VOC Emissions and TTE Evaluation Test Protocol

Container Life Cycle Management LLC
Temporary Total Enclosure (TTE),
Scrubber Inlets and Outlet,
Paint Bake-Off Oven Stack, and
Overspray Filter Exhaust
3950 South Pennsylvania Avenue
St. Francis, Wisconsin 53235
Protocol No. M173801

VOC Emissions and TTE Evaluation Test Protocol

Container Life Cycle Management LLC
Temporary Total Enclosure (TTE),
Scrubber Inlets and Outlet,
Paint Bake-Off Oven Stack, and Overspray Filter Exhaust
3950 South Pennsylvania Avenue
St. Francis, Wisconsin 53235

Protocol Submittal Date
July 21, 2017
Revised August 4, 2017
Revised August 18, 2017

Submitted By

Chris Jensen
Senior Project Manager
(630) 993-2100 Phone
cjensen@mp-mail.com, Email

Prepared for Container Life Cycle Management LLC

© Copyright 2017
All rights reserved in
Mostardi Platt

Protocol No. M173801

TABLE OF CONTENTS

1.0 INTRODUCTION ..... 1.
2.0 PROCESS DESCRIPTION 2
3.0 TEST REQUIREMENTS 3
4.0 SPECIFIC TEST PROCEDURES 3
5.0 TEST PROGRAM SCHEDULE 4
6.0 PROJECT PERSONNEL 4
8.0 TEST PROCEDURES 6
Volumetric Flowrate Determination 6
Oxygen (O_2)/Carbon Dioxide (CO_2) Determination 6
Moisture (H_2O) Determination 6
Methane (CH_4) Determination 7
Total Organic Concentration Determination 7
Enclosure Evaluation Determination 8
Natural Draft Openings (NDO) Distance to Emitting Point 8
Exhaust Point Distance from NDO 8
Total NDO Area 8
Velocity of Air Flow through NDOs 8
Direction of Air Flow through the NDO 8
9.0 QUALITY ASSURANCE PROCEDURES 9

GENERAL INFORMATION APPENDED:

Sample Point Location Diagrams
Test Train Diagrams
Data Sheets
Calculation and Nomenclature Sheets
Calibration Data

1.0 INTRODUCTION

The test protocol is an emission test program to determine the volatile organic compounds (VOC) emission rate from the Container Life Cycle Management LLC facility in St. Francis, Wisconsin while all connected processes are being operated in a manner that is consistent with normal operations.

As discussed with representatives of USEPA Region 5, all testing will be performed as described in the Code of Federal Regulations, Title 40, Part 60, Appendix A (40CFR60), Methods 1, 2, 3, 18 (methane only, if applicable), 25A, and Methods 204 and 204F, 40CFR, Part 51, Appendix M, and ASTM E337-02 and the latest revisions thereof. Where applicable, the Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods, USEPA 600/4-77-027b will be used to determine the precise procedures.

Testing will be performed simultaneously at the inlets and outlet of the wet scrubber/mist eliminator (C10), Paint Bake-Off Oven Stack, and Overspray Filter Exhaust to determine of total VOC emissions to atmosphere as well as to determine the effectiveness of the scrubber as a VOC removal device. The test report will include the information requested in section 20.g.ii of the April 5, 2017 114 request from USEPA Region 5.

Project Contact Information		
Location	**Address**	**Contact**
Technical Representative	366 Greif Parkway Delaware, Ohio 43015	Mr. Geoff Westphal EHS Manager-N.A. Work: 740-657-6616 geoff.westphal@greif.com
Facility Representative	Container Life Cycle Management LLC 3950 South Pennsylvania Avenue St. Francis, Wisconsin 53235	Mr. Mark Furgason Plant Manager Work: 414-483-8801 mfurgason@masdinc.com
Testing Company Representative	Mostardi Platt 888 Industrial Drive Elmhurst, Illinois 60126	Chris Jensen Senior Project Manager (630) 993-2100 (phone) cjensen@mp-mail.com

 © Mostardi Platt

2.0 PROCESS DESCRIPTION

The CLCM facility located at 3950 South Pennsylvania Avenue in St. Francis, Wisconsin reconditions both steel and plastic drums. USEPA Region 5 has requested certain information related to process conditions on the days of testing as follows:

a. VOC emissions should be influenced most heavily by two factors – drum processing rate and the characteristics of the residual material in the drums. During the actual test runs the facility will endeavor to maximize throughput of drums on each of the two lines (poly and steel).Based on historical operations maximum expected throughput will be approximately 220 drums per hour (steel drums) and 100 drums per hour (poly). The increased scrutiny and recordkeeping during testing could slow the process rates.

b. Because the St. Francis facility does not receive a steady and predictable supply of drums, for purposes of the September 2017 testing, the facility will pre-stage as many chemical drums as possible. The testing will likely be conducted across two days to avoid running out of drums during a test run. Each test run (three total) will be one hour in duration and the chemical drums will be staged ahead of each run. Before, after and between runs the facility may revert to non-chemical drums to maintain production.

c. A sample of the scrubber water will be taken during each test run and analyzed by ASTM Method 8260 to determine VOCs plus tentatively identified compounds (TICs) to express the scrubber exhaust on a VOC basis instead of the as-calibrated basis. Total hydrocarbon emissions will be determined in accordance with USEPA Method 25A, 40CFR60 with VOC emissions determined as ppm propane. Method 204F is used for determining the input of VOCs as a segment of liquid/gas protocols for determining VOC. The amount of VOCs introduced to the process (L) is the sum of the weight (W) of each VOC containing liquid used and its VOC content (V), corrected for RF. The Scrubber water samples will be analyzed for Response Factor determinations by USEPA Method 204F, 40CFR51, Appendix M.

d. During testing drums entering the process will be counted and photographed. The counts will be used to verify line speed and the photographs will be used – after the testing – to verify the nature of the drums original contents or origin. The processing rate for each test run and a summary of the drum information for each test run will be provided in the test report.

e. Drums shipped to the CLCM facilities are accompanied by “RCRA Empty” certifications from the suppliers. For the drums shipped directly to the St. Francis facility the certification sheets will be available on site. The small percentage of drums which are initially shipped to the Oak Creek facility and evaluated may come from multiple inbound loads where multiple certifications apply. For the drums intended for processing during testing, copies of all the applicable certifications will accompany the load. EPA is not requesting copies of these certifications be included in the stack test report – the copies will be available for inspection during testing.

 © Mostardi Platt

3.0 TEST REQUIREMENTS

The following table presents a list of the pollutants to be tested at each emission source and the applicable rules or regulations for each emission test:

Test Locations	Test Parameter	Method/Regulation Citation
Scrubber Inlets	VOC	USEPA Methods 1, 2, 3, 18 (methane only, if applicable), and 25A, 40CFR60, Appendix A; and ASTM Method E37-02
Scrubber Outlet		
Paint Bake-Off Oven Stack		
Overspray Filter Exhaust		
Building	TTE	USEPA Method 204, 40CFR51, Appendix M

4.0 SPECIFIC TEST PROCEDURES

Detailed test procedures are appended. Three complete test runs will be performed for each parameter in accordance with the following USEPA methods.

1. Volumetric flow will be determined utilizing USEPA Methods 1 and 2, 40CFR60 in conjunction with each emission test. A pretest and post-test volumetric flow will be performed and averaged for each VOC gaseous test run.

2. Oxygen (O_2) and carbon dioxide (CO_2) content of the gases will be determined by USEPA Method 3, 40CFR60 during each test run.

3. Moisture content of the gases will be determined using ASTM E337-02 during each volumetric flow test run.

4. Total hydrocarbon emissions will be determined in accordance with USEPA Method 25A, 40CFR60. Each test will be one hour long for VOC emissions with the emissions determined as ppm propane.

5. The Building Temporary Building Enclosure (TTE) will be evaluated to verify that it meets the criteria of USEPA Method 204, 40CFR51, Appendix M. The Scrubber Outlet, Paint Bake-Off Oven Stack, and the Overspray Filter Exhaust will be the only Building exhausts.

6. Paint samples will be analyzed for Response Factor determinations by USEPA Method 204F, 40CFR51, Appendix M, at the Paint Bake-Off Oven Stack.

7. The Scrubber water samples will be analyzed by ASTM Method 8260 to determine VOCs plus Tentatively Identified Compounds (TICs) to express the scrubber exhaust on a VOC basis instead of the as-calibrated basis.

8. Plant VOC emission rates will be determined from the combined Scrubber Outlet, Paint Bake-Off Oven exhaust, and Overspray Filter Exhaust measurements. Separately, the Scrubber will be evaluated for VOC control efficiency. Additional information regarding the characteristics of VOC present will be gathered by collecting a single canister grab sample

 © Mostardi Platt

of the exhaust from the scrubber during each test run and analyzed using Method TO-15 for VOCs.

9. Where applicable, the *Quality Assurance Handbook for Air Pollution Measurement Systems*, Volume III, Stationary Source Specific Methods, USEPA 600/4-77-027b is used to determine the precise procedures.

5.0 TEST PROGRAM SCHEDULE

Refer to plant submittals for specific dates.

Day	Task	On-Site Hours
1	Travel to plant, set up equipment, and evaluate TTE	8
2	Perform VOC emissions tests	8
3	Perform VOC emissions tests	11

All project days are considered weekdays and are scheduled between the hours of 7:00 a.m. and 6:00 p.m., unless otherwise stated.

6.0 PROJECT PERSONNEL

1 Senior Project Manager
1 Test Supervisor
2 Test Engineers
2 Test Technicians

7.0 PLANT REQUIREMENTS

Mostardi Platt must be supplied with the following items in order to complete this test program:

1. Safe access to test positions.
2. A minimum of two separate 110 V, 15 A circuits at each test location.
3. Two-inch test ports cleaned and loose prior to arrival of test crew.
4. Any scaffolding required to perform the tests.
5. Sufficient lighting at the test site.
6. Safety belts, if required.
7. Plant or pollution control equipment-operating data, if required for report.
8. Washroom facilities for use by members of the test crew.
9. Steady load during test period.
10. Communication between the test location and plant operations.
11. Parking location to place Mostardi Platt mobile trailer within 200 feet of sampling locations with access to multiple 110 V, 15 amp, 60-cycle, 220 V, 50 amp, 60-cycle circuits, or a 480 V welding receptacle.
12. Pre- and post-test scrubber water and coating samples and exact usage during each test run for emissions determinations.

 © Mostardi Platt

 © Mostardi Platt

8.0 TEST PROCEDURES

All testing, sampling, analytical, and calibration procedures used for this test program will be performed as described in the Title 40, *Code of Federal Regulations*, Part 60, Appendix A (40CFR60), Methods 1, 2, 3, 18 (methane only, if applicable), 25A, and, 40CFR51, Appendix M, Method 204, and ASTM E337-02 and the latest revisions thereof. Where applicable, the *Quality Assurance Handbook for Air Pollution Measurement Systems*, Volume III, Stationary Source Specific Methods, United States Environmental Protection Agency (USEPA) 600/R-94/038c, September 1994 was used to supplement procedures.

Volumetric Flowrate Determination

In order to determine emission rates on a lb/hr basis, the gas velocities and volumetric flowrates are determined using reference Method 2.

Velocity pressures are determined by traversing the test locations with S-type pitot tubes. Temperatures are measured using a K-type thermocouple with a calibrated digital temperature indicator. The molecular weight and moisture content of the gases are determined to permit the calculation of the volumetric flowrate. Sampling points utilized are determined using Method 1, 40CFR60.

Oxygen (O_2)/Carbon Dioxide (CO_2) Determination

O_2 and CO_2 gas content are determined at the test locations in accordance with Method 3, 40CFR60. This method collects samples in a grab or integrated manner and analyzes the samples using a Fyrite gas analyzer. Several passes of the gas are made during each run to ensure a stable reading. Mandatory leak checks are performed prior to and following each use. Chemicals are changed frequently and inspected for reactivity prior to each use.

Moisture (H_2O) Determination

Determining the moisture content in the gas stream is necessary to calculate the stack gas volumetric air flow on a dry basis and the emission rate in lbs/hr. For this purpose, Mostardi Platt will use American Standard Testing Method (ASTM) Method E337-02.

American Standard Testing Method (ASTM) Method E337-02 reapproved 2002, wet bulb/dry bulb measurements will be made at the test locations during each VOC sampling run and the water vapor content is calculated as follows:

$$Bws = \frac{e' - AP(t - t')}{P}$$

where:

e' = saturated vapor pressure of water, in. Hg, at the wet bulb temperature, t'

A = $3.67 \times 10^{-4}\,[1 + 0.00064(t' - 32)]$

P = absolute pressure, in. Hg, in duct

t = dry bulb temperature, °F

t' = wet bulb temperature, °F

 © Mostardi Platt

Methane (CH_4) Determination

The Method 18, 40CFR60, sampling and measurement system meets the requirements for stack sampling of gaseous organic compounds set forth by the United States Environmental Protection Agency (USEPA). In particular, it meets the requirements of USEPA Reference Method 18, "Determination of Gaseous Organic Compound Emissions by Gas Chromatography," 40CFR60, Appendix A. This method applies to the analysis of approximately 90% of the total gaseous organics emitted from an industrial source. The major organic components of a gas mixture are separated by gas chromatography, and methane is quantified by a flame ionization detector.

The gas chromatograph to be used during this program is a VIG 200 with a flame ionization detector. This instrument is calibrated using ultra-zero air, methane (CH_4) in nitrogen certified standards. The calibrations are performed before and after sampling with calibration checks performed each day. Sample times and locations are logged on integrator printouts.

Total Organic Concentration Determination

The Method 25A sampling and measurement system meets the requirements for stack sampling of volatile organic compounds (VOCs) set forth by the United States Environmental Protection Agency (USEPA). In particular, it meets the requirements of USEPA Reference Method 25A, "Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer," 40CFR60, Appendix A. This method applies to the measurement of total gaseous organic concentration of hydrocarbons. With this method, gas samples are extracted from the sample locations through heated Teflon sample lines to the analyzers.

The flame ionization detectors (FIDs) to be used during this program are VIG High-Temperature Total Hydrocarbon Analyzers. They are highly sensitive FIDs that provide a direct reading of total organic vapor concentrations with linear ranges of 0-10, 100, 1000, and 10,000 ppm by volume. The instruments are calibrated using ultra-zero air and propane in air EPA Protocol standards. The calibrations are performed before and after sampling with calibration checks performed between each test run. Sample times and locations are logged simultaneously on data loggers.

Calculations are performed by computer or by hand. An explanation of the nomenclature and calculations along with the complete test results is included in the appendix. Also appended are calibration data and copies of the raw field data sheets.

 © Mostardi Platt

Enclosure Evaluation Determination

A 100% Temporary Building Enclosure (TBE) must meet five (5) specific engineering criteria. The criteria are described in USEPA Method 204, 40CFR51, Appendix M. A summary of these items and the evaluation technique used are described below.

Natural Draft Openings (NDO) Distance to Emitting Point

Criteria: All NDOs such as open doorways, windows, etc. must be at least four equivalent NDO diameters from the nearest potential VOC emission point.

Technique: The dimensions of all NDOs and potential emission points are measured. The calculated NDO equivalent diameters are compared to the emission point distances measured.

Exhaust Point Distance from NDO

Criteria: Any exhaust point from the enclosure must be at least four equivalent hood or duct diameters from all NDOs.

Technique: The dimensions of all NDOs and potential emission points are measured. The calculated NDO equivalent diameters are compared to the exhaust point distances measured.

Total NDO Area

Criteria: The area of all NDOs divided by the total area of all walls, floor and ceilings in the enclosure (called the "NEAR" ratio in the procedure) must not exceed 0.05.

Technique: Actual measurements are used to determine a composite surface area of the room and the NDOs and the NEAR ratio is determined.

Velocity of Air Flow through NDOs

Criteria: The calculated face velocity through the NDOs must be greater than 200 fpm. This is defined as the total exhaust volume (in scfm), less make up air, divided by the area of all NDOs (in square feet).

Technique: The composite area of the NDOs (as determined above) is used along with the measured net exhaust volume, as determined by USEPA Method 2, 40CFR60, Appendix A, of the enclosure to calculate the face velocity or alternately, the static pressure of the enclosure is measured to determine if it meets the $\geq$ 0.007 inches H_2O criteria.

Direction of Air Flow through the NDO

Criteria: The direction of air flow through all NDOs must be into the enclosure.

Technique: Smoke tubes or paper streamers are used at each NDO to measure the direction of the air flow. A record of this data will be included on the scale drawing

 © Mostardi Platt

9.0 QUALITY ASSURANCE PROCEDURES

Mostardi Platt recognizes the previously described reference methods to be very technique-oriented and attempts to minimize all factors which can increase error by implementing its Quality Assurance Program into every segment of its testing activities.

Shelf life of chemical reagents prepared at the Mostardi Platt laboratory or at the jobsite does not exceed those specified in the above mentioned methods. In addition, those reagents having a shelf life of one week are prepared daily at the jobsite. When on-site analyses are required, the same person performing the analysis performs all reagent standardization daily.

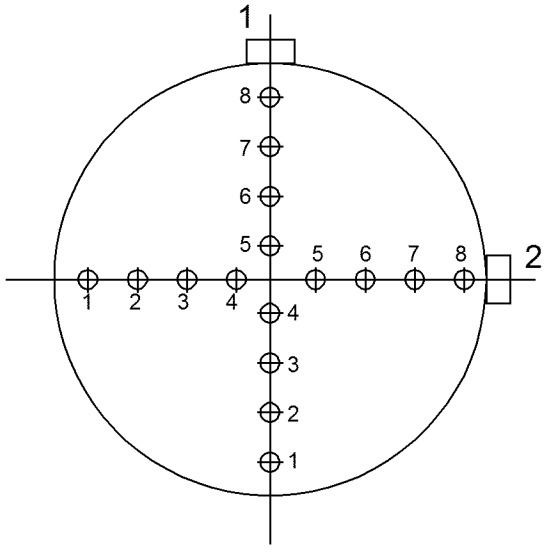
Dry and wet test meters are calibrated according to methods described in the *Quality Assurance Handbook for Air Pollution Measurement Systems*, Sections 3.3.2, 3.4.2 and 3.5.2. Percent error for the wet test meter according to the methods is less than the allowable error of 1.0%. The dry test meters measure the test sample volumes to within 2% at the flowrate and conditions encountered during sampling.

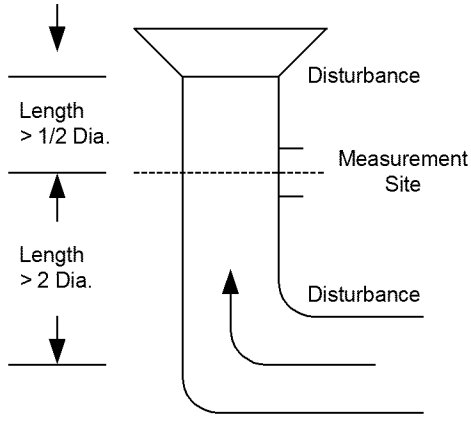
Calibration gases are EPA Protocol gases.

 © Mostardi Platt

APPENDIX

EQUAL AREA TRAVERSE FOR ROUND DUCTS





Job: Container Life Cycle Management LLC
St. Francis, Wisconsin

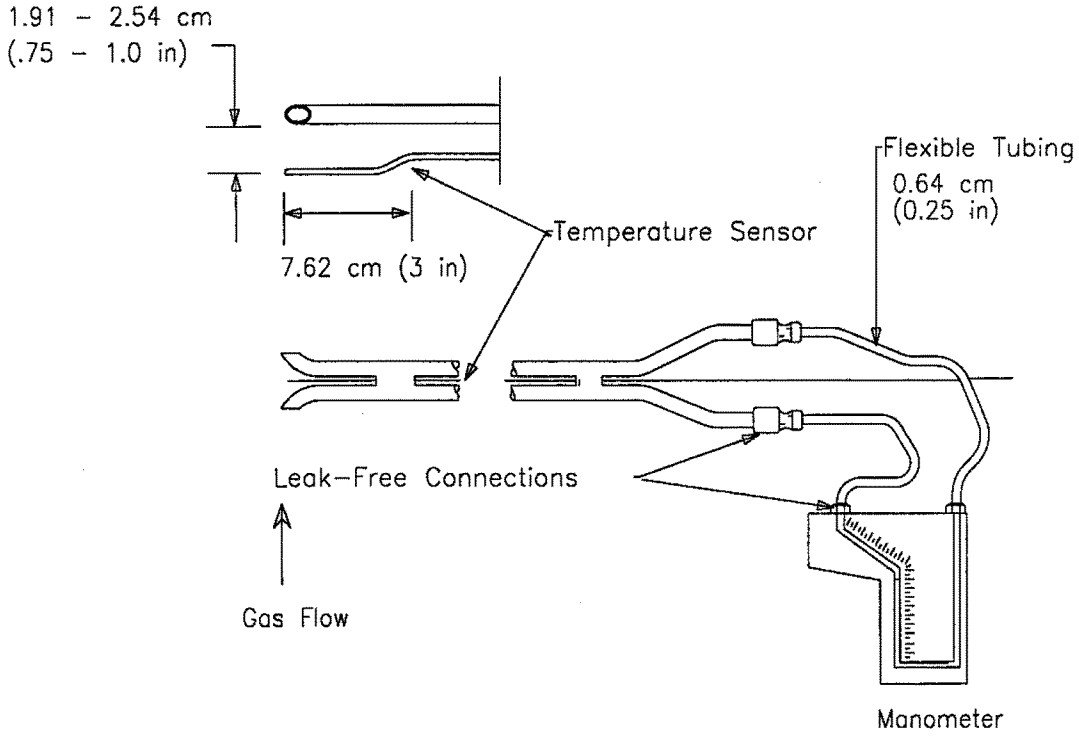
Date: TBD

Test Locations: Scrubber Inlets
Scrubber Outlet
Paint Bake Off Oven Exhaust
Overspray Filter Exhaust

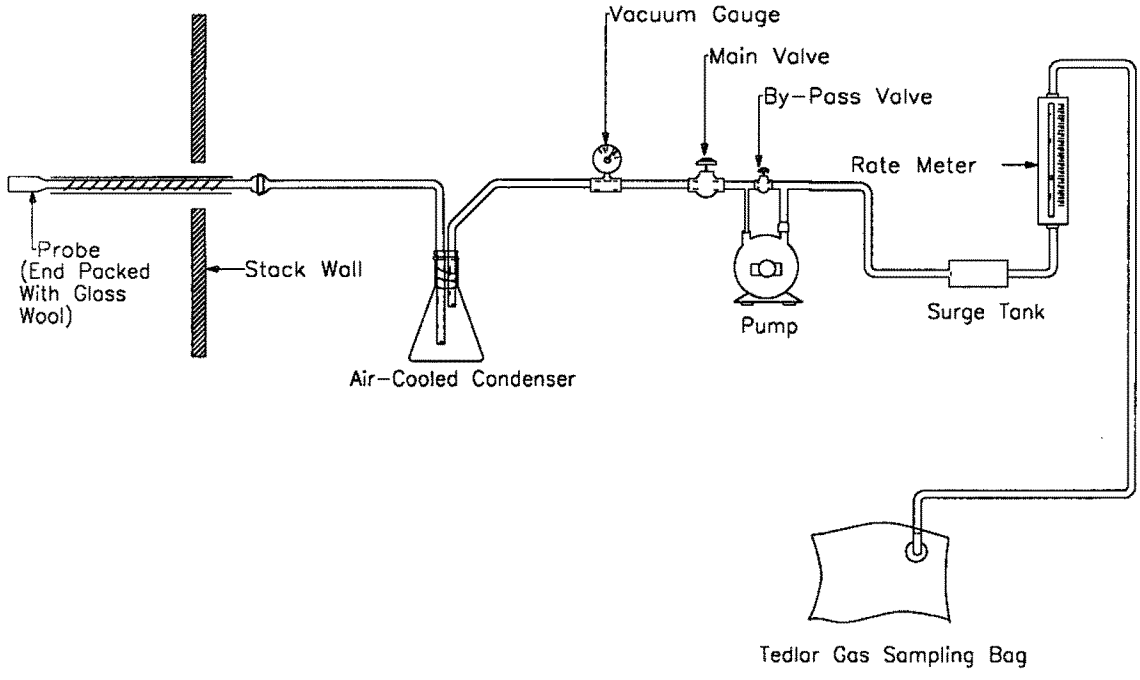
Stack Diameter: TBD

Stack Area: TBD

USEPA Method 2 - S-Type Pitot Tube Diagram

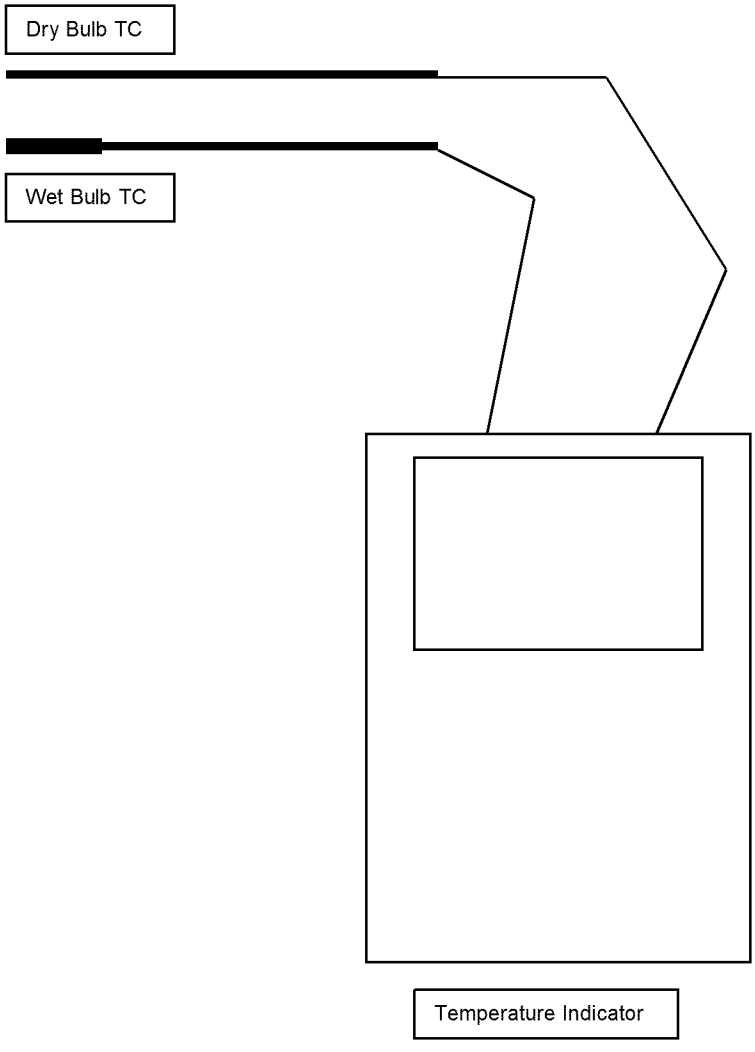


USEPA Method 3 - Integrated Oxygen/Carbon Dioxide Sample Train Diagram utilizing Fyrite Gas Analyzer

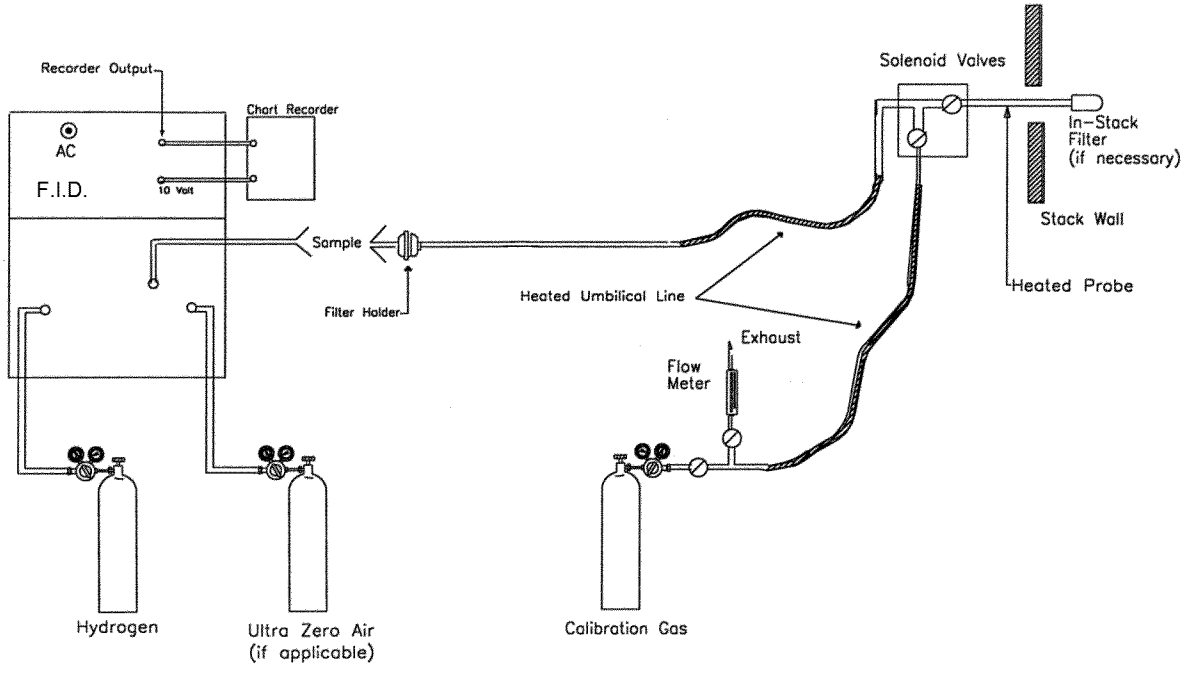


Moisture Determination

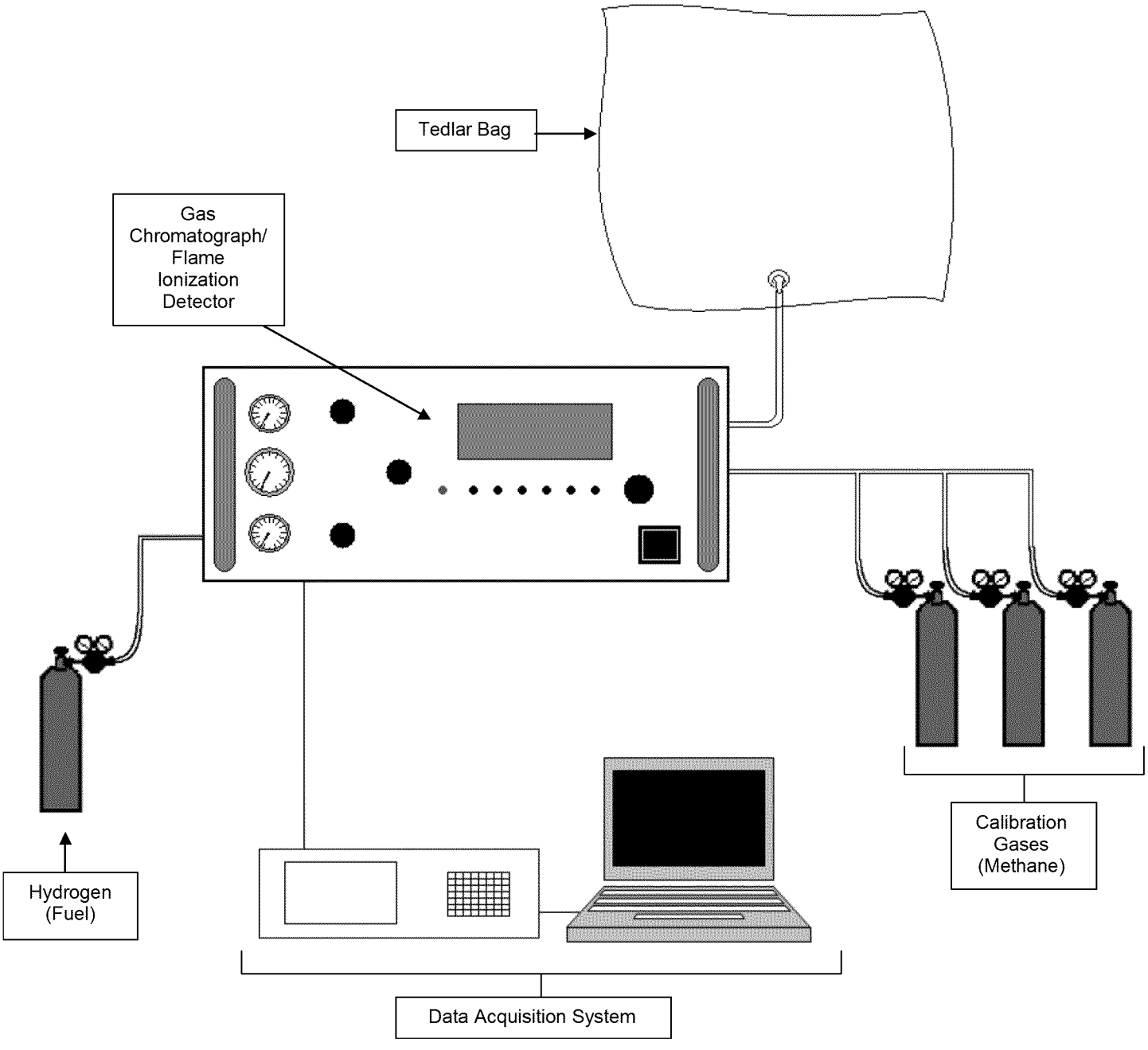
ASTM Method E337-02, Reapproved 2002



USEPA Method 25A -Total Gaseous Organic Compound Sample Train



USEPA Method 18 – Methane Using an Integrated Bag Sample



Volumetric Flow Rate Determination Field Data Sheet

Project Number: _____ Date: _____

Client: _____ Test Number: _____

Test Location: _____ Start Time: _____

Source Condition: _____ End Time: _____

Test Engineer: _____ Test Tech: _____

Duct Diameter _____ ft Upstream Disturbance, Diameters _____

Flue Area _____ ft^2 Downstream Disturbance, Diameters _____

Port Length _____ " Pitot ID_____ Pitot Coefficient (C_p) _____

P_{bar}_____ "Hg CO_2 % _____ Wet Bulb Temp _____ Leak Checks

Static_____ "H_2O O_2 % _____ Dry Bulb Temp _____ Pre _____

Static_____ "Hg N_2 % _____ B_{ws} _____ Post _____

P_s_____ "Hg Meter No._____

Port-Point #	ΔP	Temp. °F	$\sqrt{\Delta P}$	Null Point Angle, Degrees	Port-Point #	ΔP	Temp. °F	$\sqrt{\Delta P}$	Null Point Angle, Degrees
Average									

.44 x CO_2% + .32 x O_2% + .28 x N_2% = _____(Md)

(_____Md × _____1-Bws) + (18 ×_____Bws) = _____(Ms)

$$85.49 \times ____ Cp \times \sqrt{\frac{(_____)Ts\ °R}{____ Ms \times ____ Ps}} \times ____ \sqrt{\Delta P} = ____\ ft/sec\ (Vs)$$

_____ Vs × _____ Flue Area × 60 = _____acfm

$$17.647 \times _____ acfm \times \frac{Ps}{Ts\ °R} = _____\ scfm \times 60 = _____\ scfh$$

Method 25A Field Data Sheet

Project: _____ Operator: _____
Client: _____ Source: 1. _____
Location: _____ 2. _____
Date: _____ 3. _____

Parameters	Location 1	Location 2	Location 3
Test 1			
Time			
VOC ppmv as			
Air flow, scfm			
VOC lbs/hr as			
Removal Efficiency, %			
Test 2			
Time			
VOC ppmv as			
Air flow, scfm			
VOC lbs/hr as			
Removal Efficiency, %			
Test 3			
Time			
VOC ppmv as			
Air flow, scfm			
VOC lbs/hr as			
Removal Efficiency, %			

METHOD 204 ENCLOSURE DATA SHEET

Project: _____
Location: _____
Date: _____

Sketch enclosure, all ducts, NDOs and potential VOC emission points on accompanying page. Label all dimensions.

Enclosure Designation: _____ Process(es) Enclosed: _____
Control Devices (s): _____

NDO to VOC Emission Point

NDO	Dimensions	Area	Equivalent Diameter	VOC Emission Point	Distances		Pass/ Fail?
					Minimum	Actual	

$$\text{NDOs equivalent diameter} = \left(\frac{4 \times \text{area}}{\pi}\right)^{0.5}$$

$$\text{Minimum Allowed Distance} = 4 \times \text{Equivalent Diameter (NDO)}$$

NDO to Exhaust (TTE only)

Exhaust Point	Dimensions	Equivalent Diameter	NDO	Dimensions	Equivalent Diameter	Distances		Pass/ Fail?
						Minimum	Actual	

$$\text{Equivalent diameter} = \left(\frac{4 \times \text{area}}{\pi}\right)^{0.5}$$

$$\text{Minimum Allowed Distance} = 4 \times \text{Equivalent Diameter (NDO or Exhaust Point)}$$

METHOD 204 ENCLOSURE DATA SHEET (cont.)

Near Ratio [NDO Area/Total Enclosure Area]

NDO	Surface Area (FT^2)	Wall, Ceiling, or Floor Section	Surface Area (FT^2)
TOTAL NDO AREA=		TOTAL ENCLOSURE AREA=	

NEAR ratio:

$\frac{\text{NDOArea}}{\text{EnclosureArea}}$ =_____

Pass/Fail? _____

Velocity of Air through NDO (Volumetric Flow Method)

Exhausted Air			Make Up Air	
Exhaust Point	SCFM	Controlled? (Y/N?)	Make up point	SCFM
TOTAL			TOTAL	

total NDO area - _____ ft^2

$\frac{\text{Exhaust scfm - 1 make up scfm}}{\text{NDO area (ft}^2\text{)}}$ = _____ fpm

fpm should be ≥ 200

pass/fail? _____

Or,
Velocity of Air through NDO (Pressure Differential Method)

Pressure Differential across the enclosure =_____inches H_20
Pressure difference ≥ 0.007 inches H_2O
pass/fail?_____

METHOD 204 ENCLOSURE DATA SHEET (cont.)

Direction of Air through NDO

Checked by Smoke Tubes

NDO No.	Normally		Direction of Air Flow			NDO Required to be Normally Closed?	Direction of Air Flow (One Hour Verification)						
							Initial:	10 min:	20 min:	30 min:	40 min:	50 min:	60 min:
	Open	Closed	Into Enclosure	Out of Enclosure	Swirled		Actual Time:	Actual Time:	Actual Time:	Actual Time:	Actual Time:	Actual Time:	Actual Time:

***Check to verify that airflow was checked at top, bottom, middle, and both sides of enclosure.**

Status of doors and windows

Are all access doors and windows whose areas are not included as NDOs closed during normal operation?

☐ Yes ☐ No

Capture of VOC Emissions

Does all exhaust ductwork go to control (for PTE) or to a point where it can be measured (for TTE).

☐ Yes ☐ No

MOSTARDI PLATT

Volumetric Air Flow Calculations (Wet Bulb/ Dry Bulb)

$$Bws = \left[\frac{e' - AP(t - t')}{P}\right]$$

e' = saturated vapor presssure of water, in.Hg,
at the wet bulb temperature, t'
$A = 3.67 \times 10^{-4} \left[1 + 0.00064(t' - 32)\right]$
P = pressure, inches mercury, in the duct
t = dry bulb temperature, °F
t' = wet bulb temperature, °F
Bws = water vapor in gas stream proportion
by volume

$$Md = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + \left[0.28 \times (100 - \%CO_2 - \%O_2)\right]$$

$$MS = Md \times (1 - Bws) + (18 \times Bws)$$

$$Vs = \sqrt{\frac{(Ts + 460)}{Ms \times Ps}} \times \sqrt{DP} \times Cp \times 85.49$$

$$Acfm = Vs \times \text{Area (of stack or duct)} \times 60$$

$$Dscfm = Acfm \times 17.647 \times \left[\frac{Ps}{(460 + Ts)}\right] \times (1 - Bws)$$

$$Scfm = Acfm \times 17.647 \times \left[\frac{Ps}{(460 + Ts)}\right]$$

$$Scfh = Scfm \times 60 \frac{min}{hr}$$

acfm = actual cubic feet per minute
dscfm = dry standard cubic feet per minute
scfm = standard cubic feet per minute
scfh = standard cubic feet per hour

Cp = pitot tube correction factor
Ps = absolute flue gas pressure
Ms = molecular weight of gas (lb/lb mole)
Md = dry molecular weight of gas (lb/lb mole)

MOSTARDI PLATT

ppmv to lb/hr Conversion Calculations

1. $$\text{ppm } SO_2 \times 1.660 \times 10^{-7} = \frac{\text{lbs}/SO_2}{\text{scf}}$$

$$\frac{\text{lbs } SO_2}{\text{scf}} \times \frac{\text{scf}}{\text{min}} \times \frac{60 \text{ min}}{\text{hr}} = \frac{\text{lbs } SO_2}{\text{hr}}$$

2. $$\text{ppm } NO_x \times 1.194 \times 10^{-7} = \frac{\text{lbs}/NO_x}{\text{scf}}$$

$$\frac{\text{lbs } NO_x}{\text{scf}} \times \frac{\text{scf}}{\text{min}} \times \frac{60 \text{ min}}{\text{hr}} = \frac{\text{lbs } NO_x}{\text{hr}}$$

3. $$\text{ppm CO} \times 7.266 \times 10^{-8} = \frac{\text{lbs}/\text{CO}}{\text{scf}}$$

$$\frac{\text{lbs CO}}{\text{scf}} \times \frac{\text{scf}}{\text{min}} \times \frac{60 \text{ min}}{\text{hr}} = \frac{\text{lbs CO}}{\text{hr}}$$

4. $$\text{ppm } C_3H_8 \times 1.142 \times 10^{-7} = \frac{\text{lbs}C_3H_8}{\text{scf}}$$

$$\frac{\text{lbs } C_3H_8}{\text{scf}} \times \frac{\text{scf}}{\text{min}} \times \frac{60 \text{ min}}{\text{hr}} = \frac{\text{lbs } C_3H_8}{\text{hr}}$$

5. $$\text{ppm } CH_4 \times 4.164 \times 10^{-8} = \frac{\text{lbs}CH_4}{\text{scf}}$$

$$\frac{\text{lbs } CH_4}{\text{scf}} \times \frac{\text{scf}}{\text{min}} \times \frac{60 \text{ min}}{\text{hr}} = \frac{\text{lbs } CH_4}{\text{hr}}$$

MOSTARDI PLATT

Procedures for Calibration

Temperature Sensing Devices

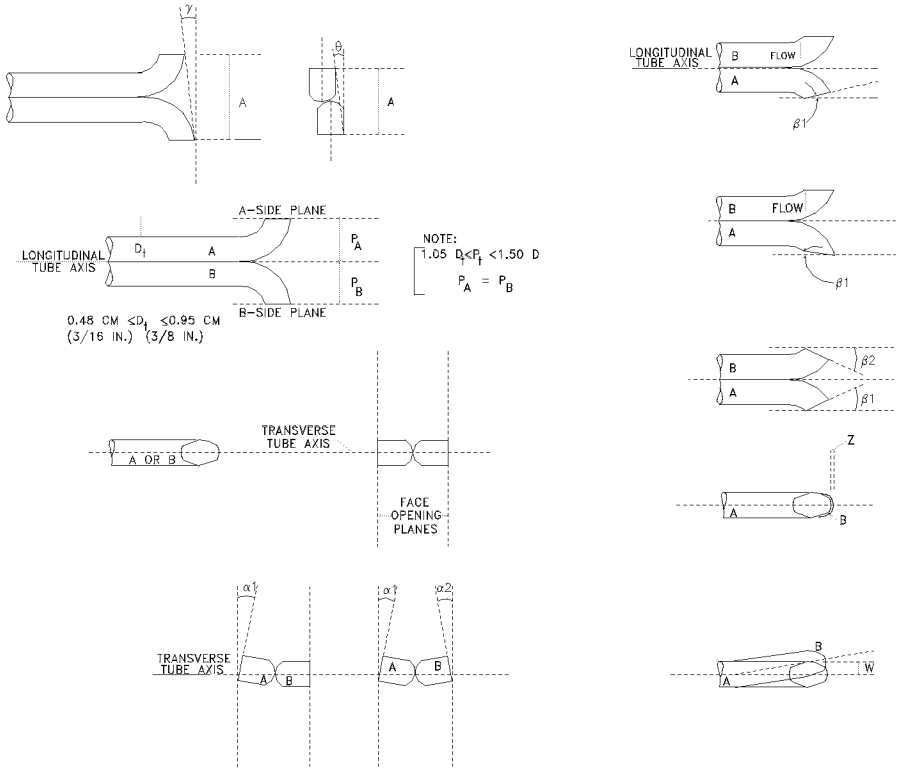
The potentiometer and thermocouples are calibrated utilizing a NBS traceable millivolt source.

Pitot Tubes

The pitot tubes utilized during this test program are manufactured according to the specification described and illustrated in the *Code of Federal Regulations*, Title 40, Part 60, Appendix A, Methods 1 and 2. The pitot tubes comply with the alignment specifications in Method 2, Section 4; and the pitot tube assemblies are in compliance with specifications in the same section.

S TYPE PITOT TUBE INSPECTION FORM

Pitot Tube Nc 1 Date: 10/10/2011 Inspectors Name: DTEM



Pitot tube assembly level? x yes _____ no

Pitot tube openings damaged? _____ yes (explain below) x no

a_1 = 1 ° (<10°), a_2 = 1 ° (<10°) z = A sin g = 0.008 (in.); (<0.125 in.)

b_1 = 0 ° (<5°), b_2 = 2 ° (<5°) w = A sin q = 0.025 (in.); (<0.03125 in.)

γ = 0.5 °, θ = 1.5 °, A = 0.938 (in.) P_A = 0.477 (in.), P_B = 0.477 (in.), D_t = 0.375 (in.)

Calibration required? _____ yes x no

Stack Temperature Sensor Calibration

Meter Box # : *CM1* *Name :* *BWH*

Ambient Temperature : *59* *°F* *Date :* *December 28, 2011*

Calibrator Model # : *CL23A*

Serial # : *T-276953*

Date Of Certification : *January 11, 2011*

Primary Standards Directly Traceable National Institute of Standards and Technology (NIST)

Reference Source Temperature (° F)	***Test Thermometer Temperature (° F)***	***Temperature Difference %***
0	*0*	0.0
250	*249*	0.0
600	*599*	0.0
1200	*1201*	0.0

$$\frac{(\text{Ref. Temp., °F} + 460) - (\text{Test Therm. Temp., °F} + 460)}{\text{Ref. Temp., °F} + 460} * 100 <= 1.5\ \%$$

Method 25A Calibration Summary

Project: _____ Date: _____
Client: _____ Operator: _____
Location: _____ Analyzer ID: _____
Analyzer Range: _____

Cal Run	Cal Level	Test Location	Cylinder ID Serial Number	Cal Gas Type	Cal Time	Expected Cal Value	Actual Response	Difference (% of cal value)	Drift (% of span)	Cylinder Pressure
Pre 1	Zero								N/A	
	Low								N/A	
	Mid								N/A	
	High								N/A	
Post 1/ Pre 2	Zero									
	Low									
	Mid									
	High									
Post 2/ Pre 3	Zero									
	Low									
	Mid									
	High									
Post 3	Zero									
	Low									
	Mid									
	High									
	Zero									
	Low									
	Mid									
	High									
	Zero									
	Low									
	Mid									
	High									