ATTACHMENT #6
PART A

Quality Assurance/Quality Control Guidelines for Monitor Labs RM4200 Visible Emissions Monitoring System and LS710 Control Unit

Prepared by
ASARCO, Inc.

November 20, 1995
Revised: June 6, 1996

QUALITY ASSURANCE/QUALITY CONTROL GUIDELINES
for
MONITOR LABS
RM4200 VISIBLE EMISSION MONITORING SYSTEM
and
LS710 CONTROL UNIT

Prepared by:

TRC ENVIRONMENTAL CORPORATION
11 Inverness Drive East
Englewood, Colorado 80112

Prepared for:

ASARCO INCORPORATED
East Helena Plant
P.O. Box 1230
Highway 12 East
East Helena, Montana 59635

November 20, 1995
Revision 1.0 - June 6, 1996

TABLE OF CONTENTS

1.0 OVERVIEW

This quality control (QC) and quality assurance operating procedure guideline document (QAOP) is written for the technician that will be responsible for the operation of the continuous opacity monitoring system (COMS). It provides an overview of the system description, routine maintenance requirements, and quality control checks necessary to ensure accurate and continuous operation and representative data collection. These procedures are not intended to replace the detailed procedures defined in the complete systems manual. Reference to the *RM4200 Operators Manual,* supplied by the manufacturer, is recommended for complete understanding of specific operational, maintenance, and troubleshooting requirements.

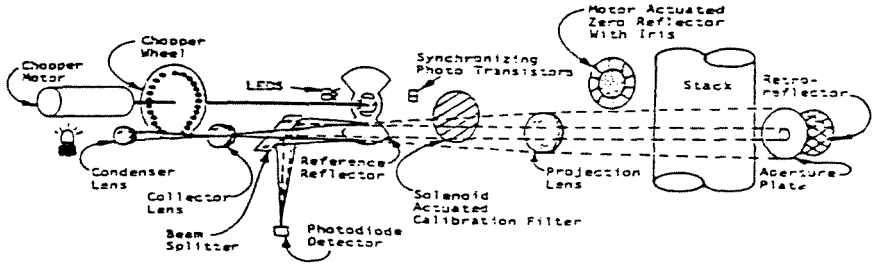
Specific responsibilities and procedures have been defined in this written document that will support the day-to-day operation of the RM4200 system. Further defined written procedures for daily, weekly, monthly, and quarterly activities are referenced as part of this document with specific step-by-step procedures and documentation requirements defined in the following procedures:

- Procedure 4200-01 Daily Operational Verification
- Procedure 4200-02 Monthly Transmissometer Cleaning Procedure
- Procedure 4200-03 Projection Lamp Replacement
- Procedure 4200-04 Quarterly Neutral Density Audit Procedure and Form

1.1 Basic System Configuration

The RM4200 is a combined optical and electronic system that detects and measures the optical density and opacity of stack gas emissions. The RM4200 consists of three primary assemblies. The transmitter/receiver (transceiver) is located on one side of the stack, while the retro reflector is located on the opposite side of the stack. The transceiver transmits the measurement signal through a junction to a control unit. The transceiver and retro reflector combine to provide the measured signals for input into the control unit (LS710). The LS710 simultaneously provides an indication of double-pass optical density and opacity corrected for stack-exit conditions. Figure 1 illustrates the arrangement of the four major components of the transmissometer system as mounted on a typical stack.

FIGURE 1
RM4200 GENERAL SYSTEM CONFIGURATION
PRIMARY COMPONENTS



- Transceiver (Analyzer/Electronics)
- Retro reflector
- J-Box (Interconnect between Analyzer and Acquisition)
- LS710 Control Unit (Data Interpretation and Acquisition)

2.0 GENERAL SYSTEM INSPECTION and MAINTENANCE

The following section outlines basic system checks and maintenance activities that are not component specific, but cover the entire monitoring system (transceiver, retro reflector, J-box, and control unit) for the opacity monitoring system. Although each component function is critical, the operation of all components combined into a fully validated system is required to ensure acceptability of the continuous opacity monitoring system (COMS).

2.1 Daily (Weekday) Inspections

Daily (Weekday) inspections of the RM4200 system, by a qualified instrument technician, is paramount in the acceptable operation and data collection activities. Daily (Weekday) system integrity checks assist in minimizing system down time and provide an avenue of decreased long term maintenance requirements.

All inspections that are defined in these routine maintenance procedures will be recorded in the systems log book. The following section provides a brief background of the general procedures that are followed in the daily (weekday) inspection routines. The *QUALITY CONTROL GUIDELINE PROCEDURE Daily Operational Verification* ***(Procedure 4200-01)*** is provided in Appendix A of this QAOP for reference in conducting the daily inspection activities.

2.1.1 Data Assessment/Confirmation of Z/S results

To support the quality of data generated by the COMS, zero and span (Z/S) checks will be conducted once per day (every twenty three hours). The zero/span checks will be conducted using the electro-optical method (EO). The Z/S will be automated to provide unattended action. The results of the most recent zero and span values will be reviewed by the ASARCO instrument technician. If zero/span values exceed ± 3.0 percent calibration drift, calibration procedures and/or corrective action will take place to met the drift check criteria.

2.1.2 Activities and Indicators

Included in the logs are all maintenance activities, planned and unplanned, any system modifications, consumable uses, electronic checks (manual zero/span checks) that effect the digital data, changes or entries in the LS710 menu systems, and calibration/zero/span values observed during the past 24 hour period.

As a component of this inspection, review of data to determine reasonableness is extremely important. Confirmation of zero/span activity and pre and post response values (i.e. opacity levels prior to and after the calibration cycles) to confirm data acceptability is required. Any anomalies, changes, or general observations are entered in the system log book.

Status indication of the system, as provided by the LS710 control unit display, is also reviewed and noted in the daily logs. System indicator lights and LED display on the control panel assist in identifying potential problems.

Diagnostic fault indicator lights and **IFAILURE** message is displayed any time a system fault is detected. Key fault indications under the **DIAGNOSTIC** heading and **FAULT** subheading of the LS710 control unit that relate to specific instrument failures (requiring immediate attention and possible component replacement) include:

- **RAM** (Random Access Memory)
- **TIMR** (Time Chip)
- **WDOG** (Watchdog device failure)
- **DAC** (Digital to Analog Converter Failure)
- **EEPR** (Fault in EPROM circuitry)
- **ROM** (Read Only Memory)
- **PIC** (Peripheral Interrupt Controller)
- **AGC TRANS** (Auto Gain Control Fault in Transceiver)
- **PIO** (Output Device Error)
- **RM REF** (Out of Tolerance Ref Signal)

If any of the diagnostic faults are indicated from this partial list, the operator must refer to the *Standard Operating Procedures for the RM4200/LS710* and corresponding manufacturers manual for specific troubleshooting and component replacement procedures.

Additional display indicators that the user must be aware of in the visual inspection deal with Calibration status outputs of the LS710. Although most of these indicators do not specifically dictate system problems, it is important that the display indications are identified and understood. They include:

- CALIB STARTED (Appears when Cal Check button is pressed)
- CALIB IN PROG (Appears during calibration cycle)
- CAL PURGE (Appears during cavity purging of process gases)
- ZERO CAL (Appears during ZERO portion of calibration cycle)
- SPAN CAL (Appears during SPAN portion of calibration cycle)
- TEMP CHECK (Appears after cal cycle completion and awaiting valid data)
- RM MANUAL (Appears when Auto/Manual Switch in J-Box set at Manual)
- CONTIN ZERO (Continuous Zero parameter entered in E-O heading)
- CONTIN SPAN (Continuous Span parameter entered in E-O heading)
- ZERO ERROR (Appears if zero for opacity falls outside ± 4%)
- SPAN ERROR (Appears when span falls outside ± 3% of value entered in SPAN OP)

2.2 *Monthly Cleaning*

Monthly inspection and cleaning of the transmissometer optical surfaces by a qualified instrument technician, is to be conducted as an additional activity to the normal daily (weekday) inspections conducted by the site technician. Monthly cleaning and verification assist in continued operation and reduce excessive maintenance. The monthly activities are directed primarily towards maintaining the system optics. All monthly inspections that are conducted will be recorded in a systems log book.

The *QUALITY CONTROL GUIDELINE PROCEDURE Monthly Cleaning (**Procedure 4200-02**)* is the primary guideline used in the inspection process. The individual quality assurance operating procedures (QAOP's) are provided in Appendix A of the document. For diagnostic procedures and other non-routine maintenance activities beyond the scope of these quality assurance operating procedures, the technician must refer to the manufacturer manual.

2.2.1 *Monthly Cleaning and Optics Check*

The following section provided the general procedure that is followed for the monthly activities.

1. Release the four quick-release latches that secure the transceiver to the probe assembly and swing the transceiver to the side on its hinges.
2. Clean the optical surfaces of the transceiver carefully with one of the optical cloths supplied with the maintenance kit, located in the retro-reflector unit. Re-secure the transceiver unit with the four latches when cleaning is complete.
3. Remove the black aperture plate from the retro-reflector by taking out the three screws securing it. This will allow for complete cleaning of the retro-reflector unit. Carefully clean the surface of the retro-reflector with a clean dry optical cloth.

CAUTION: DO NOT use solvents on the lens or any other materials during cleaning except for the lens cloth supplied in the maintenance kit.

4. Once cleaning is completed resecure the transceiver and retro-reflector in place. Secure the four latches.

5. Check that all mounting bolts at the probe/flange interface are secure.

NOTE: If the bolts and nuts that face the transceiver are loose, the transceiver/probe may require realignment (see the Probe Replacement Procedure in the manual for alignment instructions). However, if the bolts can be tightened without changing the previously established alignment, no adjustment is necessary.

6. Check the desiccant indicator on top of the transceiver. The center spot of the desiccant capsule should be blue. If it is not, replace the desiccant cartridge.

2.3 *Projection Lamp Replacement*

Under normal operating conditions, the projection lamp should last in excess of 20,000 hours. If the lamp fails (i.e. needs to be replaced), **LAMP** will be displayed on the front panel of the LS710. Appendix A contains the procedure for *QUALITY CONTROL GUIDELINE PROCEDURE Projection Lamp Replacement (Procedure 4200-03).*

2.4 *Semi-Annual Maintenance and Inspection*

Semi-annual inspections of the COMS, by a qualified instrument technician, are to be conducted as a primary activity to ensure the continued operation of the COMS and confirm the operational status of key system components and are directed primarily at the cleaning and inspection of the transceiver and retro-reflector. All semi-annual maintenance and inspection activities will be preceded by the daily (weekday) system checks. The semi-annual inspections will assist in continued operation of the COMS and track primary component performance. All semi-annual inspections are recorded in the systems log book.

The summary of the routine maintenance recommended to ensure continued trouble-free operation is followed for semi-annual maintenance.

- Inspect transceiver desiccant cartridge (Part No. 16000053)[1]
- Inspect desiccant capsules in the J-Box air filter (Part No. 80180305)

[1] If the transceiver desiccant cartridge requires replacement more frequently, the instrument air system may require more thorough drying.

NOTE: The transceiver internal optics are sealed from the electronics to prevent optical contamination during checkout, servicing, or calibration, refer to the RM4200 Instrumentation Manual if internal optics maintenance is required.

3.0 QUALITY CONTROL

The following section summarizes the general requirements for quality assessment of the monitoring system for drift, precision and accuracy. The basis of the quality assurance requirements are derived from *40CFR60 Appendix A PS1 "Performance and Specification Procedures for Continuous Opacity Monitoring Systems in Stationary Sources."*

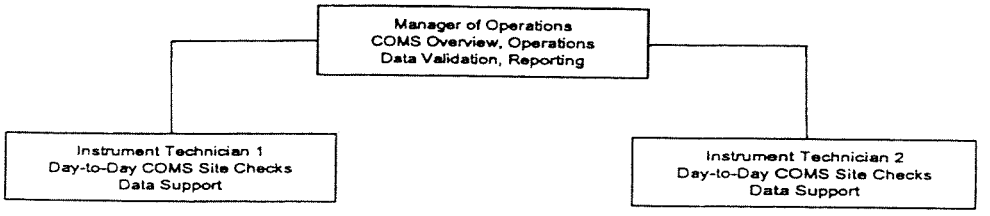
The general purpose of the procedures applied under these quality control guidelines is to determine the effectiveness of quality control (QC) and quality assurance (QA) procedures and the quality of the data collected by the COMS that are in place. In evaluation of the Continuous Opacity Monitoring System (COMS) it should be emphasized that the COMS is the *entire* and *total* component system required for determination of opacity in the stack or duct.

3.1 QA Program Description

The organizational development covers the basic requirements for designating individuals into a comprehensive quality control over structure. To optimize the continuous operation and proper implementation of the quality control (QC) procedures, it is important that a program structure and organization be maintained to support the monitoring and reporting objectives. Delegation of authority and responsibility among the individual involved in the program is necessary for maintenance of a quality program. The Manager of Operations, with support from site personnel, should be able to address most operational (instrument) problems or ancillary problems that may affect the data. It should be stressed that the fundamental source and focus of the quality assurance practices are maintained with personnel in the field. *Figure 2* provides a general organizational structure.

The Manager of Operations is responsible for the oversight of the day to day instrument operations, periodic review of the data records, verification of data acceptability, data validation, and reporting. The Instrument Technicians provide the day to day support of COMS operation, provide maintenance support, and report any system or data problems to the Manager of Operations. Technicians also support routine data reduction and validation.

Figure 2
General Organizational Overview



When accuracy checks are performed, the assessment is provided on the entire system response. This is not component specific but includes the analyzer, data acquisition, and final data output as a whole. The accuracy of the COMS is based upon each interrelated component working together to derive source data that is representative. If any one component of the system is inaccurate, it will cause the entire COMS response to be inaccurate. Therefore, the quality checks are designed to periodically confirm the accurate operation of the system, not an individual component. In general the key QA/QC procedures include:

- Assessment of the Quality of the Data
- Drift Determination and Correction
- Quarterly Accuracy Performance Audits

3.2 Data Assessment/Handling/Reporting

Data from the RM4200 opacity monitor will be collected in 6- minute rolling data blocks. The six minute data blocks will be comprised of a minimum of four valid one minute average values. The one minute values will be held as intermediate data points until each 6 minute block is recorded. The one minute data will not be recorded.

At the completion of each quarter of monitoring (within 45 days), ASARCO will submit a quarterly report of all excess emission. Periods of excess emissions will be defined as the emissions in excess of 20% opacity, as determined by the COMS on a rolling six minute basis. Each quarterly report will contain the following:

- The magnitude of excess emissions and the beginning and ending date and time of the period of excess emissions.
- Specific identification of each period of excess emissions that occurred during startup, shutdown and/or malfunctions. This will also include the corrective action taken to remedy the cause of excess emissions.
- Date and time identifying time periods when the COMS was inoperative due to repairs, calibrations or maintenance.
- If no excess emissions have been recorded, and/or the COMS has been completely operational without any required repairs or adjustments during the quarter, the report shall provide a such a statement.

- The percentage of time the COMS was operational will be reported using the following calculation:

$$[\ 1 - \frac{\textit{hours of COMS downtime during quarter}}{\textit{hours the source operated during quarter}}\ ] \times 100$$

- The percentage of time the COMS indicated compliance will be reported using the following equation:

$$[\ 1 - \frac{\textit{total hours of excess opacity during reporting period}}{\textit{total hours of COMS availability during reporting period}}\ ] \times 100$$

All data collected shall be maintained in a file at the ASARCO Environmental office. The data file shall contain: all measurements collected from the COMS; all performance testing measurements; all COMS performance evaluations; all COMS maintenance, calibrations, repairs and audits. The data and associated documentation will be maintained on-site for a minimum of five years after completion of the monitoring.

3.2.1 Corrective Action

ASARCO will flag data collected during excessive calibration drift periods. If any zero/span exceeds ± 3.0 percent calibration drift the data will be flagged. If drift exceeds four times the applicable drift standard (or 12%), this is considered and "out of control" occurrence. If an out-of-control condition exists, corrective action must be taken immediately or data invalidation will continue until drift conformance (within the 12%) has been met. The data collected during this "non-conformance" cannot be used as "valid" data for reporting compliance or be counted as available hours to meet data recovery rates. The "non-conformance" period is defined as the time immediately proceeding the recorded out-of-control drift record and data is not accepted until the system has been verified to meet allowable tolerances. Adjustments with post verification of span and zero checks or system audits are acceptable corrective measures.

The "out of control" levels to exist if the following is determined:

1. Zero or Span level drifts exceed +/- 5% of full scale (FS) (2 times the applicable standard) for a period of five consecutive days.
2. The Zero or Span drifts exceed +/- 12% of full scale (FS) (4 times the applicable drift specification) during any one period the COMS is "out of control."

If the RM4200 COMS is not operating for a period greater than 24 hours, ASARCO shall monitor visible emissions from the affected stack at least once every week day (during daylight hours) using a certified visible emissions observer who will perform visible emissions observations and record the results. These observations shall be conducted in accordance with *40CFR Part 60, Appendix A, Method 9.*

3.3 Drift Assessment

The RM4200 system calibration (zero and span) should not be required to be adjusted on a daily (24 hour) basis. Zero and Span procedures or corrective action must be "evaluated" if the drift is found to be outside ± 3.0% calibration drift. Readjustment is required when the *system* output for zero (baseline) or span (upscale calibration) exceed the "out of control limits.

If an out-of-control condition exists (as defined above) corrective action must be taken immediately or data invalidation will continue until drift conformance has been met. The data collected during this "non-conformance" cannot be used as "valid" data for reporting compliance or be counted as available operational hours. The "non-conformance" period is defined as the time immediately proceeding the recorded out-of-control drift record and data is not accepted until adjustments have been verified to confirm system accuracy. Internal adjustments with post verification of E-O span and zero checks or system audits are acceptable corrective measures.

3.4 Quarterly Neutral Density Audit Procedures

The purpose of the quarterly neutral density filter audit is to demonstrate operational status of the system and provide a performance evaluation of the continuous opacity monitoring system (COMS). The audits will be conducted following the procedures defined in *40CRF60 Appendix B*, Performance Specification 1 for Continuous Opacity Monitoring Systems (COMS).

The *QUALITY CONTROL GUIDELINE PROCEDURE Quarterly Neutral Density Audit Procedure and Form (Procedure 4200-04)*, provided in Appendix A discusses the procedures required in conducting the quarterly audit.

The following calculations are used in the confirmation and determination of system accuracy as further illustrated in *Performance Specification 1, Section 8.0 Equations*; mean percent difference (*Section 8.1 equation 1-2*), confidence coefficient (*Section 8.3 equation 1-3*), and error (*Section 8.4 equation 1-5*).

$$\text{Confidence Coefficient (CC)} = t_{0.975} \times \frac{S_d}{\sqrt{n}}$$

$$\text{Calibration Err } (E_r) = |x| + |CC|$$

where:

x	=	arithmetic mean of single filter data set (absolute value)
$t_{0.975}$	=	t-value for 5 test runs (2.776)
S_d	=	Standard Deviation of single filter data set
n	=	number of test runs

All field data collected during each audit will be recorded on the field work sheets. Procedure 42000-04 provides the field forms that are completed during each quarterly verification.

4.0 REFERENCES

5.1 RM4200 Visible Emissions Monitor; INSTRUCTION MANUAL. Lear Siegler Measurement Controls Corporation, 80250255 Rev. C 11/91.

5.2 LS710 Control Unit; INSTRUCTION MANUAL. Lear Siegler Measurement Controls Corporation, 80250378 September 1991 w/Addendum ECO # 3258 4/92.

5.3 Handbook Continuous Air Pollution Source Monitoring Systems. EPA 625/6-79-005. June 1979.

5.4 Code of Federal Register, Title 40 Part 60, Appendix B; Performance Specification 1.

5.7 Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III Stationary Source Specific Methods, Revision 2, January 1982.

QUALITY CONTROL GUIDELINE
RM4200 VISIBLE EMISSIONS ANALYZER
Daily (Weekday) Operational Verification

PROCEDURE 4200-01
Page 1 of 1

Purpose

This procedure is used to verify the equipment is operating correctly in reporting. The procedure applies to the RM4200 Visible Emissions Analyzer and the related recording equipment, if any.

Tools and Equipment Required

No special tools or equipment are needed.

Estimated Time Required to Perform the Procedure

Approximately 5 minutes, if no corrective action is required.

Procedure

1. OPERATIONAL VERIFICATION ; Perform the following:

a. Record the Opacity Reading, as indicated on the LS710, before any other checks are performed in the logbook.

b. Using the LS710 Heading and Subheading buttons for the appropriate J box, select E/O Cal and VEZ and VES, respectively. Record the last zero and span value indicated on the LS710 panel in the log book. Verify the values are within 5% of the current values and record on data sheet;

c. Return the system to operational status.

d. Record the Opacity Reading, as indicated on the LS710, after the system has been returned to operational in the logbook.

2. DIAGNOSTIC FAULTS

a. Verify that the LS710 is clear of all fault indicators and make entry in log book to verify operational.

3. SYSTEM CONDITION

a. Provide a visual check of the transciever, weather cover (if applicable), mounting bolts, J-box, LS710 operation, cables, and air purge. Confirm that these visual checks were completed on the data form.

Corrective Action

Should corrective action be required, refer to the RM4200 instruction manual maintenance section.

Reference Documents or Procedures

RM4200 Visible Emissions Analyzer Instruction Manual.

QUALITY CONTROL GUIDELINE
RM4200 VISIBLE EMISSIONS ANALYZERS
Monthly Cleaning and Verification Procedure

PROCEDURE 4200-02
Page 1 of 1

Purpose

This procedure is used monthly to verify the equipment is operating correctly, that the optics are clean, and that the reference levels are within defined limits.

Safety Precautions

Exercise appropriate safety precautions associated with climbing, should accessing the transceiver require climbing.

Tools and Equipment Required

Clean, soft, lint-free cloth
RM4200 Visible Emissions Analyzer Instruction Manual

Time Required to Perform the Procedure

Approximately 30 minutes.

Procedure

1. Reference Verification and Documentation

   a. Perform procedure 4200-01, Operational Verification and document readings

   b. Verify that the reference reading for Opacity (OP) is within acceptable ranges and record on data sheet.

   c. Put the LS710 into the normal operating mode by selecting PANEL, subheading REF and press INCREMENT to OFF.

2. Cleaning and Optics Check

   a. Release the six latches that secure the transceiver to the probe assembly and swing the transceiver to the side on its hinges.

   b. Verify that all optical surfaces of the transceiver are clean and free of debris by cleaning the outside of the transceiver lens with a clean, dry lens cloth.

   c. Swing the transceiver back into position. Check that the transceiver is properly aligned on the alignment pins opposite the hinged side. Secure the six latches.

   d. Check that all mounting bolts at the flange interface are secure.

Corrective Action

See the RM4200 Instruction Manual maintenance section.

QUALITY CONTROL GUIDELINE
RM4200 VISIBLE EMISSIONS ANALYZERS
Semiannual Maintenance and Inspection

PROCEDURE 4200-03
Page 1 of 1

Purpose

This procedure defines the semi-annual cleaning and inspection of the RM4200 transceiver. This procedure may be performed more frequently, if needed.

Tools and Equipment Required

9/16" open end wrench
lint-free cloth or lens wipes
soap and water (optional)
1/2" open end wrench
protective gloves

Time Required to Perform the Procedure

Approximately 60 minutes.

Procedure

1. Perform procedures 4200-01 and 4200-02.
2. Place the LS710 out of service by selecting heading E/O, subheading CALIB and press CONTIN (in J-Box 2) to OUT.
3. Examine the exterior weather covers on the transceiver and clean as required.
4. Open the transceiver weather cover and release the latches securing the transceiver to the probe. Disconnect the purge line and the thermocouple connector located below the lens. Lift the transceiver off the hinge pins and place it on the deck.
5. Examine the transceiver lens and housing for cracks and particulate accumulations. Replace as necessary.
6. Mount the transceiver on the hinge pins.
7. Latch the transceiver to the probe and close the weather cover.
8. Restore the LS710 to the normal operating mode.
9. Record this activities in the log book.
   - Inspect desiccant capsules in the J-Box air filter

Reference Documents or Procedures

This procedure occurs at the time of alternating quarterly procedures and may be performed at the same time to avoid extended system downtime and lost data.

RM4200 Instruction Manual.

QUALITY CONTROL GUIDELINE
RM4200 VISIBLE EMISSIONS ANALYZERS
Quarterly Neutral Density Filter Verification

PROCEDURE 4200-04
Page 1 of 2

Purpose

Quarterly neutral density filter audits are conducted in order to meet USEPA requirements. The audit (verification) also provides an indication of the accuracy of the opacity measurements made by the RM4200.

Safety Precautions

Exercise precautions associated with climbing, should accessing the instrumentation require climbing.

Tools and Equipment Required

- large adjustable wrench
- RM4200 attenuator fixture for neutral density filters
- set of 3 (minimum) neutral density filters with calibration certification
- electrical tape (possibly required for securing neutral density filters in attenuator fixture)

Time Required to Perform the Procedure

This procedure requires approximately 60 minutes for one technician.

Procedure

1. Release the six latches that secure the transceiver to the probe assembly and swing the transceiver to the side on its hinges.
2. Secure the calibration housing to the transceiver with the mounting fixture provided with the calibrator.
3. Insert the one of the three neutral density filters into the calibration fixture following the manufacturers instructions. The filters are designated as low range (low), mid range (mid), and high range (high).
4. Once the LS710 display has stabilized, record the reading calibration form.
5. Repeat steps 3 and 4 for the other two range filters. Perform five non-consecutive runs for each range of neutral density filter (15 total runs consisting of five runs for each neutral density filter).
6. Calculate the arithmetic mean, confidence coefficient and calibration error for each set of runs for each range of neutral density filter.

$$\textit{Arithmetic Mean} = \Sigma \frac{x}{n}$$

$$\textit{Confidence Coefficient (CC)} = t_{0.975} \times \frac{S_d}{\sqrt{n}}$$

$$\textit{Calibration Err } (E_r) = |x| + |CC|$$

7. Complete all spaces on the Quarterly Neutral Density Calibration Form.

8. Perform a response time determination test using the high range neutral density filter. This is done by calculating an upscale value (0.95 x filter value) and a downscale value (0.05 x filter value).

9. Five runs are performed each for the upscale determination and for the downscale determination. From the 10 readings, an average response time is calculated.

10. Complete all spaces on the quarterly response time determination form.

Corrective Action

If the test results are not as expected, refer to the maintenance section of the RM4200 Instruction Manual.

Reference Documents or Procedures

RM4200 Visible Emissions Analyzer Instruction Manual.

Person Conducting Test _____ Analyzer Manufacturer _____
Affiliation _____ Model/Serial No. _____
Date _____ Location _____
Monitor Pathlength, L1 _____ Emission Outlet Pathlength, L2 _____
Monitoring System Output Pathlength Corrected? Yes____ No____

Calibrated Neutral Density Filter Values

Actual Optical Density (Opacity):
Low-Range _____ (_____)
Mid-Range _____ (_____)
High Range _____ (_____)

Path Adjusted Optical Density (Opacity)
Low-Range _____ (_____)
Mid-Range _____ (_____)
High-Range _____ (_____)

Run Number	Calibration Filter Value (Path-Adjusted Percent Opacity)	Instrument Reading (Opacity), percent	Arithmetic Difference (Opacity), percent		
			Low	Mid	High
1 – Low				–	–
2 – Mid			–		–
3 – High			–	–	
4 – Low				–	–
5 – Mid			–		–
6 – High			–	–	
7 – Low				–	–
8 – Mid			–		–
9 – High			–	–	
10 – Low				–	–
11 – Mid			–		–
12 – High			–	–	
13 – Low				–	–
14 – Mid			–		–
15 – High			–	–	–
			XXXXXX	XXXXXX	XXXXXX
Arithmetic Mean (Equation 1-2) $\bar{X}$					
Confidence Coefficient (Equation 1-4) CC					
Calibration Error $\bar{X}$ ± CC					

Figure 1-6. Calibration error determination.

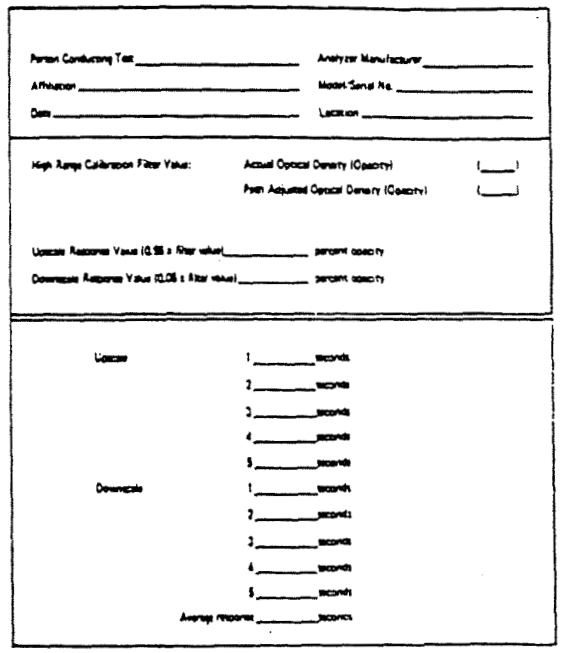


Figure 1-7. Response time determination.