



E40 The Measurand Problem in Breath Alcohol Testing

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After attending this presentation, attendees will have a better understanding of: (1) how the law and science interact to define the measurand of a breath test; (2) where and how this interaction has created confusion, what forensic breath alcohol tests actually measure and their results mean; and, (3) what factors should be considered in the determination of the uncertainty of breath test results.

This presentation will impact the forensic science community by dispelling a source of confusion that often leads to breath alcohol test results being misinterpreted by those presenting and relying upon them. Attendees will be better able to present breath test results for what they actually represent, dispel erroneous legal challenges, and determine the uncertainty associated with breath test results. This should facilitate enactment of per se legislation that avoids the measurand problem and the establishment of a nationally standardized breath test measurand for per se legislation.

Breath alcohol testing is relied upon to measure the concentration of alcohol in breath and, indirectly, in blood. The concentration sought constitutes the “quantity intended to be measured,” referred to as the measurand.¹ The measurand of a breath test is dictated by law and varies between jurisdictions. Thus, identical numerical values obtained from tests in disparate jurisdictions may refer to different quantities and may not indicate the relevant statutory quantity. This can lead to misinterpretation of results, referred to as the “measurand problem.”

The measurand problem arises where the identity of the quantity subject to measurement and the quantity intended to be measured are distinct but not well specified. It is a common source of confusion in forensic breath alcohol testing. The origin of the measurand problem in forensic breath alcohol analysis is the fact that what constitutes an individual’s alcohol concentration for purposes of a per se DUI offense is defined by law-making authorities, not science. To illustrate the confusion, the work of both Hlastala and Gullberg will be considered.^{2,3}

Hlastala’s paradigm describes the dynamic processes that cause the concentration of alcohol in a sample of breath to continuously change as it is inhaled and exhaled. The mechanisms described determine what an individual’s Breath Alcohol Concentration (BrAC) will be. Scientifically, Hlastala’s paradigm is critical when considering the meaning and accuracy of breath alcohol test results. In the context of statutory/regulatory per se prohibitions; however, it is not science that determines the measurand of a breath test but the law. In many jurisdictions, Hlastala’s paradigm is critical when considering the meaning and accuracy of breath alcohol test results. Many jurisdictions; however, define BrAC such that it is irrelevant for these purposes. The failure of forensic and legal professionals to appreciate this leads to reliance upon Hlastala’s where it is irrelevant and its preclusion where it is relevant and critical.

As breath test programs have sought to become compliant with international standards, the uncertainty associated with breath test results has become a growing topic of discussion and confusion. Many have turned to the work done by Gullberg to help make sense in this area. Gullberg’s methodology does not apply to the results of all breath tests; however, rather, it directly applies only to results obtained in a particular type of jurisdiction, the type where Hlastala’s work is irrelevant. Gullberg’s work can be extended to other jurisdictions under certain circumstances. This requires an understanding of what it is originally intended to apply to. This understanding evades many forensic and legal professionals.

This presentation will set forth three models of distinct but representative jurisdictional types defined by the manner in which per se statutes/regulations determine the measurand of a breath test. It will be shown how these laws operate to dictate not only what is measured and what BrAC results actually indicate, but how and where both Hlastala’s and Gullberg’s work does and does not apply. This will reveal the nature and impact of the measurand problem and suggest solutions that can be adopted to address it.

References:

1. ISO. International Vocabulary of Metrology — Basic and general concepts and associated terms (VIM), § 2.3, § 2.6, Geneva, Switzerland: International Organization for Standardization, 2008.
2. Hlastala MP. Paradigm shift for the alcohol breath test. *J Forensic Sci* 2010; 55(2):451-6.
3. Gullberg, RG. Estimating the measurement uncertainty in forensic breath-alcohol analysis. *Accred Qual Assur* 2006;11(11):562-8.



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