Alberta Government

Air Monitoring Directive
Chapter 8: AMBIENT AUDIT

[referred to as 'the Audit Chapter' of the Air Monitoring Directive]

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TABLE OF CONTENTS

1.0 PURPOSE 3
1.1 Amendments to the Air Monitoring Directive 4
2.0 STATION AUDIT PREPARATION AND DELIVERY 4
2.1 Preparation 4
2.2 Delivery 4
2.3 Post-Audit 5
3.0 CALIBRATION SYSTEM AND GAS AUDITS 6
3.1 Calibration Systems Audit 6
3.2 Calibration Gas Audit 8
4.0 AUDIT FAILURE 8
4.1 Data Handling 9
5.0 STATION AUDIT FOLLOW-UP 10
5.1 On-Site Checklist 10
5.2 Data Review Checklist 10
5.3 Response Letters and Reports 11
5.4 Third Party Review 13
5.5 Timeline and Late Reports 14
APPENDIX A SAMPLE AUDIT REPORT 15
APPENDIX B AUDIT ASSESSMENT CRITERIA 26
APPENDIX C AMBIENT AIR MONITORING AUDIT – ON-SITE CHECKLIST 29
APPENDIX D AMBIENT AIR MONITORING AUDIT – DATA REVIEW CHECKLIST 35

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1.0 PURPOSE

This Ambient Audit document forms a part (Chapter 8) of Alberta's Air Monitoring Directive (Alberta Environment and Sustainable Resource Development 2014, as amended) and will hereafter be referred to as the Audit Chapter. Refer to Chapter 1 of the AMD (Introduction) for requirements and definitions that apply to all parts of the AMD, a list of what components constitute the AMD, and details on review of and revisions to the AMD.

Audits are conducted by AEMERA, on behalf of the Regulator, on all continuous ambient air monitoring equipment operating in continuous ambient air monitoring stations in Alberta. These audits are used to verify that all continuous ambient air monitoring in Alberta is conducted in accordance with the AMD. Consistent monitoring practices across the province that adhere to the requirements of the AMD ensure that the data that is submitted is comparable and of high quality.

The purpose of this Audit Chapter is to outline the minimum requirements for:

- preparing a continuous ambient air monitoring station for audit;
- verifying calibration systems and calibration gases against known standards;
- preparing continuous ambient air monitoring equipment (including calibration systems and calibration gases) for audit; and
- following up on and responding to audit reports issued by the auditor to the person responsible.

The Audit Chapter is relevant to any person responsible conducting continuous ambient air monitoring, including all continuous ambient air monitoring stations in Alberta as well as the equipment used by station operators and third parties to calibrate these stations. If the results of an audit indicate that a particular instrument is unacceptable, then the person responsible will be required to take corrective action.

The Ambient Audit Program Protocol used for audits of ambient air monitoring stations and equipment and an Audit Process Flow Chart are available from the AMD website.

Requirements for inspection and cleaning of sample intakes is found in the Site Selection Chapter (Chapter 3) of the AMD, while calibration requirements are found in the Calibration Chapter (Chapter 7) of the AMD. Minimum performance specifications for continuous ambient air analyzers and meteorological sensors are found in the Monitoring Chapter (Chapter 4) of the AMD.

Aud 1-A	*The person responsible must comply with the requirements in the Audit Chapter of the AMD on or before September 23, 2015 for all continuous ambient air monitoring stations.*

1.1 Amendments to the Air Monitoring Directive

The Air Monitoring Directive (Alberta Environment 1989), also called the AMD 1989, is hereby amended as follows:

Aud 1-B	*Section II C 1 e) ii of the AMD 1989 is repealed and replaced with the Audit Chapter.*
Aud 1-C	*Section II C 1 n) of the AMD 1989 is repealed and replaced with the Audit Chapter.*
Aud 1-D	*Appendix A-10 Section 1.8 of the AMD 1989 is repealed and replaced with the Audit Chapter.*

2.0 STATION AUDIT PREPARATION AND DELIVERY

2.1 Preparation

Audits may be conducted with minimum notification. Prior arrangement to gain access to the monitoring station will be made with the station operator no earlier than the business day immediately prior to the audit day, or the Friday prior to a week-long audit of a monitoring network.

Aud 2-A	*Upon receiving notice of the date and time of an audit, the person responsible shall provide the auditor with access to the ambient air monitoring station(s).*
Aud 2-B	*The person responsible shall not (a) make changes to, or (b) calibrate, the ambient air monitoring station(s) after notification of the audit and prior to the start except for regularly scheduled calibrations or an emergency.*

2.2 Delivery

Aud 2-C	*The person responsible or station operator must be present at minimum during the initial and final stages of the audit of each ambient air monitoring station audited.*

The person responsible or station operator is required to be present during the ambient monitoring station audit for:

- a pre-audit meeting;
- providing the auditor access to the monitoring station shelter and the on-site data acquisition system prior to commencement of the audit;

- examination of the station prior to the audit to ensure all equipment is operating and that the audit equipment can be accommodated inside the monitoring station;
- marking down all channels for the analyzer(s) being audited on the data acquisition system and displaying the data for the analyzer(s);
- discussing the audit findings with the auditor at the completion of the audit, including the completion of an on-site checklist; and
- verifying that the auditor leaves the ambient air monitoring station in the same condition as prior to the audit.

The person responsible or station operator should be present during all stages of the audit. If the person responsible or station operator chooses to leave during an audit, the opportunity for immediate on-site correction of any minor deficiencies is forgone.

Aud 2-D	*The person responsible or station operator must have data averages available at the ambient air monitoring station while the audit is being conducted.*

During the audit, one-minute data averaging is preferred for the equipment being audited, however instantaneous data is acceptable.

During the audit, the following documentation may be requested by the auditor from the person responsible or station operator for review:

- the calibration document(s) for the analyzer(s) being audited;
- maintenance record or ambient air monitoring station logbook (note: the date, time and nature of the audit visit are recorded in the logbook at the time of the audit);
- site documentation for each ambient air monitoring station; and
- wind sensor calibration records.

Requirements for site documentation can be found in the Site Selection Chapter (Chapter 3) of the AMD.

2.3 Post-Audit

When the audit is complete, the auditor will restore the ambient air monitoring station(s) to the original configuration as it was prior to the commencement of the audit. A post-audit meeting will be conducted on site as soon as possible following the audit to review the audit results with the station operator.

Aud 2-E	*The person responsible or station operator shall sign the post audit checklist verifying that the ambient air monitoring station has been returned to pre-audit conditions.*
Aud 2-F	*If immediate action is required to correct an audit finding, the person responsible shall immediately correct the deficiency.*

Aud 2-G	*If other action is required to correct an audit finding, the person responsible shall:* *(a) correct the deficiency within the time frame required in writing by the auditor; and* *(b) report to the auditor once the correction in Aud 2-G(a) has been completed.*

A written audit report, including the results for all stations audited, will be sent to the person responsible or the station operator. Any audit failures will be brought to the attention of the person responsible and/or station operator as soon as possible.

An example of an audit report is provided in Appendix A.

3.0 CALIBRATION SYSTEM AND GAS AUDITS

In addition to ambient air monitoring station audits, the person responsible is required to verify calibration systems and calibration gases to ensure they are acceptable for conducting calibrations.

Aud 3-A	*The person responsible must cross-check the performance of all continuous ambient air monitoring station calibration systems against the auditor's audit standards once per year at a minimum.*

Calibration equipment and gases may be brought to AEMERA's audit facility to challenge them against audit analyzers which have been previously calibrated with audit standards. This serves as a verification of the entire calibration system. This service is offered by AEMERA to help minimize audit failures and ultimately contribute to better data quality from all continuous ambient air monitoring stations.

Aud 3-B	*The person responsible shall contact the auditor to schedule an appointment to have calibration systems or gases verified as required in Aud 3-A.*

The Calibration Chapter (Chapter 7) of the AMD outlines requirements for the use of calibration systems and calibration (standard) gases.

3.1 Calibration Systems Audit

Calibration systems include calibrators, standards, gas cylinder regulators, zero air systems, flow measurement devices, calculations, calculators and procedures.

Aud 3-C	*For a calibration systems audit, the person responsible shall deliver calibration systems to the auditor with sufficient time in advance of the audit appointment so that equipment is fully operational and all gases are at room temperature by the scheduled audit start time.*

Calibration systems audits will be assessed using the criteria as specified in the Ambient Audit Program Protocol, available from the AMD website.

Aud 3-D	*For the calibration systems audit in Aud 3-C:* *(a) the person responsible or station operator must remain at the lab for the duration of the calibration systems audit;* *(b) the person responsible must supply their complete calibration systems and accompanying documentation for the audit; and* *(c) the calibration systems being audited must challenge the auditor's ambient analyzer(s) with a zero and 3 upscale points.*

In Aud 3-D, the station operator can answer questions and potential procedural problems can be addressed on the spot.

It is the responsibility of the person responsible to troubleshoot and correct calibration system deficiencies that arise as a result of the calibration systems audit.

Calibration systems audit results that fall very near the failure criteria will be considered marginal. The cause of any marginal results should be investigated by the person responsible in order to minimize future failures.

Aud 3-E	*If any of the assessment criteria are not met during a calibration systems audit, the person responsible shall cease using that calibration system for any calibrations in Alberta until the auditor confirms that the assessment criteria have been met.*
Aud 3-F	*When operational concerns are identified during a calibration systems audit, the person responsible shall supply a written report to the auditor, within one month of the audit, detailing which actions have been taken to address the operational concerns.*

Aud 3-F refers to a scenario where an analyzer has not failed, but station operation and data quality could be improved by rectifying specific operational concerns. In this scenario, the auditor will verbally communicate the concerns at the time of the audit and a follow up will be conducted at the next scheduled audit/inspection.

3.2 Calibration Gas Audit

Aud 3-G	*For a calibration gas audit, the person responsible or station operator shall deliver the calibration gas cylinder(s) to the auditor with sufficient time in advance of the audit appointment so that the gas will be at room temperature by the scheduled audit start time.*
Aud 3-H	*For the calibration gas audit in Aud 3-G, the person responsible shall provide to the auditor along with each gas cylinder to be audited:* *(a) the proper regulator for the gas in the cylinder; and* *(b) the cylinder gas certificate provided by the manufacturer.*

4.0 AUDIT FAILURE

Audit Acceptance Criteria are provided in Appendix B.

Aud 4-A	*In the event of any ambient air monitoring station, calibration systems or calibration gas audit failure reported by the auditor, the person responsible must:* *(a) commence the corrective action process detailed within the person responsible's Quality Assurance Plan; and* *(b) report the results of the corrective action taken in Aud 4-D(a) to the auditor within one month of the audit failure notice.*
Aud 4-B	*When written notification of audit failure or non-compliance with the AMD is received, the person responsible shall supply a written report to the auditor within one month, or other time period as specified in writing by the auditor, detailing the actions taken to address the failure or non-compliance.*

Audit failure or non-compliance will be communicated at the time of the audit. Written notification from the auditor will be provided within five working days from completion of the audit.

Aud 4-C	*In the event of a calibration system or calibration gas audit failure reported by the auditor:* *(a) the person responsible must provide the auditor with a list of all stations and analyzers where the calibration system or calibration gas were used; and* *(b) the person responsible shall cease using the failed calibration system or calibration gas for calibrations in Alberta until the auditor confirms that the calibration system or calibration gas is within acceptable tolerances.*
Aud 4-D	*Procedures or calculations used by the person responsible that contribute to a calibration system or calibration gas audit failure must be changed to comply*

with calibration requirements outlined in the Calibration Chapter (Chapter 7) of the AMD .

4.1 Data Handling

Aud 4-E *Following an ambient air monitoring station audit failure, the person responsible shall invalidate all data collected from the analyzer(s) in question:*
(a) back to the time that it can be demonstrated to be valid; and
(b) up to the time that corrective action(s) have been completed to address the audit failure.

It is the responsibility of the person responsible to determine at what point the data became invalid after the last documented time of proper operation.

Aud 4-F *The person responsible shall invalidate data collected from any analyzer that was calibrated with a failed calibration system or calibration gas back to the last calibration conducted with a verified, functioning calibration system, unless:*
(a) the data has been (i) reviewed and validated or (ii) reviewed and corrected; and
(b) evidence has been provided in writing to the auditor demonstrating the validity of the data.

It is the responsibility of the person responsible to provide an explanation to the auditor as to why data should not be considered invalid following a failed calibration system or calibration gas audit.

Aud 4-G *Following any audit failure, the person responsible shall flag all data invalidated in Aud 4-E and Aud 4-F according to the requirements of the Data Quality Chapter (Chapter 6) of the AMD.*

Aud 4-H *Following any audit failure, the person responsible shall:*
(a) resubmit invalid data to the Regulator with flags according to Aud 4-G; or
(b) when acceptable, resubmit corrected data to the Regulator along with justification and a description of the corrections made.

The Reporting Chapter (Chapter 9) of the AMD provides requirements for resubmitting continuous ambient air data to Alberta's Ambient Air Quality Data Warehouse.

Whether or not invalid data can be corrected is dependent on the cause of the audit failure. The Regulator will determine whether or not corrected data can be accepted.

5.0 STATION AUDIT FOLLOW-UP

A follow-up audit will be conducted on any analyzer(s) for which the Audit Assessment Criteria or current AMD requirements have not been met during an ambient air monitoring station audit. The follow-up audit preparation and delivery will be conducted in accordance with Section 2.0 of the Audit Chapter.

5.1 On-Site Checklist

Following an ambient air monitoring station audit failure or operational issues discovered during a station audit, the station operator along with the auditor should investigate and determine the cause of any issues arising from the audit findings.

Aud 5-A	*The person responsible must complete the On-site Checklist in Appendix C at the (a) time and (b) location of the ambient air monitoring station audit when:* *(i) there is an audit failure; and* *(ii) there are operational issues discovered during an audit.*

The On-site Checklist is provided in Appendix C and is also downloadable from the AMD website. The On-site Checklist should be completed cooperatively between the auditor and the person responsible or station operator.

The best time to determine the cause of an audit failure is at the time it was discovered, rather than attempting to recreate the incident. Completion of the On-site Checklist should make the reason(s) for most audit findings apparent.

Only those portions of the On-site Checklist relevant to the audit failure or operational issue need be completed. The completed checklist becomes part of the audit documentation and is available to all parties.

5.2 Data Review Checklist

Aud 5-B	*If, in the opinion of the auditor, the audit reveals operational issues that cause the integrity of the data to be in question, the person responsible must complete the Data Review Checklist in Appendix D.*

During the audit closure process, data review is required for data quality validation and assurance. The Data Review Checklist should be used in conjunction with the draft audit field sheets, On-site Checklist, draft summary audit report and any other documents deemed necessary for the data review. The Data Review Checklist is provided in Appendix D and on the AMD website.

5.3 Response Letters and Reports

Throughout the audit process, the person responsible may be required to submit various response letters or reports to the auditor. The Audit Process Flow Chart, available from the AMD website, shows the situations where the various letters and reports are required.

Aud 5-C	*When required in writing by the auditor, the person responsible shall prepare and submit a First Response Letter to the auditor by the date specified.*
Aud 5-D	*The First Response Letter in Aud 5-C must include the following information, at a minimum:* *(a) the monitoring station identification;* *(b) a description of the audit finding(s) in question;* *(c) a description of the steps taken to correct the issue;* *(d) the timeline for corrections;* *(e) completed On-site Checklist in Aud 5-A;* *(f) identification of amount of data affected by the audit finding(s);* *(g) the completed Data Review Checklist in Aud 5-B; and* *(h) an explanation of the data handling (if applicable) including the timeline for completion of this task.*
Aud 5-E	*If the person responsible disputes the audit findings, the First Response Letter in Aud 5-C must (a) explain the reason for the dispute, and (b) provide all additional detailed evidence to uphold the claim.*

First Response Letters lacking any of the above elements in Aud 5-D and Aud 5-E will be considered incomplete.

Receipt of the First Response Letter by the auditor is acknowledged in writing through a Meeting Letter. If the content of the First Response Letter does not warrant closing the audit, the Meeting Letter will provide reasons and/or explanations and a list of actions that remain to be performed. The Meeting Letter will request a meeting with the person responsible and include the date that a response is required.

An Action Plan will be developed jointly by the auditor and the person responsible, and will be written by the person responsible. The Action Plan should address the following:

- what actions will be taken;
- who will take these actions; and
- the proposed timeline for completing these actions.

Aud 5-F	*When required in writing by the auditor, the person responsible shall prepare and submit a Second Response Letter to the auditor by the date specified.*
Aud 5-G	*The Second Response Letter in Aud 5-F must include the following information, at a minimum:*

(a) the monitoring station identification;
(b) a description of the audit finding(s) in question;
(c) a description of the steps taken to correct the issue;
(d) the timeline for corrections;
(e) completed On-site Checklist in Aud 5-A;
(f) identification of amount of data affected by the audit finding(s);
(g) completed Data Review Checklist in Aud 5-B; and
(h) an explanation of the data handling (if applicable) including the timeline for completion of this task.

Receipt of the Second Response Letter by the auditor is acknowledged in writing through a Second Meeting Letter. The Second Meeting Letter will include:

- reason(s) and or explanations if the Second Response Letter does not warrant closing the audit, why the letter did not warrant closure and a list of actions that remain to be performed, including a third party review;
- acknowledgement of any actions that have been completed and deemed satisfactory;
- a request for a meeting; and
- the date that a response is required from the person responsible.

Aud 5-H *When required in writing by the auditor, the person responsible shall prepare and submit an Implementation Plan to the auditor by the date specified.*

Aud 5-I *The Implementation Plan in Aud 5-H must include the following information, at a minimum:*
(a) the monitoring station identification;
(b) the audit finding(s) in question;
(c) a copy of the contracted third party report, including findings and recommendations;
(d) a plan of (i) which data and (ii) the time period of the data that will be under review; and
(e) a plan of which actions will be taken to correct the data including the timeline for completion of this task.

Aud 5-J *When required in writing by the auditor, the person responsible shall prepare and submit an Action Report to the auditor by the date specified.*

Aud 5-K *The Action Report in Aud 5-J must include the following information, at a minimum:*
(a) the monitoring station identification;
(b) the audit finding(s) in question;
(c) details of what steps in the Implementation Plan have been completed and if some steps have yet to be completed as of the date of this report, a timeline as to when these will be completed;
(d) details of any data flagging or other data treatment recommended by the third party; and

(e) *a description of (i) what actions were taken to correct the data, (ii) the time period of the data corrected, and (iii) the completion date of data corrections.*

A Closure Letter from the auditor is directed to the person responsible to:

- acknowledge receipt of a response letter from the person responsible; and
- notify that the audit is closed when actions are deemed complete and satisfactory.

5.4 Third Party Review

Aud 5-L *In the event that a third party is engaged by the auditor and the person responsible to complete a review of the audit findings and associated data, the person responsible shall provide the following information to the third party, at a minimum:*

(a) *the Quality Assurance Plan(s) for the station in question, including all applicable standard operating procedures (SOPs);*
(b) *the Audit Summary Report;*
(c) *the audit report for the analyzer(s) in question;*
(d) *all correspondence between the auditor and the station operator arising from the audit;*
(e) *completed On-site Checklist in Aud 5-A;*
(f) *results of verifications of standards and equipment;*
(g) *reports of verification checks performed on the person responsible's equipment by the auditor;*
(h) *completed Data Review Checklist in Aud 5-B;*
(i) *raw one minute average data (or shortest time increment available) for the parameter(s) in question (the amount as determined by the Terms of Reference);*
(j) *raw one hour average data for the parameter(s) in question (the amount as determined by the Terms of Reference);*
(k) *corrected and reported one hour average data for the parameter(s) in question (the amount as determined by the Terms of Reference);*
(l) *zero/span logs for the analyzer(s) in question;*
(m) *maintenance reports and logs;*
(n) *calibration records (the number of months as determined by the Terms of Reference);*
(o) *station activity log;*
(p) *copy of the Air Monitoring Directive if the third party is located outside of Alberta; and*
(q) *site documentation for the site in question.*

The Terms of Reference document is developed jointly by the auditor and the person responsible for a third party review and will be dated and signed by both the auditor and the person responsible. The Terms of Reference will contain:

- Scope: What will be achieved?;
- Roles and responsibilities: Who will take part in it?;
- Resources, quality plans, tasks: How will it be achieved?; and
- Schedule: When it will be achieved?

The details on the third party review (Aud 5-L) will be established at the terms of reference meeting, including which areas the review will examine and make recommendations on.

Once it is decided that a third party will be engaged, the data in question will be flagged as 'Under Investigation' in Alberta's Ambient Air Quality Data Warehouse. Data may be flagged back to the previous audit that was passed.

5.5 Timeline and Late Reports

The time allotted for the entire audit process, from the audit to the closure letter, is a maximum of three months. A typical audit from start to finish with no audit failures should take 30 days to complete. Where a third party must be engaged to resolve issues, a maximum of six months will be provided. Time frames are shown in the Audit Process Flow Chart that is available from the AMD website.

A late response letter by the station operator will reduce the time allowed for future steps in the process. The audit process may be extended past the allotted time period due to exceptional circumstances, as determined by the auditor. If late replies from the station operator cause the resolution time to extend beyond 30 business days without due cause, the process may be terminated and the data in question flagged as Questionable due to audit failure.

APPENDIX A SAMPLE AUDIT REPORT

September 10, 2013 File No(s): 2013 – X20A / XA

Mr. John
Program Manager
ABC Airshed

Dear Mr. John:

Re: ABC Airshed Ambient Air Monitoring Station Audit

Please see attached audit summary for all audit findings from the audit conducted on the ABC Airshed ambient air monitoring station.

Alberta Environment Sustainable Resource Development (ESRD) has received documentation from Contractor Y and has verified that the actions to correct the audit findings at Station1 have been taken. Airshed ABC will need to verify the amount of data that is affected from the audit findings and re-adjust any data that has been affected. Please respond in writing by October 10, 2013 detailing what corrective actions will be taken.

Yours truly,

Monitoring Systems Auditor

Attachment(s): Audit Summary Report

cc:

Audit Summary

Form No. X-AA
Version 1.2
Page 1 of 1

Facility / Zone	Airshed ABC
Total # of parameters that passed	20
Total # of parameters audited in the network	22
Date(s) of the audit	3-Sep-13
Issue Date of Audit Summary	

Station Name	Station1		
Auditor	Auditor X		
Audit Date	September 3, 2013		
Critical	**Pass**	**Fail**	
H_2S	√		
SO_2	√		
TRS			
NO / NO_2 / NO_X	√		
O_3	√		
THC	√		
TEOM/BAM $PM_{2.5}$		X	Flow
			Leak
Wind Speed / Wind Direction	√		
Wind head Orientation	√		
Manifold Fan	√		
Precipitation Sampler			
Zero/Span Systems Operational	√		

Inspection Items	**OK**	**Need for Improvement**	
Sample pump venting/scrubbing	√		
Heating / Air Conditioning	√		
Manifold	√		
Sample Lines	√		
TEOM/BAM $PM_{2.5}$		X	Temperature
Safety	√		
Site Conditions	√		

Non-critical	**OK**	**Opportunity for Improvement**	
RH			
Station Temperature	√		
Ambient Temperature			
Barometric Pressure			
Tipping bucket			
Station Condition	√		
Station Documentation	√		

Not monitored at this location

Form No. F-AA-001
Version No. 1.2

STATION AUDIT

File No. 2013 – X20A / XA

Date: September 3, 2013 Performed by: Auditor X

Station

Name: Station1 Location: Townsville

Facility/Zone: ABC Airshed Operator: Contractor Y

Temp: 21.7 C Barometric Press: 709 mmHg

Location

Latitude N 51° 20' 48.6"

Longitude W 111° 12' 56.8"

Elevation 514 m

Status of Site Documentation On site - Complete

Manifold Material Glass

Manifold Condition Good

Meteorological

	Observed	Audit Value
Wind Speed Direction	23.4 kph / 316 deg	20-25 kph / NNW
Station Temperature	23.6 C	23.4 C
Relative Humidity	41.4%	41.5%
Ambient Temperature	17.1 C	17.1 C
BP	N/A	N/A
Precipitation	N/A	N/A

Remarks:

Form No. F-AA-003
Version No. 1.3

SO_2 ANALYZER AUDIT

File No. 2013 – X20A / XA

Date: September 3, 2013 Performed by: Auditor X

Station

Name: Station1 Location: Townsville

Facility/Zone: ABC Airshed Operator: Contractor Y

Temp: 21.7 C Barometric Press: 709 mmHg

Monitor

Make/Model: Teco 43i Serial No: 0106728532

Inlet flow (sccm): 447 Full Scale Range ppm: 0.5

Last cal. Date: Sep 11/12 Old C.F. 0.9952

Zero/Bkg 6.0

Span Coef 1.031

Calibrator

Calibration Method: GAS DILUTION

Make/Model: R&R MFC 201 AMU # : 1691

Cylinder # : CLM005829 SO_2 Concentration PPM: 50.4

Calibrator Flow (sccm)			Calculated Conc. (ppm)	Indicated Concentration (ppm)	% Difference vs Audit Gas	% Difference Limits
Air	Gas	Total				
5054	0.0	5054	0.000	0.000		
5092	38.7	5131	0.380	0.371	-2%	± 15%
5072	17.3	5089	0.171	0.170	-1%	± 15%
5063	8.2	5071	0.081	0.080	-2%	± 15%
			Absolute Average Percent Difference		2%	

Linear Regression Analysis:

y=mx+b (where x=calculated concentration, y=indicated concentration)

		LIMITS
Correlation Coeff.=	1.0000	**≥ 0.995**
m (Slope)=	0.9760	**0.85-1.15**
b (Intercept as % of full scale)=	0.1617	**± 3% F.S.**

Remarks:

Form No. F-AA-004
Version No. 1.3

TRS ANALYZER AUDIT

File No. 2013 – X20A / XA

Date: September 3, 2013 Performed by: Auditor X

Station

Name: Station1 Location: Townsville

Facility/Zone: ABC Airshed Operator: Contractor Y

Temp: 21.7 C Barometric Press: 709 mmHg

Monitor

Make/Model: Teco 450i Serial No: 0512323468

Inlet flow (sccm): 451 Full Scale Range ppm: 0.1

Last cal. Date: Aug 27/13 Old C.F. 0.9719

Zero/Bkg 12.9

Span Coef 1.014

Calibrator

Calibration Method: GAS DILUTION

Make/Model: R&R MFC 201 AMU # : 1691

Cylinder # : FF15612 H_2S Concentration PPM: 10.0

Calibrator Flow (sccm)			Calculated Conc. (ppm)	Indicated Concentration (ppm)	% Difference	
Air	Gas	Total			vs Audit Gas	Limits
5054	0.0	5054	0.000	0.000		
5092	38.6	5131	0.075	0.071	-6%	± 15%
5071	17.8	5089	0.035	0.033	-6%	± 15%
5062	9.1	5071	0.018	0.017	-5%	± 15%
				Absolute Average Percent Difference	6%	

Linear Regression Analysis:

y=mx+b (where x=calculated concentration, y=indicated concentration)

		LIMITS
Correlation Coeff.=	1.0000	**≥ 0.995**
m (Slope)=	0.9435	**0.85-1.15**
b (Intercept as % of full scale)=	0.0227	**± 3% F.S.**

Remarks:

Form No. F-AA-006
Version No.1.2

HC ANALYZER AUDIT

File No. 2013 – X20A / XA

Date: September 3, 2013 Performed by: Auditor X

Station

Name: Station1 Location: Townsville

Facility/Zone: ABC Airshed Operator: Contractor Y

Temp: 21.7 C Barometric Press: 709 mmHg

Monitor

Make/Model: Teco 51CLT Serial No: 0329408413

Inlet flow (sccm): 6.5 Full Scale Range ppm: 50.0

Last cal. Date: Aug 27/13 Old C.F. 0.9982

Calibrator

Calibration Method: Gas Dilution

Make/Model: Sabio 2010 AMU # : 1778

HC cylinder # : Sg090044A HC concentration ppm: 1063.5

Calibrator Flow (sccm)			Calculated Conc. (ppm)	Indicated Concentration (ppm)	% Difference	
Air	Gas	Total			vs Audit Gas	Limits
3526	0.0	3526	0.0	0.1		
3524	80.1	3604	23.6	23.0	-3%	± 15%
3524	40.2	3564	12.0	11.5	-5%	± 15%
3525	20.2	3545	6.1	5.8	-6%	± 15%
				Absolute Average Percent Difference	5%	

Linear Regression Analysis:

y=mx+b (where x=calculated concentration, y=indicated concentration)

		LIMITS
Correlation Coeff.=	0.9999	**≥ 0.995**
m (Slope)=	0.9701	**0.85-1.15**
b (Intercept as % of full scale)=	-0.0237	**± 3% F.S.**

Remarks:

NO-NOx-NO2 Analyzer Audit

File No. 2013 – X20A / XA

Date: September 3, 2013 Performed by: Auditor X

Station: Name: Station1 Location: Townsville Operator: Contractor Y
Facility/Zone: ABC Airshed Temp. 21.7 C BP: 709 mmHg

Monitor: Make/Model: Teco 42C Serial No. 0121808412
Inlet flow (sccm): 725 Range ppm: 0.5
Last cal. Date: Aug 27/13 Old C.F.'s NO: 1.000
NOx: 1.000
NO2: 0.997

NO Bkg 3.7
NOx Bkg 4.0
NO Coef 0.956
NOx Coef 1.002
NO2 Coef 0.998

Calibration Method: Gas Dilution / GPT
Calibrator: Make/Model: Sabio 2010 AMU# 1749
NO cylinder # CLM006307 NO conc. ppm 50.0 NOx conc. ppm 50.1

Calibrator Flows			Calc. Conc.		Indicated Concentration		% Difference vs Audit Gas	
Air	Gas	Total	NO (ppm)	NOx (ppm)	NO (ppm)	NOx (ppm)	NO	NOx
5020	0.0	5020	0.000	0.000	0.000	0.000	Limit ± 15%	
5021	40.1	5061	0.396	0.397	0.395	0.403	0%	2%
5020	20.2	5040	0.200	0.201	0.198	0.202	-1%	1%
5021	10.2	5031	0.101	0.102	0.099	0.102	-2%	0%
						Absolute Average Percent Difference	1%	1%

Linear Regression Analysis: *y=mx+b (where x=calculated concentration, y=indicated concentration)*

	NO	NOx	NO_2	LIMITS
Correlation Coeff.=	1.0000	1.0000	0.9999	≥ 0.995
m (Slope)=	0.9983	1.0156	1.0018	0.85-1.15
b (Intercept as % of full scale)=	-0.2367	-0.1625	0.1971	± 3% F.S.

O_3 Setting	Flow Rate	Indicated Conc. (ppm) NO	NOx	NO_2	NO Decrease	NO_2 Increase	% Difference vs Audit Gas	
0.000 V	5061	0.395	0.399	0.005				%Dif Limit
0.600 V	5061	0.101	0.402	0.301	0.294	0.296	1%	± 15%
0.400 V	5061	0.223	0.400	0.177	0.172	0.172	0%	± 15%
0.287 V	5061	0.293	0.402	0.109	0.102	0.104	2%	± 15%
						Absolute Average Percent Difference	1%	

Converter Efficiency
Average Converter Efficiency 100.9%

Remarks:

Form No. F-AA-009
Version No. 1.2

O_3 ANALYZER AUDIT

File No. 2013 – X20A / XA

Date: September 3, 2013 Performed by: Auditor X

Station

Name: Station1 Location: Townsville

Facility/Zone: ABC Airshed Operator: Contractor Y

Temp: 19.8 C Barometric Press: 709 mmHg

Monitor

Make/Model: Teco 49i Serial No: 0208719311

Inlet flow (sccm): 708 / 748 Full Scale Range ppm: 0.5

Last cal. Date: Aug 27/13 Old C.F. 0.9968

Zero/Bkg -0.1

Span Coeff. 1.039

Calibrator

Calibration Method: Generator

Make/Model: Sabio 2010 AMU # : 1778

NO cylinder # : N/A NO concentration ppm: N/A

Ozone Setting	Calibrator Flow (sccm) Air	Gas	Total	Calculated Conc. (ppm)	Indicated Conc. (ppm)	% Difference vs Audit Gas	Limits
0.000 V	4984		4984	0.000	0.001		
0.795 V	4984		4984	0.402	0.419	4%	± 15%
0.429 V	4984		4984	0.200	0.207	3%	± 15%
0.249 V	4984		4984	0.101	0.102	0%	± 15%
				Absolute Average Percent Difference		2%	

Linear Regression Analysis:

y=mx+b (where x=calculated concentration, y=indicated concentration)

		LIMITS
Correlation Coeff.=	0.9999	≥ **0.995**
m (Slope)=	1.0427	**0.85-1.15**
b (Intercept as % of full scale)=	-0.1998	**± 3% F.S.**

Remarks:

Form No. F-AA-012
Version No.1.5

TEOM AUDIT

File #: 2013 – X20A / XA
Date: September 3, 2013 Performed by: Auditor X

Station

Name:	Station1	Location:	Townsville
Facility/Zone:	ABC Airshed	Operator:	Contractor Y
Temperature:	21.7 C	Barometric Press.	709 mmHg

Audit Transfer Standard

Make/Model:	DeltaCal	Cell s/n:	1002
Serial Number:	AMU 1738		

Sampler Set-up and Current Readings

Make/Model	Teom 1405-F	F-Main Set Pt (l/min)	3.00
Unit #	PM2.5	F-Aux Set Pt (l/min)	13.67
Control unit s/n	1905A2014203864	Filter Load (%)	24.3
Transducer s/n	1905A2014203864	K_O Factor	14578
		Temp (°C)	19.6
		Press (ATM)	0.965

Conversion from mm Hg or " Hg to ATM (Atmospheres)

ATM = (mm Hg) X (1.316×10^{-3}) or ATM = ("Hg) X (3.34207×10^{-2})

Note: Tolerances are noted as **BOLD** in Brackets

Zero Flow

Pump Off		**Pump On (Time to reach set points)**	
F-Main (l/min)	N/A	**(45-60 Sec)**	N/A
F-Aux (l/min)	N/A	**(45-60 Sec)**	N/A

Temperature/Pressure

Measured Temp **(± 2 °C)**	19.8	**Δ°C**	0.2
Measured Press **(± 1.5% ATM)**	0.933	**Δ% ATM**	**-3.32%**

Flow Audit

			Δ% of Measured Flow from Set-point		
Indicated Main/Aux Flow (l/min)	3.00	13.68	**(± 2%)**	0.0%	0.1%
Total Flow = Main + Aux (l/min)	16.68		**(± 2%)**	0.1%	
			Δ of Measured Flow from Indicated		
Measured Total Flow (l/min)	17.42		**(± 1.00 l/min)**	0.74	
Measured Main Flow (l/min)	3.27		**(± 0.20 l/min.)**	**0.27**	

Leak Check

		Actual leakage = Pump On – Pump Off
Base **(< 0.15 l/min)**	0.52 / 2.57	**Fail**
Ref **(< 0.65 l/min)**	0.13 / 0.64	**Fail**

K_O Factor

Measured	14544
K_O % Difference **(± 2.5%)**	0.23

Remarks:

Heads Clean.

Note - Leak repaired September 12, 2013, flows rechecked OK now.
Pressure adjusted after audit

Form No. F-AA-015
Version No. 1.5

Station Performance Audit Summary

Company: ABC Airshed Facility Name: Townsville

Approval No.: N/A Site Name: Station1

AENV Region: Northern AENV District: North East

Parameters audited:

H_2S	X	SO_2	X	NO_X	X	NH_3		O_3	X
CO		CH_4		NonCH4		THC	X	Ethylene	
$PM_{2.5}$	X	PM_{10}		TSP		BTEX		Wind Speed	X
Wind Dir	X	Amb. Temp	X	Stn.Temp	X	RH	X	Solar Radiation	
Rainfall		Precip		VWS		Other			
All parameters monitored as per approval: Yes				No		N/A			

	YES	NO	N/A
GENERAL			
Has the location remained unchanged from previous audit?	X		
Is site secure?	X		
Are station operating conditions adequate?	X		
DATA ACQUISITION			
Are strip charts in use?		X	
Is a telemetry system for data acquisition in use?	X		
SYSTEM COMPONENTS			
Is a glass sampling manifold installed?	X		
Is sampling manifold clean?	X		
Is a manifold trap in place?	X		
Are spare manifold ports capped	X		
Is manifold oriented so it is not exactly horizontal?	X		
Are manifold ports situated to prevent water entering monitors?	X		
Is manifold pump properly installed and operative?	X		
Do sample lines extend at least 3/4"into manifold?	X		
Are monitor sampling lines connected to manifold?	X		
Are sampling lines clean?	X		
Are monitors properly mounted and secure?	X		
Are monitors properly exhausted from room or scrubbed?	X		
Are zero and span systems operational?	X		
WIND EQUIPMENT			
Is wind sensor properly oriented?	X		
Does wind equipment appear to be functioning properly?	X		
Date of last calibration. Date: Nov 2010			

COMMENTS:

AUDITOR: Auditor X *DATE:* September 13/13

November 10, 2013 File No(s): 2013 – X20A / XA

Mr. John
Program Manager
ABC Airshed

Dear Mr. John:

Re: ABC Ambient Air Monitoring Station Audit Closure Letter

Alberta Environment Sustainable Resource Development (ESRD) has received and reviewed the content of your letter dated October 28th, 2013. Although ESRD has not verified the actions, ESRD is satisfied and considers this audit closed.

Yours truly,

Auditor X
Monitoring Systems Auditor
Monitoring Programs & Validation

Attachment(s):

cc:

APPENDIX B AUDIT ASSESSMENT CRITERIA

Continuous Analyzers

Continuous analyzers will be deemed to have failed an audit if any one of the following are demonstrated in its response to audit gas(es):

- the least squares regression analysis of the analyzer response results in a slope of less than 0.900;
- the least squares regression analysis of the analyzer response results in a slope of greater than 1.100;
- the comparison of the audit gas to the analyzer response results in a correlation coefficient of less than 0.995;
- the least squares regression analysis of the analyzer output results in an intercept being greater than ± 3% of the operating full scale of the analyzer;
- the least squares regression analysis of the analyzer response results in any one upscale point (excluding the first or high point) that deviates more than ±5% from the slope; or
- any single upscale response point (excluding the zero) of the analyzer deviates from the audit gas by more than 10%.

Results that are very near the failure criteria will be considered marginal. The station operator should investigate the causes of these marginal results in order to minimize future failures.

Particulate Analyzers

The following audit criteria apply to Thermo Tapered Element Oscillating Microbalance (TEOM) $PM_{2.5}$ and PM_{10} Model 1400(xx) analyzers:

- TEOM external temperature sensor:
  The allowable measured difference of the temperature sensor from the audit reference device is ± 2.0°C. TEOM reported temperature greater than ± 2.0°C from the audit reference device will be noted as a need for improvement.

- Leak Check:
  The allowable main flow leak check test result is less than 0.15 litres per minute (lpm). The allowable auxiliary flow in the leak check test result is less than 0.65 lpm.

- Flow Audit:
  Difference of Measured Flow from Indicated Flow are measured and reported in lpm only without a percentage limit and reported to two decimal places. TEOM flows are specified in operating manuals to two decimal places rather than one (i.e., 3.00 lpm for Main Flow and 13.67 lpm for Auxiliary Flow). Allowable difference of Measured Total Flow from Indicated Flow is ±1.00 lpm and allowable difference of Measured Main Flow from Indicated Flow is ±0.20 lpm.

- Pump On Time (time to reach set points):
  Pump on time results of greater than 60 seconds will be considered as an opportunity for improvement rather than an audit failure. This test is intended to give a warning of overall system performance if the flow takes too long to achieve the final level.

- These criteria reflect varying manufacturer's specifications for different generations of TEOM analyzers as stated in operating manuals since the first units in 1993. Rather than attempt to determine which serial numbered units will be audited to what limits, all TEOMs will be audited to the same limits. These limits are in use by other Canadian jurisdictions.

Particulate loading or any loose material of sufficient quantity that impedes or alters the flow through the sample manifold or particulate head will be noted as 'excessive' in the audit report. This will result in a failure of the audit, with a requirement to investigate the data reported from that analyzer.

Where the SOP is being followed with respect to cleaning frequency of particulate sampler intakes and sample manifold assemblies, as recorded in documents such as service logs or check sheets, but the cleaning frequency is such that excessive material has accumulated, this will be noted in the audit report as a need for improvement of the SOP itself.

Lack of documentation of particulate sampler intake and sample manifold assembly cleaning, or documentation that shows a cleaning frequency that is less than specified in the AMD (Chapter 3, Site Selection) or the applicable SOP, will be considered a need for improvement.

Other Analyzers

Meteorological (except wind) and other analyzers can be considered to have failed an audit if their outputs deviate more than 15% from the audit reference.

Wind direction analyzers can be considered to have failed if the output to a datalogger deviates more than 20 degrees from compass observation.

Wind speed analyzers can be considered to have failed if the output data falls outside the observed wind speed range.

Particulate or other analyzers that cannot be challenged with standards will be considered to have failed an audit if the operating parameters such as flow, temperature or programmed settings are outside the manufacturer's specified limits.

Results very near the failure criteria will be considered marginal. The station operator should investigate the causes of these marginal results in order to minimize future failures.

Calibration Systems

A calibration system will be deemed to have failed an audit if the auditor's analyzer(s) demonstrated response results in any one of the following:

- the least squares regression analysis of the analyzer response results in a slope of less than 0.900;
- the least squares regression analysis of the analyzer response results in a slope of greater than 1.100;
- the comparison of the audit gas to the analyzer response results in a correlation coefficient of less than 0.995;
- the least squares regression analysis of the analyzer output results in an intercept being greater than ± 3% of the operating full scale of the analyzer;
- the least squares regression analysis of the analyzer response results in any one upscale point (excluding the first or high point) that deviates more than ±5% from the slope; or
- any single response point of the analyzer (excluding the zero) deviates from the calibration gas value by more than 10%.

Results very near the failure criteria will be considered marginal. The station operator should investigate the causes of these marginal results in order to minimize future failures.

Calibration Gas

A calibration gas will be deemed to have failed the audit if the auditor's analyzer(s) demonstrated response results in the deviation between the manufacturer's stated cylinder gas concentration and the determined cylinder gas concentration of greater than 5% outside the tolerances specified by the manufacturer's certificate (e.g., if the certificate is ± 2% and you add the ± 5%, the calibration gas it could be out ± 7%).

APPENDIX C AMBIENT AIR MONITORING AUDIT – ON-SITE CHECKLIST

Today's Date:_____

Air Monitoring Network: _____

Most Recent Calibration Date: _____

Station Number:_____ Station Name:_____

This checklist is to be followed in the event of an analyzer, monitor or sensor failure during a field audit of an ambient air monitoring station. The intent is to determine the reason for the failure so that corrective action can, at a minimum, be identified and possibly taken at the time of the audit. It is important that these steps be taken at the time of the audit, as conditions that may contribute to the reason for the failure are typically impossible to re-create once the auditor and the station operator have left the station. This information is also very important in evaluating the data after the field audit has been completed. Only use the applicable sections below, some may not apply.

Initial checks – Audit Calibration System

Auditor	Operator	
□ Yes □ No	□ Yes □ No	**1.** Are the flow set points and flow readings what they were at the beginning of the audit?
If no, why		
□ Yes □ No	□ Yes □ No	**2.** Are the flow and concentration calculations correct for the Outgoing Gas Concentration?
If no, why		
□ Yes □ No	□ Yes □ No	**3.** Are the plumbing connections from the cylinder to the calibrator still connected properly and without compromise?
If no, why		

Initial checks – Audit Calibration System …continued

Auditor	Operator	
□ Yes □ No	□ Yes □ No	**4.** Has the audit gas cylinder regulator been properly evacuated? If no, why
□ Yes □ No	□ Yes □ No	**5.** Are the plumbing connections from the calibrator to the analyzer still connected properly and without compromise? If no, why
□ Yes □ No	□ Yes □ No	**6.** Is the audit calibrator generating enough flow to meet the analyzer(s) flow demand? If no, why
□ Yes □ No	□ Yes □ No	**7.** Is the zero air system still working and scrubbing properly? If no, why
□ Yes □ No	□ Yes □ No	**8.** Did you compare the audit zero-air source to an alternate source of zero air? If no, why
□ Yes □ No	□ Yes □ No	**9.** Did you compare the audit zero-air source to the response from the daily zero source? If no, why
□ Yes □ No	□ Yes □ No	**10.** Did the station temperature remain constant during the audit (no drastic swings)? If no, why

Secondary – Analyzer Systems Checks

Auditor	Operator	
□ Yes □ No	□ Yes □ No	**11.** Is the analyzer still set to sample ambient? (not inadvertently switched to zero or span mode) If no, why
□ Yes □ No	□ Yes □ No	**12.** Is the sample filter still in good condition? If no, why
□ Yes □ No	□ Yes □ No	**13.** Is the sample filter properly seated? If no, why
□ Yes □ No	□ Yes □ No	**14.** Is the sample filter holder itself leak-tight and connections in good condition? If no, why
□ Yes □ No	□ Yes □ No	**15.** Are the sample lines clean and free of moisture, cracks and excessive bending? If no, why
□ Yes □ No	□ Yes □ No	**16.** Are the analyzer signal output connections to the data system still tight? If no, why
□ Yes □ No	□ Yes □ No	**17.** Does the display of the analyzer correspond to the data system reading? If no, why
□ Yes □ No	□ Yes □ No	**18.** Are all of the analyzer sub systems (i.e., air supply and support gases) operating properly? If no, why

NO2 Audit Calibration – GPT Points

Auditor	Operator	
□ Yes □ No If no, why	□ Yes □ No	**19.** Is the O_3 flow accounted for in the total dilution flow? (This could be the reason for a difference from the station operator's to auditor's rig)
□ Yes □ No If no, why	□ Yes □ No	**20.** Is the GPT NO reference the same as the NO/NO_x high point?
□ Yes □ No If no, why	□ Yes □ No	**21.** Are the O_3 generator feedback readings stable? (This could be an issue for either the auditor's or station operator's calibration rig)
□ Yes □ No If no, why	□ Yes □ No	**22.** Are the NO_x channel readings stable?
□ Yes □ No If no, why	□ Yes □ No	**23.** Did a confirmation NO/NO_x reference point performed at the conclusion of the GPT confirm NO/NO_x has not shifted?
□ Yes □ No If no, why	□ Yes □ No	**24.** If correct NO_2 response is not observed and an O_3 analyzer is available, does it indicate a correct response from the calibrator generator?

Two Most Recent Calibration Reports

Auditor	Operator	
□ Yes □ No If no, why	□ Yes □ No	**25.** If the source cylinder was changed, did the calibration response stay the same?
□ Yes □ No If no, why	□ Yes □ No	**26.** Are the analyzer test parameters (flow, temps, etc.) comparable to the last calibration observations?
□ Yes □ No If no, why	□ Yes □ No	**27.** Did the percent changes for the high point adjustments stay within 10%?
□ Yes □ No If no, why	□ Yes □ No	**28.** Is the NO_2 (if any) in the cylinder being properly accounted for?
□ Yes □ No If no, why	□ Yes □ No	**29.** Did the calibration after any maintenance show that the analyzer was returned to proper operation?

Network Checks

Auditor	Operator	
□ Yes □ No	□ Yes □ No	**30.** If the failure is part of a network audit, did other analyzers of the same type in the network pass?
If no, why		
□ Yes □ No	□ Yes □ No	**31.** Does recent historical data look to be good without any undesirable trends, power failures, lightning strikes or other indications as to the cause of the audit failure?
If no, why		

Station Operator System Checks

Auditor	Operator	
□ Yes □ No	□ Yes □ No	**32.** Do the calibration points re-introduced by the calibration system normally used to calibrate the station indicate a correct response?
If no, why		
□ Yes □ No	□ Yes □ No	**33.** Were all the Audit Calibration System checks in Section 1 repeated for the station operator's calibration system used during this cross-check?
If no, why		
□ Yes □ No	□ Yes □ No	**34.** Did the checks point to any problems with the calibration system?
Explain:		

Particulate Systems

Auditor	Operator	
□ Yes □ No	□ Yes □ No	**35.** Check flows with another flow meter. Are the flow readings similar?
If no, why		
□ Yes □ No	□ Yes □ No	**36**. Check ambient temperature with another thermometer or device. Are the temperature readings similar?
If no, why		

Wind Sensor

Auditor	Operator	
□ Yes □ No	□ Yes □ No	**37.** Is the wind sensor orientation mark known and visible?
If no, why		
□ Yes □ No	□ Yes □ No	**38.** Was a compass reading of sensor orientation taken from two different vantage points?
If no, why		

General Notes

_____

_____

_____

_____

_____

_____

_____

_____

_____

If the checks completed above do not provide conclusive evidence as to why the audit failed, an action plan will be agreed upon by the auditor and the station operator to move forward. This will likely include returning to AEMERA's audit facility to verify both calibration systems and calibration gasses.

Signatures

Auditor: _____ Print Name_____

Operator: _____ Print Name_____

Date: _____

APPENDIX D AMBIENT AIR MONITORING AUDIT – DATA REVIEW CHECKLIST

Today's Date:_____

Air Monitoring Network: _____

Station Number:_____ Station Name:_____

Quality assurance of monitoring data is linked to the entire air quality monitoring process, from selection of site, instrumentation selection, proficiency of staff, multipoint calibrations, daily zero and span checks, maintenance processes, data storage, and retrieval and analysis systems. The final ambient air monitoring data will only ever be as good and reliable as the systems that produce it. The data validation process involves a critical review of all information relating to a particular data set in order to verify, amend or reject data that may not represent actual air quality conditions found at the site.

During the Audit Closure Process, when a data review is required, it is important that the validation process be undertaken very carefully. This checklist should be used in conjunction with the draft audit field sheets, on-site checklist, summary report and any other documents deemed necessary for the data review. The following checklist is provided to assist in the data review process.

☐	**1.** Has the source of the problem with the analyzer or the calibration system been identified? Notes:
☐	**2.** Has the period during which the data may have been affected been determined? Notes:
☐	**3.** Check the monthly multipoint calibrations with respect to significant changes in the analyzer response and compliance with AMD requirements. Notes:
☐	**4.** Compile raw (unprocessed) data files for the period. Raw data is defined as any values (engineering units or analyzer output signals) without the application of data correction. Notes:
☐	**5.** Compile raw (unprocessed) data files for the daily zero and span responses observed during the period. Notes:

☐	**6.** Check the monthly multipoint calibrations with respect to significant change in the analyzer response and compliance with the AMD requirements. Notes:
☐	**7.** Review the automatic daily span response for changes in analyzer response of 10% or greater from the last span target setting. Document the number of days the spans deviated by 10% or more since the last span target setting. Is there any reason external to the analyzer that may have contributed to the analyzer response? Notes:
☐	**8.** Review the automatic daily zero response checks for the analyzer response. Are there days when the zero response was greater than the typical performance specifications as indicated in the AMD or manufacturers specifications? Notes:
☐	**9.** Review the output signal of the analyzer response. Is the noise in the output signal within the typical performance specifications as indicated in the AMD or manufacturers specifications? Notes:
☐	**10.** Review the operation logs for station events and station operator activities that may have an impact on the analyzers response. Notes:
☐	**11.** Check instrument and calibrator history for events when this equipment may have malfunctioned this way previously. Notes:
☐	**12.** Check the calibration system for changes in gas standards, calibrator setup, dilution air generators and scrubbers. Were there additional contaminates in the station or ambient air that may have affected the normal operation of the dilution air generators? Was the dilution calibrator working properly? Notes:
☐	**13.** Verify the analyzer's monitoring range and output signal. Does the monitoring range and output signal conform to the data logger slope and intercept or scaling? Notes:
☐	**14.** Review the standard operating procedures for the multipoint calibrations and the automated daily zero and span systems operation. Compare the calibrations and daily zero and span checks against the SOPs. Notes:

In instances when data validity is suspected and/or the cause of the problem is not limited to the analyzer, the calibration system information should also be reviewed. The following checklist is provided to assist with this review.

☐	**15.** Review the operation and maintenance log notes of the calibration system. When was the system last calibrated? When was the system last audited? Did it meet the calibrator audit criteria and/or the manufacturer's specifications? Identify if any maintenance that was performed. Notes:
☐	**16.** Review the flow meter and calibrator master flow controller verification reports for compliance with manufacturer specifications. Identify if any maintenance was performed on these units. Notes:
☐	**17.** Confirm the calibration system measurement capabilities. Does it meet the standard to which the audit was conducted? Does it meet the AMD criteria? Notes:
☐	**18.** Confirm the calibration gas concentration. Was it cross-referenced by a reference standard? Was the gas concentration within the acceptable limits of the cross-reference test? Notes:
☐	**19.** Check the performance of the scrubber material used by the dilution air generator and the automated daily zero system. When was the last time these materials were replaced? Was it replaced before the expiration date? Notes:
☐	**20.** Determine and document the data correction plan for auditor authorization. Notes:
☐	**21.** Other: