EMISSION TECHNOLOGIES, INC.
ENVIRONMENTAL EQUIPMENT & SERVICES

Sierra Pacific Industries
Dry Kiln

Engineering Testing for Filterable and Condensable Particulates

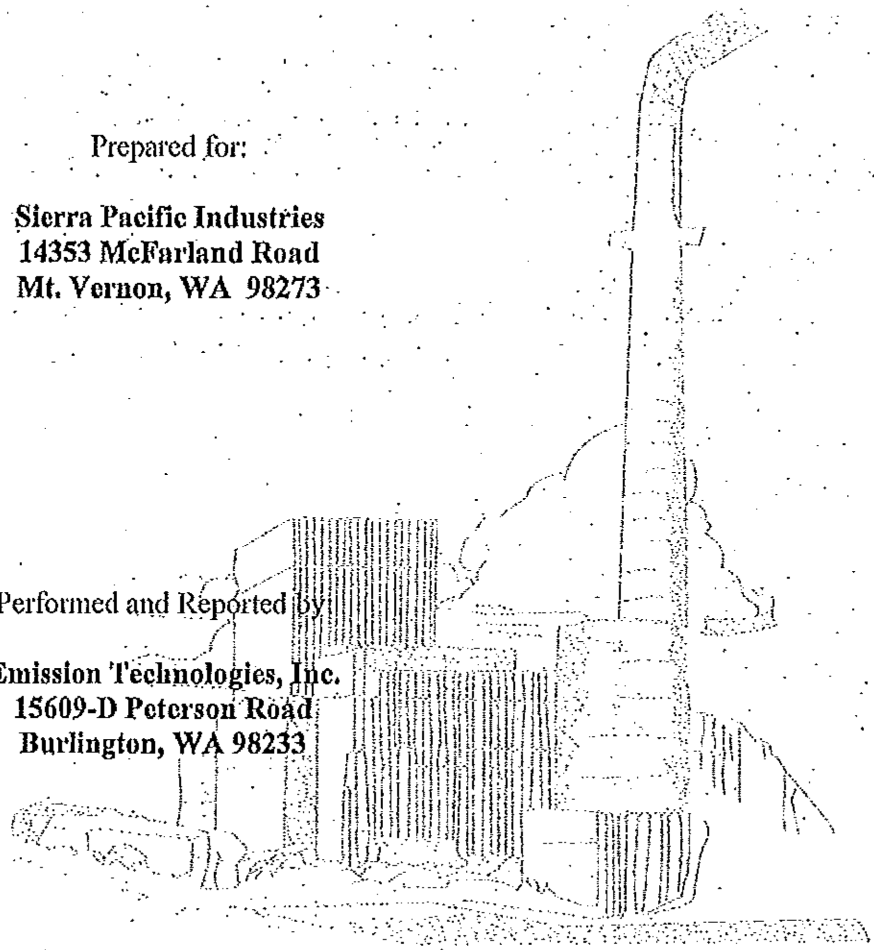
Report Number: 13-2447

Prepared for:

Sierra Pacific Industries
14353 McFarland Road
Mt. Vernon, WA 98273

Performed and Reported by:

Emission Technologies, Inc.
15609-D Peterson Road
Burlington, WA 98233



Report Certification

The emission testing for this report was carried out under my direction and supervision. In addition, I have reviewed all analysis and test results, and certify that the test and report meet EPA requirements and that, to the best of my knowledge, this test report is authentic and accurate.

Date: 3/20/2013 Signed: ______________________

Project Manager, QSTI 2012-655

Scott Chesnut

I have reviewed all analysis and test results, and certify that, to the best of my knowledge, this test report is authentic and accurate.

Date: 3-20-13 Signed: ______________________

Quality Assurance Manager, QSTI 2012-654

Wendy Pounds

Reproducing portions of this test report may omit critical substantiating documentation or be taken out of context so due care must be exercised in this regard.

Test Date: February 21-23, 2013

Date Issued: March 19, 2013

Emission Test Summary:

Source Name:	Sierra Pacific Industries
Test performed by:	Emission Technologies, Inc.
Emission/Process Unit:	Pilot Kiln
List Operational Parameters recorded during testing (e.g., Btu input, gallons loaded, steam production, % capacity, fuel feed rate, control device parameters, etc.):	
Regulation requiring test: ---------------------- Required frequency of test:	-- Engineering
Proposed Test Date(s): ---------------------- Actual Test Date(s)	February 21-23, 2013 -- February 21-23, 2013
Test Method(s): ---------------------- Modifications (if any):	US EPA Methods 1, 2, 3, 4, 5 & 202 -- Non-isokinetic, single point
Pollutant(s), units: ---------------------- Emission or concentration limit:	Total particulates; grains/dscf, lb/hr -- 0.00028gr/dscf 0.00026 lb/hr
Average Emission/Concentration: (include averaging time, correction if applicable)	0.00028gr/dscf 0.00068 lb/hr 0.00614 lb/Mbf
In Compliance (Y/N)	N/A

INVOLVED PARTIES:

Sierra Pacific Industries

Contact:
Curt Adcock
Division Manager
Sierra Pacific Industries
14353 McFarland Rd
Mt. Vernon, WA 98273

Phone; (360) 424-7619
Fax: (360) 428-6834
Email: cadcock@spi-ind.com

Emission Technologies, Inc.

Contact:
Robert Rusi
15609-D Peterson Rd.
Burlington, Washington 98233

Phone: (800) 507-9018
Phone: (360) 757-1210
Fax: (360) 757-1118
Email: ETI@stacktester.com

Table of Contents

List of Tables

List of Figures

1. REPORT TEXT

1.1 Purpose

Emission Technologies, Inc. (ETI) was contracted by Sierra Pacific Industries (SPI) to perform emissions tests on the exhaust stack of the pilot kiln located at the Chemco facility in Ferndale, Washington. SPI is using the pilot kiln to obtain emissions factors for particulate matter while drying hemlock lumber. The pilot kiln was used because all emissions from the unit could be vented out a single stack.

1.2 Test Overview

Testing was conducted from February 21-23, 2013 on the outlet stack of the pilot kiln. Environmental Protection Agency (EPA), Code of Federal Regulations, Title 40, Part 60 (40 CFR 60) Appendix A Methods 1, 2, 3, 4 and 5 were used to perform the filterable particulate matter (PM) test. Title 40, Part 60 (40 CFR 51) Appendix A Method 202 was used for condensable particulate matter. A single run was performed on the kiln exhaust. Table 1.1 presents the test protocol used.

Table 1.1 Test Protocol

Parameter	Test Method	Number of Runs	Run Time
Traverse Points	EPA 1	1	-
Stack Gas Velocity	EPA 2	1	53 hr
O_2 and CO_2	*EPA 3	1	53 hr
Moisture	EPA 4	1	53 hr
Filterable PM	EPA 5	1	53 hr
Condensable PM	EPA 202	1	53 hr

*Molecular weight is assumed to be that of ambient air

The entire kiln was encapsulated in an enclosure made of new polyethylene sheeting. A sheet metal exhaust stack extended above the enclosure and had a single sample port for measuring the particulates. Two inlets allowed ambient air to enter the kiln on the back of the enclosure.

Due to the extremely low exhaust gas velocity, all particulates were assumed to be less than 2.5 microns. The velocity pressure was measured using an Air Data electronic micromanometer.

1.3 Overview of the Sampling Methods

EPA Method 1 – Sample and Velocity Traverses

EPA Method 1 was used to aid in the representative measurement of pollutant emissions and/or total volumetric flow rate from the source. A measurement site where the effluent stream was flowing in a known direction was selected, and the cross-section of the stack was divided into a number of equal areas. A traverse point was then located within each of these equal areas. This method includes the procedure for cyclonic flow check.

EPA Method 2 - Determination of Stack Gas Velocity and Volumetric Flow Rate

This method is applicable for the determination of the average velocity and volumetric flow rate of a gas stream. The average gas velocity in a stack was determined from the gas density and from measurement of the average velocity head with a Type S (Stausscheibe or reverse type) pitot tube.

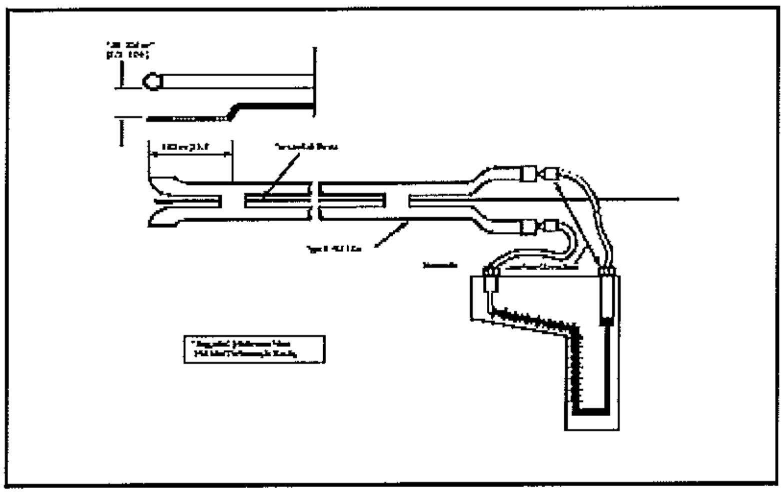


Figure 1.1 Pitot Tube Manometer Assembly

EPA Method 4 - Moisture Content in Stack Gas

This method is applicable for the determination of the moisture content of stack gas. A sample of the gas stream was extracted at a constant rate and then condensed and metered using an EPA Method 5 sample train. The weight gain of moisture condensed was determined gravimetrically by measuring the weight change of the impingers.

EPA Method 5 - <u>Determination of Filterable Particulate Matter</u>

Particulate matter was withdrawn from the source and collected on a quartz fiber filter maintained at a temperature in the range of 248 ± 25°F (120 ± 14°C). Particulate matter that was deposited on the nozzle, probe and front half of the filer holder were rinsed with acetone and collected in sample bottles. The acetone was then evaporated off at the laboratory and desiccated for 24 hours. The particulate mass from the rinse and filter were determined gravimetrically after removal of uncombined water. The impinger contents were weighed to determine moisture content of the exhaust stream.

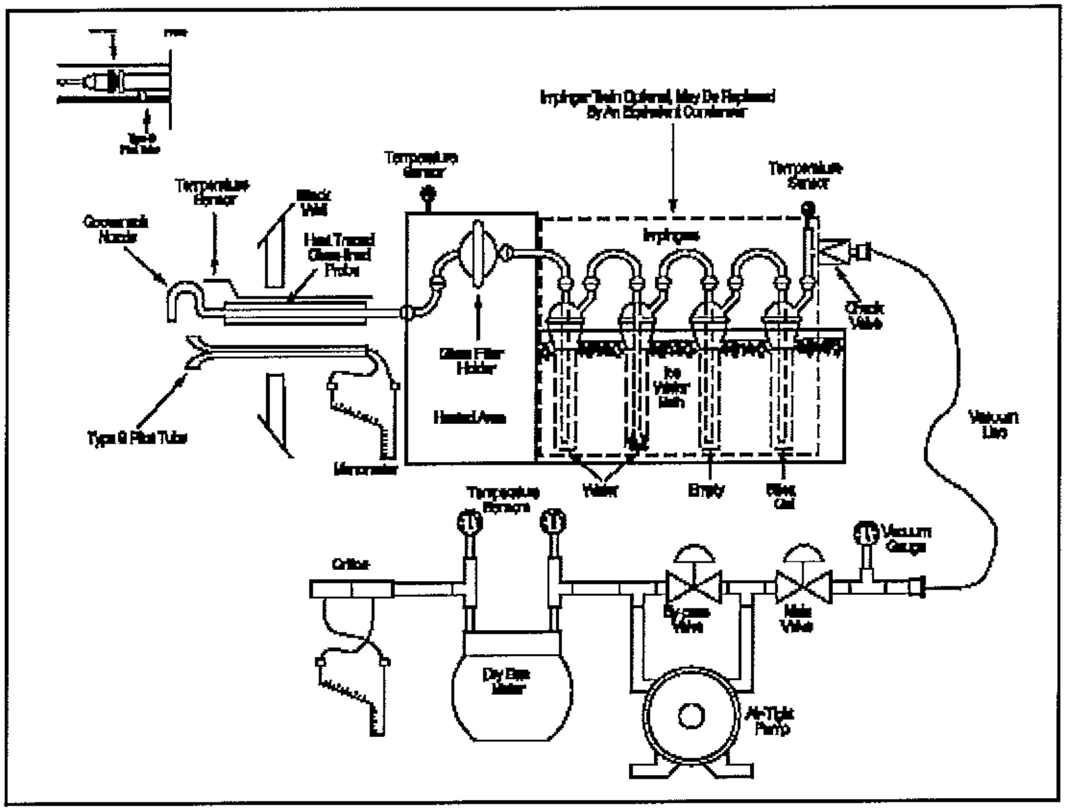
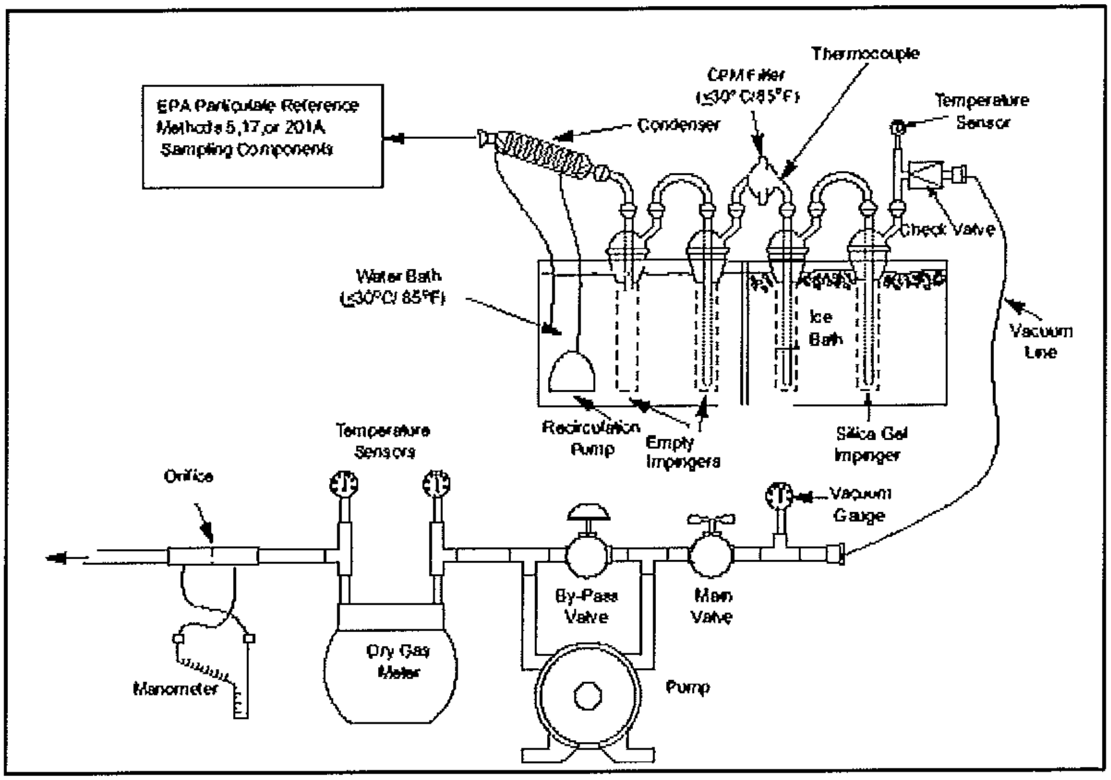


Figure 1.2 EPA Method 5 Diagram

EPA Method 202 - <u>Dry Impinger Method for Determining Condensable Particulate Matter</u>

The condensable particulate matter (CPM), back half fraction, is the material that condenses after passing through the filter and was analyzed using Method 202 (OTM28). The method uses a Method 5 sampling train with the addition of a condenser, a water dropout impinger and a modified Greenburg Smith impinger (both dry) followed by a Teflon CPM filter. The impinger contents are immediately purged after the run for one hour with nitrogen to remove dissolved sulfur dioxide gases. The CPM filter is extracted with water and hexane. The impingers are recovered, rinsed and the organic and aqueous fractions are separated using hexane. The organic and aqueous fractions are then taken to dryness and residues weighed. The total of both fractions represents the CPM.



1.4 Results

The results of the particulate emission tests are summarized below in Table 1.2 and presented in the Summary section of the report (Table 2.1). The units of reporting for the particulates are pounds per hour (lb/hr), pounds per thousand board feet (lb/Mbf)and grains per dry standard cubic foot (gr/dscf.

Table 1.2 Performance Test Results

Unit	Parameter	Test Average
Dry Kiln	$PM_{2.5}$	0.00029 gr/dscf
Dry Kiln	$PM_{2.5}$	0.00068 lb/hr
Dry Kiln	$PM_{2.5}$	0.00614 lb/Mbf

The emission rates presented in the summaries are referenced to EPA standard conditions of 29.92 inches of mercury ("Hg) and 68 °F. The pollutant concentration (gr/dscf) multiplied by the stack gas velocity, a conversion factor and the cross-sectional area of the stack give the emission rate in pounds per hour.

1.5 As Found

During the drying process the impingers were changed out once and the silica gel impingers were changed out several times to keep from becoming saturated. The sample probe was positioned in the center of the exhaust stack throughout the test program. This provided the highest flow measurement throughout the test program.

The kiln was loaded with 2,267 board feet of 2"x10" Western Hemlock lumber from Sierra Pacific's Burlington sawmill. The kiln was operated for 55 hours and the the boards were dried to 17.3 % moisture content with a Standard Deviation of 6.3%.

The isokinetic sample rate was not within the limits of ± 10% for EPA Method 5. Due to the extremely low exhaust flow rate and small filterable particulate catch, this should not have a significant effect on the results.

1.6 Process Overview

The Wellons Dry kiln is heated with steam from a 25MMBtu/hr boiler. The heating cycle for the unit is controlled by a computer that monitors wet bulb and dry bulb temperatures with the kiln. There are two inlet vents and two outlet vents that maintain temperature within the kiln. A single fan circulates air flow within the kiln.

Figure 1.3 below presents the kiln sample arrangement.

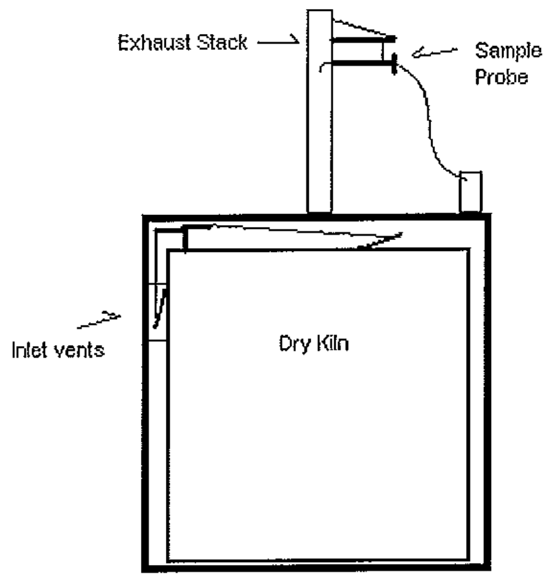


Figure 1.3 SPI Stack Diagram

1.7 Participants

- Mr. Scott Chesnut, Project Manager, QSTI 2012-655
- Mr. Robert Rusi, Operations Manager, QSTI 2012-656
- Mr. Dave Worgum, Field Technician, QSTI 2012-657
- Mr. Dave Wagner, Field Technician QSTI 2012-658
- Ms. Wendy Pounds, Quality Assurance Supervisor QSTI 2012-654

Mr. Don Lee served as Kiln Operator for SPI.

Mr. Curt Adcock served as Project Manager for SPI

2. SUMMARY

Table 2.1 Method 5 Particulate Summary

Client: Sierra Pacific		**Date:** 02/21/13 - 02/23/13
	Bd-Ft Dried: 2267	
Unit: Dry Kiln	**Test Hours:** 53	**ETI Job Number:** 13-2447

Filterable Catch	**Run Number** 1	
mg	2.5	
gr/dscf	0.00003	
lb/hr	0.00008	
Condensable Catch	**Run Number** 1	
Organic Fraction		
mg	6.0	
gr/dscf	0.00008	
lb/hr	0.00019	
Inorganic Fraction		
mg	13.4	
gr/dscf	0.00018	
lb/hr	0.00041	
Total Condensable		
gr/dscf	0.00026	
lb/hr	0.00060	
Total Particulate	**Run Number** 1	**Limit**
mg	21.9	
gr/scf	0.00028	
gr/dscf	0.00029	
lb/hr	0.00068	
lb/Mbf	0.0158	

3. ETI FIELD TEST DATA

Table 3.1 Flows & Moisture Field Data

Client: Sierra Pacific Industries
Date: 2-21to23-2013
Site: Dry Kiln
ETI Job Number: 13-2447

		Run Number: 1
	Run Start Time:	
	Run Finish Time:	
θ	Sample Time, minutes	3180
	Stack Shape (Circle or Rectangle):	Circle
V_m	Dry Gas Meter Reading, dcf ....INITIAL:	745.964
	FINAL:	1933.014
V_m	Volume of dry gas sampled, dcf	1187.050
Y	Meter box calibration factor	0.992
P_{bar}	Barometric pressure, inches Hg	29.69
P_{static}	Stack static pressure, inches H_2O	0.00
ΔH	Differential meter press, inches H_2O	0.67
T_m	Meter temperature, degrees F	71.5
V_{lc}	Volume of H_2O collected, ml	1200.0
% O_2	Percent of oxygen in stack gas	20.90
% CO_2	Percent carbon dioxide in stack gas	0.04
C_p	Type-S pitot tube coefficient	0.84
$\sqrt{\Delta P}_{avg}$	Ave. square root of pitot readings, (inches $H_2O)^{1/2}$	0.1089
T_s	Stack temperature, degrees F	87.2
D_s	Stack diameter, feet - CIRCLE	1.00
L_s, W_s	Stack dimensions, feet - RECTANGLE	
D_n	Nozzle diameter, inches	0.486
A_n	Nozzle area, ft^2	0.001288
Calculated Values:		
$V_{m(std)}$	Meter corrected volume, dscf	1162.733
$V_{w(std)}$	Volume of water vapor, dscf	56.580
B_{ws}	Fraction of H_2O vapor	0.0464
$B_{ws/sat}$	Fraction of H_2O vapor at saturated conditions	0.0438
% N_2	Percent nitrogen in stack gas	79.06
M_d	Dry molecular weight of stack gas, lb/lb-mole	28.84
M_w	Wet molecular weight of stack gas, lb/lb-mole	28.37
A_d	Cross sectional area of stack, ft^2	0.785
P_s	Absolute stack gas pressure, inches Hg	29.69
V_s	Average stack gas velocity, ft/sec	6.30
Q_{std}	Average stack volumetric flowrate, wscfm	284.42
Q_{std}	Average stack volumetric flowrate, dscfm	271.97
I	Percent isokinetic sampling	82.0

4. LABORATORY DATA

Table 4.1 PM Gravimetrics Data

Client: Sierra Pacific

Date: 02/21/13 - 02/23/13

Site: Dry Kiln

ETI Job Number: 13-2447

PARTICULATE LABORATORY DATA:

FRONT HALF OF TRAIN	Run Number: 1
Probe/Nozzle Wash Residue Wt.	
Final weight, g:	68.5352
Tare weight, g:	68.5329
Blank acetone weight, g	0.0005
Weight gain, g:	0.0018
Filter Wt.	
Final weight, g:	0.3993
Tare weight, g:	0.3986
Weight gain, g:	0.0007
TOTAL FRONT HALF PARTICULATE, g:	**0.0025**

BACK HALF OF TRAIN	Run Number: 1	Field Blank
Inorganic:		
Final weight, g:	2.0186	2.0072
Tare weight, g:	2.0116	2.0064
Weight gain, g:	0.0070	0.0008
Organic:		
Final weight, g:	2.0154	2.0003
Tare weight, g:	2.0010	1.9985
Weight gain, g:	0.0144	0.0018
Blank Correction, g:	0.0020	
TOTAL BACK HALF PARTICULATE, g:	**0.0194**	**0.0026**

TOTAL PARTICULATE, g:	**0.0219**

5. RAW FIELD DATA SHEETS

Project #

FIELD DATA

Page 2 of ___

Test Date 2.21.2013	Run # 1	Probe Length 2'	Filter #
Client Sierra Pacific	Test Box # HF-I	Pitot Tube Cp 0.84	P Bar 29.99
Plant Ferndale, WA	Stack Diameter 12	Delta H @ 1.83	Est.% H_2O 30
Site Chemco	Avg. Nozzle	Y Factor 0.992	Static Pres. Ø
Operator DJW, DW, SC	Diameter 0.486"	Pitot # PR12A	% O_2 20.9
EPA Method 5/202	1. ___ 2. ___ 3. ___	Thermocouple # PR12A	% CO_2 0.04

System Leak Check

	Vacuum in. HG	DGM cfm
Post		

Pitot Leak Check

	Pos. +	Neg. -
Post	OK 3"	OK 3"

#	Contents	Final Grams	Initial Grams	Net Wt. Grams
1			473.2	
2			656.0	
3			740.0	
4		1057.6	1015.3	42.3
5				
6				

Total Back Half Volume W/Rinse ___

Total Grams ___

Pt.	Time Min.	Clock Time	Stack °F	Meter Temp. In °F	Meter Temp. Out °F	Pitot Delta P " H_2O	Dry Gas Meter Cu. Ft.	Orifice Delta H " H_2O	Vac "Hg	Filter Temp.	Impin. Exit Temp	CPM
360	~~345~~		83	70	71	0.0100	820.400	.328	1	245	44	69
	375		85	69	70	0.0106	823.61	0.346	1	245	43	69
	390		85	69	69	0.0100	826.57	0.326	1	245	43	69
	405		85	69	69	0.0106	829.54	0.346	1	245	43	68
	420		85	69	69	0.0111	832.48	0.362	1	246	43	69
	435		85	68	68	0.0108	835.43	0.352	1	245	43	69
	450		86	68	68	0.0106	838.41	0.345	1	245	44	69
	465		87	68	68	0.0113	841.36	0.367	1	244	44	69
	480		87	68	68	0.0114	844.28	0.370	1	245	44	70
	495		88	68	68	0.0113	847.21	0.366	1	245	47	70
	510		88	68	68	0.0116	850.16	0.376	1	244	47	70
	525		89	68	68	0.0120	853.06	0.388	1	244	47	71
	540		88	68	68	0.0121	855.99	0.392	1	245	46	71
	555		88	68	67	0.0122	859.08	0.395	1	244	46	71
	570		88	68	67	0.0123	862.66	0.398	1	244	46	71
	585		96	68	68	0.0124	866.16	0.396	1	245	46	71
	600		95	68	68	0.0118	869.71	0.377	1	245	48	73
	615		90	70	68	0.0119	873.22	0.385	1	245	50	72
	630		89	72	70	0.0107	876.67	0.348	1	247	50	72
	645		88	74	71	0.0114	879.79	0.372	1	245	50	73
	660		88	74	71	0.0122	883.29	0.399	1	247	50	72
	675		95	75	74	0.0127	886.74	0.411	1	245	52	72
	690		91	75	74	0.0123	890.69	0.401	1	244	52	72
	705		92	75	74	0.0117	894.62	0.381	1	246	52	73
	720		97	74	74	0.0123	898.19	0.397	1	244	52	73
			TS °F	Avg.		ΔP	DGM	ΔH				

√ΔP -

Project # ______ **FIELD DATA** Page 3 of ___

Test Date 2-21-2013	Run # 1	Probe Length 2'	Filter # ___
Client Sierra Pacific	Test Box # HE-I	Pitot Tube Cp 0.84	P Bar 29.99
Plant Ferndale, WA	Stack Diameter 12	Delta H @ 1.88	Est.% H2O 30
Site Chemco	Avg. Nozzle	Y Factor 0.992	Static Pres. Ø
Operator DRO DW SC	Diameter 0.486 "	Pitot # PR12A	% O_2 20.9
EPA Method 5/202	1.___ 2.___ 3.___	Thermocouple # PR12A	% CO_2 0.04

System Leak Check

	Vacuum in. HG	DGM cfm
Post		

Pitot Leak Check

	Pos. +	Neg. -
Post	OK	OK
	3"	3'

Kf=32.45
30.2174

#	Contents	Final Grams	Initial Grams	Net Wt. Grams
1			493.2	
2			656.0	
3			740.0	
4			981.7 new 471	
5				
6				

Total Back Half Volume W/Rinse ______ Total Grams ______

Pt.	Time Min.	Clock Time	Stack °F	Meter Temp. In °F	Meter Temp. Out °F	Pitot Delta P " H_2O	Dry Gas Meter Cu. Ft.	Orifice Delta H " H_2O	Vac "Hg	Filter Temp.	Impin. Exit Temp	CPM
	720		97	74	74	0.0123	898.19	0.397	1	244	52	73
	735		90	73	73	0.0111	901.78	0.362	1	244	52	72
	750		100	72	72	0.0122	905.08	0.390	1	244	56	72
	765		89	72	72	0.0124	908.67	0.404	1	245	58	72
	780		94	71	71	0.0129	912.19	0.416	1	245	56	72
	795		89	70	70	0.0128	915.65	0.416	1	244	56	72
	810		88	70	70	0.0128	919.15	0.416	1	244	56	72
	825		88	70	70	0.0122	922.52	0.397	1	244	56	72
	840		88	70	70	0.0122	926.450	0.397	1	244	56	72
	855		88	70	70	0.0147	930.510	0.478	1	244	56	72
	870		95	71	70	0.0138	936.75	0.444	1	244	56	72
	885		89	71	70	0.0140	942.23	0.455	2	244	56	72
	900		93	71	70	0.0140	947.41	0.452	2	244	56	72
	915		94	71	70	0.0156	952.65	0.506	2	244	56	72
	930		87	71	70	0.0120	957.80	0.389	3	244	56	72
	945		89	71	70	0.0130	962.85	0.422	3	244	56	72
	960		93	71	70	0.0147	967.95	0.477	3	244	56	71
	975		87 98	71	70	0.0158	974.03	0.513	4	244	56	71
	990		89	71	70	0.016	979.650	0.519	4	244	56	71
	1005		92	71	70	0.0169	985.44	0.548	5	244	56	71
	1020		92	71	70	0.0119	990.55	0.386	5	244	56	70
	1035		92	71	70	0.0118	996.350	0.383	5	244	56	70
	1050		86	71	70	0.0137	002.35	0.445	5	244	56	70
	1065		91	71	70	0.0130	008.45	0.422	5	244	54	70
	1080		87	71	70	0.0130	011.21	0.422	5	244	54	70
				Avg.								
			TS °F			ΔP	DGM	ΔH				

√ΔP

Project # ______ **FIELD DATA** Page 1 of ______

Test Date 2-21-2013	Run # 1	Probe Length 2'	Filter #
Client Sierra Pacific	Test Box # HF-I	Pitot Tube Cp 0.84	P Bar 29.99
Plant Ferndale, WA	Stack Diameter 12	Delta H @ 1.83	Est.% H_2O 30
Site Chemco	Avg. Nozzle	Y Factor 0.992	Static Pres. -0-
Operator DJW, DW	Diameter 0.486 "	Pitot # PR12A	% O_2 20.9
EPA Method 5/202	1. 0.486 2. 0.486 3. 0.486	Thermocouple # PR12A	% CO_2 0.04

System Leak Check

	Vacuum in. HG	DGM cfm
Post		

Pitot Leak Check

	Pos. +	Neg. -
Post	OK	OK
	3"	3"

Batch Start 10:29

#	Contents	Final Grams	Initial Grams	Net Wt. Grams
1			493.2	
2			656.0	
3			740.0	
4			1015.3	
5				
6				
	Total Back Half Volume W/Rinse ______		Total Grams	

Pt.	Time Min.	Clock Time	Stack °F	Meter Temp. In °F	Meter Temp. Out °F	Pitot Delta P " H_2O	Dry Gas Meter Cu. Ft.	Orifice Delta H " H_2O	Vac "Hg	Filter Temp.	Impin. Exit Temp	CPM
	0	10:40	68	63	63	0.0077	745.964	0.257	1	245	44	65
	15	10:55	64	63	63	0.0064	750.17	0.215	1	245	44	65
	30		63	64	63	0.0057	754.22	0.192	1	246	44	65
	45		64	67	65	0.0044	757.64	0.216	1	246	44	65
	60		66	70	67	0.0065	761.43	0.220	1	245	45	65
	75		68	72	69	0.0075	764.92	0.254	1	245	46	66
	90		69	73	71	0.0076	768.42	0.257	1	243	46	65
	105		70	74	72	0.0069	771.81	0.234	1	245	46	65
	120		71	75	73	0.0068	775.05	0.230	1	246	46	65
	135		72	74	73	0.0073	777.42	0.246	1	246	46	65
	150		73	74	74	0.0079	779.97	0.266	1	245	46	65
	165		75	74	74	0.0078	783.29	0.262	1	245	46	65
	180		77	74	74	0.0083	787.78	0.278	1	245	46	65
	195		78	74	74	0.0072	789.81	0.240	1	244	47	65
	210		78	74	74	0.0088	792.60	0.294	1	245	47	65
	225		78	74	74	0.0068	795.19	0.227	1	245	48	65
	240		79	73	73	0.0087	798.03	0.290	1	244	47	65
	255		80	73	73	0.0098	800.10	0.326	1	245	47	65
	270		81	73	73	0.0091	801.35	0.302	1	246	47	65
	285		82	72	72	0.0083	802.78	0.274	1	244	48	65
	300		83	72	71	0.0112	806.43	0.369	1	245	44	66
	315		84	72	71	0.0109	810.82	0.358	1	246	45	66
	330		84	71	71	0.0112	814.42	0.368	1	246	44	67
	345		83	70	71	0.0096	817.59	0.315	1	245	44	68
	360		83	70	71	0.0100	820.64	0.328	1	245	44	67
			TS °F	Avg.		ΔP	DGM	ΔH				

$\sqrt{\Delta P}$ = ______

Project # ________ **FIELD DATA** Page 4 of ____

Test Date 2-22-13	Run #	Probe Length 2'	Filter #
Client Sierra Pacific	Test Box # HFI	Pitot Tube Cp 0.84	P Bar 29.99
Plant Fernd WR	Stack Diameter 12	Delta H @ 1.83	Est. % H_2O 3.0
Site Chemco - Pilot Kiln	Avg. Nozzle Diameter .486"	Y Factor 0.992	Static Pres. 0
Operator DW, BV, SC	1. ___ 2. ___ 3. ___	Pitot # PR12A	% O_2 20.9
EPA Method 5/202		Thermocouple # PR12A	% CO_2 0.04

System Leak Check

	Vacuum in. HG	DGM cfm
Post		

Pitot Leak Check

	Pos. +	Neg. -
Post	ok	ok

H: 32.45
R: 30.00

#	Contents	Final Grams	Initial Grams	Net Wt. Grams
1			493.2	
2			656.0	
3			740.0	
4		1083.2	981.7 New	~~101.~~
5		1128.4	(70) 1039.6 New	
6				

Total Back Half Volume W/Rinse ____ Total Grams ____

Pt.	Time Min.	Clock Time	Stack °F	Meter Temp. In °F	Meter Temp. Out °F	Pitot Delta P " H_2O	Dry Gas Meter Cu. Ft.	Orifice Delta H " H_2O	Vac "Hg	Filter Temp.	Impin. Exit Temp	CPM
	1095		85	72	70	0.0150	019.50	0.467	4	244	47	69
	1110		88	72	70	0.0118	025.06	0.383	4	244	47	69
	1125		86	72	71	0.0157	030.485	0.509	4	244	47	69
	1140		84	72	71	0.0145	035.940	0.471	4	244	47	69
	1155		85	72	71	0.0118	041.980	0.383	4	244	47	69
	1170		85	72	71	0.0130	046.990	0.422	4	244	47	70
	1185		85	72	71	0.0130	52.35	0.422	4	244	47	70
	1200		85	72	71	0.0200	58.500	0.649	4	244	47	70
	1215		90	72	71	0.0135	63.100	0.438	4	244	47	70
	1230		86	70	70	0.0107	68.481	0.321	4	245	47	70
	1245		94	71	70	0.0105	73.262	~~0.573~~ 0.315	4	246	47	70
	1260		87	71	70	0.0120	77.974	0.360	4	244	47	70
	1275		84	71	70	0.0109	82.676	0.327	4	246	47	70
	1290		85	71	70	0.0078	87.613	0.234	3	244	47	70
	1305		84	71	70	0.0158	91.809	0.474	5	245	47	70
	1320		84	71	70	0.0120	96.995	0.360	4	245	47	70
	1335		84	71	70	0.0089	102.281	0.495	5	243	47	70
	1350		85	72	70	0.0114	107.928	0.633	6	246	48	70
	1365		91	73	71	0.0127	114.880	0.699	6	246	48	70
	1380		84	74	71	0.0143	122.008	0.798	6	244	48	71
	1395		85	74	71	0.0122	129.523	0.680	5	245	48	71
	1410		85	73	71	0.0090	136.025	0.501	5	245	48	71
	1425		87	74	72	0.0146	142.681	0.811	6	246	48	71
	1440						150.383					
	1455											
			TS °F	Avg.		ΔP	DGM	ΔH				

√ΔP =

Section: Raw Field Data Sheets

Project # ____

FIELD DATA

Page 5 of ____

Test Date 2/22/2013	Run # 1	Probe Length 2'	Filter #
Client Sierra Pacific	Test Box # HE-I	Pitot Tube Cp 0.84	P Bar 29.69
Plant Ferndale, WA	Stack Diameter 12	Delta H @ 1.83	Est.% H_2O 4
Site Chemco Pilot Kiln	Avg. Nozzle	Y Factor 0.992	Static Pres.
Operator (SD), DW, DJW, RR	Diameter 0.486"	Pitot # PR 12A	% O_2 20.9
EPA Method 5/202	1. ____ 2. ____ 3. ____	Thermocouple # PR 12A	% CO_2 0.04

System Leak Check

	Vacuum in. HG	DGM cfm
Post		

Pitot Leak Check

	Pos. +	Neg. -
Post	ok 3"	ok 3"

#	Contents	Final Grams	Initial Grams	Net Wt. Grams
1				
2				
3				
5	Silica		929.0 New	
4	MT		660.1	
6				

Total Back Half Volume W/Rinse ____ Total Grams ____

Pt.	Time Min.	Clock Time	Stack °F	Meter Temp. In °F	Meter Temp. Out °F	Pitot Delta P " H_2O	Dry Gas Meter Cu. Ft.	Orifice Delta H " H_2O	Vac "Hg	Filter Temp.	Impin. Exit Temp	CPA
	1440	11:27	86	74	72	0.0148	150.383	0.824	6	247	48	71
	1455		88	74	72	0.0114	157.026	0.632	5	245	48	71
	1470		88	74	72	0.0129	163.871	0.715	6	247	48	71
	1485		87	74	72	0.0121	171.935	0.672	5	244	48	71
	1500		87	74	72	0.0123	178.908	0.683	5	245	46	71
	1515		92	74	72	0.0126	185.770	0.694	5	245	47	71
	1530		90	74	72	0.0108	192.982	0.597	5	243	47	71
	1545		87	74	72	0.0123	199.639	0.683	5	245	47	71
1560	~~1590~~		86	74	72	0.0139	206.639	0.774	6	246	47	70
1575	~~1605~~		89	74	72	0.0124	214.126	0.686	5	245	47	71
1590	~~1620~~		94	74	72	0.0116	221.183	0.636	5	245	47	71
1605	~~1635~~		94	75	72	0.0096	228.002	0.527	5	244	47	71
1620	~~1650~~	15:20	110	80	73	0.0151	231.708	0.810	6	243	47	← change
1635	~~1665~~		94	77	72	0.0120	239.731	0.660	5	243	47	71 Silica Gel
1650	~~1680~~		92	77	73	0.0123	246.842	0.679	5	247	47	72
1665	~~1695~~		96	77	73	0.0123	253.420	0.674	5	244	47	72
1680	~~1710~~		94	73	73	0.0110	260.098	0.603	5	246	48	72
1695	~~1725~~		95	71	72	0.0136	266.554	0.742	5.5	242	48	72
1710	~~1740~~		93	71	71	0.0135	273.627	0.738	5.5	243	48	73
1725	~~1755~~		88	71	72	0.0132	280.527	0.729	5	247	48	73
1740	~~1770~~		91	72	70	0.0139	287.528	0.763	6	246	47	72
1755	~~1785~~		90	72	70	0.0127	294.823	0.698	5	248	47	72
1770	~~1800~~		86	73	71	0.0127	301.712	0.705	5	244	47	72
1785			83	72	71	0.0125	308.707	0.697	5	244	47	71
1800	18:34		83	73	71	0.0125	315.738	0.698	5	245	48	70
			Ts °F	Avg.		ΔP	DGM	ΔH				

$\sqrt{\Delta P}$ =

Section: Raw Field Data Sheets

Project # ______ **FIELD DATA** Page 6 of ___

Test Date 2-22-13	Run # 1	Probe Length 2'	Filter #
Client Sierra Pacific	Test Box # HF-I	Pitot Tube Cp 0.84	P Bar 29.69
Plant Ferndale, WA	Stack Diameter 12'	Delta H @ 1.83	Est.% H2O 4
Site Chemco Pilot Kiln	Avg. Nozzle	Y Factor 0.992	Static Pres. Ø
Operator SG DJO QWO RR	Diameter 0.486"	Pitot # PR12A	% O2 20.9
EPA Method 5/202	1. — 2. — 3. —	Thermocouple PR12A	% CO2 0.04

System Leak Check

	Vacuum in. HG	DGM cfm
Post		

Pitot Leak Check

	Pos. +	Neg.
Post	OK	OK
	3"	3"

#	Contents	Final Grams	Initial Grams	Net Wt. Grams
1			493.2	
2			656.0	
3			740.0	
4	MT		660.1	
5	Silica	~~950.1~~ 950.2	929.0	~~21.1~~ 21.2
6	New		new 940.5	

Total Back Half Volume, W/Rinse ______ 9:30

Total Grams ______

Pt.	Time Min.	Clock Time	Stack °F	Meter Temp. In °F	Meter Temp. Out °F	Pitot Delta P " H_2O	Dry Gas Meter Cu. Ft.	Orifice Delta H " H_2O	Vac "Hg	Filter Temp.	Impin. Exit Temp	CPM
	1800	18:34	83	73	71	0.0125	315.738	0.698	5	245	48	70
	1815	18:49	78	73	71	0.0126	322.765	0.710	5	245	49	70
	1830	19:04	83	73	71	0.0128	329.810	0.714	5	244	46	72
	1845	19:19	88	73	72	0.0115	336.973	0.637	4.5	246	45	71
	1860	19:34	88	73	72	0.0111	343.675	0.614	4.5	244	45	71
	1875	19:49	88	73	72	0.0111	350.176	0.614	4	245	45	70
	1890	20:04	89	71	70	0.0117	357.042	0.644	4.5	245	45	71
	1905	20:19	90	70	70	0.0113	363.164	0.620	4.5	242	44	70
	1920	20:44	93	70	70	0.0103	~~369~~.593	0.562	4	246	45	70 (369)
	1935	20:59	92	71	69	0.0123	375.707	0.673	4.5	246	45	70
	1950	21:14	88	71	69	0.0113	382.517	0.623	4	246	47	69
	1965	21:29	93	70	69	0.0117	389.050	0.638	4	244	47	69 9:30
	1980	21:44	89	70	69	0.0124	396.702	0.681	4.5	245	47	69 Silica
	1995	21:59	90	71	69	0.0129	403.319	0.708	4.5	245	47	70
	2010	22:14	91	71	69	0.0129	410.017	0.707	4.5	245	48	71
	2025	22:29	90	69	69	0.0115	417.516	0.630	4.5	246	48	70
	2040	22:44	88	69	68	0.0133	423.931	0.731	5	243	48	70
	2055	22:59	91	70	68	0.0111	430.999	0.607	4.5	246	50	70
	2070	23:14	94	70	68	0.0127	437.531	0.691	4.5	244	52	71
	2085	23:29	91	71	68	0.0131	444.434	0.717	5	245	52	72
2100	~~2100~~	23:44	89	71	69	0.0113	451.449	0.621	4.5	245	52	71
	2115	23:59	88	70	69	0.0124	458.300	0.683	4.5	259	41	73
	2130	00:14	92	72	69	0.0125	465.290	0.684	4.5	246	40	72
	2145	00:29	92	74	73	0.0124	473.690	0.688	4.5	240	40	71
	2160	00:44	92	74	72	0.0136	480.010	0.748	4.5	239	40	72
				Avg.								
			TS °F			ΔP	DGM	ΔH				

√ΔP =

Project #

FIELD DATA

Page 7 of ____

Test Date 2-23-13
Client Sierra Pacific
Plant Ferndale WA
Site Chemco Pilot Kiln
Operator RBR
EPA Method 5/202

Run # 1
Test Box # HE-I
Stack Diameter 12"
Avg. Nozzle Diameter 0.486
1. ____ 2. ____ 3. ____

Probe Length 12"
Pitot Tube Cp 0.84
Delta H @ 1.85
Y Factor 0.992
Pitot # PR 12A
Thermocouple # PR 12A

Filter #
P Bar 29.69
Est.% H_2O 4
Static Pres. 0
% O_2 20.9
% CO_2 0.04

System Leak Check

	Vacuum in. HG	DGM cfm
Post		

Pitot Leak Check

	Pos +	Neg. -
Post	3"	3"

#	Contents	Final Grams	Initial Grams	Net Wt. Grams
1			493.2	
2			656.0	
3			740.0	
4			660.1	
5			940.5	
6				

Total Back Half Volume W/Rinse ____ Total Grams ____

Pt.	Time Min.	Clock Time	Stack °F	Meter Temp. In °F	Meter Temp. Out °F	Pitot Delta P " H_2O	Dry Gas Meter Cu. Ft.	Orifice Delta H " H_2O	Vac "Hg	Filter Temp.	Impin. Exit Temp	CPM
	2160	00:59	92	74	72	0.0136	1480.01	0.748	4.5	253	41	72
	2175	01:14	88	75	72	0.0144	1486.45	0.799	4.5	250	46	73
	2190	01:29	90	75	72	0.0133	1493.010	0.735	4.5	246	39	72
	2205	01:44	91	75	73	0.0142	1500.230	0.784	4.5	256	39	73
	2220	01:59	89	75	73	0.0131	1507.230	0.726	4.5	241	35	72
	2235	02:14	89	74	73	0.0133	1514.201	0.737	4.5	245	39	72
	2250	02:29	88	75	73	0.0149	1521.800	0.827	4.5	246	40	72
2265	2265	02:44	90	76	73	0.0140	1528.653	0.775	4.5	243	40	72
2280	2320	02:59	89	76	74	0.0144	1536.000	0.799	4.5	239	39	72
2295	2335	03:14	88	76	74	0.0152	1543.510	0.734	4.5	247	39	72
2310	2350	03:29	89	76	74	0.0145	1551.300	0.805	4.5	242	39	73
2325	2405	03:44	90	76	74	0.0141	1558.680	0.781	4.5	248	39	75
2340	2420	03:59	93	76	74	0.0138	1565.950	0.761	4.5	251	39	72
2355	2435	04:14	90	76	74	0.0142	1573.850	0.787	4.5	250	38	73
2370	2450	04:29	90	75	74	0.0133	1580.912	0.736	4.5	251	38	73
2385	2505	04:44	90	76	74	0.0155	1588.200	0.859	4.5	250	39	74
2400		04:59	106	76	74	0.0146	1595.891	0.746	4.5	251	39	73
05:14	2415	05:14	98	76	74	0.0162	1602.310	0.806	4.5	250	39	73
05:29	2430	05:29	95	75	74	0.0143	1610.012	0.785	4.5	235	39	73
	2445	05:44	81	73	73	0.0113	1618.130	0.634	4	256	42	72
	2460	05:59	85	75	74	0.0152	1626.100	0.849	4	243	39	74
	2475	06:14	89	74	73	0.0137	1632.880	0.758	4	250	39	75
	2490	06:29	89	72	72	0.0116	1640.610	0.640	4	244	39	74
	2505	06:44	82	72	71	0.0127	1647.100	0.714	4	248	39	74
	2520	06:59					1653.500					

TS °F	Avg		ΔP	DGM	ΔH

$\sqrt{\Delta P}$ =

Project # ________ **FIELD DATA** Page 8 of ____

Test Date 2-23-13	Run # 1	Probe Length 8'	Filter # ____
Client Sierra Pacific	Test Box # HF-I	Pitot Tube Cp 0.84	P Bar 29.69
Plant Ferndale WA	Stack Diameter 12"	Delta H @ 1.83	Est.% H_2O 4
Site Chemco Pilot Kiln	Avg. Nozzle Diameter 0.486"	Y Factor 0.992	Static Pres. 0
Operator RBR / SC	1. ___ 2. ___ 3. ___	Pitot # PR 12A	% O_2 20.9
EPA Method 5/202		Thermocouple # PR 12A	% CO_2 0.04

System Leak Check

	Vacuum in. HG	DGM cfm
Post		

Pitot Leak Check

	Pos. +	Neg. -
Post	3"	3"

BH-Train #1

#	Contents	Final Grams	Initial Grams	Net Wt. Grams
1		1130.2	493.2	
2		715.8	656.0	
3		809.3	740.0	
4		664.4	660.1	
5		972.0	940.5	
6				

Total Back Half Volume W/Rinse ______ Total Grams ______

Pt.	Time Min.	Clock Time	Stack °F	Meter Temp. In °F	Meter Temp. Out °F	Pitot Delta P " H_2O	Dry Gas Meter Cu. Ft.	Orifice Delta H " H_2O	Vac "Hg	Filter Temp.	Impin. Exit Temp	CPM
	2520	7:10	90	72	72	0.0121	1653.500	0.667	4	246	39	73
	2535	7:25	89	71	70	0.0139	1660.400	0.760	4	243	40	73
	2550	7:40	89	72	70	0.0128	1667.60	0.706	4	250	42	73
	2565	7:55	91	72	70	0.0136	1675.100	0.747	4	245	40	73
	2580	8:10	92	71	70	0.0163	1682.210	0.893	4	254	40	73
	2595	8:25	95	73	70	0.0144	1688.950	0.786	4	238	41	73
	2610	8:40	93	72	70	0.0154	1696.346	0.843	4	244	41	73
	2625	8:55	93	73	70	0.0162	1704.102	0.888	4	245	41	73 change
	2640	9:16	91	71	70	0.0144	1712.035	0.790	4	250	41	73 silica
	2655	9:31	91	72	70	0.0151	1719.400	0.830	4	244	41	72
	2670	9:46	92	72	70	0.0148	1727.081	0.812	4	239	41	72
	2685	10:01	91	73	70	0.0152	1734.862	0.836	4	235	41	72
	2700	10:16	91	72	70	0.0155	1742.580	0.852	4	237	41	72
	2715	10:31	92	73	70	0.0149	1750.200	0.818	4	234	41	72
	2730	10:46	92	73	70	0.0115	1757.810	0.631	4	236	41	72
	2745	11:01	93	72	70	0.0141	1764.500	0.772	4	239	41	72
	2760	11:16	91	73	70	0.0152	1771.857	0.836	4	241	41	73
	2775	11:31 / 11:53	91	70	70	0.0135	1779.4 / 1777.508	0.740	3	240	41	72 Change
	2790	12:08	90	72	70	0.0148	1786.530	0.815	3	234	41	72 impingers
	2805	12:23	90	74	70	0.0152	1794.048	0.838	4	237	41	72
	2820	12:38	92	75	71	0.0141	1801.670	0.776	3	244	41	72
	2835	12:53	91	75	72	0.0137	1809.111	0.756	3	245	41	72
	2850	13:08	91	75	72	0.0188	1816.459	1.038	4	246	41	72
	2865	13:23	92	76	72	0.0134	1824.868	0.739	3	247	41	72
	2880						1832.272					
			TS °F	Avg.		ΔP	DGM	ΔH				

$\sqrt{\Delta P}$ =

1779.448 End leak ✓
1779.508 start

Project # ______ **FIELD DATA** Page ____ of ____

Test Date 2/23/2013	Run # 1	Probe Length 2'	Filter #
Client Sierra Pacific	Test Box # HF-I	Pitot Tube Cp 0.84	P Bar 30.18
Plant Ferndale, WA	Stack Diameter 12	Delta H @ 1.83	Est.% H_2O 4%
Site Chemco Pilot Kiln	Avg. Nozzle	Y Factor 0.992	Static Pres. -0
Operator (SD), RR, DJW, DW	Diameter 0.486 "	Pitot # PR12A	% O_2 20.9
EPA Method 5/202	1.____ 2.____ 3.____	Thermocouple # PR12A	% CO_2 0.04

System Leak Check

	Vacuum in. HG	DGM cfm
Post	7	0.001

Pitot Leak Check

	Pos. +	Neg. -
Post	OK	OK

Box #8

BH-Train #2

#	Contents	Final Grams	Initial Grams	Net Wt. Grams
1		610.1	498.8	
2		658.8	658.8	
3		767.8	762.3	
4		955.1	~~1039.6~~ ~~987.8~~	924.7
5		659.8	657.6	
6				
	Total Back Half Volume W/Rinse ____		Total Grams	

Pt.	Time: Min.	Clock Time	Stack °F	Meter Temp. In °F	Meter Temp. Out °F	Pitot Delta P " H_2O	Dry Gas Meter Cu. Ft.	Orifice Delta H " H_2O	Vac "Hg	Filter Temp.	Impin. Exit Temp	CPM Filter
	2880	13:39	95	75	72	0.0140	832.272	0.767	3	244	41	73
	2895	13:54	95	76	73	0.0173	1839.686	0.950	4	238	41	73
	2910	14:09	96	76	73	0.0139	1847.894	0.762	3	241	41	73
	2925	14:24	96	76	73	0.0152	1855.198	0.833	3	244	41	73
	2940	14:39	96	76	73	0.0160	1862.912	0.877	4	248	41	72
	2955	14:54	94	76	73	0.0166	1870.804	0.913	4	251	41	73
	2970	15:09	94	76	73	0.0111	1878.817	0.611	3	247	41	73
	2985	15:24	95	76	73	0.0144	1885.441	0.791	3	245	41	73
	3000	15:39	93	75	73	0.0149	1892.894	0.820	4	243	41	72
	3015	15:54	94	75	73	0.0129	1900.511	0.709	3	240	42	72
	3030	16:09	94	75	72	0.0133	1907.600	0.730	3	236	40	72
	3045	16:24	95	74	72	0.0138	1914.771	0.756	3	238	40	72
	3060	16:39	93	74	72	0.0129	1922.076	0.709	3	238	40	72
	3075	16:54	94	74	72	0.0139	1929.074	0.762	3	244	40	72
	~~3090~~	~~17:09~~	17:02	Stop			1933.014					
	~~3105~~	~~17:24~~										
	~~3120~~	~~17:39~~										
				Avg.								
			TS °F			ΔP	DGM	ΔH				

$\sqrt{\Delta P}$ = ______

6. PROCESS DATA

To:
M
Scott Chesnut

Scott will this information help in your report.

Curt Adcock
Division Manager Burlington WA.
Sierra Pacific Industries
Bus. 360-424-7619
Cell 360-480-0663
cadcock@spi-ind.com

From: Don W. Lee
Sent: Monday, March 18, 2013 2:26 PM
To: Curt Adcock
Subject: RE:

Curt;

The pilot kiln ran for 55 hours.

The dry bulb got up to 172 to 175 degree F.

MC was 17.3 % with Std. Dev. Of 6.2

2,267 bd ft. Western Hemlock 2x10.

From: Curt Adcock
Sent: Monday, March 18, 2013 1:44 PM
To: Don W. Lee
Subject: FW:

Don, I have the BF. But can you tell me the rest so I can make sure Scott puts this in the report. Any additional information will help.

Curt Adcock
Division Manager Burlington WA.
Sierra Pacific Industries
Bus. 360-424-7619
Cell 360-480-0663
cadcock@spi-ind.com

7. QUALITY ASSURANCE/QUALITY CONTROL

7.1 ETI Quality Assurance/Quality Control Document

Emission Technologies, Inc. continued success is an example of their pride taken in quality testing.

Analytical procedures and environmental measurement data are structured with a quality assurance program which equals or exceeds the minimum QA/QC requirements set forth by the U.S. Environmental Protection Agency (EPA) for each applicable method.

ETI executes the following topics through every test project to ensure valid measurement data:

* Preventable Maintenance
* Pre-test and Post-test Calibration
* Blanks and Spiked Samples
* Field System Checks
* QA/QC Matrix Tables
* Employment of QA/QC Officer

The following table is an activity matrix for Method 8 from the EPA Quality Assurance Handbook for Air Pollution Measurement Systems. By diligently following such activity matrix tables, Emission Technologies, Inc. reports justifiable, valid measurement data.

TABLE 1.1 ACTIVITY MATRIX FOR PROCUREMENT OF APPARATUS & SUPPLIES

APPARATUS	ACCEPTANCE LIMITS	FREQUENCY AND METHOD OF MEASUREMENT	ACTION IF REQUIREMENTS ARE NOT MET
Sampling			
Sampling probe with heating system	Capable of 100° C (212° F) exit air at flow rate of 20 L/min	Visually check; run heating system checkout	Repair, return to supplier, or reject
Probe nozzle	Stainless steel (316); sharp, tapered, leading edge (angle ≤30°); difference between measured ID's ≤0.1 mm (0.004 in.); no nicks, dents, or corrosion; uniquely identified (Meth. 5, Sec. 3.4.2)	Visually check before each test; use a micrometer to measure ID before field use after each repair	Reshape and sharpen, return to the supplier, or reject
Pitot tube	Type-S (Meth. 2, Sec. 3.1.2); attached to probe with impact (high pressure) opening plane even with or above	Calibrate according to Meth. 2, Sec. 3.1.2	Repair or return to supplier

nozzle entry plane

TABLE 1.1 (CONTINUED)

APPARATUS	ACCEPTANCE LIMITS	FREQUENCY AND METHOD OF MEASUREMENT	ACTION IF REQUIREMENTS ARE NOT MET
Differential pressure gauge (manometer)	Criteria in Meth. 2, Sec. 3.1.2; agree within 5% of gauge-oil manometer used to calibrate	Check against gauge-oil manometer at a minimum of three points: [0.64(0.025), 12.7(0.5), 25.4(1.0)] mm (in.) H_20	As above
Vacuum gauge	0-760 mm Hg range; $\pm$25 mm (1 in.) Hg accuracy at 380 mm (15 in.) Hg	Check against a mercury U-tube manometer upon receipt	Adjust or return to supplier
Vacuum pump	Capable of maintaining a flow rate of 0.03-0.05 m^3/ min (1-1.7 ft^3/ min) for pump inlet vacuum of 380 mm (15 in.) Hg with pump outlet at 760 mm (29.92 in.) Hg; leak free at 380 mm (15 in.) Hg	Check upon receipt for leaks and capacity	Repair or return to supplier
Orifice meter	ΔH @ of 46.74 $\pm$6.35 mm (1.84 $\pm$0.25 in.) (recommended)	Visually check upon receipt for damage; calibrate against wet test meter	Repair, if possible; otherwise, return to supplier
Impingers	Standard stock glass; pressure drop across impingers not excessive	Visually check upon receipt; check pressure drop (Method 8, Sec. 3.7.1)	Return to supplier
Filter holder	Leak free (Method 8, Sec. 3.7.1)	Visually check before use	As above
Filters	Glass fiber without organic binder designed to remove 99.95% ($\leq$0.05% penetration) of 0.3-µm dioctyl phthalate smoke particles	Manufacture's guarantee that filters meet ASTM standard method D2986-71; observe under light for defects	Return to supplier and replace

TABLE 1.1 (CONTINUED)

APPARATUS	ACCEPTANCE LIMITS	FREQUENCY AND METHOD OF MEASUREMENT	ACTION IF REQUIREMENTS ARE NOT MET
Hydrogen peroxide	30% H_2O_2 reagent grade or certified ACS	Upon receipt, check label for grade or certification	Replace or return to supplier
Potassium iodide	KI reagent grade or certified ACS	As above	As above
Thorin indicator	1-(o-arsonophenylazo)-2-naphthol-3,6 disulfonic acid disodium salt, reagent grade or certified ACS	Upon receipt, check label for grade or certification	As above
Barium perchlorate trihydrate solution	$Ba(ClO_4)_2$ -$3H_20$, -reagent grade or certified ACS	As above	As above
Sulfuric acid solution	H_2SO_4, 0.0100N $\pm$ 0.0002N	Certified by manufacturer, or standardize against 0.0100N NaOH previously standardized against potassium acid phthalate (primary standard grade)	As above
NO_x Chemiluminescence Analyzer	NO_x to NO conversion efficiency $\geq$ 90%	Before each field test; Introduce a concentration of 40-60 ppm NO_2 to the analyzer in direct cal mode; Calculate converter efficiency: $Eff_{NO_2} = \frac{C_{Dir}}{C_V} \times 100$	Repair

7.2 Hand Calculations

METHOD 5 CALCULATIONS

CLIENT: Sierra Pacific

SITE LOCATION: Dry Kiln

PROJECT #: 12-2351 **Run #:** 1

Nomenclature:

A_d = cross-sectional area of stack, ft.^{2}
A_n = cross-sectional area of nozzle, ft^2
B_{ws} = water vapor in the gas stream, proportion by volume
C_p = pitot tube coefficient, dimensionless
D_s = diameter of stack, ft^2
I = percent isokinetic
K_p = pitot tube constant = 85.49 ft/sec $\sqrt{\frac{(\text{lb/lb}-\text{mole})(\text{inches Hg})}{(^\circ\text{R})(\text{inches H}_2\text{O})}}$
M_d = molecular weight of stack gas, dry basis, lb./lb.-mole
M_w = molecular weight of stack gas, wet basis, lb./lb.-mole
$= M_d(1-B_{ws}) + 18(B_{ws})$
ΔH = differential meter pressure, inches H_2O
$\%CO_2$ = percent by volume of carbon dioxide in stack gas
$\%N_2$ = percent by volume of nitrogen in stack gas
$\%O_2$ = percent by volume of oxygen in stack gas
P_{bar} = barometric pressure, inches Hg
$\sqrt{\Delta P}_{avg}$ = average velocity head of stack gas, $\sqrt{\text{inches H}_2\text{O}}$
P_s = absolute stack gas pressure, inches Hg
P_{static} = static pressure of the stack, inches H_2O
P_{std} = standard absolute pressure, 29.92 inches Hg
Q_{std} = stack flow rate, dscfm
θ = sample time, minutes
T_m = meter temperature, $^\circ$F
T_s = average stack temperature, $^\circ$F
T_{std} = standard absolute temperature, 528°R
$T_{s(avg)}$ = Average absolute stack temperature, $^\circ$R = 460 + T_s
V_{mstd} = corrected meter volume, dscf
V_S = average stack gas velocity, ft./sec.
V_{lc} = volume of water gain in the impingers, ml
Y = dry gas meter calibration factor
7000 = conversion from grains to pounds; divide by

Volume of metered sample gas at standard conditions:

$$P_{meter} = P_{bar} + \frac{\Delta H}{13.6} = \underline{29.69} + \frac{\underline{0.67}}{13.6} = \underline{29.7392647} \text{ inches Hg}$$

$$V_{m(std)} = \frac{(V_m)\times(T_{std})\times(P_{meter})\times(Y)}{(T_m + 460)\times(P_{std})}$$

$$V_{m(std)} = \frac{(1187.050)\times(528)\times(29.7392647)\times(0.992)}{(71.5 + 460)\times(29.92)} = 1162.33293838 \text{ dscf}$$

Moisture Content:

$$V_{w(std)} = (0.04715 \text{ ft}^3/\text{gram water})\times(V_{lc})$$ 1 gram water = 1 ml water

$$V_{w(std)} = (0.04715)\times(1200) = \underline{56.58} \text{ scf}$$

$$B_{ws} = \frac{V_{w(std)}}{(V_{w(std)} + V_{m(std)})}$$

$$B_{ws} = \frac{(56.58)}{(56.58 + 1162.33293838)} = \underline{0.04640318} \text{ water vapor fraction}$$

Moisture Content Saturated Stack Gas

vapor pressure = e"
T_d = dry stack gas temperature, °F
T_w = wet stack gas temperature, °F

$$e'' = 6.08764\times10^{-6}\times tw^3 - 1.00431\times10^{-3}\times tw^2 + 0.0756026\times tw - 1.69343$$

$$e'' = 6.08764\times10^{-6}\times(87.2)^3 - 1.00431\times10^{-3}\times(87.2)^2 + 0.0756026\times(87.2) - 1.69343 = \underline{1.29894533845}$$

$$B_{ws} = \frac{\left[e'' - \left(\frac{(P_{bar} - e'')\times(t_d - t_w)}{(2800 - (1.3\times t_w))}\right)\right]}{P_s}$$

$$B_{ws} = \frac{\left[1.29894533845 - \left(\frac{(29.69 - 1.29894533845)\times(87.2 - 87.2)}{(2800 - (1.3\times 87.2))}\right)\right]}{(29.69)} = \underline{0.043750198}$$

*Use B_{ws} that is the smallest for proceeding calculations.

Molecular Weight:

Dry:

$\%N_2 = 100\% - \%O_2 - \%CO_2$

$\%N_2 = 100 - (\underline{20.9}) - (\underline{0.04}) = \underline{79.06}\ \%N_2$

$$M_d = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + (0.28 \times \%N_2)$$

$$M_d = (0.44 \times \underline{0.04}) + (0.32 \times \underline{20.9}) + (0.28 \times \underline{79.06}) = \underline{28.8424}\ \text{lb/lb} - \text{mole}$$

Wet:

$$M_w = M_d \times (1 - B_{ws}) + (18 \times B_{ws})$$

$$M_w = (\underline{28.8424}) \times (1 - \underline{0.043750198}) + (18 \times \underline{0.043750198}) = \underline{28.36604285}\ \text{lb/lb} - \text{mole}$$

Average Velocity of Stack Gas:

$$V_s = K_p \times C_p \times \sqrt{\Delta P_{avg}} \times \sqrt{\frac{T_{s(avg)}}{M_w \times P_s}} \qquad P_s = P_{bar} + \frac{P_{static}}{13.6}$$

$$P_s = (\underline{29.69}) + \frac{(\ 0\ )}{13.6} = \underline{29.69}$$

$$V_s = 85.49 \times \underline{0.84} \times \underline{0.1089} \times \sqrt{\frac{(\ 87.2 + 460)}{\underline{28.36604285} \times \underline{29.69}}} = \underline{6.30341268}\ \text{ft/sec}$$

Volume Flow Rate:

$$Q_{std} = 60 \times (1 - B_{ws}) \times V_s \times A_d \times \frac{T_{std} \times P_s}{T_{s\,(avg)} \times P_{std}}$$

$$Q_{std} = 60 \times (1 - \underline{0.043750198}) \times \underline{6.303412684} \times \underline{0.7853975} \times \frac{528 \times 29.69}{(\underline{87.2} + 460) \times 29.92} = \underline{271.97207}\ \text{dscfm}$$

Percent Isokinetic:

$$I = \frac{0.0945 \times (T_s + 460) \times V_{m(std)}}{P_s \times V_s \times A_n \times \theta \times (1 - B_{ws})}$$

$$I = \frac{0.0945 \times (\ 87.2 + 460) \times (1162.73293838)}{\underline{29.69} \times \underline{6.303412684} \times \underline{0.00128824934} \times \underline{3160} \times (1 - \underline{0.043750198})} = \underline{82.0113}\ \%$$

Particulate (front half) Calculations:

M_{FH} = weight of front half particulate matter, g
M_{pn} = mass of probe& nozzle rinse, g
M_F = mass of filter, g
Mb = måss of field total cpm blank (shall not exceed 2 mg), g
0.0154 = conversion of mg to grains (gr)
1/7000 = conversion of grains to pounds
M_n = weight of particulate in mg

Blank Correction:

$$M_{FH} = M_{pn} + M_F - M_b \quad = (0.0023) + (0.0007) - (0.0005) = \underline{0.0025}\ \text{g}$$

as gr/dscf:

$$C_s = \frac{0.0154 \times M_n}{V_{m(std)}} = \frac{0.0154 \times (2.5)}{(1162.73295838)} = \underline{3.3116 \times 10^{-5}}\ \text{gr/dscf}$$

as gr/dscf @ 7% O_2:

NA

$$C_s = \frac{(C_s \text{ as gr/dscf}) \times (20.9 - 7)}{(20.9 - O_{2measured})} = \frac{(3.3116 \times 10^{-5}) \times 13.9}{(20.9 - \underline{20.9})} = \underline{\qquad}\ \text{gr/dscf}$$

as lb/hour:

$$C_s = \frac{(C_s \text{ as gr/dscf}) \times Q_{std} \times 60}{7000} = \frac{(3.3116 \times 10^{-5}) \times (271.93207) \times 60}{7000} = \underline{7.31845 \times 10^{-5}}\ \text{lb/hr}$$

Particulate (back half) Calculations:

Blank Correction:

$$M_{cpm} = M_i + M_o - M_b \quad = (0.0070) + (0.0144) - (0.0020) = \underline{0.0194}\ \text{g}$$

as gr/dscf:

$$C_s = \frac{0.0154 \times M_n}{V_{m(std)}} = \frac{0.0154 \times (19.4)}{(1162.73295838)} = \underline{2.5694 \times 10^{-4}}\ \text{gr/dscf}$$

as gr/dscf @ 7% O_2:

NA

$$C_s = \frac{(C_s \text{ as gr/dscf}) \times (20.9 - 7)}{(20.9 - O_{2\,measured})} = \frac{(\_\_\_\_\_\_) \times 13.9}{(20.9 - \_\_\_\_\_\_)} = \_\_\_\_\_\_ \text{ gr/dscf}$$

as lb/hour:

$$C_s = \frac{(C_s \text{ as gr/dscf}) \times Q_{std} \times 60}{7000} = \frac{(2.56946 \times 10^{-4}) \times (271.97207) \times 60}{7000} = 5.9899 \times 10^{-4} \text{ lb/hr}$$

Technician Signature ______________

7.3 Meter Calibration

METHOD 5 DRY GAS METER CALIBRATION USING CRITICAL ORIFICES

1) Select three critical orifices to calibrate the dry gas meter which bracket the expected operating range.
2) Record barometric pressure before and after calibration procedure.
3) Run at tested vacuum (from Orifice Calibration Report), for a period of time necessary to achieve a minimum total volume of 5 cubic feet.
4) Record readings in outlined boxes below, other columns are automatically calculated.

DATE: 8/21/2012 METER SERIAL #: 1095387
METER PART #: HP-D CRITICAL ORIFICE SET SERIAL #: co-1545a

BAROMETRIC PRESSURE (in Hg): INITIAL 29.34 FINAL 29.84 AVG (P_{bar}) 29.84

IF Y VARIATION EXCEEDS 2.00%, ORIFICE SHOULD BE RECALIBRATED

ORIFICE #	RUN #	K' FACTOR (AVG)	TESTED VACUUM (in Hg)	DGM READINGS (FT³) INITIAL	FINAL	NET (V_m)	TEMPERATURES °F AMBIENT	DGM INLET INITIAL	DGM INLET FINAL	DGM OUTLET INITIAL	DGM OUTLET FINAL	DGM AVG	ELAPSED TIME (MIN) θ	DGM ΔH (in H_2O)	(1) V_m (STD)	(2) V_{cr} (STD)	(3) Y	Y VARIATION (%)	$\Delta H_@$
13	1	0.5155	16	643.450	648.700	5.330	69	69	70	69	69	69.25	8.00	1.5	5.3238	5.3620	1.005		1.80
	2	0.5155	16	648.780	654.132	5.352	70	70	71	69	71	70.25	8.00	1.5	5.3357	5.3470	1.002		1.80
	3	0.5155	16	654.132	659.464	5.332	71	71	72	71	72	71.5	8.00	1.5	5.3032	5.3419	1.007		1.80
																AVG =	1.005	0.51	
24	1	0.6497	10	659.464	665.355	5.891	72	72	73	72	72	72.25	7.00	2.3	5.0624	5.0855	1.004		1.82
	2	0.6497	10	665.356	671.268	5.913	72	73	73	72	72	72.5	7.00	2.3	5.0816	5.0855	1.001		1.82
	3	0.6497	10	671.268	677.175	5.907	72	73	73	72	72	72.6	7.00	2.3	5.0756	5.0856	1.002		1.82
																AVG =	1.002	0.23	
16	1	0.443	10	677.175	683.018	5.843	72	73	74	72	73	73	10.00	1.1	5.7894	5.7320	0.990		1.87
	2	0.443	10	683.018	688.843	5.825	72	74	74	73	73	73.5	10.00	1.1	5.7662	5.7320	0.994		1.86
	3	0.443	10	688.843	694.679	5.836	72	74	74	73	73	73.5	10.00	1.1	5.7771	5.7320	0.992		1.86
																AVG =	0.992	-0.75	

USING THE CRITICAL ORIFICES AS CALIBRATION STANDARDS:
The following equations are used to calculate the standard volumes of air passed through the DGM, V_m (std), and the critical orifice, V_{cr} (std), and the DGM calibration factor, Y. These equations are automatically calculated

AVERAGE DRY GAS METER CALIBRATION FACTOR, Y = 1.000

AVERAGE $\Delta H_@$ = 1.86

(1) $$V_{m_{(std)}} = K_1 \cdot V_m \cdot \frac{P_{bar} + (\Delta H / 13.6)}{T_m}$$ = Volume of gas sample passed through DGM, corrected to standard conditions
K_1 = 17.64 °R/in. Hg (English), 0.3858 °K/mm Hg (Metric)
T_m = Absolute DGM avg. temperature (°R - English, °K - Metric)

$$\Delta H_@ = \left(\frac{0.75\,\theta}{V_{cr}(std)}\right)^2 \Delta H \left(\frac{V_m(std)}{V_m}\right)$$

(2) $$V_{cr_{(std)}} = K' \cdot \frac{P_{bar} \cdot \Theta}{\sqrt{T_{amb}}}$$ = DGM calibration factor

(3) $$Y = \frac{V_{cr_{(std)}}}{V_{m_{(std)}}}$$ = Volume of gas sample passed through the critical orifice, corrected to standard conditions
T_{amb} = Absolute ambient temperature (°R - English, °K - Metric)
K' = Average K' factor from Critical Orifice Calibration

METHOD 5 DRY GAS METER CALIBRATION USING CRITICAL ORIFICES

1) Select three critical orifices to calibrate the dry gas meter which bracket the expected operating range.
2) Record barometric pressure before and after calibration procedure.
3) Run at tested vacuum (from Orifice Calibration Report), for a period of time necessary to achieve a minimum total volume of 5 cubic feet.
4) Record readings in outlined boxes below, other columns are automatically calculated.

DATE: 2/8/13 METER SERIAL #: 1695387
METER PART #: HF-D CRITICAL ORIFICE SET SERIAL #: co-1645s

BAROMETRIC PRESSURE (in Hg): INITIAL 29.83 FINAL 29.85 AVG (P_{bar}) 29.84

IF Y VARIATION EXCEEDS 2.00%, ORIFICE SHOULD BE RECALIBRATED

ORIFICE #	RUN #	K' FACTOR (AVG)	TESTED VACUUM (in Hg)	DGM READINGS (FT³) INITIAL	DGM READINGS FINAL	NET (V_m)	TEMPERATURES °F AMBIENT	DGM INLET INITIAL	DGM INLET FINAL	DGM OUTLET INITIAL	DGM OUTLET FINAL	DGM AVG.	ELAPSED TIME (MIN) θ	DGM ΔH (in H_2O)	(1) V_m (STD)	(2) V_{cr} (STD)	(3) Y	Y VARIATION (%)	$\Delta H_@$
	1					.0						0							
	2					.0						0							
	3					.0						0							
																AVG =			
24	1	0.0497	20	397.70	403.426	5.726	68	42	43	38	39	40.5	7.00	2.36	6.0607	5.9150	0.977		1.96
	2	0.0497	20	403.425	410.024	6.598	66	43	48	39	43	43.25	8.00	2.35	6.9465	6.7710	0.975		1.94
	3	0.0497	20	410.024	416.311	5.787	66	48	51	43	45	46.75	7.00	2.35	6.0497	5.9190	0.978		1.93
																AVG =	0.977	0.00	
	1					.0						0							
	2					.0						0							
	3					.0						0							
																AVG =			

USING THE CRITICAL ORIFICES AS CALIBRATION STANDARDS:
The following equations are used to calculate the standard volumes of air passed through the DGM, V_m (std).

AVERAGE DRY GAS METER CALIBRATION FACTOR, Y = 0.977

AVERAGE $\Delta H_@$ = 1.94

(1) $V_{m_{(std)}} = K_1 * V_m * \frac{P_{bar} + (\Delta H / 13.6)}{T_m}$ = Net volume of gas sample passed through DGM, corrected to standard conditions
K_1 = 17.64 °R/in. Hg (English), 0.3858 °K/mm Hg (Metric)
T_m = Absolute DGM avg. temperature (°R - English, °K - Metric)

$$\Delta H_@ = \left(\frac{0.75\,\theta}{V_{cr}(std)}\right)^2 \Delta H \left(\frac{V_m(std)}{V_m}\right)$$

(2) $V_{cr_{(std)}} = K' * \frac{P_{bar} * \Theta}{\sqrt{T_{amb}}}$ = Volume of gas sample passed through the critical orifice, corrected to standard conditions
T_{amb} = Absolute ambient temperature (°R - English, °K - Metric)
K' = Average K' factor from Critical Orifice Calibration

(3) = DGM calibration factor

7.4 Temperature Sensor Calibrations

Meter Box Temperature Read-out Checks

Date: 9/5/2012 Calibrator: DJW

Read out ID	Meter Box #	Set Temp.	Box Temp.	Set Temp.	Box Temp.	Set Temp.	Box Temp.	% Diff.	% Diff.	% Diff.
Main #1	HF-A	250	251	125	126	68	68	-0.19	-0.25	0.00
Main #2	HF-A	250	252	125	125	68	68	-0.38	0.00	0.00
Main #3	HF-A	250	253	125	126	68	69	-0.57	-0.25	-0.29
Main #4	HF-A	250	252	125	124	68	68	-0.38	0.25	0.00
Main #5	HF-A	250	253	125	126	68	68	-0.57	-0.25	0.00
Probe	HF-A	250	252	125	126	68	69	-0.38	-0.25	-0.29
Main #1	HF-I	250	252	125	126	68	69	-0.38	-0.25	-0.29
Main #2	HF-I	250	252	125	125	68	69	-0.38	0.00	-0.29
Main #3	HF-I	250	252	125	125	68	68	-0.38	0.00	0.00
Main #4	HF-I	250	252	125	125	68	66	-0.38	0.00	0.59
Probe	HF-I	250	249	125	124	68	68	0.19	0.25	0.00
Filter	HF-I	250	250	125	125	68	67	0.00	0.00	0.29
Main #1	HF-M	250	252	125	125	68	67	-0.38	0.00	0.29
Main #2	HF-M	250	253	125	125	68	69	-0.57	0.00	-0.29
Main #3	HF-M	250	253	125	125	68	68	-0.57	0.00	0.00
Main #4	HF-M	250	251	125	124	68	69	-0.19	0.25	-0.29
Main #5	HF-M	250	253	125	126	68	68	-0.57	-0.25	0.00
Probe	HF-M	250	251	125	126	68	70	-0.19	-0.25	-0.59
Filter	HF-M	250	252	125	126	68	69	-0.38	-0.25	-0.29
Main #1	HF-E	250	251	125	126	68	68	-0.19	-0.25	0.00
Main #2	HF-E	250	251	125	126	68	70	-0.19	-0.25	-0.59
Main #3	HF-E	250	251	125	126	68	69	-0.19	-0.25	-0.29
Main #4	HF-E	250	251	125	126	68	69	-0.19	-0.25	-0.29
Main #5	HF-E	250	251	125	126	68	68	-0.19	-0.25	0.00
Probe	HF-E	250	251	125	126	68	68	-0.19	-0.25	0.00
Filter	HF-E	250	251	125	126	68	69	-0.19	-0.25	-0.29
Main #1	HF-B	250	249	125	126	68	72	0.19	-0.25	-1.17
Main #2	HF-B	250	249	125	126	68	70	0.19	-0.25	-0.59
Main #3	HF-B	250	249	125	127	68	70	0.19	-0.50	-0.59
Main #4	HF-B	250	249	125	126	68	70	0.19	-0.25	-0.59
Main #5	HF-B	250	251	125	126	68	69	-0.19	-0.25	-0.29
Probe	HF-B	250	252	125	127	68	69	-0.38	-0.50	-0.29
Filter	HF-B	250	250	125	125	68	70	0.00	0.00	-0.59
Main #1	HF-D	250	257	125	124	68	65	-1.34	0.25	0.88
Main #2	HF-D	250	258	125	124	68	66	-1.53	0.25	0.59
Main #3	HF-D	250	257	125	124	68	62	-1.34	0.25	1.76
Main #4	HF-D	250	255	125	122	68	64	-0.96	0.75	1.17
Main #5	HF-D	250	256	125	122	68	64	-1.15	0.75	1.17
Main #6	HF-D	250	256	125	122	68	65	-1.15	0.75	0.88
Probe	HF-D	250	252	125	125	68	66	-0.38	0.00	0.59
Filter	HF-D	250	252	125	125	68	63	-0.38	0.00	1.47
Main #1	HF-J	250	251	125	126	68	66	-0.19	-0.25	0.59
Main #2	HF-J	250	251	125	127	68	66	-0.19	-0.50	0.59
Main #3	HF-J	250	251	125	127	68	66	-0.19	-0.50	0.59
Main #4	HF-J	250	251	125	126	68	66	-0.19	-0.25	0.59
Probe	HF-J	250	251	125	125	68	65	-0.19	0.00	0.88
Filter	HF-J	250	251	125	125	68	66	-0.19	0.00	0.59
Main #1	LF-3-1598D	250	252	125	125	68	66	-0.38	0.00	0.59
Main #2	LF-3-1598D	250	252	125	126	68	66	-0.38	-0.25	0.59
Main #3	LF-3-1598D	250	252	125	126	68	66	-0.38	-0.25	0.59
Main #4	LF-3-1598D	250	253	125	126	68	67	-0.57	-0.25	0.29
Probe	LF-3-1598D	250	252	125	126	68	67	-0.38	-0.25	0.29
Filter	LF-3-1598D	250	252	125	126	68	66	-0.38	-0.25	0.59

Themocouple Calibrations

Date: 9/5/2012 Operator: DJW Ref. ID#: Control Company

S/N: 90832009

Therm. ID #	Ref. Set Point in Degrees C			Thermocouple Response In Degrees C			Difference in %		
	Ice	Ambient	Boiling				Ice	Ambient	Boiling
3361	1	20	103	0	20	101	0.365	0.000	0.532
P-537	1	20	102	1	19	102	0.000	0.341	0.000
ETI 73	1	20	101	0	20	100	0.365	0.000	0.267
PT-1	1	20	101	0	19	101	0.365	0.341	0.000
3296	1	20	98	0	20	98	0.365	0.000	0.000
3311	1	19	98	0	20	97	0.365	-0.342	0.270
3314	1	20	104	1	20	101	0.000	0.000	0.796
3353	1	19	98	0	20	98	0.365	-0.342	0.000
PT-2	1	20	102	1	20	100	0.000	0.000	0.533
ETI60B	1	20	99	1	20	100	0.000	0.000	-0.269
ETI40A	1	19	98	0	20	100	0.365	-0.342	-0.539
P-441	1	20	100	1	20	100	0.000	0.000	0.000
HF-E in	1	21	103	1	20	101	0.000	0.340	0.532
HF-B in	1	19	100	1	18	101	0.000	0.342	-0.268
HF-B out	1	19	100	2	18	100	-0.365	0.342	0.000
HF-D in	1	21	100	1	20	100	0.000	0.340	0.000
HF-D out	1	20	103	1	20	101	0.000	0.000	0.532
HF-E out	1	21	103	1	20	101	0.000	0.340	0.532
HF-M in	1	20	100	1	20	101	0.000	0.000	-0.268
HF-M out	1	20	100	1	21	100	0.000	-0.341	0.000
HF-I in	1	18	100	0	18	99	0.365	0.000	0.268
HF-I out	1	18	100	0	19	100	0.365	-0.344	0.000

Date: 9/5/2012 Operator: DJW Ref. ID#: Control Company

S/N: 90832009

Therm. ID #	Ref. Set Point in Degrees C			Thermocouple Response In Degrees C			Difference in %		
	Ice	Ambient	Boiling				Ice	Ambient	Boiling
3363	4	20	101	5	20	100	-0.36	0.00	0.27
3464	5	20	101	5	20	100	0.00	0.00	0.27
3226	4	20	100	5	20	100	-0.36	0.00	0.00
3482	5	20	100	5	20	100	0.00	0.00	0.00
3468	4	20	101	5	20	100	-0.36	0.00	0.27
3312	4	20	101	4	20	100	0.00	0.00	0.27
3377	4	20	100	5	20	100	-0.36	0.00	0.00
3474	4	20	100	3	20	100	0.36	0.00	0.00
3375	2	20	100	3	20	100	-0.36	0.00	0.00
3264	4	20	100	4	20	100	0.00	0.00	0.00
3357	5	20	100	4	19	100	0.36	0.34	0.00
3376	4	20	100	3	20	100	0.36	0.00	0.00
3074	3	20	100	3	22	100	0.00	-0.68	0.00
3122	5	21	100	5	20	100	0.00	0.34	0.00
3360	4	20	101	4	19	100	0.00	0.34	0.27
3081	5	20	100	5	20	100	0.00	0.00	0.00
3364	4	20	100	5	20	100	-0.36	0.00	0.00
3265	5	20	99	4	19	100	0.36	0.34	-0.27
3351	4	20	100	5	20	100	-0.36	0.00	0.00
3352	4	20	100	5	19	100	-0.36	0.34	0.00
3355	4	20	101	5	19	100	-0.36	0.34	0.27
3354	5	20	100	5	19	100	0.00	0.34	0.00
3069	4	20	100	5	19	100	-0.36	0.34	0.00
3358	3	20	101	4	19	100	-0.36	0.34	0.27
3436	3	20	100	4	20	100	-0.36	0.00	0.00
2032	3	19	101	2	20	99	0.36	-0.34	0.53
PR-2	2	20	100	1	21	99	0.36	-0.34	0.27
ETI 16	2	20	101	2	20	99	0.00	0.00	0.53
ETI 14	2	20	101	2	19	99	0.00	0.34	0.53
ETI 3	2	20	100	2	20	99	0.00	0.00	0.27
ETI 2	1	20	101	2	20	99	-0.36	0.00	0.53
ETI 12	2	20	99	2	19	99	0.00	0.34	0.00
ETI 4	2	20	100	2	19	99	0.00	0.34	0.27
ETI 15	2	20	99	2	19	99	0.00	0.34	0.00

7.5 Pitot Tube Calibration

ETI Emission Technologies, Inc.

S-Type Pitot Tube Calibration Sheet

Pitot I. D.:	PR-2
Calibration Date:	1/7/2013
Calibrated By:	David Wagner
Pitot C_p =	0.84
Tube Diameter (D_t)=	0.375
P_a=	0.470
P_b=	0.470
P_t=	0.940
$P_a + P_b = P_t$	(See Figure 2-2 (b))

Is $1.05D_t$ <= $P_{a\ or\ b}$ <= $1.5D_t$

Pass
YES

Transverse tube (See Figure 2-3 (a) & (b))

α_1	α_2	Limit	Pass
0	0	<5°	YES

Longitudinal Tube (See Figures 2-3 (c), (d) & (e))

β_1	β_2	Limit	Pass
0	1	<5°	YES

Longitudinal Tube (See Figures 2-3 (f))

z - angle	z	Limit	Pass
0	0.000	<= 0.125"	YES

Longitudinal Tube (See Figures 2-3 (g))

w - angle	w	Limit	Pass
1	0.016	<= 0.03125"	YES

Comments:

END OF TEST REPORT