April 2023 | Volume 46, Issue 7

SADO
State Appellate Defender Office
Criminal Defense Resource Center

Criminal Defense Newsletter

Introducing the Intoxilyzer 9000 – Michigan's New Breath Test Instrument

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Something is about to happen in Michigan that has not happened in at least half a century. The Michigan State Police is about to introduce a breath test instrument manufactured by a company other than National Patent Analytic Systems ("NPAS"). The new breath test instrument is manufactured by CMI, Inc., and is called the Intoxilyzer® 9000 ("9000").

How Did We Get Here?

Toward the end of the 1990s, the DataMaster instruments in use throughout the State of Michigan had reached the end of their service life. NPAS had also begun to develop a new instrument, which eventually came to be called the DataMaster DMT ("DMT"). This new series of breath test instruments first became available for purchase in 2005.

The DMT series instrument included many of the same analytical components of its predecessors, but with several important and significant changes. The sample chamber had been reconfigured. Unlike its predecessor, the DMT contains a shortened (54cm) and folded chamber. Also, a third infrared filter (3.50) was made standard. The interface was upgraded to include a real time graph showing breath flow and breath alcohol content (BrAC). The graph also showed the duration of the blow and breath volume. Finally, the case of the DMT was also updated and improved, to be powder coated and seamless.

NPAS claimed that these changes to the DMT case made it impervious to radio frequency interference and therefore eliminated the RFI antenna. Because RFI was no longer thought to be an issue, the DMT was marketed as being transportable. This meant that the DMT could be used to obtain immediate breath test results in the field at the time of the arrest.

The following year, the Michigan State Police entered into a contract with NPAS to purchase several hundred DMTs. But some of the new functionality of the new DMTs was either not ordered or turned off, including the breath graph and data storage. In March 2013, one of NPAS's competitors, Intoximeters, announced that it was purchasing NPAS. Subsequently, Intoximeters took over the maintenance contract for all of Michigan's DMTs.

In 2019, and after a personnel change, the MSP began to bring accreditation to its breath testing program. As a part of these efforts, the MSP began an audit of the 120-day inspections of the DMTs and it came to light that two of the three technicians that worked throughout Michigan were engaged in fraud related to the required 120-day inspection. For a short period of time many DMTs were decertified. Prosecutions followed,[1] and MSP took over instrument calibration and maintenance.

Public Hearings and Input from the Defense Community

Perhaps partially due to the fraud described above, the MSP decided to replace the "outdated fleet of Evidential Breath Alcohol instruments currently in use"[2] with the 9000 – new instruments that have "additional technology, features, and expanded capabilities."[3] Based upon currently available information, MSP will be purchasing 250 units over 3 years at a unit cost of $9,566 per unit, for a total cost of $2,391,500.[4] However, there will be additional costs for required consumables, such as mouthpieces and dry-gas controls and calibrators. These additional costs combined for an estimated additional total of 2.44 million. These amounts do not include the necessary training, continuing education, or officer certifications.

Another important part of the MSP's decision to replace the DMT with the 9000 was a 2021 "meeting with stakeholders," including representatives from the Criminal Defense Attorneys of Michigan (CDAM) and the Prosecuting Attorneys Association of Michigan (PAAM).[5] As reported by the MSP, stakeholders at that meeting encouraged the Michigan State Police Forensic Science Division to:

- Field a new evidential breath alcohol instrument that allows for measurement of uncertainty. This requires instrumentation that can reliably report to 0.000 grams alcohol/210 L breath.
- Increase the information available within a standard breath test report by the instrument, including a breath flow profile and instrument uncertainty.
- Allow for improved and/or streamlined instrument data access and discovery.[6]

Although the overall theme of these changes was to improve instrument reliability and increase program transparency, as will be discussed below, it remains to be determined whether these goals have been met.

Infrared Spectroscopy in Evidential Breath Testing

To ascertain the motivation behind the change in breath test instruments, as well as the

significance of any differences between the DMT and the 9000, it is helpful to first understand some basic scientific concepts intrinsic to infrared breath testing.

All evidentiary breath testing instruments rely on the science of infrared spectroscopy which in turn is based on the basic scientifical concept that chemical compounds absorb light. Furthermore, different chemical compounds have varying sensitivity to different wavelengths of light, and this sensitivity impacts the degree of light absorption. This light absorption is a function of the chemical makeup of the compound being analyzed, and the arrangement of the chemical bonds within that compound. When organic compounds absorb IR energy at certain wavelengths, the vibration and rotational motion of chemical bonds in the molecule become amplified and more intense.[7] This is part of the reason that spectroscopy can be used to identify an unknown compound's molecular identity.

By way of elaboration, infrared spectroscopy involves shining infrared light (radiation) through a breath sample and measuring how much of the radiation is absorbed by the molecules in the sample. Identifying the amount of an unknown molecule in this way is based on the principles of the Beer-Lambert Law, which dictates that the quantity of light absorbed will always be proportional to the concentration of the molecule in the sample.[8] The qualitative assessment of the molecule doing the absorbing is a bit more difficult. While it is true that the amount of infrared energy absorbed is a function of quantity, the qualitative determination is mostly a function of the specific infrared wavelength or frequency involved.

The total wavelength range of infrared light as expressed in microns (µm) is approximately 0.78 µm to 100 µm.[9] This range is often divided into sub-ranges, and each subrange has different properties and are used for various applications such as spectroscopy, thermal imaging, communication, and sensing.

The portion of the infrared region most useful for analysis of organic compounds is that having a wavelength range from 2.5 um to 16 um.[10] The 3-um and 9-um regions are mostly used for the detection of ethanol in human breath samples in drunk driving investigations because the absorption peaks in these regions are strong and distinct, making it easy to measure the concentration of ethanol in the breath sample.[11]

Knowing the specific infrared wavelength of absorption can aid in the qualitative assessment because organic molecules may have a specific infrared "fingerprint." The trouble comes when the fingerprints of two organic molecules are similar and "overlap."

When a person consumes alcohol, some of it is metabolized by the liver and eventually excreted. Some of the unmetabolized alcohol is carried to the lungs where it is exhaled through the breath. When a breath sample is taken, it is captured in the instrument's sample chamber. An IR light is transmitted through the chamber and measured by the instrument's detector. An algorithm converts the signal emitted by the detector into a breath alcohol concentration. The various components involved in the transmission and measurement of the IR signal comprise the instrument's optical bench.

Differences in Optical Bench of DMT and 9000

Before we discuss the optical bench and "features and capabilities," of the 9000,

including its purported ability to distinguish ethanol from other organic molecules, let's have a brief refresher about the DataMaster. Over many decades Michigan used the DataMaster for all law enforcement purposes. During this time there have been several incarnations of the DataMaster. While minor differences did exist between models, all DataMaster models were (and are) analytically identical with only the optical system, electronics, and packaging slightly updated over the years.

All DataMaster models, including the DMT, use a grey body infrared source lamp and cooled lead selenide detector along with a long sample chamber. The narrow bandpass optical filters are centered at 3.37 microns and 3.44 microns, with an optional filter available at 3.50 microns. The filters in the optical path are designed to isolate the specific wavelengths of light that are absorbed by alcohol, and to block out any other wavelengths of light that might interfere with the measurement of the unknown.

By comparison, the features and the expanded capabilities of the 9000 are not specified in any MSP materials obtained to date. Unlike NPAS, which was very open about its technology, obtaining specific information from CMI, Inc. had proven much more difficult.

DMTs Chopper Wheel and Filters

Promotional materials from CMI, Inc. indicate at least some of what MSP may be referencing when it suggests that the 9000 has "additional technology, features, and expanded capabilities." CMI, Inc.'s website indicates the 9000, using "4 infrared wavelengths for sample analysis, has unparalleled performance in accuracy, precision and interferent detection by using pulsed infrared technology, eliminating chopper motors or mechanical filters in the analytical system."[12] Thus, we know one difference between the DMT and the 9000 is that the latter does not have a chopper wheel, but instead uses a "digitally controlled pulsed IR source."

The function of the chopper wheel was to "chop" the IR signal into pulses. This was/is necessary because the instrument's detector can only "read" alternating current. The problem is that if the IR signal is not "chopped" it remains in direct current. As an alternative to the mechanical chopper wheel, the 9000 uses pulsing LEDs (Light Emitting Diodes) to produce the IR signal,[13] which effectively fulfills the same function electronically. The frequency range of the light emitted is believed to be 10 Hz.[14]

Photo of folded sample chamber

The sample chamber of the 9000 is also believed to be shorter and it is not folded, as it is in the DMT. The advantage of a folded-path chamber is it can be longer while maintaining a more compact size. A longer sample chamber is also considered to be more precise. This is because as the path length of an optical system increases, the sensitivity to the concentration of the gas being analyzed increases.[15] This fact appeals to logic because a larger chamber requires a larger breath volume, and therefore a larger overall quantity of ethanol to measure. The internal size of the 9000's sample chamber is unknown.

Increasing the Probability of Reporting Only Breath Alcohol

In addition to ethanol, human breath can also contain a wide range of other volatile organic compounds (VOCs), such as acetone, isopropanol, and methanol. In the past, various manufacturers of breath test instruments elected to use either the 3-um or the 9-um regions for ethanol detection.[16] The DMT utilizes the 3-um range, whereas the Drager utilizes the 9-um range. The 9000 uses both the 3-um and the 9-um range. This may or may not make the 9000 better at distinguishing ethanol from possible sample contaminants.

Like ethanol, these VOCs also absorb infrared (IR) radiation at either the 3-um or 9-um regions. This overlap has the potential to lead to falsely elevated breath test results in drunk driving investigations.[17] Thus, to be useful for law enforcement purposes, not only must a breath test instrument be precise and accurate; it must also be specific. That is, the thing measured and the BrAC reported must represent ethanol and only ethanol.

The 9000 accomplishes measurement specificity by measuring the breath sample at both the 3 um and 9 um ranges. It also uses 4 filters rather than up to 3 in the DMT. Some breath analyzers use 5 filters.[18] The purpose of the filters is to increase the refinement of the guess as to what VOCs are contained in the sample chamber.

The specific filter specifications, such as wavelengths and resolution in the 9000 are not known. The filters perform an essential quality control safeguard. Because other VOCs also absorb IR radiation in the 3-um and 9-um frequencies it is necessary to attempt to rule out contamination by looking at the relative absorption at various frequencies. The instrument must be programmed to flag contamination if the difference between the baseline (no filter) and the subsequent readings are greater than a specified amount. As it relates to the 9000, these tolerances are not known.

Being aware that filters cannot eliminate the possibility of breath sample contamination, other manufacturers, such as Dräger, utilize dual technology. They measure the breath sample using both infrared spectroscopy and fuel cell technology. A version of the DMT was available that had both filters and fuel cell technology. Fuel cell sensors work by measuring the electrical current produced when alcohol molecules are oxidized at the surface of the fuel cell. These sensors are highly sensitive to alcohol. By combining both fuel cell sensors and infrared spectroscopy in the same instrument, manufacturers can take advantage of the strengths of both methods while minimizing the possibility of sample contamination leading to a false high result.

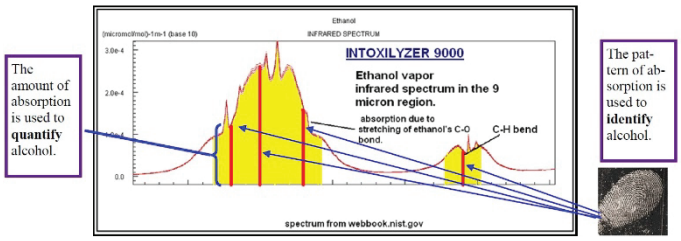

Image taken from Georgia's 2015 Operator's Training Manual

However, it is important to note that no analytical method is completely free from the possibility of sample contamination or other sources of error, and results from breath tests from the 9000 can be imprecise, even with all the existing safeguards.

Mouth Alcohol Also Remains as a Potential Problem

Slope detection exists on the 9000, but it is significantly different from the DMT. The purpose of slope detection on a breath test instrument is to ensure that the breath sample being analyzed is free from mouth alcohol, which can lead to a falsely high reading.[19] Mouth alcohol can be caused by recent consumption of alcohol, use of mouthwash or other oral hygiene products, silent regurgitation or even belching.

Just as with the DMT, in the 9000 slope detection works by analyzing the rate of change in the alcohol concentration in the breath sample over time. When a person exhales into the machine, the alcohol concentration in their breath initially rises rapidly, but then levels off and eventually starts to decrease as the subject's breath becomes depleted.

The slope detector measures the rate of change in the alcohol concentration during this leveling off period, and if it detects a sudden increase in the slope, it indicates that the person may have mouth alcohol present. The machine will then abort the test and prompt the operator to perform a new test after a specified waiting period to allow any residual mouth alcohol to dissipate. This helps to ensure the accuracy and reliability of the breath test results.

In the DMT, slope detection was accomplished by an algorithm that considered four sample acceptance parameters. Three of the four concern breath flow and breath volume. One of the four specifically "examines" the slope and requires that the rate of increase (in breath alcohol detection) must slow to a max of .001 g% as shown by 2 consecutive 2-point averages. The datapoints for the slope detection in the DMT were derived from alcohol reading every ½ second.

The 9000 also has four parameters, and like the DMT, three of them relate to breath flow and breath volume. The 9000, however, requires less volume provided over a shorter period than did the DMT. Regarding the slope detection parameter, CMI suggests that "the IR source on the 9000 pulses at only 10 cycles per second (Hz). With four filters, a breath sample reading is obtained every 1/10 of a second (100 milliseconds) on each of the four filtered points, for a total of 40 discrete pulses per second. As pulses are analyzed, consecutive BrAC readings that do not differ by a pre-determined margin will indicate a level slope." It remains to be seen whether slope detection on the 9000 is any better than it was on the DMT. At least one hands-on testing indicates that the DMT performed better than the 9000 regarding slope detection; or Residual Alcohol Detection System (RADS).[20]

Dr. Michael Hlastala is a respiratory physiologist who has conducted research on breath testing for alcohol. In his research, he has raised concerns about the reliability of slope detection as a means of detecting mouth alcohol. Overall, Dr. Hlastala's research suggests that slope detection may not be a foolproof method for detecting mouth alcohol and that other measures, such as observing the person for signs of recent alcohol consumption or performing a blood test, may be necessary to ensure the accuracy of breath test results.[21] However, even with these safeguards, the kind of mouth alcohol caused by GERD is a particularly pernicious problem that slope detection fails to adequately address.[22]

Internal Standards and Breath Flow Graphs

The 9000 has also eliminated the quartz internal standard. This was a 1mm thick piece of quartz glass that was moved into the optical path with the internal standard check was performed. Quartz was used because it has a consistent, repeatable attenuation of IR energy throughout the spectral region used in the DMT. As such it is used as a reference to determine the consistency of the analytical portion of the instrument.

When the instrument is calibrated the quartz standard is inserted into the optical path and the amount of IR energy attenuated is translated into an equivalent ethanol absorption value. This value is stored in the calibration factors and compared with each new reading during each subject test. This is what current breath test tickets reference where they indicate "internal standard verified." Apparently, the 9000 eliminated this internal standard in favor of an actual ethanol standard, which, according to the proposed administrative rules, can be either wet bath or dry gas.[23]

A final thing worthy of consideration is that, like the DMT, the 9000 can display and print a breath flow graph. When contracting for the DMT, MSP decided to order units with this functionality disabled. It remains to be determined whether MSP can or will order the 9000 with this function similarly disabled. MSP remains silent as to exactly what will constitute the additional information the 9000 makes available that is supposed to benefit the criminal justice system MSP also remains palpably silent regarding how CDAM or PAAM's input, and concerns have been met by the changes in the State's breath test program.

Proposed Changes to Administrative Rules, and What They Portend

Again, a bit of a refresher. As it relates to what might loosely be called quality control, the administrative rules currently require that the instrument's calibration be checked at least once per calendar week. Additionally, the current rules require that the instrument be inspected by a class IV operator at least once per every 120 days.[24]

The proposed rules will do away with these requirements provided the instrument examines a known standard with each subject test.[25] What this tells us is that the 9000 will incorporate a calibration check within the subject test sequence. The new rule further indicates that "if an accuracy check is conducted, then the results must be retained either in log form by the agency where the instrument is installed or electronically within the instruments memory."[26] It would appear that this is a tacit acknowledgement that the instrument has a memory and can store the history of prior tests. The DMT has always had this ability and in other states, such as Washington, months of download history was routinely provided to the defense. This type of data is essential to confirm, or not, that an instrument is accurate, reliable, and precise over time, but it has never been available in Michigan

CMI also has an option to include proprietary software called "Cal-Guard."[27] CMI refers to Cal-Guard as a "watchdog" that assures that the parameters of CMI's Quality Assurance Plan are realized. For example, according to CMI, the allowable interval between calibration verification tests for the Intoxilyzer® 9000 breath testing instrument should not exceed 30 days or 150 tests.[28] Cal-Guard ensures that this frequency of verification tests is in compliance with these

parameters because each time a calibration verification test is performed, the Cal-Guard™ timer and test counter are reset to allow another 30 days or 150 tests. With Cal-Guard™, the instrument will not allow a subject test to be performed if the minimum calibration verification test parameters are not met. At this time there is no information from Michigan State Police whether this, or similar software, will be included or utilized.

Whether Cal-Guard is used or not, the new administrative rule language indicates that reference checks will be stored in memory for later retrieval. This suggests that memory downloads from the instrument will finally be available to us, though it's unclear exactly how this might work in practice. According to the contract language, COBRA V5 Software will be included, which should also record error messages and testing times for subjects. Cobra is the network communication capability of the Intoxilyzer 9000.[29] This software and available data is used in other 9000 states like Texas and Colorado. MSP may claim that the device only stores very limited data for a very limited period thereby eviscerating the usefulness of this data.

The 120-day inspections are also gone for the 9000. The new instruments only need be "inspected, verified for accuracy, and certified as to their proper working order" 2 times per year, or half as often as the DMT[30] if certain conditions have been met, which include known standards during subject samples.

Additionally, the processes for which a class IVB operator is certified have changed. The rule applicable to the DMT read: "[I]nspect, certify, service, repair, and calibrate evidentiary breath alcohol test instruments approved for use by the department for proper working order."[31] The rule changes indicate, for the 9000, that a Class IVB operator, or a manufacturer-trained representative approved by department, will, 2 times per year, "[C]alibrate and service an evidential breath testing instrument approved for use by the department,"[32] if there is a known alcohol standard with each subject sample. Both changes are interesting if only because it was the 120-day inspections that lead to the fraud debacle previously referenced.

Apparently, the 9000 is so "technologically advanced" that it is no longer necessary to inspect or repair them. However, if there is a diagnostic error, the device is programmed to prevent a subject test, and the operator is directed to consult the user manual. Further, if it fails a self-diagnostic test, it should be removed from service, which should include a print-out of the error.[33]

Result Details

Test	g/210L	Time
Air Blank	0.000	00:57:22
Diagnostics	Passed	00:57:57
Air Blank	0.000	00:58:36
Subject Sample	0.175	00:59:06
Breath Volume	1.49 Liters	
Air Blank	0.000	00:59:59
Dry Cal Chk	0.085	01:00:20
Air Blank	0.000	01:01:00
Diagnostics	Passed	01:02:38
Air Blank	0.000	01:03:15
Subject Sample	0.167	01:03:38
Breath Volume	1.61 Liters	
Air Blank	0.000	01:04:31

Breath Test Ticket from GA Manual

The one final change of import is that breath test tickets from the 9000 will now read to the 3rd digit for both the subject sample as well as for the interim calibration checks.

The acceptable variability between samples has not changed. For example, for 0.000 - 0.149, the two subject samples can be as much as +/- 0.010, and still be good enough for police work.

Putting this all together, the new OD-80 (breath test ticket) in Michigan may look like the sample ticket from the State of Georgia

depicted above. The readings are all to the third digit. The breath volume is listed, as are several "air blanks" and one dry gas calibration check.

Creation of an Uncertainty Budget

Another issue that arose out of the stakeholders meeting relates to measurement uncertainty and the need for MSP to derive an appropriate uncertainty budget for the DMT. Measurement uncertainty exists because, no matter how well a measurement is performed, it never permits us to know the "true" value of a quantity intended to be measured—the measurand. To the contrary, for any measurement, there is not one value, but an infinite number of values dispersed about the result that are consistent with all of the observations and data and one's knowledge of the physical world, and that with varying degrees of credibility can be attributed to the measurand."[34]

Presumably the fact that the 9000 will read to the third digit allows for the calculation of an uncertainty budget. This is something that any good forensic practice requires and is a requirement of accreditation.

It is interesting to note that prior DMT courtroom testimony proffered by the State on this topic suggested that the number was truncated for the benefit of the defendant.

With New Technology Comes New Opportunities

While the new 9000, with its potentially intimidating breath test ticket, may seem even more difficult to defend in trial, many of the existing potential problems with breath tests that may give rise to reasonable doubt have not been eliminated. For example, insufficiencies in slope detection, or Residual Alcohol Detection System (RADS), has been a previous forensic defense to a breath test result. The 9000 does not eliminate this defense, but establishing reasonable doubt due to mouth alcohol now requires a detailed understanding of the methods utilized by the 9000.

Further, the Georgia training manual for the 9000 previously indicated that there should be approximately 5 minutes between subject samples. An example of this is contained in the breath test printout above. This intermission between breath samples is probably intended to provide the subject with sufficient time to recover from giving the first sample and allow time for their deep lung air to equilibrate. The wait time between replicate samples is an important component of the instrument's safeguards against residual or mouth alcohol.[35]

Regarding the need for MSP to create an uncertainty budget, this also creates an opportunity for the defense. Creating an uncertainty budget for breath testing is a difficult task and before any State witness should be allowed to testify about one, it must be tested under the crucible of cross-examination in the context of a *Daubert*[36] hearing.

Also, because the proposed administrative rules use the word "if" as it relates to type and frequency of calibration checks it is fair to assume that MSP anticipates that the 9000 will be folded into use over time. The method for this is likely to be like what occurred with the new DMT where the new units were placed in use in areas of lower population first. Regardless of how the fold out occurs, MSP anticipates that for a period of time both the DMT and the 9000 will co-exist in various counties around the State.

This inherent conflict in what State witnesses have said, and what MSP now claims relative to readings to the third digit may give rise to reasonable doubt relative to the DMT while the two breath test instruments coexist.

Creativity is the only requirement when evaluating the information contained herein and determining how it will impact your first trial that includes an evidence ticket from the 9000. There will be new areas to address, new for the defense bar, but also new for judges and prosecutors. Such creativity requires as a precedent that competent counsel obtain sufficient subject matter training. Also, to investigate what is and is not working in other states where the 9000 is currently in place. Our hope is that this article is a good starting point as you begin to fathom how your defense of intoxicated driving cases may change once the 9000 begins to be used in Michigan.

Patrick T. Barone, Esq.
Michael J. Boyle, Esq.

Patrick T. Barone is the principal and founding member of the Barone Defense Firm, headquartered in Birmingham, Michigan with offices also in Grand Rapids, Michigan. He is the author of several books on criminal law, gun law and DUI defense, including the well-respected two volume treatise Defending Drinking Drivers (James Publishing). Mr. Barone is an adjunct professor at the Western Michigan University/Thomas M. Cooley Law School where he teaches Drunk Driving Law and Practice, is on the faculty of the Michigan Trial Practice College, and is a graduate of the Gerry Spence Trial Lawyer's College. He is also certified by the American Board of Examiners as a trainer, educator, and practitioner (TEP) of psychodrama, sociometry and group psychotherapy and is the only Michigan lawyer to hold this distinction. Additionally, Mr. Barone has an "AV" (highest) rating from Martindale-Hubbell, and since 2009 has been included in the highly selective US News & World Report's America's Best Lawyers while The Barone Defense Firm appears in their companion America's Best Law Firms. He has been rated "Seriously Outstanding" by Super Lawyers, rated "Outstanding/10.0" by AVVO and was appointed to the advisory board for the Michigan edition of Leading Lawyers Magazine.

Michael J. Boyle is a Partner and Senior Trial Attorney at the Barone Defense Firm, with offices in Birmingham and Grand Rapids.

Mr. Boyle represents the rights and lives of individuals accused of criminal charges in State and Federal Courts throughout the State of Michigan. He is a founding member and board member of the Michigan Association of OWI Attorneys.

He is a regular presenter for CDAM, Marijuana Law Section, and MIAOWIA on complex scientific matters including infrared spectrometry, liquid and gas chromatography, and trial practice and strategy. He has served as an instructor for Michigan Trial Practice College, and an occasional visiting professor at Cooley Law School, and is a graduate of Gerry Spence Trial Lawyers College.

Mr. Boyle has been recognized for his legal expertise and dedication to his clients. He has been recognized as a Rising Star by Super Lawyers, AVVO Client's Choice Award and 10.0 Rating, Leading Lawyers Magazine, and as a Top Lawyer by Grand Rapids Magazine and Business Journal.

Endnotes

1. Press Release, Michigan Department of Attorney General, *DataMaster Defender Sentenced Following Guilty Verdicts* (June 24, 2022), available at https://tinyurl.com/ybxpptf3 (last checked 4.18.23); Berg, *Man sentenced for forging Michigan State Police alcohol breath test equipment records*, Lansing State Journal (Dec. 14, 2020).
2. Request for Rulemaking (RFR) submitted by Michigan Office of Administrative Hearings and Rules Administrative Rules Division (ARD) pursuant to MCL 24.239 <https://tinyurl.com/52hsu57w> (accessed 4.18.23).
3. *Id.*
4. State of Michigan Procurement Notice of Contract 220000000902 and Schedule B <https://tinyurl.com/42jm3nfe> (accessed 4.18.23).
5. Request for Rulemaking (RFR), *supra* note 2.
6. *Id.*
7. Jones, Alcohol: Breath Analysis, *Encyclopedia of Forensic and Legal Medicine* (2d Ed. 2016).
8. Edinburgh Instruments, The Beer-Lambert Law https://www.edinst.com/blog/the-beer-lambert-law/ (accessed 4.18.23).
9. International Commission on Non-Ionizing Radiation Protection, *Infrared Radiation* <https://tinyurl.com/2ap26yxj> (accessed 4.18.23).
10. Reusch, *Virtual Book of Organic Chemistry* (Infrared Spectroscopy) <https://tinyurl.com/2b5n4n9z> (accessed 4.18.23).
11. Jones, *supra* note 7.
12. Intoxylizer 9000 <https://www.alcoholtest.com/intoxilyzer-9000/> (accessed 4.18.23).
13. Semenoff, An Independent Review of the Intoxilyzer 9000, pt 2, *Counterpoint, the Journal of Science and the Law,* Vol. 2, Issue 2; Article 4 (2017).
14. *Id.*
15. Infrared Spectroscopy, *LibreTexts* (Jan. 2023) <https://tinyurl.com/ytfbs76d> (accessed 4.18.23).
16. Labianca, *Breath-alcohol analysis: A commentary on ethanol specificity in the 3-µm and 9-µm regions of the IR spectrum*, 24 Forensic Toxicology 92-94 (2006) <https://tinyurl.com/mutzusfk> (accessed 4.18.23).
17. *Id.*
18. Jones, *supra* note 7.
19. Hlastala, *The slope detector* (1996), available at https://tinyurl.com/bdpcwwuj (last checked 4.13.23).
20. Semenoff, *supra* note 13.
21. Hlastala, Lam, and Nesci, *The Slope Detector Does Not Always Detect the Presence of Mouth Alcohol*, For the Defense (March 2006), and Wigmore and Leslie, *The Effect of Swallowing or Rinsing Alcohol Solution on the Mouth Alcohol Effect and Slope Detection of the Intoxilyzer 5000*. 25 Journal of Analytical Toxicology 2 (2001).
22. Jones, *Breath Tests for Alcohol in Gastroesophageal Reflux Disease*, 130 Annals of Internal Medicine 4 (1999); Jones, *Reflections on the GERD Defense*, DWI Journal: Law & Science, 20; 3-9, 2005; Jones, *Gastric Reflux, Regurgitation, and the Potential Impact of Mouth-Alcohol on the Results of Breath-Alcohol Testing*, DWI Journal: Law and Science 22; 1-8, 2007.

23. Mich. Admin. Code, Tests for Breath Alcohol, R 325.2653 Equipment accuracy evidential breath test instruments. (Pending Draft Rule Language updated on: 2/13/2023 9:35:47 AM).
24. Mich. Admin. Code, Tests for Breath Alcohol, Section R. 325.2653 - Equipment accuracy (Current through Vol. 23-04, March 15, 2023).
25. Mich. Admin. Code, Tests for Breath Alcohol, R 325.2653 Equipment accuracy evidential breath test instruments. (Pending Draft Rule Language updated on: 2/13/2023 9:35:47 AM).
26. *Id.*
27. CMI, Inc., *Instrument Quality Assurance Plan,* (March 7, 2012), p 2.
28. *Id.*
29. Source Code Assessment of the CMI Intoxilyzer 9000 Instrument, State of Georgia Criminal Justice Coordinating Council, Andrew Howard, Georgia Tech Research Institute, Appendix A, September 20, 2013.
30. Mich. Admin. Code 325.2653 (pending) <https://tinyurl.com/52hsu57w> (accessed 4.18.23).
31. Mich. Admin. Code 325.2658.
32. Mich. Admin. Code 325.2658 (pending) <https://tinyurl.com/52hsu57w> (accessed 4.18.23).
33. CMI, *Instrument Quality Assurance Plan,* (March 7, 2012) p 2.
34. Vosk and Barone, *Breath and Blood Tests in Intoxicated Driving Cases, Why They Currently Fail to Meet Basic Scientific and Legal Safeguards for Admissibility*, Mich. Bar Jrn, pp. 30, 35 (July 2015).
35. Dubowski, *Quality assurance in breath-alcohol analysis*. 18 J Anal. Toxicol. 6 (Oct. 1994).
36. *Daubert v Merrell Dow Pharmaceuticals Inc.,* 509 US 579 (1993).