

2009 and 2010 Quality Assurance Report Atmospheric Mercury Network



National Atmospheric Deposition Program

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Abbreviations

AMNet	Atmospheric Mercury Network
DQO	Data Quality Objective
GEM	Gaseous Elemental Mercury (expressed in ng/m ³)
GOM	Gaseous Oxidized Mercury (expressed in pg/m ³)
MDN	Mercury Deposition Network
NADP	National Atmospheric Deposition Program
PBM _{2.5}	Particulate-Bound Mercury less than 2.5 µm in diameter (expressed in pg/m ³)
QAP	Quality Assurance Program
SOP	Standard Operating Procedures

Units and Conversion Factors

°	degrees
°C	degrees Celsius
cm	centimeters
L	liters
lpm	liters per minute
ng	nanograms (1 ng = 10 ⁻⁹ g)
ng/m ³	nanograms per cubic meter
pg	picograms (1 pg = 10 ⁻¹² g)
pg/m ³	picograms per cubic meter

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1.0 Introduction

The Atmospheric Mercury Network (AMNet) started in 2009. In both 2009 and 2010, the network consisted of 20 sites across North America. The concentrations of gaseous elemental mercury (GEM), gaseous oxidized mercury (GOM) and particulate bound mercury (PBM_{2.5}) were measured at each site following the AMNet Standard Operating Procedures (SOPs).

The AMNet Site Liaison provides remote technical support to site operators in the operation of AMNet equipment, performs site performance and systems surveys, and reviews the data on a monthly basis to identify problems. Data review includes both manual and automated quality control checks. Site operators are notified whenever problems are discovered.

In 2009 thirteen sites were surveyed by the AMNet Site Liaison. In 2010 no site surveys were performed. A summary of the findings from each of the surveys is presented in this report.

Changes in 2009 include the following:

CA48 (Elkhorn Slough, CA) started operation on 03/01/2010

NY43 (Rochester, NY) Collocated measurements stopped on 11/13/2009

Changes to data in 2009 include the following:

MD08 (Piney Reservoir) PBM and GOM concentrations were adjusted by a factor of 4.167 for the period 01 January (at 11:45) through 06 October (at 16:45). The instrument scale factors were reset in the instrument BIOS to 1.0.

NY06 (Bronx) PBM and GOM concentrations for the entire year were adjusted by a factor of 0.5. Scale factors in the instrument BIOS were set to 8.333 instead of 4.167.

Changes in 2010 include the following:

none

Changes to data in 2010 include the following:

CA48 (Elkhorn Slough) GOM and PBM concentrations were adjusted by a factor of 4.167 for the period 18 March (at 18:25) through 22 March (at 1330). The instrument scale factors were set in the instrument BIOS to 1.0.

MD08 (Piney Reservoir) PBM and GOM concentrations were adjusted by a factor of 4.167 for the period 25 February through 28 February (at 01:55). When the instrument was repaired all scale factors were set in the instrument BIOS to 1.0 by mistake.

MD08 (Piney Reservoir) PBM and GOM concentrations were adjusted by a factor of 4.167 for the period 18 October through 22 October (at 12:55). The instrument scale factors were not saved and were set in the instrument BIOS to 1.0.

NY06 (Bronx) PBM and GOM concentrations for the entire year were adjusted by a factor of 0.5. Scale factors in the instrument BIOS were set to 8.333 instead of 4.167.

NY95 (Rochester – collocated instrument) GOM concentrations were adjusted by a factor of 4.167 for the period 02 June through 31 December. Flag 4 was changed in the instrument BIOS, but the scale factor had not been changed.

2.0 Site Performance and Systems Surveys

Sites are surveyed at least once every two years by the AMNet Site Liaison. Normally, the site performance and systems surveys would be performed by an independent entity. This is true for the other four NADP networks. The expertise required to operate and troubleshoot the AMNet instrumentation prohibits an independent third party from providing this service. Field survey reports are completed to document problems that are discovered and their resolution.

Site surveys evaluate both field and laboratory operations (including equipment operation), and siting criteria. Site surveys ensure data comparability within the network, resolve operational problems that may not be apparent in data review, and address training needs at each site.

Additional information regarding site surveys may be found in the document titled *Atmospheric Mercury Network: Site Performance and Systems Survey*. This document is available from the NADP website (<http://nadp.isws.illinois.edu/>).

Appendix B to this report includes survey results for 2008. This work was performed while AMNet was a new initiative, prior to it becoming an official NADP network. Results of the site surveys conducted during 2008 are included to complete the site records.

2.1 AMNet Sites Surveyed in 2009 and 2010

Site surveys were conducted at twelve AMNet sites in 2009. Station ID's, survey dates and station names are presented in Table 1. Two site IDs are associated with Beltsville, MD. This site operated collocated instruments for at least a portion of the period covered by this report.

Table 1. AMNet Sites Surveyed.

Site ID	Station Name	Survey Date
MD08	Piney Reservoir	6/9/2009
MD96/MD97	Beltsville	5/28/2009
NH06	Thompson Farm	2/11/2009
NJ05	Brigantine	4/22/2009
NJ30	New Brunswick	4/24 & 5/12/2009
NJ32	Chester	4/20/2009
NJ54	Elizabeth	4/23/2009
NS01	Kejimkujik	8/17/2009
NU15	Alert	3/26/2009
NY06	Bronx	1/26/2009
OH02	Athens	6/23/2009
OK99	Stilwell	1/14/2009

2.2 Instrument Test Results

As part of the site survey, instrument sensitivity (i.e., response factor) and the internal calibration source are verified. Independent, third party calibration certificates for the survey test equipment are included in Appendix A to this document.

Table 2 lists the serial numbers for the AMNet instruments at each site. Illegible serial numbers are listed as “n/a” (not available).

Table 2. Serial Numbers for Instruments at Surveyed Sites.

Site ID	1102	2537	1130P	1130	1135	2505
MD08	8	220	61	60	48	73
MD96	52	314	82	84	79	151
MD97	43	342	88	88	74	151
NH06	n/a	252	59	98	91	n/a
NJ05	82	125	23	n/a	14	n/a
NJ30	n/a	133	26	n/a	11	n/a
NJ32	n/a	132	24	n/a	13	n/a
NJ54	n/a	134	25	25	12	n/a
NS01	78	189	30	n/a	17	90
NU15	n/a	40	18	n/a	2	n/a
NY06	n/a	327	84	82	n/a	n/a
OH02	38	174	49	47	36	81
OK99	56	335	90	86	76	n/a

Table 3 lists the results [i.e., pass (p), fail (f)] for each test of the field instruments. Criteria for assigning pass/fail are defined in *Atmospheric Mercury Network: Site Performance and Systems Survey*. Significant deviation from the test criteria are indicated with an uppercase F. Extensive equipment repairs were required at some sites. As a result, there was insufficient time to complete a full survey of the site. Parameters that were not tested are listed as “n/a.” As noted earlier, no site surveys were conducted in 2010. Results presented in Tables 3 and 4 reflect surveys performed in 2009.

Table 3. Survey Results.

Site ID	Survey Date	Air Flow and Leak Tests				Cartridge A and B Recoveries			
		Temps OK	Inlet Flow	2537 Flow	Leak Check	Response Factor	Low Level	High Level	Ambient Air
MD08	6/9/2009	p	F/p ²	p	n/a	p	p	p	p
MD96	5/28/2009	F/p ¹	p	p	n/a	F/p ⁴	p	n/a	n/a
MD97	5/28/2009	p	p	F/p ³	n/a	n/a	n/a	n/a	n/a
NH06	2/11/2009	p	p	p	n/a	p	p	p	p
NJ05	4/22/2009	F/p ¹	p	p	n/a	p	p	p	p
NJ30	4/24 & 5/12/2009	F/p ¹	p	n/a	n/a	F/p ⁴	p	n/a	n/a
NJ32	4/20/2009	F/p ¹	F/p ²	F/p ³	n/a	F/p ⁴	p	n/a	n/a
NJ54	4/23/2009	p	p	p	n/a	F/p ⁴	p	p	p
NS01	8/17/2009	p	p	F/p ³	p	p	p	p	p
NU15	3/26/2009	p	p	p	n/a	p	p	p	p
NY06	1/26/2009	p	p	n/a	n/a	p	n/a	n/a	n/a
OH02	6/23/2009	p	F/p ²	F/p ³	n/a	p	p	p	p
OK99	1/14/2009	p	p	F/p ³	n/a	p	p	p	p

¹ 1135 required repaired which were performed

² Inlet flows required adjustment

³ 2537 flows required adjustment

⁴ Sensitivity required increase

2.3 Siting Criteria

Siting criteria is evaluated with regard to obstructions in each of 8 directions (i.e., N, NE, E, SE, S, SW, W, and NW) from the instrument inlet. Inlet heights from the ground are also measured. Results are presented in Table 4. Obstructions are evaluated as pass (p)/fail (f). Deviations from the siting criteria are discussed with the operator during the site survey. Corrective action, when possible, is the responsibility of the site operator and the site supervisor.

Table 4. Siting Criteria Obstructions and Inlet Heights.

Site	Inlet Height (m)	N	NE	E	SE	S	SW	W	NW
MD08	3.1	p	p	p	p	p	p	p	p
MD96	10.0	p	p	p	p	p	p	p	p
MD97	10.0	p	p	p	p	p	p	p	p
NH06	4.3	p	p	p	p	p	p	p	p
NJ05	n/a	p	p	p	p	p	p	p	p
NJ30	n/a	p	p	p	p	p	p	p	p
NJ32	f	p	f	p	p	p	p	p	f
NJ54	n/a	p	p	p	p	p	p	p	p
NS01	4.9	p	p	p	p	p	p	p	p
NU15	4.3	p	p	p	p	p	p	p	p
NY06	9.1	p	p	p	p	p	p	p	f
OH02	2.5	p	p	p	p	p	p	p	p
OK99	4.8	p	p	p	p	p	p	p	p

2.4 Instrument Repairs

In 2009, six instruments (MD96, MD97, NJ05, NJ30, NJ32 and NY06) required repairs in order to complete the survey.

3.0 Training

Formal AMNet training began in April 2010 with a 3 day session held at the USGS in Middleton, WI. A second course was held in June 2010 at the Wisconsin Department of Natural Resources. Informal training occurs as part of the site survey with the site liaison observing the maintenance activities, making recommendations. All site surveys in 2009 focused on adherence to AMNet SOPs and training.

4.0 Data

AMNet data are evaluated using a series of automated checks, and through manual inspection by the AMNet Site Liaison. Additional information on this process is available in the *Atmospheric Mercury Network Data Management Manual*. Table 5 lists the percent valid data for each site in 2009. Table 6 lists the percent valid data for each site in 2010. Values are presented for each of the three forms of interest, that is, GEM, GOM, and PBM_{2.5}.

In 2009:

Two sites, AL19 and WV99, did not meet data quality objectives ($\geq 75\%$ data completeness on annual basis) for any parameters. Three sites, NJ05, OK99 and UT97 did not meet DQO's for GOM or PBM.

AL19 experienced 2537 pump problems during the months of November and December.

NJ05 experienced high desorption blanks from 26 June – 12 August. The PBM analyzer was removed from service from 12 November – 11 December.

OK99 experienced several periods throughout the year when the GOM and PBM analyzer was out of service.

UT97 experienced several periods of downtime due to 1130 pump failure.

WV99 experienced two periods of extended down time. From 01 September – 01 December the gold cartridges were passivated. From April through the end of the year, no PBM was collected.

Three other sites experienced periods of downtime greater than 2 weeks. MD96 experienced cartridge bias from 7 April – 26 April. The NY20 2537 pump failed from 11 November – 2 December. PA13 experienced many problems during the period 20 March – 6 November resulting in the data being invalidated.

Field notes were not received for NJ30, NJ32 or NJ54. As such, data from these sites were not quality controlled and were not posted to the NADP website.

Table 5. Percent Valid Data by Site for 2009.

Site ID	GEM	GOM	PBM
AL19	72	76	76
FL96	97	93	93
GA40	97	93	93
MD08	96	90	90
MD96	82	82	82
MD97	96	93	93
MS12	94	86	84
MS99	90	87	84
NH06	98	83	82
NJ05	74	67	39
NS01	95	86	87
NY06	88	80	83
NY20	95	89	90
NY43	95	90	90
NY95	91	87	87
OH02	99	95	94
OK99	80	81	80
UT96	89	93	91
UT97	92	76	82
VT99	97	97	97
WV99	55	88	92
Average	89	86	85

In 2010:

NY06 did not meet data quality objectives ($\geq 75\%$ data completeness on annual basis) for any parameters. Two sites, UT97 and WV99 did not meet DQO's for GOM or PBM.

NY06 experienced 2537 pump problems at several times throughout the year.

UT97 experienced extended periods of downtime due to failure of the 1130 pump.

WV99 was out of service from 01 January -20 April. High baseline deviation was observed for the period 08 June – 09 September. The 2537 pump failed on 23 September and was not repaired.

Three other sites experienced periods of downtime greater than 2 weeks. MD96 experienced cartridge bias for the time periods 04 February – 24 February and 14 June – 16 July. NY20 experienced cartridge bias from 01 January – 14 January. PA13 experienced cartridge bias from 01 April – 01 July.

Table 6. Percent Valid Data by Site for 2010.

Site ID	GEM	GOM	PBM
AL19	88	89	89
CA48	93	90	91
FL96	84	83	83
GA40	95	92	92
MD08	97	92	92
MD96	92	86	88
MD97	92	84	84
MS12	96	93	89
MS99	98	95	94
NH06	97	84	85
NJ05	99	97	96
NS01	99	97	97
NY06	62	61	60
NY20	90	84	84
NY95	95	86	86
OH02	96	95	95
OK99	90	86	83
UT96	84	82	81
UT97	91	79	82
VT99	97	96	96
WV99	78	74	0
Average	91	87	83

Appendix A – Test Equipment Calibration Documents

Bios International Calibration Certificate

Cert No. 104579
Product Definer 220-M
Serial No. 113396
Cal. Date 02 January 2008
Sale Date 17 April 2008

US Geological Survey
 12201 Sunrise Valley Drive
 Reston VA 20192



As Shipped Temperature and Pressure data:

All units tested in accordance with Bios International Corporation test number PR18-11 Rev A , PR18-12 Rev A using high-purity bottled nitrogen or dry filtered laboratory air.

Technician Steve Shattls
Precision Thermometer 22.5 °C **Definer Temperature** 22.5 °C **Allowable Deviation** ±0.8 °C
Precision Barometer 750 mmHg **Definer Pressure** 750 mmHg **Allowable Deviation** ±3.5 mmHg

Asset Number	Cal Date	Due Date	Description
305460	8/3/2007	8/3/2008	Precision Thermometer
43198-07	4/8/2008	4/8/2009	Precision Barometer

As Shipped Flow Test Data

All units tested in accordance with Bios International Corporation test number PR18-13 Rev D using high-purity bottled nitrogen or dry filtered laboratory air.

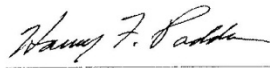
Reference Standard	Description	Cal Date	Due Date
ML-500-24 100499	ML-500 Medium Flow Cell	12/7/2007	12/7/2008
ML-500-10 102174	ML-500 Low Flow Cell	5/24/2007	5/24/2008
ML-500-44 100392	ML-500 High Flow Cell	12/19/2007	12/19/2008

Technician Steve Shattls **Lab. Pressure** 750 mmHg
Lab. Temperature 22.5 °C

Instrument Reading (scc/min)	Lab Standard Reading (scc/min)	Lab Standard Unit No.	Deviation	Allowable Deviation	Condition Shipped
100.51	100.385	102174	0.12 %	1.00%	in tolerance
1003.1	1000.32	100499	0.28 %	1.00%	in tolerance
5020.6	5004.55	100392	0.32 %	1.00%	in tolerance

Calibration Notes

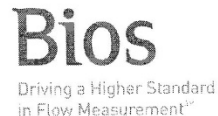
Bios is an ISO 17025-accredited metrology laboratory. Each Bios primary gas flow standard is dynamically verified by comparing it to one of our laboratory standards, which is a Proven DryCal® Technology volumetric piston prover of much higher accuracy (±0.25% or better) but of similar operating principles. For this purpose, a flow generator of ±0.03% stability is used. Throughout testing, the stability of the flow generator is maintained due to the similar operating principles and construction of our laboratory standards and the devices under test (DUT), assuring the flow generator's validity as a transfer standard. Our laboratory standards are qualified by direct measurement of their dimensions (diameter, length of measured path, time base) using NIST-traceable precision gauges and instruments, such as depth micrometers and laser micrometers. NIST numbers for these gauges and instruments are available upon request. Rigorous analyses of our laboratory standards' uncertainties have been performed, in accordance with The Guide to the Expression of Uncertainty in Measurement (the GUM), assuring their traceable accuracy.


 Harvey Padden, President

Bios International Corporation
 10 Park Place, Butler, NJ 07405 USA
 www.biosint.com

Printed 17 April 2008
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Calibration Certificate

Certificate No. 500757 Sold to: US Geological Survey - Reston
 Product Definer 220 High Flow 8505 Research Way
 Serial No. 114711 Middleton, WI 53562
 Cal. Date 6/24/2008 USA
 Sales Date 8/21/2008 Calibration interval commences on sale date.

All calibrations are performed in accordance with ISO 17025 at Bios International Corporation, 10 Park Place, Butler, NJ, 07405, 800-663-4977, an ISO 17025:2005 – accredited laboratory through NVLAP. This report shall not be reproduced except in full without the written approval of the laboratory. Results only relate to the items calibrated. This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

All units tested in accordance with Bios International Corporation test number PR18-13 using high-purity bottled nitrogen or dry filtered laboratory air.

Calibration Data

Technician Jacquella Shives Lab. Pressure 752 mmHg
 Lab. Temperature 22.6 °C

Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Shipped
508.87 sccm	508.04 sccm	0.16 %	1.00%	In Tolerance
5009.4 sccm	5006 sccm	0.07 %	1.00%	In Tolerance
30279 sccm	30189 sccm	0.3 %	1.00%	In Tolerance
22.6 °C	22.6 °C	-	±0.8°C	In Tolerance
750 mmHg	750 mmHg	-	±3.5 mHg	In Tolerance

Bios International Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML_800_44	103521	10/22/2007	10/21/2008
Precision Thermometer	305460	5/1/2008	5/1/2009
Precision Barometer	431/98-07	4/8/2008	4/8/2009

Calibration Notes

Bios is an ISO 17025-accredited metrology laboratory. Each Bios primary gas flow standard is dynamically verified by comparing it to one of our laboratory standards, which is a Proven DryCal® Technology volumetric piston prover of much higher accuracy but of similar operating principles. For this purpose, a flow generator of ±0.03% stability is used. Our laboratory standards are qualified by direct measurement of their dimensions (diameter, length and time) using NIST-traceable precision gauges and instruments, such as depth micrometers and laser micrometers. NIST numbers for these gauges and instruments are available upon request. Rigorous analyses of our laboratory standards' uncertainties have been performed, in accordance with The Guide to the Expression of Uncertainty in Measurement (the GUM), assuring their traceable accuracy.

Harvey Padden, President and Chief Metrologist



Calibration Certificate

Certificate No.	39844	Sold to:	US Geological Survey - Reston
Product	Definer 220 Medium Flow		8505 Research Way
Serial No.	113878		Middleton, WI 53562
Cal. Date	7/30/2009		USA

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All units tested in accordance with Bios International Corporation test number PR18-13 using high-purity bottled nitrogen or dry filtered laboratory air.

As Received Calibration Data

Technician	Steve Shattls	Lab. Pressure	751 mmHg
		Lab. Temperature	22.5 °C

Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Received
100.53 sccm	99.8425 sccm	0.69%	1.00%	In Tolerance
1003.7 sccm	1000.4 sccm	0.33%	1.00%	In Tolerance
5026.1 sccm	5002.05 sccm	0.48%	1.00%	In Tolerance
22.3 °C	22.3 °C	0°C	±0.8°C	In Tolerance
749 mmHg	751 mmHg	-2 mmHg	±3.5mmHg	In Tolerance

Bios International Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML-800-24	100439	4/2/2009	4/2/2010
Precision Thermometer	305460	8/6/2008	8/6/2009
Precision Barometer	431/98-07	4/15/2009	4/15/2010

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As Shipped Calibration Data

Certificate No. 39844 Lab. Pressure 760 mmHg
Technician Steve Shattls Lab. Temperature 22.5 °C

Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Shipped
100.35 sccm	100.075 sccm	0.27%	1.00%	In Tolerance
999.15 sccm	999.47 sccm	-0.03%	1.00%	In Tolerance
4989.4 sccm	5001.3 sccm	-0.24%	1.00%	In Tolerance
22.5 °C	22.5 °C	-	±0.8°C	In Tolerance
749 mmHg	749 mmHg	-	±3.5mmHg	In Tolerance

Bios International Standards Used

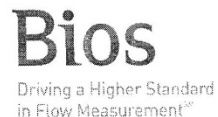
Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML-800-24	100439	4/2/2009	4/2/2010
Precision Thermometer	305460	8/6/2008	8/6/2009
Precision Barometer	431/98-07	4/15/2009	4/15/2010

Calibration Notes

Bios is an ISO 17025-accredited metrology laboratory. Each Bios primary gas flow standard is dynamically verified by comparing it to one of our laboratory standards, which is a Proven DryCal® Technology volumetric piston prover of much higher accuracy but of similar operating principles. For this purpose, a flow generator of ±0.03% stability is used. Our laboratory standards are qualified by direct measurement of their dimensions (diameter, length and time) using NIST-traceable precision gauges and instruments, such as depth micrometers and laser micrometers. NIST numbers for these gauges and instruments are available upon request. Rigorous analyses of our laboratory standards' uncertainties have been performed, in accordance with The Guide to the Expression of Uncertainty in Measurement (the GUM), assuring their traceable accuracy. Flow readings in sccm performed at STP of 21.1°C and 760 mmHg.

Technician Notes:

Harvey Padden, President and Chief Metrologist



Calibration Certificate

Certificate No.	39845	Sold to:	US Geological Survey - Reston
Product	Definer 220 High Flow		8505 Research Way
Serial No.	114711		Middleton, WI 53562
Cal. Date	7/30/2009		USA

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All units tested in accordance with Bios International Corporation test number PR18-13 using high-purity bottled nitrogen or dry filtered laboratory air.

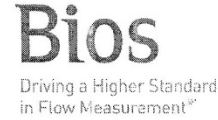
As Received Calibration Data

Technician	Steve Shattls	Lab. Pressure	752 mmHg
		Lab. Temperature	22.5 °C

Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Received
485.94 sccm	498.995 sccm	-2.62%	1.00%	Out of Tolerance
4975.8 sccm	5003.15 sccm	-0.1%	1.00%	In Tolerance
29917 sccm	30022.5 sccm	-0.35%	1.00%	In Tolerance
22.6 °C	22.7 °C	-0.1°C	±0.8°C	In Tolerance
751 mmHg	752 mmHg	-1 mmHg	±3.5mmHg	In Tolerance

Bios International Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML-800-44	103521	10/20/2008	10/20/2009
Precision Thermometer	305460	8/6/2008	8/6/2009
Precision Barometer	431/98-07	4/15/2009	4/15/2010



As Shipped Calibration Data

Certificate No. 39845
Technician Steve Shattls

Lab. Pressure 748 mmHg
Lab. Temperature 22.5 °C

Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Shipped
499.80 sccm	500.965 sccm	-0.23%	1.00%	In Tolerance
4999.1 sccm	5001.1 sccm	-0.04%	1.00%	In Tolerance
30098 sccm	30004 sccm	0.31%	1.00%	In Tolerance
22.6 °C	22.6 °C	-	±0.8°C	In Tolerance
749 mmHg	749 mmHg	-	±3.5mmHg	In Tolerance

Bios International Standards Used

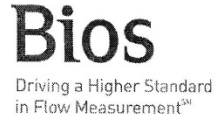
Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML-800-44	101897	9/3/2008	9/3/2009
Precision Thermometer	305460	8/6/2008	8/6/2009
Precision Barometer	431/98-07	4/15/2009	4/15/2010

Calibration Notes

Bios is an ISO 17025-accredited metrology laboratory. Each Bios primary gas flow standard is dynamically verified by comparing it to one of our laboratory standards, which is a Proven DryCal® Technology volumetric piston prover of much higher accuracy but of similar operating principles. For this purpose, a flow generator of ±0.03% stability is used. Our laboratory standards are qualified by direct measurement of their dimensions (diameter, length and time) using NIST-traceable precision gauges and instruments, such as depth micrometers and laser micrometers. NIST numbers for these gauges and instruments are available upon request. Rigorous analyses of our laboratory standards' uncertainties have been performed, in accordance with The Guide to the Expression of Uncertainty in Measurement (the GUM), assuring their traceable accuracy. Flow readings in sccm performed at STP of 21.1°C and 760 mmHg.

Technician Notes:

Harvey Padden, President and Chief Metrologist



Calibration Certificate

Certificate No. 506151 Sold to: Tekran Inc. - Toronto
 Product Definer 220 Medium Flow 330 Nantucket Blvd.
 Serial No. 119093 Toronto, ON M1P 2P4
 Cal. Date 3/2/2010 Canada
 Sales Date 3/15/2010 Calibration interval commences on sale date.

All calibrations are performed in accordance with ISO 17025 at Bios International Corporation, 10 Park Place, Butler, NJ, 07405, 800-663-4977, an ISO 17025:2005 - accredited laboratory through NVLAP. This report shall not be reproduced except in full without the written approval of the laboratory. Results only relate to the items calibrated. This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

All units tested in accordance with Bios International Corporation test number PR18-13 using high-purity bottled nitrogen or dry filtered laboratory air.

Calibration Data

Technician Zenaida Ortiz Lab. Pressure 748 mmHg
 Lab. Temperature 21.9 °C

Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Shipped
100.89 sccm	100.715 sccm	0.17 %	1.00%	In Tolerance
1003.8 sccm	1004.65 sccm	-0.08 %	1.00%	In Tolerance
4999.5 sccm	5006.35 sccm	-0.14 %	1.00%	In Tolerance
21.9 °C	21.9 °C	-	±0.8°C	In Tolerance
748 mmHg	748 mmHg	-	±3.5 mHg	In Tolerance

Bios International Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML_800_24	100439	4/3/2009	4/3/2010
Precision Thermometer	305460	4/29/2009	4/29/2010
Precision Barometer	431/98-07	4/15/2009	4/15/2010

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Harvey Padden, President and Chief Metrologist



Calibration Certificate

Certificate No. 506213
 Product Definer 220 High Flow
 Serial No. 119152
 Cal. Date 3/5/2010
 Sales Date 3/15/2010 *Calibration interval commences on sale date.*

Sold to: Tekran Inc. - Toronto
 330 Nantucket Blvd.
 Toronto, ON M1P 2P4
 Canada

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All units tested in accordance with Bios International Corporation test number PR18-13 using high-purity bottled nitrogen or dry filtered laboratory air.

Calibration Data

Technician Zenaida Ortiz

Lab. Pressure 751 mmHg
 Lab. Temperature 22.6 °C

Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Shipped
500.48 sccm	500.495 sccm	0 %	1.00%	In Tolerance
4990.2 sccm	5004.9 sccm	-0.29 %	1.00%	In Tolerance
30031 sccm	30038 sccm	-0.02 %	1.00%	In Tolerance
22.6 °C	22.6 °C	-	±0.8°C	In Tolerance
751 mmHg	751 mmHg	-	±3.5 mHg	In Tolerance

Bios International Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML_800_44	103521	10/19/2009	10/19/2010
Precision Thermometer	305460	4/29/2009	4/29/2010
Precision Barometer	431/98-07	4/15/2009	4/15/2010

Calibration Notes

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Harvey Padden, President and Chief Metrologist

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Calibration Certificate

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 Serial No. 119152
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Sold to: Tekran Inc. - Toronto
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Bios International Standards Used

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Calibration Notes

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Harvey Padden, President and Chief Metrologist

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CERTIFICATE of CALIBRATION

This is to Certify that

the following described Hamilton Digital Syringe has been calibrated by
Hamilton Company, and is accurate within $\pm 0.5\%$ of full scale reading.

This Digital Syringe, as specified below, has been calibrated as a complete assembly at ambient
pressure. The calibration is performed pursuant to ANSI/NCSL Z540-1-1994, with an unbroken chain
of calibrations traceable to NIST

Capacity 25 μ l

Model 1702RN,25UL

Serial No. 07133 Accuracy 0.203%

Date of Calibration June 23, 2008

Calibrated by Jelene Meyer

HAMILTON
THE MEASURE OF EXCELLENCESM

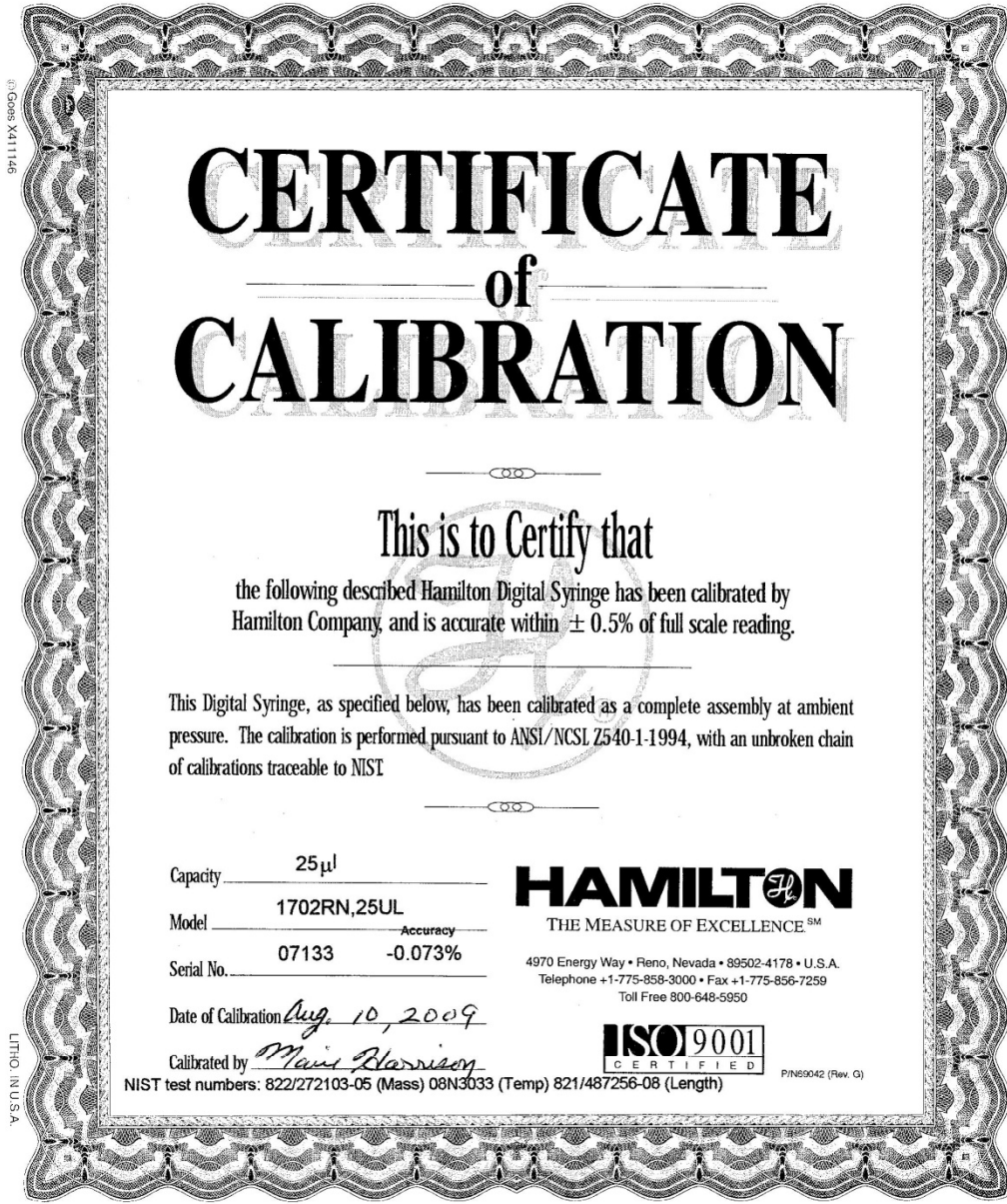
4970 Energy Way • Reno, Nevada • 89502-4178 • U.S.A.
Telephone +1-775-858-3000 • Fax +1-775-856-7259
Toll Free 800-648-5950

ISO 9001
CERTIFIED

P/N69042 (Rev. G)

NIST test numbers: 822/272103-05 (Mass) 07N2764 (Temp) 821/274437-07 (Length)

LITHO IN U.S.A.



CERTIFICATE of CALIBRATION

This is to Certify that

the following described Hamilton Digital Syringe has been calibrated by Hamilton Company, and is accurate within $\pm 0.5\%$ of full scale reading.

This Digital Syringe, as specified below, has been calibrated as a complete assembly at ambient pressure. The calibration is performed pursuant to ANSI/NCSL Z540-1-1994, with an unbroken chain of calibrations traceable to NIST

Capacity 25 μ l
Model 1702RN, 25UL
Serial No. 07133
Accuracy -0.073%

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4970 Energy Way • Reno, Nevada • 89502-4178 • U.S.A.
Telephone +1-775-858-3000 • Fax +1-775-856-7259
Toll Free 800-648-6950

Date of Calibration Aug. 10, 2009

Calibrated by Mavis Harrison



P/N69042 (Rev. G)

NIST test numbers: 822/272103-05 (Mass) 08N3033 (Temp) 821/487256-08 (Length)

Appendix B – AMNET Survey Results for 2008

Survey Results, 2008.

Site ID	Survey Date	Air Flow and Leak Tests				Cartridge A and B Recoveries			
		Temps OK	Inlet Flow	2537 Flow	Leak Check	Response Factor	Low Level	High Level	Ambient Air
NY20	11/12/2008	f/p ²	p	p	n/a	p	p	p	n/a
NY43	11/10/2008	f ¹	p	f/p ³	n/a	p	p	p	p
NY95	11/10/2008	p	p	p	n/a	p	p	p	p

¹ 1135 case temperature low

² 1135 ceramic base replaced

³ 2537 flows required adjustment

Siting Criteria Obstructions and Inlet Heights, 2008.

Site	Inlet Height (m)	N	NE	E	SE	S	SW	W	NW
NY20	4.9	p	p	p	p	p	f	f	f
NY43	4.3	p	p	p	p	p	p	f	f
NY95	4.1	p	p	p	p	p	p	f	f