

# State of Alaska Dept. Environmental Conservation Division of Air Quality

## M&QA Program

### *Meteorological Measurement Methods Validation Criteria*

is to be used for the following purposes:

- To provide a "look-up" table of all the significant quality control criteria important for the proper implementation of the Meteorological Measurement methods, and
- As a tool for validating Meteorological Measurement data.

In order to accomplish both objectives the quality control criteria is organized into the following three classes/tables:

1. **Critical Criteria Table**
2. **Operational Evaluations Table**
3. **Systematic Issues Table**

#### **Critical Criteria Table**

Criteria that were deemed critical to maintaining the integrity of a sample or group of samples were placed in the first table. Observations that do not meet each and every criterion on the **Critical Criteria Table** should be invalidated unless there are compelling reasons and justification for validation. Basically, the sample or group of samples for which one or more of these criteria are not met is invalid until proven otherwise. The cause of not operating in the acceptable range for each of the violated criteria must be investigated and minimized to reduce the likelihood that additional samples will be invalidated.

#### **Operational Evaluations Table**

Criteria that are important for maintaining and evaluating the quality of the data collection system are included on the second table, the **Operational Evaluations Table**. Violation of a criterion or a number of criteria may be cause for invalidation. The decision should consider other quality control information that may or may not indicate the data are acceptable for the parameter being controlled. Therefore, the sample or group of samples for which one or more of these criteria are not met is suspect unless other quality control information demonstrates otherwise. The reason for not meeting the criteria must be investigated, mitigated or justified.

#### **Systematic Issues Table**

Finally, those criteria which are important for the correct interpretation of the data but do not usually impact the validity of a sample or group of samples are included on the third table, the **Systematic Issues Table**. For example, the data quality objectives are included in this table; if they are not met, this does not invalidate any of the samples but it may impact the error rate associated with the attainment/non-attainment decision.

## CRITICAL CRITERIA TABLE – METEOROLOGICAL MEASUREMENT METHODS

S- single instrument hourly value, G group of hourly values from 1 instrument

Parameter	Criteria	Acceptable Range								Frequency	Samples Impacted	EPA -454/R-99-005 Feb 2000	EPA Regulation & Guidance	ADEC AM&QA QAPP
	Method	Measurement Method Characteristics												
		Reporting Units	Range	Accuracy	Resolution	Starting Speed	Distance Constant	Sampling Frequency	Raw Data Collection Frequency					
Wind Speed (WS)	Cup, blade, or heated/unheated sonic anemometer	m/s	0.5 m/s – 50 m/s	± 0.2 m/s	0.25 m/s	≤ 0.5 m/s	≤ 5 m @ 1.2 kg/m <sup>3</sup>	hourly	1 minute	All Data	Chapter 2 Sec 1 & 8, Chapter 5 Sec 1 & 2 Chapter 8 Sec 1	QA Handbook Vol IV Section 0 Tables 0-3, 0-4, 0-5, 0-6 and EPA Met Monitoring Guidance for Regulatory Modeling Applications Section 8	Section 7 Table A8	
Vertical WS (VWS)			-25 m/s – +25 m/s	± 0.2 m/s	0.1 m/s	≤ 0.25 m/s	≤ 5 m @ 1.2 kg/m <sup>3</sup>	hourly	1 minute	All Data				
		Reporting Units	Range	Accuracy Total	Resolution	Starting Speed	Damping Ratio	Sampling Frequency	Raw Data Collection Frequency			Delay Distance		
WD (azimuth & elevation)	Vane or heated/unheated sonic anemometer	Degrees (°)	1° – 360° or 540°	± 5 degrees	1.0 degree	≤ 0.5 m/s @ 10 degrees	0.4 to 0.7 @ 1.2 kg/m <sup>3</sup>	hourly	1 minute	All Data		≤ 5 m @ 1.2 kg/m <sup>3</sup>		
		Reporting Units	Range	Accuracy	Resolution	Time Constant	Spectral Response	Sampling Frequency	Raw Data Collection Frequency					
Ambient Temp	Thermistor 10m – 2m	Degrees Celsius (°C)	-40°C to +40°C <small>Note: State of Alaska criteria</small>	± 0.5°C	0.1°C	≤ 1 minute		hourly	1 minute	All Data	Chapter 2 Sec 3 & 8, Chapter 3 Sec 6 Chapter 5 Sec 1 & 2 Chapter 8 Sec 1	Section 7 Table A8		
Vertical Temp Difference (ΔT)				± 0.1°C	0.02°C	≤ 1 minute		hourly	1 minute	All Data				
Dew Point Temperature	Psychrometer/ Hygrometer %	°C		± 1.5°C	0.1°C	≤ 30 minutes		hourly	1 minute	All Data	Chapter 2 Sec 4 & 8, Chapter 5 Sec 1 & 2			
Relative Humidity/		%	0 – 100%	± 7%	0.5 %	≤ 30 minutes		hourly	1 minute	All Data				
Barometric Pressure (BP)	Aneroid Barometer	mbHg	950 mb to 1050 mb Hg	± 3 mb Hg (0.3 kPa)	0.5 mb Hg			hourly	1 minute	All Data	Chapter 2 Sec 6 & 8, Chapter 5 Sec 1 & 2			
Solar Radiation	Pyranometer	Watts/m <sup>2</sup>	0 – 1300 W/m <sup>2</sup>	± 5% of observed	10 W/m <sup>2</sup>	5 seconds	285 nm to 2800 nm	hourly	1 minute	All Data	Chapter 2 Sec 7 & 8, Chapter 5 Sec 1 & 2			
Precipitation	Tipping Bucket (with Alter type windscreen & heater)	mm H <sub>2</sub> O	0 – 50 mmH <sub>2</sub> O/hr	± 10% of observed or ± 0.5	0.3 mm H <sub>2</sub> O			hourly	1 minute	All Data	Chapter 2 Sec 5 & 8, Chapter 5 Sec 1 & 2			

## CRITICAL CRITERIA TABLE – METEOROLOGICAL MEASUREMENT METHODS

S- single instrument hourly value, G group of hourly values from 1 instrument

Parameter	Criteria	Acceptable Range						Frequency	Samples Impacted	EPA -454/R-99-005 Feb 2000	EPA Regulation & Guidance	ADEC AM&QA QAPP
Method		Measurement Method Characteristics (continued)										
		Reporting Units	Range	Accuracy	Resolution			Sampling Frequency	Raw Data Collection Frequency			
Vector Data WS	DAS Calculation	m/s	0 – 50.0 m/s	± 0.2 m/s	0.1 m/s			hourly	1 minute	All Data	Chapter 4 Section 6 Chapter 8	QA Handbook Vol IV Section Tables 0-3, 0-4, 0-5, 0-6
Vector Data WD	DAS Calculation	Degrees (°)	0 - 360°	± 5°	1.0°			hourly	1 minute	All Data	Chapter 4 Section 6 Chapter 8	
sigma theta (σθ)	DAS Calculation SD of azimuth angle of WD	Degrees (°)	0 - 105°	± 5°	1.0°			hourly	15 minute	All Data	Chapter 4 Section 6 Chapter 8	
sigma phi (σw)	DAS Calculation SD of vertical component of WS	m/s	0 – 10 m/s	± 0.2 m/s	0.1 m/s			hourly	1 minute	All Data	Chapter 4 Section 6 Chapter 8	Section 7 Table A8
		Radiation Range	Flow Rate	Radiation Error	Type	Estimates of Means		Estimates of Variance				
Motor aspirated temp radiation shield (T, Δ,T RH/Dew Point )		-100 to 1300 W/m <sup>2</sup>	≥ 3 m/s	< 0.2°C							Chap 2 Sec 3 & 4 Chapter 8 Sec 1	
Data Acquisition System (DAS)					Microprocessor-based digital	1/min for hourly mean (60 samples/hour)	6 samples/minute for hourly variance (360 samples/hour)				Chapter 4 Section 6 Chapter 8	
Reporting Intervals												
All parameters	Hourly average							Quarterly	All	Chapter 5 Section 1		Section 7
Data Completeness												
All parameters	Valid data capture	≥75 %						Hourly	G	Chapter 5 Sections 3 & 4	QA Handbook Vol IV Section 0 Tables 0-3, 0-4, 0-5, 0-6	Section 7 18 AAC 50.010
	(PSD Quality Monitoring) Valid data capture	≥ 90% hourly data, joint collection of WS, WD , and stability (SRDT, σθ, or σw depending upon model selection)						Quarterly (4 consecutive quarters)	G			

## CRITICAL CRITERIA TABLE – METEOROLOGICAL MEASUREMENT METHODS

S- single instrument hourly value, G group of hourly values from 1 instrument

Parameter	Criteria	Acceptable Range	Frequency	Samples Impacted	EPA -454/R-99-005 Feb 2000	EPA Regulation & Guidance	ADEC AM&QA QAPP
	<b>Calibration</b>						
WS, VWS (cup or aerovane)	<b>Multi-point Calibration</b>	5 points including zero, 2 m/s and 3 additional evenly spaced upscale points covering expected wind speeds for the site All test points $\leq \pm (2 \text{ m/s} + 5\% \text{ of observed})$  WS bearing torque threshold $\leq$ <b>PSD quality sensor's manufacturer's specs</b>	Initially, 1/6 months thereafter	G	Chapter 5	QA Handbook Vol IV , All Sections and 0 Tables 0-3, 0-4, 0-5, 0-6	Section 7 MQO Table A8
WS/WD, VWS/VWD (Sonic Anemometer)	<b>Multi-point Calibration</b>	Multipoint calibration via wind tunnel by manufacturer	Initially, 1/year thereafter				
WD, VWD (blade or aerovane)	<b>Multi-point Calibration</b>	Alignment to True North + linearity test points at: 0°, 45°, 90°, 135°, 180°, 225°, 270°, 315°, 360° Alignment $\leq \pm 5^\circ$ Linearity (All Points) $\leq \pm 3^\circ$ (included in $\leq \pm 5^\circ$ above)  WD bearing torque threshold $\leq$ <b>PSD quality sensor's manufacturer's specs</b>	Initially, 1/6 months thereafter	G	Chapter 5 Chapter 8		
Temp	<b>Multi-point Calibration</b>	Minimum 3 point calibration representative of min avg low to max avg high temps for the location. (e.g., -30°C, 0°C, +30°C) <b>Note:</b> State of Alaska criteria Each point $\leq \pm 0.5^\circ\text{C}$ of NIST Traceable Standard	Initially, 1/6 months thereafter	G	Chapter 5 Chapter 8		MQO Table, Table A8  Section 16
$\Delta T$	<b>Multi-point Calibration</b>	Side-by-side calibration of 10m and 2m temp probes with a Minimum 3 point calibration representative of min avg low to max avg high temps for the location. (e.g., -30°C, 0°C, +30°C) <b>Note:</b> State of Alaska criteria Each point $\leq \pm 0.5^\circ\text{C}$ of NIST Traceable Standard and 10m sensor $\leq \pm 0.1^\circ\text{C}$ of 2 m sensor at all points	Initially, 1/6 months thereafter	G	Chapter 5 Chapter 8		MQO Table, Table A8  Section 16
RH/Dew point	<b>Multi-point Calibration</b>	Factory multi-point calibration followed by on-site 1-point verification of RH/DP sensor against NIST Traceable RH Standard ( RH Std $\leq \pm 2\%$ RH accuracy) RH sensor $\leq \pm 7\%$ of RH Standard	Initially, 1/6 months thereafter	G	Chapter 5 Chapter 8		MQO Table, Table A8  Section 16
Solar Radiation (SR)	<b>Multi-point Calibration</b>	Factory multi-point calibration followed by on-site zero check with opaque cover and 1-point verification against in-cert. First Class collocated Pyranometer SR sensor $\leq \pm 5\%$ of First Class Pyranometer	Initially, 1/6 months thereafter	G	Chapter 5 Chapter 8		MQO Table, Table A8  Section 16

## CRITICAL CRITERIA TABLE – METEOROLOGICAL MEASUREMENT METHODS

S- single instrument hourly value, G group of hourly values from 1 instrument

Parameter	Criteria	Acceptable Range	Frequency	Samples Impacted	EPA -454/R-99-005 Feb 2000	EPA Regulation & Guidance	ADEC AM&QA QAPP
Barometric Pressure (BP)	<b><u>Multi-point Calibration</u></b>	Factory multi-point calibration followed by on-site 1-point verification against pressure standard of known quality (see pressure std. min requirements) BP sensor $\leq \pm 3 \text{ mb (0.3 kPa)}$	Initially, 1/6 months thereafter	G	Chapter 5 Chapter 8		MQO Table, Table A8  Section 16
Precipitation	<b><u>Multi-point Calibration</u></b>	Minimum 3 point calibration Each point $\leq \pm 10\%$ of measured $\text{H}_2\text{O}$ input, or $\leq \pm 5 \text{ mm H}_2\text{O}$	Initially, 1/6 months thereafter	G	Chapter 5 Chapter 8	QA Handbook Vol IV Sec 4 and Sec 0 Tables 0-3, 0-4, 0-5, 0-6	MQO Table, Table A8  Section 16
Vector Data/DAS (WS, WD, $\sigma\theta$ , $\sigma\omega$ )	<b><u>Multi-point Calibration</u></b>	Calibrate/check DAS voltage input against sensor inputs <b>WS, <math>\sigma\omega \leq \pm 0.2 \text{ m/s}</math></b> <b>WD, <math>\sigma\theta \leq \pm 5^\circ</math></b>	Initially, 1/6 months thereafter	G	Chapter 5 Chapter 8	QA Handbook Vol IV Sec 9 and Sec 0 Tables 0-3, 0-4, 0-5, 0-6	

## OPERATIONAL EVALUATIONS TABLE – METEOROLOGICAL MEASUREMENT METHODS

S- single instrument hourly value, G group of hourly values from 1 instrument

Parameter	Criteria	Acceptance Range	Frequency	Samples Impacted	EPA -454/R-99-005 Feb 2000	EPA Regulation & Guidance	ADEC AM&QA QAPP
<b>Siting &amp; Exposure Criteria</b>							
All met parameters	Representativeness	Site must be representative for the intent of the monitoring scale , No prescribed quantitative criteria <b>See references</b>	All	All	Chapter 3 Sec 1	QA Handbook Vol IV , Section 10-6 specific to equipment under Installation	
All met parameters	Probe Siting	<i>See references for specific siting criteria for simple, complex, coastal and urban terrain locations</i>	All	All	Chapter 3 Sec 2 & 3		
<b>Calibration/Audit Standards</b>							
WS/ VWS	WS standard Sonic Anemometers calibrated @ factory	NIST Traceable Synchronous motor, or Series of NIST Traceable constant speed motors to generate WS in range of 2 m/s thru 50 m/s	Purchase, recalibrate 1/year or at frequency dependent upon use	G		QA Handbook Vol IV Section 0 Tables 0-3, 0-4, 0-5, 0-6 Section 2	Sections 16
WS/WD	Collocated Transfer Standard (CTS) for sonic anemometer audits	CTS must be cup/vane or aerovane anemometer that is calibrated on-site with standards/personnel independent from routine operator/calibration staff and equipment/standards. CTS must meet all PSD quality criteria	Purchase, Calibrate CTS on site prior to conducting each site audit, and CTS collocated for 72 hr minimum	G			
WD/VWD	WD Standard	<p style="text-align: center;"><b>Alignment to True North</b></p> <ul style="list-style-type: none"> <li>• Solar Noon method, and or</li> <li>• Transit &amp; Compass, map, and site magnetic declination, or</li> <li>• GPS accuracy ≤3 meters with lock on minimum 3 satellite signals</li> </ul> <p style="text-align: center;"><b>Linearity</b></p> Linearity wheel with evenly spaced preset markings, e.g., 0°, 45°, 90°, 135°, 180°, 225°, 270°, 315°, 360°	Purchase, recalibrate 1/year or at frequency dependent upon use	G			
Temperature	Thermister	<ul style="list-style-type: none"> <li>• measurement range -40°C to + 40°C</li> <li>• Accuracy ≤±0.2°C NIST traceable certified over -30°C to +30°C (<b>Note:</b> State of Alaska criteria)</li> <li>• Resolution ≤±0.1°C</li> </ul>	Purchase, recertify 1/year or per NIST/ASTM certification frequency	G		QA Handbook Vol IV Section 3, and Section 0 Tables 0-3, 0-4, 0-5, 0-6	

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Parameter	Criteria	Acceptance Range	Frequency	Samples Impacted	EPA -454/R-99-005 Feb 2000	EPA Regulation & Guidance	ADEC AM&QA QAPP
RH/Dew Point	RH meter or Psychrometer	<p><b>RH meter</b> NIST Traceable Standard <math>\pm</math> 2% RH</p> <p><b>Psychrometer</b> with matched pair NIST Traceable/ASTM Thermometers with measurement Resolution 0.1° C each and appropriate temp range <b>Note:</b> State of Alaska criteria <b>No Sling Psychrometers Acceptable</b></p>	Purchase, recertify 1/year or per NIST traceable certification frequency	G		QA Handbook Vol IV, Section 5 and Section 0 Tables 0-3, 0-4, 0-5, 0-6	
Solar Radiation	NIST Traceable Pyranometer	<p><b>First Class Pyranometer</b> Measurement range Measurement resolution Measurement accuracy</p>	Purchase, recertify 1/year or per NIST traceable certification frequency	G		QA Handbook Vol IV Section 6, and Section 0 Tables 0-3, 0-4, 0-5, 0-6	Sections 16
Barometric Pressure	NIST Traceable Aneroid Barometer	Measurement accuracy $\pm$ 1mb, Measurement resolution 0.1 mb, Measurement range 950 – 1050 mbHg	Purchase, verify 1/year against NWS-FAA or NIST Traceable Std. or per NIST traceable certification frequency	G		QA Handbook Vol IV Section 7, and Section 0 Tables 0-3, 0-4, 0-5, 0-6	
Precipitation	Separatory funnel, graduated cylinder, and deionized water	<p><b>Volumetric Glassware</b> Calibrated (50ml or 100 ml, 1 ml divisions), and <b>Deionized H<sub>2</sub>O</b></p>	Purchase	G		QA Handbook Vol IV Section 5, and Section 0 Tables 0-3, 0-4, 0-5, 0-6	
<b>Visual QC Checks-Field</b>							
	Sky Check	Note & Record sky conditions (cloud cover, temp/WS/WD, etc estimates)	Each site visit	G		QA Handbook Vol IV Section 10.2	
WS	WS sensor	Moving freely, no visual damage	Each site visit	G			
WD	WD sensor	Moving freely, no visual damage	Each site visit	G			
Temperature, $\Delta$ T	Temperature sensors and aspirated temperature shields	No visual damage or obstruction, Motor in aspirated shield working	Each site visit	G			
SR	Solar Radiation Sensor	Radiometer/pyranometer face clear of dirt/debris/snow	Each site visit	G			
BP	Pressure sensor	No visual damage or obstruction	Each site visit	G			
RH	RH sensor, aspirated shield	No visual damage or obstruction, Motor in aspirated shield working	Each site visit	G			

## OPERATIONAL EVALUATIONS TABLE – METEOROLOGICAL MEASUREMENT METHODS

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Parameter	Criteria	Acceptance Range	Frequency	Samples Impacted	EPA -454/R-99-005 Feb 2000	EPA Regulation & Guidance	ADEC AM&QA QAPP	
Precipitation	Precipitation sensor	No visual damage or obstruction, free of ice and snow, Heater working	Each site visit	G		QA Handbook Vol IV Section 10.4		
DAS	Data Acquisition System	DAS time ≤ 1 minute NIST Alaska Standard Time (AST)	Each site visit	G				
<b>Data Screening Criteria</b>								
WS/ VWS	Hourly Recorded WS	0 m/s ≤ WS ≤ 25 m/s, WS varies > 0.1 m/s/3 consecutive hours, WS varies > 0.5 m/s/12 consecutive hours, per site specific climatology criteria	1/week or more frequent	G	Chapter 8, Table 8-4			
WD/VWD	Hourly Recorded WD	0° ≤ WD ≤ 360°, WD varies > 1°/3 consecutive hours, WD varies > 10°/12 consecutive hours, per site specific climatology criteria	1/week or more frequent	G	Chapter 8, Table 8-4			
Temperature	Hourly Recorded Ambient Temperature	Local record low ≤ Temp ≤ local record high, Temp ≤ 5°C from previous hourly record, Temp varies ≥ 0.5°C/12 consecutive hours, per site specific climatology criteria	1/week or more frequent	G	Chapter 8, Table 8-4			
10m – 2 m ΔT	Hourly Recorded 10m – 2m Temperature Difference	Day time ΔTemp ≤ 0.1°C/m, Night time ΔTemp > -0.1°C/m, -3.0°C ≤ ΔT ≤ 5.0°C, or Per site specific climatology criteria	1/week or more frequent	G	Chapter 8, Table 8-4			
RH/Dew Point	Hourly Recorded Relative Humidity	Dew Pont Temp ≤ Amb Temp for time period, Δ Dew Pont Temp ≤ 5°C change from previous hour, Δ Dew Pont Temp ≥ 0.5°C over 12 consecutive hours, Dew Pont Temp ≠ Ambient Temp for 12 consecutive hrs.	1/week or more frequent	G	Chapter 8, Table			
Solar Radiation	Hourly Recorded Solar Radiation	Night time SR = 0, Day time SR < max SR for date and latitude	1/week or more frequent	G	Chapter 8, Table			
Barometric Pressure	Hourly Recorded Barometric Pressure	BP < 1050 mb (sea level), BP > 945 mb (sea level), or Per site specific climatology criteria	1/week or more frequent	G	Chapter 8, Table			
Precipitation	Hourly Recorded Precipitation	Note: Develop site specific climatology criteria for each season	1/week or more frequent	G	Chapter 8, Table			

## OPERATIONAL EVALUATIONS TABLE – METEOROLOGICAL MEASUREMENT METHODS

S- single instrument hourly value, G group of hourly values from 1 instrument

Parameter	Criteria	Acceptance Range	Frequency	Samples Impacted	EPA -454/R-99-005 Feb 2000	EPA Regulation & Guidance	ADEC AM&QA QAPP
	<b>Maintenance</b>						
WS/VWS	Sensor bearings	Replace	1/6 months	G			
WD/VWD	Sensor Bearings	Replace	1/6 months	G			
SR		Per manufacturer's recommendations	Per manufacturer's recommendations	G			
DAS	Data Acquisition System (internal battery back-up)	Check Battery Back-up, Replace as needed	1/6 months	G			
	<b>Bias/Accuracy</b>						
WS, VWS	<b>Performance Audit</b>	5 points including zero, 2 m/s and 3 additional evenly spaced upscale points covering expected wind speeds for the site Audit points $\leq \pm (2 \text{ m/s} + 5\% \text{ of observed})$  WS bearing torque threshold $\leq$ PSD quality sensor's manufacturer's specs	<b>NCORE/SLAMS</b> 1/year <b>SPM</b> 1/yr (suggested) <b>PSD</b> Every sensor Within 30 days of start-up and 1/6 months thereafter	G	Chapter 5	QA Handbook Vol IV Section 2.7	Section 7 MQO Table A8
WS/WD (Sonic Anemometer)	<b>Performance Audit</b>	Collocated for min 72 hrs, compare hourly data against hourly on-site calibrated cup/vane or aerovane anemometer CTS <b>WS criteria</b> <ul style="list-style-type: none"> <li>• <math>\leq \pm 0.2 \text{ m/s} + 5\% \text{ observed CTS}</math></li> <li>• SD of differences <math>\leq \pm 0.2 \text{ m/s}</math></li> <li>• Qualifications WS &gt; 1 m/s</li> </ul> <b>WD criteria</b> <ul style="list-style-type: none"> <li>• <math>\leq \pm 5^\circ \text{ observed CTS}</math></li> <li>• SD of differences <math>\leq \pm 2^\circ</math></li> <li>• Qualifications WS &gt; 1 m/s</li> </ul>			QA Handbook Vol IV Section 2.7.3.2 CTS Method		
WD, VWD	<b>Performance Audit</b>	Alignment to True North + linearity audit points at: 0°, 45°, 90°, 135°, 180°, 225°, 270°, 315°, 360° Alignment $\leq \pm 5^\circ$ Linearity (All Points) $\leq \pm 3^\circ$ (included in $\leq \pm 5^\circ$ above) WD bearing torque threshold $\leq$ PSD quality sensor's manufacturer's specs		G	Chapter 5 Chapter 8	QA Handbook Vol IV Section 2.7	MQO Table, Table A8 Section 16
Vector Data/DAS (WS, WD, $\sigma\theta$ , $\sigma w$ )	<b>Performance Audit</b>	<b>WS, <math>\sigma w \leq \pm 0.2 \text{ m/s}</math></b> <b>WD, <math>\sigma\theta \leq \pm 5^\circ</math></b>		G	QA Handbook Vol IV Section 2.8		

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S- single instrument hourly value, G group of hourly values from 1 instrument

Parameter	Criteria	Acceptance Range	Frequency	Samples Impacted	EPA -454/R-99-005 Feb 2000	EPA Regulation & Guidance	ADEC AM&QA QAPP
Temp	<b>Performance Audit</b>	Minimum 3 point audit representative of min avg low to max avg high temps for the location. (e.g., -30°C, 0°C, +30°C) <b>Note:</b> State of Alaska criteria Each point $\leq \pm 0.5^\circ\text{C}$ of NIST Traceable Standard		G	Chapter 5 Chapter 8	QA Handbook Vol IV Section 3.6	MQO Table, Table A8  Section 16
$\Delta T$	<b>Performance Audit</b>	Side-by-side audit of 10m and 2m temp probes with a Minimum 3 point audit representative of min avg low to max avg high temps for the location. (e.g., -30°C, 0°C, +30°C) <b>Note:</b> State of Alaska criteria Each point $\leq \pm 0.5^\circ\text{C}$ of NIST Traceable Standard and 10m sensor $\leq \pm 0.1^\circ\text{C}$ of 2 m sensor at all points		G	Chapter 5 Chapter 8	QA Handbook Vol IV Section 3.6	MQO Table, Table A8  Section 16
RH/Dew point	<b>Performance Audit</b>	1-point audit of RH/DP sensor against NIST Traceable RH Standard ( $\pm 2\%$ RH accuracy) <b>RH sensor <math>\leq \pm 7\%</math> of RH Standard</b>		G	Chapter 5 Chapter 8	QA Handbook Vol IV Section 5	MQO Table, Table A8  Section 16
Solar Radiation (SR)	<b>Performance Audit</b>	1-point audit against in-cert. First Class Pyranometer <b>SR sensor <math>\leq \pm 5\%</math> of First Class Pyranometer</b>		G	Chapter 5 Chapter 8	QA Handbook Vol IV Section 6	MQO Table, Table A8  Section 16
Barometric Pressure (BP)	<b>Performance Audit</b>	1-point audit against pressure standard of known quality (see pressure std. min requirements) <b>BP sensor <math>\leq \pm 3 \text{ mb (0.3 kPa)}</math></b>		G	Chapter 5 Chapter 8	QA Handbook Vol IV Section 7	MQO Table, Table A8  Section 16
Precipitation	<b>Performance Audit</b>	Minimum 3 point audit Each point $\leq \pm 10\%$ of measured $\text{H}_2\text{O}$ input, or $\leq \pm 5 \text{ mm H}_2\text{O}$		G	Chapter 5 Chapter 8	QA Handbook Vol IV Section 4	MQO Table, Table A8  Section 16

## SYSTEMATIC ISSUES GASEOUS – METEOROLOGICAL MEASUREMENT METHODS

S- single instrument hourly value, G group of hourly values from 1 instrument

Parameter	Criteria	Acceptable Range	Frequency	Samples Impacted	EPA -454/R-99-005 Feb 2000	EPA QA Handbook Volume IV	ADEC AM&QA QAPP
	<b>Data Completeness</b>						
All Met Parameters		≥ 90% NCore, SLAMS, SPM	quarterly	G			
	<b>QC Checks</b>						
	DAS Clock/timer Verification	≤ ± 1 minute.	Each site visit	G			
	<b>Bias/Accuracy</b>						
All Met parameters	Technical Systems Audit	NCore/SLAMS/SPM networks	1/3 years.	G		QA Handbook Vol IV Section 10 & Appendix A	
		PSD	Within 1 month of start-up and annually thereafter	G			