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Strengthening Forensic Alcohol Analysis in California DUI Cases: A Prosecutor's Perspective

Christopher Boscia

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STRENGTHENING FORENSIC ALCOHOL ANALYSIS IN CALIFORNIA DUI CASES: A PROSECUTOR'S PERSPECTIVE

Christopher Boscia*

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INTRODUCTION

After a night of drinking at a campus bar, the defendant, Jaskaran Gill, began a forty-mile drive home to San Ramon.¹ He drove along Interstate 880 in a reckless fashion.² He frequently passed cars on the right at speeds exceeding 100 mph.³

Two California Highway Patrol officers used lights and sirens to stop the defendant a few miles north of San Jose.⁴ A toxicologist would later testify that the defendant's delayed reaction to the lights and sirens was consistent with impairment due to alcohol.⁵ The officers observed objective signs of intoxication, including the strong odor of alcohol from his breath, an unsteady gait, slurred speech, and red and watery eyes.⁶ The defendant performed poorly on a series of field sobriety tests and admitted to drinking before driving.⁷

After the officers arrested him on suspicion of driving under the influence, a Phlebotomist drew the defendant's blood according to standard procedures.⁸ The vials containing

1. Reporter's Transcript of Proceedings on Appeal at 499, 502, 513, *People v. Gill*, No. C1069900 (Cal. Super. Ct. Dec. 6, 2011).

2. *Id.* at 491–93.

3. *Id.*

4. *Id.* at 493–95.

5. *Id.* at 749–50, 862.

6. *Id.* at 498, 500–01.

7. *Id.* at 500, 502, 513, 517–21, 538–43.

8. *Id.* at 543, 546–50, 688–705. *See generally* CAL. VEH. CODE § 23158(a) (West 2000) (a qualified individual may draw blood for the purpose of determining alcohol content); *id.* § 23158(f) (blood shall be drawn according to the regulations of the state); CAL. CODE REGS. tit. 17, § 1219.1(a) (2013) (“Blood samples shall be collected by venipuncture from living individuals as soon as feasible after an alleged offense”); *id.* § 1219.1(b) (“Sufficient blood shall be collected to permit duplicate determinations.”); *id.* § 1219.1(c) (“Alcohol or other volatile organic disinfectant shall not be used to clean the skin where a specimen is to be collected. Aqueous benzalkonium chloride (zephiran), aqueous merthiolate or other suitable aqueous disinfectant shall be used.”); *id.* § 1219.1(d) (“Blood samples shall be collected using sterile, dry hypodermic needles and syringes, or using clean, dry vacuum type containers with sterile needles. Reusable equipment, if used, shall not be cleaned or kept in alcohol or other volatile organic solvent.”); *id.* § 1219.1(e) (“The blood sample shall be deposited into a clean, dry container which is closed with an inert stopper. (1) Alcohol or other volatile organic solvent shall not be used to clean the container. (2) The blood shall be mixed with an anticoagulant and a preservative.”).

defendant's blood were taken to the Santa Clara County Crime Laboratory where his blood was analyzed for BAC.⁹ The defendant's BAC measured .14%, almost twice the legal limit.¹⁰

While not dissimilar from many of the 200,000 driving under the influence (DUI) prosecutions in California each year,¹¹ this misdemeanor case involved a novel defense tactic.¹² If successful, this tactic could undermine every DUI prosecution in the state.¹³ The tactic involved a motion *in limine* to exclude the most important evidence in a DUI prosecution: the blood results.¹⁴ Per the defense, the reported results were scientifically invalid.¹⁵ The focus of this tactic was that the blood results are "neither reliable nor interpretable" to a jury if the measured results are not reported with an accompanying level of uncertainty.¹⁶ Further, the defense argued that the crime laboratory could not establish the traceability of its equipment and materials.¹⁷ In other words, without demonstrated

9. Reporter's Transcript of Proceedings, *supra* note 1, at 922–25.

10. *Id.* at 948. The legal limit of alcohol that can be in a person's blood while driving is .08%. CAL. VEH. CODE § 23152(b).

11. California has averaged slightly fewer than 200,000 DUI prosecutions per year since 1999. See CAL. DEPT OF ALCOHOL & DRUG PROGRAMS, FACT SHEET: DRIVING-UNDER-THE-INFLUENCE (DUI) STATISTICS 2010 (2012), available at <http://www.adp.ca.gov/factsheets/drivingundertheinfluencestatistics.pdf> (showing 2010 statistics); CAL. DEPT OF MOTOR VEHICLES, CALIFORNIA DUI FACT SHEET: 1999–2009, available at http://apps.dmv.ca.gov/about/profile/rd/DUI_Fact_Sheet_1999-2009.pdf (last visited Apr. 22, 2013) (showing 1999–2009 statistics).

12. To my knowledge and based on conversations with other county prosecutors in California, the *Gill* case was the first DUI trial in California to involve a motion to exclude BAC results from a chemical test based on a failure to report uncertainty and a lack of traceability. Moreover, the defense asserts the same. See Defendant's Motion to Suppress at 4 *Gill*, No. C1069900.

13. While blood is not drawn in every DUI, the majority of cases involve some chemical test to determine BAC. See CAL. VEH. CODE § 23612. Each of the tests utilized in California involves measurements that would be subject to an attack based on measurement uncertainty and traceability. This Article focuses solely on blood results with implications for testing in the other areas.

14. Throughout the Article, I will refer to BAC, blood results, and results interchangeably to be that percentage of alcohol by weight/volume in a person's blood that would indicate whether a person was in violation of § 23152(b) of the California Vehicle Code. See CAL. CODE REGS. tit. 17, § 1220.4 (2013).

15. Defendant's Motion to Suppress, *supra* note 12 at 4.

16. *Id.* at 3–4.

17. See *id.* at 4.

traceability, the reported result would be arbitrary.¹⁸ Without an associated uncertainty, the reported result alone would communicate a false sense of certainty to the jury. The judge did not agree with these defense arguments and did not exclude the blood results.¹⁹ Mr. Gill was convicted.²⁰ However, this novel attack raises a question about the state of forensic alcohol analysis in California.

Using the case of *People v. Gill* as a touchstone, this Article will demonstrate how California has fallen behind national and international scientific standards with regard to reporting uncertainty of measurement and the utilization of traceable materials and standards. Part I will explore measurement uncertainty and traceability both conceptually and historically. This section will conclude with a presentation of how these concepts conflict with current California law and regulation. Part II will review the significance and potential consequences of this conflict by examining cases where reported results have been challenged in California and elsewhere. Part III will propose a path forward to strengthen the reporting of measurement results in California. This can be accomplished by amending the Health and Safety Code sections governing forensic alcohol analysis and updating title 17 of the California Code of Regulations. Finally, this Article will recommend the development of a framework for ongoing review of forensic alcohol analysis in crime laboratories across the state.

I. THE CONFLICT

A. *The Concepts*

The two concepts that are the focus of the conflict are measurement uncertainty and traceability.²¹ Both concepts have a direct impact on the prosecution of DUI cases because they affect headspace gas chromatography (GC).²² GC is an

18. *Id.*

19. Ruling on Motions at 7–8, 18, *Gill*, No. C1069900.

20. Verdict of the Jury, *Gill*, No. C1069900.

21. I will use the terms measurement uncertainty and uncertainty of measurement interchangeably.

22. I will also use GC to refer to a gas chromatograph instrument as well as the process of gas chromatography.

accepted method of forensic alcohol analysis²³ that involves making numerous measurements.²⁴

1. *Headspace Gas Chromatography*

In *Gill*, forensic scientists²⁵ described how GC is used to identify and measure a defendant's BAC²⁶ to determine whether it exceeded the legal limit of .08%.²⁷ A GC is a box that looks like an oven.²⁸ Inside the GC, there is a long, coiled, wire-like tube, called a capillary column, which loops through the machine.²⁹ The column is hollow and coated inside with a stationary phase; an inert gas like helium is applied to the column.³⁰

To identify and measure a blood sample for BAC, the blood sample is heated.³¹ The vapor that arises from the sample is injected into the column.³² As the heated vapor passes through the column, the components of the vapor are separated and shoot out the end of the column into the detector at different times depending on molecular size, as long as the oven is kept at a certain temperature.³³

Retention time, or the time that elapses from injection to expulsion, determines the identity of the substance being tested.³⁴ Each substance, such as alcohol, can have a unique retention time that can be known at a specific temperature in a column of a specific length.³⁵ For example, using GC to identify whether an unknown substance is alcohol, a toxicologist will first analyze a known sample of alcohol and pass it through the GC to establish the retention time for

23. Reporter's Transcript of Proceedings, *supra* note 1, at 758.

24. See Theodore Wayne Vosk, FORENSIC METROLOGY: A PRIMER FOR LAWYERS, JUDGES AND FORENSIC SCIENTISTS 55–57 (2009), available at <http://www.cowanlawfirm.com/wp-content/themes/client/pdf/Forensic-Metrology.pdf>.

25. I will use the words toxicologist, criminalist, and forensic scientist interchangeably. I acknowledge these terms are not coequal. For the purposes of this Article, such distinctions are not important.

26. Reporter's Transcript of Proceedings, *supra* note 1, at 758–59.

27. CAL. VEH. CODE § 23152(b) (West 2000).

28. Reporter's Transcript of Proceedings, *supra* note 1, at 758–59.

29. *Id.*

30. *Id.*

31. *Id.*

32. *Id.*

33. *Id.*

34. *Id.*

35. *Id.*

alcohol which depends on the temperature and length of the particular column being used.³⁶ The toxicologist then analyzes the unknown sample, here the vapor arising from defendant's heated blood, under the same instrumental conditions.³⁷ If the retention times are the same for the known and unknown samples, then the toxicologist can identify the unknown sample as alcohol.³⁸

To measure the amount of alcohol in the defendant's blood sample, the toxicologist also uses the GC method. As the compound comes off the column, it creates ions in a flame ionization detector.³⁹ The amount of ions generated during combustion indicates to the toxicologist how much alcohol is present.⁴⁰ Peaks on the GC's chromatograms represent the amount of alcohol that was ionized.⁴¹ To determine the amount of alcohol in a sample, the GC software measures the area under the peak.⁴²

Numerous measurements are made in the GC analysis by the temperature of the oven, the length of the column, and characteristics of the known sample. According to the new scientific standards, these measurements should be performed using traceable materials and equipment.⁴³ Moreover, experts in the field of metrology, i.e., the science of measurement and its application,⁴⁴ agree that measurements, such as those performed in the GC analysis, are subject to uncertainty.⁴⁵

36. *Id.* at 957.

37. *Id.*

38. *Id.*

39. *Id.* at 759.

40. *Id.*

41. *Id.* at 961.

42. *Id.*

43. See generally JOINT COMM. FOR GUIDES IN METROLOGY (JCGM), INTERNATIONAL VOCABULARY OF METROLOGY—BASIC AND GENERAL CONCEPTS AND ASSOCIATED TERMS (VIM) § 2.41, at 29 (3d ed. 2008), available at http://www.bipm.org/utis/common/documents/jcgm/JCGM_200_2008.pdf.

44. *Id.* § 2.2, at 16.

45. Edward J. Imwinkelreid, *Forensic Metrology: The New Honesty About the Uncertainty of Measurements in Scientific Analysis 3* (UC Davis Legal Studies, Research Paper No. 317, 2012), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2186247; Jesper Kristiansen & Henning Willads Petersen, *An Uncertainty Budget for the Measurement of Ethanol in Blood by Headspace Gas Chromatography*, 28 *J. Analytical Toxicology* 456, 456 (2004).

2. *Measurement Uncertainty*

Uncertainty, as it pertains to measurements, is not the same as error.⁴⁶

The use of the term error implies that [a person] know[s] the true value of what is being measured. If the true value were known, the error rate would be the single value difference between the measurement result and this ‘true value.’ In forensic measurements, the true value is not known.⁴⁷

Uncertainty, therefore, exists because a person taking a measurement cannot identify the true value.⁴⁸ As the American Society of Crime Laboratory Directors/Laboratory Accreditation Board (ASCLD/LAB) makes clear, “[w]hat can be known is the most likely estimated value, the components that cause variability in the measurement result, and the estimated magnitude of the variability.”⁴⁹

The concept of uncertainty has been discussed in scientific circles at least since the early 1900s.⁵⁰ Over the course of the past three decades, however, the international scientific community began to develop a process of determining uncertainty.⁵¹ According to one such gathering of the international scientific community, the Joint Committee for Guides in Metrology (JCGM),⁵² uncertainty of measurement is the “parameter, associated with the result of

46. JOINT COMM. FOR GUIDES IN METROLOGY (JCGM), EVALUATION OF MEASUREMENT DATA—GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT (GUM) § 3.2.2, at 5 n.2 (2008).

47. AM. SOC’Y OF CRIME LAB. DIRS./LAB. ACCREDITATION BD. (ASCLD/LAB), ASCLD/LAB GUIDANCE ON THE ESTIMATION OF MEASUREMENT UNCERTAINTY—OVERVIEW 5 (2011). This guidance was approved August 5, 2011, effective July 1, 2012, withdrawn, and placed under review by the Board of Directors. <http://www.asclcd-lab.org/documents/AL-PD-3055.pdf>.

48. *Id.* at 5.

49. *Id.*

50. *Id.* at 4.

51. *See id.*

52. The JCGM was formed in 1997 by seven organizations, including representatives from the International Bureau of Weights and Measures (BIPM), the International Electrotechnical Commission (IEC), the International Federation of Clinical Chemistry and Laboratory Medicine (IFCC), the International Organization for Standardization (ISO), the International Union of Pure and Applied Chemistry (IUPAC), the International Union of Pure and Applied Physics (IUPAP), and the International Organization of Legal Metrology (OIML). The International Laboratory Accreditation Cooperation (ILAC) officially joined the group of seven in 2005. JCGM, *supra* note 46, at vi.

a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand.”⁵³ A measurement is the “process of experimentally obtaining one or more quantity values that can reasonably be attributed to a quantity.”⁵⁴ A measurand is a “quantity intended to be measured.”⁵⁵ The measurement result therefore, which itself is only an estimate,⁵⁶ is the “set of quantity values being attributed to a measurand together with any other available relevant information.”⁵⁷

Applying these concepts and definitions to *Gill*, the measurand was the BAC of the blood sample taken from the

53. *Id.* § 2.2.3, at 2. Measurement uncertainty is defined slightly differently in VIM as a “non-negative parameter characterizing the dispersion of the quantity values being attributed to a measurand, based on the information used.” JCGM, *supra* note 43, § 2.26, at 25.

54. JCGM, *supra* note 43, § 2.1, at 16. JCGM describes the concept more clearly in GUM:

[t]he objective of a measurement . . . is to determine the value . . . of the measurand . . . , that is, the value of the particular quantity . . . to be measured. A measurement therefore begins with an appropriate specification of the measurand, the method of measurement . . . , and the measurement procedure

JCGM, *supra* note 46, § 3.1.1, at 4.

To demonstrate how these definitions change over time, JCGM included yet another definition to measurement in its annex to the 2008 edition of the GUM, i.e., a “set of operations having the object of determining a value of a quantity.” *Id.* at 33 (Annex B.2.5). The origin of this pithy definition is the 1993 edition of VIM. *Id.* As knowledge expands, so too do definitions.

55. JCGM, *supra* note 43, § 2.3, at 17; *see also* JCGM, *supra* note 46, § 3.1.1, at 4, 34 (Annex B.2.9).

The scientists who drafted GUM delve into the epistemological when they write that concepts such as true value and error are unknowable. *See* JCGM, *supra* note 46, at 49 (Annex D). However, the words of Harvard President Drew Gilpin Faust, in her address to Boston College upon the occasion of the University’s Sesquicentennial, remind us that meaning is not derived exclusively from a measurement. In a comment on the observation that “[e]ducation is the process through which we become more fully human, and also more like God,” Faust embraced this observation in light of a world in which “the measure of things so often trumps the meaning of things.” Drew Gilpin Faust, *Scholarship and the Role of the University, Sesquicentennial Address at Boston College*, BOSTON COLL. OFFICE OF NEWS & PUB. AFFAIRS (Oct. 10, 2012), http://www.bc.edu/content/bc/offices/pubaf/news/2012-sep-oct/faust_sesquicentennial.html (internal quotation marks omitted). This Article will address measurements and their meanings.

56. JCGM, *supra* note 46, § 3.1.2, at 4; *see also* BARRY N. TAYLOR & CHRIS E. KUYATT, NIST TECHNICAL NOTE 1297: GUIDELINES FOR EVALUATING AND EXPRESSING THE UNCERTAINTY OF NIST MEASUREMENT RESULTS § 2.1, at 1 (2d ed. 1994), *available at* <http://physics.nist.gov/Pubs/guidelines/TN1297/tn1297s.pdf>.

57. JCGM, *supra* note 43, § 2.9, at 19.

defendant as soon as possible after he was arrested on suspicion of DUI. Using the GC analysis, a toxicologist made numerous measurements to identify and quantify the BAC in the defendant's blood sample.⁵⁸ The measurement result therefore is the set of quantified values being attributed to the BAC along with any other available relevant information about the sources of error⁵⁹ that could affect that measurement and its process. Among the possible sources of error that could affect the result⁶⁰ are

inadequate knowledge of the effects of environmental conditions on the measurement or imperfect measurement of environmental conditions; . . . personal bias in reading . . . instruments; . . . inexact values of measurement standards and reference materials; . . . [and] approximations and assumptions incorporated in the measurement method and procedure.⁶¹

Experts have attempted to identify sources of uncertainty in the GC process of analyzing BAC.⁶² In *Gill*, Criminalist Mark Burry identified possible sources of uncertainty in the forensic alcohol analysis process of the Santa Clara County Crime Laboratory.⁶³ Those sources include: analysis repeatability, temperature effect, humidity effect, barometric pressure effect, inter/intra-analyst variability effect, inter/intra instrument variability effect, blood matrix effect, urine matrix effect, sodium fluoride effect, potassium oxalate effect, 100 μ L Hamilton Pipettor/Dilutor syringe uncertainty, 1400 μ L Hamilton Pipettor/Dilutor syringe uncertainty, titration repeatability, temperature effect on titration, humidity effect on titration, inter/intra-analyst variation

58. Reporter's Transcript of Proceedings, *supra* note 1, at 758–59.

59. In *GUM*, “great care is taken to distinguish between the terms ‘error’ and ‘uncertainty.’ They are not synonyms, but represent completely different concepts; they should not be confused with one another or misused.” *JCGM, supra* note 46, § 3.2.2, at 5 n.2.

60. See INT’L ORG. FOR STANDARDIZATION & INT’L ELECTROTECHNICAL COMM’N (ISO/IEC), GENERAL REQUIREMENTS FOR THE COMPETENCE OF TESTING AND CALIBRATION LABORATORIES § 5.4.6.3, at 15 (2d ed. 2005).

61. *JCGM, supra* note 46, § 3.3.2, at 6.

62. See generally ISO/IEC, *supra* note 60, § 5.4.6.3, at 15; Rod G. Gulberg, *Estimating the Measurement Uncertainty in Forensic Blood Alcohol Analysis*, 36 *J. Analytical Toxicology* 153 (2012); Kristiansen & Petersen, *supra* note 45; Jason H. Sklerov & Fiona J. Couper, *Calculation and Verification of Blood Ethanol Measurement Uncertainty for Headspace Gas Chromatography*, 35 *J. Analytical Toxicology* 402 (2011).

63. Clerk's Transcript of Proceedings at 174–85, *Gill*, C1069900.

effect on titration, thermometer uncertainty, water density, balance uncertainty, 500 μ L pipet uncertainty, 5 mL buret uncertainty, 5 mL volumetric pipet, 1 L volumetric flask, potassium dichromate purity uncertainty, and ethanol purity uncertainty.⁶⁴ Everything from the uncertainty in a piece of glassware to the variability of analysis amongst analysts can be factored in as a source of uncertainty. Experts, including those at the Santa Clara County Crime Laboratory, use mathematical⁶⁵ and empirical models⁶⁶ as well as statistics⁶⁷ to quantify and understand the uncertainty that goes into the art⁶⁸ of measurement.

3. *Traceability*

A number of the sources of uncertainty cited by Mr. Burry implicate the second concept mentioned above: traceability.⁶⁹ Metrological traceability is the “property of a measurement result whereby the result can be related to a reference through a documented unbroken chain of calibrations,⁷⁰ each contributing to the measurement uncertainty.”⁷¹

To illustrate the concept, imagine you purchased an expensive, metal eighteen-inch ruler from a reputable scientific instrument supplier to measure one side of a standard piece of 8.5” by 11” paper. You place the long edge of the ruler with the hash marks and numbers flush against the side of the paper. You line up the edges neatly and observe the hash mark that corresponds to the edge of the paper. Your eye traces from the edge of the page through the

64. *Id.*

65. *See* JCGM, *supra* note 46, § 3.4.1, at 7.

66. *See id.* § 3.4.2, at 7.

67. *See id.* §3.4.1, at 7.

68. *See id.* §7.1.4, at 25.

69. “The abbreviated term ‘traceability’ is sometimes used to mean ‘metrological traceability’ as well as other concepts, such as ‘sample traceability’ or ‘document traceability’ or ‘instrument traceability’ or ‘material traceability,’ where the history (‘trace’) of an item is meant.” JCGM, *supra* note 43, § 2.41, at 30 n.8. This Article will address only metrological traceability; however, the other meanings of traceability will often be subsumed within that larger concept.

70. ILAC considers the chain of calibrations to be unbroken when it traces back to a national or international measurement standard, “a documented measurement uncertainty, a documented measurement procedure, accredited technical competence, . . . and calibration intervals.” *Id.* § 2.4.1, at 30 n.7.

71. *Id.* § 2.41, at 29.

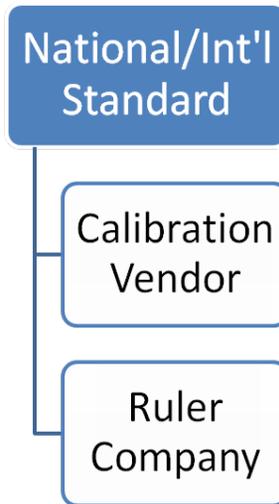
closest corresponding hash mark to the number associated with that hash mark. You see the number eleven.

Imagine further that you have been handed a second eighteen-inch ruler, this one made of cheap plastic purchased from a children's toy store, to measure the same piece of paper. You follow the same procedure of lining up the ruler flush against the paper. However, as your eye traces from page to ruler, you observe that the hash mark is closest to ten. Assume for the purposes of this illustration that the paper has been certified as 8.5" x 11," there was no user error during either measurement, and nothing about the density or length of the paper changed between measurements.

How can these conflicting results be explained? Traceability. Although both rulers indicate that they measure eighteen inches, one is slightly shorter than the other. Without knowing the true value of the measurand, i.e., the length of the paper, you could use those rulers independently and never know you were getting inaccurate results with one and accurate results with the other.

Traceability ensures that the measuring device used, e.g., a ruler, can be traced back through an unbroken chain of comparisons.⁷² In the hypothetical above, the unbroken chain of comparisons starts with the purchase of the ruler. Prior to making the measurement, the manufacturer of the ruler would certify that the ruler is actually eighteen inches. Such a certification would note that when the company measured each ruler, it used a reference (possibly a machine or another ruler) that was properly calibrated and certified by its vendor to be traceable to a national or international source. See Figure 1, an example of a documented unbroken chain of comparisons.

72. *See id.*

Figure 1

To satisfy the standard of traceability, the international scientific community requires “[a]ll equipment used for tests and/or calibrations, including equipment for subsidiary measurements (e.g. for environmental conditions) having a significant effect on the accuracy or validity of the result of the test, calibration or sampling [to] be calibrated before being put into service.”⁷³ Moreover, the international standard requires that “[t]he laboratory shall have an established programme and procedure for the calibration of its equipment.”⁷⁴ Furthermore, traceability requires documentation to demonstrate the calibration status and performance of each element of the measurement system such that if the analytical process, from the collection of the sample to the reporting of the result, were to be recreated at a different laboratory on a different date,⁷⁵ all the information necessary to reconstruct the measurement would be available to the interpreter.⁷⁶

73. ISO/IEC, *supra* note 60, § 5.6.1, at 17.

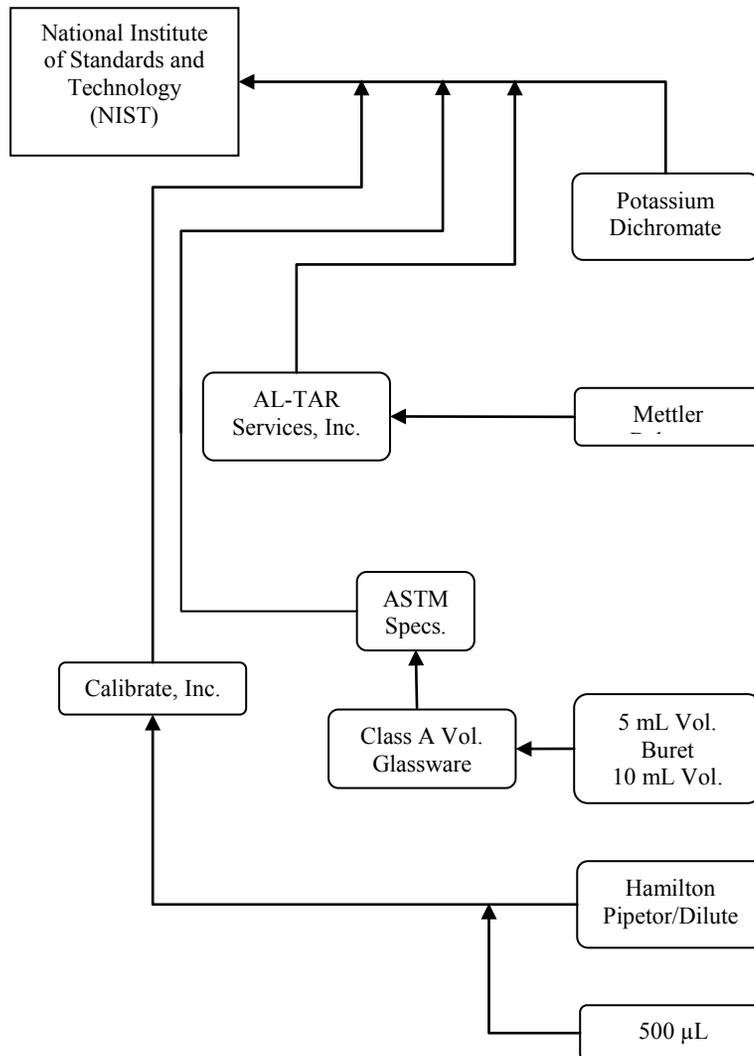
74. *Id.*

75. Reporter’s Transcript of Proceedings, *supra* note 1, at 29.

76. JCGM, *supra* note 46, § 7.1.1, at 24 (“[A]ll of the information necessary for the re-evaluation of the measurement should be available to others who may have need of it.”). In the prosecution of a DUI, the others who may need to review the lab’s procedures are defense attorneys, defense experts, and the court.

Using *Gill* as an example, Mr. Burry used reference samples of ethanol for comparison.⁷⁷ Each piece of equipment and reference material he used must also be traceable to a national or international standard. Once traceability is established, laboratory personnel will take a measurement. The Santa Clara Crime Laboratory created a flow chart to document the traceability of its standards and equipment related to forensic alcohol analysis. See Figure 2.

Figure 2



77. Reporter's Transcript of Proceedings, *supra* note 1, at 758–59.

4. *Evaluating Uncertainty*

To properly interpret the results, the process must be evaluated for uncertainty. When laboratory personnel make a measurement and observe a result, the result can be characterized in one of three ways: the indication, the uncorrected result, or the corrected result.⁷⁸ The indication is “the quantity value provided by [the] measuring instrument or [the] measuring system.”⁷⁹ For example, when you measure the paper with a ruler, the indication is the observation made by the analyst of which number corresponds most closely to the hash mark nearest the edge of the paper. The uncorrected result is the “result of a measurement before correction for systematic error.”⁸⁰ The corrected result is the “result of a measurement after correction for systematic error.”⁸¹ Error generally has two components, one random and one systematic.⁸² Random error can never be fully corrected,⁸³ but can be reduced.⁸⁴ Systematic error can be identified, evaluated, and corrected, but not eliminated completely.⁸⁵

While the correction process reduces some sources of error, there will always be uncertainty in the measurement process. That uncertainty must be assessed and evaluated. As explained in the GUM, “measuring instruments and systems are adjusted and calibrated using measurement standards and reference materials to eliminate systematic effects; however, the uncertainties associated with these standards and materials must still be taken into account.”⁸⁶ This holds true for calculating measurement uncertainty associated with the result and necessarily the whole process.⁸⁷ For example, in *Gill*, the GC process involves comparing known quantities of a substance to unknown

78. JCGM, *supra* note 46, at 34 (Annex B.2.11, n.1).

79. JCGM, *supra* note 43, § 4.1, at 37.

80. JCGM, *supra* note 46, at 34 (Annex B.2.12).

81. *Id.* at 34 (Annex B.2.13).

82. *Id.* § 3.2.1, at 5.

83. *Id.* § 3.2.2, at 5.

84. *Id.*

85. *Id.* § 3.2.3, at 5. “The exact error of a result of a measurement is, in general, unknown and unknowable.” *Id.* at 51 (Annex D.6.1).

86. *Id.* § 3.2.4, at 5 n.1.

87. *See id.* § 3.3.1, at 5.

quantities.⁸⁸ The foundation for that comparison is made using equipment such as the 5 mL volume Buret and the 1 L volumetric flask. Even when the Buret and flask are certified traceable to a national standard, uncertainty remains. Using Figure 2, there is uncertainty associated with each calibration and measurement made in the steps leading from the equipment back to the national standard. Mr. Burry combines the uncertainties at each step and includes them in his estimation of uncertainty for the measurement and therefore the whole process.

In order to evaluate the uncertainty associated with a measurement result,⁸⁹ laboratory personnel must identify the sources of uncertainty,⁹⁰ model the measurement,⁹¹ evaluate both random⁹² and systematic standard uncertainty,⁹³ determine the combined standard uncertainty⁹⁴ by considering uncorrelated⁹⁵ and correlated⁹⁶ input quantities, determine the expanded uncertainty,⁹⁷ and choose a coverage factor.⁹⁸

The GUM provides a formula of what must be done to assume that a measurement result is a reliable estimate of the value of a measurand and that “its combined standard uncertainty is a reliable measure of its *possible* error.”⁹⁹ Values must be given to the sources of error, including corrections for those recognized as systematic error.¹⁰⁰ Those sources and corrections are combined with standard uncertainties taken either from studies or from experience within the laboratory.¹⁰¹ After calculating the results, “[o]nly

88. Reporter’s Transcript of Proceedings, *supra* note 1, at 40–41.

89. A more complete and scientific explanation of the process of evaluating uncertainty of measurement, including the difference between combined standard uncertainty and expanded uncertainty, as well as the mathematical formulas underlying these concepts, can be found in the GUM. *See* VOSK, *supra* note 24.

90. *See* JCGM, *supra* note 46, § 3.3.2, at 6.

91. *See id.* § 4.1, at 8.

92. *See id.* § 4.2.1, at 10.

93. *See id.* § 4.3.1, at 11.

94. *See id.* § 5, at 18.

95. *See id.* § 5.1, at 18.

96. *See id.* § 5.2, at 21.

97. *See id.* § 6.2, at 23.

98. *See id.* § 6.3, at 24.

99. *Id.* at 51 (Annex D.6.1).

100. *See id.*

101. *Id.*

if there is a sound basis for believing that all of this has been done properly, with no significant systematic effects having been overlooked, can one assume that the measurement result is a reliable estimate of the value of the measurand.”¹⁰²

5. *Reporting Results of a Measurement with an Associated Expanded Uncertainty*

Measurement results are particularly useful when they are expressed. The expression, or reporting, of measured results is where the controversy occurs.¹⁰³ The international scientific community has set out the method for reporting results with an associated uncertainty in the GUM.¹⁰⁴ According to the GUM, when an individual reports the result of a measurement and accompanies that report with an expanded uncertainty, the individual should “give a full description of how the measurand . . . is defined,” state the result of the measurement as a mathematical formula, include the relative expanded uncertainty where appropriate, and give a confidence level for the result.¹⁰⁵

In Santa Clara County, prior to *Gill*, the laboratory reported BAC measurement results as a single value, as required by law.¹⁰⁶ However, after *Gill*, the laboratory began reporting measurements accompanied by a statement of uncertainty according to GUM and ISO/IEC 17025. See Figure 3. Using the example in Figure 3, a toxicologist would testify that the individual’s BAC measured 0.31% and that this result was subject to an estimated uncertainty of +/- 4% of the untruncated result,¹⁰⁷ using a confidence level of 99.7%.

102. *Id.*

103. See Vosk, *supra* note 24; Imwinkelreid, *supra* note 45; see also COMM. ON IDENTIFYING THE NEEDS OF THE FORENSIC SCIS. CMTY., NAT’L RESEARCH COUNCIL, STRENGTHENING FORENSIC SCIENCE IN THE UNITED STATES: A PATH FORWARD 185–86 (2009).

104. See JCGM, *supra* note 46, § 0.1, at viii.

105. *Id.* § 7.2.3, at 26.

106. See CAL. CODE REGS. tit. 17, § 1220.4 (2013). I characterize the reporting of a single digit value as by law because title 17 clearly defines how measurement results are to be expressed, including the number of decimal places and the symbols to be used. *Id.* Title 17 is a regulation, not a law. Moreover, title 17 does not require uncertainty to be reported. In the absence of inclusion by the Legislature or a regulatory body, one must infer exclusion. See *expressio unius est exclusio alterius*, i.e., “the expression of one thing is the exclusion of another.” *People v. DeGuzman*, 6 Cal. Rptr. 3d 739, 743 (2003).

107. When BAC is measured using the GC process, the result is expressed to three decimal points. Reporter’s Transcript of Proceedings, *supra* note 1, at

Figure 3

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JLQC          V08          QUERY LAB CASE          08/25/2011 07:55 PAGE: 01
CASE: ██████ OFCN: ██████ CASE TYPE: TOX          INCIDENT DT: 08/17/2011
LAST NAME ██████ FIRST NAME ██████ MIDDLE NAME ██████ CEN ██████ ARREST DT/TM
████████████████████ 08/17/2011 14:40
SUBMIT AGY/OFCR: 04300 FOREST          TECH: VU
RECEIVED BY: LAM          RECEIVED DATE: 08/18/2011
OFFENSES: 23152 VC
REMRK: 23152 B VC CHARGE

TOXICOLOGY REQUESTS
BARCODE TEST TYPE          EVIDENCE TYPE          SAMPLE AMT
AS1106755 BA          BLOOD          7.5 ML
BS1106755 NONE          BLOOD          2 ML

TOXICOLOGY RESULTS
RESULT TYPE: BA          REPORTED: 0.31%
EVIDENCE TYPE: BLOOD          SAMPLE AMT: 7.5 ML
ANALYSIS DATE: 08/19/2011          ANALYST: DESAI
TEST GROUP: BLOOD ALCOHOL ANALYSIS (GC) BARCODE: AS1106755
ALC ENTRY DATE: 08/22/2011
THE REPORTED BLOOD ALCOHOL VALUE IS SUBJECT TO AN ESTIMATED
UNCERTAINTY OF MEASUREMENT OF +/- 4% OF THE UN-TRUNCATED RESULT,
USING A CONFIDENCE LEVEL OF 99.7%

*** END OF LIST ***

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According to the GUM method, after taking into account the numerous sources of systematic and random error in the process and correcting for some error, the Santa Clara County Crime Laboratory toxicologist could reasonably testify with 99.7% confidence that the defendant's BAC (the measurand) falls somewhere in the parameter between $\pm 4\%$ of 0.31%.¹⁰⁸ To increase confidence in the result, the criminalist who measured the result would expand the parameter. For a narrower parameter of possible results, the criminalist could contract the parameter. The expansion or contraction of the parameter becomes especially important when measured results are close to the limit value of .08% BAC. However, the value of the associated uncertainty becomes less important or not important at all the farther the measured result is from the limit value.

768. For purposes of estimating uncertainty, the Santa Clara County crime laboratory uses the untruncated result, i.e., the result measured to three decimal places. See *infra* Figure 3. In practice, the third digit is eliminated (or rounded down to the defendant's benefit) and the two-digit report conforms to the requirements of California law. See REGS. tit. 17, § 1220.4(b).

108. In other words, if the defendant's blood were sampled 1000 times, 997 of those sample sets would have the true value included within $\pm 4\%$ of the mean of the sample set.

In the past, courts required that experts present measurement results as certainties.¹⁰⁹ In light of the reality of uncertainty in measurement results, the courts dispensed with this requirement¹¹⁰ and prohibited experts from reporting results as certainties.¹¹¹ A new trend is emerging where courts are requiring experts to testify to uncertainty.¹¹²

In practice, this seems to be both unnecessary and unwarranted. GUM allows leeway to omit reporting uncertainty when it is not a required specification of the measurement. The GUM method acknowledges that numerous measurements are provided every day in industry and commerce without any mention of uncertainty.¹¹³ Those measurements may be performed “with instruments subject to periodic calibration or legal inspection.”¹¹⁴ Uncertainty itself can be inferred by reference to the laws that govern those inspections or the accreditation that requires periodic calibration.¹¹⁵ Therefore, if the law or accreditation process were to require periodic inspection and calibration of the instruments used in forensic alcohol analysis, a criminalist may not need to report a result with an associated uncertainty.

The GUM method gives primacy in determining uncertainty and the need to express it to the individual laboratory personnel who take measurements. GUM

provides a framework for assessing uncertainty, [but] it cannot substitute for critical thinking, intellectual honesty and professional skill. The evaluation of uncertainty is neither a routine task nor a purely mathematical one; it depends on detailed knowledge of the nature of the measurand and of the measurement. The quality and utility of the uncertainty quoted for the result of a measurement therefore ultimately depend on the understanding, critical analysis, and integrity of those who contribute to the assignment of its value.¹¹⁶

109. Imwinkelreid, *supra* note 45, at 7–9.

110. *Id.* at 9–15.

111. *Id.* at 15–18.

112. *Id.* at 19–24.

113. JCGM, *supra* note 46, § 7.1.3, at 25.

114. *Id.*

115. *Id.*

116. *Id.* § 3.4.8, at 8.

According to the experts assembled by JCGM, reporting measurement results with an associated uncertainty is certainly a best practice. The question remains; however, whether forensic alcohol analysis in California, which is governed by a combination of regulation¹¹⁷ and accreditation, requires the reporting of measurement results with an accompanying uncertainty. This is the crux of the novel defense tactic.

B. The History and Development of the National and International Standards Related to Measurement Uncertainty and Traceability

The historical development of measurement uncertainty and traceability is critical for understanding whether or not California law and regulations currently require the implementation of the new standards. This section of Part I will address the historical development of the concepts of measurement uncertainty and traceability, and how those concepts affect forensic alcohol analysis and reporting. Furthermore, this section will explore the response of the national forensic science community and a blue-ribbon panel of experts in California.

1. International and National Scientific Bodies Build Consensus Over the Course of Thirty Years

The concept of uncertainty is a divergence from the older and unknowable concepts of *true* value and error.¹¹⁸ Although error and error analysis have long been a part of measurements, “[t]he concept of uncertainty as a quantifiable attribute is relatively new in the history of measurement.”¹¹⁹

The modern understanding of how uncertainty affects measurements began in earnest within the last thirty-five years. The history is set out in the Foreword to GUM:

[i]n 1977, recognizing the lack of international consensus on the expression of uncertainty in measurement, the world’s highest authority in metrology, the Comité International des Poids et Mesures (CIPM), requested the Bureau International des Poids et Mesures (BIPM) to

117. CAL. CODE REGS. tit. 17, §§ 1215–22 (2013).

118. JCGM, *supra* note 46, at 59 (Annex E.5.1).

119. *Id.* § 0.2, at viii (emphasis omitted).

address the problem in conjunction with the national standards laboratories and to make a recommendation.¹²⁰

BIPM prepared a questionnaire sent out to a number of interested laboratories and received responses from twenty-one laboratories by 1979.¹²¹ Almost all those laboratories “believed that it was important to arrive at an internationally accepted procedure for expressing measurement uncertainty and for combining individual uncertainty components into a single total uncertainty.”¹²² However, consensus did not emerge about the method for calculating uncertainty.¹²³

To help build consensus on calculating uncertainty, BIPM convened a working group of experts who developed INC-1 (1980), *Expression of Experimental Uncertainties*.¹²⁴ This statement outlined the general characteristics of uncertainty rather than detailing the precise demands for measurements in various fields such as business and industry.¹²⁵ CIPM approved INC-1 in 1981 and reaffirmed it in 1986.¹²⁶

As consensus developed about the general characteristics of uncertainty, the international scientific community published a document that would define key terms used in any discussion of uncertainty. In 1984,¹²⁷ ISO published the first edition of the *International Vocabulary of Basic and General Terms in Metrology* (VIM), a document that would introduce basic vocabulary and terms of metrology to scientists who use measurements.¹²⁸

In 1985,¹²⁹ CIPM asked ISO to establish a working group to “develop a guidance document based upon the recommendation of the BIPM Working Group on the Statement of Uncertainties,” e.g., INC-1.¹³⁰ The guidance document was designed to “provide[] rules on the expression of measurement uncertainty for use within standardization,

120. *Id.* at vi.

121. *Id.*

122. *Id.*

123. *Id.*

124. *Id.*

125. *Id.*

126. *Id.*

127. *Id.* at 114 (bibliog. [6], n.3).

128. See JCGM, *supra* note 43, § 0.1, at vii.

129. TAYLOR & KUYATT, *supra* note 56, § 1.2, at 1.

130. JCGM, *supra* note 46, at vi.

calibration, laboratory accreditation, and metrology services,” and “to promote full information on how uncertainty statements are arrived at” and “provide a basis for the international comparison of measurement results.”¹³¹ The guidance document became the Guide to the Expression of Uncertainty in Measurement (GUM).¹³²

In the United States, one body addressed this emerging international consensus. The National Institute of Standards and Technology (NIST), a branch of the United States Department of Commerce, Technology Administration,¹³³ issued a new policy on expressing measurement uncertainty in 1992,¹³⁴ “based on the approach to expressing uncertainty in measurement recommended by the CIPM in 1981 . . . and the elaboration of [the] approach” in the GUM.¹³⁵ After the publication of a technical note on the topic, NIST issued a second edition of its policy in 1994 to address questions raised by scientists concerning uncertainty in measurement.¹³⁶

At the same time NIST was publishing national standards on measurement uncertainty, the international scientific community published the second edition of VIM in 1993 to “cover measurements in chemistry and laboratory medicine for the first time, as well as to incorporate concepts such as those that relate to metrological traceability, measurement uncertainty, and nominal properties.”¹³⁷

“In 1997 the [JCGM], chaired by the Director of the BIPM, was formed by the seven [o]rganizations that had prepared the original versions of the [GUM] and the [VIM].”¹³⁸ The JCGM was formed to “develop and maintain, at the international level, guidance documents addressing the general metrological needs of science and technology, and to consider arrangements for their dissemination.”¹³⁹ JCGM has particular responsibility for updating GUM and VIM.¹⁴⁰

131. *Id.*

132. *See id.* § 1.1, at 1.

133. *See* TAYLOR & KUYATT, *supra* note 56.

134. *Id.* § 1.1, at 1.

135. *Id.* § 1.2, at 1 (footnote omitted).

136. *Id.* at iii.

137. JCGM, *supra* note 43, § 0.1, at vii.

138. *Id.* at v.

139. *Charter*, JOINT COMM. FOR GUIDES IN METROLOGY (JCGM), <http://www.iso.org/sites/JCGM/JCGM-charter.htm> (last updated Dec. 10, 2009).

140. *Id.*

To harmonize standards and procedures of laboratories across boundaries, two international standards organizations teamed up to produce guidance documents specifically targeted to help labs demonstrate competence. In 1999, ISO and IEC, the bodies that “form the specialized system for worldwide standardization,”¹⁴¹ published the first edition of *ISO/IEC 17025, General Requirements for the Competence of Testing and Calibration Laboratories*.¹⁴² The first edition “contained all of the requirements that testing and calibration laboratories have to meet if they wish to demonstrate that they operate a management system, are technically competent, and are able to generate technically valid results.”¹⁴³

In 2005, ISO/IEC published its second edition of ISO/IEC 17025, which “cancels and replaces the first edition.”¹⁴⁴ The 2005 edition encouraged national accreditation bodies to use the 17025 standard as a basis for accrediting laboratories that do testing and calibration.¹⁴⁵ The 2005 edition included sections on estimation of uncertainty of measurement¹⁴⁶ and traceability.¹⁴⁷

The International Laboratory Accreditation Cooperation (ILAC) became an organization that could hold national accreditation bodies accountable to these newly harmonized international standards. ILAC began in 1977 “with the aim of developing international cooperation for facilitating trade by promotion of the acceptance of accredited test and calibration results.”¹⁴⁸ In 1996, ILAC’s charter was created to “establish a network of mutual recognition agreements among accreditation bodies” that would further its goal of promoting the acceptance of accredited test and calibration results such as ISO/IEC 17025.¹⁴⁹ As far as the implementation of the ISO/IEC 17025 standard was concerned, ILAC “set a transition period of two years from date of publication of the

141. ISO/IEC, *supra* note 60, at v.

142. *See id.*

143. *Id.* at vi.

144. *Id.* at v.

145. *Id.* at vi.

146. *Id.* § 5.4.6, at 14.

147. *Id.* § 5.6, at 17.

148. *About ILAC*, INT’L LAB. ACCREDITATION COOPERATION, <https://www.ilac.org/aboutilac.html> (last visited Apr. 24, 2013).

149. *Id.*; *see also* Reporter’s Transcript of Proceedings, *supra* note 1, at 96.

new edition—May 12, 2005—for accredited laboratories to comply with the standard’s requirements.”¹⁵⁰

In 2004, a JCGM working group submitted a first draft of a third edition of VIM to the eight organizations that made up JCGM.¹⁵¹ A final draft of the third edition was submitted to the eight JCGM organizations in 2006.¹⁵² JCGM published the third edition in 2008.¹⁵³

While the international conversation on measurement uncertainty developed over the course of thirty years, the inclusion of the forensic science community in that conversation occurred considerably later. In the introduction to the third edition of VIM, published in 2008, the authors wrote:

it is taken for granted that there is no fundamental difference in the basic principles of measurement in physics, chemistry, laboratory medicine, biology or engineering. Furthermore, an attempt has been made [presumably through this new edition of VIM] to meet conceptual needs of measurement in fields such as biochemistry, food science, *forensic science*, and molecular biology.¹⁵⁴

2. *How the International and National Standards Affect Forensic Alcohol Analysis and the Reporting of BAC Results*

Certainly ILAC expected accredited laboratories to comply with the ISO/IEC 17025 standard by 2007. However the application of this standard to the forensic science community was still developing as late as 2008. Neither the most recent version of ISO/IEC 17025 nor VIM indicates whether forensic science laboratories were expected to have adopted the new standards to demonstrate competence. As noted, ISO/IEC 17025 “contained all of the requirements that testing and calibration laboratories have to meet if they wish to demonstrate that they operate a management system, are

150. Roger Frost, *New Edition of Influential ISO/IEC Standard on Competence of Laboratories*, ISO MGMT. SYSS. 33, 34 (July–Aug. 2005), available at www.iso.org/iso/livelinkgetfile-isocs?nodeId=15015492.

151. JCGM, *supra* note 43, at v. For a list of those organizations, see *supra* note 52.

152. JCGM, *supra* note 43, at v.

153. *See id.* at i–ii.

154. *Id.* § 0.1, at vii (emphasis added).

technically competent, and are able to generate technically valid results.”¹⁵⁵ However, as the introduction to the third edition of VIM observed in 2008, the international scientific community was still *attempting* to meet the conceptual needs of the forensic science community.¹⁵⁶

Whether required or not, the ISO/IEC 17025 standard does affect forensic alcohol analysis in significant ways. For example, ISO/IEC 17025 requires document control,¹⁵⁷ i.e., the ability to establish and maintain procedures that can control all documents that would aid in recreating the measurement process.¹⁵⁸ This degree of control over the process is not currently required under California law or title 17. For the GC process, such documentation would include the traceability of each piece of equipment and reference standard as well as any records made during the measurement process itself. ISO/IEC 17025 also governs whether and how labs should subcontract portions of their testing and calibration.¹⁵⁹ The Santa Clara County Crime Lab purchases potassium dichromate that is used to quantitate the known reference sample of ethanol to compare to the measurand.¹⁶⁰ ISO/IEC 17025 standards are clear that each subcontractor, such as the vendor that provides potassium dichromate, must also provide certification of traceability to a national or international standard.¹⁶¹ Simply buying potassium dichromate is not enough; to be ISO/IEC 17025 compliant vendors must provide paperwork certifying each batch of the substance.

Thanks to recent efforts by the international scientific community, the forensic science community (and within that community the forensic alcohol analysis community) will eventually adopt the requirements of ISO/IEC 17025. While traceability and estimation of uncertainty are required in ISO/IEC 17025,¹⁶² the standard itself is flexible. When reporting the results of a measurement, a test report shall,

155. ISO/IEC, *supra* note 60, at vi.

156. See JCGM, *supra* note 43, § 0.1, at vii.

157. ISO/IEC, *supra* note 60, § 4.3.1, at 4.

158. See JCGM, *supra* note 46, § 7.1.1, at 24.

159. ISO/IEC, *supra* note 60, § 4.5, at 6.

160. Reporter's Transcript of Proceedings, *supra* note 1, at 42.

161. See ISO/IEC, *supra* note 60, § 4.5.1, at 6.

162. *Id.* § 5.4.6, at 14, § 5.6, at 17.

“where necessary for the interpretation of the test results,”¹⁶³ include “where applicable, a statement on the estimated uncertainty of measurement.”¹⁶⁴ The qualifiers “where necessary for the interpretation of the test result” and “where applicable” do not indicate a rigid scientific ideology about measurements, such as when courts required experts to testify to the certainty of their results, but rather an expansive and open policy befitting the uncertainty encountered in the art of measurement.

3. *The Forensic Science Community in the United States and California—ASCLD/LAB, the National Academy of Science, and the California Commission on the Fair Administration of Justice*

In the United States, the American Society of Crime Laboratory Directors/Laboratory Accreditation Board (ASCLD/LAB) has been primarily responsible for forensic laboratory accreditation.¹⁶⁵ ASCLD/LAB “offers voluntary accreditation to public and private crime laboratories in the United States and around the world. Accreditation is offered in the forensic disciplines for which services are generally provided by forensic laboratories.”¹⁶⁶ ASCLD/LAB provides accreditation services to almost all the laboratories in California that provide forensic analysis in criminal cases.¹⁶⁷ For example, the Santa Clara County Crime Laboratory is accredited for forensic alcohol analysis by ASCLD/LAB.¹⁶⁸

The laboratory accreditation component of this organization was created in 1981 as “a committee of its mother organization,” ASCLD.¹⁶⁹ “In 1984, ASCLD/LAB became a separate corporate entity with its own Board of

163. *Id.* § 5.10.3.1, at 21.

164. *Id.* § 5.10.3.1(c), at 21.

165. See COMM. ON IDENTIFYING THE NEEDS OF THE FORENSIC SCIS. CMTY., *supra* note 103, at 197.

166. *Welcome...*, AM. SOC'Y OF CRIME LAB. DIRS./LAB. ACCREDITATION BD. (ASCLD/LAB), <http://www.ascl-d-lab.org/> (last visited Apr. 24, 2013).

167. See CAL. COMM'N ON THE FAIR ADMIN. OF JUSTICE, REPORT AND RECOMMENDATIONS REGARDING FORENSIC SCIENCE EVIDENCE 5 (2007), available at http://ag.ca.gov/meetings/tf/pdf/ccfaj_science.pdf.

168. *Certificate Number: ALI-207-T*, AM. SOC'Y OF CRIME LAB. DIRS./LAB. ACCREDITATION BD. (ASCLD/LAB), <http://www.ascl-d-lab.org/cert/ALI-207-T.html> (last visited Apr. 24, 2013).

169. *Welcome...*, *supra* note 166.

Directors that is elected by a Delegate Assembly composed of the directors of accredited laboratories and laboratory systems.”¹⁷⁰

ASCLD/LAB operates in conjunction with the international scientific community to ensure that domestic laboratories are meeting the newest standards and expectations,¹⁷¹ particularly on the topic of measurement uncertainty and traceability. ASCLD/LAB is a signatory to ILAC’s Mutual Recognition Agreement (MRA).¹⁷² By becoming a signatory, ASCLD/LAB agreed to ILAC’s requirement to implement ISO/IEC standards in its accreditation process in the United States.¹⁷³ This requirement includes the need to report results with uncertainty and to use traceable standards and equipment.¹⁷⁴

Seven months after ASCLD/LAB embraced the ISO/IEC 17025 standard by signing the MRA with ILAC, the National Academy of Sciences (NAS) issued a critique of the way forensic scientists were handling uncertainty of measurement in the United States.¹⁷⁵ The report, published in November 2009,¹⁷⁶ opined that “[f]ew forensic science methods ha[d] developed adequate measures of the accuracy of inferences made by forensic scientists.”¹⁷⁷

Echoing the international standards set down by GUM and ISO/IEC 17025, the NAS report declared: “[a]ll results for every forensic science method should indicate the uncertainty in the measurements that are made.”¹⁷⁸ However, while little reported, NAS qualified its declaration about report requirements when it said the reports “should describe, at a minimum, methods and materials, procedures, results, and conclusions, and they should identify, *as appropriate*, the sources of uncertainty in the procedures and conclusions along with estimates of their scale (to indicate the level of

170. *Id.*

171. *See id.*

172. *Id.*; *see also* Reporter’s Transcript of Proceedings, *supra* note 1, at 99, ..

173. *Id.* at 100.

174. *See generally* COMM. ON IDENTIFYING THE NEEDS OF THE FORENSIC SCIS. CMTY., *supra* note 103.

175. *Id.*

176. Reporter’s Transcript of Proceedings, *supra* note 1, at 95.

177. COMM. ON IDENTIFYING THE NEEDS OF THE FORENSIC SCIS. CMTY., *supra* note 103, at 184.

178. *Id.* at 184.

confidence in the results).¹⁷⁹ The NAS report did not list examples of when it would not be appropriate to report sources of uncertainty in forensic science.

Shortly after the U.S. Congress authorized the NAS to begin drafting its report,¹⁸⁰ a blue-ribbon commission of experts from the criminal justice system began a review of the accreditation of forensic science labs in California.¹⁸¹ In 2006, former Attorney General John Van de Kamp chaired the California Commission on the Fair Administration of Justice (CCFAJ).¹⁸² CCFAJ was charged by the California State Senate “to study and review the administration of criminal justice in California, determine the extent to which that process has failed in the past, examine safeguards and improvements, and recommend proposals to further ensure that the administration of justice in California is just, fair and accurate.”¹⁸³ CCFAJ convened a public hearing on the topic of forensic science evidence and heard testimony from Innocence Project Co-Director, Peter Neufeld; former Director of the Los Angeles County Sheriff Crime Laboratory, Barry Fisher; Chief of the Bureau of Forensic Services for the California Department of Justice, Lance Gima; and a host of other experts in the field of forensic science.¹⁸⁴

CCFAJ found that by 2007, the state of accreditation for crime labs in California was commendable.¹⁸⁵ As its report on the topic explained, to obtain accreditation from ASCLD/LAB, “a laboratory must demonstrate that its management, operations, personnel, procedures, equipment, facility, security, and health and safety procedures meet established

179. *Id.* at 186 (emphasis added).

180. *Id.* at 1.

181. See generally *Membership*, CAL. COMM’N ON THE FAIR ADMIN. OF JUSTICE, <http://www.ccfaj.org/membership.html> (last visited Apr. 24, 2013) (listing individuals that served on the California Commission on the Fair Administration of Justice).

182. *Membership: John K Van De Kamp*, CAL. COMM’N ON THE FAIR ADMIN. OF JUSTICE, <http://www.ccfaj.org/m-JohnVanDeKamp.html> (last visited Apr. 24, 2013).

183. CAL. COMM’N ON THE FAIR ADMIN. OF JUSTICE, *supra* note 167, at 1 (internal quotation marks omitted); see also *Charge*, CAL. COMM’N ON THE FAIR ADMIN. OF JUSTICE, <http://www.ccfaj.org/charge.html> (last visited Apr. 24, 2013).

184. CAL. COMM’N ON THE FAIR ADMIN. OF JUSTICE, *supra* note 167, at 1.

185. See *id.* at 5.

standards.”¹⁸⁶ Accredited laboratories are also required “to implement proficiency testing, continuing education, and other programs that improve the overall skills and services of laboratory personnel.”¹⁸⁷ The commission concluded, “further action to achieve accreditation of California publicly funded crime labs [was] not necessary.”¹⁸⁸ While the CCFAJ did not opine specifically about forensic alcohol analysis and whether measurement uncertainty and traceability were required, the Commission did indicate that forensic labs were doing what they could to stay current with established standards. As late as 2007, therefore, the issue of measurement uncertainty and traceability was not being considered or discussed by policymakers in California.

C. The Current State of California Law and Practice Regarding Measurement Uncertainty and Traceability

Today, almost all of the forensic science laboratories that provide measurement results for the criminal justice system in California are accredited by ASCLD/LAB.¹⁸⁹ However, the requirements of the accreditation process are different from the requirements of the law. In California, the Health and Safety Code (Health & Safety Code)¹⁹⁰ and title 17 of the California Code of Regulations (title 17) govern forensic alcohol analysis.¹⁹¹ These statutes and regulations are woefully inadequate to keep up with developing standards of the national and international scientific community regarding measurement uncertainty and traceability.

The Health & Safety Code rules regarding forensic alcohol analysis are a regulatory patchwork. The Legislature vested authority for ensuring compliance in the field of forensic alcohol analysis to title 17, “until the time when those regulations are revised.”¹⁹² However in the same chapter, the Legislature separated out proficiency testing and awarded that responsibility to ASCLD/LAB.¹⁹³ This act

186. *Id.*

187. *Id.*

188. *Id.*

189. *See id.*

190. CAL. HEALTH & SAFETY CODE §§ 100700–03 (West 2006).

191. CAL. CODE REGS. tit. 17, §§ 1215–22 (2013).

192. CAL. HEALTH & SAFETY CODE § 100700 (West 2006).

193. *Id.* §100702.

abrogated the effect of regular inspections by the Department of Public Health mandated by title 17.¹⁹⁴ In an odd twist, the Legislature maintained the authority of the Department of Public Health to enforce the Health and Safety Code sections pertaining to forensic alcohol analysis, as well as title 17's requirements of laboratories.¹⁹⁵ Finally, the Legislature ordered the Department of Public Health to establish a forensic alcohol review committee (FARC) on or before July 1, 2005.¹⁹⁶ The FARC was created to evaluate title 17 and to "determine revisions that will limit . . . regulations to those that [FARC] determines are reasonably necessary to ensure the competence of laboratories and employees to prepare, analyze, and report the results of the tests and comply with applicable laws."¹⁹⁷ In the seven years since the FARC has been meeting, title 17 has not been amended.¹⁹⁸ It remains untouched since 1986.¹⁹⁹

Title 17 is silent regarding traceability and measurement uncertainty. It is unlikely that in 1986 legislators or regulators could have anticipated such concepts. While a consensus on calculating uncertainty had formed through a BIPM working group in 1980,²⁰⁰ it would be six years before the publication of GUM and another thirteen years before the publication of ISO/IEC 17025 in 1999.²⁰¹ Moreover, the international scientific community did not begin to reach out in earnest to the forensic science community to translate its new concepts until the third revision of VIM in 2008.²⁰²

The jury instructions and case law on DUI provide a disincentive for laboratories to calculate and report uncertainty. In *Gill*, the People of the State of California charged the defendant with a violation of section 23152(a) of the California Vehicle Code (driving under the influence of alcohol), a violation of section 23152(b) (driving with a BAC of

194. See REGS. tit. 17, § 1217.7.

195. CAL. HEALTH & SAFETY CODE § 100725 (West 2006).

196. See *id.* § 100703.

197. *Id.* § 100703(d).

198. See Letter from Jennifer Shen, FAR Comm. CACLD Representative, to Kimberly Belshe, Sec'y of Cal. Health & Human Servs. (Apr. 21, 2010), available at <http://www.cdph.ca.gov/services/boards/farc/Documents/FARC-Letter-from-FAR-Committee-to-HHSA-2010-0421.pdf>.

199. See *id.*

200. JCGM, *supra* note 46, at vi.

201. ISO/IEC, *supra* note 60, at vi.

202. See JCGM, *supra* note 43, § 0.1, at vii.

.08% or greater), an enhancement under section 23582 (reckless driving at least thirty or more miles over the posted speed limit), and an enhancement under section 23540 (enhanced punishment for second DUI offense within ten years).²⁰³ After the close of evidence, the judge instructed the jury.²⁰⁴ The Judicial Council of California provides instructions for the jury, called CALCRIM, that correspond to the defendant's charges.²⁰⁵ CALCRIM 2110 corresponds to section 23512(a)²⁰⁶ and CALCRIM 2111 corresponds to section 23152(b).²⁰⁷

In both CALCRIM 2110 and 2111, there is a presumption that the jurors may lend more weight to the measurement results if the person who tested the blood sample or the agency that maintained the testing device followed the regulations of title 17.²⁰⁸ The regulations of title 17, however, are silent on uncertainty of measurement and traceability but give great detail as to the maintenance of the instruments used for testing and the expression of the result.²⁰⁹ The failure of the Legislature or regulators to include language about uncertainty or traceability can only be viewed as a deliberate decision to exclude such concepts.²¹⁰

Here lies the conflict. The international and national scientific community requires the use of traceable materials and equipment, as well as the reporting of measurement results with an accompanying estimate of uncertainty.²¹¹ The national accrediting body (ASCLD/LAB) that accredits California's crime laboratories embraced these concepts when it signed the MRA with ILAC in 2009. However, ASCLD/LAB

203. Reporter's Transcript of Proceedings, *supra* note 1, at 457–58.

204. *Id.* at 1233–47.

205. See JUDICIAL COUNCIL OF CAL., JUDICIAL COUNCIL OF CALIFORNIA CRIMINAL JURY INSTRUCTIONS (CALCRIM), at iii (2013), available at http://www.courts.ca.gov/partners/documents/calcrim_juryins.pdf.

206. *Id.* at liii.

207. *Id.*

208. "In evaluating any test results in this case, you may consider whether or not the person administering the test or the agency maintaining the testing device followed the regulations of the California Department of Health Services." *Id.* at 116, 132.

209. See CAL. CODE REGS. tit. 17, §§ 1215–22 (2013).

210. See *People v. DeGuzman*, 6 Cal. Rptr. 3d 739, 743 (Ct. App. 2003) (defining *expressio unius est exclusio alterius* as "the expression of one thing is the exclusion of another").

211. See ISO/IEC, *supra* note 60, § 5.4.6, at 14, § 5.6, at 17.

only recently published official guidance for the labs in its accreditation program to implement measurement uncertainty and traceability.²¹² As of the publication of this Article, only a handful of laboratories in California are reporting results with an associated uncertainty²¹³ or are using traceable equipment and materials in conformity to the ISO/IEC 17025 standard. Now that ASCLD/LAB has published its guidance and will require conformity to ISO/IEC 17025 for accreditation purposes, California labs will be in the difficult position of maintaining the status quo to preserve the presumption from CALCRIM or complying with the voluntary accreditation of ASCLD/LAB by implementing traceability and uncertainty of measurement.

The Santa Clara County Crime Laboratory has chosen to forgo the benefit of the presumption and implement traceability and measurement uncertainty. In other words, we want to do the best science regardless of what the law requires. The law and regulations governing forensic alcohol analysis should be updated as soon as possible so that prosecutors and crime laboratories across California are not punished with the loss of a favorable presumption for implementing best practices.

212. See *ASCLD/LAB—International—Program Applications, Guidance & Board Interpretations*, AM. SOC'Y OF CRIME LAB. DIRS./LAB. ACCREDITATION BD. (ASCLD/LAB), http://www.ascl-d-lab.org/interpretations/applicationsintl_2011.html (last visited Apr. 24, 2013). Note that policies on measurement uncertainty and traceability had been published with an effective date of implementation of July 2012. *Id.* However, those policies were withdrawn, placed under review, and republished by the ASCLD/LAB Board of Directors, effective May 1, 2013, with an implementation deadline of December 31, 2013. *See id.*

213. This information was gleaned from an informal survey I took of the fifty-eight county District Attorneys' Offices in 2012.

II. THE CONSEQUENCES²¹⁴

If the law and regulations governing forensic alcohol analysis in California remain static, the State could follow Washington or Michigan. In those states, trial courts excluded blood results from trial during *in limine* rulings. In *State v. Weimer*, a commissioner in the State of Washington used the equivalent of section 352 of the California Evidence Code to exclude the blood results, finding that “[t]o allow the test value into evidence without stating a confidence level” would lead to substantial prejudice that is not outweighed by the probative value of the result.²¹⁵ In *People v. Jabrocki*, a state court judge in Michigan found the blood test results unreliable and inadmissible “until the state police crime lab calculates an uncertainty budget or error rate and reports that calculation along with the blood results.”²¹⁶ Other courts have reached similar conclusions regarding breath tests in unpublished opinions.²¹⁷

California has already seen other challenges to the admissibility of chemical tests in addition to *People v. Gill*. In *People v. Roe*, defense counsel sought unsuccessfully to exclude the blood results based on the theory that the results

214. Very few published cases address the issues of measurement uncertainty and traceability. Some of those cases are: *State v. Holland*, 32 A.3d 571 (N.J. Super. Ct. App. Div. 2011) (discussing traceability of calibration for thermometer used in breath testing); *Ludvigsen v. City of Seattle*, 174 P.3d 43 (Wash. 2007) (holding that government had to prove that a test machine’s thermometer was traceable to NIST standards when regulation required it at time of offense); *City of Seattle v. Clark-Munoz*, 93 P.3d 141 (Wash. 2004) (finding that breath test results excluded for lack of traceability and failure to measure and record uncertainties), *superseded by statute*, 448-16 WAC, *as recognized in Ludvigsen*, 174 P.3d 43.

215. Memorandum Decision on Motion to Suppress at 4, *State v. Weimer*, No. 7036A-09D (Wash. Dist. Ct. March 23, 2010), *available at* http://www.cacj.org/documents/SF_Crime_Lab/Case_Law/WA-State-Decision-analysis-of-error-rate-is-applicable-across-many-fields-of-forensic-science-especially-drug-testing.pdf; Imwinkelreid, *supra* note 45, at 21.

216. *People v. Jabrocki*, No. 08-5461-FD, at 12 (Mich. Dist. Ct. May 6, 2011), *available at* <http://www.ncids.com/forensic/metrology/Jabrocki.pdf>.

217. *See* Order Suppressing Defendant’s Breath-Alcohol Measurements in the Absence of a Measurement for Uncertainty at 31, *State v. Fausto et al.*, No. C076949, 9Y6231062 (Wash. Dist. Ct. Sept. 21, 2010), *available at* <http://www.ncids.com/forensic/metrology/Fausto.pdf>; Order Suppressing Defendant’s Breath-Alcohol Measurements in the Absence of a Measurement for Uncertainty at 14, *City of Kent v. McDaniel et al.*, No. K81862, K81680, K77149 (Wash. Muni. Ct. Cty. May 4, 2011), *available at* <http://www.ncids.com/forensic/metrology/Kent.pdf>.

would be neither reliable nor interpretable by a jury without a corresponding estimation of uncertainty.²¹⁸ There have been at least two cases in Contra Costa County involving challenges based on the same theory.²¹⁹ It is simply a matter of time before a trial court in California excludes blood results based on this novel defense tactic despite the fact that neither California law nor regulation requires the use of traceable equipment and standards or the reporting of results with an associated uncertainty.

III. THE PATH FORWARD

Because of the conflicting statutory and regulatory system presently prevailing in California, trial court judges should not grant motions to exclude blood results (or breath tests) from DUI trials when the results are not reported with an associated uncertainty. Both GUM and ISO/IEC 17025 have limiting language that allow for instances, where applicable, that results could be mentioned as a single digit.²²⁰ Moreover, neither California law nor regulations require the reporting of measurement results with uncertainty.²²¹ The same analysis should be applied to traceability. California laboratories and prosecutors should not be punished for following existing law and regulations in order to preserve the presumption provided by law despite advances in the understanding of the scientific community.²²²

Before a California judge rules it necessary to exclude a critical piece of evidence such as a blood result from a DUI trial, the California Legislature and the Department of Public Health must act to bring California's laws and regulations

218. Email from Deputy District Attorney Madeleine Seiff, Office of the District Attorney for Santa Clara County, San Jose, California, mseiff@da.sccgov.org, to author (May 9, 2013, 10:41 AM) (on file with author).

219. *People v. Najarro*, Dkt. 4-169717-6, and *People v. Bonilla*, Dkt. 1-154515-1. Email from Supervising Deputy District Attorney Bruce Flynn, Office of the District Attorney for Contra Costa County, Martinez, California, bflynn@contracostada.org, to author (May 9, 2013, 1:48 PM) (on file with author).

220. ISO/IEC, *supra* note 60, § 5.10.3.1(c), at 21.

221. *See, e.g.*, CAL. CODE REGS. tit. 17, §§ 1215–22 (2013).

222. Assuming California trial courts continue to deny pretrial motions to exclude evidence based on measurement uncertainty and traceability, California criminalists should aim to testify to the uncertainty inherent in all measurements and the importance of traceability regardless of whether uncertainty is calculated and traceability is documented.

into conformity with the international and national consensus of the scientific community regarding measurement uncertainty and traceability. On April 21, 2010, the FARC sent a letter to Kimberly Belshe, then secretary of the California Department of Health and Human Services,²²³ with a set of proposed revisions to title 17.²²⁴ Those revisions, including the addition of measurement uncertainty and traceability, have yet to be included in title 17. The Legislature should hold public hearings on the FARC's recommendations and update the Health & Safety Code and title 17 after a sufficient period of public comment from prosecutors, defense attorneys, and California criminalists.

The Legislature should also do away with the redundancy of the Department of Public Health oversight over labs voluntarily choosing to be accredited by ASCLD/LAB.²²⁵ ASCLD/LAB's process is transparent, open to feedback, and consistent with the highest standards of the national and international scientific community. In doing so, the Legislature would not be ceding the responsibility for preventing DUI to an extragovernmental body, but would be recognizing the inherent limitations of legislative oversight of such highly technical areas of public safety such as forensic laboratories.

To ensure that the best science is being practiced in California and presented to juries in California courtrooms, the Legislature should create a mechanism for ongoing review and reform. In 2007, the CCFAJ recommended that California create a Forensic Science Board similar to that created by the State of Virginia, to "review and make recommendations as necessary to [the State] concerning . . . [n]ew scientific programs, protocols, and methods of testing."²²⁶ In doing so, the Legislature would ensure that a quarter century would not pass before the law and regulations governing forensic alcohol analysis were updated.

223. The California Department of Public Health was renamed the California Department of Health and Human Services.

224. See Letter from Jennifer Shen to Kimberly Belshe, *supra* note 198.

225. See *generally id.*

226. CAL. COMM'N ON THE FAIR ADMIN. OF JUSTICE, *supra* note 167, at 9.