Equipment Evaluation and Approval, 2018-09
Version 2.0

Guidelines for Evaluation and Approval of Equipment for the NADP Wet Deposition Networks

National Atmospheric Deposition Program

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Document Change History

Version	Description	Effective Date
2.0	Updated contact information to Wisconsin State Laboratory of Hygiene.	09/2018
1.0	Initial document	05/2011

Abbreviations

AIRMoN	Atmospheric Integrated Research Monitoring Network
AMNet	Atmospheric Mercury Network
AMoN	Ammonia Monitoring Network
EC	Executive Committee of the NADP
MDN	Mercury Deposition Network
NADP	National Atmospheric Deposition Program
NOS	Network Operations Subcommittee
NTN	National Trends Network
PO	Program Office
QA	Quality Assurance
QAAG	Quality Assurance Advisory Group
QC	Quality Control
QR	Quality Rating
SOP	Standard Operating Procedure
U.S. EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WSLH	Wisconsin State Laboratory of Hygiene

Introduction

This document, *Guidelines for Evaluation and Approval of Equipment for the NADP Wet Deposition Networks*, details the criteria for the evaluation and approval of new equipment for use in the National Atmospheric Deposition Program (NADP) wet deposition networks. These networks include: the National Trends Network (NTN), the Mercury Deposition Network (MDN), and the Atmospheric Integrated Research Monitoring Network (AIRMoN).

Candidate equipment for use in the NADP wet deposition networks will be evaluated according to a multi-step process. Those steps are discussed below. Equipment may be submitted for consideration by the manufacturer, or by an advocate associated with the NADP.

Evaluation Process (Step 1)

First, the manufacturer's specifications for the equipment will be compared with the requirements for network use. Tables 1-3 indicate the minimum requirements for use in NADP wet deposition networks for raingages, wet deposition collectors, and sensors, respectively. Failure to meet one or more of these requirements may eliminate the equipment from further consideration.

Table 1. Minimum Requirements for Raingages in NADP Networks.

Parameter	Value
Capacity	10" of precipitation
Operating Temperature	-30 to 40°C
Accuracy	0.02" of precipitation
Resolution	0.01" of precipitation
Threshold	0.01" of precipitation
Power	12 V DC or 120 V AC
Time Resolution	1 hour
Output	Continuous chart or digital time series

Table 2. Minimum Requirements for Wet Deposition Collectors in NADP Networks.

Parameter	Value
Capacity	2 L of precipitation
Operating Temperature	-30 to 40°C
Open	Within 15 seconds of sensor signal event
Close	Within 15 seconds of sensor signal event
Power	12 V DC or 120 V AC
Event	Time referenced recording of collector opening and closing
Types of Deposition	Wet deposition only
Types of Precipitation	All
Temperature Control	Option to allow control of sample temperature

Table 3. Minimum Requirements for Sensors in NADP Networks.

Parameter	Value
Trigger	All types of precipitation
Switching on condition	Within 30 seconds of onset of precipitation event
Switching off condition	< 15 minutes after end of precipitation event
Droplet size	≥ 0.2 mm
Measurement area	≥ 15cm^2
Operating Temperature	-30 to 40°C
Power	12 V DC or 24 V DC

Laboratory/Controlled Testing (Step 2)

The second step of the evaluation process is performed under controlled conditions, such as in the laboratory. Tests conducted during this step of the evaluation process are designed to verify the operation of the equipment, and the repeatability of the measurements. Testing may include freezer tests to assess any limitations of the equipment under cold conditions. Failure to meet one or more of the requirements for network use may eliminate the equipment from further consideration.

Testing at the NADP Program Office (PO) is not a requirement. Testing may occur at any NADP affiliated agency (e.g., U.S. EPA, USGS, Frontier Geosciences). At least one member of the NADP Quality Assurance Advisory Group (QAAG) must be included as part of the testing process. The QAAG member does not need to conduct the tests, but should review results of the tests and provide technical consultation.

Field Testing (Step 3)

The third step in the evaluation process is performed in the field, with the equipment installed at one or more existing monitoring sites. This allows the candidate equipment to be evaluated side by side against currently approved equipment. Field testing should include a range of meteorological conditions: snow, freezing rain, rain, and wind. Collection efficiency, durability, mean-time between equipment failure, ease of operation, and ease of support may be used to evaluate the performance of the candidate equipment.

Equipment Scoring (Step 4)

In step four of the evaluation process the candidate equipment is scored. Equipment is scored with regard to the criteria listed in Table 4. A score of 0 is given if the equipment fails to meet the criterion, or if there is concern relating to the ability to meet the criterion. A score of 1 is given if the equipment meets the criterion unconditionally. Fractional scores should not be used.

Table 4. Equipment Scoring.

Criterion	Items to Consider	Notes	Score
1) Bias/Accuracy	a) Results from laboratory/controlled testing.		
	b) Data are within 5% of vales from approved equipment based on collocated testing.		
2) Precision	a) Data from testing multiple units are within 5% of one another.		
3) Comparability	a) Conformity to NADP equipment specifications (Tables 1-3, herein).		
	b) Data are within 5% of vales from approved equipment based on collocated testing.		
4) Completeness	a) Collection efficiency ≥ existing equipment for all precipitation types.		
	b) Proven reliability of equipment (i.e., mean time between failures ≥ 1 year).		
	c) Equipment stability in the field. (e.g., ability to withstand high winds, snow, ice). Was the equipment impacted adversely by environmental conditions?		
	d) Durability and ruggedness of the equipment (i.e., appropriateness for high elevation, coastal areas, arid regions). Was the equipment durable in the environment where it was tested?		
5) Representativeness	a) Results from collocated testing.		
	b) Time to open (compare with minimum requirements for sensor).		
	c) Time to close (compare with minimum requirements for sensor).		
	d) Data are superior to values from approved equipment, based on variability and bias of collocated data using scientific and/or statistical methods.		

Table 4. Equipment Scoring – continued.

Criterion	Items to Consider	Notes	Score
6) Usability	a) Delivery schedule, and ability to meet production and delivery requirements (i.e., ≤ 60 days).		
	b) Usefulness of additional equipment features. Do extra features benefit NADP operations?		
	c) Ease of installation.		
	d. Ease of use of hardware. Base on skills of typical site operator.		
	e. Ease of use of software (if applicable). Base on skills of typical site operator.		
	f) Compatibility with existing NADP equipment.		
	g) Ease of troubleshooting problems.		
	h) Ease of re-starting equipment after critical failure (e.g., persistence of volatile RAM, programming, siteID, etc).		
	i) Equipment footprint (i.e., less than or equal to a standard Aerochem Metrics collector).		
	j) Cost (parts and labor) to maintain and repair vulnerable components (e.g., load cells, motorboxes).		
	k) Availability of spare parts (i.e., downtime ≤ 1 week).		
	l) Power requirements (AC and solar powered sites).		
	m) Quality and availability of vendor support for both field operations and engineering design.		
	n) Projected long-term stability of manufacturer and/or vendor ≥ 5 years.		
	o) Warranty, terms of support (≥ 1 year).		
	p) Positive references/recommendations from other agencies and/or networks.		
	q) Long-term stability of technology. Is it likely to be retired/replaced within 10 years.		
Total (out of 6)			

Final Approval and Required Documentation (Step 5)

The final step of the evaluation process is the presentation of the results from the equipment evaluation to the Network Operations Subcommittee (NOS) of the NADP. NOS will vote whether to recommend acceptance of the candidate equipment in the wet deposition network. This recommendation is presented to the Joint Subcommittees, and to the NADP Executive Committee (EC). Final approval for network acceptance is given by the EC.

NOS and the EC meet twice a year, once in the spring and then again in the fall. Testing of candidate equipment should be scheduled to allow sufficient time for completion of the multi-step process prior to those meetings. The testing process and the results of the testing, regardless of approval for use in the network, should be documented in a written report. That report should be archived with the NADP PO for future reference. At a minimum, the report should include the following:

- Comparison with NADP minimum requirements (sample tables included in the Appendix to this document)
- When the testing occurred
- Where the testing occurred
- What tests were conducted
- Who conducted the tests
- Test results
- Equipment scoring (Table 4)
- Recommendation made to NOS
- Final decision made by the NADP EC

Presentations to NOS, and the written report are the responsibility of the individual(s) responsible for testing the candidate equipment.

Appendix

Comparison of Candidate Raingages Parameters with NADP Minimum Requirements.

Parameter	NADP Minimum Requirement	Candidate Raingage
Capacity	10” of precipitation	
Operating Temperature	-30 to 40°C	
Accuracy	0.02” of precipitation	
Resolution	0.01” of precipitation	
Threshold	0.01” of precipitation	
Power	12 V DC or 120 V AC	
Time Resolution	1 hour	
Output	Continuous chart or digital time series	

Comparison of Candidate Wet Deposition Collector Parameters with NADP Minimum Requirements.

Parameter	NADP Minimum Requirement	Candidate Wet Deposition Collector
Capacity	2 L of precipitation	
Operating Temperature	-30 to 40°C	
Open	Within 15 seconds of sensor signal event	
Close	Within 15 seconds of sensor signal event	
Power	12 V DC or 120 V AC	
Event	Time referenced recording of collector opening and closing	
Types of Deposition	Wet deposition only	
Types of Precipitation	All	
Temperature Control	Option to allow control of sample temperature	

Comparison of Candidate Sensor Parameters with NADP Minimum Requirements.

Parameter	NADP Minimum Requirement	Candidate Sensor
Trigger	All types of precipitation	
Switching on condition	Within 30 seconds of onset of precipitation event	
Switching off condition	< 15 minutes after end of precipitation event	
Droplet size	≥ 0.2 mm	
Measurement area	≥ 15 cm^2	
Operating Temperature	-30 to 40°C	
Power	12 V DC or 24 V DC	