Breath Alcohol Testing Instrument Performance Reviews

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I participated in the task of reviewing the performance of four new and different breath alcohol testing instruments; the NPAS DataMaster DMT™, the CMI Intoxilyzer® 8000, the Drager Alcotest® 7110 MKIII-C and the Intoximeter EC/IR-II. The instruments were analyzed for precision, accuracy, linearity, interference detection capabilities and mouth alcohol detection capabilities, ease of use, durability and overall performance.

The instruments were analyzed as provided by the manufacturer. No calibrations, certifications or other adjustments were made. The simulators used were Guth 2100 and Guth 34CNP.

Method:

- **Precision:**
  - Aqueous ethanol solutions of 0.08g/210L and 0.16g/210L were analyzed with n=10
  - The standard deviations were calculated
- **Accuracy**
  - Aqueous ethanol solutions with nominal concentrations of 0.02g/210L, 0.04g/210L, 0.08g/210L, 0.16g/210L and 0.40g/210L were analyzed as calibration checks.
  - All solutions were verified by Headspace gas chromatography with flame ionization detection. Actual concentrations are listed with results data.
- **Linearity**
  - The five aqueous ethanol solutions were prepared over a concentration range that will provide vapor concentrations from 0.02 through 0.40g/210L.
  - The ensuing results from the breath alcohol testing instruments were plotted against the known concentrations generated from the Headspace GC/FID.
  - The results formed a straight line with Correlation Coefficients (R^2 values) of at least 0.99.
- **Interference**
  - Compounds were prepared and tested in the instruments to evaluate the interference detection systems (N=5)
    - 0.02% Acetone in 0.08% EtOH
    - 0.05% Acetone in 0.08% EtOH
    - 0.10% Acetone in 0.08% EtOH
    - 0.04% Methanol
    - 0.04% Isopropanol
    - 0.04% Methanol in 0.08% EtOH
    - 0.04% Isopropanol in 0.08% EtOH
  - The mouth alcohol detection system was tested. Each test was taken at 3-5 minute intervals subsequent to the use of mouthwash until such time as no mouth alcohol was detectable.

Results:

- **Table 1: Standard Deviations (Precision)**

		DMT			INTox 8000			DRA-IR			INTOX EC/IR-II		
		N	Std Dev		N	Std Dev		N	Std Dev		N	Std Dev	
0.02		10	0.0003		10	0.0007		10	0.0024		10	0.0003	
0.04		10	0.0004		10	0.0005		10	0.001		10	0.0003	
0.08		10	0.0004		10	0.0008		10	0.0013		10	0.0025	
					10	0.0058		10	0.0043				
					10	0.0022		10	0.0005				
					10	0.0037		10	0.0045				
					10	0.0036		10	0.0026				
						0.0032			0.0026				Mean Std Dev
0.16		10	0.0008		10	0.0064		10	0.0017		10	0.0005	
					10	0.0067		10	0.0011				
					10	0.0056		10	0.0229				
					10	0.0096		10	0.0011				
					10	0.0067		10	0.0051				
								10	0.004				
						0.007			0.006				Mean Std Dev
0.4		10	0.0008		10	0.0156		10	0.009		10	0.0023	
						(.366-.317)							
			0.0005			0.0054			0.0042			0.0012	Grand Mean Std Dev

- **Table 2: Accuracy for Intoxilyzer Instrument**

Date	Operator	Instrument	Sim Lot	Sim [X]	N=	Avg	Std Dev
12/15/2005	SH	INT	06-01-020	0.0203	10	0.0175	0.0007
12/16/2005	SH	INT	06-06-040	0.0376	10	0.031	0.0005
12/14/2005	SH	INT	06-05-080	0.0815	10	0.0728	0.0008
12/15/2005	SH	INT	06-05-080	0.0815	10	0.0841	0.0058
12/15/2005	ALB	INT	06-05-080	0.0815	10	0.0765	0.0022
12/16/2005	SH	INT	06-05-080	0.0815	10	0.0756	0.0037
12/19/2005	ALB	INT	06-05-080	0.0815	10	0.0777	0.0036
12/15/2005	SH	INT	06-07-160	0.1582	10	0.1523	0.0064
12/15/2005	ALB	INT	06-07-160	0.1582	10	0.1542	0.0067
12/19/2005	RD	INT	06-07-160	0.1582	10	0.1609	0.0056
12/20/2005	RD	INT	06-07-160	0.1582	10	0.1491	0.0096
12/21/2005	TM	INT	06-07-160	0.1582	10	0.1526	0.0067
12/19/2005	ALB	INT	06-03-400	0.3807	10	0.3543	0.0156

- **Table 3: Accuracy for Drager Instrument**

Date	Operator	Instrument	Sim Lot	Sim [X]	N=	Avg	Std Dev
12/15/2005	SH	DRA-IR	06-01-020	0.0203	10	0.0207	0.0024
		DRA-EC				0.02	0
		IR & EC				0.0204	0.002
12/15/2005	ALB	DRA-IR	06-06-040	0.0376	10	0.0356	0.001
		DRA-EC				0.0364	0.0007
		IR&EC				0.036	0.0009
12/14/2005	SH	DRA-IR	06-05-080	0.0815	10	0.0784	0.0013
		DRA-EC				0.0787	0.0016
		IR&EC				0.0786	0.0014
12/16/2005	SH	DRA-IR	06-05-080	0.0815	10	0.0831	0.0043
		DRA-EC				0.0835	0.0041
		IR&EC				0.0833	0.0041
12/16/2005	ALB	DRA-IR	06-05-080	0.0815	10	0.0794	0.0005
		DRA-EC				0.0802	0.0006
		IR&EC				0.0798	0.0007
12/16/2005	RD	DRA-IR	06-05-080	0.0815	10	0.0822	0.0045
		DRA-EC				0.0829	0.0044
		IR&EC				0.0826	0.0043
12/20/2005	ALB	DRA-IR	06-05-080	0.0815	10	0.0825	0.0026
		DRA-EC				0.0827	0.0028
		IR & EC				0.0826	0.0026
12/16/2005	SH	DRA-IR	06-07-160	0.1582	10	0.1561	0.0017
		DRA-EC				0.1555	0.001
		IR&EC				0.1558	0.0014
12/19/2005	SH	DRA-IR	06-07-160	0.1582	10	0.1528	0.0011
		DRA-EC				0.1518	0.0012
		IR&EC				0.1523	0.0013
12/19/2005	ALB	DRA-IR	06-07-160	0.1582	10	0.1802*	0.0229
		DRA-EC				0.1831*	0.0238
		IR & EC				0.1817*	0.0228
12/19/2005	ALB	DRA-IR	06-07-160	0.1582	10	0.1584	0.0011
		DRA-EC				0.1611	0.0023
		IR & EC				0.1598	0.0022
12/20/2005	RD	DRA-IR	06-07-160	0.1582	10	0.1534	0.004
		DRA-EC				0.1527	0.003
		IR & EC				0.1531	0.0032
12/21/2005	TM	DRA-IR	06-07-160	0.1582	10	0.1491	0.0051
		DRA-EC				0.1483	0.0051
		IR & EC				0.1487	0.005
12/19/2005	ALB	DRA-IR	06-03-400	0.3807	10	0.3792	0.009
		DRA-EC				0.3831	0.0079
		IR & EC				0.3812	0.0085

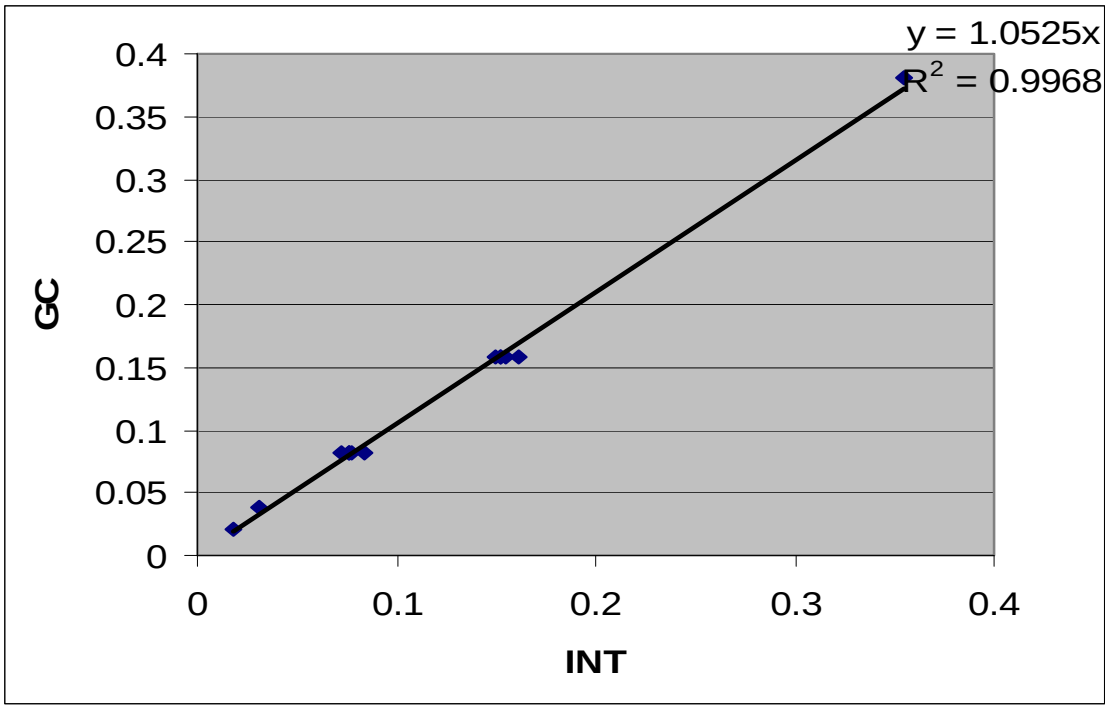
- **Table 4: Accuracy for DataMaster Instrument**

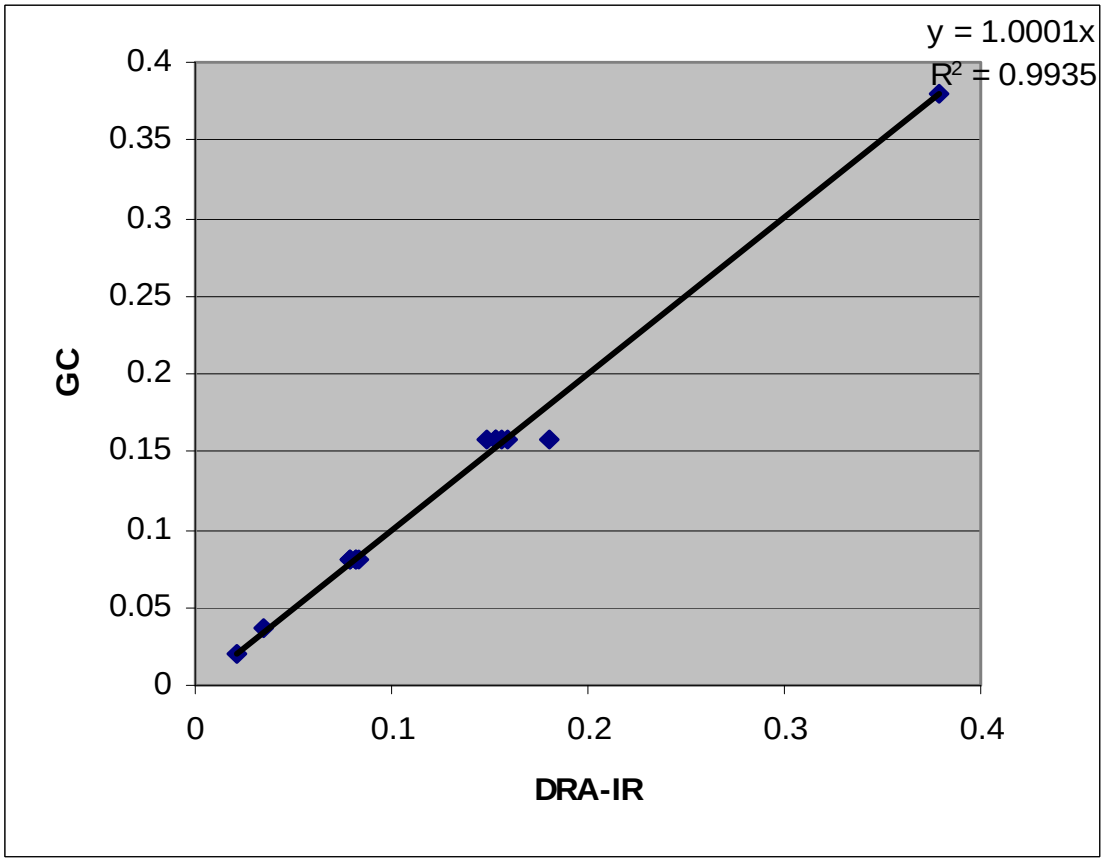
Date	Operator	Instrument	Sim Lot	Sim [X]	N=	Avg	Std Dev
3/8/2006	SH	DMT	06-01-020	0.0203	10	0.0214	0.0003
3/9/2006	ALB	DMT	06-06-040	0.0376	10	0.0375	0.0004
3/10/2006	DMR	DMT	06-05-080	0.0815	10	0.0791	0.0004
3/9/2006	DMR	DMT	06-07-160	0.1582	10	0.1602	0.0008
3/10/2006	DMR	DMT	06-03-400	0.3807	10	0.389	0.0008

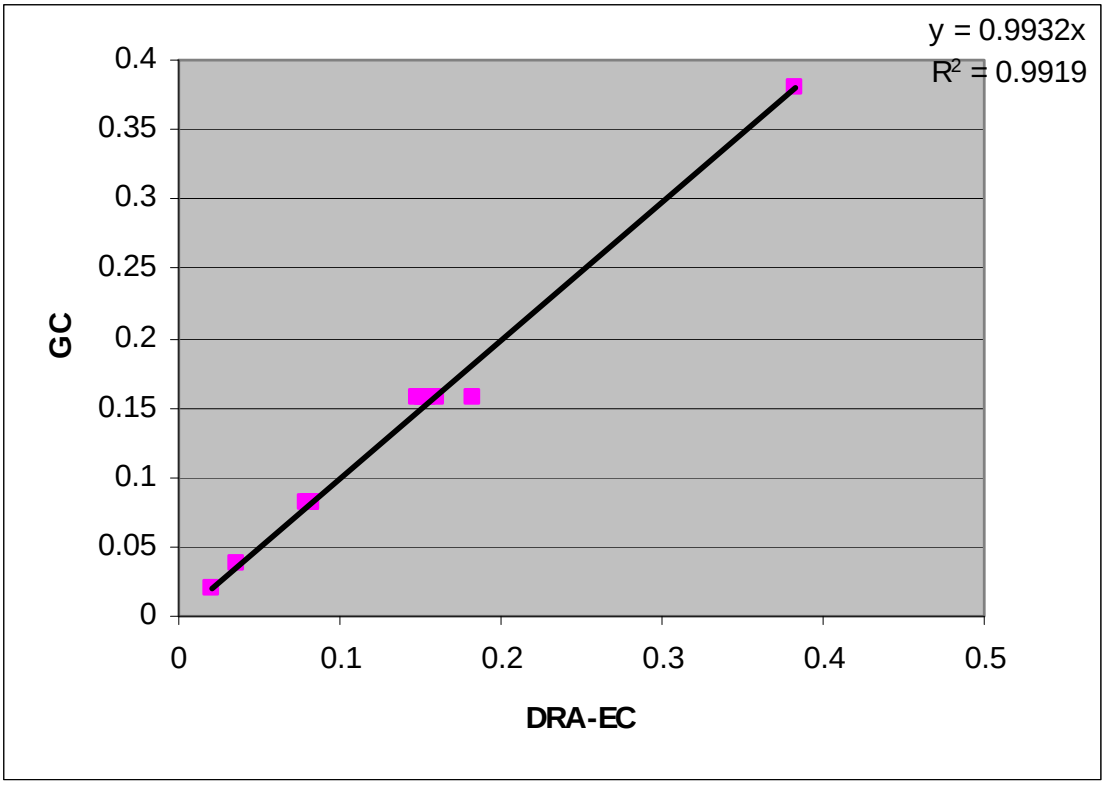
- **Table 5: Accuracy for Intoximeter Instrument**

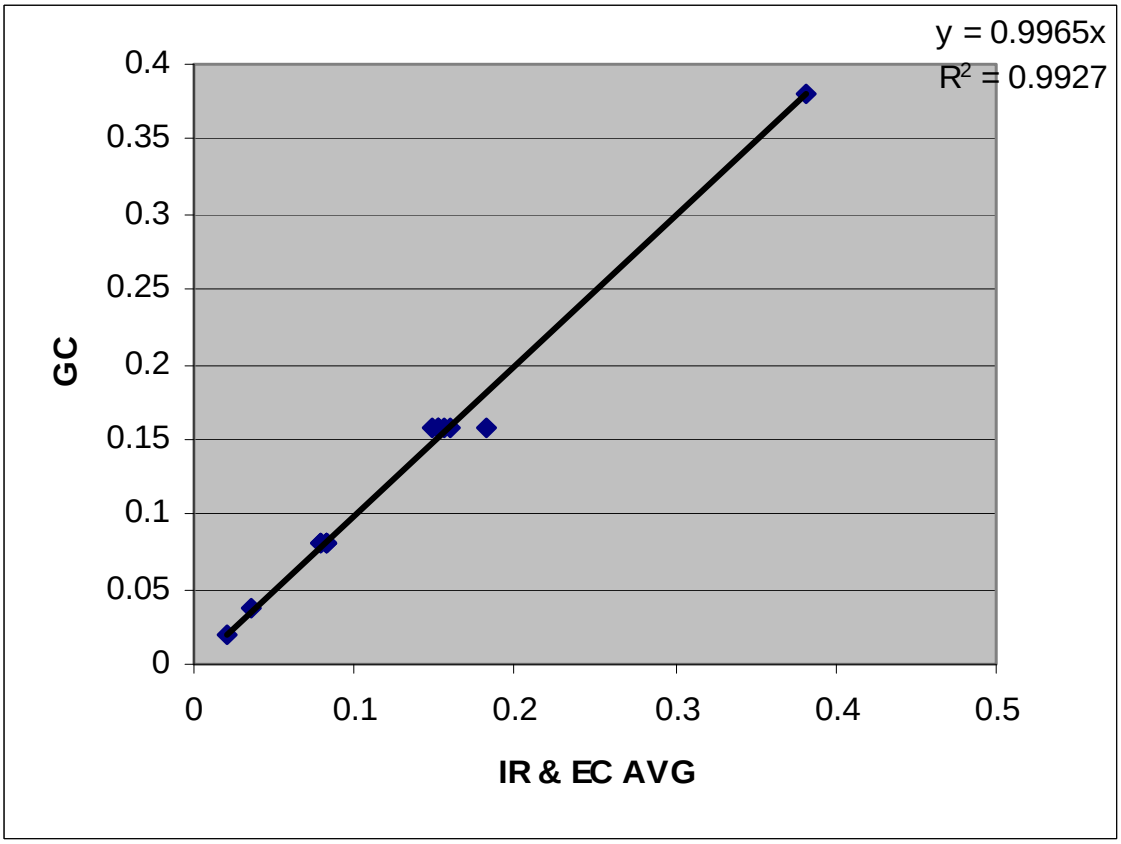
Date	Operator	Instrument	Sim Lot	Sim [X]	N=	Avg	Std Dev
3/8/2006	SH	INTox II	06-01-020	0.0203	10	0.0219	0.0003
3/9/2006	ALB	INTox II	06-06-040	0.0376	10	0.0389	0.0004
3/9/2006	DMR	INTox II	06-05-080	0.0815	10	0.078	0.0025
3/10/2006	DMR	INTox II	06-07-160	0.1582	10	0.16	0.0005
3/13/2006	ALB	INTox II	06-03-400	0.3807	10	0.379	0.0023

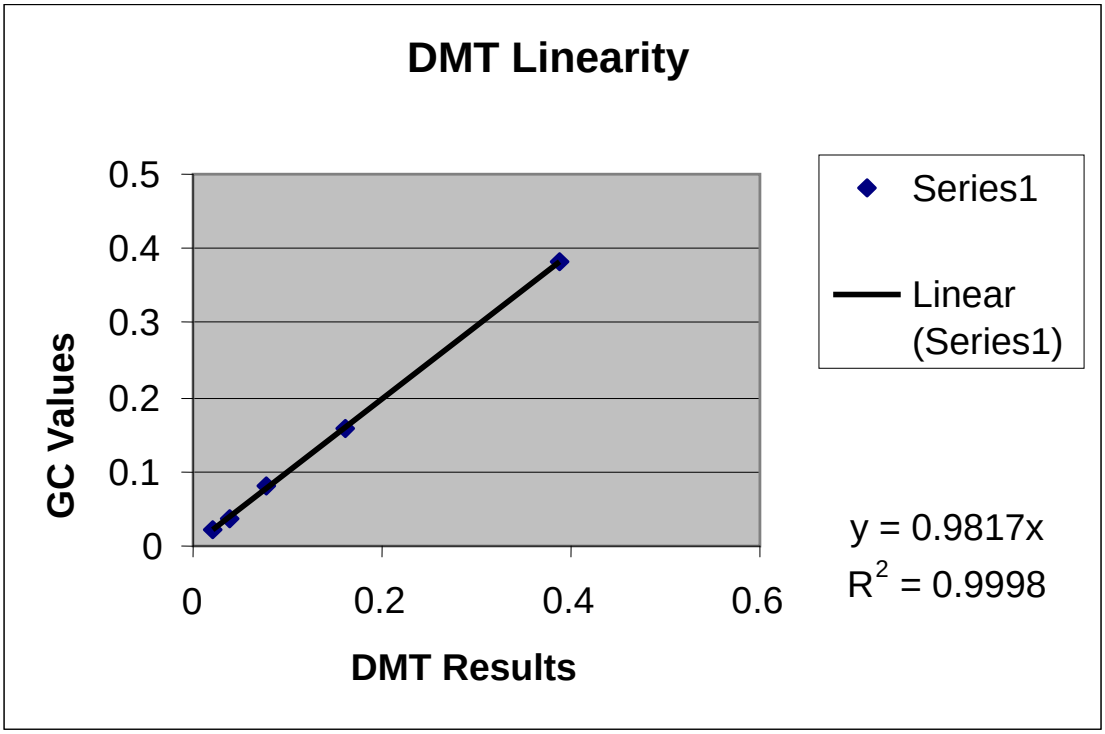
- **Linearity**

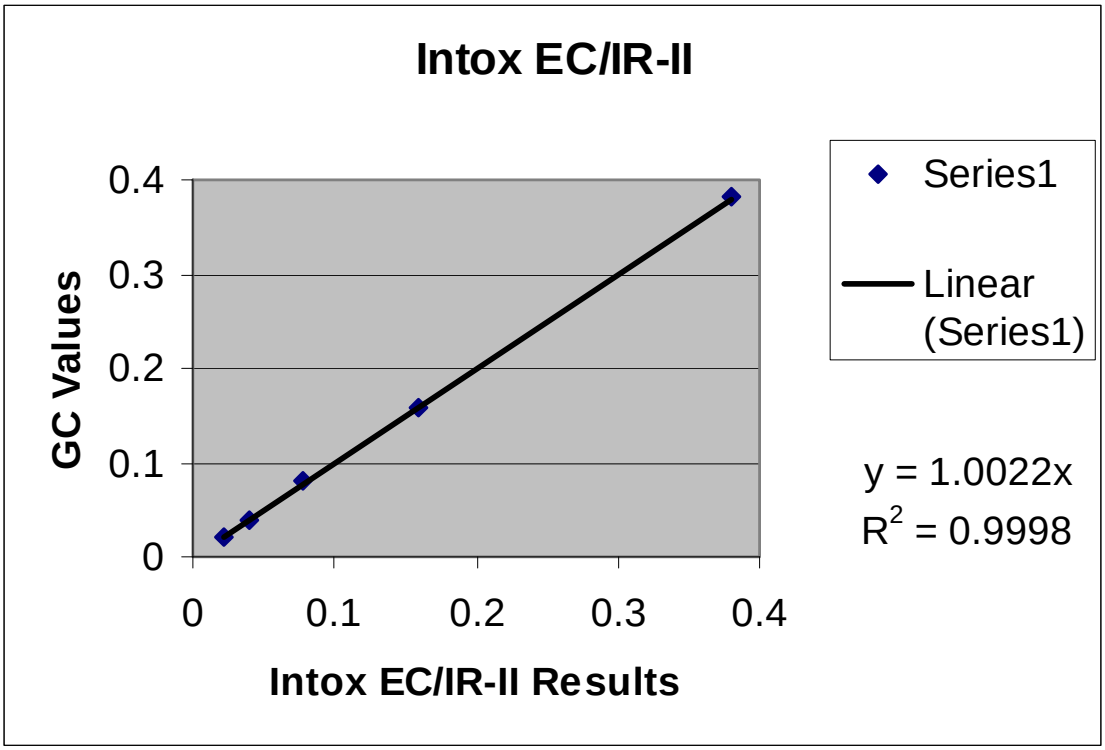





y = 0.9932x
R² = 0.9919
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
GC
0
0.1
0.2
0.3
0.4
0.5
DRA-EC


y = 0.9965x
R² = 0.9927
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
GC
0
0.1
0.2
0.3
0.4
0.5
IR & EC AVG


DMT Linearity
0.5
0.4
0.3
0.2
0.1
0
GC Values
0
0.2
0.4
0.6
DMT Results
Series1
Linear (Series1)
y = 0.9817x
R2 = 0.9998


Intox EC/IR-II
0.4
0.3
0.2
0.1
0
GC Values
0
0.1
0.2
0.3
0.4
Intox EC/IR-II Results
Series1
Linear (Series1)
y = 1.0022x
R2 = 0.9998

- **Table 5: Interference**

Positive Interference Message Given

N=5 X/N

Interferent	Date	DMT	Intox EC/IR	Date	INTOX 8000	DRA
.02% Acetone in 0.1% EtOH	2/28/06	6 for 6	0 for 5	12/21/05	1 for 5	0 for 5
Error Message reported		X.XXX	None (0.90- 0.97)		Invalid Sample	None (.071-.074)
.05% Acetone in 0.1% EtOH	3/1/06	6 for 6	0 for 5	12/22/05	5 for 5	0 for 5
Error Message reported		X.XXX	Mouth Alc, Sample over range, 0.95- 0.96		Invalid Spl(2); Interferent Detect(3)	None (.072-.077)
0.1% Acetone in 0.1% EtOH	3/1/06	6 for 6	0 fo 5	12/22/05	5 for 5	0 for 5
Error Message reported		X.XXX	EtOH Baseline err, Spl over rng, Mouth Alc, 0.98		Interferent Detect (4); Improper Spl (1)	None (.07-.079)
.04% Methanol	2/27/06	6 for 6	0 for 5	12/22/05	1 for 5	5 for 5
Error Message reported		X.XXX	None (0.36- 0.40)		Improper Spl (1); None(4) (.022g/210L)	Interference
.04% Isopropanol	3/3/06	6 for 6	0 for 5	12/23/05	5 for 5	5 for 5
Error Message reported		X.XXX	None (0.018- 0.020)		Interferent Detect	Interference
.04% MeOH in .08% EtOH	3/3/06	3 for 9	0 for 5	12/23/05	2 for 5	5 for 5
Error Message reported		X.XXX, None (0.096-0.097)	None (0.090-0.097)		Improper Spl (2), None (3) (.097-.099)	Interference
.04% Iso in .08% EtOH	3/8/06	6 for 6	0 for 5	12/23/05	5 for 5	5 for 5
Error Message reported		X.XXX	None (0.092 - 0.093)		Interferent Detect	Interference

- **Table 6: Mouth Alcohol Detection**

DMT

Elapsed Time (min)	Detected Y/N	BrAC
0:00	Mouthwash 1st used	
1:00	Y	INVALID
6:00	Y	INVALID
11:00	N	0.000

INTox 8000

Elapsed Time (min)	Detected Y/N	BrAC
0:00	Mouthwash 1st used	
5:00	Y	XXX*
9:00	Y	XXX*
12:00	Y	XXX*
16:00	N	0.000

*Invalid Sample

DRA

Elapsed Time (min)	Detected Y/N	BrAC
0:00	Mouthwash 1st used	
1:00	y	-.---
5:00	Y	-.---
10:00	N	0.057g/210L
14:00	N	0.030 g/210L
16:00	N	0.000

INTOX EC/IR-II

Elapsed Time (min)	Detected Y/N	BrAC
0:00	Mouthwash 1st used	
5:00	N	0.029
9:00	N	0.008
15:00	N	0

Discussion:

- **NPAS DataMaster DMT™**
  - **Features**

The DataMaster DMT™ uses the judicially accepted method of infrared spectroscopy to determine breath alcohol levels. The detector is a thermo-electrically-cooled PbSe detector regulated to operate at 0ºC. Regulating the operating temperature of the detector allows for greater sensitivity while maintaining a stable detector output. This enhances the precision, repeatability and low-level performance of the DMT. A stepper motor precisely controls all the optical filters (including the quartz internal standard). The use of narrow bandpass (10 nanometer) optical filters at 3.44, 3.37 and 3.50 micron allows the passage of a limited frequency range of infrared energy. This makes the DMT highly specific to ethanol to the exclusion of other alcohols and interfering compounds. The long life gray body infrared source generated very little visible light. This maximizes power usage and reduces instrument temperatures giving the DMT a high level of stability.

A powerful 32 bit, 206 Mhz processor administers signal processing. This facilitates the use of a short sample path (57cm) and a small sample chamber volume (23cc). This allows for an accurate measurement of the deep lung sample across a wide range of blowing patterns and subject vital lung capacities. The processor permits the use of an advanced breath sampling system. This new system accurately measures the breath flow rate and volume, including negative flow rates, eliminating any questions about sample acceptance.

The DMT software is built on the Microsoft .NET framework. This platform provides for a familiar graphical user interface making the DMT operator friendly.

  - **Precision**

The DMT had produced an average standard deviation of 0.0005 with a range of 0.0003-0.0008.

  - **Accuracy**

The DataMaster performed to +/- 5% of the true value at each concentration with one exception. At 0.0203g/210L at N=10, the DMT had an average result of 0.0214g/210L and standard deviation of 0.0003. This gives a of 105.4% recovery.

  - **Linearity**

The results were plotted against the GC value for each concentration and a line was generated. The formula for the line is $y=0.9817x$. $R^2=0.9998$.

  - **Interference**

The DMT reports an error message of X.XXX instead of an ethanol concentration when an interfering agent is detected. At concentrations of .02%, .05% and 0.1% acetone in 0.10% ethanol, the DMT reported an interference message 100% of the time. At a concentration of 0.04% methanol in

0.08% ethanol, the DMT only reported an interference message 3 out of 9 tries. On 6 of 9 tries it reported the concentration at an average of 0.097g/210L EtOH.

Mouthwash was used by a subject who subsequently provided breath samples until such time as no mouth alcohol was detected. At an elapsed time since use of mouthwash of one minute, the DMT reported an invalid sample. Invalid was also reported at an elapsed time of six minutes. At an elapsed time of eleven minutes, no mouth alcohol was detected and the BrAC was reported at 0.000g/210L.

- **Ease of use, durability and overall performance**

The DMT is equipped with a full graphics touch screen which is extremely operator friendly. The windows-based operating system provides a very familiar platform for data entry. The processor permits the use of an advanced breath sampling system. The new system accurately measures the breath flow rate and volume, including negative flow rates, eliminating any questions about sample acceptance. The screen also displays a subject's breath flow curve in real time along with the alcohol absorption curve. This greatly enhances the operators ability to determine the subject's level of cooperation during a test. This information can also be part of the test ticket. The utilization of an external printer eliminates the need for special tickets.

The DataMaster Operation Guide is very clear, understandable and helpful. It had detailed instructions and explanations and photos to aid in instrument set up and software navigation. When additional support was necessary, it was easy to contact National Patent's customer service department, who were knowledgeable and extremely helpful.

The DMT's overall performance would be classified "excellent".

- **CMI Intoxilyzer® 8000**
  - **Features**

The Intoxilyzer is an infrared-based device designed for both mobile and stationary evidential breath alcohol testing. It utilizes an internal printer unit of either the impact or thermal type onto a paper roll. The Intoxilyzer has been designed in such a way that it will allow for prolonged use without the requirement for recalibration. The reason for this is there are no moving parts within the device. The infrared light is pulsed in order that the dual pyroelectric detectors may accurately quantify as well as qualify the alcohol concentration present within the analytical cell. The Intoxilyzer was also designed to operate using infrared light at two wavelengths, 3 and 9 microns. The absorption ratio that is generated when alcohol alone is supplied in the path of the infrared light creates what may be termed as a fingerprint and that allows the device to discriminate between those samples, which are contaminated by breath interferents, and those that are not.

  - **Precision**

At a concentration of .08g/210L EtOH, the Intoxilyzer had a standard deviation range of 0.0008-0.0058 at N=10. At a concentration of 0.16g.210L EtOH, the Intoxilyzer had a standard deviation range of 0.0056-0.0096 at N=10.

  - **Accuracy**

The Intoxilyzer did not perform to +/- 5% of the true value during almost every test. It has been approximately two years since the instrument was last calibrated. Although; the inter-day and intra-day results were also inconsistent.

  - **Linearity**

The Intoxilyzer results were plotted against the GC value for each concentration and a line was generated. The formula for the line is $y=1.0525x$. $R^2=0.9968$.

  - **Interference**

The Intoxilyzer gave three different error messages during the testing of interferents; "Invalid Sample", "Improper Sample" and "Interferent Detect". The operators manual did not define these error messages and calls to the CMT customer service center were not returned, therefore we cannot conclude if the error messages were due to interference or another problem. Assuming that "Invalid" and "Improper" samples were due to interference, the Intoxilyzer detected acetone 20% of the time at .02%, and 100% of the time at .05% and 0.1% concentrations. Methanol was detected 20% of the time at .04%

MeOH in water and 40% of the time at .04% MeOH in .08% EtOH. Isopropanol was detected 100% of the time at both concentrations.

Mouthwash was used by a subject who subsequently provided breath samples until such time as no mouth alcohol was detected. Mouthwash was used at 15:08. Mouth alcohol was detected at 15:13, 15:17, and 15:20. No mouth alcohol was detected at 15:24 and the BrAC was 0.000.

- **Ease of use, durability and overall performance**

The CMI Intoxilyzer® 8000 is a compact unit which takes up far less workspace than other instruments. It is also designed for both mobile and stationary evidential breath alcohol testing. When the calibration of the device is verified during periodic checks, security tabs can be attached to the device in such a way that prevents any unauthorized opening of the casing. Provided they remain unbroken, the tabs confirm that the device has remained in a fully operational condition between the periodic verification checks. The Intoxilyzer has also been designed in such a way that it will allow for prolonged use without the requirement for recalibration. This is because there are no moving parts within the device.

The Intoxilyzer instrument provides quick calibrations and results. It has a fairly simple data input system when conducting a suspect test. The supervisor menu for maintenance, settings adjustments and routine performance checks is cryptic at best. It is confusing to navigate and the manual provides little support or explanations. The customer service department was impossible to reach despite repeated attempts and messages.

The instrument does not utilize heated simulator solution hoses. Heated simulator hoses would prevent condensation which causes external calibration failures. The unit displayed frequent RAM failure messages causing the machine to become inoperable for periods of time. We were unable to diagnose, nor fix the RAM failure because the manual fails to address failure messages. We were also unable to determine the difference between sample failure messages “Invalid” and “Improper” for the same reason. We had hoped to contact customer support for assistance, but have so far been unable to reach anyone.

The Intoxilyzer’s overall performance would be classified “unsatisfactory”.

- **Draeger Alcotest® 7110 MKIII-C**
  - **Features**

The Drager utilizes two independent alcohol measuring technologies. The first is infrared which detects alcohol in the 9.5um region of the IR spectrum. It utilizes an absorption chamber (cuvette) with 70 mL chamber volume, gold-coated parabolic mirrors, an electronically modulated infrared transmitter, and a pyroinfrared detector with an integrated IR filter. The second method is an electrochemical sensor. This measures small samples from inside the cuvette. Once ethanol reaches the sensor, a chemical reaction is triggered. The resulting current is used to determine the amount of alcohol in the sample. By combining two distinct analytical systems to analyze a subject’s breath, the DRA is able to provide two precise, accurate, and independent test results. The dual system also allows for a greater degree of sensitivity to any possible existence of interfering substances. Because the fuel cell is alcohol specific, and the IR sensor operates at 9.5um in the IR spectrum, the possibility of an interfering substance influencing a subject’s ethanol reading is “virtually” impossible.

  - **Precision**

At a concentration of 0.08g/210L EtOH, the DRA had a standard deviation range of 0.0005-0.0045 at N=10. At a concentration of 0.16g.210L EtOH, the DRA had a standard deviation range of 0.0011-0.0229 at N=10.

  - **Accuracy**

The DRA performed to +/- 5% of the true value at each concentration with three exceptions. At concentration 0.0376g/210L the result was 0.0356g/210L with a standard deviation of 0.001 and a recovery of 94.7%. At concentration .1582g/210L one resulting average was .1802g/210L with a standard deviation of .0229 and a recovery of 113.9%. Also at this concentration there was an average of .1491g/210L with a standard deviation of .0051 and a recovery of 94.2%.

- **Linearity**

The DRA results were plotted against the GC value for each concentration and a line was generated. The formula for the line for the infrared (IR) result is y=1.0001x R^2=0.9935. The formula for the line for the electrochemical (EC) result is y=0.9932x R^2=.09919. The formula for the line for the average of both results is y=0.9965x R^2=0.9927.

- **Interference**

The DRA's infrared sensor operates in the 9.5um range of the infrared spectrum. Because of this range, the DRA is free from the influence of acetone, toluene and acetaldehyde as they relate to a human submitting a breath sample. The DRA also employs an alcohol specific electrochemical (fuel cell) sensor which is not influenced by acetone, toluene or acetaldehyde. When tested for acetone in ethanol, the DRA reported only ethanol in the appropriate concentration which was neither influenced, nor interfered by the acetone. The DRA reported error messages for both the presence of methanol and isopropanol 100% of the time.

The DRA's mouth alcohol detection capabilities are not satisfactory. At one and five minutes after mouthwash use, the DRA detected mouth alcohol and reported an interference message. At ten minutes after mouthwash use, the DRA did not report mouth alcohol, but reported at BrAC of 0.057g/210L. At fifteen minutes after use it reported a BrAC of 0.030g/210L. At twenty minutes the BrAC was 0.000g/210L and no mouth alcohol was detected.

- **Ease of use, durability and overall performance**

The Drager Alcotest® 7110 MKIII-C is a dual detection, compact, portable breath alcohol analyzer capable of providing two precise, accurate, and independent test results. The DRA is powered by either AC or DC power which is convenient for portable use. The DRA is capable of using either an onboard or external printer. The onboard printer paper was difficult to replace. The externally generated evidence reports are neat and understandable. The onboard generated supervisor reports do not include averages or standard deviations. We were unable to find a way to include this in the generated report. Ticket reprint are possible only when the given test number is known. This may cause difficulties should tickets become lost.

The instrument employs a mandatory fifteen minute wait period after data is entered and before the breath is given. It is not possible to terminate the wait period once started. This means that should there be a need to restart the test period in the middle of the observation, it is not possible. We were also unable to override the wait period for testing purposes which was quite inconvenient. When problems such as this one arose, customer service at Drager was difficult to reach. We had to wait three business days for a response to our message.

The instruction manual is thorough, although difficult to understand. The layout of functions and explanation is confusing. The menu of options on the instrument is also difficult to navigate, and not intuitive. When attempting to use the manual to navigate the menu, it is difficult at best.

The overall performance of the instrument would be classified as "satisfactory".

- **Intoximeter EC/IR-II**
  - **Features**

The Intoximeter EC/IR-II utilizes both an electrochemical sensor and an infrared detector. The infrared system is capable of simultaneously analyzing carbon dioxide concentrations and alcohol concentrations in the breath. This capability allows the instrument to determine a deep lung breath sample on both alcohol rich and alcohol free samples. It employs an easy to read 256 x 32 pixel graphic vacuum fluorescent display.

  - **Precision**

The Intoximeter had an overall average standard deviation of 0.0012. At a concentration of 0.08g/210L EtOH, the Intoximeter had a standard deviation of 0.0025; n=10. At 0.4g/210L EtOH the standard deviation was 0.0023; n=10. All other concentrations had standard deviations < 0.0005.

  - **Accuracy**

The Intoximeter performed to +/- 5% the true value with one exception. At 0.0203g/210L the Intoximeter reported the concentration as 0.0219g/210L with a standard deviation of 0.0003 and a 107.89% recovery.

- **Linearity**

The Intoximeter results were plotted against the GC value for each concentration and a line was generated. The formula for the line is $y=1.0022x$ $R^2=0.9998$.

- **Interference**

The Intoximeter failed to detect any of the introduced interferents. Customer support was contacted and the software was updated three times to correct the units ability to detect and report interfering compounds. The unit continued to fail to detect interferents.

- **Ease of use, durability and overall performance**

The Intoximeter EC/IR-II is a compact, easy to operate breath alcohol testing instrument. It utilizes dual technology, however only the electrochemical fuel cell is used to calculate the results of the suspect sample. The infrared result is used to rule out mouth alcohol and compound interference.

The instrument employs and onboard printer, however it is capable of printing to an external unit. The display was easy to read. For a basic test, the instrument was very straight forward and easy to use. To do more complicated or higher level functions on the instrument, the software was not intuitive and very difficult to navigate. The operators manual was minimally helpful. None of the reported error messages were explained in the operators manual.

The customer service at Intoximeter was sub-standard. Reported problems were not rectified. Additional equipment and support (including heated simulator hoses, and interferent detecting software) were promised by the company, however was never received.

The overall performance of the instrument would be classified “unsatisfactory”.