Custom
Stack Analysis, LLC.
1-800-824-4274

The Log Boiler, Inc.
4308 Quincy Street
Hudsonville, Michigan 49426

Report

Performed Velocity, Moisture, Temperature, Volumetric Flow Rate, Particulate, Oxygen, Carbon Dioxide and Carbon Monoxide Emissions Testing

Sampling performed on the Log Boiler Outlet

Hudsonville, MI 49426

Test Date: 5/20/2014

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Signed by: customstack

Brian E. Lemasters
Custom Stack Analysis, LLC.

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APPENDIX

EXECUTIVE SUMMARY

Custom Stack Analysis, LLC. conducted emissions sampling using USEPA Methods 1-5 and 10. Testing was conducted on the Log Boiler Outlet on May 20th, 2014 for engineering purposes. The Custom Stack Analysis, LLC. test crew consisted of Mr. James Gray, Mr. Jordan Smith and Mr. Brian Lemasters. The testing procedures were coordinated by Mr. Tom Lubbers of The Log Boiler, Inc.

A description of the testing protocol is included on pages 3-5. All testing calculations are located on pages 9-13. Appendix 1 includes field test data. Appendix 2 contains laboratory data. Appendix 3 contains calibration data for the equipment used on test day. Appendix 4 contains monitoring data. Appendix 5 contains process data. Test results are located on page 2.

Test Results

The Log Boiler, Inc. - Log Boiler Outlet
5/20/2014
Methods 1-5 & 10

		Run #1	Run #2	Run #3	Avg.
Stack Gas Velocity (ft/sec)		18.07	16.81	15.45	16.77
Standard Cubic Feet an Hour		30,221	28,295	29,107	29,208
Actual Cubic Feet per Minute		851	792	728	790
Stack Temperature (F)		310	319	267	298
Moisture % (Measured)		11.69%	10.06%	6.04%	9.26%
Isokinicity %		105.4%	100.2%	97.0%	100.9%
Carbon Dioxide %		8.00%	7.00%	3.00%	6.00%
Oxygen %		11.00%	12.00%	17.00%	13.33%
Nitrogen %		81.00%	81.00%	80.00%	80.67%
Wood	**(lbs/hr)**	420	420	420	420
BTU	**(BTU/lb)**	7252	7252	7252	7252
BTU	**(mmBTU/hr)**	3.05	3.05	3.05	3.05
Particulate	**(lbs/hr)**	0.4473	0.1288	0.1532	0.2431
Particulate	**(gr/dscf)**	0.10360	0.03186	0.03685	0.05744
Particulate	**(lbs/dscf)**	1.48E-05	4.55E-06	5.26E-06	8.21E-06
Particulate	**(lbs/mmBTU)**	0.14685	0.04229	0.05030	0.07981
CO	**(ppm)**	9400.95	7910.07	7767.14	8359.39
	(lbs/hr)	20.63	16.25	16.41	17.76

METHOD 1

Sample and velocity traverses for stationary sources.

To aid in the representative measurement of pollutant emissions and/ or total volumetric flow rate from a stationary source, a measurement site where the effluent stream is flowing in a known direction is selected, and the cross-section of the stack is divided into a number of equal areas. A traverse point is then located within each of these equal areas.

METHOD 2

Determination of stack gas velocity and volumetric flow rate.

The average gas velocity in a stack is determined from the gas density and from measurement of the average velocity head with a Type S (Stausscheibe or reverse type) pitot tube.

METHOD 3

Gas analysis for the determination of dry molecular weight.

This method is applicable for determining carbon dioxide and oxygen concentrations and dry molecular weight of a sample from a gas stream of a fossil-fuel combustion process.

METHOD 4

Determination of moisture content in stack gases.

A gas sample is extracted at a constant rate from the source. It is determined either volumetrically or gravimetrically.

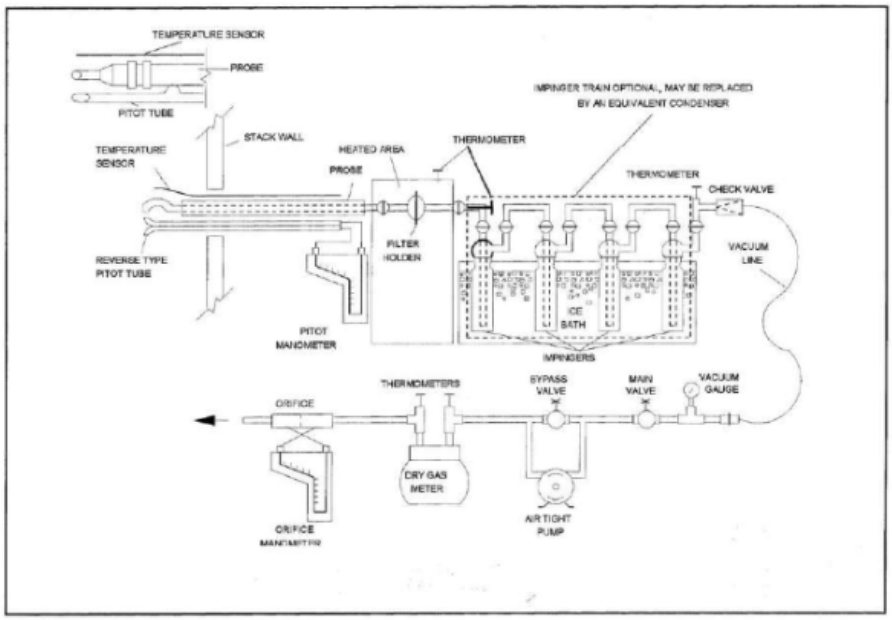
METHOD 5 TESTING DESCRIPTION

Particulate samples were collected following EPA Methods 1-5. The equipment used for testing consisted of a Custom Stack Analysis Stack Train Sampler (EPA type). A type “S” pitot and a heated sampling probe were used with the sampling train. All equipment was calibrated in the laboratory prior to the test. The sampling nozzle and the pitot tubes were measured on the day of the test. All calibrations can be found in the appendix. The dust laden gases are passed through a heated pyrex probe and a heated glass four inch filter holder containing Gelman Type A-E fiberglass filter media. The gases leaving the filter were collected in a series of four impingers packed in ice. The first, third, and fourth impingers were the modified Greenburg-Smith type and the second one was a standard Greenburg-Smith type. The first and second impinger contained 100 ml of distilled water. After leaving the third and fourth empty impingers the gases passed through a “Drierite” column containing about 500 grams of indicating silica gel to remove any remaining water vapor. The dry gas then passed through the hose portion of the umbilical cord to a Custom Stack Analysis Model #3000 “Stacksampler” module. In the module the gas was moved through the system by a leakless air pump to a Rockwell 175-S dry test meter. The dry test meter exhausted to a calibrated orifice to measure the flow rate of the gases passing through the sampling apparatus. A type “S” pitot tube was attached to the sheath of the heated probe and nozzle. The orifice pressure taps and the pitot tube were connected to a Dwyer duel 10 inch combination inclined-well type manometer. One half of the manometer measured the orifice differential pressure (^H) and the other half measured the flue gas velocity head (^P). The temperature of the flue gas was measured by a type “K” thermocouple connected to a Marlin Digital Temperature controller. The $C0_2$ and 0_2 levels were analyzed using a Bacharach Fyrite analyzer.

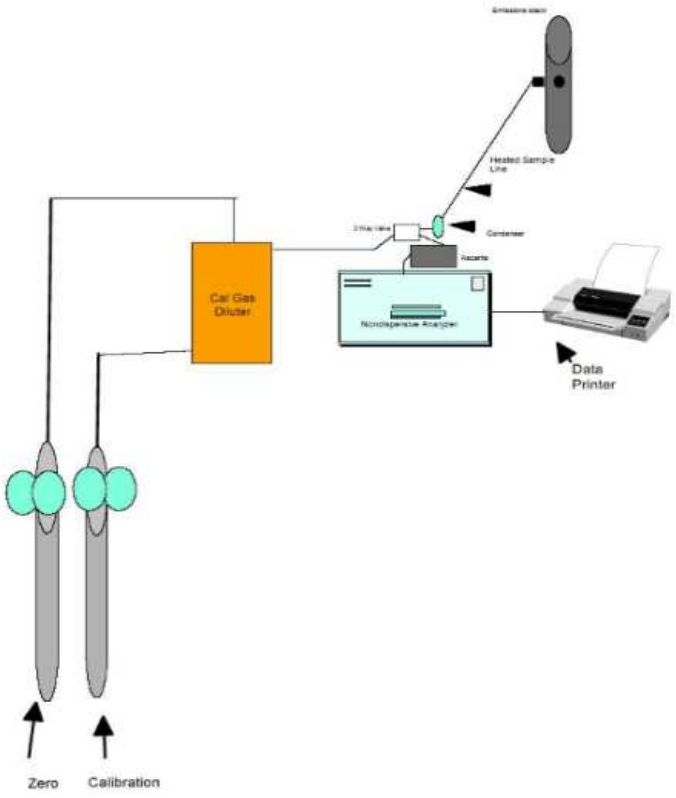
METHOD 10 TESTING DESCRIPTION

A gas sample is continuously extracted from the stack, and a portion of the sample is conveyed to an instrumental analyzer for determination of CO gas concentration using a Luft-type nondispersive infrared analyzer. The gases pass through a heated sampling probe and filter to prevent condensation. The gases then pass through a calibration valve to a heated sampling line. After the heated sampling line is a Universal Analyzers Model 530 air cooled single sample thermoelectric water condenser with a perostolic pump for moisture removal. The sample is then passed through an ascarite tube to a Thermo Environmental Instruments Model 48 Luft-type analyzer where the gases are analyzed for CO concentrations. Before the testing procedures commence the analyzer is left to warm up for a 90 minute period. It is then calibrated according to Method 7E specifications. To the extent practicable, the measured emissions should be between 20 to 100 percent of the selected calibration span. Three calibration gases are selected. The High-Level gas concentrations shall be equivalent to 20 to 100 percent of the calibration span. Mid-Level concentrations shall be equivalent to 40 to 60 percent of the calibration span. The Low-Level Gas concentrations of less than 20 percent of the span. Before the first run an analyzer calibration error check is conducted. If the low-level, mid, or high cal gases expected concentrations differ by more than +-2% of the span then the procedure needs to be repeated until an acceptable 3 point calibration is obtained. After the analyzer calibration check the upscale and low level calibration gases are introduced to the sampling calibration valve and recorded. System bias calibration must be within 5.0% of the analyzer calibration span for low-scale and upscale calibration gases. At the conclusion of each of the test runs the low-level gas and an upscale gas closest to the concentrations are introduced to the calibration valve assembly. If either the low-level or upscale value exceeds +-3% of the span, then the run is considered invalid.

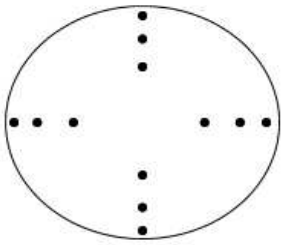
5 Sampling System



10 Sampling System



Location of Sampling Points



Location:	Log Boiler Outlet	
Upstream	24"	
Downstream	24"	
Stack Diameter	12	Inches
Sample Point #		
		Inches
1	0.5	
2	1.8	
3	3.6	
4	8.4	
5	10.2	
6	11.5	

CALCULATIONS

Outlet **Methods 1-5 & 10**

		RUN #1	RUN #2	RUN #3		
1.	**Vm (std)**	54.40	48.40	48.23	=	$VM * 17.64 * \frac{PBAR + \frac{\hat{H}}{13.6}}{Tm} * Y$

		RUN #1	RUN #2	RUN #3
Vm (std) = Volume of gas collected, corrected to standard conditions, cuft.	=	54.40	48.40	48.23
Vm = Volume of gas sampled at meter box, cuft.	=	56.55	51.01	51.15
17.64 = Standard temperature, 528 Rankine / std pressure, 29.92.	=	17.64	17.64	17.64
Tm = Average dry gas meter temperature, + 460 Rankine.	=	539.4	546.3	549.7
Pbar = Barometric pressure, inches of mercury (Hg)	=	29.21	29.21	29.21
^H = Average pressure differential across orifice.	=	2.79	2.39	2.34
13.6 = Specific gravity of mercury.	=	13.6	13.6	13.6
Y = Calibration factor of meter box.	=	1	1	1

		RUN #1	RUN #2	RUN #3		
2.	**Vw (std)**	7.20	5.41	3.10	=	$Vlc * \frac{P\ H20}{Mh20} * \frac{R\ Tstd}{Pstd} = K2 * Vlc$

		RUN #1	RUN #2	RUN #3
Vlc = Volume of water and silica colected.	=	152.8	114.9	65.8
P H20 = Density of water, 0.002201 lb/ml.	=	0.002201	0.002201	0.002201
M H20 = Molecular weight of water, 18.01 lb/lb-mole.	=	18.01	18.01	18.01
R = Ideal gas constant, 21.85 in. hg - ft3/R-lb-mole.	=	21.85	21.85	21.85
Tstd = Standard absolute temperature, 528 R.	=	528	528	528
Pstd = Standard absolute pressure, 29.92 in. Hg.	=	29.92	29.92	29.92
K2 = 0.0471 ft3 / ml.	=	0.0471	0.0471	0.0471

		RUN #1	RUN #2	RUN #3		
3.	**Bws**	0.1168918	0.1006051	0.0604069	=	$\frac{Vw(std)}{Vm(std) + Vw(std)}$

		RUN #1	RUN #2	RUN #3
Bws = Water vapor in the gas stream, proportion.	=	0.1168918	0.1006051	0.0604069
Vw(std) = Volume of water vapor in the gas sample, scf.	=	7.20	5.41	3.10
Vm(std) = Volume of gas sampled at meter box, scf.	=	54.40	48.40	48.23

		RUN #1	RUN #2	RUN #3		
4.	**Md**	29.72	29.6	29.16	=	0.44 (%CO2) + 0.32 (%O2) + 0.28 (%N2) + %CO)

			RUN #1	RUN #2	RUN #3
Md	= Dry molecular weight, lb / lb-mole.	=	29.72	29.6	29.16
0.44	= Molecular weight of CO2 divided by 100.	=	0.44	0.44	0.44
0.32	= Molecular weight of O2 divided by 100.	=	0.32	0.32	0.32
0.28	= Molecular weight of N2 or CO divided by 100.	=	0.28	0.28	0.28

Co2, O2, N2, and CO are in percent by volume, dry basis.

		RUN #1	RUN #2	RUN #3		
5.	**Ms**	28.35	28.43	28.49	=	Md * (1-Bws) + M H20 * (Bws)

			RUN #1	RUN #2	RUN #3
Ms	= Molecular weight of gas , wet basis, lb /lb-mole.	=	28.35	28.43	28.49
M H20	= Molecular weight of water, 18 lb / lb-mole.	=	18	18	18

		RUN #1	RUN #2	RUN #3		
6.	**Vs**	18.07	16.81	15.45	=	$85.49 * Cp * \sqrt{\Delta p} * \sqrt{\frac{Ts + 460}{Ps * Ms}}$

			RUN #1	RUN #2	RUN #3
Vs	= Average stack gas velocity, ft / sec.	=	18.07	16.81	15.45
85.49	= Pitot tube constant, ft / sec.	=	85.49	85.49	85.49
Cp	= Pitot tube coefficient, dimensionless.	=	0.84	0.84	0.84
^P	= Velocity head of stack gas, avg. sq rt.	=	0.261	0.242	0.230
Ts	= Temperature of stack gas, + 460 (Rankine).	=	769.6	778.8	726.9
Ps	= Absolute stack gas pressure, barometric + static.	=	29.22	29.22	29.22
Ms	= Molecular weight of stack gas, wet basis.	=	28.35	28.43	28.49

		RUN #1	RUN #2	RUN #3		
7.	**ACFM**	851	792	728	=	Stack Area * 60 * Vs

			RUN #1	RUN #2	RUN #3
Vs	= Average stack gas velocity, ft / sec.	=	18.07	16.81	15.45

		RUN #1	RUN #2	RUN #3		
8.	**Isokinicity**	105.4	100.2	97.0	=	$\frac{K4 * Ts * Vmstd}{Ps * Vs * An * Min * (1-Bws)}$

			RUN #1	RUN #2	RUN #3
K4	= 0.09450 for English units.	=	0.0945	0.0945	0.0945
Ts	= Stack temperature + 460 R.	=	769.6	778.8	726.9
Vmstd	= Volume of gas collected, scf.	=	54.40	48.40	48.23
Ps	= Stack pressure, inches Hg.	=	29.22	29.22	29.22
Vs	= Stack velocity, ft / sec.	=	18.07	16.81	15.45
An	= Area of the sampling nozzle, cuft.	=	0.0013418	0.0013418	0.0013418
Min.	= Minutes of test	=	60	60	60
Bws	= Water vapor in the gas stream, proportion.	=	0.1168918	0.1006051	0.0604069

		RUN #1	RUN #2	RUN #3		
9.	**Lbs/Hr**	0.45	0.13	0.15	=	$2.205 * E\text{-}6 * \frac{Mn}{Vm\ std} * scfh$

				RUN #1	RUN #2	RUN #3
2.205 * E-6	=	Conversion from mg to lbs.	=	2.205 * E-6	2.205 * E-6	2.205 * E-6
Mn	=	Weight gain of filter and wash minus blank.	=	365.95	100.15	115.4
scfh	=	Standard stack volumetric flow rate.	=	30221	28295	29107
Vm std	=	Volume of air sampled at stp.	=	54.40	48.40	48.23

		RUN #1	RUN #2	RUN #3		
10.	**Gr/Dscf**	0.10360	0.03186	0.03685	=	$0.0154 * \frac{Mn}{Vmstd}$

				RUN #1	RUN #2	RUN #3
0.0154	=	Conversion to grains from mg.	=	0.0154	0.0154	0.0154
Vm std	=	Volume of air sampled at stp.	=	54.40	48.40	48.23
Mn	=	Weight gain of filter and wash minus blank.	=	365.95	100.15	115.4

		RUN #1	RUN #2	RUN #3		
11	**SCFH**	30221	28295	29107	=	$3600 * (1 - Bws) * Vs * A * \frac{Tstd}{Ts} * \frac{Ps}{Pstd}$

					RUN #1	RUN #2	RUN #3
3600	=	Seconds per hour.	=		3600	3600	3600
Bws	=	Water vapor in the gas stream, proportion.	=		0.1168918	0.1006051	0.0604069
A	=	Area of stack in sq ft.	=		0.7853982	0.7853982	0.7853982
Tstd	=	Standard absolute temperature, 528 R.	=		528	528	528
Pstd	=	Standard absolute pressure, 29.92 in. Hg.	=		29.92	29.92	29.92
Ts	=	Temperature of stack gas, + 460 (Rankine).			769.6	778.8	726.9
Ps	=	Absolute stack gas pressure, barometric + static.			29.21	29.21	29.21
Vs	=	Average stack gas velocity, ft / sec.			18.07	16.81	15.45

CALCULATIONS

CO

	RUN #1	RUN #2	RUN #3		
Lbs/Hr	20.62610	16.24909	16.41308	=	.726 * SCFH * PPM * 10^- 7

				RUN #1	RUN #2	RUN #3
scfh	=	Standard stack volumetric flow rate.	=	30221	28295	29107
PPM	=	PPM	=	9400.95	7910.07	7767.14

Appendix #1

Test Data

TEST DATA

COMPANY NAME	The Log Boiler, Inc. - Log Boiler Outlet
ADDRESS	4308 Quincy Street
CITY	Hudsonville
STATE	MI
ZIP	49426
TEST METHODS	Methods 1-5 & 10
CREW MEMBERS	Jim G, Jordan S, Brian L
LOCATION	Outlet
SOURCE	Log Boiler Outlet
CONTROL	Log Boiler

	RUN #1	**RUN #2**	**RUN #3**
DATE	5/20/2014	5/20/2014	5/20/2014
TIME	10:28-11:32	12:35-13:38	14:20-15:25
RUN LENGTH (min)	60.00	60.00	60.00
VOLUME (cubic feet)	56.55	51.01	51.148
BAROMETRIC (in. Hg)	29.21	29.21	29.21
METER TEMP. (R)	539.4	546.3	549.7
STACK TEMP. (R)	769.6	778.8	726.9
AVERAGE ?P (in. WC)$^{1/2}$	0.26	0.24	0.23
AVERAGE ?H (in. WC)	2.79	2.39	2.34
IMPINGER VOLUME (ml)	152.80	114.90	65.80
PITOT COEF.	0.84	0.84	0.84
Static Pressure (in. WC)	0.10	0.10	0.10
STACK AREA (sq/ft)	0.79	0.79	0.79
NOZZLE SIZE (sq/ft)	0.0013418	0.001342	0.001342
CARBON DIOXIDE (%)	8.00	7.00	3.00
OXYGEN (%)	11.00	12.00	17.00
NITROGEN (%)	**81**	**81**	**80**

WEIGHTS			
INITIAL PROBE #1 (mg)	**101685.1**	**108453.6**	**108946.8**
POST PROBE #1 (mg)	**101752.5**	**108465.8**	**108976.3**
TOTAL (mg)	**67.4**	**12.2**	**29.5**
INITIAL PROBE #2 (mg)	**101684.8**	**108453.5**	**108946.6**
POST PROBE #2 (mg)	**101753**	**108466.2**	**108976.8**
TOTAL (mg)	**68.2**	**12.7**	**30.2**
AVG Probe Weight (mg)	**67.8**	**12.45**	**29.85**
INITIAL FILTER #1 (mg)	**27236.7**	**28951.8**	**27420.7**
POST FILTER #1 (mg)	**27534.8**	**29039.2**	**27505.9**
TOTAL (mg)	**298.1**	**87.4**	**85.2**
INITIAL FILTER #2 (mg)	**27236.3**	**28951.5**	**27420.4**
POST FILTER #2 (mg)	**27534.5**	**29039.5**	**27506.3**
TOTAL (mg)	**298.2**	**88**	**85.9**
AVG Filter Weight (mg)	**298.15**	**87.7**	**85.55**

TEST RESULTS

OUTLET

	RUN #1	RUN #2	RUN #3
VM (std) ft^3	54.40	48.40	48.23
VW (std) ft^3	7.20	5.41	3.10
BWS Fraction (measured)	0.117	0.101	0.060
MD (lb/lb-mole (dry))	29.72	29.60	29.16
MS (lb/lb-mole (wet))	28.35	28.43	28.49
VS (ft/sec)	18.07	16.81	15.45

SCFH	30221	28295	29107
ACFM	851	792	728
DCFM	504	472	485
ISOKINETIC %	105.4	100.2	97.0

PARTICULATE			
LBS/HR	0.447270	0.128797	0.153219
GR/DSCF	0.103600	0.031863	0.036848
LBS/DSCF	1.48E-05	4.55E-06	5.26E-06

Vm (std) = Volume of gas sampled at standard conditions.

Vw (std) = Volume of water vapor collected at standard conditions.

Bws = Stack moisture content.

Md = Determination of dry molecular weight of stack gas.

Ms = Determination of stack gas molecular weight.

Vs = Average gas stack velocity. (ft/sec.)

ACFM = Actual cubic feet per minute of gas velocity.

DCFM = Dry standard cubic feet per minute of gas velocity.

Lbs/Hr = Pounds per Hour.

Gr/Dscf = Grains per dry standard cubic feet.

TEST RESULTS

	RUN #1	RUN #2	RUN #3
CEM MONITORING			
CO (lbs/hr)	20.63	16.25	16.41
O2 %	13.41	14.06	15.84

TEST DATA

	RUN #1	RUN #2	RUN #3
CEM MONITORING			
CO (ppm)	9400.95	7910.07	7767.14
O2 (%)	13.41	14.06	15.84

The Log Boiler, Inc. - Log Boiler Outlet							Methods 1-5 & 10		Test Date	5/20/2014	
Meter Box Id:	2	Probe ID			Cold Box ID:	3		EPA Observer:			

As ft^2	Pbar	Pq (static)	Ps		Avg. Ts F	CO2 - F_{CO2}	O2	N2+C	Md	Ms	Pitot Ck
0.79	29.21	0.10	29.22		310	8.00	11.00	81.00	29.72	29.13	ok

Y	ΔH :	Cp	Vm cf	Vlc	Avg. Tm F	Vm std	Vw std	Bws	S Bws		Leak Ck
1.0000	1.745	0.84	56.550	152.80	79.42	54.398	7.192	0.117	5.157		.002 @ 14"
								Assumed Bws:	5.000		

Avg. Sqrt Dlp	Vs	scfm wet	acfm		Qsd dscfh	# Sample Points	Dn	Total Test time	Time @ point	Avg. Dlh	Test Time
0.261	17.82	563	840		2.98E+04	12	0.496	60	5.00	2.794893	10:28-11:32

TRUE

Point No.	Meter (cf)	dl "p"	Target dl "h"	Actual dl "h"	Ts F	tm F (in)	tm F (out)	Cond Temp F	Filter Temp F	Probe Temp F	Vacuum	Imp. Liquid Collected		
A-1	561.00	0.05	2.25	2.25	232	75	75	40	259	256	6	Wt. (end)	Wt. (start)	lc
2	565.590	0.05	1.98	1.98	324	75	75	40	258	252	6	692.9	623.4	69.5
3	569.910	0.06	2.32	2.32	343	75	75	42	252	260	7	617.0	567.5	49.5
4	574.180	0.07	2.71	2.71	344	76	76	43	249	258	8	674.7	666.5	8.2
5	578.680	0.10	3.84	3.84	351	80	73	49	255	256	12	0.0	0.0	0.0
6	584.010	0.10	3.82	3.82	357	80	75	52	253	257	12	0.0	0.0	0.0
B-1	589.315	0.05	2.22	2.22	245	80	78	52	249	257	7	0.0	0.0	0.0
2	593.720	0.06	2.61	2.61	261	81	78	53	249	257	8	828.5	802.9	25.6
3	598.110	0.06	2.46	2.46	307	82	79	53	248	259	8			
4	602.610	0.07	2.80	2.80	327	83	80	53	250	259	9	Isokinetics	106.8	
5	607.390	0.09	3.70	3.70	305	83	80	53	248	258	12	Test Date	5/20/2014	
6	612.720	0.07	2.83	2.83	319	83	81	53	253	259	10			
0	617.550													

Protect

Unprotect

An
0.00134181

The Log Boiler, Inc. - Log Boiler Outlet							Methods 1-5 & 10	Test Date	5/20/2014		
Meter Box Id:	2	Probe ID			Cold Box ID:	4		EPA Observer:			

As ft^2	Pbar	Pq (static)	Ps		Avg. Ts F	CO2 - F_{CO2}	O2	N2+C	Md	Ms	Pitot Ck
0.79	29.21	0.10	29.22		319	7.00	12.00	81.00	29.60	29.02	ok

Y	ΔH :	Cp	Vm cf	Vlc	Avg. Tm F	Vm std	Vw std	Bws	S Bws		Leak Ck
1.0000	1.745	0.84	51.008	114.90	86.25	48.404	5.408	0.101	5.869		0 @ 15"
								Assumed Bws:	5.000		

Avg. Sqrt Dlp	Vs	scfm wet	acfm		Qsd dscfh	# Sample Points	Dn	Total Test time	Time @ point	Avg. Dlh	Test Time
0.242	16.63	519	784		2.80E+04	12	0.496	60	5.00	2.388670	12:35-13:38

Protect

Unprotect

An
0.00134181

TRUE

Point No.	Meter (cf)	dl "p"	Target ΔH	Actual dl ΔH	Ts F	tm F (in)	tm F (out)	Cond Temp F	Filter Temp F	Probe Temp F	Vacuum	Imp. Liquid Collected		
												Wt. (end)	Wt. (start)	lc
A-1	618.001	0.04	1.85	1.85	225	85	83	56	247	255	6	809.3	766.6	42.7
2	621.930	0.05	2.21	2.21	255	85	83	51	250	257	6	680.3	637.8	42.5
3	625.670	0.06	2.45	2.45	315	85	84	52	249	255	8	598.0	586.4	11.6
4	629.930	0.08	3.17	3.17	339	86	84	52	250	254	10	0.0	0.0	0.0
5	634.610	0.08	3.10	3.10	356	86	84	55	249	254	10	0.0	0.0	0.0
6	639.480	0.07	2.69	2.69	365	86	84	54	249	253	9	0.0	0.0	0.0
B-1	644.220	0.04	1.77	1.77	256	87	85	54	253	254	7	0.0	0.0	0.0
2	648.120	0.05	2.19	2.19	263	87	85	56	249	256	8	878.8	860.7	18.1
3	652.070	0.05	2.01	2.01	327	87	85	56	250	257	8			
4	656.110	0.06	2.32	2.32	359	87	85	57	251	256	10	Isokinetics	101.2	
5	660.340	0.06	2.27	2.27	380	87	85	58	247	255	10	Test Date	5/20/2014	
6	664.650	0.07	2.63	2.63	385	87	86	58	248	254	11			
0	669.009													

The Log Boiler, Inc. - Log Boiler Outlet						Methods 1-5 & 10		Test Date	5/20/2014		
Meter Box Id:	2	Probe ID			Cold Box ID:	5		EPA Observer:			

As ft^2	Pbar	Pq (static)	Ps		Avg. Ts F	CO2 - F_{CO2}	O2	N2+C	Md	Ms	Pitot Ck
0.79	29.21	0.10	29.22		267	3.00	17.00	80.00	29.16	28.60	ok

Y	ΔH :	Cp	Vm cf	Vlc	Avg. Tm F	Vm std	Vw std	Bws	S Bws		Leak Ck
1.0000	1.745	0.84	51.148	65.80	89.67	48.229	3.097	0.060	2.687		0 @ 15"
								Assumed Bws:	5.000		

Avg. Sqrt Dlp	Vs	scfm wet	acfm		Qsd dscfh	# Sample Points	Dn	Total Test time	Time @ point	Avg. Dlh	Test Time
0.230	15.42	515	726		2.90E+04	12	0.496	60	5.00	2.338974	14:20-15:25

TRUE

Point No.	Meter (cf)	dl "p"	Target dl "h"	Actual dl "h"	Ts F	tm F (in)	tm F (out)	Cond Temp F	Filter Temp F	Probe Temp F	Vacuum	Imp. Liquid Collected		
												Wt. (end)	Wt. (start)	lc
A-1	671.77	0.03	1.57	1.57	150	89	87	50	249	259	5	785.5	767.0	18.5
2	675.350	0.04	2.01	2.01	172	89	87	52	250	255	6	774.4	749.9	24.5
3	679.223	0.04	1.81	1.81	245	89	87	53	253	257	6	553.0	545.8	7.2
4	683.080	0.05	2.10	2.10	299	89	88	53	255	255	7	0.0	0.0	0.0
5	686.940	0.08	3.30	3.30	312	89	88	53	256	257	12	0.0	0.0	0.0
6	691.920	0.06	2.42	2.42	329	89	87	54	248	257	10	0.0	0.0	0.0
B-1	696.410	0.04	1.91	1.91	209	90	88	60	246	254	8	952.3	936.7	15.6
2	700.310	0.04	1.89	1.89	215	90	88	60	257	256	7			
3	704.280	0.06	2.59	2.59	278	90	89	60	248	256	10			
4	708.830	0.07	2.81	2.81	335	90	89	61	249	257	11			
5	713.510	0.08	3.24	3.24	328	91	90	61	250	255	12			
6	718.380	0.06	2.42	2.42	331	91	89	60	248	258	10			
0	722.918													

Isokinetics	97.2
Test Date	5/20/2014

Protect

Unprotect

An
0.00134181

5-20-14

Run #1
Start 10:28
Stop 11:32

Stack Diamater 12"
upStream 24"
down 24"

Run #2
Start 12:35
Stop 1:38

Run #3
Start 2:20
Stop 3:25

Fyrite

Date: 5-20-14 **Technician:** Brian L

		1		2		3		Avg
Run #1	Time		Time		Time			
	CO^2	8	CO^2	6	CO^2	6.5	CO^2	
	O^2	11	O^2	13	O^2	13	O^2	

		1		2		3		Avg
Run #2	Time		Time		Time			
	CO^2	7	CO^2	7	CO^2	4	CO^2	
	O^2	12	O^2	12.5	O^2	15.5	O^2	

		1		2		3		Avg
Run #3	Time		Time		Time			
	CO^2	3	CO^2	3.5	CO^2	3.5	CO^2	
	O^2	17	O^2	16	O^2	15.5	O^2	

Appendix #2

Laboratory Data

Lab Data Sheet For: The Log Boiler, Inc. - Log Boiler Outlet By: Brian L

Moisture Weights

Method 5 Moisture

			grams	grams	grams	grams	grams	grams	grams
RUN # 1		Box ID	1	2	3	4	5	6	Drierite
	Gross	3	692.9	617.0	674.7				828.5
	Tare		623.4	567.5	666.5				802.9
	Net		69.5	49.5	8.2	0.0	0.0	0.0	25.6
	Reagent		H2O	H2O	H2O	H2O			
	mLs		100.0	100.0	100.0	100.0			

			grams		grams
Intial Imp mL =	300.0	Impinger Total =	127.2	Total =	152.8

			grams	grams	grams	grams	grams	grams	grams
RUN # 2		Box ID	1	2	3	4	5	6	Drierite
	Gross	4	809.3	680.3	598.0				878.8
	Tare		766.6	637.8	586.4				860.7
	Net		42.7	42.5	11.6	0.0	0.0	0.0	18.1
	Reagent		H2O	H2O	H2O	H2O			
	mLs		100.0	100.0	100.0	100.0			

			grams		grams
Intial Imp mL =	300.0	Impinger Total =	96.8	Total =	114.9

			grams	grams	grams	grams	grams	grams	grams
RUN # 3		Box ID	1	2	3	4	5	6	Drierite
	Gross	5	785.5	774.4	553.0				952.3
	Tare		767.0	749.9	545.8				936.7
	Net		18.5	24.5	7.2	0.0	0.0	0.0	15.6
	Reagent		H2O	H2O	H2O	H2O			
	mLs		100.0	100.0	100.0	100.0			

			grams		grams
Intial Imp mL =	300.0	Impinger Total =	50.2	Total =	65.8

Conditions:	Temp	RH	Date	Pb		Scales
Initial	65	51	5/16/2014	28.59	s/n	1203240794
Post	66	52	5/22/2014	28.59	s/n	7124111434

Lab Data Sheet For: The Log Boiler, Inc. - Log Boiler Outlet By: Brian L

Filter Weight Method 5

Run #	ID#	Temp	RH	Barometric	Time	Date	Gross	Temp	RH	Barometric	Time	Date	Tare	Net Gain
1	2088	66	52	28.73	8:32	6/2/2014	27534.8	65	51	28.59	14:52	5/16/2014	27236.7	298.1
1	2088	68	56	28.59	9:17	6/3/2014	27534.5	59	46	28.88	5:00	5/20/2014	27236.3	298.2
													AVG	298.15
2	2089	66	52	28.73	8:34	6/2/2014	29039.2	65	51	28.59	14:54	5/16/2014	28951.8	87.4
2	2089	68	56	28.59	9:19	6/3/2014	29039.5	59	46	28.88	5:02	5/20/2014	28951.5	88
													AVG	87.7
3	2091	66	52	28.73	8:36	6/2/2014	27505.9	65	51	28.59	14:55	5/16/2014	27420.7	85.2
3	2091	68	56	28.59	9:20	6/3/2014	27506.3	59	46	28.88	5:07	5/20/2014	27420.4	85.9
													AVG	85.55

Scale Serial # 39080133 Total Gain 471.4

Lab Data Sheet For: The Log Boiler, Inc. - Log Boiler Outlet By: Brian L

Probe Rinse Weight

Run #		Temp	RH	Barometric	Time	Date	Gross	Temp	RH	Barometric	Time	Date	Tare	Net Gain
1		66	52	28.73	8:25	6/2/2014	101752.5	59	46	28.88	5:12	5/20/2014	101685.1	67.4
1		68	56	28.59	9:11	6/3/2014	101753	66	53	28.56	12:52	5/22/2014	101684.8	68.2
													AVG	67.8
2		66	52	28.73	8:27	6/2/2014	108465.8	59	46	28.88	5:13	5/20/2014	108453.6	12.2
2		68	56	28.59	9:12	6/3/2014	108466.2	66	53	28.56	12:54	5/22/2014	108453.5	12.7
													AVG	12.45
3		66	52	28.73	8:29	6/2/2014	108976.3	59	46	28.88	5:15	5/20/2014	108946.8	29.5
3		68	56	28.59	9:14	6/3/2014	108976.8	66	53	28.56	12:56	5/22/2014	108946.6	30.2
													AVG	29.85

Scale Serial # 39080133 Total Gain 110.1

REAM & HAAGER ENVIRONMENTAL LABORATORY INC.
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Email: rhlab@rhlab.us
Ohio EPA Chemical Certification # 4162
Ohio EPA Bacteria Certification # 893

- Certificate of Analysis -

for

CUSTOM STACK ANALYSIS
14614 CANFIELD STREET NE
ALLIANCE, OH 44601

Final Report

Report Date: 5/27/2014
Report Number: 20996-0
Chain of Custody #: 118870
Project Name: EMISSIONS TESTING

Lab ID: 14053330
Sample Type: Solid
Your Sample ID: MICHIGAN

Date Sampled: 5/21/2014 11:59:00AM
Date Received: 5/23/2014
Collection: GRAB

Method	Analyte	Result	Units	MDL/PQL	Analysis Date	Analyst
ASTM D5865	BTU per Lb	7252	BTU/Lb		5/23/14	FE

QA/QC Manager

Appendix #3

Calibration Data

ACCREDITED
Calibration
Certificate No. 1750.01

Calibration complies with ISO/IEC 17025, ANSI/NCSL Z540-1, and 9001

Cert. No.: 3415-5329390

Traceable® Certificate of Calibration for Digital Calipers

Cust ID:Custom Stack Analysis, LLC, 14614 Canfield St NE, Attn: Brian Lemasters, Alliance, OH 44601 U.S.A. (RMA:980260)

Instrument Identification:

Model: 3415 S/N: 101856179 Manufacturer: Control Company

Standards/Equipment:

Description	Serial Number	Due Date	NIST Traceable Reference
Gage Set	99146223	10/08/13	1000325819

Certificate Information:

Technician: 57 Procedure: CAL-05 Cal Date: 8/29/13 Cal Due: 8/29/14

Test Conditions: 23.0°C 46.0 %RH 1017 mBar

Calibration Data:

Unit(s)	Nominal	As Found	In Tol	Nominal	As Left	In Tol	Min	Max	±U	TUR
in	0.0000	0.0000	Y	0.0000	0.0000	Y	-0.0010	0.0010	0.0008	1.2:1
in	0.1000	0.0995	Y	0.1000	0.0995	Y	0.0990	0.1010	0.0006	1.5:1
in	2.0000	2.0000	Y	2.0000	2.0005	Y	1.9980	2.0020	0.0007	2.9:1
in	4.0000	4.0000	Y	4.0000	4.0005	Y	3.9960	4.0040	0.0006	>4:1
in	6.0000	6.0000	Y	6.0000	6.0005	Y	5.9940	6.0060	0.0007	>4:1
in depth	2.0000	2.0000	Y	2.0000	2.0005	Y	1.9980	2.0020	0.0003	>4:1
in step	2.0000	1.9995	Y	2.0000	1.9990	Y	1.9990	2.0010	0.0004	2.8:1
in inside	1.0000	1.0010	Y	1.0000	1.0010	Y	0.9990	1.0010	0.0007	1.5:1

This Instrument was calibrated using Instruments Traceable to National Institute of Standards and Technology.

A Test Uncertainty Ratio of at least 4:1 is maintained unless otherwise stated and is calculated using the expanded measurement uncertainty. Uncertainty evaluation includes the instrument under test and is calculated in accordance with the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM). The uncertainty represents an expanded uncertainty using a coverage factor k=2 to approximate a 95% confidence level. In tolerance conditions are based on test results falling within specified limits with no reduction by the uncertainty of the measurement. The results contained herein relate only to the item calibrated. This certificate shall not be reproduced except in full, without written approval of Control Company.

Nominal=Standard's Reading; As Left=Instrument's Reading; In Tol=In Tolerance; Min/Max=Acceptance Range; ±U=Expanded Measurement Uncertainty; TUR=Test Uncertainty Ratio; Accuracy=±(Max-Min)/2; Min = As Left Nominal(Rounded) - Tolerance; Max = As Left Nominal(Rounded) + Tolerance; Date=MM/DD/YY

Nicol Rodriguez, Quality Manager

Aaron Judice, Technical Manager

Maintaining Accuracy:

In our opinion once calibrated your Digital Calipers should maintain its accuracy. There is no exact way to determine how long calibration will be maintained. Digital Calipers change little, if any at all, but can be affected by aging, temperature, shock and contamination.

Recalibration:

For factory calibration and re-certification traceable to National Institute of Standards and Technology, contact Control Company.

CONTROL COMPANY 4455 Rex Road Friendswood, TX 77546 USA
Phone 281 482-1714 Fax 281 482-9448 service@control3.com www.control3.com

Calibration Certificate No. 1750.01

Calibration complies with ISO/IEC 17025, ANSI/NCSL Z540-1, and 9001

Cert. No.: 1870-5331789

Traceable® Certificate of Calibration for Digital Barometer Module

Cust ID:Custom Stack Analysis, LLC, 14614 Cenfield St NE, Attn: Brian Lemasters, Alliance, OH 44601 U.S.A. (RMA:980260)

Instrument Identification:

Model: 1870 S/N: 90724105 Manufacturer: Control Company

Standards/Equipment:

Description	Serial Number	Due Date	NIST Traceable Reference
Digital Barometer	D4540001	8/28/13	1000323498
Chilled Mirror Hygrometer	4485472H3737	5/14/15	11028
Digital Thermometer	90969500	9/17/13	4000-5608482

Certificate Information:

Technician: 57 Procedure: CAL-31 Cal Date: 8/28/13 Cal Due: 8/28/14

Test Conditions: 24.0°C 42.0 %RH 1018 mBar

Calibration Data:

Unit(s)	Nominal	As Found	In Tol	Nominal	As Left	In Tol	Min	Max	±U	TUR
mb/hPa	804.85	810	Y	806.60	812	Y	796	817	0.70	>4:1
mb/hPa	909.55	913	Y	909.48	914	Y	899	920	0.70	>4:1
mb/hPa	1,014.05	1,017	Y	1,013.45	1,016	Y	1,003	1,024	0.70	>4:1
°C	24.132	24	Y	26.023	26	Y	25	27	0.580	1.7:1
%RH	42.370	33	Y	39.720	32	Y	30	50	1.300	>4:1

This instrument was calibrated using Instruments Traceable to National Institute of Standards and Technology.

A Test Uncertainty Ratio of at least 4:1 is maintained unless otherwise stated and is calculated using the expanded measurement uncertainty. Uncertainty evaluation includes the instrument under test and is calculated in accordance with the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM). The uncertainty represents an expanded uncertainty using a coverage factor k=2 to approximate a 95% confidence level. In tolerance conditions are based on test results falling within specified limits with no reduction by the uncertainty of the measurement. The results contained herein relate only to the item calibrated. This certificate shall not be reproduced except in full, without written approval of Control Company.

Nominal=Standard's Reading; As Left=Instrument's Reading; In Tol=In Tolerance; Min/Max=Acceptance Range; ±U=Expanded Measurement Uncertainty; TUR=Test Uncertainty Ratio; Accuracy=±(Max-Min)/2; Min = As Left Nominal(Rounded) - Tolerance; Max = As Left Nominal(Rounded) + Tolerance; Date=MM/DD/YY

Nicol Rodriguez, Quality Manager

Aaron Juckes, Technical Manager

Maintaining Accuracy:

In our opinion once calibrated your Digital Barometer Module should maintain its accuracy. There is no exact way to determine how long calibration will be maintained. Digital Barometer Modules change little, if any at all, but can be affected by aging, temperature, shock, and contamination.

Recalibration:

For factory calibration and re-certification traceable to National Institute of Standards and Technology contact Control Company

CONTROL COMPANY 4455 Rex Road Friendswood, TX 77546 USA
Phone 281 482-1714 Fax 281 482-9448 service@control3.com www.control3.com

ACCREDITED
Calibration
Certificate No. 1750.01

Calibration complies with ISO/IEC 17025, ANSI/NCSL Z540-1, and 9001

Cert. No.: 1870-5243247

Traceable® Certificate of Calibration for Digital Barometer Module

Cust ID:Custom Stack Analysis, LLC, 14614 Cenfield St NE, Attn: Brian Lemasters, Alliance, OH 44601 U.S.A. (RMA:979530)

Instrument Identification:

Model: 23609-208 S/N: 41370014 Manufacturer: Control Company

Standards/Equipment:

Description	Serial Number	Due Date	NIST Traceable Reference
Digital Barometer	D4540001	8/28/13	1000323498
Chilled Mirror Hygrometer	44654/2H3737	5/14/15	11028
Digital Thermometer	90969500	9/17/13	4000-5608482

Certificate Information:

Technician: 57 Procedure: CAL-31 Cal Date: 7/23/13 Cal Due: 7/23/14

Test Conditions: 26.5°C 41.0 %RH 1015 mBar

Calibration Data:

Unit(s)	Nominal	As Found	In Tol	Nominal	As Left	In Tol	Min	Max	±U	TUR
mb/hPa	909.90	908	Y	909.22	908	Y	899	920	1.20	>4:1
mb/hPa	1,014.47	1,013	Y	1,013.90	1,013	Y	1,003	1,024	1.20	>4:1
°C	24.588	25	Y	24.507	24	Y	24	26	0.580	1.7:1
%RH	44.960	37	Y	44.770	37	Y	35	55	1.300	>4:1

This Instrument was calibrated using Instruments Traceable to National Institute of Standards and Technology.

A Test Uncertainty Ratio of at least 4:1 is maintained unless otherwise stated and is calculated using the expanded measurement uncertainty. Uncertainty evaluation includes the instrument under test and is calculated in accordance with the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM). The uncertainty represents an expanded uncertainty using a coverage factor k=2 to approximate a 95% confidence level. In-tolerance conditions are based on test results falling within specified limits with no reduction by the uncertainty of the measurement. The results contained herein relate only to the item calibrated. This certificate shall not be reproduced except in full, without written approval of Control Company.

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Aaron Judice, Technical Manager

Maintaining Accuracy:

In our opinion once calibrated your Digital Barometer Module should maintain its accuracy. There is no exact way to determine how long calibration will be maintained. Digital Barometer Modules change little, if any at all, but can be affected by aging, temperature, shock, and contamination.

Recalibration:

For factory calibration and re-certification traceable to National Institute of Standards and Technology contact Control Company.

CONTROL COMPANY 4455 Rex Road Friendswood, TX 77546 USA
Phone 281 482-1714 Fax 281 482-9448 service@control3.com www.control3.com

Control Company is an ISO 17025:2005 Calibration Laboratory Accredited by (A2LA) American Association for Laboratory Accreditation, Certificate No. 1750.01
Control Company is ISO 9001:2008 Quality Certified by (DNV) Det Norske Veritas, Certificate No. CERT-01805-2006-AQ-HOU-RvA
International Laboratory Accreditation Cooperation (ILAC) - Multilateral Recognition Arrangement (MRA).

Calibration
Certificate No. 1750.01

Calibration complies with ISO/IEC 17025, ANSI/NCSL Z540-1, and 9001

Cert. No.: 3415-5225577

Traceable® Certificate of Calibration for Digital Calipers

Manufactured for and distributed by: Fisher Scientific, 300 Industry Drive, Pittsburgh, PA 15275-1001

Instrument Identification:

Model Numbers: 14-648-17, FB70250, 32599 S/N: 130402110 Manufacturer: Control Company

Standards/Equipment:

Description	Serial Number	Due Date	NIST Traceable Reference
Gage Set	99146223	10/08/13	1000325819

Certificate Information:

Technician: 57 Procedure: CAL-05 Cal Date: 7/16/13 Cal Due: 7/16/15

Test Conditions: 22.5°C 46.0 %RH 1017 mBar

Calibration Data: (New Instrument)

Unit(s)	Nominal	As Found	In Tol	Nominal	As Left	In Tol	Min	Max	±U	TUR
in		N.A.		0.0000	0.0000	Y	-0.0010	0.0010	0.0003	3.3:1
in		N.A.		0.1000	0.1000	Y	0.0990	0.1010	0.0003	3.3:1
in		N.A.		2.0000	1.9995	Y	1.9980	2.0020	0.0003	>4:1
in		N.A.		4.0000	4.0000	Y	3.9960	4.0040	0.0004	>4:1
in		N.A.		6.0000	6.0020	Y	5.9940	6.0060	0.0004	>4:1
in depth		N.A.		2.0000	2.0000	Y	1.9980	2.0020	0.0003	>4:1
in step		N.A.		2.0000	2.0000	Y	1.9990	2.0010	0.0004	2.7:1
in inside		N.A.		1.0000	1.0000	Y	0.9990	1.0010	0.0003	3.1:1

This Instrument was calibrated using Instruments Traceable to National Institute of Standards and Technology.

A Test Uncertainty Ratio of at least 4:1 is maintained unless otherwise stated and is calculated using the expanded measurement uncertainty. Uncertainty evaluation includes the instrument under test and is calculated in accordance with the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM). The uncertainty represents an expanded uncertainty using a coverage factor k=2 to approximate a 95% confidence level. In tolerance conditions are based on test results falling within specified limits with no reduction by the uncertainty of the measurement. The results contained herein relate only to the item calibrated. This certificate shall not be reproduced except in full, without written approval of Control Company.

Nominal=Standard's Reading; As Left=Instrument's Reading; In Tol=In Tolerance; Min/Max=Acceptance Range; ±U=Expanded Measurement Uncertainty; TUR=Test Uncertainty Ratio; Accuracy=±(Max-Min)/2; Min = As Left Nominal(Rounded) - Tolerance; Max = As Left Nominal(Rounded) + Tolerance; Date=MM/DD/YY

Aaron Judice, Technical Manager

Maintaining Accuracy:

In our opinion once calibrated your Digital Calipers should maintain its accuracy. There is no exact way to determine how long calibration will be maintained. Digital Caliperss change little, if any at all, but can be affected by aging, temperature, shock, and contamination.

Recalibration:

For factory calibration and re-certification traceable to National Institute of Standards and Technology contact Control Company.

CONTROL COMPANY 4455 Rex Road Friendswood, TX 77546 USA
Phone 281 482-1714 Fax 281 482-9448 service@control3.com www.control3.com

Calibration
Certificate No. 1750.01

Calibration complies with ISO/IEC 17025, ANSI/NCSL Z540-1, and 9001

Cert. No.: 3415-4815771

Traceable® Certificate of Calibration for Digital Calipers

Instrument Identification:

Model: 3415 S/N: 122726984 Manufacturer: Control Company

Standards/Equipment:

Description	Serial Number	Due Date	NIST Traceable Reference
Gage Set	99146223	10/08/13	1000325819

Certificate Information:

Technician: 57 Procedure: CAL-05 Cal Date: 12/17/12 Cal Due: 12/17/14

Test Conditions: 24.0°C 38.0 %RH 1011 mBar

Calibration Data: (New Instrument)

Unit(s)	Nominal	As Found	In Tol	Nominal	As Left	In Tol	Min	Max	±U	TUR
in		N.A.		0.0000	0.0000	Y	-0.0010	0.0010	0.0003	3.3:1
in		N.A.		0.1000	0.1000	Y	0.0990	0.1010	0.0003	3.3:1
in		N.A.		2.0000	2.0000	Y	1.9980	2.0020	0.0003	>4:1
in		N.A.		4.0000	4.0005	Y	3.9960	4.0040	0.0004	>4:1
in		N.A.		6.0000	6.0005	Y	5.9940	6.0060	0.0004	>4:1
in depth		N.A.		2.0000	2.0005	Y	1.9980	2.0020	0.0003	>4:1
in step		N.A.		2.0000	2.0000	Y	1.9990	2.0010	0.0004	2.8:1
in inside		N.A.		1.0000	0.9990	Y	0.9990	1.0010	0.0003	3.2:1

This Instrument was calibrated using Instruments Traceable to National Institute of Standards and Technology.

A Test Uncertainty Ratio of at least 4:1 is maintained unless otherwise stated and is calculated using the expanded measurement uncertainty. Uncertainty evaluation includes the instrument under test and is calculated in accordance with the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM). The uncertainty represents an expanded uncertainty using a coverage factor k=2 to approximate a 95% confidence level. In tolerance conditions are based on test results falling within specified limits with no reduction by the uncertainty of the measurement. The results contained herein relate only to the item calibrated. This certificate shall not be reproduced except in full, without written approval of Control Company.

Nominal=Standard's Reading; As Left=Instrument's Reading; In Tol=In Tolerance; Min/Max=Acceptance Range; ±U=Expanded Measurement Uncertainty; TUR=Test Uncertainty Ratio; Accuracy=±(Max-Min)/2; Min = As Left Nominal(Rounded) - Tolerance; Max = As Left Nominal(Rounded) + Tolerance; Date=MM/DD/YY

Nicol Rodriguez, Quality Manager

Wallace Berry, Technical Manager

Maintaining Accuracy:

In our opinion once calibrated your Digital Calipers should maintain its accuracy. There is no exact way to determine how long calibration will be maintained. Digital Calipers change little, if any at all, but can be affected by aging, temperature, shock, and contamination.

Recalibration:

For factory calibration and re-certification traceable to National Institute of Standards and Technology contact Control Company.

CONTROL COMPANY 4455 Rex Road Friendswood, TX 77546 USA
Phone 281 482-1714 Fax 281 482-9448 service@control3.com www.control3.com

ilac-MRA ACCREDITED Calibration Certificate No. 1750.01

Calibration complies with ISO/IEC 17025, ANSI/NCSL Z540-1, and 9001

Cert. No.: 3418-4793889

Traceable® Certificate of Calibration for Digital Calipers 150 Mm

Manufactured for and distributed by: Fisher Scientific, P.O. Box 1768, Pittsburgh, PA 15230

Instrument Identification:

Model: S90187B S/N: 122706687 Manufacturer: Control Company

Standards/Equipment:

Description	Serial Number	Due Date	NIST Traceable Reference
Gage Set	99146223	10/08/13	1000325819

Certificate Information:

Technician: 57 Procedure: CAL-05 Cal Date: 12/06/12 Cal Due: 12/06/14

Test Conditions: 23.0°C 49.0 %RH 1016 mBar

Calibration Data: (New Instrument)

Unit(s)	Nominal	As Found	In Tol	Nominal	As Left	In Tol	Min	Max	±U	TUR
in		N.A.		0.000	0.00	Y	-0.01	0.01	0.000	>4:1
in		N.A.		0.100	0.10	Y	0.09	0.11	0.000	>4:1
in		N.A.		2.000	1.99	Y	1.99	2.01	0.000	>4:1
in		N.A.		4.000	3.99	Y	3.99	4.01	0.000	>4:1
in		N.A.		6.000	5.99	Y	5.99	6.01	0.000	>4:1
in inside		N.A.		1.000	1.00	Y	0.99	1.01	0.000	>4:1

This Instrument was calibrated using Instruments Traceable to National Institute of Standards and Technology.

A Test Uncertainty Ratio of at least 4:1 is maintained unless otherwise stated and is calculated using the expanded measurement uncertainty. Uncertainty evaluation includes the instrument under test and is calculated in accordance with the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM). The uncertainty represents an expanded uncertainty using a coverage factor k=2 to approximate a 95% confidence level. In tolerance conditions are based on test results falling within specified limits with no reduction by the uncertainty of the measurement. The results contained herein relate only to the item calibrated. This certificate shall not be reproduced except in full, without written approval of Control Company.

Nominal=Standard's Reading; As Left=Instrument's Reading; In Tol=In Tolerance; Min/Max=Acceptance Range; ±U=Expanded Measurement Uncertainty; TUR=Test Uncertainty Ratio; Accuracy=±(Max-Min)/2; Min = As Left Nominal(Rounded) - Tolerance; Max = As Left Nominal(Rounded) + Tolerance; Date=MM/DD/YY

Nicol Rodriguez, Quality Manager

Wallace Berry, Technical Manager

Maintaining Accuracy:

In our opinion once calibrated your Digital Calipers 150 Mm should maintain its accuracy. There is no exact way to determine how long calibration will be maintained. Digital Calipers 150 Mms change little, if any at all, but can be affected by aging, temperature, shock, and contamination.

Recalibration:

For factory calibration and re-certification traceable to National Institute of Standards and Technology contact Control Company.

CONTROL COMPANY 4455 Rex Road Friendswood, TX 77546 USA
Phone 281 482-1714 Fax 281 482-9448 service@control3.com www.control3.com

Calibration complies with ISO/IEC 17025, ANSI/NCSL Z540-1, and 9001

ACCREDITED
Calibration
Certificate No. 1750.01

Cert. No.: 1870-5428153

Traceable® Certificate of Calibration for Digital Barometer Module

Cust ID:Custom Stack Analysis, LLC, 14614 Cenfield St NE, Attn: James Gray, Alliance, OH 44601 U.S.A. (RMA:981318)

Instrument Identification:

Model: 23609-208 S/N: 61542879 Manufacturer: Control Company

Standards/Equipment:

Description	Serial Number	Due Date	NIST Traceable Reference
Digital Barometer	D4540001	9/09/14	1000343419
Chilled Mirror Hygrometer	31874/H2048MCR	6/14/15	11081
Digital Thermometer	221197993	9/27/14	4000-5384623

Certificate Information:

Technician: 57 Procedure: CAL-31 Cal Date: 10/14/13 **Cal Due: 10/14/14**

Test Conditions: 22.5°C 46.0 %RH 1018 mBar

Calibration Data:

Unit(s)	Nominal	As Found	In Tol	Nominal	As Left	In Tol	Min	Max	±U	TUR
mb/hPa	805.10	802	Y	805.05	802	Y	795	816	0.70	>4:1
mb/hPa	909.05	906	Y	910.00	908	Y	900	921	0.70	>4:1
mb/hPa	1,017.70	1,016	Y	1,017.43	1,016	Y	1,007	1,028	0.70	>4:1
°C	24.156	24	Y	24.769	24	Y	24	26	0.580	1.7:1
%RH	42.890	39	Y	43.430	40	Y	33	53	1.300	>4:1

This Instrument was calibrated using Instruments Traceable to National Institute of Standards and Technology.

A Test Uncertainty Ratio of at least 4:1 is maintained unless otherwise stated and is calculated using the expanded measurement uncertainty. Uncertainty evaluation includes the instrument under test and is calculated in accordance with the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM). The uncertainty represents an expanded uncertainty using a coverage factor k=2 to approximate a 95% confidence level. In tolerance conditions are based on test results falling within specified limits with no reduction by the uncertainty of the measurement. The results contained herein relate only to the item calibrated. This certificate shall not be reproduced except in full, without written approval of Control Company.

Nominal=Standard's Reading; As Left=Instrument's Reading; In Tol=In Tolerance; Min/Max=Acceptance Range; ±U=Expanded Measurement Uncertainty; TUR=Test Uncertainty Ratio; Accuracy=±(Max-Min)/2; Min = As Left Nominal(Rounded) - Tolerance; Max = As Left Nominal(Rounded) + Tolerance; Date=MM/DD/YY

Nicol Rodriguez, Quality Manager

Aaron Judice, Technical Manager

Maintaining Accuracy:

In our opinion once calibrated your Digital Barometer Module should maintain its accuracy. There is no exact way to determine how long calibration will be maintained. Digital Barometer Modules change little, if any at all, but can be affected by aging, temperature, shock, and contamination.

Recalibration:

For factory calibration and re-certification traceable to National Institute of Standards and Technology contact Control Company.

CONTROL COMPANY 4455 Rex Road Friendswood, TX 77546 USA
Phone 281 482-1714 Fax 281 482-9448 service@control3.com www.control3.com

TRANSCAT® TRANSCAT.COM
800.828.1470

NVLAP®

NVLAP LAB CODE
200867-0

CERTIFICATE OF CALIBRATION

Customer: CUSTOM STACK ANALYSIS
14614 CENFIELD STREET NE
ALLIANCE, OH 44601

Customer Nbr: 1-597810-000
PO Nbr: BL13014
Date Received: January 24, 2014

Cert/SO Nbr: 15-CH8HB-1-1
Manufacturer: Altek Industries Corp
Model Nbr: 22

Date Completed: January 31, 2014
Due Date: January 31, 2015

Description: Thermocouple Calibrator
Serial Nbr: 243783
ID Nbr: NONE
Unit Barcode: 901B0096753

Calibrated To: Manufacturer Specification
Calibration Proc: 1-AC06679-5
Item Received: In Tolerance
Item Returned: In Tolerance

Transcat Calibration Laboratories have been audited and found in compliance with ISO/IEC 17025:2005. Accredited calibrations performed within the Lab's Scope of Accreditation are indicated by the presence of the Accrediting Body's Logo and Certificate Number on this Certificate of Calibration. Any measurements on an accredited calibration not covered by that Lab's Scope are listed in the notes section of the certificate. This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

Transcat calibrations, as applicable, are performed in compliance with the requirements of ISO9001:2008, ISO TS16949, ANSI/NCSL Z540-1994, and ISO 10012-1992. When specified contractually, the requirements of 10CFR21, 10CFR50 App. B and NQA-1 are also covered.

Traceability includes no less than An unbroken chain of comparison, realization of SI units, measurement uncertainty, documentation, competence, periodic recalibration, and measurement assurance. Transcat documents the traceability of measurements to the SI units through the National Institute of Standards and Technology(NIST) or the National Research Council of Canada(NRC), or other recognized national measurement institutes (NMI's) or international standard bodies, or to measurable conditions created in our laboratory, or accepted fundamental and/or natural physical constants, ratio type of calibration, or by comparison to consensus standards. The specific path of traceability for the reported measurement results is maintained at the Transcat facility and is available there for review.

Complete records of work performed are maintained by Transcat and are available for inspection. Laboratory standards used in the performance of this calibration are shown on the Supplemental Report.

The results in this report relate only to the item calibrated or tested and the determination of in or out of tolerance is specific to the model/serial no. referenced above based on the tolerances shown on the supplemental report; these tolerances are either the original equipment manufacturer's (OEM's) warranted specifications or the client's requested specifications.

The applied uncertainty is the uncertainty of the calibration process. The Test Uncertainty Ratio (TUR) is calculated as per NCSL International RP-9, section 8.2. All calibrations have been performed using processes having a TUR of 4 : 1 or better (3:1 for mass calibrations), unless otherwise noted on the Supplemental Report. Uncertainties have been estimated at a 95 percent confidence level (k=2). Calibration at a 4:1 TUR (or greater) provides reasonable confidence that the instrument is within the stated tolerances. For measuring instruments, in order to consider the contribution to the uncertainty from reproducibility of the unit under test (UUT), add 0.6 of the UUT's least significant digit to the reported uncertainty. For mass calibrations: Conventional mass referenced to 8.0 g/cm³.

Any number of factors can cause a unit to drift out of tolerance at any time following its calibration. Limitations on the uses of this instrument are detailed in the OEM's operating instructions.

Notes: Calibration adjustments performed for optimal readings.

Calibrated At:
2056 S. Alex Road
West Carrollton, OH 45449
By: Marc Rhoades
Digitally Signed On January 31, 2014

Facility Responsible:
2056 S. Alex Road
West Carrollton, OH 45449
937-866-1033

Digitally Signed By Derek Atkinson
Date: January 31, 2014

Derek Atkinson
Lab Manager

Revision 0

F0013R23 03/08/13

APEX INSTRUMENTS
EPA Method 5
560 Series Meter Box Calibration
Pre-Test Orifice Method
Metric Meter Box Volume Units, English K' Factor

Filename: \\JAMESGRAY-PC\Customer Project Files\APPENDIX\Cal Sheets\Meter Boxes\[Meter Box 2 4-2-14.xls]A
Revised: 7/25/95 Version: 2.2

CONVERSION FACTORS

1 mm Hg =	0.13330	kPa
1 inch =	0.39370	cm
1 inch =	0.03937	mm
1 cu ft =	28.32	liters

Model #: 2
Serial #:

Date: ----------> 4/2/2014
Barometric Pressure: ----------> 28.73 (in. Hg)
Theoretical Critical Vacuum:---> 13.55 (in. Hg)

!!!!!!!!
IMPORTANT For valid test results, the Actual Vacuum should be 1 to 2 in. Hg greater than the Theoretical Critical Vacuum shown above.
IMPORTANT The Critical Orifice Coefficient, K', must be entered in English units, (ft)^3*(deg R)^0.5/((in.Hg)*(min)).
!!!!!!!!

---------- DRY GAS METER READINGS ----------

dH (in H2O)	Time (min)	Volume Initial (ft^3)	Volume Final (ft^3)	Volume Total (liters)	Initial Temps. Inlet (deg F)	Initial Temps. Outlet (deg F)	Final Temps. Inlet (deg F)	Final Temps. Outlet (deg F)
0.49	10	745.581	749.685	116.22528	56	55	56	55
0.9	10	749.685	755.157	154.96704	56	55	57	55
1.3	10	755.157	761.667	184.3632	57	55	59	56
2.1	5	761.667	765.768	116.14032	58	56	60	56
3.8	5	765.768	771.201	153.86256	59	56	60	56

-CRITICAL ORIFICE READINGS-

Orifice Serial# (number)	K' Orifice Coefficient (see above)	Actual Vacuum (in Hg)	-- Ambient Temperature -- Initial (deg F)	Final (deg F)	Average (deg F)
12	0.31925367	15	55	55	55
16	0.42601437	15	55	56	55.5
19	0.50685283	15	56	57	56.5
23	0.63942715	15	57	57	57
31	0.85057287	14.5	57	57	57

-- Average Temperatures --

DGM Outlet (deg R)	DGM Overall (deg R)	Ambient Temp (deg R)
515	515.5	515
515	515.75	515.5
515.5	516.75	516.5
516	517.5	517
516	517.75	517

********** RESULTS **********

--- DRY GAS METER ---

VOLUME CORRECTED Vm(std) (cu ft)	VOLUME CORRECTED Vm(std) (liters)
4.0397751	114.41
5.389398	152.63
6.4058573	181.41
4.0377695	114.35
5.3697875	152.07

--------- ORIFICE ---------

VOLUME CORRECTED Vcr(std) (cu ft)	VOLUME CORRECTED Vm(std) (liters)	VOLUME NOMINAL Vcr (cu ft)
4.0417356	114.46195	4.10715
5.3907047	152.66476	5.48327
6.4074075	181.45778	6.53008
4.0397215	114.40491	4.12105
5.373681	152.18265	5.48186
Average Y ------->		

-- DRY GAS METER --

CALIBRATION FACTOR Y

Value (number)	Variation (number)
1.00049	5E-05
1.00024	-0.00019
1.00024	-0.00019
1.00048	4.8E-05
1.00073	0.00029
1.00044	

--------- ORIFICE ---------

CALIBRATION FACTOR dH@

Value (in H2O)	Value (mm H2O)	Variation (in H2O)
1.66102632	42.19	-0.08378
1.71501398	43.56	-0.02979
1.75175541	44.49	0.00695
1.77799369	45.16	0.03319
1.81825005	46.18	0.07344
1.74480789	44.32	<------- Average dH@

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.

For Orifice Calibration Factor dH@, the orifice differential pressure in inches of H20 that equates to 0.75 cfm of air at 68 F and 29.92 inches of Hg, acceptable tolerance of individual values from the average is +-0.2.

SIGNED:_____ Brian Lemasters

Date:_____ 4/2/2014

BRECHBUHLER SCALES, INC. An ISO Company

SCALE INSPECTION REPORT

FOR CUSTOM STACK 593P - COD

14614 CENFIELD ST ALLIANCE, OH 44601

P.O. _____ DATE APR 03-14

❑ 14941 Liberty Hi Rd. BOWLING GREEN, OH 43402 419-354-2030
❑ 1414 Scale St. S.W. CANTON, OH 44706-3096 330-453-2424
❑ 7550 Jacks Lane CLAYTON, OH 45315 937-832-2040
❑ 520 Brookpark Rd. CLEVELAND, OH 44109-5898 216-661-2660
❑ 4070 Perimeter Dr. COLUMBUS, OH 43228 614-274-9009
❑ 1001 Findlay Rd. LIMA, OH 45801 419-228-5021
❑ 1080 National Parkway MANSFIELD, OH 44906 419-529-3006
❑ 9914 Crescent Park Drive WEST CHESTER, OH 450 513-777-5800
❑ 4005 South Ave. YOUNGSTOWN, OH 44512 330-259-0414
❑ 980 South Marr Rd. COLUMBUS, IN 47201 812-372-8374
❑ 3306 Cavalier Dr. FORT WAYNE, IN 46808 260-496-8469
❑ 5525 Galaeo Court INDIANAPOLIS, IN 46241 317-548-7821
❑ 5200 Grand Avenue PITTSBURGH, PA 15225 412-299-7960
❑ 477 North Pike Rd. SARVER, PA 16055 724-224-7180
❑ 526 31st St. PARKERSBURG, WV 26101 304-428-1792
❑ 100 McJunkin Road NITRO, WV 25143 304-755-0686

TEST WEIGHTS USED ARE CERTIFIED TO COMPLY WITH STANDARD MASSES, AND ARE NIST TRACEABLE.

STATE OF Ohio TRACEABLE TO NIST CALIBRATION LAB TEST REPORT NO. 2013-527

WEIGHT S/N'S GRAM KIT 13

SCALE TECHNICIAN: Mike Tindall SIGNATURE

ACCEPTED BY: _____ SIGNATURE

PARTS USED _____

TAG NO.	MFG	MOD NO.	S/N	LOC.	CAP.	GRAD. SIZE	NORM RNG	CAL FRQ	CLEAN TEST	CAL STICK	NEXT CA
-	SCOUT PRO O SP2001 HAUS		7124111434	LAB	2000 G --	.1 G --	HI --	6 Months	YES	YES ✓	10 201
	-	-	-				LO --			NO	

	WGHT USED	AS FOUND	DEV.	TOL. +/-	ADJUSTED	AS LEFT	COMMENTS
1	500	500.0	0	+/-.2%	YES / (NO)	500.0	
2	1000	999.9	-.1	+/-.2%	(YES) / NO	1000.0	
3	1500	1499.9	-.1	+/-.2%	(YES) / NO	1500.0	
4	2000	1999.0	~~-.02~~ -2.0	+/-.2%	(YES) / NO	2000.0	CALIBRATED FOR ERRORS
5					YES / NO		
6					YES / NO		

PARTS USED _____

The above indicated equipment has been tested/calibrated by Brechbuhler Scales, In in conformance to ISO 9001 and ANSI/NCSL Z540.

BRECHBUHLER SCALES, INC. An ISO Company

SCALE INSPECTION REPORT

FOR CUSTOM STACK 593P - COD

14614 CENFIELD ST ALLIANCE, OH 44601

P.O. _____ DATE APRIL 03-14

☐ 14941 Liberty Hi Rd. BOWLING GREEN, OH 43402 419-354-2030
☐ 414 Scale St. S.W. CANTON, OH 44706-3096 330-453-2424
☐ 7550 Jacks Lane CLAYTON, OH 45315 937-832-2040
☐ 520 Brookpark Rd. CLEVELAND, OH 44109-5898 216-661-2660
☐ 4070 Perimeter Dr. COLUMBUS, OH 43228 614-274-9009
☐ 1001 Findlay Rd. LIMA, OH 45801 419-228-5021
☐ 1080 National Parkway MANSFIELD, OH 44906 419-529-3006
☐ 9914 Crescent Park Drive WEST CHESTER, OH 450 513-777-5800
☐ 4005 South Ave. YOUNGSTOWN, OH 44512 330-259-0414
☐ 980 South Marr Rd. COLUMBUS, IN 47201 812-372-8374
☐ 3306 Cavalier Dr. FORT WAYNE, IN 46808 260-496-8469
☐ 5525 Galaeo Court INDIANAPOLIS, IN 46241 317-548-7821
☐ 5200 Grand Avenue PITTSBURGH, PA 15225 412-299-7960
☐ 477 North Pike Rd. SARVER, PA 16055 724-224-7180
☐ 526 31st St. PARKERSBURG, WV 26101 304-428-1792
☐ 100 McJunkin Road NITRO, WV 25143 304-755-0686

TEST WEIGHTS USED ARE CERTIFIED TO COMPLY WITH STANDARD MASSES, AND ARE NIST TRACEABLE.

STATE OF OHIO TRACEABLE TO NIST CALIBRATION LAB TEST REPORT NO. 2013-527

WEIGHT S/N'S Gram Kit #13

SCALE TECHNICIAN: Mike Trinkle SIGNATURE

ACCEPTED BY: _____ SIGNATURE

PARTS USED _____

TAG NO.	MFG	MOD NO.	S/N	LOC.	CAP.	GRAD. SIZE	NORM RNG	CAL FRQ	CLEAN TEST	CAL STICK	NEXT CAL
-	SARTORIUS	A2005	39080133	LAB	100 GM g	0.1 g	HI - g	6 Months	YES	YES ✓	10-201
	-	-	-				LO - g			NO	

WGHT USED	AS FOUND	DEV.	TOL. +/-	ADJUSTED	AS LEFT	COMMENTS
1 10g	10.0	0	+/-.2%	YES / NO	10.0	
2 20g	20.0	0	+/-.2%	YES / NO	20.0	
3 50g	50.0	0	+/-.2%	YES / NO	50.0	
4 100g	100.0	0	+/-.2%	YES / NO	100.0	
5 g				YES / NO		
6 g				YES / NO		

PARTS USED _____

The above indicated equipment has been tested/calibrated by Brechbuhler Scales, In in conformance to ISO 9001 and ANSI/NCSL Z540.

BRECHBUHLER SCALES, INC. An ISO Company

SCALE INSPECTION REPORT

FOR CUSTOM STACK 593P - COD

14614 CENFIELD ST ALLIANCE, OH 44601

P.O. _____ DATE APR 03-11

❑ 14941 Liberty Hi Rd. BOWLING GREEN, OH 43402 419-354-2030
❑ 4005 South Ave. YOUNGSTOWN, OH 44512 330-259-0414
❑ 414 Scale St. S.W. CANTON, OH 44706-3096 330-453-2424
❑ 980 South Marr Rd. COLUMBUS, IN 47201 812-372-8374
❑ 7550 Jacks Lane CLAYTON, OH 45315 937-832-2040
❑ 3306 Cavalier Dr. FORT WAYNE, IN 46808 260-496-9469
❑ 520 Brookpark Rd. CLEVELAND, OH 44109-5898 216-661-2660
❑ 5525 Galaeo Court INDIANAPOLIS, IN 46241 317-548-7821
❑ 4070 Perimeter Dr. COLUMBUS, OH 43228 614-274-9009
❑ 5200 Grand Avenue PITTSBURGH, PA 15225 412-299-7960
❑ 1001 Findlay Rd. LIMA, OH 45801 419-228-5021
❑ 477 North Pike Rd. SARVER, PA 16055 724-224-7180
❑ 1080 National Parkway MANSFIELD, OH 44906 419-529-3006
❑ 526 31st St. PARKERSBURG, WV 26101 304-428-1792
❑ 9914 Crescent Park Drive WEST CHESTER, OH 450 513-777-5800
❑ 100 McJunkin Road NITRO, WV 25143 304-755-0686

TEST WEIGHTS USED ARE CERTIFIED TO COMPLY WITH STANDARD MASSES, AND ARE NIST TRACEABLE.

STATE OF Ohio TRACEABLE TO NIST CALIBRATION LAB TEST REPORT NO. 2013-527

WEIGHT S/N'S C-Ram kit #13

SCALE TECHNICIAN: Mike Tinkle (SIGNATURE)

ACCEPTED BY: _____ (SIGNATURE)

PARTS USED _____

TAG NO.	MFG	MOD NO.	S/N	LOC.	CAP.	GRAD. SIZE	NORM RNG	CAL FRQ	CLEAN TEST	CAL STICK		NEXT CA
-	OHAUS	ADVENTURER	1203240794	LAB	4100 g	.1 g	HI - g	6 Months	YES	YES	✓	10-201
	-	-	-				LO - g			NO		

WGHT USED		AS FOUND	DEV.	TOL. +/-	ADJUSTED	AS LEFT	COMMENTS
1	10g	10.0	0	+/-.2%	YES / NO	10.0	
2	20g	20.0	0	+/-.2%	YES / NO	20.0	
3	50g	50.0	0	+/-.2%	YES / NO	50.0	
4	100g	100.0	0	+/-.2%	YES / NO	100.0	
5	1kg	1000.0	0	+/-.2%	YES / NO	1000.0	
6	2kg	2000.0	0	+/-.2%	YES / NO	2000.0	

PARTS USED _____

The above indicated equipment has been tested/calibrated by Brechbuhler Scales, In conformance to ISO 9001 and ANSI/NCSL Z540.

H-B Instrument - Manufacturing Since 1903
A Division of Bel-Art Products

Triple Accredited/Registered
ISO 9001:2008 Registered Manufacturer
ISO 14001:2004 Registered Manufacturer
ISO/IEC 17025:2005 Accredited Laboratory

H-B Instrument

Thermometer Calibration Report

Traceable to NIST

Calibration Cert. # 2448.01

This laboratory is accredited in accordance with the recognized International Standard **ISO/IEC 17025:2005** General Requirements for the Competence of Testing and Calibration Laboratories. This laboratory also meets the requirements of **ANSI/NCSL Z540-1-1994** and any additional program requirements in the field of calibration. This accreditation also demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated 18 June 2005).

The instrument described below has been examined and tested in H-B Instrument's Calibration Laboratory using controlled constant temperature equipment and standard thermometers traceable to NIST in accordance with our calibration procedure LAB-20 which is based in part on NBS Monograph 150, ASTM Method E-77, NIST SP 1088, and the International Temperature Scale ITS-90. Calibration is traceable to NIST. For a discussion of accuracy obtainable with such thermometers, see NIST SP 250-23. The results stated relate only to the instrument bearing the serial number identified.

This instrument is in good working order and is suitable for calibration. The capillary of the thermometer has been examined under magnification and no discernable capillary irregularities were noted. Strains in the glass revealed by examination under a polarized lens, if any, were judged to be minimal and of no detriment to the function of the instrument.

02/10/2014

Custom Stack Analysis, LLC.
Brian LeMasters
14614 Cenfield St. NE
Alliance OH 44601

Tel: 1-330-525-51 Fax:
Reference No: Verbal
Calibration Due Date: 2/10/2015

Report No.	345718
Serial No	4B5200
Part No	61099-046
Distributor	H-B Instrument
Manufacturer	H-B Instrument/MW
Item	Thermometer, ASTM 63F
Range	18/89°F, 0.2°F Div., Total Imm., Hg
Tolerance	±0.2°C

N.I.S.T. Standard	Instrument Tested	Correction (ITS-90)*	Standard Serial No.	Traceability	Expanded Uncertainty (k=2)	Emer. Stem** Temperature
20.00 ° F	19.98 ° F	0.02	1285-028-415	CAL125680	± 0.151	°
32.00 ° F	32.04 ° F	-0.04	1285-028-415	CAL125680	± 0.092	°
50.00 ° F	50.00 ° F	0.00	1285-028-415	CAL125680	± 0.099	°

Ambient Air Temperature: 73 ° F

Relative Humidity: 23 %

* Observed instrument readings should be increased by positive numbers or reduced by negative numbers indicated by a minus (-) sign.
** Emergent Stem Temperature relates to PARTIAL IMMERSION thermometers ONLY.

The best measurement uncertainties associated with our calibration system are ±0.074°C from -80 to -1°C, ±0.041°C at the ice point in melting ice bath, ±0.045°C from 1 to 100°C, ±0.051°C from 101 to 200°C, ±0.047°C from 201 to 300°C, and ±0.052°C from 301 to 400°C. These uncertainties have been calculated using our Work Instruction WI-19 to 22 that utilizes methods found in NIST Technical Note 1297. The reported uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2. The uncertainty of measurement is an important factor to consider when evaluating this instrument for conformance to tolerance standards.

Erika Reedy, Calibration Manager
Calibrated By — Title

Amaritza Caballero, Production Assistant
Checked By — Title

H-B Instrument
102 West Seventh Avenue, Trappe, PA 19426-0770 USA
Telephone: (610) 489-5500 • Fax: (610) 489-9100
Email Address: cal@hbinstrument.com
Website Address: www.hbinstrument.com

 Form 0-592 Rev. 14

H-B Instrument - Manufacturing Since 1903
A Division of Bel-Art Products

Triple Accredited/Registered
ISO 9001:2008 Registered Manufacturer
ISO 14001:2004 Registered Manufacturer
ISO/IEC 17025:2005 Accredited Laboratory

H-B Instrument

Thermometer Calibration Report

Traceable to NIST

ilac-MRA ACCREDITED
Calibration Cert. # 2448.01

This laboratory is accredited in accordance with the recognized International Standard **ISO/IEC 17025:2005** General Requirements for the Competence of Testing and Calibration Laboratories. This laboratory also meets the requirements of **ANSI/NCSL Z540-1-1994** and any additional program requirements in the field of calibration. This accreditation also demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated 18 June 2005).

The instrument described below has been examined and tested in H-B Instrument's Calibration Laboratory using controlled constant temperature equipment and standard thermometers traceable to NIST in accordance with our calibration procedure LAB-20 which is based in part on NBS Monograph 150, ASTM Method E-77, NIST SP 1088, and the International Temperature Scale ITS-90. Calibration is traceable to NIST. For a discussion of accuracy obtainable with such thermometers, see NIST SP 250-23. The results stated relate only to the instrument bearing the serial number identified.

This instrument is in good working order and is suitable for calibration. The capillary of the thermometer has been examined under magnification and no discernable capillary irregularities were noted. Strains in the glass revealed by examination under a polarized lens, if any, were judged to be minimal and of no detriment to the function of the instrument.

02/10/2014

Custom Stack Analysis, LLC.
Brian LeMasters
14614 Cenfield St. NE
Alliance OH 44601

Tel: 1-330-525-51 Fax:
Reference No: Verbal
Calibration Due Date: 2/10/2015

Report No.	345717
Serial No	4A6108
Part No	61099-126
Distributor	H-B Instrument
Manufacturer	H-B Instrument/MW
Item	Thermometer, ASTM 66F-86
Range	167/221°F, 0.2°Div., Total Imm., Hg
Tolerance	±0.2°C

N.I.S.T. Standard	Instrument Tested	Correction (ITS-90)*	Standard Serial No.	Traceability	Expanded Uncertainty (k=2)	Emer. Stem** Temperature
185.00 ° F	185.06 ° F	-0.06	1285-028-415	CAL125680	± 0.099	°
212.00 ° F	212.02 ° F	-0.02	1285-028-415	CAL125680	± 0.099	°
220.00 ° F	220.00 ° F	0.00	1285-028-415	CAL125680	± 0.110	°

Ambient Air Temperature: 73 ° F **Relative Humidity:** 23 %

* Observed instrument readings should be increased by positive numbers or reduced by negative numbers indicated by a minus (-) sign.
** Emergent Stem Temperature relates to PARTIAL IMMERSION thermometers ONLY.

The best measurement uncertainties associated with our calibration system are ±0.074°C from -80 to -1°C, ±0.041°C at the ice point in melting ice bath, ±0.045°C from 1 to 100°C, ±0.051°C from 101 to 200°C, ±0.047°C from 201 to 300°C, and ±0.052°C from 301 to 400°C. These uncertainties have been calculated using our Work Instruction WI-19 to 22 that utilizes methods found in NIST Technical Note 1297. The reported uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2. The uncertainty of measurement is an important factor to consider when evaluating this instrument for conformance to tolerance standards.

Calibrated By: Erika Reedy, Calibration Manager
Title

Checked By: Amaritza Caballero, Production Assistant
Title

H-B Instrument
102 West Seventh Avenue, Trappe, PA 19426-0770 USA
Telephone: (610) 489-5500 • Fax: (610) 489-9100
Email Address: cal@hbinstrument.com
Website Address: www.hbinstrument.com

 Form 0-592 Rev. 14

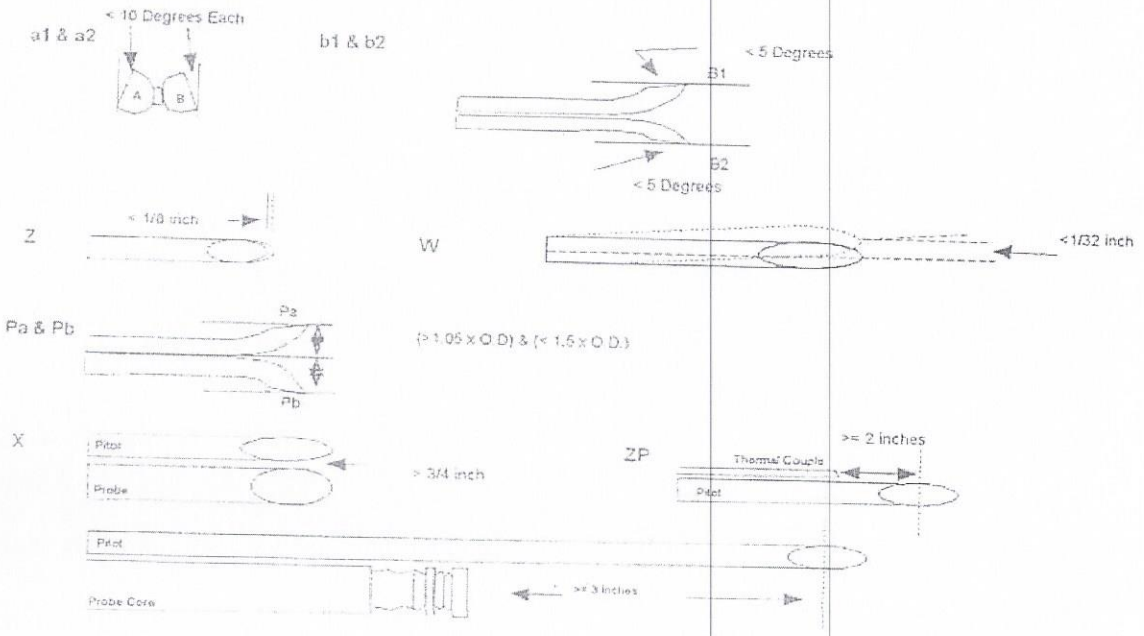
Client: The Log Boiler Pitot Tube Inspection Date: 5-20-14

Probe/Pitot Number	SP-2	A (Pa + Pb)	.883
Level and Perpendicular	yes	Zs= A tan Y (< 0.125")	.071
Obstruction?	no	Ws= A tan 0 (< 0.03125")	0
Damaged?	no	D_t (0.1875" < D_t < 0.375")	.375
a_1 (-10° < a_1 < +10°)	0	P_a (1.05 D_t < P_a < 1.5 D_t)	.455
a_2 (-10° < a_2 < +10°)	0	P_b (1.05 D_t < P_b < 1.5 D_t)	.428
b_1 (-5° < b_1 < +5°)	0	Pa = Pb ± 0.063"	.027
b_2 (-5° < b_2 < +5°)	0		

Probe Minimum Interferences

Y (>= 3.0")	3.65	D_n	
X (> .75")	1.10	X /D_n (>= 1.5")	
Zp (>= .75")	.93		

Pa	Distance between where pitots adjoin to tip of pitot (Must be between 1.05 & 1.50 times O.D. of tubing)
Pb	Distance between where pitots adjoin to tip of pitot (Must be between 1.05 & 1.50 times O.D. of tubing)
Dt	Diameter of pitot tube (0.375 inches on all pitots)
Zs	Distance between the tip of the impact and static line along the length of the pitot (Must be <1/8 inch(0.1250))
Ws	Spacing between Pitot tubes where welded together (Must be <1/32 inch (0.0313))
a1	Angle across opening of Pitot tube from side to side or perpendicular to length of probe (Must be <10 Deg)
a2	Angle across opening of Pitot tube from side to side or perpendicular to length of probe (Must be <10 Deg)
b1	Angle across opening of Pitot tube from side to side or perpendicular to length of probe (Must be <5 Deg)
b2	Angle across opening of Pitot tube from side to side or perpendicular to length of probe (Must be <5 Deg)
X	Distance between side of nozzle and side of pitot tube (Must be >3/4 inch)
Zp	Distance from center of pitot opening back to tip of thermal couple (Must be >=3/4 inch (0.75))
Y	Distance from center of pitot opening back to probe (Must be >=3 inches)



THERMOCOUPLE CALIBRATIONS FOR SOURCE SAMPLING APPARATUS

CALIBRATION DATE 5-16-14 BY Brian L

FACILITY The Log Boiler

UNIT NO _____ SERIAL NO. _____ Pb 28,59

CALIBRATED IN ICE WATER AND BOILING WATER USING A CMS PRECISION GLASS THERMOMETER NO. 229-054, ASTM NO. 63F FOR ICE WATER AND CMS NO. 229-088, ASTM NO. 66F FOR BOILING WATER.

TC	ICE WATER PRECISION	ICE WATER TC	BOILING WATER PRECISION	BOILING WATER TC
CONDENSOR THERMOCOUPLES				
C-1	32	32	212	212
C-2	32	32	212	211
C-3	32		212	
C-4	32	32	212	212
C-5	32		212	
PROBE THERMOCOUPLES	32			
2P-1	32		212	
2P-2	32		212	
2P-3	32		212	
3P-1	32	32	212	212
3P-2	32	32	212	212
3P-3	32		212	
3P-4	32		212	
4P-1	32		212	
4P-2	32		212	
4P-3	32		212	
4P-4	32		212	
6P-1	32		212	
6P-2	32		212	
6P-3	32		212	
6P-4	32		212	
8P-1	32		212	
8P-2				
8P-3				

THERMOCOUPLE TEMPERATURES ARE READ ON THE DTI USED DURING TEST.
DTI CALIBRATED BY ALTEK 22 TC SOURCE S# 243783 PRIOR TO TC CAL.

THERMOCOUPLE CALIBRATIONS FOR SOURCE SAMPLING APPARATUS

CALIBRATION DATE 5-16-14 BY Brian C

UNIT NO _____ SERIAL NO. _____ Pb 28.59

CALIBRATED IN ICE WATER AND BOILING WATER USING A CMS PRECISION GLASS THERMOMETER NO. 229-054, ASTM NO. 63F FOR ICE WATER AND CMS NO. 229-088, ASTM NO. 66F FOR BOILING WATER.

TC OVEN THERMOCOUPLES	ICE WATER PRECISION	ICE WATER TC	BOILING WATER PRECISION	BOILING WATER TC
O-3	32		212	
O-4	32	32	212	212
O-5	32	32	212	212
O-6	32	32	212	212
O-7	32		212	
O-8	32		212	
O-9	32		212	
STACK THERMOCOUPLES	32		212	
2S-1	32		212	
2S-2	32		212	
2S-3	32		212	
3S-1	32	32	212	212
3S-2	32	32	212	212
3S-3	32		212	
4S-1	32		212	
4S-2	32		212	
4S-3	32		212	
6S-1	32		212	
6S-2	32		212	
6S-3	32		212	
6S-4	32		212	
8S-1	32		212	
8S-2				
8S-3				

THERMOCOUPLE TEMPERATURES ARE READ ON THE DTI USED DURING TEST.
DTI CALIBRATED BY ALTEK 22 TC SOURCE S# 243783 PRIOR TO TC CAL.

THERMOCOUPLE CALIBRATIONS FOR SOURCE SAMPLING APPARATUS

CALIBRATION DATE 5-16-14 BY Brian L

UNIT NO _____ SERIAL NO. _____ Pb 28.59

CALIBRATED IN ICE WATER AND BOILING WATER USING A CMS PRECISION GLASS THERMOMETER NO. 229-054, ASTM NO. 63F FOR ICE WATER AND CMS NO. 229-088, ASTM NO. 66F FOR BOILING WATER.

TC STACK THERMOCOUPLE	ICE WATER PRECISION	ICE WATER TC		BOILING WATER PRECISION	BOILING WATER TC	
12S-1	32			212		
PROBE THERMOCOUPLES						
12P-1	32			212		
12P-2	32			212		
12P-3	32			212		
METER THERMOCOUPLES - UNIT 001						
M-1	32		31	212		212
M-2	32		32	212		212
METER THERMOCOUPLES - UNIT 002	32			212		
M-1	32		32	212		212
M-2			32			212
METER THERMOCOUPLES - UNIT 003	32			212		
M-1	32			212		
M-2						
METER THERMOCOUPLES - UNIT 004	32			212		
M-1	32			212		
M-2	32			212		
METER THERMOCOUPLES - UNIT 15	32			212		
M-1						
M-2	32			212		
METER THERMOCOUPLES - UNIT 17	32			212		
M-1						
M-2	32			212		
METER THERMOCOUPLES - UNIT 18	32			212		
M-1						
M-2						

THERMOCOUPLE TEMPERATURES ARE READ ON THE DTI USED DURING TEST.
DTI CALIBRATED BY ALTEK 22 TC SOURCE S# 243783 PRIOR TO TC CAL.

Nozzle Calibration Data

Facility: The Log Boiler

Date: 5-20-14

Location: Outlet

Source: log Boiler

Method: 1-5

Analyst: Jordan Smith

Run #1

			Mean
.496	.496	.497	.496

Run #2

			Mean
.496	.495	.497	.496

Run #3

			Mean
.496	.495	.497	.496

Appendix #4

Monitoring Data

The Log Boiler, Inc.
Log Boiler Outlet

CO PPM	O2 %	Time Stamp	
9533.13	11.19	5/20/2014 10:29:23 AM	Start R-1
9603.58	11.35	5/20/2014 10:30:27 AM	
9897.77	11.48	5/20/2014 10:31:32 AM	
9880.00	11.63	5/20/2014 10:32:36 AM	
9517.49	11.82	5/20/2014 10:33:41 AM	
9606.58	12.00	5/20/2014 10:34:45 AM	
9853.30	12.17	5/20/2014 10:35:50 AM	
9516.21	12.36	5/20/2014 10:36:54 AM	
9553.94	12.50	5/20/2014 10:37:59 AM	
9864.67	12.60	5/20/2014 10:39:03 AM	
9775.53	12.71	5/20/2014 10:40:08 AM	
8776.54	12.72	5/20/2014 10:41:12 AM	
9579.34	12.82	5/20/2014 10:42:17 AM	
9893.14	12.90	5/20/2014 10:43:21 AM	
9581.55	12.93	5/20/2014 10:44:26 AM	
9501.07	13.00	5/20/2014 10:45:30 AM	
9664.80	13.05	5/20/2014 10:46:35 AM	
9820.73	13.11	5/20/2014 10:47:39 AM	
9797.88	13.15	5/20/2014 10:48:44 AM	
9577.75	13.18	5/20/2014 10:49:48 AM	
9644.25	13.23	5/20/2014 10:50:53 AM	
9853.45	13.26	5/20/2014 10:51:57 AM	
9547.68	13.28	5/20/2014 10:53:02 AM	
9783.78	13.28	5/20/2014 10:54:06 AM	
9827.13	13.20	5/20/2014 10:55:11 AM	
9654.66	13.15	5/20/2014 10:56:15 AM	
9759.15	13.20	5/20/2014 10:57:20 AM	
9533.75	13.24	5/20/2014 10:58:24 AM	
9768.48	13.28	5/20/2014 10:59:29 AM	
9994.81	14.56	5/20/2014 11:00:33 AM	
3033.14	20.07	5/20/2014 11:01:38 AM	
561.21	18.25	5/20/2014 11:02:42 AM	
9589.53	13.54	5/20/2014 11:03:47 AM	
9759.38	13.60	5/20/2014 11:04:52 AM	
9734.43	13.63	5/20/2014 11:05:56 AM	
9519.91	13.66	5/20/2014 11:07:01 AM	
9523.32	13.67	5/20/2014 11:08:05 AM	
8500.67	13.56	5/20/2014 11:09:10 AM	
9847.96	13.51	5/20/2014 11:10:14 AM	
9820.39	13.55	5/20/2014 11:11:19 AM	
9799.18	13.55	5/20/2014 11:12:23 AM	
9654.77	13.58	5/20/2014 11:13:28 AM	
9873.99	13.59	5/20/2014 11:14:32 AM	
9842.65	13.61	5/20/2014 11:15:37 AM	
9614.86	13.65	5/20/2014 11:16:41 AM	
9597.81	13.70	5/20/2014 11:17:46 AM	
9804.47	13.65	5/20/2014 11:18:50 AM	
9624.47	13.66	5/20/2014 11:19:55 AM	
9890.78	13.79	5/20/2014 11:20:59 AM	
9835.29	13.88	5/20/2014 11:22:04 AM	
9724.62	13.96	5/20/2014 11:23:08 AM	
9828.95	14.03	5/20/2014 11:24:13 AM	
9805.55	14.02	5/20/2014 11:25:17 AM	

9894.39	14.04	5/20/2014 11:26:22 AM		
9531.03	14.06	5/20/2014 11:27:26 AM		
9744.13	14.08	5/20/2014 11:28:31 AM		
9735.27	14.13	5/20/2014 11:29:35 AM		Stop R-1
9400.95	13.41		Avg	
9833.62	11.90	5/20/2014 12:35:11 PM		Start R-2
9839.41	11.94	5/20/2014 12:36:15 PM		
9609.02	11.96	5/20/2014 12:37:20 PM		
9509.06	11.98	5/20/2014 12:38:24 PM		
9701.06	12.00	5/20/2014 12:39:29 PM		
9849.50	11.99	5/20/2014 12:40:33 PM		
9621.85	12.02	5/20/2014 12:41:38 PM		
9773.52	12.08	5/20/2014 12:42:42 PM		
9703.12	12.06	5/20/2014 12:43:47 PM		
9510.00	12.04	5/20/2014 12:44:51 PM		
9854.12	12.05	5/20/2014 12:45:56 PM		
9699.94	12.03	5/20/2014 12:47:00 PM		
9793.20	11.96	5/20/2014 12:48:05 PM		
9899.95	11.93	5/20/2014 12:49:10 PM		
9850.38	11.86	5/20/2014 12:50:14 PM		
9763.29	11.82	5/20/2014 12:51:19 PM		
9800.59	11.80	5/20/2014 12:52:23 PM		
9580.82	11.70	5/20/2014 12:53:28 PM		
9626.30	11.67	5/20/2014 12:54:32 PM		
9605.07	11.81	5/20/2014 12:55:37 PM		
9623.06	12.10	5/20/2014 12:56:41 PM		
9870.49	12.40	5/20/2014 12:57:46 PM		
9543.84	12.66	5/20/2014 12:58:50 PM		
9831.94	12.80	5/20/2014 12:59:55 PM		
9941.09	12.76	5/20/2014 1:00:59 PM		
9474.79	12.97	5/20/2014 1:02:04 PM		
9042.66	13.23	5/20/2014 1:03:08 PM		
8721.61	13.57	5/20/2014 1:04:13 PM		
8494.56	13.68	5/20/2014 1:05:17 PM		
7887.87	15.81	5/20/2014 1:06:22 PM		
962.82	20.10	5/20/2014 1:07:26 PM		
1010.43	17.13	5/20/2014 1:08:31 PM		
7876.89	14.01	5/20/2014 1:09:35 PM		
8466.49	14.29	5/20/2014 1:10:40 PM		
8700.86	14.75	5/20/2014 1:11:44 PM		
8427.42	15.03	5/20/2014 1:12:49 PM		
8318.78	15.16	5/20/2014 1:13:54 PM		
7947.69	15.26	5/20/2014 1:14:58 PM		
7651.06	15.44	5/20/2014 1:16:02 PM		
7331.23	15.58	5/20/2014 1:17:07 PM		
7248.22	15.66	5/20/2014 1:18:11 PM		
7210.38	15.70	5/20/2014 1:19:16 PM		
7279.96	15.63	5/20/2014 1:20:20 PM		
7225.03	15.60	5/20/2014 1:21:25 PM		
7132.26	15.52	5/20/2014 1:22:29 PM		
6877.13	15.33	5/20/2014 1:23:34 PM		
6676.93	15.43	5/20/2014 1:24:39 PM		
6222.83	15.59	5/20/2014 1:25:43 PM		
5707.70	15.68	5/20/2014 1:26:48 PM		
5339.04	15.80	5/20/2014 1:27:52 PM		
5000.91	15.95	5/20/2014 1:28:57 PM		
4926.45	16.06	5/20/2014 1:30:01 PM		
4958.18	16.15	5/20/2014 1:31:06 PM		
4937.43	16.20	5/20/2014 1:32:10 PM		
4898.37	16.24	5/20/2014 1:33:15 PM		
4974.05	16.37	5/20/2014 1:34:19 PM		
5400.08	16.45	5/20/2014 1:35:24 PM		
5632.01	16.50	5/20/2014 1:36:28 PM		

5497.74	16.56	5/20/2014 1:37:33 PM		Stop R-2
7910.07	14.06		Avg	
4201.35	18.25	5/20/2014 2:20:33 PM		Start R-3
4898.37	17.85	5/20/2014 2:21:38 PM		
5099.79	17.42	5/20/2014 2:22:42 PM		
5813.90	16.98	5/20/2014 2:23:47 PM		
7095.64	16.52	5/20/2014 2:24:52 PM		
8255.30	16.11	5/20/2014 2:25:56 PM		
9577.33	15.57	5/20/2014 2:27:01 PM		
9932.55	15.97	5/20/2014 2:28:05 PM		
6803.89	17.62	5/20/2014 2:29:09 PM		
4801.93	17.92	5/20/2014 2:30:14 PM		
4347.83	17.91	5/20/2014 2:31:18 PM		
3980.40	17.93	5/20/2014 2:32:23 PM		
4244.07	17.81	5/20/2014 2:33:28 PM		
4688.41	17.63	5/20/2014 2:34:32 PM		
4886.16	17.46	5/20/2014 2:35:37 PM		
5191.34	17.26	5/20/2014 2:36:41 PM		
5508.72	17.10	5/20/2014 2:37:46 PM		
5802.91	16.93	5/20/2014 2:38:50 PM		
6152.03	16.76	5/20/2014 2:39:55 PM		
6386.41	16.59	5/20/2014 2:40:59 PM		
5556.33	16.41	5/20/2014 2:42:04 PM		
7023.61	16.21	5/20/2014 2:43:08 PM		
7327.57	15.99	5/20/2014 2:44:13 PM		
7421.56	15.79	5/20/2014 2:45:17 PM		
7633.97	15.59	5/20/2014 2:46:22 PM		
7813.41	15.44	5/20/2014 2:47:26 PM		
8075.86	15.28	5/20/2014 2:48:31 PM		
8263.85	15.13	5/20/2014 2:49:35 PM		
8376.15	15.03	5/20/2014 2:50:40 PM		
8621.51	14.95	5/20/2014 2:51:44 PM		
8890.07	14.88	5/20/2014 2:52:49 PM		
4771.42	19.35	5/20/2014 2:53:53 PM		
1310.72	17.46	5/20/2014 2:54:58 PM		
9308.77	14.68	5/20/2014 2:56:02 PM		
9706.72	14.62	5/20/2014 2:57:07 PM		
9751.89	14.48	5/20/2014 2:58:11 PM		
9976.50	14.39	5/20/2014 2:59:16 PM		
10000.91	14.38	5/20/2014 3:00:21 PM		
9999.69	14.34	5/20/2014 3:01:25 PM		
9713.59	14.33	5/20/2014 3:02:30 PM		
9578.60	14.33	5/20/2014 3:03:34 PM		
9576.01	14.24	5/20/2014 3:04:38 PM		
9793.53	14.20	5/20/2014 3:05:43 PM		
9878.05	14.26	5/20/2014 3:06:47 PM		
9645.39	14.31	5/20/2014 3:07:52 PM		
9539.65	14.41	5/20/2014 3:08:57 PM		
9562.73	14.45	5/20/2014 3:10:01 PM		
9607.88	14.54	5/20/2014 3:11:06 PM		
9875.00	14.58	5/20/2014 3:12:10 PM		
9874.48	14.63	5/20/2014 3:13:15 PM		
9602.09	14.71	5/20/2014 3:14:19 PM		
9837.22	14.78	5/20/2014 3:15:24 PM		
9703.77	14.89	5/20/2014 3:16:28 PM		
9760.22	15.04	5/20/2014 3:17:33 PM		
9560.00	15.23	5/20/2014 3:18:37 PM		
9988.70	15.46	5/20/2014 3:19:42 PM		
9410.09	15.77	5/20/2014 3:20:46 PM		
8737.48	16.06	5/20/2014 3:21:51 PM		
7518.00	16.35	5/20/2014 3:22:55 PM		Stop R-3
7767.14	15.84		Avg	

Appendix #5

Process Data

Run #1	Run #2	Run #3
420 lbs/hr	420 lbs/hr	420 lbs/hr