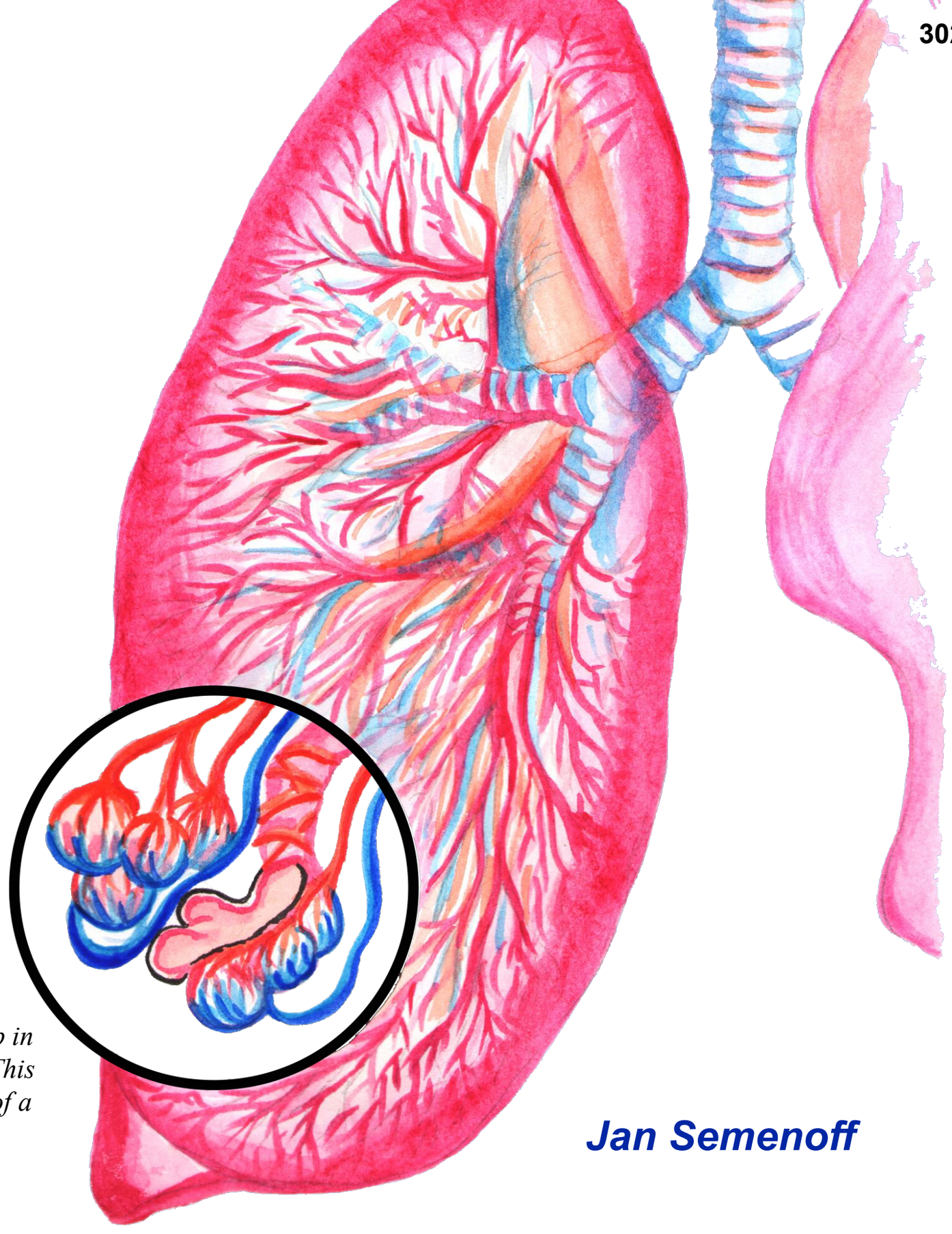
Breath Sampling Criteria

Determining the Suitability of a Breath Sample

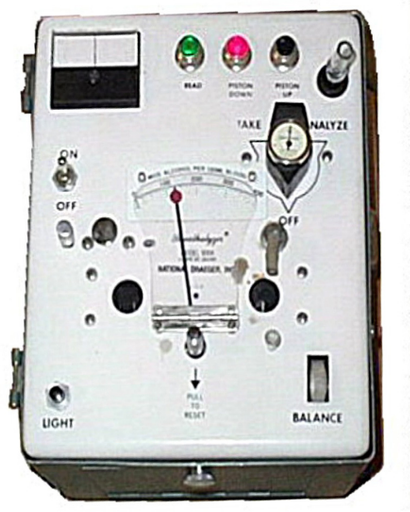


Determining the suitability of a breath sample is the first step in determining the overall reliability of the breath test results. This article addresses the criteria for determining the suitability of a breath sample received for analysis.

Jan Semenoff

Breath Sampling Criteria
Determining the Suitability of a Breath Sample

I have a confession to make. I am old enough that I was initially trained as a Qualified Breath Alcohol Technician on the Borkenstein Breathalyzer Model 900A. Although invented in 1954 (9 years before I was born) the unit was used long and wide by police departments across Canada from 1957 until well after the turn of the millennium, being removed from the list of Approved Evidentiary Instruments only a few years ago.



The Breathalyzer 900A

Evidentiary testing using a Breathalyzer Model 900A was very much a manual "hands-on" experience. Every aspect of the testing sequence was controlled by the Qualified Technician, and more importantly, the technician was required to determine *when a suitable sample had been obtained.* This situation lead to a great deal of variability among breath test technicians. I personally timed the sampling event, and made a note of the duration of the sample to observable taper in exhalation. I also encouraged the subject to provide a good sample of deep lung air. However, I have watched operators who were content to obtain whatever sample the subject provided, with I feel, a lesser likelihood of obtaining a true deep lung alveolar sample.

Now, it may be that the "deep lung air" sample is not quite the gold-standard that has been made of it, but that is the subject for another article…

Newer automated breath alcohol testing devices attempted to take back control of the testing sequence as much as possible. This is most readily apparent in determining the suitability of breath samples. Remember, though, that ultimately the suitability of the breath sample is still the responsibility of the qualified operator.

We need to differentiate two distinct concepts. We've dealt with the *reliability* of a reading in this issue, and others of Counterpoint. Reliability refers to the accuracy, precision and specificity of the reading itself. The suitability of a breath sample is discussed below, and refers to how the breath sample was obtained. In short, we need a suitable breath sample to be received and analyzed by the breath test system BEFORE we can obtain a reliable reading. We need BOTH a suitable sample, analyzed by a reliable system to create a "true" reading.

Modern police evidentiary breath test instruments use four criteria to *assist* in the determination of the suitability of a breath sample:

- **Pressure** of exhaled breath flow
- **Time** of exhalation (as in *duration*)
- Exhaled breath **Volume**, and
- "**Slope**"

The Sampling Criteria

The Pressure Sensor, Timer, Volume Calculation and *Slope Detector* work together to assist in obtaining a suitable sample from *the majority of the population*. The emphasis is important. Some people will be able to exceed these requirements, and conversely, some may indeed have difficulty meeting the minimum testing requirements.

In order to determine the pressure and time of breath samples that subjects can provide, physiologists look at their "*Forced Vital Capacity*" or FVC. FVC is the total volume of breath that can be delivered by a subject after they make a full inhalation. FVC will vary from person to person based upon the size of the individual, their age and their inherent lung volume capacity. Typical values are between 3-6 litres.

Some people are smaller in stature and have a lower FVC than other larger bodied people. FVC is also determined by pre-existing medical conditions, especially COPD (Chronic Obstructive Pulmonary Disorder) or chronic Asthma. Variability also exists among individuals. My lung volume is about 118% of normal, as an example and I have an average FVC of 5.36 litres.

Larger, fuller-lunged persons may have to blow harder and longer than persons with reduced lung capacity to give an end-expiratory breath sample. The breath alcohol device has no way of knowing, so they use their own criteria.

Pressure & Time

When the subjects first provide their breath samples, they must blow with sufficient force to activate a pressure transducer. The threshold value to activate this transducer is equivalent to 15 cm of water, or 0.2 psi (pounds per square inch) in the majority of breath testing devices. This is not a very great value, and can be easily provided by most persons. Once the pressure transducer is activated, the timing circuitry is engaged. An audible tone is emitted that indicates the subject is providing an adequate air flow. As long as the pressure of the breath sample exceeds the threshold value, the tone continues to emit.

Again, in most devices, a timing circuit is activated that requires a minimum breath sample time of 5 seconds. The pressure of the sample must be maintained during this entire five-second period. If the subject does not maintain the minimum pressure for the minimum time, the tone stops and the pressure circuit is re-set. Any re-attempt at the provision of a breath sample will start the cycle over again.

This system is the same as employed by many roadside screening devices. It is assumed that five seconds of breath sample at the minimum threshold value will produce a sample of deep-lung alveolar air in the majority of persons tested.

Volume

Volume is done a little differently than you might expect. The true volume of a sample is not *measured*. It is a *calculated* value, determined by multiplying the flow rate of the sample by the number of seconds the sample was delivered. Most modern units require a minimum of 1.1 to about 1.5 litres of exhaled breath in order to meet the volume requirement.

VOLUME = FLOW RATE x EXHALATION TIME

The Slope Detector

Mouth Alcohol Detection & the *Residual Alcohol Detection System*

You may hear someone refer to a "Slope Detector". More correctly, they are called "Residual Alcohol Detections Systems", and are programmed algorithms built into the software of the device. You can't actually point to a "Slope Detector" inside a breath alcohol testing device. It would be like opening up your computer right now, and pointing to your "Word Processor". You can't point to a *Word Processor* any more than you can point to a *Slope Detector*. They are simply **programs,** *with the inherent limitations software programs have…*

Modern breath alcohol testers use this additional aid in determining the suitability of the breath sample. This system is ONLY available in units that provide real-time measurement of the breath sample's BrAC (**Breath** Alcohol Concentration). Units that use infrared technology to create a breath alcohol measurement incorporate this fourth component. Units that create readings using fuel cell technology are not real-time measurements, and do NOT incorporate slope detection analysis.

Using an infrared breath alcohol device, as the subject starts to exhale, their initial reading is ZERO, and rises from that point onward, measured second by second by the device. *Although the slope detector circuitry is initialized at the beginning of exhalation, the readings are not considered as part of the BrAC until the minimum pressure and time values are met.* Five seconds of sufficient force are required before the BAC readings may be obtained.

A disposable mouthpiece

A "normal" breath sample will give the following slope curve:

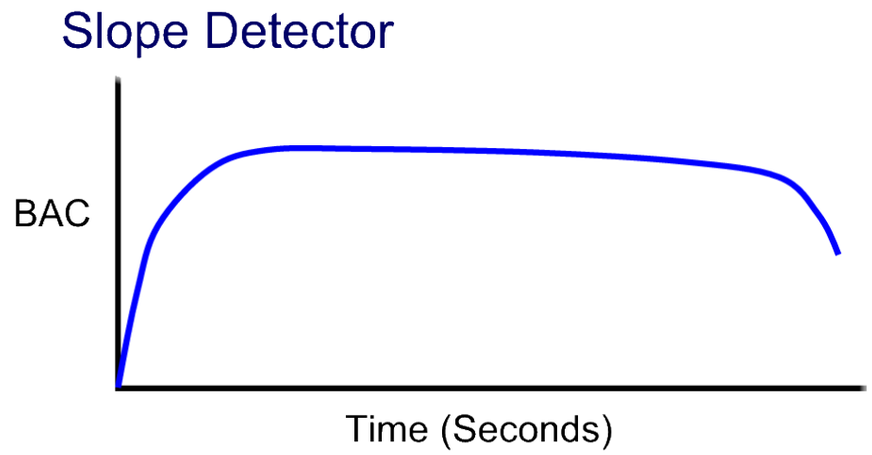


Figure 1 - An exhalation profile showing the Breath Alcohol Concentration over the time the sample is provided

The alcohol level will sharply rise at first as alcohol is introduced to the test chamber, and will start to level off as stable deep-lung alveolar air is delivered. Towards the end of expiration, as the volume capacity is met, the BAC level will fall off rapidly. Since the first 5-seconds of readings are not considered as a part of the breath sample, we get a slope determination that looks like this:

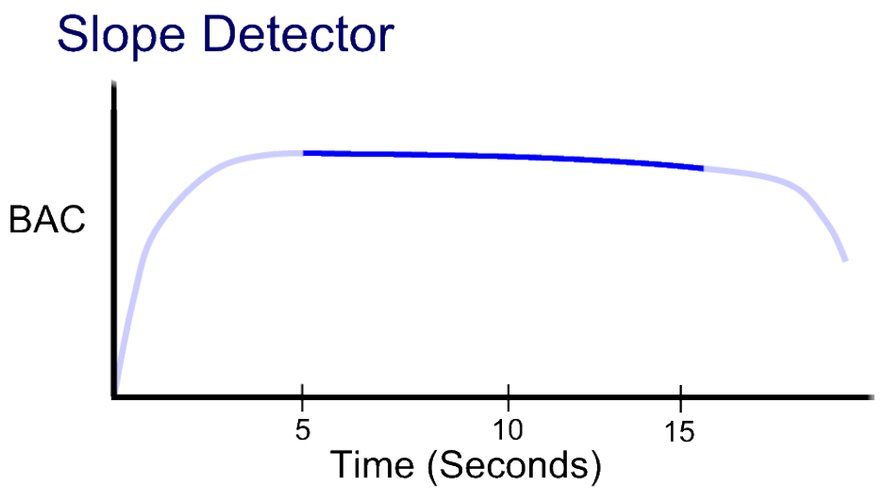


Figure 2 - The first five seconds are not considered when calculating the Breath Alcohol Concentration of the exhaled sample.

The rapid fall of BrAC at the *end* of the sample is also disregarded for two reasons. First, the pressure of the exhalation will close the pressure transducer switch. Since the minimum 5-second sample has already been obtained, no error messages will be displayed. Secondly, the slope detector is programmed to expect a fall-off in BAC at the end of the breath sample. In essence, the reading is taken from the middle, nearly horizontal portion of the slope reading, with the highest reading displayed.

The specific FVC of the subject determines the length of time it takes before a plateau of BAC occurs. While a small person may level-off after 5-seconds, a larger person may require considerably more time. In fact, the volume they provide is immaterial, as long as the slope detector doesn't detect a rise of more than 3 mg/100mL (0.003g) per second of the BAC reading. The actual volume of breath analyzed by the instrument plays no part in determining the subject's BAC reading.

The slope detector plays an important role in determining the presence of fresh-mouth alcohol. A subject who may have recently introduced alcohol into their mouth and respiratory tract by:

- Vomiting
- Burping
- A condition such as *Acid Reflux Disease, or GERD*

will have an initial rapid rise in BrAC that also falls off sharply as the false-high alcohol reading dissipates and is replaced by a "true" near-level slope.

The Intoxilyzer 8000

Let's pretend that the subject above has "micro-burped" immediately prior to, or while providing, a breath alcohol sample:

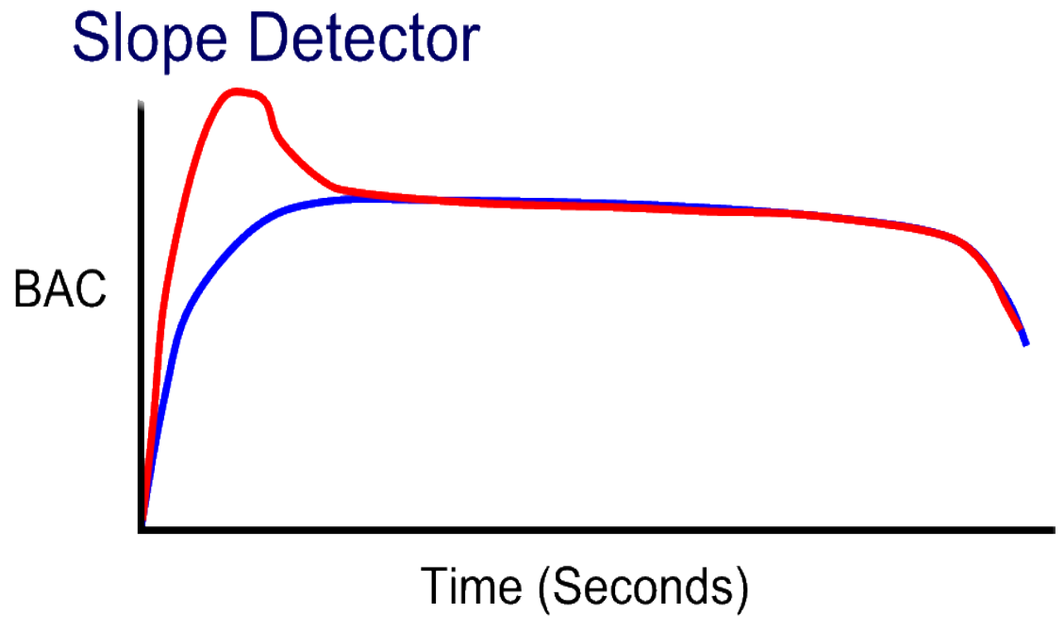


Figure 3 - The "true BrAC reading (blue) with a contaminated reading (red)

The red line in the diagram above represents the exhalation pattern with contamination at the beginning of the sample. The "true" value of the reading is shown in blue. The device is supposed to pick up the sudden rise and sharp drop (in the red line) and determine that the entire sample is contaminated due to that profile. It is the rise AND subsequent drop that upsets the programmed values, and triggers the *Residual Alcohol Detection System* into believing contamination is present.

The forensically acceptable standard of obtaining two readings within 20 mg/100mL (0.02 grams/100mL) of each another, coupled with the observation period either before or between the two readings *assists* in obtaining suitable samples. The slope detector system adds only a certain degree of validity to our testing process. Many jurisdictions around the world do not obtain two readings, so the slope detector becomes even more valuable to them.

Different devices use different algorithms. The Intoxilyzer 5000, as an example, needs to have a BrAC reading that exceeds + 0.003 gram per second AND a negative slope of minus 0.005 grams per second or greater to trigger the Slope Detector. If the red line, indicating breath contamination shown in Figure 3 had a + 0.003 gram per second rise AND a negative slope of only minus 0.004 grams, the pre-programmed amounts would NOT be triggered, and the Residual Mouth Alcohol Detection System would NOT flag the breath sample as contaminated.

The Intoxilyzer 8000, on the other hand, has different requirements in determining a sample's suitability. First, there is a minimum flow rate requirement of 0.15 litres per second, with a minimum breath time of only one second. The sample must be a minimum of 1.1 litres in volume. The IR source on the Intoxilyzer 8000 pulses at only 2 cycles per second (Hz). With two filters, a reading is obtained every ¼ second (250 ms). As the pulses are analyzed, consecutive BrAC readings that do not differ by more than 3 percent will indicate a level slope. So, if all the parameters are met, the theoretical minimum breath sample duration is only 1.75 seconds.

As with the Intoxilyzer Model 5000, once the four criteria (flow rate, time, volume and slope) are met, a Zero will appear in front of the preliminary breath test results, indicating that the sample received is deemed *suitable by the programed algorithm*.

The Intoxilyzer 5000EN

However, it has been my experience that the slope detector can, and often is, fooled under a variety of circumstances, most notably, recent consumption of an amount of alcohol, similar to what would occur during a burp or "micro-burp". Listerine PocketPaks® also give a minor but perceptible false positive reading. This circumstance is precisely what the slope detector was designed to detect. I have routinely observed the slope detector fail to register mouth alcohol that is as much as 12-15 minutes old, often allowing the unit to register an abnormally high reading given a simple swish of alcohol. A small burp, or trapped alcohol can also produce falsely inflated breath alcohol readings. **I can only conclude that the slope detector is merely an investigative aid, and is a highly inaccurate detector of mouth alcohol.**

I'm not alone in this assertion. Published studies indicate failure of the Residual Alcohol Detection System to identify mouth alcohol bias between 37% (Harding et al, 1992) and 48 % failure (Simpson et al, 2004). Gullberg (2000) also reports on the inadequacy of the mouth alcohol detection systems. Harding reported that some of these failures occurred after more than 15 minutes of deprivation.

Obtaining Proper Samples & Operational Implications

Relying upon four criteria outlined (pressure, time, volume, and slope) to automatically determine the suitability of the sample is insufficient. It must still be the responsibility of the qualified technician to ensure that a suitable sample is properly obtained. Some subjects will be able to provide a breath sample that far exceeds the minimum 5-second requirement of the pressure-time circuit. Modern units will set *minimum* standards for a suitable sample, based on an average subject. The qualified operator is the one who must ensure that a given test subject has provided *their own unique suitable breath sample*.

There is no manual override on many evidentiary breath alcohol testers as there are on some roadside screeners that are capable of automatically drawing a breath sample into the test chamber. The evidentiary units will continue to receive the sample as long as its parameters don't fall outside the slope detection system's threshold values. As long as the subject continues to provide air sufficient to keep the pressure transducer open, the sample will be analyzed either 4 or 30 times per second[5].

This, coupled with an observation period of a reasonable length of time, should provide a degree of credibility in the breath testing results. But remember, an observation period is exactly that – observation. The operator should be paying attention with their eyes, ears, and in some cases their noses to detect the smell of the fresh burp, or unnoticed "micro-burp".

Final Thoughts

So, a suitable breath sample must be received before a reliable breath alcohol reading can be obtained. They are separate concepts, intrinsically tied together. Think of it this way – If an unsuitable breath sample was received (it doesn't meet the pressure/time/volume/slope detector requirements), by its very definition, it CAN NOT produce a ***reliable*** breath alcohol reading. This is no different from anything else. A "bad" blood sample can't be analyzed by even the best, most reliable Gas Chromatograph to produce a reliable BAC reading. The old adage, "Garbage in, garbage out…" seems to apply.

5 Some of the most recent units produce a graphical printout of the breath sample itself that indicates, among other things, the volume of breath sample of the subject, a graphical representation of the force and duration of their breath sample, the BAC slope – indicated as a graph, and even the exhaled breath temperature. Although the information can result in court challenges, it also provides quantified data.

For Further Inquiry:

1. Dubowski, K.M. "Absorption, Distribution and Elimination of Alcohol: Highway Safety Aspects", 10 J. Stud. Alcohol Suppl., 1985.

2. Dubowski, K.M., The Technology of Breath-Alcohol Analysis, U.S. Department of Health and Human Services, Prepared for The National Institute on Alcohol Abuse and Alcoholism, 1991.

3. Dubowski, K.M., Quality Assurance in Breath-Alcohol Analysis, Journal of Analytical Toxicology, Vol. 18, Oct 1994.

4. Dubowski, K.M., Acceptable Practices for Evidential Breath-Alcohol Testing, Center for Studies of Law in Action, Borkenstein Course Materials, Indiana University, May 2008.

5. Hlastala, M., Lam, W., and Nesci, J., The Slope Detector Does Not Always Detect the Presence of Mouth Alcohol, For the Defense, March 2006.

6. Gullberg, R.G., The Inadequacy of Instrumental "Mouth Alcohol" Detection Systems in Forensic Breath Alcohol Measurement, Northwest Association of Forensic Sciences, Oct., 2000.

7. Gullberg, R. G., Breath Alcohol Measurement Variability Associated with Different Instrumentation and Protocols, Forensic Science International 131 (2003) 30-35.

8. Jones, A. W., Concerning Accuracy and Precision of Breath-Alcohol Measurements, Clinical Chemistry, 33/10, 1701-1706 (1987).

9. Sterling, Kari, The Rate of Dissipation of Mouth Alcohol in Alcohol Positive Subjects, The Journal of Forensic Science, 2011.

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