AQR: Uncertainty of Measurement – Balances

Introduction
5.4.6.2

This document lists the procedure for estimating the uncertainty and the results from those calculations for balances from the disciplines where uncertainty is reported.

Method for determining uncertainties

Refer to AQR*: Process of Estimating Uncertainty* for the process used in determining the listed uncertainties.

Refer to *AQR: Uncertainty of Measurements* for additional information on the uncertainty estimations.

Grouping

Estimated uncertainties for balances will be grouped based on the readability of the balance. This means that all balances which have the same readability (for example, all balances which read to 0.001 g) will be grouped together for the purpose of estimating the uncertainty.

The disciplines (laboratory units) that include the balance uncertainty in their uncertainty budget are the following:

- Toxicology (Blood Alcohol)
- Drug Chemistry

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Procedure
5.4.6.3

The following procedure is to be used the estimation of uncertainty for balances.

Step	Action
1	For each balance, the analyst using the balance will make 10 measurements of each calibration mass used for that balance and record their results in a log. The analyst must take 2 sets of measurements. One set of at least two measurements must be collected within one measurement session (repeatability). Another set must be collected in separate sessions (reproducibility), accounting for such variables as fluctuation in temperature, analyst fatigue, and instrument drift. NOTE: Separate sessions means measurements can be performed on the same day but at different times. It is preferred that not more than three sessions be performed on the same day. For balances used by multiple analysts, each analyst who uses the balance must perform the data collection for that instrument.
2	For each unit, the combined standard deviation of all analysts for each calibration mass for each balance type will be calculated. Example: all results for the 200 mg mass taken by all the analysts in the Chemistry Unit on their 0.0001 g readable balances are grouped together and one standard deviation is calculated. If a standard deviation is 0, the standard deviation is calculated based on the readability of the balance: Std. dev = (readability)/sqrt 3.

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Procedure (continued)
5.4.6.3

The following procedure is to be used for all subsequent estimations of uncertainty for balances.

Step	Action
3	The following are combined using the root sum squares (RSS) method: • the largest standard deviation for all of the calibration masses used for the balances in the group throughout the discipline (laboratory unit) – Example: if the standard deviation for the 200 mg mass is 0.0001 and the standard deviation for the 5 g mass is 0.0002 for the 0.0001 g readable balances, then only 0.0002 will be used in the calculation. • all other sources of uncertainty as identified in the *Uncertainty Budget*, including, but not limited to – the largest standard uncertainty for the calibration check masses used for that balance type throughout the discipline (laboratory unit) ▪ Example: the u for the 200 mg mass is 0.00004 and the u for the 5 g mass is 0.00001, then only the value for the 200 mg mass will be used in the calculation. – the largest standard uncertainty for the balances in the group ▪ Example: if balance #1 has a u of 0.0002 and balance #2 has a u of 0.0003, and balance #3 has a u of 0.0005, then only the value of balance #3 will be used in the calculation.
4	The result is expanded by the coverage factor. Refer to *AQR: Uncertainty of Measurements, Coverage factor*.
5	The values are recorded in the *Estimated uncertainties* block.

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Estimated uncertainties

5.10.3.1.c

Estimated uncertainties for balances are listed for each discipline unless otherwise noted in a particular section's procedures. The uncertainties are grouped based on balance readability. The following calculated expanded estimated uncertainties (expressed at 99.73% confidence interval with a coverage factor of **k** = 3) can be applied to measurements of mass:

- for balances readable to 1 g, U = 3 g
- for balances readable to 0.1 g, U = 0.3 g
- for balances readable to 0.001 g, U = 0.004 g
- for balances readable to 0.0001 g, U = 0.0005g

Updates

Refer to *AQR: Uncertainty of Measurements* for the scheduled updates for the uncertainty estimation.

Records

Refer to *AQR: Uncertainty of Measurements* for record keeping requirements.