

South Coast Air Quality Management District
Science and Technology Advancement

Monitoring and Analysis Division
Atmospheric Measurements Branch



STANDARD OPERATING PROCEDURE

FOR

Operations of Horbia
Ambient CO Monitor
APMA-370

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Version 1.0
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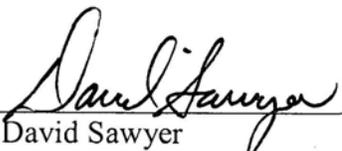
PREPARATION, REVIEWS AND APPROVALS

Standard Operating Procedure for Horiba CO 370 series Instrument

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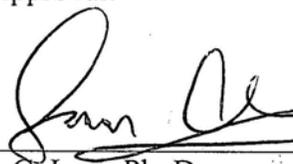
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Standard Operating Procedure for Horiba CO 370 series Instrument

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Standard Operating Procedure for Horiba CO 370 series Instrument

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1 General:

1.1 Purpose

The purpose of this Standard Operating Procedure (SOP) is to provide a set of written instructions that document routine maintenance and operation procedures for measurement of the Horiba APMA -370CO Analyzer

- ☞ The AQIS Operator is ultimately responsible for the Air Monitoring Site data quality. If a critical failure is being reported or the analyzer is over the "Validation Tolerance" the **AQIS Operator shall "Disable" the onsite Datalogger immediately.** Consultation with the Senior AQIS can be made after the fact.

1.2 Safety

Air Monitoring Stations have a great many reasons for safety concerns. Please see "Station Safety Manual", SOP's for Specific Instrumentation and Manufacture's Instrument Manuals and Recommendations.

1.3 References

- Horiba MODEL APMA 370 CO Carbon Monoxide ANALYZER, Instruction Manual
- "SOP for General Air Monitoring Station Operations"

1.4 General Description

The APMA-370 monitor continuously measures concentrations of ambient carbon monoxide (CO) using non-dispersive infrared (NDIR) analysis as its operating principle.

EPA Reference # and Description

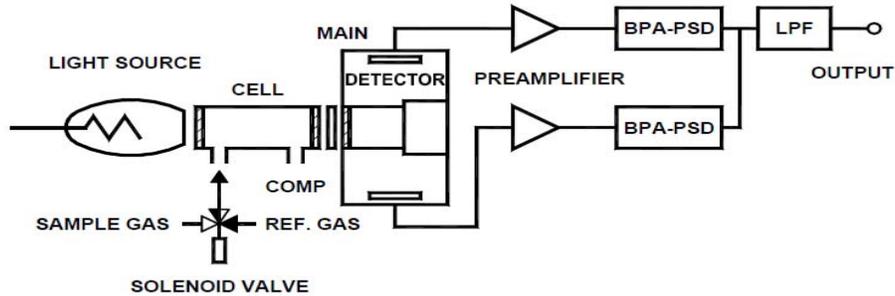
1.5 Principal of Operation

The APMA-370 uses cross-flow modulation, non-dispersive monobeam infrared absorptiometry (NDIR) to measure CO in the sample gas. In cross-flow modulation, sample gas and reference, or zero, gases are alternately sent to the measurement cell. A three-way solenoid valve operating at a constant duty cycle introduces the sample and reference gases at a constant flow rate. A typical duty frequency is 1 Hz. The infrared beam passes through the gas in the measurement cell. The energy absorbed by the detector displaces the membrane in the cell.

This displacement is converted into an electrical signal, amplified and read by the analyzer's processor. With the cross-flow modulation method; if the same gas is used for both the sample gas and the reference gas (e.g., zero gas could

be used for both), no modulation signal will be generated. This has the advantage that there is no zero drift. An additional advantage is the elimination of rotary sectors used in more conventional designs. This, in turn, precludes the frequent need for optical alignment. These features assure improved stability over long periods of operation.

The APMA-370 has a built-in interference compensating detector for CO₂. In the front chamber of the detector, the measurable components, including interference components, are detected; in the rear chamber, interference components only are detected. By means of subtraction processing, any CO₂ interference is eliminated. The APMA-370 has a built-in catalytic oxidizer which removes any CO in the reference gas stream. Thus, the reference gas may be ambient air.



Monobeam Cross-Flow Modulated NDIR Analyzer with Compensating Detector

2 Siting and Installation:

2.1 Initial Setup and Installation: Station Operations

- Verify Correct Instrument Installation
- Verify Receipt of Current Instrument Manual
- Verify Receipt of all Instrument Log Books
- Verify Receipt of Instrument Specific Maintenance Sheet

2.2 Physical Instrument Inspection: Station Operations Verify the Following:

- Sufficient space in front of and behind the instrument for service and maintenance routines. Back of the instrument > 6 in. (150mm) (Horiba Ambient CO Monitor APMA-370 Operations Manual section 10.4.2)
- Electrical Connections:
Verify Clean and professional installation, check for loose wires and connections and proper clearance for instrument inspection and maintenance (Figure 4) (Horiba Ambient CO Monitor APMA-370 Operations Manual sec. 1.3.2)
- Pneumatic Connections:
Verify correct tubing and connection installation, check for clearance and damaged tubing, verify correct inlet/outlet (exhaust) connections (Figure 4) (Horiba Ambient CO Monitor APMA-370 Operations Manual sec. 1.3.2)
- Initial Startup:
Verify Initial startup procedure corresponds with factory firmware and calibration (Horiba Ambient CO Monitor APMA-370 Operations Manual sec. 2.1-2.3)
- Initial Calibration:
Verify multi-point calibration; verify documentation of calibration in Station Logbook, Instrument Logbook & Monthly Maintenance Sheet (Horiba Ambient CO Monitor APMA-370 Operations Manual sec. 4.0)

3 Routine Servicing:

3.1 General information

Perform the following checks at the intervals specified in the service schedule. The checks may be performed more frequently but should be performed at least at the prescribed intervals. Be sure to document all results of maintenance and downtime on the monthly maintenance sheet and downtime log. The Downtime Log, Monthly Maintenance sheet and Maintenance Summary Table are included as attachments.

3.2 Data Validation

CO Validation Template			
Requirement	Frequency	Acceptance Criteria	Information /Action
CRITICAL CRITERIA-CO			
One Point QC Check Single analyzer	1/2 weeks	$\leq \pm 10\%$ (percent difference)	1 - 10 ppm Relative to routine concentrations 40 CFR Part 58 App A Sec 3.2
Zero/span check	1/2 weeks	Zero drift $\leq \pm 2\%$ of full scale Span drift $\leq \pm 10\%$	

- ☛ *One Point QC Check - Daily - Required every 2 Weeks*
 $\pm 10\%$ = Out of Tolerance - Disable - Report
 $\pm 07\%$ = Out of Tolerance Warning - Report

AQIS Operator shall record the current Span readings from the Chessell Video Recorder on the PC/SPAN maintenance sheet. Verify that the readings are within the Acceptance Criteria Range.

Data Validation can be an issue if the Data is outside this range. Perform a visual inspection of all instruments to ensure that they are not damaged and are functioning correctly.

Review the Chessell Video Recorder data for the preceding week to ensure that data appears to follow normal patterns and check appropriate box to indicate whether traces are normal on maintenance sheets.

3.3 AM Work Orders

The AQIS Operator shall in the course of duties utilize as explained in the “SOP for General Air Monitoring Station Operations” the “AM Work Order” Procedure.

If a critical failure is being reported or the analyzer is over the “Validation Tolerance” the **AQIS Operator shall “Disable” the on-site Datalogger immediately**. Consultation with the Senior AQIS can be made after the fact.

3.4 Daily* Tasks: Station Operations Horiba APMA – 370 CO Instruments

- Check CO Instrument Status
- Check that the MEAS or Measurement window is functioning by pressing any key when screen is blank
- Check for Alarms if Alarm function displayed
- Record any problems or changes in Station Logbook, Instrument Logbook & Monthly Maintenance Sheet & Notify Senior if unable to resolve Fill out Downtime log if necessary),
*on the day that the operator services the station

3.5 Weekly Tasks: Station Operations Horiba APMA – 370 CO Instruments

- All Checks to be run with Zero Air through gas calibrator for a minimum of 15 minutes: Record downtime in downtime log.
 - Record Verification of Alarms (Record in Station Logbook, Instrument Logbook & Monthly Maintenance Sheet & Notify Senior if unable to resolve, Fill out Downtime log if necessary)
 - Verify Zero & Span Values with those recorded in the Instrument Logbook & record on monthly maintenance sheet (Menu (exec) > Calibration (exec))
 - Check Time & Align with ESC (± 5 min)
 - Record Verification of Filter Change (Change Instrument Filter Minimum of every two weeks)
 - Complete Monthly Maintenance sheet (Values Obtained from (Menu (exec) > Maintenance (exec) > Analog Input (exec))
 1. Record Signal Main: Voltage of the measured CO value
 2. Record Signal Comp: Voltage of the interference component
 3. Record Pump Pressure: Current Atm Pressure (≤ 65 kPA)
 4. Record Cell Temperature: Ambient Temp + (5°C to 15°C)
 5. Record Sample Flow: (1 – 2 Lpm)
 6. Record Power Supply Voltages 24/5V (± 0.5 V)

3.6 Monthly Task: Station Operations Horiba APMA – 370 CO Instruments

- Perform Analog Output Test for Zero & Full Scale (Menu (exec) > Maintenance (exec) > Analog Output)
(Horiba Ambient CO Monitor APMA-370 Operations Manual sec. 6.3.1)
- Zero Span Check For CO

Parameters	Response
> or < than +/- 1.5 PPM	Invalid Data Call in work order

-1.5 to -0.5 or 0.5 to 1.5 PPM Perform Manual Zero Adjustment
-0.5 to 0 or 0 to 0.5 PPM No Adjustment Needed
(See Detailed Maintenance Procedure: Zero Span Check)

3.7 Semi-Annual Tasks: Horiba APMA – 370 CO Instruments

3.7.1 Station Operations:

Clean Manifold, Probe Inlet, & Instrument tubing/lines
Verify Following Task Completion and Documentation of the following

3.7.2 Support Group:

Multipoint Calibration:
(Horiba Ambient CO Monitor APMA-370 Operations Manual sec 4.2-4.4)

3.8 Annual Tasks: Horiba APMA – 370 CO Instruments

3.8.1 Station Operation:

Verify Following Task Completion and Documentation of the following:

3.8.2 Support Group:

Analog Output Calibration (Horiba Ambient CO Monitor APMA-370
Operations Manual sec 6.3.1)

Part Replacement

Part	Replacement Schedule
O-ring	yearly
Filter Packing	yearly
Diaphragm Assembly	yearly
Catalyst Tube Assembly	yearly
Filter Element	yearly
Scrubber	yearly

4 Documentation:

4.1 Station & Instrument Logbooks

The AQIS Operator shall maintain as explained in the “SOP for General Air Monitoring Station Operations” the Station and Instrument Logbooks.

4.2 Monthly Downtime Log

Complete the Monthly Downtime Log as per instructions in the “SOP for General Air Monitoring Station Operations” Section.4.5 and submit as described.

4.3 Maintenance Sheets

Complete and submit the API 200E NO/NOx Monthly Maintenance sheet to the Senior AQIS for review. Once reviewed, the Senior AQIS submits the maintenance sheet to Data Validation for review

5 Troubleshooting:

Before starting any troubleshooting procedure, refer to Horiba Ambient CO Monitor APMA-370 Operations Manual section 8.3 for more on specific information.

Check for Leaks at all obvious connections
Check all electrical connections, specifically those at the ESC & Chessell connection, check for proper grounding

5.1 Detailed Maintenance Procedures

5.1.1 Replacing the Filter Element

The filter element is used to purify the sample gas and protect the analyzer from possibly corrosive contaminants. If the filter element is used continuously over a long time period, the flow rate of the sample will decrease due to build up of particulates on the filter.

The filter should be replaced minimum of every two weeks, more often if necessary depending on sample conditions.

Filter Replacement procedure:

1. PUSH the area indicated on the door of the analyzer front panel to open.
2. Turn the filter cover towards the left (counter clockwise) and pull out.
3. Remove the filter packing and replace the filter element.
4. Put the filter packing back in place.
5. Turn the filter cover towards the right (clockwise) to re-install it.
6. Close the front panel door.

Figure 1 Sample Filter Door

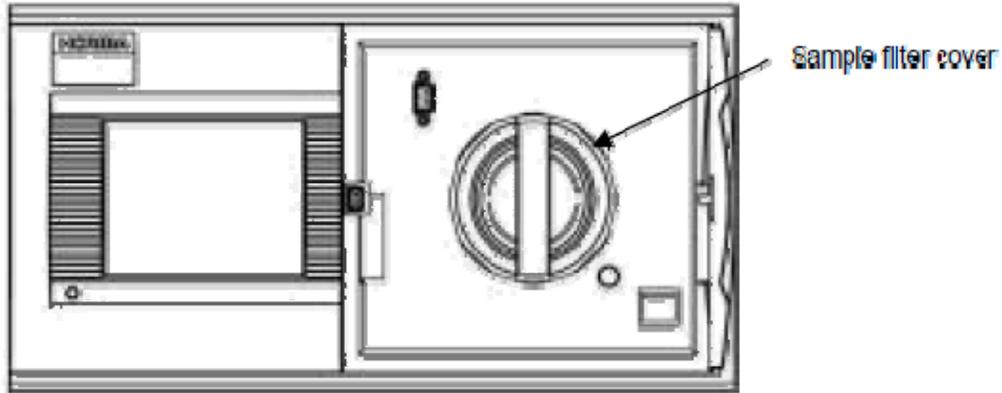
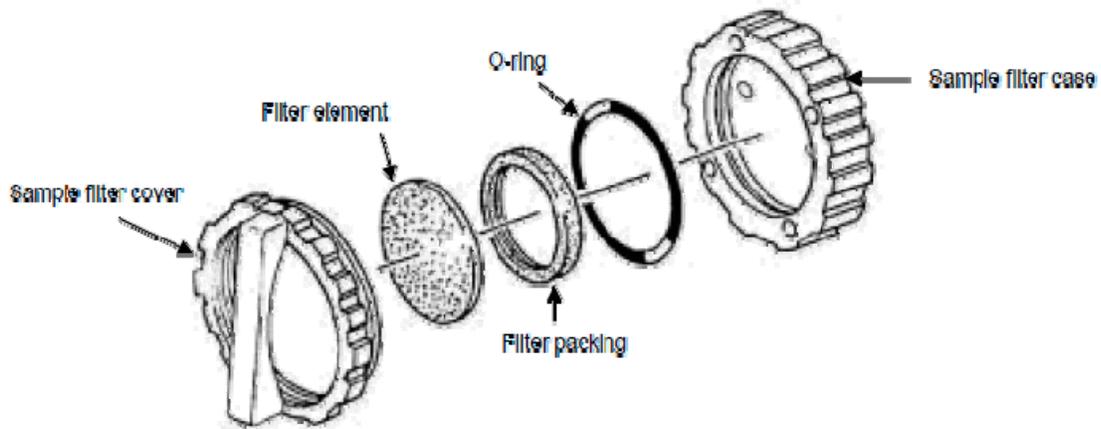


Figure 2 Filter Element – Exploded View



5.1.2 Zero Span Check: General

The zero and span check procedure is performed at the air monitoring site. When completing this procedure the operator will comply with instruction from the manufacturer's operation manual.

To complete the procedure the operator may examine the nightly span/precision values to verify zero values or the operator use the gas dilution system to zero/span the criteria pollutant analyzers. During the procedure verify the analyzer is in normal operation mode.

The following is a *general description* of the instrument zeroing procedure. Instrument specific procedures are included in the attached appendix.

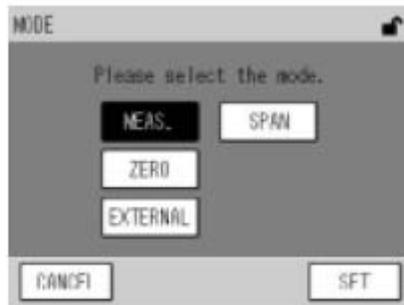
- Initiate the flow of zero air through the analyzer until it stabilizes; approximately 15 minutes
- Compare the values from the Chessell or ESC data logger to the table and determine if adjustments are required
- If adjustments are required note the old calibration factors both in the logbook and on the maintenance sheet.
- While running zero air, place the instrument in the calibration mode and run for at least 15 additional minutes.
- Press the "zero mode" function
- Press the "enter button"
- The instrument should now have a new "zero" or "intercept "value"
- Record these new values both in the log book and on the maintenance sheet.

Please be sure to note any additional information regarding erratic instrument behavior

5.1.3 Zero Span Calibration

(Horiba Ambient CO Monitor APMA-370 Operations Manual section 4.4.2)

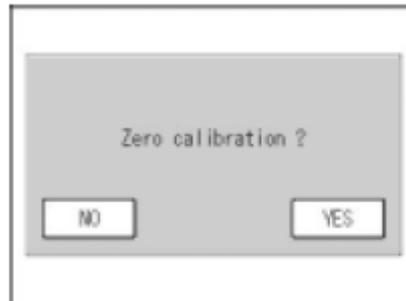
- **On the CAL. screen, check that the proper sample line type is selected.** If necessary, press the MODE setting on the CAL. screen to display the MODE screen, change the setting and press the [SET] key on the MODE screen. Use the measured gas line: Select [MEAS.]



Mode Screen

- **Wait for the readouts to stabilize and then press the [ZERO] key on the CAL. screen.**

The zero calibration message will appear.



Zero Calibration Message

Note: The [ZERO SET] key on the CAL. screen is enabled only when MODE is set to MEAS. or ZERO.

- **Press the [YES] button.**

The zero calibration will be started. After the calibration is completed, the zero calibration coefficient will be updated and the CAL. screen will be displayed again.

(Record these new values both in the log book and on the maintenance sheet)

Figure 3 Front Panel

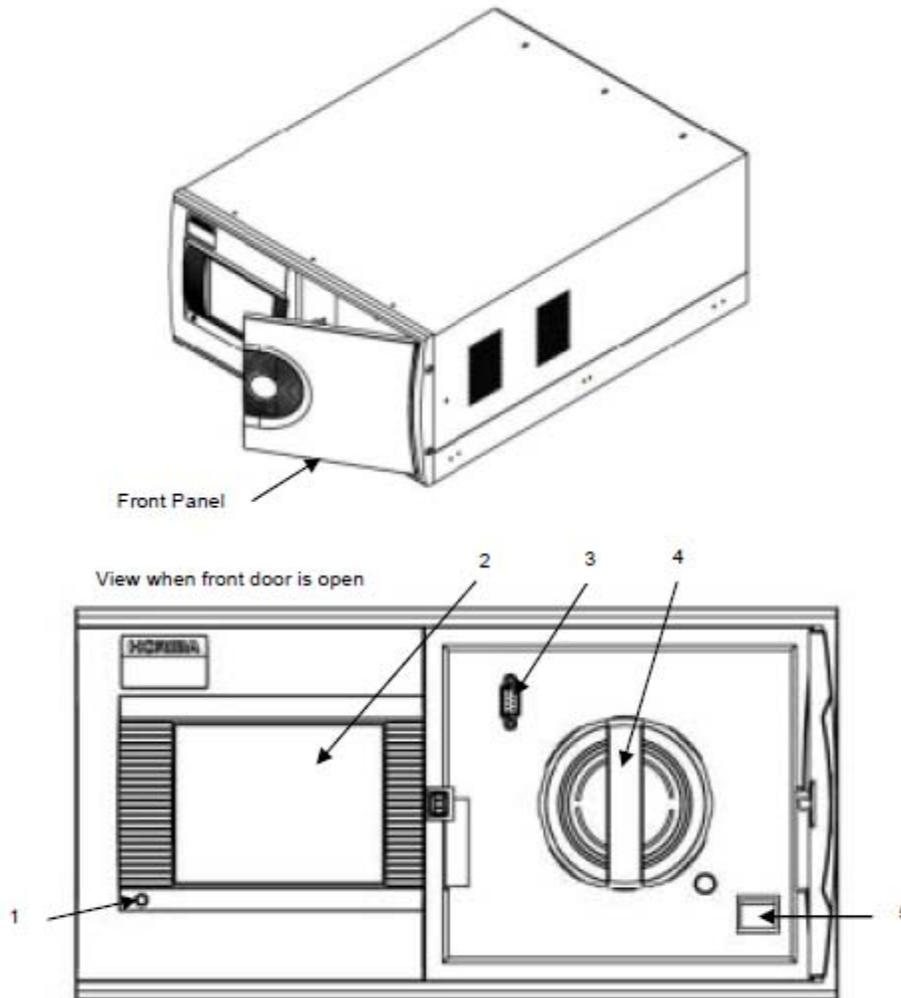


Table 1 Front Panel Description

Name	Description
1 Power ON LED	When the APMA-370 is ON, this LED is illuminated as follows: Green: normal operation, Red: in alarm condition.
2 Touch panel	Displays the measured values, alarms, etc. and contains touch-keys used for operation and setting parameters.
3 RS-232C output port	Used for maintenance and adjustments.
4 Sample filter	A filter for the sample line. Replace this filter about every 2 weeks. (The actual replacement frequency will depend on the sample gas conditions.)
5 Power switch	Used to turn ON/OFF the main power supply.

Figure 4 Rear Panel

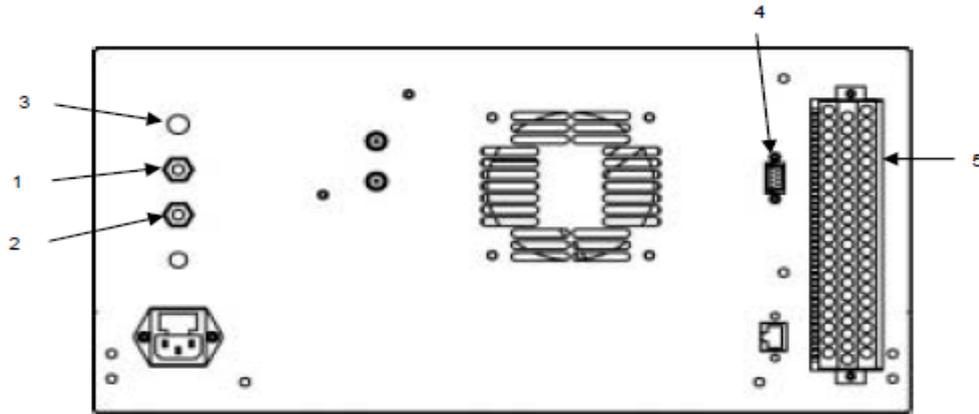


Table 2 Rear Panel Description

Name	Description
1 Sample inlet	The sample gas inlet consists of a connection port for a 6 mm O.D. / 4 mm I.D. Teflon tube. Sample gas pressure must be maintained within ± 980 Pa. A vented tee should be used to prevent over-pressurization of the sample inlet. To prevent condensation, the sample piping must not be exposed to cool ambient air conditions.*
2 Exhaust outlet	The sample gas outlet consists of a connection port for a 6 mm O.D. / 4 mm I.D. Teflon tube. The gas sample must be released to a safe location where backpressure is maintained within ± 490 Pa.
3 Calibration gas inlet	The calibration gas inlet consists of a connection port for a 6 mm O.D. / 4 mm I.D. Teflon tube. The calibration gas pressure must be maintained within ± 500 Pa.
4 RS-232C (optional)	
5 Signal connection terminal block	For a description of the signal, refer to Chapter 9, External Input/Output

Table 3: Maintenance Summary Interval:

(Horiba Ambient CO Monitor APMA-370 Operations Manual section 7.3)

Maintenance Summary Table

Interval	Maintenance	Responsibility
Daily	Review all data collected from the previous day for all sites by viewing data remotely or Chessell stripchart. Data should be compared to the previous day for consistency. Perform a visual inspection of all instruments to ensure that they are not damaged and are functioning correctly.	Station Operator
Weekly	Complete all weekly maintenance sheet tasks. Record the current readings from the Chessell stripchart recorder and data logger in the appropriate columns on the PC/SPAN maintenance sheet. Perform a visual inspection of all instruments to ensure that they are not damaged and are functioning correctly. Review the Chessell stripchart data for the preceding week to ensure that data appears to follow normal patterns and check appropriate box to indicate whether traces are normal on maintenance sheets. Notify Senior if otherwise.	Station Operator
Monthly	Perform Analog Output Test for Zero & Full Scale	Station Operator
Bi-Annually	Clean Manifold, Probe Inlet, & Instrument tubing/lines	Station Operator
	Multi-Point Calibration	Repair/Calibration Technician
Annually	Analog Output Calibration, Replace the Following Items: O-ring, Filter Packing, Diaphragm Assembly, Catalyst Tube Assembly, Filter Element, Scrubber	Repair/Calibration Technician
2-Years	Replace the Following Items Pump Unit, Solenoid Valve Unit	Repair/Calibration Technician
3-Years	Replace the Following Items LCD Unit, Battery	Repair/Calibration Technician

Appendix A: Horiba 370 No/NOx Maintenance Sheet

South Coast Air Quality Management District
 Monthly Maintenance Report
 Horiba Model # APMA - 370 CO

See SOP for Maintenance Sheet Instructions

Location:	Month & Year:
Station #	Technician:
Instrument Serial #	AQMD Property #

DATE:				
TIME:				
Change Filter				
Signal (MAIN) mV				
Signal (COMP) mV				
Cell Temp (5-40°C)				
Pump Pressure (≤65kPa)				
Ambient Pressure				
Sample Flow (1-2.0 Lpm)				
DC 24V (±0.5V)				
DC 5V (±0.5V)				
Alarm				
Inst. Calibration Zero:				
Inst. Calibration Span:				

Monthly: Perform Analog Output Test (± 1% Full Scale)

DATE:	TELEMETRY		CHESSEL	
	ZERO	SPAN	ZERO	SPAN

Comments:

Calibration Date: _____ Reviewed BY: _____