

2016 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

°F	degrees Fahrenheit
°C	degrees Celsius
cm	centimeters
L	liters
μl	microliter (1 μl = 10 ⁻⁶ L)
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

Table of Contents

1.0 Introduction

2.0 Site Performance and Systems Surveys

- 2.1 AMNet Sites Surveyed in 2016
- 2.2 Instrument Test Results
- 2.3 Siting Criteria
- 2.4 Instrument Repairs
- 2.5 Certification of Test Equipment

3.0 Training

4.0 Data

Appendix Test Equipment Calibration Documents

List of Tables

Table 1	AMNet Sites.
Table 2	AMNet Sites Surveyed in 2016.
Table 3	Serial Numbers for Instruments at Surveyed Sites.
Table 4	Survey Results.
Table 5	Siting Criteria Obstructions and Inlet Heights.
Table 6	Flow meter calibration results from 2016 and 2017.
Table 7	Problems Impacting Data Completeness.
Table 8	Percent Valid Data by Site for 2016
Table 9	Number of Hourly Records by Site for 2016.

1.0 Introduction

The Atmospheric Mercury Network (AMNet) started in 2009. Twenty-five AMNet sites operated in 2016, including one site (Mt LuLin) in Taiwan (Table 1). The concentration of gaseous elemental mercury (GEM) was measured at all sites. Speciated mercury: gaseous oxidized mercury (GOM), and particulate bound mercury (PBM_{2.5}), was measured at 19 sites in 2016. Two sites (AK03 and NJ54) measure GEM only. Two sites (NY06 and NY43) changed to GEM-only in 2016. All measurements followed 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 2016, nineteen sites were surveyed by the AMNet Site Liaison. This report includes a summary of the findings from each of the surveys.

Table 1. AMNet Sites

NADP Site ID	State	Operating Agency	START_DATE	END_DATE	Lapse
AK03	Alaska	National Park Service	2/5/2014	Current	
AL03	Alabama	ARA Inc.	1/29/2016	11/9/2016	
AL19	Alabama	ARA Inc.	1/1/2009	6/28/2016	
FL96	Florida	ARA Inc.	1/1/2009	10/5/2016	
GA40	Georgia	ARA Inc.	1/1/2009	10/4/2016	
HI00	Hawaii	NOAA/EPA	12/30/2010	Current	
IN21	Indiana	LADCO	4/29/2016	Current	
MD08	Maryland	University of Maryland	1/1/2008	Current	6/30/2011 - 1/12/2012
MD98	Maryland	NOAA	11/7/2006	Current	
ME97	Maine	Micmac Tribe	12/3/2013	Current	
MI09	Michigan	University of Michigan	8/10/2015	7/11/2016	
MS12	Mississippi	NOAA	9/29/2006	Current	
NJ30	New Jersey	State of New Jersey	10/11/2016	Current	
NJ54	New Jersey	State of New Jersey	10/12/2016	Current	
NS01	Nova Scotia, Canada	Environment Canada	1/26/2009	Current	
NU15	Nunavut, Canada	Environment Canada	1/4/2002	Current	
NY06	New York	State of New York	8/27/2008	Current	
NY20	New York	SUNY ESF	11/21/2007	Current	
NY43	New York	State of New York	11/21/2007	Current	
OH02	Ohio	Ohio University	1/1/2007	Current	2/15/2012 – 9/24/2013
OH52	Ohio	Ohio State University	1/1/2012	Current	
OK99	Oklahoma	Cherokee Nation	10/20/2008	Current	
TW01	Taiwan	EPA Taiwan	1/1/2010	Current	
UT97	Utah	State of Utah	11/23/2008	Current	
VT99	Vermont	University of Vermont	1/1/2008	1/4/2016	
WI07	Wisconsin	State of Wisconsin	2/1/2012	Current	

Changes in 2016 include the following:

Six sites (AL03, AL19, FL96, GA40, MI09 and VT99) closed in 2016.

Four sites (AL03, IN21, NJ30 and NJ54) started in 2016.

Two sites (NY06 and NY43) changed to GEM only on February 4th and 11th, respectively.

Six sites replaced their existing Tekran mercury analyzers (either model 2537A or 2537B) with new Tekran model 2537X. These sites include: AL19, FL96, GA40, NY06, NY43 and TW01. FL96 and TW01 upgraded from model 2537A while AL19, GA40, NY06, and NY43 upgraded from model 2537B. AL03, a new site, also installed a Tekran model 2537X mercury analyzer.

In June 2016, speciation instrumentation was transferred from NY43 to NY20.

Two sites (ME97 and OK99) did not submit data for 2016.

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 inhibits an independent third party from providing this service. Site survey reports are completed to document problems that are discovered during the survey 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 in draft form and will be available from the NADP website (<http://nadp.isws.illinois.edu/>) once it has been approved.

2.1 AMNet Sites Surveyed in 2016

Site surveys were conducted at nineteen AMNet sites in 2016. Station ID's, survey dates and station names are presented in Table 2.

Table 2. AMNet Sites Surveyed in 2016.

Site ID	Station Name	Survey Date
AL03*†	Centerville	10/10/2016
AL19*	Birmingham	6/28/2016
FL96*	Pensacola	10/5/2016
GA40*	Yorkville	10/4/2016
HI00	Mauna Loa	9/17/2016
IN21†	Clifty Falls	4/29/2016
MD08	Piney Reservoir	2/10/2016
ME97	Presque Isle	9/23/2016
MI09*	Pellston	5/24/2016
MS12	Grand Bay NERR	12/13/2016
NJ30†	New Brunswick	10/11/2016
NJ54†	Elizabeth	10/12/2016
NY06	Bronx	6/8/2016
NY20	Huntington Forest	4/12/2016
NY43	Rochester	6/6/2016
OH02	Athens	6/20/2016
OH52	South Bass Island	5/9/2016
UT97	Salt Lake City	5/5/2016
WI07	Horicon	9/8/2016

* Site closed during 2016. † Site started during 2016.

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 3 lists the serial numbers for the AMNet instruments at each site. Illegible serial numbers are listed as “n/a” (not available). Not present instruments are listed as “n/p”. NJ54 (Elizabeth) measured GEM only.

Table 3. Serial Numbers for Instruments at Surveyed Sites.

Site ID	1102	2537	1130P	1130	1135	2505
AL03	n/p	5103	6	n/a	n/a	96
AL19	73	5102	87	9	n/a	144
FL96	74	5101	9	n/a	n/a	28
GA40	5	5104	118	n/a	n/a	104
HI00	53	130	18	18	9	51
IN21	n/p	312	083	n/a	n/a	n/p
MD08	85	220	61	60	48	73
ME97	125	5041	150	147	134	232
MI09	n/p	345	95	91	81	n/p
MS12	36	291	69	66	53	147
NJ30	140	5114	167	162	152	n/p
NJ54	n/p	5110	n/p	n/p	n/p	n/p
NY06	n/p	5035	n/p	n/p	n/p	90
NY20	46	326	147	144	133	n/p
NY43	n/p	5039	n/p	n/p	n/p	n/p
OH02	54	174	47	47	36	n/p
OH52	94	397	112	n/a	n/a	196
UT97	77	364	105	103	88	169
WI07	95	396	117	110	97	231

Table 4 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. Parameters that were not tested are listed as “n/a.” ME97 and UT97 did not have argon during the site visit. As such, full surveys could not be performed at those sites. Again, the *Site Performance and Systems Survey* document is a draft document. It will be posted on the NADP website when it has been approved.

Table 4. Survey Results.

Site ID	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
AL03	p	p	p	p	p	p	p	p
AL19	p	P	p	p	p	p	p	p
FL96	p	p	p	p	p	p	p	f
GA40	p	p	p	p	p	p	p	f
HI00	p	p	p	p	p	p	p	f
IN21	p	p	p	p	p	n/a	n/a	n/a
MD08	p	p	p	p	p	p	p	p
ME97	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
MI09	p	p	p	p	p	p	p	p
MS12	p	p	p	f	p	p	p	p
NJ30	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
NJ54	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
NY06	n/a	p	p	p	p	p	f	p
NY20	p	p	p	p	p	p	p	p
NY43	n/a	n/a	p	p	p	p	p	p
OH02	p	p	p	p	p	p	f	f
OH52	p	p	p	p	p	p	p	p
UT97	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
WI07	p	p	p	p	p	p	p	f

2.3 Siting Criteria

Compliance with siting criteria is evaluated with regard to obstructions (>20°) in each of 8 directions (i.e., N, NE, E, SE, S, SW, W, and NW) from the instrument inlet. Also, the height from the ground to each inlet is measured. Results are presented in Table 5. 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. Site photos can be found at:

<http://nadp.isws.illinois.edu/data/sites/list/?net=AMNet>

Table 5. Siting Criteria Obstructions and Inlet Heights.

Site	Inlet Height (m)	N	NE	E	SE	S	SW	W	NW
AL03	5.1	p	p	p	p	p	p	p	p
AL19	5.2	p	p	p	p	p	p	p	p
FL96	5.2	p	p	p	p	p	p	p	p
GA40	5.2	p	p	p	p	p	p	p	p
HI00	5.1	p	p	f	p	p	p	p	p
IN21	3.6	p	p	p	p	p	p	p	p
MD08	3.1	p	p	p	p	p	p	p	p
ME97	3.4	p	p	p	p	p	p	p	p
MI09	1.4	f	p	p	p	p	p	p	f
MS12	10	p	p	p	p	p	p	p	p
NJ30	4.9	p	p	f	p	p	p	p	p
NJ54	3.2	f	p	p	p	p	p	f	p
NY06	14.1	p	p	p	p	p	p	p	p
NY20	4.9	p	p	p	p	p	p	p	p
NY43	4.3	f	p	p	p	p	p	p	f
OH02	2.5	p	p	p	p	p	p	p	p
OH52	1.9	f	f	f	f	p	f	p	p
UT97	8.2	p	p	p	p	p	p	p	p
WI07	4.8	p	p	p	p	p	p	p	p

2.4 Instrument Repairs

In 2016, no instruments needed repair.

2.5 Test Equipment Calibration

Two Bios Definer 220 flow meters are used to verify analyzer and inlet flow rates. The high range meter (3-30 lpm) is used to measure the inlet flow rate. The medium range meter (0.5-5 lpm) is used to measure the 2537 sample flow rate. Each flow meter is certified annually checking the thermocouple, the barometer, and three flow rates across the range of the instrument. Values are reported both pre- and post-calibration (i.e., as-received and as-shipped). Table 6 lists the calibration results for the two flow meters as reported in January 2016 (the start of the reporting year) and in February 2017 (the end of the reporting year).

Table 6. Flow Meter Calibration Results for 2016 and 2017.

Flow Meter		Calibration Date	
		01/2016	02/2017
medium range (0.5 – 5.0 lpm)	as-received	within tolerance for all parameters	Flow rates low by 6.5%
	as-shipped	within tolerance for all parameters	within tolerance for all parameters
high range (3 – 30 lpm)	as-received	within tolerance for all parameters	Flow rates low by 7.0%
	as-shipped	within tolerance for all parameters	within tolerance for all parameters

Before each site visit, field flow meters were verified against the laboratory flow meters. Both meters were checked 5 times during the year. The greatest difference measured was 1.2% on the medium and 1.1% on the high range meter, both on 09/07/2016. All other checks were well below 1% difference.

A Tekran 2505 Mercury Vapor Primary Calibration Unit and a certified Hamilton 25 µL syringe (model 1702RN) are used to validate instrument internal permeation sources. On February 8, 2017 syringe SN 6793 was found to be within tolerance both as-received and as-shipped, SN 7473 was received with a clogged tip and did not pass. As a preventative measure, tips will be replaced at least annually.

3.0 Training

No formal AMNet training sessions held in 2016. Operator performance is reviewed with each site visit.

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 7 lists problems impacting data completeness for individual sites. Table 8 lists the percentage of valid data collected at each site in 2016. Values are presented for each of the three forms of mercury that are measured including: GEM, GOM, and PBM_{2.5}. Two sites did not meet data quality objectives ($\geq 75\%$ data completeness on an annual basis) for GEM in 2016. One site did not meet data quality objectives for GOM and two sites for PBM_{2.5}.

Table 7. Problems Impacting Data Completeness.

SiteID	Problem Description	Period Impacted
IN21	Electrical problems impacting PBM _{2.5} measurements	May
MI09	No argon gas	multiple
UT97	Trap bias	multiple

Table 9 lists the number of hourly records for each of the three forms of mercury at each site in 2016. It is important to note that some sites measure 1-hour mean values for GOM and PBM, while other sites measure a 2-hour mean value. The sampling period will impact the number of samples that can be collected during the course of the year. Accounting for calibration periods, a site that measures a 2-hour mean value will have approximately 5,800 records for GEM, and approximately 2,800 records for GOM and PBM, during the year. A site that measures 1-hour mean values will have approximately 4,300 records for GEM, and approximately 4,260 records for GOM and PBM. GEM-only sites will have approximately 8,600 records. Entries in red indicate site and mercury species that do not meet the completeness criterion of $\geq 75\%$ valid data for the year.

Table 8. Percent Valid Data by Site for 2016*.

Site ID	GEM	GOM	PBM _{2.5}
AK03	87	n/a	n/a
AL03	94	93	93
AL19	96	95	95
FL96	97	98	98
GA40	97	96	97
HI00	92	89	90
IN21	84	78	72
MD08	85	94	94
MD98	96	95	95
ME97	n/a	n/a	n/a
MI09	49	77	78
MS12	97	91	88
NJ30	89	75	75
NJ54	99	n/a	n/a
NS01	97	95	95
NY06	99	99	99
NY20	77	83	84
NY43	99	99	99
OH02	95	92	83
OH52	79	79	79
OK99	n/a	n/a	n/a
TW01	Data QA performed external to NADP.		
UT97	26	31	31
VT99	99	99	99
WI07	98	95	93
Average	90	89	87

* Based on period of operation.

Table 9. Number of Hourly Records by Site for 2016*.

Site ID	GOM, PBM sampling period (hour)	NGEM	NGOM	NPBM
AK03	GEM only	7145	0	0
AL03	1	2689	2689	2689
AL19	1	1659	1659	1659
FL96	1	3365	3365	3365
GA40	1	2978	2978	2978
HI00	1	3539	3539	3539
IN21	2	1400	1399	1399
MD08	2	1883	1883	1883
MD98	1	4046	4047	4047
ME97	2	no data submitted		
MI09	2	549	549	549
MS12	1	3360	3361	3361
NJ30	2	575	575	575
NJ54	GEM only	1839	0	0
NS01	2	2768	2768	2768
NY06	2 GEM only from 2/4/2016	8022	269	269
NY20	2	2305	2306	2306
NY43	2 GEM only from 2/11/2016	7561	295	295
OH02	2	2451	2452	2452
OH52	2	2229	2230	2230
OK99	2	no data submitted		
TW01	2	8784	2471	2471
UT97	1	1644	1644	1644
VT99	2	27	27	27
WI07	2	2882	2883	2883

* Refer to Table 1 for period of operation for each site.

Appendix – Test Equipment Calibration Documents



Calibration Certificate

CertificateNo. 140065	Sold To: National Atmospheric Deposition Program (NADP) 2204 Griffith Drive Champaign, IL 61820 US
Product 200-220M Definer 220 Medium Flow	
Serial No. 113878	
Cal. Date 12-Jan-2017	

All calibrations are performed at Mesa Laboratories, Inc., 10 Park Place, Butler, NJ, 07405, an ISO 17025:2005 accredited laboratory through NVLAP of NIST. 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.

As Received Calibration Data

Technician	Lilianna Malinowska	Lab. Pressure	760 mmHg
		Lab. Temperature	22.2 °C

Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Received
4482.66 sccm	4821.41 sccm	-7.03%	1.00%	Out of Tolerance
1014.18 sccm	1091.39 sccm	-7.07%	1.00%	Out of Tolerance
265.49 sccm	286.66 sccm	-7.39%	1.00%	Out of Tolerance
20.1 °C	21.5 °C	-	± 0.8°C	Out of Tolerance
766 mmHg	759 mmHg	-	± 3.5 mmHg	Out of Tolerance

Mesa Laboratories Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML-800-24	100439	16-Jun-2016	16-Jun-2017
Precision Thermometer	305460	19-Sep-2016	19-Sep-2017
Precision Barometer	2981392	12-Jul-2016	12-Jul-2017



As Shipped Calibration Data

Certificate No 140065 Lab. Pressure 763 mmHg
Technician Lilianna Malinowska Lab. Temperature 22.2 °C

Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Shipped
4828.34 sccm	4828.54 sccm	0.0%	1.00%	In Tolerance
1089.31 sccm	1092.09 sccm	-0.25%	1.00%	In Tolerance
284.99 sccm	286.75 sccm	-0.61%	1.00%	In Tolerance
22.4 °C	22.4 °C	-	± 0.8°C	In Tolerance
761 mmHg	761 mmHg	-	± 3.5 mmHg	In Tolerance

Mesa Laboratories Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML-800-24	100439	16-Jun-2016	16-Jun-2017
Precision Thermometer	305460	19-Sep-2016	19-Sep-2017
Precision Barometer	2981392	12-Jul-2016	12-Jul-2017

Calibration Notes

The expanded uncertainty of flow, temperature, and pressure measurements all have a coverage factor of $k = 2$ for a confidence interval of approximately 95%.

Flow testing is in accordance with our test number PR18-13 with an expanded uncertainty of 0.18% using high-purity nitrogen or filtered laboratory air. Flow readings in sccm are performed at STP of 21.1°C and 760 mmHg.

Pressure testing is in accordance with our test number PR18-11 with an expanded uncertainty of 0.16 mmHg.

Temperature testing is in accordance with our test number PR18-12 with an expanded uncertainty of 0.04 °C.

Traceability to the International System of Units (SI) is verified by accreditation to ISO/IEC 17025 by NVLAP under NVLAP Code 200661-0.

Technician Notes:

Louis Guido, Chief Metrologist



Calibration Certificate

CertificateNo. 140064	Sold To: National Atmospheric Deposition Program (NADP) 2204 Griffith Drive Champaign, IL 61820 US
Product 200-220H Definer 220 High Flow	
Serial No. 114711	
Cal. Date 12-Jan-2017	

All calibrations are performed at Mesa Laboratories, Inc., 10 Park Place, Butler, NJ, 07405, an ISO 17025:2005 accredited laboratory through NVLAP of NIST. 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.

As Received Calibration Data

Technician	Lilianna Malinowska	Lab. Pressure	759 mmHg
		Lab. Temperature	22.4 °C

Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Received
24636.9 sccm	26344.75 sccm	-6.48%	1.00%	Out of Tolerance
4941.79 sccm	5285.66 sccm	-6.51%	1.00%	Out of Tolerance
1512.94 sccm	1617.78 sccm	-6.48%	1.00%	Out of Tolerance
20.1 °C	21.7 °C	-	± 0.8°C	Out of Tolerance
767 mmHg	758 mmHg	-	± 3.5 mmHg	Out of Tolerance

Mesa Laboratories Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML-800-44	103521	06-Jul-2016	06-Jul-2017
Precision Thermometer	305460	19-Sep-2016	19-Sep-2017
Precision Barometer	2981392	12-Jul-2016	12-Jul-2017



As Shipped Calibration Data

Certificate No 140064 **Lab. Pressure** 763 mmHg
Technician Lilianna Malinowska **Lab. Temperature** 22.4 °C

Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Shipped
26382.3 sccm	26360.92 sccm	0.08%	1.00%	In Tolerance
5290.53 sccm	5289.14 sccm	0.03%	1.00%	In Tolerance
1620.3 sccm	1617.68 sccm	0.16%	1.00%	In Tolerance
22.4 °C	22.4 °C	-	± 0.8°C	In Tolerance
761 mmHg	761 mmHg	-	± 3.5 mmHg	In Tolerance

Mesa Laboratories Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML-800-44	101897	18-Jul-2016	18-Jul-2017
Precision Thermometer	305460	19-Sep-2016	19-Sep-2017
Precision Barometer	2981392	12-Jul-2016	12-Jul-2017

Calibration Notes

The expanded uncertainty of flow, temperature, and pressure measurements all have a coverage factor of k = 2 for a confidence interval of approximately 95%.

Flow testing is in accordance with our test number PR18-13 with an expanded uncertainty of 0.18% using high-purity nitrogen or filtered laboratory air. Flow readings in sccm are performed at STP of 21.1°C and 760 mmHg.

Pressure testing is in accordance with our test number PR18-11 with an expanded uncertainty of 0.16 mmHg.

Temperature testing is in accordance with our test number PR18-12 with an expanded uncertainty of 0.04 °C.

Traceability to the International System of Units (SI) is verified by accreditation to ISO/IEC 17025 by NVLAP under NVLAP Code 200661-0.

Technician Notes:

Louis Guido, Chief Metrologist

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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. 07473 Accuracy 0.194%

Date of Calibration February 8, 2017

Calibrated by K. Jones

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

PN69042 (Rev. G)

NIST test numbers: 822/272872-11 (Mass) Z236411 (Temp) 683/283699-13 (Length)

9H111X1 ssp0e

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. 06793 Accuracy -0.125%

Date of Calibration February 8, 2017

Calibrated by E. Jones

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