U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

DOT HS 807 415 **May 1989**

Technical Note

The Accuracy of Evidential Breath Testers at Low BACs

The United States Government does not endorse products or manufacturers. Trade or manufacturers' names appear only because they are considered essential to the object of this report.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT HS 807 415		

4. Title and Subtitle	5. Report Date
The Accuracy of Evidential Breath Testers at Low BACs	6. Performing Organization Code: PPA 834
	8. Performing Organization Report No.
7. Author(s): James F. Frank and Arthur L. Flores	
9. Performing Organization Name and Address: Office of Driver and Pedestrian Research, Research and Development, National Highway Traffic Safety Administration, Washington, DC 20590	10. Work Unit No. (TRAIS)
	11. Contract or Grant No.
12. Sponsoring Agency Name and Address: Office of Driver and Pedestrian Research, Research and Development, National Highway Traffic Safety Administration, Washington, DC 20590	13. Type of Report and Period Covered: Technical Note 1989
	14. Sponsoring Agency Code

15. Supplementary Notes

The laboratory work for this project was completed by Dr. Arthur Flores and Mr. Arnold Spicer of the Transportation Systems Center, Cambridge, Massachusetts.

16. Abstract

This Technical Note reports on the low BAC laboratory testing of seven evidential breath testers widely used by law enforcement. The findings indicated that these devices are just as accurate at low BACs in the 0.020-0.040% range as they were when tested at 0.050%, 0.100%, and 0.150% against the NHTSA model specifications for evidential breath testers. In the field, the high quality performance of evidential breath testers is contingent on their proper maintenance and use by trained and knowledgeable operators.

17. Key Words	18. Distribution Statement
Alcohol, drunk driving, low BACs, DWI, DUI, EBT performance, evidential breath tester, highway safety, breath tester	Document is available to the U.S. public through the National Technical Informatic Service, Springfield, VA 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified		

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

THE ACCURACY OF EVIDENTIAL BREATH TESTERS AT LOW BACs

James F. Frank and Arthur L. Flores

Two recent research summaries (Transportation Research Board, 1987; Moskowitz and Robinson, 1988) conclude that alcohol levels below 0.050% may impair driving-related skills. This in turn has raised some concern among the police regarding the accuracy of their Evidential Breath Test (EBT) devices at these levels. The objective of the work reported on here was to provide information on the accuracy of EBTs at the BAC levels below 0.050%.

Method

Seven breath test devices meeting the NHTSA Model Specifications for Evidential Breath Testers (NHTSA, 1984a) were tested ten times at the following simulated BACs: 0.010%, 0.020%, 0.030%, 0.040%, and 0.100%. The units tested and their respective manufacturers are presented in Table 1.

Table 1
Breath Test Units Evaluated

Model (see Note 1) (in alphabetical order)	Manufacturer
Alco-Sensor III	Intoximeters, Inc. St. Louis, MO
BAC Verifier	Analytical Systems, Inc. East Hartford, CT
Intoxilyzer 4011AS-A	CMI, Inc. (see Note 2) Owensboro, KY
Intoxilyzer 5000	CMI, Inc. Owensboro, KY
Intoximeter 3000	Intoximeters, Inc. St. Louis, MO
Lion Alcometer S-D2	Lion Laboratories (see Note 3) South Tlamorgen, England
Smith and Wesson Breathalyzer 2000	Smith & Wesson (see Note 4) Springfield, MA

Note 1: The Alco-Sensor III and the Lion Alcometer S-D2 are portable, handheld units that use a fuel cell technology. All of the other units use an infrared technology.
Note 2: CMI, Inc., formerly of Minturn, CO, has been purchased by MPD, Inc. of Owensboro, KY. They will continue to manufacture under the CMI label.
Note 3: This device is distributed in the USA by CMI, Inc.
Note 4: The breath testing subsidiary of Smith & Wesson was purchased by National Draiger, Inc. of Pittsburgh, PA. While the Smith & Wesson Breathalyzer 2000 is no longer manufactured, some of these devices are still in use in the field.

Simulated alcohol vapor at the specified concentrations was created using a Smith & Wesson Mark IIA Calibrating Unit, which meets the requirements of the NHTSA model specifications for such units (NHTSA, 1984b).

Results and Discussion

The mean recorded BACs for the simulated BACs of 0.010%, 0.020%, 0.030%, 0.040%, and 0.100% for all seven evidential breath testers are presented in Table 2, while the raw data are presented in the Appendix. For reference, the NHTSA model specifications call for evidential testers to perform within ±0.005% BAC (or ±5%, whichever is greater) when tested for ten trials each at BACs = 0.050%, 0.100%, and 0.150%. Based on our best estimates, these seven devices represent at least 60% of the units currently used by police to enforce drinking and driving laws.

All of the devices met the ±0.005% BAC accuracy requirements when tested at BACs greater than or equal to 0.030%, and six of seven tested devices also met those requirements at 0.020% BAC. Two devices gave readings between 0 and 0.005% when the simulator was set at BAC = 0.010%, suggesting that some devices may miss some samples at the 0.010% BAC level.

All of the models examined in this report were previously tested by NHTSA in the course of routine testing against the model specifications. As part of those tests, they were evaluated using non-alcoholic (i.e 0.00% BAC) samples. In all ten zero-BAC trials for each model tested, readings were 0.000% BAC, except the Alco-Sensor III, which gave ten consecutive readings of 0.001% BAC. It is reasonable to conclude that these devices do not produce false positive readings.

Parties interested in the accuracy and precision of evidential breath test devices at low BACs can be confident that they continue to perform with the same accuracy at BACs at and above 0.020% as when they were tested against the NHTSA guidelines at 0.050%, 0.100%, and 0.150% BACs. In the field, the high quality performance of evidential breath testers is contingent on their proper maintenance and use by trained and knowledgable operators.

Table 2

Performance of Seven Evidential Breath Testers at Low BACs.*

Evidential Testers	Simulated BACs 0.010	0.020	0.030	0.040	0.100
Alco-Sensor III	0.011	0.021	0.030	0.040	0.099
BAC Verifier	0.003	0.014	0.025	0.035	0.101
Intoxilyzer 4011 AS-A	0.006	0.017	0.029	0.039	0.101
Intoxilyzer 5000	0.001	0.016	0.027	0.037	0.101
Intoximeter 3000	0.013	0.023	0.034	0.044	0.103
Lion Alcometer S-D2**	0.010	0.020	0.030	0.040	0.099
S & W Breathalyzer 2000	0.011	0.021	0.031	0.041	0.098

*Mean scores based on ten trials/condition.

**Manufacturer reports that this device is programmed so that the third digit reads either "5" or "0". All readings reflect that feature.

References

Moskowitz, H. and Robinson, C. D. "Effects of Low Doses of Alcohol on Driving-related Skills: A Review of the Evidence." Washington, DC: U.S. Department of Transportation, NHTSA Technical Report No. DOT HS 807 280, July 1988.

National Highway Traffic Safety Administration, "Model Specifications for Evidential Breath Testing Devices and Publication of a Conforming Products List." Federal Register, Vol. 49, No. 242, pages 48855-48864 (December 14, 1984a).

National Highway Traffic Safety Administration, "Model Specifications for Calibrating Units for Breath Alcohol Testers and Publication of a Conforming Products List" Federal Register, Vol. 49, No. 242, pages 48865-48872 (December 14, 1984b).

Transportation Research Board, Zero Alcohol and Other Options. Limits for Truck and Bus Drivers. Washington,DC: National Research Council, Special Report No. 216, 1987

Table 1

Performance at Low BACs of the
Alco-Sensor III
S/N B21682
Intoximeters, Inc.
St. Louis, Missouri

Simulated BACs

Trial No.	0.100	0.040	0.030	0.020	0.010
1	.102	.041	.031	.021	.011
2	.100	.040	.031	.021	.011
3	.100	.040	.032	.021	.011
4	.100	.040	.030	.021	.011
5	.100	.041	.030	.021	.011
6	.098	.040	.030	.021	.011
7	.098	.040	.030	.021	.012
8	.098	.041	.029	.021	.011
9	.097	.040	.030	.021	.011
10	.096	.041	.030	.021	.011
Avg.	0.0989	0.0404	0.0303	0.0210	0.0111
SD	0.0018	0.0005	0.0008	0.0000	0.0003
systematic error	- 1.1%	+1.0%	+1.0%	+5.0%	+11.0%

Individual trials separated by a 15 minute interval, as specified in the manufacturer's manual for users.

Table 2

Performance at Low BACs of the
BAC Verifier
(S/N 509241)
Analytical Systems, Inc.
East Hartford, CT.

Simulated BACs

Trial No.	0.100	0.040	0.030	0.020	0.010
1	.101	.032	.024	.013	.003
2	.099	.033	.025	.015	.003
3	.101	.034	.024	.014	.003
4	.101	.038	.025	.014	.003
5	.103	.038	.025	.015	.004
6	.101	.036	.026	.015	.003
7	.101	.035	.025	.013	.002
8	.099	.035	.024	.015	.005
9	.100	.035	.024	.014	.003
10	.100	.036	.025	.014	.002
Avg.	0.1006	0.0352	0.0247	0.0142	0.0031
SD	0.0012	0.0019	0.0007	0.0008	0.0009
systematic error	-0.6%	-12.0%	-17.7%	-29.0%	-69.0%

Table 3

Performance at Low BACs of the CMI Intoxilyzer 4011 A-SA
(S/N 94-001112)
CMI, Inc.
Owensboro, KY

Simulated BACs

Trial No.	0.100	0.040	0.030	0.020	0.010
1	.102	.039	.029	.014	.005
2	.101	.040	.028	.018	.006
3	.098	.040	.031	.017	.007
4	.102	.042	.025	.017	.004
5	.102	.038	.030	.015	.005
6	.102	.035	.030	.018	.004
7	.102	.039	.030	.016	.008
8	.102	.041	.028	.020	.007
9	.100	.039	.030	.015	.006
10	.102	.039	.027	.018	.005
Avg.	0.1013	0.0392	0.0288	0.0168	0.0057
SD	0.0013	0.0019	0.0018	0.0018	0.0013
systematic error	+1.3%	-2.0%	-4.0%	-16.0%	-43.0%

Table 4

Performance at Low BACs of the Intoxilyzer 5000
(S/N 64-001591)
CMI, Inc.
Owensboro, KY

Simulated BACs

Trial No	0.100	0.040	0.030	0.020	0.010
1	.100	.037	.026	.016	.007
2	.100	.037	.025	.017	.000
3	.101	.037	.029	.016	.000
4	.100	.037	.027	.018	.000
5	.101	.038	.026	.015	.000
6	.101	.037	.026	.015	.000
7	.102	.037	.027	.016	.000
8	.101	.038	.027	.014	.007
9	.100	.036	.027	.016	.000
10	.101	.037	.026	.015	.000
Avg.	0.1007	0.0371	0.0266	0.0158	0.0014
SD	0.0007	0.0006	0.0011	0.0011	0.0030
systematic error	+0.7%	-7.3%	-11.3%	-21.0%	-86.0%

Table 5

Performance at Low BACs of the Intoximeter 3000
(S/N 4354)
Intoximeters, Inc.
St. Louis, MO

Simulated BACs

Trial No.	0.100	0.040	0.030	0.020	0.010
1	.103	.045	.035	.021	.013
2	.104	.043	.035	.024	.013
3	.103	.042	.035	.022	.013
4	.104	.044	.035	.023	.014
5	.103	.044	.033	.023	.012
6	.102	.043	.034	.023	.013
7	.104	.044	.033	.023	.014
8	.102	.044	.034	.023	.013
9	.102	.043	.032	.023	.013
10	.103	.043	.033	.023	.013
Avg.	0.103	0.0435	0.0339	0.0228	0.0131
SD	0.0008	0.0008	0.0011	0.0008	0.0006
systematic error	+3.0%	+8.8%	+13.0	+14.0%	+31.0%

Table 6

Performance at Low BACs of the
Lion Alcometer S-D2
S/N 024606
Lion Laboratories
South Tlamorgan, England

Simulated BACs

Trial No.	0.100	0.040	0.030	0.020	0.010
1	.100	.040	.030	.020	.010
2	.100	.040	.030	.020	.010
3	.095	.040	.030	.020	.010
4	.100	.040	.030	.020	.010
5	.100	.040	.030	.020	.010
6	.100	.040	.030	.020	.010
7	.100	.040	.030	.020	.010
8	.100	.040	.030	.020	.010
9	.100	.040	.030	.020	.010
10	.100	.040	.030	.020	.010
Avg.	0.0995	0.0400	0.0300	0.0200	0.0100
SD	0.0016	0.0	0.0	0.0	0.0
systematic error	- 0.5%	0	0	0	0

Tests were run with 15 minute intervals between trials. This device is programmed so that the third digit of the readout is either "5" or "0", so that scores could only read 0.--5 or 0.--0.

Table 7

Performance at Low BACs of the
Smith and Wesson Breathalyzer 2000
(S/N 20557)
Springfield, Mass.

	Simulated BACs				
Trial No.	0.100	0.040	0.030	0.020	0.010
1	.099	.040	.031	.021	.011
2	.099	.041	.031	.021	.011
3	.099	.041	.030	.021	.011
4	.098	.041	.030	.021	.011
5	.098	.041	.031	.021	.012
6	.098	.041	.031	.021	.011
7	.097	.041	.031	.021	.011
8	.096	.040	.031	.021	.011
9	.095	.041	.031	.020	.012
10	.097	.040	.030	.020	.011
Avg.	0.0976	0.0407	0.0307	0.0208	0.0112
SD	0.0013	0.0005	0.0005	0.0004	0.0004
systematic error	-2.4%	-1.8%	+2.3%	+4.0%	+12.0%