

South Coast Air Quality Management District
Science and Technology Advancement

Monitoring and Analysis Division
Atmospheric Measurements Branch



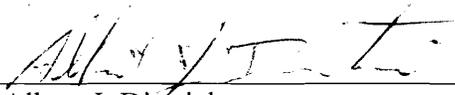
STANDARD OPERATING PROCEDURE

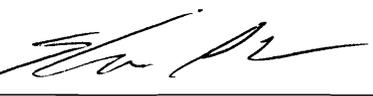
FOR

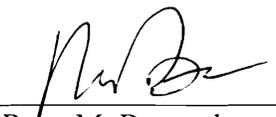
Operations of Horiba
Ambient CO Monitor
APMA-360

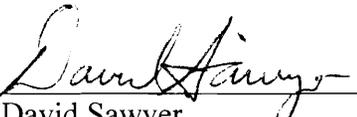
SOP00051A
Version 1.1
December 2012

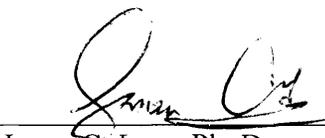
PREPARATION, REVIEWS AND APPROVALS
Standard Operating Procedure for
Operations of Horiba Ambient CO Monitor
APMA-360

Prepared By:  Date: 12/06/12
Albert J. Dietrich
Senior Air Quality Instrument Specialist

Prepared By:  Date: 12/7/12
Keith C. Brown
Senior Air Quality Instrument Specialist

Prepared By:  Date: 12/18/12
Rene M. Bermudez
Principal Air Quality Instrument Specialist

Reviewed By:  Date: 12/18/12
David Sawyer
Principal Air Quality Instrument Specialist

Approved By:  Date: 12/18/12
Jason C. Low, Ph. D
Atmospheric Measurements Manager

Quality Assurance Approval:

Approved By:  Date: 12-19-2012
Chung Liu, D.Env
DEO STA

REVISION HISTORY

Standard Operating Procedure for Horiba CO 360 series Instrument

Version	Date
1.0	January 07, 2010
1.1	December 5, 2012

REVISION CHANGES FROM PREVIOUS VERSION

Standard Operating Procedure for Horiba CO 360 series Instrument

Section	Revisions
4.3	Instrument reference changed to Horiba APMA-360 CO from API 200E NO/NOx
Appendix A	Appendix A maintenance sheet re-titled Horiba APMA 360 Maintenance Sheet

TABLE OF CONTENTS

Standard Operating Procedure for Horiba CO 360 series Instrument

1	GENERAL:	1
1.1	PURPOSE	1
1.2	SAFETY	1
1.3	REFERENCES	1
1.4	PRINCIPAL OF OPERATION.....	1
2	SITING AND INSTALLATION:	3
2.1	INITIAL SETUP AND INSTALLATION: STATION OPERATIONS	3
2.2	PHYSICAL INSTRUMENT INSPECTION:.....	3
3	ROUTINE SERVICING:	4
3.1	GENERAL INFORMATION	4
3.2	DATA VALIDATION	4
3.3	AM WORK ORDERS	4
3.4	DAILY* TASKS: STATION OPERATIONS HORIBA APMA – 360 CO INSTRUMENTS	5
3.5	WEEKLY TASKS: STATION OPERATIONS HORIBA APMA – 360 CO INSTRUMENTS	5
3.6	MONTHLY TASK: STATION OPERATIONS HORIBA APMA – 360 CO INSTRUMENTS.....	6
3.7	SEMI-ANNUAL TASKS: HORIBA APMA – 360 CO INSTRUMENTS	6
3.7.1	<i>Station Operations:</i>	6
3.7.2	<i>Support Group:</i>	6
3.8	ANNUAL TASKS: HORIBA APMA – 360 CO INSTRUMENTS	6
3.8.1	<i>Station Operation</i>	6
3.8.2	<i>Support Group:</i>	6
4	DOCUMENTATION:	7
4.1	STATION & INSTRUMENT LOGBOOKS.....	7
4.2	MONTHLY DOWNTIME LOG	7
4.3	MAINTENANCE SHEETS.....	7
5	TROUBLESHOOTING:	8
5.1	DETAILED MAINTENANCE PROCEDURES.....	8
5.1.1	<i>Replacing the Filter Element</i>	8
	<i>Figure 1: Filter Element – Exploded View</i>	8
5.1.2	<i>Zero Span Check: General</i>	9
5.1.3	<i>Zero Span Calibration</i>	9
FIGURE 2	FRONT PANEL	10
FIGURE 3	REAR PANEL (WIRING)	10
FIGURE 4	REAR PANEL (PIPING)	11
TABLE 1	MAINTENANCE SUMMARY INTERVAL:	12
APPENDIX A:	HORIBA APMA 360 MAINTENANCE SHEET	13

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 -360CO 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.

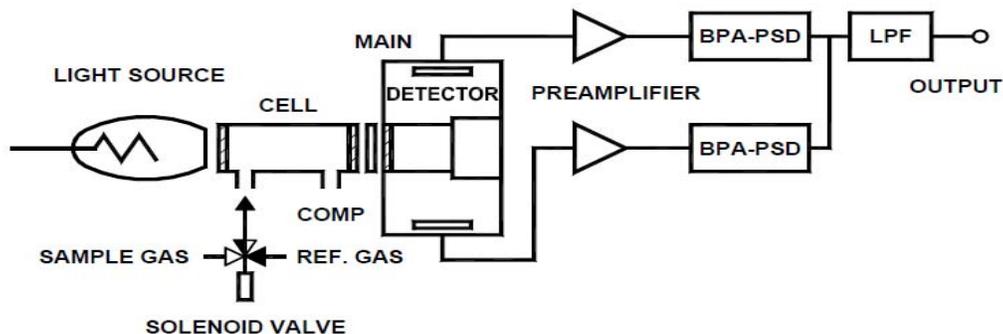
1.2 Safety

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 APMA 360 Carbon Monoxide ANALYZER, Instruction Manual
- "SOP for General Air Monitoring Station Operations"

1.4 Principal of Operation



Monobeam Cross-Flow Modulated NDIR Analyzer with Compensating Detector

The APMA-360 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-360 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-360 has a built-in catalytic oxidizer which removes any CO in the reference gas stream. Thus, the reference gas may be ambient air.

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-360 Installation Manual section 3.2 & 3.3)
- Electrical Connections:
Verify Clean and professional installation, check for loose wires and connections and proper clearance for instrument inspection and maintenance (Figure 3)
(Horiba Ambient CO Monitor APMA-360 Installation Manual sec. 3.4.1)
- 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-360 Installation Manual sec. 3.4.2)
- Initial Startup:
Verify Initial startup procedure corresponds with factory firmware and calibration
(Horiba Ambient CO Monitor APMA-360 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-360 Operations Manual sec. 2.4.2)

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 $\pm 2\%$ of full scale Span drift $\pm 10\%$	

- ☛ *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 – 360 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 – 360 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 Time & Align with ESC (± 5 min)
 - Record Verification of Filter Change (Change Instrument Filter Minimum of every two weeks)
 - 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)
 - Complete maintenance check sheet (Values Obtained from MENU cursor then EXEC.....) (Horiba Ambient CO Monitor APMA-360 Operations Manual sec. 4.1)
 1. Record Cell Pressure: Current Atm Pressure ± 4 kPa
(Menu (exec) > Maintenance (exec) > Analog Input (exec))
 2. Record Cell Temperature: Ambient Temp +(5°C to 15°C)
(Menu (exec) > Maintenance (exec) > Analog Input (exec))
 3. Record Sample Flow: 1.5 Lpm ± 0.3
(Menu (exec) > Maintenance (exec) > Analog Input (exec))
 - Verify Zero & Span Values with those recorded in the Instrument Logbook & record on monthly maintenance sheet (Menu (exec) > Calibration (exec))

3.6 Monthly Task: Station Operations Horiba APMA – 360 CO Instruments

- Perform Analog Output Test for Zero & Full Scale (Menu (exec) > Maintenance (exec) > Analog Output)
 (Horiba Ambient CO Monitor APMA-360 Operations Manual sec. 4.1)

- 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 – 360 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-360 Operations Manual sec 2.4.2)

3.8 Annual Tasks: Horiba APMA – 360 CO Instruments

3.8.1 Station Operation

- Verify Following Task Completion and Documentation of the following:

3.8.2 Support Group:

- Replacement (Horiba Ambient CO Monitor APMA-360 maintenance Manual sec 5 & 6)

Part	Replacement Schedule
O-ring	yearly
Filter Packing	yearly
Diaphragm Assembly	yearly
Catalyst Tube Assembly	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 Horiba APMA-360 CO 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-360 Operations Manual and Maintenance Manual section 8 for more on specific information.

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

5.1 Detailed Maintenance Procedures

5.1.1 Replacing the Filter Element

(Horiba Ambient CO Monitor APMA-360 Operations Manual section 5.2)

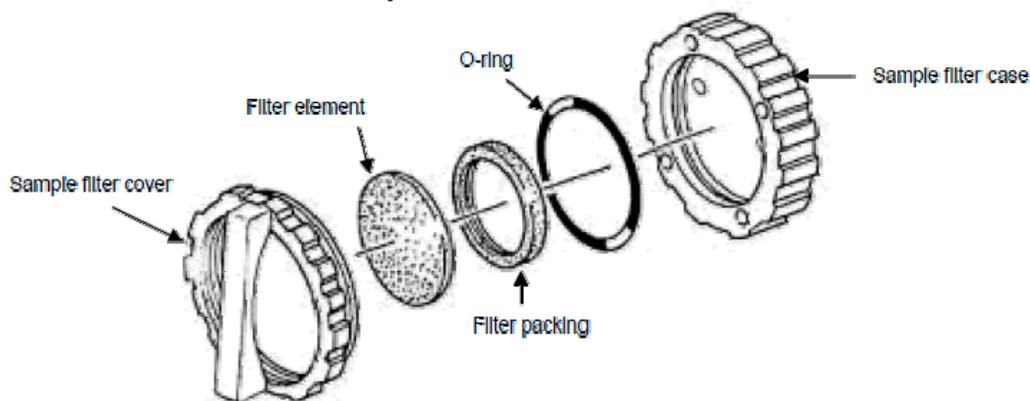
The filter element is used to purify the sample gas and protect the analyzer from possibly corrosive contaminants. If the filter element is used continuously over a long time period, the flow rate of the sample will decrease due to build up of particulates on the filter.

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

Replacement procedure:

1. Pull the knob and then open panel.
2. Turn the filter cover towards the left (counter clockwise) and then remove.
3. Remove the filter packing and the filter element.
4. Fit a new filter element or a new O-ring and packing.
5. Mount the filter cover.
6. Close the front panel door.

Figure 1: 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-360 Operations Manual section 2.4.2 ZERO Calibration)

The ZERO key functions only when **MEAS** or **ZERO** is set in the **LINE** field.

- Set up the APMA-360 and the gas cylinders so that the zero calibration gas is introduced by setting either **MEAS** or **ZERO** in the **LINE** field
- Set either **Zero** or **MEAS** in the **LINE** field and then introduce the zero calibration gas
- Wait for the measured value (momentary value) to stabilize (at least 15min)
- Press the **ZERO** key. "ZERO" will blink for about 10 seconds. Subsequently, the zero calibration coefficient will be calculated and then updated with **ZERO** stopped from blinking.

Figure 2 Front Panel

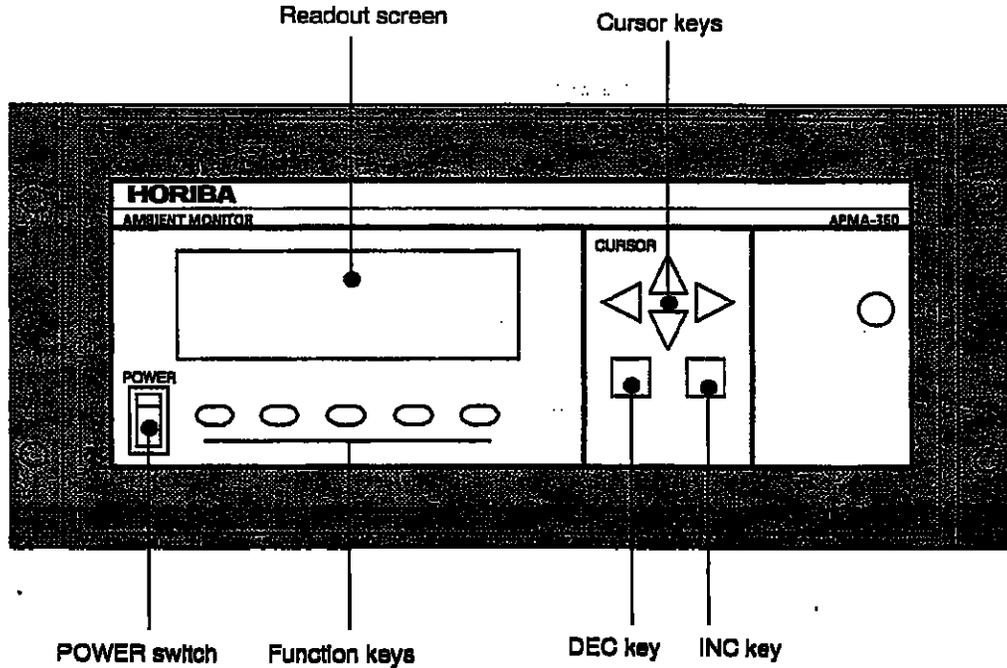


Figure 3 Rear Panel (Wiring)

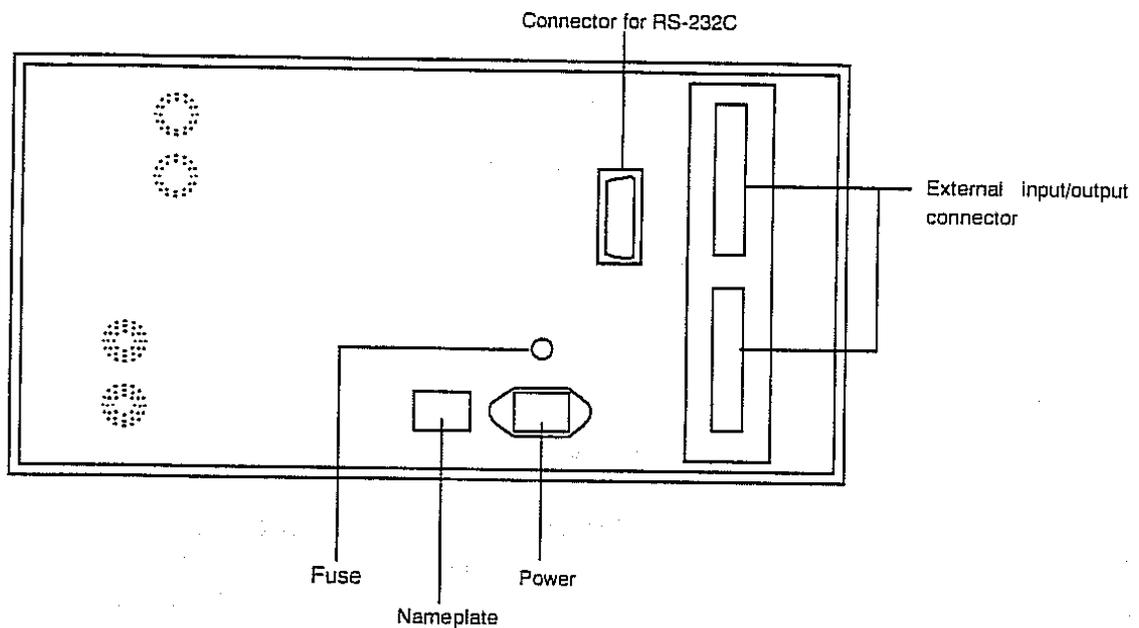


Figure 4 Rear Panel (piping)

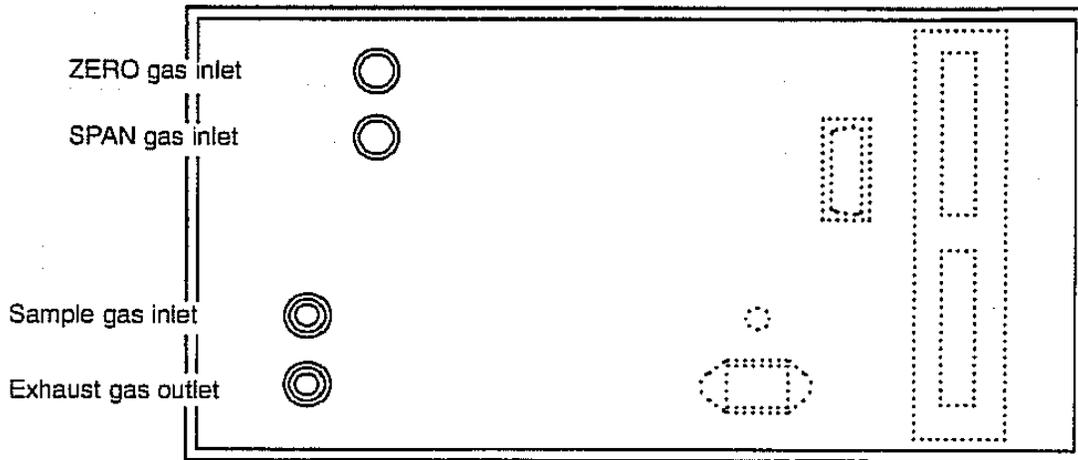


Table 1 Maintenance Summary Interval:

(Horiba Ambient CO Monitor APMA-360 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 Chessel strip chart. 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 strip chart 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 strip chart data for the preceding week to ensure that data appears to follow normal patters 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	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 APMA 360 Maintenance Sheet

South Coast Air Quality Management District
 Monthly Maintenance Report
 Horiba Model # APMA - 360 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 Pressure (Amb \pm 4kPa)				
Cell Temp (Amb + 5-15°C)				
Sample Flow (1.5 Lpm \pm 0.3)				
Alarm				
Zero:				
Span:				

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

DATE:	TELEMETRY		CHESSEL	
	ZERO	SPAN	ZERO	SPAN

Comments:

Calibration Date: _____

Reviewed BY: _____