



## Breath Temperature: An Alabama Perspective

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Over the past several months the Alabama Department of Forensic Sciences, with the assistance of the Alabama Department of Public Safety, has been conducting an evaluation of current evidential breath testing instruments. Currently, Alabama utilizes the 64 series Intoxilyzer 5000 that has proven to be durable, analytically acceptable, and an instrument well accepted in the Alabama courts. Despite this track record, new generation instruments offer increased capabilities, especially in data acquisition and storage. Alabama's evaluation has centered on three evidential breath testing instruments, all of which performed well during simulator studies at or about 0.08%. The Draeger Alcotest 7110 MK III is one of the instruments being evaluated in Alabama. The Alabama evaluation instrument has the capability of measuring the exhalation breath temperature and correcting the resultant breath alcohol concentration (BrAC) to the reference temperature of 34°C. The reason for our interest in breath temperature correction is the well-recognized influence of temperature on Henry's Law, the scientific cornerstone of breath alcohol testing. Henry's Law describes the proportional relationship of the concentration of a particular volatile compound of interest in the liquid phase, to the concentration of the same compound in the gaseous phase at equilibrium. Accordingly, when the temperature of the liquid phase increases (core body temperature) the concentration of the compound

(ethanol) in the gaseous phase (breath) will increase.

One aspect of our evaluation was to place two instruments in the field and perform parallel testing of actual arrestees with the current Alabama evidential breath testing instrument. Almost all (93%, 81%) of the collected breath samples acquired on the Alcotest 7110 MK IIIs had breath temperatures above 34°C. Our results show a breath temperature range of 32.4-36.2°C with a mean of 34.9°C<sup>1</sup>. This is in agreement with the earlier work of Harger and Forney<sup>2</sup>, Schoknecht and Stock<sup>3</sup> who found mean breath temperatures of 35.1°C and 35°C, respectively. Intrigued by our findings, we performed a review of the literature as to the origin of the universally-accepted exhalation breath temperature of 34°C.

The following table summarizes selected original research regarding breath exhalation temperatures since 1950.

AUTHOR	DATE	TEMP	RANGE	SUBJECTS
SCHOKNECHT <sup>3</sup>	1995	35	33-36.7	700
JONES <sup>4</sup>	1982	34.48	—	8
JONES <sup>5</sup>	1982a	34.8	—	6
JONES <sup>5</sup>	1982b	35.3	—	7
DUBOWSKI <sup>6</sup>	1975	34.53	32.41-35.69	55
HARGER <sup>7</sup>	1969a	34.4	-	"A Few"
HARGER <sup>7</sup>	1969b	35.1	34.4-35.7	20
HARGER <sup>2</sup>	1950	Adopts 34	31-35	6
WINSLOW <sup>8</sup>	1941	Adopts 34	32-35	Literature Review

The origin of 34°C as the average breath temperature appears to predate modern literature indicating the average to be higher (34.4°-35.1°C). The literature citations in the table, as well as several others articles (Jones<sup>9-10</sup>, Dubowski<sup>11-16</sup>, Mulder and Neuteboom<sup>19</sup>, Fox and Hayward<sup>20, 21</sup>, Legge<sup>22</sup>, Wright<sup>23</sup>), trace the use of 34°C to the 1950 publications of Harger. Harger reports that the temperature of the expired air rose from 31°C at the beginning of expiration to 35°C at the end of expiration for six subjects. Harger concluded that his results agreed with the findings presented in a 1942 review article by Winslow<sup>6</sup> that under normal circumstances the temperature of expired air was between 32°-35°C. Both Winslow and Harger adopted 34°C as the average temperature of expired breath.



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The importance of breath temperature in breath alcohol testing has been mentioned in the literature repeatedly. The Draeger Alcotest 7110 MK III is the first commercial evidential breath testing instrument available for field use that addresses breath temperature. Once a suspect's breath temperature is known the resultant BrAC can be corrected to 34°C. Utilization of this breath temperature correction feature in Alabama will follow the policy of giving arrestees every benefit of the doubt. This is, when a suspect's breath temperature is lower than 34°C, breath temperature correction will not be used to increase the test result. Breath temperature correction will be utilized only to lower the test result in suspects with breath temperatures over 34°C. This policy circumvents the inability to perform thermistor calibration checks at the time of a suspect's sample collection, because there is no convenient method available. It should be noted that the Draeger Alcotest 7110 MK III is equipped with two redundant thermistors. Once calibrated, the likelihood that both thermistors would electronically drift at the same time, in the same direction, and at the same rate, is remote. Any individual drift of the thermistors violates the software algorithm triggering an error message. Currently, Draeger is developing a portable device to perform thermistor as well as calibration checks. Until this device is available for our evaluation regularly-scheduled calibration checks will be performed using a precisely controlled temperature stabilized water bath. Details of our field evaluation of the Draeger Alcotest 7110 MK III will be forthcoming.

1. Alabama Department of Forensic Sciences, Birmingham and Auburn respectively, AL. The mouthpiece utilized throughout the Alabama field study was a cylindrical-shaped Siemen's mouthpiece, part # C79451-A3182-B18. For a study concerning the effects of different mouthpieces on breath temperature see Bell, C., "What About the Humble Mouthpiece? Breath Sample Modification and Implications for Breath Alcohol Analysis," Proceedings of the ICADTS T-95, Adelaide Australia, 1995.
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