Air → 1999.01.18 Emissions Monitoring Program

Norlite Corporation

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February 9, 1999

Mr. Parag Amin
Environmental Engineer
New York State Department of
Environmental Conservation
Division of Solid and Hazardous Waste
50 Wolf Road
Albany, NY 12233

Re: Emissions Monitoring Protocol for Norlite's Annual Data Accuracy Assessment Program.

Dear Mr. Amin:

Please find enclosed one copy of the Emissions Monitoring Protocol for Norlite's annual Data Accuracy Assessment Program for your review and approval. Testing has been scheduled for March 16th - 18th, 1999.

If you have any questions or additional information is needed please feel free to contact me at (518) 235-0401 Ext. 4049.

Sincerely,

Norlite Corporation

Stan C. Milos

Stan C. Milos
Environmental Manager

cc: Jeffrey Gregg (NYSDEC)

EMISSIONS MONITORING PROTOCOL
NORLITE CORPORATION (KILNS 1 & 2) - COHOES, NEW YORK
CONTINUOUS EMISSIONS MONITORING SYSTEM (CEMS)
DATA ACCURACY ASSESSMENT PROGRAM

1ST QUARTER, 1999

Prepared by:
CEMServices Inc.
32 Taunton Avenue, P.O. 2147
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DATA ACCURACY ASSESSMENT PROGRAM

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Source Designation:
Norlite Corporation
Rotary Kilns No. 1 & 2
628 South Saratoga Street
Cohoes, New York

Concerning:
CEMS Relative Accuracy Test Audit
O2, CO CISCO CEMS

Prepared for:
Norlite Corporation
628 South Saratoga Street
Cohoes, New York

Prepared by:
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32 Taunton Avenue, P.O. 2147
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Sean M. MacKay
Manager, Environmental Services

January 18, 1999
Date

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1. INTRODUCTION

CEM Solutions of Hudson, New York and CEMServices of Norton, Massachusetts have been retained by the Norlite Corporation of Cohoes, New York to conduct a Continuous Emissions Monitoring System (CEMS) data accuracy assessment program on the primary and backup CEMS installed on Kilns No. 1 and 2 at the facility. The program is scheduled for the 1st quarter of 1999.

The Norlite Corporation operates two dry process rotary kilns (Kiln No. 1 and Kiln No. 2). Each of these kilns has an independent CEMS to monitor flue gas emissions. In addition, there are backup CEMS that monitor each kiln. The backup systems are identical to the primary systems and operate independently with the exception of sharing the data acquisition system with their respective primary systems. These CEMS monitor the Oxygen (O2) and Carbon Monoxide (CO) in each kiln's exhaust gas.

The objective of the data accuracy assessment test program is to determine the calibration error, response time and relative accuracy (RA) of these primary and backup CEMS as required by the Methods Manual for Compliance with the Boiler/Industrial Furnace (BIF) Regulations (40 CFR 266), Appendix IX, Section 2.0 - Performance Specifications for CEMS. The RA's will be determined by Relative Accuracy Test Audits (RATA's).

Table 1-1 indicates the air contaminants to be tested and the test methodologies to be used during the emissions test program. Table 1-2 indicates the emission limits and the allowable RA's for the facility.

TABLE 1-1
POLLUTANTS AND TEST METHODOLOGIES

Constituents	Test Methods
Oxygen (O2), Carbon Dioxide (CO2)	EPA Test Method 3A
Carbon Monoxide (CO)	EPA Test Method 10

TABLE 1-2
EMISSION LIMITS, ALLOWABLE RA'S AND PERFORMANCE SPECIFICATIONS

Parameter	Emissions Limit	Allowable RA	Calibration Drift 24 Hour	Calibration Error	Response Time
CO	100 ppmv @ 7% O2	10 % *	< 6 ppm low range < 90 ppm high range	< 10 ppm low range < 150 ppm high range	< 2 min (both ranges)
O2	N/A	N/A	< 0.5 %	< 0.5 %	< 2 min

1. INTRODUCTION (continued)

As specified in 40 CFR 266, CEMServices will conduct Reference Method (RM) tests to acquire emissions data for comparison to data generated by the facility's CEMS. Each RATA will consist of nine to twelve, twenty-one (21) minute test runs. This data will be used to calculate the Relative Accuracy (RA) of each facility monitor for the following units: O2 (%dv), CO (ppmdv @ 7% O2). The RA of each facility monitor will be calculated using the following equation:

$$RA = \{|d| + |CC|\} \times 100 / RM$$
$$CC = t \times S_d / (n)^{0.5}$$

Where:
RA = Relative Accuracy, percent
|d| = Mean absolute value of the differences between the CEMS and RM values
|CC| = Absolute value of the 2.5 percent error confidence coefficient
RM = Average Reference Method value or emission standard (or permit limit)
t = student t-value (2.5 percent error, one-tailed)
Sd = Standard deviation of the differences between the CEMS and RM values
n = number of data points (9)

Testing will be performed while the kiln's are operating at a minimum of 50 % of waste feed and/or shale feed capacity.

Sean M. MacKay, CEMServices Manager of Environmental Services, will be the Project Director for the RATA portions of this test program. He will be assisted by a qualified engineer. Mark Krizar, CEM Solutions Project Engineer, will be responsible for the calibration error tests, the response time tests, and the collection of facility CEM and operating data. Mr. Stan Milos of the Norlite Corporation is the facility contact and can be reached at:

Mr. Stan Milos
Norlite Corporation
P.O. Box 694
Cohoes, New York

(518) 235-0401

2. FACILITY DESCRIPTION

A. General

The Norlite facility produces an expanded shale lightweight aggregate in two dry process rotary kilns which are capable of firing liquid waste fuel, fuel oil, natural gas or a combination of these fuels.

Kiln No. 1 is manufactured by Fuller-Taylor and is steel shell lined with approximately six-inch refractory brick. The burn zone extends approximately 30 feet from the burner end of the kiln. The burning zone gas temperature is maintained at 2,200 °F to 3,000 °F. Kiln No. 2 is manufactured by Allis-Chalmers and is nearly identical in design, engineering, and constructions as Kiln No. 1.

Raw materials are quarried on-site, sized and transported to the kiln via trucks and a conveyor system, The basic material (shale) is proportioned and stored in a silo, or fed directly to the kiln. The raw product is introduced to the kiln at the feed (back) end. Calcination of the product occurs at a product temperature of 1,700 °F to 2,000 °F. The shale is then heated to the point of incipient fusion where it is in a semi-plastic state to expand internal gases, thereby creating voids. The cooled vitreous clinker is then discharged and stockpiled.

The rated capacity of the kilns are approximately 27 tons per hour (tph) clinker, however each unit is permitted for 22 tph maximum. Typically, 2.5 MMBtu are required to produce one ton of clinker at maximum capacity. Heat is supplied by firing No. 4 fuel oil, natural gas, waste oils and/or low grade fuel (LGF). All fuel is injected countercurrent to the product flow through the kiln by burners at the discharge (front) end of the kiln. Fuel firing rates typically range from 4 to 10 gallons per minute (gpm), depending upon the fuel energy content.

Each kiln has thermocouples mounted at the kiln gas exit and heat exchanger outlet for monitoring process temperature. Optical pyrometers monitor both flame and stone exit temperatures. LGF feed is monitored continuously with a Micromotion Doppler flow meter. Typical kiln exhaust gas and material retention times are 15 seconds and 45 minutes, respectively. Draft for each kiln is supplied by a Barrons 400 HP induced draft fan rated at 53,000 ACFM at 450 °F. Secondary combustion air is supplied by ford draft clinker cooler fans rated at a total of 25,000 CFM. The secondary combustion air is preheated by the clinker cooler at the front end of the kiln.

2. FACILITY DESCRIPTION (continued)

B. Test Locations

All RM testing will take place at the sampling locations of each kiln. These sampling locations are in close proximity to the facility CEM sample probes. The diameter of the steel ducts at these locations are four feet. The sample ports for the primary CEMS on Kiln No. 1 are located approximately 6.5 feet (1.6 diameters) downstream of a bend in the duct exiting the bag house and approximately 9.5 feet (2.4 diameters) upstream of an expansion joint prior to the ID fan. The sample ports for the backup CEMS sample probes are located approximately 9.3 feet (2.3 diameters) of a bend in the duct exiting the bag house and approximately 6.7 feet (1.7 diameters) upstream of an expansion joint prior to the ID fan.

The sample ports for the primary and backup CEMS sample probes on Kiln No. 2 are located approximately 11 feet (2.8 diameters) downstream of the exit of the bag house outlet duct and 5.75 feet (1.4 diameters) upstream of a 45 degree bend in the duct leading to the ID fan. The primary and backup probes are on opposite sides of the duct.

C. Facility CEMS

As a condition of the New York State Part 373 Hazardous Waste Permit, Norlite is required to operate a CEMS to monitor O2, and CO in each kiln's exhaust gas. Norlite's permit requires that they operate the CEMS in accordance with the applicable standards defined in 40 CFR 264, and 266. CEMS calibration checks are conducted daily using NIST traceable gas standards. In addition to the annual RATA, quarterly cylinder gas audits are conducted on each CEMS.

The extractive CEMS at Norlite was manufactured by Custom Instrumentation Services Corporation of Englewood, CO. The system measures and records dry undiluted concentrations of CO and O2 on the two kilns. To comply with the data availability requirements, two points in each stack are sampled with two sets of analyzers (CO and O2) on each stack. From this data, one database is created which, under normal operating conditions, has values for every minute in the hour. Table 2-1 is a description of the facility's monitors:

TABLE 2-1
FACILITY CEMS (KILNS 1 & 2)

Parameter	Manufacturer	Operating Principle	Ranges
O2	Siemens/Oxymat 5E	Paramagnetic	0-25 %
CO	Siemens/Ultramat 5E	Infrared	0-200, 0-3000 ppm (dual)

3. REFERENCE METHOD TEST PROCEDURES

A. Relative Accuracy Test Audit

The data accuracy assessment of the CEMS will be conducted using a Relative Accuracy Test Audit. This audit will consist of comparing data generated by the facility CEMS to data acquired simultaneously using US EPA reference test methods. Nine (9) to twelve (12), twenty-one (21) minute test runs will be conducted. All testing will take place at the stack sampling locations.

The clock time of the data acquisition system in the CEMServices mobile laboratory will be set exactly to the facility CEMS time. The start and stop time of each test run will be documented on the facility's data acquisition system. During each test run, all CEM and process operation data will be printed out. Load conditions will be well above fifty (50) percent of rated maximum during all RATA testing.

B. CEM Calibration Procedures - EPA Test Method 6C

Method 6C specifies the calibration procedures and requirements for the instrumentation methods (as well as the requirements for the determination of Sulfur Dioxide emissions from stationary sources). Before any testing is conducted, the analytic range of all test analyzers will be set up so that expected source emissions are at least thirty (30) percent of this range and do not exceed this range. Once this range is determined, calibration gases will be chosen within this range. Only gases prepared according to EPA Protocol #1 will be used.

Analyzer calibration error checks will be conducted by challenging each analyzer with a zero, mid, and high range gas. Analyzer responses to these gases will be within two (2) percent of the instrument's analytical range. Before and after each test run a sampling system bias check will be conducted on each monitor. This check consists of introducing the calibration gases at the base of the sampling probe thus allowing the gases to travel through the entire sampling system including the condensers used to remove moisture content. The analyzer responses to this check will be recorded onto field calibration sheets. All system bias check responses will be within five (5) percent of the instruments analytical range, when compared to the analyzer calibration error check conducted initially.

The sampling system bias check conducted prior to each test run will be compared to the sampling system bias check conducted at the completion of that same run. Differences between the two bias checks constitute the upscale and zero calibration drifts. All calculated calibration drifts will be below three (3) percent of the analytical range of the analyzer.

3. REFERENCE METHOD TEST PROCEDURES (continued)

Once the initial system bias check are conducted the system will be put into the sample mode and data acquisition will be initiated. The probe will be positioned at the first traverse point. The probe will be 5/8" stainless steel tube that will be traversed at 16.7%, 50.0%, and 83.3% of the stack diameter as follows:

TABLE 3-1
PS2 CEM RM TRAVERSE POINT LOCATIONS (KILNS 1 & 2)

Traverse Point #	% of Diameter	Probe Mark (inches)
1	16.7	8.0
2	50.0	24.0
3	83.3	40.0

Voltage output from each monitor will be documented by a strip chart-data logger in series with a Strawberry Tree Data Shuttle. The data shuttle sends all signals via a RS-232 cable to a computer for data archiving. Data points will be logged every two (2) seconds and averaged in one minute increments during each test run. At the test run completion, one minute averages will be automatically printed out and a calibration will be performed. Calibration values will be logged in the program and printed out with calculated bias and drift percentages.

Results from the initial and final system bias checks will be used to adjust the raw run average to correct it for any deviations due to the system bias. This data will be printed out in a format that lists the analyzers response to the gas, the bias, the drift, the raw run average, and the corrected run average.

C. Carbon Monoxide - EPA Test Method 10

Method 10 is used for the determination of Carbon Monoxide emissions from stationary sources using instrumental analyzer procedures. Because Method 10 procedures are much less stringent than Method 6C, all calibration procedures and requirements will be conducted according to EPA Test Method 6C to improve data quality.

A Thermo Environmental Model 48 Gas Filter Correlation (GFC) analyzer will be used to continuously sample the CO concentrations in the gas stream. GFC spectroscopy is based on the comparison of the infrared (IR) absorption spectrum of the measured gas to that of other gases in the sample being analyzed.

3. REFERENCE METHOD TEST PROCEDURES (continued)

This technique is implemented by using a high concentration sample of the measured gas (i.e. CO) as a filter for the infrared radiation transmitted through the analyzer. Radiation from an IR source is chopped and passed through a gas filter alternating between CO and N2 due to rotation of the filter wheel. The radiation then passes through an interference filter and on to an absorption cell. The IR radiation exits the sample cell and falls on to an IR detector. The CO gas filter produces a reference beam which cannot be further attenuated by CO in the sample cell. The N2 side of the filter wheel is transparent to the IR radiation and thus produces a measure beam which is partially absorbed by CO in the cell. The chopped detector signal is modulated by the alternation between the two gas filters with is amplified and related to the concentration of CO in the sample cell. Other gases, which absorb the reference and measure beams equally, do not cause modulation of the detector signal leaving the GFC responding specifically to CO. With this in mind, there is no need for an ascarite trap (ascarite scrubs out CO2).

An interference check is performed on the CO analyzer (and all other analyzers) every six months in accordance with the interference check procedures described in EPA Method 20. In addition, an interference check is performed during each field use in the form of the calibration error test. Since the calibration gases go to all analyzers during the test, the CO response to nitrogen can be compared to responses to the mid and high level O2, CO2 blends. If the CO2 gas is interfering it will bias the CO result which should otherwise be reading near zero. All interference checks will be below the required allowable limit of 1% described in 40 CFR 266, Appendix IX, Section 2.1 (the limit is 2% in Method 20 of 40 CFR 60).

D. Oxygen and Carbon Dioxide - EPA Test Method 3A

Method 3A is used for the determination of Oxygen and Carbon Dioxide emissions from stationary sources using instrumental analyzer procedures. All calibration procedures and requirements for this instrumentation method are identical to those found in EPA Test Method 6C.

O2 content in the effluent will be determined by a Teledyne Model 326A monitor which utilizes a micro-fuel cell that consumes O2 from the atmosphere surrounding the measurement probe. The consumption of O2 generates a proportional electrical current. This current is then amplified and provides a signal output of 0-1 V DC which corresponds to a full scale range of 0-25 % O2.

A Fuji Model ZRH non-dispersive infrared analyzer is used to continuously measure the CO2 concentration in the effluent . The theory of operation for this analyzer is based on the principle that CO2 has a unique absorption line spectrum in the infrared region.

3. REFERENCE METHOD TEST PROCEDURES (continued)

The instrument consists of an infrared light source, a chopper, a measurement cell, and a detector. The infrared light beam emitted by the source passes through the measuring cell, which is filled with a continuously flowing gas sample. The light beam is partially absorbed or attenuated by the gas species of interest in this cell before reaching the front chamber of the detector. Both the front and rear chambers of the sealed detector are filled with a reference gas. The difference in the amount of light absorbed between the front and rear chambers are dependent of the concentration of the gas species of interest within the sample measurement cell. A pressure differential is thus created between the two chambers. This pressure difference is then observed as gas flow by the micro-flow sensor located in a channel connecting the two chambers. The resulting AC signal from the micro-flow sensor is rectified, amplified, and linearized into a DC voltage signal for output.

E. Calibration Drift, Calibration Error and Response Time Tests - Pt. 266, Appendix IX, PS 2

A calibration drift (CD) test will be conducted during the RATA test. While the facility is operating at normal conditions, the CD will be determined at twenty four hour intervals for seven consecutive days. For this test two calibration gases (zero and span) are introduced into the entire system. The CEMS response is recorded and subtracted from the gas value. The span gas values for the CO monitors will be 100-180 ppm for the low range (0-200 ppm) and 1500-2700 ppm for the high range (0-3000 ppm). For the O2 monitors the span gas value will be 12.5-22.5 %. The calibration drift may not exceed 3 % of span

The calibration error (CE) test will consist of challenging the facility CEMS with EPA Protocol 1 gases at three measurement points within both ranges of the analyzers corresponding to zero (0 to 20 % of span), mid (30-40 % of span) and high (70-80 % of span) level gases. The mean difference between the CEMS response to these gases and the actual gas values may not exceed 5 % of span.

Response time of the facility CEMS measurement system will be determined by first introducing zero gas into the system at the calibration valve until the reading is stable (no change greater than 1 % of full scale for 30 sec); then the valve will be switched to sample to monitor the stack effluent until a stable reading is obtained. This will be the upscale response time. Next, the high level gas will be introduced to the system. Once the system has stabilized at this point, the system will be switched to sample mode to monitor the effluent until a stable reading is obtained. This will be the downscale response time. This procedure will be repeated three times at each range and the response time will be the "greater" of the times.

4. REFERENCE METHOD TEST EQUIPMENT

A. Mobile CEM Laboratory

All reference method test methods described in Section 3 will be conducted using the CEMServices mobile CEM laboratory. This laboratory consists of all analyzers and support equipment used to conduct the CEM sampling during this test program. The following is a description of each item that makes up the entire system:

Sample Probe - A stainless steel probe will be used for this test program. The probe has a filter at the end of it to remove particulate matter. The other end contains a heated "flood chamber" to allow either sample or system calibration.

Particulate Filter - This in-stack filter is a Labyrinth Systems 5 micron sintered stainless steel design.

Calibration Valve Assembly - This assembly consists of a Labyrinth Systems heated "flood chamber". Sample and calibration modes are actuated from a valve located in the CEM lab. The flood chamber consists of "T" valve assembly that connects the sample line, the probe, and the calibration line. During calibration, gas flows up the calibration line to the "flood chamber" and down the sample line. Excess gas is discharged out the probe cleaning the filter. This chamber will be heated to 250 degrees F, with a self regulating Omega heat bar.

Heated Sample Line - The heated sample line is ten (10) feet long and transports the gas sample from the CEM probe to the moisture removal system. This jumper is temperature self regulating and will maintain a temperature of 250 degrees F.

Moisture Removal System - This system continuously removes moisture from the sample gas while maintaining minimal contact between the condensate and the sample gas. CEMServices uses an ice bath condenser consisting of three (3) stainless steel heat exchangers which are continuously drained of condensate by two (2) peristaltic pumps. The inlet to the system is connected to the heated sample line and the outlet will be connected to the sample transport line.

Sample Transport Line - 3/8 inch OD Teflon tubing will be used to transport the gas sample from the moisture removal system to the mobile laboratory. Approximately one hundred and fifty (150) feet of tubing will be used.

4. REFERENCE METHOD TEST EQUIPMENT (continued)

Sample Pump - A dual headed diaphragm pump will be used to transport the gas sample through the system to the sample gas manifold. This pump is manufactured by Air Dimension and all parts coming into contact with the gas stream are either Teflon or stainless steel.

Sample Gas Manifold - This manifold consists of a series of valves and adjustable rotameters capable of setting and maintaining the desired backpressure and flow rate to the analyzers during both sampling and calibration.

Sample Gas Analyzers - CEMServices used the following analyzers to complete this test program:

TABLE 4-1
REFERENCE METHOD ANALYZERS

Gas	Manufacturer	Model	Serial #	Range
O2	Teledyne	326A	153157	0-25 %
CO	Thermo Electron	48	48-40156-262	0-200 PPM

Data Recorder - All voltage outputs from the analyzers are sent to a Molytek 2702 programmable datalogger. This datalogger accepts up to thirty-two (32) inputs and can be programmed to trend all inputs at any scale. The chart from the Molytek serves as the backup hard copy of all run times, and raw data. In series with the Molytek is a Strawberry Tree Data Shuttle. This shuttle logged data a two second intervals. Data from the shuttle is sent to a computer where a Strawberry Tree data acquisition program lists instantaneous concentration values for each parameter. At the conclusion of each run, one minute averages are printed out and a calibration is initiated through the program. The calibration data is used to correct the raw averages for system bias and drift.

C. Calibration Gases

All calibration gases used in this test program will be prepared according to EPA Protocol #1. As per EPA Test Method 6C for all O2 testing, all mid calibration gas values will be between 40-60 % of the analytical range of the analyzer, and all high calibration gases will be between 80-100 %. As per Method 10 for all CO testing the mid calibration gas will be approximately 30 % of the analytical range of the analyzer, and the high calibration gas will be approximately 60 %. The zero calibrations for all analyzers will be conducted using pre-purified grade Nitrogen.

4. REFERENCE METHOD TEST EQUIPMENT (continued)

TABLE 4-2
REFERENCE METHOD CALIBRATION GASES - RATA

Gas/Range	Allowable Values	Cal Point
O2 0-25 %	10-15 20-25	Mid High
CO 0-200 PPM	approx. 60 approx. 120 approx. span	Mid High Span

TABLE 4-3
CALIBRATION GASES - CALIBRATION ERROR TEST

Measurement Point	CO ppm		O2 %
	Low Range	High Range	
1	0-40	0-600	0-2
2	60-80	900-1200	8-10
3	140-160	2100-2400	14-16

5. QUALITY CONTROL PROCEDURES

A. General

Throughout all phases of this test program strict attention will be given to all testing to provide the highest quality of results possible.

All of CEMServices test equipment is of the highest quality available and undergoes routine maintenance to ensure top operating condition. This includes instruments, sample conditioners, sample lines, and probes.

Sampling will be conducted by trained personnel with extensive experience in source sampling. All sampling and analysis will be conducted in strict accordance with EPA test procedures (where available). The quality control procedures found in the EPA Quality Assurance Handbook for Air Pollution Measurement Systems will be adhered to as well.

Analyzer calibrations will be performed at the beginning of each test day. System calibrations will be performed before and after each test run through the entire sampling system.

As mentioned in Section 3, an ascarite trap is not needed for the GFC CO analyzers. However, an interference check is performed on the CO analyzer (and all other analyzers) every six months in accordance with the interference check procedures described in EPA Method 20. In addition, an interference check is performed during each field use in the form of the calibration error test. Since the calibration gases go to all analyzers during the test, the CO response to nitrogen can be compared to responses to the mid and high level O2, CO2 blends. If the CO2 gas is interfering it will bias the CO result which should otherwise be reading near zero.

All calculations will be conducted in strict accordance with the equations found in the individual Methods. Calculations will be conducted on a computer and the input data will be checked by a person other than the original calculator to ensure that it is correct.

The entire staff of CEMServices is thoroughly familiar with all test methods used in this program and has extensive experience in source emission monitoring.

APPENDIX A

Definition of Abbreviations

DEFINITION OF ABBREVIATIONS

ACFM	Flowrate, reported in actual cubic feet per minute.
An	Area of the nozzle, cross-sectional, in square feet.
As	Area of the stack in square feet.
BWO	Water vapor in gas stream, proportional by volume.
CC	Percent error confidence coefficient (one tailed).
Cd	Conversion calibration for concentration (PPMdv to lbs/SCF)
Cgas	Final emissions data reported by CEMS, adjusted for calibration drift. Reported as ppm dry, proportional by volume.
Cm	Average CEM response to initial and final span gas system calibration.
Cma	Concentration of the calibration gases.
Co	Average CEM response to initial and final zero gas system calibration.
Craw	Raw emissions data reported by the CEMS, uncorrected for calibration drift.
Cwet	Final emissions data reported by CEMS, adjusted for calibration drift and water vapor. Reported as ppm wet, proportional by volume.
% CO	Percent of carbon monoxide in the flue gas.
% CO_2	Percent of carbon dioxide in the flue gas.
Cp	Pitot tube coefficient.
Cs	The concentration in the stack in pounds per standard cubic foot.
Cs'	The concentration in the stack in grains per standard cubic foot.
Cs' @ 12%	The concentration in the stack in grains per dry standard cubic feet corrected to 12% CO_2.
DELTA H	The pressure differential across orifice meter, reported in inches of H_2O.
DELTA H(ABS)	The pressure differential across orifice meter, absolute conditions in inches of mercury.
Dn (IN)	Diameter of the nozzle in inches.
DGM IN	Temperature of the dry gas meter inlet, reported in degrees Fahrenheit.
DGM OUT	Temperature of the dry gas meter outlet, reported in degrees Fahrenheit.
Ds (FT)	Diameter of the stack in feet.
DSCFH	Dry standard cubic feet per hour.
DSCFM	Dry standard cubic feet per minute.
DSCMH	Dry standard cubic meters per hour.
E	Emission rate in pounds per million Btu using F Factor of fuel burned.
END METER	The dry gas meter reading at the end of the test.
F FACTOR	The theoretical amount of air in dry standard cubic feet (DSCF) needed to combust a million Btu's worth of fuel.
GR/BHP-HR	Grams per brake horsepower hour.
IMP(FIN)	Final volume of absorbing solution in impinger.
IMP(INT)	Initial volume of absorbing solution in impinger.
INT METER	The dry gas meter reading at the beginning of the test.
% ISO	Variation of sampling from isokinetic conditions.
LB/HR	Pounds per hour.
LB/MMBTU	Pounds per million British Thermal Unit.
LB/SCF	Pounds per standard cubic foot.
Md (DRY)	The dry molecular weight of the flue gas in pounds per pound mole.
Ml	Volume in milliliters.
Mg/M3	Milligrams per cubic meter.
Mn	Total particulate found in sample minus the acetone residue (blank). Reported in milligrams.
Ms (WET)	Wet or actual molecular weight of the flue gas in pounds per pound mole.
MW	Molecular weight
% N_2	The percent of nitrogen in the flue gas.
NO. PTS	Number of traverse points.

DEFINITION OF ABBREVIATIONS (continued)

% O_2	% oxygen in the flue gas.
P BAR	Barometric pressure at test location.
PIT COEFF	Pitot tube coefficient (S Type=.84, standard=.99).
PPM	Parts per million.
PPMdv	Parts per million - dry volume.
PPMwv	Parts per million - wet volume.
P STK	Static pressure of the stack in inches of water.
PMR	The pollutant mass rate in pounds per hour.
PS (ABS)	Absolute stack pressure in inches of mercury.
Pstd	Standard absolute pressure, (29.92 in. Hg).
Qs	The volumetric flow rate of the flue gas in dry standard cubic feet per hour.
RA	Relative accuracy.
RATA	Relative accuracy test audit.
RM	Reference Method.
Sd	Emission standard (allowable emission rate).
SQ ROOT	The square root of each velocity head measurement (Delta P).
SQRT DELTA P	The average of the square roots of the measured pressure drops.
Stack Temp	The temperature of the stack in degrees TS (°F) Fahrenheit.
TM (°F)	Average temperature of the dry gas meter in degrees Fahrenheit.
TM (°R)	Average temperature of the dry gas meter in degrees Rankine.
TS (°R)	The temperature of the stack in degrees Rankine.
VEL HEAD	The pressure drop measured across the pitot tubes.
VI (TOT)	The amount of water collected in the impingers in milliliters.
VM (CF)	The volume sampled through the dry gas meter in cubic feet.
VM STD	Volume sampled through the dry gas meter corrected to standard conditions.
VOC	Volatile organic compounds
VS	Velocity of the stack gas in feet per second.
VW STD	The amount of moisture collected, corrected to standard conditions.
Y	Dry gas meter calibration factor.

APPENDIX B

Sample of Calculation Sheets

EFFLUENT GAS CALIBRATION CORRECTION

FACILITY:
UNIT :
DATE :

RUN ID# :
START TIME:
END TIME :

O2 CO

Cma= ACTUAL CAL GAS

INIT ZERO
FINAL ZERO
Co = AVG ZERO
INIT UPSCALE
FINAL UPSCALE
Cm = AVG UPSCALE

Craw = RAW RM DATA

Cgas = ADJ RM DATA

PPM @ 7% O2

$$Cgas = (Craw - Co) * \frac{Cma}{(Cm - Co)}$$

PPM @ 7% O2 = Cgas * (20.9-7)/(20.9-O2)

RELATIVE ACCURACY CALCULATION SHEET

PLANT:
LOCATION:
TEST DATE:
PARAMETER:
UNITS:

RUN NAME									
RUN #	1	2	3	4	5	6	7	8	9
RM DATA									
PLANT DATA									
DIFFERENCE									
DIFF SQRD									

D = ARITH. MEAN

SUM DIFF

(SUM DIF)SQRD

SUM(DIF SQRD)

N = NUMBER OF RUNS

Sd = STANDARD DEV.

T.975 = T VALUE

CC = T.975 * Sd / SQRT(N)

CC = CONFIDENCE COE
PLANT AVERAGE =
RM = AVG RM DATA
ABSOLUTE DIFF. =
RA = (ABS(D)+ABS(CC)) / RM * 100

Sd = STANDARD =

RA = REL ACCURACY =

APPENDIX C

Sample of Field Data Sheets

ANALYZER CALIBRATION DATA

FACILITY: _____ DATE : _____

UNIT I.D : _____ START TIME : _____

OPERATOR: _____

SPAN VALUES:

O2	CO2	CO
PCT	PCT	PPM

Gas	Range	Actual Calibration Gas Value	Analyzer Calibration Response	Absolute Difference	Difference % Span
O2	Zero				
	Mid				
	High				
CO2	Zero				
	Mid				
	High				
CO	Zero				
	Mid				
	High				

Difference = Absolute Difference / Span X 100 (May Not Exceed 2%)

SYSTEM CALIBRATION BIAS AND DRIFT DATA

FACILITY: _____ RUN I.D. : _____

UNIT I.D : _____ RUN TIME : _____

DATE : _____

SPAN VALUES:

O2	CO2	CO
PCT	PCT	PPM

CALIBRATION INFORMATION:

GAS	Analyzer Calibration Response	Initial System Bias Response	Initial System Calibration Bias (% Span)	Final System Bias Response	Final System Calibration Bias (% Span)	Drift (% Span)
O2 ZERO						
O2 UPSCALE						
CO2 ZERO						
CO2 UPSCALE						
CO ZERO						
CO UPSCALE						

System Calibration Bias = (System Cal Response - Analyzer Cal) / Span X 100
Drift = (Final System Cal Response - Initial System Cal Response) / Span X 100

System Bias may not exceed 5%
Drift may not exceed 3%

APPENDIX D

Sample of Reference Method Calibration Sheets

INTERFERENCE RESPONSE TEST

Date: _____ CEM System: _____

Calibration Span and Gas Values:

	CO	SO2	O2	CO2	NOx
Span					
Gas Value					

Analyzer Type: _____

Serial # : _____

Test Gas Type	Concentration (ppm)	Analyzer Response (ppm)	% of Span

$$\% \text{ of Span} = \frac{\text{Analyzer Response}}{\text{Intrument Span}} \times 100$$

Interference may not exceed 2 % of span

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RESPONSE TIME

FACILITY : _____ UNIT : _____

DATE : _____ OPERATOR: _____

Span Gas Concentration : _____

Analyzer Span Concentration: _____

Upscale:

1 _____ seconds

2 _____ seconds

3 _____ seconds

Average Upscale Response: _____ Seconds.

Downscale:

1 _____ seconds

2 _____ seconds

3 _____ seconds

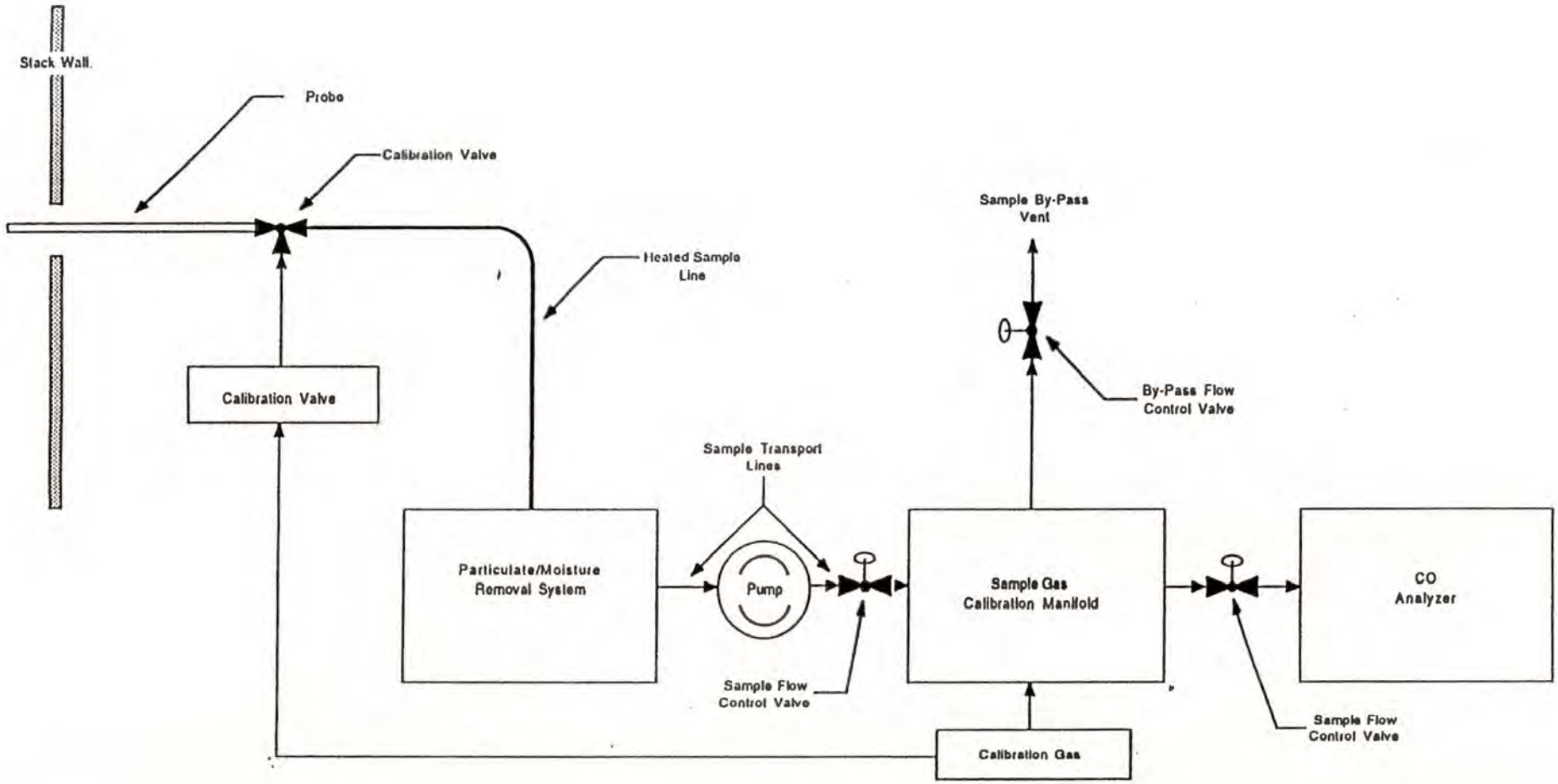
Average Downscale Response: _____ Seconds.

Average System Response: _____ Seconds.

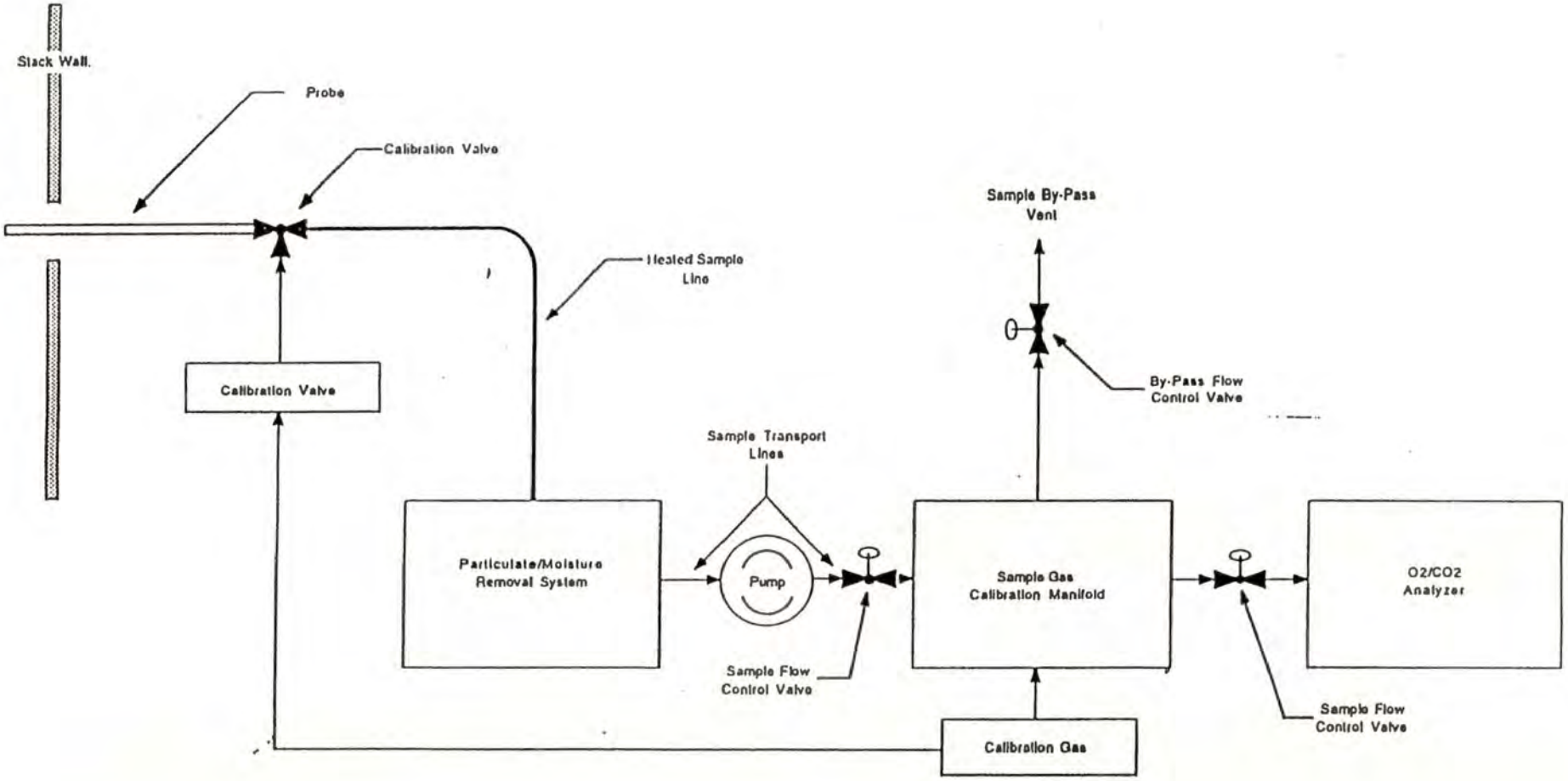
Slower Average Time: _____ Seconds.

APPENDIX E

Reference Method Sample Train Schematic



Schematic of EPA Method 10 Sampling Train



Schematic of EPA Method 3A Sampling Train

APPENDIX F

OUTLINE FOR PST REPORT

OUTLINE FOR PST REPORT

LIST OF TABLES

APPENDICES