ESTIMATION OF THE UNCERTAINTY OF MEASUREMENT FOR INSTRUMENT CALIBRATIONS

6.1. Scope

An overall estimate of the uncertainty of measurement shall be determined for Breath Alcohol instrument certifications (calibrations) for all evidentiary breath alcohol instruments used in the State of Tennessee.

The estimation of uncertainty is a representation of the confidence, or certainty, associated with a measurement.

6.2. Documentation

All calculations related to the estimation of the uncertainty of measurement for breath alcohol instrument certification shall be maintained in the Breath Alcohol Unit of the TBI Crime Laboratory where the certifying scientist is located. A reference to the estimation of the uncertainty of measurement for breath alcohol instruments shall be maintained in each instrument's folder.

Estimations of uncertainty will be updated when a significant change occurs in the budget. Uncertainty budgets should be re-evaluated on an annual basis.

6.3. Estimating the Uncertainty of Measurement

6.3.1. Uncertainty budget

- The uncertainty budget for the calibration shall include random (Type A) uncertainties.

6.3.2. Random (Type A) uncertainties

- Random (Type A) uncertainty results from measurement values being scattered in a random fashion due to laws of chance and thus has normal shaped distribution.

- Random (Type A) uncertainty is best determined by historical data of a large number of repeated measurements.

- Data from a minimum of 33% of total instruments will be used to calculate the mean, standard deviation and coefficient of variation.

  A. The data will be representative of the instrumentation that is used in the field.

  B. Multiple measurements are performed on the dry gas standard used.

  C. The results from each sample, for each standard value, will be normalized to represent non pressure adjusted target values (pressure at 760 mm Hg). This is conducted using the instrument's software.

  D. Reported sample concentration x 760 mm Hg/barometric pressure (at the time of sampling) = Normalized sample value.

  E. Normalized sample values will be used in any further calculations.

  F. The results of the normalized sample values for each standard value are averaged (mean).

- The Standard Deviation (SD) will be calculated. The SD =

$$s = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(x_i - \overline{x})^2}.$$

- The % coefficient of variation will be calculated. The % coefficient of variation (%CV) = SD/Mean x 100

- The uncertainty at the concentration used will be expressed as the target concentration +/- 99.7% confidence interval (k=3).

6.3.3. Systematic (Type B) Uncertainties

- Systematic uncertainty results from the inherent biases in measuring systems and quantitative analytical methods. These uncertainties may be reduced by optimizing the method or measuring system, but can never be completely eliminated.

- Within the Breath Alcohol section, the scope of the data used in the estimation of Type A uncertainty (control data generated by all scientists performing certifications) already encompasses the errors associated with Type B uncertainty including instruments, maintenance, and dry gas standards.

6.4. Reporting the Estimated Uncertainty of Measurement

Since the uncertainty of measurement is only an estimate. It should be truncated and reported to three (3) significant digits past the decimal.

The above results and supporting data are maintained within the Breath Alcohol Section and available upon request.