	Operational Policy Manual Environmental Protection Division	Section	Subsection
BRITISH COLUMBIA The Best Place on Earth		6.0	6.01.02

Name of Policy: **Standard Auditing Procedure for Continuous Emission Monitors and Ambient Air Monitoring Instruments**

Replaces: None

Application: Environmental Protection Division Staff

Purpose: The purpose of this policy is to establish standard audit criteria to determine if continuous emission monitors and ambient air monitoring instruments are performing within acceptable parameters.

Policy Statement: It is the purpose of EPD to prevent pollution and restore environmental quality. This policy provides guidance in the support of the following divisional goals:

1. Prevent Pollution; and
2. Continual improvement in air, land and water quality

References and Relationships: *Environmental Management Act*

Approval: Lynn Bailey **Date:** June 8, 2009
Assistant Deputy Minister
Environmental Protection Division

Contact Person: original filed (ROB)
Christa Zacharias-Homer, Deputy Director
Regional Operations Branch

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http://www.bcairquality.ca/reports/pdfs/Standard-Audit-Procedure-2-10.pdf

Standard Auditing Procedure for Continuous Emission Monitors and Ambient Air Monitoring Instruments

Procedure Number: 2.10, Version 2.16

BRITISH COLUMBIA
The Best Place on Earth

Ministry of Environment

Effective Date: January 1, 2009

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Standard Audit Equipment

Standard audit equipment for CEM and ambient instruments

All audit equipment used in the field will be at normal operating conditions prior to the delivery of upscale points of the instruments to be audited. All meteorological and flow measurement equipment will be conditioned to current conditions prior to start of the audit.

- Calibrators
    - Calibrators will be of a dynamic dilution type, containing a set of mass flow controllers (MFC) with flows traced to a primary standard flow meter. MFC verification or recalibration will occur at least once every 6 months.
- Zero Air Supply
    - Zero air for delivery to instruments and for use as dilution gas will be free of all target pollutants and interferences. The source shall be capable of delivering a steady sample of zero air up to 25 lpm at a pressure of 30 psi.
- Audit Gases
    - Blended specific compressed gases, traceable to primary standard of a suitable concentration to provide adequate flow to the instrumentation being audited. All audit gases will be verified against audit lab National Institute of Standards and Technology (NIST) primary standards prior to entering into service and upon completion of service life.
- Ozone Generators
    - A UV photometric secondary ozone transfer standard calibrator verified or recalibrated at least once every six months against a UV photometer which has been referenced to a primary transfer standard verified by National Air Pollution Surveillance (NAPS) personnel.
- Support equipment
    - Each pollutant will have a dedicated set of support equipment (regulators, tubing, manifolds, etc.).

Standard Audit Equipment for Continuous and Non-continuous Particulate Instruments

- Flow Meter
    - NIST traceable transfer standard flow meters capable of measuring from 1.0 lpm to 20.0 lpm. The flow meter must be of a style acceptable to the specific equipment manufacturer.
- Flow Orifice
    - A flow orifice audit unit referenced to a positive displacement primary standard.
- Manometer
    - A manometer or magnahelic capable of measuring pressure within the range of the instrument to be audited. The manometer of magnahelic must be traced to a primary standard annually.
- Barometer
    - A barometer capable of accurately measuring the ambient air pressure at any B.C. site, during any season. The barometer must be traced to a primary standard annually.
- Thermometer
    - A thermometer capable of measuring the ambient temperature, at any B.C. site, during any season. The meter must be traced to a primary standard annually.
- Relative Humidity Meter
    - A relative humidity meter capable of measuring the relative humidity, at any B.C. site, during any season. The meter must be traced to a primary standard annually.
- Calibration Filters
    - Calibration filters acceptable to instrument manufacturer specification and stored in a desiccated container. Weighed filters must be referenced to a NIST traceable weight.
- Flow Audit Adaptor
    - Flow audit adaptor, or other suitable leak checking device of the correct size for the inlet of the instrument to be audited.
- Audit Filter Cassette
    - An audit filter cassette, with a silicone seal of the correct size for audit of the instrument, acceptable to instrument manufacturer specification.

Audit Criteria

Instrument Audit Criteria

Any instrument will FAIL an audit if:

- One or more audited instrument parameters do not meet quantified audit criteria.
- The instrument is unavailable for evaluation by the Ministry of Environment (MoE) during a scheduled audit.
- The instrument is setup for dynamic adjustment of the instrument calibration factors without prior MoE approval.
- Operator adjusts the instrument after notification on an impending audit has been given.
- The instrument is not properly connected to the sample inlet.
- The sampling site, instrument housing, or sampling site access are in violation of WorkSafeBC, Occupational Health and Safety Regulation (OHSR) requirements and consequently prevent MoE staff from conducting an audit.

An audit FAIL will result in the instrument being audited quarterly. Audit frequency will be returned to a twice per year (once per year for non-continuous instruments) after the instrument passes two consecutive audits.

An instrument will CONDITIONALLY PASS an audit if:

- An operator does not have, or fails to keep current, a logbook of calibration and maintenance activities or the logbook is unavailable for review by the audit staff at the time of an audit.

Station Logbook Criteria

A station logbook must be kept. It must include a record of all work performed on an instrument. The logbook is a journal that should be kept on site with the instrument. The logbook needs to be kept in conjunction with other operator logs (sometimes referred to as monthly reports) which are servicing information forms that are submitted routinely to a MoE Quality Assurance Officer.

The logbook must be kept current and must be available onsite for review by MoE auditors. It should be maintained by the technicians responsible for the calibration, maintenance and repair of the instruments and must contain the following:

- Date and time of service activity.
- Data relevant to calibration or maintenance including, calibration values, instrument settings and brief description of any service performed.

Quantified Audit Criteria

Continuous Emission Monitors

Point Error

Satisfactory (PASS)	≤ ± 15%	Error at any audit point
Unsatisfactory (FAIL)	> ± 15%	Error at any audit point

Slope

Satisfactory (PASS)	0.850 to 1.150	Between instrument response and audit concentration
Unsatisfactory (FAIL)	< 0.850 or > 1.150	Between instrument response and audit concentration

Intercept

Satisfactory (PASS)	≤ ± 3%	Of instrument range
Unsatisfactory (FAIL)	> ± 3%	Of instrument range

Correlation Coefficient

Satisfactory (PASS)	0.995 to 1.000	Linear instrument response to audit concentration
Unsatisfactory (FAIL)	< 0.995	Non-linear instrument response to audit

Stability

Satisfactory (PASS)	≤ ± 5%	Deviation of instrument values at audit point
Unsatisfactory (FAIL)	> ± 5%	Deviation of instrument values at audit point

Time to reach stability at audit point

Satisfactory (PASS)	≤ 20 minutes or meets manufacturer specification	Stable
Unsatisfactory (FAIL)	> 20 minutes or does not meet manufacturer specification	Unstable

Continuous Ambient Ozone Instruments

Point Error

Satisfactory (PASS)	≤ ± 7%	Error at any audit point
Unsatisfactory (FAIL)	> ± 7%	Error at any audit point

Slope

Satisfactory (PASS)	0.930 to 1.070	Between instrument response and audit concentration
Unsatisfactory (FAIL)	< 0.930 or > 1.070	Between instrument response and audit concentration

Intercept

Satisfactory (PASS)	≤ ± 1.5%	Of instrument range
Unsatisfactory (FAIL)	> ± 1.5%	Of instrument range

Correlation Coefficient

Satisfactory (PASS)	0.997 to 1.000	Linear instrument response to audit concentration
Unsatisfactory (FAIL)	< 0.997	Non-linear instrument response to audit

Stability

Satisfactory (PASS)	≤ ± 1%	Deviation of instrument values at audit point
Unsatisfactory (FAIL)	> ± 1%	Deviation of instrument values at audit point

Time to reach stability at audit point

Satisfactory (PASS)	≤ 5 minutes or meets manufacturer specification	Stable
Unsatisfactory (FAIL)	> 5 minutes or does not meet manufacturer specification	Unstable

Continuous Ambient Gas Instruments

Point Error

Satisfactory (PASS)	≤ ± 10%	Error at any audit point
Unsatisfactory (FAIL)	> ± 10%	Error at any audit point

Slope

Satisfactory (PASS)	0.900 to 1.000	Between instrument response and audit concentration
Unsatisfactory (FAIL)	< 0.900 or > 1.100	Between instrument response and audit concentration

Intercept

Satisfactory (PASS)	≤ ± 2%	Of instrument range
Unsatisfactory (FAIL)	> ± 2%	Of instrument range

Correlation Coefficient

Satisfactory (PASS)	0.995 to 1.000	Linear instrument response to audit concentration
Unsatisfactory (FAIL)	< 0.995	Non-linear instrument response to audit

Stability

Satisfactory (PASS)	≤ ± 5%	Deviation of instrument values at audit point
Unsatisfactory (FAIL)	> ± 5%	Deviation of instrument values at audit point

Time to reach stability at audit point

Satisfactory (PASS)	≤ 20 minutes or meets manufacturer specification	Stable
Unsatisfactory (FAIL)	> 20 minutes or does not meet manufacturer specification	Unstable

Sample Inlet Cleanliness

Satisfactory (PASS)	Less than significant build-up in the sample inlet
Unsatisfactory (FAIL)	Significant build-up in the sample inlet

Temperatures

Satisfactory (PASS)	≤ ± 2°C	From measured ambient or measured instrument condition
Unsatisfactory (FAIL)	> ± 2°C	From measured ambient or measured instrument condition

Pressure

Satisfactory (PASS)	≤ ± 0.02 atm	From measured ambient or measured instrument condition
Unsatisfactory (FAIL)	> ± 0.02 atm	From measured ambient or measured instrument condition

Relative Humidity

Satisfactory (PASS)	≤ ± 5%	From measured ambient or measured instrument condition
Unsatisfactory (FAIL)	> ± 5%	From measured ambient or measured instrument condition

Time / Date

Mechanical

Satisfactory (PASS)	≤ ± 30 minutes	From current time in PST
Unsatisfactory (FAIL)	> ± 30 minutes	From current time in PST

Digital

Satisfactory (PASS)	≤ ± 5 minutes	From current time in PST
Unsatisfactory (FAIL)	> ± 5 minutes	From current time in PST

TEOM K_o verification

Satisfactory (PASS)	≤ ± 2.5%	Error from internal instrument K_o value
Unsatisfactory (FAIL)	> ± 2.5%	Error from internal instrument K_o value

Flow Rates

TEOM Total	Satisfactory (PASS)	≤ ± 5.9%	From 16.67 lpm measured instrument flow
	Unsatisfactory (FAIL)	> ± 5.9%	From 16.67 lpm measured instrument flow
TEOM Main	Satisfactory (PASS)	≤ ± 6.9%	From 3.00 lpm measured instrument flow
	Unsatisfactory (FAIL)	> ± 6.9%	From 3.00 lpm measured instrument flow
Partisol Total	Satisfactory (PASS)	≤ ± 7.0%	From 16.67 lpm target instrument flow
	Unsatisfactory (FAIL)	> ± 7.0%	From 16.67 lpm target instrument flow
BAM 1020	Satisfactory (PASS)	≤ ± 5.0%	From 16.67 lpm target instrument flow
	Unsatisfactory (FAIL)	> ± 5.0%	From 16.67 lpm target instrument flow
Hi-vol	Satisfactory (PASS)	≤ ± 12.5%	From 40.0 scfm measured instrument flow
	Unsatisfactory (FAIL)	> ± 12.5%	From 40.0 scfm measured instrument flow
GRIMM	Satisfactory (PASS)	≤ ± 5.0%	From 1.2 lpm measured instrument flow
	Unsatisfactory (FAIL)	> ± 5.0%	From 1.2 lpm measured instrument flow

Leak check

TEOM Main	Satisfactory (PASS)	≤ 0.6 lpm	instrument flow
	Unsatisfactory (FAIL)	> 0.6 lpm	instrument flow
TEOM Aux.	Satisfactory (PASS)	≤ 0.15 lpm	instrument flow
	Unsatisfactory (FAIL)	> 0.15 lpm	instrument flow
Partisol Total	Satisfactory (PASS)	≤ half initial press	instrument flow
	Unsatisfactory (FAIL)	> half initial press	instrument flow
Dichot total	Satisfactory (PASS)	≤ ± 25 mmHg	instrument press
	Unsatisfactory (FAIL)	> ± 25 mmHg	instrument press
BAM 1020 leak	Satisfactory (PASS)	≤ 1.5 lpm	instrument flow
	Unsatisfactory (FAIL)	> 1.5 lpm	instrument flow
BAM 1020 offset	Satisfactory (PASS)	≤ 0.2 lpm	instrument flow
	Unsatisfactory (FAIL)	> 0.2 lpm	instrument flow

Other Instrument Parameters

	Satisfactory (PASS)	Operating within instrument manufacturer specification
	Unsatisfactory (FAIL)	Operating outside of instrument manufacturer specification

Continuous and Non-continuous Audit Procedures

General Continuous Instrument Audit Procedure

1. Each step of the instrument audit is documented.

2. Upon arriving on site, the audit team will record the instrument make, model, serial number, and the "as found" status of the instrument. The parameter being audited and the model of the instrument are verified against the current site documentation on record with the MoE.

3. If the station chart recorder is not in continuous use, the audit team shall start the chart recorder (if available) to provide a visual record of the audit. The date, time and parameter are recorded on the chart.

4. All relevant channels pertaining to the instrument to be audited will be marked down on the station data logger.

5. The offset and slope values and any other pertinent information from the instrument are taken and recorded in the audit report.

6. For NOx instrument audits, the cylinder regulator to be used is purged to prevent any contamination of the cylinder and residual oxygen from affecting the instrument readings.
    - Connect the regulator to the cylinder and connect the line that will feed the mass flow controller to a vacuum pump.
    - With the cylinder valve tightly closed, open the regulator valve and vacuum the regulator for two minutes.
    - Close the regulator valve and open the cylinder valve. Increase the pressure to 100 psig.
    - Close the cylinder valve.
    - Repeat steps 2 - 4 an additional 4 times. During the last run, drop the regulator pressure to the normal operating level (usually 20-30 psig). Do not close the cylinder valve after the last run.
    - Disconnect the line from the vacuum pump and open the regulator valve to allow a very low flow to prevent ambient air from entering the tubing.
    - Connect the tubing to the pollutant mass flow controller in the dynamic dilution system.
    - Fully open the regulator valve.
    - Once the audit is under way the auditors will check to see that NO_2 conversion is < 3% of instrument range. If the conversion is >3%, the procedure must be repeated.

7. For SO_2, H_2S and TRS audits, transfer gas at a concentration two to three times higher than the maximum reading on the instrument's range is fed through the tubing and manifold to condition the system. During the conditioning, the vents in the manifold are plugged and the tubing is fed into an exhaust line to vent the sample out of the station. The conditioning is done to ensure the accuracy of the sample at the inlet to the system to be audited, with no losses to the audit gas sample delivery system. The amount of time the sample delivery system takes to condition is dependant on ambient conditions and the parameter being audited, but in most cases a time of 30 minutes is sufficient.
8. The instrument audit, which is a verification of the "as found" condition of the instrument, begins by introducing a zero concentration of gas to the instrument upstream of the inlet filter, at the first accessible connection point nearest to the manifold. Once the sample delivery system has been purged by the zero air, the instrument baseline should stabilize and the baseline value is recorded.
9. Once the baseline has been recorded and the gas delivery system properly purged and/or conditioned, the audit continues by introducing four upscale gas concentrations for approximately 20 minutes each. The upscale concentrations will be at approximately 80%, 60%, 40% and 20% of the operating range of the instrument, and in this order. Upscale gas points must be delivered at ambient pressure and total flow of the audit gas should be 3 times the sample flow of combined instruments being audited.
10. Initial stabilization of the first (80%) point should not take longer than 20 minutes to achieve. Each upscale concentration should be stabilized for 15 to 20 minutes and the value of the audit point should be the average of the last 5 minutes of the point. These values will be recorded in the audit report.
11. For NO_x instruments that include NO_2 channels, once the audit of the NO channel has been completed the audit team will perform a gas phase titration (GPT) to verify the efficiency of the molybdenum converter.
    - Flow of NO gas will be stopped and an ozone (O_3) concentration equivalent to approximately 40% of the instrument range will be delivered.
    - Once the generated concentration of O_3 has stabilized, a NO gas flow equivalent to approximately 60% of the instrument range will be mixed with the previously generated O_3.
    - Once readings have stabilized, the individual concentrations of NO, NO_2, and NOx will be recorded and the overall converter efficiency will be calculated.
12. Upon completion of the upscale calibration points, zero gas should be supplied from the audit calibrator to the instrument, until the baseline values are stable.

13. The initial and final baseline values should be comparable. If so, the instrument should be disconnected from the audit system, and returned to its "as found" status. All channels previously marked down on the data logger are to be marked up.
14. The logbook at the station is updated to reflect the start and end times in Pacific Standard Time (PST), values and result of an audit.

Ambient Particulate Monitors

Tapered Element Oscillating Microbalance (TEOM)

1. Specifically related to TEOM monitors, it is the responsibility of the station operating staff to ensure that the TEOM monitor is operating correctly once the audit has been completed.

2. Upon completion of the audit, the audit team may have to leave the station before the TEOM monitor has resumed operation. In addition, in the event that the operator is unavailable at the station, the audit team will remove the filter from the sensor head to perform K_o verification, but take no responsibility or liability if a sensor element is damaged or broken.

3. Each step of the instrument audit is documented.

4. Upon arriving on site, the audit team records the instrument make, model, serial number, particulate type (TSP, PM_{10}, $PM_{2.5}$, and/or PM_1) and the "as found" status of the instrument. The parameter being audited, air particulate type, and the model of the instrument are verified against the current site documentation on record with the MoE.

5. All relevant channels pertaining to the instrument to be audited will be marked down on the station data logger.

6. The ambient temperature, barometric pressure and relative humidity (when applicable) are measured and compared with the ambient conditions as stated on the instrument audit screen. Results will be recorded in the audit report.

7. The software adjustment values and any other pertinent information from the instrument are taken and recorded in the audit report.

8. Instrument measurement will be stopped by pressing <data stop> on the instrument key pad.

9. The size selective inlet/s (SSI) are removed and an audit leak check adaptor with an appropriate filter is placed on the inlet.

10. The operator or audit team will remove the current particulate filter. The sensor unit of the instrument is then closed without a filter on the element.

11. The leak check is now carried out using the following procedure:
    - The audit leak check adaptor is closed and the flow readings on the front panel of the instrument are monitored until they are stable.
    - The flow readings are recorded as Main Leak and Auxiliary Leak readings and are then entered into the audit report.
    - If the instrument is an AB model, the pump is disconnected and the same two flow readings are observed. These readings are recorded as offsets and the true zero is found by subtracting the offset from the original zero flow readings.

12. Once the leak check has been performed, the audit flow adaptor is opened and the instrument flow is allowed to stabilize. Once stable, the flow is measured using the following procedure:
    - The audit team removes the audit leak check adaptor and places a flow measurement device over the sample inlet. The flow measured is entered into the audit report as the instrument total flow.
    - The audit team disconnects the auxiliary flow tube from the sample inlet and caps the connection. The flow measured is entered into the audit report as the instrument main flow.
    - The flow measurement device is removed from the inlet and the auxiliary flow tube is reconnected to the sample inlet.
    - The audit leak check adaptor with an appropriate filter is replaced on the inlet.

13. The calibration constant, $K_{0,}$ of the tapered element is then checked using the following procedure:
    - Go to the K_o verification screen.
    - Input the weight of the pre-weighed calibration filter on the line labelled "Filt Wght."
    - Operate the system without a filter and wait for the oscillating frequency shown in the upper right-hand corner of the screen to stabilize.
    - Press the <First/Last> key to record the frequency, $f_{0,}$ once the frequency has stabilized.
    - Install the calibration verification filter onto the element and wait for the frequency to stabilize again.
    - Press the <First/Last> key again to record the frequency, $f_{1,}$ once the frequency has stabilized.
    - The instrument will automatically compute and display the audit value of the calibration constant, K_0 on the line entitled "Audit K_0."
    - This number is entered on the audit report and compared to the instrument $K_{0.}$

14. A post-audit leak check is performed using the same procedure as the initial leak check to assure the instrument is left in “as found” status.

15. The size selective inlet/s are inspected for cleanliness and recorded on the audit report.

16. At this point the audit is complete. The operator or audit team replaces the filter on the element and the size selective inlet/s is replaced on the sample inlet line and the data acquisition system is re-enabled.

Beta-Attenuation Monitor (BAM)

1. Each step of the instrument audit is documented.

2. Upon arriving on site, the audit team records the instrument make, model and serial number, particulate type (TSP, PM_{10}, $PM_{2.5}$, and/or PM_1) and the “as found” status of the instrument. The parameter being audited and the model of the instrument are verified against the current site documentation on record with the MoE.

3. All relevant channels pertaining to the instrument to be audited will be marked down on the station data logger.

4. Instrument measurement will be stopped by pressing <operate> then <Down Arrow> on the instrument key pad.

5. The ambient temperature <OPERATE> <INST>, barometric pressure <OPERATE> <NORMAL> and relative humidity (when applicable) are taken and compared with the ambient conditions as stated on the instrument audit screen. The data are recorded in the audit report.

6. Press <TAPE> and then <self test> to start the internal tape movement process. This will advance the filter tape to a blank window and assure the free movement of the tape cycle. The result of the self test will be recorded in the audit report.

7. The Absorption Coefficient (μ_{sw}), Regression Factor (K), Average Reference Membrane mass sensitivity (ABS), Background Concentration (BKGD), Pressure-Flow Proportionality (C_v), and Flow Offset (Q_o) are taken and recorded in the audit report. Press <SETUP> <CALIBRATE>.

8. Ensure that the flow mode is set to “STD” <SETUP> <CALIBRATE> and the RH control is set to “Yes” and the RH set point is set to 35% <SETUP> <HEATER>.

9. The size selective inlet/s is removed and an audit leak check adaptor with an appropriate filter is placed on the inlet.

10. The leak check is now carried out using the following procedure:
    - Close the valve on the audit leak Check adaptor.
    - Press the <TEST> key on the main menu, then the <TAPE> key. This will advance the tape 1 window.
    - Press the <PUMP> key and allow the flow to stabilize. Record the flow value on the audit report as the leak flow.
    - Open the audit leak check adaptor and disconnect the pump. Once the flow value stabilizes, it is entered into the audit report as the flow offset.

11. Once the leak check has been performed, the audit flow adaptor is opened and the instrument flow is allowed to stabilize. Once stable, the flow is measured using the following procedure:
    - The audit team removes the audit leak check adaptor and places a flow measurement device over the sample inlet. The flow measured is entered into the audit report as the instrument total flow.

12. The size selective inlet/s are inspected for cleanliness and recorded on the audit report.

13. At this point the audit is complete. The operator or auditor advances the filter tape and the size selective inlet/s are replaced on the sample inlet line. Once the instrument has stabilized, the data logger is re-enabled.

Other Continuous Monitoring Instruments

- For monitoring instruments with operational principles outside of the above listed audit procedures, specific procedures will need to be developed based on instrument manufacturer or certifying body operational standards. Audit procedures are required before new instrumentation is installed in the provincial air monitoring program. Upon proposing the use of a new monitoring instrument a standard calibration procedure for the instrument will need to be provided to the MoE, so that an acceptable audit procedure and criteria can be developed.

Non-continuous Monitors

High Volume Samplers (Hi-vol)

1. Upon arriving on site, the audit team records serial numbers found on the inlet head, sampler body, MFC and instrument chart recorder. The "as found" status and the start and finish volume's number from the MFC will also be recorded. This information is verified against the current site documentation on record with the MoE.

2. Instrument audits on non-continuous monitoring instruments will typically only be performed on non-sampling dates, but may be performed during sampling times at the discretion of the audit team. If this occurs, start and end time of the audit will be recorded.

3. The flow check of the instrument is done using the following procedure:
   - The operator or auditor removes the current particulate filter.
   - A blank audit filter is placed on the inlet.
   - The orifice is placed on the instrument using the adaptor provided in the flow meter kit.
   - The motor is turned on and allowed to stabilize.
   - The manometer or magnahelic is used to measure the pressure drop across the orifice. The data are entered into the audit report.

4. The inlet head is checked for cleanliness and recorded in the audit report.

5. The instrument time to next sample date is checked and recorded in the audit report.

6. The audit is now complete. The operator or audit team replaces the current particulate filter and returns the hardware to its "as found" status.

Partisol Samplers

1. Upon arriving on site, the audit team records the instrument make, model, serial number, particulate type and the "as found" status of the instrument. The parameter being measured and the model of the instrument are verified against the current site documentation on record with the MoE.

2. Instrument audits conducted on non-continuous monitors will typically only be performed on non-sampling dates, but may be performed during sampling times at the discretion of the audit team. If this occurs, start and end time of the audit will be recorded.

3. The operator or audit team removes the current sample cassette using the following procedure:
   - Sample head is opened and the cassette holder plate is removed.
   - The sample cassette is carefully removed from the holder plate and placed into the sample cassette packaging.
   - The sample cassette packaging is closed.

4. The audit team installs the audit cassette in the cassette holder plate, places it into the sample position and then closes the instrument head.

5. The operator or audit team places the instrument in the STOP mode by pressing <Run/Stop> key twice. The audit screen is then accessed by pressing <F5: Audit>.

6. The internal instrument time, ambient temperature, barometric pressure and relative humidity (when applicable) are taken and compared with the ambient conditions as stated on the instrument audit screen. The data are recorded in the audit report.

7. The slope and offset for temperature, pressure, relative humidity and flow are taken from the <calibrate> screen and recorded in the audit report.

8. The leak check of the instrument is performed using the following procedure:
   - Remove the size selective inlet/s from the sample tube and install the audit leak check adaptor.
   - Press <F1:Hub1> to select the sampling station.
   - Turn on the sample pump by pressing <F5:Pump>.
   - Shut off the valve on the audit leak check adaptor.
   - Shut off the flow to the flow controller assembly by turning the manual shut off valve on the left side of the vacuum gauge in the hub.
   - Record the reading on the vacuum gauge.
   - Shut off the flow to the pump by turning the manual shut off valve located under the vacuum gauge in the hub.
   - Record the reading on the vacuum gauge ten seconds after the pump valve is closed. Enter the reading in the audit report.
   - Open the flow controller valve and the pump valve and open and remove the audit leak check adaptor from the sample tube.

9. The flow check of the instrument is performed using the following procedure:
   - Ensure that the audit filter cassette installed for the leak check procedure remains in position during the flow check procedure.
   - Remove the size selective inlet from the sample tube and install the flow measurement device.
   - Press <F1:Hub1> to select the sampling station.
   - Turn on the sample pump by pressing <F5:Pump>.

- The flow measured is entered into the audit report.
- Return to the main screen by pressing <ESC> twice.

10. The instrument's size selective inlet/s will be checked for cleanliness. These data will be recorded in the audit report.

11. The audit is now complete. The operator or auditor replaces the sample cassette and returns the hardware to its "as found" state.

Dichotomous Samplers (Dichot)

1. Upon arriving on site, the audit team records the instrument make, model, serial number, particulate type and the "as found" status of the instrument. The parameter being measured and the model of the instrument are verified against the current site documentation on record with the MoE.

2. Instrument audits on non-continuous monitors will typically only be performed on non-sampling dates, but may be performed during sampling times at the discretion of the audit team. If this occurs, the start and end time of the audit will be recorded.

3. The operator or audit team places the instrument in the STOP mode. The audit screen is then displayed using the following procedure:
   - Press menu to display the master menu.
   - Scroll to the service mode and press enter.
   - Press <F1: Audit> to display the audit screen.

4. The internal instrument time, ambient temperature, barometric pressure and relative humidity (when applicable) are taken and compared with the ambient conditions as stated on the instrument audit screen. The data are recorded in the audit report.

5. The slope and offset for temperature, pressure, relative humidity and flow are taken and recorded in the audit report.

6. Add audit filter cassettes to the top position of each of the supply magazines on the left hand side of the filter exchange mechanism. Once the filters have been loaded, advance the audit filters into the sample position of the unit using the <filter adv> button in the audit screen.

7. The leak check of the instrument is done using the following procedure:
   - Attach the audit leak check adaptor to the sample inlet and close the valve.
   - In the audit screen, press <F5:LeakChk> to display the leak check screen.
   - Press <F2:Start>.
   - Follow the instructions on the screen to go through the leak check cycle.

- Record the “Pass” or “Fail” message displayed at the end of the leak check cycle in the audit report.
- If a “Fail” message is displayed, repeat the leak check procedure once more.
- Record the leak check pressure, the “Pass” or “Fail” message and the differential displayed at the end of the leak check cycle in the audit report.
- Slowly open the valve on the audit leak check adaptor.

8. The flow check of the instrument is done using the following procedure:
   - Ensure that the filter cassette installed in the sampling position for the leak check procedure, remains in position for the flow check procedure.
   - Remove the size selective inlet/s from the sample tube and install the flow measurement device.
   - Press <F5:Audit> to enter the audit screen and confirm that the set flows are 15.0 l/min and 1.67 l/min.
   - Press <F1:Pump> and then <F2:Valve 1> to start the 15 l/min flow.
   - The flow measured is entered into the audit report.
   - Press <F3:Valve 2> to start the 1.67 l/min flow.
   - The flow measured is entered into the audit report.
   - Press <F1:Pump> and then <F3:Valve 2> to stop the 1.67 l/min flow.

9. The filter temperatures are taken using the following procedure:
   - Remove the size selective inlet/s.
   - Unlatch and open the sampler’s top cover.
   - Remove the virtual impactor.
   - The temperature from each of the filter chambers is taken and compared with the filter temperatures as stated on the instrument audit screen. The data are recorded in the audit report.

10. Check the size selective inlet for cleanliness and record the information in the audit report.

11. Replace the virtual impactor and the sampler top cover. Perform a final leak check on the instrument as per item 7.

12. The audit is now complete. Return the sampler to its “as found” state using the following procedure:
    - Replace the size selective inlet on the inlet tube.
    - Remove both the original sample cassettes from the top position of the storage magazines on the right side of the filter exchange mechanism.
    - Place the original sample cassettes in the top of there respective supply magazines located on the left side of the filter exchange mechanism.
    - Press the filter advance key. The original sample cassettes will be reloaded into the sample position.

- Remove the audit cassettes from the upper most position of the storage magazines on the right side of the filter exchange mechanism.
- Escape from the audit screen and return the unit to the “as found” operational status.

Other Non-continuous Instruments

- For non-continuous monitoring instruments with operational principles outside of the above listed audit procedures, specific procedures will need to be developed based on instrument manufacturer or certifying body operational standards. Audit procedures are required before new instrumentation is installed in the provincial air monitoring program. Upon proposing the use of a new monitoring instrument a standard calibration procedure for the instrument will need to be provided to the MoE, so that an acceptable audit procedure and criteria can be developed.