



**SOUTH COAST AIR QUALITY
MANAGEMENT DISTRICT**
ENGINEERING & COMPLIANCE
INDUSTRIAL COMPLIANCE BRANCH

Combustion Gas
PERIODIC MONITORING PROTOCOL



**FOR THE PERIODIC MONITORING OF NITROGEN OXIDES, CARBON
MONOXIDE, AND OXYGEN FROM COMBUSTION SOURCES SUBJECT TO
RULES 1110.2, 1146, AND 1146.1**

**Version 0.0
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RULE 1110.2

PERIODIC MONITORING PROTOCOL

FOR THE PERIODIC MONITORING OF NITROGEN OXIDES, CARBON MONOXIDE,
AND OXYGEN FROM STATIONARY ENGINES SUBJECT TO
SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT RULE 1110.2

1.0 OVERVIEW AND APPLICABILITY

South Coast Air Quality Management District (AQMD) Rule 1110.2 – *Emissions from Gaseous- and Liquid-Fueled Engines* (<http://www.aqmd.gov/rules/reg/reg11/r1110-2.pdf>) applies to all stationary and portable engines over 50 rated brake horsepower (50 bhp). With the exclusion of engines subject to continuous emission monitoring system (CEMS) requirements, operators of engines governed by Rule 1110.2 are required to periodically measure NO_x and CO engine emissions using a portable electrochemical analyzer, in accordance with an approved Inspection and Monitoring Plan, to ensure compliance with emission limits.

The following protocol sets forth standard procedures for the periodic monitoring of nitrogen oxides (NO and NO₂) and carbon monoxide (CO) emissions from engines subject to Rule 1110.2. This protocol applies to periodic emissions monitoring only, and shall not be substituted for source testing for purposes of demonstrating compliance with AQMD rules or permit conditions, or for obtaining a permit to operate or quantifying emissions, for which the appropriate AQMD, California Air Resources Board (CARB), or U. S. Environmental Protection Agency (EPA) reference source test methods must be used.

The Rule 1110.2 Periodic Monitoring Protocol is a simplified version of EPA Conditional Test Method CTM-030 (<http://www.epa.gov/ttn/emc/ctm/ctm-030.pdf>). AQMD reserves the right to modify this protocol without advance notice. The latest version of the protocol can be found on the AQMD web site (<http://www.aqmd.gov>).

NOTE: When CTM-030 and this protocol are in disagreement, this protocol shall supersede. When engines subject to Rule 1110.2 cannot be tested using this protocol, the protocol may be modified following written approval of the Executive Officer.

RULES 1146 & 1146.1

PERIODIC MONITORING PROTOCOL

FOR THE PERIODIC MONITORING OF NITROGEN OXIDES, CARBON MONOXIDE,
AND OXYGEN FROM UNITS SUBJECT TO
SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT RULES 1146 AND 1146.1

1.0 OVERVIEW AND APPLICABILITY

South Coast Air Quality Management District (AQMD) Rules 1146 and 1146.1–Emissions of Oxides of Nitrogen from Industrial, Institutional and Commercial Boilers, Steam Generators, and Process Heaters ([http://www.aqmd.gov/rules/reg/reg11/ r1146 or 1146.1.pdf](http://www.aqmd.gov/rules/reg/reg11/r1146%20or%201146.1.pdf)) applies to all boilers etc. with a maximum input rating over 2 million btu/hr (2 MMBtu/hr). With the exclusion of boilers subject to continuous emission monitoring system (CEMS) requirements, operators of boilers governed by Rules 1146 & 1146.1 are required to periodically measure NO_x boiler emissions using a portable electrochemical analyzer to ensure compliance with emission limits.

The following protocol sets forth standard procedures for the periodic monitoring of nitrogen oxides (NO and NO₂) and carbon monoxide (CO) emissions from boilers subject to Rules 1146 & 1146.1. This protocol applies to periodic emissions monitoring only, and shall not be substituted for source testing for purposes of demonstrating compliance with AQMD rules or permit conditions, or for obtaining a permit to operate or quantifying emissions, for which the appropriate AQMD, California Air Resources Board (CARB), or U. S. Environmental Protection Agency (EPA) reference source test methods must be used.

This Periodic Monitoring Protocol is a simplified version of EPA Conditional Test Method CTM-030 (<http://www.epa.gov/ttn/emc/ctm/ctm-030.pdf>). AQMD reserves the right to modify this protocol without advance notice. The latest version of the protocol can be found on the AQMD web site (<http://www.aqmd.gov>).

NOTE: When CTM-030 and this protocol are in disagreement, this protocol shall supersede. When boilers subject to Rules 1146 & 1146.1 cannot be tested using this protocol, the protocol may be modified following written approval of the Executive Officer.

2.0 MEASUREMENT SYSTEM: PERFORMANCE SPECIFICATIONS AND APPARATUS

Any measurement system that meets the performance and design specifications in Sections 4 and 5 of CTM-030 may be used, except as allowed by the requirements of this protocol. The measurement system shall maintain gas samples at conditions that will prevent condensation from contacting the electrochemical cells. Additions to, or modifications of, vendor-supplied electrochemical analyzers (e.g., heated sample lines, thermocouples, flow meters, etc.) may be required to meet the specifications of this protocol.

For rich-burn engines with three-way catalysts and other engines or boilers with gas streams where the NO₂ portion is less than or equal to 10% of total NO_x (based on average test data collected according to an approved source test or this protocol), use of the NO₂ electrochemical cell is voluntary.

2.1 SENSITIVITY

The minimum detectable limit depends on the nominal range and resolution of the electrochemical cell and signal-to-noise ratio of the measurement system.

- For the CO, NO, and NO₂ electrochemical cells, the minimum detectable limit shall be less than or equal to 3% of the selected range or 1 ppm, whichever is less restrictive.
- For the O₂ electrochemical cell, the minimum detectable limit shall be less than or equal to 0.3% O₂.

2.2 INTERFERENCE RESPONSE

The CO, and NO_x interference response must be less than or equal to $\pm 5\%$ as calculated by the procedures in Section 3.6.5.

NOTE: The potential for interference from other flue gas constituents should be reviewed with the electrochemical analyzer manufacturer based on site-specific data.

2.3 MOISTURE REMOVAL SYSTEM

- A chilled condenser or similar device shall be used to remove condensate continuously from the sample gas while maintaining minimal contact between the condensate and the sample gas if the NO₂ portion of

NO_x is greater than 10%, based on average test data collected according to an approved source test or this protocol.

- Alternatively, for gas streams with less than 10% NO₂, a device that uses ambient means to condense and remove moisture from the gas stream before the electrochemical cells is acceptable for this protocol.
- All sampling system components shall be non-reactive with NO₂.

2.4 ELECTROCHEMICAL CELL TEMPERATURE INDICATOR

- The analyzer shall be equipped with a temperature measurement device to monitor the electrochemical cell temperature.
- The temperature may be monitored at the surface, within the cell, or in close proximity to the cells such that it indicates the operating temperature of the cells.
- At no time shall the analyzer be used outside the manufacturer's recommended operating range.

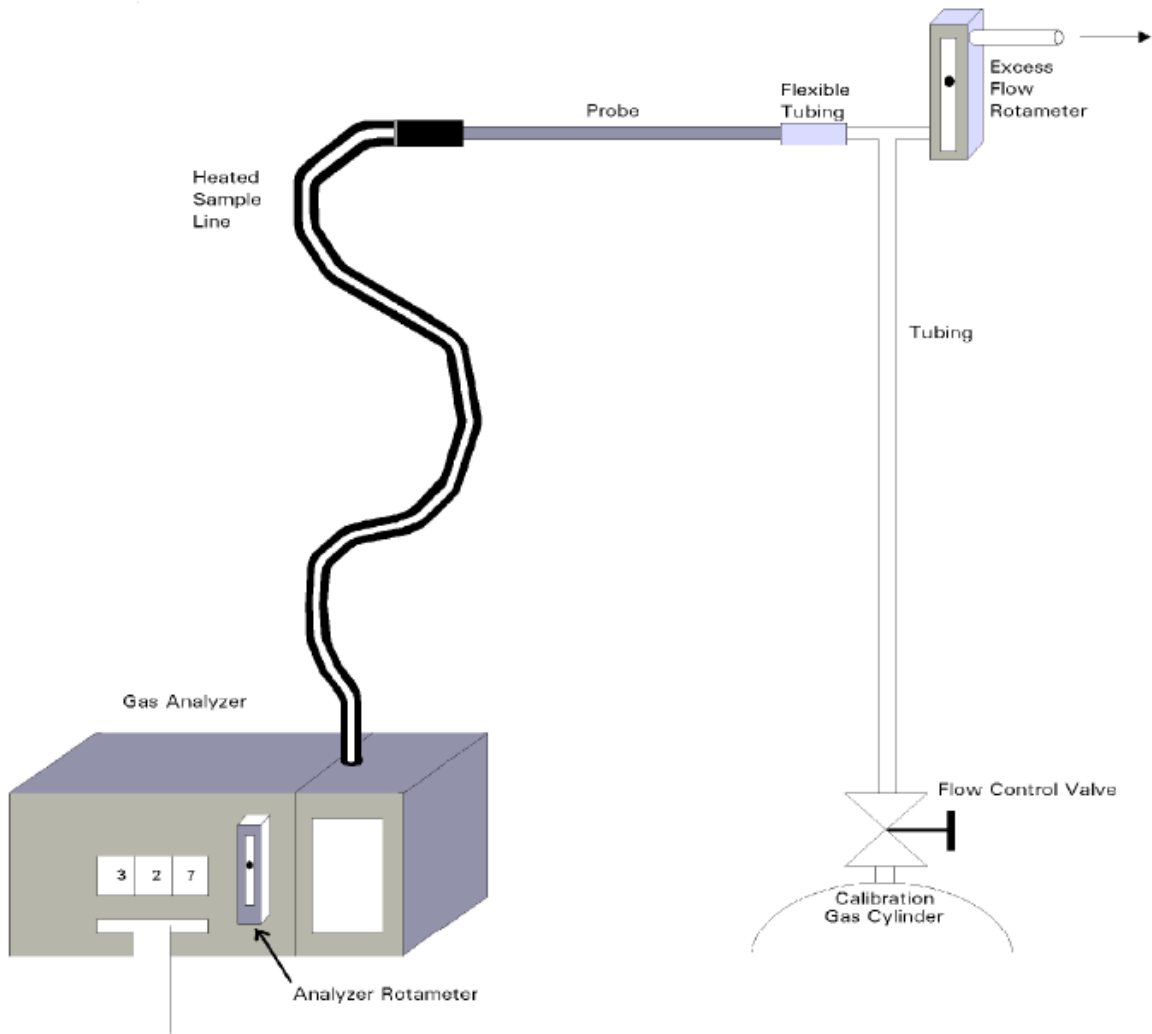
2.5 DATA RECORDER

Data shall be recorded using procedures in Section 5.1.10 of CTM-030. The data recorder must allow each data point to be read at least once every 15 seconds.

2.6 CALIBRATION ASSEMBLY

- A three-way valve assembly, tee, or equivalent shall be used to introduce calibration gases to the sample probe at ambient pressure during calibration checks.
- The assembly shall be designed such that only calibration gas is processed, and that calibration gases flow through all gas path filters and the moisture removal system.
- Figure 1 is a diagram of the calibration assembly.

FIGURE 1.
CALIBRATION SYSTEM SCHEMATIC



2.7 CALIBRATION GAS

- EPA Protocol G1 or G2 gases¹ or NIST traceable gases which are certified to an analytical accuracy of $\pm 2\%$ shall be used for calibration purposes.
- Calibration gas mixtures of NO and CO may be used, except for the interference check.
- Fresh air, defined as air free from ambient CO, NO_x, and other pollutants, is permitted as a span gas for O₂ calibration at 20.9% O₂, and as a zero gas for CO and NO_x. A CO and/or NO calibration gas may be used as an O₂ zero gas, provided it has < 0.05% O₂.
- The instrument and the electrochemical cell design will determine the analytical range for each gas component.
- CO and NO calibration span gas concentrations shall be selected so as to fall within the analytical range of the CO and NO electrochemical cells, and between 100 and 150% of the unit's CO and NO_x emission concentration limits at actual stack conditions.
- NO₂ calibration span gas shall be selected such that the expected average stack concentration will fall between 25% and 150% of the span gas concentration, except that the NO₂ concentration in the span gas is not required to be less than 30 ppm.
- The emission concentration limit at actual stack conditions shall be calculated by the following equation:

$$CL_{\text{Actual}} = (CL_{\%}) \times \left(\frac{20.9 - O_2}{20.9 - 15.0 \text{ or } 3.0} \right)$$

Where:

- CL_{Actual}** = Concentration limit at actual stack conditions, ppmvd
- CL_%** = Most stringent concentration limit corrected to 15% Oxygen, ppmvd for engines and 3% for boilers
- O₂** = Actual oxygen concentration in unit exhaust, % dry

¹ EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards, EPA-600/R-97/121, September 1997 (<http://www.epa.gov/ttn/emc/news/sec1.pdf>)

For example, a rich-burn engine with a 36 ppmvd NO_x limit at 15% O₂, and operating at or near 0% O₂, would have a 127 ppmvd concentration limit at actual stack conditions, as shown below:

$$CL_{\text{Actual}} = (36 \text{ ppmvd @ } 15\% \text{ O}_2) \times \left(\frac{20.9 - 0.0}{20.9 - 15.0} \right) = 127 \text{ ppmvd @ } 0\% \text{ O}_2$$

For example, a boiler with a 30 ppmvd NO_x limit at 3% O₂, and operating at or near 8% O₂, would have a 22 ppmvd concentration limit at actual stack conditions, as shown below:

$$CL_{\text{Actual}} = (30 \text{ ppmvd @ } 3\% \text{ O}_2) \times \left(\frac{20.9 - 8.0}{20.9 - 3.0} \right) = 22 \text{ ppmvd @ } 8\% \text{ O}_2$$

The nominal range is defined as zero to the span gas selected.

For engines with a CO limit of 2000 ppm @ 15% O₂, in order to prevent premature electrochemical cell failure a CO calibration gas may be used which is at least 4 times the observed CO concentration at actual stack conditions based on the latest source test.

For boilers utilizing the CO EMISSION (lb/MMBtu) option;

Compute using the following:

$$E = (K) \left[\frac{20.9}{20.9 - \%O_2} \right] (F_d)(P)$$

E = CO Emission Rate (lb/MMBtu);

$$K = 7.27 \times 10^{-8} \text{ for CO;}$$

%O₂ = Oxygen concentration (%), dry basis, measured in the flue gas and adjusted per Section 7.3.1 of the Compliance Protocol for sources subject to Rules 1146 and 1146.1.

F_d = Oxygen based F-Factor, dry basis; (8710 for natural gas) and,

P = NO_x or CO Concentration in flue gas, (ppm), dry basis, adjusted per Section 7.3.1 of the Compliance Protocol for sources subject to Rules 1146 and 1146.1.

3.0 MEASUREMENT SYSTEM: PERFORMANCE CHECK PROCEDURES

The following procedures describe the performance checks required to verify measurement system performance and accuracy.

Performance Check	Requirement
3.1 Pre-Test Calibration Check	<ul style="list-style-type: none"> ■ Prior to conducting each set of field emission tests
3.2 Post-Test Calibration Check	<ul style="list-style-type: none"> ■ Within 10 days of successful pre-test calibration check
3.3 Linearity Check 3.4 Stability Check 3.5 Interference Test	<ul style="list-style-type: none"> ■ To ensure proper operation of electrochemical cells: <ul style="list-style-type: none"> ◆ At least once per 12 months (or more often, as necessary) ◆ Whenever an electrochemical cell is replaced

3.1 PRE-TEST CALIBRATION CHECK

- Assemble the measurement system by following the manufacturer’s recommended procedures for preparing and preconditioning the gas analyzer.
- Assure the system has no leaks by plugging the probe tip and observing that the sample flow rate goes to zero.
- Verify that the gas scrubbing agent is not depleted.
- Energize the sample pump and allow the portable electrochemical analyzer to warm up to ambient temperature.
- Conduct the following procedures for each electrochemical cell.

3.1.1 Zero Calibration Check

- Introduce the O₂, CO, NO, and NO₂ zero calibration gas at the probe tip using the calibration assembly shown in Figure 1. During this check, do not make adjustments to the system except those necessary to achieve the correct calibration gas flow rate at the analyzer.
- Set the flow rate to the value recommended by the manufacturer. Allow the electrochemical cells’ responses to stabilize for at least thirty seconds before recording the results on **Form 2**.
 - After recording the results, disconnect the gas and briefly purge the unit with fresh air.

- If the zero calibration check results fail to fall within the following specifications, take corrective action as necessary and repeat the zero calibration check until passing results are obtained².

Electrochemical Cell Type	Analyzer Reading for Zero Calibration Check
CO, NO, NO ₂	Select the less restrictive alternative: ≤ 3 % of the span gas value; OR ≤ 1 ppm
O ₂	≤ 0.3% O ₂

3.1.2 Span Calibration Check

- For each span gas:
 - ◆ Individually inject span gas into the analyzer at the probe tip using the calibration assembly.
 - ◆ Begin recording the analyzer response on **Form 2** and continue until the electrochemical cell response stabilizes within ± 5% of the reading.
 - ◆ After recording the results, disconnect the gas and briefly purge with fresh air.
- Determine the NO, CO and, if applicable, NO₂ response times by observing the time required to respond to 95% of a step change in the analyzer response to the span gases.
 - ◆ For NO₂ span gas, record the time required to respond to 90% of a step change.
 - ◆ The longer of the times will be the analyzer response time.
- If the span calibration check results fail to fall within the following specifications, take corrective action as necessary and repeat the span calibration check until passing results are obtained³.

² From CTM-030.

³ From CTM-030.

Electrochemical Cell Type	Analyzer Reading for Span Calibration Check
CO, NO, NO ₂	Within ± 5% of the span gas values
O ₂	Within ± 0.5% O ₂

3.2 POST-TEST CALIBRATION CHECK

- After the field emission tests have been performed, and within 10 calendar days of the last successful pre-test calibration check, perform the post-test calibration check in the same manner as the pre-test calibration check (see Section 3.1).
 - ◆ If the emission test results are within 5% of the unit’s emission limits, then the post-test calibration must be performed as soon as possible after the test period to verify compliance.
 - ◆ Make no changes to the sampling system or analyzer calibration until the post-test calibration check has been recorded.
 - ◆ If the drift (difference between pre-test and post-test calibration readings) falls within the limits specified below, the test is deemed valid for purposes of demonstrating compliance. Otherwise, the testing does not meet the specifications, all test data for that component are null and void, and re-calibration and re-testing are required.

Electrochemical Cell Type	Results required to demonstrate validity of test for purposes of demonstrating compliance
CO, NO, NO ₂ , O ₂	<ul style="list-style-type: none"> ◆ Drift* ≤ ± 5 % of span gas values OR ◆ Drift* ≤ ± 10 % and corrected concentration < 75% of emission limit

*Difference between pre-test and post-test calibration readings

3.3 LINEARITY CHECK

Conduct a linearity check at least once every 12 months for each nominal range that is to be used on each electrochemical cell, CO, NO, O₂ and NO₂. Repeat the linearity check if an electrochemical cell is replaced. Linearity may be checked using a gas divider if it is calibrated according to EPA Method 205. An O₂ linearity check is not required for an analyzer used only to test rich-burn engines with three-way catalysts.

3.3.1 Linearity Check Procedure

- Select mid-level calibration gases for CO, O₂, NO, and NO₂ that are 40 - 60% of the nominal range.
- Follow the procedure for the Pre-Test Calibration Check, Section 3.1, then introduce the mid-level calibration gas for each electrochemical cell at the probe tip using the calibration assembly. During this check, do not make adjustments to the system except those necessary to achieve the correct calibration gas flow rate at the analyzer.
- Set the flow rate to the value recommended by the manufacturer. Allow each reading to stabilize within $\pm 5\%$ of the mean reading for at least 30 seconds before recording the result.
- After achieving a stable response record results on Form 1, disconnect the gas and briefly purge with fresh air.
- The mid-level analyzer response shall be within $\pm 3\%$ of the mid-level span gas concentrations for CO, NO, NO₂, and O₂ cells:

Electrochemical Cell Type	Mid-Level Analyzer Reading for Linearity Check
CO, NO, NO ₂ , O ₂	Within $\pm 3\%$ of the mid-level span gas values

3.4 STABILITY CHECK

Conduct a stability check at least once every 12 months for each nominal range that is to be used on each electrochemical cell, CO, NO, and NO₂. Repeat the stability check if an electrochemical cell is replaced or exposed to gas concentrations greater than the analytical range of electrochemical cell specified by the manufacturer.

3.4.1 Stability Check Procedure

- Energize the sample pump and allow the portable electrochemical analyzer to warm up to ambient temperature.
- Set the flow rate to the value recommended by the manufacturer.
- Introduce the span gas for each electrochemical cell at the probe tip using the calibration assembly

- Wait for at least twice the analyzer response time for the readings to stabilize, then record the analyzer response at least once per minute on **Form 4** until the conclusion of the test. During this check, do not make adjustments to the system except those necessary to achieve the correct calibration gas flow rate at the analyzer.
- At the end of the check, disconnect the gas and briefly purge with fresh air.
- Determine the difference between the highest and lowest concentrations recorded during the test period. This difference must fall below the span gas concentration corresponding to the duration of the stability check as follows:

Stability Check Duration	Difference between maximum and minimum values recorded
15-minute check	< 1% of span gas concentration
30-minute check	< 2.5% of span gas concentration

3.5 INTERFERENCE CHECKS

3.5.1 CO Interference Response

An interference test of the response of the CO electrochemical cell to NO and NO₂ shall be performed at least every 12 months, and repeated if the cell is replaced, by using the CO interference response procedure listed below and record results on Form 1. The interference response check shall be performed by:

- Injecting a NO span gas, balance nitrogen, to determine the positive interference response of the CO electrochemical cell.
- Injecting a NO₂ span gas, in either balance nitrogen or air, to determine the positive interference response of the CO electrochemical cell.

3.6 CALCULATIONS

3.6.1 Calibration error for zero and span calibration checks

The following equation shall be used to determine the calibration error (E_{CAL}) for the zero and span calibration checks (Sections 3.1.1 and 3.1.2):

$$E_{CAL} = \left(\frac{| \text{Analyzer Response} - \text{Cal. Gas Concentration} |}{\text{Cal. Gas Concentration}} \right) \times 100\%$$

3.6.2 Drift between pre-test and post-test calibration checks

The following equation shall be used to determine the drift between the pre-test calibration and post-test calibration checks (Sections 3.1 and 3.2):

$$\text{Drift} = \left(\frac{| \text{Post Test Analyzer Response} - \text{Pre Test Analyzer Response} |}{\text{Pre Test Analyzer Response}} \right) \times 100\%$$

3.6.3 Linearity

The following equations shall be used to determine linearity (E_{LIN}) (Section 3.3):

$$E_{LIN} = \left(\frac{| \text{Mid - Span Analyzer Response} - \text{Mid. Span Gas Value} |}{\text{Mid. Span Gas Value}} \right) \times 100\%$$

3.6.4 Stability deviation %

The following equations shall be used to determine the stability deviation % (Section 3.4):

$$\text{Stability Deviation \%} = \left(\frac{\text{Max. Analyzer Response} - \text{Min. Analyzer Response}}{\text{Span Gas Value}} \right) \times 100\%$$

3.6.5 Interference response

The following equations shall be used to determine the interference response (I_{CO}) (Section 3.5):

$$I_{CO} = [(R_{CO-NO} / C_{NOG}) + (R_{CO-NO_2} / C_{NO_2G})] \times 100$$

where:

- I_{CO} = CO interference response (percent)
- R_{CO-NO} = CO response to NO span gas (ppm CO)
- C_{NOG} = concentration of NO span gas (ppm NO)
- R_{CO-NO_2} = CO response to NO₂ span gas (ppm CO)
- C_{NO_2G} = concentration of NO₂ span gas (ppm NO₂)

4.0 EMISSION TEST PROCEDURE

All units shall be tested “as-found.” No tuning or maintenance for the purpose of lowering tested emissions is allowed within 72 hours prior to or during engine testing or 250 operating hours or 30 days prior to boiler testing. Unscheduled repairs performed after testing has commenced shall render such testing invalid.

4.1 SELECTION OF SAMPLING SITE AND SAMPLING POINTS

- Select a sampling point:
 - ◆ At least two stack diameters downstream of any disturbance (e.g. turbocharger exhaust, crossover junction, or recirculation take-off) and
 - ◆ At least one-half stack diameter upstream of the gas discharge to the atmosphere.

Typically, the existing sampling port will satisfy these conditions.

- Use a sample location at a single point near the center of the duct unless previous test data demonstrate that the stack gas emission concentrations across the duct centerline or diameter vary by more than 10%. If so, then traverse sampling shall be performed along one cross-sectional axis of the stack, using three points located at positions of 16.7%, 50%, and 83.3% of the stack diameter, or a centerline of a square or rectangular duct.

4.2 ELECTROCHEMICAL CELL TEMPERATURE AND FLOW MONITORING

- Do not interrupt the flow to the portable analyzer.
- Maintain a constant sampling rate ($\pm 25\%$ of the analyzer flow rate value experienced during the Pre-Test Calibration Check, or within the analyzer manufacturer’s specified range) during the entire test run.
- At no time shall the electrochemical cells be used outside the manufacturer’s recommended temperature and flow rate operating ranges.

4.3 SAMPLE COLLECTION

4.3.1 Preparation

- Assemble the measurement system by following the manufacturer's recommended procedures for preparing and preconditioning the gas analyzer.
- Assure that the system has no leaks.
- Verify that the gas scrubbing agent is not depleted.
- Zero the electrochemical analyzer with fresh air.
- Energize the sample pump and allow the portable electrochemical analyzer to warm up to ambient temperature.

4.3.2 Sampling

- Sample the stack gas for an equal period of time at each test point.
- At the start of the test, record the time, ambient temperature, and operating conditions⁴ of the unit on **Form 3**.
- Record emission data at least every 15-seconds for a minimum of 15-minutes using procedures in Section 5.1.10 of CTM-030.
- Sample the stack gas for at least twice the response time, as determined by the procedures in Section 3.1.2, before starting the 15-minute sampling period (or each of the 5-minute test periods at the three sample locations when multipoint sampling is required).
- Record on **Form 3** the operating conditions of the unit during the test.

4.3.3 Follow-up

- At the end of the test, conduct a post-test leak check of the measurement system, and then disconnect the gas and briefly purge with fresh air.
- If multiple units are to be tested at a single facility, the analyzer shall be purged with fresh air after each unit test. The post-test

⁴ Operating conditions include the engine load and other parameters required to be monitored by the engine Inspection and Monitoring Plan or the boiler load. Use Form3A for engines and 3B for boilers.

leak check may be postponed until after the last unit is tested; however, if the measurement system fails the final post-test leak check, then all of the testing after the last successful leak check is null and void and re-testing is required.

4.4 TESTING UNDER NON-IDEAL CONDITIONS

In general, where non-ideal testing conditions exist (e.g., stack gas oxygen concentration greater than 19%), the facility must submit a source test protocol for review and written approval by the Executive Officer prior to testing. Under limited circumstances, however, facilities may be able to use a portable analyzer for testing under less than ideal conditions. Examples of such circumstances are described below.

4.4.1 Load changes

If there are fluctuations in the process or operating conditions, such as changes in load, portable analyzer testing may continue as long as the operating conditions are recorded to show each fluctuation. If the unit shuts down completely or if there are severe fluctuations during sampling, testing must be repeated for a minimum of 15 continuous minutes during acceptable operating conditions. All changes in process and operating conditions and test interruptions must be noted with the beginning and ending times of each occurrence on the field data sheets.

4.4.2 Bypass stack

If excess air is frequently introduced to the exhaust stack at a variable rate where dampers or bypass stacks are present, concentration testing shall be performed while no excess air is introduced to the exhaust stack.

4.4.3 Multiple stacks

For multiple stacks, sampling need not be performed simultaneously but should be conducted under acceptable test conditions for each individual stack.

4.5 CALCULATIONS AND COMPLIANCE DETERMINATION

The following procedure will determine the mean concentration of NO_x and CO, adjusted for calibration results and corrected to either 15% or 3% O₂, to determine compliance with Rule 1110.2 (or 1146 or 1146.1) and equipment permit condition emission limits for each test.

- a. Determine the arithmetic mean of each gas concentration (NO, NO₂, CO and O₂) measured during the test period.
- b. The mean of each measured concentration (NO, NO₂, CO and O₂) shall be corrected using the following equation to give values adjusted for the pre-test calibration and post-test calibration results (C_{ADJ}):

$$C_{ADJ} = (C_{MEAS} - C_{CZ}) \times \left(\frac{C_{CAL}}{C_{CM} - C_{CZ}} \right)$$

Where: C_{ADJ} = pollutant concentration adjusted for calibration, parts per million dry and by volume (ppmdv)

C_{MEAS} = measured pollutant concentration, ppmdv

C_{CAL} = span gas concentration, ppmdv

C_{CZ} = average concentration of the pre-test and post-test analyzer responses to zero gas, ppmdv

C_{CM} = average concentration of pre-test and post-test analyzer responses to span gas, ppmdv

- c. Add NO and NO₂, together to determine NO_x.
- d. Compute the corrected concentrations with the following formula using adjusted concentrations (C_{ADJ}) to determine compliance with emission limits for NO_x and CO:

$$N = (C_{ADJ}) \times \left(\frac{20.9 - 15 \text{ or } 3.0}{20.9 - O_2} \right)$$

Where: N = NO_x or CO concentration corrected to either 15% or 3% O₂, ppmdv

C_{ADJ} = pollutant concentration of NO_x or CO adjusted per Section 4.5(b), ppmdv

O₂ = oxygen concentration (%), dry basis, measured in the flue gas and adjusted per Section 4.5(b)

5.0 ENGINE RECORDKEEPING REQUIREMENTS

The following records shall be kept on site for no less than five (5) years and made available to AQMD upon request. Electronically stored records are acceptable only if reproducible electronic and/or hard copies are retrievable upon request.

5.1 MEASUREMENT SYSTEM LOG

For each individual measurement system, maintain a binder with the following information:

- Linearity and Interference Tests Recordkeeping Form (**Form 1**), which must be completed and signed by trained personnel.
- Calibration Recordkeeping Form (**Form 2**), which must be completed and signed by trained personnel.
- Stability Check Recordkeeping Form (**Form 4**), which must be completed and signed by trained personnel.
- Certificates of analysis for all calibration gases listed on **Forms 1, 2, and 4**.
- All maintenance and service records, including but not limited to dates that electrochemical cells and filters were replaced, and replacement parts purchase records.

5.2 ENGINE COMPLIANCE LOG

For each engine, maintain a binder with the following information:

- Periodic Monitoring Recordkeeping Form (**Form 3 Engines**), which must be completed and signed by trained personnel.
- Source test reports, including those required per Rule 1110.2.
- Records required by the Inspection and Monitoring Plan.
- Monthly operating log required by Rule 1110.2 subparagraph (f)(1)(E), including:
 - ◆ Total hours of operation.
 - ◆ Type of fuel burned.
 - ◆ Fuel consumption (cubic feet of gas and gallons of liquid). This may be estimated based on engine load, efficiency,

and/or operating hours if a dedicated fuel meter is not available.

- ◆ Cumulative hours of operation since the last source test required by Rule 1110.2 or permit condition.

5.0 BOILER RECORDKEEPING REQUIREMENTS

The following records shall be kept on site for no less than two (2) years and made available to AQMD upon request. Electronically stored records are acceptable only if reproducible electronic and/or hard copies are retrievable upon request.

5.1 MEASUREMENT SYSTEM LOG

For each individual measurement system, maintain a binder with the following information:

- Linearity and Interference Tests Recordkeeping Form (**Form 1**), which must be completed and signed by trained personnel.
- Calibration Recordkeeping Form (**Form 2**), which must be completed and signed by trained personnel.
- Stability Check Recordkeeping Form (**Form 4**), which must be completed and signed by trained personnel.
- Certificates of analysis for all calibration gases listed on **Forms 1, 2, and 4**.
- All maintenance and service records, including but not limited to dates that electrochemical cells and filters were replaced, and replacement parts purchase records.

5.2 BOILER COMPLIANCE LOG

For each boiler, maintain a binder with the following information:

- Periodic Monitoring Recordkeeping Form (**Form 3 Boilers**), which must be completed and signed by trained personnel.
- Source test reports, including those required per Rule 1146 & 1146.1.

6.0 REPORTING REQUIREMENTS

6.1 BREAKDOWNS

- Within one hour of discovery of any breakdown resulting in emissions in excess of rule or permit emission limits, operators shall notify AQMD at 1-800-CUT-SMOG of the time, specific location, equipment involved, responsible party to contact for further information, and to the extent known, the causes of the noncompliance, and the estimated time for repairs.
- Within seven calendar days after the reported breakdown has been corrected, but no later than thirty calendar days from the initial date of the breakdown, operators shall submit a written breakdown report to AQMD which:
 - ◆ Identifies the equipment involved in causing, or suspected of having caused, or having been affected by the breakdown;
 - ◆ Includes the duration of the breakdown;
 - ◆ Includes the date of correction and information demonstrating that compliance is achieved;
 - ◆ Identifies the types of excess emissions, if any, resulting from the breakdown;
 - ◆ Quantifies the excess emissions, if any, resulting from the breakdown and the basis used to quantify the emissions;
 - ◆ Substantiates whether the breakdown resulted from operator error, neglect or improper operation or maintenance procedures;
 - ◆ Substantiates that steps were immediately taken to correct the condition causing the breakdown, and to minimize the emissions, if any, resulting from the breakdown;
 - ◆ Describes the corrective measures undertaken and/or to be undertaken to avoid such a breakdown in the future; and
 - ◆ Includes pictures of any equipment which failed, if available.
- In addition to the requirements specified above, Title V facility operators shall submit a written report to AQMD with 14 days of the date of

discovery of the emission exceedance using **Form 500-N Deviations, Emergencies & Breakdowns**

6.2 ENGINE QUARTERLY REPORTS

Within 15 days of the end of each calendar quarter, the operator shall submit to AQMD in a District-approved format, a Quarterly Report that shall:

- List, for each occurrence of a breakdown, fault, malfunction, alarm, engine or control system operating parameter out of the acceptable range established by an I&M plan or permit condition, or an emission check that finds excess emissions:
 - ◆ The time of the incident
 - ◆ The time the operator learned of the incident
 - ◆ The specific location
 - ◆ The equipment involved,
 - ◆ The responsible party to contact for further information
 - ◆ The causes of the event, to the extent known
 - ◆ The time and description of corrective actions, including shutting an engine down, and the results of all portable analyzer NO_x and CO emissions checks performed before or after the corrective actions.
- Indicate if no incidents occurred.