

# **2011 Quality Assurance Report Atmospheric Mercury Network**



National Atmospheric Deposition Program

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## Abbreviations

AMNet	Atmospheric Mercury Network
GEM	Gaseous Elemental Mercury (expressed in ng/m <sup>3</sup> )
GMOS	Global Mercury Observation System
GOM	Gaseous Oxidized Mercury (expressed in pg/m <sup>3</sup> )
MDN	Mercury Deposition Network
NADP	National Atmospheric Deposition Program
PBM <sub>2.5</sub>	Particulate-Bound Mercury less than 2.5 µm in diameter (expressed in pg/m <sup>3</sup> )
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 <sup>-9</sup> g)
ng/m <sup>3</sup>	nanograms per cubic meter
pg	picograms (1 pg = 10 <sup>-12</sup> g)
pg/m <sup>3</sup>	picograms per cubic meter

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## 1.0 Introduction

The Atmospheric Mercury Network (AMNet) started in 2009. In 2011 the network consisted of 21 sites across North America. The concentrations of gaseous elemental mercury (GEM), gaseous oxidized mercury (GOM) and particulate bound mercury (PBM<sub>2.5</sub>) are 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 system 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 2011 thirteen sites were surveyed by the AMNet Site Liaison. This report includes a summary of the findings from each of the surveys.

Changes in 2011 include the following:

CA48 (Elkhorn Slough, CA) discontinued operations on 12/31/2011

NH06 (Thompson Farm, NH) discontinued operations on 11/29/2011

NY06 (Bronx, NY) Matt Hirsch replaced Dirk Felton as site operator

NY20 (Huntington Forest, NY) Timothy Chang replaced Jioyan Huang as site operator

NY95 (Rochester, NY) Matt Hirsch replaced Dirk Felton as site operator

PA13 (Allegheny Portage, PA) discontinued operations on 11/10/2011

UT96 (Antelope Island, UT) discontinued operations on 06/30/2011

Changes to data in 2011 include the following:

NY06 (Bronx) GOM concentrations were adjusted by a factor of 4.167 for the period 01 January through 01 April (at 1355). Flag 4 was changed in the instrument BIOS, but the scale factor had not been changed. PBM<sub>2.5</sub> data for the same period were adjusted by a factor of 0.5 because the scale factor was set to 8.333 rather than 4.167.

NY20 (Huntington Forest, NY) PBM and GOM concentrations were adjusted by a factor of 4.167 for the period 16 February (at 1225) through 1 March (at 1045). Scale factors in the instrument BIOS were set to 1.0.

NY95 (Rochester) GOM concentrations were adjusted by a factor of 4.167 for the period 01 January through 31 December. Flag 4 was changed in the instrument BIOS, but the scale factor had not been changed.

VT99 (Underhill, VT) GOM concentrations were adjusted by a factor of 5.21 for the period 01 January through 31 December. Flag 4 was changed in the instrument BIOS, but the scale factor had not been changed.

## 2.0 Site Performance and System 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/>).

## 2.1 AMNet Sites Surveyed in 2011

Site surveys were conducted at thirteen AMNet sites in 2011. Station ID's, survey dates and station names are presented in Table 1. Two site ids are associated with the site at Grand Bay, MS. This site operated collocated instruments throughout the year.

**Table 1.** AMNet Sites Surveyed in 2011.

Site ID	Station Name	Survey Date
MD08	Piney Reservoir	8/29/2011
MS12/MS99	Grand Bay NERR	1/31/2011
NH06	Thompson Farm	8/15/2011
NS01	Kejimkujik	7/27/2011
NY06	Bronx	8/17/2011
NY20	Huntington Wildlife Forest	8/12/2011
NY95	Rochester	8/8/2011
OH02	Athens	9/1/2011
PA13	Allegheny Portage	8/31/2011
UT96	Antelope Island	6/9/2011
UT97	Salt Lake City	6/8/2011
VT99	Underhill	8/10/2011
WV99	Canaan Valley	8/30/2011

## 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 the appendix 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	85	220	61	60	48	73
MS12	25	254	69	66	53	147
MS99	36	291	78	67	n/a	147
NH06	69	361	111	n/a	91	n/a
NS01	78	34	110	n/a	89	n/a
NY06	n/a	327	84	n/a	n/a	n/a
NY20	35	211	51	n/a	n/a	n/a
NY95	46	326	83	n/a	n/a	n/a
OH02	54	174	47	47	36	81
PA13	24	212	58	n/a	49	n/a
UT96	68	360	101	99	77	160
UT97	77	364	105	103	88	169
VT99	22	178	53	n/a	94	97
WV99	105	365	57	n/a	n/a	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.”



**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	8/29/2011	p	p	p	p	p	p	f	F
MS12	1/31/2011	p	p	p	F <sup>3</sup>	p	f	f	F
MS99	1/31/2011	p	p	p	f <sup>3</sup>	p	f	f	F
NH06	8/15/2011	p	p	p	p	p	p	p	p
NS01	7/27/2011	p	p	p	p	f	p	p	p
NY06	8/17/2011	p	f	p	p	p	p	p	n/a
NY20	8/12/2011	p	f	p	p	p	p	n/a	n/a
NY95	8/8/2011	p	p	p	n/a	n/a	p	n/a	n/a
OH02	9/1/2011	p	p	p	p	p	p	n/a	p
PA13	8/31/2011	F/p <sup>2</sup>	p	p	p	f	p	p	n/a
UT96	6/9/2011	p	p	p	p	p	f	n/a	n/a
UT97	6/8/2011	p	n/a	p	n/a	p	p	n/a	n/a
VT99	8/10/2011	F/p <sup>1</sup>	p	p	n/a	F	p	p	f
WV99	8/30/2011	p	p	p	p	p	p	p	p

<sup>1</sup> 1135 pyrolyzer heater non functional and repaired

<sup>2</sup> 1135 particulate heater thermocoupler non functional and repaired

<sup>3</sup> Leak checks were high which may be due to incorrect mass flow meter zero offset

## 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
MS12	10	p	p	p	p	p	p	p	p
MS99	10	p	p	p	p	p	p	p	p
NH06	4.3	p	p	p	p	p	p	p	p
NS01	4.9	p	p	p	p	p	p	p	p
NY06	9.1	p	p	p	p	p	p	p	f
NY20	4.9	f	p	p	p	p	p	f	f
NY95	4.3	f	p	p	p	p	p	f	p
OH02	2.5	p	p	p	p	p	p	p	p
PA13	3.6	p	p	p	p	p	p	p	p
UT96	3.2	p	p	p	p	p	p	p	p
UT97	8.2	p	p	p	p	p	p	p	p
VT99	5.9	p	p	p	p	p	p	p	p
WV99	3.2	p	p	p	p	p	p	p	p

## 2.4 Instrument Repairs

In 2011, seven instruments required repairs in order to complete of the survey. The sites needing repairs were MS99, NY06, NY20, NY95, UT96, UT97 and VT99. By comparison, only one site survey was completed in 2010 which didn't require repairs. In 2012 only one instrument required repairs.

## 3.0 Training

Two formal training sessions were held in 2011. Providence, Rhode Island was host to a one day course on 24 October with 10 NADP attendees. A three day course was held 15-17 November in Rome, Italy with 23 Global Mercury Observation System (GMOS) attendees. Informal training occurs as part of the site survey with the site liaison observing the maintenance activities, and making recommendations.

## 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 2011. Values are presented for each of the three forms of interest, that is, GEM, GOM, and PBM<sub>2.5</sub>. Four sites, AL19, CA48, UT96 and WV99, did not meet data quality objectives of 75% for completeness.

AL19 experienced excessive contamination in the calibration blank periodically prior to 18 May and consistently from 18 May to 25 October (19:00). All species were invalidated with the Z2 flag.

CA48 experienced multiple cartridge bias differences resulting in significant periods when the C2 and A2 flags invalidated the data. The cartridges were cleaned and changed multiple times throughout the year.

UT96 experienced periodic contamination, possibly from the shelter housing the instruments. Recommendations to reduce the indoor air levels were made during the site visit. The site closed on 30 June.

WV99 experienced extended down times due to low response factor and severe cartridge bias. Little valid data was produced from 01 January through May and again from October through the end of 2011.

Eight other sites experienced periods of downtime greater than 2 weeks

GA40 data from 23 March to 08 May was assigned multiple invalidation flags leaving little valid data for that period.

NY06 experienced 2537 pump failure from 20 April to 10 May and detector problems from 05 July to 08 August.

NY20 required the 2537 to be changed 10 times throughout 2011 with no valid data for the month of December.

OH02 was out of service for repair from 03 May to 19 May.

OK99 experienced 1130 pump failure from 29 July to 08 September, collecting GEM only.

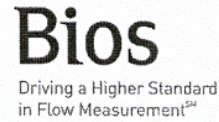
PA13 operated throughout 2011. Only GEM data for the period 26 August to 10 November was received.

UT97 was out of service until the site visit on 06 June.

**Table 5. Percent Valid Data by Site for 2011.**

<b>Site ID</b>	<b>GEM</b>	<b>GOM</b>	<b>PBM</b>
AL19	46	41	41
CA48	79	81	80
FL96	94	84	84
GA40	84	83	83
HI00	93	92	90
MD08	97	92	94
MD96	98	95	94
MD97	95	91	91
MS12	97	94	91
MS99	98	95	92
NS01	98	97	97
NY06	90	87	87
NY20	97	90	93
NY95	85	79	77
OH02	91	91	91
OK99	79	86	86
PA13	30	91	91
UT96	79	68	64
UT97	87	82	79
VT99	98	95	94
WI07	97	95	94
WV99	49	52	47
Average	84	85	84

## **Appendix – Test Equipment Calibration Documents**



## Calibration Certificate

<b>Certificate No.</b>	5006926	<b>Sold to:</b>	National Atmospheric Deposition Program- NADP - IL
<b>Product</b>	Definer 220 High Flow		1876 Lewis Road
<b>Serial No.</b>	114711		Mt. Hereb, WI 53572
<b>Cal. Date</b>	7/18/2011		USA

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.

### As Received Calibration Data

Technician Sonia Otero

Lab. Pressure 751 mmHg  
Lab. Temperature 22.5 °C

Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Received
498.96 sccm	501.995 sccm	-0.6%	1.00%	In Tolerance
4989.7 sccm	5007 sccm	-0.35%	1.00%	In Tolerance
30122 sccm	30039 sccm	0.28%	1.00%	In Tolerance
23.5 °C	22.5 °C	1°C	±0.8°C	Out of Tolerance
750 mmHg	751 mmHg	-1 mmHg	±3.5mmHg	In Tolerance

### Bios International Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML-800-44	103521	11/10/2010	11/10/2011
Precision Thermometer	305460	8/9/2010	8/9/2011
Precision Barometer	431/98-07	4/25/2011	4/24/2012

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**As Shipped Calibration Data**

Certificate No. 5021752                      Lab. Pressure     760 mmHg  
Technician Jacquella Shives              Lab. Temperature 22.4 °C

Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Shipped
502.62 sccm	501.285 sccm	0.27%	1.00%	In Tolerance
5009.9 sccm	5008.95 sccm	0.02%	1.00%	In Tolerance
30193 sccm	30150.5 sccm	0.14%	1.00%	In Tolerance
22.4 °C	22.4 °C	-	±0.8°C	In Tolerance
760 mmHg	760 mmHg	-	±3.5mmHg	In Tolerance

**Bios International Standards Used**

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML-800-44	101897	11/16/2012	11/16/2013
Precision Thermometer	305460	8/20/2012	8/20/2013
Precision Barometer	2981392	6/4/2012	6/4/2013

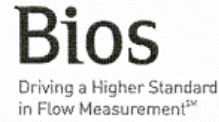
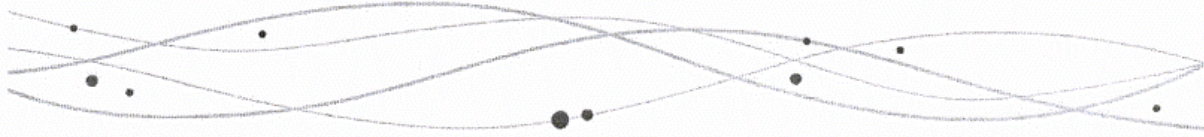
**Calibration Notes**

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 DryCat® Technology volumetric piston prover of much higher accuracy (±0.25 % or less) but of similar operating principles. For this purpose, a flow generator of ±0.10 % or less 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. Calibration Certificates 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: \_\_\_\_\_

David W. Wilson, Chief Metrologist

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(973) 492-8400 FAX (973) 492-8270 [www.biosint.com](http://www.biosint.com) [www.mesalabs.com](http://www.mesalabs.com) Symbol "MLAB" on the NASDAQ



## Calibration Certificate

<b>Certificate No.</b>	5006925	<b>Sold to:</b>	National Atmospheric Deposition Program- NADP - IL
<b>Product</b>	Definer 220 Medium Flow		1876 Lewis Road
<b>Serial No.</b>	113878		Mt. Hereb, WI 53572
<b>Cal. Date</b>	7/19/2011		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

<b>Technician</b>	Sonia Otero	<b>Lab. Pressure</b>	751 mmHg
		<b>Lab. Temperature</b>	22.6 °C

Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Received
100.32 sccm	100.415 sccm	-0.09%	1.00%	In Tolerance
1007.4 sccm	1009.2 sccm	-0.18%	1.00%	In Tolerance
5008.3 sccm	5007.55 sccm	0.01%	1.00%	In Tolerance
22.6 °C	22.6 °C	0°C	±0.8°C	In Tolerance
750 mmHg	752 mmHg	-2 mmHg	±3.5mmHg	In Tolerance

### Bios International Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML-800-24	100439	4/21/2011	4/20/2012
Precision Thermometer	305460	8/9/2010	8/9/2011
Precision Barometer	431/98-07	4/25/2011	4/24/2012

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**As Shipped Calibration Data**

Certificate No. 5021751                      Lab. Pressure     760 mmHg  
Technician Jacquella Shives              Lab. Temperature 22.4 °C

Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Shipped
100.51 sccm	100.45 sccm	0.06%	1.00%	In Tolerance
1004.9 sccm	1005.15 sccm	-0.02%	1.00%	In Tolerance
4998.2 sccm	5003.65 sccm	-0.11%	1.00%	In Tolerance
22.4 °C	22.4 °C	-	±0.8°C	In Tolerance
760 mmHg	760 mmHg	-	±3.5mmHg	In Tolerance

**Bios International Standards Used**

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML-800-24	100439	4/24/2012	4/24/2013
Precision Thermometer	305460	8/20/2012	8/20/2013
Precision Barometer	2981392	6/4/2012	6/4/2013

**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 less) but of similar operating principles. For this purpose, a flow generator of ±0.10 % or less 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. Calibration Certificates 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: \_\_\_\_\_

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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  $\mu$ l

Model 1702RN,25UL

Serial No. 06793 Accuracy 0.086%

Date of Calibration August 19, 2011

Calibrated by Jolene Mayer

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F/N69042 (Rev. G)

NIST test numbers: 821/878169-09 (Mass) S168036 (Temp) 822/785634-10 (Length)

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