Sierra Pacific Industries
Dry Kiln

Emissions Testing for
Filterable and Condensable Particulates

Report Number: 13-2476

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: 7-8-13 Signed: ____________________

Operations Manager, QSTI 2012-656

Robert Rusi

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: 7-8-13 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: May 29- June 1, 2013

Date Issued: July 8, 2013

Revision Log

Revision No.	Revision Date	Revised Sections	Notes	Initials

<u>Emission Test Summary:</u>

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.):	Board feet dry, Final % moisture content
Regulation requiring test: --- Required frequency of test:	--- Engineering
--- Actual Test Date(s)	--- May 29-June 1, 2013
Test Method(s): --- Modifications (if any):	US EPA Methods 1, 2, 3, 4, 5 & 202 ---
Pollutant(s), units: --- Emission Factor	Total particulates; grains/dscf, lb/hr, lb/Mbf --- 0.022 lb/Mbf for Douglas fir, and 0.051 lb/Mbf for hemlock
Average Emission/Concentration: (include averaging time, correction if applicable)	0.00029gr/dscf 0.00065 lb/hr 0.0197 lb/Mbf
In Compliance (Y/N)	

Sierra Pacific Industries

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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 Background

The following excerpts are taken from a memorandum dated April 11, 2012 from Environ (on behalf of SPI) to NWCAA:

SPI operates a lumber manufacturing facility in Burlington, Washington that, from an air emissions perspective, primarily consists of a cogeneration unit, a sawmill and planer mill, and six double-track steam-heated lumber dry kilns. Air pollutant emissions attributable to the facility are governed by permits issued by the Washington Department of Ecology (Ecology) and NWCAA. The Prevention of Significant Deterioration (PSD) permit issued by Ecology (PSD 05- 04, Amendment 1) limits the quantity of lumber dried in the kilns to 804 thousand board feet per day (Mbf/day) if only hemlock is dried, or 1,608 Mbf/day – a total day's load – if hemlock and other wood species are dried. The air permit application submitted on June 10, 2008 included PM emission rates for the kiln, which were calculated using the maximum expected kiln throughput and emission factors for the two principal wood species processed by the facility: hemlock and Douglas fir. Typically, emission factors for a proposed emission unit are obtained from source tests performed by stack testing companies or manufacturers on similar existing emission units. For some emission unit categories, multiple source tests have been compiled into databases, and representative emission factors have been calculated by the U.S. EPA or state agencies (e.g., U.S. EPA's AP- 42) using the database information. Steam-heated lumber dry kilns began receiving attention from an air pollution perspective approximately 15 or 20 years ago, and the majority of that interest has been focused on volatile organic compounds (VOCs) and hazardous air pollutants (HAPs), not PM. Source testing of in-use production kilns is extremely difficult, so most emission factor studies have been done in laboratories on scaled-down versions of production kilns. The few studies that have produced PM emission factors for kilns were done in the 1990s, and all confirm that steam-heated kilns do not produce non-condensable (i.e., filterable) PM of any size. This is not surprising, because kilns heated by steam do not feature either of the primary mechanisms for producing filterable PM: fuel combustion or mechanical generation (e.g., cutting, grinding). Source tests conducted on kilns indicate that the PM emitted by kilns is comprised of VOCs that condense and coagulate to form small particles, the vast majority of which are less than 2.5 microns in diameter. This, in addition to a widely accepted understanding of the processes that generate PM2.5, is the basis for the assumption that all PM from kilns is condensable PM2.5. In fact, the PSD permit essentially equates PM10 and PM2.5 with respect to kiln emissions, in that the criterion for terminating the PM2.5 monitoring required by the permit is a kiln PM10 emission rate threshold. The only instances of agency-endorsed PM emission factors for steam-heated kilns that ENVIRON was been able to identify during the preparation of the PSD permit application were the emission factors provided in Oregon Department Environmental Quality (ODEQ) Forms AQEF02,2 AQGP-110,3 and AQGP-010.4 Among other things, these forms provide PM emission factors for both Douglas fir and hemlock lumber dried by a steam-heated kiln. Because there is some variability in the PM emission factor for hemlock within the forms, ENVIRON requested the source test results upon which the emission factors were based. ODEQ staff provided the results of the underlying tests, which were conducted using a 16-foot-long, laboratory-scale version of a Wellons production kiln5 in the Forest Research Lab at Oregon State University in Corvallis, Oregon. Two hemlock tests were conducted in November 1998, and two Douglas fir tests were conducted in December 1998. The tests, which used ODEQ Method 7 to measure condensable PM, resulted in emission factors of 0.022 lb/Mbf for Douglas fir, and 0.051 lb/Mbf for hemlock. These four laboratory source tests, conducted over 13 years ago in a laboratory, constitute the basis for the emission factors used to calculate PM emission rates for steam-heated kilns drying Douglas fir and hemlock in the PSD permit application (the "calculated kiln emissions rates"). SPI, with this test desires to use the results of the kiln testing as further specified with the intent that the data will support a decrease in the emission factor used for Hemlock during kiln drying operations. This emission factor change is ultimately intended to modify the PSD permit for the facility to allow increase in Hemlock throughput at the kiln based on the anticipated lower emission factors.

1.3 Test Overview

Testing was conducted from May 29-June 1, 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. For Quality Assurance precision determination, ETI sampled the test kiln simultaneously using two Method 5/202 trains. Table 1.1 presents the test protocol used.

Table 1.1 Test Protocol

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

1.4 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.

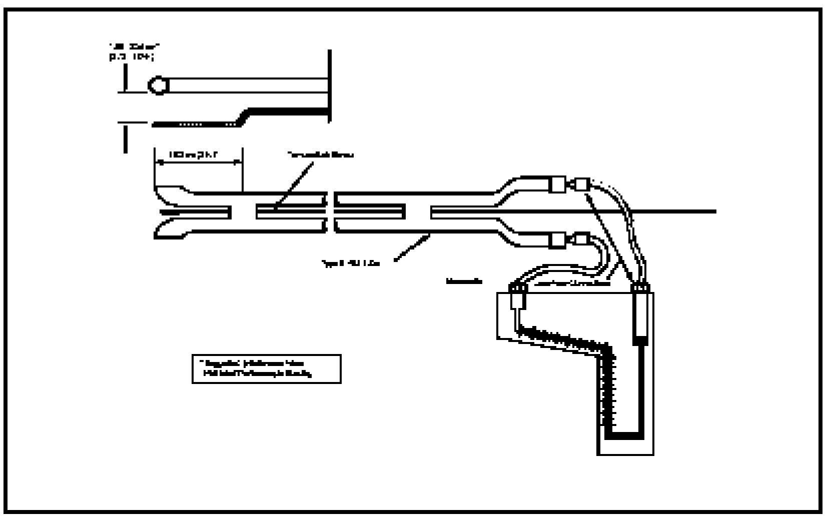


Figure 1.1 Pitot Tube Manometer Assembly

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.

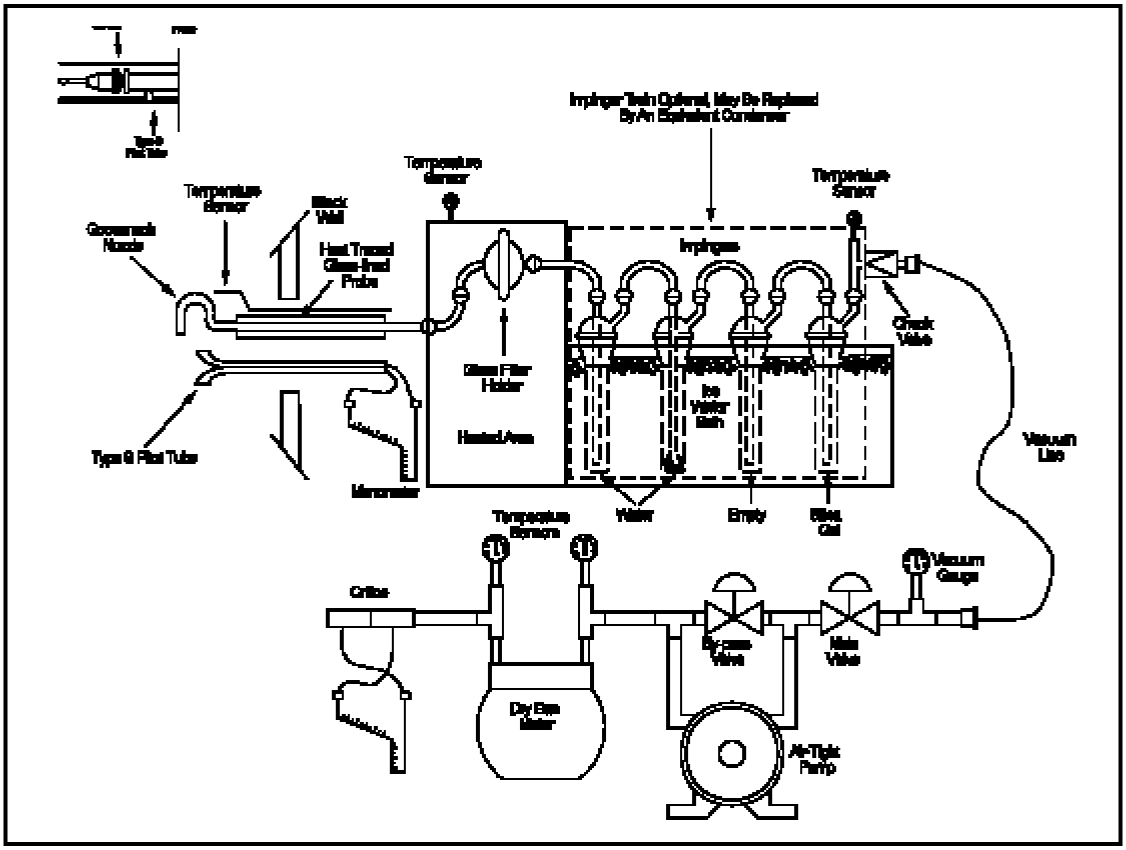
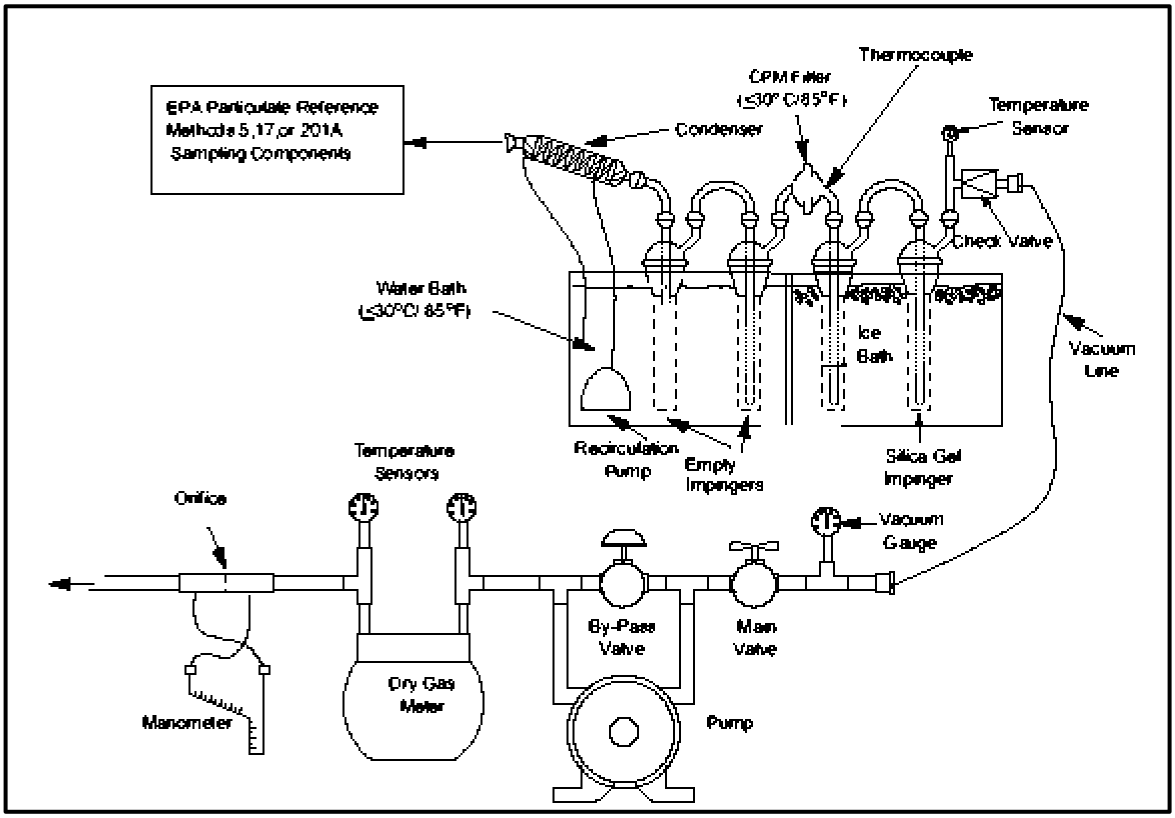


Figure 1.2 EPA Method 5 Diagram

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.



1.5 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 grains per dry standard cubic foot (gr/dscf), pounds per hour (lb/hr) and pounds per thousand board feet (lb/Mbf).

Table 1.2 Performance Test Results

Unit	Parameter	Test Average
Dry Kiln	$PM_{2.5}$	0.00029 gr/dscf
Dry Kiln	$PM_{2.5}$	0.00065 lb/hr
Dry Kiln	$PM_{2.5}$	0.0197 lb/Mbf

The emission rates presented in the summaries are referenced to EPA standard conditions of 29.92 inches of mercury (“Hg) and 68 ^{o}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.

1.6 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 69 hours and the boards were dried to 10.3 % moisture content with a standard deviation of 3.1%.

1.7 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 (site photos in Section 7).

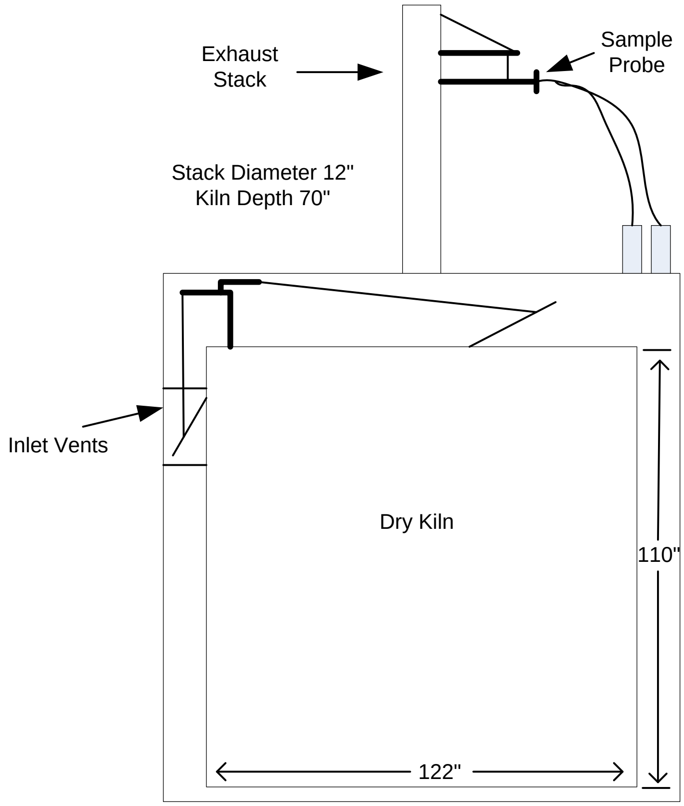


Figure 1.3 SPI Stack Diagram

1.8 Participants

- Mr. Robert Rusi, Project Manager, QSTI 2012-656
- Mr. Robert Wilson, Field Technician
- 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	**Bd-Ft Dried:** 2267	**Date:** 05/29/13 - 06/01/13	
	Test Hours: 69		
Unit: Dry Kiln	**Lbf (Mbf/hr):** 0.0329	**ETI Job Number:** 13-2476	

Filterable Catch	**Run Number**		
	HF I	**HFK**	**Average**
mg	3.8	3.4	**3.6**
gr/dscf	0.00004	0.00003	**0.00004**
lb/hr	0.00010	0.00006	**0.00008**
Condensable Catch	**Run Number**		
	HF I	**HFK**	**Average**
Organic Fraction			
mg	6.4	11.1	**8.8**
gr/dscf	0.00007	0.00009	**0.00008**
lb/hr	0.00016	0.00020	**0.00018**
Inorganic Fraction			
mg	15.0	21.0	**18.0**
gr/dscf	0.00017	0.00018	**0.00017**
lb/hr	0.00038	0.00038	**0.00038**
Total Condensable			
gr/dscf	0.00025	0.00027	**0.00026**
lb/hr	0.00054	0.00059	**0.00056**
Total Particulate	**Run Number**		
	HF I	**HFK**	**Average**
mg	25.2	35.5	**30.4**
gr/scf	0.00028	0.00028	**0.00028**
gr/dscf	0.00029	0.00030	**0.00029**
lb/hr	0.00064	0.00065	**0.00064**
lb/Mbf	0.0194	0.0198	**0.0196**

3. ETI FIELD TEST DATA

Table 3.1 Flows & Moisture Field Data

Client:	Sierra Pacific	**Date:**	05/29/13 - 06/01/13
Site:	Dry Kiln	**ETI Job Number:**	13-2476

		Run Number:	
		HF I	**HFK**
	Run Start Time:		
	Run Finish Time:		
θ	Sample Time, minutes	4140	4140
	Stack Shape (Circle or Rectangle):		Circle
V_m	Dry Gas Meter Reading,dcf ....INITIAL:	428.600	665.649
	FINAL:	1790.165	2549.625
V_m	Volume of dry gas sampled, dcf	1361.565	1883.976
Y	Meter box calibration factor	0.992	0.999
P_{bar}	Barometric pressure, inches Hg	29.65	29.65
P_{static}	Stack static pressure, inches H_2O	0.00	0.00
ΔH	Differential meter press, inches H_2O	0.3217	0.6555
T_m	Meter temperature, degrees F	73.0	74.3
V_{lc}	Volume of H_2O collected, ml	1562.0	2110.0
% O_2	Percent of oxygen in stack gas	20.90	20.90
% CO_2	Percent carbon dioxide in stack gas	0.10	0.10
C_p	Type-S pitot tube coefficient	0.84	0.84
$\sqrt{\Delta P}_{avg}$	Ave. square root of pitot readings, (inches $H_2O)^{1/2}$	0.1045	0.1047
T_s	Stack temperature, degrees F	104.1	104.1
D_s	Stack diameter, feet - CIRCLE	1.00	1.00
L_s, W_s	Stack dimensions, feet - RECTANGLE		
D_n	Nozzle diameter, inches	0.418	0.496
A_n	Nozzle area, ft^2	0.000953	0.00134
Calculated Values:			
$V_{m(std)}$	Meter corrected volume,dscf	1326.986	1846.112
$V_{w(std)}$	Volume of water vapor,dscf	73.648	99.487
B_{ws}	Fraction of H_2O vapor	0.0526	0.05113
$B_{ws/sat}$	Fraction of H_2O vapor at saturated conditions	0.0729	0.07288
% N_2	Percent nitrogen in stack gas	79.00	79.00
M_d	Dry molecular weight of stack gas, lb/lb-mole	28.85	28.85
M_w	Wet molecular weight of stack gas, lb/lb-mole	28.28	28.30
A_d	Cross sectional area of stack, ft^2	0.785	0.785
P_s	Absolute stack gas pressure, inches Hg	29.65	29.65
V_s	Average stack gas velocity, ft/sec	6.15	6.17
Q_{std}	Average stack volumetric flowrate, wscfm	269.03	269.47
Q_{std}	Average stack volumetric flowrate, dscfm	254.89	255.70
I	Percent isokinetic sampling	103.7	102.1

4. LABORATORY DATA

Table 4.1 PM Gravimetrics Data

Client: Sierra Pacific

Date: 05/29/13 - 06/01/13

Site: Dry Kiln

ETI Job Number: 13-2476

PARTICULATE LABORATORY DATA:

FRONT HALF OF TRAIN	Run Number: HF I	Run Number: HFK
Probe/Nozzle Wash Residue Wt.		
Final weight, g:	66.9431	67.2857
Tare weight, g:	66.9394	67.2829
Blank acetone weight, g	0.0001	0.0001
Weight gain, g:	0.0036	0.0027
Filter Wt.		
Final weight, g:	0.3885	0.3084
Tare weight, g:	0.3883	0.3077
Weight gain, g:	0.0002	0.0007
TOTAL FRONT HALF PARTICULATE, g:	**0.0038**	**0.0034**

BACK HALF OF TRAIN	Run Number: HF I	Run Number: HFK	Field Blank
Inorganic:			
Final weight, g:	2.0073	2.0173	2.0094
Tare weight, g:	1.9999	2.0052	2.0073
Weight gain, g:	0.0074	0.0121	0.0021
Organic:			
Final weight, g:	2.0244	2.0392	2.0125
Tare weight, g:	2.0084	2.0172	2.0104
Weight gain, g:	0.0160	0.0220	0.0021
Blank Correction, g:	0.0020		
TOTAL BACK HALF PARTICULATE, g:	**0.0214**	**0.0321**	**0.0042**
TOTAL PARTICULATE, g:	**0.0252**	**0.0355**	

5. RAW FIELD DATA SHEETS

5.1 HFI Raw Data

Nomograph

P_{bar}	29.65	$\%O_2$	20.90	ΔP_{avg}	0.00661	$D_{s,ft}$	1.00	C_p	0.84
P_{static}	0.00	$\%CO_2$	0.10	$\sqrt{\Delta P}_{avg}$	0.0808	D_n	0.418	Y	0.992
$\Delta H@$	1.83	$\%N_2$	79	B_{ws}	0.0400	A_n	0.000953	P_s	29.6500
Q_m		M_d	28.8520	M_w	28.4179			P_m	29.7846

	Time	θ	$V_{m\ start}$	$V_{m\ end}$	V_m	$T_{m\ in}$	$T_{m\ out}$	ΔP	T_s	$\sqrt{\Delta P}_{avg}$	ΔH	$V_{m(std)}$	V_s	I	Calc. D_n
5/29/13 9:27	0	15	428.600	431.852	3.252	68.0	68.0	0.0043	68.00	0.07	**0.13369**	3.198	3.73	**105.2**	0.000
5/29/13 9:42	15	15	431.852	434.743	2.891	63.0	63.0	0.0040	71.00	0.06	**0.12248**	2.870	3.61	**98.2**	0.000
5/29/13 9:57	30	15	434.743	438.176	3.433	65.0	64.0	0.0059	74.00	0.08	**0.18017**	3.396	4.39	**95.9**	0.000
5/29/13 10:12	45	15	438.176	442.180	4.004	66.0	65.0	0.0066	75.00	0.08	**0.20155**	3.953	4.65	**105.7**	0.000
5/29/13 10:27	60	15	442.180	445.838	3.658	68.0	66.0	0.0057	77.00	0.08	**0.17391**	3.598	4.33	**103.7**	0.000
5/29/13 10:42	75	15	445.838	449.927	4.089	69.0	68.0	0.0070	75.00	0.08	**0.21498**	4.014	4.79	**104.2**	0.000
5/29/13 10:57	90	15	449.927	454.016	4.089	70.0	69.0	0.0074	76.00	0.09	**0.22727**	4.007	4.93	**101.2**	0.000
5/29/13 11:12	105	15	454.016	458.119	4.103	69.0	69.0	0.0075	78.00	0.09	**0.22927**	4.028	4.97	**101.3**	0.000
5/29/13 11:27	120	15	458.119	462.662	4.543	68.0	68.0	0.0082	81.00	0.09	**0.24881**	4.469	5.21	**107.8**	0.000
5/29/13 11:42	135	15	462.662	466.918	4.256	69.0	68.0	0.0089	82.00	0.09	**0.26980**	4.179	5.43	**96.8**	0.000
5/29/13 11:57	150	15	466.918	470.426	3.508	70.0	69.0	0.0064	84.00	0.08	**0.19367**	3.437	4.62	**94.1**	0.000
5/29/13 12:12	165	15	470.426	474.417	3.991	68.0	69.0	0.0074	86.00	0.09	**0.22269**	3.926	4.97	**100.1**	0.000
5/29/13 12:27	180	15	474.417	478.800	4.383	68.0	68.0	0.0090	89.00	0.09	**0.26910**	4.312	5.50	**100.0**	0.000
5/29/13 12:42	195	15	478.800	483.407	4.607	69.0	68.0	0.0090	91.00	0.09	**0.26838**	4.523	5.51	**105.1**	0.000
5/29/13 12:57	210	15	483.407	488.332	4.925	70.0	68.0	0.0100	92.00	0.10	**0.29794**	4.827	5.81	**106.5**	0.000
5/29/13 13:12	225	15	488.332	492.929	4.597	69.0	68.0	0.0092	95.00	0.10	**0.27237**	4.514	5.59	**104.1**	0.000
5/29/13 13:27	240	15	492.929	497.200	4.271	69.0	68.0	0.0092	94.00	0.10	**0.27286**	4.193	5.59	**96.6**	0.000
5/29/13 13:42	255	15	497.200	501.900	4.700	69.0	68.0	0.0095	98.00	0.10	**0.27974**	4.615	5.70	**105.0**	0.000
5/29/13 13:57	270	15	501.9	506.571	4.671	68	68	0.0098	100	0.10	**0.28727**	4.595	5.80	**103.1**	0.000
5/29/13 14:12	285	15	506.571	511.300	4.729	67	67	0.0104	103	0.10	**0.30266**	4.661	5.99	**101.8**	0.000
5/29/13 14:27	300	15	511.3	516.539	5.239	67	67	0.0119	104	0.11	**0.34569**	5.164	6.41	**105.6**	0.000
5/29/13 14:42	315	15	516.539	521.650	5.111	68	66	0.0117	107	0.11	**0.33809**	5.029	6.37	**103.9**	0.000
5/29/13 14:57	330	15	521.65	526.590	4.940	68	67	0.0110	110	0.10	**0.31649**	4.860	6.19	**103.9**	0.000
5/29/13 15:12	345	15	526.59	531.596	5.006	70	67	0.0111	112	0.11	**0.31885**	4.906	6.23	**104.6**	0.000
5/29/13 15:27	360	15	531.596	536.361	4.765	71	68	0.0107	114	0.10	**0.30687**	4.661	6.13	**101.4**	0.000
5/29/13 15:42	375	15	536.361	541.500	5.139	72	70	0.0120	113	0.11	**0.34573**	5.018	6.49	**102.9**	0.000
5/29/13 15:57	390	15	541.5	546.650	5.150	73	71	0.0112	107	0.11	**0.32671**	5.019	6.23	**106.0**	0.000
5/29/13 16:12	405	15	546.65	551.780	5.130	72	71	0.0112	113	0.11	**0.32298**	5.009	6.27	**106.4**	0.000
5/29/13 16:27	420	15	551.78	556.930	5.150	72	71	0.0122	114	0.11	**0.35121**	5.029	6.55	**102.4**	0.000

	Time	θ	$V_{m\,start}$	$V_{m\,end}$	V_m	$T_{m\,in}$	$T_{m\,out}$	ΔP	T_s	$\sqrt{\Delta P}_{avg}$	ΔH	$V_{m(std)}$	V_s	I	Calc. D_n
5/29/13 16:42	435	15	556.93	562.000	5.070	72	71	0.0115	112	0.11	**0.33222**	4.951	6.35	**103.7**	0.000
5/29/13 16:57	450	15	562	567.100	5.100	73	71	0.0111	113	0.11	**0.32040**	4.970	6.24	**106.0**	0.000
5/29/13 17:12	465	15	567.1	572.260	5.160	73	72	0.0116	110	0.11	**0.33691**	5.029	6.36	**104.7**	0.000
5/29/13 17:27	480	15	572.26	577.360	5.100	72	71	0.0110	109	0.10	**0.31945**	4.980	6.19	**106.3**	0.000
5/29/13 17:42	495	15	577.36	582.100	4.740	72	71	0.0100	109	0.10	**0.29041**	4.628	5.90	**103.6**	0.000
5/29/13 17:57	510	15	582.1	587.070	4.970	72	71	0.0109	108	0.10	**0.31710**	4.853	6.16	**104.0**	0.000
5/29/13 18:12	525	15	587.07	591.950	4.880	73	72	0.0100	107	0.10	**0.29198**	4.756	5.89	**106.3**	0.000
5/29/13 18:27	540	15	591.95	596.790	4.840	73	72	0.0100	106	0.10	**0.29249**	4.717	5.89	**105.3**	0.000
5/29/13 18:42	555	15	596.79	601.600	4.810	73	72	0.0099	105	0.10	**0.29008**	4.687	5.85	**105.1**	0.000
5/29/13 18:57	570	15	601.6	606.500	4.900	74	72	0.0108	104	0.10	**0.31731**	4.767	6.11	**102.3**	0.000
5/29/13 19:12	585	15	606.5	611.520	5.020	73	72	0.0108	103	0.10	**0.31758**	4.892	6.10	**104.9**	0.000
5/29/13 19:27	600	15	611.52	616.420	4.900	73	72	0.0103	102	0.10	**0.30341**	4.775	5.95	**104.7**	0.000
5/29/13 19:42	615	15	616.42	621.240	4.820	73	72	0.0096	101	0.10	**0.28330**	4.697	5.74	**106.6**	0.000
5/29/13 19:57	630	15	621.24	626.200	4.960	73	72	0.0107	101	0.10	**0.31576**	4.834	6.06	**103.9**	0.000
5/29/13 20:12	645	15	626.2	631.100	4.900	73	72	0.0109	100	0.10	**0.32223**	4.776	6.11	**101.6**	0.000
5/29/13 20:27	660	15	631.1	635.830	4.730	73	72	0.0102	100	0.10	**0.30154**	4.610	5.91	**101.4**	0.000
5/29/13 20:42	675	15	635.83	640.850	5.020	74	72	0.0111	101	0.11	**0.32787**	4.883	6.17	**103.1**	0.000
5/29/13 20:57	690	15	640.85	645.840	4.990	73	72	0.0110	100	0.10	**0.32519**	4.863	6.14	**103.0**	0.000
5/29/13 21:12	705	15	645.84	650.800	4.960	74	72	0.0103	100	0.10	**0.30478**	4.825	5.94	**105.6**	0.000
5/29/13 21:27	720	15	650.8	655.900	5.100	73	72	0.0117	99	0.11	**0.34650**	4.971	6.33	**102.0**	0.000
5/29/13 21:42	735	15	655.9	661.210	5.310	73	72	0.0114	99	0.11	**0.33762**	5.175	6.25	**107.6**	0.000
5/29/13 21:57	750	15	661.21	666.500	5.290	73	72	0.0118	99	0.11	**0.34947**	5.156	6.35	**105.4**	0.000
5/29/13 22:12	765	15	666.5	671.570	5.070	73	72	0.0108	100	0.10	**0.31928**	4.941	6.08	**105.6**	0.000
5/29/13 22:27	780	15	671.57	676.540	4.970	72	71	0.0104	100	0.10	**0.30688**	4.853	5.97	**105.7**	0.000
5/29/13 22:42	795	15	676.54	681.480	4.940	72	71	0.0102	101	0.10	**0.30044**	4.823	5.92	**106.2**	0.000
5/29/13 22:57	810	15	681.48	686.300	4.820	72	71	0.0107	101	0.10	**0.31517**	4.706	6.06	**101.2**	0.000
5/29/13 23:12	825	15	686.3	691.430	5.130	70	71	0.0124	102	0.11	**0.36390**	5.029	6.53	**100.5**	0.000
5/29/13 23:27	840	15	691.43	696.310	4.880	68	69	0.0117	102	0.11	**0.34207**	4.801	6.34	**98.8**	0.000
5/29/13 23:42	855	15	696.31	702.100	5.790	69	68	0.0145	103	0.12	**0.42317**	5.687	7.07	**105.2**	0.000
5/29/13 23:57	870	15	702.1	707.550	5.450	71	69	0.0127	102	0.11	**0.37236**	5.332	6.61	**105.3**	0.000
5/30/13 0:12	885	15	707.55	712.850	5.300	71	69	0.0117	104	0.11	**0.34182**	5.185	6.36	**106.9**	0.000
5/30/13 0:27	900	15	712.85	718.350	5.500	69	69	0.0130	102	0.11	**0.38043**	5.402	6.69	**105.4**	0.000
5/30/13 0:42	915	15	718.35	723.540	5.190	70	69	0.0117	103	0.11	**0.34210**	5.087	6.35	**104.8**	0.000
5/30/13 0:57	930	15	723.54	728.730	5.190	72	69	0.0122	102	0.11	**0.35803**	5.068	6.48	**102.1**	0.000
5/30/13 1:12	945	15	728.73	733.940	5.210	73	70	0.0121	102	0.11	**0.35577**	5.078	6.45	**102.7**	0.000
5/30/13 1:27	960	15	733.94	739.290	5.350	73	71	0.0122	102	0.11	**0.35905**	5.215	6.48	**105.1**	0.000
5/30/13 1:42	975	15	739.29	744.630	5.340	73	71	0.0120	101	0.11	**0.35379**	5.205	6.42	**105.7**	0.000
5/30/13 1:57	990	15	744.63	749.980	5.350	73	71	0.0119	101	0.11	**0.35084**	5.215	6.39	**106.3**	0.000
5/30/13 2:12	1005	15	749.98	755.320	5.340	73	72	0.0123	101	0.11	**0.36297**	5.205	6.50	**104.4**	0.000
5/30/13 2:27	1020	15	755.32	760.750	5.430	73	72	0.0122	101	0.11	**0.36002**	5.293	6.47	**106.5**	0.000
5/30/13 2:42	1035	15	760.75	766.170	5.420	73	72	0.0125	101	0.11	**0.36888**	5.283	6.55	**105.1**	0.000
5/30/13 2:57	1050	15	766.17	771.440	5.270	73	72	0.0119	101	0.11	**0.35117**	5.137	6.39	**104.7**	0.000

	Time	θ	$V_{m\ start}$	$V_{m\ end}$	V_m	$T_{m\ in}$	$T_{m\ out}$	ΔP	T_s	$\sqrt{\Delta P}$	ΔH	$V_{m(std)}$	V_s	I	Calc. D_n
5/30/13 3:12	1065	15	771.44	776.610	5.170	73	72	0.0114	101	0.11	**0.33642**	5.039	6.26	**104.9**	0.000
5/30/13 3:27	1080	15	776.61	782.050	5.440	73	72	0.0122	101	0.11	**0.36002**	5.302	6.47	**106.7**	0.000
5/30/13 3:42	1095	15	782.05	787.320	5.270	73	72	0.0120	101	0.11	**0.35412**	5.137	6.42	**104.3**	0.000
5/30/13 3:57	1110	15	787.32	792.460	5.140	73	72	0.0115	100	0.11	**0.33997**	5.010	6.28	**103.8**	0.000
5/30/13 4:12	1125	15	792.46	797.690	5.230	73	72	0.0117	100	0.11	**0.34588**	5.097	6.33	**104.7**	0.000
5/30/13 4:27	1140	15	797.69	802.740	5.050	73	72	0.0114	100	0.11	**0.33702**	4.922	6.25	**102.4**	0.000
5/30/13 4:42	1155	15	802.74	808.130	5.390	73	72	0.0121	99	0.11	**0.35835**	5.254	6.43	**106.0**	0.000
5/30/13 4:57	1170	15	808.13	813.280	5.150	73	72	0.0120	99	0.11	**0.35539**	5.020	6.41	**101.7**	0.000
5/30/13 5:12	1185	15	813.28	818.580	5.300	73	72	0.0120	99	0.11	**0.35539**	5.166	6.41	**104.7**	0.000
5/30/13 5:27	1200	15	818.58	823.930	5.350	73	72	0.0122	99	0.11	**0.36131**	5.215	6.46	**104.8**	0.000
5/30/13 5:42	1215	15	823.93	829.280	5.350	73	72	0.0119	98	0.11	**0.35306**	5.215	6.37	**106.0**	0.000
5/30/13 5:57	1230	15	829.28	834.480	5.200	73	72	0.0113	100	0.11	**0.33406**	5.068	6.22	**105.9**	0.000
5/30/13 6:12	1245	15	834.48	839.820	5.340	73	72	0.0119	99	0.11	**0.35243**	5.205	6.38	**105.9**	0.000
5/30/13 6:27	1260	15	839.82	844.930	5.110	73	72	0.0119	100	0.11	**0.35180**	4.981	6.39	**101.4**	0.000
5/30/13 6:42	1275	15	844.93	850.220	5.290	73	72	0.0123	100	0.11	**0.36362**	5.156	6.49	**103.3**	0.000
5/30/13 6:57	1290	15	850.22	855.290	5.070	72	72	0.0110	100	0.10	**0.32489**	4.951	6.14	**104.9**	0.000
5/30/13 7:12	1305	15	855.29	860.400	5.110	72	71	0.0115	100	0.11	**0.33933**	4.990	6.28	**103.4**	0.000
5/30/13 7:27	1320	15	860.4	865.420	5.020	73	71	0.0114	101	0.11	**0.33610**	4.893	6.26	**101.9**	0.000
5/30/13 7:42	1335	15	865.42	870.190	4.770	72	72	0.0111	101	0.11	**0.32725**	4.658	6.17	**98.3**	0.000
5/30/13 7:57	1350	15	870.19	875.230	5.040	72	71	0.0116	102	0.11	**0.34107**	4.921	6.32	**101.7**	0.000
5/30/13 8:12	1365	15	875.23	880.600	5.370	72	71	0.0114	102	0.11	**0.33519**	5.244	6.26	**109.3**	0.000
5/30/13 8:27	1380	15	880.6	885.500	4.900	72	71	0.0109	104	0.10	**0.31935**	4.785	6.13	**102.2**	0.000
5/30/13 8:42	1395	15	885.5	890.500	5.000	74	72	0.0113	104	0.11	**0.33200**	4.864	6.25	**102.0**	0.000
5/30/13 8:57	1410	15	890.5	895.400	4.900	73	71	0.0112	103	0.11	**0.32903**	4.776	6.21	**100.5**	0.000
5/30/13 9:12	1425	15	895.4	900.540	5.140	73	72	0.0113	105	0.11	**0.33110**	5.010	6.25	**105.2**	0.000
5/30/13 9:27	1440	15	900.54	905.600	5.060	73	72	0.0116	105	0.11	**0.33989**	4.932	6.33	**102.2**	0.000
5/30/13 9:42	1455	15	905.6	910.600	5.000	73	72	0.0117	106	0.11	**0.34222**	4.873	6.37	**100.6**	0.000
5/30/13 9:57	1470	15	910.6	915.900	5.300	73	72	0.0108	106	0.10	**0.31589**	5.165	6.12	**111.0**	0.000
5/30/13 10:12	1485	15	915.9	921.100	5.200	73	72	0.0110	106	0.10	**0.32174**	5.068	6.17	**107.9**	0.000
5/30/13 10:27	1500	15	921.1	926.600	5.500	71	71	0.0112	100	0.11	**0.33017**	5.381	6.20	**113.0**	0.000
5/30/13 10:42	1515	15	926.6	931.900	5.300	72	70	0.0121	104	0.11	**0.35417**	5.176	6.46	**104.9**	0.000
5/30/13 10:57	1530	15	931.9	937.025	5.125	73	71	0.0117	105	0.11	**0.34250**	4.995	6.36	**103.1**	0.000
5/30/13 11:12	1545	15	937.025	941.990	4.965	74	72	0.0117	106	0.11	**0.34254**	4.830	6.37	**99.7**	0.000
5/30/13 11:27	1560	15	941.99	947.100	5.110	74	72	0.0105	109	0.10	**0.30579**	4.971	6.05	**108.6**	0.000
5/30/13 11:42	1575	15	947.1	952.000	4.900	74	72	0.0117	111	0.11	**0.33954**	4.767	6.39	**98.9**	0.000
5/30/13 11:57	1590	15	952	957.100	5.100	74	73	0.0119	114	0.11	**0.34386**	4.961	6.47	**102.3**	0.000
5/30/13 12:12	1605	15	957.1	962.050	4.950	75	73	0.0115	112	0.11	**0.33378**	4.806	6.35	**100.6**	0.000
5/30/13 12:27	1620	15	962.05	967.090	5.040	75	73	0.0105	111	0.10	**0.30529**	4.893	6.06	**107.1**	0.000
5/30/13 12:42	1635	15	967.09	971.930	4.840	75	73	0.0113	112	0.11	**0.32797**	4.700	6.29	**99.3**	0.000
5/30/13 12:57	1650	15	971.93	976.975	5.045	75	74	0.0115	113	0.11	**0.33351**	4.899	6.35	**102.7**	0.000
5/30/13 13:12	1665	15	976.975	982.090	5.115	75	74	0.0124	113	0.11	**0.35961**	4.967	6.59	**100.2**	0.000
5/30/13 13:27	1680	15	982.09	987.060	4.970	75	74	0.0116	114	0.11	**0.33582**	4.826	6.38	**100.8**	0.000

Time	θ	$V_{m\,start}$	$V_{m\,end}$	V_m	$T_{m\,in}$	$T_{m\,out}$	ΔP	T_s	$\sqrt{\Delta P}_{avg}$	ΔH	$V_{m(std)}$	V_s	I	Calc. D_n
5/30/13 13:42 1695	15	987.06	992.175	5.115	75	74	0.0122	114	0.11	0.35319	4.967	6.55	101.1	0.000
5/30/13 13:57 1710	15	992.175	997.189	5.014	75	74	0.0116	115	0.11	0.33524	4.869	6.39	101.8	0.000
5/30/13 14:12 1725	15	997.189	1002.230	5.041	75	74	0.0120	117	0.11	0.34559	4.895	6.51	100.8	0.000
5/30/13 14:27 1740	15	1002.23	1007.380	5.150	75	74	0.0112	116	0.11	0.32312	5.000	6.28	106.5	0.000
5/30/13 14:42 1755	15	1007.38	1012.470	5.090	76	74	0.0119	115	0.11	0.34423	4.933	6.47	101.8	0.000
5/30/13 14:57 1770	15	1012.47	1017.500	5.030	76	74	0.0118	118	0.11	0.33956	4.875	6.46	101.3	0.000
5/30/13 15:12 1785	15	1017.5	1022.610	5.110	77	75	0.0116	119	0.11	0.33386	4.943	6.41	103.7	0.000
5/30/13 15:27 1800	15	1022.61	1027.590	4.980	77	75	0.0119	122	0.11	0.34072	4.818	6.51	100.0	0.000
5/30/13 15:42 1815	15	1027.59	1032.650	5.060	76	75	0.0118	120	0.11	0.33871	4.904	6.47	102.1	0.000
5/30/13 15:57 1830	15	1032.65	1037.750	5.100	75	75	0.0124	120	0.11	0.35560	4.952	6.63	100.6	0.000
5/30/13 16:12 1845	15	1037.75	1042.800	5.050	76	75	0.0117	127	0.11	0.33183	4.894	6.48	102.9	0.000
5/30/13 16:27 1860	15	1042.8	1048.080	5.280	76	75	0.0118	127	0.11	0.33467	5.117	6.51	107.2	0.000
5/30/13 16:42 1875	15	1048.08	1048.080	0.000	77	75	0.0115	126	0.11	0.32702	0.000	6.42	0.0	0.000
5/30/13 16:57 1890	**15**	**1048.08**	**1053.100**	**5.020**	**77**	**75**	**0.0115**	**126**	**0.11**	**0.32702**	**4.856**	**6.42**	**102.9**	**0.000**
5/30/13 17:12 1905	15	1053.1	1058.000	4.900	75	75	0.0104	115	0.10	0.30084	4.757	6.05	105.0	0.000
5/30/13 17:27 1920	15	1058	1063.100	5.100	76	75	0.0125	114	0.11	0.36255	4.943	6.63	99.4	0.000
5/30/13 17:42 1935	15	1063.1	1068.000	4.900	76	76	0.0112	110	0.11	0.32743	4.749	6.25	100.6	0.000
5/30/13 17:57 1950	15	1068	1072.900	4.900	77	75	0.0107	110	0.10	0.31282	4.740	6.11	102.7	0.000
5/30/13 18:12 1965	15	1072.9	1078.100	5.200	77	76	0.0121	103	0.11	0.35848	5.031	6.46	101.9	0.000
5/30/13 18:27 1980	15	1078.1	1083.240	5.140	77	76	0.0120	106	0.11	0.35363	4.973	6.45	101.4	0.000
5/30/13 18:42 1995	15	1083.24	1088.500	5.260	77	76	0.0122	109	0.11	0.35763	5.089	6.32	103.2	0.000
5/30/13 18:57 2010	15	1088.5	1093.590	5.090	77	76	0.0115	112	0.11	0.33534	4.924	6.35	103.1	0.000
5/30/13 19:12 2025	15	1093.59	1098.700	5.110	77	76	0.0113	107	0.11	0.33241	4.943	6.26	104.0	0.000
5/30/13 19:27 2040	15	1098.7	1103.850	5.150	77	76	0.0117	108	0.11	0.34357	4.982	6.38	103.1	0.000
5/30/13 19:42 2055	15	1103.85	1108.950	5.100	77	76	0.0112	108	0.11	0.32889	4.934	6.24	104.3	0.000
5/30/13 19:57 2070	15	1108.95	1114.150	5.200	77	76	0.0120	107	0.11	0.35301	5.031	6.45	102.7	0.000
5/30/13 20:12 2085	15	1114.15	1119.300	5.150	77	75	0.0118	105	0.11	0.34803	4.982	6.39	102.3	0.000
5/30/13 20:27 2100	15	1119.3	1124.450	5.150	77	75	0.0119	105	0.11	0.35098	4.982	6.41	101.9	0.000
5/30/13 20:42 2115	15	1124.45	1129.700	5.250	76	75	0.0119	104	0.11	0.35127	5.088	6.41	104.0	0.000
5/30/13 20:57 2130	15	1129.7	1134.880	5.180	76	75	0.0121	104	0.11	0.35717	5.021	6.46	101.8	0.000
5/30/13 21:12 2145	15	1134.88	1140.050	5.170	75	74	0.0120	104	0.11	0.35356	5.020	6.44	102.2	0.000
5/30/13 21:27 2160	15	1140.05	1144.830	4.780	75	74	0.0110	100	0.10	0.32641	4.641	6.14	98.3	0.000
5/30/13 21:42 2175	15	1144.83	1149.760	4.930	75	74	0.0110	102	0.10	0.32525	4.787	6.15	101.6	0.000
5/30/13 21:57 2190	15	1149.76	1154.670	4.910	75	74	0.0107	102	0.10	0.31638	4.767	6.07	102.6	0.000
5/30/13 22:12 2205	15	1154.67	1159.870	5.200	74	73	0.0119	101	0.11	0.35183	5.059	6.39	103.1	0.000
5/30/13 22:27 2220	15	1159.87	1164.710	4.840	74	73	0.0103	101	0.10	0.30453	4.708	5.95	103.2	0.000
5/30/13 22:42 2235	15	1164.71	1169.880	5.170	74	73	0.0116	100	0.11	0.34357	5.030	6.31	103.7	0.000
5/30/13 22:57 2250	15	1169.88	1175.100	5.220	75	73	0.0114	99	0.11	0.33857	5.069	6.25	105.4	0.000
5/30/13 23:12 2265	15	1175.1	1180.300	5.200	75	73	0.0115	100	0.11	0.34093	5.049	6.28	104.6	0.000
5/30/13 23:27 2280	15	1180.3	1185.180	4.880	74	73	0.0105	100	0.10	0.31099	4.747	6.00	102.9	0.000
5/30/13 23:42 2295	15	1185.18	1190.080	4.900	74	73	0.0103	99	0.10	0.30561	4.766	5.94	104.2	0.000
5/30/13 23:57 2310	15	1190.08	1195.050	4.970	74	73	0.0109	100	0.10	0.32284	4.835	6.11	102.9	0.000

Time	θ	$V_{m\ start}$	$V_{m\ end}$	V_m	$T_{m\ in}$	$T_{m\ out}$	ΔP	T_s	$\sqrt{\Delta P}_{ave}$	ΔH	$V_{m(std)}$	V_s	I	Calc. D_n
5/31/13 0:12 2325	15	1195.05	1200.120	5.070	74	73	0.0107	100	0.10	0.31692	4.932	6.06	105.9	0.000
5/31/13 0:27 2340	15	1200.12	1205.180	5.060	74	73	0.0106	100	0.10	0.31395	4.922	6.03	106.2	0.000
5/31/13 0:42 2355	15	1205.18	1209.910	4.730	74	72	0.0105	100	0.10	0.31070	4.601	6.00	99.8	0.000
5/31/13 0:57 2370	15	1209.91	1215.000	5.090	73	72	0.0109	99	0.10	0.32281	4.961	6.11	105.5	0.000
5/31/13 1:12 2385	15	1215	1220.070	5.070	74	72	0.0107	99	0.10	0.31719	4.932	6.05	105.8	0.000
5/31/13 1:27 2400	15	1220.07	1225.170	5.100	74	72	0.0107	99	0.10	0.31719	4.961	6.05	106.5	0.000
5/31/13 1:42 2415	15	1225.17	1230.060	4.890	74	72	0.0105	99	0.10	0.31126	4.757	5.99	103.0	0.000
5/31/13 1:57 2430	15	1230.06	1235.080	5.020	74	72	0.0106	99	0.10	0.31422	4.883	6.02	105.3	0.000
5/31/13 2:12 2445	15	1235.08	1239.920	4.840	74	72	0.0105	99	0.10	0.31126	4.708	5.99	102.0	0.000
5/31/13 2:27 2460	15	1239.92	1244.640	4.720	73	71	0.0105	99	0.10	0.31067	4.600	5.99	99.6	0.000
5/31/13 2:42 2475	15	1244.64	1249.510	4.870	72	71	0.0107	100	0.10	0.31573	4.755	6.06	102.1	0.000
5/31/13 2:57 2490	15	1249.51	1254.410	4.900	72	70	0.0101	100	0.10	0.29774	4.784	5.88	105.8	0.000
5/31/13 3:12 2505	15	1254.41	1259.310	4.900	72	70	0.0102	99	0.10	0.30123	4.784	5.91	105.1	0.000
5/31/13 3:27 2520	15	1259.31	1264.370	5.060	72	70	0.0109	99	0.10	0.32190	4.941	6.11	105.0	0.000
5/31/13 3:42 2535	15	1264.37	1269.350	4.980	72	71	0.0110	98	0.10	0.32574	4.863	6.13	102.8	0.000
5/31/13 3:57 2550	15	1269.35	1274.180	4.830	72	71	0.0098	99	0.10	0.28969	4.716	5.79	105.7	0.000
5/31/13 4:12 2565	15	1274.18	1278.870	4.690	72	71	0.0098	99	0.10	0.28969	4.579	5.79	102.7	0.000
5/31/13 4:27 2580	15	1278.87	1283.670	4.800	72	71	0.0099	99	0.10	0.29264	4.687	5.82	104.5	0.000
5/31/13 4:42 2595	15	1283.67	1288.570	4.900	72	71	0.0109	99	0.10	0.32220	4.785	6.11	101.7	0.000
5/31/13 4:57 2610	15	1288.57	1293.260	4.690	72	71	0.0095	99	0.10	0.28082	4.579	5.70	104.3	0.000
5/31/13 5:12 2625	15	1293.26	1298.130	4.870	72	71	0.0109	99	0.10	0.32220	4.755	6.11	101.1	0.000
5/31/13 5:27 2640	15	1298.13	1302.910	4.780	72	71	0.0103	99	0.10	0.30447	4.667	5.94	102.1	0.000
5/31/13 5:42 2655	15	1302.91	1307.560	4.650	72	71	0.0097	99	0.10	0.28673	4.540	5.76	102.3	0.000
5/31/13 5:57 2670	15	1307.56	1312.210	4.650	72	71	0.0095	99	0.10	0.28082	4.540	5.70	103.4	0.000
5/31/13 6:12 2685	15	1312.21	1316.870	4.660	71	70	0.0099	99	0.10	0.29209	4.558	5.82	101.7	0.000
5/31/13 6:27 2700	15	1316.87	1321.610	4.740	71	70	0.0105	98	0.10	0.31035	4.637	5.99	100.4	0.000
5/31/13 6:42 2715	15	1321.61	1326.280	4.670	71	70	0.0103	98	0.10	0.30444	4.568	5.93	99.8	0.000
5/31/13 6:57 2730	15	1326.28	1330.990	4.710	71	70	0.0102	98	0.10	0.30148	4.607	5.90	101.2	0.000
5/31/13 7:12 2745	15	1330.99	1335.740	4.750	71	70	0.0095	98	0.10	0.28079	4.646	5.70	105.7	0.000
5/31/13 7:27 2760	15	1335.74	1340.270	4.530	71	70	0.0094	98	0.10	0.27784	4.431	5.67	101.4	0.000
5/31/13 7:42 2775	15	1340.27	1345.050	4.780	71	70	0.0091	98	0.10	0.26897	4.676	5.57	108.7	0.000
5/31/13 7:57 2790	15	1345.05	1349.700	4.650	71	70	0.0102	98	0.10	0.30148	4.549	5.90	99.9	0.000
5/31/13 8:12 2805	15	1349.7	1354.200	4.500	71	70	0.0106	98	0.10	0.31331	4.402	6.02	94.8	0.000
5/31/13 8:27 2820	15	1354.2	1358.900	4.700	71	70	0.0103	98	0.10	0.30444	4.598	5.93	100.5	0.000
5/31/13 8:42 2835	15	1358.9	1363.200	4.300	72	70	0.0098	100	0.10	0.28890	4.198	5.80	94.2	0.000
5/31/13 8:57 2850	15	1363.2	1367.500	4.300	71	70	0.0092	99	0.10	0.27144	4.206	5.61	97.3	0.000
5/31/13 9:12 2865	15	1367.5	1372.100	4.600	71	70	0.0106	101	0.10	0.31163	4.500	6.03	97.2	0.000
5/31/13 9:27 2880	15	1372.1	1376.900	4.800	71	70	0.0105	102	0.10	0.30814	4.696	6.01	102.0	0.000
5/31/13 9:42 2895	15	1376.9	1382.000	5.100	71	70	0.0110	102	0.10	0.32282	4.989	6.15	105.9	0.000
5/31/13 9:57 2910	15	1382	1386.900	4.900	71	70	0.0110	103	0.10	0.32224	4.794	6.16	101.8	0.000
5/31/13 10:12 2925	15	1386.9	1391.750	4.850	71	70	0.0106	104	0.10	0.30997	4.744	6.05	102.7	0.000
5/31/13 10:27 2940	15	1391.75	1396.675	4.925	71	71	0.0113	107	0.11	0.32901	4.818	6.26	101.3	0.000

Time	θ	$V_{m\,start}$	$V_{m\,end}$	V_m	$T_{m\,in}$	$T_{m\,out}$	ΔP	T_s	$\sqrt{\Delta P}_{ave}$	ΔH	$V_{m(std)}$	V_s	I	Calc. D_n
5/31/13 10:42 2955	15	1396.675	1401.700	5.025	71	71	0.0115	107	0.11	**0.33483**	4.916	6.32	**102.5**	0.000
5/31/13 10:57 2970	15	1401.7	1406.500	4.800	72	71	0.0110	110	0.10	**0.31889**	4.687	6.19	**100.2**	0.000
5/31/13 11:12 2985	15	1406.5	1411.300	4.800	72	71	0.0110	112	0.10	**0.31777**	4.687	6.21	**100.3**	0.000
5/31/13 11:27 3000	15	1411.3	1416.300	5.000	71	70	0.0123	113	0.11	**0.35404**	4.892	6.57	**99.1**	0.000
5/31/13 11:42 3015	15	1416.3	1421.500	5.200	71	70	0.0120	110	0.11	**0.34722**	5.087	6.47	**104.1**	0.000
5/31/13 11:57 3030	15	1421.5	1426.150	4.650	71	70	0.0108	112	0.10	**0.31141**	4.549	6.15	**98.3**	0.000
5/31/13 12:12 3045	15	1426.15	1431.080	4.930	70	70	0.0116	111	0.11	**0.33474**	4.832	6.37	**100.6**	0.000
5/31/13 12:27 3060	15	1431.08	1436.020	4.940	71	70	0.0117	109	0.11	**0.33914**	4.833	6.38	**100.1**	0.000
5/31/13 12:42 3075	15	1436.02	1440.960	4.940	71	69	0.0117	115	0.11	**0.33528**	4.833	6.42	**100.6**	0.000
5/31/13 12:57 3090	15	1440.96	1446.030	5.070	71	69	0.0119	117	0.11	**0.33983**	4.960	6.48	**102.5**	0.000
5/31/13 13:12 3105	15	1446.03	1451.000	4.970	71	69	0.0113	116	0.11	**0.32326**	4.862	6.31	**103.1**	0.000
5/31/13 13:27 3120	15	1451	1455.800	4.800	71	69	0.0110	119	0.10	**0.31304**	4.696	6.24	**101.1**	0.000
5/31/13 13:42 3135	15	1455.8	1460.800	5.000	71	69	0.0119	119	0.11	**0.33866**	4.892	6.49	**101.3**	0.000
5/31/13 13:57 3150	15	1460.8	1465.600	4.800	71	69	0.0110	119	0.10	**0.31304**	4.696	6.24	**101.1**	0.000
5/31/13 14:12 3165	15	1465.6	1470.510	4.910	73	71	0.0120	122	0.11	**0.34102**	4.786	6.54	**98.9**	0.000
5/31/13 14:27 3180	15	1470.51	1475.600	5.090	74	72	0.0122	120	0.11	**0.34856**	4.952	6.58	**101.4**	0.000
5/31/13 14:42 3195	15	1475.6	1480.700	5.100	75	73	0.0126	120	0.11	**0.36066**	4.952	6.69	**99.8**	0.000
5/31/13 14:57 3210	15	1480.7	1485.800	5.100	76	73	0.0120	122	0.11	**0.34263**	4.943	6.54	**102.2**	0.000
5/31/13 15:12 3225	15	1485.8	1490.975	5.175	77	75	0.0121	124	0.11	**0.34526**	5.006	6.58	**103.3**	0.000
5/31/13 15:27 3240	15	1490.975	1496.300	5.325	78	75	0.0125	124	0.11	**0.35701**	5.142	6.68	**104.3**	0.000
5/31/13 15:42 3255	15	1496.3	1501.300	5.000	78	76	0.0119	122	0.11	**0.34136**	4.828	6.51	**100.2**	0.000
5/31/13 15:57 3270	15	1501.3	1506.300	5.000	78	76	0.0123	122	0.11	**0.35283**	4.828	6.62	**98.6**	0.000
5/31/13 16:12 3285	15	1506.3	1511.550	5.250	79	77	0.0132	123	0.11	**0.37871**	5.060	6.86	**99.8**	0.000
5/31/13 16:27 3300	15	1511.55	1516.750	5.200	79	77	0.0123	125	0.11	**0.35168**	5.012	6.64	**102.6**	0.000
5/31/13 16:42 3315	15	1516.75	1522.230	5.480	80	78	0.0130	123	0.11	**0.37366**	5.272	6.81	**104.8**	0.000
5/31/13 16:57 3330	15	1522.23	1527.730	5.500	81	79	0.0132	124	0.11	**0.37946**	5.282	6.87	**104.3**	0.000
5/31/13 17:12 3345	15	1527.73	1533.050	5.320	81	79	0.0121	125	0.11	**0.34725**	5.109	6.58	**105.5**	0.000
5/31/13 17:27 3360	15	1533.05	1538.470	5.420	81	80	0.0124	124	0.11	**0.35680**	5.205	6.66	**106.0**	0.000
5/31/13 17:42 3375	15	1538.47	1543.700	5.230	81	80	0.0119	127	0.11	**0.34066**	5.022	6.54	**104.7**	0.000
5/31/13 17:57 3390	15	1543.7	1548.830	5.130	81	80	0.0118	126	0.11	**0.33837**	4.926	6.51	**103.1**	0.000
5/31/13 18:12 3405	15	1548.83	1554.230	5.400	82	80	0.0129	125	0.11	**0.37089**	5.176	6.80	**103.5**	0.000
5/31/13 18:27 3420	15	1554.23	1559.670	5.440	83	81	0.0130	125	0.11	**0.37446**	5.205	6.82	**103.7**	0.000
5/31/13 18:42 3435	15	1559.67	1564.925	5.255	84	82	0.0122	124	0.11	**0.35266**	5.018	6.60	**103.1**	0.000
5/31/13 18:57 3450	15	1564.925	1570.210	5.285	84	82	0.0124	122	0.11	**0.35968**	5.047	6.65	**102.7**	0.000
5/31/13 19:12 3465	15	1570.21	1575.120	4.910	84	82	0.0114	122	0.11	**0.33067**	4.689	6.37	**99.5**	0.000
5/31/13 19:27 3480	15	1575.12	1580.100	4.980	85	83	0.0115	118	0.11	**0.33650**	4.747	6.38	**99.9**	0.000
5/31/13 19:42 3495	15	1580.1	1585.600	5.500	85	83	0.0126	114	0.11	**0.37125**	5.243	6.65	**105.1**	0.000
5/31/13 19:57 3510	15	1585.6	1590.740	5.140	85	83	0.0114	113	0.11	**0.33648**	4.899	6.32	**103.1**	0.000
5/31/13 20:12 3525	15	1590.74	1595.800	5.060	84	83	0.0113	109	0.11	**0.33557**	4.832	6.27	**101.8**	0.000
5/31/13 20:27 3540	15	1595.8	1601.050	5.250	84	83	0.0115	107	0.11	**0.34271**	5.013	6.32	**104.5**	0.000
5/31/13 20:42 3555	15	1601.05	1606.150	5.100	83	82	0.0116	104	0.11	**0.34689**	4.879	6.33	**101.0**	0.000
5/31/13 20:57 3570	15	1606.15	1611.100	4.950	82	82	0.0104	103	0.10	**0.31127**	4.744	5.99	**103.6**	0.000

Time	θ	$V_{m\ start}$	$V_{m\ end}$	V_m	$T_{m\ in}$	$T_{m\ out}$	ΔP	T_s	$\sqrt{\Delta P}_{avg}$	ΔH	$V_{m(std)}$	V_s	I	Calc. D_n
5/31/13 21:12 3585	15	1611.1	1615.900	4.800	81	81	0.0109	102	0.10	0.32621	4.609	6.12	98.3	0.000
5/31/13 21:27 3600	15	1615.9	1620.800	4.900	81	81	0.0104	102	0.10	0.31125	4.705	5.98	102.7	0.000
5/31/13 21:42 3615	15	1620.8	1625.550	4.750	80	80	0.0104	100	0.10	0.31178	4.569	5.97	99.5	0.000
5/31/13 21:57 3630	15	1625.55	1630.360	4.810	80	80	0.0103	100	0.10	0.30879	4.627	5.94	101.3	0.000
5/31/13 22:12 3645	15	1630.36	1635.530	5.170	79	79	0.0114	100	0.11	0.34113	4.983	6.25	103.7	0.000
5/31/13 22:27 3660	15	1635.53	1640.390	4.860	78	78	0.0103	100	0.10	0.30764	4.692	5.94	102.7	0.000
5/31/13 22:42 3675	15	1640.39	1645.520	5.130	77	77	0.0113	99	0.11	0.33749	4.963	6.22	103.6	0.000
5/31/13 23:57 3690	15	1645.52	1650.700	5.180	76	76	0.0118	99	0.11	0.35176	5.021	6.35	102.6	0.000
6/1/13 0:12 3705	15	1650.7	1655.500	4.800	69	70	0.0104	97	0.10	0.30737	4.713	5.95	102.4	0.000
6/1/13 0:27 3720	15	1655.5	1660.340	4.840	71	70	0.0104	97	0.10	0.30795	4.735	5.95	102.9	0.000
6/1/13 0:42 3735	15	1660.34	1665.260	4.920	71	70	0.0112	97	0.11	0.33164	4.813	6.18	100.8	0.000
6/1/13 0:57 3750	15	1665.26	1670.250	4.990	71	70	0.0112	98	0.11	0.33104	4.882	6.18	102.3	0.000
6/1/13 1:12 3765	15	1670.25	1674.979	4.729	71	70	0.0109	98	0.10	0.32218	4.626	6.10	98.3	0.000
6/1/13 1:27 3780	15	1674.979	1679.810	4.831	72	70	0.0110	98	0.10	0.32544	4.717	6.13	99.7	0.000
6/1/13 1:42 3795	15	1679.81	1684.720	4.910	73	71	0.0104	97	0.10	0.30882	4.785	5.95	104.0	0.000
6/1/13 1:57 3810	15	1684.72	1689.640	4.920	73	71	0.0104	97	0.10	0.30882	4.795	5.95	104.2	0.000
6/1/13 2:12 3825	15	1689.64	1694.550	4.910	74	72	0.0104	98	0.10	0.30885	4.776	5.96	103.9	0.000
6/1/13 2:27 3840	15	1694.55	1699.480	4.930	74	72	0.0100	97	0.10	0.29750	4.796	5.84	106.3	0.000
6/1/13 2:42 3855	15	1699.48	1704.410	4.930	74	73	0.0103	97	0.10	0.30671	4.796	5.93	104.7	0.000
6/1/13 2:57 3870	15	1704.41	1709.370	4.960	74	73	0.0104	97	0.10	0.30969	4.825	5.95	104.8	0.000
6/1/13 3:12 3885	15	1709.37	1714.260	4.890	74	73	0.0098	97	0.10	0.29182	4.757	5.78	106.5	0.000
6/1/13 3:27 3900	15	1714.26	1719.180	4.920	74	73	0.0103	97	0.10	0.30671	4.786	5.93	104.5	0.000
6/1/13 3:42 3915	15	1719.18	1723.930	4.750	74	73	0.0098	98	0.10	0.29130	4.620	5.79	103.5	0.000
6/1/13 3:57 3930	15	1723.93	1728.970	5.040	74	73	0.0111	98	0.11	0.32994	4.903	6.16	103.2	0.000
6/1/13 4:12 3945	15	1728.97	1733.910	4.940	74	73	0.0106	98	0.10	0.31508	4.805	6.02	103.5	0.000
6/1/13 4:27 3960	15	1733.91	1738.730	4.820	74	73	0.0106	98	0.10	0.31508	4.689	6.02	101.0	0.000
6/1/13 4:42 3975	15	1738.73	1743.570	4.840	74	73	0.0103	98	0.10	0.30616	4.708	5.93	102.9	0.000
6/1/13 4:57 3990	15	1743.57	1748.380	4.810	74	73	0.0107	98	0.10	0.31805	4.679	6.04	100.3	0.000
6/1/13 5:12 4005	15	1748.38	1753.350	4.970	74	73	0.0108	96	0.10	0.32218	4.835	6.06	103.0	0.000
6/1/13 5:27 4020	15	1753.35	1758.140	4.790	74	73	0.0106	97	0.10	0.31565	4.660	6.01	100.3	0.000
6/1/13 5:42 4035	15	1758.14	1762.760	4.620	74	73	0.0095	97	0.10	0.28289	4.494	5.69	102.2	0.000
6/1/13 5:57 4050	15	1762.76	1767.780	5.020	75	73	0.0106	97	0.10	0.31594	4.874	6.01	104.9	0.000
6/1/13 6:12 4065	15	1767.78	1772.650	4.870	74	73	0.0101	97	0.10	0.30076	4.737	5.87	104.4	0.000
6/1/13 6:27 4080	15	1772.65	1777.340	4.690	74	73	0.0100	97	0.10	0.29778	4.562	5.84	101.1	0.000
6/1/13 6:42 4095	15	1777.34	1782.010	4.670	74	73	0.0100	98	0.10	0.29724	4.543	5.84	100.7	0.000
6/1/13 6:57 4110	15	1782.01	1786.710	4.700	74	73	0.0097	99	0.10	0.28781	4.572	5.76	103.0	0.000
6/1/13 7:12 4125	11	1786.71	1790.165	3.455	74	73	0.0094	98	0.10	0.27941	3.361	5.67	104.8	0.000
		1790.165												

5.2 HFK Raw Data

Nomograph

P_{bar}	29.65	%O_2	20.90	ΔP_{avg}	0.00661	$D_{s,ft}$	1.00	C_p	0.84
P_{static}	0.00	%CO_2	0.10			D_n	0.496	Y	0.999
$\Delta H@$	1.87	%N_2	79	B_{ws}	0.0400	A_n	0.001342	P_s	29.6500
Q_m		M_d	28.8520	M_s	28.4179			P_m	29.7875

	Time	θ	$V_{m\ start}$	$V_{m\ end}$	V_m	$T_{m\ in}$	$T_{m\ out}$	ΔP	T_s		ΔH	$V_{m(std)}$	V_s	I	Calc. D_n
5/29/13 9:25	0	15	665.649	669.607	3.958	61.0	61.0	0.0043	68.00	0.07	**0.26721**	3.974	3.73	**92.8**	0.000
5/29/13 9:40	15	15	669.607	673.438	3.831	63.0	62.0	0.0040	71.00	0.06	**0.24788**	3.831	3.61	**93.1**	0.000
5/29/13 9:55	30	15	673.438	678.147	4.709	65.0	64.0	0.0059	74.00	0.08	**0.36496**	4.693	4.39	**94.1**	0.000
5/29/13 10:10	45	15	678.147	683.274	5.127	68.0	66.0	0.0066	75.00	0.08	**0.40943**	5.081	4.65	**96.5**	0.000
5/29/13 10:25	60	15	683.274	687.997	4.723	70.0	67.0	0.0057	77.00	0.08	**0.35329**	4.662	4.33	**95.4**	0.000
5/29/13 10:40	75	15	687.997	693.269	5.272	71.0	68.0	0.0070	75.00	0.08	**0.43631**	5.195	4.79	**95.8**	0.000
5/29/13 10:55	90	15	693.269	698.767	5.498	72.0	69.0	0.0074	76.00	0.09	**0.46125**	5.408	4.93	**97.0**	0.000
5/29/13 11:10	105	15	698.767	704.287	5.520	72.0	70.0	0.0075	78.00	0.09	**0.46618**	5.430	4.97	**97.0**	0.000
5/29/13 11:25	120	15	704.287	710.013	5.726	70.0	69.0	0.0082	81.00	0.09	**0.50544**	5.654	5.21	**96.8**	0.000
5/29/13 11:40	135	15	710.013	715.916	5.903	71.0	69.0	0.0089	82.00	0.09	**0.54809**	5.819	5.43	**95.7**	0.000
5/29/13 11:55	150	15	715.916	720.883	4.967	71.0	69.0	0.0064	84.00	0.08	**0.39268**	4.894	4.62	**95.1**	0.000
5/29/13 12:10	165	15	720.883	726.311	5.428	70.0	69.0	0.0074	86.00	0.09	**0.45195**	5.359	4.97	**97.1**	0.000
5/29/13 12:25	180	15	726.311	732.319	6.008	70.0	69.0	0.0090	89.00	0.09	**0.54666**	5.933	5.50	**97.7**	0.000
5/29/13 12:40	195	15	732.319	738.307	5.988	71.0	68.0	0.0090	91.00	0.09	**0.54468**	5.903	5.51	**97.4**	0.000
5/29/13 12:55	210	15	738.307	744.731	6.424	71.0	69.0	0.0100	92.00	0.10	**0.60467**	6.333	5.81	**99.2**	0.000
5/29/13 13:10	225	15	744.731	750.900	6.169	70.0	69.0	0.0092	95.00	0.10	**0.55277**	6.093	5.59	**99.8**	0.000
5/29/13 13:25	240	15	750.900	756.852	5.952	71.0	68.0	0.0092	94.00	0.10	**0.55377**	5.867	5.59	**96.0**	0.000
5/29/13 13:40	255	15	756.852	763.086	6.234	71.0	69.0	0.0095	98.00	0.10	**0.56826**	6.145	5.70	**99.3**	0.000
5/29/13 13:55	270	15	763.086	769.448	6.362	69	68	0.0098	100	0.10	**0.58246**	6.295	5.80	**100.3**	0.000
5/29/13 14:10	285	15	769.448	775.853	6.405	69	68	0.0104	103	0.10	**0.61483**	6.339	5.99	**98.3**	0.000
5/29/13 14:25	300	15	775.853	782.765	6.912	69	67	0.0119	104	0.11	**0.70159**	6.842	6.41	**99.3**	0.000
5/29/13 14:40	315	15	782.765	789.341	6.576	68	67	0.0117	107	0.11	**0.68550**	6.521	6.37	**95.7**	0.000
5/29/13 14:55	330	15	789.341	796.278	6.937	68	67	0.0110	110	0.10	**0.64110**	6.878	6.19	**104.4**	0.000
5/29/13 15:10	345	15	796.278	802.937	6.659	70	67	0.0111	112	0.11	**0.64589**	6.578	6.23	**99.6**	0.000
5/29/13 15:25	360	15	802.937	809.639	6.702	72	68	0.0107	114	0.10	**0.62220**	6.595	6.13	**101.8**	0.000
5/29/13 15:40	375	15	809.639	816.500	6.861	73	70	0.0120	113	0.11	**0.70099**	6.740	6.49	**98.2**	0.000
5/29/13 15:55	390	15	816.5	823.900	7.400	73	71	0.0125	107	0.11	**0.73862**	7.270	6.59	**103.2**	0.000
5/29/13 16:10	405	15	823.9	830.600	6.700	72	71	0.0115	113	0.11	**0.67178**	6.594	6.35	**98.1**	0.000
5/29/13 16:25	420	15	830.6	837.710	7.110	71	71	0.0122	115	0.11	**0.70953**	7.011	6.55	**101.5**	0.000

	Time	θ	$V_{m\ start}$	$V_{m\ end}$	V_m	$T_{m\ in}$	$T_{m\ out}$	ΔP	T_s		ΔH	$V_{m(std)}$	V_s	I	Calc. D_s
5/29/13 16:40	435	15	837.71	845.010	7.300	71	71	0.0123	113	0.11	0.71784	7.199	6.57	103.6	0.000
5/29/13 16:55	450	15	845.01	852.000	6.990	71	71	0.0123	111	0.11	0.72036	6.893	6.56	99.0	0.000
5/29/13 17:10	465	15	852	859.000	7.000	71	71	0.0120	111	0.11	0.70279	6.903	6.48	100.4	0.000
5/29/13 17:25	480	15	859	866.300	7.300	72	71	0.0127	109	0.11	0.74710	7.186	6.65	101.4	0.000
5/29/13 17:40	495	15	866.3	872.400	6.100	73	71	0.0091	108	0.10	0.53677	5.990	5.62	99.8	0.000
5/29/13 17:55	510	15	872.4	878.790	6.390	73	71	0.0100	108	0.10	0.58986	6.276	5.90	99.7	0.000
5/29/13 18:10	525	15	878.79	885.200	6.410	75	72	0.0096	108	0.10	0.56786	6.272	5.78	101.7	0.000
5/29/13 18:25	540	15	885.2	892.260	7.060	73	74	0.0118	106	0.11	0.70046	6.936	6.39	101.3	0.000
5/29/13 18:40	555	15	892.26	899.305	7.045	75	72	0.0113	105	0.11	0.67197	6.895	6.25	102.8	0.000
5/29/13 18:55	570	15	899.305	906.150	6.845	76	73	0.0097	104	0.10	0.57893	6.685	5.79	107.5	0.000
5/29/13 19:10	585	15	906.15	912.970	6.820	76	73	0.0107	104	0.10	0.63861	6.661	6.08	102.0	0.000
5/29/13 19:25	600	15	912.97	919.400	6.430	75	73	0.0096	102	0.10	0.57446	6.291	5.75	101.5	0.000
5/29/13 19:40	615	15	919.4	926.390	6.990	75	73	0.0115	102	0.11	0.68815	6.841	6.29	100.8	0.000
5/29/13 19:55	630	15	926.39	933.100	6.710	75	73	0.0099	100	0.10	0.59453	6.566	5.83	104.1	0.000
5/29/13 20:10	645	15	933.1	940.000	6.900	75	73	0.0118	99	0.11	0.70990	6.753	6.35	98.0	0.000
5/29/13 20:25	660	15	940	946.900	6.900	75	73	0.0117	100	0.11	0.70262	6.753	6.33	98.5	0.000
5/29/13 20:40	675	15	946.9	953.830	6.930	76	73	0.0118	100	0.11	0.70929	6.770	6.36	98.3	0.000
5/29/13 20:55	690	15	953.83	960.900	7.070	75	73	0.0109	99	0.10	0.65575	6.919	6.11	104.5	0.000
5/29/13 21:10	705	15	960.9	967.900	7.000	75	73	0.0120	99	0.11	0.72193	6.851	6.41	98.6	0.000
5/29/13 21:25	720	15	967.9	975.070	7.170	75	73	0.0117	99	0.11	0.70388	7.018	6.33	102.3	0.000
5/29/13 21:40	735	15	975.07	982.100	7.030	75	73	0.0111	99	0.11	0.66778	6.880	6.16	102.9	0.000
5/29/13 21:55	750	15	982.1	989.000	6.900	75	73	0.0101	99	0.10	0.60762	6.752	5.88	105.9	0.000
5/29/13 22:10	765	15	989	996.000	7.000	74	72	0.0110	100	0.10	0.65935	6.863	6.14	103.3	0.000
5/29/13 22:25	780	15	996	1002.890	6.890	74	72	0.0112	100	0.11	0.67134	6.756	6.20	100.7	0.000
5/29/13 22:40	795	15	1002.89	1010.100	7.210	74	72	0.0123	101	0.11	0.73596	7.070	6.50	100.7	0.000
5/29/13 22:55	810	15	1010.1	1017.400	7.300	75	72	0.0112	101	0.11	0.67077	7.144	6.20	106.6	0.000
5/29/13 23:10	825	15	1017.4	1024.850	7.450	73	71	0.0133	102	0.12	0.79289	7.321	6.76	100.3	0.000
5/29/13 23:25	840	15	1024.85	1031.890	7.040	71	70	0.0127	102	0.11	0.75498	6.943	6.61	97.4	0.000
5/29/13 23:40	855	15	1031.89	1039.180	7.290	71	69	0.0114	103	0.11	0.67586	7.188	6.27	106.5	0.000
5/29/13 23:55	870	15	1039.18	1046.470	7.290	73	71	0.0114	103	0.11	0.67841	7.161	6.27	106.1	0.000
5/30/13 0:10	885	15	1046.47	1053.600	7.130	72	70	0.0117	103	0.11	0.69495	7.018	6.35	102.6	0.000
5/30/13 0:25	900	15	1053.6	1060.670	7.070	71	70	0.0122	103	0.11	0.72397	6.972	6.48	99.9	0.000
5/30/13 0:40	915	15	1060.67	1067.770	7.100	72	70	0.0116	103	0.11	0.68901	6.988	6.32	102.6	0.000
5/30/13 0:55	930	15	1067.77	1074.930	7.160	73	70	0.0126	102	0.11	0.75045	7.035	6.58	99.1	0.000
5/30/13 1:10	945	15	1074.93	1082.210	7.280	75	71	0.0121	102	0.11	0.72270	7.126	6.45	102.4	0.000
5/30/13 1:25	960	15	1082.21	1089.340	7.130	75	72	0.0122	102	0.11	0.72936	6.979	6.48	99.9	0.000
5/30/13 1:40	975	15	1089.34	1096.310	6.970	75	72	0.0115	101	0.11	0.68874	6.822	6.28	100.5	0.000
5/30/13 1:55	990	15	1096.31	1103.410	7.100	75	72	0.0119	101	0.11	0.71269	6.949	6.39	100.6	0.000
5/30/13 2:10	1005	15	1103.41	1110.560	7.150	75	72	0.0123	101	0.11	0.73665	6.999	6.50	99.7	0.000
5/30/13 2:25	1020	15	1110.56	1117.870	7.310	75	72	0.0122	101	0.11	0.73066	7.155	6.47	102.3	0.000
5/30/13 2:40	1035	15	1117.87	1125.410	7.540	75	73	0.0125	101	0.11	0.74933	7.381	6.55	104.3	0.000
5/30/13 2:55	1050	15	1125.41	1132.670	7.260	75	73	0.0118	101	0.11	0.70737	7.106	6.37	103.3	0.000

	Time	θ	$V_{m\ start}$	$V_{m\ end}$	V_m	$T_{m\ in}$	$T_{m\ out}$	ΔP	T_s		ΔH	$V_{m(std)}$	V_s	I	Calc. D_s
5/30/13 3:10	1065	15	1132.67	1139.880	7.210	75	73	0.0114	101	0.11	**0.68339**	7.056	6.26	**104.4**	0.000
5/30/13 3:25	1080	15	1139.88	1147.110	7.230	75	73	0.0122	101	0.11	**0.73134**	7.077	6.47	**101.2**	0.000
5/30/13 3:40	1095	15	1147.11	1154.430	7.320	75	73	0.0120	101	0.11	**0.71935**	7.165	6.42	**103.3**	0.000
5/30/13 3:55	1110	15	1154.43	1161.770	7.340	75	73	0.0115	100	0.11	**0.69061**	7.184	6.28	**105.7**	0.000
5/30/13 4:10	1125	15	1161.77	1168.780	7.010	75	73	0.0116	100	0.11	**0.69662**	6.861	6.31	**100.5**	0.000
5/30/13 4:25	1140	15	1168.78	1176.030	7.250	75	73	0.0114	100	0.11	**0.68461**	7.096	6.25	**104.9**	0.000
5/30/13 4:40	1155	15	1176.03	1183.150	7.120	75	73	0.0120	99	0.11	**0.72193**	6.969	6.41	**100.3**	0.000
5/30/13 4:55	1170	15	1183.15	1190.340	7.190	75	73	0.0120	99	0.11	**0.72193**	7.037	6.41	**101.3**	0.000
5/30/13 5:10	1185	15	1190.34	1197.450	7.110	75	73	0.0120	99	0.11	**0.72193**	6.959	6.41	**100.1**	0.000
5/30/13 5:25	1200	15	1197.45	1204.760	7.310	75	73	0.0122	98	0.11	**0.73528**	7.155	6.45	**102.0**	0.000
5/30/13 5:40	1215	15	1204.76	1212.220	7.460	75	73	0.0119	99	0.11	**0.71591**	7.302	6.38	**105.5**	0.000
5/30/13 5:55	1230	15	1212.22	1219.130	6.910	75	72	0.0113	100	0.11	**0.67797**	6.763	6.22	**100.4**	0.000
5/30/13 6:10	1245	15	1219.13	1226.250	7.120	75	72	0.0119	99	0.11	**0.71524**	6.969	6.38	**100.7**	0.000
5/30/13 6:25	1260	15	1226.25	1233.530	7.280	75	72	0.0119	100	0.11	**0.71396**	7.125	6.39	**103.1**	0.000
5/30/13 6:40	1275	15	1233.53	1240.760	7.230	75	72	0.0122	100	0.11	**0.73196**	7.077	6.47	**101.1**	0.000
5/30/13 6:55	1290	15	1240.76	1247.910	7.150	74	72	0.0110	100	0.10	**0.65935**	7.010	6.14	**105.5**	0.000
5/30/13 7:10	1305	15	1247.91	1255.070	7.160	74	72	0.0115	100	0.11	**0.68932**	7.021	6.28	**103.3**	0.000
5/30/13 7:25	1320	15	1255.07	1262.290	7.220	75	72	0.0114	101	0.11	**0.68275**	7.066	6.26	**104.5**	0.000
5/30/13 7:40	1335	15	1262.29	1269.020	6.730	75	72	0.0104	101	0.10	**0.62286**	6.586	5.98	**102.0**	0.000
5/30/13 7:55	1350	15	1269.02	1275.930	6.910	74	72	0.0114	102	0.11	**0.68089**	6.775	6.26	**100.3**	0.000
5/30/13 8:10	1365	15	1275.93	1282.900	6.970	74	72	0.0114	102	0.11	**0.68089**	6.834	6.26	**101.2**	0.000
5/30/13 8:25	1380	15	1282.9	1289.600	6.700	74	72	0.0113	103	0.11	**0.67372**	6.569	6.24	**97.8**	0.000
5/30/13 8:40	1395	15	1289.6	1296.290	6.690	74	72	0.0113	104	0.11	**0.67253**	6.560	6.25	**97.7**	0.000
5/30/13 8:55	1410	15	1296.29	1303.200	6.910	75	72	0.0112	104	0.11	**0.66720**	6.762	6.22	**101.2**	0.000
5/30/13 9:10	1425	15	1303.2	1310.000	6.800	75	72	0.0113	105	0.11	**0.67197**	6.655	6.25	**99.2**	0.000
5/30/13 9:25	1440	15	1310	1316.900	6.900	75	73	0.0116	105	0.11	**0.69045**	6.753	6.33	**99.4**	0.000
5/30/13 9:40	1455	15	1316.9	1324.100	7.200	75	73	0.0117	106	0.11	**0.69517**	7.047	6.37	**103.3**	0.000
5/30/13 9:55	1470	15	1324.1	1330.950	6.850	75	73	0.0112	106	0.11	**0.66547**	6.704	6.23	**100.5**	0.000
5/30/13 10:10	1485	15	1330.95	1338.600	7.650	75	73	0.0120	106	0.11	**0.71300**	7.488	6.45	**108.4**	0.000
5/30/13 10:25	1500	15	1338.6	1345.800	7.200	73	72	0.0112	101	0.11	**0.66951**	7.073	6.20	**105.5**	0.000
5/30/13 10:40	1515	15	1345.8	1352.525	6.725	74	71	0.0122	104	0.11	**0.72541**	6.595	6.49	**94.5**	0.000
5/30/13 10:55	1530	15	1352.525	1359.030	6.505	75	72	0.0117	105	0.11	**0.69575**	6.367	6.36	**93.3**	0.000
5/30/13 11:10	1545	15	1359.03	1365.900	6.870	76	72	0.0113	105	0.11	**0.67260**	6.711	6.25	**100.1**	0.000
5/30/13 11:25	1560	15	1365.9	1372.900	7.000	76	73	0.0108	108	0.10	**0.64004**	6.837	6.13	**104.5**	0.000
5/30/13 11:40	1575	15	1372.9	1379.650	6.750	76	73	0.0117	111	0.11	**0.68973**	6.594	6.39	**97.1**	0.000
5/30/13 11:55	1590	15	1379.65	1386.750	7.100	77	73	0.0119	114	0.11	**0.69851**	6.923	6.47	**101.4**	0.000
5/30/13 12:10	1605	15	1386.75	1393.900	7.150	77	74	0.0115	113	0.11	**0.67684**	6.971	6.35	**103.8**	0.000
5/30/13 12:25	1620	15	1393.9	1400.580	6.680	77	74	0.0109	111	0.10	**0.64377**	6.513	6.17	**99.4**	0.000
5/30/13 12:40	1635	15	1400.58	1407.500	6.920	77	75	0.0119	111	0.11	**0.70349**	6.748	6.45	**98.6**	0.000
5/30/13 12:55	1650	15	1407.5	1414.500	7.000	77	75	0.0113	113	0.11	**0.66569**	6.825	6.30	**102.5**	0.000
5/30/13 13:10	1665	15	1414.5	1421.750	7.250	77	75	0.0129	114	0.11	**0.75862**	7.070	6.73	**99.4**	0.000
5/30/13 13:25	1680	15	1421.75	1428.700	6.950	77	75	0.0117	114	0.11	**0.68805**	6.777	6.41	**100.1**	0.000

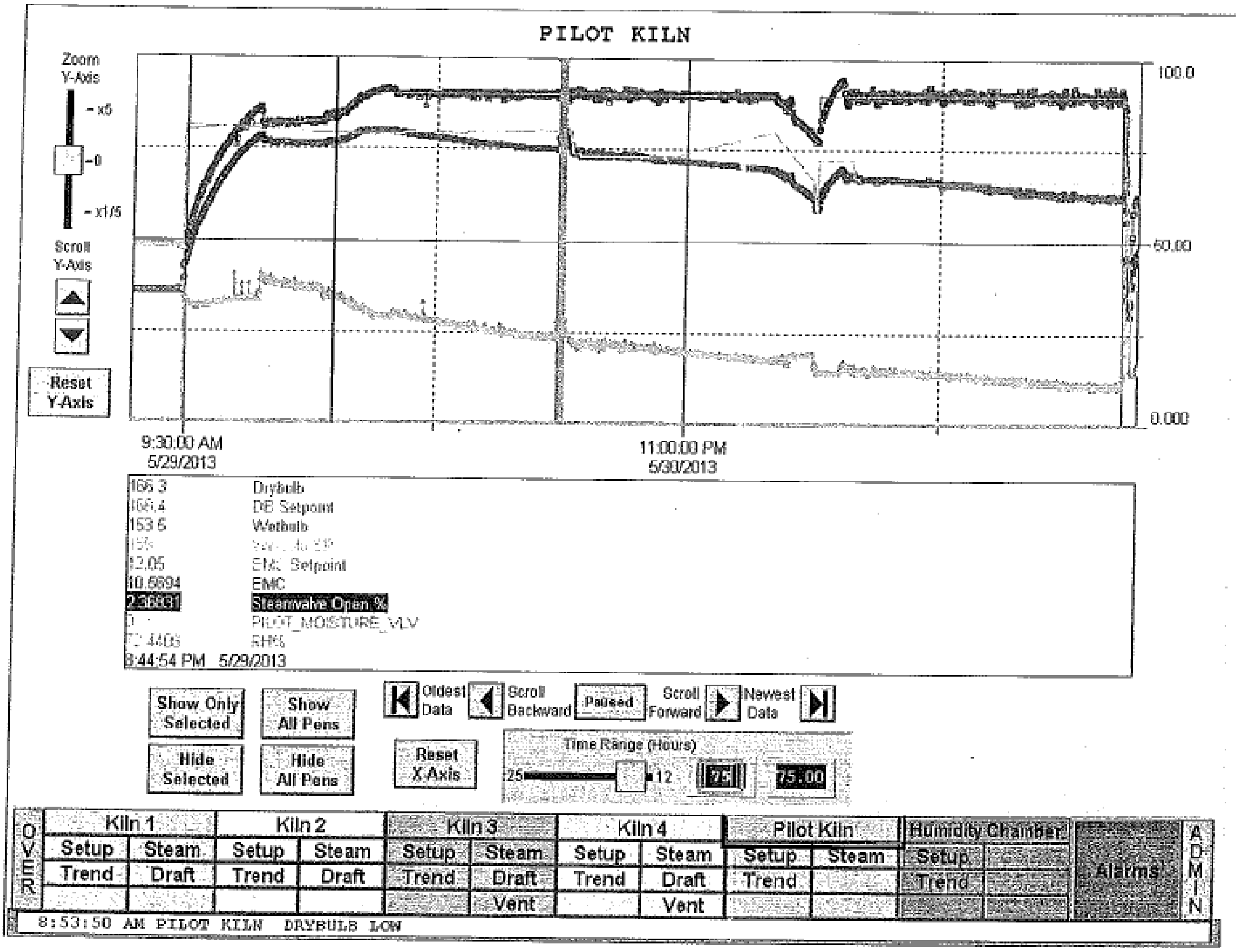
	Time	θ	$V_{m\ start}$	$V_{m\ end}$	V_m	$T_{m\ in}$	$T_{m\ out}$	ΔP	T_s		ΔH	$V_{m(std)}$	V_s	I	Calc. D_n
5/30/13 13:40	1695	15	1428.7	1435.900	7.200	77	75	0.0121	114	0.11	**0.71158**	7.021	6.52	**102.0**	0.000
5/30/13 13:55	1710	15	1435.9	1443.050	7.150	77	75	0.0116	115	0.11	**0.68099**	6.972	6.39	**103.5**	0.000
5/30/13 14:10	1725	15	1443.05	1450.100	7.050	77	75	0.0120	117	0.11	**0.70203**	6.874	6.51	**100.5**	0.000
5/30/13 14:25	1740	15	1450.1	1456.800	6.700	78	75	0.0111	116	0.11	**0.65111**	6.520	6.26	**99.0**	0.000
5/30/13 14:40	1755	15	1456.8	1463.800	7.000	78	75	0.0119	115	0.11	**0.69925**	6.813	6.47	**99.9**	0.000
5/30/13 14:55	1770	15	1463.8	1470.900	7.100	78	75	0.0118	118	0.11	**0.68977**	6.910	6.46	**102.0**	0.000
5/30/13 15:10	1785	15	1470.9	1477.600	6.700	79	76	0.0116	119	0.11	**0.67817**	6.508	6.41	**97.0**	0.000
5/30/13 15:25	1800	15	1477.6	1484.310	6.710	79	76	0.0119	122	0.11	**0.69213**	6.518	6.51	**96.1**	0.000
5/30/13 15:40	1815	15	1484.31	1491.500	7.190	78	76	0.0118	120	0.11	**0.68804**	6.998	6.47	**103.4**	0.000
5/30/13 15:55	1830	15	1491.5	1498.480	6.980	78	76	0.0124	119	0.11	**0.72427**	6.794	6.63	**97.9**	0.000
5/30/13 16:10	1845	15	1498.48	1505.100	6.620	78	76	0.0117	127	0.11	**0.67407**	6.443	6.48	**96.2**	0.000
5/30/13 16:25	1860	15	1505.1	1512.600	7.500	78	76	0.0118	127	0.11	**0.67983**	7.299	6.51	**108.5**	0.000
5/30/13 16:40	1875	15	1512.6	1513.680	1.080	79	76	0.0114	125	0.11	**0.65965**	1.049	6.39	**15.8**	0.000
5/30/13 16:55	**1890**	**15**	**1513.68**	**1520.400**	**6.720**	**76**	**76**	**0.0102**	**120**	0.10	**0.59364**	6.563	6.02	**104.3**	0.000
5/30/13 17:10	1905	15	1520.4	1527.530	7.130	77	76	0.0133	117	0.12	**0.77881**	6.954	6.85	**96.6**	0.000
5/30/13 17:25	1920	15	1527.53	1534.130	6.600	78	76	0.0101	114	0.10	**0.59507**	6.422	5.96	**102.1**	0.000
5/30/13 17:40	1935	15	1534.13	1541.100	6.970	79	76	0.0116	111	0.11	**0.68768**	6.771	6.37	**100.2**	0.000
5/30/13 17:55	1950	15	1541.1	1547.650	6.550	79	76	0.0106	108	0.10	**0.63171**	6.362	6.07	**98.2**	0.000
5/30/13 18:10	1965	15	1547.65	1554.400	6.750	79	77	0.0112	104	0.11	**0.67283**	6.557	6.22	**98.1**	0.000
5/30/13 18:25	1980	15	1554.4	1561.400	7.000	79	77	0.0112	106	0.11	**0.67045**	6.800	6.23	**101.9**	0.000
5/30/13 18:40	1995	15	1561.4	1568.250	6.850	78	76	0.0111	108	0.11	**0.66089**	6.666	6.21	**100.5**	0.000
5/30/13 18:55	2010	15	1568.25	1575.600	7.350	79	76	0.0125	111	0.11	**0.74103**	7.141	6.61	**101.8**	0.000
5/30/13 19:10	2025	15	1575.6	1582.700	7.100	79	76	0.0114	108	0.11	**0.67939**	6.897	6.30	**102.6**	0.000
5/30/13 19:25	2040	15	1582.7	1590.100	7.400	79	76	0.0122	107	0.11	**0.72835**	7.189	6.51	**103.3**	0.000
5/30/13 19:40	2055	15	1590.1	1597.300	7.200	79	76	0.0125	108	0.11	**0.74494**	6.995	6.59	**99.4**	0.000
5/30/13 19:55	2070	15	1597.3	1604.300	7.000	79	76	0.0115	108	0.11	**0.68535**	6.800	6.32	**100.8**	0.000
5/30/13 20:10	2085	15	1604.3	1611.500	7.200	79	76	0.0121	106	0.11	**0.72365**	6.995	6.47	**100.9**	0.000
5/30/13 20:25	2100	15	1611.5	1618.610	7.110	79	76	0.0119	106	0.11	**0.71169**	6.907	6.42	**100.4**	0.000
5/30/13 20:40	2115	15	1618.61	1625.950	7.340	79	76	0.0120	105	0.11	**0.71894**	7.131	6.44	**103.2**	0.000
5/30/13 20:55	2130	15	1625.95	1633.400	7.450	78	75	0.0120	104	0.11	**0.71888**	7.251	6.44	**104.8**	0.000
5/30/13 21:10	2145	15	1633.4	1640.310	6.910	77	75	0.0100	104	0.10	**0.59851**	6.736	5.88	**106.7**	0.000
5/30/13 21:25	2160	15	1640.31	1647.420	7.110	77	75	0.0109	99	0.10	**0.65821**	6.932	6.11	**104.7**	0.000
5/30/13 21:40	2175	15	1647.42	1654.280	6.860	77	76	0.0110	103	0.10	**0.66014**	6.688	6.16	**100.9**	0.000
5/30/13 21:55	2190	15	1654.28	1661.100	6.820	77	74	0.0102	102	0.10	**0.61208**	6.649	5.92	**104.1**	0.000
5/30/13 22:10	2205	15	1661.1	1668.150	7.050	76	74	0.0112	101	0.11	**0.67266**	6.887	6.20	**102.8**	0.000
5/30/13 22:25	2220	15	1668.15	1675.100	6.950	76	74	0.0121	101	0.11	**0.72671**	6.790	6.45	**97.5**	0.000
5/30/13 22:40	2235	15	1675.1	1682.170	7.070	76	74	0.0115	100	0.11	**0.69191**	6.907	6.28	**101.6**	0.000
5/30/13 22:55	2250	15	1682.17	1689.300	7.130	76	74	0.0116	100	0.11	**0.69792**	6.965	6.31	**102.0**	0.000
5/30/13 23:10	2265	15	1689.3	1696.290	6.990	76	74	0.0110	100	0.10	**0.66182**	6.828	6.14	**102.7**	0.000
5/30/13 23:25	2280	15	1696.29	1703.470	7.180	76	74	0.0110	100	0.10	**0.66182**	7.013	6.14	**105.5**	0.000
5/30/13 23:40	2295	15	1703.47	1710.350	6.880	76	74	0.0109	100	0.10	**0.65581**	6.720	6.11	**101.6**	0.000
5/30/13 23:55	2310	15	1710.35	1717.340	6.990	76	74	0.0105	99	0.10	**0.63287**	6.827	5.99	**105.0**	0.000

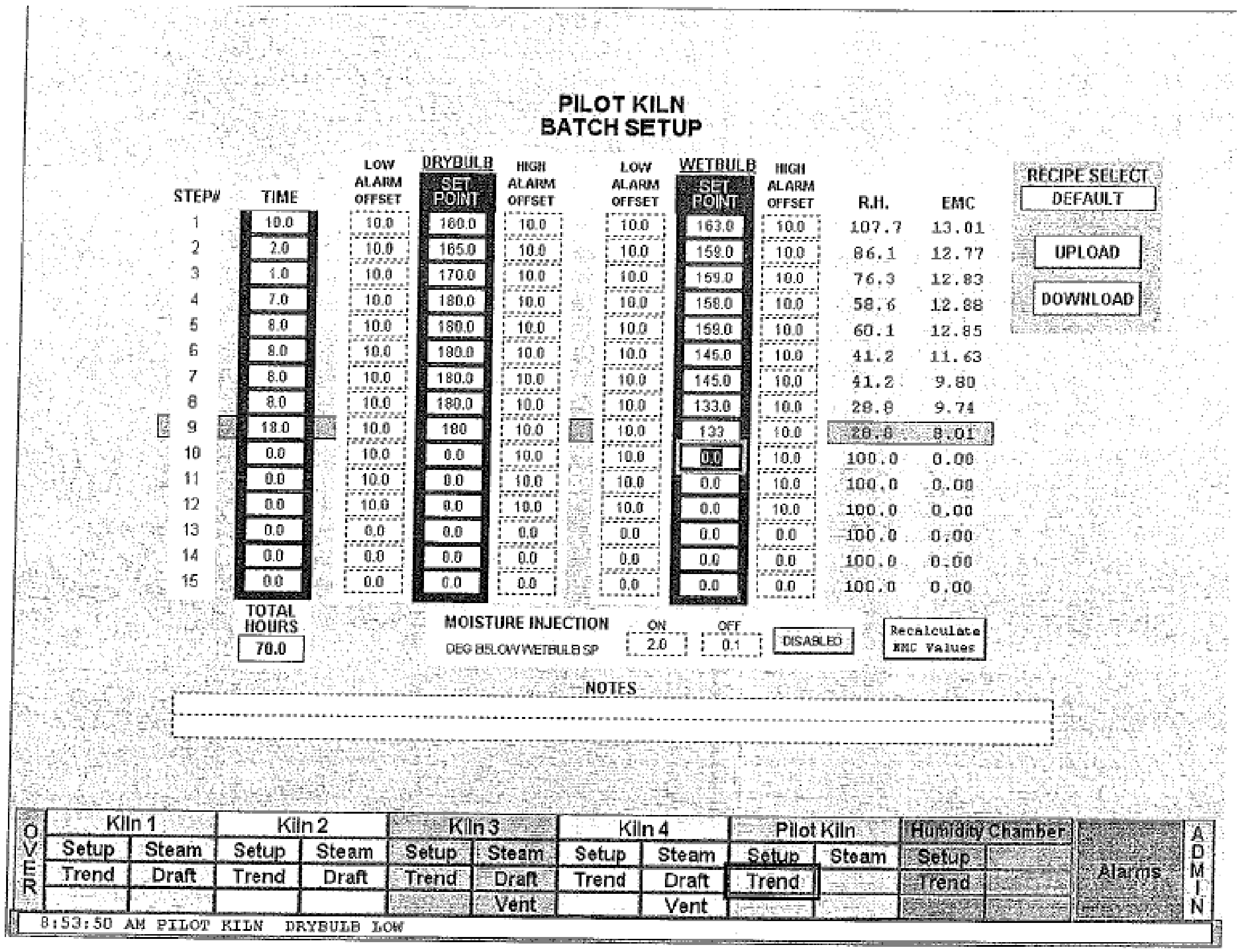
	Time	θ	$V_{m\ start}$	$V_{m\ end}$	V_m	$T_{m\ in}$	$T_{m\ out}$	ΔP	T_s		ΔH	$V_{m(std)}$	V_s	I	Calc. D_0
5/31/13 0:10	2325	15	1717.34	1724.220	6.880	76	74	0.0107	100	0.10	**0.64377**	6.720	6.06	**102.5**	0.000
5/31/13 0:25	2340	15	1724.22	1731.290	7.070	76	74	0.0107	100	0.10	**0.64377**	6.906	6.06	**105.3**	0.000
5/31/13 0:40	2355	15	1731.29	1738.410	7.120	76	73	0.0104	100	0.10	**0.62514**	6.954	5.97	**107.6**	0.000
5/31/13 0:55	2370	15	1738.41	1745.130	6.720	75	73	0.0109	99	0.10	**0.65575**	6.576	6.11	**99.3**	0.000
5/31/13 1:10	2385	15	1745.13	1751.980	6.850	75	73	0.0107	99	0.10	**0.64372**	6.703	6.05	**102.2**	0.000
5/31/13 1:25	2400	15	1751.98	1758.830	6.850	75	73	0.0107	99	0.10	**0.64372**	6.703	6.05	**102.2**	0.000
5/31/13 1:40	2415	15	1758.83	1765.540	6.710	75	73	0.0105	99	0.10	**0.63169**	6.566	5.99	**101.0**	0.000
5/31/13 1:55	2430	15	1765.54	1772.470	6.930	75	73	0.0105	99	0.10	**0.63169**	6.781	5.99	**104.3**	0.000
5/31/13 2:10	2445	15	1772.47	1779.130	6.660	75	72	0.0105	99	0.10	**0.63110**	6.517	5.99	**100.3**	0.000
5/31/13 2:25	2460	15	1779.13	1786.020	6.890	74	72	0.0107	99	0.10	**0.64251**	6.755	6.05	**102.9**	0.000
5/31/13 2:40	2475	15	1786.02	1792.770	6.750	73	70	0.0107	100	0.10	**0.63956**	6.630	6.06	**101.1**	0.000
5/31/13 2:55	2490	15	1792.77	1799.320	6.550	73	71	0.0102	100	0.10	**0.61025**	6.433	5.91	**100.5**	0.000
5/31/13 3:10	2505	15	1799.32	1806.020	6.700	74	71	0.0102	99	0.10	**0.61192**	6.568	5.91	**102.5**	0.000
5/31/13 3:25	2520	15	1806.02	1812.870	6.850	74	71	0.0109	99	0.10	**0.65391**	6.716	6.11	**101.4**	0.000
5/31/13 3:40	2535	15	1812.87	1819.970	7.100	74	71	0.0110	98	0.10	**0.66109**	6.961	6.13	**104.5**	0.000
5/31/13 3:55	2550	15	1819.97	1826.870	6.900	74	71	0.0098	99	0.10	**0.58792**	6.764	5.79	**107.7**	0.000
5/31/13 4:10	2565	15	1826.87	1833.590	6.720	74	71	0.0098	99	0.10	**0.58792**	6.588	5.79	**104.9**	0.000
5/31/13 4:25	2580	15	1833.59	1840.010	6.420	74	71	0.0099	99	0.10	**0.59392**	6.294	5.82	**99.7**	0.000
5/31/13 4:40	2595	15	1840.01	1846.800	6.790	74	71	0.0109	99	0.10	**0.65391**	6.657	6.11	**100.5**	0.000
5/31/13 4:55	2610	15	1846.8	1853.570	6.770	74	71	0.0095	99	0.10	**0.56992**	6.636	5.70	**107.3**	0.000
5/31/13 5:10	2625	15	1853.57	1860.790	7.220	74	71	0.0109	99	0.10	**0.65391**	7.079	6.11	**106.9**	0.000
5/31/13 5:25	2640	15	1860.79	1867.550	6.760	74	71	0.0103	99	0.10	**0.61791**	6.627	5.94	**102.9**	0.000
5/31/13 5:40	2655	15	1867.55	1873.930	6.380	74	71	0.0097	99	0.10	**0.58192**	6.254	5.76	**100.1**	0.000
5/31/13 5:55	2670	15	1873.93	1880.220	6.290	73	71	0.0095	99	0.10	**0.56939**	6.177	5.70	**99.9**	0.000
5/31/13 6:10	2685	15	1880.22	1886.660	6.440	73	71	0.0099	99	0.10	**0.59336**	6.325	5.82	**100.2**	0.000
5/31/13 6:25	2700	15	1886.66	1893.510	6.850	73	71	0.0105	98	0.10	**0.63045**	6.728	5.99	**103.4**	0.000
5/31/13 6:40	2715	15	1893.51	1900.130	6.620	73	71	0.0103	98	0.10	**0.61844**	6.502	5.93	**100.9**	0.000
5/31/13 6:55	2730	15	1900.13	1907.030	6.900	73	71	0.0102	98	0.10	**0.61244**	6.777	5.90	**105.7**	0.000
5/31/13 7:10	2745	15	1907.03	1913.690	6.660	73	71	0.0095	98	0.10	**0.57041**	6.541	5.70	**105.7**	0.000
5/31/13 7:25	2760	15	1913.69	1920.230	6.540	73	71	0.0094	98	0.10	**0.56440**	6.423	5.67	**104.3**	0.000
5/31/13 7:40	2775	15	1920.23	1926.500	6.270	73	71	0.0091	98	0.10	**0.54639**	6.157	5.57	**101.7**	0.000
5/31/13 7:55	2790	15	1926.5	1932.700	6.200	72	70	0.0103	98	0.10	**0.61728**	6.101	5.93	**94.7**	0.000
5/31/13 8:10	2805	15	1932.7	1939.200	6.500	73	70	0.0106	98	0.10	**0.63586**	6.385	6.02	**97.7**	0.000
5/31/13 8:25	2820	15	1939.2	1945.800	6.600	74	71	0.0103	98	0.10	**0.61902**	6.470	5.93	**100.4**	0.000
5/31/13 8:40	2835	15	1945.8	1952.050	6.250	73	71	0.0098	100	0.10	**0.58632**	6.138	5.80	**97.8**	0.000
5/31/13 8:55	2850	15	1952.05	1958.500	6.450	73	71	0.0092	99	0.10	**0.55141**	6.334	5.61	**104.1**	0.000
5/31/13 9:10	2865	15	1958.5	1965.100	6.600	72	71	0.0106	101	0.10	**0.63246**	6.495	6.03	**99.6**	0.000
5/31/13 9:25	2880	15	1965.1	1971.390	6.290	73	71	0.0105	102	0.10	**0.62596**	6.178	6.01	**95.3**	0.000
5/31/13 9:40	2895	15	1971.39	1978.000	6.610	73	71	0.0110	102	0.10	**0.65577**	6.493	6.15	**97.9**	0.000
5/31/13 9:55	2910	15	1978	1984.700	6.700	74	71	0.0110	103	0.10	**0.65522**	6.569	6.16	**99.1**	0.000
5/31/13 10:10	2925	15	1984.7	1991.300	6.600	74	71	0.0106	104	0.10	**0.63027**	6.471	6.05	**99.5**	0.000
5/31/13 10:25	2940	15	1991.3	1998.200	6.900	74	71	0.0113	106	0.11	**0.66952**	6.765	6.26	**101.0**	0.000

	Time	θ	$V_{m\ start}$	$V_{m\ end}$	V_m	$T_{m\ in}$	$T_{m\ out}$	ΔP	T_s		ΔH	$V_{m(std)}$	V_s	I	Calc. D_n
5/31/13 10:40	2955	15	1998.2	2005.200	7.000	74	71	0.0115	108	0.11	**0.67897**	6.864	6.32	**101.7**	0.000
5/31/13 10:55	2970	15	2005.2	2011.650	6.450	74	71	0.0110	109	0.10	**0.64831**	6.324	6.19	**95.9**	0.000
5/31/13 11:10	2985	15	2011.65	2018.500	6.850	74	71	0.0110	112	0.10	**0.64491**	6.716	6.21	**102.1**	0.000
5/31/13 11:25	3000	15	2018.5	2025.450	6.950	73	71	0.0123	113	0.11	**0.71919**	6.828	6.57	**98.3**	0.000
5/31/13 11:40	3015	15	2025.45	2033.000	7.550	73	71	0.0126	110	0.11	**0.74061**	7.418	6.63	**105.2**	0.000
5/31/13 11:55	3030	15	2033	2039.450	6.450	73	71	0.0105	113	0.10	**0.61395**	6.335	6.07	**98.7**	0.000
5/31/13 12:10	3045	15	2039.45	2046.300	6.850	73	71	0.0121	111	0.11	**0.70998**	6.730	6.50	**97.5**	0.000
5/31/13 12:25	3060	15	2046.3	2052.800	6.500	73	71	0.0117	109	0.11	**0.68892**	6.385	6.38	**93.9**	0.000
5/31/13 12:40	3075	15	2052.8	2059.630	6.830	73	70	0.0114	115	0.11	**0.66363**	6.709	6.33	**100.5**	0.000
5/31/13 12:55	3090	15	2059.63	2066.600	6.970	74	71	0.0119	118	0.11	**0.69043**	6.834	6.49	**100.4**	0.000
5/31/13 13:10	3105	15	2066.6	2073.300	6.700	74	71	0.0113	116	0.11	**0.65790**	6.569	6.31	**98.9**	0.000
5/31/13 13:25	3120	15	2073.3	2080.100	6.800	74	71	0.0110	118	0.10	**0.63822**	6.667	6.24	**101.9**	0.000
5/31/13 13:40	3135	15	2080.1	2086.950	6.850	74	71	0.0120	119	0.11	**0.69503**	6.717	6.52	**98.4**	0.000
5/31/13 13:55	3150	15	2086.95	2093.800	6.850	75	72	0.0111	119	0.11	**0.64411**	6.703	6.27	**102.1**	0.000
5/31/13 14:10	3165	15	2093.8	2100.500	6.700	76	72	0.0120	122	0.11	**0.69340**	6.545	6.54	**96.1**	0.000
5/31/13 14:25	3180	15	2100.5	2107.030	6.530	76	73	0.0122	120	0.11	**0.70805**	6.379	6.58	**92.7**	0.000
5/31/13 14:40	3195	15	2107.03	2113.900	6.870	78	74	0.0126	121	0.11	**0.73205**	6.687	6.69	**95.7**	0.000
5/31/13 14:55	3210	15	2113.9	2120.900	7.000	78	75	0.0119	122	0.11	**0.69084**	6.813	6.51	**100.5**	0.000
5/31/13 15:10	3225	15	2120.9	2128.200	7.300	79	76	0.0123	123	0.11	**0.71416**	7.092	6.62	**102.9**	0.000
5/31/13 15:25	3240	15	2128.2	2135.500	7.300	79	76	0.0121	124	0.11	**0.70135**	7.092	6.58	**103.9**	0.000
5/31/13 15:40	3255	15	2135.5	2142.500	7.000	81	77	0.0119	121	0.11	**0.69525**	6.775	6.51	**99.8**	0.000
5/31/13 15:55	3270	15	2142.5	2149.780	7.280	81	78	0.0123	122	0.11	**0.71805**	7.046	6.62	**102.2**	0.000
5/31/13 16:10	3285	15	2149.78	2156.950	7.170	82	78	0.0126	123	0.11	**0.73499**	6.927	6.71	**99.4**	0.000
5/31/13 16:25	3300	15	2156.95	2163.840	6.890	82	79	0.0111	124	0.11	**0.64698**	6.655	6.30	**101.8**	0.000
5/31/13 16:40	3315	15	2163.84	2171.430	7.590	83	79	0.0126	124	0.11	**0.73509**	7.320	6.71	**105.1**	0.000
5/31/13 16:55	3330	15	2171.43	2178.810	7.380	85	80	0.0126	123	0.11	**0.73839**	7.091	6.71	**101.7**	0.000
5/31/13 17:10	3345	15	2178.81	2186.210	7.400	85	81	0.0124	125	0.11	**0.72485**	7.110	6.66	**103.0**	0.000
5/31/13 17:25	3360	15	2186.21	2193.640	7.430	85	81	0.0126	124	0.11	**0.73780**	7.139	6.71	**102.5**	0.000
5/31/13 17:40	3375	15	2193.64	2200.880	7.240	84	81	0.0118	127	0.11	**0.68679**	6.969	6.51	**103.6**	0.000
5/31/13 17:55	3390	15	2200.88	2208.260	7.380	84	81	0.0124	126	0.11	**0.72295**	7.104	6.67	**103.0**	0.000
5/31/13 18:10	3405	15	2208.26	2215.550	7.290	85	81	0.0119	124	0.11	**0.69681**	7.004	6.52	**103.5**	0.000
5/31/13 18:25	3420	15	2215.55	2222.650	7.100	86	82	0.0111	125	0.11	**0.65005**	6.808	6.30	**104.2**	0.000
5/31/13 18:40	3435	15	2222.65	2230.200	7.550	87	83	0.0131	124	0.11	**0.76991**	7.229	6.84	**101.8**	0.000
5/31/13 18:55	3450	15	2230.2	2237.570	7.370	87	83	0.0133	122	0.12	**0.78435**	7.056	6.88	**98.4**	0.000
5/31/13 19:10	3465	15	2237.57	2245.070	7.500	87	83	0.0126	121	0.11	**0.74435**	7.180	6.69	**102.8**	0.000
5/31/13 19:25	3480	15	2245.07	2252.290	7.220	88	84	0.0117	119	0.11	**0.69484**	6.899	6.44	**102.3**	0.000
5/31/13 19:40	3495	15	2252.29	2259.500	7.210	88	84	0.0111	115	0.11	**0.66379**	6.889	6.25	**104.5**	0.000
5/31/13 19:55	3510	15	2259.5	2267.300	7.800	88	85	0.0125	113	0.11	**0.75081**	7.454	6.62	**106.4**	0.000
5/31/13 20:10	3525	15	2267.3	2274.800	7.500	88	85	0.0124	110	0.11	**0.74872**	7.167	6.58	**102.5**	0.000
5/31/13 20:25	3540	15	2274.8	2282.180	7.380	87	85	0.0117	107	0.11	**0.70954**	7.065	6.37	**103.7**	0.000
5/31/13 20:40	3555	15	2282.18	2289.420	7.240	85	83	0.0117	105	0.11	**0.70945**	6.956	6.36	**101.9**	0.000
5/31/13 20:55	3570	15	2289.42	2296.570	7.150	85	83	0.0106	103	0.10	**0.64503**	6.869	6.04	**105.5**	0.000

	Time	θ	$V_{m\ start}$	$V_{m\ end}$	V_m	$T_{m\ in}$	$T_{m\ out}$	ΔP	T_s		ΔH	$V_{m(std)}$	V_s	I	Calc. D_n
5/31/13 21:10	3585	15	2296.57	2303.800	7.230	85	83	0.0104	103	0.10	0.63280	6.943	5.99	107.7	0.000
5/31/13 21:25	3600	15	2303.8	2310.810	7.010	84	82	0.0107	102	0.10	0.65107	6.747	6.07	103.1	0.000
5/31/13 21:40	3615	15	2310.81	2318.100	7.290	83	81	0.0111	100	0.11	0.67658	7.029	6.17	105.3	0.000
5/31/13 21:55	3630	15	2318.1	2325.480	7.380	83	81	0.0114	100	0.11	0.69486	7.117	6.25	105.2	0.000
5/31/13 22:10	3645	15	2325.48	2332.400	6.920	82	80	0.0105	99	0.10	0.63997	6.684	5.99	102.8	0.000
5/31/13 22:25	3660	15	2332.4	2339.620	7.220	81	79	0.0117	100	0.11	0.71052	6.988	6.33	101.9	0.000
5/31/13 22:40	3675	15	2339.62	2346.460	6.840	80	78	0.0107	99	0.10	0.64975	6.632	6.05	101.1	0.000
5/31/13 23:55	3690	15	2346.46	2352.900	6.440	79	77	0.0106	100	0.10	0.64133	6.255	6.03	95.9	0.000
6/1/13 0:10	3705	15	2352.9	2359.500	6.600	76	71	0.0111	98	0.11	0.66835	6.447	6.16	96.4	0.000
6/1/13 0:25	3720	15	2359.5	2366.540	7.040	81	72	0.0110	98	0.10	0.66606	6.813	6.13	102.3	0.000
6/1/13 0:40	3735	15	2366.54	2373.520	6.980	82	74	0.0112	98	0.11	0.68006	6.743	6.18	100.4	0.000
6/1/13 0:55	3750	15	2373.52	2380.760	7.240	82	74	0.0112	98	0.11	0.68006	6.994	6.18	104.1	0.000
6/1/13 1:10	3765	15	2380.76	2387.830	7.070	82	74	0.0109	98	0.10	0.66185	6.830	6.10	103.0	0.000
6/1/13 1:25	3780	15	2387.83	2394.820	6.990	81	75	0.0110	98	0.10	0.66792	6.765	6.13	101.6	0.000
6/1/13 1:40	3795	15	2394.82	2401.820	7.000	80	76	0.0104	97	0.10	0.63262	6.787	5.95	104.7	0.000
6/1/13 1:55	3810	15	2401.82	2408.550	6.730	76	76	0.0104	97	0.10	0.63027	6.573	5.95	101.4	0.000
6/1/13 2:10	3825	15	2408.55	2415.150	6.600	76	75	0.0104	98	0.10	0.62855	6.446	5.96	99.6	0.000
6/1/13 2:25	3840	15	2415.15	2421.670	6.520	70	73	0.0100	97	0.10	0.60094	6.440	5.84	101.3	0.000
6/1/13 2:40	3855	15	2421.67	2428.470	6.800	68	72	0.0103	97	0.10	0.61722	6.742	5.93	104.5	0.000
6/1/13 2:55	3870	15	2428.47	2435.210	6.740	68	71	0.0104	97	0.10	0.62263	6.683	5.95	103.1	0.000
6/1/13 3:10	3885	15	2435.21	2441.060	5.850	68	70	0.0098	97	0.10	0.58615	5.800	5.78	92.2	0.000
6/1/13 3:25	3900	15	2441.06	2447.930	6.870	69	69	0.0103	97	0.10	0.61606	6.799	5.93	105.4	0.000
6/1/13 3:40	3915	15	2447.93	2454.670	6.740	70	69	0.0098	98	0.10	0.58565	6.657	5.79	105.9	0.000
6/1/13 3:55	3930	15	2454.67	2461.760	7.090	71	69	0.0111	98	0.11	0.66397	6.991	6.16	104.5	0.000
6/1/13 4:10	3945	15	2461.76	2468.730	6.970	72	70	0.0106	98	0.10	0.63526	6.859	6.02	104.9	0.000
6/1/13 4:25	3960	15	2468.73	2475.680	6.950	72	70	0.0106	98	0.10	0.63526	6.839	6.02	104.6	0.000
6/1/13 4:40	3975	15	2475.68	2482.510	6.830	72	70	0.0104	98	0.10	0.62327	6.721	5.96	103.8	0.000
6/1/13 4:55	3990	15	2482.51	2489.570	7.060	72	71	0.0107	98	0.10	0.64185	6.948	6.04	105.8	0.000
6/1/13 5:10	4005	15	2489.57	2496.530	6.960	73	72	0.0108	96	0.10	0.65141	6.837	6.06	103.4	0.000
6/1/13 5:25	4020	15	2496.53	2503.420	6.890	73	72	0.0106	97	0.10	0.63820	6.768	6.01	103.4	0.000
6/1/13 5:40	4035	15	2503.42	2510.020	6.600	73	72	0.0095	97	0.10	0.57197	6.482	5.69	104.6	0.000
6/1/13 5:55	4050	15	2510.02	2516.960	6.940	74	73	0.0106	97	0.10	0.63939	6.804	6.01	104.0	0.000
6/1/13 6:10	4065	15	2516.96	2523.710	6.750	74	73	0.0101	97	0.10	0.60923	6.617	5.87	103.6	0.000
6/1/13 6:25	4080	15	2523.71	2530.460	6.750	74	73	0.0100	97	0.10	0.60320	6.617	5.84	104.1	0.000
6/1/13 6:40	4095	15	2530.46	2537.220	6.760	74	73	0.0100	98	0.10	0.60212	6.627	5.84	104.4	0.000
6/1/13 6:55	4110	15	2537.22	2543.910	6.690	74	73	0.0097	99	0.10	0.58301	6.558	5.76	105.0	0.000
6/1/13 7:10	4125	13	2543.91	2549.625	5.715	74	73	0.0094	98	0.10	0.56599	5.602	5.67	105.0	0.000
6/1/13 7:23	4140	15	2549.625												

6. PROCESS DATA





STEP#	TIME	LOW ALARM OFFSET	DRYBULB SET POINT	HIGH ALARM OFFSET	LOW ALARM OFFSET	WETBULB SET POINT	HIGH ALARM OFFSET	R.H.	EMC
1	10.0	10.0	160.0	10.0	10.0	163.0	10.0	107.7	13.01
2	2.0	10.0	165.0	10.0	10.0	159.0	10.0	86.1	12.77
3	1.0	10.0	170.0	10.0	10.0	159.0	10.0	76.3	12.83
4	7.0	10.0	180.0	10.0	10.0	158.0	10.0	58.6	12.88
5	8.0	10.0	180.0	10.0	10.0	159.0	10.0	60.1	12.85
6	8.0	10.0	180.0	10.0	10.0	145.0	10.0	41.2	11.63
7	8.0	10.0	180.0	10.0	10.0	145.0	10.0	41.2	9.80
8	8.0	10.0	180.0	10.0	10.0	133.0	10.0	28.8	9.74
9	18.0	10.0	180	10.0	10.0	133	10.0	28.8	8.01
10	0.0	10.0	0.0	10.0	10.0	0.0	10.0	100.0	0.00
11	0.0	10.0	0.0	10.0	10.0	0.0	10.0	100.0	0.00
12	0.0	10.0	0.0	10.0	10.0	0.0	10.0	100.0	0.00
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.00
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.00
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.00

Stat-Pak

Group Report

The Very Big Handmeter Company

Start 6/4/2013 2:30:59
Stop 6/4/2013 3:22:24

Meter Number: 0001

Kiln:

Unit Ref.

Supplier Ref.

%MC	*Readings*	*Std. Dev.*	*High*	*Low*	*Group*	*Location*	*Species*	*SG*
10.3	136	3.1	25.9	6.0	0		Hemlock,West	0.45

%MC	*Readings*	*'%' Total*	Histogram..............12.5%...................25%
<	0	0.0	
5	0	0.0	
6	3	2.2	
7	17	12.5	
8	18	13.2	
9	25	18.4	
10	18	13.2	
11	13	9.6	
12	22	16.2	
13	5	3.7	
14	5	3.7	
15	5	3.7	
16	2	1.5	
17	0	0.0	
18	0	0.0	
19	0	0.0	
20	1	0.7	
21	0	0.0	
22	0	0.0	
23	0	0.0	
24	0	0.0	
25	0	0.0	
26	2	1.5	
27	0	0.0	
28	0	0.0	
29	0	0.0	
30	0	0.0	
>	0	0.0	

Stat-Pak

Readings Report

The Very Big Handmeter Company

Start 6/4/2013 2:30:59
Stop 6/4/2013 3:22:24

Meter Number: **00001**

Kiln:

Unit Ref.

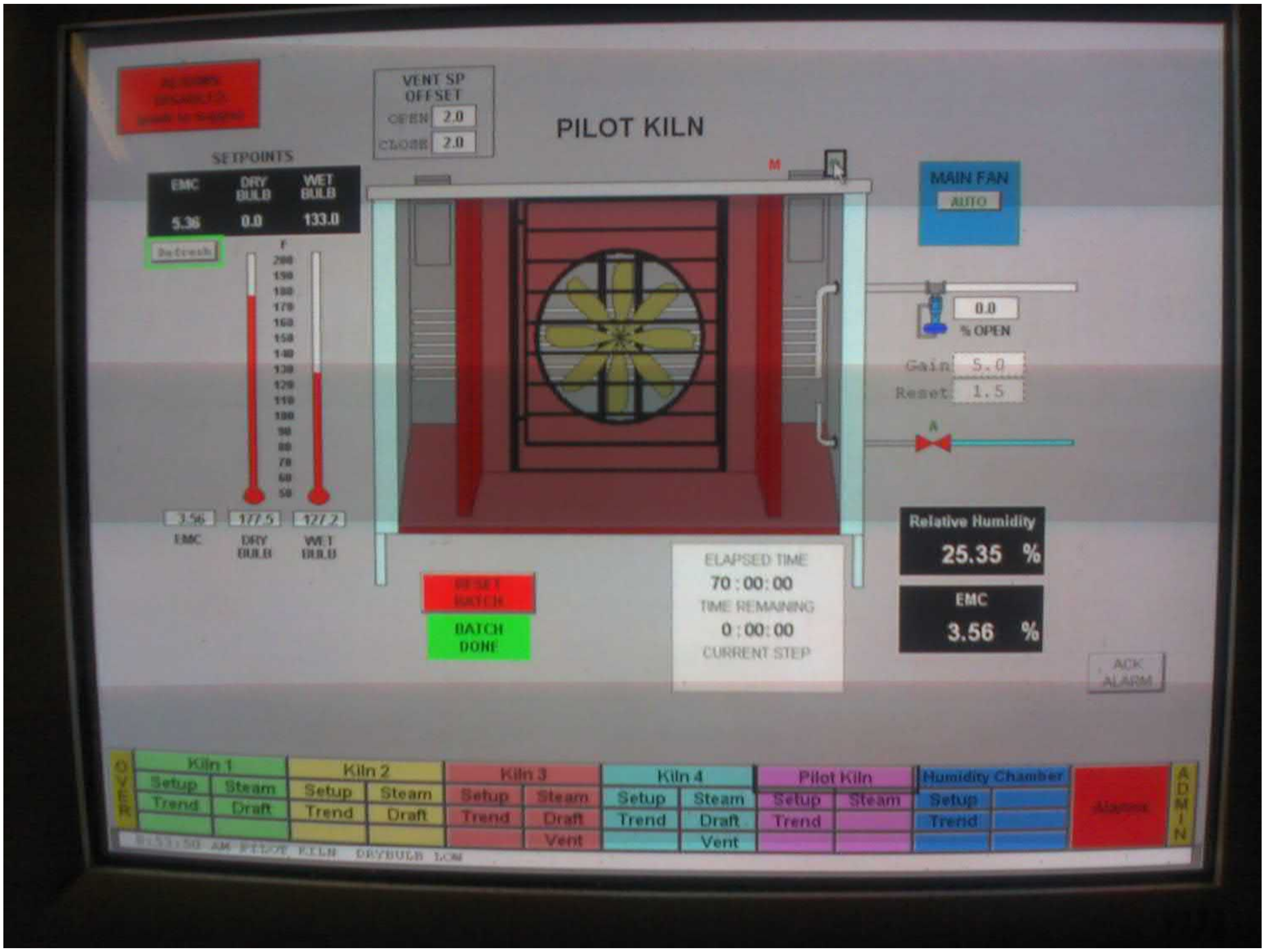
Supplier Ref.

%MC	*Readings*	*Std. Dev.*	*High*	*Low*	*Group*	*Location. Species*	*SG*
10.3	136	3.1	25.9	6.0	0	Hemlock,West	0.45

No.	*%MC*	*No.*	*%MC*	*No.*	*%MC*	*No.*	*%MC*	*No.*	*%MC*	*No.*	*%MC*
1	6.2	2	14.5	3	13.4	4	12.2	5	12.1	6	9.1
7	7.1	8	16.3	9	8.8	10	9.0	11	16.0	12	11.1
13	11.7	14	9.0	15	15.1	16	7.6	17	10.2	18	8.7
19	11.8	20	9.7	21	7.3	22	9.5	23	11.9	24	14.8
25	6.6	26	6.9	27	10.2	28	12.5	29	7.3	30	12.3
31	11.2	32	7.6	33	11.9	34	11.1	35	9.1	36	12.7
37	12.4	38	9.4	39	10.1	40	25.6	41	9.1	42	12.2
43	10.5	44	11.4	45	11.4	46	11.8	47	12.4	48	25.9
49	9.1	50	14.2	51	11.1	52	15.4	53	8.1	54	14.3
55	11.8	56	13.5	57	9.5	58	13.3	59	11.2	60	19.6
61	9.2	62	11.2	63	12.2	64	14.2	65	9.8	66	12.4
67	13.5	68	11.5	69	9.8	70	6.2	71	8.5	72	8.8
73	7.8	74	6.0	75	10.0	76	12.3	77	8.1	78	6.6
79	7.4	80	7.8	81	9.2	82	14.9	83	9.2	84	10.1
85	10.7	86	10.1	87	6.6	88	6.7	89	12.2	90	7.8
91	8.0	92	6.5	93	10.9	94	12.6	95	9.1	96	9.5
97	7.3	98	7.4	99	8.8	100	7.3	101	8.0	102	8.7
103	7.7	104	8.3	105	9.8	106	8.5	107	11.5	108	7.3
109	7.4	110	10.4	111	7.8	112	10.1	113	9.1	114	11.7
115	10.0	116	9.7	117	8.1	118	7.7	119	9.8	120	11.2
121	9.2	122	9.4	123	8.0	124	8.0	125	7.0	126	8.3
127	7.1	128	9.4	129	8.7	130	11.7	131	7.7	132	11.7
133	9.0	134	8.8	135	10.8	136	11.5				

7. SITE PHOTOS


Cleaver Brooks
CB Packaged Boiler
Cleaver-Brooks Company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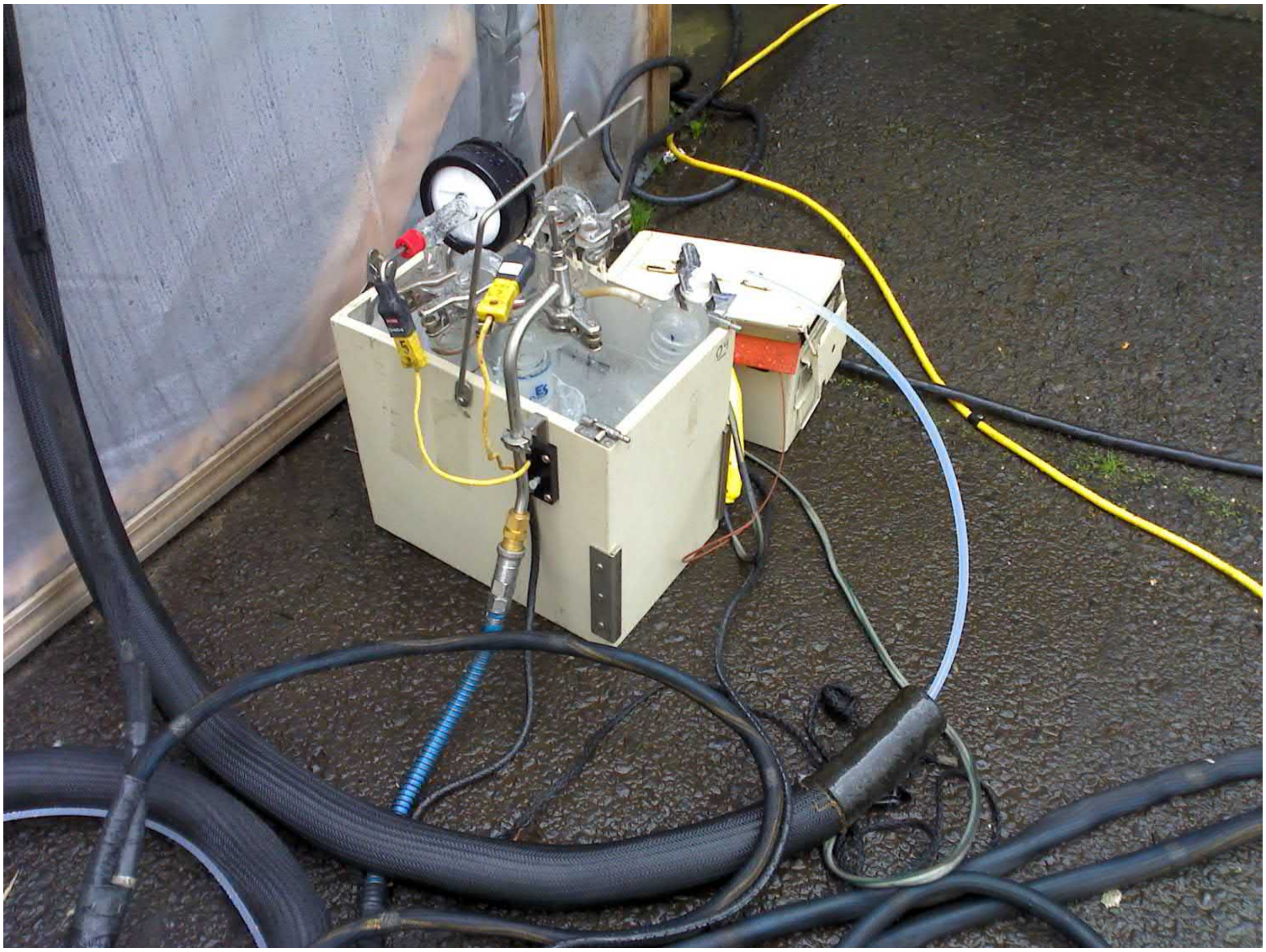
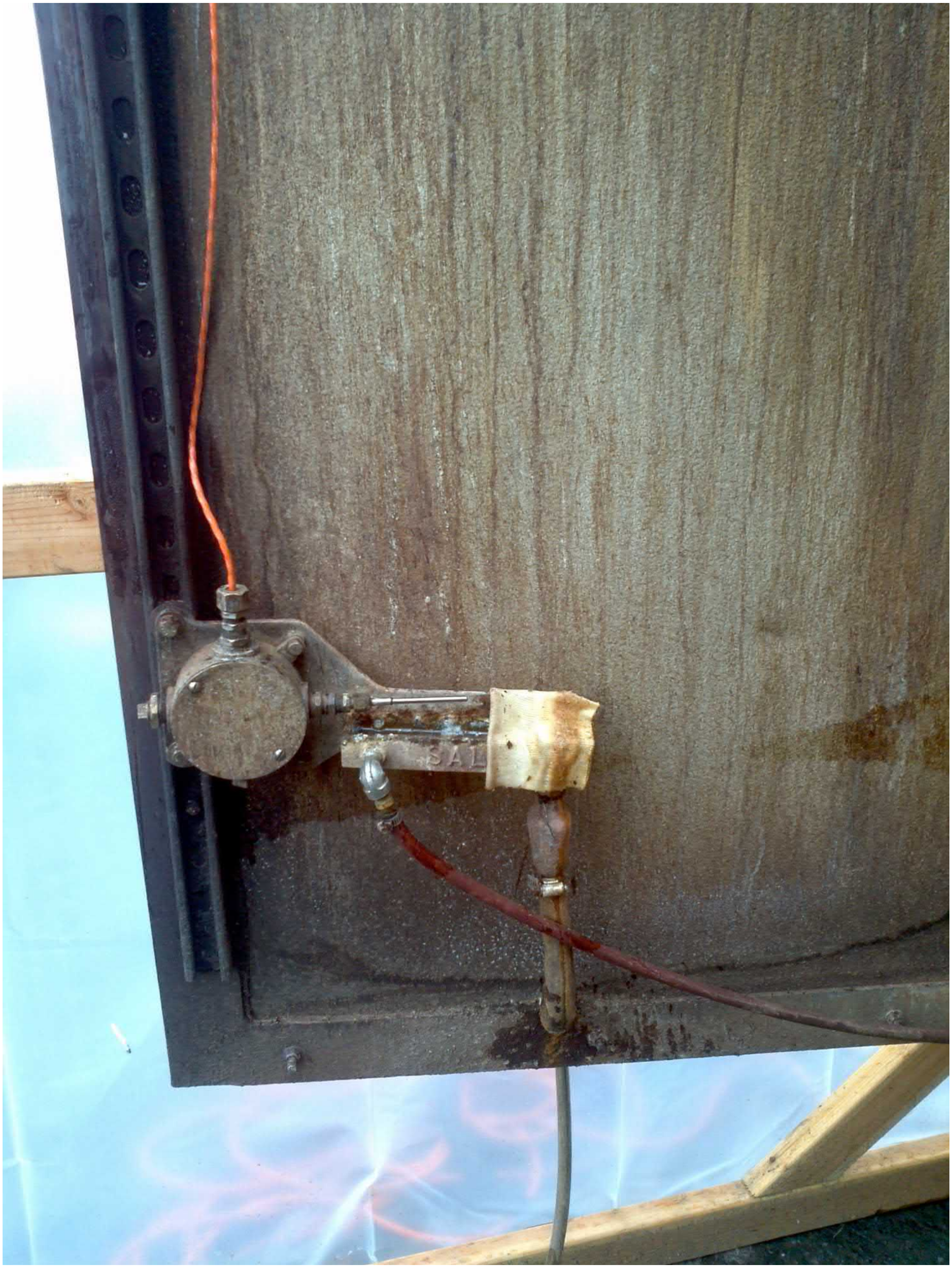
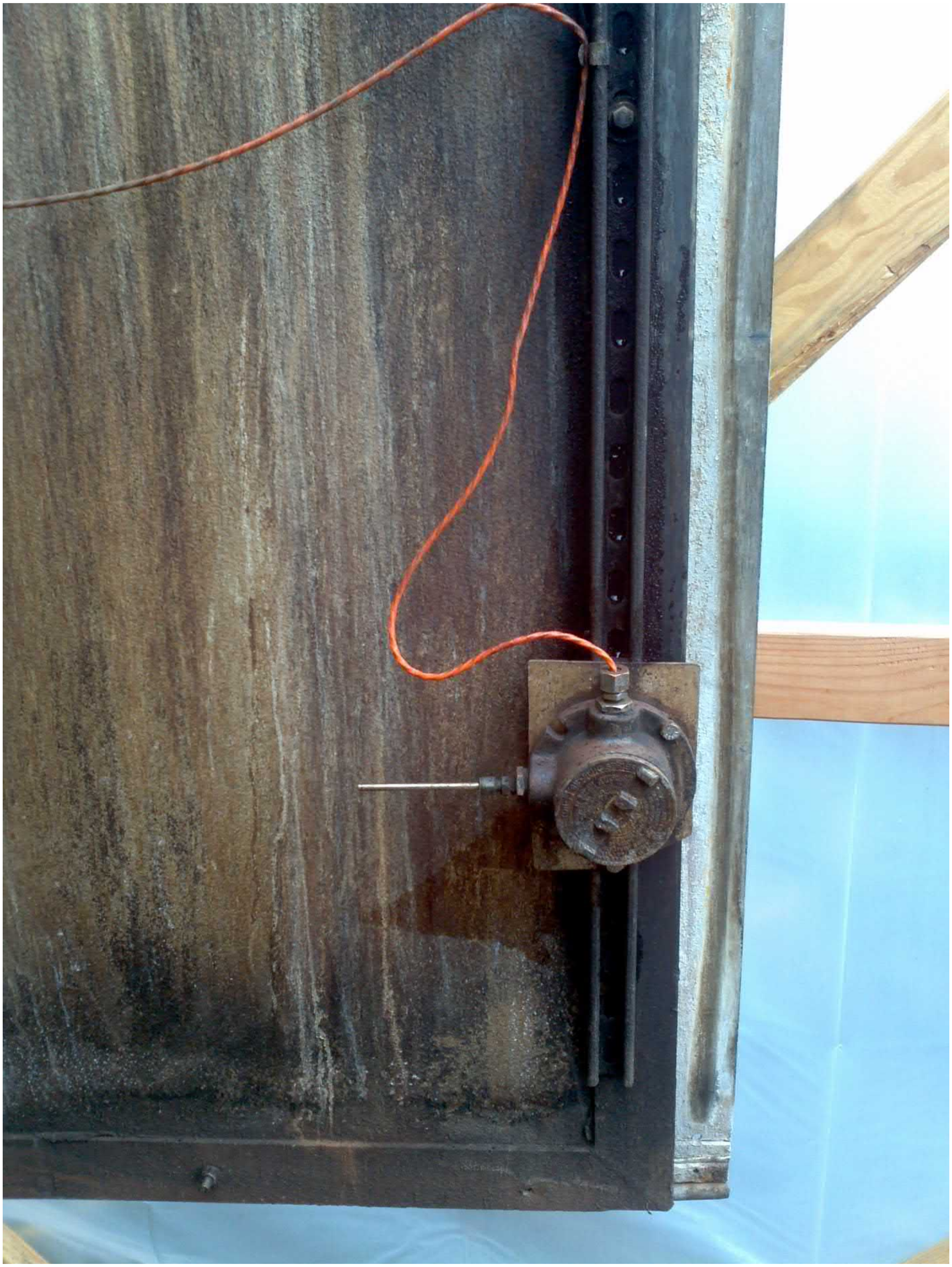
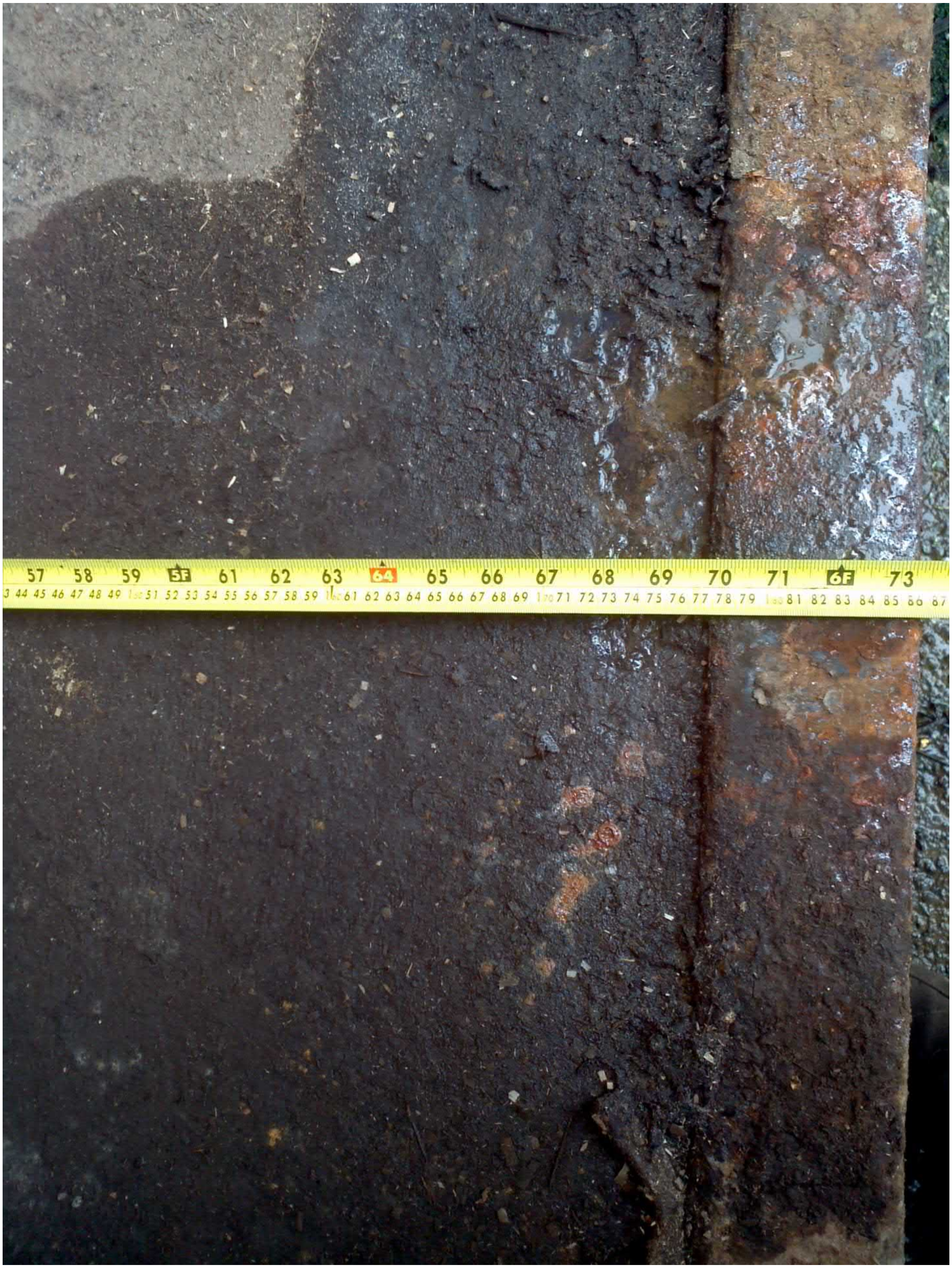
OFFSET
OPEN 2.0
CLOSE 2.0
PILOT KILN
SETPOINTS
EMC DRY BULB WET BULB
5.36 0.0 133.0
MAIN FAN
AUTO
0.0
% OPEN
Gain 5.0
Reset 1.5
3.56 177.5 177.2
EMC DRY BULB WET BULB
Relative Humidity
25.35 %
EMC
3.56 %
ELAPSED TIME
70 : 00 : 00
TIME REMAINING
0 : 00 : 00
CURRENT STEP
RESET BATCH
BATCH DONE
ACK ALARM
Kiln 1 Setup Steam Trend Draft
Kiln 2 Setup Steam Trend Draft
Kiln 3 Setup Steam Trend Draft Vent
Kiln 4 Setup Steam Trend Draft Vent
Pilot Kiln Setup Steam Trend
Humidity Chamber Setup Trend
OVER
ADMIN









8. QUALITY ASSURANCE/QUALITY CONTROL

8.1 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 nozzle entry plane	Calibrate according to Meth. 2, Sec. 3.1.2	Repair or return to supplier

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; $\underline{+}$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 $\underline{+}$6.35 mm (1.84 $\underline{+}$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% (≤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 disul-fonic acid disodium salt, reagent grade or certified ACS	Upon receipt, check label for grade or certification	As above
Barium perchlor-ate 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

Section: Quality Assurance/Quality Control

8.2 Hand Calculations

METHOD 5/202 CALCULATIONS

CLIENT: Sierra Pacific

SITE LOCATION: Dry kiln

PROJECT #: 13-2476 **Run #:** HFK

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
e" = vapor pressure
T_d = dry stack gas temperature, °F
T_w = wet stack gas temperature, °F
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 $\sqrt{\frac{(lb/lb-mole)(inches\ Hg)}{(^{o}R)(inches\ H_2O)}}$
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, $\sqrt{inches\ H_2O}$
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 or hours
T_m = meter temperature, °F
T_s = average stack temperature, °F
T_{std} = standard absolute temperature, 528°R
$T_{s(avg)}$ = Average absolute stack temperature,°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
M_{FH} = weight of front half particulate matter, g

M_{pn} = mass of probe& nozzle rinse, g
M_F = mass of filter, g
M_a = mass of acetone reagent blank, g
Mb = mass of field total cpm blank (shall not exceed 2 mg), g
0.0154 = conversion of mg to grains (gr)
M_n = weight of particulate in mg
C_s = concentration in pounds per dry standard cubic feet (lb/dscf)
E_1 = emission rate in pounds/hour (lb/hr)
E_2 = emission rate in pounds/thousand board feet (lb/Mbf)
Lf = lumber feed in board feet = bf processed for the test

Volume of metered sample gas at standard conditions:

$$P_{meter} = P_{bar} + \frac{\Delta H}{13.6} = \underline{29.65} + \frac{\underline{0.6555}}{13.6} = \underline{29.698199} \text{ inches Hg}$$

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

$$V_{m(std)} = \frac{(1983.976) \times (528) \times (29.698199) \times (0.999)}{(\underline{74.3} + 460) \times (29.92)} = \underline{1846.1123156} \text{ dscf}$$

Moisture Content:

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

$$V_{w(std)} = (0.04715) \times (\underline{2110}) = \underline{99.48650} \text{ scf}$$

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

$$B_{ws} = \frac{99.48650}{(99.48650 + 1846.1123156)} = \underline{0.05113} \text{ water vapor fraction}$$

Saturated Stack Moisture Content:

$$e'' = 6.08764 \times 10^{-6} \times tw^3 - 1.00431 \times 10^{-3} \times tw^2 + 0.0756026 \times tw - 1.69343$$

$$e'' = 6.08764 \times 10^{-6} \times (104.1)^3 - 1.00431 \times 10^{-3} \times (104.1)^2 + 0.0756026 \times (104.1) - 1.69343 = \underline{2.16082326}$$

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

$$B_{ws} = \frac{\left[2.16082326 - \left(\frac{(29.65 - 2.16082326) \times (104.1 - 104.1)}{(2800 - (1.3 \times \quad))}\right)\right]}{(29.65)} = 0.072878$$

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

Molecular Weight:

Dry:

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

$\%N_2 = 100 - (20.9) - (0.1) = 79 \ \%N_2$

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

$M_d = (0.44 \times 0.1) + (0.32 \times 20.9) + (0.28 \times 79) = 28.852 \ \text{lb/lb-mole}$

Wet:

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

$M_w = (28.852) \times (1 - 0.05113) + (18 \times 0.05113) = 28.29714 \ \text{lb/lb-mole}$

Average Velocity of Stack Gas:

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

$$P_s = P_{bar} + \frac{P_{static}}{13.6}$$

$$P_s = (29.65) + \frac{(0)}{13.6} = 29.65$$

$$V_s = 85.49 \times 0.84 \times 0.1047 \times \sqrt{\frac{(104.1 + 460)}{28.29714 \times 29.65}} = 6.16504 \ \text{ft/sec}$$

Volume Flow Rate:

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

$$Q_{std} = 60 \times (1 - 0.05113) \times 6.16504 \times 785.3975 \times \frac{528 \times 29.65}{(104.1 + 460) \times 29.92} = 255{,}696 \ \text{dscfm}$$

Percent Isokinetic:

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

$$I = \frac{0.0945 \times (104.1 + 460) \times (1846.1123156)}{29.65 \times 6.16504 \times 0.00134180913 \times 4140 \times (1 - 0.0728)} = 102.138\ \%$$

Particulate (front half) Calculations:

Blank Correction:

$$M_{FH} = M_{pn} + M_F - M_a = (0.0027) + (0.0007) - (0.0001) = 0.0034\ \text{g}$$

as gr/dscf:

$$C_s = \frac{0.0154 \times M_n}{V_{m(std)}} = \frac{0.0154 \times (3.4)}{(1846.1123156)} = 0.000028362\ \text{gr/dscf}$$

as lb/hour:

$$E_1 = \frac{(E_1 \text{ as gr/dscf}) \times Q_{std} \times 60}{7000} = \frac{(0.000028362) \times (255.696) \times 60}{7000} = 0.00062\ \text{lb/hr}$$

as lb/Mbf:

$$E_2 = \frac{E_1 \times \theta_{hr} \times 1000}{Lf} = \frac{(0.000062893) \times (69) \times 1000}{(2267)} = 0.001914\ \text{lb/Mbf}$$

Particulate (back half) Calculations:

Blank Correction:

$$M_{cpm} = M_i + M_o - M_b = (0.0121) + (0.0220) - (0.002) = 0.0321\ \text{g}$$

as gr/dscf:

$$C_s = \frac{0.0154 \times M_n}{V_{m(std)}} = \frac{0.0154 \times (32.1)}{(1846.1123156)} = 0.00026777\ \text{gr/dscf}$$

as lb/hour:

$$C_s = \frac{(C_s \text{ as gr/dscf}) \times Q_{std} \times 60}{7000} = \frac{(0.00026777) \times (258.705675) \times 60}{7000} = 0.000593782\ \text{lb/hr}$$

as lb/Mbf:

$$E_2 = \frac{E_1 \times \theta_{hr} \times 1000}{Lf} = \frac{(0.000593782) \times (69) \times 1000}{(2267)} = 0.018073\ \text{lb/Mbf}$$

Technician Signature ____________

8.3 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: 6/22/2012 | METER PART #: MF-1 | METER SERIAL #: 1620 4049 | CRITICAL ORIFICE SET SERIAL #: 1545a

BAROMETRIC PRESSURE (in Hg): INITIAL 30.11 | FINAL 30.11 | AVG (P_{bar}) 30.11

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 (%)	$\Delta H_@$
24	1	0.6497	16	504.380	510.282	5.902	64	67	67	65	65	66	7.00	2.3	5.9967	5.9839	0.998		1.80
	2	0.6497	16	510.282	516.175	5.893	64	66	67	65	66	66	7.00	2.3	5.9875	5.9839	0.999		1.80
	3	0.6497	16	516.175	522.080	5.905	64	67	67	66	66	66.5	7.00	2.3	5.9940	5.9839	0.998		1.80
																AVG =	0.999	0.69	
19	1	0.5155	16	522.080	527.454	5.374	64	67	67	66	66	66.5	8.00	1.5	5.4464	5.4262	0.997		1.86
	2	0.5155	16	527.454	532.830	5.376	64	67	67	66	66	66.5	8.00	1.5	5.4465	5.4262	0.996		1.86
	3	0.5155	16	532.830	538.225	5.395	64	67	67	66	66	66.5	8.00	1.5	5.4657	5.4262	0.993		1.86
																AVG =	0.995	0.36	
16	1	0.443	16	538.328	544.201	5.873	64	67	67	66	66	66.5	10.00	1.1	5.9462	5.8288	0.981		1.84
	2	0.443	16	545.350	551.215	5.865	64	66	67	66	66	66.25	10.00	1.1	5.9309	5.8288	0.981		1.84
	3	0.443	16	551.215	557.083	5.868	64	67	67	66	66	66.5	10.00	1.1	5.9391	5.8288	0.981		1.84
																AVG =	0.981	-1.06	

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

AVERAGE DRY GAS METER CALIBRATION FACTOR, Y = 0.992

AVERAGE $\Delta H_@$ = 1.83

(1) $$Vm_{(std)} = K_1 * Vm * \frac{Pbar + (\Delta H / 13.6)}{Tm}$$ = 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)

(2) $$Vcr_{(std)} = K' * \frac{Pbar * \Theta}{\sqrt{Tamb}}$$ = 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) $$Y = \frac{Vcr_{(std)}}{Vm_{(std)}}$$ = DGM calibration factor

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

HP-I Post cal 6-13-13

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: 6/13/2013 METER SERIAL #: 1001
METER PART #: HP-I CRITICAL ORIFICE SET SERIAL #: 1545s

BAROMETRIC PRESSURE (in Hg): INITIAL 30.18 FINAL 30.18 AVG (P_{bar}) 30.180

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 H₂O)	(1) V_m(STD)	(2) V_{cr}(STD)	(3) Y	Y VARIATION (%)	$\Delta H_@$
	1					0						0							
	2	0	0	0		0		0		0		0	0.00	0	0.0	0.0	#DIV/0!		#DIV/0!
	3	0	0	0		0		0		0		0	0.00	0	0.0	0.0	#DIV/0!		#DIV/0!
																AVG =	#DIV/0!	#DIV/0!	
24	1	0.6487	19	436.699	442.653	5.954	67	70	70	68	68	69	7.00	2.2	6.0081	5.8017	0.966		1.79
	2	0.6487	19	442.653	448.607	5.954	67	70	70	68	68	69	7.00	2.2	6.0080	5.8017	0.966		1.79
	3	0.6487	19	448.607	454.640	5.993	67	70	70	68	68	69	7.00	2.2	6.0081	5.8017	0.966		1.79
																AVG =	0.966	-0.67	
19	1	0.6186	20	454.640	460.043	5.403	67	70	70	68	69	69	8.00	1.41	5.4465	5.4242	0.996		1.74
	2	0.6186	20	460.043	465.466	5.423	67	70	71	68	69	69.5	8.00	1.41	5.4453	5.4242	0.996		1.74
	3	0.6186	20	465.266	470.707	5.423	67	71	71	69	70	70.25	8.00	1.41	5.4466	5.4242	0.996		1.74
																AVG =	0.996	-1.07	
16	1	0.465	20	470.707	476.388	5.681	68	71	71	70	70	70.5	10.00	1.1	5.6461	5.8211	1.018		1.84
	2	0.465	20	476.388	482.061	5.673	68	71	71	70	70	70.5	10.00	1.1	5.7108	5.8211	1.018		1.84
	3	0.465	20	482.061	487.734	5.673	68	71	71	70	70	70.5	10.00	1.1	5.7108	5.8211	1.018		1.84
																AVG =	1.002	2.04	
	1					0						0							
	2	0	0	0		0		0		0		0	0.00	0	0.0	0.0	#DIV/0!		#DIV/0!
	3	0	0	0		0		0		0		0	0.00	0	0.0	0.0	#DIV/0!		#DIV/0!
																AVG =	#DIV/0!	#DIV/0!	

AVERAGE DRY GAS METER CALIBRATION FACTOR, Y = 1.003

AVERAGE $\Delta H_@$ = 1.79

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

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 in the spreadsheet above.

(1) $$Vm_{(std)} = K_1 * Vm * \frac{Pbar + (\Delta H / 13.6)}{Tm}$$ = 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)

(2) $$Vcr_{(std)} = K' * \frac{Pbar * \Theta}{\sqrt{Tamb}}$$ = 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) $$Y = \frac{Vcr_{(std)}}{Vm_{(std)}}$$ = DGM calibration factor

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: [illegible]
METER PART #: [illegible]
METER SERIAL #: [illegible]
CRITICAL ORIFICE SET SERIAL #: [illegible]

BAROMETRIC PRESSURE (in Hg): INITIAL 30.11 FINAL 30.11 AVG (P_{bar}) 30.11

IF Y VARIATION EXCEEDS 3.00%, ORIFICE SHOULD BE RECALIBRATED

ORIFICE #	RUN #	K' FACTOR (AVG)	TESTED VACUUM (in Hg)	DGM READINGS (FT³) INITIAL	DGM READINGS (FT³) FINAL	DGM READINGS (FT³) 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 %	$\Delta H_@$
14	1	[illegible]	13	[illegible]	[illegible]	[illegible]	76	66	69	66	66	66.75	7.00	3.32	[illegible]	[illegible]	0.984		1.84
	2	[illegible]	13	[illegible]	[illegible]	[illegible]	76	68	69	65	67	67.25	7.00	3.32	[illegible]	[illegible]	0.986		1.84
	3	[illegible]	13	[illegible]	[illegible]	[illegible]	76	69	71	67	68	68.75	7.00	3.32	[illegible]	[illegible]	0.986		1.82
																AVG =	0.985	-0.01	
16	1	[illegible]	16	[illegible]	[illegible]	[illegible]	76	70	73	68	70	70.25	5.00	1.8	[illegible]	[illegible]	1.007		1.82
	2	[illegible]	16	[illegible]	[illegible]	[illegible]	76	72	74	70	71	71.75	5.00	1.8	[illegible]	[illegible]	1.005		1.86
	3	[illegible]	16	[illegible]	[illegible]	[illegible]	76	74	75	71	72	73	5.00	1.8	[illegible]	[illegible]	1.012		1.86
																AVG =	1.008	1.01	
18	1	[illegible]	18	[illegible]	[illegible]	[illegible]	76	75	76	74	74	74.75	15.00	1.14	[illegible]	[illegible]	0.989		1.85
	2	[illegible]	18	[illegible]	[illegible]	[illegible]	76	76	77	74	74	75.25	15.00	1.14	[illegible]	[illegible]	0.984		1.86
	3	[illegible]	18	[illegible]	[illegible]	[illegible]	76	77	78	74	75	76	15.00	1.14	[illegible]	[illegible]	1.001		1.86
																AVG =	0.992	-0.01	

AVERAGE DRY GAS METER CALIBRATION FACTOR, Y = 0.999

AVERAGE $\Delta H_@$ = 1.87

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

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

(1) $$Vm_{(std)} = K_1 * Vm * \frac{Pbar + (\Delta H / 13.6)}{Tm}$$ = 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)

(2) $$Vcr_{(std)} = K' * \frac{Pbar * \Theta}{\sqrt{Tamb}}$$ = 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) $$Y = \frac{Vcr_{(std)}}{Vm_{(std)}}$$ = DGM calibration factor

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:	[illegible]
METER PART #:	[illegible]
METER SERIAL #:	[illegible]
CRITICAL ORIFICE SET SERIAL #:	[illegible]
BAROMETRIC PRESSURE (in Hg): INITIAL	[illegible]
FINAL	[illegible]
AVG (P_{bar})	[illegible]

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 (%)	$\Delta H_@$
	1					[illegible]						[illegible]							
	2	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]		[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	#DIV/0!		#DIV/0!
	3	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]		[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	#DIV/0!		#DIV/0!
																AVG =	#DIV/0!	#DIV/0!	
	1					[illegible]						[illegible]							
	2	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]		[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	#DIV/0!		#DIV/0!
	3	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]		[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	#DIV/0!		#DIV/0!
																AVG =	#DIV/0!	#DIV/0!	
10	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
	2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
	3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
																AVG =	[illegible]	[illegible]	
11	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
	2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
	3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
																AVG =	[illegible]	[illegible]	
11	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
	2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
	3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
																AVG =	[illegible]	[illegible]	

USING THE CRITICAL ORIFICES AS CALIBRATION STANDARDS:

[illegible]

AVERAGE DRY GAS METER CALIBRATION FACTOR, Y = 0.991

AVERAGE $\Delta H_@$ = 1.89

(1) $Vm_{(std)} = K_1 * Vm * \frac{Pbar + (\Delta H/13.6)}{Tm}$ = Net volume of gas sample passed through DGM, corrected to standard conditions

[illegible]

(2) $Vcr_{(std)} = K' * \frac{Pbar * \Theta}{\sqrt{Tamb}}$ = Volume of gas sample passed through the critical orifice, corrected to standard conditions

[illegible]

(3) $Y = \frac{Vcr_{(std)}}{Vm_{(std)}}$ = DGM calibration factor

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

8.4 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

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

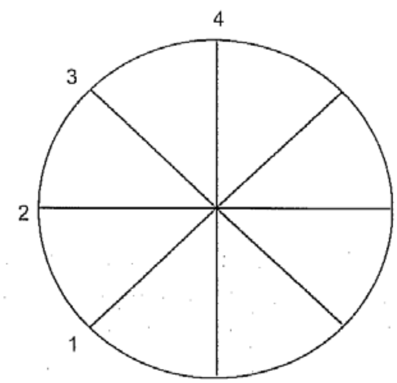
w - angle	w	Limit	Pass
1	0.016	<= 0.03125"	YES

Comments:

8.6 Nozzle Calibration

Emission Technologies, Inc.
Nozzle Calibration

Date:	5-30-13
Operator:	E.L.
Nozzle Type:	Glass
Nozzle ID:	23
Ambient Temperature:	60°F



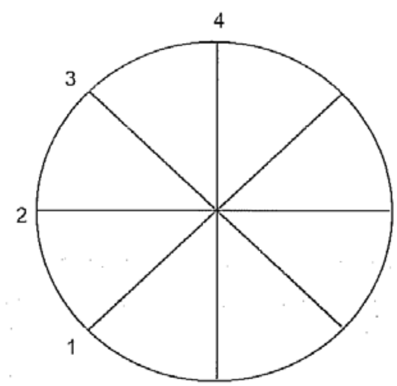
Measured Nozzle Diameters:

D1 =	0.497
D2=	0.495
D3=	0.496
D4=	0.496
Average:	0.496

4 point Nozzle Calibration Sheet

Emission Technologies, Inc.
Nozzle Calibration

Date: 5-30-18
Operator: EOL
Nozzle Type: Glass
Nozzle ID: 0.418
Ambient Temperature: 60°F



Measured Nozzle Diameters:

D1 =	0.419
D2=	0.418
D3=	0.418
D4=	0.417
Average:	0.418

4 point Nozzle Calibration Sheet

8.7 Balance and Weights Calibrations/Certifications

Certificate of Calibration

North West Instrument Services

To: [illegible]
Laboratory
15609 [illegible] Rd
[illegible]

Next Service Due April 2014

The balances listed below have been serviced on: April 26, 2013 This is to certify that the test weights used during calibration are traceable to the ***National Institute of Standards and Technology*** and **Compliant** with ***Mfg.specifications and ISO 9001:2008*** .

Standards are ASTM-CLASS #1.	*#1.Analytical*	*#2.Precision*	*#3.Precision*
The identification number of test weights:	Set # 1.	Set # 2.	Set # 3.
The calibration date of weights used:	2-14-2012	2-14-2012	2-14-2912
Next calibration due:	2-14-2014	2-14-2014	2-14-2014
N.I.S.T. traceability test number is:	20120345	20120346	20120347
Weight Description:	10mg-100g+	100g-5kg+	1kg-10kg+

Preventive maintenance consists of: a thorough functional check, cleaning, lubrication, corner load, calibration, linearity uncertainty and hysterisis checks and adjustments to original ***Mfg. specifications.***

Four or more of the above standards were used as references for linearity and calibration.

Notice all balances are serviced under lab ambient conditions. Manufacturer's tolerances are for new equipment used under ideal conditions. Your results may reflect the age of the equipment and the environmental conditions.

	Model.	Serial#.	Pre. Adj.Reading:	Post. Adj.Reading:	Liniarity:	Readability:	Wgt. Set #:
1.	AE200	FB1252	+- 100.0012g	+- 100.0000g	+- 0.2mg	+- 0.1mg	# 1
2.	100g wt	62765	+- 100.0001	+- n/a	+- n/a	+- n/a	# n/a
3.			+-	+-	+-	+-	#
4.			+-	+-	+-	+-	#
5.			+-	+-	+-	+-	#
6.			+-	+-	+-	+-	#
7.			+-	+-	+-	+-	#
8.			+-	+-	+-	+-	#
9.			+-	+-	+-	+-	#
10.			+-	+-	+-	+-	#

Comments.

[illegible signature]
Representative

Page 1 **Of** 1

Customer

PO Box 2448 Oak Harbor, WA 98277-6448 Ph 360-202-0960 / Fax 360-675-4116

TROEMNER
Henry Troemner LLC

Traceable Certificate

201 Wolf Drive • P.O. Box 87 • Thorofare, NJ 08086-0087 • Phone:856-686-1600 • Fax: 856-686-1601 • www.troemner.com • e-mail: troemner@troemner.com

Weight

Emission Technologies
15609 D Peterson Road
Burlington, WA 98233

Order Number	CC
Certificate Number	722059
Date of Calibration	24-MAY-2013
Calibration Due Date	24-MAY-2014

Description of Weights: ASTM Weight

Material	Assumed Density at 20°C	Range
Stainless Steel	8.03 g/cm3	3g

Tested with Reference Standards Traceable to the National Institute of Standards & Technology through NIST Test Number 822-275872-11.

We certify that the weights listed are calibrated to ASTM E617-97 Class 1 tolerances.

The calibration of these weights is based on apparent mass vs material of density 8.0g/cm3.

Nominal Mass Value	Serial Number	Correction *	Tolerance (+ or -)	Uncertainty (+ or -)
3 g	1000073386	+0.0104 mg	0.034 mg	0.0110 mg

* Correction is defined as the difference between the mass value of a weight and its nominal value. A positive correction indicates that the mass value is greater than the nominal value by the amount of the correction.

Joseph Moran, Metrology Manager, Approved Signatory

TROEMNER
Henry Troemner LLC

Traceable Certificate

201 Wolf Drive • P.O. Box 87 • Thorofare, NJ 08086-0087 • Phone:856-686-1600 • Fax: 856-686-1601 • www.troemner.com • e-mail: troemner@troemner.cc

Weight

Emission Technologies
15609 D Peterson Road
Burlington, WA 98233

Order Number	CC
Certificate Number	722059A
Date of Calibration	24-MAY-2013
Calibration Due Date	24-MAY-2014

Description of Weights: ASTM Weight

Material	Assumed Density at 20°C	Range
Stainless Steel	7.95 g/cm3	500mg

Tested with Reference Standards Traceable to the National Institute of Standards & Technology through NIST Test Number 822-275872-11.

We certify that the weights listed are calibrated to ASTM E617-97 Class 1 tolerances.

The calibration of these weights is based on apparent mass vs material of density 8.0g/cm3.

Nominal Mass Value	Serial Number	Correction *	Tolerance (+ or -)	Uncertainty (+ or -)
500 mg	1000073387	+0.0039 mg	0.010 mg	0.0032 mg

* Correction is defined as the difference between the mass value of a weight and its nominal value. A positive correction indicates that the mass value is greater than the nominal value by the amount of the correction.

Joseph Moran, Metrology Manager, Approved Signatory

8.8 Chemical Certificates of Analysis

PHARMCO-AAPER
THE POWER OF THREE³

CERTIFICATE OF ANALYSIS

WATER

GLASS PURIFIED, GLASS DISTILLED, HPLC GRADE

Lot # PB003806WTR
QC # 1.03316
Date of Manufacture: 04-11-11
Recommended Retest Date: Three Years from Date of Manufacture
Main Catalog #: 23200HPLC, zh23200HPLC

Gradient Elution: A 40 ml volume of water is passed through a column for 20 minutes and eluted with a water to Acetonitrile gradient of 5% per minute.

Test		**Specification**	**Result**
Fluorescence at 450 nm (as Quinine)		0.1 ppb max.	<0.1 ppb
LC Gradient Elution Suitability		To Pass Test	Pass
Residue after Evaporation		1 ppm max.	<0.1 ppm
Optical Absorbance at:	190 nm	0.01 max.	0.009
	200 nm	0.01 max.	<0.001
	210 nm	0.01 max.	<0.001
	250 nm	0.005 max.	<0.001
	400 nm	0.005 max.	<0.001
Filtered to 0.2 um max		Per Lot	Pass

Form: Water, Distilled, #101, Rev. 2.5, 11/10, ML

Purified and distilled in glass - Suitable for: Critical & Routine HPLC Analysis

Approved by: P. McGowan, Quality Assurance + Technical Support

Disclaimer: For Industrial, Pharmaceutical, Flavor & Fragrance or Lab Use. Not intended for use as an active substance in Food or Drug. Not to be considered a Medical Device. Not intended for use as a Disinfectant as defined by the EPA. The appropriate use of this product is the sole responsibility of the user. (Rev. # disclaimer only, rev 3.5 11/06 EF)

Pharmco Products Inc: 58 Vale Road, Brookfield, CT 06804 1.800.243.5360 Fax: 1.203.740.3481
Aaper Alcohol & Chemical Co: 1101 Shelby Drive, Shelbyville, KY 40065 1.800.456.1017 www.pharmcoaaper.com

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SDW

PHARMCO-AAPER
THE POWER OF THREE³

CERTIFICATE OF ANALYSIS
ACETONE
GLASS PURIFIED, GLASS DISTILLED
HRGC/HPLC – TRACE GRADE
LOT # PB004807ACE ✓
Q.C. # 1204264
Date of Manufacture: 05-04-12
Expiration Date: Three Years from Date of Manufacture*
Main Catalog #: 329000DIS
Alt. Catalog #: 32900HPLC, 329000ACS

Gas Chromatographic Analysis of this product using an electron capture detector shows no peaks with a response greater than 10 ppt as Heptachlor Epoxide.

Product Specifications	Limits	Results
GC-ECD	10ppt max	<1ppt
UV Absorbance @ 330 nm	1.000 max	0.68
340 nm	0.100 max	0.05
350 nm	0.020 max	<0.001
375 nm	0.010 max	<0.001
400 nm	0.005 max	<0.001
Assay, (GC), min	99.9%	99.98%
Residue After Evaporation	3 ppm max	<0.1 ppm
Boiling Range	56-57C	56.1C – 57C
Color (APHA), max	10	<5
Fluorescence Background	1 ppb	<1ppb
Appearance	Clear	Clear
Solubility in Water	To Pass Test	Pass
Titrable Acid, max	0.0005 meq/g	0.0001 meq/g
Titrable Base, max	0.0006 meq/g	0.00006 meq/g
Aldehyde (as HCHO), max	0.002%	<0.002%
IPA, max	0.05%	<0.005%
Methanol, max	0.05%	0.01%
Substances Red. $KMnO_4$	To Pass Test	Pass
Water, max	0.5%	0.3%
Specific Gravity @ 25C	0.7890, max.	0.7883
Liquid Chromatography (ACS)	To Pass Test(s)	
Absorbance (UV)		Pass
Gradient Elution		Pass
Gradient Analysis		Pass
Identification (IR/GC)	To Conform	Pass
Filtered to 0.2 um max	Per Lot	Pass

Form Acetone Distilled, # 201, Rev. 2.4, 1/07, EF

Purified, dried and distilled in glass – Suitable for: High Resolution Gas Chromatography, Mass Spectroscopy, Trace Organic Analysis, Critical and Routine HPLC. Meets all other ACS Specifications for General Use Reagent, Spectrophotometric Analysis and General Use HPLC.

Approved by: P. McGowan, Quality Assurance + Technical Support

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Aaper Alcohol & Chemical Co: 1101 Shelby Drive, Shelbyville, KY 40065 1.800.456.1017 www.pharmcoaaper.com

THE POWER OF THREE³
PHARMCO-AAPER
AND COMMERCIAL ALCOHOLS

CERTIFICATE OF ANALYSIS
n-HEXANE, 60% min.
GLASS PURIFIED, GLASS DISTILLED
HRGC/HPLC – TRACE GRADE

Lot # PL001277HEX60
QC # A0471
Date of Manufacture: 3/23/07
Main Catalog No: 359060DIS

GC Analysis of this product using an electron capture detector shows no peaks with a response greater than 10ppt as Heptachlor Epoxide.

PRODUCT SPECIFICATIONS	LIMITS	LOT ANALYSIS
GC-ECD	10ppt max	0.8ppt
UV Absorbance @ 195nm	1.00 max	0.8130
210nm	0.30 max	0.2086
220nm	0.20 max	0.0590
230nm	0.10 max	0.0167
240nm	0.04 max	0.0017
250nm	0.02 max	0.0000
280nm	0.01 max	0.0000
400nm	0.01 max	0.0000
Assay, (GC), n-Hexane	60.0% min	61%
Assay, (GC), C6 (Hexanes)	99.0% min	99.98%
Residue After Evaporation	10 ppm max	1 ppm
Water, max	0.01%	0.003%
Thiophene	To Pass	Pass
Color (APHA)	10 max	<5
Fluorescence Background (as Quinine Sulfate)	1ppb	<1ppb
Water Soluble Titrable Acid	0.0003meq/g	0.0002meq/g
Sulfur (as S)	0.005% max	<0.001%
LC Suitability	To Pass Test	Pass
Identification (IR/GC)	To Conform	Pass

Form n-Hexane 60%-Distilled, #101, Rev. 2.0, 11/06, EF

Purified, dried and distilled in glass – Suitable for: High Resolution Gas Chromatography, Mass Spectroscopy, Trace Organic Analysis, Critical and Routine HPLC. Meets all other ACS Specifications for General Use Reagent, Spectrophotometric Analysis and General Use HPLC.

Approved by: P. McGowan, Laboratory Manager
Disclaimer: For Industrial, Pharmaceutical, Flavor & Fragrance or Lab Use. Not intended for use as an active substance in Food or Drug. Not to be considered a Medical Device. Not intended for use as a Disinfectant as defined by the EPA. The appropriate use of this product is the sole responsibility of the user. (Rev. # disclaimer only, rev 3.3 10/05/05 PD)

An ISO 9001:2000 Certified Company
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END OF TEST REPORT