**Uncertainty Evaluation Form**

*NOTES: SOP expected to be NIST OWM publications that include published uncertainty budget tables and may include alternative publications that include technically validated uncertainty budget tables. Numbers in parenthesis correspond to ISO/IEC 17025:2017.*

| Uncertainty Step and Factors from SOP 29 | Evaluation and Verification Notes | List Reviewed Objective Evidence, Note Action Items |
|---|---|---|
| Laboratory uncertainty documents | - Excel file includes good document control and records of reviews and changes (authorized changes, evaluations, approvals and dates) (8.3.2)<br>- Includes records of Software V&V. See GLP 15, Form A / Appendix A<br>- Filenames include dates and/or good date references in the files to indicate updates and reviews ("Electronic File Organization Tips")<br>- GUM and SOP adoptions are current, correct, and complete with titles and dates (7.2.1.2, 7.2.1.3)<br>- Consistent approaches are used throughout the Scope with good software design and data management concepts, especially regarding document control, linking of date, and use of updated components (7.11) | |
| 3.1 Measurement equation (Specify) | - SOP includes equations that can be used in uncertainty evaluations (7.2.2.1) – also for lab developed procedures; what are the revision dates and selected options (and are they identified in the spreadsheet)<br>- Each component in equation includes evidence of traceability and uncertainty (6.5.1)<br>- Standards used have certificates and uncertainties are up to date in the Excel file (internal calibrations) (7.6.2) | |
| 3.2 Uncertainty components identified (Identify) | - Identifies and uses appropriate analysis for each component (7.6.1)<br>- List is complete and calculations include all components based on SOP used (complies with SOP)<br>- Items considered negligible must be documented and valid<br>- Components are clearly identified (labeled, not just with variables); longer heading names, list at bottom or comments added below tables to clarify<br>- Includes up to date repeatability from control charts or repeatability data<br>- Reproducibility is reflected with check standards or suitable alternative approaches (identify how if no check standards)<br>- Includes uncertainties for standards that are correct/current and with verifiable certificates | |

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| 3.3, 3.4 Components quantified correctly (Quantify and Convert) | - Component values represent "1 sigma values" (using correct divisors for distributions where appropriate; distributions are identified in laboratory documents)<br>- Units are correctly represented (e.g., not inappropriately combining mass and temperature units in an uncertainty calculation)<br>- Values are all CURRENT – representing latest calibrations and current control chart values<br>- May use baseline approach, partial derivatives, or Kragten approach to identify individual component contributions | |
| 3.5 Calculate the Combined Uncertainty (Combine) | - All values represent the same units and are 1 sigma before combined (e.g., mass for mass, not ˚C in a mass RSS)<br>- Calculated correctly as root sum square (unless alternative equations are used for unique measurements that must be identified) | |
| 3.6 Expand combined uncertainty with appropriate *k* value (Expand) | - Control chart data or repeatability data includes suitable degrees of freedom based on statistical procedures (> 25 for confidence in uncertainties); action items identified for low degrees of freedom (minimum 7 to 12 required to start charts and larger *k* values used as needed); (evaluate control charts and note gaps in Excel file for Unc)<br>- Coverage factor, *k* value is based on degrees of freedom OR<br>- Includes Welch-Satterthwaite equation to calculate *effective d.f.* and not just d.f. in control charts (evidence) | |
| 3.7 Evaluate Uncertainty (Evaluate) | - $P_n$ assessments (suitability and compliance with decision rules)<br>o Tolerances listed are verified as current; tolerance source document is listed with revision date<br>o Correct decision rules are used, and calculations are correct<br>o $P_n$ failures have associated action items and are not being performed for current calibrations (it's nonconforming work to do with failures!)<br>- Represents the realistic uncertainty of measurements for submitted standards (7.5.1 and SOPs use "duplication of the process")<br>- Meets customer requirements and expectations (decision rules documented in contract reviews with customers?)<br>- Expanded uncertainty values are NOT less than published scope (NVLAP) or submitted values (OWM) without updating and submitting to Recognition or Accreditation bodies | |

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| 3.8 Report (Report) | - Values of units match measurement results on certificates (7.8.4.1 a); there are exceptions in mass where conventional mass corrections can be reported in mg units (even for *avoirdupois* standards)<br>- Reported values are rounded correctly in Uncertainty files and on certificates (no more than 2 significant digits)<br>- Calibration certificates include: a complete Uncertainty Statement that includes method of combining components; list of components included and components that are <u>not</u> included; *k* factor(s) used; and statement that confidence levels reported to approximately 95 %<br>- Statement includes GUM compliance (SOP 29 compliance) with full title and revision date<br>- *May include decision rules reference or statement regarding how uncertainties are used in decisions regarding conformity – could be included in conformity statement.*<br>- *NVLAP requirement: "Uncertainty was taken into account when determining conformity".* | |
| Other Observations | Uncertainties use an estimation process to quantify a value to be associated with reported measurement results. Use of statistical methods (Type A) are estimates of repeatability. Values are reported to approximately a 95 % level of confidence, which is also a statistical estimate. | |