

## Measurement of uncertainty of the calibration for the Intoxilyzer® 8000 breath alcohol analyzer

Breath alcohol analysis is most prevalent in determining a subject's blood alcohol level for forensic use. This analysis is often used by law enforcement to determine if a driver is unfit to operate their vehicle on a public roadway. One complaint often brought up in conversation is that the instruments used by law enforcement "aren't that accurate" and that they are prone to "false positives" or are "reading high" and give benefit to the prosecutors and arresting institutions.



Fig. 1.

As an independent laboratory and the overseeing body of the breath alcohol program in New Mexico, this laboratory wanted to determine the accuracy and precision of the calibration for these instruments. The Intoxilyzer® 8000 is the evidential breath analyzer used in the State of New Mexico, which conforms with the National Highway Traffic Safety Administration (NHTSA) approved product list. To perform this oversight several requirements must be met such as regular quality control testing, certification and maintenance to guarantee that the results can be relied upon in criminal hearings.

All measurements have some degree of uncertainty associated with them. If you were to give a roomful of people a set of rulers and had them all measure a length of string, you will likely end up with several different measured values for that length of string. However, all those results would probably be close enough to each other that they would not be considered different enough to matter. This variation is what we call the uncertainty of a measurement. The uncertainty of any given measurement is the result of several different sources acting together to form the total uncertainty (combined standard uncertainty) of that measurement.

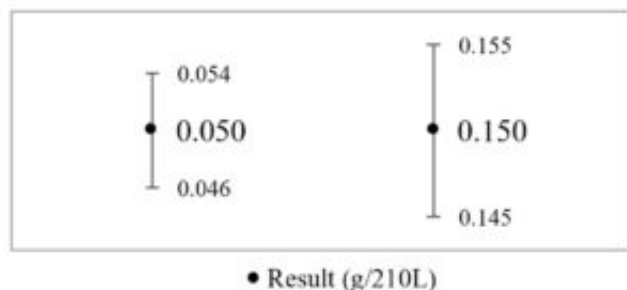


Fig. 2. Alcohol Concentration with Uncertainty Range

When the alcohol concentration is 0.05 g/210L the range will be 0.054 g/210L to 0.046 g/210L and when the concentration is 0.150 g/210L the range will be 0.155 g/210L to 0.145 g/210L.

The size (magnitude) of each of these sources will vary and contribute to the total uncertainty by root-sum-squares where the individual magnitudes are squared, added together and the square root calculated. If the magnitude of an individual source's uncertainty is small enough, it can be ignored because it will not have a significant effect on the total uncertainty. The rule of one-third can be used to decide which sources are significant and which are not. Any source's uncertainty whose magnitude is less than one-third of the largest can be considered insignificant.

The sources of uncertainty in this analysis were the gas chromatograph calibration adjustment, the gas chromatograph analytical controls, the certified reference materials, the Intoxilyzer<sup>®</sup> 8000 calibration adjustment and the Intoxilyzer<sup>®</sup> 8000 analytical. The total uncertainty from these sources was calculated, simplified and then further expressed as expanded uncertainty. This laboratory found that if the concentration of an alcohol solution measured below 0.10 g/210L then the expanded uncertainty would be reported as  $\pm 0.0036$  g/210L and if the concentration of an alcohol solution measured at or above 0.10 g/210L then the expanded uncertainty would be reported as  $\pm 3.6\%$ . For evidential purposes, the expanded uncertainty is at a 95.45% confidence level. Based upon the narrow range of the calibration measurement of uncertainty in this study, the accuracy and precision of the Intoxilyzer<sup>®</sup> 8000 is appropriate for use in forensic breath alcohol analysis.

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## Publication

[Measurement of Uncertainty for Vaporous Ethanol Concentration Analyzed by Intoxilyzer<sup>®</sup> 8000 Instruments.](#)

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