

Manual of Procedures
VOLUME V
Continuous Emission Monitoring
Policy and Procedures
TABLE OF CONTENTS

1. Introduction
2. Applicability
3. Instrumentation
 - 3.1. General
 - 3.2. Specifications
 - 3.3. Placement
4. Installation Schedules
 - 4.1. General
 - 4.2. Submittal of Plans and Specifications
 - 4.3. Proof of Intent to Purchase
 - 4.4. Completion of Installation
 - 4.5. Completion of Testing Requirements
5. Operation
 - 5.1. General Requirements
 - 5.2. Calibration
 - 5.3. Maintenance
6. Testing Requirements
 - 6.1. Performance Specification Tests
 - 6.2. Field Accuracy Tests
7. Records Retention

8. Reports
 - 8.1. Performance Specification Test Report
 - 8.2. Field Accuracy Test Report
 - 8.3. Report of Excesses
 - 8.4. Monthly Emissions Report

APPENDICES	Pages	
A.	*	Test 1 - Opacity
B.	*	Test 2 - Sulfur Dioxide and Nitrogen Oxides
C.	*	Test 3 - Oxygen and Carbon Dioxide
D.	9-15	Field Accuracy Test Procedure
E.	16-17	Monthly Report Form

* See 40 CFR Part 60 Appendix B

CONTINUOUS EMISSION MONITORING

POLICY AND PROCEDURES

(ADOPTED 1/20/82)

1. Introduction

The purpose of this Volume of Manual of Procedures is to advise persons subject to the Regulations of the Bay Area Air Quality Management District of the requirements which must be met by continuous emission monitoring installations.

This volume is an elaboration of the requirements in the Regulations and has been adopted by the Board of Directors of this District. Persons failing to comply with its provisions will be subject to penalty action as provided for in the Health and Safety Code of the State of California.

2. Applicability

The procedures set forth in this Volume are applicable to the requirements for those monitors specified by District regulations. Generally, these regulations are designed to fulfill the requirements of State and Federal Law, i.e., Sections 42700 of the California Health and Safety Code along with California Air Resources Board Resolution 75-59 and Title 40, U.S. Code of Federal Regulations, Part 51, Appendix P and Part 60.

These documents are available to the public. Persons subject to these monitoring requirements are encouraged to obtain them and review their contents.

In addition to the above requirements, District Regulations provide that the "Air Pollution Control Officer (APCO) may require additional monitors where there is reason to believe a potential violation may exist or as a permit condition. For these monitors the maximum requirements would be those of paragraphs 5, 6, 7 and 8 of this volume (applicable to regulated monitors). Lesser requirements may be determined by the APCO on a case-by-case basis. For purposes of identification, monitors with reduced requirements will be referred to as "Category B Monitors" whereas all others are "Category A".

3. Instrumentation

3.1 **General:** The Air Pollution Control Officer (APCO) shall approve plans and specifications for monitor selection and placement.

Alternate monitoring requirements may be approved on a case-by-case basis for reasons of economic reasonableness, plant physical limitations, infrequent operations, technological feasibility or equivalence.

In some cases where gaseous monitors are installed it will be necessary to determine mass emission rates. Flow rate may be determined either by

installing a stack gas velocity monitor or by calculations. Any such calculations must be clear, easy to verify, and of demonstrated reliability.

All monitors on sources subject to an emission standard shall be equipped with an acceptable data recording system. Chart speeds and ranges on analog recorders shall be such that violations of the emission standard are readily discernible.

The instrument span shall be two to four times the anticipated stack concentration. If necessary to provide a clear record of any violations, the instruments shall be dual range with automatic attenuation and an event marker to indicate span on the chart recorder.

In certain situations it may be possible to use a single monitor on a combination of sources or, in the case of an extractive system, to use one monitoring system on multiple sources. The APCO will approve any such applications on a case-by-case basis.

3.2 **Specifications:** Factors taken into consideration when the APCO evaluates a proposed monitor installation will be the performance specifications shown in Appendices A, B, and C, if applicable, and the state of the art.

3.3 **Placement:** The monitoring location shall be such that a representative sample is obtainable. The APCO may provide alternates to these requirements in cases of hardship or physical impossibility.

4. Installation Schedules

Occasionally additional monitors may be required by written notification from the APCO, new regulations, or permit conditions. For the purpose of installation scheduling, the effective date shall be the date of the letter from the APCO, the date of adoption of the regulation, unless otherwise specified or the date of the authority to construct.

The following timetable shall apply to such installations, except in those cases where regulations or the issuance of a permit to operate provide a greater amount of time.

4.1 **Submittal of Plans and Specifications:** A person shall respond to the Air Pollution Control Officer in writing within 45 days from the date of notification that a monitor is required. Such response shall include the plans and specifications of monitor selection and placement-and shall include a descriptive brochure from the manufacturer containing performance specifications and an engineering drawing depicting the placement.

4.2 **Proof of Intent to Purchase:** Within 45 days of the date of notification by APCO of approval of plans and specifications, a person shall furnish the Air Pollution Control officer documentary proof of intent to purchase, in the form of a copy of a purchase order.

- 4.3 **Completion of Installation:** Within 180 days of submission of Intent to Purchase the Installation the preliminary field calibration shall have been completed; and the Air Pollution Control Officer so notified.
- 4.4 **Completion of Testing Requirements:** Within 45 days of completion of installation, all required tests shall have been completed and reported to the APCO. It may be preferable that part of the required testing be done by the manufacturer at the factory.
- 4.5 **Time Extensions:** For monitors which are mandated by regulations, time extensions shall be subject to variance requirements of the District Hearing Board. The Air Pollution Control Officer may, at his discretion, grant time extensions for other monitor installations.

5. Operation

- 5.1 **General:** Instrument malfunctions are to be reported on the monthly report indicating times, type and a brief description of the repairs. Periods of inoperation greater than 24 hours must be reported by phone to the District dispatcher by the following working day, followed by notification of completion of repairs. Repairs must be made as soon as possible. Downtimes in excess of fifteen consecutive days may be deemed a failure to monitor if adequate proof of expeditious repair is not furnished to the APCO.

A record shall be maintained for each monitor describing maintenance calibration and inspection.

The Source Test Section of this District will conduct periodic Field Accuracy Tests to assure proper maintenance and accuracy.

- 5.2 **Calibration and Span:** Daily calibration and span checks shall be made using procedures recommended by the manufacturer, except for velocity sensing instrumentation which shall be calibrated on a monthly basis. Daily records shall be kept and adjustments shall be made if the drift is greater than ten percent of the applicable emission standard or, if none applies, ten percent of span.

Calibration gases shall be traceable to NBS standards where such reference gases are available. Every three months from the date of manufacture, gases must be re-analyzed by the reference methods indicated in the Appendices. Gases shall not be used after their stated shelf life has expired. For extractive systems, the calibration gases must be introduced as close to the tip of the probe as possible.

- 5.3 **Maintenance:** All monitoring systems shall be maintained in a good state of repair. At the discretion of the APCO, either complete performance specification tests or field accuracy tests may be required after repairs have been made an the system.

6. Testing Requirements

Testing requirements depend on the type of monitor and source. Performance tests shall be conducted at the completion of installation and preliminary field calibrations. A copy of the test results shall be furnished to the APCO and one copy shall be retained in owners file.

- 6.1 **Performance Specification Tests:** Performance Specification Tests are detailed tests designed to insure that an instrument meets performance specifications for accuracy, zero and span drift, response time and stability. These tests are required on the following monitors on indicated sources.

<u>Monitor</u>	<u>Sources</u>
SO ₂	Fossil Fuel Fired Steam Generators, H ₂ SO ₄ plants
NO _x	Fossil Fuel Fired Steam Generators, HNO ₃ plants
O ₂ or CO ₂	Fossil Fuel Fired Steam Generators
Opacity	All

The applicable Performance Specification Test procedures are identical to EPA Performance Specification Tests 1, 2 and 3.

- 6.2 **Field Accuracy Tests:** Field Accuracy Tests are a portion of the Performance Specification Test which are designed to insure the accuracy of the monitoring system. They are applicable to all systems except transmissometers. The accuracy requirement is that the monitoring system must be within ± 20 percent or 10 percent of the applicable emission standard, or 5 percent of full scale where there is no applicable emissions standard, whichever is greater, when compared to the Field Accuracy Test Procedure. This means that not only the component monitors, but also, the resultant mass emission rate must meet this specification. Water monitors accuracy comparisons shall be based on dry gas percentage. The sampling facilities requirements of paragraph 1.2.4 of Volume IV of this Manual are incorporated herein by reference.

Field Accuracy Test Procedure is shown as Appendix D.

7. Records Retention

All persons subject to monitoring requirements must maintain a file of all pertinent information, emission measurements, system performance specification and field accuracy tests, calibration checks; adjustments and maintenance.

These records must be retained for not less than two years and made available to the APCO upon request. Source Test personnel may inspect them during periodic Field Accuracy Tests.

8. Reports

8.1 **Performance Specification Test Report:** This test is to be conducted by the person responsible for the installation. One copy of the test results is to be furnished to the APCO upon completion. The APCO will notify the person of the acceptability of the report.

8.2 **Field Accuracy Test Report:** This test may be conducted either by the person responsible for the monitor or the APCO. Copies of the test results are to be furnished by either party to the other upon completion of the test.

8.3 Report of Excesses

8.3.1 **Reporting Requirements:** Any indicated excess of any emission standard to which the stationary source is required to conform, as indicated by the monitoring device, shall be reported by the operator of the source by telephone to the District dispatcher within 96 hours after such occurrence. The report should include the nature, extent, cause and corrective action taken.

8.3.2 **Determination of Indicated Excesses of Gaseous Pollutant:** An indicated excess will be considered to have occurred if the average concentration over any clock hour exceeds the emission standard, except as follows:

1. Sulfur dioxide emissions from Sulfuric Acid Plants shall be averaged over the first four hours during start-up.
2. Hydrogen sulfide concentrations from petroleum refinery fuel gas systems shall be averaged over any continuous three hour period.
3. Reduced sulfur emissions are defined in Regulation 12-1-300.
4. ~~Sulfur dioxide emissions are defined in Regulation 9-1-305.2 Deleted Regulation.~~
5. During gas-oil fuel switches on fossil fuel fired steam generators, the nitrogen oxides emission standard (Reg. 9-3-301) for oil shall apply.
6. Oxygen correction factors as determined by diluent shall not apply during conditions of start-up or shut-down.

8.3.3 **Determination of Indicated Excesses of Opacity:** An indicated excess will be considered to have occurred if any cumulative period of one minute increments totaling more than three minutes within any clock hour was in excess of the opacity standard.

Where computerized data processing systems are used the APCO may approve alternate requirements.

- 8.4 **Monthly Monitoring Report:** The data from monitors required by this District will be used as proof of violations of applicable emission standards, to relate sources to ground level monitoring excesses and provide emission inventory information. Therefore, the emissions to be reported will vary with the type of monitor. The following is a list of the type of emissions that must be reported for each pollutant:

<u>Pollutant</u>	<u>Emission</u>
Opacity	Excesses only
NO _x	Mass Emission Rate (Ton/day) plus NO _x concentration at 3 percent O ₂ for Regulated boilers.
SO ₂	Average 24 hour concentration, maximum one hour concentration, mass Emission rate (Tons/day), and emissions based on production rate, where applicable
H ₂ S	Excesses only
TRS	In units prescribed by Regulation 12-1-300.

All concentration data is to be reported on a dry basis. A water monitor is not necessary for the dry basis calculation. Data from previous tests, process Parameters or calculations may be used.

In addition to the emission data, the monthly monitoring report shall include:

- a) The date and time identifying each period the system was inoperative, except for daily calibrations, and the nature of repairs.
- b) A summary of the excesses including a negative declaration if applicable.

The monthly calibration data on the flow sensor need not be reported and is to be kept available in files.

An example of the reporting format is shown as Appendix E.

This report is due within 30 days after the end of the month and shall be sent to the attention of the Technical Services Division.

Appendix D

**FIELD ACCURACY TEST PROCEDURE
FOR CONTINUOUS EMISSION MONITORS****1. Applicability**

- 1.1 This procedure is used to evaluate the accuracy of continuous mass emission monitoring systems for sulfur dioxide, nitrogen oxides, carbon monoxide, carbon dioxide, oxygen, hydrogen sulfide, or any other gaseous compounds whose monitoring may be required by the Bay Area Air Quality Management District. Both the accuracy of the gas species concentration analyzer and the accuracy of the stack gas flow rate monitor are tested.

2. Principle

- 2.1 A continuous gas sample, representative of atmospheric emissions, is extracted from the source and conditioned to remove moisture and particulate material. A small portion of the conditioned sample is passed through a continuous analyzer sensitive to the species of interest. The average concentration of the specie determined over 90 minutes is compared with a similar reading determined by the continuous emission monitoring system.
- 2.2 Carbon dioxide and carbon monoxide are analyzed by non-dispersive infrared spectroscopy (NDIR). Sulfur dioxide is analyzed by ultraviolet (UV) absorption spectroscopy. Oxides of nitrogen are analyzed as nitric oxide by chemiluminescent detection. Oxygen is analyzed by galvanic measurement at a sample/fuel cell interface. Petroleum refinery fuel gas monitors are tested by being referenced with a known NBS traceable standard H₂S span gas.
- 2.3 A pitot tube is used to measure the velocity pressure in the stack, from which the stack gas volumetric flow rate is calculated.

3. Interferences

- 3.1 The various analytical methods have potential interferences as described below.
- 3.1.1 Carbon dioxide - methanol, ethanol, and water. (No interferences exist with the analyzer mentioned in 5.1.1)
 - 3.1.2 Carbon monoxide - cyanocen methyl azide
 - 3.1.3 Nitrogen oxides - other nitrogen compounds (except ammonia)
 - 3.1.4 Sulfur dioxide - elemental sulfur, sulfur trioxide, carbon disulfide.
 - 3.1.5 Oxygen - halogens and halogenated compounds.
 - 3.1.6 H₂S - None
- 3.2 If interferences are anticipated with the use of any method herein, the Source Test Section of the BAAQMD should be consulted or else an alternate method(s) as described in MOP., Volume IV, Source Test Policy and Procedures shall be used.

4. Sampling Ports and Facilities

- 4.1 Sampling ports and facilities shall be provided for purposes of field accuracy tests of continuous monitoring systems according to the requirements of Sections 2.3 and 2.4 of "Source Test Policy" in the Manual of Procedures, Volume IV, Source Test Policy and Procedures.
- 4.2 Petroleum Refinery Fuel Gas systems only: A swagelock "T" system shall be installed prior to the monitor, to facilitate introduction of the standard span gas into the monitor. Also, the gas sampling system must be such that the gas sample can be diverted away from the monitor while the accuracy test is being performed.

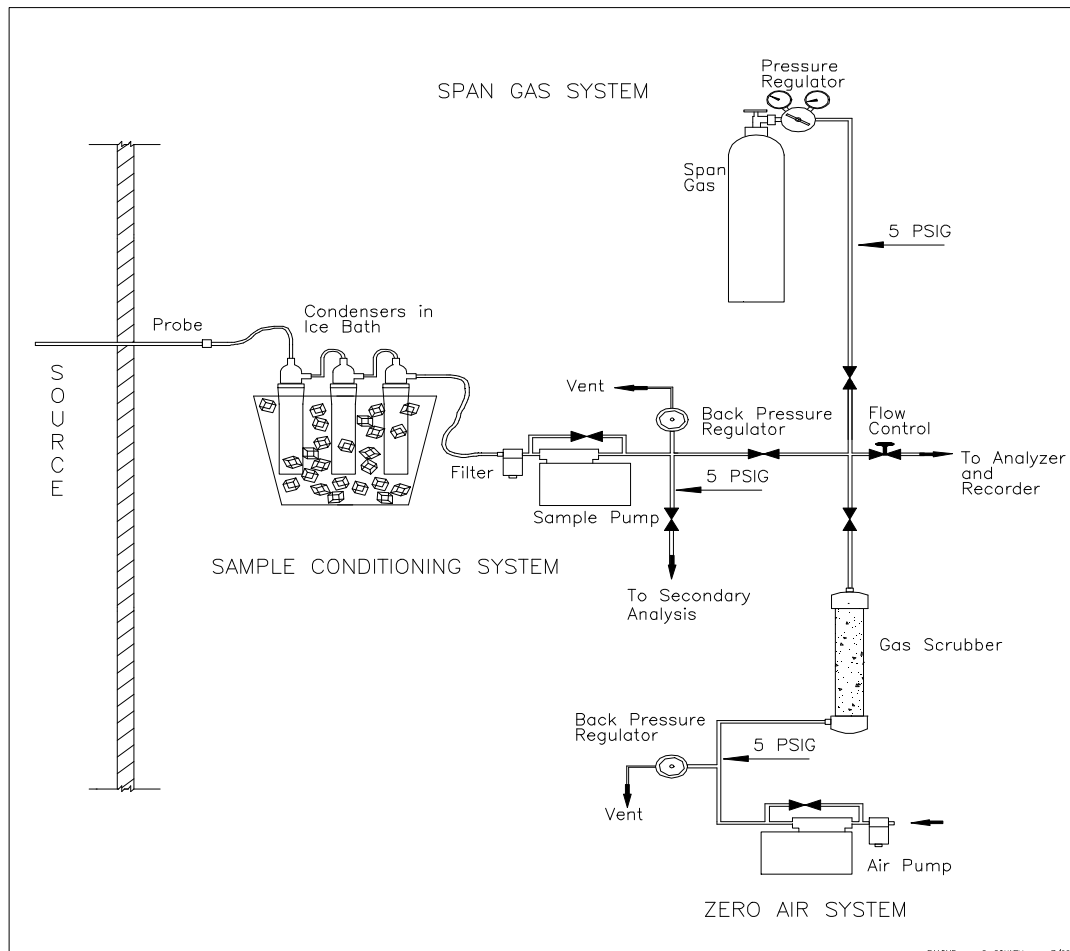
5. Apparatus

- 5.1 Instrumentation
 - 5.1.1 The analyzers, by test species, are indicated below.
 - 5.1.1.1 Carbon Dioxide - Use Infrared Industries Inc. Infrared Gas Analyzer Model 703, or equivalent.
 - 5.1.1.2 Carbon Monoxide - Use MSA Co. LIRA Model 202 carbon monoxide analyzer, or equivalent
 - 5.1.1.3 Oxides of Nitrogen - Use Thermo Electron Corp. Chemiluminescent Analyzer Model 10A or equivalent.
 - 5.1.1.4 Sulfur Dioxide - Use E.I. DuPont de Nemours and Co. Photometric Analyzer Model 400, or equivalent.
 - 5.1.1.5 Oxygen - Use Teledyne Analytical Instruments Model 326 Analyzer, or equivalent.
 - 5.1.2 Potentiometric recorder - The recorder monitors and records the continuous output from the analyzers.
- 5.2 Sample conditioning, zero air, and span gas system. (figure 1)
 - 5.2.1 Materials and construction - Except as specified, all valves, fittings, lines and other sample-contacting surfaces shall be Teflon or stainless steel.
 - 5.2.2 Sample probe - Use a borosilicate glass tube fitted at the downstream end with a tubing connector. The length of the probe shall be at least equal to the radius of the stack being tested. If stack temperature exceeds 800 °F, substitute quartz for the borosilicate tube. Other sample probes are acceptable subject to prior approval of the Source Test Section.
 - 5.2.3 Moisture condensers - Use modified Greenburg-Smith impingers with the impaction plate removed and the inlet tube shortened to 3 to 4 inches. At least two condensers shall be connected in series. Other condensers are acceptable if they are as efficient as impingers.
 - 5.2.4 Ice bath - Immerse the condensers in a ice bath during sampling.
 - 5.2.5 Particulate filter - Use a Balston type 95 holder with a grade B filter, or equivalent, in sample system.

- 5.2.6 Pumps - Use leak-free, Teflon-lined diaphragm pumps, Thomas Industries Model No. 908CA18TFE, or equivalent, in the sample and zero air systems. The pumps must have a free-flow capacity of at least 28 liters/min (1.0 CFM).
- 5.2.7 Back pressure regulator - Use a back pressure regulator to maintain sample and zero gas pressures to the analyzers at 5 psig.
- 5.3 Zero Air System (Figure 1)
- 5.3.1 This system provides clean, dry atmospheric air for analyzer calibration.
- 5.3.2 Gas scrubber - Use a bed of silica gel, Ascarite (or soda-lime), and charcoal to remove moisture, carbon dioxide, and hydrocarbons from the zero air system.
- 5.4 Span gas cylinder of appropriate species with inert balance at a concentration between 20 and 80 percent of full scale on the analyzer. The concentration shall be traceable to primary standards.
- 5.5 Velocity Measurement - Refer to Source Test Procedure ST-17, (M.O.P., Vol IV).

Figure 1

Sample Conditioning, Zero Air, and Span-Gas Systems



6. Pre-Test Procedures

- 6.1 Instrument warm-up - time shall be per manufacturer's recommendation or until stability is achieved.
- 6.2 Leak Test - the sampling system shall be leak-tested by turning on the sample pump, plugging the probe and ascertaining that the sample pressure to the analyzer falls to zero. Other leak tests are acceptable subject to prior approval by the Source Test Section.
- 6.3 Calibration, Zero - zero air shall be introduced at the manufacturer's recommended flow rate, and the analyzer shall be zero-adjusted, except the oxygen analyzer shall be adjusted to read 20.9 percent.
- 6.4 Calibration, Span - span gas shall be introduced at the rate in § 6.3, and the analyzer span shall be accordingly adjusted (except for the oxygen analyzer.)
- 6.5 Concentration Traverse - the stack shall be traversed with the probe to determine whether the concentration of any of the species of interest is radically variant. The probe shall be positioned at approximately 1/5, 2/5, 3/5, 4/5 and 5/5 of the stack diameter, long enough at each point to record a representative measure of the concentration of each species. If the concentration of any test species varies at any single point by over 10 percent of the average over all points, the stack shall be traversed during sampling according to paragraph 7.2.
- 6.6 Petroleum Refinery Fuel Gas Systems Only: The NBS traceable span gas used shall be quantitatively analyzed no later than three days prior to the testing of the monitor. Analysis shall be performed using a gas chromatograph equipped with flame photometric detector, or an equivalent method.

7. Sampling

- 7.1 Sampling shall be done continuously for a 90 minute period. The analyzer(s) shall be zero and span-checked at the beginning and end of the test period according to paragraphs 6.3 and 6.4.
- 7.2 If stack traversing is necessary (see paragraph 6.5) the traverse points shall be specified in Source Test Procedure ST-18 (M.O.P., Volume IV). Each traverse point shall be sampled for an equal length of time.
- 7.3 Petroleum Refinery Fuel Gas Systems Only: Sampling shall be done continuously for a thirty minute period after stabilization has occurred.
- 7.4 The continuous emission monitor shall not be adjusted during the test period.

8. Post Test Procedures

- 8.1 Petroleum Refinery Fuel Gas Systems Only: The NBS traceable standard H₂S span gas shall be quantitatively analyzed no later than three days after the performance of the monitor test pursuant to the method referenced in Volume V, Section 6.5 of the M.O.P.

9. Auxiliary Tests

- 9.1 Water Vapor - The moisture content of the stack gas should be measured once during the field accuracy test period according to Source Test Procedure ST-23 (M.O.P. Vol. IV) unless it is reliably known by other means.
- 9.2 Stack Gas Flowrate - The flow rate shall be determined according to Source Test Procedure ST-17 once during the test period. The exact time intervals during which the stack velocity pressure is measured shall be recorded on the stack flow rate monitor chart.

10. Calculations (each test period)

- 10.1 The calculations herein assume that the stack monitors report data at actual stack (wet) conditions.
- 10.2 The time-averaged (dry basis) test concentrations of each species, C_T , shall be computed.
- 10.3 The stack gas water vapor content, H (%), shall be computed as in Source Test Procedure ST-23.
- 10.4 The test standard dry stack flowrate, Q_O , shall be computed as in Source Test Procedure ST-17.
- 10.5 The time-averaged concentration (actual basis) of each species as measured by the continuous monitor(s), C_M , shall be computed.
- 10.6 The average monitor concentration(s) shall be changed to a dry basis as:

$$C'_M = \frac{C_M \times 100}{100}$$

- 10.7 The actual stack gas flow rate as reported by the monitor at the time of the velocity pressure test shall be corrected to standard, dry conditions as:

$$Q'_M = \frac{Q_M \times 530^\circ R \times P \times 100}{29.92 \text{ in.Hg} \times T \times (100 - H)}$$

- where: Q_M = actual stack gas flow rate as reported by monitor, CFM.
 P = stack static pressure, inches of Hg. (abs)
 T = stack temperature, °F.

10.8 Petroleum Refinery Fuel Gas Systems Only:

Take the average H_2S ppm concentration of the two analysis reports for the span gas, CT.

Obtain the average H₂S ppm concentration as per Volume V, Section 10.5: C_m; and Section 10.6, C'_m.

10.9 Percent Difference Calculation:

$$\% \text{ Difference} = \frac{C_T - C'_m}{C_T} \times 100$$

11. Reporting

11.1 The data indicated in Table 1 shall be reported for each test period and as the average of the test periods.

Table I - Field Accuracy Reporting Data

SOURCE INFORMATION		PROCEDURAL DATA
Firm Name and Address:	Source:	Daily zero and Span check made? Yes <input type="checkbox"/> No <input type="checkbox"/> Records maintained for 2 years? Yes <input type="checkbox"/> No <input type="checkbox"/> Gases acceptable? Yes <input type="checkbox"/> No <input type="checkbox"/>
Conditions During Test:	Monitor(s) Tested:	Test Methods Used:
	Parameters Tested:	

Test Results and Comments:

TEST METHOD RESULTS

SOURCE MONITOR RESULTS

RUN A RUN B RUN C AVG. RUN A RUN B RUN C AVG. % DIFFERENCE

Flowrate, SDCFM									
Water Content, %									
SO ₂ , ppm (dry)*									
SO ₂ , lb/hr									
NO _x , ppm (dry)**									
NO _x (as NO ₂), lb/hr									
CO ₂ , % (dry)									
O ₂ , % (dry)									
H ₂ S, ppm (dry)									

*Acid plant SO₂ concentrations are to be corrected to 12% O₂
Sulfur Recovery Unit SO₂ concentrations are to be corrected to 0% O₂

**NO_x concentrations are to be corrected to 3% O₂

COMMENTS:

Appendix E

MONTHLY CONTINUOUS EMISSION MONITORING REPORT

COMPANY:

SOURCE:

MONTH:

POLLUTANT:

I. EMISSION DATA

DAY	AVERAGE 24 HR CONCENTRATION, ppm	MAXIMUM 1 Hr CONCENTRATION, ppm	DAILY MASS EMISSION, TONS	EMISSION BASED ON PRODUCTION*
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				

* For Sulfuric Acid plants and Sulfur Recovery Units use pounds per short ton of production based on a daily average. This data requirement is not applicable to other sources or those emission points serving multiple sources.

II. STATEMENT OF EXCESS EMISSIONS
 (Negative declaration required, including Opacity)

DATE	TIME	DURATION	MAGNITUDE	REMARKS

III. MONITOR MALFUNCTION

DATE	TIME	DURATION	PROBLEM/CORRECTIVE ACTION

 Signature and Date