STATE OF CALIFORNIA

AIR RESOURCES BOARD

AIR MONITORING QUALITY ASSURANCE

VOLUME V

AUDIT PROCEDURES MANUAL

APPENDIX B

PERFORMANCE AUDIT PROCEDURES USING DILUTION TECHNIQUES

TECHNICAL SERVICES DIVISION
AUGUST 1983

TABLE OF CONTENTS

APPENDIX B

PERFORMANCE AUDIT PROCEDURES
USING
DILUTION TECHNIQUES

FIGURES

STATE OF CALIFORNIA

AIR RESOURCES BOARD

AIR MONITORING QUALITY ASSURANCE

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PERFORMANCE AUDIT PROCEDURES USING DILUTION TECHNIQUES

TECHNICAL SERVICES DIVISION

AUGUST 1983

B.1.0 PROCEDURE

B.1.0.1 Introduction - Auditors use compressed gas cylinders of ultrapure zero air and high level concentrations of carbon monoxide (CO), methane or propane (CH4, C3H8), sulfur dioxide (SO2), nitric oxide (NO), and nitrogen dioxide (NO2) to conduct certain performance audits. Gas concentrations of these audit standards are traceable to National Bureau of Standards, Standard Reference Materials (NBS SRM5) or other authoritative standards. These high concentration compressed gas standards may be used until the pressure in the cylinder is approximately 500 psi.

The auditor uses certified mass flow controllers (MFC), a mixing chamber, zero air and the high concentration audit gases to prepare various concentrations of the pollutant(s) audited (Figure B.1.0.2). After the zero air and audit gases are blended the resultant ambient level concentration of pollutant gas is fed directly to an analyzer's sample inlet port through as much of the analyzer's normal sample inlet line as possible. Whenever possible the audit gas is fed directly into a site's sampling manifold and the analyzer is audited as if it were sampling ambient air (Figure B.1.0.1). Under these conditions special care is taken by the auditor to assure that audit gas flow rates to the sampling manifold and analyzer are adequate to supply the analyzer's needs while providing enough flow to backflush the sampling manifold and prevent audit gas dilution with ambient air.

Normally, zero and up to four upscale concentrations of audit gas covering the analyzer's operational range and meeting EPA's audit level concentrations are included in the audit. (See the Federal Register 40 CFR Part 58 Appendix A or Volume I of this Manual for the appropriate levels of audit gas concentrations). Procedures for processing the audit results are presented in Volume I of this Manual.

B.1.0.2 Preaudit Inspection - If necessary, conduct a preaudit inspection of the air monitoring site. Details concerning the preaudit inspection are given in Section 5.0.2.3 of this Volume. Special equipment needs should be noted on the preaudit inspection report.

B.1.0.3 Equipment - The basic equipment required for performance audits by dilution is listed below. Other equipment may be required depending upon the particular requirements of a site or analyzer.

1. A certified set of mass flow controllers (0-200 SCCM and 0-5000 SCCM) and/or a certified Dasibi Model 1009 gas phase titration system. Some audits will require the use of a dual mass flow controller and dilution chamber assembly (Figure B.1.0.2).

2. Compressed gas standards of the concentrations necessary to meet EPA's required audit ranges after dilution (see EPA's CFR Part 58, Appendix A or Volume I of this Manual). The minimum assay frequency of the compressed gas standards shall be:

    a. Three cylinder assays (two preaudit and one post audit) are required to determine a gas standard's mean value.

    b. Ultrapure zero air cylinders require a preaudit assay against laboratory zero air.

3. Specific regulators, fittings, and Teflon* lines, dedicated to each pollutant.

4. The following test equipment with calibration frequencies meeting or exceeding those presented in EPA guidelines are required:

    a. Digital volt meter with A/C adapter and test leads.

    b. An NBS certified precision thermometer.

    c. A Vol-o-Flo** laminar flow measuring device (0 to 3 liters), or equivalent.

5. A zero air generator (AADCO, or equivalent) capable of providing up to 15 SLPM of pollutant free zero air at 30 PSIG.

6. Audit log book and forms.

7. A tool kit.

8. Spare parts (stainless steel fittings, Teflon lines, Dasibi components, etc.).

9. Spare eight port sampling manifold (Figure B.1.0.1).

B.1.0.4 Audit Log Book and Report Form Entries - Record the audit information as required in Section 5.0.2.5.

B.1.0.5 Equipment Setup

1. Setup the dual mass flow controller test box, connect the unit to a 115 VAC power source and turn the unit on. Allow approximately one hour stabilization time (see Figure B.1.0.2).

* Trade Mark DuPont Corporation
** Registered trademark of CME, Inc.

2. Connect an ultrapure air cylinder with a CGA 590 pressure regulator to the air mass flow controller inlet which will be used to verify the purity of the pure air generator air supply.

3. Connect the pure air generator to a 115 VAC power source, turn the unit on and allow it to stabilize.

4. Connect the compressed gas cylinder (CO, CH4, C3H8, SO2, NO or NO2) with the appropriate pressure regulator to the gas mass flow controller inlet.

5. Connect the digital volt meter in parallel with the analyzer's signal output. If possible, use the AC adapter to conserve the volt meter's internal battery.

6. The audited analyzer should receive the audit gas(es) in the same manner as it receives the ambient sample. The audit concentration must enter through the analyzer's sample inlet port after passing through as much of the ambient sampling inlet line as possible.

B.1.0.6 Audit Procedure

1. Connect the calibrated Vol-o-Flo to the sample inlet line of the analyzer to be audited. Determine the sample flow rate and record the flow rate in the log book and on the preliminary audit report form.

2. Disconnect the Vol-o-Flo and arrange the air monitoring sampling train to accept the audit gas (see Figure B.1.0.2). Adjust the air mass flow controller (MFC) so approximately 100 SCCM to 200 SCCM flow is shown on the bypass flow meter of the flow panel. Obtain a stable output of no less than 10 minutes duration. The audited agency's staff shall determine when a stable output is obtained and shall provide the auditor with the value of the analyzer's response to the audit gas. Record the value reported by the air monitoring staff member and the digital volt meter reading in the log book and on the preliminary audit report form.

3. Disconnect the ultrapure zero air cylinder from the zero air inlet of the control panel and attach the pure air generator line. Obtain a stable analyzer output (approximately 10 minutes) and record the chart and the digital display readings in the log book and on the preliminary audit report form.

4. Attach a pressure regulator to the appropriate compressed gas cylinder of CO, THC, SO2, NO or NO2. Connect the regulator outlet line to the control panel and set the pressure regulator to approximately 15 pounds.

5. Adjust the air and gas mass flow controllers to obtain an audit test concentration between 80% and 90% of the full scale range of the analyzer. Check for approximately 100 to 200 SCCM of bypass flow. If this bypass flow is not present, increase the air flow, and the gas flow if necessary, until it is obtained. Obtain a stable analyzer output as verified by an air monitoring staff member and then record the chart and digital volt meter readings in the audit log and on the preliminary audit report form.

6. Repeat Step 5 for those audit concentration levels shown in Volume I of this Manual and in EPA's Federal Register 40 CFR Part 58 Appendix A.

7. When auditing an NO/NO2/NOx analyzer, repeat Step 5 using a compressed gas cylinder of NO (NO2 free) to determine the converter efficiency. Where:

$$\text{Percent Converter Efficiency} = \frac{NO2}{NO} \times 100$$

NOTE: When a Dasibi Model 1009 is used, gas phase titration can determine the converter efficiency by titrating ozone with NO gas. The change in the NO and the NOx responses is compared to calculate the converter efficiency:

$$\text{Percent Converter Efficiency} = \left[1 - \frac{NOx}{NO} \right] \times 100$$

8. Disconnect the output line from the analyzer or manifold. Remove the pressure bypass vent line from the sample manifold (when applicable) and recap the port.

9. Remove the equipment from the site and complete the equipment inventory sheet.

B.1.0.7 Data Handling

1. Transmit the data from the log book to the Single Continuous Analyzer Audit/Accuracy Report and calculate the audit statistics.

2. After the results are calculated, have an independent check of your calculations.

3. Send copies of the Single Continuous Analyzer Audit/Accuracy report to the ARB quality assurance coordinator after completion of the audit. Note on the report that the results are preliminary. After the final report is complete, file a copy of the accuracy report in the ARB-QA file.

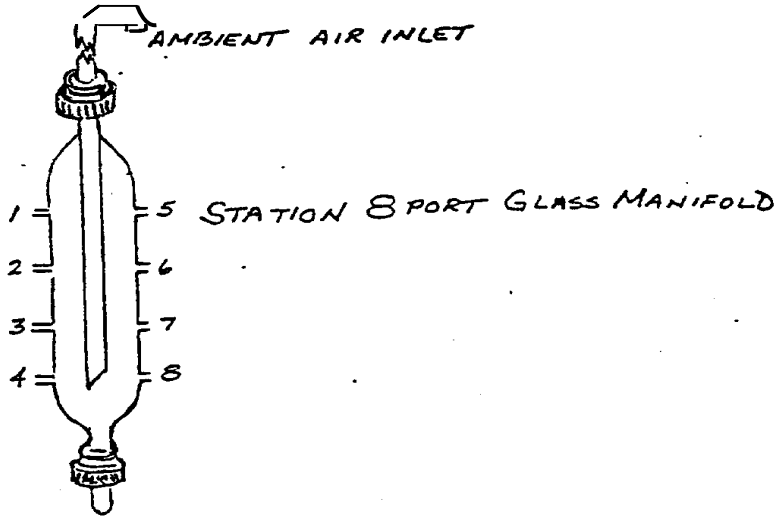

Figure B.1.0.1

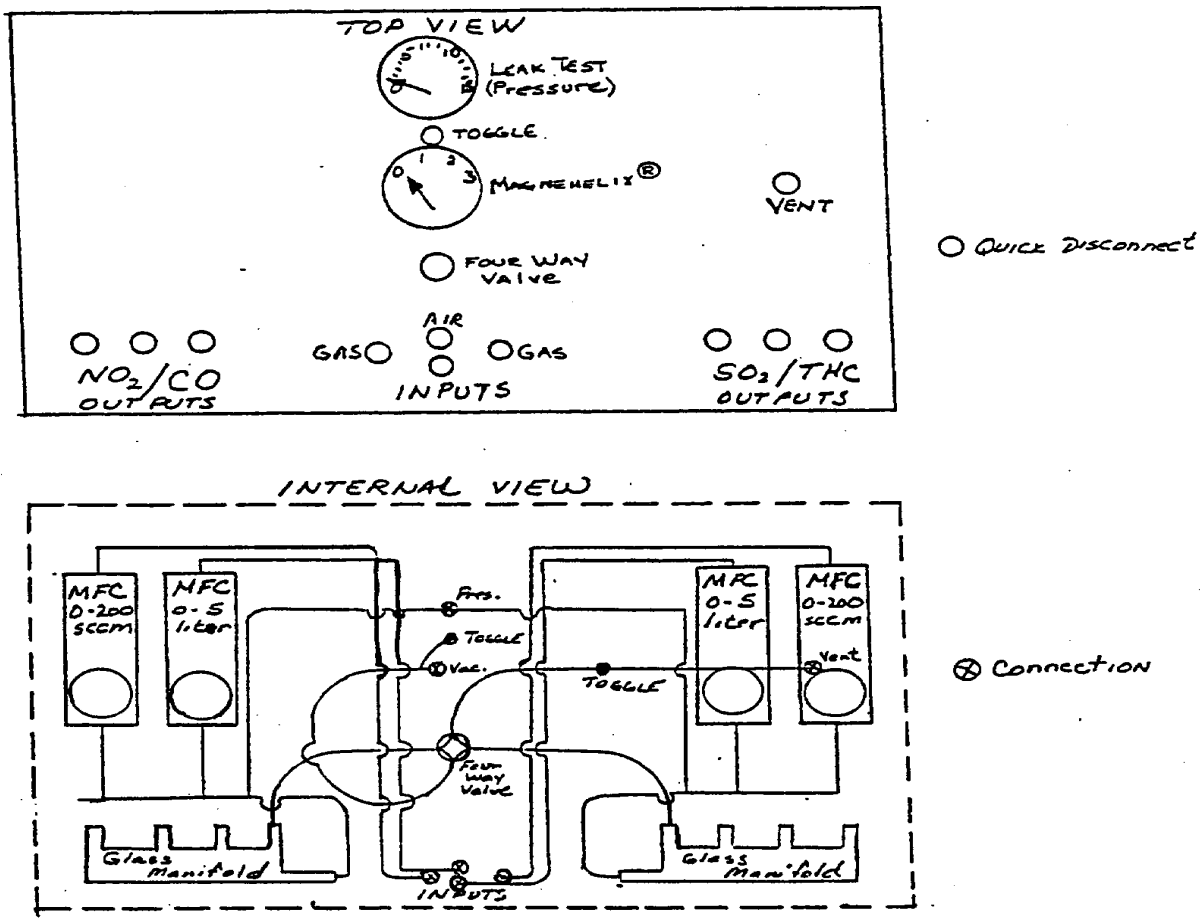

Figure B.1.0.2
Dual Mass Flow Controller Test Box