Chapter 3:
Anatomy of a Breath Test and the Challenges You Can Make

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ANATOMY OF A BREATH TEST
-AND-
THE CHALLENGES YOU CAN MAKE

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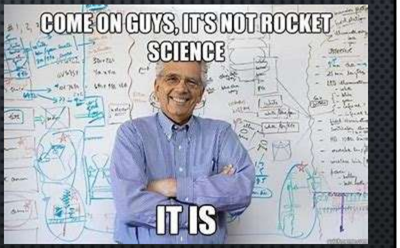
DON'T FEAR THE SCIENCE



WHAT IS A BREATH TEST MACHINE?


My friend:
"What do you call those things you blow and make a wish?"

Me: "Breathalyzer?"

Evidentiary Machines

Datamaster (K/CDM)
Intoxilyzer (5000/8000)

ANATOMY OF A BREATH TEST

- IMPORTANT PHASES OF A BREATH TEST
  - 1. HOW DOES ALCOHOL GET INTO THE BREATH
  - 2. HOW DOES THE MACHINE RECOGNIZE THE ALCOHOL
  - 3. HOW DOES THE MACHINE QUANTIFY (MEASURE) THE ALCOHOL
  - 4. WHAT MISTAKES CAN THE MACHINE MAKE IN RECOGNIZING AND MEASURING THE ALCOHOL

HOW DOES ALCOHOL GET INTO THE BREATH? HENRY'S LAW

- Assume a volatile liquid, a closed system, and constant temperature. After a period of time, some of the molecules of the liquid will have moved into the gaseous phase in the headspace above that liquid. The number of molecules that have passed into the gaseous phase will be directly proportional to the number of molecules remaining in the liquid.

WHAT DOES THAT MEAN?

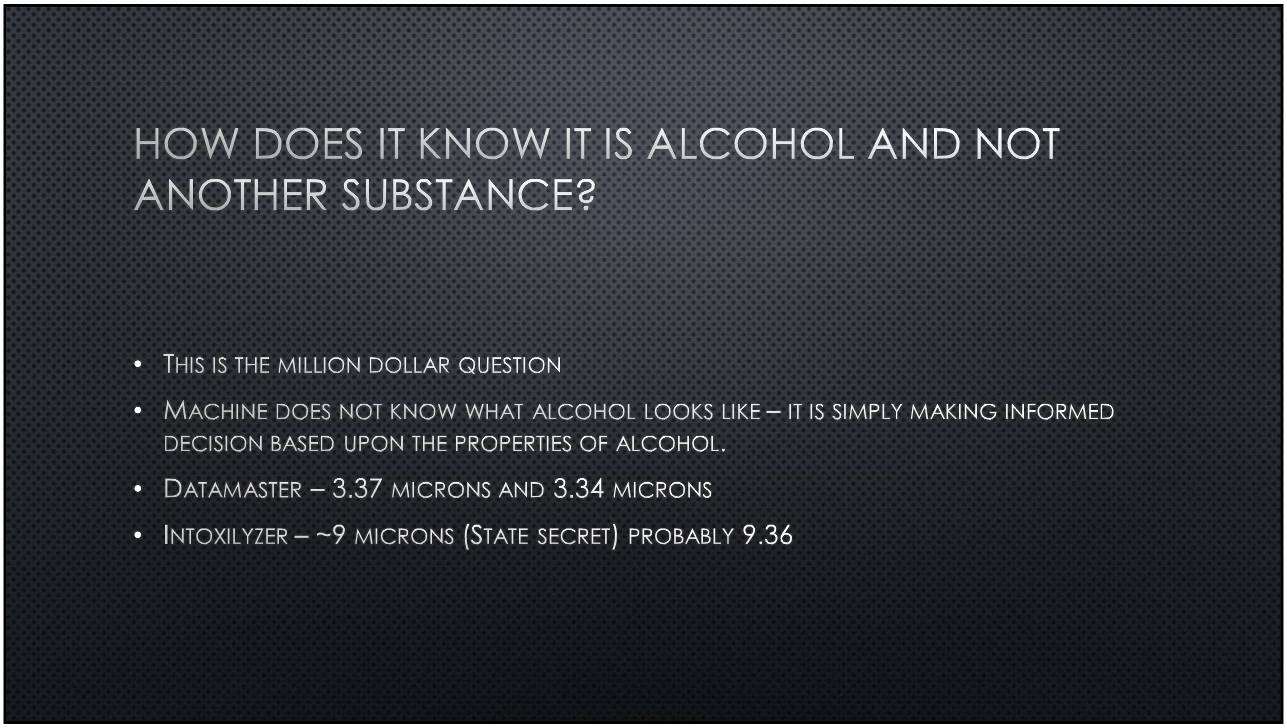
- 1. volatile liquid – a liquid that evaporates at room temperature, like alcohol.
- 2. closed container – human body?
- 3. constant temperature

- Conclusion – partition ration
- Known ratio of alcohol in blood to breath
- Is that true?

CONSTANT TEMPERATURE

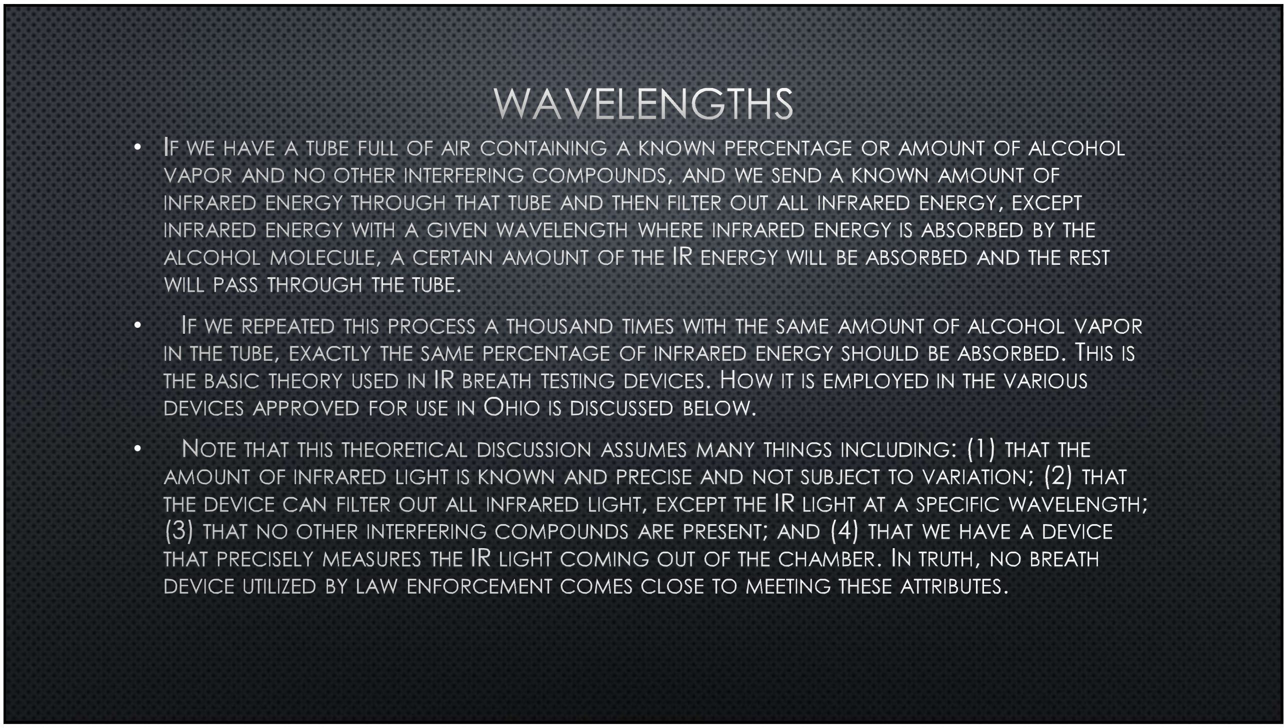
INFRARED LIGHT ABSORPTION

- THIS IS THE PRINCIPLE THAT GOVERNS HOW THE MACHINE DETECTS THE ALCOHOL MOLECULE
- A SPECIFIC WAVELENGTH OF LIGHT IS BEAMED THROUGH THE SAMPLE CHAMBER
- THE AMOUNT OF ALCOHOL IS DETECTED BY HOW MUCH OF THE INFRARED LIGHT WAS ABSORBED



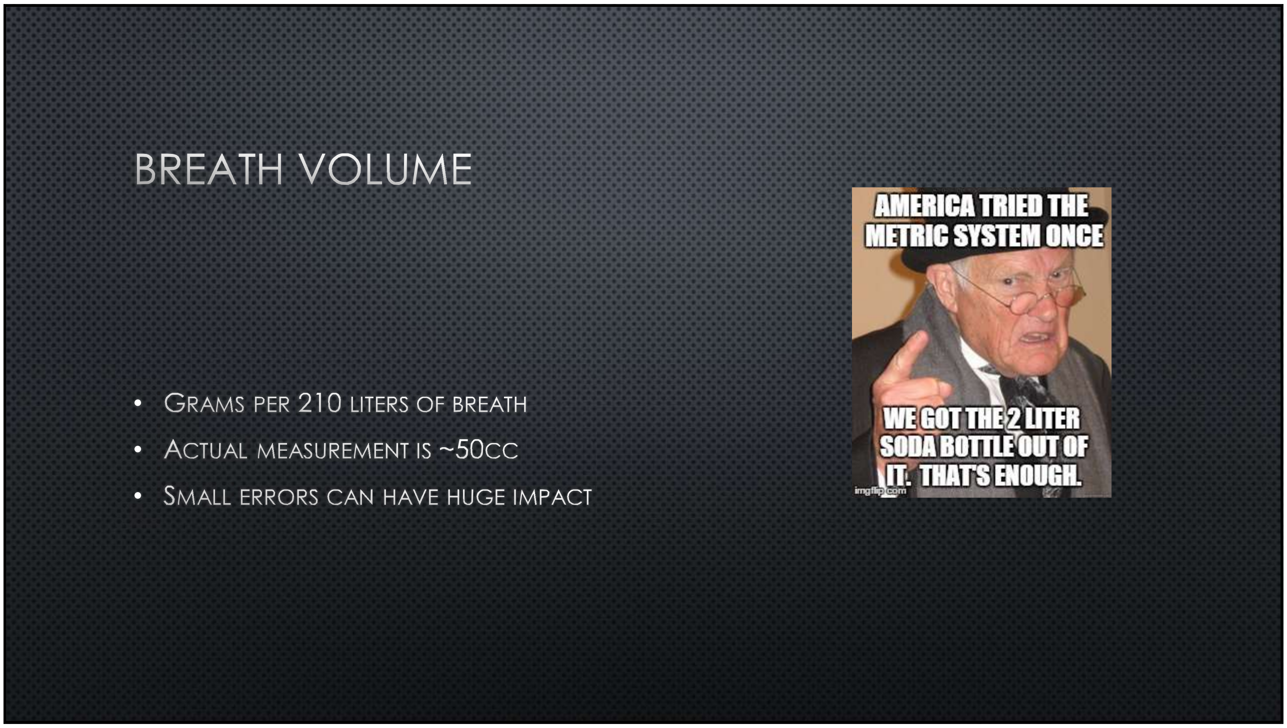
HOW DOES IT KNOW IT IS ALCOHOL AND NOT ANOTHER SUBSTANCE?

- This is the million dollar question
- Machine does not know what alcohol looks like – it is simply making informed decision based upon the properties of alcohol.
- Datamaster – 3.37 microns and 3.34 microns
- Intoxilyzer – ~9 microns (State secret) probably 9.36



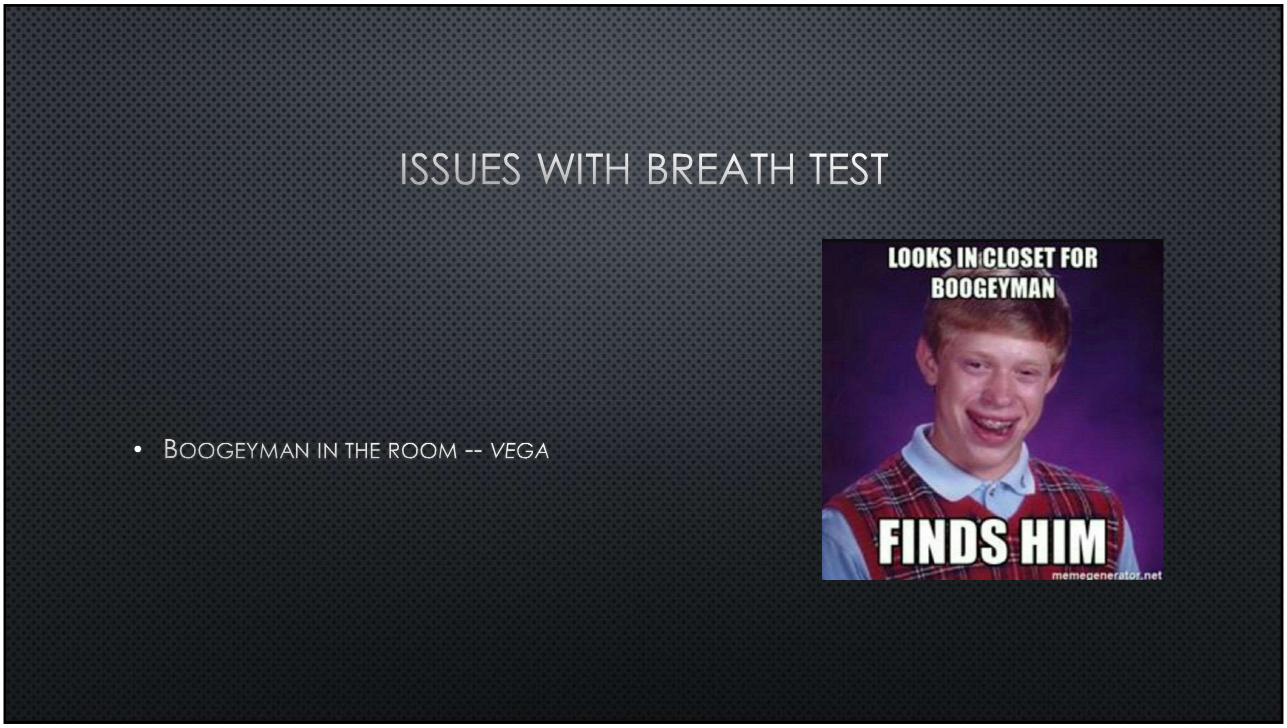
WAVELENGTHS

- If we have a tube full of air containing a known percentage or amount of alcohol vapor and no other interfering compounds, and we send a known amount of infrared energy through that tube and then filter out all infrared energy, except infrared energy with a given wavelength where infrared energy is absorbed by the alcohol molecule, a certain amount of the IR energy will be absorbed and the rest will pass through the tube.
- If we repeated this process a thousand times with the same amount of alcohol vapor in the tube, exactly the same percentage of infrared energy should be absorbed. This is the basic theory used in IR breath testing devices. How it is employed in the various devices approved for use in Ohio is discussed below.
- Note that this theoretical discussion assumes many things including: (1) that the amount of infrared light is known and precise and not subject to variation; (2) that the device can filter out all infrared light, except the IR light at a specific wavelength; (3) that no other interfering compounds are present; and (4) that we have a device that precisely measures the IR light coming out of the chamber. In truth, no breath device utilized by law enforcement comes close to meeting these attributes.



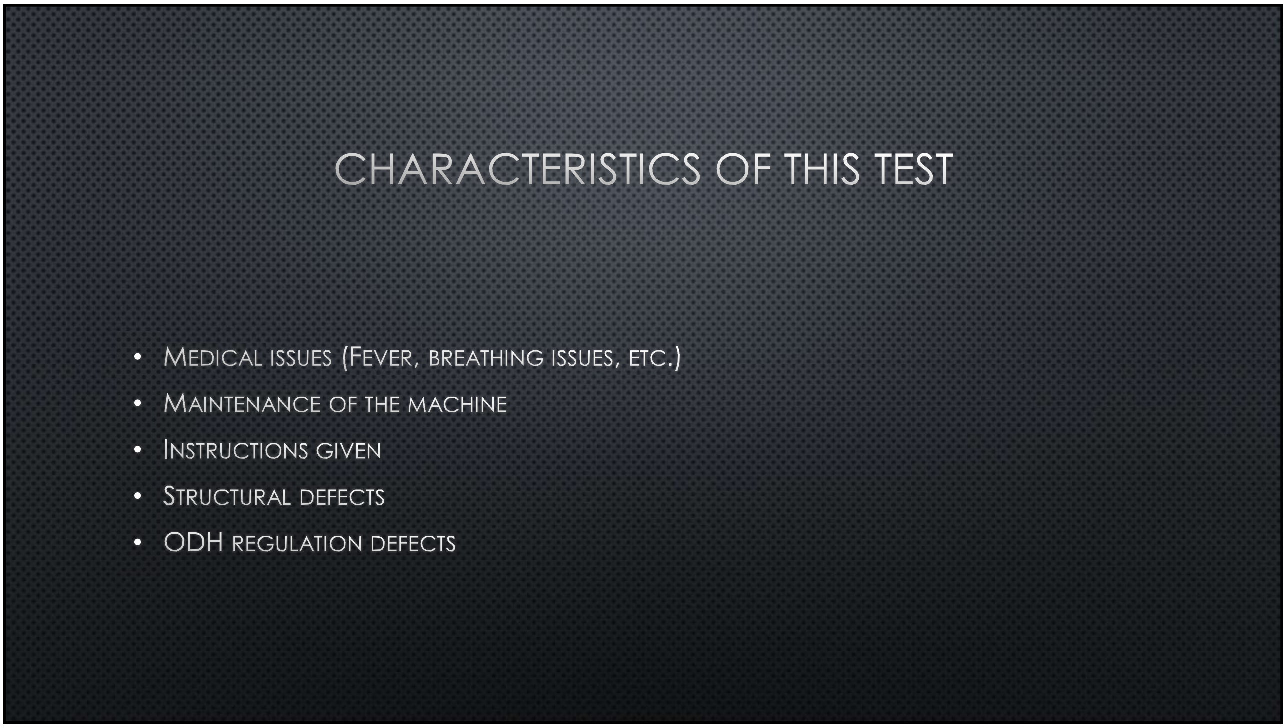
BREATH VOLUME

- Grams per 210 liters of breath
- Actual measurement is ~50cc
- Small errors can have huge impact



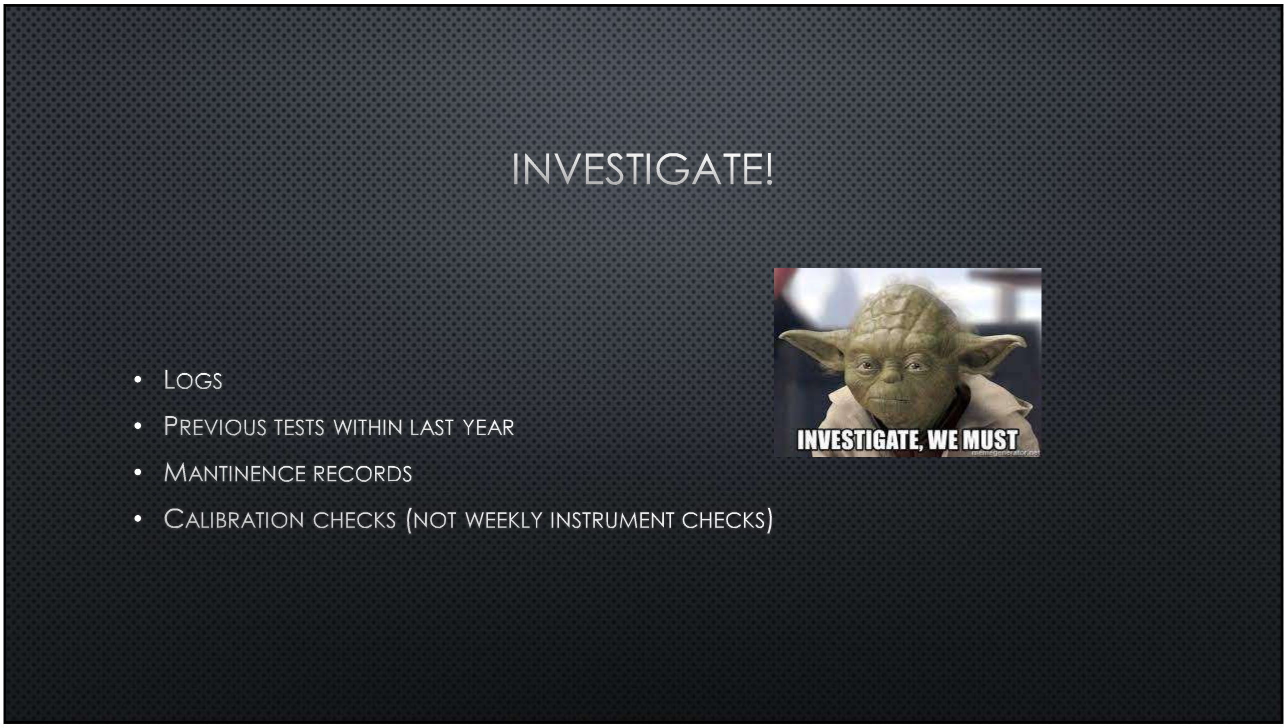
ISSUES WITH BREATH TEST

- Boogeyman in the room -- *Vega*



CHARACTERISTICS OF THIS TEST

- Medical issues (Fever, breathing issues, etc.)
- Maintenance of the machine
- Instructions given
- Structural defects
- ODH regulation defects



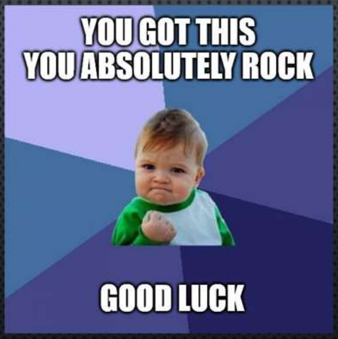
INVESTIGATE!

- Logs
- Previous tests within last year
- Mantinence records
- Calibration checks (not weekly instrument checks)

ERROR CODES

- Know your error codes
- Invalid sample vs. insufficient sample
- Review manual

GOOD LUCK!



Chapter 11

Chemical Testing

Synopsis

11.1 Preliminary Breath Testing

Preliminary Breath Tests (PBT) are often used for probable cause purposes. Because they carry neither the safeguards nor the documentation of evidential breath testers, from a scientific viewpoint they should not be admitted as evidence. In this text we use PBT to mean Preliminary Breath Test or Preliminary Breath Testing device. PBTs are almost always portable devices and are generally handheld. Typically, PBTs are used on scene at the side of the roadway. There are also Evidentiary Breath Test (EBT) devices that are portable. In some states, these portable EBTs are handheld devices. During the period when Ohio officials went through the motions of considering other devices (prior to selecting the Intoxilyzer 8000) a handheld device was in the running and was favored by selection committee members. Portable EBTs may be referred to as "Portable Breath Test" devices, leading to the temptation to use the familiar acronym (PBT) when referring to them. This leads to great confusion and should be avoided.

There are two general types of scientific tests: 1) preliminary screening tests, and 2) official quantitative tests. Thus, when distinguishing PBTs and EBTs, the portability of the device does not matter; what does matter, is whether the test is meant to produce official quantitative results.

11.2 Law

In Ohio, the distinction between an Evidentiary Breath Test (EBT) device and a Preliminary Breath Test (PBT) device depends on whether the Ohio Department of Health (ODH) has approved the device for "evidential breath testing" per OAC 3701-53-02. If the device has been approved as such, the device is an EBT.

In the past, the ODH has approved "nonevidential preliminary breath-testing devices". OAC 3701-53-02(D) previously read:

> "(D) The breath testing instruments listed in this paragraph are approved as nonevidential preliminary breath testing instruments. These instruments are not approved for use in determining whether an individual's breath contains a concentration of alcohol prohibited or defined by division (A)(3) of section 4511.19, division (A)(4) of section 1547.11, division (B) of section 2903.06, division (B) of section 2903.07 of the Revised Code, and any other statute or local ordinance prescribing a defined or prohibited breath-alcohol concentration. The approved preliminary breath testing instruments are:
> "(1) `Alco-Sensor' (two-digit display model); and
> "(2) `Alco-Sensor' (pass, warn, fail light display model)." Ohio Adm.Code 3701-53-02(D).

Seemingly, the ODH intended to approve these for use as preliminary testing devices in support of probable cause, but that was not specified in the regulations. In fact, the regulations did not specify any particular use. The term "nonevidential device" was bound to cause questions. Did the ODH intend for the results of these devices to be used as evidence in any fashion? If so, why did they select the term "non-evidentiary device"? Did the ODH mean that an officer could use a PBT, but the results could not be admitted as evidence? If so, why bother? What is the benefit of using an approved PBT over an unapproved PBT if neither device's results can be admitted?

Many courts held that the results of the approved nonevidential devices were admissible in probable cause hearings, but nonapproved PBT results were not. The ODH no longer approves of any "nonevidential preliminary devices."

In an example of strictly logical, but completely wrong reasoning, one appellate judge wrote:

> "I read Ohio Adm.Code 3701-53-02(D) to prohibit the use of PBT results only when a defendant is charged with a violation of a state statute or local ordinance proscribing a defined or prohibited breath-alcohol concentration. In this case, appellant was tried under Elyria's ordinance prohibiting driving under the influence, which does not set out a defined breath-alcohol concentration. Therefore, I would find the testimony about the PBT admissible."

Elyria v. Hebebrand, 85 Ohio App. 3d 141, 619 N.E.2d 445 (9th Dist. Ct. App. 1993). Note that the above appellate judge would have upheld the trial court in allowing the "nonevidential" PBT to be admitted at trial in an impaired case.

Some judges are favorably disposed to PBTs and others are not. During the ODH Rules consideration hearing, where removal of OAC 3701-53-02(D) was being considered, a prosecutor testified against the elimination of the approval of nonevidential PBTs, stating that "we are a rural county with limited resources and not a great number of officers; when they can save time by using a PBT that helps a lot." It is not uncommon for judges to worry about county resources, and in some cases even police department budgets. Perhaps some judges share the same view regarding PBTs as the aforementioned prosecutor.

Given that the ODH withdrew any sort of approval for PBTs, one would think that would have pretty much sealed the deal and no courts would permit PBT results.. Many courts have cited this in barring PBT results from being admitted into evidence. See *State v. Ferguson*, 2002-Ohio-1763 (3rd Dist.) However, the Ohio appellate courts are still split on whether PBTs are admissible to establish probable cause.

PBTs are not Admissible at Probable Cause Hearings

The Third, Seventh, Eighth, Eleventh, and Twelfth Districts have determined that PBT results are not admissible, even for a probable cause determination. See *State v. Ferguson*, 2002-Ohio-1763, (3rd Dist.); *State v. Derov*, 2008-Ohio-1672 (7th Dist.); *Cleveland v. Sanders*, 2004-Ohio-4473 (8th Dist.); *State v. Delarosa*, 2005-Ohio-3399 (11th Dist.); *State v. Mason* (Nov. 27, 2000), 12th Dist. No. CA99-11-033, 2000 WL 1741621. Note that post-*Delarosa*, some might argue that the Eleventh District has changed its mind. In *State v. Maloney*, 2008-Ohio-1492 (11th Dist.) the court concluded its decision with:

> {¶58} Even if we were to find that the HGN and walk and turn tests were not administered in substantial compliance with NHTSA standards, sufficient probable cause exists for Mr. Maloney's arrest since he displayed other factors of intoxication and tested a .134 on the portable breathalyzer test, and then tested later at the police station, a .122 on the BAC test. Moreover, the state carried its burden of proof by introducing the testimony of a competent officer and the NHTSA manual. There is nothing to indicate that the tests were administered improperly and not in substantial compliance with the NHTSA standards.

Does the above mean that PBTs are now admissible in that district? *Maloney* did not address, much less overrule, *Delarosa*. Moreover, it appears that the accused in *Maloney* did not challenge the admission of the PBT. Finally, given that the appellate court had already found probable cause existed without reference to the PBT, it was no more determinative, nor relevant to the decision than the post-arrest breath test also mentioned by the court in its probable cause review.

Districts that have avoided the issue thus far

Some courts seem to prefer to avoid deciding the issue by concluding that the officer had probable cause, even without the PBT result. See *State v. Howard*, 2008-Ohio-2241, ¶ 29 (2nd Dist.); *State v. Jividen*, 2006-Ohio-2782, ¶ 18 (9th Dist.); *State v. Morgan*, 2006 -Ohio- 5297, ¶ 41 (10th Dist.)

PBTs are admissible at Probable Cause Hearings

The Fourth, Fifth, and Sixth Districts have allowed PBT results for probable cause purposes only. See *State v. Gunther*, 2005-Ohio-3492, ¶ 23 (4th. Dist.); *State v. Lominack*, 2013-Ohio-2678, ¶ 34 (5th Dist.); *State v. Henry*, 191 Ohio App.3d 151, 945 N.E.2d 544, ¶ 36 (6th Dist.).

While the above cases are often cited by the prosecution for the proposition that the results of a PBT are admissible at a probable cause hearing, defense counsel should not simply accept that proposition without further analysis. More importantly, counsel should review the decisions. Many of them are simply illogical, miss important issues, or both.

Review the Cases Cited in Support of Admissibility

State v. Gunther, is a good example of flawed reasoning, leading to the admission of PBT results in support of probable cause. In *Gunther*, the Trooper was permitted to give the numerical result from the PBT. (Some courts will only allow the officer to state whether the PBT was "positive for the presence of alcohol.") The court summarized the issues raised in the trial court regarding the PBT results:

> "After hearing arguments by counsel, the trial court overruled the motion to suppress in its entirety, making several findings regarding probable cause to stop and arrest Appellant and also the admissibility of the PBT results, including the following… 1) that the PBT is not an evidentiary device like the Datamaster, but is a fact to be weighed among all other things, ***but given no scientific credibility***." Gunther at ¶10, emphasis added.

The appellate court affirmed with little discussion, citing its previous decisions permitting PBT results to be "used solely as a factor to consider in the totality of the circumstances for establishing probable cause." *State v. Gunther* at ¶25. How can the PBT results be admissible and relevant, but not as scientific evidence?

The court focused more attention on a novel issue regarding the PBT that the "patrolman arguably misstated the law" in obtaining the accused's cooperation and consent. The court noted "there is no indication from a review of the video that the patrolman intentionally misstated the law in order to get Appellant to submit to the test." *Id.* at ¶24. Below are excerpts from the exchange between the trooper and the accused about the PBT.

> "TROOPER: What I'm offering here is a PBT test okay? You can take it or not. * * *.
> APPELLANT: So, what are my rights according to blowing in that and not blowing in that?
> TROOPER: This here can't be used against you in court, okay?
> APPELLANT: It can't?
> TROOPER: This here just gives us another reason just to see where you're at * * * Alright. It just lets us know where you're at on this, okay?
> *****
> APPELLANT: What happens if I don't take it?
> TROOPER: Well, we'll, you'll go through something here in a little bit, okay?
> APPELLANT: Well, tell me what that is.
> TROOPER: Well, I'll probably end up taking you in. Alright? Probably will arrest you for DUI. This here is just to make sure, we'll see where you're at. So, you want to take it or not?
> APPELLANT: Okay. So, what happens if I take it and my breath alcohol . . .
> TROOPER: If you're way below then we'll kick you loose.

The court of appeals found that the above was "not completely inaccurate" because in other districts, PBT results are not admissible (and presumably the trooper had previously been assigned to those other districts.) The court went on to hold that, "[i]deally, the trooper should not have attempted to give Appellant legal advice regarding the admissibility of the test results; however, we find that this error does not amount to police misconduct that would give rise to a constitutional violation in the form of a deprivation of due process. Nor did the trooper coerce Appellant into submitting to the test, but rather, he gave Appellant the option of taking or not taking the test four different times." *Id.* at ¶24.

The authors of this book submit that the first error the court made was in viewing the issue as being similar to a confession and holding that "deception on the part of the police in no way vitiates the voluntary nature of an otherwise valid statement." *Id.* ¶26 (internal citations omitted.) As discussed below, a chemical test is a search governed by the Fourth Amendment, while confessions are governed by the Fifth and Sixth Amendments. The purpose and goals of these three Amendments are quite different. Therefore, the analysis must be different where false statements made by police officials lead a suspect to waive the protections of the Fourth Amendment. This should be particularly true where the false statements are false statements of the applicable law.

The authors of this book submit that the second error the court made was in holding that the matter was fully resolved by *Fairborn v. Mattachione* (1996), 72 Ohio St.3d 345, 1995-Ohio-207. All Ohio DUI lawyers should be familiar with *Mattachione*.

The *Gunther* Court cited *Mattachione* for the proposition that "Ohio courts have held that evidence obtained through intentional misrepresentation by police is not excludable unless it amounts to a constitutional violation, even if the conduct constitutes a statutory violation." The court then held, "[h]ere, we know of no statutory violation, let alone a constitutional violation, that occurred because of the officer's arguable misstatement." *State v. Gunther* at ¶27.

An understanding of the facts in *Mattachione* is important. We only learn the facts from the three dissenting Ohio Supreme Court justices as the majority opinion contained no statement of facts. According to the dissenting opinion, *Mattachione* involved a situation where a lady was arrested for DUI. At the station, she stated three separate times that she would not take the test without her attorney present. Her husband arrived at the station and advised the officer that Mrs. Mattachione's attorney was on his way. Shortly thereafter, an officer told Mrs. Mattachione "there's no attorney coming." The dissent further noted that "[t]here is no evidence that Mattachione's husband or anyone else told any officer or dispatcher that an attorney would not be coming to the police station. Believing the officer's false assertion that no attorney was coming, Mattachione finally agreed to take the breathalyzer test." *Mattachione* at 347.

Mattachione pointed to R.C. 2935.20 in challenging the admissibility of the breath test results. That statute provides a statutory right to counsel after arrest, detention, or being taken into custody and requires that the person be given the opportunity to call counsel or someone in an attempt to procure counsel. Moreover, it contains "a right to be visited immediately by any attorney at law so obtained and to consult with him privately." The statute further provides that," [n]o officer or any other agent of this state shall prevent, attempt to prevent, or advise such person against the communication, visit, or consultation provided for by this section" and "[w]hoever violates this section shall be fined not less than twenty-five nor more than one hundred dollars or imprisoned not more than thirty days, or both."

Mrs. Mattachione argued that the officers' actions violated RC 2935.20 and, in an attempt to raise the violation to constitutional level, argued that the actions denied her due process of law in violation of the Fourteenth Amendment to the United States Constitution. The trial court, court of appeals, and three Ohio Supreme Court justices agreed with her. However, in an extremely cursory decision, the majority noted that the certified question was **"whether or not the exclusionary rule is applicable as a sanction for violation of RC 2935.20"** and held **"[t]his court answers the certified question in the negative."** *Id.* at 346 (emphasis added).

Thus the *Mattachione* majority did not decide the due process issue, nor did it hold that intentional misrepresentation by police officers will never be grounds for exclusion of evidence. Moreover, *Mattachione* was not applicable to *Gunther*, and certainly not controlling as the misrepresentations made by the officer in *Gunther* implicated Fourth Amendment constitutional guarantees.

PRACTICE TIP: If you have ever have to fight to talk to or see a client, RC 2935.20 is a good statute to remember and even carry with you. Similarly, if a client calls from the police station in the middle of the night, it is a good statute to cite to the officer if she will not allow your client privacy to speak with you. Note: always insist on a non-recorded line.

Start your analysis with PBT as a search implicating the Fourth Amendment

"[T]he collection and subsequent analysis of … biological samples must be deemed Fourth Amendment searches…" *Skinner v. Railway Labor Executives' Assn.*, 489 U.S. 602 at 617, 109 S. Ct. 1402, 103 L. Ed. 2d 639 (1989). While *Skinner* dealt with urine testing, the collection and analysis of deep lung air should similarly be viewed as searches governed by the Fourth Amendment. Thus, both *Gunther* and *Mattachione* should have included a Fourth Amendment analysis. Because *Mattachione* involved an EBT that was requested as a part of Ohio's implied consent provision, it is not clear whether such an analysis would have led to the suppression of the test results. However, application of basic Fourth Amendment principles should have led to the suppression of the PBT results in *Gunther*.

It is a basic principle of Fourth Amendment jurisprudence that warrantless searches can be permitted if the owner of the place or thing to be searched consents. However, consent must be knowingly and voluntarily given. See generally, *Stoner v.* California (1964), 376 U.S. 483. In PBT cases, this principle is almost always overlooked. In cases like *Gunther*, we would suggest that an officer's assertion that the PBT "cannot be used against you in court" is likely to affect the person's decision as to whether to submit to the test. If the test is later used against him in court, one is hard pressed to see how the person's consent was knowing and voluntary.

Refusal to Submit to a PBT

Another basic principle of Fourth Amendment jurisprudence is that one cannot be penalized for exercising her Fourth Amendment rights and refusing to consent to a warrantless search. *Camara v. Municipal Court of City and County of San Francisco*, 387 U.S. 523, 87 S. Ct. 1727, 18 L. Ed. 2d 930 (1967). In fact, one cannot be penalized for asserting any constitutional right and to "punish a person because he has done what the law plainly allows him to do is a due process violation of the most basic sort." *Bordenkircher v. Hayes* (1978) 434 U.S. 357, 363; 54 L.Ed.2d 604, 610; 98 S.Ct. 663, 668. See also *Doyle v. Ohio*, (1976) 426 U.S. 610, 96

S. Ct. 2240, 49 L. Ed. 2d 91 holding "the use for impeachment purposes of petitioners' silence, at the time of arrest and after receiving Miranda warnings, violated the Due Process Clause of the Fourteenth Amendment." *Id* at 620. As discussed in Chapters 3 and 4, the implied consent provisions in RC 4511.19, et sec. may change the foregoing where the test is an EBT that is properly requested *after arrest* pursuant to those provision, however, that is not true with regard to PBTs.

Columbus v. Dials, 2006-Ohio-227 is a case involving a refusal of a PBT and exemplifies some of the important issues courts and lawyers overlook in regard to PBTs. In *Dials*, the accused refused a PBT. Not only did the trial court allow the state to introduce this fact at trial, it gave a "refusal instruction." The court of appeals initially held that such an instruction was permissible pursuant to *Maumee v. Anistik* (1994), 69 Ohio St.3d 339, 632 N.E.2d 497, which held that "when evidence of a refusal of a reasonably reliable chemical test is introduced" a trial court may give an instruction "that allows the jury to weigh all the facts and circumstances surrounding the refusal, as well as the proper significance to attach to it." *Maumee v. Anistik* at 344. (See original decision at 2005-Ohio-6305.) Dials moved for reconsideration pointing out that *Maumee v. Anistik* involved an EBT requested after arrest. Ultimately the court of appeals reversed its ruling but its reasoning was pretty circuitous, ultimately deciding that PBTs had not been determined to be "reasonably reliable" in that district, and thus *Anistik* did not apply.

The authors of this book submit that the issue could have been easily resolved by starting with the understanding that a PBT is a search; a citizen has the constitutional right to decline such a search and cannot be penalized for doing so.

The Ohio Supreme Court on PBTs

Note: the appellate court's decision in *Derov*, which barred the PBT results as being "unreliable," was appealed to the Ohio Supreme Court and accepted as a conflict case. The Ohio Association of Criminal Defense Lawyers (OACDL) Amicus brief, filed by attorneys Scott Cochran and Tim Huey, addressed a number of issues and challenges related to PBTs and would serve as a good resource to review in crafting your motions and challenges to PBT admissibility. That brief can be accessed via the Ohio Supreme Court's website. The OACDL and Ms. Derov's counsel, Rob Kokor, were successful and the court of appeals decision was left intact. However, it was clear at oral argument that at least one justice was very bothered by the fact that the appellate court had used "PBT" and "unreliable" in the same sentence. The justice was seemingly eager to hold that PBTs are admissible and would have so voted but for the fact that the record in support of the PBT was abysmal. Thus, undoubtedly at that justice's urging, the Court held:

> {¶ 1} The record in the trial court concerning the portable breathalyzer test used in this case is not sufficient to support either the statements in the opinion of the court of appeals regarding the use of the portable breathalyzer and the value of its test results or the judgment that the trial court should not have considered the results of the portable breath test. Accordingly, that portion of the judgment of the court of appeals is reversed, and the cause is remanded to the court of appeals for further proceedings.
> {¶ 2} In view of the foregoing disposition of appellant's Proposition of Law No. II, the notice of certified conflict is dismissed for want of a conflict.
> {¶ 4} The opinion of the court of appeals may not be cited as authority except by the parties inter se.

Ironically, *Derov* was before the court on the basis of a conflict between the *Derov* decision, excluding PBTs, and a number of Fourth District decisions, permitting PBTs for probable cause purposes, and the *Derov* Court was quoting a Fourth District case when it called PBTs "inherently unreliable."

> "Even the Fourth District, which has concluded that portable breath tests are admissible for purposes of a probable-cause determination, admits that these tests are highly unreliable."

> “{¶ 11} “[Portable breath test] devices are not among those instruments listed in Ohio Adm.Code 3701-53-02 as approved evidential breath-testing instruments for determining the concentration of alcohol in the breath of individuals potentially in violation of R.C. 4511.19. PBT results are considered inherently unreliable because they `may register an inaccurate percentage of alcohol present in the breath, and may also be inaccurate as to the presence or absence of any alcohol at all.’ See *State v. Zell* (Iowa App.1992), 491 N.W.2d 196, 197. [Portable breath test] devices are designed to measure the amount of certain chemicals in the subject’s breath. The chemicals measured are found in consumable alcohol, but are also present in industrial chemicals and certain nonintoxicating over-the-counter medications. They may also appear when the subject suffers from illnesses such as diabetes, acid reflux disease, or certain cancers. Even gasoline containing ethyl alcohol on a driver’s clothes or hands may alter the result. Such factors can cause [portable breath tests] to register inaccurate readings, such as false positives. See Tebo, New Test for DUI Defense: Advances in Technology and Stricter Laws Create Challenges for Lawyers, Jan. 28, 2005, www.duicentral. com/aba_journal/.”

State v. Derov, 2008-Ohio-1672 (7th Dist.) (quoting State *v. Shuler*, 2006-Ohio-4336 (4th Dist.) at ¶ 10). Note that in *Shuler* the Fourth District found that PBTs were inherently unreliable when the *accused* sought to use the results at trial. Note also that the *Shuler* Court had no more evidence before it of unreliability or reliability than the *Derov* Court and that the *Derov* court of appeals also cited cases from four other districts supporting its holding. Nonetheless, the *Derov* Court received criticism from the Ohio Supreme Court for its conclusions, presumably because the conclusion was drawn from other courts’ decisions, rather than from evidence relating to reliability and/or unreliability submitted into evidence in the case *sub judice*. On the other hand, the Supreme Court had no problem doing the same thing in finding HGN reliable in *State v. Bresson* (1990), 51 Ohio St.3d 123.

Since the Supreme Court took the unusual step of holding that “the opinion of the court of appeals may not be cited as authority except by the parties[,]” you cannot cite the *Derov* appellate decision for the proposition that PBTs are unreliable. However, you can borrow the above analysis and quote the same sources.

There is a final irony in the *Derov* saga. The prosecution in *Derov* was not that concerned about how the Supreme Court would rule on the PBT issue, but rather, was unhappy with the dicta in the decision suggesting that “the smell of alcohol and red glassy eyes at a late hour do not permit an officer to conduct field sobriety tests.” The prosecution hoped the Court would accept that issue and hold otherwise. The Court did accept the issue, but the entire case was remanded to the court of appeals and the dicta that the prosecution did not like became the majority decision when the court held:

> “{¶18} Thus, we maintain our previous conclusion that the trial court erred by denying Derov’s motion to suppress, although for different reasons. Specifically, we hold that the Trooper lacked reasonable suspicion to conduct the field sobriety tests and the portable breath test in the first instance. Although reasonable suspicion was not argued at length in the trial court, nor raised on appeal, we exercise our discretion to sua sponte notice the plain error. *State v. Derov*, 2009-Ohio-5513.

Counsel can freely cite this second Derov decision. Those in the Seventh District should take note that the court held that it was plain error for the trial court not to suppress the PBT result, under these circumstances.

PRACTICE TIP: If the Ohio Supreme Court takes a case based upon a conflict existing between the appellate districts, the Court will normally, upon motion of counsel, review the determinations on all assignments of errors raised in the court of appeals, as it did in *Derov*. This can be a useful tactic to greatly raise your chances of review of non-conflict issues.

Sometimes the prosecutor will attempt to admit the results to show “presence of alcohol” but with no quantification. If your client has acknowledged drinking, there is no real danger in admitting the result to show presence of alcohol only. However, you should argue that whether the person had alcohol on her breath is “not a fact in dispute,” and the evidence would, at best, be cumulative. Moreover, the state should still have to lay a scientific foundation, even if they are only asserting that the device can discern the presence of alcohol, which presumes that the test will not falsely identify other substances as alcohol. You may lose these arguments, especially if you are in a probable cause hearing, but there is real danger, that the courts will be lulled into a sense of routine admission where the next step is to allow the prosecutor to admit the quantitative results. This violates several rules of admissibility and the cornerstone principles of reliability of a breath test result in most jurisdictions.

11.3 Safeguards

Unless an evidential breath testing device is used for the PBT, there may be no safeguards against mouth alcohol. Even where an evidential machine is used, the other safeguards of replicate testing and a deprivation period will not be used. Thus, mouth alcohol can certainly be a factor.

Often, a PBT device will not be checked for function and accuracy by a quality assurance specialist, if it is tested at all. Maintenance logs and repair records are rarely kept for PBTs.

Unless an evidential breath testing machine is used as a PBT, radio frequency interference (RFI) may be present and interfere with the test, unknown to the officer.

All of the PBTs described below use fuel-cell technology to determine alcohol concentration. Infrared technology, described later in this chapter, is far too bulky and delicate and uses too much energy to be practical as used in a PBT. In its simplest form, the alcohol fuel cell consists of a porous, chemically inert disk coated on both sides with finely divided platinum (called platinum black). The porous disk is impregnated with an acidic electrolyte solution. Platinum wire electrical connections are applied to the platinum black surfaces. The entire assembly is mounted in a plastic case, which has a gas inlet that allows a fixed volume of breath to be introduced to the upper portion of the fuel cell.

In general terms, the reaction on the cell surface is simple: alcohol is converted to acetic acid. In the conversion process, two free electrons per molecule of alcohol are produced. The reaction takes place on the upper surface of the fuel cell. During the process, H+ ions are freed and migrate to the lower surface of the cell where they combine with atmospheric oxygen to form water, consuming one electron per H+ ion in the reaction. The process causes the upper surface of the disk to have an excess of electrons while the lower surface has a corresponding deficiency of electrons. When the two surfaces are connected electrically, a current flows through the external circuit to neutralize the charge. The current is called a “signal.” The signal is electronically amplified and software interprets the amplified signal as a specific amount of alcohol consumed by the fuel cell. See Figure 11.1.

11.4 Commonly Used PBT Devices

The Intoxilyzer® 300

The Intoxilyzer® 300 is a small, hand-held, lightweight and portable device. It is so lightweight, in fact, that it comes with a wrist strap attached to the base. It weighs approximately one pound and is 3-1/4 inches wide by 1-3/4 inches thick by 6-3/4 inches tall. The Intoxilyzer® 300 is powered by five AA batteries with no provision for outside power sources, although a rechargeable power supply is optional. The batteries should last for about 1,000 tests.

It has a four-digit LCD backlit digital display, but no printing capabilities. The memory has a last-test recall feature but is not capable of downloading any stored information.

The machine is designed to be used in ambient temperature conditions between 23°F and 104°F which could create various problems in hot climates.

The Intoxilyzer® 300 is a fuel-cell device as opposed to an infrared device such as the Intoxilyzer® 5000 and 8000 models. That means that it uses two platinum electrodes that react chemically with alcohol, consuming the alcohol and converting it to an electrical signal that is then interpreted by software to be a particular breath alcohol concentration. All of the traditional breath testing errors applicable to infrared evidential machines apply, such as expired breath temperature, partition ratio, hematocrit levels and breathing patterns. The machine is claimed to be specific to alcohol, so it will not mistake other compounds, such as acetone, for alcohol. There is much dispute about specificity, however.

There is no slope-detector for purposes of determining the presence of mouth alcohol. The machine's manual states that a 20-minute observation period must be maintained to ensure that there is no mouth alcohol affecting the result. Moreover, PBTs are generally only used as a screening device, so replicate testing is rarely performed with a PBT.

The manufacturer claims that the machine is "immune to high levels of radio frequency interference." This claim seems suspect because most electronic devices are affected in some manner by high levels of radio frequency interference.

The machine must be used carefully. Rapidly testing one subject after another could create false readings. At least two minutes must pass after a test of an alcohol-positive subject to allow the fuel cell to clear, otherwise the alcohol from the previous subject may have an additive effect to the next subject's reading. There is no ambient air check or air blank mode. Testing of a subject may be done sooner than two minutes after testing of an alcohol-free subject. The most commonly seen rapid-test problem occurs at parties where the police suspect underage drinking. The police may be hasty in their attempts to test all the underage subjects and not wait the proper amount of time between subjects. An alcohol-free subject may thus be deemed to have had alcohol because of the residual amount left in the machine and the lack of replicate testing and air blank safeguards.

The Intoxilyzer® 300 will sample a specimen of breath automatically, but a manual sample can be taken by the operator in the event that the operator believes that the subject is not blowing hard enough to trip the automatic sensor.

The Intoxilyzer® 300 can use a wet-bath simulator and a dry-gas tank for calibration purposes. There is no separate calibration port for introduction of the standard. It can be recalibrated in the field via the menu options on the machine and does not need to be sent back to the factory for recalibration.

Fuel cells have a limited life and will need to be replaced as their sensitivity is lost. Blowing tobacco smoke into the device will permanently damage the fuel cell.

The Intoximeter® Alco-Sensor IV®

The Alco-Sensor IV® (Figure 11.2) is the sensing unit portion of the Intoximeter® RBT-IV (Roadside Breath Tester).

The Alco-Sensor IV® is DOT approved. It is 5-1/2 inches tall by 3 inches wide and weighs just 11 ounces. The unit is powered by one heavy-duty 9-volt alkaline battery and has a test capacity of more than 300 tests per battery. It features a last-test recall function but may be equipped with a larger memory that is able to store more than 100 tests. The unit has a four-digit LED display and can be connected to a printer, whereas the Intoxilyzer® 300 cannot. The unit is designed to operate at ambient temperatures between 32°F and 104°F. (There is a confirmed report from Arizona of a Tucson Police Department Motorcycle Officer who wanted to test a subject in the summertime, but his Alco-Sensor IV® unit was too hot after being stored in his motorcycle's saddle-bag. He brought the unit into a grocery store and placed in the refrigerated food section long enough to cool it to within operating temperatures, then administered the test.)

Like the Intoxilyzer® 300, the Alco-Sensor IV® is a fuel-cell device as opposed to an infrared device. It uses two platinum electrodes that react chemically with alcohol, consuming the alcohol, and converting it to an electric signal that is then interpreted by software to be a particular breath alcohol concentration. All of the traditional breath testing errors applicable to infrared evidential machines apply, such as expired breath temperature, partition ratio, hematocrit levels and breathing patterns. The machine is claimed to be specific to alcohol, so it will not mistake other compounds, such as acetone, for alcohol. There is much dispute about specificity, however.

It will sample a specimen of breath automatically, but a manual sample can be taken by the operator in the event the operator believes that the subject is not blowing hard enough to trip the automatic sensor.

There is no radio-frequency interference detector or slope-detector.

For calibration purposes, the Alco-Sensor IV® can use a wet-bath simulator and a dry-gas tank as well. There is no separate calibration port for introduction of the standard. The machine can be recalibrated in the field via the menu options on the machine and does not need to be sent back to the factory for recalibration.

Fuel cells have a limited life and will need to be replaced as their sensitivity is lost. Blowing tobacco smoke into the device will permanently damage the fuel cell.

The Intoximeter Alco-Sensor III

The Alco-Sensor III (Figure 11.3), is a pocket-sized breath testing device, operated by a 9-volt alkaline battery, that is designed to read blood alcohol concentrations. With normal usage, like its cousin the Alco-Sensor IV, it should provide thousands of tests before the sensor needs replacing. Supposedly, the Alco-Sensor IV will hold its calibration for months. The manual suggests having the device calibrated every 60 to 90 days by a qualified technician in order to maintain good working condition.

The Alco-Sensor III also comes with a 15-minute waiting period between contact with subject and administration of device to insure the elimination of any potential mouth alcohol which could contaminate any offered result.

The Alco-Sensor III is designed to operate at temperatures between 68°F and 98°F. Thus, as the rate of the electro-chemical reaction is affected by temperature, temperature is an important factor for proper administration. The unit will operate at temperatures lower than 68°F / 20°C. The manual states that it will work as low as 0°C. However, the response is sluggish, with some sensitivity being sacrificed when the temperature is lower than 68°F / 20°C. The optimal temperature is between 68°F / 20°C and 98°F / 36°C.

Instrument temperature on the Alco-Sensor III can be checked by the liquid crystal thermometer built into the back panel of the device. It reads the temperature in centigrade degrees, and has a range of 20 degrees C to 36 degrees C. If no temperature figure is visible then the unit is either too hot or too cold. The manual suggests having the officer place the device in her “shirt pocket,” which will cause the device to achieve appropriate operating temperature in a “short amount of time.” Once the unit achieves appropriate operating temperature it will function properly in temperatures ranging from 0 degrees C to 100 degrees C, atmospheric pressure of 435 to 787 mm of mercury, and relative humidity of 0 to 100 percent.

The higher the operating temperature the more efficient the unit becomes. In theory, higher temperatures not only minimize condensation and assure rapid reading, but the unit also becomes reusable in a shorter period of time.

The manual suggests that with a “good deep lung breath sample” the Alco-Sensor III carries an accuracy rate, in comparison to a blood draw at the same time, of +/- 5 percent. However, the unit will lose sensitivity if more than five positive alcohol tests are run in an hour. The manual suggests avoiding mass testing of subjects of more than .10 BAC unless the unit is re-calibrated every five tests. Like the Intoxilyzer S-D2 and Alco-Sensor IV, the Alco-Sensor III is more specific to alcohol than infrared devices. Fuel cells for this device generally last 2 to 5 years. Like all fuel-cell-based devices, blowing tobacco smoke into it will permanently damage the fuel cell.

The Intoxilyzer S-D2

The Intoxilyzer S-D2 (Figure 11.4), manufactured by CMI, Inc., is a small, handheld lightweight and portable device. It weighs approximately 7.5 ounces, including pouch and battery, and is 2-3/4 inches wide by 1-1/2 inches thick by 5 inches tall. The Intoxilyzer S-D2 is powered by a 9 volt battery which should last for a minimum of 500 tests before needing to be replaced.

It has a three-digit illuminated liquid crystal display screen with a marketed +/- 5 percent accuracy rate when properly administered. The machine is designed to be used in temperature conditions between 32 and 104°F.

The Intoxilyzer S-D2 is a fuel-cell device as opposed to an infrared device such as the CMI Intoxilyzer 5000 and 8000 models. A fuel cell device uses two platinum electrodes that react chemically with alcohol, consuming the alcohol and converting it to an electrical signal which is then interpreted by software to be a particular breath alcohol concentration. All of the traditional breath testing errors applicable to infrared evidential machines apply, such as expired breath temperature, partition ratio, hematocrit levels and breathing patterns. The machine, however, is more specific to alcohol than infrared devices which often mistake many different compounds, such as acetone, for alcohol.

There is no slope-detector for purposes of determining the presence of mouth alcohol. The machine's manual states that a 15-minute observation period must be maintained to ensure that there is no mouth alcohol affecting the result. Moreover, PBT's are generally only used as a screening device, so replicate testing is rarely performed with a PBT.

There is no radio-frequency interference detector with this device. The manual advises against use of this device in close proximity to radio transmitters while they are transmitting.

The device must be used carefully. Rapidly testing one subject after another could create false readings. At least two minutes must pass after a test of an alcohol-positive subject to allow the fuel cell to clear, otherwise the alcohol from the previous subject may have an additive effect to the next subject's reading. There is no ambient air check or air blank mode. Testing of a subject may be done sooner than two minutes after testing of an alcohol-free subject. The most commonly seen rapid-test problem occurs at parties where the police suspect underage drinking. The police may be hasty in their attempts to test all the underage subjects and not wait the proper amount of time between subjects. An alcohol-free subject may thus be deemed to have had alcohol because of the residual amount left in the machine and the lack of replicate testing and air blank safeguards.

The Intoxilyzer S-D2 will sample a specimen of breath automatically. It can use a dry gas standard or wet-bath simulator for calibration purposes. There is no separate calibration port for introduction of the standard. It can be recalibrated in the field via the menu options on the device. However, while the manual suggests the S-D2's will generally hold its calibration for months, it is recommended that to get good results the device must be calibrated every 60 to 90 days by a toxicologist or other qualified personnel.

Fuel cells have a limited life and will need to be replaced as their sensitivity is lost. Blowing tobacco smoke into the device will permanently damage the fuel cell.

The Alco-Sensor FST

The Alco-Sensor FST (Figure 11.5) is the newest of the preliminary breath testing devices being used nationwide. It is DOT approved. It too is a handheld fuel-cell-based device and operates much like the SD-2 and Alco-Sensor III and IV models. The FST fuel cell is designed to respond only to alcohol in the human breath. It is operated by two AA batteries which are supposed to provide approximately 1,500 tests before needing replaced. The FST supposedly will not respond to hydrocarbons or acetone, which may be found in the breath of a diabetic, someone on a high-protein diet or someone who regularly exercises strenuously like a professional athlete or marathon runner. In fact, the manual boasts that the FST has no significant cross sensitivity to any substance that may be found in the human body after the mandatory minimum 15-minute waiting period is adhered from initial contact to administration. The fuel cell is supposed to last anywhere from 3 to 6 years before needing to be replaced. As with all other PBT devices, blowing tobacco smoke directly into the fuel cell will damage it. It is recommended that accuracy checks be performed on this device at least once a month. An external accuracy check and/or calibration, like other fuel-cell-based PBT devices, can be performed using a dry gas standard (approved by both NHTSA and Intoximeters) or a wet bath simulator with properly certified and maintained ethanol solutions. The wet bath simulator should also be approved for use by NHTSA and Intoximeters. In either case, the compressed gas tanks, simulators and simulator solutions are to be used and maintained only in accordance with quality assurance plans provided by the manufacturer.

The Alco-Sensor FST's casing is supposed to be designed to provide Radio Frequency Interference shielding from other electronics that are in operation in close proximity. The test will be voided and is to be restarted when RFI is detected by the device. When this occurs, the manual advises one to remove the mouthpiece, which turns the unit off, locate the source of the RFI, remove it and restart the test. Examples of commonly seen RFI's include officer walkie-talkies, cell phones and other radio-transmitting sources. The manufacturer claims that the Alco-Sensor FST also has a +/- 5 percent accuracy rate when compared to a known sample, even if working properly.

11.5 Henry's Law and the Blood to Breath Ratio

In 1803 a British chemist, William Henry, developed a principal concerning the actions of volatile substances when placed in water and brought into contact with air. This discovery is called Henry's Law and is stated as follows:

> Assume a closed system and constant temperature. After a period of time, some of the molecules of the liquid will have moved into the gaseous phase in the headspace above that liquid. The number of molecules that have passed into the gaseous phase will be directly proportional to the number of molecules remaining in the liquid.

Alcohol and many other substances are volatile substances, meaning that they have a tendency to rapidly change states (liquid to air: evaporation; or air to liquid: condensation), whether they are alone or in solution. If one places a volatile substance, such as alcohol, in solution with water in a sealed container, the air in the container above the liquid will become saturated with alcohol vapor. When the amount of alcohol evaporating into the air space above the solution, equals the amount of alcohol condensing and returning to the water, equilibrium has been reached. At equilibrium, there is a fixed ratio between the alcohol in the water and the alcohol in the air above it. This ratio is dependent upon the temperature of the solution and atmospheric pressure within the container. If either the temperature or the pressure is changed, the ratio will change.

William Henry did not use alcohol in his experiments. However, later experimentation confirmed that water and blood solutions using alcohol do obey Henry's Law except when the alcohol concentration exceeds 20 percent (about 50 times lethal dosage), which far exceeds any concentrations found in humans.

Applying Henry's Law to the Human Body

Does the human body meet the requirements of Henry's Law? The answer is unclear. First, we must think of alcohol consumption as placing a volatile substance into a "container." There is water present with which the alcohol can come into solution. Although the body is only a "closed" container when the subject does not breathe in or out, conventional breath testing science ignores this fact. The body is, however, regulated at a fairly constant temperature (98.6°F or 37°C) and external atmospheric pressure does not change rapidly. Breathing, on the other hand, does change pressure within the body with normal inspiration and exhalation.

The human respiratory system quickly brings some gaseous and volatile substances contained in the blood into equilibrium with the alveolar air of the lungs. The air passages of the lung may be compared to an inverted tree. The windpipe or "trachea" is the trunk. From there, one large branch or "bronchus" goes into each lung. The branches further divide into smaller and smaller branches. These smaller branches or "bronchi" finally become microscopic tubes, each ending in a thin irregularly shaped sac. Each sac is composed of a number of smaller sacs called "alveolus." Each alveolus is approximately 0.1 millimeter in diameter; its wall is only two cells in thickness, and it is honeycombed with capillaries. A normal lung will contain about 750 million alveoli, creating a surface area of approximately 600 square feet. It is here, in the alveolar region, that the exchange of some gases occurs. Some scientists also believe that this is where alcohol exchange occurs. It is this belief, which has not been empirically proven, that provides the basis for the science of alcohol breath testing.

Each time we breathe, we take in oxygen. The oxygen is brought into the alveolar section of the lungs where it will pass from the alveolar sacs directly into the blood, thereby creating arterial or oxygenated blood. The arterial blood then travels throughout the body delivering oxygen to all body tissues. After the arterial blood delivers its supply of oxygen and other nutrients, it collects carbon dioxide, and other waste products from the various bodily tissues. The blood carrying the carbon dioxide, now called “venous” or “deoxygenated blood,” returns to the alveolar region; it passes the carbon dioxide into the alveolar sac before it receives new oxygen. When we exhale, the carbon dioxide which has been collected from body tissues will be passed out of the body. Alcohol in our system is thought to follow this same exit route. Conventional breath testing theory states that as blood that contains alcohol comes into contact with the alveolar region, the alcohol will pass from the blood into the alveolar sacs. This intimate contact between the alcohol-laden blood and the alveolar region supposedly satisfies the requirements for Henry’s Law, not only with alcohol, but oxygen, carbon dioxide and many other volatiles. Current breath testing science relies on the ratio of alcohol between the air and the blood occurring in the alveolar region of the lungs.

The Development of the 2100:1 “Blood to Breath” Ratio

Dr. Rolla Harger first attempted to apply Henry’s Law to analyze breath for alcohol concentration. In an effort to assist the law enforcement community in combating the intoxicated driver, Dr. Harger began experimenting with methods of quickly and accurately determining alcohol levels without the need for invasive testing or waiting for lengthy laboratory analysis.

Initial experiments were done by placing whole blood combined with known quantities of alcohol, into a rotating cylinder. By rotating the cylinder Dr. Harger believed he was able to simulate the gas exchange processes occurring in the lung system. Samples were drawn from the blood and the air until a constant ratio was established. Other types of blood and different concentrations of alcohol were used until Dr. Harger felt confident that the correct blood to breath ratio had been established. Dr. Harger then published his findings, and the science of breath analysis was born. It is critical to understand the exact basis of this “blood to breath” statement. Dr. Harger concluded that 2100ml of alveolar air will contain the same weight of alcohol as does 1ml of pulmonary blood.

This conclusion has prompted much debate in both science and law. Most of the legal debate, however, is based on a misunderstanding of the statement. In almost every court across the country this is referred to as the “blood to breath ratio.” However this statement refers neither to breath in general, nor blood in general, but rather to alveolar air and pulmonary arterial blood.

Just as there are specific types of blood in the body — arterial, venous, capillary — and each have specific characteristics, there are different types of breath. It is thought that the type of breath where the alcohol is in greatest contact, and therefore the prime sample to collect for a breath analysis, is the alveolar air. However, collecting a pure sample of alveolar would cause the lungs to collapse. Obviously this type of sample capture cannot be conducted in a breath analysis. Breath analysis is mathematically based on the ratio involving the alcohol concentration in the blood and that of the alveolar air, but what is collected is actually deep lung air. A deep lung breath sample is the closest one can get to the actual sample mathematically required by breath analysis instrumentation. This type of breath is thought to be representative of the alcohol concentration ratio between the arterial blood and the alveolar air. The “blood to breath ratio” of 2100:1 is still generally accepted by police, prosecutors, crime lab personnel and some experts as the best ratio to date for the accurate analysis of breath in an effort to establish alcohol concentrations in the blood.

Is Alveolar Alcohol Exchange a Myth?

Does alcohol really exchange in the alveolar sacs of the lungs, or does it exchange elsewhere in the respiratory system? One of the premier respiratory physiologists in the world holds a different opinion than the originators of breath alcohol testing, and he has done much research and experimentation to prove his point.

Dr. Michael Hlastala has shaken the very foundations of the conventional evidential breath testing world. The result of his research is politically dangerous to the scientists who have founded and contributed to the conventional theories of evidential breath testing. Tens of millions of dollars have been spent on the application of the conventional theory of human respiratory physiology to modern breath testing. If the basic assumptions were to be proved wrong, breath testing devices would be useless unless modified to account for human respiratory physiology as it actually exists. Scientists who have staked their reputations on false assumptions would be unfairly vilified by the defense. Breath testing programs in every state would be thrown into utter chaos. In short, it is not in the best interests of the government to tell the truth to the citizens irrespective of what science dictates.

It is important to realize that the scientists who first proposed, and still support, the alveolar-air-ethanol-exchange model of the former paradigm are not doing so out of malice. They simply did not have the scientific tools available to them sixty years ago that scientists have today. Hardware in the form of infrared breath testing devices had not yet been invented. But, more importantly, computer software has allowed today's respiratory physiologists to go where scientists could never have imagined going fifty years ago. New studies have led to different conclusions about gas exchange within the lungs. Physiology has not changed, but our understanding of it has changed.

In a nutshell, Dr. Hlastala's work proves that although some gases, such as oxygen and carbon dioxide, exchange between the breath and the blood in the alveoli, other compounds, such as ethanol, exchange much higher up in the airway. The location of exchange is directly related to the solubility of the substance. Substances such as sulfur hexafluoride and ethane have very low solubility, whereas oxygen, carbon dioxide and ether have intermediate levels of solubility. Acetone, ethyl alcohol and water have much higher solubility. Substances with higher solubility values exchange higher in the airway while those with lower solubility exchange lower in the airway—such as in the alveolar sacs.

Conventional evidential breath testing theory relies on an exchange of alcohol between blood and breath in the alveolar sacs of the lungs as seen in Figure 11.6. However, this paradigm is at its end. There are simply too many anomalies to the long-held (and never empirically proven) conventional theory for it to hold true.

For example, the conventional theory states that there is an "alveolar plateau" as seen in Figure 11.7. This supposed plateau is the point where enough air has been expelled from the subject's lungs, such that the very end of the expiration contains mostly alveolar air (it is impossible to get a sample of purely alveolar air without collapsing the lungs and killing the subject—let's hope that the legislature never makes that type of testing a reality). The conventional theory holds that when a breath sample is taken at any point during the alveolar plateau, the result will be the same as a sample taken at any other point during the alveolar plateau. Clearly, this is false. Anyone who has practiced in the DUI defense area knows that the longer the subject blows, the higher the result. There is no alveolar plateau (George, Babb & Hlastala. *J.Appl.Physiol* 75:2439-2449, 1993; Ohlsson, Ralph, Mandelkorn, Babb & Hlastala. J.Stud.Alc. 51:6-13, 1990).

Dr. Hlastala's work has proven that there are significant differences when breath results are captured during the time which was previously thought to have been the alveolar plateau. In Figure 11.8, one can see significant differences between breath results at T1, T2 and T3. These differences should not exist if there is an alveolar plateau.

If conventional breath testing theory was correct, then there would be an "anatomic dead space" recorded for each subject test. In other words, there would be little or no alcohol at the beginning of the breath and it would rise only when alveolar air enters the mix as represented in Figure 11.9. Yet, we know that there is no anatomic dead space when a subject blows into a breath testing machine. (George, Babb & Hlastala. *J.Appl.Physiol* 75:2439-2449, 1993). This means that even after a deprivation period, there must still be some alcohol in the upper airways.

Moreover, if conventional breath test theory was correct, breathing patterns immediately before breath testing should have no effect on the reported result. Yet, breathing patterns immediately prior to a breath test can have a significant result as Dr. A.W. Jones discovered. Hyperventilation and hypoventilation will cause as much as a ±15 percent variation in a breath test result (Jones, A.W.; *Physiological Aspects of Breath-*

Alcohol Measurement, Alcohol, Drugs & Driving, 6:1-25, 1990). The longer a person holds her breath, the higher the result. Short, rapid breaths tend to flush out the lungs and result in a lower reading. See Figure 11.10.

Dr. Hlastala's theory is graphically shown in Figure 11.11. The alcohol resides in the mucus lining of the trachea and other parts of the respiratory system. Alcohol is hydrophilic—that is, it can be found where there is water in the body. Mucus is mostly water and, just like every other water-bearing substance in the body, alcohol will be in solution with it in higher concentrations than in other areas of the body such as bone and fat.

When a subject breathes in and out, alcohol evaporates from the mucus lining and travels out of the mouth or nose with expiration. When the subject inhales, alcohol evaporates from one part of the mucus and is re-deposited into other parts of the mucus lining. This does not mean, however, that breath testing cannot be useful in an evidentiary sense. It simply means that it has to be performed differently.

Dr. Hlastala has advocated "re-breathing" as a means of more closely equilibrating the breath alcohol with the blood alcohol. When re-breathing, a subject inhales, then exhales into a device which captures the breath, The subject then "re-breathes" the air sample several times until the temperature and humidity of the sample is fairly constant. It is the "re-breathed" air sample that is then analyzed through conventional means. It is ironic that Dr. Rolla Harger, widely credited with being the father of conventional breath testing theory, developed a method of re-breathing by having a subject breath into a balloon a minimum of four times before the air was tested in order to assure that the sample was virtually the same composition as a purely alveolar sample. Harger's method, however, was limited because he did not control the temperature of the re-breathing bag. Condensation formed in the bag and ultimately lowered the reported breath alcohol result.

One of the government's arguments against using re-breathing as a part of breath testing is that it might be difficult to get an uncooperative subject to go through the steps necessary to re-breathe properly in order to provide a quality breath sample. Another argument is that the subject might be too intoxicated to re-breathe properly. Clearly these are valid arguments, but they provide no excuse for inaccurate breath test results. If the government cannot obtain valid, accurate and reliable results through current breath testing methods, perhaps the government should rethink the whole breath-testing proposition and gather evidence of intoxication by other means.

For conventional breath testing theory to be acceptable, there have to be explanations for the fact that there is no anatomic dead space, no alveolar plateau, that breath alcohol concentration depends upon exhaled volume, that the breath alcohol concentration depends upon pre-test breathing patterns and that re-breathing blood to breath values are lower than single-breath values.

The Use of the "Blood to Breath" Ratio in Instrumentation

The first breath analysis instrument, known as the "Drunkometer," was developed by Dr. Rolla Harger. The critical basis of the instrument was determining the exact amount of alveolar air contained in the sample since the instrument used "mixed expired" air which was composed of all the types of breath. The captured breath was bubbled into a reagent until the reagent had turned a specific color. The amount of breath it took to cause this reaction would vary depending on the alcohol concentration of the subject: the higher the alcohol concentration in the subject, the smaller the amount of captured sample it took to cause the reaction. The exact amount of alveolar breath then had to be determined. This was done by measuring the weight of carbon dioxide, which is found only in the alveolar air, captured by an ascarite tube, which had to be weighed before and after the test. Analysis also required applying mathematical formulas, assessing the exact amount of alveolar air, then correcting for the captured amount of alcohol. The instrument was later modified using a "re-breathing" technique whereby the individual would exhale into a "balloon," breathe the sample back in, and then exhale again. By having the subject perform this technique a minimum of four times the sample which was then analyzed was believed to be virtually the same composition as alveolar air.

In 1954 Dr. Robert Borkenstien introduced the "Breathalyzer." The Breathalyzer was designed to capture a specific amount of end-expired breath from the subject. Whereas the Drunkometer would use different amounts of breath, the Breathalyzer would capture only 52.5 cc of end-expired breath. The basis in this case was not the amount of breath used, but the amount of reagent destroyed based on a constant sample. The alcohol concentration would be proportional to the amount of reagent which reacted with the alcohol. To determine the amount of reagent destroyed in an ampoule, a “test” ampoule and a “standard” ampoule were used. The ampoules where placed in front of matched photocells and a movable light source was adjusted until the amount of light able to pass through the ampoules was equal. When the alcohol reacted in the test ampoule a portion of the reagent was destroyed, thereby altering the reagent’s light absorption. The light source was readjusted until the amount of light passing through the ampoules was equal once again. The distance the light source had to move was directly proportional to the alcohol concentration.

In the 1960s investigations concerning the use of infrared light as a method of alcohol analysis were under way. A company called “Omicron” introduced the first infrared type of device. The basis of the infrared unit was to use an infrared light beam: when brought into contact with alcohol, the alcohol molecule would absorb some of the infrared light energy. The blood to breath ratio is an integral part of the design of this type of instrument.

11.6 Evidential Breath Testing

The breath testing devices used in Ohio are also used in other states and we can often find out more about a particular device by comparing notes with our out of state colleagues. Again, the National College for DUI Defense is a good resource for such endeavors. In learning more about the devices and procedures used in other states, you quickly become aware that, while various states use the same instruments, the statutes, rules, procedures and, particularly, the case law governing the use of such devices, vary greatly. The statutes and case law applicable to Ohio breath test devices are discussed in other relevant portions of this book, particularly Chapters 3 and 6. The breath testing procedures and approved instruments are discussed below. While Ohio has a significantly less stringent set of procedures than many other states, it is Ohio’s case law that truly sets us apart from virtually every other state in the Union.

Below we will primarily focus on Ohio’s approved machines. However, it is important to note that all breath testing devices are designed to allow quite a bit of variation in the way the machine is setup and in the software that runs the device. In short, the manufacturers do not want to lose sales. Therefore, they design their machines so that each individual state can choose their own rules and procedures. This means the manufacturers produce devices that can be used in states that have a very thorough and stringent set of rules and procedures, as well as states with minimal procedures. The manufacturers take no position in regard to what procedures are necessary to ensure scientifically accurate breath test results, as to do so would, obviously, make many of their customers unhappy. And make no mistake, the various state agencies and police departments are the customers. The history of the industry makes clear that customer satisfaction will trump scientific accuracy almost every time. Thus, while other states using the same machines require duplicate testing, Ohio can opt not do so.

Often the manufacturer will provide additional options or safeguards, which are built into the design of the device, that the purchaser or approving body can opt out of. Digital data collection and downloading is an example. Virtually all BAC DataMasters used in Ohio since 1988 were built to store data which could be downloaded to a computer; indeed that is the reason the name of the device was changed from “BAC Verifier.” Most, if not all, Intoxilyzers used in Ohio during the last twenty-five years also have had this capability. Other options that are available on DataMasters that Ohio opts not to employ are discussed below.

Some states have only one approved model of breath testing device that every police department must use. Other states allow the police agencies to choose from a small list of approved devices. Still others, California for example, allow agencies to use just about any device manufactured for use for law enforcement purposes. All states have an agency or department that sets the rules and procedures that law enforcement personnel must follow in performing breath tests. The same agency typically sets rules or specific procedures required to ensure proper maintenance of the machines and mandates periodic quality control procedures.

In 1968, the Ohio legislature decided the agency that will fill the above role in Ohio would be the Ohio

Department of Health (ODH.) Specifically, the Director of Health was "delegated" that responsibility in RC 3701.143. Indeed, that statute gives the Director such authority over "whole blood, blood serum or plasma, urine, breath, or other bodily substance[,]" where the testing is "to ascertain the amount of alcohol, a drug of abuse, controlled substance, metabolite of a controlled substance, or combination of them." Specifically, the statutes provides the "director shall approve satisfactory techniques or methods, ascertain the qualifications of individuals to conduct such analyses, and issue permits to qualified persons authorizing them to perform such analyses. Such permits shall be subject to termination or revocation at the discretion of the director." However, it is important to note that the Director's authority and his approval of testing procedures and devices is limited to testing done for "purposes of sections 1547.11, 4511.19, and 4511.194" of the Revised Code, which are directed at operating a vehicle or watercraft under the influence.

Although devices approved and maintained for OVI enforcement are often used to test young adults who are not operating a vehicle or watercraft, but rather are suspected of consuming alcohol, such use is not governed by RC 3701.143 and thus does not require compliance with the ODH rules. At the same time, unlike results used in OVI enforcement, the results of such tests should only be admitted into evidence if scientific reliability is established under Evidence Rule 702. The same should be true if a civil suit arose out of an OVI-related crash and a chemical test was conducted pursuant to RC 4511.19 and/or RC 4511.194.

In fulfilling the responsibilities delegated to him in RC 3701.143, the Director is supposed to promulgate rules and regulations that are published in Chapter 3701 of the Ohio Administrative Code. These rules and regulations are supposed to govern all chemical testing and, we are told, are supposed to provide a scientifically acceptable breath testing program to ensure that the test results are accurate and reliable. Specifically, the rules should provide for proper training, certification, and recertification, of breath test operators, and provide adequate procedures for breath testing as well as maintenance of the machines.

The authors of this book submit that the Ohio rules have never lived up to these goals. Moreover, in the early 2000s, it appears a decision was made to simplify or eliminate the rules. Interestingly, in 2008, several Ohio Highway Patrol Officers were caught cheating on the yearly recertification exam. See Inspector General's Report No. 2008097 issued 7-16-2008. At the time, Dean Ward, a former police officer with no science background, was Chief of ODH's Bureau of Alcohol and Drug Testing. Review of the IG's report makes it clear that Mr. Ward assured the IG that once the Intoxilyzer 8000 was in place, statewide, he intended to modify the rules so there would be no written tests. In his recommendations, the IG approved of this plan. Thus, a cynic might say that ODH's solution to a problem with cheating on an exam is to eliminate the exam. Given the previous and subsequent modification of the rules, it is clear that Mr. Ward's method for ensuring compliance with the rules was to eliminate most of the rules. The history of the selection, approval, and problems with implementation of the Intoxilyzer 8000, including court challenges, was the subject of an article written by one of the authors of this book entitled, *The OACDL challenges the Intoxilyzer 8000 and the Department of Health Responds; Is this what they mean by Putting Lipstick on a Pig?*, which was published in the Ohio Association of Criminal Defense Lawyer's Vindicator magazine. This article was cited by at least one appellate court, *State v. Dugan*, 2013-Ohio-447, and has been referred to or included in a number of trial court and appellate court briefs. The author, Tim Huey, hereby gives permission to any and all who may find it useful to use for such purposes to do so, with proper attribution to the OACDL and the author. A copy of that article is included in the Book-Disc and is hereinafter referred to as *Huey Intoxilyzer 8000 Vindicator article 2012*.

As a part of the authority delegated to the Director of Health through RC 3701.143, he is to "determine, or cause to be determined, techniques or methods for chemically analyzing a person's blood, urine, breath." This has been viewed as giving the Director authority to approve particular makes and models of breath testing instruments. While the Director could, hypothetically, approve only one make and model, and thus require all law enforcement agencies in Ohio to use that device, this has never been the practice in Ohio. Instead, the Director has approved a number of instruments that police departments can choose from, and each department purchases its own device or devices. However, all of the Intoxilyzer 8000s that are in use in Ohio were purchased by the Ohio Department of Public Safety (DPS). While many of these devices were provided to local agencies, the DPS continues to own the machines. As such, while all other devices are maintained by the police department that owns them, all of the Intoxilyzer 8000s are maintained by the Department of Health. Thus, if Mr. Ward's dream ever comes to fruition, the DPS and ODH will make all decisions related to selection and use of breath testing instruments, and local agencies will have no choice. Moreover, local courts and prosecutors will be at the mercy of the ODH and its employees' availability in scheduling suppression hearings related to breath test results and the foundation required for admissibility under *State v French*. See Chapter 6.

In contrast to the scheme envisioned with the approval of the Intoxilyzer 8000, evidential breath testing in Ohio, particularly which device an agency or officer may use, has historically been a decision left to the individual police agencies. As noted above and detailed below, several breath testing instruments are approved for use in Ohio. Due to issues with the Intoxilyzer 8000, the choice of which machine can or will be used by a particular agency or patrol post may now vary on a weekly or even daily basis. Indeed, many agencies now have an Intoxilyzer 8000 sitting next to an Intoxilyzer 5000 or a DataMaster. While the police agency typically advises officers (formally or informally) which machine to use, the choice may well be left to the individual officer.

Approved Breath Testing Instruments

Currently, the following devices are on Ohio's approved list of breath testing devices for evidential purposes: Intoxilyzer 8000 ® , the Intoxilyzer 5000 ®, the BAC DataMaster, BAC DataMaster K, and BAC DataMaster cdm. Ohio Adm.Code 3701–53–02. The Intoxilyzer 5000 ® and the BAC DataMaster have been in use in Ohio since the late 1980s and the early 1990s respectively. On January 8, 2009 the Ohio Department of Health formally amended Ohio Adm.Code 3701-53-02 to approve the Intoxilyzer 8000 ® evidential breath testing device, for use in Ohio.

Since all of these devices utilize the scientifically accepted principle that molecules in alcohol and other hydrocarbons will absorb (attenuate or block) infrared energy, it makes sense to discuss the basic principles of "infrared light absorption," before discussing the design and basic operation of Ohio's various approved evidential breath testing devices.

Please note that just because the underlying principle (infrared absorption) is scientifically accepted, does not mean the principle is perfect for the application in question. Just as important is the manner in which a principle is employed. Some safeguards are purportedly built into all such devices; however, to a large extent the manufacturer leaves it up to the end-user (the state) to decide what safeguards to employ.

As noted by Judge Teresa Liston in a ruling on a challenge to the Intoxilyzer 8000 device, part of the confusion over the decision in *State v Vega*, 12 Ohio St.3d 185, 465 N.E.2d 1303(1984) can be attributable to a misunderstanding of the court's ruling that Mr. Vega could not bring a generalized attack on "the reliability of intoxilyzers as valid, reliable testing machines." *Vega* 186. The critical issue, as Judge Liston pointed out, is whether the *Vega* Court meant Mr. Vega could not challenge "the general reliability of the particular model of alcohol concentration testing instrument" or that the general underlying scientific theories and the basic concept of breath alcohol testing have been found to be generally accepted? In short, did the court mean the Intoxilyzer (with a capital "I") brand of machine could not be questioned, or did it mean the basic scientific principles employed by instruments generically known as "intoxilyzers" (with a small i) could not be generally challenged at trial? Judge Liston looked to the sources cited by the *Vega* Court and the language employed, including its holdings that "wide acceptance by courts of alcohol breath tests in 'drunk driving' cases is well-documented," and that "such tests are today generally recognized as being reasonably reliable on the issue of intoxication." *Id.* Ultimately, Judge Liston concluded that that the *Vega* Court meant that the general science underlying the type of breath testing device used in *Vega* was widely accepted. See Judge Liston's decision in *State v Lancaster*, Marietta Municipal Court Case No. 12 TRC 1615, decided August 14, 2014, included in the Book-Disc. See also discussion of *Cincinnati v. Ilg* in Chapter 6.

Obviously it behooves us to understand the scientific principals underlying these machines and what limitations apply.

11.7 Infrared Light Absorption

Both visible and IR light are wavelengths of what is known as the “electromagnetic spectrum.” Humans and animals can see visible light. Other wavelengths of the electromagnetic spectrum are invisible to us, such as radio waves. The wavelengths in the spectrum vary in size from the height of skyscrapers to very short gamma rays, smaller than the nucleus of an atom.

Electromagnetic wavelengths are measured in terms of microns (one-millionth of a meter). The wavelength of the light that we see is from 0.4 microns (blue light) to 0.7 microns (red light).

The Electromagnetic Spectrum

Portion of the Spectrum	Wavelength in Microns
Radio Waves	Greater than 10^{+3}
Microwaves	25 to 10^{+3}
Far Infrared	15 to 50
Mid Infrared	2.5 to 15
Near Infrared	0.7 to 2.5
Visible Light	0.4 (blue) to 0.7 (red)
Ultraviolet	10^{-3} to 4×10^{-1}
X-rays	10^{-6} to 10^{-3}
Gamma Rays	Less than 10^{-6}

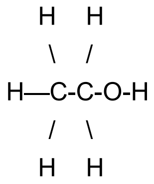
Organic molecules are made up of groups of atoms. IR light is absorbed by organic molecules, in this case ethanol, and converted into a type of energy called “molecular vibration.” Certain groups of those atoms will absorb bands of IR light at or near predictable and characteristic wavelengths irrespective of the structure of the rest of the organic molecule. Alcohol is one of those molecules. Since alcohol molecules have characteristic wavelengths of absorption, the Intoxilyzers are set to filter IR light at those particular wavelengths and measure it. Different Intoxilyzers and different devices by other manufacturers use different filters. See Figure 11.12.

Notice that while both the three-filter and five-filter Intoxilyzer® 5000 models absorb alcohol on a similar wavelength (3.48 and 3.47, respectively), the Intoxilyzer® 8000 absorbs near the other end of the IR spectrum at 9.36 microns. The mid-infrared spectrum starts at only 2.5 microns and goes to 15 microns. This means that the Intoxilyzer® 8000 measures absorption at a different part of the alcohol molecule than does either version of the Intoxilyzer® 5000 or the BAC Datamaster cdm®.

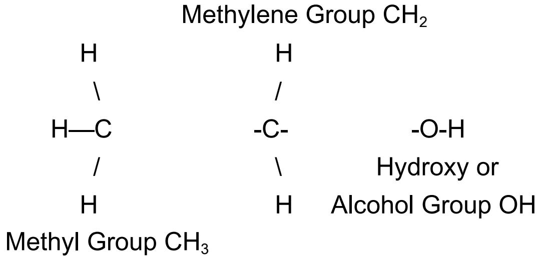
The Intoxilyzer® 5000 measures the C-H bonds (3.38 to 3.48 microns) of the methyl group and of the similar C-H bonds of the methylene group (3.43 to 3.51 microns), while the Intoxilyzer® 8000 measures the C-O (7.93 to 10.00 microns) of the alcohol group. Below is a schematic representation of the molecular bonds within the ethanol molecule.

Structure of the EtOH Molecule

H = Hydrogen Atom
C = Carbon Atom
O = Oxygen Atom



Chemical Subgroups of Atoms of the EtOH Molecule



Basic Theory of IR Absorption as Employed in Breath Testing

If we have a tube full of air containing a *known* percentage or amount of alcohol vapor and no other interfering compounds, and we send a *known* amount of infrared energy through that tube and then filter out all infrared energy, except infrared energy with a given wavelength where infrared energy is absorbed by the alcohol molecule, a certain amount of the IR energy will be absorbed and the rest will pass through the tube.

If we repeated this process a thousand times with the same amount of alcohol vapor in the tube, exactly the same percentage of infrared energy should be absorbed. This is the basic theory used in IR breath testing devices. How it is employed in the various devices approved for use in Ohio is discussed below.

Note that this theoretical discussion assumes many things including: (1) that the amount of infrared light is known and precise and not subject to variation; (2) that the device can filter out all infrared light, except the IR light at a specific wavelength; (3) that no other interfering compounds are present; and (4) that we have a device that precisely measures the IR light coming out of the chamber. In truth, no breath device utilized by law enforcement comes close to meeting these attributes. Thus, as discussed below, breath machine manufacturers have to employ certain fudge factors in an attempt to make the theory work in practice. Moreover, the foregoing generally does not take into consideration the biological variability of human beings.

The term fudge factor typically means a figure included in a calculation to account for error or unanticipated circumstances, or to ensure a desired result. As used here it means that there is a certain amount of leeway built into various processes or measurements performed by breath testing instruments. To the extent that the fudge factors are employed in breath testing to try to ensure a desired result, the desired result is not a specific numerical result. The desired result of end-users (police departments) is to have a machine produce an *apparently valid* result almost every time the device is used. A device that reports a possible problem (error code) in more than a small percentage of tests would not be very popular with end-users even if the results it reports as valid are much more accurate and reliable than the results produced by a competing device.

11.8 Basic Design and Operation of Ohio's Machines

The BAC DataMaster

Until recently, National Patent Analytical Systems, Inc. (NPAS), located in Mansfield, Ohio, manufactured, sold, and serviced all BAC DataMaster models. In the 1980s, NPAS bought the rights to a breath testing instrument called the "BAC Verifier." A few years later, NPAS introduced the BAC DataMaster, which was also initially also known as the BAC Verifier DataMaster. The Ohio Highway Patrol selected the BAC DataMaster as the device to be used at all its posts, and the majority of police agencies throughout Ohio followed suit.

Until March of 2013, NPAS also owned all of the rights to these devices and directly sold the devices to police departments, states, and even defense attorneys. However, on March 14, 2013, Intoximeters, Inc. (St. Louis, MO) sent out a press release stating that Intoximeters, Inc "is pleased to announce the acquisition of the breath alcohol testing business of National Patent Analytical Systems, Inc. (NPAS) (Mansfield, OH)." See www.intox.com/t-Press_031413_Datamaster_DMT.aspx.

This is unfortunate for many reasons. In the past, NPAS had been open to inquiries by defense counsel and defense experts, even allowing them to obtain training at the factory and purchase equipment. Indeed, NPAS is the only breath test instrument manufacturer to ever offer to allow its "source code" to be examined, without insisting upon ridiculous requirements and conditions designed to ensure no expert would ever agree to them. Intoximeters, Inc. does not enjoy a similar reputation. We are told that Intoximeters Inc. is similar to CMI, the manufacturer of the Intoxilyzer 8000, in terms of its unwillingness to disclose information about its machines, provide training, or sell breath testing equipment to anyone other than law enforcement.

What the above change means to the future of breath testing in Ohio is uncertain. We are told that NPAS will continue to service the DataMaster models used in Ohio (discussed below), at least for the time being. NPAS continued to manufacture the newer DataMaster DMT model for some period after the Intoximeter acquisition but, as we understand it, the plan was for them to phase out of the breath instrument manufacturing business in 2015 or 2016. Indeed, the NPAS website no longer mentions breath testing devices, but rather, focuses on the other items it manufactures. A device called the "Intox DMT Desktop Evidential Instrument" is featured on the Intoximeters Inc. website and looks exactly like the DataMaster DMT, although there is nothing indicating it had a former incarnation. What internal changes or software changes Intoximeters Inc. has or may make to this device are unknown, and given the corporate culture of secrecy we are told is characteristic of Intoximeters Inc., it seems unlikely that such information will be easy to obtain.

The discussion below will focus primarily on the DataMasters used in Ohio, but will provide a comparison to the DataMaster DMT, in part, because review of the information about the DMT tells us a lot about what Ohio DataMasters are currently capable of. Having an overview of the DataMaster DMT also shows us the technology Ohio rejected when it decided to spend over 6.4 million dollars on Intoxilyzer 8000 devices. Note: as the DataMaster DMT was designed to be flexible and to easily allow for modifications of both hardware and software, one should assume that the Intox DMT is, or will be, a different instrument than the DataMaster DMT.

Infrared Technology

The standard DataMaster, the DataMaster "K" option (with integral keyboard), and the DataMaster cdm all operate on the scientifically accepted principle of absorption of infrared energy as does the DMT model. See previous section for a discussion of infrared light absorption

As previously noted, just because the underlying principle is scientifically accepted does not mean the principle is perfect for the application in question. Additionally, the manner in which a principle is employed, including safeguards, is very important, and to a large extent the manufacturer leaves it up to the end-user (the state) to decide what safeguards to employ.

Model Design

By and large, the DataMaster models used in Ohio share the same basic design. The BAC DataMaster cdm is a little smaller; note that cdm stands for "compact DataMaster." (We have no idea why they chose lowercase lettering for the cdm and uppercase lettering for the DMT.)

The cdm is indeed more compact, which was accomplished by substituting slightly smaller components where possible. For example, the sample chamber is slightly smaller (as noted below).

In terms of basic design, there is almost no difference in the models, except that the cdm printer uses a smaller paper roll and the "evidence ticket" looks like a cash register receipt, rather than the full size tickets, which are manually fed into the standard size DataMasters. In terms of operation, different nomenclature is used to describe some of the processes, but all DataMasters used in Ohio perform exactly the same processes and follow the same, very basic, breath testing protocol. The only exception is that the cdm adds an extra step, and "zeros out" before and after the subject sample is analyzed. The standard DataMasters only "zeros out" before the subject sample is analyzed. See discussion of Basic Operation below.

National Patent Analytical Services, Inc. (NPAS) also produced, until recently, a model known as the DataMaster DMT. (DMT stands for DataMaster Transportable.) While the DMT uses the same infrared technology and implements it in much the same way, this model is significantly different than the previous models. It is much lighter and is, indeed, much more portable, but is not a handheld unit. It uses a Windows CE-based computer system and provides a graphic, nearly real-time, display of both the alcohol analysis and the breath flow. By saving these measurements, which are shown as lines on a graph, it allows for a better review of possible issues, particularly issues related to "Invalid Samples." We are told that the data points used to plot that graph are stored in the machine, and thus could be provided to a defense expert to review. There is no reason that the same could not be done with all DataMaster models as they take the same readings; the DMT merely takes those readings and exports them to a visual display.

The DMT's Windows CE-based system also allows the manufacturer to more easily make modifications to the software, and incorporate additional features. For example, to meet one end-user's needs, NPAS slightly modified the design of the DMT to accommodate a fuel cell analyzer, in addition to the IR analysis. Additionally, we are told that NPAS provided a prototype model to one state (Alabama) that was able to monitor breath temperature, and could adjust the result to comport with that state's protocol. As discussed in previous sections, historically all breath machines have been designed and programmed based upon the assumption that the average human breath is 34°C. All breath test results in Ohio are based upon that assumption. However, based upon more recent data, Alabama determined that the average breath temperature likely exceeds 34° C, in most subjects. Breath temperature above 34° will improperly inflate the results of a breath test. As such, any device approved for use in Alabama must be capable of measuring actual breath temperature and reducing the tests results appropriately. (See *Breath Temperature an Alabama Perspective*, International Association of Chemical Testers Newsletter Volume 9, Issue 2, July 1998.)

Ohio has not adjusted its protocol to account for the likelihood that the subject's breath temperature will be above 34° C. Moreover, police agencies in Ohio are not permitted to use DataMaster DMT model instruments as the Director of Health has refused to approve it. This refusal occurred when the Intoxilyzer 8000 was approved. Rejecting the DMT was presumably part and parcel of the plan to make the Intoxilyzer 8000 the universally used machine in Ohio and to put the Department of Public Safety (State Highway Patrol) in control of all machines.

The peak infrared wavelength frequency analyzed by the DataMaster is 3.44 microns. This is the wavelength at which the sample analysis for the quantification of alcohol is performed. An analysis is also done at the infrared wavelength frequency of 3.37 microns. Thus, as further discussed below, the DataMaster typically uses two filters in its analysis; one filter attempts to eliminate all IR wavelengths, except the 3.44 wavelength, and the other filter attempts to eliminate all IR wavelengths, except the 3.37 wavelength.

NPAS calls the 3.44 filter the "alcohol filter" and the 3.37 filter the "acetone filter," but these terms are misleading. If either alcohol or acetone is present in a sample and the 3.44 filter is used, you will receive a positive reading. The same is true with the 3.37 filter. Thus, neither filter is specific for alcohol or specific for acetone. Indeed, a whole host of other organic compounds containing molecules that have a carbon-hydrogen bond will give positive readings at both 3.44 micron and the 3.37 micron wavelengths. An additional 3.50 micron filter is available for the DataMaster cdm and is standard on the new DMT model.

Why were these filters chosen? The answer, in part, is because they were commercially available and reasonably cheap. Note: by and large few parts in the DataMaster or other breath testing devices were specifically designed and produced for use in breath testing applications. Thus, these machines are a conglomeration of parts that are more commonly used in very different applications.

The sample chamber used in the DataMaster is perhaps the only part that was specifically designed for use in the device. The sample chamber is manufactured in-house, by NPAS. The sample chamber of the standard size DataMasters holds approximately 50 cubic centimeters of air. Note: many sources list the sample chamber volume as 50 cc; however, the Ohio Department of Health DataMaster training guide lists it as 52.5 cc. (See DataMaster Renewal Guide revised 1-2009 available at www.odh.ohio.gov.)

Some sources list the DataMaster cdm sample chamber volume as 37 cc, but at least one NPAS DataMaster Manual lists it as 38 cc. The previously mentioned ODH Renewal Guide says the DataMaster cdm sample chamber holds 39.5. Similarly, many sources state that the DataMaster DMT holds 23.0 cc, but the new manual for the DMT, published by Alaska Scientific Crime Detection Laboratory, lists the volume as 28 milliliters which is the same as 28 cc.

In attempting to find definitive information about the size of the sample chambers for the various DataMasters, the authors of this book were surprised to find these inconsistencies. The most significant inconsistency being that the specifications listed by ODH and the specifications listed by the manufacturer are in conflict.

It is well known that all standard DataMasters have virtually interchangeable parts, as do all DataMaster cdms, and thus, there should be a known standard capacity for the sample chambers in each model. One would think that precision would be important when discussing any aspect of an analytical device that is ultimately measuring a quantity of alcohol equal to 0.000019 grams or 19 hundred thousandths of a pack of Sweet ‘N Low. See next Practice Tip.

PRACTICE TIP: To get an understanding of the measurements involved, 50 cubic centimeters is equal to 50 milliliters. The cap dispenser for a bottle of Nyquil holds 30 ml. A two ounce shot glass holds approximately 50 ml. On the other hand, in a sample chamber that is 50 cc, the amount of alcohol it should take to register .08 is 0.000019 grams. For comparison, a packet of Sweet’ N Low is 1 gram. So try to visualize an amount equal to 0.000019 of a pack of Sweet ‘N Low in a two ounce shot glass. While actual sample size is approximately 50 cc, the printout reports the results as an amount of alcohol per 210 liters. Looking at it from that perspective, a 210 liter container would be very close in size to a 55 gallon barrel and .08 grams would be about 8/10ths of a pack of Sweet N’ Low. That is the amount of alcohol would be in 210 liters of breath if a person tested a .08.

The temperature of the sample chamber of all DataMasters is said to be 50°C, but no error code is reported unless it rises above 55°C or will not heat to at least 47°C and stay above 45°C once it hits the 47°C mark. The theory is that human breath temperature is only 34°C and keeping the sample chamber at 50°C will prevent condensation from forming on the lenses and mirrors inside the chamber. Condensation or fogging of the mirrors, lens, or windows can reduce the transmittance of the IR light, which the machine would treat as being caused by alcohol molecules absorbing the IR energy and the reduction of IR energy would be reported as alcohol in the sample.

The mirrors within the DataMaster sample chamber are used to extend the path length of the infrared light as it travels from the light source to the detector. This is said to increase the stability of the signal and the readings. The sample chamber is, in effect, three tubes stacked, more or less, on top of each other, with angled mirrors at the ends. This allows the path length to extend to 43.3 inches (1.1 meters) inches, while the sample chamber takes a space approximately one-third that length.

In a publication discussed below, Dr. Alfred Staubus, who the authors of this book consider to be one of the most distinguished experts in the DUI chemical testing area and is a reliable source for DataMaster information, lists the path length of the sample chamber in the DataMaster cdm as 34 inches (between or .86 and .87 meters), however, in one NPAS publication, it is listed as .78 meters, and in another, .84 meters.

Similarly, one source lists the DMT path length as 21 inches (between .53 and .54 meters); but a NPAS publication lists it as 65 cm (.65 meters.) While NPAS would certainly assert that knowing the precise path length is not important, we are reasonably certain that for each of these models, only one size and length sample chamber was designed and produced. The fact that the capacity and IR path length of the respective chambers varies from publication to publication is, again, puzzling, in an application that purportedly aims at precision.

The inside diameter of these tubes is consistently listed as 5/16 of an inch.

Rule of Thumb Sample Chamber Length and Capacity Figures

As discussed above, there is clearly conflicting information as to the length and capacity of sample chambers of the various models of DataMasters. The authors choose to use as our "rule of thumb" guide those listed in *Understanding DUI Scientific Evidence*, 2nd edition published by Thompson Reuters / Aspatore wherein the author of the chapter on *Evidential Breath-Alcohol Testing Machines*, Dr. Alfred Staubus, provided the figures we used for the below chart.

Rule of Thumb Summary of DataMaster Sample Chamber Lengths and Volumes

Instrument Model	Sample Chamber Length	Sample Chamber Volume
Standard BAC DataMaster	43.3 inches	50.0 cc
DataMaster cdm	34 inches	39.5 cc
DataMaster DMT	21 inches	23.0 cc

Software Configurations

The DataMaster software is designed to allow the end-user to select many different configurations and/or options. Normally, the configuration will be dictated by the breath testing protocol adopted by the state. Every DataMaster in use in Ohio could, tomorrow, be switched to accommodate a testing protocol that includes taking two breath samples and running external controls during the subject test. Additional procedures, including data capture and computer downloading, are also part of the basic design.

Ohio Software Configuration

While advanced software configurations are built into the device, Ohio has chosen the most basic configuration for conducting a breath test. In Ohio, per the Ohio Department of Health training manual, the standard BAC DataMaster software configuration for conducting a breath test is a "blank test," followed by an "internal standard check," followed by the "subject sample," followed by a "blank test." Per the same manual, the configuration for the BAC DataMaster cdm is the same but rather than the term "blank test," they use the term “air blank.” Thus, the protocols for all DataMasters used in Ohio can be summarized as:

Air Blank → Internal Standard → Subject Test → Air Blank.

As discussed below, “internal standard” is somewhat of a misnomer and description of it in the ODH DataMaster training manual as an “accuracy check” is misleading at best.

PRACTICE TIP: Breath testing nomenclature can be confusing as two terms can be interchangeable; this is the case with “blank test” and “air blank.” The latter term is more broadly used in the industry which may be why NPAS adopted it with the newer cdm model. Worse yet, terms used by one breath test manufacturer may have a different meaning altogether when used by a different manufacturer. Thus the terms “Invalid Sample,” “Deficient Sample” and “Incomplete Sample” may have different meanings, depending on the device being used. In addition, some manufacturers allow the end-user to decide what code will be displayed when a certain condition is present. Finally, manufacturers tend to modify the published definitions of terms. Undoubtedly, this often occurs at the request of customers. At the end of this section are terms and definitions used in various BAC DataMaster manuals. You will note that there are duplicate terms with differing definitions.

The chart below indicates DataMaster filters for each machine type and also compares them to the Intoxilyzer 8000 ®.

Instrument Model	Primary Filter	Secondary Filter(s)	Optional Filter(s)
Standard BAC DataMaster	3.44 microns	3.37 microns	none
DataMaster cdm	3.44 microns	3.37 microns	3.50 microns
DataMaster DMT	3.44 microns	3.37 and 3.50 microns	none
Intoxilyzer 8000	9.37 microns	3.47 microns	none

As shown above the BAC DataMaster has two filters, but the DataMaster cdm often has three filters. The use of all three filters is standard on the DataMaster DMT.

Data Storage and Computer Downloads

All BAC DataMaster Models are designed to internally store data produced during a breath test including but certainly not limited to the readings produced during the test. This model was named the “DataMaster” for that very reason. The new DMT model with its Windows-based computer system *should* be able to monitor and record all of the processes involved in the testing, as well as the results of all tests. All BAC DataMasters come off of the production line equipped with computer communication abilities. As discussed below, we know that the DataMasters used in Ohio monitor such things as air flow and air volume, and send the data to the CPU. Thus, this data could easily be stored and provided to the accused. Such data has been very useful to the defense and problematic to the prosecution in cases involving the Intoxilyzer 8000, which does save and download such information.

The downloading of data and information for all subject tests, instrument checks, calibrations, and operations conducted on a specific machine can be accomplished with the use of the DM Host program. The DM Host is computer software that allows a PC or laptop to communicate with the DataMaster, and compiles the data in a useable format. An RS 232 communications cable or a dial-up modem connection can be used to connect the computer to the DataMaster. If you look at the back of any DataMaster you will see a receptacle for a modem cable to be plugged into.

Ohio does not use either the data storage or computer downloading features.

Flexible and easy to Reprogram by User

The DataMaster is designed to be flexible. It is preprogrammed to allow the end-user to select many operating functions, without changing software. For example, an operator with the “supervisor password” can press a few keys and set the device so that it will administer more than one subject test as a part of its testing sequence. Additionally, the operator can set the instrument to conduct multiple instrument checks, using either a wet bath simulator or dry gas canister, during the subject test sequence. Using these features would provide better quality assurance and control, and bring the testing protocol closer to compliance with sound scientific principles of reliable breath testing. In Ohio, while the end-user is the police officer, the functions to be employed are selected by the Department of Health, which advises NPAS on how to preset these devices. “Senior Operators” do, however, have the supervisor password and thus, technically, have the ability to change the functions operable during a breath test. The Department of Health also selects other programing options. Interestingly, neither the breath test protocol nor the options selected by the ODH have been formally adopted and published in the Ohio Administrative Code or elsewhere.

BAC DataMaster Basic Operation

To operate the DataMaster once it is plugged in, warmed up, and the “Ready - Push Run” display appears, the operator inserts an evidence ticket, presses the “Run” button, enters a password and then completes basic data entry with information such as subject’s name etc. Once that is complete, the data is printed on the evidence ticket, the ticket is advanced, and the machine is ready to begin its pretest process.

During the pretest process, the machine first automatically purges its sample chamber by pumping through an “air blank” or “blank sample” comprised of ambient room air. In doing so, the machine attempts to purge itself of any residue of the previous sample in the chamber. During this process, the display will read “Purging.” The display will then read “Ambient Zeroing,” and begins a process known as “zeroing out” or “resetting zero.” During this process the machine takes readings of the “air blank” in a similar manner as when a breath sample is being analyzed.

The Blank Test Fallacy

If there is alcohol or an interferent in the ambient air, the machine should produce positive readings when analyzing the air blank. However, no readings are displayed on the display or printed out. Presumably, these are readings that could be stored in the machine’s memory. If the machine receives positive readings as a result of alcohol or other contaminants (interferents), the machine purportedly adjusts itself or “resets its zero point.”

The theory is that if there is any alcohol or interferents in the ambient air during the blank test, a similar amount would be added to the subject test result. Resetting the zero point means the machine would, in effect, subtract out whatever the ambient reading was from the subject test result. This assumes that any reading is caused by alcohol or an interferent, and not some other cause. Moreover, we are required to "trust" that the machine does this properly, as no report is provided advising us as to what the reading was during the ambient air test or showing how much, if any, was deducted from the subject test.

Other things will also cause readings during this process. Most commonly, the machine will get positive readings from the air blank due to the presence of "electronic noise" within the device. Virtually all electro-mechanical devices produce an electronic signal typically called "electronic noise." This noise can cause the DataMaster, or any similar breath testing device, to produce a positive reading even when the sample chamber is completely free of alcohol or other compounds (interferents) that will cause a positive reading. When the machine zeros, it supposedly removes the noise from the equation. However, that assumes the noise is constant and non-fluctuating. Radio Frequency Interference not flagged by the detector or other external electromagnetic energy could also cause "ambient" readings.

Although we do not know what it is, there is obviously a threshold level for the readings during the blank test above which the device will not attempt to reset its zero point. We know this because in those instances, the device will terminate the testing process and give an error message of "ambient fail" or "system won't zero."

After zeroing out, the display will then read "Blank Test" and again an air blank of room air is tested. Note that, at this point, the zero level is purportedly set to account for ambient conditions. However, this air blank test need not give a zero reading either. The machine is programed to ignore a reading below a certain threshold. In Ohio, we are told that the threshold is anything below a .003. The machine can be programed to report the reading or not report the reading. If the reading is above the threshold level, the machine will end the test cycle and "Ambient Fail" will be printed on the evidence ticket.

After the blank test, the machine display will read "Checking Internal Standard." Officers will describe this process as "a check for accuracy," but this is a very misleading description. See discussion below of the Internal Standard Check and the "quartz plate" used in this process.

Breath Sampling

After all of the above, the device is ready to accept a breath sample. The display will ask the operator "Subject Refuse <Y/N>." If "Y" is entered, the sequence ends and an evidence ticket is printed saying "subject refused." If "N" is entered, "Please Blow" appears in the display. The subject is then told to blow into a disposable mouthpiece which has been inserted into the breath tube. The mouth piece contains internal baffles which allegedly prevent saliva from being introduced into the machine. However, by putting water in your mouth and blowing through a mouthpiece you can show that water will easily pass through it. In fact, you can even produce a steady stream, like a squirt gun.

On the other hand, those baffles may trap saliva that contains alcohol. If that is initially trapped in the mouthpiece and then blown into the breath tube and sample chamber, the reported subject breath test reading may be a cumulative reading. If the subject requires a second test sequence and the mouthpiece is not changed, the saliva that contains alcohol may get sucked into the sample chamber during the next test purge phase. That process could result in a false zero reference. Additionally, water, or practically anything introduced into the sample chamber that is not supposed to be there, could cause an inflated reading or an invalid sample reading if the object or substance blocks or defects infrared light. See Invalid Sample discussion below.

PRACTICE TIP: DataMaster manuals used to list a "particularly moist sample" and/or "saliva droplets" as a possible cause of an invalid sample; perhaps, not surprisingly, when that explanation appeared in the manual, officers frequently claimed to have observed that the subject spit into the mouthpiece. Newer manuals assert that blowing patterns may cause invalid samples, and officers now report observing subjects "not blowing right" or "sucking air back through the breath tube" during just about any subject test that produces an Invalid Sample. As discussed below, sucking air back through breath tube should not occur with a properly working machine. Moreover, the power of suggestion seems to play a big role in these "observations."

The subject breath sample goes through the mouthpiece and breath tube, and enters the machine. In some configurations, there is a one way "check valve" at the bottom of the breath tube, in other configurations, the check valve is fitted to the tubing inside the case before the sample chamber. This valve is meant to only allow air to flow into –and not out of- the sample chamber. Thus, if the machine is "in proper working order," the subject should never be able to suck air back out of the sample chamber and cause an invalid sample error message; yet we have heard officers claim, innumerable times, to have seen this happen during a subject test.

Once inside the machine, the breath sample passes across a thermistor. The thermistor is a device that attempts to measure breath flow by measuring heat displacement and replacement. Breath flow and breath volume are very important as the DataMaster assumes that a certain flow rate and volume are needed to ensure a sample of deep lung air has been provided and is free of mouth alcohol or other extrinsic alcohol. Thermistors are not the best devices for measuring air flow if accuracy of the measurement is truly the goal. From review of hundreds of maintenance and repair records, it does not appear that these thermistors are ever checked to see if accurate measurements are being provided. With the DMT model, the thermistor was finally retired in favor of a mass airflow sensor.

After passing the thermistor, the breath sample is directed by a five-way valve into the aluminum sample chamber described above. A five-way valve is used as it allows the machine to accept an air blank or sample from a simulator and direct it through the same path the breath sample travels, after the sample passes through the mouth piece and breath tube. Note that typical simulator tests and air blanks do not travel through the same path as breath, prior to reaching the five-way valve.

The five-way valve also allows the machine to, more or less, seal off the sample chamber once the "sample acceptance parameters" are met. After passing through the five-way valve, the sample travels through the three stacked tubes to the end of the last tube, then heads out of the machine through a "breath out" port.

PRACTICE TIP: Note: a company named Toxtrap manufactures a simple device that allows breath samples exiting the machine to be captured and later analyzed via gas chromatography. Subjects in Ohio are not given the option of having their breath sample preserved and independently analyzed.

At the same time the breath sample travels through the sample chamber, infrared (IR) light, or energy, also travels through the chamber. There is an infrared light source just outside the front end of the sample chamber and a window at that end through which the light enters the chamber. At the other end of the sample chamber there is another window leading to the Detector Block Assembly.

Although it is really a heat source, which does not produce visible light, it is easiest to visualize the IR light source as a flashlight beam, but instead of visible light, it sends out a beam of IR energy. The beam goes into the first tube in the sample chamber, and at the far end of the tube, the beam hits an angled mirror that reflects it into the second tube; another angled mirror at the end of the second tube reflects the beam into the third tube. This process is employed to lengthen the light path to a length of 1.1 meters.

At the opposite end of the chamber, the IR light exits the chamber through another window and ultimately hits the detector, which causes a conductive reaction that the device converts into a reading. Readings are taken and recorded every quarter second.

The above process is what lawyers and judges are generally told breath testing consists of: an IR beam passes through a breath sample, some of the IR energy is absorbed by alcohol in the sample, the detector "reads" the IR light, and the machine tells us how much alcohol is in the sample based upon how much IR light was absorbed. This is also what police officers are told and they repeat it to judges and jurors. This sounds like a simple process and, of course, the simpler it sounds the more accurate and beyond question it seems.

But it is not that simple. Breath testing involves many more steps and processes. These additional steps and processes are required in order for infrared breath alcohol analysis to be remotely accurate. However, as discussed below, these processes involve certain, generally undisclosed, "fudge factors," as well as secret settings and computations. By fudge factor, we mean that the device is given certain leeway in regard to its measurement.

For the most part, these additional steps and processes involve parts that are located within the Detector Block Assembly discussed below.

Detector Block Assembly

At the end of the last tube in the sample chamber, is a glass window. Just below that window is the "breath out" port. At this point, the breath leaves the sample chamber, and ultimately the machine, but the IR light continues on. As the IR beam leaves the sample chamber, a "focusing lens" directs it into the Detector Block Assembly. Within the Detector Block Assembly, are several important parts, without which the machine simply would not work. These parts include: the "chopper wheel," the "quartz plate," and the "filter lens assembly," containing the 3.44 and 3.37 micron lenses (at minimum). These parts and their functions are discussed below.

The Chopper Wheel

The detector in the DataMaster will conduct and react to any current produced by, or flowing through, the device. Thus, it reads any non-infrared energy produced by or flowing through the device as well as the IR energy. The designer had to find a way to separate out these the IR readings. The answer was simple; since the energy (electricity) needed to run the machine is direct current (DC) converting the IR energy to alternating current (AC) distinguishes it. That is the purpose of chopper wheel; it is used to modulate or "chop" the IR signal; visualize a flashlight shining through a fan. This process purportedly allows the device to better distinguish the base current flowing through it from the current produced by the IR energy.

In the factory training materials NPAS advises that the AC signal output is approximately 550 hertz. Later materials used in DataMaster DMT training list the signal output for the DMT as 525 hertz. 1 hertz is equal to 1 cycle per second. Thus presumably the DataMaster detector receives 550 distinct pulses per second and the DMT detector receives 525 pulses per second.

Compare this to the Intoxilyzer 8000 which pulses the energy at the IR source rather than chopping the signal as it comes through. Pulsed IR sources used in breath instruments can only produce a maximum of 4 pulses per second. For more information and comparisons between these devices, see the publication featuring Dr. Staubus' work mentioned above.

The bottom line is that each of these pulses creates a "reading" or a potential reading and thus the Intoxilyzer 8000 has a lot less potential readings to work with. This is very important, for one thing; less readings means less ability to monitor the stability of the signal and/or detector. Just as importantly, less readings means less ability to monitor the "alcohol slope" and flag potential mouth alcohol, extraneous alcohol contamination. (See Sample Criteria for a Valid Sample below.) This helps explain why the Intoxilyzer 8000 appears to be significantly less capable of flagging extraneous alcohol contamination than the DataMaster or the earlier Intoxilyzer 5000 models, which, like the DataMaster, chop the IR signal.

The Detector

Below we will discuss other steps that occur before the signal reaches the detector but ultimately it is when the above mentioned pulses hit the detector that a reading or potential reading occurs. For nerds who care about such things; the detector in the DataMaster is made of PbSe material. That is only important because this material is a good "photoconductor." This means it conducts electricity to an extent that depends on the intensity of light-radiant energy striking the surface of the detector. In short, the material is useful in measuring the intensity of light-radiant energy.

Each time a pulse or burst of IR light strikes the surface of the detector it produces a reading or potential reading. We are told that the microprocessor in the machine is monitoring or watching these readings. Frankly, we have not been told what, if anything, it does with most of these readings or potential readings. Similarly, we do not know if those readings or the calculations or conclusions the machine makes based on them are stored in the computer memory.

We do know that the DataMaster "takes a reading" every quarter second and saves those readings. These quarter second readings are critical in determining whether presumably valid sample is obtained. See "Sample Criteria for a 'Valid' Sample" below.

The PbSe material is more sensitive the colder it is. NPAS reports that the detector in the DataMaster is cooled to an operating temperature of 0 degrees Centigrade. A thermoelectric cooler is utilized and a thermistor is used to monitor and regulate the temperature. (See discussion of thermistors herein.)

Quartz Plate and Internal Standard Checks

As noted above, the quartz plate (really a quartz disc) is used to conduct what is called an "Internal Standard Check," as a part of the pretest. In simple terms, during the Internal Standard Check, the IR light is directed through the sample chamber and then the quartz plate is inserted between the sample chamber and the detector. The quartz plate blocks or diffuses some of the IR waves. When the machine is calibrated at the factory, the amount of energy the detector reads when the IR beam is passed through the quartz plate is stored in the machine's memory. If, during subsequent Internal Standard Checks, the detector reads a similar amount of energy, the machine passes. However, if the amount of energy the detector reads during the pretest Internal Standard Check is "significantly" higher or lower than the amount reported during calibration, the devise should not pass the Internal Standard Check. See "How much can the Internal Standard be Off" below, for discussion of what "significantly higher or lower" might mean.

Mr. Adams and Mr. Huey have both received training on the operation of the DataMaster at the NPAS factory. During that training the following explanation is given relative to the quartz plates:

> The reasoning behind utilizing the quartz plate is that, once a specific machine is calibrated, the quartz plate or disc in that specific machine will permit only so much light through to the detector. This verification system is also referred to as beam attenuation and the quartz plate or disc would be a beam attenuator. The amount of light that is allowed through to the detector should not change significantly unless something has transpired to cause a change, or the machine has been recalibrated. The light that reaches the detector produces what looks like an alcohol reading as it relates to how it is reported, but in reality, it is not an alcohol sample. The internal standard reading is measuring the amount of infrared energy at the vital wavelengths blocked by the quartz plate. This is not the same wavelength used for detection of alcohol; however the machine reports it as an ethanol sample. Typically, the reading will be between 0.075 and 0.110 g/210L. It will only apply to the quartz disc in the specific machine under the current calibration. The value designated at the time of the manufacturer's calibration should not change significantly assuming the device is well calibrated, maintained, and serviced. The internal standard value is subsequently measured during a subject test and compared to the value that was stored in the machine at the time of the last calibration performed by the manufacturer. If there is a significant difference a status code error message indicating "Calibration Error" should appear on the visual display of the machine. Conversely, the DataMaster Evidence ticket should indicate the internal standard is "verified" if the machine is theoretically operating properly at the time of the subject test.

As noted above, during the calibration process, the quartz plate reading is stored in the computer memory. Anyone with a Senior Operator password could retrieve and print out this value and other "calibration factors" by pushing a couple buttons. Indeed, while it is unlikely that any would do so, Ohio officers are provided the instructions for retrieving and printing out this information. This reading, as well as the reading during the Internal Standard Check, would seem to be important information that the defense should have access to. However, if you do obtain this information, remember that although a reading generated by the analysis of the quartz plate will be reported as if it was a reading of grams of alcohol per 210 liters of breath, it is really only a reading of how much light made it through the quartz plate.

PRACTICE TIP: The machine reports the quartz plate result as if it were reading an alcohol sample because that is what it is trained to do – report any reading as alcohol. Hypothetically, if a BB was blown into the sample chamber, the machine would report the amount of light it blocks as a breath alcohol reading.

Passing or Failing the Internal Standard Check

It is interesting to note that the error code is not "Internal Standard Failure" or "Machine Needs Repair," but those are much more accurate descriptions of the situation. It is extremely unlikely that the error resulted from something that occurred during the calibration of the device, and while it might show that the device is "out of calibration," that is a very generic term. When the device fails this test what it really means is that it is very likely that something is seriously wrong with one of the many mechanical or electronic parts in the machine, or with the computer. Simply "recalibrating" the machine is not likely to fix the problem.

Not an Accuracy Check

Moreover, as previously noted, the term "accuracy check," which officers are taught to use, is highly misleading. What the check really does is determine whether the IR light source, the chopper wheel, and the detector are, more or less, working properly.

Calling this an accuracy check is like taking a sniper rifle, aiming it at a target two feet away and pulling the trigger. If the rifle fires and hits anywhere in the biggest circle of the target would you call that an accuracy check?

How much can the Internal Standard reading be off and still pass the test?

As stated above, if the reading during the Internal Standard Check is "significantly" higher or lower than the amount reported during calibration, the devise should not pass the check. How much is significant?

The authors have been advised by NPAS that the range typically programed into the device is plus or minus 10%. However, if a state specifies a wider or narrower range, the machine can be programed at the factory to accommodate such specifications. It is important to note that if the range is (only) plus or minus 10%, the Internal Standard Check can show that the machine is providing readings up to 10% higher than it should and the machine will "pass" the test. Additionally, since Ohio has chosen not to do external standard checks during subject tests done on DataMasters, even though it requires them on Intoxilyzer 8000 tests, the only check done during subject testing can show that the machine is reading 10% higher than it should and the testing officer will assert that "the machine passed an accuracy test" just before your client's breath was analyzed.

Perhaps most importantly, the readings done in the pretest are not printed out. Neither the pretest readings nor the readings obtained during calibration are provided to the defense, the court, or the jury. One would think that if the machine was off on such a basic test by 10%, this would be information a jury would want to know about. Moreover, without access to the pretest readings and the readings during calibration, the manufacturer's claims are impossible to verify. Without the ability to verify the process and the readings, this "check" is no more than the machine saying "trust me I am working fine." Our scientist friends often say “there is no *trust me* in science.”

Note: some of the NPAS publications indicate that the machine will “compensate” for the amount the quartz plate is off on “all subsequent readings.” It is not clear if that means subsequent readings during that test cycle or, as it states “all subsequent readings.” And, again, we have no way of knowing if the machines in use in Ohio are set up to do this, or how the machine purportedly compensates for the lack of precision. Once again, we are required to trust the machine.

Filters and Interferents

As shown in the chart on a previous page, the filter assembly in standard DataMasters and most DataMaster cdms contain two IR filters. One of the filters attempts to filter out all IR wavelengths, except the 3.44 micron wavelength (range), and the other attempts to filter out all but the 3.37 wavelength (range.) We have parenthetically inserted the word “range” here because the authors have been told that these numbers are approximate, due to quality of the filters and/or loose product specifications.

NPAS manuals describes these as “two narrow band pass filters; the 3.44 micron filter used to attempt to identify ethanol and the 3.37 micron filter used to attempt to identify and exclude interferents.” As discussed below, the key word in that sentence is “attempt,” as the 3.44 filters does not and cannot identify ethanol to the exclusion of a 100 or more other organic compounds and similarly the 3.37 filter does not identify interferents. Given the foregoing, it should not be surprising that one cannot say the use of these filters actually accomplishes either of the stated goals.

Unlike with the Intoxilyzer 5000, which utilizes a spinning wheel containing several filters (see a filter wheel discussion in the Intoxilyzer 5000 section below), in the Datamaster, the filters are sequentially moved into the light’s path; you can actually hear the click when a filter is set in place. These filters are used to provide the machine two or more readings for comparison purposes.

The device will first take readings through the 3.44 micron filter. These are the readings being taken as the subject blows into the breath tube. Once the “sample acceptance criteria” (discussed below) are met, the five-way valve in front of the sample chamber engages, and the sample is trapped in the chamber. The machine continues taking readings through the 3.44 micron filter and then the 3.37 micron filter replaces it and additional readings are taken through that filter.

The readings taken when the 3.44 micron filter is in place are used to determine the “alcohol profile” or “slope” (discussed below) and are used to provide the final breath alcohol reading. As noted previously, the machine is designed to view as alcohol anything that causes a reading or contributes to a reading. Since many organic compounds, including, but not limited to, acetone, will cause readings at the 3.44 micron range, there is obviously a need to, as NPAS says, “attempt to identify and exclude interferents.” That is the reason readings are taken through the 3.37 micron filter, but even in theory this would not “identify” any interferents. In any event, the purpose of the 3.37 filter is to provide the machine a comparison. The idea is that, while the readings will be different at each micron level, if only alcohol is in the breath sample, the readings from the two filters should be proportional.

How the filters work in theory

Since the DataMaster primarily does its analysis using the 3.44 micron filter, it may aid our understanding if we restate the basic theory as to how infrared breath testing works, as set forth in Section 11.7, using this wavelength.

If the air in a sample chamber contains a known quantity of alcohol, and no other interferents, and a known amount of infrared energy is sent through that chamber and all infrared energy is filtered out, except infrared energy with a 3.44 micron wavelength, a certain amount of the IR energy will be absorbed by the alcohol molecules and the rest will pass through the filter. One could measure the percentage of energy exiting the filter and thus know how much IR energy was absorbed.

Now add to the above, the fact that the alcohol molecule will also absorb infrared light at the 3.37 micron wavelength, but that the percentage of absorption at this wavelength is significantly different than at the 3.44

micron wavelength. Therefore, if the same process were repeated at 3.37 micron wavelength, a *different* percent of the IR energy will be absorbed.

Let's say that, at 3.44 microns, we had 75% absorption, and, at the 3.37, we have 25% absorption, then the ratio between the filters would be 3 to 1. When an unknown amount of alcohol is in the chamber and the process is repeated, the ratio of absorption should be the same between these two filters. If that ratio is off, there is a problem. Note: the above process of establishing a known ratio is something the DataMaster is programed to do during the calibration process. See Calibration and Instrument Checks below.

But remember that our theoretical explanation of how infrared breath analysis works assumed many things including: (1) that the amount of infrared light is known and precise and not subject to variation; (2) that the device can filter out all infrared light except the IR light at a specific wavelength; and (3) that we have a device that precisely measures the IR light coming out of the chamber. In truth, no breath device utilized by law enforcement comes close to meeting these attributes. Thus, as previously noted, they have to have certain fudge factors built into the program.

In the case of the filters, the manufacturer does not require that the agreement between the filters be identical to the ratio the machine establishes during calibration process. Thus, in our hypothetical, instead of requiring 3/1 ratio, the manufacturer may accept a range, say, 3/.99 to 3/1.1, or perhaps a wider range of, say, 3/.50 to 3/1.5. The first range, being narrower, would be more likely to spot interferents than the much broader second range; however, it might flag them too often to be to the liking of the manufacturer or the end-user. We have no way of knowing or verifying what filter agreement fudge factors are programed into Ohio DataMasters.

The use of the two filter comparison in order to spot or flag the presence of interferents assumes that none of the 100 or so organic compounds that can be on the human breath absorb infrared energy at the two selected wavelengths, in approximately the same ratio as alcohol. Remember, also, that these filters are not precise enough to filter out all IR light, except the light at the selected wavelength, but rather, narrows it down close to that wavelength.

Thus, one question is how many other compounds can be found on the human breath which absorb at the two filter ranges in a similar ratio as alcohol? Such interferents may be missed by the breath testing device, particularly given the built in fudge factor. While it seems no effort has been made to ascertain the answer to this question, the fact that a third filter has been added to the new models certainly seems to be an acknowledgment that this is a problem. The British certainly seem to think so. (See discussion below.)

The Optional Third Filter

In some DataMaster cdms and all DataMaster DMTs, a third filter has been installed. This is used to take readings in the range of 3.50 micron wavelength. The reason this filter was added was because NPAS wanted to market their DataMaster cdm device to end-users in England. English scientists believed that other compounds are common on human breath and, apparently will be missed using the 3.44 and 3.37 filter comparison. One of these compounds is Diethyl Either. It is interesting that NPAS says on the one hand that, in essence, the English went a bit overboard and that this is not really an issue. But, on the other hand, they made this third filter an integral part of the design of the Datamaster DMT. Moreover, NPAS will concede that having three filters for comparison purposes is better than having only two and having four filters is better than having three. Obviously, having only two filters is good enough for Ohio.

What happens when there is an interferent?

According to NPAS:

> "each using agency [or state] has the discretion of specifying how the DataMaster handles the presence of interfering substances." *Basic Science of Evidential Breath Alcohol Testing*, John D. Fusco & David M. Radomski (2003). (These are self-published materials NPAS uses to conduct training classes.)

Additionally:

> "***Some*** options include quantifying the amount of interference present in the sample, assuming it is acetone, and report the corrected ethanol concentration or simply aborting the breath test altogether if interference is detected." *Id.* (emphasis added.)

Since only "some" of the options are listed, one must assume other options exist, and we are left to wonder what those options are. Is just ignoring the interference an option given to the end-user?

Presumably, the Ohio Department of Health has advised NPAS as to how Ohio DataMasters should handle interferents. However, that directive has never been published. Note also that the phrase "the presence of interfering substances" above may be a loose term, as it appears the end-user can specify the threshold level below which the machine will not flag interference.

Interestingly, the Ohio Department of Health DataMaster Study Guide, Revised 2009-1, states relative to the standard DataMaster models:

> "If **acetone** or other interfering substance is detected in the sample **INTERFERENCE** will be displayed. If interference is present, the instrument will separate and print the interference level below the subject sample on the printout. The alcohol level printed will be correct." (emphasis added)

However, on the same page of that guide says, relative to the DataMaster cdm:

> "If **acetone** or other interfering substance is detected in the sample, the test will abort with 2 short beeps. Push **RUN** to restart test." *Id.* (emphasis added)

Does the above mean that, under Ohio's protocol, interference is treated differently if a subject is tested on a cdm versus a standard DataMaster? If so, what is the basis for this different treatment? Which protocol provides a more reliable result?

Review of various, generic (not Ohio specific) NPAS manuals tends to indicate that a reading of .003 or less is the typical threshold for "the presence of an interfering substance." Does any of that or any of the above information really tell us what happens with Ohio's machines; especially the notation that Ohio "has the discretion of specifying" what happens when the machine detects the presence of interfering substances?

Sample Criteria for a "Valid" Sample

For a breath sample to be viewed by the machine as a valid sample, three basic criteria must be met: 1) the machine must read that the person is providing enough air pressure to meet a "minimum flow" rate, 2) based on those readings, a "minimum volume" of air must be received, and 3) the "alcohol profile" or "slope" has to have the characteristics that the machine has been programmed to view as the characteristics of an uncontaminated deep lung air sample.

The process works like this: as the subject blows air into the device the IR signal passes through the sample and the chopper wheel chops the signal such that the detector is receiving 550 pulses or readings every second. The device monitors those readings and saves (records) one every quarter second. This is done while the 3.44 micron filter in place to establish a "breath alcohol profile" discussed below. The device also monitors the information from the thermistor, which, as noted previously, is used to measure air flow. To have a valid test, the readings from the thermistor must establish that the subject is providing a minimum flow rate of approximately 3.7 liters per minute, and that a minimum of 1.5 liters of air has been delivered to the device.

When the subject is meeting the 3.7 liters per minute flow rate, the device sounds a steady audible tone and the "Please Blow" display remains constant. When the minimum flow rate is not being met, there is an intermittent tone and “Please Blow” flashes. According to NPAS, a blow of 4 to 5 seconds can meet the DataMaster flow, volume, and “slope” criteria. On the other hand, if a person blows at the minimum flow rate, it will take 20 seconds to reach the minimum volume. Note: any time the person stops blowing or the air pressure drops below the minimum threshold, the previous readings are not supposed to be used in determining whether the valid sample criteria are met.

The Alcohol Profile

In addition, the flow and volume criteria the “profile” established by the quarter of second readings -which purport to show the alcohol in the sample- must first be rising then plateauing or only rising slightly. To make this determination, the machine is designed to take two consecutive readings, average them, and then compare that result to the average of the next two consecutive readings and compare that average to the average of the next two consecutive readings and so on. The comparison between these averages helps define the slope.

When the profile rises and then plateaus or begins to show only a slight rise the device accepts this as a valid profile, meeting the characteristics of a deep lung breath sample as determined by the machine’s programmers.

To be plateauing or only slightly rising the machine’s comparison of one two-point average to the next two point average must be equal to or less than a reading of + 0.001 grams per 210 liters and the amount of the second average cannot be less than the first average, if it is less that would be a negative slope and should trigger an invalid sample, see discussion below. Note: from four readings there will be three averages as the first and second reading are averaged, then the second and third, then the third and fourth.

When Sample Criteria are met

Once minimum flow, minimum volume and the proper profile are obtained the “sample criteria” are met. (See chart at the end of this section.) However, the machine will continue to read the sample until the airflow drops below the 3.7 liters per minute minimum threshold, at which point the machine assumes the subject is running out of breath, as one would at the end of a deep breath. When this occurs, the sampling will be complete and the tone will stop.

With the Ohio DataMasters, there is no way to verify or challenge whether any of the above actually occurred in a given case. In particular, there is no way to verify that plateauing occurs, or that there was not a negative slope the machine missed; we are provided no data from DataMaster tests. On the other hand, data related to breath volume, the number of sample attempts, and sample duration data which have been provided relating to the Intoxilyzer 8000 has been useful in raising questions about some subject tests on that machine. See Huey Intoxilyzer 8000 Vindicator Article 2012 in the Book-Disc.

Once the tone stops, the five-way valve will be activated. Air can no longer enter the sample chamber and the breath sample, in essence, sits there. The machine completes its measurement of the IR light that has passed through the 3.44 micron filter, which is then replaced by the 3.37, as discussed previously. If there were a 3.50 filter, reading from that would follow.

After the test, the machine runs another purge cycle. The DataMaster cdm does a second ambient zeroing, after the final purge; the standard DataMasters do not. Does this second ambient zeroing improve the accuracy of the readings and/or provide an additional safeguard? If not, why was it added to the protocol programed into the newer Ohio machines?

Timing Out

Once the “Ready - Please Blow” message appears, and the beeping tone starts, a subject has approximately two minutes to provide a sample the machine accepts as valid. After that, the machine will “time out” and will, depending on the software, either produce an “Incomplete Sample” message, or a message that asks the operator “Subject Refuse <Y/N>.” If the operator types a “Y,” then “Subject Refused” will be printed on the evidence ticket, if an “N” is entered, the ticket will show “Subject Sample Incomplete” or “Subject Test - Incomplete Sample,” and the operator will push “Run” to start a new two-minute window. Note: the machine does not make a determination that the person is refusing. If a breath ticket shows the subject refused, it is merely reporting the opinion of the operator.

Mouth Alcohol, the "Slope Detector," and Invalid Sample Errors

The manufacturers of the DataMaster and other infrared breath testing devices concede that fuel cell devices are more specific for alcohol. However, they select IR over fuel cell analysis because IR allows the device to provide sequential readings as the sample is being collected. This, in turn, allows the device to monitor the progression of such readings. The manufacturer of the DataMaster refers to this as monitoring the "breath alcohol profile." As noted previously, those who program these devices assume the breath sample will initially have less alcohol in the sample reflecting the "tidal" sample, and as the person empties her lungs, the alcohol level in the sample will be greater. (See, however, discussion of research done by Dr. Hlastala, the only pulmonary expert to study breath alcohol testing, discussed earlier in this chapter, which calls these assumptions into question.)

Thus one benefit in using an IR device, is the ability to look for a profile that shows readings that are at first rising, then plateauing. However, the primary reason one would select the less specific IR analysis method over the more specific fuel cell, is that the IR devices are better at spotting contamination by extraneous alcohol that did not come into the sample through the deep lung blood-breath exchange, discussed earlier in this chapter. Note: the term generally used to describe this extraneous alcohol is "mouth alcohol," even though it may originate in the oral cavity or elsewhere, such as the stomach or esophagus.

Mouth alcohol has long been known to be a potential source of error in breath alcohol testing. Moreover, the manufacturer of the DataMaster has consistently conceded that no IR device can completely eliminate the possibility of such extraneous (mouth) alcohol contamination (especially in drinking subjects). However, the DataMaster software is designed to attempt to spot or "flag" a sample that appears to meet a certain profile, which the programmers believe is characteristic of mouth alcohol contamination. Or, put another way, the machine flags a profile that does not meet the characteristics of what it has been programed to accept as a proper, uncontaminated, breath sample.

The methodology employed in this process is often referred to as a "slope detector;" however, there is no such detector per se. More accurately, the software program is designed to flag certain "negative slope" occurrences. That means if the progressive readings, rather than showing a rising and then nearly plateauing pattern, instead show a rising and then a significant drop or a spike and a drop, the device should flag this and report it as an "Invalid Sample." Remember that the device takes two readings or "points," averages them, and then compares that with the average of the next two points. According to NPAS, the DataMaster will report a test as an "Invalid Sample" anytime there is drop in the readings of three consecutive two-point averages, after a "positive slope." It is unclear how many readings must be rising for the machine to conclude there was a positive slope; moreover, it appears "drop in readings" may be a term of art. We have been told that a drop has to be "significant," thus not just any drop in readings will be flagged.

Remember that, according to the manufacturer, a valid breath sample meeting all necessary criteria can be obtained in 4 seconds. This would seem to be a very small number of data points for the machine to consider in determining whether the sample was valid or invalid.

Note also that, if the subject stops blowing ***or at any time while she is blowing the thermistor reports that her breath flow has dropped below the minimum threshold*** prior to all the acceptance criteria being met, the machine is supposed to ignore all prior data points and begin analyzing a new "profile."

What does an Invalid Sample Error Message mean?

If we look to the manufacturer's manuals for a definition and explanation, the answer depends on which manual you happen to have in front of you. Below are four different notations about invalid samples from four different manuals. These notations are listed below in chronological order based on the publication date on the manuals.

> “INVALID SAMPLE: The instrument has detected a negative going value during the test that is inconsistent with the expected test progression (i.e. mouth alcohol.)”

This notation appeared in the original DataMaster manuals and in follow-up manuals for many years. In essence, it says that what causes the Invalid Sample is that the machine has reported that the alcohol profile did not match the parameters it was programmed to view as a sample of deep lung air uncontaminated by extraneous alcohol “i.e. mouth alcohol.” The use of “i.e.,” rather than “e.g.” is telling. I.e. stands for id est or, in English, “that is.” E.g. stands for exempli gratia or, in English, “for example.” Thus, originally, and for many years, NPAS took the position that if an Invalid Sample error message was seen, it meant there was mouth alcohol present—period.

> “INVALID SAMPLE This message is seen only during a subject or simulator test if conducted during the subject test mode. The instrument has detected a negative going value during the test and the assumption is that there is mouth alcohol present. This can [also] be caused by a subject blowing too hard as saliva droplets can be forced through the mouthpiece and into the sample chamber causing a somewhat unstable reading and is more commonly seen when the subject has a very high alcohol level.”

This notation is from a NPAS DataMaster Supervisor Guide with a copyright date of 1994. Note that mouth alcohol is still the *assumed* cause but the manufacturer now suggests a possible alternative explanation. The authors have discussed this explanation with folks at NPAS who conceded that this alternative explanation was not based upon internal experimentation but rather on anecdotal evidence and, they said, to some extent, common sense. The thought process went like this: 1) Officers were reporting that a large number of invalid samples were followed by (presumably valid) tests with high breath test levels; 2) folks at high test levels tend to be sloppy drunks and may have excess saliva and/or be slobbering or drooling etc.; 3) excess moisture can cause the machine to give a false high / spike reading and, therefore, 4) excess moisture in breath sample can cause Invalid Sample error messages.

Note that in stating that moisture can cause an Invalid Sample error, the manufacturer is conceding that water droplets or water vapor can be block or reflect infrared light and affect the reading. While that could cause an Invalid Sample, it could also cause a falsely high breath test result if the machine mistakenly accepted the result as valid.

Note also that once the “saliva droplets” explanation started appearing in the manuals, there was a seemingly exponential increase in the number of instances where officers wrote in their reports that subjects allegedly spit or blew spit into the mouth piece, causing an Invalid Sample. The officers typically marked the subject as “refusing” the test. One has to wonder if this increase was truly a result of folks somehow guessing that spitting in the mouthpiece would help them and managing to pull it off or whether it was a matter of “power of suggestion” affecting officers; upon obtaining an Invalid Sample did the officer jump to the conclusion that it must have been caused by the subject? Typically the officer would assume that since he, the officer, did everything right and the machine is perfect, that the fact that a valid sample was not obtained must be the fault of the accused. Only video in the breath test room can answer such questions and such video ought to be mandatory.

PRACTICE TIP: NPAS representatives will concede, when directly questioned, that the “slope detector” is not fail safe and samples contaminated with mouth alcohol can escape detection leading to inflated test results. Dr. Al Staubus has demonstrated this numerous times with all models of DataMaster and Intoxilyzer 8000 machines at the annual OACDL advanced DUI Seminar, where he will typically bring several machines and allow defense lawyers, judges, prosecutors and police officers to experiment as they desire.

Note: typically, when the ODH or police officers “test” the slope detector, they use a non-drinking subject who swishes alcohol in his mouth, spits it out and then blows. In that scenario, the spike and drop will be dramatic with the drop going all the way to zero. In drinking subjects, the extraneous mouth alcohol spike and drop are not necessarily as dramatic as the spike and drop from the mouth alcohol is often masked (or is less dramatic, obvious) by the concurrent rise resulting from the lung air containing alcohol following the non-lung air. Thus, as Dr. Staubus' demonstrations show, the machines often fail to flag mouth alcohol in the later scenario.

> "INVALID SAMPLE: This message is seen only during a subject or simulator test if conducted in the subject test mode. The instrument has detected a negative going value during the test that is inconsistent with the expected test progression. Usually retesting the subject after a short waiting period will result in a valid test. Consult your state or department guidelines for additional information."

This notation is from a BAC DataMaster & DataMaster cdm Supervisor Guide with copyright date of 1994-2003. Thus, sometime between 1994 and 2003, NPAS decided that it was better to give no explanation as to "actually cause," taking the position that "Invalid Sample" means only that the test was not valid and that it is up to the individual states/agencies to decide why it was invalid, and what to do about it. One might call this a "cause neutral" explanation of the Invalid Sample error message.

This cause-neutral position is very consistent with the general position that NPAS likes to take with regard to any potential issues that come up, related to the *science* of breath testing and the procedures required to ensure minimal scientific accuracy. As stated earlier, the manufacturers do not want to take any position on any such issues, especially any position that might be contrary to the desires of their customers. As discussed in the Practice Tip below, if mouth alcohol is the cause, or the most likely cause, additional procedures may be warranted and an immediate retest on the same machine would not be consistent with basic scientific principles.

> "INVALID SAMPLE: There is mouth alcohol, excessive moisture or starting and stopping blowing."

This is the notation that appears in the more recent NPAS DataMaster supervisor manuals and is the, perhaps, final word for DataMasters in Ohio, at least in terms of anything appearing in an official manual. The above is the sum and substance of what is included in the official DataMaster Renewal guide, published by the ODH Bureau of Alcohol and Drug Testing revised 1-2009; no other information whatsoever relating to invalid samples is included in the 1-2009 ODH BADT DataMaster Guide. It seems unlikely that any new guide or other DataMaster-related material will ever be published by the ODH, as they still appear to be pursuing the goal of replacing all DataMasters with Intoxilyzer 8000s.

In 2002-2003, we began to first hear that "breathing patterns" could cause Invalid Sample error messages. Many officers claimed that they had been told by ODH representatives and/or NPAS representatives that "sucking back" on the breath tube and "stopping and starting" blowing could cause Invalid Samples. One of the authors, Tim Huey, and attorney Terry Rudes, deposed the President of NPAS as a part of the Administrative License Suspension action associated with *State of Ohio v. David Hall*, Ottowa County Municipal Court Case No. TRC-03-0718A (Deposition 3-19-2003.)

In that deposition Mr. Fusco stated that sucking back on the breath tube could "possibly" cause an Invalid Sample; however, he ultimately agreed that the one-way check valve in the machine would have to be extremely faulty for that to occur and that would likely affect other processes. Thus, a machine with such a faulty valve would not be in proper working order. Mr. Fusco also indicated that he believed a breathing pattern where the person started and stopped could cause an Invalid Sample error. He mentioned that a police agency in Canada reported being able to cause this to happen, but had little more information about this "study from Canada," and conceded that NPAS never conducted or participated in any scientific experiments to prove this theory to be true.

Mr. Fusco was also asked what an appropriate waiting period after an Invalid Sample would be. He indicated that he believed the period should be 15 minutes, but that NPAS did not specifically advocate this in their manuals. When asked why not, the following exchange occurred at page 88 of the transcript.

> Mr. Fusco We don't attach a number to it. And the reason we don't is because different states have different policies regarding that and we don't want to step on anybody's toes.
> Mr. Huey It is a political decision?
> Mr. Fusco Exactly.

In general, Mr. Fusco's position at that time was "… it's not our responsibility to explain the science to them." (*Id.* at page 64.) And as to what causes Invalid Samples the position was "we have taken the position … we can't make a valid judgment, so let's give them the technical information." (*Id.* at 63.)

A few months later, in August of 2003, in a training course offered to attorneys at National Patent Analytical Systems, Inc., Mr. Fusco, who is a very intelligent guy but is not an engineer or degreed scientist, presented a theory as to how starting and stopping or "huffing and puffing" blowing patterns could cause Invalid Samples. At that time, David Radomski, the head engineer for NPAS, did not appear to agree with Mr. Fusco's theory. This session was videotaped by Indiana Attorney Charles Rathburn, who helped organize this and several other NPAS training courses, and now occasionally testifies for the defense in cases based upon the expertise he gained through these courses.

While Mr. Fusco and Mr. Radomski disagreed on whether huffing and puffing or stopping and starting could produce Invalid Samples, they both agreed that the DataMaster was designed to try and prevent such breathing patterns, or anything but mouth alcohol, from causing that error code.

By 2005, it appears that Mr. Fusco had convinced Mr. Radomski that his theory could, at least potentially, cause Invalid Samples. They circulated a paper discussing these issues to their customers, under both their names. Regarding these issues, the paper initially states that:

> "The only certain reason that we can give for any instance in which the 'Invalid Sample' message appears is that the reading was going 'down' instead of 'up' as expected. There can be a number of reasons as to why it can go down. Some of these reasons and our position regarding the probability of each causing the 'Invalid Sample' message are as follows…"

Immediately following, the paper states, "Invalid Samples are seen most often on tests where the subject has not provided a continuous sample…" The paper cites no basis for this assertion and conclusion except, perhaps, the report from the Canadian police agency. By and large, the discussions in this paper, as with NPAS's earlier discussions, seem to be based upon anecdotal evidence. The paper notes that "The starting and (premature) stopping of the blow by the subject, while taking a fresh breath between these blows, sucking backwards instead of blowing, and blowing so softly that the flow rate falls below the minimum are some of the more common tactics, among others."

The paper does not say, point blank, that these tactics will cause Invalid samples, but rather says, "These blowing patterns are, at best, unpredictable, and, at worst, are conducive to conditions that will cause an "Invalid Sample" message to occur." However, the basic tone of the paper is that all other possibilities, including mouth alcohol, are unlikely. Thus, the paper states, without citing any source, that non-compliant blowing patterns are the most likely cause of "Invalid Samples." "The officer's notes and recollection of the test are of vital importance in substantiating this kind of uncooperative behavior." Elsewhere in the paper, it is noted that these behaviors can be substantiated by the use of video tape during the test.

PRACTICE TIP: If the science of breath testing is going to come down to the opinion of an officer, who really has almost no training, as to why the machine is registering an Invalid Sample, which is based upon his purported observations and subjective beliefs, videotaping of the breath test room would seem to be necessary. This is something defense lawyers should be demanding from the legislature and arguing to the jury.

We also see NPAS assert, again without any source or documentation, that Invalid Samples are seen most often with subjects with higher BACs. However, excess moisture is no longer mentioned as a possible cause. In this paper it is suggested that those with higher BACs will have abnormal blowing patterns or a bad attitude and thus be uncooperative.

The paper did note that all its assumptions are based upon a proper observation period. However, as noted above, NPAS has declined to take a position on what a proper observation would consist of, as that is one of those "political decisions" they prefer to stay away from. On the other hand, the paper does seem to presume that the officers are watching the subject to ascertain whether there is any sign of regurgitation, burping, etc.

PRACTICE TIP: Practitioners should be aware that the terms "observation period" and "deprivation period" are distinct terms in the breath testing community. The former is what adherence to science would require and would consist of actually observing the subject for the entire period and looking for any burping, belching, hiccupping, crying, deep breathing etc., and noting such observations. During a "deprivation period" the officer simply makes sure that the subject does not put anything in his mouth or "intake anything orally." Ohio actually uses the term "observation period" but, by virtue of the procedure they specify, it is really a deprivation period. Typically you will want to use the term "observation period" when cross-examining the officer; the officer might not think truly observing the subject is important, but jurors might.

Finally, the paper states:

> **"[T]he administration of a second complete test, with an appropriate agreement between the two complete tests, lends substantial additional confidence to the evidence."**

Ohio DataMaster results must then give us substantially less confidence as there is no requirement of two tests and an appropriate agreement requirement between them.

In 2008, NPAS circulated another paper discussing data related to Invalid Samples from DMTs that had been installed in New York State in 2007. NPAS noted that this paper was an "informational report only" and not "offered as a scientific study." For our purposes, the interesting points from that paper are:

1) With the DMT, NPAS changed the sample acceptance criteria requiring a longer positive slope than previously required (previously any positive slope seemed to be sufficient),
2) With the DMT, NPAS added additional situations where Invalid Sample will be triggered:
    a. If any final result equal to or above 0.060 g/210 liters is less than 95% of any previous high reading during that successfully delivered sample, or
    b. If any final result equal to or above 0.003 g/210 Liters but less than 0.060 g/210 Liters is lower than any previous high reading during that successfully delivered sample by at least 0.003 g/210,
3) Approximately 50 % of the Invalid Samples found in the New York testing occurred during fully completed blows, which means they could not have been produced by huffing and puffing.

PRACTICE TIP: NPAS adopting the “cause-neutral” description of Invalid Sample message, seems to be simply a function of the political nature breath machine manufacturing. Historically NPAS acknowledged the cause or most likely cause was mouth alcohol. This is clearly not something their clients want to hear.

NPAS also admits that the “slope detector” will not always flag mouth alcohol when it is present. So if one ignores the Invalid Sample message and retests the subject shortly thereafter, mouth alcohol would very likely still be present and yet missed by the machine. The ostensibly valid result would actually be inaccurately high.

This might explain why, per NPAS, the “valid” results after an invalid sample tend to show the subject having a high BAC level. That is; perhaps ***most*** of the results following an Invalid Sample are inflated.

In all the manuals, NPAS in fact recommends “a short waiting period” after an invalid sample, but as the manufacturer does not want to take a position on what is scientifically necessary, it sets no mandatory waiting time. In some manuals it says “*usually* a retest of the subject after a short waiting period (5–10 Min.) will result in a *valid test*” (emphasis added) In others, it just says “after a short waiting period,” with no time frame mentioned. Authors’ observations: “usually” is not a particularly scientific term; and by “valid test,” do they mean a test free from extraneous alcohol, or a test that the machine has decided is valid?

Dr. Craig Sutheimer, a PhD. Toxicologist and the most qualified individual to ever head the ODH breath, blood, and urine testing program, was confronted with the foregoing, and acknowledged the problem. Since Ohio’s “observation period” is 20 minutes, he concluded that after an invalid sample, a new 20 minute period should be observed, and issued a Memo to this effect to all agencies using DataMasters. See Book-Disc ODH Sutheimer Invalid Sample Memo. Initially, court’s viewed this memo as defining what the “short waiting period” after an Invalid Sample should be. See *State v. Williams*, 2004-Ohio-2453 (6th Dist.) However, courts soon began finding reasons to disregard it. Thus, in *State v. Hayes*, 2005 Ohio 6607 (9th Dist.) the court held, “As the State points out, the above memorandum deals with the BAC Verifier and the BAC DataMaster, not the apparatus that was used in the instant case, the Intoxilyzer 5000. Further, the memorandum does not rise to the level of a regulation [and] is not enforceable.” *Id.* See, also, *State v. Reiger*, 2002-Ohio-6673 (5th Dist.)

Most appellate courts have adopted this position that the Invalid Sample Memo is not a rule and therefore failure to follow it does not require suppression of the test. However, that does not undermine the basic analysis, nor does it preclude use of the memo or analysis for “weight of the evidence” at trial.

Note: Dr. Sutheimer did not last long as BADT Chief and retired rather unexpectedly. Many suggest that this was directly related to his willingness to discuss basic scientific principles when discussing or testifying about breath testing. After he retired, the job qualifications, which previously mandated the BADT Chief have at least a bachelor’s degree in one of the sciences, were changed, and Dean Ward, a police officer, replaced him.

The Bottom Line on Invalid Sample Result

The bottom line regarding Invalid Samples would seem to be: the slope detecting software in the machine was specifically designed to flag mouth alcohol contamination and only mouth alcohol contamination but the manufacturer has been willing to entertain the possibility that other things can cause the Invalid Sample error and yet has conducted no study or experiment to prove this possibility. Perhaps this is because customers prefer to be able to make such assertions, based upon conjecture, rather than see it disproved through experimentation. Moreover, if a subject can cause an Invalid Sample, especially through by his manner of blowing, this would seem to be a flaw in the device that should be immediately addressed and one would think that minor software adjustments could fix the problem.

Minimum Testing Time	As little as 4-5 seconds according to NPAS
Maximum Testing Time	Machine will “time out” in approximately 2 minutes if no valid sample, if Invalid Sample is detected the test will terminate and report that
Sampling Rate	Once every quarter second
*Minimum Breath Flow	Breath being delivered at a rate of at least 3.7 liters per minute
*Minimum Breath Volume	At least 1.5 liters of air delivered into the device
*Breath Alcohol Profile	Rising then leveling off (plateauing) or rising only slightly (+.001 or less)
Apparently Valid Sample	When two readings are averaged and compared to the average of the next pair of readings; if they are within .001 or less of each other and not dropping (see Invalid Sample) and the other two criteria are met this is considered by the machine to be a valid sample
Invalid Sample	The device constantly averages two readings and compares the result to the average of the next two readings and then the next two and so on. Once a positive slope has been established if three consecutive two point averages shows a negative slope or “drop” this will be reported as an Invalid Sample

* The asterisks denote that these are part of the “sample criteria”.

Radio Frequency Interference (RFI) Detection

Radio Frequency Interference (RFI) and Electromagnetic Inference (EMI) have long been accepted as a possible cause of error in breath testing. This concern has generally been discounted in Ohio, where DataMasters are concerned. This is, in part, due to the design of the DataMaster and, more so, due to the drafting of the rules relating to testing for this interference with these devices.

It is assumed that police radios would be the most likely source of RFI or EMI interference, and as a general rule this may be correct. The DataMaster has a dedicated antenna which screws into the back of the machine resulting in a fixed position reference in order to check for radio frequency interference (RFI). Inside the case, there is a Radio Frequency (RF) detector. In theory, if there is RF present in the testing area significant enough to affect machine and thus the results, it would strike the antenna and be read by the detector. When that happens, an “RFI Inference” error code is produced and the test is aborted. Note the RF detector does not tell us when RF is affecting the machine, it only tells us if the RF detector has received an RF signal equal to or above the level it is designed and tuned to report. That means the detector could abort a test even though RF is not affecting the results and, conversely, RF could be present and affecting the test results without the detector being triggered. Note: in order to set or tune the detector, a technician turns a screw a quarter turn if the detector does not trigger during an RFI Check; the screw is turned until it does trigger.

Prior to 2002, Ohio had reasonably extensive requirements for testing the breath room for the presence of RF, using handheld radios at various distances and across many axises. This was required based upon an understanding that RF can come from various directions and be reflected off walls and objects. In 2002, the RFI survey was jettisoned in favor of the procedure contained in the current rule, discussed below. Shortly after this change, Mr. Huey established in litigation that the notes and minutes of the ODH committee that drafted the new rule contained no scientific documentation supporting the change. See New Players Same Game? OACDL Vindicator (Fall 2003.)

Under the current rule, as a part of the Instrument Check procedure, once a week, an officer takes a handheld radio, turns it on, and activates it as close to that antennae as possible, while the machine is in the subject test mode. If the device aborts the test and produces an “RFI Detected” error code, we are told this means the RF detector is working perfectly and any test the following week that does not abort due RFI being detected is free from RFI.

From a scientific standpoint, this is ridiculous. It is like taking a hearing impaired person to a concert, and before it starts, taking him over to the base drum, turning on his hearing aid and beating the drum. All you establish is whether he can hear a drum that is right next to him. You do not establish that he could hear it a reasonable distance away. Moreover, you have no idea if he will hear the flute or the violin. The latter is a very apt analogy. We have established in Intoxilyzer 8000 litigation, that things that operate on a very different frequency than police band radios, particularly smart phones and other modern devices, can affect even newer breath instruments. These same devices could affect the old DataMasters and the RF detector could be completely deaf to the frequencies at which they operate.

Instrument Check Procedures and Calibration

The purpose of this section of this book is to provide Ohio practitioners with a basic understanding of the instruments used in Ohio and the Ohio procedures. It is not intended to and cannot provide the type of advanced knowledge one would obtain through a multiday course on breath testing instruments and/or scientific aspects of a DUI case. Any reader who truly desires to understand these machines and their limitations will need to invest additional time in a classroom setting to gain that level of knowledge and understanding. NPAS, the original manufacturer of the BAC DataMaster, used to offer such classes. However it appears NPAS will no longer be offering them. Mr. Huey intends to arrange and help conduct courses that will cover these matters and other scientific aspects of a DUI case. Please contact Mr. Huey at dthlaw@gmail.com if you would like more information about such courses.

Given the above, this book cannot and will not attempt to fully cover calibration procedures for the DataMaster. The above notwithstanding one cannot discuss breath testing without discussing the concept of calibration.

Calibration

Calibration is a term that most people think they understand but few actually do. Even the majority of the people in the breath testing industry do not understand what the term calibration means to scientists as it relates to instruments that perform scientific measurements.

Metrology is the science of measurement. The Joint Committee for Guides in Metrology (JCGM) is a committee whose members come from virtually every international association that deals with scientific measurement. The JCGM publishes guides related to measurement which are accepted worldwide and serve as the basis for international uniformity in measurement and the terms used in regard to scientific measurement. JCGM 200:2008 Section 2.39 (6.11) is entitled "International vocabulary of metrology — Basic and general concepts and associated terms" and provides the following definition of calibration:

> Calibration - operation that, under specified conditions, in a first step, establishes a relation between the quantity values with measurement uncertainties provided by measurement standards and corresponding indications with associated measurement uncertainties and, in a second step, uses this information to establish a relation for obtaining a measurement result from an indication.

Thus at minimum the calibration process involves an attempt to identify and quantify aspects of the process which may create uncertainty in the measurement. This is typically known as creating an "uncertainty budget." Neither the Ohio Department of Health nor NPAS has disclosed or published an uncertainty budget or formula to create an uncertainty budget for Ohio breath test machines. Note: in the wake of the 2009 National Academy of Sciences report, discussed later in this section, all labs, including the Ohio State Highway Patrol lab, have created uncertainty budgets for their analytical procedures, which should be disclosed to the defense.

In 2015 attorneys Ted Vosk of Seattle Washington and Michael Nichols of East Lansing Michigan presented on Measurement Uncertainty in Breath Testing at the annual Ohio Association of Criminal Defense Lawyers (OACDL) Advanced DUI Defense seminar. In their respective states both Vosk and Nichols have challenged breath tests on DataMaster machines raising the lack of proper calibration due to the failure to provide for or disclose a proper uncertainty budget relative to their client's tests. Vosk and Nichols have both had success in pretrial motions and at trial raising such issues. Any attorney interested in breath test measurement uncertainty should obtain the materials from the OACDL seminar and/or contact Vosk and Nichols.

Following the above definition of calibration, the JCGM includes notes. Note 2 warns:

> "Calibration should not be confused with adjustment of a measuring system, often mistakenly called 'self-calibration', nor with verification of calibration."

The process breath test manufacturers typically refer to as calibrating a machine is more likely a "**calibration adjustment**." See "Brief overview of DataMaster Calibration procedures," below.

The procedure that Ohio Department of Health refers to as an instrument check is, at best, an attempted "**verification of calibration**" or "**calibration verification**." As discussed below, if it is intended to be a calibration verification, it not a very thorough one, which may explain why they chose the term "instrument check" instead.

The quartz plate check, aka internal standard check, does not legitimately fall into any of these categories. See discussions above about this procedure.

Ohio's Rules and Procedures relating to Calibration

Quite simply, Ohio has no rules or procedures addressing calibration or even governing the calibration adjustment typically performed by breath test manufacturers and erroneously labelled as calibration or recalibration in their maintenance and repair records. You will not find the word calibration in any of the sections of the Ohio Adm. Code governing breath testing. Indeed, you will find no mandate that the machine must *ever* be calibrated.

In the Administrative Code, specifically regulation 3701-53-04, you will find only references to an "RFI check" and an "instrument check." These checks are to be performed when a new machine is first placed in service and when a machine is returned to service after being repaired. Once in service these checks must be performed not less frequently that every seven days. Please note that nothing prevents an agency from performing them more frequently than every seven days. Thus an agency could perform these checks daily or even before every subject test. The latter is what Dr. Kurt Dubowski, who was the universally acknowledged top government expert on breath testing for decades, recommended when he wrote the National Safety Council recommendations, discussed later herein.

Strangely, while seven twenty-four hour days would be equal to one-hundred sixty-eight hours, the Ohio regulation specifies that an instrument check "may be performed anytime up to one hundred and ninety-two hours after the last instrument check." Thus the ODH has seemingly redefined a day to include more than twenty-four hours or a week to include more than seven twenty-four hour days.

The bottom line is that Ohio leaves it completely up to the manufacturer to determine when and how to calibrate Ohio machines and/or to adjust the calibration of the machines. Given that the Director of Health is tasked with ensuring that the instruments and procedures used provide accurate results it would seem that leaving these critical matters up to the manufacturer could give rise to a challenge based upon abuse of discretion. See discussion of abuse of discretion below.

This, hands-off, approach has come back to haunt the ODH on previous occasions. For example, successful challenges occurred when bottles of solution from the same batch were used by the manufacturer to calibrate or adjust the calibration of an instrument and by police agencies to "check the calibration," via an instrument check. Stated more simply; NPAS did its calibration using a bottle from a certain batch of solution and bottles from that same batch were used in the weekly "Instrument Check." This violates basic rules of scientific procedure. Note: while the foregoing major faux pas did not lead to the creation and publication of Ohio regulations related to calibration or calibration adjustments, NPAS and the ODH, and perhaps the solution manufacturer, clearly now have a process or procedure in place to try to ensure this error does not happen again. If this process or procedure was ever reduced to writing, it certainly has never been codified or publicized.

Instrument Check Procedure per "the Rules"

The only published ODH rule that remotely relates to calibration is Adm. Code Sec. 3701-53-04 which governs the weekly instrument checks and it certainly does not address how the machine is to be calibrated. Moreover, to the extent that the instrument check serves as "a calibration check" it is a very limited check at best.

Adm. Code 3701-53-04 (effective 07/25/2013) in pertinent part, provides:

> (A) A senior operator shall perform an instrument check on approved evidential breath testing instruments listed under paragraphs (A)(1), (A)(2), and (B) of rule 3701-53-02 no less frequently than once every seven days in accordance with the appropriate instrument checklist for the instrument being used. The instrument check may be performed anytime up to one hundred and ninety-two hours after the last instrument check.
>
> (1) The instrument shall be checked to detect radio frequency interference (RFI) using a hand-held radio normally used by the law enforcement agency performing the instrument check. The RFI detector check is valid when the evidential breath testing instrument detects RFI or aborts a subject test. If the RFI detector check is not valid, the instrument shall not be used until the instrument is serviced.

> (2) An instrument shall be checked using a solution containing ethyl alcohol approved by the director of health. An instrument check result is valid when the result of the instrument check is at or within five one-thousandths (0.005) grams per two hundred ten liters of the target value for that approved solution. An instrument check result which is outside the range specified in this paragraph shall be confirmed by the senior operator using another bottle of approved solution. If this instrument check result is also out of range, the instrument shall not be used until the instrument is serviced or repaired.
>
> ****
>
> (D) An instrument check or certification shall be made in accordance with paragraphs (A) and (C) of this rule before a new evidential breath testing instrument is placed in service or before the instrument is placed into service following repairs, before the instrument is used to test subjects.

The Instrument Check Solution

As most practitioners know, the Ohio "instrument check solutions" are generally referred to as a ".10 solutions." (Phonetically you hear the solution referred to as a "point-one-oh solution.") While we sometimes see solutions with stated target values of .098 to .102 these solutions are intended to be .10 solutions; however, the solution manufacturer does not always get the mixture just right and the "official" target value is actually set after post production testing.

Each batch of solution used for an instrument check in Ohio must be "approved" by the Director of Health. There are no further details in the Administrative Code as to what goes into the approval process. In practice, a certificate, such as the one shown below, is issued signifying this approval. These documents are known as "batch solution certificates."

Each .10 solution certificate states that the solution "contains 1.217 mg/mL ethyl alcohol in purified water." If you convert that to grams per 100 mL it would be .1217 grams per 100 mL and this is an important conversion to make note of.

The certificate goes on to say "when used according to instrument check forms" the solution "will produce a result at or within +/- 0.005 g/210L of the target value in the approved breath testing instrument, when that instrument is in proper working condition."

It is important to understand that .10 solutions do not contain .10% alcohol; they are closer to .12% alcohol. This is very counter intuitive. If a .10 breath test was designed to be the equivalent of a .10 blood test and a .10 blood alcohol level means that the blood sample was .10% alcohol, why isn't a .10 simulator solution .10% alcohol? This is a question you should always consider asking the Senior Operator who did the instrument check. It is unlikely that any Ohio police officer actually knows enough about breath testing and/or the machine to give an accurate answer; unless she purchased this book.

The simple explanation, which the manufacturer likes to promote, is that .10 solution label refers to ***the result the solution is designed to produce*** when heated to the proper temperature in a simulator and pumped through a breath testing device. But that answer is not particularly satisfactory, especially when you are told that the simulator is supposed to "simulate human breath." The truth is that the real answer to the riddle actually helps you establish that "partition ratio" is a very important part of the breath test equation. (See the next Practice Tip for an in depth answer to this riddle.)

The bottom line is that a simulator solution that contains only alcohol and water will never have the same partition ratio as a blood sample because, in addition to water, blood contains other material and the presence of that material, as well as the amount of that material, will affect the partition ratio. See description of partition ratio and a discussion of its importance earlier in this chapter.

PRACTICE TIP: The first step in gaining a more advanced understanding of breath alcohol testing is to review and mentally process the following; 1) Simulator solutions are designed to read .10 grams of alcohol per

210 liters of air when "simulating" human breath; 2) All breath analyzers were designed such that a test result showing .10 grams of alcohol per 210 liters of breath is supposed to mean that the person's blood contains .10% alcohol, and yet; 3) the simulator solutions contain approximately .12% alcohol.

You can establish the latter point and make a direct comparison to blood by doing some simple mathematical conversions. However, before doing so it is very important to note that a .10 % alcohol blood result means that the blood sample contains .10 grams per 100 milliliters (mL) of blood. Indeed, Ohio Adm. Code 3701-53-01(A)(1) requires that the results of blood alcohol testing for use in DUI prosecutions must be reported as "grams by weight of alcohol per one hundred milliliters of whole blood." Thus to make a comparison between blood and the solution we will convert the solution level to grams (G) per 100 milliliters (mL.) By the way, the below can also help you learn how to convert hospital blood tests to grams per 100 mL in order to compare the hospital results those to the blood or plasma statutory DUI per se levels.

As noted above, a .10 instrument check solution contains 1.217 milligrams (mg) of alcohol per each milliliter (mL) of water. To convert this to grams per 100 mL, in order to compare it to blood alcohol, it helps to note that there are 1000 milligrams (mg) in a gram, so 1 milligram equals 0.001 gram. Therefore, 1.217 mg per mL is the same as .001217 grams per mL. To convert that to grams per 100 milliliters you merely multiply by 100, which moves the decimal point two places to the left. Therefore, there would be .1217 grams per 100 milliliters of simulator solution; rounded to two decimal places that would be .12 grams per 100 mL. Without doing any more math we know this is equal to approximately .12% percent alcohol because a blood alcohol result of .12 grams per 100 mL is .12% alcohol.

So, again, the million dollar question is why doesn't the instrument check solution contain .10% alcohol if a .10 breath test result is supposed to be equivalent to a .10% blood alcohol level? The key to answering this requires an understanding of the concept of a partition ratio, discussed earlier in this chapter, which allows us to determine the amount or percentage of alcohol in a solution based upon the amount of alcohol contained in the vapor above the solution.

The reason that the .10 simulator solution does not contain the same percentage of alcohol as a .10 blood sample is because the partition ratio for each ***has to*** be different. The partition ratio is dependent, in part, on what else is in the solution besides alcohol and water. A whole blood sample will always contain some amount of solid material (red and white blood cells, protein, etc.) and this will always make the partition ratio of a given blood alcohol sample different than the partition ratio of a water and alcohol solution.

As previously noted, the calculations programed into the breath machine ***falsely assume*** all blood alcohol samples have a 2,100 to 1 partition ratio. Since a water and alcohol solution does not have this same partition ratio, extra alcohol has to be added to the solution to produce the result a solution with a 2,100 to 1 partition ratio would produce. Therefore, to explain this seeming discrepancy one has to get into a discussion of partition ratios. That is very important because, as discussed earlier, the assumption that all breath alcohol samples will have a 2,100 to 1 partition ratio is false. Indeed it is very likely that your client's sample did not have a 2,100 to 1 partition ratio. Unlike a water and alcohol solution, your client's partition ratio may well have been lower than 2,100 to 1 and, if so, the blood alcohol estimate produced by the machine will be inflated.

Thus, in summary, the Ohio instrument check solutions are called .10 solutions because they are designed and formulated to read .100 grams per 210 liters of air (+/- .005 g/210L) when certain steps not specified in the Ohio Adm. Code are followed. Those steps involve placing the solution into a device called a "simulator," which is heated to 34° +/- .2 degrees Celsius, and pumping the vapor produced by heating the solution through the breath testing device.

Because these solutions are designed and produced solely for use in the simulator device these solutions are more universally known as "simulator solutions" and although Ohio only uses the .10 solutions, simulator solutions are available with various target values from .02 to .30.

Steps missing from “the Rules”

OAC Section 3701-53-04 does not delineate the steps that must be followed for a proper instrument check. Indeed, it does not even mention that a simulator is used in the process. However, it is black letter law that the state must produce evidence that all the correct steps have been taken in order to show “compliance with the ODH rules.”

Therefore, in order to ascertain this necessary information one has to locate the “appropriate instrument checklist for the instrument” and review it to begin to understand the process. However; the current rule does not even tell us where to locate the instrument checklist or the “check list form” mentioned in the batch solution certificate. Similarly, the rule does not specify who is in charge of creating the checklist or check list forms or approving changes to these documents. That is a very significant change from prior procedure.

Prior to 2002 the ODH rules published in the Ohio Administrative Code included the approved “Checklist Form.” These were a part of the published appendices to rules. Thus one could look to the published appendices and ascertain exactly what was on the form. Therefore, the steps that were required to be performed during the instrument check were easily ascertainable. If the procedures were modified, a new form would be published.

Given that the forms were “published” with the rules, they carried the same import and effect as a statute and the courts could take “judicial notice” of those forms and their contents. The rules published in 2002 and thereafter do not contain any checklists or “check list forms.”

The same is true for the checklist and check list forms that are to be followed in conducting a subject test. The only administrative rule related to subject tests is Ohio Adm. Code Section 3701-53-02 which, in paragraph D, provides, “Breath samples … shall be analyzed according to the operational checklist for the instrument being used and checklist forms recording the results of subject tests shall be retained in accordance with paragraph (A) of rule 3701-53-01” and “the results shall be recorded on forms prescribed by the director of health.”

There are literally no other published procedures that must be complied with in conducting a subject test. That means that, ironically, the best known “rule” of breath testing, which requires that the subject be observed for twenty minutes prior to starting the test, does not appear in the formal rules at all; yet you will find many, many references in the case law to “the twenty minute observation rule.” This raises many questions; is it really a rule? If so, doesn’t it have to be published? If it is not a rule, can it be ignored? If so, can a reasonably reliable result be obtained without an observation period? If not, is it an abuse of discretion not to include the “rule” as a part of the published, mandated procedures?

PRACTICE TIP: the authors suggest that the failure to publish these checklists as part of the rules or to properly incorporate them by reference in the manner provided for in the administrative procedures act (Chapter 119 of the Ohio Revised Code) may render the rules and/or the forms invalid. At minimum it may create an extra hurdle for the state at the motion hearing as discussed below.

The form typically used by officers, at present, to conduct an instrument check contains the steps listed below. If you review the log books you will find the form used by a Senior Operator to conduct the (more or less) weekly instrument checks on the machine used in your case.

INSTRUMENT CHECK FORM

(1) Press “RUN” button.

(2) Enter data as prompted by instrument display.

(3) When instrument displays “PLEASE BLOW”, transmit using hand-held radio near instrument

without touching it, until RFI detector aborts the test.

(4) With the simulator at 34 degrees + . 2 degrees Celsius.

(5) Connect “SIMULATOR OUTPUT” to the “VAPOR IN” connection and the “SIMULATOR INPUT” to the “PUMP OUT” or “PRESSURE OUT” connection.

(6) Press “SUP” button.

(7) Enter data as prompted by instrument display.

INSTRUMENT CHECK RESULT

0. ________ g/210L

Typically there is also a box for “SIMULATOR SERIAL # _____________” as well as places to record information about the solution batch / bottle, the senior operator’s information and the “Test ID #.”

PRACTICE TIP: The authors of this text do not assert nor assume that the form typically used by officers is the proper form. This would seem to be a matter that the state would have to prove in order to prove compliance with the ODH rules. Again, judicial notice of a particular form would no longer seem to be appropriate. In short, removing the forms from the published rules should cause problems for the government to prove compliance with the rules. At minimum it should require them to prove the form the officer followed was the proper, approved and current form. The same should hold true for the forms required to be followed, per Adm. Code 3701-53-02, in performing a subject test.

Steps 1–3 the RFI Check

The first three steps above constitute what is typically called the “RFI check.” This is to be performed in the “Subject Test” mode; e.g. it is just like a subject test except that when the subject would normally blow the officer is to transmit using hand-held radio near instrument without touching it ***until the RFI detector aborts the test***. It would be very interesting to know how long that took in a particular case and or whether the officer started transmitting from several feet away and it the machine did not detect the signal and abort until the radio was next to the antenna; or whether the officer touched the antenna. It would be really interesting to know if the machine timed out during this test. It does not take a skeptic to assume that it would be rare that the defense would ever learn the answers to these questions unless the instrument checks were videotaped; and frankly that should be required.

We suspect that the Senior Operator will typically just start with the radio inches from the RFI antenna and push the transmit button. Note: if the radio or radio’s antenna touches the antenna on the machine (or if anything touches it) a RFI error message will appear and the test will abort and this holds true during any subject test as well; all trained DataMasters operators, and certainly “Senior Operators,” should know this.

Steps 4–7 the instrument check

Let’s be clear about the terms we use. The process described in steps 4–7 are an “***instrument check***” as per the ODH rules. In other states a similar procedure might be called a “calibration check” or a “simulator check” but not here; the proper term is instrument check.

Moreover, if the above process was meant to be a “calibration check” it would have to be viewed as an extremely basic version of such a check. Thus what is referred to as a “calibration check” in others states would typically include additional steps and will often include the use of simulator solutions at various levels from .02 to .20.

PRACTICE TIP: There is no universal definition or standard accepted process for conducting a "calibration check" on a breath testing device. This is another example of how breath testing nomenclature varies from manufacturer to manufacturer and from state to state. The primary reason that there is a lack of uniformity in terms and no accepted standards is because breath alcohol testing is, to a large extent, "science" made up for, and initially by, law enforcement. Other than DUI prosecution, probation officer supervision and commercial driver testing there is no other industry that relies upon these devices. While scientific procedures utilized in commercial applications are generally subject to nationally consistent "industry standards" and are typically regulated by independent federal government agencies, there are no such standards for, or regulation of, breath testing.

While representatives from the state agencies meet and interact in various national level organizations they have rejected any formal adoption of set standards including the "recommendations" made by the National Safety Council. See Book-Disc. In short those in the law enforcement community and state agencies that oversee them do not want to be bound by such standards. There is a movement by the International Association of Chemical Testers (IACT) to adopt some standards relating to calibration, calibration solutions and calibration checks, however, voting membership in this group is limited to those employed by governmental entities and "associate members" are mostly employees of the various breath instrument manufacturers. Thus any standards they adopt would likely promote their own interests in simplicity and ease over concerns about scientific accuracy. Indeed, the impetus for their moving towards formulating their own set of standards is to head off any outside interference, particularly interference that may be forthcoming as a result a report by the National Academy of Sciences which was highly critical of forensic science in general. See Strengthening Forensic Science in the United States: A Path Forward (2009) http://www.nap.edu/catalog/12589.html

The bottom line is we in Ohio should use the term "instrument check" as that is the term used by the ODH in its rule. Do not get in the habit of using the term "calibration check" and to allow police officers to use that term during their testimony. Jurors have heard that term "calibration" and, indeed, while most really won't know what it means many do expect to hear about how and when the machine was "last calibrated." As discussed below, the state is probably not going to present any evidence that the machine was ever calibrated. Do not allow the officer to bootstrap in that term unless you have a clear purpose for doing so.

PRACTICE TIP: It is best to first challenge and chide an officer who uses the term "calibration check" by asking "where in the rules or training manuals does it use the term calibration check?" "Where does it say that the instrument check has anything to do with checking the calibration of the machine?" "The proper term for this process is 'instrument check is it not?" "Can we agree to use the correct term?" Fight this battle during the motion hearing and you won't have to do it during the trial. If the officer claims to have knowledge about the science of breath testing that is not in the manuals and rules more than 99% of the time you are in for a lot of fun as that opens him up questioning about a lot of processes he really knows nothing about.

The solution approval process

OAC Section 3701-53-04 specifies that "a solution containing ethyl alcohol" is to be used as a part of the instrument check. Police agencies purchase bottles of the instrument check solution from a third-party vendor. However, because the solution must be approved by the Ohio Director of Health, before offering the solutions for sale the vendor submits a number of bottles from a solution "batch" to the ODH as a part of the batch approval process. Currently Guth Laboratories Inc. is the only vendor from which Ohio law enforcement agencies can purchase such solutions.

If ODH continues to employ past practices, it tests a small number of these bottles via gas chromatography (GC) to check the amount of ethyl alcohol listed by the solution manufacturer in each 100 milliliter bottle and the target value. Presumably if the ODH testing shows a different amount than specified by the manufacturer, which would change the target value, the official Ohio target value will be the value obtained by the ODH during its testing not the value originally determined by the manufacturer. The ODH used to test only four bottles but as a result of testimony from experts during successful defense challenges that followed the "Porter Memo" in 1996 it seemed to be the consensus that the testing should consist of a random sample of bottles equal to the square root of the number of bottles produced plus one. See *State v. Workman*, 79 Ohio Misc. 2d 26, 670 N.E.2d 315, at 43. The ODH later procured support from a statistics professor at the Ohio State University that if the forgoing number exceeded ten bottles then testing only ten should be sufficient. Testing ten bottles then became the ODH's standard practice.

Ultimately the Director of Health "approves" the batch as containing a specific amount of ethyl alcohol and a specific target value and an official certificate showing such approval is issued by the ODH.

Each bottle delivered by a vendor to an Ohio police agency should come with a copy of the batch approval certificate signed by the Ohio Director of Health. The box in which the bottle is shipped should also contain a sticker listing all pertinent information, such as batch number, bottle number, target value, date of manufacture etc., with blank spaces after "date of first use" and "date to discard."

When a bottle is opened that date should be written on the sticker and with a corresponding date to discard filled in. This sticker should be attached to a copy of the batch approval certificate. The original certificate as well as the copy with the sticker should be kept with the DataMaster records and you should be able to review them to see if the information is consistent with the information on the instrument check form.

These instrument check approval certificate have historically been referred to in court decisions as the "Batch and Bottle Affidavits" and because the certificates come from the Department of Health courts previously required that an original, properly notarized affidavit of the ODH custodian of records be submitted with the certificate in order for it to be admitted at a motion hearing. However, the Ohio Supreme Court eliminated the need for that formality in *State v Edwards*, 107 Ohio St. 3d 169, 2005-Ohio-6180 (2005).

Note: the *Edwards* court did not say that these Batch and Bottle affidavits are admissible at trial without the proper records custodian's affidavit and it would be a serious abridgment of the right to confront witnesses at trial if they did.

PRACTICE TIP: Prosecutors and judges have become very used the Batch Certificate being introduced without proper authentication. At trial you should object and have a copy of *Edwards* and some of the cases discussed therein and use them to show the court what the proper procedure for admission is when the hearsay rules do apply. If the Batch Certificate is not admissible then there should be a domino effect as the instrument check should not be admissible either; at minimum it should be redacted to eliminate the target value and all other information that comes from the certificate. Similarly, the Senior Operator's testimony about performing the instrument check would also be lacking in proper foundation and/or irrelevant without her being able to mention the alleged target value.

As noted in Chapter 6, proof that the pre-test and post-test instrument checks were performed may not be a requirement for admissibility of the subject test at trial; however, prosecutors tend to like to admit this evidence to give the jury the belief that proper checks of the machine's reliability are periodically performed rather than just having the breath test operator testify about the instant test. If you can keep the Batch Certificate out and the dominos fall as discussed above, not only does it keep out the instrument check evidence, it will tend to throw the prosecutor off his game plan.

Problems and issues related to solutions

The below will give you a little background on the Batch Solution approval process and show why it pays to not accept anything at face value. It also serves as a reminder that one ought to periodically obtain, via public records request, the ODH procedures for conducting its testing on the instrument check solutions as well as the gas chromatograms for review by your expert. Such a review by Dr. Al Staubus led to what Ohio's Governor at the time called a "fiasco" relating to breath testing in Ohio and affected thousands and thousands of DUI prosecutions. Actually it led to a series of fiascos all of which were pounced upon by defense lawyers to the benefit of untold numbers of their clients.

In late 1995 Dr. Staubus reviewed the ODH testing results (and later the GC data) and found that the target values of various solutions as listed by the vendors (Guth and Rep Co.) were not the correct values according to ODH testing. On January 29, 1996 Mr. Leonard J. Porter, the former ODH Chief of the Alcohol Testing and Approval Program, sent out a memo (now called "the Porter Memo") attempting to explain the situation and correcting the target values. As many weekly instrument checks should have been marked as "failed" given the new target values this led to trouble for Mr. Porter who was forced to resign less than a month later. Although he became somewhat facile at avoiding subpoenas Mr. Porter was called against his wishes as a defense witness in cases related to the memo as well as issues related to the Director of Health's approval of solutions and lack of oversight of Mr. Porter's work discussed below.

This all led to Dr. Staubus asking to review the gas chromatograms from 1993-1996 and asking questions about the procedures used to approve the batch solutions. The ODH did not provide the data to defense experts but rather brought in two "experts" employed by state crime labs to review the data. The experts were Dr. Craig Sutheimer and Mr. James Ferguson (who was later convicted for giving false testimony when testifying as a scientific expert in murder case) and they ultimately claimed their "audit" showed the batches were properly approved.

Defense experts finally got a chance to review the data and, notably, the audit notes when an OSU football player was charged with DUI and Dr. Staubus and Dr. Robert Belloto were retained as experts. See *State v Workman,* discussed below. The disclosure did not come without a fight; Mr. Ferguson, in particular, strongly objected that their notes and records of their data were never intended to be public. Judge Anne Taylor, of the Franklin County Municipal Court, ordered the disclosure and after hearings were held in the case, found that the official audit report was, in effect, a whitewash job. (See quotations below.)

At the hearings Sutheimer and Ferguson testified on behalf of the state supporting approval of the batch solutions in question. Dr. Staubus and Dr. Belloto testified for the defense. Judge Anne Taylor's opinion provides a very thorough summary of the problems and issues and was ultimately published in the Ohio Official Reports; see *State v. Workman*, 79 Ohio Misc. 2d 26, 670 N.E.2d 315. Relative to the audit she wrote, "it appears that nothing except the sanitized final conclusion was intended for public dissemination" (*Id.* at 33.) Moreover, she found that the "results contained many calculation errors and misplaced values. When confronted with the data errors, Dr. Sutheimer and Mr. Ferguson and Steve Wagner all concurred with the recalculation provided by the defense." (*Id.* at 44.) Ultimately she concluded that the Court "does not agree that the audit in anyway supports an approval [of the batch]. The defense has shown by a preponderance of the evidence that the data did not even meet the criteria set forth by [the state's own experts] Dr. Sutheimer and Mr. Ferguson." (*Id.* at 43.)

In short the court found that the Director of Health ***abused his discretion*** in approving the batch solutions in question and suppressed the test results.

Courts became concerned enough about these issues to allow defense attorneys to subpoena the Director of Health and his subordinates into court for motion hearings and this led to trial courts across the state holding that the ODH failed to "properly" test and approve a number of the batches. As you can imagine it also led to an untold number of cases being settled favorably to the defense.

A less sophisticated variation on this theme was to use a partial transcript of the Director's testimony from *Workman* to make a challenge to the approval based upon an argument that the Director of Health had improperly sub-delegated his responsibilities to Mr. Porter. The batch certificates bore the signature of the ODH Director, Dr. Somani, but it turned out Mr. Porter ran the entire approval process with no oversight and was given the authority to stamp the Director's signature on the batch certificate. This was also a less expensive approach as the ODH was happy to provide copies of the Director's testimony to avoid his appearance.

This approach also led to positive resolutions for a large number of defendants and one extremely well written trial court decision by Judge Charles Schneider *State v Cooper* (see citation below.) That decision was appealed, and reversed, and can be read in its entirety as the dissenting appellate judge appended it to his dissenting opinion which held:

> "The appendix to this dissent is the trial court's well-written decision. He says it well—I will not repeat it. I would emphasize, however, that the trial court's holding that evidence to be admissible should possess "circumstantial guarantees of trustworthiness tending to assure the truthfulness of the hearsay testimony despite the absence of oath and cross-examination" is the cornerstone of evidence.
>
> Quite simply put, the Director of the Department of Health neither delegated his authority nor performed the required testing himself. There was no properly authenticated calibration solution certificate, and the results of the BAC verifier test cannot, therefore, be admitted. *Columbus v. Robbins* (1989), 61 Ohio App.3d 324, 572 N.E.2d 777.
>
> I would affirm the well-reasoned and thoughtful judgment of the trial court.

State v Cooper, 120 Ohio App.3d 284 (1997) judge Michael Close dissenting.

PRACTICE TIP: Anyone considering bringing an "abuse of discretion" or "improper delegation of authority" challenge should read *Workman* and *Cooper*, which both appear to support the idea that such challenges are proper and, in the proper case, exclusion of the test results is an appropriate sanction. Note that the majority in *Cooper* apparently had no problem with the abuse of discretion attack in *Workman* and in distinguishing the two cases it discussed Judge Taylor's decision approvingly:

"Unlike *Workman*, appellee does not attack the integrity of the particular batch of calibration solution or suggest that ODH should not have approved it. Nor does appellee attack the scientific protocol for testing the calibration solution, allege lack of compliance with that protocol, or allege that he was prejudiced by ODH's approval of batch 95080. *Id* at 288.

The *Cooper* majority was also not thrilled with having only a partial transcript from Workman to review reminding us that the less thorough and less expensive approach will usually not build the record we need for the court of appeals.

Shortly after *Workman* Dr. Sutheimer was chosen to replace Mr. Porter obviously with a mandate to get the problems under control. What ultimately happened is the ODH and prosecutors gave up on trying to support many of the batches resulting in lots of reductions and offers defendants couldn't refuse. With other batches Dr. Sutheimer was able to convince courts that the audit data (more or less) supported approval and that really ODH testing isn't as important as the *Workman* decision made out because the manufacturer itself did testing and had outside testing done. Moreover, many judges seemed to accept the prosecutors' argument that Ohio had been using these manufacturers for a long time and had not had any problems (that they were aware of). Note: these arguments had not persuaded Judge Taylor who noted that the data supporting outside testing had never been produced and as to reputation she wrote "… an employee of the Ohio State Highway Patrol [testified that he had] never found a problem with solutions provided by manufacturers …. Again, the purpose of ODH testing was one of quality assurance not of reputation. To base criminal convictions on a lesser standard would be a great injustice and would make the presumption of innocence a meaningless phrase." *Workman* at 43.

This argument that the manufacturers' did more extensive testing turned out to be untrue, although Dr.

Sutheimer most likely believed it. In *State v. Beardsley* (Oct. 20, 1997), Marietta Cty. M.C. No. 97-TR4176, and in *State v. Harris* (1998), Franklin Cty. M.C. No. M9709TFC-142093 (both unreported) he testified that Guth had assured him that they did extensive testing. The Judge in *Beardsley*, who had studied pharmacy before switching to law said in effect "great, show us the data." Dr. Sutheimer was unable able to get Guth to provide the data and it became pretty clear that was because they did not actually do the type of thorough testing Sutheimer told the court they did.

Ultimately Dr. Sutheimer was able to salvage a couple of the batches –that were still being used- by rounding up bottles in possession of police agencies and having them tested. This was good enough for a number of trial courts and the decisions held up on appeal. For example see *State v. Holly*, 135 Ohio App. 3d 512, 734 N.E.2d 869 (Ct. App. 1999).

Dr. Sutheimer seemingly decided that it was unwise to trust the solution manufacturers and thus instituted a practice of doing adequate testing of at least 10 bottles of a batch solution before submitting the batch for approval and the batches are now supposed to be actually submitted to the Director of Health for approval.

Dr. Sutheimer, who had extensive laboratory experience but no experience with breath testing, soon learned that instrument check solution issues were not the only problems with Ohio's breath testing procedures. He seemed poised to revamp the system and implement a protocol which would include dual testing when his employment with the ODH was abruptly terminated. Dean Ward, a retired police officer replaced Dr. Sutheimer.

The Simulator

While the ODH calls these solutions instrument check solutions, the manufacturer calls them "simulator solutions" for the simple reason that they are solely designed to be used in a device called a "simulator." As noted above, the ODH rules do not mention that a simulator must be used in the above process or mention a simulator at all. While there are a number of simulator models to choose from the ODH has no "approved list." There is no published set of specifications that a simulator must meet. Apparently the only requirements are that a simulator must have an input connection that can connect to the "PRESSURE OUT" port from the DataMaster and an output connection that can hook up with the DataMaster's "VAPOR IN" port. The device must also heat itself up to 34° or at least report that it has heated up to that level ± .2 degrees.

Typically the bulk of a simulator will look like an old fashioned glass peanut butter jar or a Ball jar. It is called the "simulator jar." On top, instead of a jar lid there is metal box, approximately 5 × 5 × 5 inches, which screws onto the jar. There are metal tubes and a propeller like "paddle" coming out of the bottom of the box that extend into the glass jar. There are hoses coming out of the top of the box that attach to the DataMaster. The box contains a heating element and a motor to spin the paddle and thus coming out of the side of the box is an electric cord and three prong plug.

There will also be an external thermometer built into or attached to the box. Obviously if there is a heating element there has to be a thermostat built into the device to shut off the heating element when the solution reaches the desired temperature, typically the thermostat will utilize a separate thermometer. These thermometers may be solid-state digital thermometers or old fashioned mercury thermometers. If the external thermometer is a mercury thermometer, it must have gradient lines at meaningful intervals from which one can determine if the temperature is above or below 34° by .2 degrees; e.g. gradient lines at every .5 degrees cannot give you such information. Do not assume the thermometer has the proper gradient lines, in other states the accepted variance may by +/- .5° and thus there are likely simulator thermometers with gradient lines at .5 intervals.

PRACTICE TIP: Most Senior Operators have never really looked at the thermometer and cannot tell you how many gradient lines are between 34° and 35° on their thermometer. If you craft your questions carefully, they will not be able to tell you whether the thermometer showed that the temperature was within +/- .2°

of the 34° mark. Therefore, the state cannot establish that solution was heated to the required temperature.

The ODH has no requirements for certification, maintenance or repair of simulator thermometers or thermostats. Interestingly, when Rep Co. came out with its digital thermometer its sales material asserted that litigation in Washington State had shown that some of the mercury thermometers used in their simulators were off by as much as .4 degrees. Washington State now requires that simulator thermometers be calibrated and checked by NIST (National Institute of Standards and Technology) traceable thermometers. While the ODH does not require it, we understand that in the past the ODH inspectors have, informally, suggested to the local agencies that it would be a good idea to have the simulators / thermometer certified at least once a year.

We often see Guth simulators or yearly inspection certificates from Guth that assert the calibration of the thermometers is "traceable to NIST." However we recommend that you take any assertion made by Guth, or any manufacturer, with a grain of salt. Indeed you should trust no assertions without verification. Be aware that the term "traceable to NIST" has a specific meaning in the scientific community with specific steps that must be followed and documented. In the scientific community anyone making this claim should be ready and willing to provide such documentation. A self-serving certificate by a vendor claiming something is "traceable to NIST" does not constitute full documentation. Note also that the Intoxilyzer 8000 regulations require that the dry gas canister (which itself is a simulator) have an alcohol concentration that is traceable to NIST.

Using the solution to "simulate" human breath

While the ODH rules do not say so, officers will often testify that the purpose of the instrument check, specifically steps 4-7 on the check list, is to run a sample of "simulated human breath" through the machine to check its accuracy. Calling it simulated human breath makes some sense – what else would the simulator simulate? However, for many reasons, some of which are discussed below, the device does a pretty poor job if its goal is to actually simulate human breath.

PRACTICE TIP: The simulator is good fodder at trial. Once you get the officer to answer the question, "what is it supposed to simulate?" you can go through all the ways that this apparatus differs from the complex human digestive, respiratory and circulatory systems. Does this device have a mouth? Teeth? Throat? Stomach? Trachea? Esophagus? Does it ever belch, burp, hiccup, cough or run a fever, etc.

While the simulator does not simulate the human body very well, it does a very good job of producing and delivering an alcohol vapor that any breath machine that is not obviously broken should be able to accurately analyze. In part this is because the device heats the solution to a reasonably precise temperature, mixes it to produce a consistent and stable vapor, pumps it through the machine at a constant pressure and returns the vapor to the device and thus is a closed system. If you review our discussions of Henry's Law, you will note that the simulator is designed to ensure almost perfect application of that law which requires consistent pressure, constant temperature, full equilibration (e.g. the alcohol content in vapor is unchanging) and all occurring within a closed system.

To complete steps 4-7 the Senior Operator pours the ODH approved "instrument check solution" into the simulator jar, screws on the box, plugs the plug into a wall and switches the simulator on. He then connects two flexible tubes coming out of the simulator to the DataMaster and waits until the simulator solution heats up to 34° C +/- .2 degrees. This process can take around twenty minutes and typically the Senior Operator does all this before he starts the RFI check and thus the instrument check ticket will show a time within a few minutes of the end of the RFI check.

PRACTICE TIP: If the machine tests low, especially if its more than the .005 below the target value, the Senior Operator will often attribute that to not allowing long enough for the solution heat up. Temperature is extremely important to Henry's Law and thus to running the simulator and to breath testing (see discussion of *Horton* case in chapter 6) and thus this explanation makes sense. But the Senior Operator checked the box next to step 4 asserting that the simulator was at the proper temperature. Thus the "solution wasn't heated enough" explanation seems to provide proof that this Senior Operator does not follow the rules and did not actually check the temperature notwithstanding her written assertion that she did and can provide fodder for cross-examination.

While the simulator solution is heating up it is also being mixed by the paddle that extends down into the solution. The Senior Operator connects the simulator to the DataMaster, presses the "Sup" button, feeds an "evidence ticket" into the machine and enters the required data. The DataMaster takes over from there. A pump within the DataMaster pumps the vapor above the solution out of the simulator into the breath machine and through the sample chamber then back out of the machine and back into the simulator. This creates a big loop and thus is obviously a closed system. A human being blowing into a breath machine does not create a closed system. Moreover just looking at the device you can see that it does not duplicate or even approximate the interplay of the human cardiovascular, respiratory and digestive system.

Ultimately the DataMaster spits out the evidence ticket and if the result is within +/- .005 of the target value approved by the Director of Health the machine has passed the instrument check. If the result is not within that range the Senior Operator is supposed to run the check again using a different bottle of solution, which can be from the same or a different batch. As noted above, if the machine fails both these instrument checks it "shall not be used until the instrument is serviced or repaired." Adm. Code 3701-53-04(A)(2) and before it is "placed into service following repairs" a new instrument check shall be performed "before the instrument is used to test subjects." Adm. Code 3701-53-04 (D.)

PRACTICE TIP: Typically a police agency will keep two record books. One is generally referred to as a log book and contains all test results including subject tests and instrument checks but also including the results of any proficiency tests (see Adm. Code section 3701-53-08) if they were done on that machine and any tests done on people charged with other offenses. Another book, which may be called the "maintenance and repair book" will contain the solution certificates, permits for all Senior Operators, limited repair records (typically they have "service action report" from NPAS) and/or invoice and any other documents the record keeper deems relevant. But the records are not required to be organized in that fashion. The Columbus Police Department keeps all proficiency tests in a separate binder and other agencies use a hodgepodge of folders for documents other than the test results; fortunately almost all agencies maintain the test results in a log book.

Unfortunately there is no uniform standard or method for record keeping. Adm. Code Sections 3701-53-01 to 3701-53-04 require the results of subject tests, the check list forms and records of maintenance and repair to be "retained in accordance with paragraph A of rule 3701-53-01" or "retained in a manner prescribed by the director of health" and referencing rule 3701-53-01 paragraph A. However, that rule specifies only that "the results of the tests shall be retained for not less than three years." Nowhere in the rules has the director prescribed a "manner" in which these results and documents are to be retained. Thus not only does that mean that there is no uniform system of record keeping it leads to very sloppy record keeping practices that any scientist would find abhorrent. In scientific testing the lack of proper and complete record keeping would undermine the credibility of the testing.

While courts seem to understand this "We recognize that record keeping, including maintenance and repair records, is important so that defendants may conduct complete and relevant discovery concerning the instrument that was used to conduct their test" (*State v. Lentz*, 2010 Ohio 762 (Fifth Dist. 2010) at ¶19) they often seem too willing to ignore it. "However, rigid compliance with the three-year specification in the ODH record-keeping regulation is not required where the records themselves are not shown to be misleading, inaccurate, or incomplete." (*Id.*) "[S]ubstantial compliance *** was established ***. Accordingly, the burden shifted to Appellant to rebut such presumption by a showing of prejudice." *Id* at ¶20. In *Lentz* even an ODH site inspection report that noted missing records was not enough to show lack of substantial compliance. "The absence of the records at the patrol post on the date of the Department of Health's inspection in 2008 does not mandate the conclusion that the records were not kept properly." *Id* at ¶17.

The bottom line is that you will need to be very thorough in your search for records and if records are missing or unavailable and you cannot convince the trial court that this is a failure to show substantial compliance you may want to present expert testimony to the effect that the inability to review such records prejudices your client.

Ultimately you cannot trust any assurances that all records have been maintained and produced unless those assurances are made under oath and subject to cross-examination; even then you cannot be sure. See *State v. Raleigh*, 2008 Ohio 6843 (Fifth Dist. 2008), wherein a senior operator testified in *Raleigh's* motion hearing that all records required to kept under the ODH rules were kept for three years, including all instrument checks yet, after her motion was overruled, Raleigh's counsel learned that in a later case (*State v. Dimitri Hatzimbes*, Licking County Municipal Court) the same senior operator testified that "no records of instrument check results which indicated the results were outside the acceptable limits were retained; rather, he threw those out." *Raleigh* at ¶68.

Brief overview of DataMaster factory calibration procedures

It is well beyond the scope of this text to attempt to fully dissect the process used by the DataMaster Manufacturer in conducting what came to be labeled in the repair record's as a "calibration" of the instrument.

We can make the following observations:

1. The process the manufacturer refers to as calibration would be deemed to be a calibration adjustment under the definition accepted by those engaged in scientific measurement. Please review the definition of "Calibration" as per JCGM 200:2008 Section 2.39 (6.11) which was set forth earlier in this section.
2. Serious scientists would most likely consider the process used by NPAS to be a "Calibration Adjustment." See JCGM 200:2008 Section 2.39 (6.11).

The process basically does four things:

1. It erases all information stored during the previous "calibration,"
2. It sets a (single) reference point by analyzing a "known solution" using the 3.44 micron filter and storing that reading in the computer memory,
3. It takes a reading of blank air through the quartz plate and saves that reading in the computer memory for future reference and comparison against readings taken through the quartz plate during a subject test and,
4. It takes readings through the 3.44 micron filter, the 3.37 micron filter and, perhaps, the 3.50 micron filter, saves these readings and plugs them into the computer algorithm which is used to determine whether or not there is an "interferent" present in any subject sample that is later analyzed. As noted earlier in the discussion of filters and interferents, this algorithm decides if the proportional comparisons of the readings through the filters during a subject test are close enough to the proportional comparison done during the calibration process.

The “calibration” process

If we were to watch a DataMaster being calibrated by a technician at the factory, it would look a lot like he was performing the instrument check procedure described above but omitting the RFI check.

We would see a technician take a bottle solution and put it into a simulator. When calibrating Ohio machines the manufacturer uses a “.10 solution,” for other states a .08 solution may be used. The technician would then heat the simulator up to 34 degrees Centigrade and connect the simulator to the breath machine.

He would then press the appropriate keys on the keyboard that instructs the machine to initiate the calibration process; for the most part the machine takes over. There is really only one further task required of the technician. Since that is a pretty important task let’s first discuss what the device does at this point.

Virtually the first thing the machine does once the calibration process is initiated is it erases from its computer memory all information stored during the previous calibration. If the procedure were aborted at that point the machine would be completely unable to provide a result. In simple terms, at that point the machine is “dumb,” and needs to be “trained.”

Thus if the device were to be used to try to conduct an analysis the detector would still get readings and send those readings to the central processing unit but the CPU would not know what those readings mean in terms of the amount of alcohol in the sample because it has no “reference.”

One of the primary functions of the calibration process for any analytical device is to establish reference points. As discussed below, where accuracy and precision are critical it is considered mandatory that multiple reference points be established.

Setting a Reference Point

The DataMaster calibration process creates only one reference point. This is established when the simulator solution is run through the machine. For this reason these solutions are also called “reference solutions.” A .10 solution is used to “teach” the device what a .10 looks like or set a “reference point” at that level.

Perhaps the most important step the technician performs in the calibration process is typing in the “known” value of the reference solution. To do this he uses the “target value” listed for the solution. In this instance the target value is treated as if it is the precise value.

Thus, when calibrating an Ohio DataMaster the technician basically tells the machine “the solution which you will be analyzing is a .10 solution; remember that.” Once the machine completes its analysis it stores the readings. Presumably, any time thereafter that the machine obtains the same readings it, in essence, says “aha this sample contains .10 grams of alcohol per 210 liters of air.”

Multiple Reference Points and “Linearity”

As noted above, except in breath testing, the calibration process for all other devices and instruments used for forensic analysis and measurement where accuracy and precision are critical, multiple reference points are always required. Thus, in all other testing, multiple solutions containing various levels of the analyte or substance that will be measured would be used. This is true because analytical testing produces results are not necessarily linear; that is, the “reading” of a 20 percent alcohol solution would not be, simply, twice (or half) the reading produced when a 10 percent alcohol solution is analyzed.

Thus, in real science, once the reference points are established the analyst has to create what is known as a “calibration curve” (which ironically involves drawing a straight line graph.) Ultimately, this allows the instrument to report a measurement of an unknown sample which falls between the established reference points. (This is known as interpolation and, when done properly, is considered acceptable in scientific measurement.)

This “multipoint calibration” is a part of the calibration process for any gas chromatograph (GC) instrument intended to be used for blood alcohol testing. Labs doing such testing for use in a DUI prosecution would use reference standards as low as .01 percent alcohol and as high as .60 percent alcohol and various levels in between. The range from the low point to the high point is known as the “linear range” or “range of analyses.”

Scientists would be uncomfortable ascribing a value to a result that falls outside this range, indeed most, if not all, reputable scientists, would refuse to do so. (Guessing at a value outside the linear range is known as extrapolation and generally is not considered acceptable in scientific measurement when precision and accuracy are required.)

The Ohio State Highway Patrol uses a multipoint calibration procedure for their gas chromatographs used in testing blood and urine. Generally they do this part of the calibration procedure every time they run a batch of subject samples. The ODH rules require that procedures used in testing for alcohol in blood, urine and other bodily substances must have documented sensitivity, specificity, accuracy, precision and linearity" and checked for proper calibration "each testing day." See, Ohio Adm. Code Sec. 3701-53-03 and 3701-53-04.

Ironically, the Ohio Department of Health has a gas chromatograph that it sets up to test the solutions which the director "approves" for use in the breath analyzer instrument check procedure. In setting up this GC testing the ODH uses a multipoint calibration with a linear range from .02 percent alcohol to (at minimum) .30 percent alcohol. Note that they are not testing completely unknown samples in this testing, they know that these solutions have a stated target value of .10 and yet they still calibrate the device through a wide linear range.

Single Point calibration

The calibration process programed into the DataMaster software involves the use of only one solution at only one level. This is seemingly true for all breath testing instruments, although other manufacturers are less open about anything that occurs at the factory. Note: the specifications for the Intoxilyzer 9000 indicates that it provides, as a built in option, the ability to do multipoint calibrations.

Indeed, the manufacturer of the DataMaster touts this "single point calibration" process as a selling point. It claims that once a single point is established the software is designed to extrapolate the results at all other points throughout the necessary range; e.g. from .00 to .60. The manufacturers GC machines, which are typically ten times more expensive, do not make such claims.

As part of any calibration process and/or immediately after calibration, it would be standard to test a number of samples of various alcohol levels. Typically, NPAS will do this, but please note; running checks at various levels after calibration is not the same as doing a multipoint calibration.

Setting the Interferent Filter

During the NPAS "calibration" process readings are taken through the 3.44 micron filter, the 3.37 micron filter and the 3.50 micron filter (if this filter is installed.). Those readings are saved and then used by the computer algorithm to determine whether or not there is an "interferent" present in any subject sample that is later analyzed. See discussion of filters earlier in this section.

As with many procedures related to these devices, it appears that how this is done depends upon what the end-user requires. In all instances a known alcohol and water solution is tested using each of the filters and the detector output (reading) is saved in the memory. In Ohio the solution would be a .10 solution. Thus the machine is being told "A is what a .10 solution should look like when run through a 3.44 and B is what a .10 solution should look like when run through 3.37 filter." From review of the NPAS training materials it appears that there is an option to also run a water and acetone solution through each of the filters and save those results.

Again, the readings taken through these filters are used for comparison during the running of a subject sample, which is similarly analyzed through each of the filters.

The quartz plate reading

As noted, as a part of the calibration process the machine takes a reading of blank air with the quartz plate in place in front of the detector. It saves that reading in the computer memory as a part "calibration factors." Prior to a subject test the machine will do the same process and will call it an "internal standard" check.

In this process the machine is doing nothing but reading the amount of IR light that is absorbed or blocked by the quartz plate on one day versus another day. The makeup of the quartz plate does not change and, thus, if the light source maintains the same strength and the detector maintains the same sensitivity the readings taken during the calibration process and during the internal standard check, respectively, should pretty close to identical. However, as noted previously, typically the machine is programmed to report that the machine "passed" the internal standard check if the latter reading is within +/- 10 percent of the former and the machine can be programmed to allow a wider variance. We are told Ohio machines are programmed to the standard 10 percent variance but there is not rule or regulation that so specifies. Nor is that documented in any of the records provided to the agency maintaining the machines or anyone else as far as we know.

BAC DataMaster Status/Error Codes

There are numerous instrument status codes that indicate sources of error for the BAC DataMaster listed below. These have been culled from several manuals and thus you will see different definitions/explanations for the same code.

RFI DETECTED: Radio frequency interference is being transmitted too close to the instrument during testing.
RFI DETECTED: Radio transmissions are too close to instrument during testing.
TEMPERATURE LOW: Temperature of the sample chamber is below 45°C.
TEMPERATURE HIGH: Temperature of the sample chambers above 55°C.
SYSTEM WON'T ZERO: The instrument will not automatically zero itself or properly purge itself of air being contaminated with ethanol.
PRINTER ERROR: The printer has mechanically malfunctioned.
CRC ERROR: There is an error in the circuitry.
PUMP ERROR: Pump flow is blocked or interrupted.
INVALID SAMPLE: There is mouth alcohol, excessive moisture or allegedly starting and stopping blowing.
BLANK ERROR: The blank tests do not agree with each other or they exceed .003.
CALIBRATION ERROR: The internal standard check has failed.
AMBIENT FAIL: The air is contaminated with alcohol or another detectable substance.
DETECTOR OVERFLOW: The detector output exceeds the reading by the instrument A/D converter.
DETECTOR TOO LOW: The voltage output of the detector is not showing enough signals to be usable.
DETECTOR TOO HIGH: The voltage output of the detector is so high that it is not usable.
FATAL SYSTEM ERROR AT (XXXX): Some portion of the software or memory is not responding correctly to the computer.
FILTERS ERROR: The instrument is unable to detect a difference in voltages at the time the optical filters are switched into the light path.
FLOW DETECTOR ERROR: A diagnostic test has determined that the flow thermistor is unable to detect airflow.
INTERFERENCE DETECTED: Some substance other than ethanol may be present in the sample.
INVALID SAMPLE: The instrument has detected a negative going value during the test that is inconsistent with the expected test progression. (i.e. mouth alcohol)
NOT CALIBRATED: The calibration factors used by the instrument either have not been established or have been lost due to a memory failure.
NOT SET UP: The stored options settings either have not been established or been lost due to a memory problem.
PRINTER ERROR: The printer is unable to respond to the computer.
PUMP ERROR: The flow detector does not detect pump operation.
RADIO INTERFERENCE: The radio frequency detection circuit has been activated. For this error, the

manufacturer states that “Since the system is very sensitive, it is possible that the circuit can be activated by a hand touching the antenna. Be careful when handling the breath tube so as not to touch the antenna.” Moreover, the manufacture states that “The RF circuit is not designed to detect all RF signals that may be generated; only those of sufficient strength yet still below the susceptibility level of the DataMaster.”

RAM ERROR AT (XXXX): The RAM Bite check does not match the calculated value.

SYSTEM WON’T ZERO: There is a problem with instability in the infrared detector processing the electronics. Prior to the subject test reading the DataMaster must determine a zero reference point and the machine is not starting at .000 before a subject test.

Intoxilyzer 5000 and 8000

It is appropriate to discuss both the CMI Intoxilyzer® 5000 and 8000 models together for comparative purposes, especially since readers may be more familiar with the 5000. The BAC DataMaster incorporates the same infrared technology as the Intoxilyzers however they are manufactured by a different company and employ the technology differently.

The basic theory of operation of the three machines is the same, yet there are important differences from both mechanical and legal aspects. The Intoxilyzer® 5000 had three basic models in use in Ohio; the Series 64, 66, and 68EN. The Intoxilyzer® 8000 has one model; Series 80. As previously noted, the BAC DataMaster has three models in use and Ohio; the BAC DataMaster, the DataMaster cdm, and the BAC DataMaster option “K”.

A Series 68EN Intoxilyzer® 5000 is a different version of a Series 68 Intoxilyzer® 5000.

Series 66 and 68 Intoxilyzer® 5000s come equipped with three filters but can be upgraded to five filters. All Series 68 and 80 machines are equipped with computer communication abilities. Some Series 66 are similarly equipped. No Series 64 machines are equipped with computer communications capabilities.

Although the Series 68 Intoxilyzer® 5000 looks similar to the 64 and 66 Series, it is almost an entirely different machine under the metal cover. True, it uses infrared spectrometry to analyze samples, but the hardware and software differ significantly from its predecessors.

The Series 68EN has a single-stage, thermoelectrically cooled lead selenide detector with an integral thermistor for temperature regulation. This is supposed to extend the life of the detector. It can be equipped with three or five filters. Although a simulator temperature monitor may be added so that the machine can check the simulator temperature and record the results, that feature is not used in Ohio. A card reader is available to swipe and record the operator’s I.D. as well as the driver’s license of the subject, but that feature is not used in Ohio.

While the Series 66 Intoxilyzer® 5000’s internal memory can be disabled, the Intoxilyzer® 5000 Series 68EN’s internal memory cannot be disabled. Although these machines are capable of downloading information onto a computer database for quality assurance purposes, the Ohio Department of Health and the respective police departments that use these machines do not use that critically important feature. It is believed that the Intoxilyzer® 8000 memory cannot be disabled. This belief has not been confirmed. The above machines are also capable of being programmed for dual testing, but Ohio does not require dual testing for the Intoxilyzer® 5000 Series 66 and the Intoxilyzer® 5000 Series 68 EN. The 68 EN is also capable of measuring breath volume of the sample, but Ohio does not require that feature.

The Intoxilyzer 8000 is programed for dual testing and is used for dual testing in Ohio. Furthermore, the Intoxilyzer 8000 is capable of measuring the breath volume of the sample, thereby allowing a comparison between the reported results and the volume of breath introduced into the machine. In fact, the Intoxilyzer® 8000 models in Ohio and Florida but not Arizona monitor and print breath volume. Since a longer blow can result in higher reported BAC, this could explain the value differences between two samples within one replicate test.

The Series 68 EN and 8000 ® come from the factory ready for dry-gas as well as a wet-bath simulator. In Ohio, the Series 68 EN uses a wet-bath simulator. However, the Intoxilyzer 8000 ® uses a dry-gas simulator. If dry-gas is used, a barometric sensor provides automatic correction for variances in barometric pressure and altitude.

Basic Operation Of the Intoxilyzer Devices

The basic operation of both 5000 and 8000 series machines is similar. An IR (Infra-Red) light source resides at one end of a tube-shaped sample chamber and an IR detector(s) resides at the opposite end. IR light is shone through the sample chamber tube. The amount of light that passes through the tube is captured at the other end of the tube by the IR detector(s). The light energy captured is then converted to an electrical signal correlating to a baseline (part of the “differential voltage measurement” or DVM) according to the software programmed into the machine.

When a person blows into the machine, the alcohol molecules that are in the breath absorb some of the IR light as it passes through the sample chamber tube. This means that less IR light strikes the detector than before the breath entered the sample chamber tube. The new light measurement is also converted to an electrical signal (another part of the DVM). The machine’s software calculates the difference in the amount of IR light detected before the person blew (baseline DVM) and while the breath was in the sample chamber tube (second DVM) and converts this to a BAC that is printed in conformance with the Uniform Vehicle Code of grams of alcohol per 210 liters of breath.

Because different molecules absorb light of different wavelengths, and because the wavelengths that alcohol absorbs IR light are well-known, the machines all use IR filters that allow only certain wavelengths of IR light to pass through, corresponding to the wavelengths that the alcohol molecules absorb. If they did not filter the light, then theoretically one could blow smoke through the sample chamber, reducing all wavelengths of light and get a positive reading for alcohol. This problem is avoided by several means, both internal and external to the machine.

All models of the Intoxilyzer ®5000 have some sort of reference IR filter in addition to the filters meant for alcohol and other substances. The reference filter is set at a wavelength that nothing on the human breath should interfere with. If the machine detects a drop in the light shone through the tube at the reference wavelength, or if it is not captured by the IR detector at the proper time, then the machine should abort the test.

The Intoxilyzer® 8000 is different than the Intoxilyzer® 5000 in that it measures IR light absorption by the alcohol portion of the molecule. Thus, it is claimed to be more specific to alcohol than the 5000 model—yet this is only a manufacturer’s claim. The truth of the matter is that since the machine measures the alcohol molecule at a different portion of the IR spectrum, interferents at or near the 3.4 micron range should not be of concern, but a whole new class of interferents exists at the nine micron range.

While both the 5000 and 8000 models filter out unwanted wavelengths, they do this in very different ways. The Intoxilyzer® 5000 has a filter wheel with filters or lenses mounted at specific points on the wheel. The wheel is attached to a “chopper motor” that rotates the filters into the path of the IR light beam at one end of the sample chamber at specific times. The act of the filters being placed in front of the IR light source “chops” the light into segments as it hits the detector. Thus, the filters will alternately chop the light into segments at wavelengths corresponding to the wavelengths of absorption for alcohol, acetone, toluene, acetaldehyde and the reference wavelength of 3.8 microns. The Intoxilyzer® 5000 is programmed to expect the IR light to be “chopped” at specific intervals and read by the IR detector at the other end of the sample chamber. Problems arise when the chopper motor does not work as expected.

Clearly, like any electric motor, the chopper motor can fail catastrophically, and the failure will prevent the machine from working at all. But not all failures are catastrophic. A chopper motor that is wearing out may have intermittent problems not detected at the regular maintenance intervals. It may slow down or speed up or work irregularly in other manners. If not caught by the internal safeguards of the machine, this could lead to inaccurate results or no results at all. Power fluctuations can also cause varying speeds of the chopper motor.

PRACTICE TIP: Always check the maintenance logs for the Intoxilyzer® in addition to the calibration logs (whether paper or computer data). If you do many DUI cases, it is wise to keep your own set of records for each machine. While the function and accuracy records may indicate no problems immediately before and after your client's test, you may find intermittent problems with the machine every six months or more. Intermittent problems are a great source for reasonable doubt arguments.

The Intoxilyzer 8000 does not have a chopper motor. It claims to have a vastly improved design with a pulsed IR beam of light. That is, instead of the IR light source being a constantly burning incandescent light bulb as found in the Intoxilyzer 5000 with a chopper motor, the Intoxilyzer 8000 uses a light source that flashes on and off to provide IR light to the detector. Clearly, the Intoxilyzer 8000 design is a theoretical improvement over the chopper-motor/incandescent setup, and it does eliminate the failing chopper-motor and incandescent light issue; but it causes a whole new problem—one that affects every test. See Figure 11.13.

The Intoxilyzer 5000 chopper motor spins the filter wheel at approximately 2,400 rpm, which means that each filter is placed in front of the detector 40 times per second. Thus, the Intoxilyzer 5000 is capable of 40 readings of light per second and can translate all of those readings into data points for analysis. Since the minimum time that a person can blow into the Intoxilyzer 5000 for a sufficient reading is 4 seconds, that means that the Intoxilyzer 5000 has at least 160 data points from which to plot the rise and run of the slope of the alcohol curve.

By contrast, the Intoxilyzer 8000 only pulses the light source two times per second. With a minimum blow time of one second for a sufficient sample, that means that the Intoxilyzer 8000 has only two real data points to plot the slope (even though CMI claims 480 points). Even if the subject blows for four seconds, that still only creates eight data points. This is the exact reason that the Intoxilyzer 8000 has a more difficult time recognizing and flagging mouth alcohol errors than did the Intoxilyzer 5000.

Moreover, having less data points creates problems when the machine tries to calculate the point at which a sufficient sample has been achieved (i.e., when the subject has reached deep-lung air).

While the pulsed IR light source can be made to flash well more than two times per second, the weak link in the system is the detector. The detector is actually made up of two detectors, called pyroelectric detectors. The entire sensing unit is referred to as dual-pyroelectric detectors. See Figures 11.14 and 11.15.

When the IR source pulses, the detector receives an IR signal. When the IR source is off, the detector receives no signal. However, even though the pulse of light looks instantaneous to the human eye, it is not. There is always a lag time between the start of the pulse, full-power, and the end of the pulse. The detector receives a signal as long as the IR source is emitting IR light, whether it is receiving power or unpowered and just cooling down before the next pulse. This lag time between pulses is known as "noise." See Figure 11.16.

Thus, there is a signal-to-noise ratio that affects every IR detector. If the IR light is pulsed too fast, the IR source never has a chance to recover and cool down before the next pulse. In the case of the Intoxilyzer 8000, the detector becomes saturated with IR noise at levels only slightly above two pulses per second. The Intoxilyzer 5000 did not have this problem because it used a completely different type of detector. Unfortunately, the IR source in the Intoxilyzer 8000 is incompatible with the Intoxilyzer 5000 detector. See Figure 11.17.

Not only are there significant differences between the IR source and detectors, the Intoxilyzer 8000 sample chamber is a completely different design than the Intoxilyzer 5000 sample chamber as well. The Intoxilyzer 8000 chamber volume (29 ml) is less than half that of the Intoxilyzer 5000 (81 ml). Moreover, it is a triple-barrel design. That is, the Intoxilyzer 8000 has two pre-heat chambers milled into the aluminum sample chamber block. The subject's breath passes through these two pre-heat chambers before it enters the analytical chamber. See Figure 11.18.

11.9 Intoxilyzer Printouts

The Intoxilyzer® 5000 can be programmed to sample breath in a specific sequence and print the results. The sequence of testing is governed by letter codes. The machine comes with sequences already programmed into the software which can be accessed and set through a series of switches located behind a panel on the side of the machine. The quality assurance specialist can choose among the pre-programmed sequences or input a custom program.

The Intoxilyzer® 8000 can be custom programmed as well through the attached keyboard. The program in use in Ohio is as follows:

Code	Test Sequence
ABA	Air Blank, Subject Test, Air Blank
ABACA	Air Blank, Subject Test, Air Blank, Calibration Check, Air Blank
ABABA	Air Blank, Subject Test, Air Blank, Subject Test, Air Blank
ACABA	Air Blank, Calibration Check, Air Blank, Subject Test, Air Blank
ACABABACA	Air Blank, Calibration Check, Air Blank, Subject Test, Air Blank, Subject Test, Air Blank, Calibration Check, Air Blank
CMS	Custom Mode Sequence

Notice that some of the Intoxilyzer® 5000 sequences above use a concurrent calibration check and some do not. The Intoxilyzer 8000 is fitted with a dry-gas standard attached to the back of the device which provides convenient concurrent calibration checks for every test. Dry-gas is roughly 98 percent nitrogen and two percent ethanol. See Figure 11.19.

The Intoxilyzer 8000 may also be outfitted with a wet-bath simulator for calibration checks as in Figure 11.20. Note that the connection ports for the dry-gas and the wet-bath are the same; however the wet-bath recirculates into the simulator while the dry-gas is vented to the atmosphere after use.

The Intoxilyzer® 5000 can be programmed for sample capture. Sample capture allows the exact same sample of breath that was analyzed by the Intoxilyzer® 5000 to be captured in a silica gel tube for later reanalysis. The exhaust port on the back of the Intoxilyzer® 5000 connects to a Toxtrap® holder that contains the silica gel tube. The silica gel tube is then sealed, removed from the holder and given to the suspect. The Intoxilyzer 8000® cannot capture a sample.

11.10 Breath Testing: Methods of Attack

There are three areas of attack on any breath test presented by the prosecution. They are machine-based, operator-based, and subject-based.

Machine-based attacks

a. Intermittent problems

Intermittent problems include vibrations to the machine while it is working, inadequate or improper power supplies, bad chopper motors and fluctuating DVM. Some Intoxilyzers® are used in the back of patrol cars or inside vans. In addition to the inherent vibration associated with a running engine, power supplies can fluctuate as well. Watch for calibration logs from these mobile machines. Often they are removed from the vehicle and tested inside a building with a stable power source. Unstable power sources can result in a fluctuating DVM, inconsistent rpm on the chopper motor, dimming or brightening infra-red source lamps and other problems. Be aware, however, that the Intoxilyzer® 8000 is designed to be powered by a vehicle's cigarette lighter. This does not eliminate power fluctuations, but at least the manufacturer was aware of the problem when designing the machine. Several instances of power-related problems have been reported throughout the country with the Intoxilyzer® 8000. Power supply boards have been replaced, but the most common "fix" for the problem has been simply to unplug the machine and try a different power source. Note that this type of "fix" is rarely reported by police.

b. Warranty

The breath testing device may not be warranted to test breath for alcohol accurately or reliably by the manufacturer. Bring this out at trial with your expert witness and the operator's manual, then leave it alone until closing argument when you can say to the jury—"And the manufacturer of this machine doesn't even warrant that it will test breath accurately. Do you want to place your trust in that machine?"

c. Lack of concurrent calibration checks

A concurrent calibration check is a series of two calibration checks that bracket a subject test(s), immediately before and after the subject test. They are printed on the same card as the subject test(s). A concurrent calibration check can be accomplished by attaching either a wet-bath simulator or a dry-gas standard to the Intoxilyzer® and programming the machine to run the concurrent calibration check. This provides a calibration check within minutes before, and minutes after a subject test. Intoxilyzer® 5000s can be set up to do concurrent calibration checks every time a subject test is run. All Intoxilyzer® 8000 models can be programmed to do concurrent calibration checks as well. They can be done with a dry-gas standard or with a wet-bath simulator. The results print on the breath-test card and bracket the subject tests.

The advantages to the defense when there is a lack of concurrent calibration checks are numerous. Despite the fact that concurrent calibration checks have replaced proper maintenance procedures, they do provide a measure of scientific confidence far beyond handwritten records. However, one has to look at a series of calibration checks over time to spot problems. If there are trends regarding calibration issues with the particular machine used and only handwritten records are available, they would only provide about 12 data points for comparison throughout an entire year if done monthly. Whereas if the Intoxilyzer® is used 50 times every week with concurrent calibration checks, it would provide 2,600 data points for comparison over one year.

d. COBRA (Computerized Online BReath Archive)

The COBRA system is a computer-based record keeping database for the Intoxilyzer®. COBRA data are very useful in that it can record everything that happens with the Intoxilyzer®. It is capable of recording subject tests, quality assurance testing, error codes and more. COBRA data can certainly be used to check the trends of individual machines for machine-based errors, but they can also be used to track officers for operator-based errors. (See Operator-Based Attacks, below.) Beware, however, that tampering with COBRA data is not unheard of see e.g.*State v. Meza*, 203 Ariz. 50, 50 P.3d. 407, (Ariz. App. Div. 1, 2002).

The lack of COBRA data is certainly worthy of an attack in virtually every DUI case. Although the state may insist that COBRA data cannot be provided in its current format or is sought to mount a general attack on the machine in violation of Vega, at least one appellate court has held that the COBRA data is relevant and material to an accused's defense. *Cincinnati v. Ilg*, 2013-Ohio-2191. Notably, the Ohio Supreme Court accepted a discretionary appeal to address whether *Vega* prohibits an accused from obtaining COBRA data. 136 Ohio St.3d 1556, 996 N.E.2d 985. Simply put, more data are better than less data when one is asked to review quality assurance records for an Intoxilyzer®. Certainly one can review the hand-written calibration checks and other quality assurance procedures to determine whether a particular Intoxilyzer® was working properly or not on any date in between those checks, but one has to assume no maintenance or repairs during that time frame as well. The COBRA data can provide much of that missing information for a reviewing forensic toxicologist. With the COBRA software and downloading capabilities readily available, there is no valid reason for any agency not to use the COBRA package if the particular Intoxilyzer® is capable of memory storage. Many Intoxilyzer® 5000s are capable, but to be sure one must check the Intoxilyzer® 5000 for the presence of a RS-232C computer port on the rear of the machine. Every Intoxilyzer® 8000 sold in the United States, without exception, is capable and comes with an RS-232 direct-connect computer port, and a modem for remote operation. See Figures 11.21 and 11.22.

e. Inherent margin of error

All measuring devices have some error. Some devices may have greater accuracy or precision than others, but they all encompass some error. The accuracy rate is based on a bell curve (Gaussian Distribution) with standard deviations. For a 10 percent margin of error, it statistically breaks down as follows:

680 out of 1,000 tests will be within 3 $^1/_3$ percent
950 out of 1,000 tests will be within 6 $^2/_3$ percent
997 out of 1,000 tests will be within 10 percent

This means that three out of 1,000 tests will fall outside of ±10 percent, but more importantly, it shows that the inherent margin of error is random. It can strike at any time, and there is no way to tell if it affected your client's test. If it is the state's burden to show that a defendant's test was over the legal limit by proof beyond every reasonable doubt, and if it cannot account for the ±5 percent inherent margin of error of a .08 result, then it cannot prove its case. See Figure 11.23.

f. Radio Frequency Interference (RFI)

Probably the most overlooked and improperly used attack is RFI. RFI is an electromagnetic wave. We think of it most frequently as a police radio transmitting near an Intoxilyzer® during the administration of a test. But that is not the most frequent source of RFI during a subject test. RFI is generated whenever and wherever an electric motor is running. The Intoxilyzer® 5000 has an electric motor turning the filter wheel, known as a "chopper motor." The Intoxilyzer® 5000 also has an RFI antenna, which is contained in the wrapping of the breath tube, as well as a heavy-duty metal case designed to shield the internal components from RFI. Both safeguards do a pretty good job (but not perfect), but herein lies the problem: the heavy-duty metal case shields the RFI antenna from *internal* RFI. Internal RFI exists every time the Intoxilyzer® 5000 samples breath, and the externally located antenna will not pick it up. Experienced practitioners have all seen what we commonly refer to as "sick machines," i.e., those machines that seem to have a high number of inexplicable errors. Clearly, this problem could be caused by the inherent design flaw of the Intoxilyzer® 5000.

The Intoxilyzer® 8000 reduces the chances of internal RFI happening because the Intoxilyzer® 8000 has no chopper motor, but it does have an internal fan and air pump. Moreover, the Intoxilyzer® 8000 does not have a heavy-duty metal case to shield it. Instead, it has an internally applied spray-on coating which does a poor job of shielding it from RFI. The coating has a very similar look, feel and thickness to copper spray paint. Obviously, care needs to be taken whenever the Intoxilyzer® 8000's case is opened for repair and maintenance—the coating can be scratched off with a fingernail.

The Intoxilyzer® 8000 has an RFI antenna. Unlike the 5000, however, the RFI antenna is located inside of the machine right behind the faceplate.

The Intoxilyzer® 8000 has been the subject of two RFI studies commissioned by, and prepared for, the Ohio Department of Health, Bureau of Alcohol and Drug Testing. Both studies were completed by Smith Electronics, Inc. Electromagnetic Compatibility Laboratories in Brecksville, Ohio and are analyzed below.

Radio Frequency Susceptibility Evaluation of the Intoxilyzer 8000

Prepared by James R. Pollock, September 26, 2002, 18 pages. Unpublished.

The Intoxilyzer 8000 used listed a serial number of "8066-000241" on the first page of the report, which is a highly unusual serial number, and probably a typographical error as the designation "8066" is not used in any other Intoxilyzer 8000 serial number. Later in the report, it references serial number 80-000241 which is likely the correct number. The version of CMI software installed was not recorded. It is unreported whether the particular model was specially prepared by CMI for the test.

The stated goal of the test was "to determine if the RF detection circuits were sensitive enough to detect RF before the accuracy of the measurement instrument would be affected." In other words, they checked to see if the RFI antenna would recognize an RFI signal before it altered the results.

The experiment placed an RFI transmit antenna only 3-5 feet directly in front of the Intoxilyzer 8000's RFI

receiving antenna. They transmitted RFI at only eight frequencies while the machine was powered by a standard AC power source and by 14VDC power source. The test signal was slowly increased in magnitude until the RFI antenna detected it.

The flaws of the experiment were that they used only

eight frequencies and did not cover the entire band of what might be expected in mobile-use.

The RFI transmit antenna was placed directly in front of the Intoxilyzer 8000 RFI antenna and a signal was beamed directly at it from 3-5 feet. If the RFI source was placed at the back of the machine, one might expect the RFI shielding to prevent the signal from hitting the antenna, but not necessarily from entering the machine's interior.

The Intoxilyzer 8000 was placed in a "reflective environment" for testing. In other words, they put it inside of a big metal box for all testing. This is hardly a real-world test environment encountered by the police and subjects.

The experimenters disconnected the RFI antenna and ran some tests as well. At certain strength levels, the machine reported "AMBIENT FAIL" as the result and aborted the test. The logical inference is that the RFI caused the detection circuit to believe that there was alcohol present in the room atmosphere.

The experimenters also found: "At some lower levels, the calibration test would proceed to its conclusion with -either an abnormally high reading or an acceptable reading." The experimenters noted that under these conditions, the readings appeared less stable than normal as they increased to the final result. However, one should not accept this as a "safeguard" that can be used in the field by police administering a test. Typically when an officer administers a test to a subject in the field, the officer covers the digital display on the machine so that neither the officer nor the subject can watch the result rise as the subject blows. This is to prevent the subject from stopping the test before the BAC reached the prohibited level.

While covering the display solves the problem of the subject quitting before the test is complete, it also means that the officer cannot watch the digital display for stability. Moreover, even if the officer did watch the display, one can hardly expect that he would be able to notice the instability and take corrective action. Most officers simply want to finish the DUI investigation and move on to the next one. Additionally, one would have to assume that the officer is honest. The simple fact is that there are many officers who will ignore or cover up anything that will interfere with the smooth prosecution of someone arrested for DUI.

Radio Frequency Susceptibility Evaluation of the Intoxilyzer 8000
Prepared by James R. Pollock, March 20, 2007, 34 pages. Unpublished.

This study came about four and a half years after the first study and tested a different Intoxilyzer 8000. The machine was supplied by the State of Ohio and the serial number was 80-002353. Like the previous Intoxilyzer 8000 tested, it is unknown what version of software was installed. It is unreported whether the particular model was specially prepared by CMI for the test.

The experimenters disconnected the RFI antenna, positioned an RFI transmit antenna 3-5 feet away and beamed RFI at the machine. The experimenters stated that in no instance did the reading increase as a result of the RFI. The report says: "Due to a certain amount of variation in the simulator readings from test to test, it is sometimes difficult to determine if the readings are caused by the RF signal or by the natural variability of the instrument." Notice that in the previous study, date September 26, 2002, readings did increase due to RFI.

g. Software and source code issues

Source code is the human-readable version of software. Source code is the set of instructions for a particular device to operate, however, source code is unreadable by the computerized device because the device cannot read human language. The computerized device can only read and understand "machine language" which is also called "machine code," "firmware" or "software."

Source code is converted to software by another piece of software called a "compiler." Once converted, the software is burned onto a chip which is then installed in the target device—in this case, an Intoxilyzer® 8000. The chip from an Intoxilyzer® 8000 can easily be removed and the software contained in it can be stored onto a personal computer. The software can then be downloaded to a new chip in a commercially-available chip copier to another chip. If one were to obtain an Intoxilyzer® 8000 and make an exact replica of it, one could install the copied chip into the Intoxilyzer® copy and it should work exactly as the original. In fact, when one finds cheap foreign knock-offs of computerized goods, this is the typical way that it is done. The blank chip, itself, is commercially available. It is an ATMEL 4-megabit, 5-volt flash memory chip, part number AT49F040.

The source code for the Intoxilyzer 8000 is not inside of the machine. Instead, the source code is kept on a secure computer server at CMI's headquarters in Owensboro, Kentucky. There is no way to reverse-engineer the software to obtain the source code. CMI claims that it will not release the source code because it is a trade secret. However, much of what is claimed to be a trade secret is not even secret. CMI's claimed trade secret is its ability to reconfigure the machine to meet the specific needs of different customers. This is not a trade secret as CMI actually advertises the specifications.

Assuming, arguendo, that the source code is a trade secret, however, this is not a bar to disclosure. Federal law defines "fair use" of protected ideas under 17 U.S.C.A. §107. The statute states that use for purposes of "criticism" and "comment" are "not an infringement of copyright." The Code (17 U.S.C.A. §107) reads as follows:

> Notwithstanding the provisions of 106 and 106A, the fair use of copyrighted work, including such use by reproduction in copies or phonorecords or by any other means specified by that section, for purposes such as criticism, comment, news reporting, teaching (including multiple copies for classroom use), scholarship, or research, is not an infringement of copyright. In determining whether the use made of a work in any particular case is a fair use the factors to be considered shall include–
>
> (1) the purpose and character of the use, including whether such use is of a commercial nature or is for non-profit educational purposes;
>
> (2) the nature of the copyrighted work;
>
> (3) the amount and substantiality of the portion used in relation to the copyrighted work as a whole; and

(4) the effect of the use upon the potential market for or value of the copyrighted work.

The use of allegedly confidential church documents by a plaintiff in a state tort action against a church was “fair use” and was not an infringement of copyright. The documents *were provided to expert witnesses in preparation of testimony* and were not used for any other purpose. *Religious Technology Center v. Wollershein*, 971 F.2d 364 (Cal. 1992).

In *Jartech, Inc. v. Clancy*, 666 F.2d 403, 213 U.S.P.Q. 1057, certiorari denied 103 S.Ct. 175, 459 U.S. 879, 74 L.Ed.2d 143, rehearing denied 103 S.Ct. 477, 459 U.S. 1059, 74 L.Ed.2d 1453, certiorari denied 103 S.Ct. 58, 459 U.S. 826, 74 L.Ed.2d 62, rehearing denied 103 S.Ct. 477, 459 U.S. 1058, 74 L.Ed.2d 624, certiorari denied 103 S.Ct. 59, 459 U.S. 826, 74 L.Ed.2d 62, the alleged copyright infringers made abbreviated copies of some films, not for subsequent use and enjoyment, but for evidence to be used in litigation. The use was held to be neither commercially exploitive of the copyright, nor commercially exploitive of the copyright holder’s market.

Fair use even extends to disassembly of software and competition. In a reverse-engineering case, the federal courts have held that software can be “reverse engineered” under the Fair Use Doctrine. Take, for example, the case of *Sega Enterprises Ltd. v. Accolade, Inc.* C.A.9 (Cal.) 1992, 977 F.2d 1510, 24 U.S.P.Q.2d 1561, where the court found that the disassembly of computer object code of a copyrighted program was fair use of the copyrighted work, where disassembly was the only way to gain access to the ideas and functional elements embodied in the copyrighted program. Copying was performed for the purpose of competition in the marketplace for works of the same type. This case is very instructive, because if a copyrighted work can be disassembled for purposes of competition, then an uncopyrighted work can certainly be disclosed for purposes of the Sixth Amendment right to confrontation.

In *Atari Games Corp. v. Nintendo of North America Inc.*, C.A.Fed. (Cal.) 1992, 975 F.2d 832, 24 U.S.P.Q.2d 1015, rehearing denied, en banc suggestion declined, reverse engineering of the object code to discern unprotected ideas in the computer program for the purpose of understanding the ideas contained therein, was declared fair use.

The significant element of a trade secret is that it is secret. No hardware contained in the machine is a trade secret simply because of the fact that CMI has sold hundreds of Intoxilyzer® 8000’s to the State of Ohio and thousands nationwide. Most of their parts are from outside vendors and are patented, such as the light source and detectors. The operational and analytical principles are not only widely known, but are advertised by CMI. No data or software contained on the removable chip inside the machine is a trade secret because any purchaser can remove the chip and copy it without much difficulty.

The only thing that CMI claims to be a trade secret is their ability to configure the machines for different customers. Simply put: that is not a trade secret. Their ability to rewrite the source code for compliance with breath testing laws in Ohio, Florida, Minnesota or Arizona does not meet the definition of a trade secret. Ohio adopted its version of the Uniform Trade Secrets Act in 1994 and it is codified under R.C. 1333.61 to 1333.69.

The Intoxilyzer® 8000 has been used in Ohio since 2009. The Health Department, which certifies the Intoxilyzer 8000, bought 700 of the portable testers using a $5 million federal grant under its previous director, Dean Ward. Ward retired from ODH to take a position at CMI in Kentucky. About 400 machines are currently in use around Ohio. When Ohio decided to buy a new machine, Ohio only considered the Intoxilyzer 8000.

Source code is very important to the defense because it will explain the reasons for the many errors noted in the Intoxilyzer® 8000 results obtained throughout the state.

Arizona’s Experience with Software and Source Code Issues

The Intoxilyzer® 8000 was approved for use in Arizona on June 9, 2003. The state tested two machines sent from CMI for that specific purpose. Both machines contained software version 8105.40. The first four digits designate Arizona software and the two digits after the decimal point designate the specific version of Arizona software.

Immediately after approval testing, the machines were removed from the state and Arizona purchased several Intoxilyzer 8000 units with version 8105.41. There were problems with software version 8105.41, and it was replaced.

There is no record of 8105.42 or 8105.43 being used or tested. There is no record of the capabilities of the software or of its defects. In fact, there is no record of those versions even existing. However, logic tells us that the versions did exist because if Intoxilyzer software numbering follows the universal method of software numbering, there would be 8105.42 and 8105.43 if there is an 8105.44—and there *is* a version 8105.44.

Version 8105.44 did not see much use and was almost immediately replaced with 8105.45 on March 23, 2004. The differences between 8105.44 and 8105.45, according to a January 5, 2007 letter from CMI to the Department of Public Safety, are:

New mouth alcohol detect routine based on raw-raw comparison.
Removal of static delay which was causing improper samples.
Password added to L3 access when card swipe is off.
Prevent keyboard fault associated with “symbol” lockup.
All incoming characters to upper case.
QAS info update moved to precede wet/dry cal check from L2 ONLY.
PM menu option changed to reset 31 day counter ONLY.
Results for invalid sample and “no blow” recorded as .XXX and .DEF to match printout.
Reformatted external auto cal printout to include barometric readings matching internal printout.
Fix printer initialization faults.

Changes from 8105.45 to 8105.46 on May 5, 2005:

Prevent processor from entering low power mode.
Added a reference diagnostic tool.
Increased wet control test time to 30 seconds.
Adjusted 15V diagnostic limits.

Note that just because the above software changes were documented by CMI, does not mean that they were the only changes made.

Software version 8105.47 was created in late 2007 or early 2008 but it has not yet been installed as of November 2008. The parameters of the new software have not been disclosed. It is unknown what errors in version 8105.46 it attempts to correct.

Source code is very important to the defense because it will explain the reasons for the many errors noted in the Intoxilyzer® 8000 results obtained throughout the state. Some of the problems that occurred, which are directly traceable to the source code are as follows.

The software cannot properly recognize a .020 agreement between consecutive samples. Sometimes there is a .020 agreement, but the software acts as if the samples are outside of the .020 tolerance and calls for a third, unnecessary sample. Other times, there is no .020 agreement and the software directs the test sequence to proceed as if there is agreement resulting in a test that is forensically invalid.

The software is programmed not to report a value over .60 (because it is thought that no living subject could have a BAC that high), yet there is a documented case of the software reporting a .83 BAC.

There is a hierarchy of error-reporting. This means that when two or more errors occur at the same time, the Intoxilyzer® 8000 will only report one error. For example, there have been documented cases where only a “Range Exceeded” error was reported when both a “Range Exceeded” error and a “Mouth Alcohol” error should have been reported. While this may seem to be an innocuous error, it can have dire consequences for the subject being tested. If the Intoxilyzer® were to have the simultaneous errors of “Mouth Alcohol” and

“RFI” at the same time, but the Intoxilyzer® only reported the “RFI” error, the operator could do another test sequence once the RFI problem has cleared. However, because the Intoxilyzer® did not report the “Mouth Alcohol” error, the operator would not know that he had to conduct a new deprivation period in accordance with Arizona law.

There are COBRA database results which show two data entries for one subject test. This is either due to tampering with the COBRA database by the police (which the author *does not* believe happened) or it is the result of a source code error. In either event, one complete set of data for a subject test is unrecorded.

There is one Intoxilyzer® 8000 in the State of Arizona that has reported “Unknown” errors. Intoxilyzer® 8000, serial number 80-000334 reported “Unknown” in the error-reporting field seven times in a row. This is important because it may give us a glimpse into the source code. While this particular Intoxilyzer® 8000 may be malfunctioning, it may also carry a different version of software than the rest of the machines. It may also have corrupted software. There is also the possibility that there are more error categories than the manufacturer has named. In other words, the Intoxilyzer® may be recognizing an actual error, yet no name has been programmed for such an error. Could this error be one that requires the Intoxilyzer® to be taken out of service for repair? There is no way of knowing.

The Intoxilyzer® 8000 calibration check malfunctions. There are numerous reports of .110 calibration checks being flagged as not within 10 percent of the .100 calibration standard while other .110 calibration checks are counted as being within tolerance. There is also a confirmed report of a .089 calibration check as being counted as within 10 percent of a .100 calibration standard. This is due to the fact that the Intoxilyzer® 8000 software has a known mathematical error written into the source code. When the Intoxilyzer® calculates alcohol concentration, it does not do it in terms of grams of alcohol per 210 liters. Instead, it measures in a multiple of grams per liter, then converts to g/210L when it reports the result. When it makes the conversions, it truncates a number used in the mathematical calculation instead of rounding. This causes a shift in the “calibration window” and the machine recognizes .0898 to .1098 as being within plus or minus 10 percent of the .100 calibration standard. This is why the Intoxilyzer® will print “Successfully Completed Test Sequence” when the calibration check is .089 and “Not a Successfully Completed Test Sequence” when the calibration check is .110. According to CMI, this is one defect that software version 8105.47 aims to cure.

h. Intoxilyzer 8000 Performance Studies

Note that there are very few studies of the efficacy and accuracy of the Intoxilyzer® 8000. None of the studies are peer-reviewed and only one is published. In addition to the studies, individual states have tested the Intoxilyzer® 8000 for approval and those test results are available by a simple Freedom of Information Act request. Tennessee tested the Intoxilyzer® 8000 and rejected it because, among other reasons, the Intoxilyzer® 8000 failed to meet all accuracy and precision requirements.

The State of Florida, on the other hand, approved the Intoxilyzer® 8000 after testing. However, one of the two machines presented for testing began emitting smoke during the testing process and was set aside. The approval process was completed using the remaining Intoxilyzer® 8000 that, presumably, did not emit smoke during the process.

Blood Alcohol Testing Using the Intoxilyzer 5000 Series, Intoxilyzer 8000 and Gas Chromatography and Blood Alcohol and Absorption and Metabolism Study

Utah Highway Patrol and the Utah Public Health Laboratory, September 2003. 26 Pages. Unpublished.

The study had two stated goals. The first was to compare the Intoxilyzer 5000 with the 8000 and also to compare those results with direct blood alcohol measurements. However, one should not have the impression that this study was done for the sake of science. This study was undertaken by the police for law enforcement purposes in the legal environment as the study clearly states: “This comparison will be instructive to the breath alcohol-testing program and to legal proceedings in Utah involving DUI cases tested with Intoxilyzer 5000 and 8000 instruments.”

The second stated goal was to study the correlation between alcohol dose and BAC, and to determine alcohol absorption and elimination rates for humans. Once again, one should not have the impression that this study was done for the sake of science: “This firsthand study of alcohol absorption and metabolism in human subjects will better qualify both Utah Highway Patrol technicians and State Health Laboratory toxicologists who interpret alcohol levels as expert witnesses in Utah.”

This unpublished study has not been peer reviewed; however it does include the raw data. The drawbacks to the study include that it tested only six human subjects (three male, three female), which is hardly a statistically significant number on which to base predictions of such highly variable aspects of human physiology. Moreover, the study was completed by the police who were using CMI products at the time. Clearly, the police have no interest in demonstrating the flaws of the breath alcohol testing program currently in place. In fact, quite the opposite is true.

The study compared the breath results of an Intoxilyzer 5000 Series 66, Series 68, Series 68EN, 8000, and blood results from a Hewlett-Packard Gas Chromatograph. Direct blood gas chromatograph (GC) readings were “generally higher” than the results produced by the four breath testing instruments used in the experiment. The Intoxilyzer 8000 was found to be closer to the GC readings and higher than the Intoxilyzer 5000 readings. The study concluded that while all methods were close (“almost always within .020”), the GC blood measurements were the most reproducible results.

The study chose to compare post-absorptive breath alcohol results with blood rather than when the subjects were in the absorptive phase. They found a close correlation with blood. This is an important issue because the Intoxilyzer 8000 is far more portable than any of the versions of the Intoxilyzer 5000 which must rely on 110v AC power. Because the Intoxilyzer 8000 is more portable and can be plugged into a 12v DC cigarette lighter in a patrol car, the police are capable of getting a breath test reading much closer in time to the time of the subject’s last drink. Thus, since one’s breath alcohol concentration will generally overestimate one’s blood alcohol reading while in the absorptive phase, the study may not be an entirely valid representation of a good correlation between breath and blood. And, it may not be an accurate representation of the results that will be obtained from real-world use by the Utah Highway Patrol.

The study also calculated the elimination rate of alcohol from the blood. The calculated elimination rates seem somewhat at odds with well-known scientific literature regarding elimination rates. The study’s results were:

Female A	Female B	Female C	Male A	Male B	Male C
0.021	0.018	0.021	0.029	0.021	0.029

Perhaps this is explained by the fact that the “researchers” measured “the slope of the best-fit linear curve” for the elimination phase of the graph before they averaged them for each subject. This would then fit the often-used police-expert witness profile of showing that a particular driver’s BAC was higher at the time of the traffic stop than it was at the time of the breath or blood test. Simply put, the faster one eliminates alcohol from the blood, the more alcohol can be added back to the known result in a retrograde extrapolation calculation done by the police expert-witness at trial, which makes it easier for a jury to find the accused guilty.

The study also concluded that, “This study showed that breath-testing results are lower than direct blood alcohol results during the elimination phase. This can be a bias in favor of the defendant.” This author’s conclusion, however, is that this study panders to law enforcement and provides a bias in favor of the police.

Evaluation of a Portable Evidential Breath Alcohol

Analyzer
New Mexico Department of Health, Scientific Laboratory Division, Toxicology Bureau
Razaros, G., Luthi, R., Kerrigan, S.
Forensic Science International Vol. 153, 2005, pp. 17–21 ©2005 Elsevier Ireland Ltd.

This is another police-study. The laboratory that produced the study is responsible for all blood and breath testing activities for law enforcement, statewide. The study used no human subject testing for precision and accuracy evaluations. The only field testing done on the device was completed by police officers and evaluated only ease of use, durability, printout and portability. The police were also asked for their general comments on the device. They rated the device on a 1-5 scale with 5 being most favorable. The results were 4.7 for ease of use, 4.6 for durability (even though they did not use the machine very long), 4.0 for printout and 4.9 for portability. Basically, the cops loved the handle.

The precision and accuracy question was much more in-depth. Since no human subjects were tested, we have no comparison to blood. Moreover, the only other machine that was used for comparison was the Intoxilyzer® 5000. Not part of the study, but mentioned in the introduction, is that the lab evaluated four other breath testers before evaluating the Intoxilyzer® 8000. One of those breath testers was the Intoxilyzer® 5000 EN. Also worth mentioning is that New Mexico was already a CMI customer. Switching manufacturers would have meant more than simply changing machines—it would mean that there would have to be an entirely new support system. This is something that no state crime lab undertakes lightly.

The range tested consisted of seven concentrations from 0.04g/210L to 0.55g/210L. Wet-bath and dry-gas methods were used. Acetone, isopropanol, methylene chloride, toluene and benzene were added as interferents.

Operator-based attacks

a. Inadequate deprivation period

In Ohio, operators must observe the subject for 20 minutes prior to testing to prevent oral intake of any material immediately preceding the first sample. The Ohio deprivation period falls short of national standards where the operator must not only ensure that none of these things occur but must also watch the subject continuously for at least 20 minutes to ensure that the test subject has not burped. In Ohio, technically (and in reality), police can place the subject in the back of a patrol car and know that the person has not put anything into his mouth because of being handcuffed behind the back, and that is good enough for government work—and good enough for Ohio's sub-standard regulations.

b. Forced agreement

Forced agreement occurs where the breath test operator interrupts the subject's breathing pattern on the second of the two samples. The operator is supposed to tell the subject to take a deep breath and immediately blow all of that breath into the machine without stopping. The idea is to let the machine decide when an adequate sample has been taken. Once the machine determines that an adequate sample has been taken (by analyzing the profile of the slope of the alcohol curve), it will analyze the sample.

Savvy operators have realized that sometimes a second sample will not agree within .02 of the first sample by watching the digital display rising on the digital screen of the machine. This means that the operator will have to collect a third breath sample. Not only is this time-consuming in that it will not allow the officer to move on to the next DUI, but it will create an argument for the defense regarding mouth-alcohol. (See Subject-Based Attacks, below.)

When the operator sees the subject's second breath reading approach the level of the first breath reading, the operator will tell the subject to stop blowing or even pull the breath hose away from the subject's mouth. Often, the profile of the slope will be adequate for the machine to accept the reading, but had the subject blown longer, the second reading may have exceeded the first reading by more than .02. This is why it is important to ask the operator how he or she instructs subjects to blow into the machine.

c. Breath holding

Operators are supposed to instruct subjects to take a deep breath and then immediately blow all of their breath into the machine. For officer safety, the police officers are instructed to hold the breath tube while the subject is blowing and not let the subject handle the breath hose. This is because an Intoxilyzer® can be used as a weapon by an uncooperative subject. Some subjects have been known to grab an Intoxilyzer® by the hose and swing it around, injuring the officer.

This instruction to the officer about holding the breath hose has led to both intentional and unintentional breath holding. An officer who wishes to make the breath test result higher may ask the subject to take a deep breath and then blow it into the machine as directed. The subject then takes a deep breath, but the officer does not immediately present the breath hose to the subject. Instead, the officer will hold onto the breath hose for a few moments while the subject is holding her breath. (See a. Breathing patterns under Subject-based attacks below).

d. COBRA (Computerized Online BReath Archive)

The COBRA system is a computer-based record keeping database for the Intoxilyzer®. COBRA data are very useful in that they can record everything that happens with the Intoxilyzer®. It is capable of recording subject tests, QAS testing, error codes and more. COBRA data can certainly be used to check the trends of individual machines for machine-based errors, but they can also be used to track officers for operator-based errors. Since officers input the operator’s name into the COBRA database for each test, the individual officer’s performance can be tracked. For example, where an officer has many mouth alcohol errors codes on his or her test subjects, the officer might need retraining regarding the deprivation period. Or, where an officer has recorded many more refusals than co-workers, he or she may need retraining as to the definition of “refusal” to submit to a breath test.

Subject-based attacks

a. Breathing patterns

Hyperventilation and hypoventilation will cause as much as a ±15 percent variation in a breath test result (Jones, A.W.; *Physiological Aspects of Breath-Alcohol Measurement, Alcohol*, Drugs & Driving, 6:1–25, 1990). The longer a person holds his breath, the higher the result. Short, rapid breaths tend to flush out the lungs and result in a lower reading. This variance is most often seen when an operator has a subject hold his breath and then delays giving him the breath tube, or when a subject is upset to the point of crying or nearly crying. People who are crying generally are not breathing in a normal pattern—which is required for accurate breath testing. The crying subject may take deep breaths and hold them or may also have short, shallow, rapid breathing. In any event, a crying subject is likely not breathing as expected for an evidential breath test. See Figure 11.24.

b. Temperature

Temperature variations in the human body can change the amount of alcohol that is transferred from the blood to the breath. The amount of alcohol that passes from the blood into the breath is governed by *Henryís Law of Partial Pressures*, which is the cornerstone of forensic breath testing.

Henry’s Law—Assume a closed system and constant temperature. After a period of time, some of the molecules of the liquid will have moved into the gaseous phase in the headspace above that liquid. The number of molecules that have passed into the gaseous phase will be directly proportional to the number of molecules remaining in the liquid.

The concept is simple. The hotter a liquid, the more molecules of that liquid will pass into the gaseous phase. Take, for example, a small room with a very cold cup of black coffee sitting on a table in that room. It is likely that you would not smell the coffee unless you put your nose right at the lip of the cup. Take the same example, but substitute a steaming cup of coffee. Within minutes, the room would be filled with the coffee's aroma. This is because more molecules of the hot coffee passed into the gaseous phase and filled the room.

Every breath testing unit in the United States is programmed to expect a breath temperature of 34°C, but what they most often get is a breath temperature of 35°C. This is because breath testing machines were programmed based on a very small study of end-expired breath temperature. In 1950, Harger adopted a breath temperature of 34°C; however his study listed only six subjects (Harger, R.N., Forney, R.B. and Barnes, H.B., *Estimation of Level of Blood Alcohol from Analysis of Breath*, Journal of Laboratory and Clinical Medicine. Vol. 36, 1950, pp. 306–315). The range was 31°C to 35°C. In 1995, Schoknecht adopted a breath temperature that was a full degree centigrade higher than Harger's reported average temperature. Schoknecht adopted 35°C as the average human breath-temperature. The range was 33°C to 36.7°C. There were 700 subjects in that study. (Schoknecht, G. and Stock, B., *The Technical Concept for Evidential Breath testing in Germany*, Proceedings of the ICADTS T-95, Adelaide, Australia, 1995).

Each degree centigrade of variance equates to 8.6 percent variance in the breath test result (see, Fox, Glyn R., Ph.D., Hayward, John S. Ph.D., *Effect of Hyperthermia on Breath Alcohol Analysis*, Vol. 34 No. 4 July 1989, pp. 836–841; see also, Jones, A.W.; *Physiological Aspects of Breath-Alcohol Measurement*, Alcohol, Drugs & Driving, 6:1–25, 1990). Thus, someone with a .075 BAC will test at a .081 BAC if breath temperature is 35°C.

The IACT (International Association of Chemical Testers) Newsletter, Volume 9, Number 2, July 1998 carries an article by Dale Carpenter, Ph.D., and James A. Buttram, Ph.D., which shows that while 34°C is the accepted breath temperature for breath testing the human range starts at 31°C and rises to 35°C, with the average being 35°C. The argument is, if your client is the average human being, she is 1°C higher than what the machine is programmed to expect. Thus, the jury can give your client that extra 8.6 percent in addition to any other rises in temperature due to illness, infection or menstrual cycles.

c. Hematocrit

Hematocrit is a number expressing the size and number of red blood cells in proportion to rest of the blood. Hematocrit ratios vary in healthy human beings from 40.7 to 50 percent in men, and 36.1 to 44.3 percent in women. It can vary with altitude, illness, and state of hydration. The hematocrit level governs how much alcohol may be contained by the blood and, in turn, how much will pass into the breath. Normal hematocrit ratios will lead to a ±5 percent difference in a breath test result (Labianca, D. "The Chemical Basis of the Breathalyzer," *J. Chemistry Education*, 76:261, 1990; Payne, J.P., Hill, D.W. & Wood, D.G.L., "Distribution of Ethanol between Plasma and Erythrocytes in Whole Blood," *Nature*, 217:963–964, 1968; Smith, K., *The Champion*, 1987).

d. Abnormal lung physiology

Not only the Intoxilyzer, but all breath testing machines are designed to test breath from average, healthy humans. When you have abnormal lung physiology, consult heavily with your expert witness before trial. Abnormal lung physiology could have three possible outcomes: raising the reported BAC, lowering the reported BAC or no effect on the reported BAC. Sometimes, you will now that your client has abnormal lung physiology, but you will not know what the result might be of that type of abnormal lung physiology—it might make the BAC higher or lower—but isn't that the essence of reasonable doubt?

e. Mouth alcohol

Mouth alcohol is residual alcohol that remains in the mouth after drinking or is introduced into the mouth via regurgitation. In either event, mouth alcohol can add to a breath test result, increasing the value. The Intoxilyzers 5000 and 8000 both have "slope detectors," sometimes called "mouth alcohol detectors." The slope detector is a software program that looks at the slope of the graph of the ethanol in breath profile. If the slope does not fall within the parameters of the slope programmed into the Intoxilyzer, the software is supposed to flag it as mouth alcohol, alert the operator and abort the test. The operator must conduct a new deprivation period before the next test. The main parameters that must be followed to assure the operator of a valid test, free from the influence of mouth alcohol, are:

1. A valid deprivation period.
2. Replicate test samples.
3. Adequate sample of breath.

If any one of these three parameters is not met, scientific confidence in the validity of the results is lessened, and the test results may be inadmissible. The QAR should reflect a tested and working slope detector, and the breath test cards should reflect sample agreement of no more than .02 apart and consecutive tests within 5 to 10 minutes of each other.

Although a 20-minute deprivation period is required by Ohio law, 20 minutes may not be long enough. In a recent scientific study, "The Slope Detector Does Not Always Detect the Presence of Mouth Alcohol," The Champion, March, 2006, Dr. Michael P. Hlastala, Wayne J. E. Lamm, and James Nesci reported findings which showed that mouth alcohol can more than double the true breath test result in subjects who had consumed alcohol and go unnoticed by slope detectors in both the Intoxilyzer® 5000 and the BAC Datamaster®.

This confirms a long-held belief by many members of the DUI defense community—the manner of testing the slope detector by the state is inadequate. Normally, a technician has no alcohol in his system at the time of the quality assurance testing. The technician will swish an alcohol-containing liquid or spray Binaca® into his mouth, then blow into the machine to test the slope detector. Almost invariably, the slope does not fit the profile of a normal breath test slope, and the machine will flag it as mouth alcohol. However, the profile of the slope of an alcohol-free subject does not match the slope of a person who has a measurable BrAC and mouth alcohol. In fact, the breath profile of a person with a measurable BrAC and mouth alcohol will more likely fit the profile of a normal breath profile than will the alcohol-free subject with mouth alcohol. This will lead to false-positive readings for some individuals as seen in Figure 11.25. Breath test results that are contaminated with mouth-alcohol will always be higher than an uncontaminated sample.

Dentures (which may trap alcohol in the mouth) and Gastroesophogeal Reflux Disease (GERD) can contribute to mouth alcohol. The conclusion of the article was that a 15-minute deprivation period must be maintained with at least 15 minutes between replicate samples, agreeing by no more than .02.

f. Partition ratio

In courtrooms that still allow the truth to be told to juries, partition ratio can be a very powerful argument. All breath testing machines in the United States are set to a partition ratio of 2100:1. In other words, for every one part of alcohol in a subject's breath, the machine is programmed to assume that there is another 2,100 parts in the blood. Thus, the machines perform a mathematical calculation to convert a breath alcohol concentration to a blood alcohol concentration and display the results in grams of alcohol per 210 liters of blood. This would be fine if all human beings had a constant partition ratio of 2100:1. We do not. The normal, healthy human body varies from 900:1 to about 3400:1 (see, Alobaidi, T.A.A., & Payne, J.P. *Significance of Variations in Blood-Breath Partition Coefficient of Alcohol, British Medical Journal*, 1976; Mason. M.F. *Breath Alcohol Analysis: Uses, Methods & Some Forensic Problems*, *J. Forensic Sci.* 21:9–41, 1976; Yamamoto, K. and Ueda, M. *Studies on Breath Alcohol Analysis for the Estimation of Blood Alcohol Levels*, *J. Forensic Sci.* 1:207–224, 1972). See Figure 11.26.

PRACTICE TIP: Conversion to different partition ratios is a simple mathematical formula. Take the breath test reading and divide it by 2100 then multiply by the new partition ratio number that you have chosen. This will give the corrected breath test value.

Example

To convert a .100 BAC at 2100:1 to a new ratio of 1500:1 use the formula:

Step 1: (BAC Reading) ÷ 2100 = Y

Step 2:

Y x (New Partition Ratio Value) = Corrected Breath Test Value

Step 1: .100 BAC ÷ 2100 = 0.00004762
Step 2: 0.00004762 x 1500 = .071 BAC

Thus a .080 BAC at 1100:1 could be corrected to .042 and, a .080 BAC at 2800:1 could be corrected to .107

11.11 Calibration

It is important to realize that the Intoxilyzers® are not calibrated by the police agency where the machine resides. Their calibrations are only checked by a senior operator, who is merely a police officer responsible for the care, maintenance, and instrument checks of the machine or by a Department of Health "representative" if the machine is an 8000 model. Basically, the senior operator or ODH representative does a wet-bath simulator check by attaching the simulator to the machine and pressing buttons. Calibration requires that the machine be sent back to the factory or some other qualified repair facility.

Wet-bath simulators

Guth Laboratories makes high quality simulators used all over the country. A simulator is used for calibration checks of the various breath testing machines and is supposed to simulate human breath. See Figure 11.27.

The simulator consists of a glass jar about the size and shape of a typical peanut butter jar. The jar is filled about two-thirds with a simulator solution which may be made by the lab or purchased through a commercial vendor. The jar is sealed, and the solution is heated and stirred by the apparatus screwed to the top of the jar. Temperature is monitored and automatically adjusted by the simulator.

At the top of the apparatus are two ports. One port is for the headspace vapor to be transferred to the breath testing machine and the other is for return of the vapor to the simulator. The simulator has no air pump—it relies on the breath testing machine's air pump to regulate flow of the headspace vapor.

The theory is that the simulator solution, when heated to 34°C, will release a vapor equivalent to .08. This means that the simulator solution must be at a concentration higher than the headspace vapor. The mathematical formula used to determine the headspace concentration of an aqueous alcohol simulator solution at 34°C is:

Where
χ = reported value from gas chromatograph of the liquid solution and
Ω = headspace gas value at 34°C

Thus:

Value of the Alcohol Solution (χ)	**Headspace Gas Value at 34°C (Ω)**
.085	.070
.091	.075
.097	.080
.103	.085
.109	.090
.121	.100
.133	.110

The value of the simulator solution is a very important component of the overall discovery process in any breath test case. The technicians must use a solution of known value in order to test the breath testing machine. The calibration logs rarely show anything other than a .10 solution as being used, but there are surprising variances from that number found when the simulator solution used is actually checked. This is most often a result of poor lab procedures when the solution is made in-house, rather than being purchased from a reputable supplier. Additionally, overuse of the solution can contribute to problems. The concentration of alcohol in the solution depletes with use and over time. Some agencies are simply too cheap to replace the solutions as necessary. Typically, the solution is checked by way of a headspace gas chromatograph, if it is checked at all. Sometimes the crime labs will simply rely on the claims of the manufacturer of the solution for accuracy.

In addition to possible problems with the solution, the simulator itself may be suspect. Guth makes high quality simulators and guarantees them to be accurate when shipped; but if the crime lab ignores proper maintenance, care and use procedures, the simulator's accuracy will be compromised. Some improper maintenance procedures include replacing broken thermometers with lesser quality (and less accurate) thermometers, contamination of the simulator sample with cleaning agents such as acetone, toluene and other compounds, and heaters that go bad intermittently (some simulators have an alarm to alert the operator of an improper temperature—others require the operator to be vigilant). The bottom line is: no matter how high the quality of the simulator, it must be maintained and used properly to expect accurate and reproduceable results

Dry-gas standards

When a dry-gas standard is used to calibrate or check calibration of a device, an altitude correction must be made. This is not necessary for a wet-bath simulator because the wet-bath system will be adjusted to the barometric pressure due to the nature of the system itself. The dry-gas, however, comes from a sealed, pressurized tank and the concentration of alcohol contained in the inert gas (nitrogen) is dependent on pressure. The Altitude Correction Chart below should be used to figure conversion rates. The math is quite simple.

If the dry-gas standard used has a value of .080 BAC at sea level but is being used at an altitude of 2,500 feet, the correction factor applied would be .907. In order to correct the value of the dry-gas standard to 2,500 feet, one would multiply the BAC at sea level by the altitude correction factor (.080 x .907 = .073 BAC). Thus, a dry-gas standard of .080 will read as a .073 at 2,500 feet.

Be aware that some instruments, such as the Intoxilyzer® 5000EN and the Intoxilyzer® 8000, have an automatic altitude compensation feature, so altitude correction is not necessary.

The dry-gas standard will usually be contained in a “SCOTTY® Tank” manufactured by Scott Specialty Gases. Scott dry-gas standards are traceable to N.I.S.T. which assures the high quality of its product. The tank will contain an expiration date, altitude correction chart and lot number. Typically, crime labs will use the SCOTTY® 105 tank that holds 105 liters of gas at a pressure of about 1,000 psi. Unlike a wet-bath simulator, there is no specific temperature requirement for the dry-gas standard.

The dry-gas standard is introduced into the Intoxilyzer® 5000 and 8000 through a separate port than the subject’s breath is introduced.

11.12 Ohio Administrative Code Chapter 3701-53

Note that the Ohio Department of Health controls the parameters used by law enforcement for determination of alcohol concentration in humans. Alcohol and drug testing rules are governed by Chapter 3701-53.

These regulations are periodically reviewed and modified. While there are specific review dates listed in the regulations, modifications can be made at any time and a wise practitioner will make sure that she obtains the most recent version of this chapter.

See Appendix F for the regulations as of 8-17-2015.

11.13 Statutory Requirements for Admissibility of Breath Test Results

The General Assembly has legislatively provided for the admission into evidence of alcohol test results, as long as the tests were conducted in accordance with procedures adopted by the Director of the Ohio Department of Health. The legislature has given the director of the Ohio Department of Health the authority to determine which tests and procedures are generally reliable and therefore admissible in a prosecution.

R.C.4511.19. Driving while under the influence of alcohol or drugs; tests; presumptions; penalties; immunity for those withdrawing blood

(D)(1)(a) In any criminal prosecution or juvenile court proceeding for a violation of division (A)(1)(a) of this section or for an equivalent offense that is vehicle-related, the result of any test of any blood or urine withdrawn and analyzed at any health care provider, as defined in section 2317.02 of the Revised Code, may be admitted with expert testimony to be considered with any other relevant and competent evidence in determining the guilt or innocence of the defendant.

(b) In any criminal prosecution or juvenile court proceeding for a violation of division (A) or (B) of this section or for an equivalent offense that is vehicle-related, the court may admit evidence on the concentration of alcohol, drugs of abuse, controlled substances, metabolites of a controlled substance, or a combination of them in the defendant’s whole blood, blood serum or plasma, breath, urine, or other bodily substance at the time of the alleged violation as shown by chemical analysis of the substance withdrawn within three hours of the time of the alleged violation. The three-hour time limit specified in this division regarding the admission of evidence does not extend or affect the two-hour time limit specified in division (A) of section 4511.192 of the Revised Code as the maximum period of time during which a person may consent to a chemical test or tests as described in that section. The court may admit evidence on the concentration of alcohol, drugs of abuse, or a combination of them as described in this division when a person submits to a blood, breath, urine, or other bodily substance test at the request of a law enforcement officer under section 4511.191 of the Revised Code or a blood or urine sample is obtained pursuant to a search warrant. Only a physician, a registered nurse, an emergency medical technician-intermediate, an emergency medical technician-paramedic, or a qualified technician, chemist, or phlebotomist shall withdraw a blood sample for the purpose of determining the alcohol, drug, controlled substance, metabolite of a controlled substance, or combination content of the whole blood, blood serum, or blood plasma. This limitation does not apply to the taking of breath or urine specimens. A person authorized to withdraw blood under this division may refuse to withdraw blood under this division, if in that person's opinion, the physical welfare of the person would be endangered by the withdrawing of blood.

The bodily substance withdrawn under division (D)(1)(b) of this section shall be analyzed in accordance with methods approved by the director of health by an individual possessing a valid permit issued by the director pursuant to section 3701.143 of the Revised Code.

(c) As used in division (D)(1)(b) of this section, "emergency medical technician-intermediate" and "emergency medical technician-paramedic" have the same meanings as in section 4765.01 of the Revised Code.

(2) In a criminal prosecution or juvenile court proceeding for a violation of division (A) of this section or for an equivalent offense that is vehicle-related, if there was at the time the bodily substance was withdrawn a concentration of less than the applicable concentration of alcohol specified in divisions (A)(1)(b), (c), (d), and (e) of this section or less than the applicable concentration of a listed controlled substance or a listed metabolite of a controlled substance specified for a violation of division (A)(1)(j) of this section, that fact may be considered with other competent evidence in determining the guilt or innocence of the defendant. This division does not limit or affect a criminal prosecution or juvenile court proceeding for a violation of division (B) of this section or for an equivalent offense that is substantially equivalent to that division.

(3) Upon the request of the person who was tested, the results of the chemical test shall be made available to the person or the person's attorney, immediately upon the completion of the chemical test analysis.

If the chemical test was obtained pursuant to division (D)(1)(b) of this section, the person tested may have a physician, a registered nurse, or a qualified technician, chemist, or phlebotomist of the person's own choosing administer a chemical test or tests, at the person's expense, in addition to any administered at the request of a law enforcement officer. If the person was under arrest as described in division (A)(5) of section 4511.191 of the Revised Code, the arresting officer shall advise the person at the time of the arrest that the person may have an independent chemical test taken at the person's own expense. If the person was under arrest other than described in division (A)(5) of section 4511.191 of the Revised Code, the form to be read to the person to be tested, as required under section 4511.192 of the Revised Code, shall state that the person may have an independent test performed at the person's expense. The failure or inability to obtain an additional chemical test by a person shall not preclude the admission of evidence relating to the chemical test or tests taken at the request of a law enforcement officer.

R.C. 3701.143. For purposes of sections 1547.11, 4511.19, and 4511.194 of the Revised Code, the director of health shall determine, or cause to be determined, techniques or methods for chemically analyzing a person's whole blood, blood serum or plasma, urine, breath, or other bodily substance in order to ascertain the amount of alcohol, a drug of abuse, controlled substance, metabolite of a controlled substance, or combination of them in the person's whole blood, blood serum or plasma, urine, breath, or other bodily substance. The director shall approve satisfactory techniques or methods, ascertain the qualifications of individuals to conduct such analyses, and issue permits to qualified persons authorizing them to perform such analyses. Such permits shall be subject to termination or revocation at the discretion of the director.

As used in this section, “drug of abuse” has the same meaning as in section 4506.01 of the Revised Code. Blood and breath tests; violation; classification; admissible evidence

Even lab reports are admissible without further foundation if the requirements of R.C. 2929.51 are met. Be aware that an accused may demand live testimony by making a demand on the prosecutor within seven days as set forth in R.C. 2929.51(C) or request an independent test of the substance by under R.C. 2929.51(E) and (F).

11.14 Blood Testing: From the Vein to the Lab

Under R.C. 4511.19(D(1)(b), only “a physician, a registered nurse, an emergency medical technician-intermediate, an emergency medical technician-paramedic, or a qualified technician, chemist, or phlebotomist shall withdraw a blood sample for the purpose of determining the alcohol, drug, controlled substance, metabolite of a controlled substance, or combination content of the whole blood, blood serum, or blood plasma.”

Health issues and allergies

A phlebotomist should always ask the subject about health issues regarding blood clotting, blood pressure and blood-borne diseases. The subject must also be asked about allergies, especially to latex, povidone iodine and shellfish (some people do not know they are allergic to iodine; but shellfish contains a great deal of iodine, and if they are allergic to shellfish, they are likely allergic to iodine). A latex band is used as a tourniquet, hence the reason that the subject should be asked about latex allergies.

Proper site selection

In order to draw blood properly, a phlebotomist must first check for a suitable vein to puncture. Improper draw sites include the arm on the side of a mastectomy, scarred areas, arms with fistulas or vascular grafts, sites above an IV cannula, edematous areas and hematomas. The best sites for venipuncture are the superficial veins on the mid-to-upper arm including the median cubital vein found at the inside of the elbow. Also used is the cephalic vein, which can be found toward the top of the upper forearm and runs all the way up to the biceps. Another location is the basilic vein, found at the bottom side of the forearm near the median cubital vein. The back of the hand may also be used, but it may be especially painful. There are reports of police using the back of the hand as the first choice because it is easier for the officer to find a vein. There are also reports of officers using especially large-gauge needles because it allows a faster blood draw, despite the increased pain to the subject.

Once the vein is selected, the phlebotomist will wrap a latex band around the subject’s arm. This causes the vein to bulge slightly because the heart can more easily pump blood through the arteries into the lower arm, but the latex band restricts blood flow back to the heart. Pressure builds in the vein and it expands, making it easier to find and puncture the vein to draw blood.

Subject positioning

Proper phlebotomy requires that the subject be seated (or lying down) in a suitable chair that allows easy access to the arms. Care should be taken to ensure that if the subject passes out he will not fall to the ground. Contrast this scenario with reports of police drawing blood from subjects who are standing, unsupported, by the side of the roadway. The chair and surrounding area of the blood draw should be cleaned and disinfected with a suitable non-alcoholic anti-bacterial agent.

Proper officer and phlebotomist safety precautions need to be taken as well. The subject will be under arrest at this point and could be unpredictable, uncooperative and even violent. Sharp instruments will be used to complete a medical procedure. The potential for injury to officers, the phlebotomist and the subject exists which is clearly a reason that the subject should be taken to a hospital where a real, neutral phlebotomist can draw blood in an environment that is sanitary and safe for all parties.

The blood kit

The expiration date of the tubes should always be checked. The preservative and anti-coagulant do not lose potency after expiration, but the seal on the tube is not guaranteed. This means that room air could leak into the tube through a compromised seal, bringing with it Candida Albicans or other contaminants. The antiseptic swab also has an expiration date crimped into the bottom edge of its foil wrapper. The tubes should be grey-topped, 10ml. tubes. BD Vacutainer® is a brand of vacuum tubes made by Becton, Dickinson and Company (BD) and is the most common type found in blood kits. BD, however, does not create the blood draw kit. Most kits used are created by N.I.K., Public Safety, Inc., which is a division of Armor Holdings. Utah also uses blood kits created by the Lynn Peavey Company and Tri-Tech. See Figures 11.28–30.

Tri-Tech kits generally come with a Monoject® needle made by Tyco Healthcare Group in Mansfield, Massachusetts. N.I.K. and Lynn-Peavey kits come with BD needles made by Becton-Dickson in Franklin Lakes, New Jersey. It is important to note that N.I.K. states in some of its kit literature that BD Vacutainer® tubes should only be used with the other parts of the kit while Tri-Tech has no such requirements.

The grey top of the tube indicates a preservative and anti-coagulant has been added to the tube. Grey-top tubes are used in the medical world for glucose testing procedures and were not developed strictly for law enforcement purposes.

The preservative (or "antiglycolytic" agent) in a grey-top tube is sodium fluoride (chemical symbol: Na^2). The anticoagulant may be either EDTA (potassium edetate) or potassium oxalate. Note that tubes with sodium fluoride and EDTA have a white powder in the tube, while those with sodium fluoride and potassium oxalate generally have a slightly pinkish colored powder.

Other types of tubes are sometimes used when a forensic kit is unavailable. These must be scrutinized carefully for their chemical contents. As if the differing color tops were not confusing enough, the material used for the container makes a difference. Red-top glass tubes, for example, contain no chemicals. Red-top plastic tubes contain a clot-activator only.

Grey-top BD Vacutainer® tubes come in three varieties with two different types of grey tops. They may contain sodium fluoride and potassium oxalate, or sodium fluoride and EDTA, or sodium fluoride alone. The latter of the three tubes is a serum tube and contains no anticoagulant. The grey tops, themselves, may be either a traditional stopper or a Hemogard® closure. Note that traditional stoppers are less expensive, and therefore more commonly seen.

The N.I.K. 4990 kit contains two 10 ml grey-top Vacutainers®, each containing 20 mg of sodium fluoride and 10mg of EDTA, while both the N.I.K. 4994 kit and the Lynn Peavey kit contain two 10ml grey-top Vacutainers®, each containing 100mg of sodium fluoride and 20mg of potassium oxalate. The N.I.K. 4994 kit and the Lynn Peavey kits were designed to meet the requirements of states mandating, by law, that sodium fluoride be at least 1% of the 10ml blood sample. Neither Ohio nor Arizona has any such legal requirement, and a lower-strength solution results in a lower price for the Vacutainers® used in the kits. Whether it results in lower protections for the blood-draw subject is an issue to be argued to the jury.

Note in Figure 11.31 that the four tubes are different despite the fact that they are all 10 ml grey-top tubes used for law enforcement. From left to right we see a BD Vacutainer with EDTA and sodium fluoride designed to give a 1%-strength solution (N.I.K. 4990 and Lynn-Peavey). The second from the left is another BD Vacutainer with sodium fluoride and potassium oxalate, designed to create a 2%-strength solution (N.I.K. 4994 and Lynn-Peavey). Third from the left is a Monoject tube with sodium fluoride and potassium oxalate, designed to create a 1%-strength solution (various police-assembled kits). Lastly, on the far right is a Tri-Tech tube with sodium fluoride and potassium oxalate, designed to create a 2%-strength solution (Tri-Tech).

Site cleansing

The phlebotomist disinfects the draw site with povidone iodine unless the person is allergic to iodine. If so, then another non-alcoholic cleansing agent should be used. Wiping must be done in concentric circles moving outward from the intended puncture site; otherwise the bacteria is just being pushed around, not removed.

If the phlebotomist does not wipe the area properly, bacteria (Candida Albicans) can be sucked into the

Vacutainer®. Candida is everywhere. It is a yeast. When yeast and sugars (as in blood) mix, there could be fermentation, creating ethyl alcohol. This is indistinguishable from the ethyl alcohol allegedly consumed. The blood tube, however, could be tested for presence of Candida.

The blood draw

The phlebotomist will thread the safety needle supplied with the kit onto the hub until it is firmly seated. Note that a safety needle is double-ended (see Figure 11.32). One end punctures the vein while the other end punctures the stopper on the blood tube, breaking the seal. Note that the end of the needle which punctures the stopper has a retractable rubber sheath over it. As the needle penetrates the stopper, the rubber sheath is forced back, exposing the needle. The rubber sheath acts as a gasket, sealing against the stopper and allowing little outside air to enter the tube.

The first tube is then placed into the hub, but not far enough to puncture the stopper on the tube. If the stopper is punctured before the needled pierces the vein, then the tube will fill with air and will not draw blood. The vein is then punctured, and the tube is pushed further into the hub, breaking the tube's seal and allowing blood to be sucked into the tube.

Although it is uncommon, a phlebotomist may improperly seat the tube inside the hub and on the needle. This could result in an incompletely punctured stopper which will not allow any blood to flow, or a partially punctured stopper which will allow a small amount to flow and draw in outside air. The needle may also be bent, causing further problems. Check the tubes to see if they have been filled to capacity. Sometimes a partially filled tube can be the result of a collapsed vein or some other issue. However, a partially filled tube can also be the result of an improper draw. See Figure 11.33.

The phlebotomist must also take care to insert the needle all the way into the vein, so as to prevent leakage of blood into the surrounding tissue, but not far enough to puncture both vein walls. The end of the needle is beveled for ease of insertion, but care must be taken to ensure that the bevel does not "seal" against the inner wall of the vein, causing obstructed blood flow.

The phlebotomist must keep the tube at a slight angle downward, so gravity will help prevent any backflow of the tube's contents into the subject's vein. This is a highly unlikely scenario because of blood pressure and vacuum, but backflow of chemicals from the tube into the subject could have disastrous results for the subject. The latex band should be removed as soon as blood begins to flow.

Once the first tube is filled, it should be removed and replaced with a second tube. When filled, the second tube should be removed from the hub and then the needle from the arm. The second tube can be contaminated when the phlebotomist withdraws the needle from the arm without withdrawing the second tube from the hub first. This will draw outside air, including Candida into the second tube only. Some blood kit instruction sheets actually show the incorrect way to draw blood, causing contamination in this manner. Most phlebotomists and police do not distinguish first tube drawn from the second tube drawn.

Tube inversion

According to Becton-Dickson, the tubes are supposed to be gently inverted at least eight times immediately after the draw to mix the preservative and anti-coagulant. Note: Many blood kit instructions direct the phlebotomist not to shake the vials. This is for personal safety, as blood may splatter from vigorous shaking. Shaking should not affect the integrity of the blood sample unless it causes hemolysis, which is the tearing and splitting of the red blood cells. Such damage can cause the blood testing process to be more akin to a plasma test, which will cause a higher result.

The chemicals have to mix with the blood in a proper proportion; otherwise they do not work properly. If there is too much blood or too little chemical, the blood could ferment causing alcohol to form. If there is too little blood or too much chemical, the overabundance of chemicals could "salt out" the blood, causing a higher alcohol concentration under certain circumstances. See Figure 11.34.

Chain of custody and proper handling of the specimens

The preservative is supposed to prevent *endogenous formation* of alcohol, but lesser-strength solutions available will slow, but not stop, endogenous alcohol formation. Studies show that a 2 percent solution will stop the growth of Candida Albicans. Likewise, refrigeration only slows the decomposition; it does not stop it. Milk has preservatives added, yet it goes bad after a while even when refrigerated. Freezing will stop endogenous formation of alcohol, but blood tubes used for law enforcement blood kits are glass and breakage becomes a problem. Generally, 4°C has been found to be a good compromise temperature for storage. Certainly, inquiries as to whether the blood remained in an unrefrigerated police car for some period of time should be made. It is not uncommon to mail the blood sample to a crime lab. *Chain of custody* is always worth investigating.

The blood storage facility at the crime lab should be investigated. Access and inventory control can be decisive, yet simple, issues in a blood test case.

Preparation of the sample for testing

At the crime lab, the blood is taken out of the refrigerator and allowed to come to room temperature. Usually the tube is placed in a rocker that gently rocks the contents back and forth, ensuring a good mix. What exactly was the room temperature? Generally, we do not know. Often, the analysts let the samples sit for a couple of hours to get to room temperature. They say that this cannot harm the mixture, but would you leave milk out for two hours, even though it has preservatives in it? The second tube of blood should be repackaged and returned to the refrigerator in a timely manner. Due process issues may arise where the crime lab spoils the second sample.

Paperwork tracking the sample should be examined closely. Often, this will be reflected in the A*nalystís Bench Notes*. Some labs assign a bar code label to each blood kit and each tube as blood is transferred. Tracking the blood from the tube to the actual computer-generated BAC printout is very important.

Once the tube is at room temperature, the top is removed by either cutting it off or pulling it out of the tube. Care should be taken either way, as cutting requires the use of a sharp instrument and pulling could cause splatter. It should always be done under an exhaust hood, and adequate protective measures should be taken to avoid contact with the blood. Moreover, adequate ventilation in the lab and a proper hood design must ensure that airborne contaminants do not infiltrate the open sample.

Once the top is removed, the contents are poured into a container. A measured amount is removed from the container via a *pipette*. Ideally, the pipette should be electronic rather than manual to ensure greater accuracy and reliability. Maintenance and calibration records should be available for the pipette. Pipettes can be checked for accuracy by drawing a known amount of distilled water and depositing it onto a scale to check its weight.

The blood removed by the pipette is then transferred to a *headspace vial*. More sophisticated labs have pipettes that also draw a measured amount of *internal standard* and transfer the internal standard to the same headspace vial simultaneously with the blood. This is called an “auto-dilutor” and it will have a maintenance and calibration schedule as well. Two samples of blood should be prepared for testing, and the results should agree with each other to some adequate degree. Any somewhat competent lab should have no more than a 5 percent disagreement between samples.

The pipette must be rinsed clean between samples to avoid cross contamination from previous blood samples. Only de-ionized water should be used to rinse the pipette because the flame ionization detector (FID) at the end of the process counts ions that hit it, counting them as alcohol. One would not want to introduce ions that could interfere with the result.

The headspace vials are often placed into an autosampler, which is an automated rack that will move each vial into place for sampling. The use of an autosampler allows the analyst to set the machine to run samples without the need to be present to inject each sample. The autosampler also heats and shakes the vials to ensure proper mixing of the components. Check the time at which your client’s sample was injected. It might be well after working hours, and this leads to a good area of cross-examination. For example:

- You weren’t at the crime lab at 2:02 A.M. when my client’s blood was actually tested were you?

- You were home, asleep?
- If something went wrong with the process, would you expect the cleaning crew to take care of it?

11.15 Headspace Gas Chromatography

Chromatography is a separation science

Chromatography is a separation science. It relies on chemical or mechanical means of separating substances into more discrete units. Headspace gas chromatography is an indirect method of measuring the amount of a volatile substance contained in a liquid by measuring an equilibrated amount of the volatile substance in the headspace above the liquid.

Blood is prepared in a headspace vial by mixing it with a known amount of an internal standard (often a type of alcohol) as described above. The vial is crimp-sealed. The quality of the crimp at the top of the vial is important because it will be one factor that governs how much gas pressure builds up in the vial above the mixture.

The mixture is heated to a specific temperature in order to release the volatile compounds. The actual temperature is not as critical as the constancy of the temperature throughout the entire process. All vials must be heated to the same temperature. Colder temperatures result in longer times for the volatiles to move into the gaseous phase.

As the vial is heated, a gas rises above the mixture in the headspace vial like steam might rise above a pot of boiling water. The content of that gas is dependent upon *Henryís Law of Partial Pressures*. If the crimp is not perfect, it will change the pressure and the content of the gas. If the temperature varies, varying amounts of the volatiles will move into the gaseous phase as compared to other headspace vials.

Henry's Law—Assume a closed system and constant temperature. After a period of time, some of the molecules of the liquid will have moved into the gaseous phase in the headspace above the liquid. The number of molecules that have passed into the gaseous phase will be directly proportional to the number of molecules remaining in the liquid.

If we keep the temperature constant and the pressure constant, some of the alcohol molecules and the internal standard molecules will have passed from the liquid state into the headspace gaseous state. If we can measure the number of molecules in the headspace then we can, by conversion, quantify the amount of alcohol in the blood below it. Since the internal standard is mixed into the sample in a known amount and moves into the headspace at a known rate, the alcohol molecules are measured as a ratio in relation to the internal standard molecules released into the headspace.

Equilibration—Equilibration means that a constant proportion exists between the number of molecules in the gas above the liquid and the number of molecules in the liquid below, for any given volatile substance at a particular temperature and pressure. This does not mean, however, that there must be an *equal* amount of molecules in the gas and in the liquid (although a 1:1 ratio is possible for some substances).

If the temperature is not perfect, it will change the content of the gas. If the pressure is not constant, it will change the content of the gas.

In addition to the temperature and pressure, there is another factor that governs how much alcohol rises into the gas—that is called the *partition ratio*. Differing substances will have differing partition ratios, which are dependent upon many things, including the specific gravity of the substance.

Hematocrit, which is different but related to partition ratio, is also important. Hematocrit is a measure of the proportion of solid components to liquid components in the blood. Higher hematocrit means more solids. When pressurized, higher hematocrit levels push more hydrophilic molecules, such as alcohol, out of the liquid and into the gas. This can give a higher reported result if the internal standard passes into the gaseous phase at a slower rate than the alcohol.

The column

The column is a tube about as thin as a human hair and approximately 30 meters in length. It is heated in an oven inside the machine and is usually in a coil shape. The temperature in many headspace gas chromatographs used for blood testing is 60°C, but it may vary significantly and can be "ramped up" to bake-out impurities in the column between runs or as part of a maintenance procedure. See Figure 11.35.

An autosampler gently shakes and heats the headspace vials as it moves each one under a syringe. The syringe moves downward and punctures the crimped seal at the top of the headspace vial. It sucks a small amount of the headspace gas out and injects it into a transfer tube. Always check maintenance logs for syringe changes. Frequent changes may show problems with the process. Sometimes the syringes become bent because they miss the headspace vial. This is important if it happens during a blood run, and the run is continued without starting over. This means that the blood run was stopped and restarted without using new calibrators and controls.

At the same time that the headspace gas is being drawn out of the vial, an inert carrier gas (usually helium) is also introduced. The quality and content of the carrier gas should be documented as well as the intervals at which the filters for the carrier gas are inspected and changed. Ask for documentation regarding the purchase of the helium. Balloon grade helium is different from ultra-high purity scientific grade helium.

Separation of volatile substances, retention times and column maintenance

Both the carrier gas and the headspace sample move through the transfer tube and a Y-splitter. Half the mixture flows through one column, while the other half flows through a second column. As the gases move through the column, the rate of flow of some molecules is slowed by chemical attraction to the column. Thus, separation is achieved over the course of several minutes. Each volatile compound has its own unique retention time. Retention times vary from column to column. Two columns from the same manufacturer, made to the same specifications, will have different retention times for identical compounds.

It is important to realize that the column is designed to capture and slow molecules. In fact, the column has to be replaced every now and then because it gets packed with crud and blood from the samples. More often, however, the column needs to have its ends "clipped" with a file. Most problems with the column occur at either end and it can be remedied by removing the first or last inch of the column. This changes retention times. Columns are also routinely "baked out" to rid them of unwanted particulates. Baking out a column means that the temperature of the column is raised to a point much higher than that used for sampling purposes to incinerate particulate matter. Some GC programs also ramp up the temperature to a high level after each sample is run to bake out any particulates between samples. Column flow may also be reversed to dislodge particulates, much like the backwash function on a pool or spa.

Flame Ionization Detector

At the other end of the column from the injector is a Flame Ionization Detector (FID). The flame is powered by a mix of hydrogen gas and air supplied by the state. The purity of the gas mixture generally is not tested. Many labs create their own hydrogen supply with a hydrogen generator. The term generator is misleading as it does not actually create hydrogen, but separates it from other gaseous components.

The blood samples emerge (or elute) from the end of the column, striking the flame at a specific time. If we know how long it takes alcohol to move through the column and emerge at the end, we know that all substances that take the same amount of time are alcohol. The flame vaporizes every volatile substance in its path. The burnt and ionized particles stick to an oppositely charged detector which counts them by measuring the electrical energy as each ion hits. The electrical signal strength is measured and reported in units called "millivolts."

The computer program calculates BAC

The GC then makes a mathematical calculation, and converts the electrical signal to a peak on a chromatogram (a computer-generated graph with peaks representing the electrical signal strength of volatile substances as they are ionized in the FID). There should be chromatograms for every sample introduced to the column. Eventually, the blood alcohol report is generated and printed. See Figure 11.36.

The mathematical calculation is unknown to the analyst because it is proprietary information that belongs to the manufacturer of the machine. The area underneath the peak represents the signal strength. One can calculate the peak area using geometry and algebra to check the result. One can also cut the peaks out with scissors and weigh them on a scale to calculate the results (assuming constant paper thickness, a very accurate scale, and extreme precision in cutting out the peaks from the graph). The amount of alcohol that is being detected is so small that it cannot be seen with the human eye.

The sizes of the peak areas are inversely proportional. In other words, if the ethanol peak area remains static, but the size of the internal standard peak area is increased, the ethanol peak area will "look smaller" to the computer program and it will report a lower BAC. If, however, the size of the ethanol peak area remains static and the size of the internal standard peak area is reduced (as when an analyst adds too little internal standard to the sample), the reported BAC will be increased. See Figure 11.37.

Each time the GC is run, it must "learn" what differing levels of alcohol look like. Generally, four calibrators are used to "teach" the machine to recognize .01, .10, .20 and .30 percent alcohol concentrations. Calibrators are used for this purpose and are commercially available or may be made in the lab. The important issue in calibration is to run the calibrators first in the run and then to run "verifiers" at the end of the run. The verifiers should, of course, be at the same levels as the calibrators (.01, .10, .20 and .30) but must come from a different source. If they do not come from a different source, and a calibrator is incorrect, the verifier will not catch the mistake. It will simply confirm the earlier mistake as being accurate.

The calibration run will generate a *calibration curve report* which is a graphical representation of the ratio of internal standard peak size versus alcohol peak size. All subject samples can, and should, be plotted on the calibration curve report to check for accuracy. The Calibration Curve Report is a graphical representation of the calibrators. In Figure 11.38, all samples from .010 to .300 are linear, whereas samples above .300 are only assumed to be linear (and no one has any real interest in samples below .010, except in the very rare case).

To plot an individual subject's BAC on the calibration curve report, one must divide the ethanol peak area size by the internal standard peak area size. That number is then plotted on the vertical scale and a line is drawn horizontally to the point at which it intercepts the plotted curve. At the point of interception, the line is then dropped vertically to the horizontal scale. The point at which it intercepts the horizontal scale is the reported BAC.

Blanks must be run between samples at regular intervals to ensure no cross contamination from one sample to the next. *Controls*, which are blood samples of a known value, should also be run at regular intervals with the blanks to ensure that the GC is operating accurately. Controls are commercially available or may be made in the lab. Either way, documentation should be available for each control batch.

A *mixed standard*, made up of several volatile compounds including ethanol, and internal standard must be run to ensure that the columns can separate different compounds.

Since chromatography is a separation science, if the GC cannot adequately distinguish between volatile compounds in blood, it is a useless tool for law enforcement. Figure 11.39 is an example from a crime lab where six compounds were analyzed, but the GC could distinguish only five. This column needs to be taken out of service and replaced. Watch out for explanations from the government that "It's OK. We know where the other volatile compound goes." That is a poor excuse for the obvious issue—the machine is broken.

Chromatograms are subject to computer manipulation to cover poor baseline resolution. For example, the chromatogram in Figure 11.40 has significant baseline resolution problems. Normally, this would be time for a maintenance procedure, or even for a new column. However, a dishonest analyst, interested in time efficiency rather than truth, could simply manipulate the baseline to cover up the faulty baseline resolution as seen in Figure 11.41.

Watch for analysts manipulating the baseline and claiming that it was done to cure "background noise" or to bring the resolution "up out of the weeds." When the analyst gets overly technical, it is usually in an effort to hide something from the defense.

Contamination: The Dirty Little Secret

Contamination is a real threat to the entire process, and most crime lab personnel attempt to minimize its effect, both in the lab and in testimony. No lab is 100 percent contamination-free, despite the protestations of the criminalists who regularly testify in DUI cases.

Significant contamination issues are frequent in police crime labs and can come from unknown or known sources. Figure 11.42 is an example of significant contamination from a crime lab. The name of the contaminant and the source remain a mystery.

Not all contamination issues are mysterious, however. Some come from easily made mistakes and sloppy lab procedures. For example, toluene likely contaminated the sample in Figure 11.43 because an analyst switched caps on storage containers of ethanol and toluene. The next time ethanol was drawn from the container, it contained a significant amount of toluene which appeared in the calibration chromatogram.

Most disturbingly, however, is that the toluene also appeared at the same level in the .20 verification chromatogram at the end of the blood run. This means that the crime lab was using the exact same solution to calibrate the machine as was being used to verify the calibration of the machine. This is circular logic employed in its most dangerous form.

Co-elution of volatile compounds can cause a significantly increased BAC to be reported. As has been repeated over and over in this chapter, chromatography is a separation science. If the GC cannot separate compounds, it is worthless. And when compounds co-elute with ethanol, the innocent can go to prison. In an actual DPS sample in Figure 11.44, ethanol co-eluted with acetone. Acetone was clearly present, but the GC reported its value as .000, whereas it reported a .320 BAC result. The subject of this test was tried and found Not Guilty, but a less-thorough attorney might not have asked for the chromatograms and would have missed this important issue.

Co-elution, and the more common issue of poor baseline resolution do not always have to occur in a subject sample. The mixed standard chromatogram shows poor baseline resolution of ethanol and isopropanol. This column may have reached the end of its useful life and needs to be replaced. Watch out for explanations from the government that "this only happens on one column." That is a poor excuse for the obvious issue—the machine is broken. See Figure 11.45.

Be aware that all chromatograms are susceptible to computerized manipulation. Figure 11.46 is an actual Arizona DPS chromatogram showing manipulation. Fortunately, the analyst was exceedingly honest and documented the events that led to this in detail. She made proper disclosure of the issues and was forthright in her testimony. This underscores the extreme importance of integrity for all crime lab personnel. The national news is full of stories documenting how dishonest crime lab personnel have corrupted the system. It is unfortunate, but some crime lab personnel fall prey to the "us versus them" mentality and it affects the outcome of many cases.

An interruption of the gas flow can cause deleterious effects on a reported result. Most people do not even know what an interruption looks like, let alone how it occurs. An interruption can be caused by a physical blockage of the carrier gas line to the GC and it can also be caused by a leak in the gas line which allows gas pressure in the GC to drop. A leak is potentially more dangerous because the leak point can also suck in outside air and contaminate the sample. In either event, the entire GC run documentation should be saved for the purpose of disclosure and maintenance. Then the blood should be rerun. As one can see in

Figure 11.47, the evidence of interruption can appear as a very small detail on the chromatogram.

An odd situation is chronicled in Figure 11.48 where a volatile substance appears on one column, but not on the other column. The peak is too large to be any type of background noise or electronic interference. The program does not recognize the peak. Although it does not elute at the same time as any other compound, such as ethanol, on Column 2, it does not appear on Column 1. Since this compound actually exists, it must elute somewhere on the Column 1 chromatogram. It is possible for this compound to co-elute with another volatile substance on Column 1, or to remain trapped in the column until it is baked-out.

11.16 Blood Testing For Drugs

Overview

Blood is tested in a two-step process. The first step is a screening tool known as *Enzyme-Linked Immunosorbant Assay* (ELISA), and the second step is a confirmatory test known as *Liquid Chromatography Mass-Spectrometry* (LCMS).

Nothing is different in the manner in which the police collect blood samples in a DUI-drugs case as opposed to a DUI-alcohol case. What is irrelevant to the collection process, however, is the possibility of fermentation causing the neogenesis of cannabis or methamphetamine or any other drugs in the blood tube. That's not to say that the contents of the tubes could not be contaminated in some other manner, or that one drug could not be mistaken for another during the testing process, but blood collection and handling would never cause the formation of compounds of interest like cannabis in the blood tube.

As with any blood tube, the first area to check is chain-of-custody, and in some crime labs that is different from chain-of-custody in blood-alcohol cases. In a DUI-drugs analysis once the blood specimen is checked out of evidence control it may be opened by someone other than the LCMS analyst. This means that when the analyst arrives at her desk, she is working with a kit that has broken seals and is not in the same condition as when the officer submitted it into evidence. The criminalist who broke the seals is now a necessary witness in the chain of custody.

Whether it is the analyst or another crime lab employee, the person opening the blood kit must document what was found.

As mentioned earlier, the analyst who opens the blood kit may not be the same analyst who performs the ELISA screening. Additionally, the analyst who performs the subsequent LCMS confirmation testing may not be the analyst who performed the ELISA screening. The series of analysts creates a problematic chain-of-custody issue for the prosecution. Chain-of-custody is usually unassailable when an officer seals a blood kit in the field and the analyst who performs the testing is the one who broke the original seal. As long as the original seal is intact, the prosecution can claim that there is no evidence of tampering and the sample is in substantially the same condition as it was when it was sealed. Obviously, environmental conditions and length of time in transit or storage may still be an issue.

When a second, or even third analyst receives the blood tube, the original seal will be broken and some of the sample will be missing. That is prima facie evidence of tampering. Once the defense establishes that the original seal was broken and that the sample is not in substantially the same condition as it was when the officer sealed it in the field, the people who broke the seal and handled the sample must appear and give testimony before the test result is admissible.

The testing process is a three-step sequence (Figure 11.49).

A. ELISA—Enzyme-Linked Immunosorbant Assay

The first step in the actual analysis of the blood is called an "Enzyme-Linked Immunosorbant Assay" (ELISA). An "assay" is an analysis of a substance for identification, quality, or quantity of an unknown component. In the crime lab, they are assaying primarily for identification and secondarily for quantity.

An immunoassay is a "competitive binding" process commonly used in laboratories. Specific antigens with the same or similar chemical structure of the target compound compete to bind with specific binding sites on a particular antibody.

The ELISA analyst has a plate with "microwells" in rows across the plate (Figure 11.50). Microwells are simply small bowl-shaped containers molded into the plate. She pipettes a small amount of the blood sample into each of the microwells horizontally across the plate. Each horizontal row represents an individual subject's blood sample. Each well within the horizontal row represents one of the nine categories of drugs for which the crime lab has chosen to screen.

The ELISA analyst then pipettes one of the pre-determined antibodies (an enzyme-labeled drug) vertically down the plate.

The enzyme-labeled drug competes with possible drugs for antibody binding sites within a subject sample. The unbound material is then washed out of the microwells.

A chromogenic substrate is then added to the samples. The substrate develops color with the bound enzymes. The excess is washed away and a spectrophotometer is used to measure the color change to determine whether a drug category has been detected or not detected. This process is known as a "colorimetric assay."

Cross-reactivity can be a problem with ELISA. Despite the fact that the enzyme-labeled drugs are developed around a specific drug, other drugs or compounds with similar structures will also bind to the antibodies and produce a "detected" signal. This is why ELISA screening is only useful as a preliminary or presumptive tool. A second, confirmatory test must be done.

The ELISA specimen is just 0.1 mL of blood, serum or plasma. The enzyme-labeled drugs are purchased by the labs as "Immunalysis Reagent Kits" from a commercial vendor. There are specific kits for specific drug categories such as: Cocaine Metabolite, Methamphetamine, Opiates, Carisoprodol, Zolpidem, Cannabinoids, Benzodiazepines, Barbiturates, Methadone and others.

Calibrators are also purchased from a commercial vendor and are used to create high-calibrators, cutoff (low) calibrators and positive controls. Blanks are also created and used. At the end of the run, the high calibrators and positive controls should all be labeled as "detected" and the negative controls and blanks should be "not detected." But, what happens when it goes awry? Do they have to do it all over again? Not necessarily.

Data which does not meet all of the quality control criteria may be accepted at the discretion of the unit supervisor or designee. What this means in legal terms is that the unit supervisor can give all analysts the discretion to say "good enough for government work" when everything doesn't go according to plan.

While the ELISA screening is the preliminary step in the ultimate result, only a few areas are worth attacking by the defense. Realistically, ELISA is not needed by the crime lab for any purpose other than budgetary reasons. ELISA screening is not a scientific or legal prerequisite to LCMS testing. The crime lab could eliminate ELISA screening and simply test all blood samples by LCMS. They could also decide which categories of drugs to test for by LCMS by throwing darts at a dartboard labeled with the different categories of drugs. An attack on ELISA lies primarily in the chain of custody of the blood sample submitted to the crime lab. However, when a category of drugs is not detected, but is sent off for LCMS testing and results in a positive result, the conflict may provide an area of attack.

Below is an ELISA Preliminary Drug Screen result chart (Figure 11.51). It lists eight pieces of information for each of nine assays, and shows the presence of three drug categories. Note the Analyst's initials appear along with the date of analysis (Mar 19, 2013). There is also the Technical Reviewer's initials and stamp in the middle of the box, indicating review on the same date. The analyst also placed check-marks next to each category that was detected. The eight categories of information, from left-to-right, are explained below.

Assay

There are nine "Assay" categories which correspond to the nine wells across the ELISA plate. The names of the drug categories are programmed into the system, but are not necessarily limited to the specific drug named. For example, the assay category "THC" includes all forms of THC whether it is the active drug or the inactive metabolite. Likewise, "Methamp" includes all amphetamines, not just methamphetamine. ELISA screenings are not uniform across all jurisdictions. The assay category is assembled based upon the drugs for which the crime lab has chosen. ELISA screening is not limited to forensic applications, either. It is used in many formats relating to healthcare and disease prevention applications.

Result

The result category for the ELISA Preliminary Drug Screen above indicates either "ND" which stands for "Not Detected," which appears in the Barbiturate, Cocaine, Methadone, Methamphetamine and Zolpidem categories, or "DETECTED," which appears in the Benzodiazepene, Carisoprodol and Opiate categories.

Samples with a result of detected are sent off for further confirmation and, at the analyst's discretion, those labeled not detected may also be sent off for further testing. If one is sent off for confirmation, yet has been labeled not detected the analyst's reasons should be scrutinized carefully for bias.

Sample Abs.

The category "Sample Abs." stands for "Sample Absorbance." This is a measure of light which was absorbed by the sample in that particular screen. The ELISA Screen is a colorimetric screening which is a type of spectroscopy where light is passed through the sample. A sample may absorb a little bit of the light, or a lot of the light, depending on the sample's properties. The absorbance of light is altered by the addition of the substrate by the analyst when the substrate binds to the drug. (A "substrate" is the substance upon which the enzyme acts).

In the assay example above, the Sample Absorbance level is inversely proportional to the amount of drug. In other words, more drug in the blood sample causes less absorbance of the light (i.e. more light makes it through the sample). Note that not all ELISA screening kits work on the principle of inverse proportionality.

The number stated in the Sample Absorbance category is a measure of the intensity of the color as light was passed through it. It does not correspond to traditional light measurements such as "lumens" but is a simple comparative reference used by the device. In the example, above, the Opiate category has a sample absorbance of 0.919.

Cutoff Level

Moving to the right, the Opiate category has a Cutoff Level of 5 ng/mL. The Cutoff Level is the amount of drug (reported as weight per volume) where the crime lab has chosen to say that the sample is "Detected" or "Not Detected." The term "Not Detected" does not mean that there is a complete absence of the drug. It simply means that the crime lab will not submit the sample for further confirmatory testing by Liquid Chromatography/Mass Spectrometry. Keep in mind that such decisions may be for scientific reasons, such as the limits of measurement may cause too many "Detected" samples to be sent on for confirmation which are actually negative. Confirmation testing costs more by adding more personnel, equipment and time to the equation.

Neg

The "Neg" category is a programmed sample-absorbance level which corresponds to a "negative" result (which may be different from a "Not Detected" result). In the Opiate category, above, the negative result is 2.204. If the sample absorbance result is 2.204 or higher, the result is considered to be "negative" or 0 ng/mL. However in this example, the result was 1.130, which is lower, and it was reported correctly as "DETECTED."

Cutoff

The "Cutoff" category is the sample-absorbance level that the crime lab has chosen to report a drug category as Detected or Not Detected (see "Cutoff Level" above). The Cutoff for the Opiate category is set at 1.130 which is equivalent to 5 ng/mL of the drug. If the sample absorbance result indicated something between

Negative level of 2.204 and the cutoff level of 1.130, the reported result would be “DETECTED,” but it should not be sent on for confirmation testing because it did not meet the sample-absorbance parameter of the cutoff level. In other words, the drug could actually be present, but because of the scientific levels of detection, it might be classified as background noise; or, it might not be economically feasible to run a confirmatory test on every detected opiate at that level; or, it might be a policy decision not to pursue prosecution of drivers at such low levels. It is likely a combination of these factors.

High

The “High” category is the upper sample-absorbance level chosen by the crime lab. It is dependent upon the ELISA kit purchased by the crime lab. Since the levels recorded by the ELISA screen are not typically admitted in court, it serves only to provide a linear calibration curve for the crime lab. In other words, the crime lab can plot a straight line from the Negative Level through the Cutoff Level to the High Level.

High Level

The “High Level” category is a programmed sample-absorbance level which corresponds to a specific weight per volume amount In the Opiate category, the high sample-absorbance result is 0.261. If the actual sample absorbance result was exactly 0.261, would be reported as “DETECTED” and, it would equal 50 ng/mL.

Referring again to the ELISA Preliminary Drug Screen illustration, we see that the category “Benzo” (benzodiazepine) has been detected. The reported sample-absorbance is 0.083. Remembering that the sample-absorbance is inversely proportional to the amount of drug, the 0.083 sample-absorbance result puts the amount of drug (weight-per-volume measurement) above the cutoff level of 0.178, and slightly below the High Level of 250 ng/mL (0.086 sample-absorbance).

B. Liquid Chromatography/Mass-Spectrometry

Overview

The forensic sciences are full of acronyms. One of the acronyms you will run into is GCFID, which refers to “Gas Chromatography with Flame Ionization Detection.” GCFID is the most common method used for alcohol detection in blood. It is not used for drugs.

GCMS is Gas Chromatography with Mass-Spectrometry Detection which can be used for detection of certain drugs in blood or urine. Also used for detection of certain drugs in blood or urine is LCMS which is “Liquid Chromatography/Mass-Spectrometry.” A more complex version is LCMSMS which is “Liquid Chromatography/Mass-Spectrometry/Mass-Spectrometry.” A specific, and increasingly commonly-used type of LCMSMS is LC-QQQ-MS which is “Liquid Chromatography/Triple-Quadrupole/Mass-Spectrometry.”

All forms of Chromatography which use Mass-Spectrometry are methods that both identify and quantify unknown substances. Unlike GCFID, both GCMS and LCMS use a different type of detector called a “mass spectrometer.”

GCFID is used mainly for alcohol detection. The FID is sometimes known as a “dumb” detector because it cannot identify the volatile substance that it detects. For identification, the GCFID relies upon substances eluting at a known time. For example, if alcohol is known to elute at 1:00 minutes on Column A and at 2:00 minutes on Column B, then every substance which elutes at those times is presumed to be alcohol. This can only be determined by running many different known substances, several times, and recording the outcomes. If there is another compound that elutes at 1:00 minutes on Column A and at 2:00 minutes on Column B, the GCFID will mistake it for alcohol. As the compound elutes, it is burned or “ionized.” The FID then quantifies the substance by recording the energy generated as the substance is burned.

The Mass-Spectrometer, on the other hand, is sometimes known as a “smart” detector. As the ion of interest (also known as a “resonant ion”) elutes, it is fractured by one of many available methods into a known spectral pattern. Each ion has a specific pattern and, thus, identification is not governed by the time of elution, but by comparison to a spectral library. The spectral library is a series of patterns of shattered ions programmed into the database. The spectral patterns are compared by the computer and identification is made.

Definitions: An "ion" is an electrically-charged atom or groups of atoms. Typically, the number of electrons balances the number of protons in an atom making it electrically-neutral. An ion is created by the addition or loss of electrons. A "cation" has a positive charge and is created by the loss of electrons. An "anion" has a negative charge and is created by the addition of electrons. A "resonant ion" describes an ion with delocalized electrons that are contained within certain molecules.

The basic process is that a small portion of the prepared sample is injected through the sample inlet at high pressure into the mass spectrometer chamber. The mass spectrometer is housed inside of a vacuum which is created by a device called a "rough pump." The sample is struck by a high-energy ion beam which cleaves the molecular bonds of the sample. The ions created pass through a mass analyzer which sorts ions and further shatters the sample's molecules. The fragmented ions which make it to the end of the process enter an electron multiplier, causing an electron cascade, which goes to a detector for quantification. The signal from the detector is sent to an amplifier and finally to a computer which analyzes the result (Figure 11.52).

LC-QQQ-MS gets its name from the fact that it uses three quadrupoles, in sequence, to sort and identify ions of interest. A quadrupole, as the name suggests, is made up of four monopoles. A monopole is a rod, electrically neutral, but with oppositely charged ends. The strength and polarity of the monopoles is one factor that causes non-resonant ions to be sorted and filtered out of the ion stream (Figure 11.53).

LC-QQQ-MS uses three quadrupole arrays in sequence to shatter ions and filter the ion stream before it hits the detector. The first and third quadrupole arrays function as mass analyzers. The second quadrupole array is sometimes referred to as a "collision cell." All of the arrays are housed in a vacuum chamber (Figure 11.54).

The pressurized ion stream enters the first quadrupole array as it elutes from the column through a nebulizer called an "inlet cone." Periodic maintenance should be done on the inlet cone to ensure that a full, fine spray is produced.

The first ionization process used is "EI" which stands for "Electron Ionization" and consists of a high-energy beam of ions which shatters the molecules in a predictable pattern as they exit the inlet cone (EI is sometimes referred to as a "hard" method of ionization). Another common method used in LCMS is "CI" which stands for "Chemical Ionization," although it is not commonly used in forensic labs when examining for drugs (CI is sometimes referred to as a "soft" method of ionization). The advantage to using EI over CI is that with EI, the spectral pattern that results from the shattering of the molecules can be compared to a spectral library for identification of the ions, irrespective of what type of device is used. CI, on the other hand, creates patterns that are generally dependent upon the device used and the manufacturer's specifications. ESI, or "Electrospray Ionization" is another ionization method and is used at atmospheric pressures and is not housed in a vacuum.

In LCMS the ions are separated, detected and measured according to their mass-to-charge ratios. The symbol for the mass-to-charge ratio is m/z where "m" is the mass and "z" is the charge. The term "Resolving Power" (abbreviation "res") designates the relative ability of a mass spectrometer to separate two masses.

The first quadrupole array electronically filters out non-resonant ions by superimposing a radio frequency (RF) across the constant DC current potentials between the four parallel rods. This leaves the resonant ion, also known as the "parent" ion in the stream. Non-resonant ions are discarded.

The ion stream is accelerated and enters the second quadrupole array. In the second array, the ion stream is bombarded with high kinetic energy electronic pulses in a nitrogen stream (helium and argon may also be used). This shatters, or "fragments," the resonant (parent) ions by breaking their molecular bonds. This is called "Collision-Induced Dissociation" (CID) or Collisionally-Activated Dissociation (CAD). The fragments continue on in the ion stream to the third quadrupole array. Non-resonant are discarded.

The ion stream is accelerated and enters the third quadrupole array. The third quadrupole array electronically filters out non-resonant ions much like the first quadrupole, leaving ion fragments. Non-resonant ions are discarded. The remaining fragments pass into a funnel-shaped device called an "Electron Multiplier."

Electron Multiplier/Detector

After the stream of ions has been filtered and shattered by the mass analyzer (triple quadrupoles), the surviving fragments enter an "Electron Multiplier" for the final phase of the detection and quantification process (Figure 11.55).

The stream of fragments is accelerated down a curved metal funnel-like structure which is highly charged with a few hundred, to over one thousand volts, depending on the system. The fragments strike the side of the structure known as a conversion dynode, which is made of a "secondary-emissive" material. This induces the emission of one or more electrons from the secondary-emissive material. The electrons ricochet across the funnel and strike another section, each releasing one or more electrons. They, in turn, ricochet back across the funnel releasing even more electrons. This multiplication of electrons creates a cascade effect as they work their way down the funnel.

At the small-end of the funnel is an anode, which collects the electrons and produces a signal proportional to the number of electrons that are collected (Figure 11.56). The signal is amplified, recorded, and printed as a quantity.

LCMS Chromatography

LCMS produces chromatograms which plots the abundances of the ions as a signal on a vertical axis and an "Acquisition Time" on the horizontal scale for a Total Ion Chromatogram (TIC). "TIC" is sometimes known as "Total Ion Current." The signal in LCMS is electron counts plotted against the "Acquisition Time." Acquisition Time is similar to the time of elution in GCFID testing. The chromatogram lists the term "+ TIC MRM" which stands for "Positive Total Ion Chromatogram, Multiple Reaction Monitoring." The chromatograms may look similar to the ones produced by GCFID, used for alcohol detection.

MRM is accomplished by specifying the parent mass of the compound for MS/MS fragmentation and then specifically monitoring for a single fragment ion. The fragmentation results in a transition from the parent mass to the fragment mass known as a "transition" and can be written (parent mass -> fragment mass). For example 300.2 -> 199.

While positive LCMS chromatograms may look similar to GCFID, the LCMS blanks look much different than GCFID. The illustration, above, is a true-blank chromatogram for opiates prior to the opiate-detection chromatogram (Figure 11.57). It is referred to as a "true-blank" because it contains nothing—not even the internal standard.

Note that unlike a blank GCFID chromatogram for alcohol, this LCMS blank has what appear to be jagged and irregular peaks. In reality, the "peaks" are electronic "noise" from the instrument. Because the instrument is looking for such small amounts of opiates, the view is highly-magnified and the baseline appears to be jagged. If opiates were present, they would appear between the 3.8 and 4.2 minute-marks. Note the designation for TIC MRM in the upper left corner and the symbols (**->**) which indicates that it is monitoring transitions from parent ion to fragment ion (also known as a "daughter ion").

LCMS chromatograms also give a close-up view of the areas of interest. HyCod-d3 (Figure 11.58, left) is the internal standard used to measure for Hydrocodone, labeled "HyCod" on the chromatogram shown above (Figure 11.58, right). There are two lines present because it is tracking two different ions: ion 303.2 transitioning to 199.0, and; ion 303.2 transitioning to ion 171.0. If present, the internal standard (Hydrocodone-d3) would appear at the acquisition times bracketed by the vertical lines which appear at approximately 3.9 to 4.15 minutes. This is a "true-blank" as it has nothing in the sample—not even the internal standard.

The Hydrocodone chromatogram is blank as well. It tracks the ions of interest for Hydrocodone, which are: ion 300.2 transitioning to 199.0, and; 3002. Transitioning to 128.0. If present, the peak would appear at the acquisition times bracketed by the vertical lines which appear at approximately 3.9 to 4.15 minutes.

Looking more closely at the peak between 3.8 and 4.4, we see HyCod-d3, which is the internal standard used to quantify Hydrocodone (labeled "HyCod" on the chromatogram, Figure 11.59). Unlike the blank for this chromatogram, we clearly see the peaks for the internal standard and for the ion of interest, Hydrocodone, which was detected, but in an amount less than the lab's cutoff level (Figure 11.59, right). Note the analyst's handwritten checkmarks showing that he personally reviewed the results.

We can also see the two lines tracking both ions of interest: ion 303.2 transitioning to 199.0, and; ion 303.2 transitioning to ion 171.0.

Figure 11.60 is a chromatogram for showing presence of opiates and run after the blank. Note that unlike the blank chromatogram for opiates, this one has clearly-defined peaks which are smooth and not jagged. Hydrocodone appears as the sixth peak from the left, between 3.8 and 4.4 minutes.

HyMor-d3 (Figure 11.61, left) is the internal standard used to quantify Hydromorphone, which is labeled "HyMor" on the chromatogram shown, to the right of HyMor-d3. The internal standard appears in the chromatogram between the vertical lines, at approximately 1.5 to 1.7 minutes. Hydromorphone is "not found" (right) and the jagged peaks seen are merely noise.

When an ion of interest is detected, such as in the chromatogram for Carisoprodal (Figure 11.62), it contains one peak which is superimposed upon another peak.

Both peaks fall within the vertical acquisition time-lines which are programmed into the software as the expected acquisition time-range.

The peaks also fall within the horizontal dotted-lines programmed into the software for relative abundances of the ions of interest. The ions (261-transitioning-to-176, and 261-transitioning-to-55, must fall within a certain ratio of each other. In this case, the ratio is 65.4:1 which is 99.7% of the expected ratio for the ions. The reported ratio can also exceed the expected ratio.

Below is a true-blank chromatogram for Carisoprodal and Meprobamate (Figure 11.63). Compare it with the true-blank for opiates. It does not have the boxy characteristics of the opiate blank and, except for the spike at 4.8 minutes, it is relatively uniform in appearance.

The individual chromatograms, for Carisoprodal (Cari); Carisoprodal Internal Standard (Cari-d7); Meprobamate (Mepro), and; Meprobamate Internal Standard (Mepro-d7) confirm the fact that it is a true-blank (Figures 11.64 and 11.65).

Next page (Figure 11.66) is a chromatogram for Meprobamate (1.6 minutes) and Carisoprodal (3.4 minutes). Note the difference between the characteristics of this chromatogram compared to the jagged baseline of the blank.

The individual chromatograms (Figure 11.67) are for Carisoprodal (Cari); Carisoprodal Internal Standard (Cari-d7); Meprobamate (Mepro), and; Meprobamate Internal Standard (Mepro-d7). They show that each of the two drugs were detected. None of the ratios was off by more than 0.8% of the expected range and all fell within the expected acquisition-time represented by the vertical lines.

The computer print-out which describes the Carispoprodal/Meprobamate chromatograms give a more-specific retention time, area counts, and a quantification measured in nanograms per milliliter (Figure 11.68). The program also reports these results as "positive" in accordance with the lab's protocols and the analyst circled the "+" signs as an indicator that he examined this report.

The first three columns, from left to right, represent the drug's name, actual retention (or acquisition) time of the drug and the expected retention or acquisition time for each drug. (Figure 11.69.)

The "Transition" column names the ion-of-interest's mass spectral weights before it is shattered (261.0 for Carisoprodol) and after it is shattered (176.0). If the ion does not transition from 261.0 to 176.0, it is not identified as Carisoprodol. (Figure 11.70)

Likewise, the transition column identifies the Meprobamate ions-of-interest as transitioning from the mass spectral weight of 219.0 before it is shattered to 158.0 after it is shattered. The numbers in the smaller font, below the ions-of-interest are the ions for the internal standards for both drugs. The numbers in smaller font, below the ions of interest, are the internal standard ion transitions.

The Area column is a measure of the peak area counts. Q1 is the ratio of the area counts and Q1 Range is the expected ratio range. Finally, ng/mL is the calculated quantification of the compound measured as weight-per-volume in units of nanograms per milliliter. (Figure 11.71)

11.17 Blood Draws: Statutory Admissibility, Sample Preservation and Independent Testing

Admissibility of Lab Reports

In addition to the provisions of R.C. 4511.19(D) which also apply to breath tests, other provisions apply to urine and blood. In particular the following provisions govern the admissibility of lab tests where a sample was obtained at the request of law enforcement personnel.

> **R.C. 4511.19(E)**
> (E)(1) Subject to division (E)(3) of this section, in any criminal prosecution or juvenile court proceeding for a violation of division (A)(1)(b), (c), (d), (e), (f), (g), (h), (i), or (j) or (B)(1), (2), (3), or (4) of this section or for an equivalent offense that is substantially equivalent to any of those divisions, a laboratory report from any laboratory personnel issued a permit by the department of health authorizing an analysis as described in this division that contains an analysis of the whole blood, blood serum or plasma, breath, urine, or other bodily substance tested and that contains all of the information specified in this division shall be admitted as prima-facie evidence of the information and statements that the report contains. The laboratory report shall contain all of the following:
>
> (a) The signature, under oath, of any person who performed the analysis;
>
> (b) Any findings as to the identity and quantity of alcohol, a drug of abuse, a controlled substance, a metabolite of a controlled substance, or a combination of them that was found;
>
> (c) A copy of a notarized statement by the laboratory director or a designee of the director that contains the name of each certified analyst or test performer involved with the report, the analyst's or test performer's employment relationship with the laboratory that issued the report, and a notation that performing an analysis of the type involved is part of the analyst's or test performer's regular duties;
>
> (d) An outline of the analyst's or test performer's education, training, and experience in performing the type of analysis involved and a certification that the laboratory satisfies appropriate quality control standards in general and, in this particular analysis, under rules of the department of health.
>
> (2) Notwithstanding any other provision of law regarding the admission of evidence, a report of the type described in division (E)(1) of this section is not admissible against the defendant to whom it pertains in any proceeding, other than a preliminary hearing or a grand jury proceeding, unless the prosecutor has served a copy of the report on the defendant's attorney or, if the defendant has no attorney, on the defendant.
>
> (3) A report of the type described in division (E)(1) of this section shall not be prima-facie evidence of the contents, identity, or amount of any substance if, within seven days after the defendant to

whom the report pertains or the defendant's attorney receives a copy of the report, the defendant or the defendant's attorney demands the testimony of the person who signed the report. The judge in the case may extend the seven-day time limit in the interest of justice.

PRACTICE TIP: Pay attention to section E (3) above. You only have seven days after receiving the lab report to demand the testimony of the chemist. This is known as a "Notice and Demand" statute and in *Melendez-Diaz v. Massachusetts*, 129 S. Ct. 2527, 557 U.S. 305, 174 L. Ed. 2d 314 (2009), the Supreme Court indicated that "notice and demand" statutes would satisfy Confrontation Clause concerns. The majority opinion provided examples from state statutes which are almost identical to RC. 4511.19(E)(3).

R.C. 4511.19(F)

(F) Except as otherwise provided in this division, any physician, registered nurse, emergency medical technician-intermediate, emergency medical technician-paramedic, or qualified technician, chemist, or phlebotomist who withdraws blood from a person pursuant to this section or section 4511.191 or 4511.192 of the Revised Code, and any hospital, first-aid station, or clinic at which blood is withdrawn from a person pursuant to this section or section 4511.191 or 4511.192 of the Revised Code, is immune from criminal liability and civil liability based upon a claim of assault and battery or any other claim that is not a claim of malpractice, for any act performed in withdrawing blood from the person. The immunity provided in this division also extends to an emergency medical service organization that employs an emergency medical technician-intermediate or emergency medical technician-paramedic who withdraws blood under this section. The immunity provided in this division is not available to a person who withdraws blood if the person engages in willful or wanton misconduct. As used in this division, "emergency medical technician-intermediate" and "emergency medical technician-paramedic" have the same meanings as in section 4765.01 of the Revised Code.

Ohio Adm. Code Section 3701-53-05 Collection and handling of blood and urine specimens.

(A) All samples shall be collected in accordance with section 4511.19, or section 1547.11 of the Revised Code, as applicable.

(B) When collecting a blood sample, an aqueous solution of a non-volatile antiseptic shall be used on the skin. No alcohols shall be used as a skin antiseptic.

(C) Blood shall be drawn with a sterile dry needle into a vacuum container with a solid anticoagulant, or according to the laboratory protocol as written in the laboratory procedure manual based on the type of specimen being tested.

(D) The collection of a urine specimen must be witnessed to assure that the sample can be authenticated. Urine shall be deposited into a clean glass or plastic screw top container which shall be capped, or collected according to the laboratory protocol as written in the laboratory procedure manual

(E) Blood and urine containers shall be sealed in a manner such that tampering can be detected and have a label which contains at least the following information:

(1) Name of suspect;
(2) Date and time of collection;
(3) Name or initials of person collecting the sample; and
(4) Name or initials of person sealing the sample.

(F) While not in transit or under examination, all blood and urine specimens shall be refrigerated.

3701-53-06 Laboratory requirements.

(A) Chain of custody and the test results for evidential alcohol and drugs of abuse shall be identified and retained for not less than three years, after which time the documents may be discarded unless otherwise directed in writing from a court. All positive blood, urine and other bodily substances shall be retained in accordance with rule 3701-53-05 of the Administrative Code for a period of not less than one year, after which time the specimens may be discarded unless otherwise directed in writing from a court.

PRACTICE TIP: Blood and urine tests must be retained for one year. The failure to preserve the sample as required by law –where the initial test results are attempted to be used against the accused- has been held by our courts to be a violation of due process and equal protection of law. See *State v. Rains*, (1999) 135 Ohio App. 3d 547. See also *State v. Mayl, infra*. This retention requirement allows for an independent test of the sample if the defendant requests it. R.C. 4511.19(D)(3).

Hospital Tests

When the admissibility of blood draw results are challenged in a motion to suppress, the state must show substantial compliance with Department of Health regulations governing the testing of blood samples before the test results are admissible. *State v. Mayl*, 106 Ohio St.3d 207, 2005-Ohio-4629, 833 N.E.2d 1216, at syl. 1. For a blood test result to be admissible in a "per se" case hospitals must comply with the regulations governing blood tests, including seeking a permit and retaining the sample for a year. ***Id***. at ¶ 51-52. However, after *Mayl* the legislature provided in R.C. 4511.19(D)(1)(a) that in "impaired driving" prosecutions under R.C. 4511.19(A)(1)(a) or for an equivalent offense that is vehicle-related, "the result of any test of any blood or urine withdrawn and analyzed at any health care provider, as defined in section 2317.02 of the Revised Code, may be admitted with expert testimony to be considered with any other relevant and competent evidence in determining the guilt or innocence of the defendant."

Obtaining Results of Medical Tests

When a police officer requests a test result from a health care provider, the request must be in writing and comply with R.C. 2317.022.

R.C. 2317.022. Written requests from law enforcement officers to obtain test results of alcohol, drug, controlled substances, or metabolites of controlled substances from health care providers
(A) As used in this section:

(1) "Health care provider" has the same meaning as in section 2317.02 of the Revised Code.
(2) "Drug of abuse" has the same meaning as in section 4506.01 of the Revised Code.

(B) If an official criminal investigation has begun regarding a person or if a criminal action or proceeding is commenced against a person, any law enforcement officer who wishes to obtain from any health care provider a copy of any records the provider possesses that pertain to any test or the result of any test administered to the person to determine the presence or concentration of alcohol, a drug of abuse, or alcohol and a drug of abuse in the person's blood, breath, or urine at any time relevant to the criminal offense in question shall submit to the health care facility a written statement in the following form:

"WRITTEN STATEMENT REQUESTING THE RELEASE OF RECORDS

To: ……………….. (insert name of the health care provider in question).

I hereby state that an official criminal investigation has begun regarding, or a criminal action or

> proceeding has been commenced against ……………….. (insert the name of the person in question), and that I believe that one or more tests has been administered to that person by this health care provider to determine the presence or concentration of alcohol, a drug of abuse, a combination of them, a controlled substance, or a metabolite of a controlled substance in that person's whole blood, blood serum or plasma, breath, or urine at a time relevant to the criminal offense in question. Therefore, I hereby request that, pursuant to division (B)(2) of section 2317.02 of the Revised Code, this health care provider supply me with copies of any records the provider possesses that pertain to any test or the results of any test administered to the person specified above to determine the presence or concentration of alcohol, a drug of abuse, a combination of them, a controlled substance, or a metabolite of a controlled substance in that person's whole blood, blood serum or plasma, breath, or urine at any time relevant to the criminal offense in question.
>
> ……………………………….
>
> (Name of officer)
>
> ……………………………….
>
> (Officer's title)
>
> ……………………………….
>
> (Officer's employing agency)
>
> ……………………………….
>
> (Officer's telephone number)
>
> ……………………………….
>
> ……………………………….
>
> ……………………………….
>
> (Agency's address)
>
> ……………………………….
>
> (Date written statement submitted)"
>
> (C) A health care provider that receives a written statement of the type described in division (B) of this section shall comply with division (B)(2) of section 2317.02 of the Revised Code relative to the written statement.

While the officer can obtain the results of a hospital blood test under the above provision, this does not mean the results are admissible. Per *Mayl*, supra, the results were held inadmissible unless the hospital complied with all ODH rules. Thereafter, the legislature created the "Anti-*Mayl*" provisions found In R.C. 4511.19(D)(1)(a) which allow for the admissibility of hospital blood tests in an "impaired" case "with expert testimony." See 6 for a discussion of the hurdles the prosecution should have to jump to admit results under the Anti-*Mayl* provisions.

11.18 Secondary Blood Testing

Independent test versus sample

The terms *independent test* and *sample* are two very different things. Although an independent test is commonly blood, it does not necessarily have to be a blood sample (it could be urine or breath). The key to an independent test is that it is entirely separate from the police collection and testing procedures. In the case of blood, it requires a separate needle stick and collection tubes. A sample has been collected, tested and retained by the state or a hospital. It does not have the added safeguards of an independent test.

Under R.C. 4511.19(D)(3), if a chemical test was obtained, the person tested may have a physician, a registered nurse, or a qualified technician, chemist, or phlebotomist of the person's own choosing administer a chemical test or tests, at the person's expense, in addition to any administered at the request of a law enforcement officer. But if the person is jailed after arrest, a timely independent test cannot be obtained. Under these circumstances, it is not clear what remedy, if any, the accused would have, especially if the accused did not request an independent test.

O.A.C. section 3701-53-06 (A) specifies that: "All positive blood, urine and other bodily substances shall be retained in accordance with rule 3701-53-05 of the Administrative Code for a period of not less than one year, after which time the specimens may be discarded unless otherwise directed in writing from a court." There, per *Mayl*, supra, failure to maintain the sample would violate the ODH rules and the results would be inadmissible. Moreover, where the state obtains a blood test and fails to preserve a portion of the sample for independent testing by the accused due process concerns are raised. See *State v. Rains*, 135 Ohio App. 3d 547, 735 N.E.2d 1 (6th Dist. Fulton County 1999).

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ALCOHOL AND DRUG TESTING

OHIO DEPARTMENT OF HEALTH

To protect and improve the health of all Ohioans

Intoxilyzer 8000 Operator's Manual

(OH-5)

Revised 3/6/2020

TABLE OF CONTENTS

Ohio Department of Health
Alcohol & Drug Testing Program
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www.odh.ohio.gov

Alcohol in the Human Body

- Ethanol (ethyl alcohol) is the specific alcohol that is present in alcoholic beverages.
- Types of Alcohol
  - Ethyl – solvent, glues, pharmaceuticals, explosives
  - Methyl – solvent, special fuels (Sterno®), dyes, antifreeze solutions
  - Wood
  - Isopropyl – Solvent, component for acetone, antiseptics
  - Rubbing - Medicinal
  - Butyl – Solvent, diluent of hydraulic fluids, used to extract drugs
- Ethyl alcohol is less toxic that other alcohols, but all alcohols are toxic and if a sufficient quantity is consumed, death will result.
- Characteristics of ethanol:

Viscosity – Thin
Color – Colorless (clear)
Smell – Slight Odor
Taste – Irritating Burning taste, High affinity for moisture

For the remainder of this text, the term alcohol will denote ethyl alcohol.

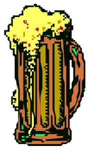
- **Acetone**, found in uncontrolled diabetics / diabetic crisis, **closely matches the signs and symptoms of alcohol. The instrument will detect acetone and display as an Interferent Detect.** The instrument will abort the test, high-low tone, display Interferent Detect, print Interferent Detect.

How Alcohol is Measured

Dosage Forms of Alcohol

- A standard drink contains 12oz beer, 4oz wine, or 1oz hard liquor. A standard drink contains approximately one-half ounce of pure ethanol.

12oz beer x 4% alcohol = .48oz ethanol
4oz wine x 12% alcohol = .48oz ethanol
1oz liquor x 50% alcohol = .50oz ethanol



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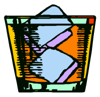
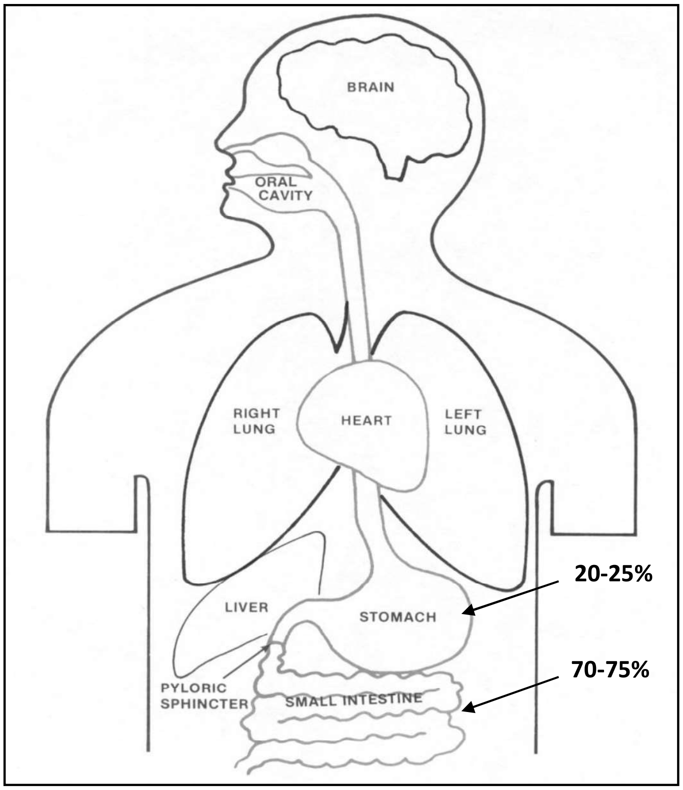


Absorption of Alcohol

- Alcohol can enter the body in several different ways: injection, inhalation, skin absorption, and **ingestion (drinking)**.
- Absorption through the skin and absorption through inhalation result in very little alcohol being introduced into the body. It is virtually impossible to have any significant concentration build up in the body in these ways.
- Alcohol is absorbed unchanged, not digested.
- Only a small amount of alcohol will be absorbed through the lining of the mouth. All traces of alcohol will be gone from the mouth within **15 to 20 minutes** after the last drink, thus the **20 minute observation period** before any breath test in Ohio. **The subject must be physically observed for this period to ensure nothing is ingested by mouth.**
- The majority of alcohol is absorbed by the stomach and small intestine.
- Food in the stomach slows the absorption of alcohol.
  - **Stomach content is the single greatest factor in the absorption rate of alcohol.**



Distribution of Alcohol

- Alcohol is absorbed into the blood stream from the small intestine and stomach. It passes through the liver and travels to the right side of the heart. The heart pumps it to the lungs and it returns to the left side of the heart. The heart then distributes the alcohol throughout the body.
- Alcohol is distributed in proportion to body water because alcohol is freely soluble in water.
- The greater the water content of a tissue, the greater its alcohol content will be in relation to other tissues.
  - -Body fat = very low alcohol concentration
  - -Blood/muscle = high alcohol concentration

Elimination of Alcohol

- **Ethanol is removed from the body through metabolism in the liver**, excretion, and evaporation. Metabolism accounts for virtually all of the elimination of alcohol. Approximately 90% of the alcohol is removed by metabolism.
- **The elimination rate, used to be conservative, is 0.015 g/210L per hour.**
- The only way to sober up is to allow the body to metabolize the alcohol. Exercise, caffeine or other stimulants will not speed up the process. While food in the stomach before drinking will slow the absorption of alcohol, eating after drinking will not affect the metabolism of alcohol.

Henry's Law

- **Henry's Law is the scientific basis for breath testing.**

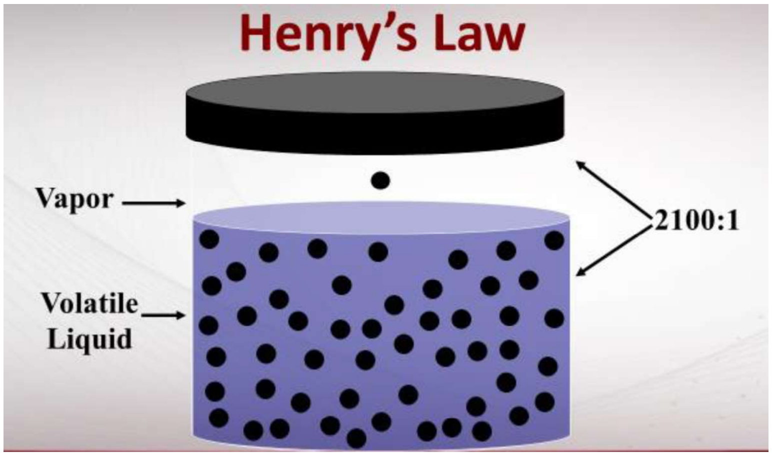
- Henry's Law states:

The concentration of a volatile substance in the air above a liquid is proportional to the concentration of the volatile substance in the liquid.

- As applied to breath testing, this means:

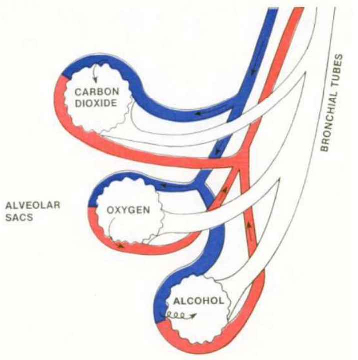
The concentration of alcohol in the breath is proportional to the concentration of alcohol in the blood.

- This proportion for blood to breath is 2100:1, which means that for every 2100 molecules of alcohol in the blood, there will be 1 molecule of alcohol in the breath.



- The exchange of alcohol molecules between the blood and the breath takes place in the *alveoli*, the air sacs deep within the lungs. **When the subject has been requested to provide a breath sample, they are instructed to give a sample of deep lung air, which will closely match the blood to breath ratio** of the alveolar air.

- Breath test:
  - Deep lung air
  - Most closely approximates blood test result
  - Easy to obtain with instantaneous results
  - **Breath units: grams alcohol per 210 L of breath (g/210 L)**
  - Blood to breath ratio: 2100:1
  - Blood units: grams alcohol per 100 ml of blood (g/100 ml)
  - Urine: grams alcohol per 100 ml of urine (g/100 ml)



Impairment/Effects of Alcohol

- Impairment is based upon measurable decreases in an individual's performance of a specific task, such as operating a motor vehicle.
- Intoxication is NOT the same as impairment – intoxication describes a type of observed behavior
- Alcohol acts as a central nervous system (CNS) depressant, which means that it slows down the responses.
- Alcohol has a continuum of effects, including cognitive, sensory, and motor. The final effect in this continuum is death.
- Alcohol also interacts with other drugs (i.e. combination with other depressants increases impairment)

Divided Attention

- Divided attention deals with having to focus on more than one task at the same time. For example, driving tasks that must be completed simultaneously include steering, working the pedals, checking the rear view mirrors, etc.

- Alcohol-impaired drivers require more time to read a street sign or to recognize and respond to a traffic signal than those who are not impaired

- Consequently, they look at fewer sources of information and acquire less total information per unit of time

According to the National Safety Council, ***all people*** are impaired for the ***task*** of operating a motor vehicle at a ***0.080 g/210L*** alcohol concentration.

Tolerance

- Tolerance is usually defined as the effect which results from the chronic use of a drug when a larger dose is needed to achieve the desired effect.
- In alcohol, tolerance is better described as the effect where the expected changes in behavior or impairment in performance of a specific task are not observed.
- Alcohol tolerance is split into two types: metabolic and functional.
- Metabolic tolerance is the ability of the body to eliminate alcohol more quickly.
- The body has a second system which can aid the liver in metabolizing alcohol. In alcoholics, where large quantities of alcohol are present on a regular basis, this system turns on and the body begins metabolizing alcohol faster.
- Functional tolerance comes from the person being used to the effects of alcohol. Because of this, the person has acquired behaviors to mask their impairment.
- As a result, the person appears less intoxicated than they really are. It is important to remember, however, that their mental and physical capacities are still impaired; they simply have found a way to make this impairment less obvious.

Effects of Alcohol at Various Doses

.60	Death occurs
.50+	Comatose
.40	Fatal dose in some persons
.27-.40	Unable to stand or walk, vomiting, lapses into sleep
.18-.30	Mental confusion, slurred speech, staggering
.18	Crash involvement increased dramatically (50+ times average)
.08-.10	Decreasing muscle control and hand coordination
.08	Illegal Per Se, all drivers impaired (National Safety Council)
.06	Vision focus recovery increases from .1 to .2 seconds
.05-.06	Fine motor skills impaired (gaze nystagmus may be noticed)
.05	AMA Recommendation for per se level
.04	DOT limit for CDL
.04	Increased crash involvement
.04	Decreased night vision, glare recovery, depth perception
.03-.10	More sociable, loss of attention, judgment & intellect impaired
.025	Alcohol content of 150 pound man with one standard drink
.02	Impairment begins, DOT screening level
.01.-05	Drinker appears normal

OHIO REVISED CODE

3701.143 Analyzing blood, urine, breath or other bodily substance to determine alcohol or drug of abuse content.

For purposes of sections 1547.11 , 4511.19 , and 4511.194 of the Revised Code, **the director of health shall determine, or cause to be determined, techniques or methods for chemically analyzing a person's whole blood, blood serum or plasma, urine, breath, or other bodily substance in order to ascertain the amount of alcohol, a drug of abuse, controlled substance, metabolite of a controlled substance, or combination of them in the person's whole blood, blood serum or plasma, urine, breath, or other bodily substance. The director shall approve satisfactory techniques or methods, ascertain the qualifications of individuals to conduct such analyses, and issue permits to qualified persons authorizing them to perform such analyses. Such permits shall be subject to termination or revocation at the discretion of the director.** As used in this section, "drug of abuse" has the same meaning as in section 4506.01 of the Revised Code.

4511.01 Traffic laws - operation of motor vehicles definitions.

(A) **"Vehicle"** means every device, including a motorized bicycle, in, upon, or by which any person or property may be transported or drawn upon a highway, except that "vehicle" does not include any motorized wheelchair, any electric personal assistive mobility device, any device that is moved by power collected from overhead electric trolley wires or that is used exclusively upon stationary rails or tracks, or any device, other than a bicycle, that is moved by human power.

(HHH) **"Operate" means to cause or have caused movement of a vehicle, streetcar, or trackless trolley.**

4511.19 Operating vehicle under the influence of alcohol or drugs - OVI

(A) (1) No person shall operate any vehicle, streetcar, or trackless trolley within this state, if, at the time of the operation, any of the following apply:

(a) The person is under the influence of alcohol, a drug of abuse, or a combination of them.

*****Note: 4511.19 (A)(1)(a) requires the officer to demonstrate the driver is impaired by the effects of alcohol and/or drugs. You must be able to demonstrate *impairment* to make an arrest. The officer must first have probable cause for the contact and subsequent arrest.**

(b) The person has a concentration of eight-hundredths of one per cent or more but less than seventeen-hundredths of one per cent by weight per unit volume of alcohol in the person's whole blood.

(c) The person has a concentration of ninety-six-thousandths of one per cent or more but less than two hundred four-thousandths of one per cent by weight per unit volume of alcohol in the person's blood serum or plasma.

(d) The person has a concentration of eight-hundredths of one gram or more but less than seventeen-hundredths of one gram by weight of alcohol per two hundred ten liters of the person's breath.

(e) The person has a concentration of eleven-hundredths of one gram or more but less than two hundred thirty-eight-thousandths of one gram by weight of alcohol per one hundred milliliters of the person's urine.

(h) The person has a concentration of seventeen-hundredths of one gram or more by weight of alcohol per two hundred ten liters of the person's breath.

(Note: Levels above the listed per se, i.e. .170% BrAC, face elevated penalties.)

4511.19 (A)(1)(j) – Addresses drug sections. If you find impairment and the subject alcohol breath test is low, call a DRE or test for alternative substances. ARIDE and DRE classes focus on drug impairment and classifications of drugs.

- CNS Depressants, e.g. barbituates, Valium, Prozac, Xanax
- CNS Stimulants, e.g. cocaine, amphetamines, meth, KAHT
- Hallucinogens, e.g. LSD, peyote (mescaline), psilocybin
- Dissociative Anesthetics, e.g. PCP, Ketamine, certain anti-tussives
- Narcotic Analgesics, e.g. morphine, heroin, oxycontin
- Inhalants, e.g. gasoline, cleaning fluid, paint, Dust-Off
- Cannabis, e.g. marijuana, hashish, Marinol

(K) Division (A)(1)(j) of this section does not apply to a person who operates a vehicle, streetcar, or trackless trolley while the person has a concentration of a listed controlled substance or a listed metabolite of a controlled substance in the person's whole blood, blood serum or plasma, or urine that equals or exceeds the amount specified in that division, if both of the following apply:

(1) The person obtained the controlled substance pursuant to a prescription issued by a licensed health professional authorized to prescribe drugs.

(2) The person injected, ingested, or inhaled the controlled substance in accordance with the health professional's directions.

(Note: Even if a person is acting within the scope of subsections (1) and (2), this does not give them the right to drive impaired while under the effect of those drugs.)

(D) (1) (b) In any criminal prosecution or juvenile court proceeding for a violation of division (A) or (B) of this section or for an equivalent offense that is vehicle-related, **the court may admit evidence on the concentration of alcohol**, drugs of abuse, controlled substances, metabolites of a controlled substance, or a combination of them in the defendant's whole blood, blood serum or plasma, breath, urine, or other bodily substance at the time of the alleged violation as shown by chemical analysis **of the substance withdrawn within three hours of the time of the alleged violation.** The three-hour time limit specified in this division regarding the admission of evidence does not extend or affect the two-hour time limit specified in division (A) of section 4511.192 of the Revised Code as the maximum period of time during which a person may consent to a chemical test or tests as described in that section.

(3) **Upon the request of the person who was tested, the results of the chemical test shall be made available to the person or the person's attorney, immediately upon the completion of the chemical test analysis.**

If the chemical test was obtained pursuant to division (D)(1)(b) of this section, the person tested may have a physician, a registered nurse, or a qualified technician, chemist, or phlebotomist of the person's own choosing administer a chemical test or tests, at the person's expense, in addition to any administered at the request of a law enforcement officer. If the person was under arrest as described in division (A)(5) of section 4511.191 of the Revised Code, the arresting officer shall advise the person at the time of the arrest that the person may have an independent chemical test taken at the person's own expense. If the person was under arrest other than described in division (A)(5) of section 4511.191 of the Revised Code, the form to be read to the person to be tested, as required under section 4511.192 of the Revised Code, shall state that the person may have an independent test performed at the person's expense. The failure or inability to obtain an additional chemical test by a person shall not preclude the admission of evidence relating to the chemical test or tests taken at the request of a law enforcement officer.

4511.191 Implied consent.

(A) (5) (a) If a law enforcement officer arrests a person for a violation of division (A) or (B) of section 4511.19 of the Revised Code, section 4511.194 of the Revised Code or a substantially equivalent municipal ordinance, or a municipal OVI ordinance and if the person if convicted would be required to be sentenced under division (G)(1)(c), (d), or (e) of section 4511.19 of the Revised Code, **the law enforcement officer shall request the person to submit, and the person shall submit, to a chemical test or tests of the person's whole blood, blood serum or plasma, breath, or urine for the purpose of determining the alcohol, drug of abuse, controlled substance, metabolite of a controlled substance, or combination content of the person's whole blood, blood serum or plasma, breath, or urine.** A law enforcement officer who makes a request pursuant to this division that a person submit to a chemical test or tests is not required to advise the person of the consequences of submitting to, or refusing to submit to, the test or tests and is not required to give the person the form described in division (B) of section 4511.192 of the Revised Code, but the officer shall advise the person at the time of the arrest that **if the person refuses to take a chemical test the officer may employ whatever reasonable means are necessary to ensure that the person submits to a chemical test of the**

person's whole blood or blood serum or plasma. The officer shall also advise the person at the time of the arrest that the person may have an independent chemical test taken at the person's own expense.

(Note: This is for two or more OVI convictions in ten years, 5 or more in 20 years or a previous felony OVI conviction.) (**This generally entails obtaining a search warrant.**)

(b) If a person refuses to submit to a chemical test upon a request made pursuant to division (A)(5)(a) of this section, **the law enforcement officer who made the request may employ whatever reasonable means are necessary to ensure that the person submits to a chemical test** of the person's whole blood or blood serum or plasma. A law enforcement officer who acts pursuant to this division to ensure that a person submits to a chemical test of the person's whole blood or blood serum or plasma is immune from criminal and civil liability based upon a claim for assault and battery or any other claim for the acts, unless the officer so acted with malicious purpose, in bad faith, or in a wanton or reckless manner.

4511.192 Advice to OVI arrestee.

(A) Except as provided in division (A)(5) of section 4511.191 of the Revised Code, the arresting law enforcement officer shall give advice in accordance with this section to any person under arrest for a violation of division (A) or (B) of section 4511.19 of the Revised Code, section 4511.194 of the Revised Code or a substantially equivalent municipal ordinance, or a municipal OVI ordinance. The officer shall give that advice in a written form that contains the information described in division (B) of this section and shall read the advice to the person. **The form shall contain a statement that the form was shown to the person under arrest and read to the person by the arresting officer. One or more persons shall witness the arresting officer's reading of the form, and the witnesses shall certify to this fact by signing the form.** The person must submit to the chemical test or tests, subsequent to the request of the arresting officer, within two hours of the time of the alleged violation and, if the person does not submit to the test or tests within that two-hour time limit, the failure to submit automatically constitutes a refusal to submit to the test or tests.

4511.194 Having physical control of vehicle while under the influence.

(A) As used in this section: (2) "Physical control" means being in the driver's position of the front seat of a vehicle or in the driver's position of a streetcar or trackless trolley and having possession of the vehicle's, streetcar's, or trackless trolley's ignition key or other ignition device.

(B) **No person shall be in physical control of a vehicle, streetcar, or trackless trolley if, at the time of the physical control, any of the following apply:**

(1) The person is under the influence of alcohol, a drug of abuse, or a combination of them.

(2) The person's whole blood, blood serum or plasma, **breath**, or urine **contains at least the concentration of alcohol specified in division (A)(1)(b), (c), (d), or (e) of section 4511.19 of the Revised Code.**

OHIO ADMINISTRATIVE CODE

Chapter 3701-53 Alcohol Testing

3701-53-01 Techniques or methods.

(A) Tests to determine the concentration of alcohol may be applied to blood, breath, urine, or other bodily substances. Results shall be expressed as equivalent to:

(1) Grams by weight of alcohol per one hundred milliliters of whole blood, blood serum or plasma (grams per cent by weight);

(2) Grams by weight of alcohol per two hundred ten liters of deep lung breath;

(3) Grams by weight of alcohol per one hundred milliliters of urine (grams per cent by weight).

(4) Nanograms by weight of a controlled substances or a metabolite or a controlled substance per milliliter of blood, urine, or other bodily substance.

The results of the tests shall be retained for not less than three years.

3701-53-02 Breath tests.

(A) The instruments listed in this paragraph are approved as evidential breath testing instruments for use in determining whether a person's breath contains a concentration of alcohol prohibited or defined by sections 4511.19 , and/or 1547.11 of the Revised Code, or any other equivalent statute or local ordinance prescribing a defined or prohibited breath-alcohol concentration. **The approved evidential breath testing instruments are:**

(1) BAC DataMaster, BAC DataMaster K, BAC DataMaster cdm;

(2) Intoxilyzer model 5000 series 66, 68 and 68 EN; and

(3) Intoxilyzer model 8000 (OH-5).

(C) Breath samples of deep lung (alveolar) air shall be analyzed for purposes of determining whether a person has a prohibited breath alcohol concentration with instruments approved under paragraphs (A) and (B) of this rule.

(E) Breath samples using the instrument listed under paragraph (A)(3) of this rule shall be analyzed according to the instrument display for the instrument being used. The results of subject tests shall be retained in a manner prescribed by the director of health and shall be retained in accordance with paragraph (A) of rule 3701-53-01 of the Administrative Code.

3701-53-04 Instrument checks, controls and certifications.

(B) **Instruments listed under paragraph (A)(3) of rule 3701-53-02 of the Administrative Code shall automatically perform a dry gas control using a dry gas standard traceable to the national institute of standards and technology (NIST) before and after every subject test.** For purposes of an instrument listed under paragraph (A)(3) of rule 3701-53-02 of the Administrative Code, **a subject test shall include the collection of two breath samples.** A dry gas control is not required between the two breath samples. **Dry gas control results are valid when the results are at or within five one-thousandths (0.005) grams per two hundred ten liters of the alcohol concentration on the manufacturer's certificate of analysis for that dry gas standard. A dry gas control result which is outside the range specified in this paragraph will abort the subject test or instrument certification in progress.**

(C) **Representatives of the director shall perform an instrument certification on approved evidential breath testing instruments listed under paragraph (A)(3**) of rule 3701-53-02 of the Administrative Code using a solution containing ethyl alcohol approved by the director of health according to the instrument display for the instrument being certified. A dry gas control using a dry gas standard traceable to the national institute of standards and technology (NIST) shall also be used when a certification is performed. **An instrument shall be certified no less frequently than once every calendar year or when the dry gas standard on the instrument is replaced, whichever comes first.** A calendar year means the period of twelve consecutive months, as indicated in section 1.44 of the Revised Code, beginning on the first day of January, and ending on the thirty-first day of December. Instrument certifications are valid when the certification results are at or within five one-thousandths grams per two hundred ten liters of the target value for that approved solution. Instruments with certification results outside the range specified in this paragraph will require the instrument be removed from service until the instrument is serviced or repaired. Certification results shall be retained in a manner prescribed by the director of health.

(G) Results of instrument checks, controls, certifications, calibration checks and records of service and repairs shall be retained in accordance with paragraph (A) of rule 3701-53-01 of the Administrative Code.

3701-53-07 Qualifications of personnel.

(C) Breath tests used to determine whether a person's breath contains a concentration of alcohol prohibited or defined by sections 4511.19 and/or 1547.11 of the Revised Code, or any other equivalent statute or local ordinance prescribing a defined or prohibited breath alcohol concentration shall be performed by a senior operator or an operator. A senior operator shall be responsible for the care, maintenance and instrument checks of the approved evidential breath testing instruments listed in paragraphs (A)(1), (A)(2), and (B) of rule 3701-53-02 of the Administrative Code. Representatives of the director shall be responsible for the instrument certifications on approved evidential breath testing instruments listed under paragraph (A)(3) of rule 3701-53-02 of the Administrative Code.

(E) An individual meets the qualifications for an operator's permit by:

(1) Being a high school graduate or having passed the "General Education Development Test";

(2) Being a certified law enforcement officer sworn to enforce sections 4511.19 and/or 1547.11 of the Revised Code, or any other equivalent statute or local ordinance prescribing a defined or prohibited breath alcohol concentration, or a certified corrections officer, and;

(3) Having demonstrated that he or she can properly operate the evidential breath testing instrument by having successfully completed a basic operator or conversion training course for the type of approved evidential breath testing instrument for which he or she seeks a permit.

3701-53-08 Surveys and proficiency examinations.

(D) Individuals desiring to function as operators who apply for or are issued an operator access card under paragraph (C) of rule 3701-53-09 of the Administrative Code, shall be subject to a proficiency examination once per calendar year conducted at the director's discretion.

(E) During proficiency examinations, senior operators, operators and applicants shall accept samples, perform tests and report all results to a representative of the director or the proficiency examination administered by a national program for proficiency testing. During surveys and proficiency examinations, permit holders, applicants and laboratories shall grant the director's representatives access to all portions of the facility where the permit is used or is intended to be used, and to all records relevant to compliance with the requirements of this chapter.

3701-53-09 Permits.

(D) **Individuals desiring to function as operators using instruments listed under paragraph (A)(3) of rule 3701-53-02 of the Administrative Code shall apply to the director of health for a permit, which shall be in the form of an operator access card, on forms prescribed and provided by the director of health. The director of health shall issue a permit, which shall be in the form of an operator access card, to perform tests to determine the amount of alcohol in a person's breath to individuals who qualify under the applicable provisions, including but not limited to, paragraph (D) and/or (E) of rule 3701-53-07 of the Administrative Code.**

(E) Permits issued under paragraph (D) of this rule shall not expire unless revoked by the director under rule 3701-53-10 of the Administrative Code or are voluntarily surrendered. To retain a permit under paragraph (D) of this rule the individual shall present evidence satisfactory to the director that he or she continues to meet the qualifications established by the applicable provisions of rules 3701-53-07 and 3701-53-08 of the Administrative Code for issuance of the permit sought.

(H) An individual may use any and all approved breath testing instruments for which the individual has been issued a permit.

3701-53-10 Revocation, suspension and denial of permits or operator access cards.

The director of health may deny, suspend or revoke the permit or operator access card of any permit holder or individual:

(A) Who obtains or seeks to obtain a permit or operator access card falsely or deceitfully;

(B) Who fails to comply with any of the provisions of rules 3701-53-01 to 3701-53-09 of the Administrative Code; or

(C) Who:

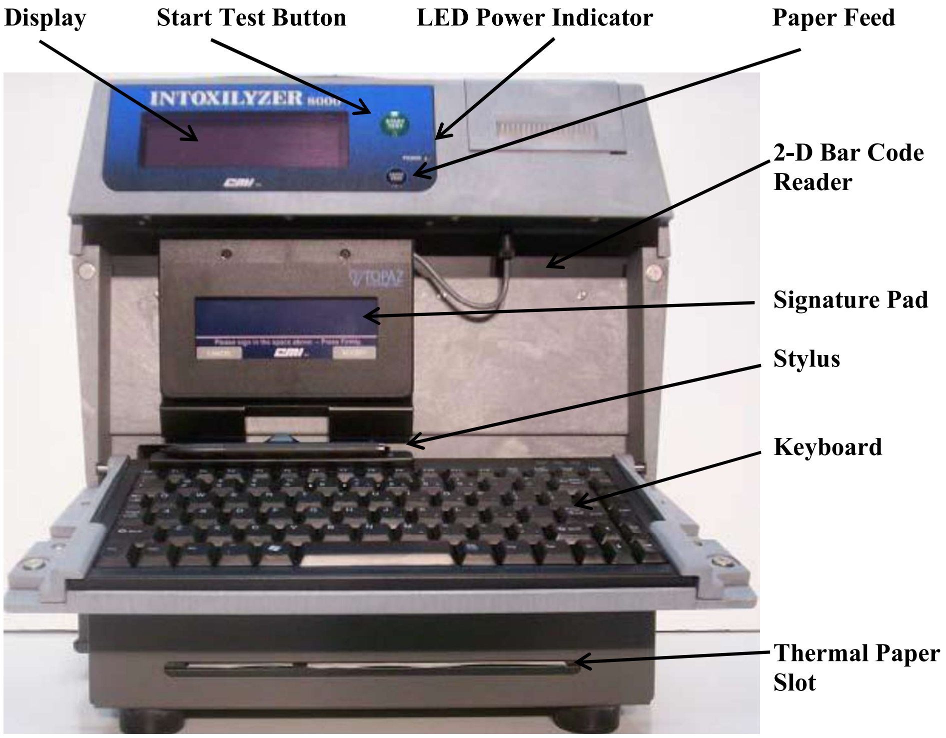
(1) As a senior operator, fails to demonstrate that he or she can properly care for, maintain, perform instrument checks upon, and operate the breath testing instrument for which the permit is held;

(2) As an operator, fails to demonstrate that he or she can properly operate the breath testing instrument for which the permit or operator access card is held;

Annual Access Card Proficiency

In order to maintain a valid access card, the card holder must perform either a complete, successful violator (subject) test with a breath alcohol concentration (refusals, time outs, or other incomplete tests do not qualify) OR a complete, successful proficiency test, following guidelines provided by the Alcohol & Drug Testing Program at least once each calendar year (January 1 through December 31). If a complete subject test or proficiency test is not provided, the access card holder is subject to revocation. Refer to Ohio Administrative Code Rules 3701-53-08 (D), 3701-53-09 (E), and 3701-53-10 (B) and (C)(2).

INTOXILYZER 8000
FRONT VIEW
OPEN



INTOXILYZER 8000
REAR VIEW

Power Switch 110 Volt AC

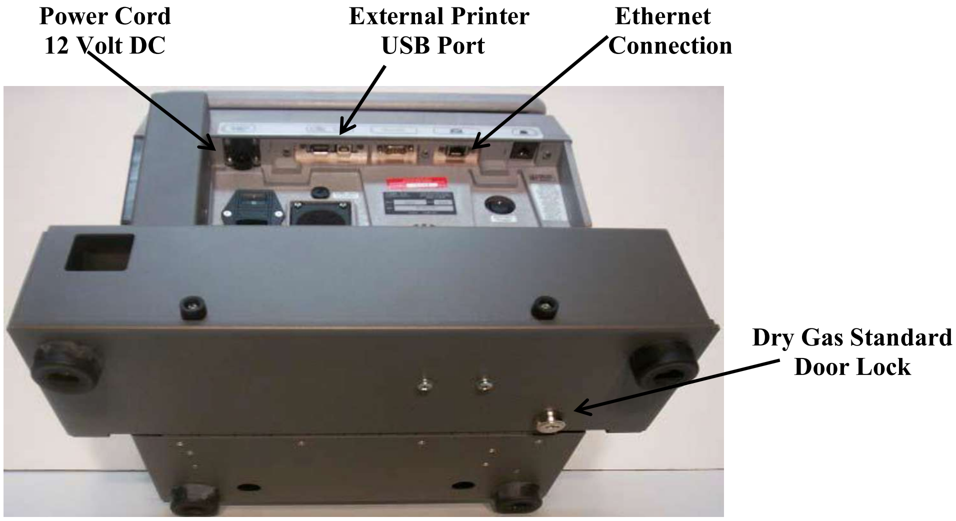
Power Cord 110 Volt AC

Battery Power Switch (12 Volt DC)

Instrument Serial Number

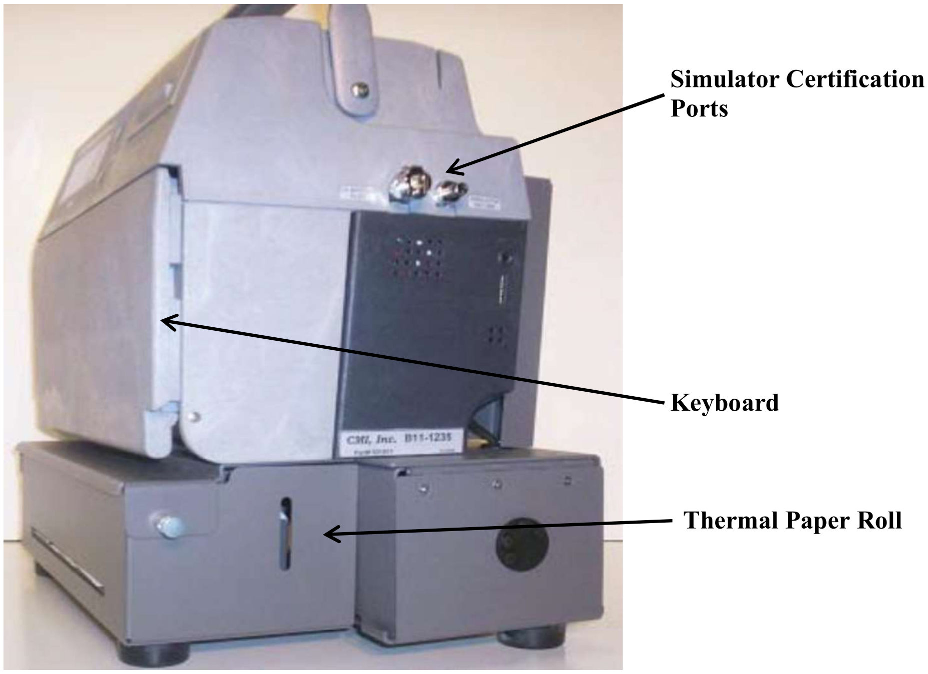
Dry Gas Standard Pressure Gauge

INTOXILYZER 8000
REAR VIEW
(BOTTOM)

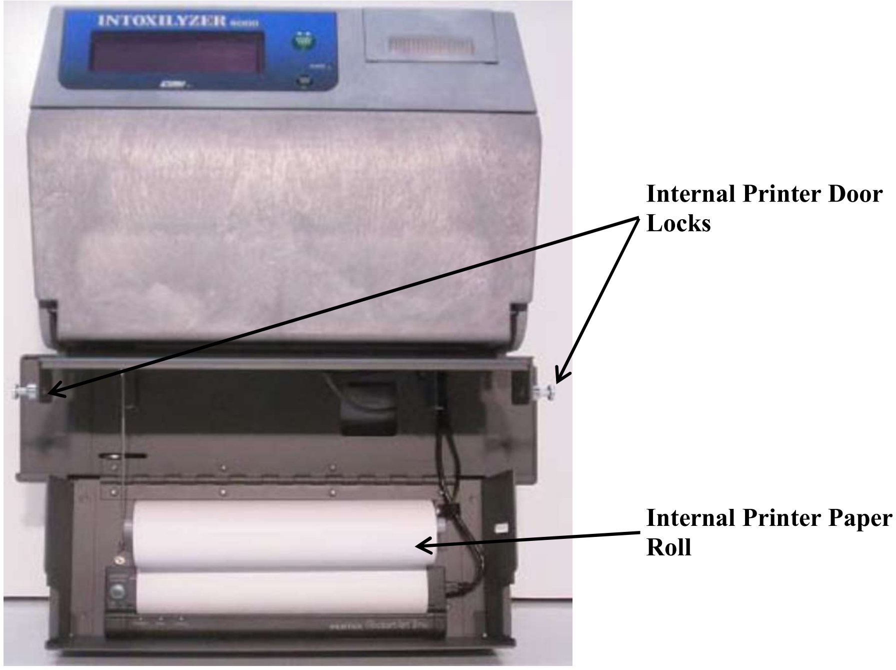


TOP VIEW

INTOXILYZER 8000
SIDE VIEW
(CLOSED)



INTOXILYZER 8000
INTERNAL PRINTER



INTOXILYZER 8000
SIGNATURE PAD

1. **DO NOT USE INK OR PENCIL ON THE SIGNATURE PAD.**

2. Use the attached **STYLUS** or an ink pen **<u>WITH PEN TIP RETRACTED</u>**.

3. **To complete a signature response press ACCEPT on the signature pad or ENTER on the keyboard.**

4. **To cancel a signature prior to pressing ACCEPT or ENTER, press CANCEL on the signature pad or ESCAPE on the keyboard.**

5. You <u>may not</u> make signature corrections after pressing **ACCEPT** or **ENTER**.

INTOXILYZER 8000
KEYBOARD

1. **To complete a response, press the ENTER key.**

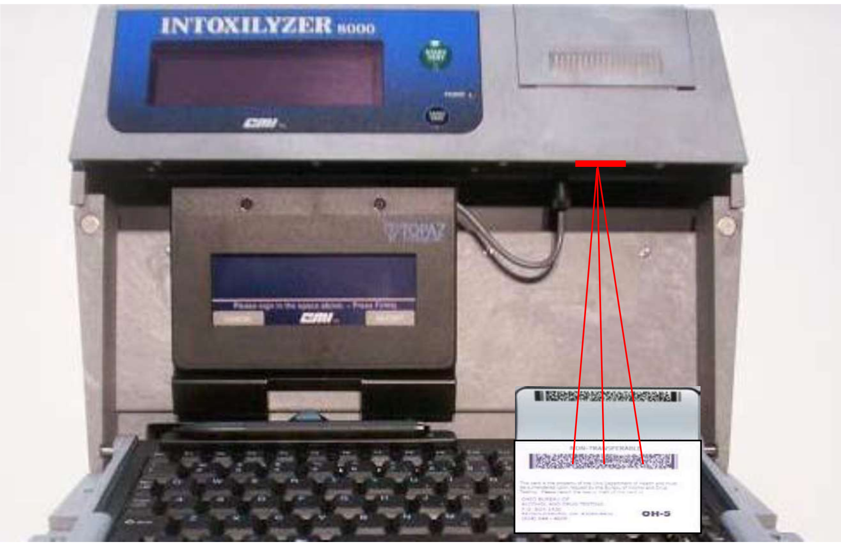
2. **To scroll through the menus**, **press the arrow↑or↓ or PgUp/PgDn keys.**

3. Correct mistakes prior to pressing **ENTER** or use the **BACKSPACE** key to erase one character at a time.

4. Make corrections after pressing **ENTER** by reviewing data.

5. Re-type the correct response.

INTOXILYZER 8000
2-D BAR CODE READER



1. When "**PLEASE SWIPE / SCAN ACCESS CARD OR PRESS ENTER**" appears on the display, the **2-D BAR CODE** reader automatically activates.

2. Place your access card under the red light near the keyboard. Do not swipe the access card in operator license reader (top of instrument).

3. **A "3-beep tone" indicates the information has been entered. (A "2-beep tone" indicates the information <u>has not</u> been entered.)**

4. If the **2-D BAR CODE** fails to operate, press **ENTER** to manually enter the required data using the keyboard while following the instrument display.

5. The **2-D BAR CODE** reader is light sensitive. Use a flashlight to illuminate the access card in low light conditions.

INTOXILYZER 8000

MAGNETIC STRIP READER
OPERATOR'S LICENSE/STATE ID CARD

1. When "**PLEASE SWIPE / SCAN DL OR PRESS ENTER**" appears on the display, slide the violator operator's license (DL) or state ID card through the magnetic card reader from left to right with the magnetic strip to the rear.

2. Slide the violator operator's license or state ID card **UPSIDE-DOWN** with license front **FACING YOU** from **LEFT** to **RIGHT** (magnetic strip upside down facing rear).

3. **A "3 beep tone" indicates the information has been entered. (A "2-beep tone" indicates the information <u>has not</u> been entered.)**

4. Press **ENTER** to manually enter the required data using the keyboard.

OPERATION

INTOXILYZER 8000
THEORY OF OPERATION

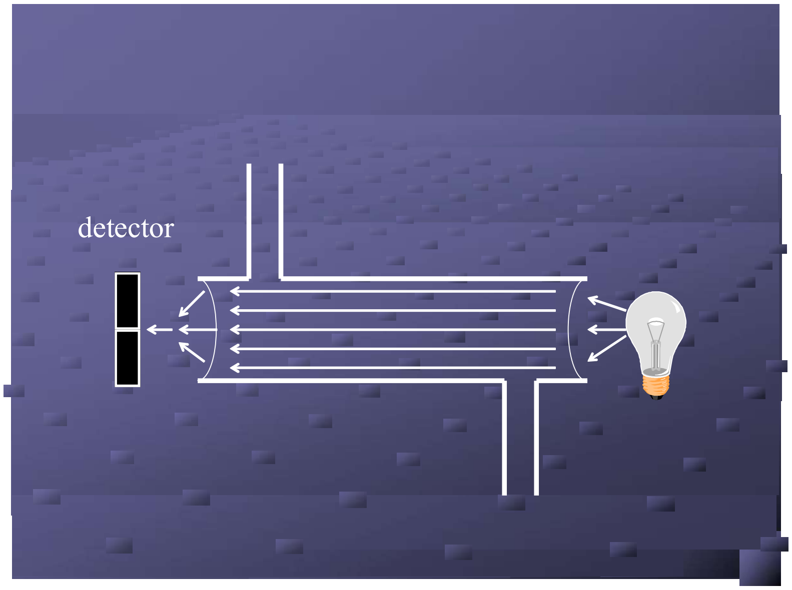
1. The Intoxilyzer 8000 uses the scientific principle of **INFRARED ABSORPTION** to analyze the breath sample.

2. The IR light source is a **PULSED INFRARED** light. Infrared light is not visible to the human eye. It is similar to the light from a TV channel changer.

3. The decrease in intensity of the IR light due to absorption by alcohol in the breath sample is proportional to the amount of alcohol in the breath.

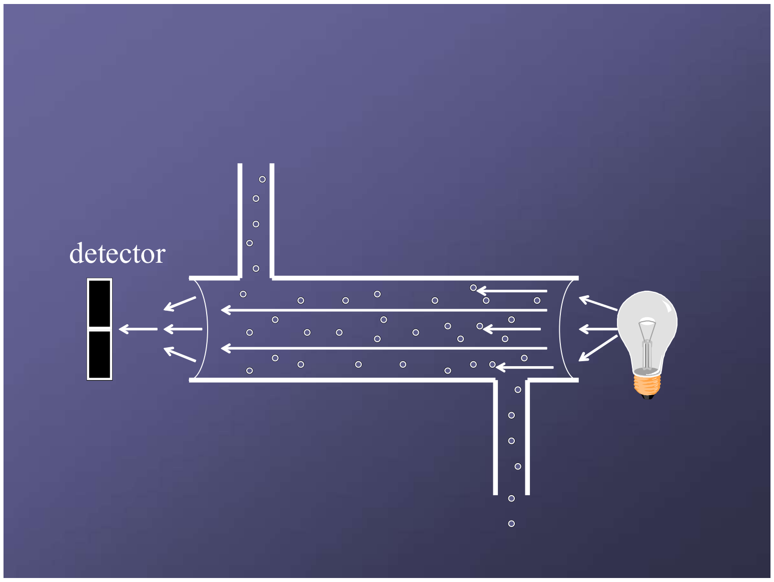
4. **The breath sample hose is heated to prevent condensation**.

Sample chamber with air only



With air only in the sample chamber, all of the infrared light from the bulb reaches the detector on the far end of the chamber. There is no change in the intensity of the light.

Sample chamber with alcohol and air



When alcohol is introduced into the sample chamber, some of the infrared light from the bulb is absorbed by the alcohol molecules. **The higher the alcohol concentration, the more light is absorbed, the higher the breath alcohol concentration reading (BrAC) on the instrument.**

INTOXILYZER 8000
POWER UP

110-VOLT AC POWER

AC Power is the **PRIMARY and default** power source for the Intoxilyzer 8000.

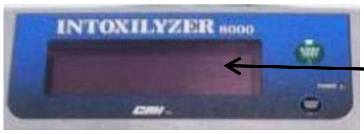
- To power up the instrument using **AC POWER**, connect the **AC POWER CORD** to the instrument and insert the **110-VOLT POWER PLUG** into a 110-volt power source.
- Move the **AC POWER SWITCH** and **BATTERY POWER SWITCH** to the **ON** position.
- Press the **START TEST** button. The instrument will power up and enter **NOT READY** Mode.

12-VOLT DC POWER

DC Power is a **SECONDARY** power source for the Intoxilyzer 8000.

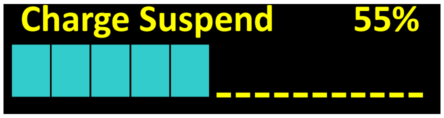
- To power up the instrument using **12-VOLT POWER**, the auxiliary power source should be started before connecting the **DC POWER CORD** to the instrument and inserting the **12-VOLT POWER TIP** into a 12-volt power source.
- If you are going to use a DC power source, you should consult with Alcohol & Drug testing prior to use.
- Move the **AC POWER SWITCH** and **BATTERY POWER SWITCH** to the **ON** position.
- Press the **START TEST** button and the instrument will power up and enter **NOT READY** Mode.

INTOXILYZER 8000

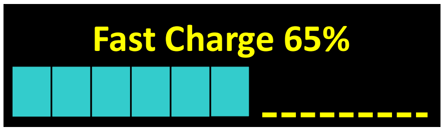


INSTRUMENT DISPLAY

The instrument will display one of the following **CHARGING INDICATORS.**



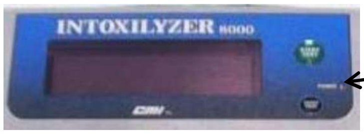
The Intoxilyzer 8000 is in **NOT READY** Mode during the warm up period using **AC** or **DC** Power.



The Intoxilyzer 8000 is in **READY** or **STANDBY** Mode using **AC** or **DC** Power.

The Intoxilyzer 8000 is in **READY** or **STANDBY** Mode using **INTERNAL BATTERY** Power.

The Intoxilyzer 8000 is in **READY** or **STANDBY** Mode using **AC** or **DC** Power. The battery is full charged.



INSTRUMENT POWER LIGHT

A green light indicates the Intoxilyzer 8000 is in **NOT READY**, **READY** or **STANDBY** Mode – Battery Charged.

An amber lights indicates the Intoxilyzer 8000 is in **NOT READY**, **READY** or **STANDBY** Mode – Battery Charging.

A red light indicates the Intoxilyzer 8000 is connected to an **AC** or **DC** power source but not powered up.

<u>TOTAL POWER OFF</u>

Move the **AC POWER SWITCH** and the **BATTERY POWER SWITCH** to the **OFF** position.

INTOXILYZER 8000
NOT READY / READY / STANDBY / DIAGNOSTICS

NOT READY MODE

The instrument enters **NOT READY MODE** after power up displaying the date and time. The display will switch between **NOT READY** and **CHARGING STATUS**. After approximately 25 minutes, the instrument will beep and display the countdown to **READY MODE**.

STANDBY MODE

When not used for approximately **30 minutes** the instrument enters **STANDBY MODE**. The instrument will remain in **STANDBY MODE** until you press the **START TEST** button or power the instrument off.

Press the **START TEST** button and the instrument will beep and display the countdown to **READY MODE**. This takes approximately one minute.

DIAGNOSTICS

The instrument performs an **AIR BLANK** and **DIAGNOSTIC TEST** as part of the startup period. The instrument will cycle through each function and display **PASS** if functioning properly. **An AIR BLANK is performed periodically throughout the operation of the instrument to purge the sample chamber.**

If any of the diagnostics **FAIL**, restart by pressing the **START TEST** button. If this second diagnostic fails, **discontinue use, NOTIFY ADT AT (614) 644-4678 and forward an Event Report**.

If any function does not perform, including but not limited to 2 D Bar Code reader, signature pad, print locks (does not print record), turn both switches off, wait momentarily, then turn both switches back on and press the START TEST button. (See also the page on data downloads.)

INTOXILYZER 8000
DATA ENTRY

To initiate a subject test sequence, press the START TEST button.

When <u>responses</u> are displayed, they are the default responses.

Place **OPERATOR ACCESS CARD** under the red light near the keyboard. The **2-D BAR CODE** reader is light sensitive. You may use a flashlight to illuminate the access card in low light conditions.	**Swipe/Scan Access Card or Press Enter**
Type in your **4-DIGIT PIN NUMBER**. Press **ENTER** to continue.	**Enter 4-Digit Pin #**

VERIFY all the information as the prompts are displayed. If the prompt information is correct, press **ENTER** to continue. If the prompt information is incorrect, correct manually using the keyboard, then press **ENTER** to continue. If you enter an incorrect PIN, the instrument will give a high/low tone and display "Incorrect PIN". You have four opportunities to enter the PIN, then the instrument will return to Start Test mode. If you have issues with the access card and/or if the information on the card is incorrect, contact the Alcohol & Drug Testing Program at 614-644-4609.

Your **LAST NAME** from the Operator access card appears on the display. Press **ENTER**, if correct, to continue.	**Operator's Last Name?**
Your **FIRST NAME** from the Operator access card appears on the display. Press **ENTER**, if correct, to continue.	**Operator's First Name?**
Your **AGENCY** from the Operator access card appears on the display. Press **ENTER**, if correct, to continue.	**Operator's Agency?**
Use **24-HOUR** format **00:00.** Press **ENTER** to continue. **Time First Observed MUST** be twenty minutes or more prior to the first breath sample.	**Time First Observed?**
The **"Y"** (Yes) response is displayed. Press **"N"** (No) if the **OPERATOR <u>is not</u>** the **ARRESTING OFFICER**. Once the correct "**Y**" or "**N**" response appears on the display. Press **ENTER** to continue.	**Is Operator Arresting Officer?**

If the **ARRESTING OFFICER** has an **OPERATOR ACCESS CARD,** place the **ARRESTING OFFICER'S OPERATOR ACCESS CARD** under the red light near the keyboard

Swipe/Scan Access Card or Press Enter

If the **ARRESTING OFFICER** does not have an **OPERATOR ACCESS CARD**, press **ENTER** to manually enter the required data using the keyboard following the instrument display.

The "**N**" (No) response is displayed. Press **ENTER** to skip **REVIEW DATA**. Press "**Y**" (Yes) to **REVIEW** the information. Press **ENTER** to verify each entry.
Press "**N**" (No) followed by **ENTER** to continue.

Review Data (Y/N)

N

TESTING SEQUENCE / SUBJECT TEST

The **SUBJECT'S LAST NAME** is displayed as it appears on the operator's license or state ID card or type the **SUBJECT'S LAST NAME** using the keyboard.
Press **ENTER** to continue.

Subject's Last Name

The **SUBJECT'S FIRST NAME** is displayed as it appears on the operator's license or state ID card or type the **SUBJECT'S FIRST NAME** using the keyboard.
Press **ENTER** to continue.

Subject's First Name

The **SUBJECT'S STREET ADDRESS** is displayed as it appears on the operator's license or state ID card or type the **SUBJECT'S STREET ADDRESS** using the keyboard. Press **ENTER** to continue.

Subject's Street Address

The **SUBJECT'S CITY** is displayed as it appears on the operator's license or state ID card or type the **SUBJECT'S CITY** using the keyboard.
Press **ENTER** to continue.

Subject's City

The **SUBJECT'S STATE** is displayed as it appears on the operator's license or state ID card. The display defaults to **"OH"**. If the state differs, type the two letter **SUBJECT'S STATE** abbreviation or scroll through the menu to select the correct state.
Press **ENTER** to continue.

Subject's State? OH

OHIO

The **SUBJECT'S ZIP CODE** is displayed. If the zip code differs, type the correct zip code. Press **ENTER** to continue.	**Subject's Zip Code**
The **SUBJECT'S DATE OF BIRTH** is displayed as it appears on the operator's license or state ID card or type the **SUBJECT'S DATE OF BIRTH** using the keyboard. The format is MM/DD/YYYY. Press **ENTER** to continue.	**Subject's Date of Birth**
The instrument will display the **SUBJECT'S AGE.** The instrument automatically forwards to the next display field after a few moments.	**Subject's Age**
The **SUBJECT'S SEX** is displayed. The prompt defaults to **"M"**. Enter the correct gender. Press **ENTER** to continue.	**Subject's Sex? M** **Male**
The **SUBJECT'S RACE** is displayed. The prompt defaults to **"W"**. Enter race format (A=Asian, B=Black, H=Hispanic, N= Native American, O=Other, W=White) or scroll through the menu. Press **ENTER** to continue.	**Subject's Race? W** **White**
REVIEW DATA (Y/N) is displayed. The display defaults to "**N**" (No). Press **ENTER** to skip **REVIEW DATA**. Press "**Y**" (Yes) to **REVIEW** the information. Press **ENTER** to verify each entry.	**Review Data (Y/N)?** **N**
The **OPERATOR** signs on the **SIGNATURE PAD.** Press **ACCEPT** on the signature pad or press **ENTER.**	**Operator** **Please Sign on Attached Pad**
The "**N**" (No) response is displayed Press "**Y**" to initiate a test refusal. Press "**N**: to continue with breath test.	**Refuse Breath Test? (Y/N)?** **N**
REVIEW DATA (Y/N) is displayed. The display defaults to "**N**" (No). Press **ENTER** to skip **REVIEW DATA**. Press "**Y**" (Yes) to **REVIEW** the information. Press **ENTER** to verify each entry.	**Review Data (Y/N)?** **N**

The operator can press "Y" or at any time during the breath sample, when Please Blow /R appears, the operator can press R and enter as a refusal.

The instrument will perform an air blank, a diagnostic test, an air blank, reference, a dry gas control (results must be +/- .005 of the target value), an air blank, and reference.

INSTALL MOUTHPIECE ON THE BREATH TUBE. PRESS ANY KEY TO PROCEED. ADVISE THE SUBJECT TO PROVIDE A BREATH SAMPLE. The subject should not quit until all breath is exhausted. The subject has three minutes to complete a sample.

Please Install Mouthpiece
Press Any Key to Proceed

<u>DISCARD THE MOUTHPIECE</u>
Press any key to Proceed.

Please Remove Mouthpiece
Press Any Key to Proceed

The instrument will perform an air blank.

The 2 minute **COUNTDOWN** will be displayed.

Please Wait
Ready in 02:00

Place a new **MOUTHPIECE** on the breath tube for the second subject sample.

Please Install Mouthpiece
Press Any Key to Proceed

ADVISE THE SUBJECT TO PROVIDE A SECOND BREATH SAMPLE. THE SUBJECT SHOULD NOT QUIT UNTIL ALL BREATH IS EXHAUSTED.

Please Blow Until
Tone Stops /R

At any time during the breath sample, when Please Blow /R appears, advise the subject to continue to provide a sample. The operator can also press R and enter as a refusal

<u>DISCARD THE MOUTHPIECE</u>
Press any key to proceed.

Please Remove Mouthpiece
Press Any Key to Proceed

The instrument will perform an air blank, reference, a dry gas control (results must be +/- .005 from the target value), and an air blank.

The instrument continues until the test is complete.
Printing of Subject Test Report begins.

Printing Form

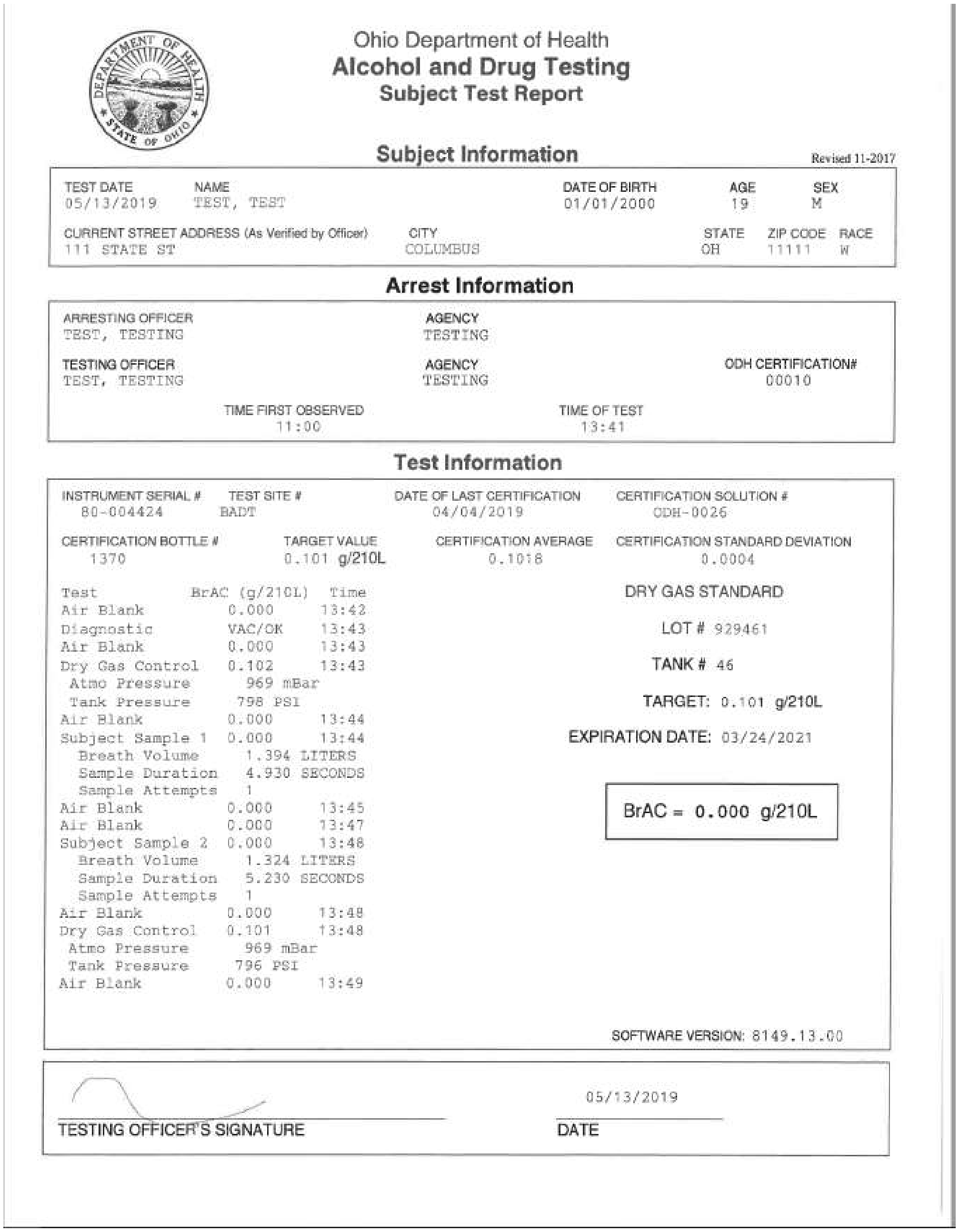
…………………………..

The instrument returns to “Ready Mode”.

Ready Mode

09/17/2019 09:40

This is a <u>complete</u> subject test form. There will be a dry gas control before the first breath sample and after the last breath sample. There must be two complete breath samples for the breath test. **The BrAC reading on the report will be the <u>lower</u> of the two sample readings.**



Ohio Department of Health

Alcohol and Drug Testing

Subject Test Report

Subject Information

Revised 11-2017

TEST DATE 05/13/2019	NAME TEST, TEST	DATE OF BIRTH 01/01/2000	AGE 19	SEX M
CURRENT STREET ADDRESS (As Verified by Officer) 111 STATE ST	CITY COLUMBUS	STATE OH	ZIP CODE 11111	RACE W

Arrest Information

ARRESTING OFFICER TEST, TESTING	AGENCY TESTING	
TESTING OFFICER TEST, TESTING	AGENCY TESTING	ODH CERTIFICATION# 00010
TIME FIRST OBSERVED 11:00	TIME OF TEST 13:41	

Test Information

INSTRUMENT SERIAL # 80-004424	TEST SITE # BADT	DATE OF LAST CERTIFICATION 04/04/2019	CERTIFICATION SOLUTION # ODH-0026
CERTIFICATION BOTTLE # 1370	TARGET VALUE 0.101 g/210L	CERTIFICATION AVERAGE 0.1018	CERTIFICATION STANDARD DEVIATION 0.0004

```
Test              BrAC (g/210L)   Time
Air Blank            0.000        13:42
Diagnostic           VAC/OK       13:43
Air Blank            0.000        13:43
Dry Gas Control      0.102        13:43
 Atmo Pressure        969 mBar
 Tank Pressure        798 PSI
Air Blank            0.000        13:44
Subject Sample 1     0.000        13:44
  Breath Volume        1.394 LITERS
  Sample Duration      4.930 SECONDS
  Sample Attempts      1
Air Blank            0.000        13:45
Air Blank            0.000        13:47
Subject Sample 2     0.000        13:48
  Breath Volume        1.324 LITERS
  Sample Duration      5.230 SECONDS
  Sample Attempts      1
Air Blank            0.000        13:48
Dry Gas Control      0.101        13:48
 Atmo Pressure        969 mBar
 Tank Pressure        796 PSI
Air Blank            0.000        13:49
```

DRY GAS STANDARD

LOT # 929461

TANK # 46

TARGET: 0.101 g/210L

EXPIRATION DATE: 03/24/2021

BrAC = 0.000 g/210L

SOFTWARE VERSION: 8149.13.00

TESTING OFFICER'S SIGNATURE

05/13/2019

DATE

ESCAPE SEQUENCES
INTOXILYZER 8000

Pressing the escape key twice on the keyboard will **DISPLAY** the following:	**Swipe/Scan Certification Card or Press Enter**

Place **OPERATOR ACCESS CARD** under the red light near the keyboard or press **ENTER** to manually enter the access card number. Enter your **PIN** number when requested.

Use the ← or → **ARROW** keys to move the cursor or press the **LETTER KEY** to go directly to that function.	**1: ADPRSQT** **Continuous Air Blank**
Press "**A**" followed by **ENTER** to perform a **CONTINUOUS AIR BLANK.** The instrument pump will **PURGE** the sample cell. Press the **START TEST** button to stop the **CONTINUOUS AIR BLANK**. The **DISPLAY** automatically returns to the menu.	**1: ADPRSQT** **Continuous Air Blank**
Press "D" followed by ENTER to perform and print a DIAGNOSTIC TEST. The **DISPLAY** automatically returns to the menu.	**1: ADPRSQT** **Diagnostic**
Press "**P**" followed by **ENTER** to perform a **PRINT TEST.** The **DISPLAY** automatically returns to the menu.	**1: ADPRSQT** **Print Test**
Press "**R**" followed by **ENTER** to **RECALL** prior subject test records from memory.	**1: ADPRSQT** **Recall Test From Mem**
The most recent **RECORD DATE** will be displayed. Press the **PgUp/PgDn** keys to scroll through dates. Once the correct **RECORD DATE** appears, press **ENTER.**	**Record Date** **10/15/2013**
The number of **RECORDS** will be displayed for that date. Press **ENTER** to continue.	**10/15/2013** **# OF RECORDS: 003**

Use the ↑ or ↓ **ARROW** keys to display each RECORD. Use the ⟵ or ⟶ **ARROW** keys to view additional information to confirm the record. Press **ENTER** to **PRINT** the displayed record. Press the **ESCAPE** key until the **DISPLAY** returns to the menu.	**10/15/2013 R#: 001** **#DOE, JOHN**
Press "S" to REPRINT LAST TEST then press **ENTER.**	**1: ADPRSQT** **Reprint Last Test**
Press "**Q**" followed by **ENTER** to return the instrument to **READY MODE**.	**1: ADPRSQT** **Quit Menu**
Press "**T**" followed by **ENTER** to test **SIGNATURE PAD**.	**1: ADPRSQT** **Sig Pad Test**
The instrument returns to Ready Mode.	**Ready Mode** **Push Any Button to Start**

EXCEPTION MESSAGES
INTOXILYZER 8000

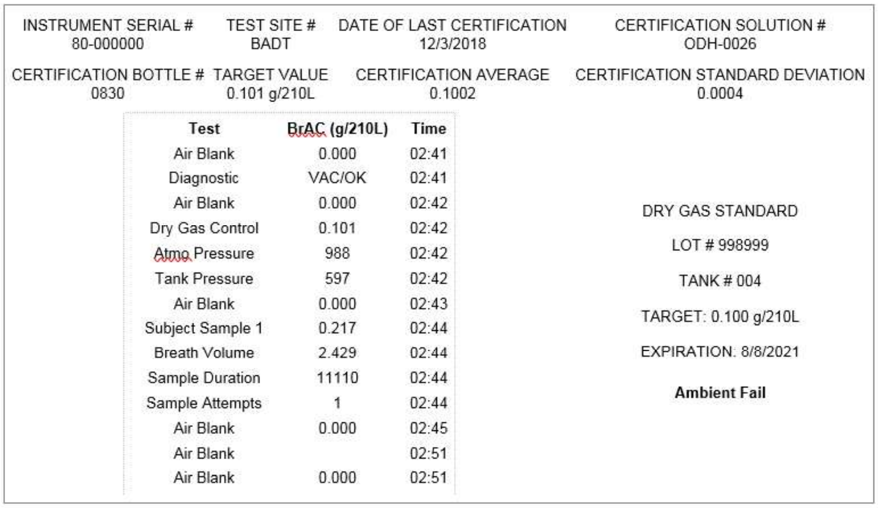
A message may be displayed to the operator indicating an exception has been identified. The following chart includes the exception messages displayed, the issue identified by the instrument and the operator's best practices to complete a valid testing sequence. Whenever a new testing sequence is initiated, the operator should reinstruct the subject on how to successfully complete a test sequence, utilize a new mouthpiece and use discretion when determining if a new observation period should be performed.

Four signs of a Terminated Test:

1. The test aborts
2. The instrument sounds a High/Low tone
3. The exception message displays
4. The exception message is printed.

Exception Displayed	Issue	Best Practice
Ambient Fail	Ethanol was detected in the air brought into the instrument during an air blank.	**Check area around instrument for a possible source of ethanol and make best effort to remove source and/or ventilate area. Retest subject**.
Deficient Sample	The subject does not provide an adequate sample during the required 3 minute time frame.	**Retest subject.**
Diagnostic Fail	The instrument did not successfully complete an internal diagnostic check. The test record will identify and print the specific diagnostic failure.	**Retest subject.** Contact ADT (see below) if second sequence is unsuccessful.
Dry Gas Out of Tolerance	The dry gas control value generated is outside of required limits.	**Retest subject.** Contact ADT (see below) if second sequence is unsuccessful.
Improper Sample	The subject provided a breath sample at the wrong time in the sequence.	**Retest subject.**
Input Timeout	The data entry function timed-out waiting for input from the operator.	**Retest subject.**

Interferent Detect	A substance other than alcohol was detected in the breath sample.	**Retest subject.** Request a blood or urine sample if second sequence is unsuccessful.
Invalid Sample	Possible mouth alcohol was detected in the subject's sample.	**Retest subject**.
No Sample Given	The subject did not provide a breath sample.	**Retest subject.** Request a blood or urine sample if second sequence is unsuccessful.
No .020 agreement	The subject test results were not within .020 g/210L of each other.	**Retest subject.**
Purge Fail	The air blank after an analytical reading was not adequately cleared within required limits.	**Retest subject.** Contact ADT (see below) if second sequence is unsuccessful.
Range Exceeded	The analytical value exceeds the maximum reported value of the instrument.	**Retest subject.** Contact ADT (see below) if second sequence is unsuccessful.
RFI Detect	Radio Frequency Interference has been detected.	**Check area around instrument for a possible source of radio frequency and make best effort to remove source from the area.** **Retest subject.**
Sequence Aborted	The Start Test button was pressed during an ongoing test sequence.	**Retest subject.**
Tank Pressure Low	Dry Gas Control pressure is below 50 PSI.	Complete testing sequence and **contact ADT** (see below).
Tank Pressure Below Minimum – Shutting Down	Dry Gas Control pressure is below 25 PSI.	Use a different instrument or method of obtaining a sample. **Contact ADT** (see below).

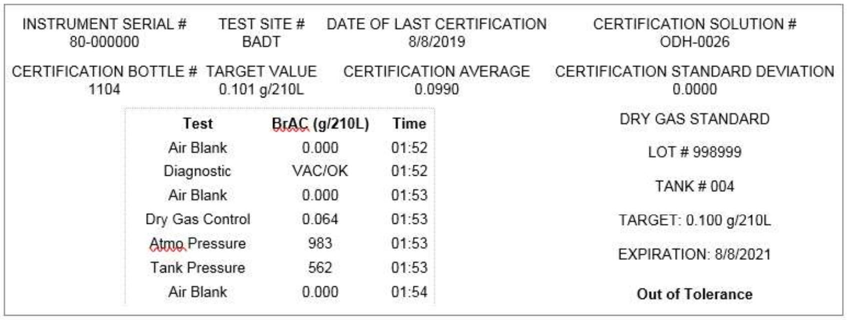


INSTRUMENT SERIAL # 80-000000
TEST SITE # BADT
DATE OF LAST CERTIFICATION 12/3/2018
CERTIFICATION SOLUTION # ODH-0026
CERTIFICATION BOTTLE # 0830
TARGET VALUE 0.101 g/210L
CERTIFICATION AVERAGE 0.1002
CERTIFICATION STANDARD DEVIATION 0.0004

Test	BrAC (g/210L)	Time
Air Blank	0.000	02:41
Diagnostic	VAC/OK	02:41
Air Blank	0.000	02:42
Dry Gas Control	0.101	02:42
Atmo Pressure	988	02:42
Tank Pressure	597	02:42
Air Blank	0.000	02:43
Subject Sample 1	0.217	02:44
Breath Volume	2.429	02:44
Sample Duration	11110	02:44
Sample Attempts	1	02:44
Air Blank	0.000	02:45
Air Blank		02:51
Air Blank	0.000	02:51

DRY GAS STANDARD
LOT # 998999
TANK # 004
TARGET: 0.100 g/210L
EXPIRATION: 8/8/2021

Ambient Fail

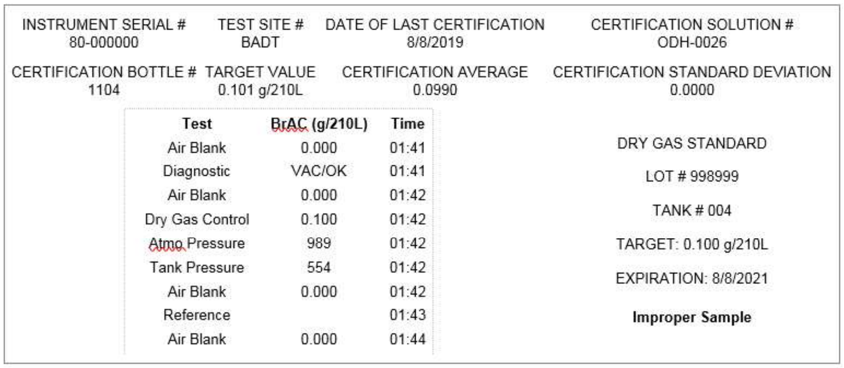


INSTRUMENT SERIAL # 80-000000
TEST SITE # BADT
DATE OF LAST CERTIFICATION 8/8/2019
CERTIFICATION SOLUTION # ODH-0026
CERTIFICATION BOTTLE # 1104
TARGET VALUE 0.101 g/210L
CERTIFICATION AVERAGE 0.0990
CERTIFICATION STANDARD DEVIATION 0.0000

Test	BrAC (g/210L)	Time
Air Blank	0.000	01:52
Diagnostic	VAC/OK	01:52
Air Blank	0.000	01:53
Dry Gas Control	0.064	01:53
Atmo Pressure	983	01:53
Tank Pressure	562	01:53
Air Blank	0.000	01:54

DRY GAS STANDARD
LOT # 998999
TANK # 004
TARGET: 0.100 g/210L
EXPIRATION: 8/8/2021

Out of Tolerance

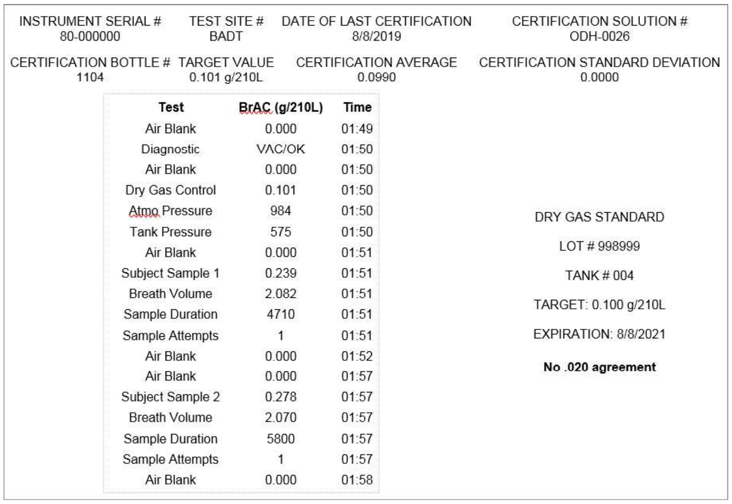


INSTRUMENT SERIAL # 80-000000
TEST SITE # BADT
DATE OF LAST CERTIFICATION 8/8/2019
CERTIFICATION SOLUTION # ODH-0026
CERTIFICATION BOTTLE # 1104
TARGET VALUE 0.101 g/210L
CERTIFICATION AVERAGE 0.0990
CERTIFICATION STANDARD DEVIATION 0.0000

Test	BrAC (g/210L)	Time
Air Blank	0.000	01:41
Diagnostic	VAC/OK	01:41
Air Blank	0.000	01:42
Dry Gas Control	0.100	01:42
Atmo Pressure	989	01:42
Tank Pressure	554	01:42
Air Blank	0.000	01:42
Reference		01:43
Air Blank	0.000	01:44

DRY GAS STANDARD
LOT # 998999
TANK # 004
TARGET: 0.100 g/210L
EXPIRATION: 8/8/2021

Improper Sample



INSTRUMENT SERIAL #	TEST SITE #	DATE OF LAST CERTIFICATION	CERTIFICATION SOLUTION #
80-000000	BADT	8/8/2019	ODH-0026

CERTIFICATION BOTTLE #	TARGET VALUE	CERTIFICATION AVERAGE	CERTIFICATION STANDARD DEVIATION
1104	0.101 g/210L	0.0990	0.0000

Test	BrAC (g/210L)	Time
Air Blank	0.000	01:49
Diagnostic	VAC/OK	01:50
Air Blank	0.000	01:50
Dry Gas Control	0.101	01:50
Atmo Pressure	984	01:50
Tank Pressure	575	01:50
Air Blank	0.000	01:51
Subject Sample 1	0.239	01:51
Breath Volume	2.082	01:51
Sample Duration	4710	01:51
Sample Attempts	1	01:51
Air Blank	0.000	01:52
Air Blank	0.000	01:57
Subject Sample 2	0.278	01:57
Breath Volume	2.070	01:57
Sample Duration	5800	01:57
Sample Attempts	1	01:57
Air Blank	0.000	01:58

DRY GAS STANDARD

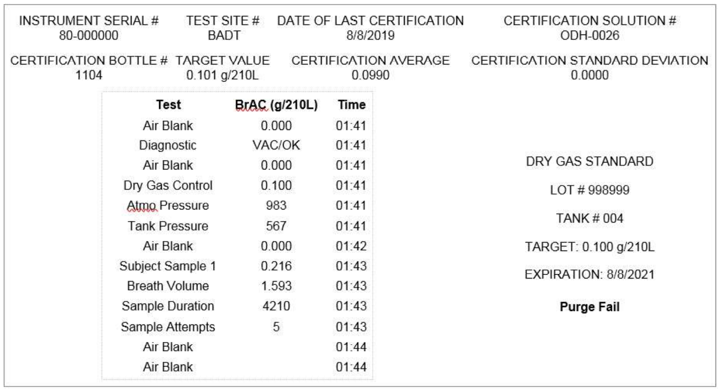
LOT # 998999

TANK # 004

TARGET: 0.100 g/210L

EXPIRATION: 8/8/2021

No .020 agreement



INSTRUMENT SERIAL #	TEST SITE #	DATE OF LAST CERTIFICATION	CERTIFICATION SOLUTION #
80-000000	BADT	8/8/2019	ODH-0026

CERTIFICATION BOTTLE #	TARGET VALUE	CERTIFICATION AVERAGE	CERTIFICATION STANDARD DEVIATION
1104	0.101 g/210L	0.0990	0.0000

Test	BrAC (g/210L)	Time
Air Blank	0.000	01:41
Diagnostic	VAC/OK	01:41
Air Blank	0.000	01:41
Dry Gas Control	0.100	01:41
Atmo Pressure	983	01:41
Tank Pressure	567	01:41
Air Blank	0.000	01:42
Subject Sample 1	0.216	01:43
Breath Volume	1.593	01:43
Sample Duration	4210	01:43
Sample Attempts	5	01:43
Air Blank		01:44
Air Blank		01:44

DRY GAS STANDARD

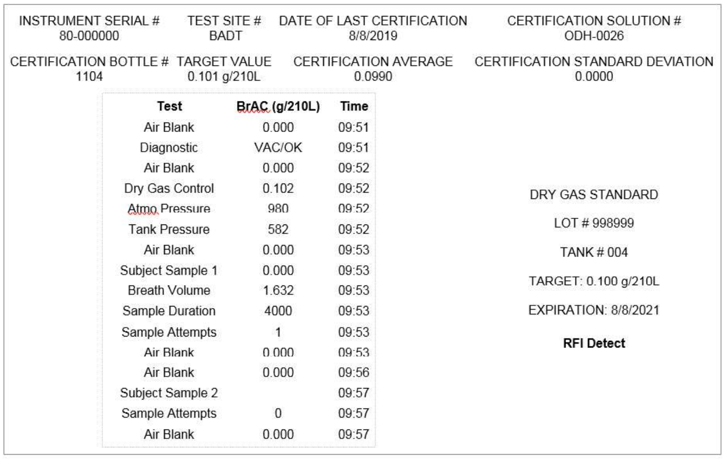
LOT # 998999

TANK # 004

TARGET: 0.100 g/210L

EXPIRATION: 8/8/2021

Purge Fail



INSTRUMENT SERIAL #	TEST SITE #	DATE OF LAST CERTIFICATION	CERTIFICATION SOLUTION #
80-000000	BADT	8/8/2019	ODH-0026

CERTIFICATION BOTTLE #	TARGET VALUE	CERTIFICATION AVERAGE	CERTIFICATION STANDARD DEVIATION
1104	0.101 g/210L	0.0990	0.0000

Test	BrAC (g/210L)	Time
Air Blank	0.000	09:51
Diagnostic	VAC/OK	09:51
Air Blank	0.000	09:52
Dry Gas Control	0.102	09:52
Atmo Pressure	980	09:52
Tank Pressure	582	09:52
Air Blank	0.000	09:53
Subject Sample 1	0.000	09:53
Breath Volume	1.632	09:53
Sample Duration	4000	09:53
Sample Attempts	1	09:53
Air Blank	0.000	09:53
Air Blank	0.000	09:56
Subject Sample 2		09:57
Sample Attempts	0	09:57
Air Blank	0.000	09:57

DRY GAS STANDARD

LOT # 998999

TANK # 004

TARGET: 0.100 g/210L

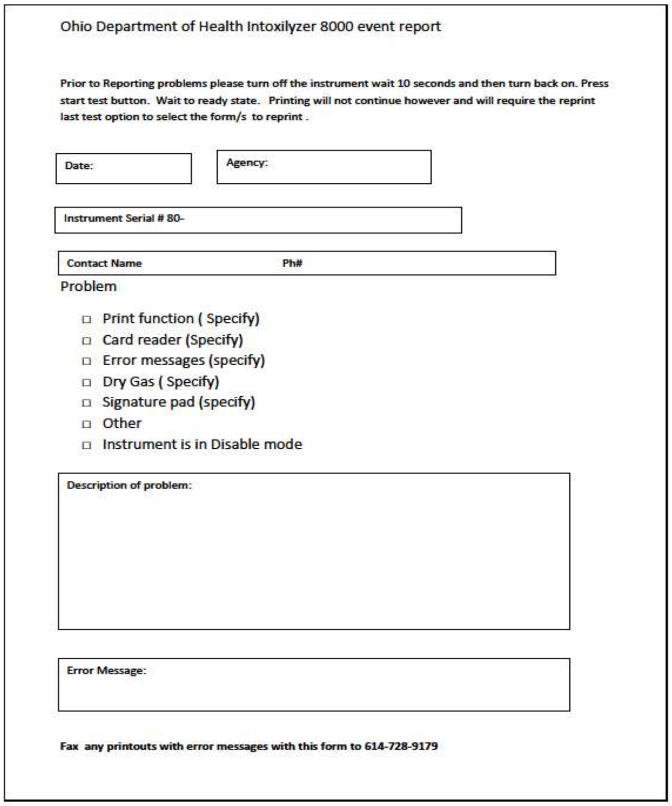
EXPIRATION: 8/8/2021

RFI Detect

Ohio Department of Health
Alcohol & Drug Testing Program
Phone (614) 644-4609
Fax (614) 728-9179

EVENT REPORT

Use this form to report any issues with the instrument. The form is available in a document file for agencies to download for their own use.



Ohio Department of Health Intoxilyzer 8000 event report

Prior to Reporting problems please turn off the instrument wait 10 seconds and then turn back on. Press start test button. Wait to ready state. Printing will not continue however and will require the reprint last test option to select the form/s to reprint .

Date:

Agency:

Instrument Serial # 80-

Contact Name **Ph#**

Problem

- ☐ Print function (Specify)
- ☐ Card reader (Specify)
- ☐ Error messages (specify)
- ☐ Dry Gas (Specify)
- ☐ Signature pad (specify)
- ☐ Other
- ☐ Instrument is in Disable mode

Description of problem:

Error Message:

Fax any printouts with error messages with this form to 614-728-9179

INTOXILYZER 8000
LASER JET PRINTER STATIONARY APPLICATION

The internal Pentax thermal printer is the default printer for the instrument.

When the instrument is used inside the station or when returned to the station after portable use, connect the instrument to the Brother Laser Jet printer with the USB cable.

Turn the Laser Jet power switch to the ON position. The USB connection automatically sends all printing to the Laser Jet printer when connected to the instrument.

A flashing yellow toner light indicates the toner needs to be replaced soon. Toner can be obtained from a local vendor.

To return to the internal Pentax thermal printer for portable use, disconnect the laser jet USB cable from the instrument. The instrument is now ready for portable use. The internal Pentax thermal printer is automatically ready for printing.

It is recommended that the Laser Jet printer remains connected unless the instrument is removed for portable use.

INTOXILYZER 8000
DATA TRANSFER / INSTRUMENT UPDATES

To transfer data from the Intoxilyzer 8000 and receive instrument updates:

1. Turn **both** power switches off, wait momentarily, then turn both switches back on and press the **START TEST** button.
2. Wait approximately one minute/**NOT READY MODE** appears on the display.
3. Press and hold the "**CTRL**" and the "**U**" keys at the same time.
4. The instrument will automatically connect to the server.
5. While **DOWNLOADING** the following appears on the instrument display:

<u>DO NOT TURN POWER OFF UNTIL TRANSFER IS COMPLETE</u>

Comms Transfer
Connecting …………………..

Comms Transfer
Connected …………………..

Comms Transfer
Comms Session Active………..

Comms Transfer
Records Downloading………..

Operator.dat file
Uploading ……………….

6. When **DOWNLOAD** is successful the following appears on the instrument display:

Comms Transfer
Upload: OK

7. Press any key on the keyboard and the instrument display returns to normal.

Ready Mode
Push Any Button To Start

If **DOWNLOAD** is **<u>UNSUCCESSFUL</u>**, the following appears on the instrument display:

No Connect
Retry? Y/N

Press Y. If the retry fails, the following appears on the display:

Comms: Transfer
Upload Fail

IF A SECOND "CTRL" "U" FAILS -
FORWARD AN EVENT REPORT VIA FAX.
NOTIFY ADT AT (614) 644-4609
LEAVE MESSAGE IF NO ANSWER.
PLEASE GIVE AGENCY NAME,
INSTRUMENT SERIAL NUMBER, AND ADVISE
COMMUNICATION TRANSFER FAILED
Press Any Key To Continue Subject Testing

Annual Access Card Proficiency

EACH YEAR every I-8000 operator MUST show proficiency

-Conduct a subject breath test (Successfully - no exceptions, BrAC result reported)

OR

-Perform a proficiency test (Follow I-8000 Proficiency test instructions from ODH website.)

THEN

-Upload results to ODH (Control-U)

Please conduct as early in the year as possible.

If you do not complete a successful proficiency or subject test in a calendar year, your card will be inactivated. You will need to pass a written test and proficiency test WITH an inspector in order to be reactivated.

Annual Access Card Proficiency

In order to maintain a valid access card, the card holder must perform either a complete, successful violator (subject) test with a breath alcohol concentration (refusals, time outs, or other incomplete tests do not qualify) OR a complete, successful proficiency test, following guidelines provided by the Alcohol & Drug Testing Program at least once each calendar year (January 1 through December 31). If a complete subject test or proficiency test is not provided, the access card holder is subject to revocation. Refer to Ohio Administrative Code Rules 3701-53-08 (D), 3701-53-09 (E), and 3701-53-10 (B) and (C)(2).