NADP AMNet Operations Manual 2015-03
Version 1.2

Atmospheric Mercury Network
Site Operations Manual

National Atmospheric Deposition Program

For information about the National Atmospheric Deposition Program (NADP) contact:

NADP Program Office
Illinois State Water Survey
University of Illinois at Urbana-Champaign
2204 Griffith Drive
Champaign, Illinois 61820-7495

URL: http://nadp.isws.illinois.edu
e-mail: nadp@isws.illinois.edu
phone: 217-333-7871

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Abbreviations

ACS	American Chemical Society
AIRMoN	Atmospheric Integrated Research Monitoring Network
AMNet	Atmospheric Mercury Network
AMoN	Ammonia Monitoring Network
CAMD	Clean Air Markets Division
CAMNet	Canadian Atmospheric Mercury Network
CASTNET	Clean Air Status and Trends Network
CVAFS	Cold Vapor Atomic Fluorescence Spectroscopy
DFU	Dry Filter Unit
DQO	Data Quality Objective
GEM	Gaseous Elemental Mercury (expressed in ng/m^3)
GOM	Gaseous Oxidized Mercury (expressed in pg/m^3)
Hg	Mercury
MDE	Mercury Deposition Event
MDN	Mercury Deposition Network
MSDS	Material Safety Data Sheet
NADP	National Atmospheric Deposition Program
NED	Network Equipment Depot
NIST	National Institute of Standards and Technology
NTN	National Trends Network
NP	No Peak
NYSDEC	New York State Department of Environmental Conservation
$PBM_{2.5}$	Particulate-Bound Mercury less than 2.5 μm in diameter (expressed in pg/m^3)
PO	Program Office
QA	Quality Assurance
QAAG	Quality Assurance Advisory Group
QC	Quality Control
RespFctr	Response Factor
RGM	Reactive Gaseous Mercury (expressed in pg/m^3)
RPF	Regenerable Particulate Filter
SAES	State Agricultural Experiment Stations
SOP	Standard Operating Procedures
TGM	Total Gaseous Mercury
UHP	Ultra-High Purity
U.S. EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UV	Ultraviolet

Units and Conversion Factors

°	degrees
°C	degrees Celcius
cm	centimeters
L	liters
lpm	liters per minute
m/sec	meters per second
mbar	millibars (1 mbar = 10^{-3} bar)
mm	millimeters (1 mm = 10^{-3} m)
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
psi	pounds per square inch
µm	micrometer (1 µm = 10^{-6} m)
V	volts
W/m^2	Watts per square meter

Introduction

The Atmospheric Mercury Network (AMNet) became an official network within the National Atmospheric Deposition Program (NADP) in the fall of 2009. The goal of this network is the measurement of the concentration of mercury species in the atmosphere on a continuous basis. This document, the *Atmospheric Mercury Network Operations Manual,* ensures consistent operation in the collection of ambient mercury data between sites and over time.

Practices described in this document resulted from an NADP questionnaire on the operation of an automated speciated ambient mercury monitoring unit. It incorporates discussions at the following meetings, workshops, and conferences:

- NADP Spring Conference in Riverside, CA on May 1, 2006
- Atmospheric Mercury Scientists Workshop in Chicago, IL on June 27, 2006
- NADP Fall Conference in Norfolk, VA on October 24-26, 2006
- NADP Spring Conference in Burlington, VT on April 9-10, 2007, and
- Atmospheric Mercury Best Practices and SOP Workshop in Chicago IL on October 3-4, 2007.

These meetings brought together atmospheric mercury scientists from throughout North America to discuss the best practices for monitoring ambient mercury.

Site Selection and Site Re-location

Sites in the NADP networks are selected to quantify the impact of deposition in major physiographic, agricultural, aquatic, and forested areas within states, regions, and ecoregions. Sites are located away from urban areas and point sources of pollution, e.g., coal-fired power plants. Siting criteria for each network are presented in detail in the *NADP Site Selection and Installation Manual* (NADP, 2009b). That document is available on the NADP website (http://nadp.isws.illinois.edu).

Should a site need to re-locate, the site sponsor should contact the Site Liaison to ensure that the new location meets NADP siting criteria. Additional information regarding site re-location is available in the *NADP Site Selection and Installation Manual*.

Approved Equipment

Table 1 lists the equipment that has been approved by the NADP for use in AMNet. Table 2 lists the recommended inventory for AMNet consumable materials. Periodically, equipment is tested and evaluated for inclusion in the network. Additional information on the procedures for evaluating and approving new equipment is available on the NADP website. The NADP website should be consulted for the most current list of approved equipment. Questions regarding the list of approved equipment may be directed to the Site Liaison for the network. Contact information for each of the manufacturers, and for the Site Liaisons is included in the Contact List section of this document.

Table 1. NADP approved equipment for use in the AMNet.

Equipment	Manufacturer*	Model Number
Continuous Mercury Vapour Analyzer	Tekran	2537A or 2537B
Air Dryer	Tekran	1102
Continuous Oxidized Mercury Speciation Module	Tekran	1130
Continuous Particulate Mercury Module	Tekran	1135

* **Disclaimer:** The use of a trade or manufacturer's name does not constitute an endorsement by the University of Illinois, the Illinois State Water Survey, or the NADP.

Table 2. Recommended inventory for AMNet consumable materials.

Description	Part Name	Tekran Part Number	Quantity
For operation of the Tekran 2537A	UV analytical lamp, 1"	90-25180-01	1
	Gold cartridge, matched pair	35-25500-00	1
	Zero air canister	90-25360-00	1
	Dry filter unit filter	90-25115-04	1
	Particulate filter, pore size 0.2 µm, diameter 47 mm	90-25102-100	10
	Injection port septum	90-25110-100	10
	Cartridge heater, pair	model specific	1
	Pump diaphragm and brushes	model specific	1
	V2 valve	80-25600-00	1
	Soda lime cartridge	90-13310-64	1
	¼" Teflon ferrules	30-25300-05	2
For operation of the Tekran 1130	Impactor disks	30-13127-10	10
	Particulate filter, borosilicate glass, pore size 1.0 µm , diameter 47 mm	90-13110-100	10
	Zero air canister	90-25360-00	2
	Dry filter unit filter	90-25115-00	2
	Impactor inlet assembly	several	1
	Pump diaphragm and brushes	model specific	1
	Quartz denuder (body only)	30-13100-00	2
For operation of the Tekran 1135	Quartz filter disks for regenerable particulate filter, pore size 0.1 µm, diameter 21 mm	90-13500-25	10
	Quartz wool regenerable particulate filter fill material	90-13510-25	1
	GL14-GL18 union	30-13510-00	1
	Teflon 90 reducing union ⅜" – ¼" elbow	30-13520-00	1
	Quartz regenerable particulate filter assembly	30-13500-00	2

Site Operation

Four entities have direct responsibility for the operation of a monitoring site: the Site Sponsor, the Funding Agency, the Site Operator, and the Site Supervisor. The individuals in these roles are responsible for the operation of the site in accordance with standard AMNet procedures and criteria.

The Site Sponsor may provide in-kind services for the operation of the monitoring site. This may include: site location, site facilities, and/or a site operator. The Funding Agency provides funds for the operation of a site. This may include: equipment, consumables, personnel, utilities, and other expenses related to operation of the site. In some cases the Site Sponsor and the Funding Agency are the same.

Tables 3 and 4 indicate the responsibilities of the Site Supervisor and the Site Operator, respectively, and the frequency of those activities.

It is recommended that each site identify a Backup Operator. The Backup Operator performs Site Operator duties when the Primary Operator is not available.

Excluding travel to and from the site, activities associated with operation of an AMNet site are expected to take at least two hours per visit to complete.

To avoid confusion with the data at a site, it is recommended that AMNet equipment clocks remain on local standard time throughout the year. Clocks should not be changed with Daylight Savings Time (DST).

Table 3. Responsibilities of the Site Supervisor.

Activity	Frequency
Ensure conformance with AMNet procedures	As needed
Ensure conformance with AMNet siting criteria	As needed
Review site data	Monthly
Review data reports and summaries	Annually
Arrange for resources to correct problems	As needed

Table 4. Responsibilities of the Site Operator.

Activity	Frequency
Inspect data	At least twice a week
Inspect site for compliance with siting criteria	Each visit*
Verify operation of the atmospheric mercury equipment	Each visit*
Verify the operation of the meteorological equipment, if applicable**	Each visit*
Site Report A *Each Visit/Weekly Activities****	Complete: each visit Submit to PO: monthly
Site Report B *Glassware Change-out/Monthly Activities****	Complete: as needed Submit to PO: monthly
Site Report C *Quarterly Activities****	Complete: as needed Submit to PO: quarterly
Site Report D *Annual/As-Needed Activities****	Complete: as needed Submit to PO: when completed
Troubleshoot equipment	As needed
Equipment repairs and maintenance	As needed
Replace/upgrade equipment	As needed
Participate in External Site Performance and Systems Survey	Once every 2 years

* an AMNet site should be visited at least once every two weeks.
** meteorological measurements are not part of AMNet. This information is included as a convenience to site operators.
*** Site Reports A-D are discussed in separate Standard Operating Procedure documents.

This document does not address safety or waste disposal issues that may result from the operation and maintenance of an AMNet site. It is the responsibility of the site operator and the site supervisor to determine regulatory requirements, and establish appropriate safety protocols. Each AMNet site is responsible for complying with all Federal, State, and local regulations governing waste management. Personnel may want to utilize the following references (see Appendix B for full reference):

- *Environmental Management Guide for Small Laboratories* (U.S. EPA, 2001),
- *Less is Better* (ACS, 2002), and
- *The Waste Management Manual for Laboratory Personnel* (ACS, 1990*)*

Meteorological equipment and meteorological measurements are <u>not</u> supported under AMNet. It is the responsibility of the site operator and the site supervisor to determine whether meteorological measurements are needed, and how those measurements should be supported.

Each Visit/Weekly Activities

As indicated in Table 4, some activities associated with the operation of an AMNet site must be performed each time the site is visited. These activities are described in more detail in the

Standard Operating Procedure (SOP) titled *Report A: Each Visit/Weekly Maintenance*, and are listed in Table 5. It is not necessary to visit the site each day or each week, but the data should be inspected at least twice a week.

Table 5. Weekly activities as reported in AMNet Site Report A.

Equipment	Maintenance Check
General	2537 date time correct
	Baseline voltage 0.100-0.250 V
	Baseline deviations < 0.100 V
	Peak status = OK, OKF, or NP
	Sample volume 5.0 L (adjustable)
	Calibration zero = 0.000
	SPAN RF ≥ 6 x 106
	Span difference A vs B ≤ 5%
	Desorbtion blank C = 0.000 pg/m3
	PBM clear peak
	GOM clear peak
	Argon tank ≥ 200 psi
	Regulator ≥ 30 psi
	2537 lamp light off
	2537 perm light blinking
	1130/1135 switches to auto
	1130 pump switch on
	1130 flow auto
	1102 warm to touch
	1102 drierite blue
1130 unit	Denuder temperature (sample) 50 °C
	Denuder temperature (desorb) 500 °C
	Elutriator heater temperature (sample) 50 °C
	Elutriator heater temperature (desorb) 75 °C
	1130 Case temperature 35-41 °C
	Sample line temperature 50 °C
1135 unit	Pyro temperature (sample) 50 °C
	Pyro temperature (desorb) 800 °C
	Part temperature (sample) 50 °C
	Part temperature (desorb) 800 °C
	1135 Case temperature 35-41 °C

Glassware Change-out/Monthly Activities

Table 6 lists activities that must be performed bi-weekly and monthly at an AMNet site. These activities are described in more detail in the Standard Operating Procedure (SOP) titled *Report B*

- *Field: Glassware Change-out/Monthly Maintenance*. A separate SOP, *Site Report B - Laboratory: Glassware Change-out/Monthly Maintenance*, describes activities that need to be completed before going to the field site.

Table 6. Glassware change-out and monthly activities as reported in AMNet Site Report B.

Frequency	Maintenance Check
Bi-weekly	Soda lime changed
	Soda lime changed (duplicate)
	Denuder changed
	Elutriator glassware changed
	1130 sample filter changed
	Leak check ≤ 0.3 ng/m^3
	Instrument meets specifications
Monthly	RPF changed
	GL 14-18 union cleaned
	1130 zero air filter changed

Quarterly Activities

Table 7 lists activities that must be performed quarterly at an AMNet site. Some activities are required each quarter. The second and the fourth quarters require additional maintenance checks that are unique to those quarters. These activities are described in more detail in the Standard Operating Procedure (SOP) titled *Report C - Field: Quarterly Maintenance*. Quarters are based on the calendar year. A separate SOP, *Site Report C – Laboratory: Quarterly Maintenance*, describes activities that need to be completed before going to the field site.

Table 7. Quarterly activities as reported in AMNet Site Report C.

Quarter	Maintenance Check
Each	2537 flow rate, instrument (lpm)
	2537 flow rate, measured (lpm)
	2537 flow rate, percent difference (%)
	1130 flow rate, instrument (lpm)
	1130 flow rate, measured (lpm)
	1130 flow rate, percent difference (%)
	Elutriator flow rate (lpm)
	Measured flow rate (lpm)
	Percent difference flow rate (%)
	2537 scale factor
	Cartridge A, mass injected (ng)
	Cartridge A, 2537 concentration (pg/m^3)
	Cartridge A, manual injection percent difference (%)
	Cartridge B, mass injected (ng)
	Cartridge B, 2537 concentration (pg/m^3)
	Cartridge B, manual injection percent difference (%)
	Nichrome heaters bright orange
	Instrument shelter air ≤ 10 ng/m^3 of mercury
	2537 sample filter changed
	Soda lime to 2537 sample line rinsed
	1130 flow within 3% of set point
Second only	1130 zero air canisters changed
	1130 pump tubing cleaned
	1130 DFU filters changed
Fourth only	2537 heater coils changed
	2537 zero air canister changed
	2537 DFU filter changed
	RPF elbow and tubing replaced
	1130 pump diaphram replaced
	1130 pump brushes ≥ 1 cm
	Denuder to RPF (14/18) union replaced

Annual/As-Needed Activities

Table 8 lists activities that must be performed annually at an AMNet site. These activities are described in more detail in the Standard Operating Procedure (SOP) titled *Report D: Annual/As-Needed Maintenance*. Depending on conditions at the site (e.g., relative humidity, line voltage) some maintenance activities may be required more frequently.

Table 8. Annual/as-needed activities as reported in AMNet Site Report D.

Equipment	Maintenance Check
2537	Lamp changed
	Gold cartridges changed -- New serial number
	Teflon valves cleaned
	Teflon valves replaced
	Cuvette cleaned
	Cuvette replaced
	Pump serviced
1130	Heated boot replaced
	Case heater replaced
1135	Case heater replaced
1130	Heated sample line rinsed
All	Independent audit performed
2537	Swap equipment -- New Serial Number
	Swap equipment -- New Cal Hg amount (pg)
1130	Swap Pump Module - New Serial Number
	Swap Sampling Head - New Serial Number
1135	Swap Sampling Head - New Serial Number

AMNet Site Reports

All AMNet Site Reports (i.e., Site Reports A-D) should be submitted to the NADP Program Office (PO) according to the schedule in Table 4. Information contained on these forms is used when performing quality assurance (QA) activities on the site data. Timely submission of all Site Reports is needed to ensure appropriate QA of the data, and early identification of problems.

Incomplete Reports require additional resources to process, and require a phone call to the Site Operator to gather the missing information. It is recommended that the Site Operator verify that the Report is complete and that the information is legible before submitting it.

Non-standard Operation

Problems encountered during the operation of the equipment, anomalies at the site (e.g., nearby fires, power outages), and problems discovered during the maintenance of the equipment should be documented in the Remarks section of the Site Report. See Figure 1. This information is useful when performing QA of the data.

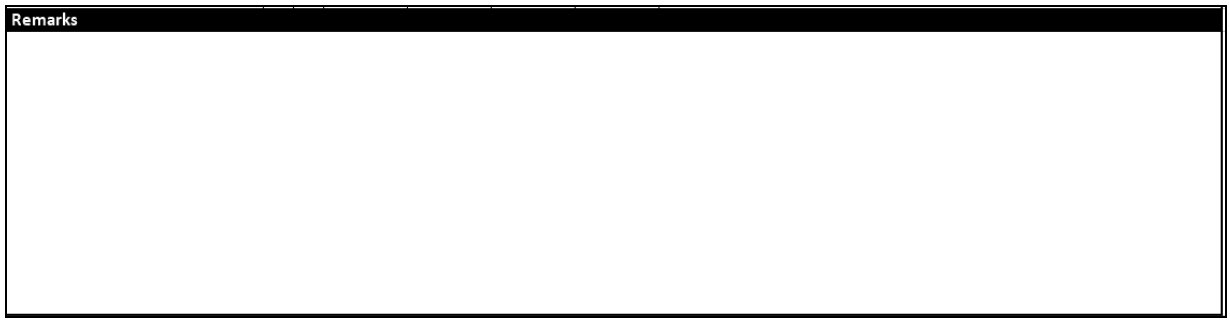

Figure 1. Remarks section of Site Report form**.**

Other Activities

The monitoring of mercury from wet-deposition is part of the NADP's Mercury Deposition Network (MDN). Additional information regarding the operation and maintenance of the MDN equipment may be found in the MDN Operations Manual and associated SOPs, and from the MDN Site Liaison. MDN documents are available from the NADP's website (http://nadp.isws.illinois.edu). Information contained in those documents will not be repeated here.

Though not part of AMNet, sites that monitor meteorological parameters should inspect that equipment on a regular basis. Table 9 suggests maintenance activities for the meteorological equipment, and a frequency for those activities. The U.S. EPA document *Meteorological Monitoring Guidance for Regulatory Modeling Applications* and the equipment user manuals should be consulted for additional recommendations.

Table 9. Other AMNet maintenance activities.

Equipment	Activity	Frequency
Wind Sensors	Visual inspection: equipment rotates freely, free of damage, reasonableness of data	Each visit
Temperature Sensor	Visual inspection: equipment free of damage, reasonableness of data	
Relative Humidity		
Atmospheric Pressure		
Solar Radiation		
Leaf Wetness		

Training

In addition to this manual and the AMNet SOPs, it is recommended that those responsible for the operation of a site read the document *NADP Site Selection and Installation Manual*. That document describes the NADP siting criteria and is available from the NADP website. Additional information regarding training in the use of AMNet equipment and operation of an AMNet site may be obtained from the AMNet Site Liaison. See Table 10 for contact information for the AMNet Site Liaison.

Troubleshooting

Many equipment problems can be resolved with phone support. The AMNet Site Liaison is a good resource for assistance with troubleshooting activities.

Appendix C lists the active Tekran Technical Notes. These documents contain useful information regarding the operation of the AMNet equipment. Individual Technical Note documents are available from the Service and Support section of the Tekran website. This is a secure site and requires a valid username and password to access. New Technical Notes may be added, and existing Technical Notes may be deprecated. Please consult the Tekran website for a current list of Technical Notes.

A separate troubleshooting document is planned and will address common AMNet equipment problems. That document will be posted on the NADP website (http://nadp.isws.illinois.edu) when it becomes available.

Field Quality Assurance Program

AMNet equipment operates continuously with 3-hour cycles. Standard operating practices include a 10-minute blank sample every 3rd hour and an instrument calibration at least once every 3 days. These activities ensure proper operation of the AMNet equipment and provide a means for assessing the quality of the data that is collected.

Other networks, including other NADP networks, use collocated equipment to provide an indication of the comparability, precision, and accuracy/bias of the measurements. The cost of the AMNet equipment makes such measurements cost-prohibitive at this time. It is hoped that these measurements can be included in AMNet in the future.

Site Performance and Systems Survey

Each site in the AMNet is surveyed once every 2 years by the AMNet Site Liaison. The Site Liaison will contact the site approximately one month prior to their visit to schedule the survey.

During the survey, the following items will be considered:

- verify the operation and calibration of the AMNet equipment
- document site information

- document compliance with siting criteria
- sketch and photograph the site
- verify conformance with NADP procedures
- answer operator questions
- assist with minor repairs and maintenance

As part of the site survey, the site operator will be asked to perform a glassware change.

A report will be sent to the Site Operator, the Site Supervisor, and the NADP QA Manager following completion of the survey. The report will provide findings from the survey including: a list of supplies to be ordered, items to be repaired, and conditions of the site relative to the approved siting criteria. Additional information regarding this program is available from the AMNet Site Liaison.

NADP Website

The NADP website can be accessed at http://nadp.isws.illinois.edu. The website contains the complete data archive for each site in the network, documents relating to the operation of the network, documentation from the site surveys, and a range of data products. Site Operators and Site Supervisors are encouraged to use the website.

Frequently Asked Questions

We would like to start a new site in the network. What do we need to do?

The "NADP Site Selection and Installation Manual" and the "Site Installation Worksheet" are two documents that will help with this process. Both documents are available from the NADP website. Once complete, the "Site Installation Worksheet," with a sketch and photos of the proposed site, should to be submitted to the NADP Program Office for possible acceptance in the network. Contact the Site Liaison for additional information.

A new operator will start next month and will assume primary responsibility for the site. What should we do?

First, we extend our thanks to the current site operator for all of their efforts operating and maintaining the site.

Next, contact the Site Liaison. The Site Liaison will need contact information for the new operator. If possible, provide overlap training for the new Site Operator. Provide a copy of this manual (the "Atmospheric Mercury Network Site Operations Manual"), and the "NADP Site Selection and Installation Manual." Both documents are available on the NADP website. An on-line training video for the AMNet is in production. These materials will be available on the NADP website.

I need to re-locate my site. What do I need to do?

The "NADP Site Selection and Installation Manual" includes guidance for site re-location. This document is available on the NADP website.

My site will be closing. What do I need to do?

Contact the Site Liaison. The final day of equipment operation will need to be documented.

What equipment is approved for use with an AMNet site?

Table 1 of this document lists the NADP approved equipment for use in the AMNet. The NADP website should be consulted for any changes to this list. In addition, a shelter is required to house the instrumentation, a sturdy mount is needed for external components, and a computer is needed for data collection.

Do I need to visit the site each day?

Daily visits are not required, but the field site should be visited at least once every 2 weeks. Remote access to the site can be used to monitor data capture, and to identify the onset of problems that require additional visits to the field site.

Daylight Savings Time (DST) starts/ends tomorrow, what do I need to do?

For an AMNet site, nothing needs to be done. The clocks associated with the AMNet equipment should remain on local standard time throughout the year. AMNet clocks should not be changed for DST. This avoids confusion with the data record for the site.

How frequently should I submit data and Site Reports?

Data and Site Reports should be submitted monthly. Timely submission of data and reports ensures appropriate QA of the data, and early identification of problems.

How do I submit data?

Raw, Tekran text files should be uploaded to the NADP PO using the following URL: http://nadp.isws.illinois.edu/upload/amn/.

How do I submit Site Reports?

Completed Site Reports should be emailed to the NADP PO at amnet@isws.illinois.edu or may be uploaded to http://nadp.isws.illinois.edu/upload/amn/.

Is loaner equipment available from NADP?

The AMNet Network Equipment Depot (AMNet NED) has some equipment that is available for loan in the event of equipment malfunction. Complete systems are not available. Please contact the Site Liaison for assistance.

Are meteorological measurements supported under AMNet?

Neither meteorological equipment nor meteorological measurements are supported under AMNet.

Contact Lists

Table 10. NADP contact information.

NADP Personnel		
Contact	**Phone Number**	**email address**
AIRMoN Site Liaison	800-952-7353	airmon@isws.illinois.edu
AMNet Site Liaison	608-335-4232	amnet@isws.illinois.edu
AMoN Site Liaison	800-952-7353	amon@isws.illinois.edu
MDN Site Liaison	877-622-6960	hal@eurofinsus.com
NTN Site Liaison	800-952-7353	ntn@isws.illinois.edu
Network Equipment Depot, wet-deposition networks	217-244-1913	tleon@illinois.edu
Network Equipment Depot, AMNet	608-335-4232	amnet@isws.illinois.edu
Site Performance and Systems Survey Program	217-244-6413	rhodes1@illinois.edu
USGS External Quality Assurance Program	303-236-1837	wetherbe@usgs.gov

Table 11. NADP approved equipment manufacturer contact information.

NADP Equipment Manufacturers		
Manufacturer	**Phone Number**	**URL**
ETI Instrument Systems, Inc.	970-484-9393	http://etisensors.com
Hach Environmental, Inc.	800-949-3766	http://www.hachenvironmental.com
Loda Electronics Company	217-386-2554	http://www.lodaelectronics.com
N-CON Systems Company, Inc.	800-932-6266	http://www.n-con.com
NovaLynx Corporation	530-823-7185	http://novalynx.com
Tekran Instruments Corporation	888-383-5726	http://www.tekran.com

Appendix A: Terms

accuracy – the closeness of agreement between the result of a measurement and its true value.

ANSI/ASQC E4-2004 – "Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs."

assessment – the evaluation process to measure the performance or effectiveness of a system and its elements; this all-inclusive term denotes evaluations, audits, or reviews.

atmospheric deposition – removal of particles and gases from the atmosphere via fallout or precipitation.

audit – a systematic and independent examination to determine whether practices comply with documented **QAPs** and **SOPs**, and that these practices are implemented effectively and are suitable to achieve stated objectives.

bias – systematic or persistent distortion of a measurement process that causes errors in one direction.

chemisorption – chemical adsorption. Adsorption at an exposed surface with the adsorbate surface undergoing a chemical change. That is, a new chemical species results at the surface.

comparability – a measure of the confidence with which one data set can be compared to another.

completeness – a measure of the amount of valid data obtained from a measurement system compared to the amount that was possible when **SOPs** are followed.

data quality assessment – scientific and statistical evaluations of validated data to determine if they are of the right type, quality, and quantity to support their intended use.

Data Quality Indicator (DQI) – quantitative statistics and qualitative descriptors used to interpret the degree of acceptability or utility of data to the user: principally **bias**/**accuracy**, **precision**, **comparability**, **completeness**, and **representativeness**.

Data Quality Objective (DQO) – qualitative and quantitative statements that specify the technical characteristics of data that are required to support the intended purposes and uses of the data. May include tolerances on the **Data Quality Indicators.**

deposition – see **atmospheric deposition**.

environmental data – any measurements or information that describe environmental processes, location, or conditions; ecological or health effects and consequences; or the performance of environmental technology. Environmental data include information collected directly from measurements, produced from models, and compiled from other sources such as databases or the literature.

Gaseous Elemental Mercury (GEM) – gas phase mercury in its ground electronic state with the chemical formula Hg^0. It is a mono-atomic gas.

Gaseous Oxidized Mercury (GOM) – oxidized gas phase compounds of mercury. It is sometimes called reactive gaseous mercury (RGM). GOM is believed to be the more accurate term as the term "reactive" can be misleading and imprecise.

metadata – data and other information about another related data set (e.g., instrument maintenance logs as metadata for direct instrument readings).

method detection limit (MDL) – the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. It is based on protocols in 40CFR Appendix B to part 136.

$PBM_{2.5}$ – mercury that is bound to particles of mean aerosol diameter less than or equal to 2.5 μm. Mercury is bound to the particle by means of physiosorption, chemisorption, or entrainment during aerosol production.

peer review – a critical review of a specific scientific and/or technical product to corroborate scientific defensibility, which may include an in-depth assessment of assumptions, calculations, extrapolations, alternative interpretations, methodology, acceptance criteria, and conclusions pertaining to the specific scientific and/or technical products and of the supporting documentation.

performance evaluation – a quantitative test to determine whether a measurement system can obtain results that meet tolerance limits.

physioadsorption - physical adsorption. Adsorption at an exposed surface with the adsorbate surface remaining intact. No chemical reaction takes place.

precision – a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions, expressed generally in terms of the standard deviation.

Quality Assurance (QA) – an integrated system of management activities involving planning, implementation, documentation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the necessary type and quality expected by the client; generally implemented before an activity has occurred.

Quality Assurance Plan (QAP) – a formal document describing in comprehensive detail the necessary QA, QC, and other technical activities that must be implemented to ensure that the results of the work performed will satisfy stated performance criteria.

Quality Control (QC) – the overall system of technical activities to measure the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; generally implemented while activities are being performed.

quality improvement – a management program to improve the quality of operations using a formal mechanism to encourage worker recommendations, timely management evaluation, and feedback or implementation.

Quality Management Plan (QMP) – a document that describes the quality system in terms of the organizational structure, functional responsibilities of management and staff, lines of authority, and required interfaces for those planning, implementing, and assessing all activities conducted.

Quality Management System (QMS) – the overall management system of the organization that determines and implements the quality policy. Includes strategic planning, allocation of resources, and other systematic activities (e.g., planning, implementation, documentation, and assessment) pertaining to the quality system.

record – a completed document that provides objective evidence of an item or process. Records may include photographs, drawings, magnetic tape, and other data recording media.

representativeness – a measure of the degree to which data accurately and precisely represent the characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

Reactive Gaseous Mercury (RGM) – see **gaseous oxidized mercury**.

specifications – a document stating requirements and that refers to or includes drawings or other relevant documents. They should indicate the means and criteria for determining conformance.

Standard Operating Procedure (SOP) – a written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps. The officially approved method for performing certain routine or repetitive tasks.

Statement of Work (SOW) – a written document detailing the procedures and deliverables required to meet contract obligations.

wet deposition – removal of particles and gases from the atmosphere via precipitation.

Appendix B: References

American Chemical Society (ACS). 2002. *Less is Better: Laboratory Chemical Management for Waste Reduction*, available from the American Chemical Society's Department of Governmental Relations and Science Policy, 1155 16th Street NW, Washington DC 20036, 202/872–4477.

American Chemical Society (ACS). 1990. *The Waste Management Manual for Laboratory Personnel*, available from the American Chemical Society's Department of Governmental Relations and Science Policy, 1155 16th Street NW, Washington DC 20036, 202/872–4477.

National Atmospheric Deposition Program (NADP). 2009a. *Mercury Deposition Network Site Operations Manual*. Illinois State Water Survey, Champaign, IL

National Atmospheric Deposition Program (NADP). 2009b. *NADP Site Selection and Installation Manual*. Illinois State Water Survey, Champaign, IL

National Atmospheric Deposition Program (NADP). 2009c. *NADP Site Information Worksheet*. Illinois State Water Survey, Champaign, IL

National Atmospheric Deposition Program (NADP). 2011a. *AMNet Standard Operating Procedure Site Report A: Each Visit/Weekly Maintenance.* Illinois State Water Survey, Champaign IL.

National Atmospheric Deposition Program (NADP). 2011b. *AMNet Standard Operating Procedure Site Report B: Glassware Change-out/Monthly Maintenance.* Illinois State Water Survey, Champaign IL.

National Atmospheric Deposition Program (NADP). 2011c. *AMNet Standard Operating Procedure Site Report C: Quarterly Maintenance.* Illinois State Water Survey, Champaign IL.

National Atmospheric Deposition Program (NADP). 2011d. *AMNet Standard Operating Procedure Site Report D: Annual/As Needed Maintenance.* Illinois State Water Survey, Champaign IL.

Tekran Instruments Corporation. 1999. *Model 2537A Mercury Vapour Analyzer: User Manual*. Toronto, Ontario.

Tekran Instruments Corporation. 1999. *Model 1130 Mercury Speciation Unit: User Manual*. Toronto, Ontario.

Tekran Instruments Corporation. 1999. *Model 1135P Particulate Mercury Unit*: User Manual. Toronto, Ontario.

United States Environmental Protection Agency (U.S. EPA). 2001. *Environmental Management Guide for Small Laboratories*. May 2000. EPA/233/B-00/00. Washington, D.C.

United States Environmental Protection Agency (U.S. EPA). 2000. *Meteorological Monitoring Guidance for Regulatory Modeling Applications*. EPA/454/R-99/005. Research Triangle Park, N.C.

Appendix C: List of Technical Notes

Equipment	Category	Technical Note Number*	Title
2537	Maintenance	TN2537_002	Cuvette Removal and Cleaning Procedure
		TN2537_003	Sample and Zero Air Inlet Filter Replacement Procedure
		TN2537_004	Pump Brushes Replacement Procedure
		TN2537_005	Lamp Replacement and Adjustment Procedure
		TN2537_011	Cleaning Procedure for Photo Diode of Lamp Block Assembly
		TN2537_202	Cuvette Reseal Kit for Models 2500 & 2537 Mercury Vapor Analyzer
	Component Replacement	TN2537_001	SBC Battery Replacement Procedure
		TN2537_006	Pump Replacement Procedure
		TN2537_007	Valve Replacement Procedure
		TN2537_008	Cartridge Heater Replacement Procedure
		TN2537_009	Cartridge Replacement Procedure
		TN2537_012	Procedure for Replacing Photo Diode of Lamp Block Assembly
		TN2537_305	New 2537A Mass Flow Controller (MFC) Replacement
	Contamination Procedures	TN2537_204	Liquid Flush Procedure for Model 2537 Mercury Vapor Analyzer
		TN2537_208	Heating Cartridges in Air to Overcome Efficiency Reduction
		TN2537_210	QA Procedure of Sample Line from Model 2537 Mercury Vapor Analyzer
	Upgrades	TN2537_010	Back Pressure Regulator Replacement Procedure
		TN2537_013	Lamp Driver Modification Kit Installation
		TN2537_108	Installation of Firmware Upgrades for Model 2537A Mercury Vapor Analyzer
		TN2537_201	2537A Firmware Upgrade
		TN2537_206	Installation and Regeneration of Gold Carrier Scrubber
		TN2537_304	New Model 2537A Zero Air Canister
		TN2537_306	Installation of Model 2537 Detector Insulation Kit
	Miscellaneous	TN2537_203	Installation of 80-25002-35 Heated Sample Line
		TN2537_205	Running Model 2537 without Zero Air May Inactivate Internal Permeation Source
		TN2537_207	Setup Checklist for Model 2537 Mercury Vapor Analyzer
		TN2537_307	Increasing Model 2537 Switching Power Supply Voltage to +26V
		TN2537_310	Model 2537A Scale Factor Loss on Power-Up

Equipment	Category	Technical Note Number*	Title
1130	Maintenance	TN1130_307	EPA Denuder Recoating Procedure
		TN1130_315	Pump Maintenance
	Component Replacement	TN1130_305	User Replaceable Heater Kit
	Upgrades	TN1130_200	Series 1100 Controller Download Kit
		TN1130_301	External Heater
		TN1130_302	Model 1130 Zero Canister Replacement Kit
		TN1130_303	Model 1130 Pump Upgrade Kit
		TN1130_304	Model 2537 and 1130 Sodalime Trap
		TN1130_306	New Model 1130 Controller
		TN1130_308	Sealing Cord Replacement Kit
		TN1130_309	Pump Drive Upgrade Kit
		TN1130_310	Using Tenax Filters with Model 1130
		TN1130_312	Support Bracket Upgrade Kit for Model 1130 Pump Module
		TN1130_318	Model 1130 & 1135 DataCom Logging Hardware Upgrades
	Miscellaneous	1130	Pre-Delivery Checklist for Model 1130 and Model 1135 Mercury Speciation Units
		TN1130_311	Moisture in Zero Air Canisters
		TN1130_313	Zero Air Plumbing Upgrade Kit for Model 1130 Pump and Denuder Modules
		TN1130_314	Model 1102 Air Dryer for Model 1130 Speciation System
		TN1130_316	1130/35 Heated Line Termination – Analyzer End
		TN1130_317	Tekran 1130 Sample Flow Reconciliation
1135	Upgrades	TN_315	Logging Hardware Modifications
		TN1135_001	1135 Heater Core Replacement

* Active Tekran Technical Notes as of 02/11/2011. Please visit the Tekran website for the latest list of Technical Note documents.