These are **stated at a minimum confidence or 95% using a coverage factor k=2 (except as appropriate) following the recommendations in ISO/IEC 98-3 Guide to the expression of uncertainty in measurement (GUM:1995), BIPM JCGM 100:2008, and NIST Technical Note 1297.**

"**TUR**" - The column labeled "**TUR**" lists the test uncertainty ratio calculated by dividing the lesser of the lower and upper reading tolerances by the 95% expanded measurement uncertainty. An entry of "**na**" indicates [1] the specified limits are one-sided, or [2] the performance characteristic **is not accredited.**

"**Result**" - The column labeled "Result" lists color-coded assessments that the observed characteristic is within its specified limits of performance. There are three possible indications:

pass	-- The <i>READING</i> is within the specified upper and lower limits reduced by guard-bands equal to the 95% expanded measurement uncertainty. The probability or risk of false acceptance is very low, typically, <0.2%.
uncertain	-- The <i>READING</i> is within the specified upper and lower limits, but it is close to one of the limits by an amount that is less than the 95% expanded measurement uncertainty. The probability or risk of false acceptance is elevated.
>> FAIL <<	-- The <i>READING</i> is outside of the specified limit range.

ADDITION REPORT INFORMATION

NON-Accredited results

In order to provide our customers with a more complete picture of the unit being evaluated – AP also reports the results of some non-accredited measurements. These results are non-accredited in the sense that typically do not rely on external test standards and are closed loop in nature. In the Calibration Report these measurement self test results are highlighted and labeled *non-accredited, self test.*

For further Information

For customers that are interested in more information on the effect of guard band use in pass fail risk determination please see,

"A Guard-Band Strategy for Managing False-Accept Risk" Michael Dobbert
<http://literature.cdn.keysight.com/litweb/pdf/5991-1267EN.pdf>

"A Guard-Band Strategy for Managing False-Accept Risk' Michael Dobbert – Measure Volume 3 No 4
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