2012 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^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 2012 the network consisted of 19 sites across North America. The concentrations of gaseous elemental mercury (GEM), gaseous oxidized mercury (GOM) and particulate bound mercury ($PBM_{2.5}$) 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 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 2012 twelve sites were surveyed by the AMNet Site Liaison. This report includes a summary of the findings from each of the surveys.

Changes in 2012 include the following:

MD08 (Frostburg, MD) discontinued operations on 01/03/2012

MS12 (Grand Bay, MS) collocated measurements stopped on 11/12/2012

MS12 (Grand Bay, MS) Ron Cole replaced Jake Walker as site operator in October 2012

MS99 (Grand Bay, MS – collocated instruments) Ron Cole replaced Jake Walker as site operator in October 2012

NS01 (Kejimkujik National Park) Rob Keenan replaced John Dalziel as site operator in September 2012

OH02 (Athens, OH) discontinued operations on 02/15/2012

VT99 (Underhill, VT) Mim Pendleton replaced Eric Miller as site operator in March 2012

WV99 (Canaan Valley, WV) discontinued operations on 10/14/2012

Changes to data in 2012 include the following:

NY06 (Bronx) GOM concentrations were adjusted by a factor of 4.167 for the period 01 January through 30 July (at 1820). Flag 4 was changed in the instrument BIOS, but the scale factor had not been changed.

NY95 (Rochester – collocated instrument) GOM concentrations were adjusted by a factor of 4.167 for the period 01 January through 12 July (at 1444). Flag 4 was changed in the instrument BIOS, but the scale factor had not been changed.

OK99 (Stilwell, OK) PBM and GOM concentrations were adjusted by a factor of 4.167 for the period 06 February (at 1320) through 20 September (at 2152). When the instrument was repaired all scale factors were reset in the instrument BIOS to 1.0 by mistake.

VT99 (Underhill, VT) GOM concentrations were adjusted by a factor of 5.21 for the period 01 January through 06 August. 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/).

2.1 AMNet Sites Surveyed in 2012

Site surveys were conducted at twelve AMNet sites in 2012. Station ID's, survey dates and station names are presented in Table 1. Two site IDs are associated with the sites at Grand Bay, MS and Beltsville, MD. These sites operated collocated instruments for at least a portion of the year.

Table 1. AMNet Sites Surveyed in 2012.

Site ID	Station Name	Survey Date
CA48	Elkhorn Slough	1/9/2012
HI00	Mauna Loa	1/13/2012
MD08	Piney Reservoir	7/3/2012
MD96/MD97	Beltsville	7/9/2012
MS12/MS99	Grand Bay NERR	3/7/2012
NY06	Bronx	7/11/2012
NY20	Huntington Wildlife Forest	8/8/2012
NY95	Rochester	7/12/2012
OH02	Athens	7/2/2012
UT97	Salt Lake City	6/12/2012
VT99	Underhill	8/6/2012
WV99	Canaan Valley Institute	7/5/2012

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
CA48	86	167	54	54	n/a	n/a
HI00	53	130	18	18	9	51
MD08	Removed from service, no instrumentation at site.					
MD96	25	342	88	n/a	n/a	151
MD97	25	314	82	88	74	151
MS12	36	254	69	66	53	147
MS99	36	291	78	67	n/a	147
NY06	n/a	327	84	n/a	n/a	n/a
NY20	35	321	57	n/a	46	n/a
NY95	46	326	83	n/a	n/a	n/a
OH02	54	174	47	47	36	81
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
CA48	1/9/2012	p	n/a	n/a	n/a	p	p	p	p
HI00	1/13/2012	p	p	p	p	p	p	p	f
MD08	7/3/2012	Removed from service							
MD96	7/9/2012	p	p	p	p	p	p	p	F
MD97	7/9/2012	p	p	p	F[3]	p	p	f	f
MS12	3/7/2012	p	p	p	F[3]	p	p	n/a	n/a
MS99	3/7/2012	p	p	p	F[3]	p	p	n/a	n/a
NY06	7/11/2012	p	p	p	p	p	p	p	F
NY20	8/8/2012	p	p	F/p[2]	F[3]	f	p	p	p
NY95	7/12/2012	p	p	p	p	p	p	p	p
OH02	7/2/2012	Removed from service							
UT97	6/12/2012	p	p	n/a	p	p	p	p	F
VT99	8/6/2012	p	p	p	p	f	n/a	n/a	n/a
WV99	7/5/2012	F[1]	p	p	n/a	F	F	n/a	F

[1] *1135 case temperature reading 175°C and was not repaired*
[2] *2537 flow was 17% low before being corrected*
[3] *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 direction (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
CA48	3.1	p	p	p	p	p	p	p	p
HI00	5.0	p	p	p	p	p	p	f	p
MD08	n/a	p	p	p	p	p	p	p	p
MD96	10	p	p	p	p	p	p	p	p
MD97	10	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
NY06	9.1	p	p	p	p	p	p	p	f
NY20	4.9	f	p	p	p	p	f	f	f
NY95	4.3	f	p	p	p	p	p	p	f
OH02	2.5	p	p	p	p	p	p	p	p
UT97	8.2	p	p	p	p	p	p	p	p
VT99	5.9	f	p	p	p	p	p	p	p
WV99	3.2	p	p	p	p	p	p	p	p

2.4 Instrument Repairs

In 2012, one instrument (located at VT99) required repairs in order to complete the survey. By comparison, in 2011, seven instruments required repairs in order to complete the survey.

3.0 Training

No formal training sessions were held in 2012. Informal training occurs as part of the site survey with the site liaison observing the maintenance activities, making recommendations. Site surveys at MS99 and VT99 occurred after new operators assumed responsibility for operation of the sites. As such, additional time was spent training the operators.

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 2012. Values are presented for each of the three forms of interest, that is, GEM, GOM, and $PBM_{2.5}$. Two sites, UT97 and WV99, did not meet data quality objectives (≥ 75% data completeness on annual basis) for 2012.

UT97 experienced two pump failures with the 2537, resulting in significant periods without data. The outage occurred 01-27 January. The second outage occurred 18 August through 17 October.

WV99 experienced severe channel bias between the cartridges from 01 January through 30 May. On 14 October, operations at WV99 were discontinued.

Two other sites experienced periods of downtime greater than 2 weeks, AL19 was shut down from 12 January through 12 March. Heater failure with the 1135 caused NY95 to be out of operation 01-25 August.

Table 5. Percent Valid Data by Site for 2012.

Site ID	GEM	GOM	PBM
AL19	92	92	92
FL96	88	86	86
GA40	84	85	85
HI00	90	86	85
MD96	98	98	96
MD97	98	97	97
MS12	97	94	92
MS99	96	92	85
NS01	96	96	96
NY06	98	94	94
NY20	94	93	93
NY95	83	87	80
OK99	75	89	88
UT97	86	76	76
VT99	97	95	96
WI07	95	95	88
WV99	38	36	36
Average	87	88	86

Appendix – Test Equipment Calibration Documents

NVLAP Lab Code 200661

Bios
Driving a Higher Standard in Flow Measurement℠

Calibration Certificate

Certificate No.	5006926	**Sold to:**	National Atmospheric Deposition Program-NADP - IL
Product	Definer 220 High Flow		1876 Lewis Road
Serial No.	114711		Mt. Hereb, WI 53572
Cal. Date	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

MesaLabs

NVLAP Lab Code 200661

As Shipped Calibration Data

Certificate No. 5021752
Technician Jacquella Shives

Lab. Pressure 760 mmHg
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 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: _____

David W. Wilson, Chief Metrologist

Bios International, a division of Mesa Laboratories Inc. 10 Park Place Butler, NJ 07405 USA
(973) 492-8400 FAX (973) 492-8270 www.biosint.com www.mesalabs.com Symbol "MLAB" on the NASDAQ

NVLAP Lab Code 200661

Bios
Driving a Higher Standard in Flow Measurement℠

Calibration Certificate

Certificate No.	5006925	**Sold to:**	National Atmospheric Deposition Program-NADP - IL
Product	Definer 220 Medium Flow		1876 Lewis Road
Serial No.	113878		Mt. Hereb, WI 53572
Cal. Date	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

Technician Sonia Otero

Lab. Pressure 751 mmHg
Lab. Temperature 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

MesaLabs

NVLAP Lab Code 200661

As Shipped Calibration Data

Certificate No. 5021751
Technician Jacquella Shives

Lab. Pressure 760 mmHg
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
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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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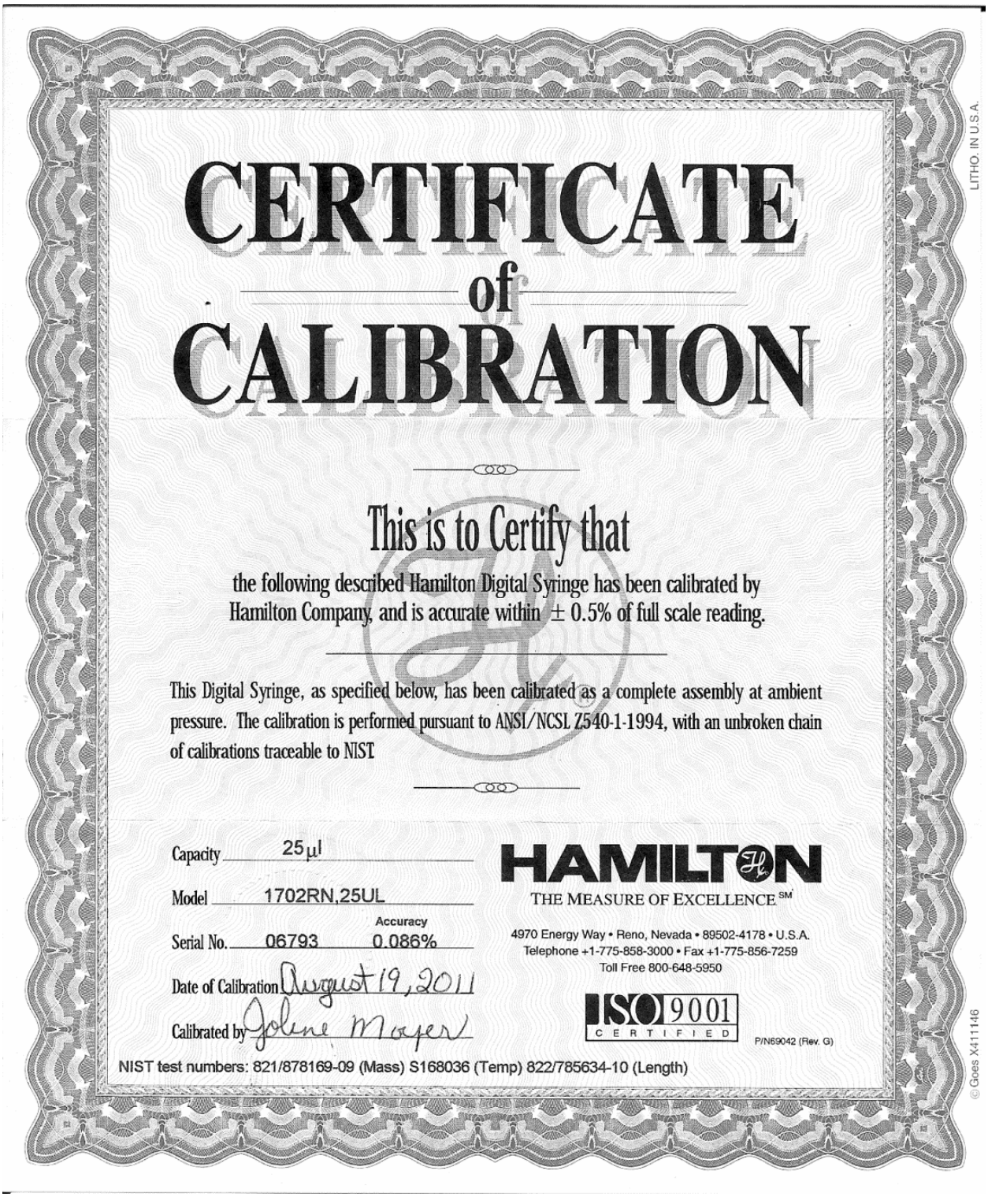

CERTIFICATE of CALIBRATION

This is to Certify that

the following described Hamilton Digital Syringe has been calibrated by Hamilton Company, and is accurate within ± 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 25µl

Model 1702RN,25UL

Serial No. 06793 Accuracy 0.086%

Date of Calibration August 19, 2011

Calibrated by Jolene Mayer

HAMILTON
THE MEASURE OF EXCELLENCE SM

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

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