

# Can the Intoxilyzer® 5000C Really Determine A Blood Alcohol Concentration?

Bruce D. Miller, B.Sc.(PMCOL), M.Sc.

Canadian Forensic Services

---

Being charged with driving with a blood alcohol concentration over the legal limit is traumatizing for any individual. The effect is compounded when an accused person does not understand the law or the relevant science.

In all probability, an accused person was tested by a police officer on a breath-testing instrument, but the results were recorded as a blood alcohol concentration. Fortunately this archaic practice of predicting the corresponding blood alcohol concentration from acceptable breath alcohol concentrations is on the wane. More and more countries are finally acknowledging that there is absolutely no scientific advantage in such a practice. Unfortunately, Canada still clings to the concept that discarding a solid piece of scientific evidence (a breath alcohol concentration) and convicting a person based upon a guess (the blood alcohol concentration) is good law. It is doubtful that history will acknowledge any wisdom in this practice.

How then do the police predict the corresponding blood alcohol concentration from a breath alcohol concentration? To understand the process, it is important to understand a bit of respiratory physiology. As one breathes in, the air enters via the nostrils and the mouth, and is pulled down into the lungs to small elastic sacs at the end of the respiratory tract. These small sacs are called alveoli, and it is here that there is an exchange of gasses between the pulmonary blood and the alveolar breath. Oxygen is absorbed from the alveolar breath into the blood and is then circulated throughout the body. In a contrary fashion, carbon dioxide is expelled from the blood into the alveolar breath and exhaled out of the body. Alcoholic vapours are also exhaled on the breath. The amount of alcohol expelled on the breath depends upon the concentration of alcohol in the pulmonary blood - the greater the alcohol concentration in the blood, the greater the amount of alcohol that will be expelled in the breath. But what is the relationship between the concentration of alcohol in pulmonary blood and alveolar air?

Over the years, a number of scientists have studied how alcohol partitions itself between the pulmonary blood and the alveolar breath. They have shown that on average, there is the same amount of alcohol in 2280 parts of breath as there is in 1 part of blood (2280:1). The range is from as low as 1706:1 to 3063:1. In humans, partition ratios are not

constant but in a continuous state of change. They are subject to such things as body temperature, and also depend upon whether the subject's blood alcohol concentration is rising, staying the same or declining with time.

In Canada, it is presumed that the partition ratio of all persons tested by the police is 2100:1. In other words, Canadian police breath testing devices collect and analyze 2100 parts of deep lung breath from the test subject and presume the same amount of alcohol as in one part of blood. If on average, they should be actually collecting 2280 parts of breath, what is the effect on the recorded blood alcohol concentration? The answer is simple. Since the police are collecting fewer parts of breath than necessary, the results will on average be lower than if a blood sample had been collected and analyzed. But is this always the case - do the police results always underestimate the corresponding blood alcohol concentration? The answer is no.

Suppose that a person's breath alcohol concentration is 90. The range of partition ratios given above is 1706:1 to 3063:1. Therefore, if the subject's actual partition ratio at the time of the collection of his breath sample were 1706:1, then the corresponding blood alcohol concentration would only be 73 milligrams of alcohol in 100 millilitres of blood. Similarly, if the partition ratio were 2100:1, then the corresponding blood alcohol concentration would be 90 milligrams of alcohol in 100 millilitres of blood. And finally, if the actual partition ratio were 3063:1, the corresponding blood alcohol concentration would be 131 milligrams of alcohol in 100 millilitres of blood. Clearly that is quite a range of blood alcohol concentrations from just one breath alcohol reading of 90. The problem is that it is impossible for the police to know what a subject's partition ratio is at the time that the breath sample is collected. Hopefully, in the not-too-distant future, Canadian legislators will get some competent scientific advice and amend the law to reflect an offence of driving with an excess of alcohol in one's breath and abandon the archaic practice of reporting scientifically acceptable breath alcohol concentrations as a predicted blood alcohol concentration.