LOKEE TESTING Laboratory

13235 Prairie Circle East, Bonney Lake, WA 98391
Telephone: 360-897-9685

September 13, 2012

Loren Sutphin
Lennox Hearth Products
1502 14th Street Northwest
Auburn, WA 98001

Loren:

Enclosed please find one copy of the woodheater certification report for the:

Model: ES2100

If you have any further questions concerning this or any other related matter please feel free to call at anytime.

Sincerely,

Chip Wadington

Chip Wadington
Owner

APPLICATION FOR U.S. EPA WOOD HEATER CERTIFICATION PURSUANT TO 40 CFR §60.533

REGULAR CERTIFICATION

1.0 ADMINISTRATIVE INFORMATION

1.1 Wood heater model name: Earth Stove ES2100

Wood heater model number: H8872

1.2 Wood heater type (catalytic, noncatalytic, other): noncatalytic

Specify other: ______________________________

1.3 Manufacturer name: Lennox Hearth Products

Mailing address: P.O. Box 987
Auburn, WA 98071

Street address* : 1502 14th Street N.W.
Auburn, WA 98001

Telephone: (253)735-1100

Fax: (253)931-1271

1.4 Owner, corporate officer or authorized representative to whom correspondence should be addressed

Name: Loren Sutphin

Title: Engineering Manager – Auburn, WA

Address: 1502 14th Street N.W. Auburn, WA 98001

____

Telephone: (253)735-1100

Fax: (253)931-1271

1.5 Production volume for this model:

1.5.1 Previous 12 month period: Zero

1.5.2 First 12 months after certification (projected): 2000 Units

1.5.3 First 24 months after certification (projected): 2000 Units

Note: EPA will maintain this data as confidential.

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* If this model will be manufactured in locations other than that listed in 1.4, please attach a page listing all plant addresses.

2.0 TESTING INFORMATION

2.1 Name of laboratory that performed certification tests:

LOKEE TESTING LAB

2.2 Date EPA was notified in writing of certification test: 8/30/2012

2.3 Dates of certification tests: 9/1/2012 thru 9/5/2012

2.4 Test method(s) used for certification. Check appropriate response(s):

- ☐ 5G-1 (dual filter, dry sampling train)
- ☐ 5G-2 (dual filter plus impingers sampling train (Sec. 7.1 in Method 5G))
- ☐ 5G-3 (two dual filter dry sampling trains (Sec. 7.2 in Method 5G))
- ☒ 5H

2.5 Test Results Summary

You must report all test results. This includes test results from simultaneous sampling trains, aborted runs and additional test runs (i.e., two or more runs in the same burn rate category, per Sections 6.6 of Method 28). Also indicated which test runs you are excluding for purposes of calculating weighted emissions and briefly state the reason (if necessary attach additional pages).

Burn Rate[a] Dry Basis (kg/hr)	Measured PM Emission Rate[b] (g/hr)	Adjusted PM Emission Rate[c] (g/hr)	Overall Efficiency[d] (%)	Indicate Runs Excluded and Why
.87	2.45			
1.09	3.48			
1.59	2.82			
2.52	3.82			
1.08	3.12			

[a] List in ascending order (i.e., lowest burn rate first).
[b] Actual particulate emission rate measured using the method identified in 2.4.
[c] Particulate emission rate adjusted for test method (Equation 5G-5 in Method 5G).
[d] Optional measurement.

2.5.1 Weighted particulate emission rate ___3.05___ g/hr (as per Section 8.1 in Test Method 28).

2.5.2 Emission Rate Plot:

Plot the burn rate and particulate emission rates for each test run. Include only those test runs to be used in calculating the weighted average.

3.0 CERTIFICATION TEST REPORT

Attach the certification test report. The test report should conform to the reporting criteria listed in Method 28, Section 8.4. An example test report outline is included below for guidance. Each of the items specified in the outline should be included in your test report. If your test report is organized differently, indicate to the left of the items below the pages in your test report where these items can be found.

Example Test Report Format:

a. Introduction
   1. Wood heater identification--manufacturer, model number, catalytic/noncatalytic, options.
   2. Testing laboratory--name, location (altitude), participants.
   3. Test information--date wood heater received, date of tests, sampling method used, number of test runs.
   4. Identify any variations in the certification test from the published test methods.

b. Summary and Discussion of Results
   1. Table of results (in order of increasing burn rate)--test run number, burn rate, particulate emission rate, efficiency (if determined), averages (indicate which test runs were used).
   2. Summary of other data--test facility conditions, surface temperature averages, catalyst temperature averages, pretest fuel weights, test fuel charge weights, run times.
   3. Discussion--specific test run problems and solutions.

c. Process Description
   1. Wood heater dimensions--volume, height, width, lengths (or other linear dimensions), weight, volume adjustments.
   2. Firebox configuration--air supply locations and operation, air supply introduction location, refractory location and dimensions, catalyst location, baffle and by-pass location and operation (include line drawings or photographs).
   3. Process operation during test--air settings and adjustments, fuel bed adjustments, draft.
   4. Test fuel--test fuel properties (moisture and temperature), test fuel crib description (include line drawings or photograph), test fuel charge density.

d. Sampling Locations
   Describe sampling location relative to wood heater. Include drawings or photograph.

e. Sampling and Analytical Procedures
   1. Sampling methods.
   2. Analytical methods.

f. Quality Control and Quality Assurance Procedures and Results
   1. Calibration procedures and results--certification procedures, sampling and analysis procedures.
   2. Test method quality control procedures and results--leak checks, volume meter checks, stratification (velocity) checks, proportionality results.

g. Appendices
   1. Results and Sample Calculations
   2. Raw Field Data
   3. Sampling and Analytical Procedures
   4. Analytical Data
   5. Participants
   6. Sampling and Operation Records
   7. Additional Information

4.0 WOOD HEATER DESCRIPTION

4.1 Attach two color photographs (side and front views) of the wood heater tested for EPA certification. (These photographs should, where possible, uniquely identify the wood heater to allow future verification of the stored unit.) IN REPORT

4.2 Pursuant to §60.537(c) designate below the permanent storage location of the tested wood heater, and the measures taken to seal the unit against tampering.

The heater tested for certification purposes is being held in the custody of

Lennox Hearth Products

and is stored at (e.g., street, city, state): 1502 14th Street N.W.

Auburn, WA 98001

The following measures have been taken to seal the heater against tampering. (Attach a statement from the laboratory describing how the heater has been sealed.)

IN REPORT

4.3 Method 28, which describes guidelines for wood heater installation and operation during certification tests, provides that the manufacturer's operating instructions be used in several aspects of the testing process. Describe below any such instructions that you provided to the testing laboratory. Will these same instructions be included in the published owner's manual? (ENCLOSE ALL INSTRUCTIONS GIVEN TO TESTING LAB.)

Instructions were given on the draft/damper settings for each burn rate.

Instructions are included in the test report.

4.4 Pursuant to §60.533(b)(3) attach detailed engineering drawing showing dimensions and material specifications for the following wood heater components and systems:

1. Firebox dimensions
2. Air introduction system: cross sectional area of inlets, outlets, and location and method of control.
3. Baffles: dimension, location
4. Refractory insulation: dimension and location
5. Catalyst: size, shape and location
6. Catalyst bypass mechanism
7. Flue gas exit: location and dimension
8. Door and catalyst bypass gaskets: dimensions, materials and fit

4.5 For each of the components or systems listed above, identify any dimensions that you expect to have tolerances greater than ± ¼" (or ± 5% for cross-sectional areas) when all components are assembled and provide your manufacturing tolerances for these items. Attach documentation demonstrating that such tolerance variations do not adversely affect emissions.

No dimensions will exceed tolerances of +/- ¼".

4.6 If the tested wood heater has a firebox composed of materials different from the material to be used in the manufactured wood heaters (as provided for in §60.533(b)(3)(ii)), describe these differences in the space below.

The tested appliance was constructed with the materials that it will be produced with.

4.7 Attach a copy of your company's plans for complying with §60.533(o), the quality assurance program.

5.0 CATALYST INFORMATION (If Applicable)

5.1 Catalyst brand and model: N/A

Substitute catalysts (see Section 5.6 below) N/A

5.2 Attach catalyst warranty

5.3 Can the catalyst be visually inspected during normal heater operation or under typical installation conditions? Describe what owner must do to make observation.
N/A

5.4 Describe catalyst installation and removal procedures. (Include descriptions and illustrations prepared for use in owner's manuals, if available.)
N/A

5.5 Describe location, size, and design of ports for monitoring catalyst temperature. Identify commercially available monitoring devices which are compatible.
N/A

5.6 Until July 1, 1990 EPA will approve the use of a substitute catalyst under the following conditions: (1) the proposed substitute has been approved by Oregon DEQ under its substitution equivalency program, and (2) the proposed substitute catalyst has been used in certifying a currently-certified wood heater (either in Oregon or under the EPA program). If you want EPA to consider a proposed substitute for the catalyst identified in Section 5.1, please indicate below and submit evidence that you meet the two tests described above.

I request EPA to approve the following catalysts as substitute catalysts for this wood heater:
N/A

6.0 AFFIRMATIONS

In accordance with the requirements set forth in 40 CFR §60.530 through 60.540, I affirm that:

6.1 A representative wood heater for the model line in question has been tested in accordance with §60.534(a), and meets the applicable emission limits in §60.532.

6.2 The results of all valid certification test runs are reported in this application and in the attached materials.

6.3 Wood heaters manufactured under this certificate will be similar in all material and dimensional respects, within tolerances of §60.533(k)(2) and (3), to that wood heater tested for certification purposes.

6.4 In-house parameter inspections and emission tests will be conducted and records will be maintained as described in §60.533(o).

6.5 Labeling requirements described in §60.536 will be adhered to.

6.6 For catalyst equipped wood heaters, warranty, inspection access and temperature port requirements as described in §60.533(c), (d) and (m) will be adhered to.

6.7 I have read, understand, and will comply with the requirements for reporting and recordkeeping set forth in §60.537.

6.8 The testing laboratory will be notified in writing within 30 days, if certification is granted as pursuant to §60.533(b)(8).

The information contained in this application is true, complete and correct to the best of my knowledge.

SIGNATURE: ______________________

TYPED NAME: Loren Sutphin

TITLE: Engineering Manager – Auburn, WA

DATE: 9/17/2012

United States
Environmental Protection Agency
Wood Heater Certification Test Report

Lennox Hearth Products
1502 14th Street Northwest
Auburn, WA 98071-0959

ES2100

Volume 1

Report By:

Chip Wadington
Armando Vedoy

CONFIDENTIAL

RELEASED ONLY BY
AUTHORIZED PERSONNEL

September 13, 2012

PAGE NUMBER INDEX

M-5H INDIVIDUAL TEST RUN PAGE INDEX

The data sheets in the individual test runs are organized in the following sequence:

A. Computer Printouts

Table 1	Field Data
Table 2	Field Data
Table 3	Field Data Averages
Table 4	Calculations
Table 5	Proportional Rate Variation

B. Raw Data Sheets

		No. of Pages
Data Sheet # 1	Computer Input Data	1
Data Sheet # 2	Meter box Data Sheets	variable
Data Sheet # 3	Particulate Catch/Moisture Data Sheet	1
Data Sheet #4-1	Filter Tare Weights	variable
4-2	Beaker Tare Weights	variable
4-3	Constant Weights	variable
4-4	Scale QA Checks	variable
Data Sheet # 5	Blank Processing Data Sheet	1
Data Sheet # 6	Net Particulate Catch Calc Sheet	1
Data Sheet # 7	Particulate Calc Sheet	1
Data Sheet # 8	Miscellaneous Test Data	1
Data Sheet # 9	Stove Operating Data	1
Data Sheet # 10	Fuel Moisture	1
Data Sheet # 11	Wood Density	1
Data Sheet # 12	Burn Rate And Flue Gas Data	variable
Data Sheet # 13	Pre Burn Data	variable
Data Sheet # 14	Temperature Data	variable
Data Sheet # 15-1	CO_2 Pre/Post test Zero/Span Audits	1
# 15-2	O_2 Pre/Post test Zero/Span Audits	1
# 15-3	CO Pre/Post test Zero/Span Audits	1
# 15-4	SO_2 Pre/Post test Zero/Span Audits	1
Data Sheet # 16	Quality Checks	1

TEST SERIES INFORMATION

Unit name and model number: ES2100

Type of unit: Wood Heater

Manufacturer: Lennox Hearth Products
Address: 1502 14th Street Northwest
Auburn, WA 98071-0959

Contact: Loren Sutphin
Phone Number: 206-735-1100
Fax Number: 206-931-1271

Observers: Bob Wayman

Date Received: 7/16/12 **Aged:** 8/13,14/12 **Tested:** 9/1-5/12

Tested by: LoKee Testing Lab using EPA Methods 28, 28A and 5H where applicable.

Test Location: 13235 Prairie Circle East
Bonney Lake, WA 98391-7250
Test Site Elevation: 627 feet above sea level

LoKee's Field Team

Team Members: Chip Wadington
Armando Vedoy

The following pages contain (1) test unit storage information, (2) a diagram showing the height and location of the stack components and sampling ports, and (3) copies of the certification test notices and cancellations sent to the EPA.

STOVE STORAGE INFORMATION

1. **Temporary Storage at LoKee Testing Laboratory**

   A single, steel, banding strap is place around the unit, preventing opening of the loading door.

2. **Permanent Storage**

   After certification is granted, additional banding is placed both horizontally and vertically around the unit to prevent access to the interior of the unit. An address label is then taped over the intersecting bands to act as a seal. Warning labels are affixed on the unit. The unit is then shipped via common carrier to the manufacturer's designated storage facility unless otherwise noted. A sample of the warning label follows.

>>WARNING<< >>WARNING<<
THIS IS A
SEALED E.P.A. TEST STOVE
DO NOT OPEN OR TAMPER WITH THE SEALS
AND PACKAGING ON THIS STOVE
TO DO SO WILL VOID THE
CERTIFICATION OF THIS STOVE
>>WARNING<< >>WARNING<<

LENNOX HEARTH PRODUCTS
ES2100

STORAGE OF TEST UNIT DOES NOT APPLY FOR QUALITY ASSURANCE TESTING

AGING DATA SHEET

UNIT : Country Stoves 210 DATE: 8-13-2012

Hr #	DATE	TIME	TEMP Stack 1	TEMP Top 2
1	8-13-12	1330	307	406
2	〃	1430	222	336
3	〃	1530	168	235
4	〃	1630	214	307
5	8-14-12	0800	575	648
6	〃	0900	322	474
7	〃	1000	468	593
8	〃	1130	286	481
9	〃	1230	181	210
10	〃	1330	286	402
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				

Hr #	DATE	TIME	TEMP 1	TEMP 2
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
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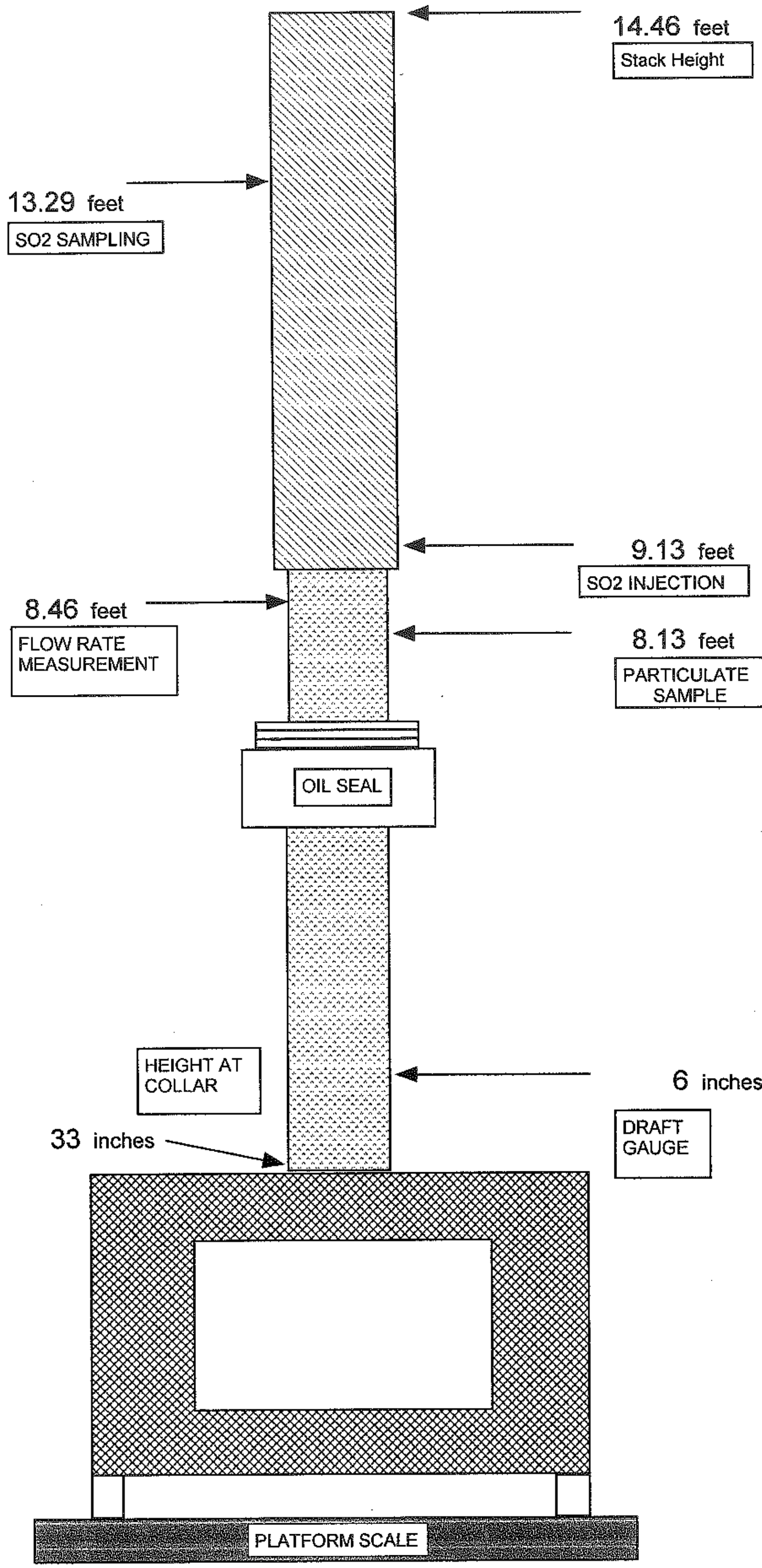
44				
45				
46				
47				
48				
49				
50				

COMMENTS:

Model: Lennox ES2100 **Date:** 09/01/12



Wood Heater Emission Test Summary

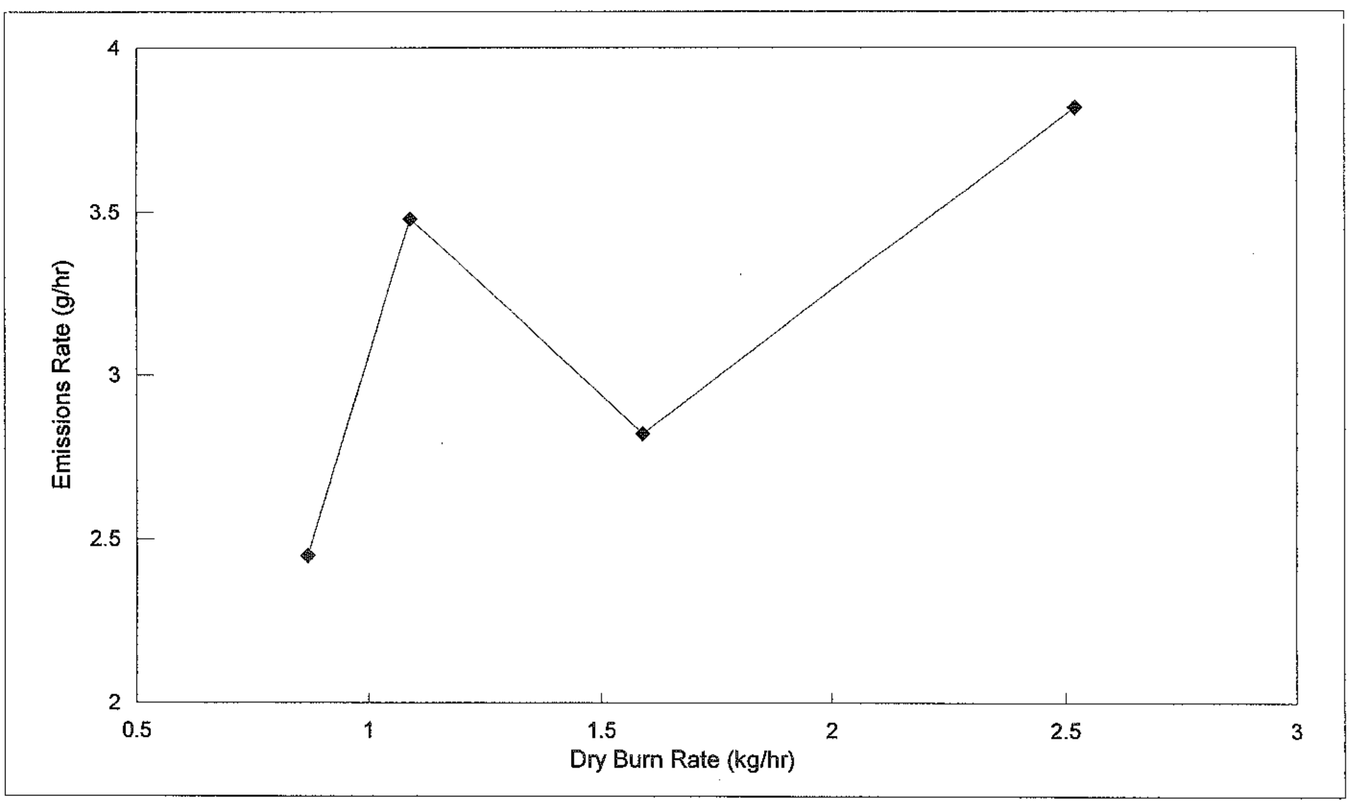
Laboratory/Wood Heater Information

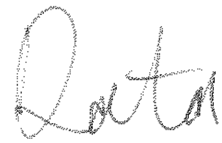
Stove Manufacturer:	Lennox Stoves
Model Identification:	ES2100
Stove Type> 1=cat, 2=noncat, 3=pellet:	2
Laboratory Name:	LoKee Testing Laboratory
Laboratory Contact:	Chip Wadington
Telephone no.:	360-897-9685
Test Dates:	9/1-5/12

Test Methods Used

Method 28/Other:	28
Sampling Method:	5H

Run no.	Burn Rate (kg/hr)	Emission Rate (g/hr)	Heat Output (Btu/hr)	Wtd Avg (g/hr) 3.05
1	0.87	2.45	10491	
2	1.09	3.48	13143	
5	1.59	2.82	19173	
3	2.52	3.82	30387	
4	1.08	3.12	13059	





DATA SUMMARY

Unit: Lennox – Model ES2100

	RUN #	1	2	5	3	4			
Particulate Emissions:						FAN			
Concentration:	grains/dscf:	.0883	.1067	.0692	.0627	.0930			
Emissions Rate	grams/hr:	2.45	3.48	2.82	3.82	3.12			
Emissions Factor	grams/kg:	2.83	3.19	1.77	1.51	2.88			
Front Half Catch	% of total	39.5	31.8	57.7	55.6	35.6			
Total Mass Captured	total catch:	.4831	.6421	.3070	.1923	.4705			
Heat Output (EPA Default):	BTU/hr	10442.4	13155.5	19160.5	30435	13059			
Fuel Burn Rates:									
Average kg/hr (dry)	Kg/hr	.87	1.09	1.59	2.52	1.08			
Fuel Moisture Content:									
Kindling (wet basis)	%	10.018	9.937	11.032	11.164	9.964			
Pretest Fuel (wet basis)	%	16.084	15.777	15.541	15.660	15.517			
Test Fuel (wet basis)	%	17.026	16.930	15.981	17.205	16.985			
Air to Fuel Ratio		-	-	-	-	-			
Average Stack Gas									
Avg CO_2	%	5.14	5.86	7.19	8.01	5.51			
Avg O_2	%	-	-	-	-	-			
Avg CO	%	.81	.64	.60	.35	.71			
Avg Moisture	%	6.60	6.67	7.84	7.49	7.04			
Avg Stack Gas Emissions:									
CO	g/Kg	134.72	98.51	79.24	43.44	113.58			
	g/hr	116.67	107.48	125.92	109.64	123.01			

Unit: Lennox – Model ES2100

	RUN #	1	2	5	3	4			
Avg Stack Gas Flow Rate									
EPA CMB	dscfm	7.15	8.38	10.47	15.66	8.62			
Tracer Gas	dscfm	5.778	7.185	10.423	15.357	8.809			
Draft (static)	in H_2O	-.037	-.044	-.044	-.051	-.036			
Proportionality Average	%	100	100	100	100	100	100	100	100
Average Temperatures									
Stack Gas	°F	207	241	304	436	244			
Firebox	°F	-	-	-	-	-			
Secondary	°F	-	-	-	-	-			
Catalytic Combustor	°F	-	-	-	-	-			
Top	°F	255	284	357	393	308			
Left Side	°F	290	284	338	422	302			
Back	°F	248	244	310	267	359			
Right Side	°F	243	257	303	368	246			
Bottom	°F	310	323	348	403	321			
Temperature Change	°F	-117.0	-82.0	-32.1	-73.1	-69.1			
Test Chamber Enviroment									
Average Barometer	in. Hg	30.18	30.22	30.06	30.18	30.21			
Average Temperature	°F	75	71	80	79	76			
Ambient Moisture	% H_2O	1.5	1.35	1.65	1.50	1.50			
Relative Humidity	%RH	44.0	45.0	47.0	45.0	50.0			
Air Velocity	m/sec	0	0	0	0	0	0	0	0
Fuel Weight and Burn Time									
Density (dry basis)	gm/cm^3	-	-	-	-	-			
Coal Bed Weight	lbs	3.3	3.0	3.2	2.9	2.9			
Pre Test Fuel (inc kindling)	lbs	36.1	29.9	35.4	32.2	33.7			
Test Fuel	lbs	13.8	14.0	13.9	14.0	13.9			
Burn Time	min	360	290	200	125	290			

Minimum
DBR

TABLE 1 ----- RAW DATA

CLIENT : Lennox TEST No. : 1

MODEL: ES2100 DATE: 01-Sep-12

TIME (MIN.)	METER READING (C F)	DELTA H (IN. H2O)	METER TEMP. (DEG. F)	PERCENT CO (%)	PERCENT CO2 (%)	SO2 COCENTR. PPM
0	357.500	0.150	77	1.09	4.80	500
5	359.000	1.250	78	0.18	8.40	175
10	363.315	0.150	78	0.41	2.30	500
15	364.834	0.140	78	0.47	2.60	525
20	366.280	0.140	78	0.56	3.10	525
25	367.726	0.120	78	0.63	3.30	575
30	369.046	0.170	78	0.42	10.70	475
35	370.645	0.210	78	0.31	11.40	425
40	372.430	0.140	79	0.42	10.90	525
45	373.882	0.240	79	0.22	10.30	400
50	375.786	0.240	80	0.26	10.20	400
55	377.697	0.240	80	0.25	10.00	400
60	379.609	0.210	80	0.27	10.50	425
65	381.408	0.210	80	0.33	10.80	425
70	383.207	0.190	80	0.35	10.70	450
75	384.906	0.190	81	0.21	10.00	450
80	386.612	0.150	81	0.42	10.00	500
85	388.147	0.190	81	0.33	9.70	450
90	389.853	0.170	81	0.34	8.70	475
95	391.469	0.170	81	0.29	8.10	475
100	393.085	0.170	81	0.31	8.00	475
105	394.701	0.170	81	0.28	8.00	475
110	396.317	0.170	81	0.25	8.20	475
115	397.933	0.170	81	0.28	7.60	475
120	399.549	0.150	82	0.35	6.40	500
125	401.085	0.140	82	0.40	5.70	525
130	402.547	0.140	82	0.40	5.60	525
135	404.009	0.140	82	0.46	5.40	525
140	405.472	0.110	82	0.54	5.20	575
145	406.807	0.110	82	0.54	5.20	575
150	408.142	0.110	82	0.60	5.20	575
155	409.478	0.100	82	0.65	5.20	600
160	410.758	0.090	82	0.71	5.20	650
165	411.939	0.080	82	0.97	4.30	675
170	413.077	0.080	82	0.96	4.30	675
175	414.214	0.058	82	0.98	4.30	675

180	415.352	0.080	82	0.99	4.30	675
185	416.490	0.080	82	1.03	4.20	700
190	417.587	0.080	82	1.07	4.20	700
195	418.684	0.070	82	1.09	4.20	725
200	419.743	0.070	82	1.15	4.20	725
205	420.803	0.070	82	1.20	4.10	725
210	421.862	0.070	82	1.44	3.90	725
215	422.921	0.070	82	1.52	3.90	750
220	423.945	0.070	82	1.53	3.70	750
225	424.969	0.070	82	1.57	3.70	750
230	425.993	0.070	82	1.50	3.80	750
235	427.017	0.060	82	1.53	3.50	775
240	428.008	0.060	82	1.46	3.60	775
245	428.999	0.060	82	1.39	3.50	775
250	429.990	0.060	82	1.58	3.30	800
255	430.950	0.060	82	1.33	3.00	825
260	431.881	0.060	82	1.21	3.20	825
265	432.812	0.060	82	1.25	3.00	825
270	433.743	0.006	82	1.37	3.00	825
275	434.674	0.050	82	1.39	2.90	850
280	435.578	0.050	82	1.17	3.10	850
285	436.481	0.050	82	1.26	2.70	850
290	437.385	0.050	82	1.31	2.50	850
295	438.288	0.050	82	1.33	2.50	900
300	439.142	0.050	82	1.30	2.50	900
305	439.995	0.040	82	1.15	2.40	925
310	440.826	0.040	82	1.05	2.30	925
315	441.656	0.050	82	0.98	2.20	900
320	442.509	0.040	82	0.92	2.10	925
325	443.340	0.040	82	0.83	2.00	925
330	444.170	0.040	82	0.69	1.80	950
335	444.979	0.040	82	0.79	1.90	975
340	445.766	0.040	82	0.89	2.10	975
345	446.554	0.050	82	0.56	2.70	900
350	447.408	0.060	82	0.66	2.80	825
355	448.339	0.060	82	0.67	3.10	825
360	449.270	0.060	82	0.70	3.10	825

TABLE 2---RAW DATA

CLIENT :	Lennox	TEST No.	1
MODEL:	ES2100	DATE:	01-Sep-12

****

METER CAL. FACTOR (Y) -------	0.935	Wt. WOOD BURNED(LB) -------	13.8	Lbs
BAROMETRIC PRESS.(Pb) -------	30.18 in Hg	WET,FUEL MOISTURE % -------	17.026	%
LEAK RATE POST (Lp) -------	0.000 cfm	Wt. PART. COLLECTED -------	0.4831	g
WATER VOL. (V1c) -------	126.8 Ml	METER VOLUME Vm -------	91.77	mcf
TEST TIME (MIN) -------	360 min	HC MOLE FRACTION -------	0.0132	

TABLE 3 -----FIELD DATA AVERAGES

CLIENT : Lennox TEST No. 1

MODEL: ES2100 DATE: 01-Sep-12

****

AVG DELTA H	-------	0.12	in H2O	AVG PRCNT CO	-------	0.81	%
AVG METER TEMP. Tm	-------	81	deg F	AVG PRCNT CO2	-------	5.14	%
AVG PPM SO2	-------	665	PPM	AVG BAL CO2/CO	-------	6.33	%

TABLE 4 ---- CALCULATIONS

CLIENT : Lennox

TEST No. 1

MODEL: ES2100

DATE: 01-Sep-12

****

STD SAMPLE VOL. Vm(std) d) ------	84.48 dscf	STACK GAS FLOW Qsd -------	428.879	dscf/Hr
			&	
			7.15	dscf/min
VOL. WATER VAPOR Vw(s td) -----	5.968 scf	PARTICULATE CONCTRT. C s ------	0.0057	g/dscf
PRCNT MSTR Bws -------	6.60 %	PARTC.EMISS. RATE E -------	2.45	g/Hr
BURN RATE BR -------	0.87 Kg/Hr	MOLES OF GAS PER Lb WOOD Nt ----	0.58	Lb-mole/Lb
CO EMISSION RATE -------	116.67 g/Hr & 134.72 g/Kgdry fuel	PART.EMISS. RATE ------	2.83	g/Kgdry fuel

TABLE 5 ----- PROPORTIONAL RATE VARIATION

CLIENT : Lennox

TEST No. : 1

MODEL: ES2100

DATE: 01-Sep-12

****

	TIME INTEVAL Ti	PPM * Vm	PROPRTN. RATE VAR. PR		PROPRTN RATE VAR. AVERAGE	
=========	=========	=========	=========	=========	=========	=========
	5	695.2	99		100	
	10	701.2	99			
	15	703.4	100			
	20	703.0	100			
	25	703.0	100			
	30	702.8	100			
	35	703.4	100			
	40	702.0	100			
	45	704.6	100			
	50	703.5	100			
	55	705.4	100			
	60	705.8	100			
	65	705.5	100			
	70	705.5	100			
	75	704.8	100			
	80	707.1	100			
	85	706.8	100			
	90	707.1	100			
	95	707.0	100			
	100	707.0	100			
	105	707.0	100			
	110	707.0	100			
	115	707.0	100			
	120	706.3	100			
	125	706.0	100			
	130	705.6	100			
	135	705.6	100			
	140	706.0	100			
	145	705.6	100			
	150	705.6	100			
	155	706.1	100			
	160	705.9	100			
	165	705.6	100			
	170	706.0	100			
	175	705.4	100			
	180	706.0	100			

185	706.0	100
190	705.8	100
195	705.8	100
200	705.6	100
205	706.3	100
210	705.6	100
215	705.6	100
220	705.8	100
225	705.8	100
230	705.8	100
235	705.8	100
240	705.9	100
245	705.9	100
250	705.9	100
255	705.8	100
260	705.9	100
265	705.9	100
270	705.9	100
275	705.8	100
280	706.2	100
285	705.4	100
290	706.2	100
295	705.4	100
300	706.4	100
305	705.5	100
310	706.4	100
315	705.6	100
320	705.5	100
325	706.4	100
330	705.6	100
335	706.3	100
340	705.2	100
345	706.1	100
350	706.4	100
355	705.9	100
360	705.9	100

COMPUTER INPUT DATA SHEET #1

Client: Lennox Hearth Products

Address: 1502 14th Street NW
Auburn, WA 98001

Phone: 253-735-1100 Fax: 253-931-1271

Run No.: 1 Date of Test: 9 - 1 -2012 Burn Rate: .866 2.45

Model No.: ES2100

☒ min ☐ min-1.25 ☐ fan

☐ 1.25-1.9 ☐ max ☐ insert

Stove Type: ☐ Cat ☒ Non Cat ☐ Pellet

Dry Gas Meter Y Factor: .935
(0.000) (Data Sheet #2)

Post Leak Rate: 0.000 cfm
(.000) (Data Sheet #2)

Time: 360 min.
(000) (Data Sheet #2)

Dry Gas Meter Volume: 91.770 cf
(00.000) (Data Sheet #2)

Stack Flow: 5.778 dscfm
(00.000) (Data Sheet #2)

Δ H: .121 in. H_2O
(.000) (Data Sheet #2)

Maximum Vac.: 6.0
(0.0) (Data Sheet #2)

Barometric Pressure: 30.18 in. Hg
(00.00) (Data Sheet #2)

H_2O Captured: 126.8 g
(00.0) (Data Sheet #3)

Front Half Catch % Of Total: 39.5 %
(00.0) (Data Sheet #6)

Total Particulate Catch: .4831 g
(0.0000) (Data Sheet #6)

Flue Gas Moisture: 6.6001 %
(00.000) (Data Sheet #7)

Particulate Emission: .0883 gr/dscf
(0.0000) (Data Sheet #7)

Relative Humidity: 44.0 % RH
(00.0) (Data Sheet #8)

Ambient Moisture: 1.5 % H_2O
(0.00) (Data Sheet #8)

Preburn Fuel Wt.: 36.1 lbs.
(00.0) (Data Sheet #8)

Coal Bed Wt.: 3.3 lbs.
(00.0) (Data sheet #8)

Test Fuel Wt.: 13.8 lbs.
(00.0) (Data sheet #8)

Heat Output (EPA Default): 10442.4 BTU/hr
(00,000.0) (Data Sheet #8)

Kindling Fuel % Moisture (wet): 10.018 %
(00.000) (Data Sheet #10)

Pretest Fuel % Moisture (wet): 16.084 %
(00.000) (Data Sheet #10)

Test Fuel % Moisture (dry): 20.520 %
(00.000) (Data Sheet #10 [wood stove] or #11 [pellet stove])

Test Fuel % Moisture (wet): 17.026 %

Fuel Higher Heating Value (dry): ______ BTU/lb.
(0000) (Data Sheet #11)

Stack Static Pressure: -.037 in. H_2O
(+/- .000) (Data Sheet #12)

Average Ambient Temperature: 75 °F
(00) (Data Sheet #14)

Stove Temperature Change: -117.0 °F
(+/- 000.0) (Data Sheet #14)

Test Start 1045

End 1645

meter temp 54.1

METER BOX DATA SHEET PAGE # 2

UNIT : ES2100 RUN : 1 DATE : 9-1-2012

Meter Box: SH Y Factor: .935

Leak checks: 15 " Hg @ .000 cfm ______ " Hg @ ______ cfm

15 " Hg @ .000 cfm ______ " Hg @ ______ cfm

Inject SO^2 @ 100 cc/min. Nozzle: Probe @ 3/8 " od Initial Volume: 1.500

ROTO: PRESS:	.18		SAMPLING RATIO: 23	: 1			BP: 30.18		
MIN	TIME	METER READING	SAMPLE MDCF	STACK DSCFM	DELTA H	METER TEMP	SO2 PPM	ROTO TEMP	PUMP VACC
240	1445	428.008	428.008	4.489	.06	82	775	82	2.0
245	50	428.999	428.999	4.489	.06	82	775	82	2.0
250	55	429.990	429.990	4.348	.06	82	800	82	2.0
255	1500	430.950	430.950	4.217	.06	82	825	82	2.0
260	05	431.881	431.881	4.217	.06	82	825	82	2.0
265	10	432.812	432.812	4.217	.06	82	825	82	2.0
270	15	433.743	433.743	4.217	.06	82	825	82	2.0
275	20	434.674	434.674	4.093	.05	82	850	82	2.0
280	25	435.578	435.578	4.093	.05	82	850	82	2.0
285	30	436.481	436.481	4.093	.05	82	850	82	2.0
290	35	437.385	437.385	4.093	.05	82	850	82	2.0
295	40	438.288	438.288	3.865	.05	82	900	82	2.0
ROTO PRESS:	.18		TOTALS:	50.431	.670	984	BP.: 30.18		
300	1545	439.142	439.142	3.865	.05	82	900	82	2.0
305	50	439.995	439.995	3.761	.04	82	925	82	2.0
310	55	440.826	440.826	3.761	.04	82	925	82	2.0
315	1600	441.656	441.656	3.865	.05	82	900	82	2.0
320	05	442.509	442.509	3.761	.04	82	925	82	2.0
325	10	443.340	443.340	3.761	.04	82	925	82	2.0
330	15	444.170	444.170	3.662	.04	82	950	82	2.0
335	20	444.979	444.979	3.568	.04	82	975	82	2.0
340	25	445.766	445.766	3.568	.04	82	975	82	2.0
345	30	446.554	446.554	3.865	.05	82	900	82	2.0
350	35	447.408	447.408	4.217	.06	82	825	82	2.0
355	40	448.339	448.339	4.217	.06	82	825	82	2.0
			TOTALS:	45.871	.550	984	MAX VACC =		
TOTAL Cu Ft.			TOTALS:	96.302	1.22	1968	AVG. BP:		

METER BOX DATA SHEET PAGE # 2

UNIT: ES2100 RUN: 1 DATE: 9-1-2012

Meter Box: SH Y Factor: .935

Leak checks: 15 " Hg @ 100 cfm ______ " Hg @ ______ cfm

15 " Hg @ 100 cfm ______ " Hg @ ______ cfm

Nozzle : Probe @ 3/8 " od Initial Volume: 1.500

Inject SO^2 @ 100 cc/min.

ROTO: PRESS:	118		SAMPLING RATIO: 23 : 1				BP: 30.18		
MIN	TIME	METER READING	SAMPLE MDCF	STACK DSCFM	DELTA H	METER TEMP	SO2 PPM	ROTO TEMP	PUMP VACC
120	1245	399.549	399.549	6.957	.15	82	500	82	2.0
125	50	401.085	401.085	6.626	.14	82	525	82	2.0
130	55	402.547	402.547	6.626	.14	82	525	82	2.0
135	1300	404.009	404.009	6.626	.14	82	525	82	2.0
140	05	405.472	405.472	6.050	.11	82	575	82	2.0
145	10	406.807	406.807	6.050	.11	82	575	82	2.0
150	15	408.142	408.142	6.050	.11	82	575	82	2.0
155	20	409.478	409.478	5.798	.10	82	600	82	2.0
160	25	410.758	410.758	5.352	.09	82	650	82	2.0
165	30	411.939	411.939	5.154	.08	82	675	82	2.0
170	35	413.077	413.077	5.154	.08	82	675	82	2.0
175	40	414.214	414.214	5.154	.08	82	675	82	2.0
			TOTALS:	71.597	1.33	984	BP.: 30.18		
ROTO PRESS:	118								
180	1345	415.352	415.352	5.154	.08	82	675	82	2.0
185	50	416.490	416.490	4.970	.08	82	700	82	2.0
190	55	417.587	417.587	4.970	.08	82	700	82	2.0
195	1400	418.684	418.684	4.798	.07	82	725	82	2.0
200	05	419.743	419.743	4.798	.07	82	725	82	2.0
205	10	420.803	420.803	4.798	.07	82	725	82	2.0
210	15	421.862	421.862	4.798	.07	82	725	82	2.0
215	20	422.921	422.921	4.638	.07	82	750	82	2.0
220	25	423.945	423.945	4.638	.07	82	750	82	2.0
225	30	424.969	424.969	4.638	.07	82	750	82	2.0
230	35	425.993	425.993	4.638	.07	82	750	82	2.0
235	40	427.017	427.017	4.489	.06	82	775	82	2.0
			TOTALS:	57.327	.860	984	MAX VACC =		
TOTAL Cu Ft.			TOTALS:	128.924	2.19	1968	AVG. BP:		

METER BOX DATA SHEET PAGE # 2

UNIT: ES2100 RUN: 1 DATE: 9-1-2012

Meter Box: 5H Y Factor: .935

Leak checks: 15 " Hg @ .000 cfm ______ " Hg @ ____ cfm

15 " Hg @ .000 cfm ______ " Hg @ ____ cfm

Inject SO² @ 100 cc/min. Nozzle: Probe @ 3/8 " od Initial Volume: 1.500

ROTO: PRESS: .18			SAMPLING RATIO: 23 : 1				BP: 30.18		
MIN	TIME	METER READING	SAMPLE MDCF	STACK DSCFM	DELTA H	METER TEMP	SO2 PPM	ROTO TEMP	PUMP VACC
0	1045	357.500	———	7.009	.15	77	500	77	2.0
5	50	359.000	———	19.989	1.25	78	175	78	6.0
10	55	363.315	363.315	6.996	.15	78	500	78	2.0
15	1100	364.834	364.834	6.663	.14	78	525	78	2.0
20	05	366.280	366.280	6.663	.14	78	525	78	2.0
25	10	367.726	367.726	6.084	.12	78	575	78	2.0
* 30	15	369.046	369.046	7.364	.17	78	475	78	2.0
35	20	370.645	370.645	8.231	.21	78	425	78	2.0
40	25	372.430	372.430	6.651	.14	79	525	79	2.0
45	30	373.882	373.882	8.729	.24	79	400	79	2.0
50	35	375.786	375.786	8.713	.24	80	400	80	2.0
55	40	377.697	377.697	8.713	.24	80	400	80	2.0
ROTO PRESS: .18			TOTALS:	101.805	3.19	941	BP.: 30.18		
60	1145	379.609	379.609	8.200	.21	80	425	80	2.0
65	50	381.408	381.408	8.200	.21	80	425	80	2.0
70	55	383.207	383.207	7.745	.19	80	450	80	2.0
75	1200	384.906	384.906	7.745	.19	81	450	81	2.0
80	05	386.612	386.612	6.957	.15	81	500	81	2.0
85	10	388.147	388.147	7.130	.19	81	450	81	2.0
90	15	389.853	389.853	7.324	.17	81	475	81	2.0
95	20	391.469	391.469	7.324	.17	81	475	81	2.0
100	25	393.085	393.085	7.324	.17	81	475	81	2.0
105	30	394.701	394.701	7.324	.17	81	475	81	2.0
110	35	396.317	396.317	7.324	.17	81	475	81	2.0
115	40	397.933	397.933	7.324	.17	81	475	81	2.0
			TOTALS:	90.521	2.16	969	MAX VACC =		
TOTAL Cu Ft.			TOTALS:	192.326	5.35	1910	AVG. BP:		

METER BOX DATA SHEET PAGE # 2

UNIT : ES2100 RUN : 1 DATE : 9-1-2012

Meter Box: 5H Y Factor: .935

Leak checks: 15 " Hg @ .1000 cfm ______ " Hg @ ______ cfm

15 " Hg @ .1000 cfm ______ " Hg @ ______ cfm

Inject SO² @ 100 cc/min. Nozzle:Probe @ 3/8 " od Initial Volume: 1.500

ROTO: PRESS: .18 SAMPLING RATIO: 23 : 1 BP: 30.18

MIN	TIME	METER READING	SAMPLE MDCF	STACK DSCFM	DELTA H	METER TEMP	SO2 PPM	ROTO TEMP	PUMP VACC
360	1645	449.270	449.270	4.217	.06	82	825	82	20
365									
370									
375									
380									
385									
390									
395									
400									
405									
410									
415									
ROTO PRESS:			TOTALS:				BP.:		
420									
425									
430									
435									
440									
445									
450									
455									
460									
465				421.769	8.82	5928			
470									
475							81.		
			TOTALS:			÷46D	MAX VACC =		6.0
TOTAL Cu Ft.		91.770	TOTALS:	5.778	.121	541	AVG. BP:		30.18

÷23

PARTICULATE CATCH / MOISTURE DATA SHEET # 3

UNIT : ESZ100 RUN : 1 DATE : 9-1-12

SCALE	WEIGHT
295.0 g	295.0
590.0 g	590.0
885.0 g	885.0

SCALE CHECK	LEVEL	ZEROED
INITIAL :	✓	✓
FINAL :	✓	✓

IMPINGER	# 1	# 2	# 3	# 4
FINAL WT	702.3	566.2	486.7	875.0
INITIAL WT	602.7	558.2	484.1	858.4
NET WT GRAMS	99.6	8.0	2.6	16.6

TOTAL CATCH : 126.8 GRAMS H_20

FRONT HALF

FILTER #	52F	
FINAL WT g	.7250	
INITIAL WT g	.6313	
NET WT g	.0937	

BEAKER #	6
DESC.	ACETONE
FINAL WT g	91.3005
INITIAL WT g	91.2026
NET WT g	.0979
VOL. DESC. ml	75

BACK HALF

FILTER #	52B	
FINAL WT g	.3414	
INITIAL WT g	.2830	
NET WT g	.0584	

BEAKER #	7	8	9	10	
DESC.	ACETONE	METHCHLOR	H_2O	H_2O	
FINAL WT g	97.2465	108.6460	108.1630	105.7632	
INITIAL WT g	97.1322	108.6309	108.0901	105.7235	
NET WT g	.1143	.0151	.0729	.0397	.1126
VOL. DESC ml	100	75	175	110	285

FILTER TARE WEIGHTS DATA SHEET #4-1

Into Dessicator : Date : 1-6-12 Time : 1000 By : CJ

Manufacturer S & S Grade : # 25 Glass Front Size : 11 cm Lot No. : 393580

Back Size: 8.2 cm Lot No. : 4642541

FILTER #	DATE: 1-13-12 FIRST WEIGHT	BY: CJ TIME	DATE: 1-14-12 SECOND WEIGHT	BY: CJ TIME	DATE: THIRD WEIGHT	BY: TIME
51F	.6325	1055	.6330	1320	✓	
52F	.6313	1056	.6313	1321	✓ R-1	
53F	.6317	1057	.6318	1322	✓	
54F	.6294	1058	.6290	1323	✓	
55F	.6330	1059	.6329	1324	✓	
56F	.6285	1100	.6287	1325	✓	
57F	.6261	1101	.6258	1326	✓	
58F	.6327	1102	.6326	1327	✓	
59F	.6298	1103	.6297	1328	✓	
60F	.6303	1104	.6300	1329	✓	

51B	.2812	1105	.2810	1330	✓	
52B	.2829	1106	.2830	1331	✓ R-1	
53B	.2825	1107	.2825	1332	✓	
54B	.2811	1108	.2811	1333	✓	
55B	.2804	1109	.2803	1334	✓	
56B	.2837	1110	.2839	1335	✓	
57B	.2831	1111	.2829	1336	✓	
58B	.2831	1112	.2829	1337	✓	
59B	.2836	1113	.2838	1338	✓	
60B	.2833	1114	.2834	1339	✓	

Checked by: Armando Verdy Date: 01-16-2012 Time: 0950

BALANCE ROOM ENVIRONMENTAL CONDITIONS

DATE	TIME	BY	WB	DB	% RH
1-13-12	1036	Cj		72	46
1-14-12	1312	Cj		70	48

BEAKER TARE WEIGHTS DATA SHEET #4-2

Into Dessicator: Date : 10-1-11 Time : 1100 By : Cg

BEAKER #	FIRST WEIGHT (DATE: 10-5-11)	TIME (BY: Cg)	SECOND WEIGHT (DATE: 10-6-11)	TIME (BY: Cg)	THIRD WEIGHT (DATE:)	TIME (BY:)
1	104.9129	1315	104.9133	1005	✓	
2	106.2505	1316	106.2506	1006	✓	
3	107.7718	1317	107.7719	1007	✓	
4	108.7694	1318	108.7690	1008	✓	
5	97.4307	1319	97.4304	1009	✓	
6	91.2030	1320	91.2026	1010	✓	
7	97.1326	1321	97.1322	1011	✓	
8	108.6309	1322	108.6309	1012	✓ R-1	
9	108.0904	1323	108.0901	1013	✓	
10	105.7240	1324	105.7235	1014	✓	
11	104.7777	1325	104.7775	1015	✓	
12	98.2142	1326	98.2137	1016	✓	
13	104.1677	1327	104.1675	1017	✓	
14	97.9658	1328	97.9655	1018	✓	
15	104.7508	1329	104.7511	1019	✓	
16	95.7284	1330	95.7289	1020	✓	
17	104.5845	1331	104.5845	1021	✓	
18	108.8518	1332	108.8519	1022	✓	
19	106.5332	1333	106.5331	1023	✓	
20	108.5821	1334	108.5818	1024	✓	
21	108.2201	1335	108.2205	1025	✓	
22	105.9186	1336	105.9189	1026	✓	
23	104.5747	1337	104.5748	1027	✓	
24	106.3950	1338	106.3951	1028	✓	
25	99.6593	1339	99.6595	1029		

BALANCE ROOM ENVIRONMENTAL CONDITIONS

DATE	TIME	BY	WB	DB	% RH
10-5-11	1310	CW	-	71	49
10-6-11	1000	CW	-	78	40
		CW	-		

Checked by : A.V.

Date : Oct - 6 - 2011

Time : 11:10

WOODSTOVE DATA SHEET # 4-3 : CONSTANT WEIGHTS

UNIT : ES2100 RUN : 1 DATE : 9-1-12 Page : 1 of 1

Beaker #	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By
6	9-2	1000	CP	91.3000	9-3	1037	CP	91.3005	9-4	1006	CP				
7	9-2	1000	CP	97.2461	9-3	1038	CP	97.2465	9-4	1007	CP				
8	9-2	1000	CP	108.6455	9-3	1039	CP	108.6460	9-4	1008	CP				
9	9-2	1000	CP	108.1629	9-3	1040	CP	108.1630	9-4	1009	CP				
10	9-2	1000	CP	105.7633	9-3	1041	CP	105.7632	9-4	1010	CP				

Filter #	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By
52F	9-1	1715	CP	.7245	9-2	0947	CP	.7250	9-3	1035	CP				
52B	9-1	1715	CP	.3437	9-2	0948	CP	.3418	9-3	1036	CP	.3414	9-4	1005	CP

SCALE ROOM ENVIRONMENTAL CONDITIONS

Weighing Session	Date	Time	By	DB	%RH
1	9-2-12	0945	CP	77	46
2	9-3-12	1030	CP	71	49
3	9-4-12	1000	CP	77	49
4					
5					

Weighing Session	Date	Time	By	DB	%RH
6					
7					
8					
9					
10					

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates: From 1-14-2012 Through	Scale: Sartorius	Model: A 120 S	SN: 37010004

100 g weight	10 g weight	1 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	% RH
100.0000	10.0000	1.0000	.0999	Cf	1-14-12	1300	70	48
100.0002	10.0001	1.0001	.1000	Cf	1-15-12	1330	68	47
99.9997	10.0000	1.0001	.1000	Cf	1-17-12	1030	73	47
99.9997	10.0001	1.0000	.1000	Cf	1-18-12	0915	74	44
99.9999	10.0002	1.0001	.1001	Cf	1-19-12	1015	70	44
100.0001	10.0001	1.0001	.0998	Cf	1-25-12	1600	72	46
99.9999	9.9998	1.0001	.1000	Cf	1-26-12	1500	70	48
99.9995	9.9999	1.0000	.0999	Cf	1-28-12	1400	70	41
100.0000	10.0000	1.0000	.0999	Cf	2-4-12	1500	73	60
100.0000	10.0003	.9999	.0999	Cf	2-6-12	1200	69	44
100.0000	10.0000	.9999	.0998	Cf	2-7-12	1030	67	42
100.0000	9.9999	1.0001	.0999	Cf	2-10-12	1630	78	49
100.0000	10.0001	1.0000	.1000	Cf	2-11-12	1630	72	46
99.9997	10.0002	1.0000	.1001	Cf	2-12-12	1530	73	47
100.0000	10.0000	.9999	.0999	Cf	2-13-12	1100	78	46
99.9995	10.0000	.9999	.0999	Cf	2-14-12	1000	76	45
100.0000	9.9999	.9999	.1000	Cf	2-15-12	1120	70	44
99.9999	10.0000	1.0000	.0999	Cf	2-17-12	1415	73	47
99.9999	10.0000	1.0000	.0998	Cf	2-19-12	1600	70	44
99.9997	9.9999	1.0000	.0999	Cf	2-20-12	1200	70	48
100.0004	10.0001	1.0000	.1000	Cf	2-23-12	1000	73	47
100.0000	9.9997	1.0000	.0999	Cf	2-24-12	1015	78	46
100.0000	10.0000	1.0000	.1001	Cf	2-25-12	1715	65	48
100.0000	9.9996	1.0000	.0999	Cf	2-27-12	1000	70	44
100.0000	10.0000	1.0001	.1002	Cf	2-28-12	1125	75	41
99.9997	10.0000	1.0000	.1000	Cf	2-29-12	1110	68	43
99.9995	9.9999	.9999	.0997	Cf	3-1-12	1330	68	47
99.9996	10.0000	1.0000	.0998	Cf	3-2-12	1430	71	45
99.9995	9.9999	1.0000	.0999	Cf	3-3-12	1430	72	42
99.9999	10.0000	.9999	.0999	Cf	9-2-12	0945	77	46
100.0000	10.0000	1.0000	.1000	Cf	9-3-12	1030	71	49
100.0002	9.9999	1.0000	.0998	Cf	9-4-12	1000	77	49
100.0000	10.0000	1.0000	.0999	Cf	9-5-12	0945	78	46
100.0000	10.0002	1.0000	.0999	Cf	9-6-12	1130	76	49
99.9997	10.0001	1.0002	.0999	Cf	9-7-12	1400	76	49
100.0000	10.0001	1.0000	.0999	Cf	9-8-12	1200	71	49

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates: From 4-13-2011 Through 1-13-2012	Scale: Sartorius	Model: A 120 S	SN: 37010004

100 g weight	10 g weight	1 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	% RH
100.0000	10.0001	1.0000	.0998	Cp	4-13-11	1030	66	49
100.0001	10.0002	1.0000	.0999	Cp	4-15-11	1330	75	48
100.0004	10.0000	.9999	.0998	Cp	4-19-11	1600	74	44
100.0003	10.0000	1.0000	.0999	Cp	4-20-11	1815	72	46
100.0000	10.0001	.9999	.1000	Cp	6-16-11	0900	76	39
99.9997	9.9999	.9998	.0999	Cp	6-19-11	1530	74	44
99.9996	10.0002	1.0000	.0999	Cp	6-20-11	1600	73	47
100.0000	10.0000	.9998	.0999	Cp	6-21-11	1400	73	47
100.0000	10.0000	1.0001	.0999	Cp	6-22-11	1200	72	46
99.9999	9.9998	1.0000	.1000	Cp	6-23-11	1700	76	49
100.0000	10.0002	1.0000	.0999	Cp	6-24-11	1400	75	48
100.0000	10.0000	1.0000	.0999	Cp	6-27-11	1230	78	46
100.0001	10.0002	.9999	.0998	Cp	6-30-11	1030	78	46
99.9995	10.0000	.9999	.0999	Cp	7-1-11	1030	70	48
99.9999	9.9999	1.0000	.1000	Cp	7-2-11	1145	75	45
100.0000	9.9999	.9999	.0999	Cp	7-5-11	1000	73	47
99.9999	10.0001	1.0000	.0999	Cp	7-6-11	0930	76	49
100.0000	9.9997	1.0000	.0997	Cp	9-22-11	1700	77	46
100.0000	10.0001	1.0000	.0999	Cp	9-24-11	1700	77	49
100.0000	9.9998	1.0001	.1000	Cp	9-25-11	1300	76	49
100.0000	9.9999	1.0001	.0998	Cp	9-27-11	1000	77	49
99.9996	9.9999	1.0000	.0998	Cp	9-29-11	0840	72	42
99.9997	9.9998	.9999	.1000	Cp	9-30-11	1000	70	48
99.9996	9.9998	1.0000	.0999	Cp	10-1-11	1520	70	45
99.9998	10.0002	1.0000	.0997	Cp	10-2-11	1430	74	47
99.9995	10.0001	1.0000	.0999	Cp	10-5-11	1510	71	49
100.0000	9.9999	1.0000	.0998	Cp	10-6-11	1000	78	40
100.0000	9.9999	1.0000	.0999	Cp	10-9-11	1130	75	45
100.0000	10.0001	1.0000	.0998	Cp	10-16-11	1540	68	47
100.0000	10.0000	1.0000	.0998	Cp	11-9-11	1230	72	46
100.0000	10.0002	.9998	.0998	Cp	11-11-11	0815	70	45
99.9999	10.0000	1.0000	.0996	Cp	11-15-11	1200	75	45
99.9995	10.0001	.9999	.0999	Cp	11-16-11	1400	70	44
99.9999	10.0001	.9999	.0998	Cp	11-20-11	1600	73	43
99.9998	9.9999	.9999	.0999	Cp	11-21-11	1715	74	47
100.0000	10.0000	1.0000	.0999	Cp	11-22-11	1600	65	48
100.0000	10.0000	1.0000	.0999	CN	1-9-12	1030	70	48
100.0000	9.9999	1.0001	.1000	Cp	1-11-12	0720	65	48
100.0000	10.0001	1.0000	.0997	Cp	1-13-12	1030	72	46

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates: From 11-11-10 Through 4-7-11	Scale: Sartorius	Model: A 120 S	SN: 37010004

100 g weight	10 g weight	1 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	% RH
100.0000	10.0002	1.0000	.0998	CP	11-11	0840	67	42
100.0000	10.0000	1.0001	.1000	CP	11-15	0930	70	48
100.0000	10.0001	1.0000	.0999	CP	11-19	0930	65	48
100.0000	10.0000	1.0000	.1000	CP	11-23	1400	66	45
100.0000	9.9997	1.0000	.0998	CP	11-24	1400	65	48
100.0000	10.0000	.9999	.0998	CP	11-26	1100	67	46
100.0000	10.0001	1.0001	.0997	CP	12-14	1000	75	41
100.0001	10.0003	1.0000	.0999	CP	12-16	1100	75	48
100.0000	10.0002	1.0000	.0999	CP	12-18	1000	77	46
100.0000	10.0000	1.0000	.0999	CP	12-21	1100	66	49
100.0000	10.0004	1.0000	.0997	CP	12-22	1400	72	48
100.0000	10.0001	1.0000	.1001	CP	12-23	1100	76	38
100.0000	10.0000	.9999	.0999	CP	12-24	1000	67	46
100.0000	10.0001	1.0001	.0999	CP	12-25	1100	70	49
100.0000	10.0000	1.0000	.0999	CP	1-19-11	0930	66	49
100.0000	9.9999	1.0000	.0999	CP	1-21-11	1400	77	49
99.9996	10.0000	1.0000	.0998	CP	1-25-11	0900	75	48
100.0000	10.0002	1.0001	.1000	CP	1-26-11	1400	74	44
100.0000	10.0001	.9998	.0998	CP	1-27-11	1200	65	48
100.0000	10.0002	1.0000	.0999	CP	1-28-11	1630	70	48
100.0000	10.0001	1.0001	.0999	CP	1-29-11	1200	68	48
100.0000	10.0002	1.0000	.0999	CP	1-30-11	1500	66	49
100.0000	9.9999	1.0000	.0999	CP	2-15-11	0930	75	41
100.0000	10.0000	1.0001	.1000	CP	2-16-11	0930	66	49
100.0000	10.0002	1.0000	.0999	CP	2-22-11	1000	70	48
100.0000	10.0001	1.0002	.0999	CP	3-4-11	1200	69	47
100.0000	10.0004	.9999	.1000	CP	3-5-11	1000	70	48
100.0000	10.0001	1.0000	.0999	CP	3-8-11	1000	74	47
100.0000	10.0000	1.0000	.1000	CP	3-9-11	1600	67	46
100.0000	10.0002	0.9999	.0999	CP	3-10-11	1600	66	49
100.0000	10.0000	1.0000	.0999	CP	3-12-11	1530	73	47
100.0000	10.0001	.9999	.0998	CP	3-13-11	1200	65	48
100.0000	10.0001	1.0000	.0999	CP	3-29-11	1120	76	49
100.0000	10.0000	.9999	.0998	CP	3-30-11	0800	74	47
100.0000	10.0001	1.0000	.0999	CP	3-31-11	1080	70	48
100.0000	10.0002	.9998	.0999	CP	4-4-11	0830	74	47
100.0000	10.0003	1.0000	.1000	CP	4-5-11	1130	73	47
100.0000	9.9999	1.0001	.0999	CP	4-6-11	1030	77	49
100.0000	10.0000	9.9999	.1001	CP	4-7-11	1000	78	40

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates: From 2-26-2010 Through 11-10-2010	Scale: Sartorius	Model: A 120 S	SN: 37010004

100 g weight	10 g weight	1 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	% RH
100.0001	10.0004	.9999	.0999	Cp	2-26-10	0840	72	46
100.0001	9.9999	.9999	.0999	Cp	2-27-10	1045	72	46
100.0000	10.0000	1.0000	.0999	Cp	2-28	1100	70	48
100.0000	10.0000	1.0000	.0999	Cp	3-1	0900	66	49
100.0000	10.0002	.9998	.1002	Cp	3-5	1200	70	48
100.0001	9.9999	.9999	.0998	Cp	3-7	1330	68	47
100.0000	9.9999	.9999	.0999	Cp	3-9	1130	70	41
100.0000	10.0001	1.0000	.0999	Cp	3-10	1200	70	44
100.0000	10.0001	.9999	.0999	Cp	3-11	0900	66	49
99.9999	9.9999	.9999	.0999	[illegible]	3-15	1000	70	48
100.0000	10.0000	1.0000	.0998	Cp	3-17	0900	72	46
100.0000	9.9998	1.0001	.1000	Cp	4-8	1930	76	49
99.9999	10.0001	1.0000	.0999	Cp	4-10	1630	73	47
99.9999	10.0001	1.0001	.1000	Cp	4-11	1430	74	47
100.0000	10.0002	1.0000	.1000	Cp	4-21	1830	77	49
100.0000	10.0000	1.0000	.0999	Cp	4-22	1130	74	47
100.0000	10.0001	1.0000	.0999	Cp	4-23	1015	74	44
100.0002	9.9999	1.0000	.1000	Cp	4-24	0930	68	47
100.0000	9.9999	.9999	.1000	Cp	4-25	0930	73	47
100.0000	9.9999	1.0001	.0999	Cp	4-26	0900	76	42
100.0000	10.0002	1.0000	.0999	Cp	4-30	1320	78	43
99.9998	10.0000	1.0002	.0999	Cp	8-26	0845	78	49
100.0000	9.9998	1.0001	.0999	Cp	8-27	0950	78	43
100.0000	10.0000	1.0000	.1000	Cp	8-28	1600	73	47
99.9998	10.0000	.9999	.1000	Cp	8-29	1400	70	48
100.0000	10.0000	1.0000	.0999	Cp	8-31	0720	72	46
100.0001	10.0000	1.0000	.1000	Cp	9-1	1330	76	49
100.0000	10.0001	1.0000	.0999	Cp	9-2	1300	68	47
100.0000	10.0000	1.0000	.1000	Cp	9-3	1130	72	46
100.0000	10.0001	1.0000	.0999	Cp	10-26	0750	70	48
100.0000	10.0000	.9998	.0997	Cp	10-27	1250	74	47
100.0000	9.9999	1.0000	.0999	Cp	10-29	1400	71	49
100.0000	9.9999	1.0000	.0999	Cp	11-1	1000	78	49
100.0000	10.0000	.9999	.0999	Cp	11-2	0715	70	48
100.0000	10.0000	1.0000	.0999	Cp	11-3	0900	70	48
100.0000	10.0001	.9999	.1000	Cp	11-5	1320	76	42
100.0000	10.0001	.9999	.1000	Cp	11-8	1230	70	48
100.0000	10.0001	1.0000	.0998	Cp	11-9	1015	71	41
100.0000	10.0000	.9999	.0995	Cp	11-10	0900	70	44

BLANK PROCESSING DATA SHEET # 5

UNIT : ES2100 RUN : 1 DATE : 9-1-12

BLANKS DONE : 8-31-2010

BEAKER	A	B	C
	200 ml ACETONE	75 ml DICHLOR	200 ml WATER
	FISHER OPTIMA LOT # 023283	FISHER OPTIMA LOT # 066390	DWNA, Inc Sparkletts Distilled
FINAL WEIGHT	108.9019	106.3074	106.9680
TARE WEIGHT	108.9001	106.3058	106.9640
NET WEIGHT	.0018	.0016	.0040

TARE BEAKERS INTO DESC : TIME : 1410 DATE : 8-7-2010

DATE 8-26 BY : CJ DATE 8-27 BY : CJ DATE : ____ BY : ____

BEAKER	1 ST WT	TIME	2 ND WT	TIME	3 RD WT	TIME
A	108.8999	0935	108.9001	1050		
B	106.3061	0936	106.3058	1051		
C	106.9641	0937	106.9640	1052		

FINAL BEAKERS INTO DESC : TIME : 8-28 DATE : 0820

DATE 8-29 BY : CJ DATE 8-31 BY : CJ DATE : ____ BY : ____

BEAKER	1 ST WT	TIME	2 ND WT	TIME	3 RD WT	TIME
A	108.9019	1501	108.9019	0742		
B	106.3076	1502	106.3074	0743		
C	106.9676	1503	106.9680	0744		

TARE QC

DATE	TIME	BY	WB	DB	%
8-26-10	0845	CJ	S	78	49
8-27-10	0955	CJ		78	43

FINAL QC

DATE	TIME	BY	WB	DB	%
8-29	1400	CJ	S	70	48
8-31	0720	CJ		72	46

NET PARTICULATE CATCH CALCULATION DATA SHEET #6

UNIT: ES2100 RUN: 1 DATE: 9-1-12

BLANK CALCULATIONS

Acetone :	.0018 g ÷ 200 ml =	.000009	g/ml
Dicholoromethane :	.0016 g ÷ 75 ml =	.000021	g/ml
Distilled Water :	.0040 g ÷ 200 ml =	.000020	g/ml

FRONT HALF CATCH

FILTERS: .0937 g (Total Catch) - 1 (# of Filters) (.0000 g) (Blank Value / Filter) = .0937 g

BEAKERS: .0979 g (Total Catch) - 75 (ml Acetone) (.000009 g) (Blank Value / ml Acetone) = .0972 g

.0007

TOTAL FRONT HALF CATCH : .1909 g

BACK HALF CATCH

FILTERS: .0584 g (Total Catch) - 1 (# of Filters) (.0000 g) (Blank Value / Filter) = .0584 g

BEAKERS:

Acetone: .1143 g (Total Catch) - 100 (ml Acetone) (.000009 g) (Blank Value / ml Acetone) = .1134 g

.0009

Extract: .0151 g (Total Catch) - 75 (ml Dichloromethane) (.000021 g) (Blank Value / Dichloromethane) = .0135 g

.0016

Water: .1126 g (Total Catch) - 285 (ml Water) (.000020 g) (Blank Value / Water) = .1069 g

.0057

TOTAL BACK HALF CATCH : .2922 g

TOTAL CATCH : .4831 g

% FRONT HALF : 39.5 %

CALCULATIONS DATA SHEET # 7

UNIT : ES2100 RUN : 1 DATE : 9- 1 -2012

1) Vm (std) = $\dfrac{(91.770\ \text{Vm})(17.64)(.935\ \text{mcf})\left(30.18\ \text{" Hg} + \dfrac{.121\ \text{" H}_2\text{O}}{13.6}\right)}{(541\ \text{TmA})} = \dfrac{84.4619}{000.0000}$ dscf

2) Vw (std) = (.04707) (126.8 ml H_2O) = $\dfrac{5.9685}{00.0000}$ scf

3) Asw = $\dfrac{(5.9685\ \text{scf})}{(5.9685\ \text{scf} + 84.4619\ \text{dscf})} = \dfrac{.0660}{.0000}$ Bws × 100 = $\dfrac{6.6001}{00.0000}$ % H_2O

4) Cs = $\dfrac{(.4831\ \text{g.})}{(84.4619\ \text{dscf})}(15.43) = \dfrac{.0883}{0.0000}$ gr / dscf

5) Estimated g / hr = $\dfrac{(.4831\ \text{g.})}{(84.4619\ \text{dscf})}\left(\dfrac{5.778}{00.0000}\ \text{dscfm}\right)(60) = \dfrac{1.9829}{00.0000}$ g / hr

Vm =	total cubic feet pulled on meter box during test	(p. 2)	(000.000 Vm)
mcf =	meter correction factor (Y factor) of meter box used for test	(p. 2)	(0.000 mcf)
" Hg =	average barometric pressure during test	(p. 2)	(00.00 " Hg)
" H_2O =	average delta H for test	(p. 2)	(.000 " H_2O)
TmA =	average meter temperature for test in degrees Absolute	(p. 2)	(000 TmA)
ml H_2O =	total water caught during test	(p. 3)	(000.0 ml H_2O)
g. =	total particulate catch for test	(p. 6)	(00.0000 g.)
dscfm =	average stack flow during test	(p. 2)	(00.000 dscf)

TEST DATA SHEET # 8

UNIT : ES 2100 RUN : 1 DATE : 9-1-2012

Test Chamber Air Velocity Start : Ø Stop : Ø Avg.: Ø

Wet Bulb / Dry Bulb

Pre : WB : 60 DB : 74 = 44.0 % RH 1.3 % H_2O

Post : WB : 66 DB : 78 = 44.0 % RH 1.7 % H_2O

Average : 44.0 % RH 1.5 % H_2O

Empty Stove Weight (lbs) : — w/ stack & oil seal : Wet : — Dry : 0.0

Kindling Weight (lbs) : Paper : .1 Wood : 2.3

Preburn Fuel Weight : 20.3 + 13.5 Total : 33.8

Kindling & Preburn Fuel Weight (wood only) (lbs) : Total : 36.1

Coal Bed Wt Range (lbs) : 3.4 - 2.8 **Scale** : 3.4 - 2.8

Upper : .25 × fuel weight : Always round DOWN to nearest tenth

Lower : .20 × fuel weight : Always round UP to nearest tenth

Actual Coal Bed Weight : 3.3

Maximum Coal Bed Removal (lbs) : ((3.4 (Upper) + 2.8 (Lower)) ÷ 2) .25 = .7 (round down to nearest tenth)

Test Fuel (.75" × 1.5" × 5" spacers) = 16 pcs

Dimensions	Length in inches	No. Pcs	Weight in lbs	% of Load
2" × 4"	16	3	5.3	38.4
4" × 4"	16	2	8.5	61.6

Test Fuel Weight : 13.8 lbs

Estimated Dry Burn Rate :

$$\frac{13.8 - (13.8 \times .17026)}{2.2046} \times \frac{60}{360 \text{ (TIME)}} = .866 \text{ kg / hr}$$

Estimated BTU's/hr : $19{,}140 \times \frac{63}{100} \times \frac{.866}{\text{DBR}} = 10442.4$ BTU's/hr

EPA Default Efficiencies : Non-cat : 63 Cat : 72 Pellet : 78

315

WOOD STOVE OPERATING DATA PAGE #9

Unit : ES 2100 Run : 1 Date : 9-1-2012

FIRE STARTED: 0715

WARM UP AND PREBURN:

PRIMARY AIR : Set wide open for all warm-up / preburn fuel charges. Then set to .75" at start of preburn.

SECONDARY AIR : N/A CAT BYPASS : N/A

CHARCOAL BED PREPARATION :

Raked and leveled prior to each warm-up / preburn charge. At 1 1/2 min. prior to loading last fuel, raked and leveled. In stove 25 sec.

TEST:

DOOR wide open during loading 6 min. 50 sec.

PRIMARY AIR : Opened full for first 5 min., then set to run setting of .75".

SECONDARY AIR : N/A CAT BYPASS : N/A

FAN:

ON / OFF during warm-up

ON / OFF first 30 minutes of test

Fan speed set at LOW

ON / OFF during preburn

ON / OFF balance of test run

WOOD DATA: KINDLING: A mix of the grades listed below:

	SIZE	MILL	GRADE	SPECIES
PREBURN:	2x4	Manke/Tacoma	Std. or better	s. grn D fir
TEST:	2x4	Packwood	# 2 or better	s. grn D fir
	4x4	Packwood	# 2 or better	s. grn D fir

PELLET FUEL MANUFACTURER : N/A BRAND : N/A

All Grades WCLB rules:

WARM UP INFORMATION:

All pre-burn / warm up fuel pieces were either 16 or 16 inches.

1st warm up / pre-burn fuel charge (20.3 lbs.) added at 0717

2nd warm up / pre-burn fuel charge (13.5 lbs.) added at 0901

3rd warm up / pre-burn fuel charge (____ lbs.) added at ____

4th warm up / pre-burn fuel charge (____ lbs.) added at ____

5th warm up / pre-burn fuel charge (____ lbs.) added at ____

TEST DATA SHEET #10

Unit : ES2100 Run : 1 Date : 9-1-2012

Room Temperature : 71 °F Temperature Correction Set? Yes No

Calibration Check: 12.0% + or – 0.2%? Yes No

Time Test Fuel moisture reading taken : 0900

pc #	Dimen.	Use	TOP	BOTTOM	SIDE	Avg Corrected
1	2"×4"×8'	K	10.3	11.7	11.4	11.133
2						
3						
4	2"×4"×8'	P	18.5	19.0	18.7	18.7
5	2"×4"×8'	P	18.8	18.8	18.9	18.8
6	2"×4"×8'	P	20.6	19.4	19.9	20.0
7	2"×4"×8'	P				57.5
8	2"×4"×8'	P				
9						
10						
11						
12	2×4×16"	T	18.1	17.9	18.0	18.0
13	"	T	20.5	19.6	20.9	20.3
14	"	T	23.4	23.1	23.1	23.2
15	4×4×16"	T	19.7	19.6	19.6	19.6
16	"	T	21.4	21.6	21.6	21.5
17						102.6
18						
19						
20	Spacers	T	18.6	19.1	19.0	

Key for Use : K = Kindling P = Pretest Fuel T = Test Fuel

	KINDLING	PRETEST FUEL	TEST FUEL
Dry Moisture % :	11.133 %	19.167 %	20.520 %
Wet Moisture % :	10.018 %	16.084 %	17.026 %

To obtain Wet from Dry : $\frac{100 \times \text{\% Dry Reading}}{100 + \text{\%Dry Reading}}$ = % Moisture, Wet Basis

Acceptable Ranges : 16 - 20 % wet: 19 - 25 % dry (17.5 - 22.5 on Meter Uncor. reading) at 70°

GAS DATA SHEET #12

WEIGHT: 3.3

DATE: 9-1-2012

UNIT: ES2100 RUN: 1 PAGE: 1 OF 3

TIME	SCALE	FUEL	DROP	V.	CO_2	V.	O_2	V.	CO	STATIC	SO_2PPM
0 / 1045	17.1	13.8	—	.194	4.8	.595	14.9	.109	1.09	-.040	.500
5 / 50	16.4	13.1	.7	.339	8.4	.487	12.2	.018	.18	-.050	.175
10 / 55	16.2	12.9	.2	.095	2.3	.718	18.0	.041	.41	-.045	.500
15 / 1100	16.0	12.7	.2	.106	2.6	.706	17.7	.047	.47	-.041	.525
20 / 05	15.8	12.5	.2	.124	3.1	.683	17.1	.056	.56	-.040	.525
25 / 10	15.5	12.2	.3	.134	3.3	.671	16.8	.063	.63	-.039	.575
30 / 15	14.8	11.5	.7	.429	10.7	.384	9.6	.042	.42	-.051	.475
35 / 20	14.0	10.7	.8	.456	11.4	.360	9.0	.035	.31	-.054	.425
40 / 25	13.3	10.0	.7	.437	10.9	.376	9.4	.042	.42	-.055	.425
45 / 30	12.6	9.3	.7	.412	10.3	.408	10.2	.022	.22	-.054	.400
50 / 35	12.0	8.7	.6	.408	10.2	.412	10.3	.026	.26	-.054	.400
55 / 40	11.4	8.1	.6	.400	10.0	.420	10.5	.025	.25	-.054	.400
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-.577	*****
60 / 45	10.7	7.4	.7	.420	10.5	.412	10.3	.027	.27	-.055	.425
65 / 50	10.0	6.7	.7	.433	10.8	.432	9.6	.033	.33	-.055	425
70 / 55	9.5	6.2	.5	.430	10.7	.428	9.7	.035	.35	-.055	450
1200	9.0	5.7	.5	.403	10.0	.420	10.5	.019	.21	-.055	450
05	8.3	5.0	.7	.400	10.0	.412	10.3	.040	.42	-.053	500
85 / 10	7.9	4.6	.4	.390	9.7	.428	10.7	.031	.33	-.051	450
90 / 15	7.5	4.2	.4	.350	8.7	.467	11.7	.032	.34	-.050	475
5 / 20	7.1	3.8	.4	.325	8.1	.495	12.4	.027	.29	-.050	475
100 / 25	6.7	3.4	.4	.320	8.0	.495	12.4	.029	.31	-.048	475
05 / 30	6.4	3.1	.3	.323	8.0	.495	12.4	.026	.28	-.048	475
110 / 35	6.2	2.9	.2	.330	8.2	.491	12.3	.023	.25	-.048	475
115 / 40	5.9	2.6	.3	.305	7.6	.515	12.9	.026	.28	-.048	475
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	.616	*****
120 / 45	5.8	2.5	.1	.259	6.4	.559	14.0	.033	.35	-.046	500
125 / 50	5.6	2.3	.2	.228	5.7	.587	14.7	.038	.40	-.043	525
0 / 55	5.5	2.2	.1	.224	5.6	.591	14.8	.038	.40	-.043	525
135 / 1300	5.4	2.1	.1	.217	5.4	.595	14.9	.044	.46	-.043	525
0 / 05	5.3	2.0	.1	.210	5.2	.599	15.0	.052	.54	-.041	575
145 / 10	5.2	1.9	.1	.210	5.2	.599	15.0	.052	.54	-.041	575
150 / 15	5.1	1.8	.1	.211	5.2	.599	15.0	.058	.60	-.039	575
5 / 20	5.1	1.8	.0	.210	5.2	.595	14.9	.063	.65	-.037	600
160 / 25	5.0	1.7	.1	.210	5.2	.591	14.8	.069	.71	-.036	650
1 / 30	4.9	1.6	.1	.175	4.3	.619	15.5	.095	.97	-.034	675
35	4.9	1.6	.0	.175	4.3	.619	15.5	.094	.96	-.034	675
175 / 40	4.8	1.5	.1	.173	4.3	.619	15.5	.096	.98	-.034	675
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	.471	*****
TOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	1.664	*****

GAS DATA SHEET #12

WEIGHT: 3.3

DATE: 9-1-2012

UNIT: ES 2100

RUN: 1

PAGE: 2 OF 3

TIME	SCALE	FUEL	DROP	V.	CO_2	V.	O_2	V.	CO	STATIC	SO_2PPM
180 / 45	4.7	1.4	.1	.172	4.3	.619	15.5	.97	.99	-.034	.675
185 / 50	4.7	1.4	.0	.171	4.2	.619	15.5	.101	1.03	-.034	.700
190 / 55	4.6	1.3	.1	.169	4.2	.619	15.5	.105	1.07	-.032	.700
195 / 1400	4.6	1.3	.0	.168	4.2	.619	15.5	.107	1.09	-.031	.725
200 / 05	4.5	1.2	.1	.168	4.2	.615	15.4	.113	1.15	-.030	.725
205 / 10	4.5	1.2	.0	.166	4.1	.619	15.5	.118	1.20	-.030	.725
210 / 15	4.4	1.1	.1	.159	3.9	.615	15.4	.142	1.44	-.030	.725
215 / 20	4.4	1.1	.0	.156	3.9	.611	15.3	.150	1.52	-.030	.750
220 / 25	4.3	1.0	.1	.151	3.7	.619	15.5	.151	1.53	-.030	.750
225 / 30	4.3	1.0	.0	.148	3.7	.619	15.5	.155	1.57	-.030	.750
230 / 35	4.2	.9	.1	.154	3.8	.619	15.5	.148	1.50	-.030	.750
235 / 40	4.2	.9	.0	.143	3.5	.627	15.7	.151	1.53	-.030	.750
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	.371	*****
240 / 45	4.1	.8	.1	.145	3.6	.627	15.7	.144	1.46	-.028	.775
245 / 50	4.1	.8	.0	.141	3.5	.635	15.9	.137	1.39	-.028	.775
250 / 55	4.0	.7	.1	.134	3.3	.635	15.9	.156	1.58	-.028	.800
255 / 1500	4.0	.7	.0	.123	3.0	.655	16.4	.131	1.33	-.028	.825
260 / 05	3.9	.6	.1	.128	3.2	.651	16.3	.119	1.21	-.028	.825
265 / 10	3.9	.6	.0	.122	3.0	.659	16.5	.123	1.25	-.028	.825
270 / 15	3.8	.5	.1	.123	3.0	.655	16.4	.135	1.37	-.028	.825
275 / 20	3.8	.5	.0	.117	2.9	.659	16.5	.137	1.39	-.028	.850
280 / 25	3.8	.5	.0	.125	3.1	.659	16.5	.115	1.17	-.028	.850
285 / 30	3.7	.4	.1	.111	2.7	.671	16.8	.124	1.26	-.028	.850
290 / 35	3.7	.4	.0	.103	2.5	.675	16.9	.129	1.31	-.028	.850
295 / 40	3.7	.4	.0	.101	2.5	.675	16.9	.131	1.33	-.028	.900
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	.336	*****
300 / 45	3.6	.3	.1	.100	2.5	.679	17.0	.128	1.30	-.026	.900
305 / 50	3.6	.3	.0	.098	2.4	.687	17.2	.113	1.15	-.026	.925
310 / 55	3.6	.3	.0	.092	2.3	.694	17.4	.102	1.05	-.026	.925
315 / 1600	3.6	.3	.0	.089	2.2	.702	17.6	.096	.98	-.026	.900
320 / 05	3.5	.2	.1	.085	2.1	.706	17.7	.090	.92	-.026	.925
325 / 10	3.5	.2	.0	.081	2.0	.714	17.9	.081	.83	-.026	.925
330 / 15	3.5	.2	.0	.075	1.8	.730	18.3	.067	.69	-.026	.950
335 / 20	3.5	.2	.0	.077	1.9	.722	18.1	.077	.79	-.026	.975
340 / 25	3.4	.1	.1	.085	2.1	.710	17.8	.087	.89	-.026	.975
345 / 30	3.4	.1	.0	.108	2.7	.698	17.5	.054	.56	-.026	.900
350 / 35	3.4	.1	.0	.112	2.8	.691	17.3	.064	.66	-.026	.825
355 / 40	3.4	.1	.0	.124	3.1	.679	17.0	.065	.67	-.026	.825
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	.312	*****
TOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	1019	*****

GAS DATA SHEET #12

WEIGHT: 3.3

DATE: 9-01-12

UNIT: ES 2100

RUN: 1

PAGE: 3 OF 3

TIME	SCALE	FUEL	DROP	V.	CO_2	V.	O_2	V.	CO	STATIC	SO_2PPM
360 45	3.3	.0	.1	.127	3.1	.679	17.0	.068	.70	.026	825
365 50											
370 55											
375 1700											
380											
385											
390											
395											
400											
405											
410											
415											
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	.26	*****
420											
425											
430											
435											
440											
445											
450											
455											
460											
465											
470											
475											
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****		*****
480											
485											
490											
495											
500											
505											
510											
515											
520											
525											
530											
535											
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****		*****
TOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	2.709	*****

737

5032

PREBURN DATA SHEET #13

UNIT: ES2100 RUN: 1 DATE: 9-1-2012 PAGE: 1 of

TIME	SCALE	DROP	STACK	TOP	LF SIDE	BACK	RT SIDE	BOTTOM	FIREBOX	SEC/CAT	AMBIENT	STATIC	COMMENTS
0 / 0945	4.4	—	514	570	425	225	408	384			71	-.058	PREBURN START: # 1.0 UP
5 / 50	4.3	.1	344	508	413	249	405	391			71	-.051	COAL BED SCALE RANGE:
10 / 55	4.2	.1	299	459	403	248	388	396			71	-.047	3.4 → 2.8
15 / 1000	4.1	.1	273	421	392	243	372	398			71	-.045	PRIMARY AIR: .75
20 / 05	4.0	.1	258	384	378	241	350	399			68	-.044	SECONDARY AIR: N/A
25 / 10	3.9	.1	249	361	367	240	342	399			69	-.043	FAN: Low
30 / 15	3.8	.1	239	337	357	238	335	398			69	-.042	PUMPS ON AT:
35 / 20	3.7	.1	230	317	345	235	329	396			68	-.042	CHECK WB/DB: N/A
40 / 25	3.6	.1	223	300	340	234	326	395			68	-.041	
45 / 30	3.5	.1	216	284	341	234	322	394			68	-.040	
50 / 35	3.5	.0	212	276	332	233	316	393			68	-.040	
55 / 40	3.4	.1	207	264	329	232	311	393			68	-.039	
*****	****	***	****	*****	*****	****	*****	*****	*****	*****	*****	****	
60 / 1045	3.3	.1	216	257	327	265	314	393			69	-.040	
65 / 50													
70													
75													
80													
85													
90													

311

Lennox- ES2100

Temperature Data Sheet 14

Run 1
9/1/12

Time	Stack	Top	LT Side	Back	Rt Side	Bottom	Firebox	Sec/Cat	Ambient	Tube Furn	Smpl Box	Smpl Out	C-Gas Box	C-Gas Out	SO2 Out
*********	Chn 103	Chn 104	Chn 105	Chn 106	Chn 107	Chn 108	Chn 109	Chn 110	Chn 111	Chn 112	Chn 113	Chn 114	Chn 115	Chn 116	Chn 117
0	216	257	327	265	314	393	######	######	69	1466	237	51	242	39	35
5	343	256	325	361	314	392	######	######	71	1441	236	44	240	39	35
10	231	266	294	361	276	392	######	######	70	1422	236	41	241	40	35
15	207	257	277	350	260	389	######	######	70	1407	236	42	241	40	36
20	199	249	261	335	246	384	######	######	70	1394	235	43	243	40	36
25	195	241	249	323	235	378	######	######	71	1383	235	43	245	40	36
30	264	249	233	316	220	371	######	######	70	1372	235	44	241	40	37
35	315	296	236	252	217	364	######	######	70	1360	236	44	238	39	37
40	330	344	240	245	220	357	######	######	71	1352	237	43	237	39	37
45	331	369	252	244	223	350	######	######	71	1346	238	43	236	39	37
50	333	388	261	247	229	344	######	######	71	1342	238	44	237	39	38
55	334	397	266	248	233	337	######	######	72	1341	239	44	236	39	38
60	339	406	271	251	239	332	######	######	72	1341	239	45	236	38	38
65	342	417	282	256	249	327	######	######	72	1339	239	45	236	38	38
70	339	425	285	261	252	322	######	######	73	1338	240	45	236	38	38
75	334	423	296	266	260	318	######	######	74	1337	240	46	237	38	38
80	323	423	299	271	268	314	######	######	74	1337	241	46	237	38	38
85	317	416	310	276	277	311	######	######	74	1337	241	47	237	38	39
90	299	411	325	285	291	308	######	######	74	1337	241	47	236	37	39
95	285	400	334	288	297	306	######	######	74	1337	242	46	236	37	39
100	277	389	342	291	299	305	######	######	74	1336	242	47	236	37	39
105	272	377	347	292	297	304	######	######	75	1336	242	47	235	37	39
110	271	367	347	293	302	303	######	######	75	1336	242	47	236	37	39
115	263	359	350	294	306	303	######	######	75	1338	242	48	236	37	39
120	251	347	351	295	306	303	######	######	74	1340	243	48	236	37	38
125	239	336	345	292	302	303	######	######	75	1342	243	48	235	36	38
130	232	321	346	290	301	303	######	######	75	1343	243	48	235	36	38
135	226	310	348	290	300	304	######	######	75	1344	243	48	236	36	38
140	219	299	347	269	297	305	######	######	76	1345	244	48	235	36	38
145	212	288	343	267	294	306	######	######	75	1345	244	49	235	36	38
150	207	278	336	264	290	307	######	######	75	1346	244	50	235	36	38
155	203	269	338	262	288	308	######	######	76	1345	244	50	234	35	37
160	195	264	362	262	283	309	######	######	76	1345	244	50	234	35	37
165	189	256	363	260	279	310	######	######	76	1346	244	52	234	35	37
170	185	249	360	261	275	311	######	######	76	1348	244	53	234	35	37

Temperature Data Sheet 14

175	182	242	352	256	272	311	######	######	76	1349	244	53	233	35	37
180	179	236	345	254	268	311	######	######	76	1349	244	53	232	35	37
185	176	230	338	250	265	311	######	######	76	1350	244	44	232	35	37
190	174	226	332	248	260	310	######	######	77	1350	245	39	232	35	37
195	172	221	327	246	260	309	######	######	77	1350	245	38	231	34	36
200	170	218	319	242	255	308	######	######	76	1351	244	38	230	34	36
205	169	212	318	241	253	306	######	######	76	1351	245	38	230	34	36
210	167	211	313	239	248	305	######	######	76	1351	244	39	230	34	36
215	166	208	309	237	246	304	######	######	77	1350	244	39	230	34	36
220	165	205	304	235	242	303	######	######	77	1349	244	39	230	34	36
225	164	203	300	235	238	302	######	######	76	1348	244	40	230	34	35
230	163	200	293	232	234	301	######	######	76	1347	244	40	229	34	35
235	161	198	290	230	233	300	######	######	76	1346	243	40	229	34	35
240	159	196	287	230	231	299	######	######	77	1346	244	40	228	33	35
245	157	193	283	229	228	297	######	######	76	1346	244	41	228	33	35
250	156	191	281	227	226	296	######	######	77	1346	244	41	229	33	35
255	154	188	277	224	222	295	######	######	77	1346	243	41	229	33	35
260	153	186	273	221	219	294	######	######	76	1345	244	42	229	33	34
265	151	184	272	221	215	293	######	######	77	1345	243	42	229	33	34
270	150	181	269	217	212	291	######	######	77	1344	243	42	230	33	34
275	149	179	266	216	210	290	######	######	77	1344	243	43	230	33	34
280	149	177	261	212	208	288	######	######	77	1343	243	43	230	33	34
285	148	176	260	210	205	287	######	######	77	1343	243	43	230	33	34
290	146	174	256	207	201	286	######	######	77	1342	242	43	233	33	34
295	145	172	253	205	199	284	######	######	77	1341	242	43	234	32	34
300	142	170	250	202	198	282	######	######	77	1341	242	44	235	32	33
305	141	167	247	199	195	281	######	######	77	1341	242	44	237	32	33
310	139	165	244	196	191	280	######	######	77	1340	243	44	238	32	33
315	138	163	240	194	189	278	######	######	77	1339	242	44	237	32	33
320	136	160	237	194	187	277	######	######	77	1338	241	44	237	32	33
325	134	158	234	191	183	275	######	######	78	1338	241	45	237	32	32
330	132	156	231	189	180	274	######	######	77	1338	241	45	237	31	32
335	130	153	227	187	178	273	######	######	77	1338	241	45	237	31	32
340	129	151	223	185	176	271	######	######	77	1338	241	46	237	31	32
345	129	149	218	182	174	270	######	######	77	1338	240	46	236	31	32
350	129	147	206	183	174	268	######	######	77	1338	237	46	234	31	33
355	130	147	200	184	175	267	######	######	76	1336	234	46	232	31	32

360	130	146	196	187	176	266	######	######	76	1335	232	46	231	31	32

TEMPERATURE DATA SHEET #14A

		TEST TIME	360		
STACK AVG	207	TOP AVG	255	LT SIDE AVG	290
BACK AVG	248	RT SIDE AVG	243	BOTTOM AVG	310
FIREBOX AVG	########	SEC/CAT AVG	########	AMBIENT AVG	75

END	194.4	
START	311.4	
	-117.0	DELTA T

CIRCLE: LOSS / GAIN

ZERO / SPAN CHECK DATA SHEET #15-1

Date : 9 - 1 -2012 Analyte : CO_2 (15-1)

Unit : ES2100 Run # : 1

Zero Cyl. # : 168TAC 3-A Conc. : 0.00 % CO_2 Cyl. Press. : 400 PSI

Certified by : AIR LIQUIDE Date : 04-19-04

Span Cyl. # : 487905 Conc. : 12.20 % CO_2 Cyl. Press. : 1300 PSI

Certified by : AIR LIQUIDE Date : 11-1-07

Analyzer : Make : HORIBA Model : PIR-2000 SN : 407069

Range : 0 - 25.0 % CO_2 Analyzer Output : 0 - 1.0 v.

Flow : 1.5 SCFH Measured by : Rotameter

EPA Span Value = 25.0 % CO_2

EPA Control Limits = ± 2.5% of 25.0 % CO_2 = ± 0.625 % CO_2

Method 28 A = ± .2 % of 25.0 % CO_2 = ± .05 % CO_2

PRE RUN Audit : by : C Washington Time : 0940 Temp : 70 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	.018	.018	.072
SPAN	48.8	.488	12.20	48.8	.488	12.21	.010	.039

POST RUN Audit : by : C Washington Time : 1710 Temp : 76 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.2	.002	.068	.068	.272
SPAN	48.8	.488	12.20	48.6	.486	12.160	-.040	-.161

± Conc. Difference = Act % - Exp (Std) %

Zero % Difference = $\frac{\text{Act \% (ppm) - Exp \% (ppm)}}{\text{Full Scale Value}}$ X 100

Span % Difference = $\frac{\text{Act \% (ppm) - Exp \% (ppm)}}{\text{Full Scale Value}}$ X100

ZERO / SPAN CHECK DATA SHEET #15-2

Date : 9-1-2012 Analyte : O_2 (15-2)

Unit : ES2100 Run # : 1

Zero Cyl. # : 168TAC 3A Conc. : 0.00 % O_2 Cyl. Press. : 400 PSI

Certified by : AIR LIQUIDE Date : 04-19-04

Span Cyl. # : 487905 Conc. : 12.60 % O_2 Cyl. Press. : 1300 PSI

Certified by : AIR LIQUIDE Date : 11-1-07

Analyzer : Make : TELEDYNE Model : 320 A SN : 37400

Range : 0 - 25.0 % O_2 Analyzer Output : 0 - 1.0 v.

Flow : 1.5 SCFH Measured by : Rotameter

EPA Span Value = 25.0 % O_2

EPA Control Limits = ± 2.5% of 25.0 % O_2 = ± 0.625 % O_2

Method 28 A = ± .2 % of 25.0 % O_2 = ± .05 % O_2

PRE RUN Audit : by : C. Watkins Jr. Time : 0940 Temp : 70 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	-.035	-.035	-.142
SPAN	12.60	.504	12.6	12.6	.504	12.617	.017	.070

POST RUN Audit : by : C. Watkins Jr. Time : 1710 Temp : 76 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.1	.002	.015	.015	.059
SPAN	12.60	.504	12.6	12.6	.503	12.592	-.008	-.031

± Conc. Difference = Act % - Exp (Std) %

Zero % Difference = $\frac{\text{Act \% (ppm) - Exp \% (ppm)}}{\text{Full Scale Value}}$ X 100

Span % Difference = $\frac{\text{Act \% (ppm) - Exp \% (ppm)}}{\text{Full Scale Value}}$ X100

ZERO / SPAN CHECK DATA SHEET #15-3

Date : 9-1-2012

Analyte : CO (15-3)

Unit : ES2100 Run # : 1

Zero Cyl. # : 168TAC 3-A Conc. : 0.00 % CO Cyl. Press. : 400 PSI

Certified by : AIR LIQUIDE Date : 04-19-04

Span Cyl. # : C487905 Conc. : 4.90 % CO Cyl. Press. : 1300 PSI

Certified by : AIR LIQUIDE Date : 11-1-07

Analyzer : Make : HORIBA Model : PIR-2000 SN : 408005

Range : 0 - 10.0 % CO Analyzer Output : 0 - 1.0 v.

Flow : 1.5 SCFH Measured by : Rotameter

EPA Span Value = 10.0 % CO

EPA Control Limits = ± 2.5% of 10.0 % CO = ± 0. 25 % CO

Method 28 A = ± .2 % of 10.0 % CO = ± .02 % CO

PRE RUN Audit : by : C. Watling Time : 0940 Temp : 70 ° F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	-.006	-.006	-.056
SPAN	49.0	.490	4.90	49.0	.490	4.911	.011	.110

POST RUN Audit : by : C. Watling Time : 1710 Temp : 76 ° F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	-.006	-.006	-.056
SPAN	49.0	.490	4.90	49.1	.491	4.921	.021	.210

± Conc. Difference = Act % - Exp (Std) %

$$\text{Zero \% Difference} = \frac{\text{Act \% (ppm)} - \text{Exp \% (ppm)}}{\text{Full Scale Value}} \times 100$$

$$\text{Span \% Difference} = \frac{\text{Act \% (ppm)} - \text{Exp \% (ppm)}}{\text{Full Scale Value}} \times 100$$

ZERO / SPAN CHECK DATA SHEET #15-4

Date : 9-1-2012 Analyte : SO_2 (15-4)

Unit : ES2100 Run # : 1

Zero Cyl. # : 168TAC 3-A Conc. : 0.00 ppm SO_2 Cyl. Press. : 400 PSI

Certified by : AIR LIQUIDE Date : 04-19-04

Span Cyl. # : CC82089 Conc. : 1250 ppm SO_2 Cyl. Press. : 1690 PSI

Certified by : AIR LIQUIDE Date : 01-31-2007

Analyzer : Make : HORIBA Model : PIR-2000 SN : 403019

Range : 0 - 2500 ppm SO_2 Analyzer Output : 0 - 1.0 v.

Flow : 1.5 SCFH Measured by : Rotameter

EPA Span Value = 2500 ppm SO_2

EPA Control Limits = ± 2.5% of 2500 ppm SO_2 = ± 62.5 ppm SO_2

PRE RUN Audit : by : C. Watkins Time : 0940 Temp : 70 ° F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	PPM	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	-1.954	-1.954	-.078
SPAN	50.0	.500	1250	50.0	.500	1252.95	2.950	.118

POST RUN Audit : by : C. Watkins Time : 1710 Temp : 76 ° F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	PPM	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	-.003	-9.483	-9.483	-.379
SPAN	50.0	.500	1250	50.1	.501	1255.5	5.462	.218

± Conc. Difference = Act % - Exp (Std) %

$$\text{Zero \% Difference} = \frac{\text{Act \% (ppm)} - \text{Exp \% (ppm)}}{\text{Full Scale Value}} \times 100$$

$$\text{Span \% Difference} = \frac{\text{Act \% (ppm)} - \text{Exp \% (ppm)}}{\text{Full Scale Value}} \times 100$$

QUALITY CHECKS DATA SHEET # 16

UNIT : ES2100 RUN : 1 DATE : 9-1-2012

Thermocouple Check:

T/C # 1	— °F	T/C # 13	70.1 °F
T/C # 2	— °F	T/C # 14	70.3 °F
T/C # 3	70.1 °F	T/C # 15	69.6 °F
T/C # 4	67.8 °F	T/C # 16	50.6 °F
T/C # 5	66.4 °F	T/C # 17	54.4 °F
T/C # 6	66.5 °F	T/C # 18	72.6 °F
T/C # 7	66.5 °F	T/C # 19	— °F
T/C # 8	65.9 °F	T/C # 20	— °F
T/C # 9	— °F	T/C # 21	— °F
T/C # 10	— °F	T/C # 22	— °F
T/C # 11	62.6 °F	T/C # 23	— °F
T/C # 12	69.9 °F	T/C # 24	— °F

Thermocouple Readout:

Pretest zero and span check and calibration		post test zero and span	% difference
ZERO 1.2 °F	Adj. to 0.0 °F	ZERO 0.2 °F	Difference .010 %
SPAN 1999.4 °F	Adj. to 2000.0 °F	SPAN 1999.7 °F	Difference .015 %

Thermocouple Readout Pretest Linearity Check:

0	= 0.0 °F	200	= 200.4 °F	400	= 400.2 °F
600	= 600.1 °F	800	= 800.0 °F	1000	= 999.9 °F
1200	= 1199.8 °F	1400	= 1399.6 °F	1600	= 1599.7 °F
1800	= 1799.9 °F	2000	= 2000.0 °F		

Sample Train Leak Check	Pre ✓	Post ✓
C-gas Train Leak Check	Pre ✓	Post ✓
SO_2 Train Leak Check	Pre ✓	Post ✓
Static Gauge Zero Check	Pre ✓	Post ✓

Scale Check Pre : 13.7 — 3.7 = 10.0

Post : 12.7 — 2.7 = 10.0

Stack Cleaned Prior to Test Run : YES X NO ______

MIN TO 1.25 DBR

TABLE 1 ---- RAW DATA

CLIENT : Lennox

TEST No. : 2

MODEL: ES2100

DATE: 02-Sep-12

TIME (MIN.)	METER READING (C F)	DELTA H (IN. H2O)	METER TEMP. (DEG. F)	PERCENT CO (%)	PERCENT CO2 (%)	SO2 COCENTR. PPM
0	449.500	0.150	74	0.90	4.60	550
5	451.000	0.500	74	0.08	12.30	300
10	453.750	0.180	76	0.45	2.80	500
15	455.414	0.180	76	0.52	3.10	500
20	457.079	0.180	76	0.47	4.40	500
25	458.744	0.240	77	0.34	9.50	425
30	460.698	0.280	77	0.21	8.50	400
35	462.774	0.310	78	0.15	8.20	375
40	464.996	0.310	78	0.14	8.40	375
45	467.218	0.270	79	0.25	7.90	400
50	469.310	0.270	79	0.36	7.20	400
55	471.401	0.210	80	0.72	5.80	450
60	473.268	0.160	80	1.13	3.90	525
65	474.868	0.170	80	1.32	3.90	500
70	476.549	0.170	80	0.96	4.10	500
75	478.229	0.210	80	0.64	6.20	450
80	480.096	0.240	80	0.27	11.20	425
85	482.072	0.240	80	0.38	10.00	425
90	484.048	0.240	81	0.39	8.70	425
95	486.031	0.240	81	0.27	9.70	425
100	488.015	0.240	81	0.19	10.20	425
105	489.998	0.240	81	0.13	10.40	425
110	491.982	0.240	81	0.16	10.00	425
115	493.965	0.240	81	0.18	10.20	425
120	495.949	0.240	81	0.16	8.20	425
125	497.932	0.210	81	0.16	7.00	450
130	499.806	0.170	81	0.42	5.40	550
135	501.339	0.170	81	0.26	6.50	500
140	503.026	0.170	81	0.29	6.30	500
145	504.712	0.170	81	0.46	5.70	500
150	506.399	0.170	81	0.34	5.60	500
155	508.085	0.160	81	0.37	5.70	525
160	509.692	0.140	81	0.51	5.30	550
165	511.225	0.130	81	0.48	5.40	575
170	512.692	0.130	81	0.50	5.40	575
175	514.159	0.140	81	0.52	5.40	550

TABLE 2---RAW DATA

CLIENT : Lennox

TEST No. 2

MODEL: ES2100

DATE: 02-Sep-12

****

METER CAL. FACTOR (Y) -------	0.935	Wt. WOOD BURNED(LB) -------	14.0	Lbs
BAROMETRIC PRESS.(Pb) -------	30.22 in Hg	WET,FUEL MOISTURE % -------	16.93	%
LEAK RATE POST (Lp) -------	0.000 cfm	Wt. PART. COLLECTED -------	0.6421	g
WATER VOL. (V1c) -------	140.9 Ml	METER VOLUME Vm -------	100.517	mcf
TEST TIME (MIN) -------	290 min	HC MOLE FRACTION -------	0.0132	

TABLE 3 ----FIELD DATA AVERAGES

CLIENT : Lennox

TEST No. 2

MODEL: ES2100

DATE: 02-Sep-12

****

AVG DELTA H	-------	0.19 in H_2O		AVG PRCNT CO	-------	0.64	%
AVG METER TEMP. Tm	-------	80 deg F		AVG PRCNT CO_2	-------	5.86	%
AVG PPM SO_2	-------	495	PPM	AVG BAL CO_2/CO	-------	9.18	%

TABLE 4 ---- CALCULATIONS

CLIENT : Lennox

TEST No. 2

MODEL: ES2100

DATE: 02-Sep-12

***

STD SAMPLE VOL. Vm(std d) ------	92.86	dscf	STACK GAS FLOW Qsd -------	502.926 & 8.38	dscf/Hr & dscf/min
VOL. WATER VAPOR Vw(s td) -----	6.632	scf	PARTICULATE CONCTRT. C s ------	0.0069	g/dscf
PRCNT MSTR Bws -------	6.67	%	PARTC.EMISS. RATE E -------	3.48	g/Hr
BURN RATE BR -------	1.09	Kg/Hr	MOLES OF GAS PER Lb WOOD Nt ----	0.54	Lb-mole/Lb
CO EMISSION RATE -------	107.48 & 98.51	g/Hr & g/Kgdry fuel	PART.EMISS. RATE ------	3.19	g/Kgdry fuel

TABLE 5 ---- PROPORTIONAL RATE VARIATION

CLIENT : Lennox

TEST No. : 2

MODEL: ES2100

DATE: 02-Sep-12

	TIME INTEVAL Ti	PPM * Vm	PROPRTN. RATE VAR. PR		PROPRTN RATE VAR. AVERAGE	
	5	770.8	99		100	
	10	770.0	99			
	15	774.5	100			
	20	774.9	100			
	25	774.2	100			
	30	771.7	99			
	35	771.0	99			
	40	773.0	100			
	45	772.3	99			
	50	774.8	100			
	55	773.7	100			
	60	776.3	100			
	65	776.1	100			
	70	776.6	100			
	75	776.1	100			
	80	776.3	100			
	85	776.0	100			
	90	775.3	100			
	95	777.4	100			
	100	777.7	100			
	105	777.4	100			
	110	777.7	100			
	115	777.4	100			
	120	777.7	100			
	125	777.4	100			
	130	777.8	100			
	135	777.6	100			
	140	777.9	100			
	145	777.4	100			
	150	777.9	100			
	155	777.4	100			
	160	778.0	100			
	165	777.5	100			
	170	777.8	100			
	175	777.8	100			
	180	777.5	100			

185	778.0	100
190	777.5	100
195	777.0	100
200	778.5	100
205	777.5	100
210	777.5	100
215	778.0	100
220	777.5	100
225	777.5	100
230	778.0	100
235	777.5	100
240	777.5	100
245	778.0	100
250	777.5	100
255	778.0	100
260	777.5	100
265	777.8	100
270	777.5	100
275	778.0	100
280	777.5	100
285	777.5	100
290	778.0	100

COMPUTER INPUT DATA SHEET #1

Client: Lennox Hearth Products

Address: 1502 14th Street NW
Auburn, WA 98001

Phone: 253-735-1100 Fax: 253-931-1271

Run No.: 2 Date of Test: 9 - 2 -2012 Burn Rate: 1.091 346

Model No.: ES2100

☐ min ☒ min-1.25 ☐ fan
☐ 1.25-1.9 ☐ max ☐ insert

Stove Type: ☐ Cat ☒ Non Cat ☐ Pellet

Dry Gas Meter Y Factor: .935 (0.000) (Data Sheet #2)
Post Leak Rate: 0.000 cfm (.000) (Data Sheet #2)
Time: 290 min. (000) (Data Sheet #2)

Dry Gas Meter Volume: 100.517 cf (00.000) (Data Sheet #2)

Stack Flow: 7.185 dscfm (00.000) (Data Sheet #2)
Δ H: .188 in. H_2O (.000) (Data Sheet #2)

Maximum Vac.: 4.0 (0.0) (Data Sheet #2)
Barometric Pressure: 30.22 in. Hg (00.00) (Data Sheet #2)

H_2O Captured: 140.9 g (00.0) (Data Sheet #3)

Front Half Catch % Of Total: 31.8 % (00.0) (Data Sheet #6)
Total Particulate Catch: .6421 g (0.0000) (Data Sheet #6)

Flue Gas Moisture: 6.651 % (00.000) (Data Sheet #7)

Particulate Emission: .1067 gr/dscf (0.0000) (Data Sheet #7)

Relative Humidity: 45.0 % RH (00.0) (Data Sheet #8)
Ambient Moisture: 1.35 % H_2O (0.00) (Data Sheet #8)

Preburn Fuel Wt.: 29.9 lbs. (00.0) (Data Sheet #8)
Coal Bed Wt.: 3.0 lbs. (00.0) (Data sheet #8)
Test Fuel Wt.: 14.0 lbs. (00.0) (Data sheet #8)

Heat Output (EPA Default): 13155.5 BTU/hr (00,000.0) (Data Sheet #8)

Kindling Fuel % Moisture (wet): 9.937 % (00.000) (Data Sheet #10)
Pretest Fuel % Moisture (wet): 15.777 % (00.000) (Data Sheet #10)

Test Fuel % Moisture (dry): 20.380 % (00.000) (Data Sheet #10 [wood stove] or #11 [pellet stove])
Test Fuel % Moisture (wet): 16.930 %

Fuel Higher Heating Value (dry): ______ BTU/lb. (0000) (Data Sheet #11)

Stack Static Pressure: -.044 in. H_2O (+/- .000) (Data Sheet #12)

Average Ambient Temperature: 71 °F (00) (Data Sheet #14)
Stove Temperature Change: -820 °F (+/- 000.0) (Data Sheet #14)

Test start 1010
End 1500

meter temp 540

METER BOX DATA SHEET PAGE # 2

Page: 1 of 3

UNIT : ES2100 RUN : 2 DATE : 9-2-2012

Meter Box: 5H Y Factor: .935

Leak checks: 15 " Hg @ .000 cfm ____ " Hg @ ____ cfm

15 " Hg @ 1.000 cfm ____ " Hg @ ____ cfm

Inject SO² @ 100 cc/min. Nozzle: Probe @ 3/8 " od Initial Volume: 1.500

ROTO: PRESS: .18			SAMPLING RATIO: 21.5 : 1				BP: 30.22		
MIN	TIME	METER READING	SAMPLE MDCF	STACK DSCFM	DELTA H	METER TEMP	SO2 PPM	ROTO TEMP	PUMP VACC
0	1010	449.500	—	6.416	.15	74	550	74	2.0
5	15	451.000	—	11.763	.50	74	300	74	4.0
10	20	453.750	453.750	7.032	.18	76	500	76	2.0
15	25	455.414	455.414	7.032	.18	76	500	76	2.0
20	30	457.079	457.079	7.032	.18	76	500	76	2.0
25	35	458.744	458.744	8.257	.24	77	425	77	2.0
30	40	460.698	460.698	8.773	.28	77	400	77	2.0
35	45	462.774	462.774	9.341	.31	78	375	78	3.0
40	50	464.996	464.996	9.341	.31	78	375	78	3.0
45	55	467.218	467.218	8.741	.27	79	400	79	3.0
50	1100	469.310	469.310	8.741	.27	79	400	79	3.0
55	05	471.401	471.401	7.755	.21	80	450	80	2.0
ROTO PRESS: .18			TOTALS:	100.224	3.08	924	BP.: 30.22		
60	1110	473.268	473.268	6.647	.16	80	525	80	2.0
65	15	474.868	474.868	6.979	.17	80	500	80	2.0
70	20	476.549	476549	6.979	.17	80	500	80	2.0
75	25	478.229	478.229	7.755	.21	80	450	80	2.0
80	30	480.096	480.096	8.211	.24	80	425	80	2.0
85	35	482.072	482.072	8.211	.24	80	425	80	2.0
90	40	484.048	484.048	8.211	.24	81	425	81	2.0
95	45	486.031	486.031	8.211	.24	81	425	81	2.0
100	50	488.015	488.015	8.211	.24	81	425	81	2.0
105	55	489.998	489.998	8.211	.24	81	425	81	2.0
110	1200	491.982	491.982	8.211	.24	81	425	81	2.0
115	05	493.965	493.965	8.211	.24	81	425	81	2.0
			TOTALS:	94.048	2.63	966	MAX VACC =		
TOTAL Cu Ft.			TOTALS:	194.272	5.71	1890	AVG. BP:		

METER BOX DATA SHEET PAGE # 2

UNIT : ES2100 RUN : 2 DATE : 9-2-2012

Meter Box: SH Y Factor: .935

Leak checks: 15 " Hg @ .000 cfm ______ " Hg @ ______ cfm

15 " Hg @ .000 cfm ______ " Hg @ ______ cfm

Initial Volume: 1.500

Inject SO² @ 100 cc/min. Nozzle : Probe @ 3/8 " od

ROTO: PRESS:	.18		SAMPLING RATIO: 21.5 : 1				BP: 30.22		
MIN	TIME	METER READING	SAMPLE MDCF	STACK DSCFM	DELTA H	METER TEMP	SO2 PPM	ROTO TEMP	PUMP VACC
120	1210	495.949	495.949	8.196	.24	81	425	81	2.0
125	15	497.932	497.932	7.741	.21	81	450	81	2.0
130	20	499.806	499.806	6.333	.14	81	550	81	2.0
135	25	501.339	501.339	6.967	.17	81	500	81	2.0
140	30	503.026	503.026	6.967	.17	81	500	81	2.0
145	35	504.712	504.712	6.967	.17	81	500	81	2.0
150	1240	506.399	506.399	6.967	.17	81	500	81	2.0
155	45	508.085	508.085	6.635	.16	81	525	81	2.0
160	50	509.692	509.692	6.333	.14	81	550	81	2.0
165	55	511.225	511.225	6.058	.13	81	575	81	2.0
170	1300	512.692	512.692	6.058	.13	81	575	81	2.0
175	05	514.159	514.159	6.333	.14	81	550	81	2.0
ROTO PRESS:	.18		TOTALS:	81.555	1.97	972	BP.: 30.22		
180	1310	515.692	515.692	6.333	.14	81	550	81	2.0
185	15	517.226	517.226	6.333	.14	81	550	81	2.0
190	20	518.759	518.759	6.333	.14	81	550	81	2.0
195	25	520.291	520.291	6.333	.14	81	550	81	2.0
200	30	521.826	521.826	6.635	.16	81	525	81	2.0
205	35	523.432	523.432	6.635	.16	81	525	81	2.0
210	40	525.038	525.038	6.635	.16	81	525	81	2.0
215	45	526.645	526.645	6.635	.16	81	525	81	2.0
220	50	528.251	528.251	6.635	.16	81	525	81	2.0
225	55	529.857	529.857	6.635	.16	81	525	81	2.0
230	1400	531.464	531.464	6.333	.14	81	550	81	2.0
235	05	532.997	532.997	6.333	.14	81	550	81	2.0
			TOTALS:	77.808	1.80	972	MAX VACC =		
TOTAL Cu Ft.			TOTALS:	159.363	3.77	1944	AVG. BP:		

METER BOX DATA SHEET PAGE # 2

Page: 3 of 3

UNIT : ES2100 RUN : 2 DATE : 9-2-2012

Meter Box: 5H Y Factor: .957

Leak checks: 15 " Hg @ .000 cfm ______ " Hg @ ______ cfm

15 " Hg @ .000 cfm ______ " Hg @ ______ cfm

Inject SO^2 @ 100 cc/min. Nozzle: Probe @ 3/8 " od Initial Volume: 1.500

ROTO: PRESS: .18			SAMPLING RATIO: 21.5 : 1				BP: 30.22		
MIN	TIME	METER READING	SAMPLE MDCF	STACK DSCFM	DELTA H	METER TEMP	SO2 PPM	ROTO TEMP	PUMP VACC
240	1410	534.530	534.530	6.333	.14	81	550	81	2.0
245	15	536.064	536.064	6.333	.14	81	550	81	2.0
250	20	537.597	537.597	6.333	.14	81	550	81	2.0
255	25	539.131	539.131	6.333	.14	81	550	81	2.0
260	30	540.664	540.664	6.058	.13	81	575	81	2.0
265	35	542.131	542.131	6.635	.16	81	525	81	2.0
270	40	543.737	543.737	6.635	.16	81	525	81	2.0
275	45	545.344	545.344	6.635	.16	81	525	81	2.0
280	50	546.950	546.950	6.333	.14	81	550	81	2.0
285	55	548.483	548.483	6.333	.14	81	550	81	2.0
290	1500	550.017	550.017	6.333	.14	81	550	81	2.0
295				70.294	1.59	891			
ROTO PRESS:			TOTALS:				BP.:		
300									
305									
310									
315									
320									
325									
330									
335									
340									
345									
350				423.929		4725			
355					11.070	80			
			TOTALS:				MAX VACC =		4.0
TOTAL Cu Ft.	100.517		TOTALS:	7.185	.188	540	AVG. BP:	30.22	

*

1.59

PARTICULATE CATCH / MOISTURE DATA SHEET # 3

UNIT : ES2100 RUN : 2 DATE : 9-2-12

SCALE CHECK	LEVEL	ZEROED
INITIAL :	✓	✓
FINAL :	✓	✓

SCALE	WEIGHT
295.0 g	295.0
590.0 g	590.0
885.0 g	885.0

IMPINGER	# 1	# 2	# 3	# 4
FINAL WT	713.2	581.1	487.1	895.0
INITIAL WT	603.5	572.8	484.5	874.7
NET WT GRAMS	109.7	8.3	2.6	20.3

TOTAL CATCH : 140.9 GRAMS H_20

FRONT HALF

FILTER #	53F	
FINAL WT g	.7428	
INITIAL WT g	.6318	
NET WT g	.1110	

BEAKER #	11
DESC.	ACETONE
FINAL WT g	104.8715
INITIAL WT g	104.7775
NET WT g	.0940
VOL. DESC. ml	85

BACK HALF

FILTER #	53B	
FINAL WT g	.3735	
INITIAL WT g	.2825	
NET WT g	.0910	

BEAKER #	12	13	14	15	
DESC.	ACETONE	METHCHLOR	H_2O	H_2O	
FINAL WT g	98.4276	104.1920	98.0220	104.8120	
INITIAL WT g	98.2137	104.1675	97.9655	104.7511	
NET WT g	.2139	.0245	.0565	.0609	.1174
VOL. DESC ml	125	75	150	160	310

FILTER TARE WEIGHTS DATA SHEET #4-1

Into Dessicator : Date : 1-6-12 Time : 1000 By : CD

Manufacturer S & S Grade : # 25 Glass Front Size : 11 cm Lot No. : 393580

Back Size: 8.2 cm Lot No. : 4642541

FILTER #	DATE: 1-13-12 FIRST WEIGHT	BY: CD TIME	DATE: 1-14-12 SECOND WEIGHT	BY: CD TIME	DATE: THIRD WEIGHT	BY: TIME
51F	.6325	1055	.6330	1320	✓	
52F	.6313	1056	.6313	1321	✓	
53F	.6317	1057	.6318	1322	← R-2	
54F	.6294	1058	.6290	1323	✓	
55F	.6330	1059	.6329	1324	✓	
56F	.6285	1100	.6287	1325	✓	
57F	.6261	1101	.6258	1326	✓	
58F	.6327	1102	.6326	1327	✓	
59F	.6298	1103	.6297	1328	✓	
60F	.6303	1104	.6300	1329	✓	

51B	.2812	1105	.2810	1330	✓	
52B	.2829	1106	.2830	1331	✓	
53B	.2825	1107	.2825	1332	✓ ← R-2	
54B	.2811	1108	.2811	1333	✓	
55B	.2804	1109	.2803	1334	✓	
56B	.2837	1110	.2839	1335	✓	
57B	.2831	1111	.2829	1336	✓	
58B	.2831	1112	.2829	1337	✓	
59B	.2836	1113	.2838	1338	✓	
60B	.2833	1114	.2834	1339	✓	

Checked by: Armando Verdy Date: 01-16-2012 Time: 0950

BALANCE ROOM ENVIRONMENTAL CONDITIONS

DATE	TIME	BY	WB	DB	% RH
1-13-12	1030	CJ		72	46
1-14-12	130	CJ		70	48

BEAKER TARE WEIGHTS DATA SHEET #4-2

Into Dessicator: Date : 10-1-11 Time : 1100 By : Cp

BEAKER #	FIRST WEIGHT (DATE: 10-5-11)	TIME (BY: Cp)	SECOND WEIGHT (DATE: 10-6-11)	TIME (BY: Cp)	THIRD WEIGHT (DATE:)	TIME (BY:)
1	104.9129	1315	104.9133	1005	✓	
2	106.2505	1316	106.2506	1006	✓	
3	107.7718	1317	107.7719	1007	✓	
4	108.7694	1318	108.7690	1008	✓	
5	97.4307	1319	97.4304	1009	✓	
6	91.2030	1320	91.2026	1010	✓	
7	97.1326	1321	97.1322	1011	✓	
8	108.6309	1322	108.6309	1012	✓	
9	108.0904	1323	108.0901	1013	✓	
10	105.7240	1324	105.7235	1014	✓	
11	104.7777	1325	104.7775	1015	✓	
12	98.2142	1326	98.2137	1016	✓	
13	104.1677	1327	104.1675	1017	✓ R-Z	
14	97.9658	1328	97.9655	1018	✓	
15	104.7508	1329	104.7511	1019		
16	95.7284	1330	95.7287	1020	✓	
17	104.5845	1331	104.5845	1021	✓	
18	108.8518	1332	108.8519	1022	✓	
19	106.5332	1333	106.5331	1023	✓	
20	108.5821	1334	108.5818	1024	✓	
21	108.2201	1335	108.2205	1025	✓	
22	105.9186	1336	105.9189	1026	✓	
23	104.5747	1337	104.5748	1027	✓	
24	106.3950	1338	106.3951	1028	✓	
25	99.6593	1339	99.6595	1029	✓	

BALANCE ROOM ENVIRONMENTAL CONDITIONS

DATE	TIME	BY	WB	DB	% RH
10-5-11	1310	CW	-	71	49
10-6-11	1000	CW	-	78	40
		CW	-		

Checked by : A.V.
Date : Oct - 6 - 2011
Time : 11:10

WOODSTOVE DATA SHEET # 4-3 : CONSTANT WEIGHTS

UNIT : E321a RUN : 2 DATE : 9-2-12

Beaker #	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By
11	9-3	1100	gp	104.8720	9-4	1013	gp	104.8715	9-5	0952	gp				
12	9-3	1100	gp	98.4281	9-4	1014	gp	98.4276	9-5	0953	gp				
13	9-3	1100	gp	104.1923	9-4	1015	gp	104.1920	9-5	0954	gp				
14	9-3	1100	gp	98.0223	9-4	1016	gp	98.0220	9-5	0956	gp				
15	9-3	1100	gp	104.8124	9-4	1017	gp	104.8120	9-5	0957	gp				

Filter #	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By
53F	9-2	1700	gp	.7522	9-3	1012	gp	.7472	9-4	1011	gp	.7431	9-5	0950	gp
				.7428	9-6	1135	gp								
53B	9-2	1700	gp	.3802	9-3	1013	gp	.3769	9-4	1012	gp	.3737	9-5	0951	gp
				.3735	9-6	1136	gp								

SCALE ROOM ENVIRONMENTAL CONDITIONS

Weighing Session	Date	Time	By	DB	%RH
1	9-3-12	1030	gp	71	45
2	9-4-12	1000	gp	77	49
3	9-5-12	0945	gp	78	46
4	9-6-12	1130	gp	76	49
5					

Weighing Session	Date	Time	By	DB	%RH
6					
7					
8					
9					
10					

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates: From 1-14-2012 Through	Scale: Sartorius	Model: A 120 S	SN: 37010004

100 g weight	10 g weight	1 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	% RH
100.0000	10.0000	1.0000	.0999	CJ	1-14-12	1300	70	48
100.0002	10.0001	1.0001	.1000	CJ	1-15-12	1330	68	47
99.9997	10.0000	1.0001	.1000	CJ	1-17-12	1030	73	47
99.9997	10.0001	1.0000	.1000	CJ	1-18-12	0915	74	44
99.9999	10.0002	1.0001	.1001	CJ	1-19-12	1015	70	44
100.0001	10.0001	1.0001	.0998	CJ	1-25-12	1600	72	46
99.9999	9.9998	1.0001	.1000	CJ	1-26-12	1500	70	48
99.9995	9.9999	1.0000	.0999	CJ	1-28-12	1400	70	41
100.0000	10.0000	1.0000	.0999	CJ	2-4-12	1500	73	60
100.0000	10.0003	.9999	.0999	CJ	2-6-12	1200	69	44
100.0000	10.0000	.9999	.0998	CJ	2-7-12	1030	67	42
100.0000	9.9999	1.0001	.0999	CJ	2-10-12	1630	78	49
100.0000	10.0001	1.0000	.1000	CJ	2-11-12	1630	72	46
99.9997	10.0002	1.0000	.1001	CJ	2-12-12	1530	73	47
100.0000	10.0000	.9999	.0999	CJ	2-13-12	1100	78	46
99.9995	10.0000	.9999	.0999	CJ	2-14-12	1000	76	45
100.0000	9.9999	.9999	.1000	CJ	2-15-12	1120	70	44
99.9999	10.0000	1.0000	.0999	CJ	2-17-12	1415	73	47
99.9999	10.0000	1.0000	.0998	CJ	2-19-12	1600	70	44
99.9997	9.9999	1.0000	.0999	CJ	2-20-12	1200	70	48
100.0004	10.0001	1.0000	.1000	CJ	2-23-12	1000	73	47
100.0000	9.9997	1.0000	.0999	CJ	2-24-12	1015	78	46
100.0000	10.0000	1.0000	.1001	CJ	2-25-12	1715	65	48
100.0000	9.9996	1.0000	.0999	CJ	2-27-12	1000	70	44
100.0000	10.0000	1.0001	.1002	CJ	2-28-12	1125	75	41
99.9997	10.0000	1.0000	.1000	CJ	2-29-12	1110	68	43
99.9995	9.9999	.9999	.0997	CJ	3-1-12	1330	68	47
99.9996	10.0000	1.0000	.0998	CJ	3-2-12	1430	71	45
99.9995	9.9999	1.0000	.0999	CJ	3-3-12	1430	72	42
99.9999	10.0000	.9999	.0999	CJ	9-2-12	0945	77	46
100.0000	10.0000	1.0000	.1000	CJ	9-3-12	1030	71	49
100.0002	9.9999	1.0000	.0998	CJ	9-4-12	1000	77	49
100.0000	10.0000	1.0000	.0999	CJ	9-5-12	0945	78	46
100.0000	10.0002	1.0000	.0999	CJ	9-6-12	1130	76	49
99.9997	10.0001	1.0002	.0999	CJ	9-7-12	1400	76	49
100.0000	10.0001	1.0000	.0999	CJ	9-8-12	1200	71	49

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates: From 4-13-2011 Through 1-13-2012	Scale: Sartorius	Model: A 120 S	SN: 37010004

100 g weight	10 g weight	1 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	% RH
100.0000	10.0001	1.0000	.0998	Cp	4-13-11	1030	66	49
100.0001	10.0002	1.0000	.0999	Cp	4-15-11	1330	75	48
100.0004	10.0000	.9999	.0998	Cp	4-19-11	1600	74	44
100.0003	10.0000	1.0000	.0999	Cp	4-20-11	1815	72	46
100.0000	10.0001	.9999	.1000	Cp	6-16-11	0900	76	39
99.9997	9.9999	.9998	.0999	Cp	6-19-11	1530	74	44
99.9996	10.0002	1.0000	.0999	Cp	6-20-11	1600	73	47
100.0000	10.0000	.9998	.0999	Cp	6-21-11	1400	73	47
100.0000	10.0000	1.0001	.0999	Cp	6-22-11	1200	72	46
99.9999	9.9998	1.0000	.1000	Cp	6-23-11	1700	76	49
100.0000	10.0002	1.0000	.0999	Cp	6-24-11	1400	75	48
100.0000	10.0000	1.0000	.0999	Cp	6-27-11	1230	78	46
100.0001	10.0002	.9999	.0998	Cp	6-30-11	1030	78	46
99.9995	10.0000	.9999	.0999	Cp	7-1-11	1030	70	48
99.9999	9.9999	1.0000	.1000	Cp	7-2-11	1145	75	45
100.0000	9.9999	.9999	.0999	Cp	7-5-11	1000	73	47
99.9999	10.0001	1.0000	.0999	Cp	7-6-11	0930	76	49
100.0000	9.9997	1.0000	.0997	Cp	9-22-11	1700	77	46
100.0000	10.0001	1.0000	.0999	Cp	9-24-11	1700	77	49
100.0000	9.9998	1.0001	.1000	Cp	9-25-11	1300	76	49
100.0000	9.9999	1.0001	.0998	Cp	9-27-11	1000	77	49
99.9996	9.9999	1.0000	.0998	Cp	9-29-11	0840	72	42
99.9997	9.9998	.9999	.1000	Cp	9-30-11	1000	70	48
99.9996	9.9998	1.0000	.0999	Cp	10-1-11	1520	70	45
99.9998	10.0002	1.0000	.0997	Cp	10-2-11	1430	74	47
99.9995	10.0001	1.0000	.0999	Cp	10-5-11	1510	71	49
100.0000	9.9999	1.0000	.0998	Cp	10-6-11	1000	78	40
100.0000	9.9999	1.0000	.0999	Cp	10-9-11	1130	75	49
100.0000	10.0001	1.0000	.0998	Cp	10-16-11	1540	68	47
100.0000	10.0000	1.0000	.0998	Cp	11-9-11	1230	72	46
100.0000	10.0002	.9998	.0998	Cp	11-11-11	0815	70	45
99.9999	10.0000	1.0000	.0996	Cp	11-15-11	1200	75	45
99.9995	10.0001	.9999	.0999	Cp	11-16-11	1400	70	44
99.9999	10.0001	.9999	.0998	Cp	11-20-11	1600	73	43
99.9998	9.9999	.9999	.0999	Cp	11-21-11	1715	74	47
100.0000	10.0000	1.0000	.0999	Cp	11-22-11	1600	65	48
100.0000	10.0000	1.0000	.0999	Cp	1-9-12	1030	76	45
100.0000	9.9999	1.0001	.1000	Cp	1-11-12	1720	65	48
100.0000	10.0001	1.0000	.0997	Cp	1-13-12	1030	72	46

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates: From 11-11-10 Through 4-7-11	Scale: Sartorius	Model: A 120 S	SN: 37010004

100 g weight	10 g weight	1 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	% RH
100.0000	10.0002	1.0000	.0998	gp	11-11	0840	67	42
100.0000	10.0000	1.0001	.1000	gp	11-15	0930	70	48
100.0000	10.0001	1.0000	.0999	gp	11-19	0930	65	48
100.0000	10.0000	1.0000	.1000	gp	11-23	1400	66	45
100.0000	9.9997	1.0000	.0998	gp	11-24	1400	65	48
100.0000	10.0000	.9999	.0998	gp	11-26	1100	67	46
100.0000	10.0001	1.0001	.0997	gp	12-14	1000	75	41
100.0001	10.0003	1.0000	.0999	gp	12-16	1100	75	48
100.0000	10.0002	1.0000	.0999	gp	12-18	1000	77	46
100.0000	10.0000	1.0000	.0999	gp	12-21	1100	66	49
100.0000	10.0004	1.0000	.0997	gp	12-22	1400	72	48
100.0000	10.0001	1.0000	.1001	gp	12-23	1100	76	38
100.0000	10.0000	.9999	.0999	gp	12-24	1000	67	46
100.0000	10.0001	1.0001	.0999	gp	12-25	1100	70	49
100.0000	10.0000	1.0000	.0999	gp	1-19-11	0930	66	49
100.0000	9.9999	1.0000	.0999	gp	1-21-11	1400	77	49
99.9996	10.0000	1.0000	.0998	gp	1-25-11	0900	75	48
100.0000	10.0002	1.0001	.1000	gp	1-26-11	1400	74	44
100.0000	10.0001	.9998	.0998	gp	1-27-11	1200	65	48
100.0000	10.0002	1.0000	.0999	gp	1-28-11	1630	70	48
100.0000	10.0001	1.0001	.0999	gp	1-29-11	1200	68	48
100.0000	10.0002	1.0000	.0999	gp	1-30-11	1500	66	49
100.0000	9.9999	1.0000	.0999	gp	2-15-11	0930	75	41
100.0000	10.0000	1.0001	.1000	gp	2-16-11	0930	66	49
100.0000	10.0002	1.0000	.0999	gp	2-22-11	1000	70	48
100.0000	10.0001	1.0002	.0999	gp	3-4-11	1200	69	47
100.0000	10.0004	.9999	.1000	gp	3-5-11	1000	70	48
100.0000	10.0001	1.0000	.0999	gp	3-8-11	1000	74	47
100.0000	10.0000	1.0000	.1000	gp	3-9-11	1600	67	46
100.0000	10.0002	0.9999	.0999	gp	3-10-11	1600	66	49
100.0000	10.0000	1.0000	.0999	gp	3-12-11	1530	73	47
100.0000	10.0001	.9999	.0998	gp	3-13-11	1200	65	48
100.0000	10.0001	1.0000	.0999	gp	3-29-11	1120	76	49
100.0000	10.0000	.9999	.0998	gp	3-30-11	0800	74	47
100.0000	10.0001	1.0000	.0999	gp	3-31-11	1000	70	48
100.0000	10.0002	.9998	.0999	gp	4-4-11	0830	74	47
100.0000	10.0003	1.0000	.1000	gp	4-5-11	1130	73	47
100.0000	9.9999	1.0001	.0999	gp	4-6-11	1030	77	49
100.0000	10.0000	9.9999	.1001	gp	4-7-11	1000	78	40

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates: From 2-26-2010 Through 11-10-2010	Scale: Sartorius	Model: A 120 S	SN: 37010004

100 g weight	10 g weight	1 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	% RH
100.0001	10.0004	.9999	.0999	CP	2-26-10	0840	72	46
100.0001	9.9999	.9999	.0999	CP	2-27-10	1045	72	46
100.0000	10.0000	1.0000	.0999	CP	2-28	1100	70	48
100.0000	10.0000	1.0000	.0999	CP	3-1	0900	66	49
100.0000	10.0002	.9998	.1002	CP	3-5	1200	70	48
100.0001	9.9999	.9999	.0998	CP	3-7	1330	68	47
100.0000	9.9999	.9999	.0999	CP	3-9	1130	70	41
100.0000	10.0001	1.0000	.0999	CP	3-10	1200	70	44
100.0000	10.0001	.9999	.0999	CP	3-11	0900	66	49
99.9999	9.9999	.9999	.0999	AV	3-15	1000	70	48
100.0000	10.0000	1.0000	.0998	CP	3-17	0900	72	46
100.0000	9.9998	1.0001	.1000	CP	4-8	1930	76	49
99.9999	10.0001	1.0000	.0999	CP	4-10	1630	73	42
99.9999	10.0001	1.0001	.1000	CP	4-11	1430	74	47
100.0000	10.0002	1.0000	.1000	CP	4-21	1830	77	49
100.0000	10.0000	1.0000	.0999	CP	4-22	1130	74	47
100.0000	10.0001	1.0000	.0999	CP	4-23	1015	74	44
100.0002	9.9999	1.0000	.1000	CP	4-24	0930	68	47
100.0000	9.9999	.9999	.1000	CP	4-25	0930	73	47
100.0000	9.9999	1.0001	.0999	CP	4-26	0900	76	42
100.0000	10.0002	1.0000	.0999	CP	4-30	1320	78	43
99.9998	10.0000	1.0002	.0999	CP	8-26	0845	78	49
100.0000	9.9998	1.0001	.0999	CP	8-27	0950	78	43
100.0000	10.0000	1.0000	.1000	CP	8-28	1600	73	47
99.9998	10.0000	.9999	.1000	CP	8-29	1400	70	48
100.0000	10.0000	1.0000	.0999	CP	8-31	0720	72	46
100.0001	10.0000	1.0000	.1000	CP	9-1	1330	76	49
100.0000	10.0001	1.0000	.0999	CP	9-2	1300	68	47
100.0000	10.0000	1.0000	.1000	CP	9-3	1130	72	46
100.0000	10.0001	1.0000	.0999	CP	10-26	0750	70	48
100.0000	10.0000	.9998	.0997	CP	10-27	1250	74	47
100.0000	9.9999	1.0000	.0999	CP	10-29	1400	71	49
100.0000	9.9999	1.0000	.0999	CP	11-1	1000	78	49
100.0000	10.0000	.9999	.0999	CP	11-2	0715	70	48
100.0000	10.0000	1.0000	.0999	CP	11-3	0900	70	48
100.0000	10.0001	.9999	.1000	CP	11-5	1320	76	42
100.0000	10.0001	.9999	.1000	CP	11-8	1230	70	48
100.0000	10.0001	1.0000	.0998	CP	11-9	1015	71	41
100.0000	10.0000	.9999	.0999	CP	11-10	0900	70	44

BLANK PROCESSING DATA SHEET # 5

UNIT : ES2100 RUN : 2 DATE : 9-2-12

BLANKS DONE : 8-31-2010

BEAKER	A	B	C
	200 ml ACETONE	75 ml DICHLOR	200 ml WATER
	FISHER OPTIMA LOT # 023283	FISHER OPTIMA LOT # 066390	DWNA, Inc Sparkletts Distilled
FINAL WEIGHT	108.9019	106.3074	106.9680
TARE WEIGHT	108.9001	106.3058	106.9640
NET WEIGHT	.0018	.0016	.0040

TARE BEAKERS INTO DESC : TIME : 1410 DATE : 8-7-2010

DATE : 8-26 BY : Cp DATE : 8-27 BY : Cp DATE : ____ BY : ____

BEAKER	1 ST WT	TIME	2 ND WT	TIME	3 RD WT	TIME
A	108.8999	0935	108.9001	1050		
B	106.3061	0936	106.3058	1051		
C	106.9641	0937	106.9640	1052		

FINAL BEAKERS INTO DESC : TIME : 8-28 DATE : 0820

DATE : 8-29 BY : Cp DATE : 8-31 BY : Cp DATE : ____ BY : ____

BEAKER	1 ST WT	TIME	2 ND WT	TIME	3 RD WT	TIME
A	108.9019	1501	108.9019	0742		
B	106.3076	1502	106.3074	0743		
C	106.9676	1503	106.9680	0744		

TARE QC

DATE	TIME	BY	WB	DB	%
8-26-10	0845	Cp		78	49
8-27-10	0955	Cp		78	43

FINAL QC

DATE	TIME	BY	WB	DB	%
8-29	1400	Cp		70	48
8-31	0720	Cp		72	46

NET PARTICULATE CATCH CALCULATION DATA SHEET #6

UNIT : ES2100 RUN : 2 DATE : 9-2-12

BLANK CALCULATIONS

Acetone :	.0018 g ÷	200 ml =	.000009	g/ml
Dicholoromethane :	.0016 g ÷	75 ml =	.000021	g/ml
Distilled Water :	.0040 g ÷	200 ml =	.000020	g/ml

FRONT HALF CATCH

FILTERS : .1110 (Total Catch) g - 1 (# of Filters) (.0000 g) (Blank Value / Filter) = .1110 g

BEAKERS : .0940 (Total Catch) g - 85 (ml Acetone) .0008 (.000009 g) (Blank Value / ml Acetone) = .0932 g

TOTAL FRONT HALF CATCH : .2042 g

BACK HALF CATCH

FILTERS : .0910 (Total Catch) g - 1 (# of Filters) (.0000 g) (Blank Value / Filter) = .0910 g

BEAKERS :

Acetone : .2139 (Total Catch) g - 125 (ml Acetone) .0011 (.000009 g) (Blank Value / ml Acetone) = .2128 g

Extract : .0245 (Total Catch) g - 75 (ml Dichloromethane) (.0016) (.000021 g) (Blank Value / Dichloromethane) = .0229 g

Water : .1174 (Total Catch) g - 310 (ml Water) .0062 (.000020 g) (Blank Value / Water) = .1112 g

TOTAL BACK HALF CATCH : .4379 g

TOTAL CATCH : .6421 g

% FRONT HALF : 31.8 %

CALCULATIONS DATA SHEET # 7

UNIT : ES2100 RUN : 2 DATE : 9 - 2 -2012

1) Vm (std) = $\dfrac{(100.517 \text{ Vm})(17.64)(.935 \text{ mcf})\left(30.22'' \text{ Hg} + \dfrac{.188'' \text{ H}_2\text{O}}{13.6}\right)}{(540 \text{ TmA})} = \dfrac{92.8742}{000.0000}$ dscf

2) Vw (std) = (.04707) (140.9 ml H_2O) = $\dfrac{6.6322}{00.0000}$ scf

3) Asw = $\dfrac{(6.6322 \text{ scf})}{(6.6322 \text{ scf} + 92.8742 \text{ dscf})} = \dfrac{.0667}{.0000}$ Bws × 100 = $\dfrac{6.6651}{00.0000}$ % H_2O

4) Cs = $\dfrac{(.6421 \text{ g.})}{(92.8742 \text{ dscf})}$ (15.43) = $\dfrac{.1067}{0.0000}$ gr / dscf

5) Estimated g / hr = $\dfrac{(.6421 \text{ g.})}{(92.8742 \text{ dscf})} \left(\dfrac{7.185}{00.0000} \text{ dscfm} \right)(60) = \dfrac{2.9805}{00.0000}$ g / hr

Vm =	total cubic feet pulled on meter box during test	(p. 2)	(000.000 Vm)
mcf =	meter correction factor (Y factor) of meter box used for test	(p. 2)	(0.000 mcf)
" Hg =	average barometric pressure during test	(p. 2)	(00.00 " Hg)
" H_2O =	average delta H for test	(p. 2)	(.000 " H_2O)
TmA =	average meter temperature for test in degrees Absolute	(p. 2)	(000 TmA)
ml H_2O =	total water caught during test	(p. 3)	(000.0 ml H_2O)
g. =	total particulate catch for test	(p. 6)	(00.0000 g.)
dscfm =	average stack flow during test	(p. 2)	(00.000 dscf)

TEST DATA SHEET # 8

UNIT : ES 2100 RUN : 2 DATE : 9-2-2012

Test Chamber Air Velocity Start : ⌀ Stop : ⌀ Avg.: ⌀

Wet Bulb / Dry Bulb

Pre : WB : 58 DB : 71 = 46.0 % RH 1.3 % H_2O

Post : WB : 62 DB : 76 = 44.0 % RH 1.4 % H_2O

Average : 45.0 % RH 1.35 % H_2O

Empty Stove Weight (lbs) : —— w/ stack & oil seal : Wet : —— Dry : 0.0

Kindling Weight (lbs) : Paper : .1 Wood : 2.1

Preburn Fuel Weight : 15.3 + 12.5 Total : 27.8

Kindling & Preburn Fuel Weight (wood only) (lbs) : **Total :** 29.9

Coal Bed Wt Range (lbs) : 3.5 - 2.8 **Scale** : 3.5 - 2.8

Upper : .25 × fuel weight : Always round DOWN to nearest tenth

Lower : .20 × fuel weight : Always round UP to nearest tenth **Actual Coal Bed Weight :** ______

Maximum Coal Bed Removal (lbs) : ((3.5 (Upper) + 2.8 (Lower)) ÷ 2) .25 = .7 (round down to nearest tenth)

Test Fuel (.75" × 1.5" × 5" spacers) = 16 pcs

Dimensions	Length in inches	No. Pcs	Weight in lbs	% of Load
2" × 4"	16	3	5.2	37.1
4" × 4"	16	2	8.8	62.9

Test Fuel Weight : 14.0 lbs

Estimated Dry Burn Rate :

$$\frac{14.0 - (14.0 \times .16930)}{2.2046} \times \frac{60}{290\ (\text{TIME})} = 1.091 \text{ kg / hr}$$

Estimated BTU's/hr : $19{,}140 \times \frac{1.3}{100} \times \frac{1.091}{\text{DBR}} = 13155.5$ BTU's/hr

EPA Default Efficiencies : Non-cat : 63 Cat : 72 Pellet : 78

WOOD STOVE OPERATING DATA PAGE #9

Unit : ES 2100 Run : 2 Date : 9-2-2012

FIRE STARTED: 0725

WARM UP AND PREBURN:

PRIMARY AIR : Set wide open for all warm-up / preburn fuel charges. Then set to 1" at start of preburn.

SECONDARY AIR : N/A CAT BYPASS : N/A

CHARCOAL BED PREPARATION :

Raked and leveled prior to each warm-up / preburn charge. At 1 1/2 min. prior to loading last fuel, raked and leveled. In stove 25 sec.

TEST:

DOOR wide open during loading Ø min. 40 sec.

PRIMARY AIR : Opened full for first 5 min., then set to run setting of 1".

SECONDARY AIR : N/A CAT BYPASS : N/A

FAN:

ON OFF during warm-up — ON OFF during preburn

ON OFF first 30 minutes of test — ON OFF balance of test run

Fan speed set at LOW

WOOD DATA: KINDLING: A mix of the grades listed below:

	SIZE	MILL	GRADE	SPECIES
PREBURN:	2x4	Manke/Tacoma	Std. or better	s. grn D fir
TEST:	2x4	Packwood	# 2 or better	s. grn D fir
	4x4	Packwood	# 2 or better	s. grn D fir

PELLET FUEL MANUFACTURER : N/A BRAND : N/A

All Grades WCLB rules:

WARM UP INFORMATION:

All pre-burn / warm up fuel pieces were either 16 or 16 inches.

1st warm up / pre-burn fuel charge (15.3 lbs.) added at 0735

2nd warm up / pre-burn fuel charge (12.5 lbs.) added at 0833

3rd warm up / pre-burn fuel charge (______ lbs.) added at ______

4th warm up / pre-burn fuel charge (______ lbs.) added at ______

5th warm up / pre-burn fuel charge (______ lbs.) added at ______

TEST DATA SHEET #10

Unit : ES2100 Run : 2 Date : 9-2-2012

Room Temperature : 71 °F Temperature Correction Set? Yes No

Calibration Check: 12.0% + or – 0.2%? Yes No

Time Test Fuel moisture reading taken : 0845

pc #	Dimen.	Use	TOP	BOTTOM	SIDE	Avg Corrected
1	2"×4"×8'	K	11.6	10.4	11.1	11.033
2						
3						
4	2"×4"×8'	P	18.1	18.2	18.2	18.2
5	2"×4"×8'	P	19.8	19.2	19.4	19.5
6	2"×4"×8'	P	18.4	18.5	18.5	18.5
7	2"×4"×8'	P				56.2
8	2"×4"×8'	P				
9						
10						
11						
12	2×4×16"	T	18.8	18.5	18.6	18.6
13	"	T	21.1	22.4	18.0	20.5
14	"	T	23.4	23.0	23.0	23.1
15	4×4×16"	T	18.8	19.0	19.0	18.9
16	"	T	20.6	20.8	21.1	20.8
17						101.9
18						
19						
20	Spacers	T	22.6	22.1	22.2	22.3

Key for Use : K = Kindling P = Pretest Fuel T = Test Fuel

	KINDLING	PRETEST FUEL	TEST FUEL
Dry Moisture % :	11.033 %	18.733 %	20.380 %
Wet Moisture % :	9.937 %	15.777 %	16.930 %

To obtain Wet from Dry : $\frac{100 \times \text{\% Dry Reading}}{100 + \text{\%Dry Reading}}$ = % Moisture, Wet Basis

Acceptable Ranges : 16 - 20 % wet: 19 - 25 % dry (17.5 - 22.5 on Meter Uncor. reading) at 70°

GAS DATA SHEET #12

WEIGHT: 3.0 DATE: 9-2-2012

UNIT: ES2100 RUN: 2 PAGE: 1 OF 2

TIME	SCALE	FUEL	DROP	V.	CO_2	V.	O_2	V.	CO	STATIC	SO_2PPM
0 / 1010	17.0	14.0	—	.184	4.6	.611	15.3	.088	.90	-.040	.550
5 / 15	16.3	13.3	.7	.493	12.3	.336	8.4	.006	.08	-.053	.300
10 / 20	15.9	12.9	.4	.112	2.8	.698	17.5	.043	.45	-.048	.500
15 / 25	15.7	12.7	.2	.127	3.1	.683	17.1	.050	.52	-.046	.500
20 / 30	15.4	12.4	.3	.178	4.4	.635	15.9	.045	.47	-.046	.500
25 / 35	14.8	11.8	.6	.380	9.5	.436	10.9	.032	.34	-.052	.425
30 / 40	14.3	11.3	.5	.341	8.5	.479	12.0	.019	.21	-.055	.400
35 / 45	13.8	10.8	.5	.329	8.2	.495	12.4	.013	.15	-.055	.375
40 / 50	13.3	10.3	.5	.336	8.4	.487	12.2	.012	.14	-.056	.375
45 / 55	12.8	9.8	.5	.317	7.9	.503	12.6	.023	.25	-.056	.400
50 / 1100	12.4	9.4	.4	.289	7.2	.527	13.2	.034	.36	-.055	.400
55 / 05	12.0	9.0	.4	.235	5.8	.567	14.2	.070	.72	-.053	.450
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	.615	*****
60 / 10	11.8	8.8	.2	.156	3.9	.627	15.7	.111	1.13	-.050	.525
65 / 15	11.6	8.6	.2	.159	3.9	.619	15.5	.130	1.32	-.048	.500
70 / 20	11.4	8.4	.2	.166	4.1	.627	15.7	.094	.96	-.047	.500
75 / 25	11.0	8.0	.4	.249	6.2	.555	13.9	.062	.64	-.049	.450
/ 30	10.4	7.4	.6	.451	11.2	.372	9.3	.025	.27	-.054	.425
85 / 35	9.9	6.9	.5	.401	10.0	.416	10.4	.036	.38	-.053	.425
90 / 40	9.4	6.4	.5	.349	8.7	.467	11.7	.037	.39	-.052	.425
5 / 45	8.9	5.9	.5	.388	9.7	.432	10.8	.025	.27	-.052	.425
100 / 50	8.4	5.4	.5	.409	10.2	.416	10.4	.017	.19	-.054	.425
05 / 55	7.8	4.8	.6	.417	10.4	.408	10.2	.011	.13	-.055	.425
10 / 1200	7.4	4.4	.4	.400	10.0	.424	10.6	.014	.16	-.055	.425
115 / 05	6.9	3.9	.5	.410	10.2	.416	10.4	.016	.18	-.055	.425
UBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	.624	*****
120 / 10	6.5	3.5	.4	.328	8.2	.495	12.4	.014	.16	-.053	.425
125 / 15	6.2	3.2	.3	.280	7.0	.543	13.6	.014	.16	-.051	.450
0 / 20	5.9	2.9	.3	.218	5.4	.595	14.9	.040	.42	-.048	.550
135 / 25	5.7	2.7	.2	.261	6.5	.559	14.0	.024	.26	-.048	.500
0 / 30	5.6	2.6	.1	.255	6.3	.567	14.2	.027	.29	-.046	.500
5 / 35	5.4	2.4	.2	.231	5.7	.583	14.6	.044	.46	-.046	.550
150 / 40	5.3	2.3	.1	.227	5.6	.591	14.8	.032	.34	-.045	.525
5 / 45	5.1	2.1	.2	.228	5.7	.587	14.7	.035	.37	-.045	.550
160 / 50	5.0	2.0	.1	.212	5.3	.595	14.9	.049	.51	-.044	.575
5 / 55	4.9	1.9	.1	.217	5.4	.595	14.9	.046	.48	-.042	.575
1 / 1300	4.8	1.8	.1	.219	5.4	.595	14.9	.048	.50	-.041	.550
1 / 05	4.7	1.7	.1	.218	5.4	.595	14.9	.050	.52	-.040	.550
S BTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	.549	*****
OTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	1.788	*****

GAS DATA SHEET #12

WEIGHT: 3.0

DATE: 9-2-2012

UNIT: ES 2100

RUN: 2

PAGE: 2 OF 2

TIME	SCALE	FUEL	DROP	V.	CO_2	V.	O_2	V.	CO	STATIC	SO_2PPM
180 / 10	4.6	1.6	.1	.218	5.4	.591	14.8	.057	.59	-.040	.550
185 / 15	4.5	1.5	.1	.217	5.4	.587	14.7	.063	.65	-.040	.550
190 / 20	4.4	1.4	.1	.188	4.7	.615	15.4	.064	.66	-.039	.550
195 / 25	4.3	1.3	.1	.185	4.6	.615	15.4	.072	.74	-.038	.550
200 / 30	4.2	1.2	.1	.184	4.6	.615	15.4	.071	.73	-.038	.525
205 / 35	4.2	1.2	.0	.173	4.3	.623	15.6	.080	.82	-.038	.525
210 / 40	4.1	1.1	.1	.172	4.3	.623	15.6	.081	.83	-.038	.525
215 / 45	4.0	1.0	.1	.175	4.3	.623	15.6	.087	.89	-.038	.525
220 / 50	3.9	.9	.1	.161	4.0	.631	15.8	.093	.95	-.037	.525
225 / 55	3.9	.9	.0	.157	3.9	.635	15.9	.097	.99	-.036	.525
230 / 1400	3.8	.8	.1	.150	3.7	.635	15.9	.111	1.13	-.035	.550
235 / 05	3.7	.7	.1	.153	3.8	.627	15.7	.119	1.21	-.035	.550
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	.452	*****
240 / 10	3.7	.7	.0	.153	3.8	.627	15.7	.120	1.22	-.035	.550
245 / 15	3.6	.6	.1	.147	3.6	.635	15.9	.124	1.26	-.035	.550
250 / 20	3.5	.5	.1	.148	3.7	.627	15.7	.138	1.40	-.035	.550
255 / 25	3.5	.5	.0	.147	3.6	.623	15.6	.149	1.51	-.035	.550
260 / 30	3.4	.4	.1	.167	4.1	.631	15.8	.087	.89	-.035	.575
265 / 35	3.3	.3	.1	.148	3.7	.647	16.2	.088	.90	-.035	.525
270 / 40	3.3	.3	.0	.143	3.5	.651	16.3	.095	.97	-.035	.525
275 / 45	3.2	.2	.1	.142	3.5	.651	16.3	.097	.99	-.035	.525
280 / 50	3.1	.1	.1	.138	3.4	.651	16.3	.105	1.07	-.035	.550
285 / 55	3.1	.1	.0	.130	3.2	.655	16.4	.109	1.11	-.035	.550
290 / 1500	3.0	.0	.1	.132	3.3	.655	16.4	.104	1.06	-.035	.550
295 / 05											
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	.385	*****
300 / 10											
305 / 15											
310 / 20											
315 / 25											
320 / 30											
325 / 35											
330 / 40											
335 / 45											
340 / 50											
345 / 55											
350 / 1600											
355 / 05											
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	.837	*****
TOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	2.625	*****

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-.044

PREBURN DATA SHEET #13

UNIT: ES2100 RUN: 2 DATE: 9-2-2012 PAGE: 1 of

TIME	SCALE	DROP	STACK	TOP	LF SIDE	BACK	RT SIDE	BOTTOM	FIREBOX	SEC/CAT	AMBIENT	STATIC	COMMENTS
0 / 0910	4.5	—	481	570	458	307	400	438			70	-.061	PREBURN START: # 60 UP
5 / 15	4.2	.3	351	524	442	311	397	440			68	-.057	COAL BED SCALE RANGE:
10 / 20	3.9	.3	314	488	441	309	391	440			70	-.054	3.5 → 2.8
15 / 25	3.7	.2	287	452	427	306	379	438			69	-.052	PRIMARY AIR: 1"
20 / 30	3.6	.1	261	412	425	297	366	434			69	-.050	SECONDARY AIR: N/A
25 / 35	3.5	.1	245	382	415	291	359	431			68	-.048	FAN: Low
30 / 40	3.4	.1	234	355	392	286	348	427			68	-.045	PUMPS ON AT:
35 / 45	3.3	.1	227	325	380	281	337	423			68	-.045	CHECK WB/DB: N/A
40 / 50	3.3	.0	221	313	378	278	333	420			67	-.044	
45 / 55	3.2	.1	215	296	368	272	327	417			67	-.043	336
50 / 1000	3.1	.1	210	284	358	269	320	415			67	-.041	
55 / 05	3.1	.0	206	271	355	264	316	412			68	-.040	
*****	****	***	****	*****	*****	****	*****	*****	*****	*****	*****	****	temp.
60 / 10	3.0	.1	212	259	357	273	314	412			68	-.040	323
65 / 15													
70 / 20													
75 / 25													
80 / 1030													
85 / 05													
90 / 10													

Lennox-ES2100 | Temperature Data Sheet 14 | Run 2
9/2/12

Time	Stack	Top	LT Side	Back	Rt Side	Bottom	Firebox	Sec/Cat	Ambient	Tube Frn	Smpl Box	Smpl Out	C-Gas Box	C-Gas Out	SO2 Out
********	Chn 103	Chn 104	Chn 105	Chn 106	Chn 107	Chn 108	Chn 109	Chn 110	Chn 111	Chn 112	Chn 113	Chn 114	Chn 115	Chn 116	Chn 117
0	212	259	357	273	314	412	######	######	68	1316	228	60	232	31	33
5	433	277	340	347	286	410	######	######	68	1316	229	41	233	31	32
10	263	303	324	348	273	409	######	######	67	1312	232	41	237	31	32
15	232	290	312	337	258	404	######	######	67	1313	236	42	240	31	32
20	228	275	301	325	241	398	######	######	66	1316	238	42	242	32	33
25	295	285	282	312	228	390	######	######	66	1317	240	43	245	32	33
30	318	317	274	306	224	382	######	######	67	1317	243	44	247	32	33
35	322	342	272	234	223	374	######	######	67	1320	245	44	248	33	34
40	326	354	269	221	222	366	######	######	67	1324	246	44	248	33	34
45	322	360	265	215	222	358	######	######	67	1331	248	45	248	34	34
50	314	359	261	212	225	350	######	######	68	1337	248	45	248	34	35
55	290	354	264	208	226	343	######	######	68	1342	249	45	248	34	35
60	256	340	262	204	225	337	######	######	69	1344	249	46	248	34	35
65	239	319	261	198	221	331	######	######	69	1345	248	46	248	35	35
70	232	300	251	189	219	326	######	######	69	1345	248	47	248	35	36
75	260	287	246	185	213	321	######	######	70	1346	248	47	248	35	36
80	311	310	252	189	219	316	######	######	69	1345	248	47	248	35	36
85	306	333	264	193	232	312	######	######	69	1344	248	46	246	35	36
90	304	342	267	201	236	309	######	######	69	1343	248	47	245	35	37
95	314	350	274	207	243	306	######	######	69	1343	248	47	245	36	37
100	325	363	281	213	248	303	######	######	70	1342	249	48	246	36	37
105	334	378	285	218	255	300	######	######	71	1342	249	48	246	36	37
110	335	390	292	224	262	298	######	######	70	1338	248	49	245	36	38
115	326	395	298	229	267	296	######	######	71	1335	247	49	245	36	38
120	314	393	300	233	270	295	######	######	71	1332	247	49	246	37	39
125	294	381	311	235	276	293	######	######	71	1331	246	50	247	37	39
130	269	365	305	237	277	293	######	######	72	1332	246	50	246	37	39
135	261	348	302	238	269	292	######	######	71	1332	246	50	247	37	39
140	257	337	309	243	269	291	######	######	71	1331	246	51	246	37	39
145	245	326	305	247	268	291	######	######	72	1331	245	51	246	37	39
150	239	315	304	250	271	291	######	######	72	1329	244	51	245	37	39
155	232	304	305	253	278	291	######	######	72	1327	244	51	245	37	39
160	223	292	308	254	287	292	######	######	72	1326	244	52	245	37	38
165	217	284	303	257	285	293	######	######	73	1326	244	52	244	36	38
170	212	273	304	260	287	295	######	######	72	1325	243	52	244	36	38

175	209	266	305	262	287	298	######	######	73	1324	243	52	243	36	37
180	207	259	305	264	288	300	######	######	72	1328	243	53	243	36	37
185	205	253	307	264	288	303	######	######	72	1332	243	53	242	35	37
190	202	249	305	265	289	306	######	######	73	1335	243	53	242	35	37
195	199	243	303	265	285	308	######	######	73	1339	243	54	241	35	37
200	197	240	298	263	281	310	######	######	73	1341	242	47	240	35	37
205	193	236	295	258	277	312	######	######	73	1343	240	44	239	35	36
210	191	231	293	256	277	314	######	######	73	1344	239	44	237	34	36
215	187	227	291	253	275	315	######	######	73	1346	238	44	236	34	36
220	185	224	285	250	270	317	######	######	73	1347	236	44	235	34	36
225	181	221	282	249	267	317	######	######	72	1348	235	44	234	33	36
230	178	216	280	245	265	318	######	######	73	1349	234	44	234	33	35
235	176	213	274	244	261	318	######	######	73	1349	234	44	232	33	35
240	175	210	269	242	258	317	######	######	73	1349	234	44	232	32	35
245	173	207	270	240	256	316	######	######	73	1350	234	44	231	32	35
250	172	204	263	239	254	316	######	######	73	1352	235	44	231	32	34
255	170	202	259	238	252	316	######	######	73	1353	234	44	230	32	34
260	169	200	258	236	253	315	######	######	74	1353	235	45	230	32	34
265	170	197	255	234	250	314	######	######	73	1353	233	45	228	32	34
270	167	195	253	232	246	313	######	######	73	1352	231	45	231	32	34
275	165	194	256	229	243	313	######	######	73	1351	229	46	233	31	34
280	163	192	250	227	242	312	######	######	73	1351	228	46	234	31	33
285	161	191	252	224	239	312	######	######	73	1351	228	46	234	31	33
290	159	189	246	221	236	312	######	######	73	1350	228	46	235	31	33

Lennox-ES2100

Run 2
9/2/12

TEMPERATURE DATA SHEET #14A

		TEST TIME	280		
STACK AVG	241	TOP AVG	284	LT SIDE AVG	284
BACK AVG	244	RT SIDE AVG	257	BOTTOM AVG	323
FIREBOX AVG	########	SEC/CAT AVG	########	AMBIENT AVG	71

END	241.0	
START	323.0	
	-82.0	DELTA T

CIRCLE: LOSS / GAIN

ZERO / SPAN CHECK DATA SHEET #15-1

Date : 9 - 2 -2012 Analyte : CO_2 (15-1)

Unit : ES2100 Run # : 2

Zero Cyl. # : 168TAC 3-A Conc. : 0.00 % CO_2 Cyl. Press. : 400 PSI

Certified by : AIR LIQUIDE Date : 04-19-04

Span Cyl. # : 487905 Conc. : 12.20 % CO_2 Cyl. Press. : 1300 PSI

Certified by : AIR LIQUIDE Date : 11-1-07

Analyzer : Make : HORIBA Model : PIR-2000 SN : 407069

Range : 0 - 25.0 % CO_2 Analyzer Output : 0 - 1.0 v.

Flow : 1.5 SCFH Measured by : Rotameter

EPA Span Value = 25.0 % CO_2

EPA Control Limits = ± 2.5% of 25.0 % CO_2 = ± 0.625 % CO_2

Method 28 A = ± .2 % of 25.0 % CO_2 = ± .05 % CO_2

PRE RUN Audit : by : C. Washington Time : 0900 Temp : 72 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	.018	.018	.072
SPAN	48.8	.488	12.20	48.8	.488	12.21	.010	.039

POST RUN Audit : by : C. Washington Time : 1530 Temp : 72 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	-.002	-.032	-.032	-.128
SPAN	48.8	.488	12.20	48.5	.485	12.135	-.065	-.261

± Conc. Difference = Act % - Exp (Std) %

$$\text{Zero \% Difference} = \frac{\text{Act \% (ppm) - Exp \% (ppm)}}{\text{Full Scale Value}} \times 100$$

$$\text{Span \% Difference} = \frac{\text{Act \% (ppm) - Exp \% (ppm)}}{\text{Full Scale Value}} \times 100$$

ZERO / SPAN CHECK DATA SHEET #15-2

Date : 9-2-2012 Analyte : O_2 (15-2)

Unit : ES2100 Run # : 2

Zero Cyl. # : 168TAC 3A Conc. : 0.00 % O_2 Cyl. Press. : 400 PSI

Certified by : AIR LIQUIDE Date : 04-19-04

Span Cyl. # : 487905 Conc. : 12.60 % O_2 Cyl. Press. : 1300 PSI

Certified by : AIR LIQUIDE Date : 11-1-07

Analyzer : Make : TELEDYNE Model : 320 A SN : 37400

Range : 0 - 25.0 % O_2 Analyzer Output : 0 - 1.0 v.

Flow : 1.5 SCFH Measured by : Rotameter

EPA Span Value = 25.0 % O_2

EPA Control Limits = ± 2.5% of 25.0 % O_2 = ± 0.625 % O_2

Method 28 A = ± .2 % of 25.0 % O_2 = ± .05 % O_2

PRE RUN Audit : by : C. Wachter Time : 0900 Temp : 72 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	-.035	-.035	-.142
SPAN	12.60	.504	12.6	12.6	.504	12.617	.017	.070

POST RUN Audit : by : C. Wachter Time : 1530 Temp : 72 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.001	-.010	-.010	-.042
SPAN	12.60	.504	12.6	12.6	.505	12.643	.042	.170

± Conc. Difference = Act % - Exp (Std) %

Zero % Difference = $\frac{\text{Act \% (ppm) - Exp \% (ppm)}}{\text{Full Scale Value}}$ X 100

Span % Difference = $\frac{\text{Act \% (ppm) - Exp \% (ppm)}}{\text{Full Scale Value}}$ X100

ZERO / SPAN CHECK DATA SHEET #15-3

Date : 9-2 -2012

Analyte : CO (15-3)

Unit : ES2100 Run # : 2

Zero Cyl. # : 168TAC 3-A Conc. : 0.00 % CO Cyl. Press. : 400 PSI

Certified by : AIR LIQUIDE Date : 04-19-04

Span Cyl. # : 487905 Conc. : 4.90 % CO Cyl. Press. : 1300 PSI

Certified by : AIR LIQUIDE Date : 11-1-07

Analyzer : Make : HORIBA Model : PIR-2000 SN : 408005

Range : 0 - 10.0 % CO Analyzer Output : 0 - 1.0 v.

Flow : 1.5 SCFH Measured by : Rotameter

EPA Span Value = 10.0 % CO

EPA Control Limits = ± 2.5% of 10.0 % CO = ± 0. 25 % CO

Method 28 A = ± .2 % of 10.0 % CO = ± .02 % CO

PRE RUN Audit : by : C. Watling Time : 0900 Temp : 72 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	-.006	-.006	-.056
SPAN	49.0	.490	4.90	49.0	.490	4.911	.011	.110

POST RUN Audit : by : C. Watling Time : 1530 Temp : 72 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	-.001	-.016	-.016	-.156
SPAN	49.0	.490	4.90	49.0	.490	4.911	.011	.110

± Conc. Difference = Act % - Exp (Std) %

$$\text{Zero \% Difference} = \frac{\text{Act \% (ppm) - Exp \% (ppm)}}{\text{Full Scale Value}} \times 100$$

$$\text{Span \% Difference} = \frac{\text{Act \% (ppm) - Exp \% (ppm)}}{\text{Full Scale Value}} \times 100$$

QUALITY CHECKS DATA SHEET # 16

UNIT : ES2100 RUN : 2 DATE : 9-2-2012

Thermocouple Check:

T/C # 1	— °F	T/C # 13	63.8 °F
T/C # 2	— °F	T/C # 14	62.6 °F
T/C # 3	63.2 °F	T/C # 15	63.4 °F
T/C # 4	61.2 °F	T/C # 16	51.0 °F
T/C # 5	61.0 °F	T/C # 17	50.3 °F
T/C # 6	61.1 °F	T/C # 18	65.5 °F
T/C # 7	60.9 °F	T/C # 19	— °F
T/C # 8	61.4 °F	T/C # 20	— °F
T/C # 9	— °F	T/C # 21	— °F
T/C # 10	— °F	T/C # 22	— °F
T/C # 11	58.1 °F	T/C # 23	— °F
T/C # 12	69.5 °F	T/C # 24	— °F

Thermocouple Readout:

Pretest zero and span check and calibration — post test zero and span — % difference

ZERO 0.0 °F Adj. to 0.0 °F ZERO 0.0 °F Difference Ø %

SPAN 1998.4 °F Adj. to 2000.0 °F SPAN 2001.1 °F Difference .055 %

Thermocouple Readout Pretest Linearity Check:

0	= 0.0 °F	200	= 200.5 °F	400	= 400.2 °F
600	= 600.1 °F	800	= 800.0 °F	1000	= 999.9 °F
1200	= 1199.8 °F	1400	= 1399.5 °F	1600	= 1599.6 °F
1800	= 1799.8 °F	2000	= 2000.0 °F		

Sample Train Leak Check	Pre ✓	Post ✓
C-gas Train Leak Check	Pre ✓	Post ✓
SO_2 Train Leak Check	Pre ✓	Post ✓
Static Gauge Zero Check	Pre ✓	Post ✓

Scale Check Pre : 13.3 − 3.3 = 10.0

Post : 13.0 − 3.0 = 10.0

Stack Cleaned Prior to Test Run : YES ______ NO X

1.25 TO 1.90

TABLE 1 ---- RAW DATA

CLIENT : Lennox TEST No. : 5

MODEL: ES2100 DATE: 05-Sep-12

TIME (MIN.)	METER READING (C F)	DELTA H (IN. H2O)	METER TEMP. (DEG. F)	PERCENT CO (%)	PERCENT CO2 (%)	SO2 COCENTR. PPM
0	688.000	0.150	77	0.58	1.10	400
5	689.500	0.780	77	0.19	5.10	175
10	692.956	0.320	78	0.36	6.60	275
15	695.169	0.380	80	0.21	9.60	250
20	697.620	0.220	80	0.60	12.80	325
25	699.507	0.150	81	0.76	13.50	400
30	701.047	0.100	81	1.38	14.10	475
35	702.343	0.170	81	0.58	14.10	375
40	703.985	0.170	81	0.70	14.20	375
45	705.627	0.120	81	1.06	14.10	450
50	706.996	0.220	82	0.31	14.00	325
55	708.890	0.310	82	0.06	11.40	275
60	711.127	0.310	82	0.08	10.90	275
65	713.365	0.260	82	0.08	10.50	300
70	715.416	0.260	82	0.09	9.90	300
75	717.468	0.260	82	0.11	9.10	300
80	719.519	0.260	82	0.13	8.50	300
85	721.571	0.260	82	0.10	8.50	300
90	723.622	0.260	82	0.11	8.10	300
95	725.674	0.220	83	0.26	7.40	325
100	727.582	0.190	83	0.28	6.70	350
105	729.354	0.190	83	0.28	6.50	350
110	731.126	0.190	83	0.25	6.30	350
115	732.898	0.190	83	0.26	6.20	350
120	734.670	0.220	84	0.33	4.70	325
125	736.591	0.220	84	0.54	4.60	325
130	738.511	0.220	84	0.66	4.60	325
135	740.431	0.220	84	0.69	4.60	325
140	742.351	0.190	84	0.76	4.50	350
145	744.135	0.190	84	0.87	4.50	350
150	745.918	0.190	84	0.82	4.50	350
155	747.701	0.190	84	0.86	4.50	350
160	749.485	0.190	84	0.87	4.00	350
165	751.268	0.160	84	1.18	3.40	375
170	752.933	0.160	84	1.27	3.20	375
175	754.597	0.160	84	1.35	3.00	375

180	756.261	0.160	84	1.20	2.90	375
185	757.927	0.140	84	1.19	3.10	400
190	759.489	0.160	84	1.13	3.20	375
195	761.154	0.140	84	1.08	3.20	400
200	762.820	0.140	84	0.92	3.20	400

TABLE 2---RAW DATA

CLIENT : Lennox   TEST No. 5

MODEL: ES2100   DATE: 05-Sep-12

****

METER CAL. FACTOR (Y) -------	0.935	Wt. WOOD BURNED(LB) -------	13.9	Lbs
BAROMETRIC PRESS.(Pb) -------	30.06 in Hg	WET,FUEL MOISTURE % -------	15.981	%
LEAK RATE POST (Lp) -------	0.009 cfm	Wt. PART. COLLECTED -------	0.307	g
WATER VOL. (V1c) -------	123.8 Ml	METER VOLUME Vm -------	74.82	mcf
TEST TIME (MIN) -------	200 min	HC MOLE FRACTION -------	0.0132	

TABLE 3 -----FIELD DATA AVERAGES

CLIENT : Lennox　　　　TEST No.　5

MODEL: ES2100　　　　DATE:　05-Sep-12

****

AVG DELTA H	-------	0.22 in H2O	AVG PRCNT CO	--------	0.60	%
AVG METER TEMP. Tm	-------	82 deg F	AVG PRCNT CO2	--------	7.19	%
AVG PPM SO2	-------	342 PPM	AVG BAL CO2/CO	--------	12.02	%

TABLE 4 ----- CALCULATIONS

CLIENT : Lennox | TEST No. 5

MODEL: ES2100 | DATE: 05-Sep-12

****

STD SAMPLE VOL. Vm(std) d) ------	68.47 dscf	STACK GAS FLOW Qsd --------	628.208 dscf/Hr & 10.47 dscf/min
VOL. WATER VAPOR Vw(s td) -----	5.827 scf	PARTICULATE CONCTRT. C s ------	0.0045 g/dscf
PRCNT MSTR Bws -------	7.84 %	PARTC.EMISS. RATE E --------	2.82 g/Hr
BURN RATE BR -------	1.59 Kg/Hr	MOLES OF GAS PER Lb WOOD Nt ----	0.47 Lb-mole/Lb
CO EMISSION RATE -------	125.92 g/Hr & 79.24 g/Kgdry fuel	PART.EMISS. RATE ------	1.77 g/Kgdry fuel

TABLE 5 ---- PROPORTIONAL RATE VARIATION

CLIENT : Lennox   TEST No. : 5

MODEL: ES2100   DATE: 05-Sep-12

****

	TIME INTEVAL Ti	PPM * Vm	PROPRTN. RATE VAR. PR		PROPRTN RATE VAR. AVERAGE	
=========	=========	=========	=========	=========	=========	=========
	5	554.5	98		100	
	10	559.3	99			
	15	560.5	99			
	20	563.4	99			
	25	563.2	99			
	30	565.1	100			
	35	564.6	100			
	40	564.8	100			
	45	564.8	100			
	50	564.5	100			
	55	563.7	99			
	60	563.5	99			
	65	563.7	99			
	70	563.5	99			
	75	563.8	99			
	80	563.5	99			
	85	563.8	99			
	90	563.5	99			
	95	563.3	99			
	100	566.8	100			
	105	566.9	100			
	110	566.9	100			
	115	566.9	100			
	120	566.3	100			
	125	569.6	100			
	130	569.3	100			
	135	569.3	100			
	140	569.3	100			
	145	569.7	100			
	150	569.3	100			
	155	569.3	100			
	160	569.7	100			
	165	569.3	100			
	170	569.6	100			
	175	569.2	100			
	180	569.2	100			

185	569.9	101
190	569.9	101
195	569.6	100
200	607.9	107

COMPUTER INPUT DATA SHEET #1

2.82

Client: Lennox Hearth Products

Address: 1502 14th Street NW
Auburn, WA 98001

Phone: 253-735-1100 Fax: 253-931-1271

Run No.: 3 Date of Test: 9 - 5 - 2012 Burn Rate: 1.59

Model No.: ES2100 ☐ min ☐ min-1.25 ☐ fan

Stove Type: ☐ Cat ☒ Non Cat ☐ Pellet ☒ 1.25-1.9 ☐ max ☐ insert

Dry Gas Meter Y Factor: .935
(0.000) (Data Sheet #2)

Post Leak Rate: .009 cfm
(.000) (Data Sheet #2)

Time: 200 min.
(000) (Data Sheet #2)

Dry Gas Meter Volume: 74.820 cf
(00.000) (Data Sheet #2)

Stack Flow: 10.423 dscfm
(00.000) (Data Sheet #2)

Δ H: .219 in. H_2O
(.000) (Data Sheet #2)

Maximum Vac.: 5.0
(0.0) (Data Sheet #2)

Barometric Pressure: 30.06 in. Hg
(00.00) (Data Sheet #2)

H_2O Captured: 123.8 g
(00.0) (Data Sheet #3)

Front Half Catch % Of Total: 52.7 %
(00.0) (Data Sheet #6)

Total Particulate Catch: .3070 g
(0.0000) (Data Sheet #6)

Flue Gas Moisture: 7.8424 %
(00.000) (Data Sheet #7)

Particulate Emission: .0692 gr/dscf
(0.0000) (Data Sheet #7)

Relative Humidity: 47.0 % RH
(00.0) (Data Sheet #8)

Ambient Moisture: 1.65 % H_2O
(0.00) (Data Sheet #8)

Preburn Fuel Wt.: 35.4 lbs.
(00.0) (Data Sheet #8)

Coal Bed Wt.: 3.2 lbs.
(00.0) (Data sheet #8)

Test Fuel Wt.: 13.9 lbs.
(00.0) (Data sheet #8)

Heat Output (EPA Default): 19160.5 BTU/hr
(00,000.0) (Data Sheet #8)

Kindling Fuel % Moisture (wet): 11.032 %
(00.000) (Data Sheet #10)

Pretest Fuel % Moisture (wet): 15.541 %
(00.000) (Data Sheet #10)

Test Fuel % Moisture (dry): 19.020 %
(00.000) (Data Sheet #10 [wood stove] or #11 [pellet stove])

Test Fuel % Moisture (wet): 15.981 %

Fuel Higher Heating Value (dry): BTU/lb.
(0000) (Data Sheet #11)

Stack Static Pressure: -.044 in. H_2O
(+/- .000) (Data Sheet #12)

Average Ambient Temperature: 80 °F
(00) (Data Sheet #14)

Stove Temperature Change: -32.1 °F
(+/- 000.0) (Data Sheet #14)

Test Start 1050

meter temp 542

End 1410

METER BOX DATA SHEET PAGE # 2

UNIT : ES2100 RUN : 5 DATE : 9-5-2012

Meter Box: 5H Y Factor: .935

Leak checks: 15 " Hg @ .005 cfm " Hg @ cfm

15 " Hg @ .009 cfm " Hg @ cfm

Inject SO^2 @ 100 cc/min. Nozzle: Probe @ 3/8 " od Initial Volume: 1.500

ROTO: PRESS: .18			SAMPLING RATIO: 29 : 1				BP: 30.10		
MIN	TIME	METER READING	SAMPLE MDCF	STACK DSCFM	DELTA H	METER TEMP	SO2 PPM	ROTO TEMP	PUMP VACC
0	1050	688.000	———	8.738	.15	77	400	77	2.0
5	55	689.500	———	19.973	.78	77	175	77	5.0
10	1100	692.956	692.956	12.687	.32	78	275	78	3.0
15	05	695.169	695.169	13.964	.38	80	250	80	3.0
20	10	697.620	697.620	10.695	.22	80	325	80	3.0
25	15	699.507	699.507	8.674	.15	81	400	81	2.0
30	20	701.047	701.047	7.304	.10	81	475	81	2.0
35	25	702.343	702.343	9.252	.17	81	375	81	2.0
40	30	703.985	703.985	9.252	.17	81	375	81	2.0
45	35	705.627	705.627	7.710	.12	81	450	81	2.0
50	40	706.996	706.996	10.675	.22	82	325	82	2.0
55	45	708.890	708.890	12.616	.31	82	275	82	2.0
ROTO PRESS: .18			TOTALS:	131.480	3.09	961	BP.: 30.10		
60	1150	711.127	711.127	12.616	.31	82	275	82	3.0
65	55	713.365	713.365	11565	.26	82	300	82	3.0
70	1200	715.416	715.416	11.565	.26	82	300	82	3.0
75	05	717.468	717.468	11.565	.26	82	300	82	3.0
80	10	719.519	719.519	11.565	.26	82	300	82	3.0
85	15	721.571	721.571	11.565	.26	82	300	82	3.0
90	20	723.622	723.622	11.565	.26	82	300	82	3.0
95	25	725.674	725.674	10.636	.22	83	325	83	3.0
100	30	727.582	727.582	9.876	.19	83	350	83	3.0
105	35	729.354	729.354	9.876	.19	83	350	83	3.0
110	40	731.126	731.126	9.876	.19	83	350	83	3.0
115	45	732.898	732.898	9.876	.19	83	350	83	3.0
			TOTALS:	132.692	2.85	989	MAX VACC =		
TOTAL Cu Ft.			TOTALS:	264.172	5.94	1950	AVG. BP:		

METER BOX DATA SHEET PAGE # 2

Page: 2 of ____

UNIT: ES2100 RUN: 5 DATE: 9-5-2012

Meter Box: SH Y Factor: .935

Leak checks: 15 " Hg @ .005 cfm ____ " Hg @ ____ cfm

15 " Hg @ .008 cfm ____ " Hg @ ____ cfm

Inject SO^2 @ 100 cc/min. Nozzle: Probe @ 3/8 " od Initial Volume: 1.500

ROTO PRESS:	.18		SAMPLING RATIO: 29. : 1				BP: 30.02		
MIN	TIME	METER READING	SAMPLE MDCF	STACK DSCFM	DELTA H	METER TEMP	SO2 PPM	ROTO TEMP	PUMP VACC
120	1250	734.670	734.670	10.588	.22	84	325	84	3.0
125	55	736.591	736.591	10.588	.22	84	325	84	3.0
130	1300	738.511	738.511	10.588	.22	84	325	84	3.0
135	05	740.431	740.431	10.588	.22	84	325	84	3.0
140	10	742.351	742.351	9.832	.19	84	350	84	3.0
145	15	744.135	744.135	9.832	.19	84	350	84	3.0
150	20	745.918	745.918	9.832	.19	84	350	84	3.0
155	25	747.701	747.701	9.832	.19	84	350	84	3.0
160	30	749.485	749.485	9.832	.19	84	350	84	3.0
165	35	751.268	751.268	9.176	.16	84	375	84	3.0
170	40	752.933	752.933	9.176	.16	84	375	84	3.0
175	45	754.597	754.597	9.176	.16	84	375	84	3.0
ROTO PRESS:	.18		TOTALS:	119.040	2.31	1008	BP.: 30.00		
180	1350	756.261	756.261	9.170	.16	84	375	84	3.0
185	55	757.927	757.927	8.597	.14	84	400	84	3.0
190	1400	759.489	759.489	9.170	.16	84	375	84	3.0
195	05	761.154	761.154	8.597	.14	84	400	84	3.0
200	10	762.820	762.820	8.597	.14	84	400	84	3.0
205				44.131	.74	420			
210									
215									
220									
225				427.343	8.99	3378			
230									
235									
			TOTALS:			82	MAX VACC =		3.0
TOTAL Cu Ft.		74.820	TOTALS:	10.423	.219	542	AVG. BP:		30.06

(14)

PARTICULATE CATCH / MOISTURE DATA SHEET # 3

UNIT : ES2100 RUN : 5 DATE : 9-5-12

SCALE CHECK	LEVEL	ZEROED
INITIAL :	✓	✓
FINAL :	✓	✓

SCALE	WEIGHT
295.0 g	295.0
590.0 g	590.0
885.0 g	885.0

IMPINGER	# 1	# 2	# 3	# 4
FINAL WT	697.6	587.0	486.6	889.7
INITIAL WT	601.2	579.5	484.2	872.2
NET WT GRAMS	96.4	7.5	2.4	17.5

TOTAL CATCH : 123.8 GRAMS H_2O

FRONT HALF

FILTER #	56F	
FINAL WT g	.7527	
INITIAL WT g	.6287	
NET WT g	.1240	

BEAKER #	26
DESC.	ACETONE
FINAL WT g	101.0745
INITIAL WT g	101.0204
NET WT g	.0541
VOL. DESC. ml	120

BACK HALF

FILTER #	56B	
FINAL WT g	.3168	
INITIAL WT g	.2839	
NET WT g	.0329	

BEAKER #	27	28	29	30	
DESC.	ACETONE	METHCHLOR	H_2O	H_2O	
FINAL WT g	106.4115	105.7430	104.4648	107.3692	
INITIAL WT g	106.3623	105.7333	104.4410	107.3458	
NET WT g	.0492	.0097	.0238	.0234	.0472
VOL. DESC ml	150	75	150	150	300

FILTER TARE WEIGHTS DATA SHEET #4-1

Into Dessicator : Date : 1-6-12 Time : 1000 By : CD

Manufacturer S & S Grade : # 25 Glass Front Size : 11 cm Lot No. : 393580

Back Size: 8.2 cm Lot No. : 4642541

FILTER #	DATE: 1-13-12 FIRST WEIGHT	BY: CD TIME	DATE: 1-14-12 SECOND WEIGHT	BY: CD TIME	DATE: THIRD WEIGHT	BY: TIME
51F	.6325	1055	.6330	1320	✓	
52F	.6313	1056	.6313	1321	✓	
53F	.6317	1057	.6318	1322	✓	
54F	.6294	1058	.6290	1323	✓	
55F	.6330	1059	.6329	1324	✓	
56F	.6285	1100	.6287	1325	← R-5	
57F	.6261	1101	.6258	1326	✓	
58F	.6327	1102	.6326	1327	✓	
59F	.6298	1103	.6297	1328	✓	
60F	.6303	1104	.6300	1329	✓	

51B	.2812	1105	.2810	1330	✓	
52B	.2829	1106	.2830	1331	✓	
53B	.2825	1107	.2825	1332	✓	
54B	.2811	1108	.2811	1333	✓	
55B	.2804	1109	.2803	1334	✓	
56B	.2837	1110	.2839	1335	← R-5	
57B	.2831	1111	.2829	1336	✓	
58B	.2831	1112	.2829	1337	✓	
59B	.2836	1113	.2838	1338	✓	
60B	.2833	1114	.2834	1339	✓	

Checked by: Armando Verdy Date: 01-16-2012 Time: 0950

BALANCE ROOM ENVIRONMENTAL CONDITIONS

DATE	TIME	BY	WB	DB	% RH
1-13-12	1030	Cg	S	72	46
1-14-12	1312	Cg		70	48

BEAKER TARE WEIGHTS DATA SHEET #4-2

Into Dessicator: Date: 10-6-11 Time: 1100 By: Cp

BEAKER #	FIRST WEIGHT (DATE: 10-9-11)	TIME (BY: Cp)	SECOND WEIGHT (DATE: 10-16-11)	TIME (BY: Cy)	THIRD WEIGHT (DATE:)	TIME (BY:)
26	101.0205	1135	101.0204	1545	✓	
27	106.3624	1136	106.3623	1546	✓	
28	105.7330	1137	105.7333	1547	✓ R-5	
29	104.4406	1138	104.4410	1548	✓	
30	107.3454	1139	107.3458	1549	✓	
31	95.5389	1140	95.5393	1550	✓	
32	107.8553	1141	107.8557	1551	✓	
33	101.1607	1142	101.1609	1552	✓	
34	106.4532	1143	106.4531	1553	✓	
35	96.5403	1144	96.5403	1554	✓	
36	94.4493	1145	94.4498	1555	✓	
37	106.5943	1146	106.5946	1556	✓	
38	96.2441	1147	96.2437	1557	✓	
39	97.1310	1148	97.1311	1558	✓	
40	106.4631	1149	106.4633	1559		
41	105.4815	1150	105.4820	1600	✓	
42	104.6647	1151	104.6652	1601	✓	
43	107.3504	1152	107.3504	1602	✓	
44	107.7858	1153	107.7858	1603	✓	
45	94.9313	1154	94.9316	1604	✓	
46	106.0431	1155	106.0436	1605	✓	
47	102.0324	1156	102.0328	1606	✓	
48	97.7428	1157	97.7430	1607	✓	
49	108.3510	1159	108.3511	1608	✓	
50	96.5249	1200	96.5250	1610		

BALANCE ROOM ENVIRONMENTAL CONDITIONS

DATE	TIME	BY	WB	DB	% RH
10-9-11	1130	CW	-	75	44
10-16-11	1540	CW	-	68	47
		CW	-		

Checked by: Armando V.
Date: 10-17-11
Time: 11:30 am

WOODSTOVE DATA SHEET # 4-3 : CONSTANT WEIGHTS

UNIT : ES 2100 RUN : 5 DATE : 9-5-12

Beaker #	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By
26	9-6	1130	cp	101.0750	9-7	1415	cp	101.0745	9-8	1211	cp				
27	9-6	1130	cp	106.4120	9-7	1416	cp	106.4115	9-8	1212	cp				
28	9-6	1130	cp	105.7433	9-7	1417	cp	105.7430	9-8	1213	cp				
29	9-6	1130	cp	104.4648	9-7	1418	cp	104.4648	9-8	1214	cp				
30	9-6	1130	cp	107.3697	9-7	1419	cp	107.3692	9-8	1215	cp				

Filter #	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By
5CF	9-5	1600	cp	.7531	9-6	1155	cp	.7527	9-7	1412	cp				
5CB	9-5	1600	cp	.3189	9-6	1156	cp	.3172	9-7	1413	cp	.3168	9-8	1210	cp

SCALE ROOM ENVIRONMENTAL CONDITIONS

Weighing Session	Date	Time	By	DB	%RH
1	9-6-12	1130	cp	76	49
2	9-7-12	1400	cp	72	45
3	9-8-12	1200	cp	71	49
4					
5					

Weighing Session	Date	Time	By	DB	%RH
6					
7					
8					
9					
10					

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates: From 1-14-2012 Through	Scale: Sartorius	Model: A 120 S	SN: 37010004

100 g weight	10 g weight	1 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	% RH
100.0000	10.0000	1.0000	.0999	CF	1-14-12	1300	70	48
100.0002	10.0001	1.0001	.1000	CF	1-15-12	1330	68	47
99.9997	10.0000	1.0001	.1000	CF	1-17-12	1030	73	47
99.9997	10.0001	1.0000	.1000	CF	1-18-12	0915	74	44
99.9999	10.0002	1.0001	.1001	CF	1-19-12	1015	70	44
100.0001	10.0001	1.0001	.0998	CF	1-25-12	1600	72	46
99.9999	9.9998	1.0001	.1000	CF	1-26-12	1500	70	48
99.9995	9.9999	1.0000	.0999	CF	1-28-12	1400	70	41
100.0000	10.0000	1.0000	.0999	CF	2-4-12	1500	73	60
100.0000	10.0003	.9999	.0999	CF	2-6-12	1200	69	44
100.0000	10.0000	.9999	.0998	CF	2-7-12	1030	67	42
100.0000	9.9999	1.0001	.0999	CF	2-10-12	1630	78	49
100.0000	10.0001	1.0000	.1000	CF	2-11-12	1630	72	46
99.9997	10.0002	1.0000	.1001	CF	2-12-12	1530	73	47
100.0000	10.0000	.9999	.0999	CF	2-13-12	1100	78	46
99.9995	10.0000	.9999	.0999	CF	2-14-12	1000	76	45
100.0000	9.9999	.9999	.1000	CF	2-15-12	1120	70	44
99.9999	10.0000	1.0000	.0999	CF	2-17-12	1415	73	47
99.9999	10.0000	1.0000	.0998	CF	2-19-12	1600	70	44
99.9997	9.9999	1.0000	.0999	CF	2-20-12	1200	70	48
100.0004	10.0001	1.0000	.1000	CF	2-23-12	1000	73	47
100.0000	9.9997	1.0000	.0999	CF	2-24-12	1015	78	46
100.0000	10.0000	1.0000	.1001	CF	2-25-12	1715	65	48
100.0000	9.9996	1.0000	.0999	CF	2-27-12	1000	70	44
100.0000	10.0000	1.0001	.1002	CF	2-28-12	1125	75	41
99.9997	10.0000	1.0000	.1000	CF	2-29-12	1110	68	43
99.9995	9.9999	.9999	.0997	CF	3-1-12	1330	68	47
99.9996	10.0000	1.0000	.0998	CF	3-2-12	1430	71	45
99.9995	9.9999	1.0000	.0999	CF	3-3-12	1430	72	42
99.9999	10.0000	.9999	.0999	CF	9-2-12	0945	77	46
100.0000	10.0000	1.0000	.1000	CF	9-3-12	1030	71	49
100.0002	9.9999	1.0000	.0998	CF	9-4-12	1000	77	49
100.0000	10.0000	1.0000	.0999	CF	9-5-12	0945	78	46
100.0000	10.0002	1.0000	.0999	CF	9-6-12	1130	76	49
99.9997	10.0001	1.0002	.0999	CF	9-7-12	1400	76	49
100.0000	10.0001	1.0000	.0999	CF	9-8-12	1200	71	49

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates: From 4-13-2011 Through 1-13-2012	Scale: Sartorius	Model: A 120 S	SN: 37010004

100 g weight	10 g weight	1 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	% RH
100.0000	10.0001	1.0000	.0998	CP	4-13-11	1030	66	49
100.0001	10.0002	1.0000	.0999	CP	4-15-11	1330	75	48
100.0004	10.0000	.9999	.0998	CP	4-19-11	1600	74	44
100.0003	10.0000	1.0000	.0999	CP	4-20-11	1815	72	46
100.0000	10.0001	.9999	.1000	CP	6-16-11	0900	76	39
99.9997	9.9999	.9998	.0999	CP	6-19-11	1530	74	44
99.9996	10.0002	1.0000	.0999	CP	6-20-11	1600	73	47
100.0000	10.0000	.9998	.0999	CP	6-21-11	1400	73	47
100.0000	10.0000	1.0001	.0999	CP	6-22-11	1200	72	46
99.9999	9.9998	1.0000	.1000	CP	6-23-11	1700	76	49
100.0000	10.0002	1.0000	.0999	CP	6-24-11	1400	75	48
100.0000	10.0000	1.0000	.0999	CP	6-27-11	1230	78	46
100.0001	10.0002	.9999	.0998	CP	6-30-11	1030	78	46
99.9995	10.0000	.9999	.0999	CP	7-1-11	1030	70	48
99.9999	9.9999	1.0000	.1000	CP	7-2-11	1145	75	45
100.0000	9.9999	.9999	.0999	CP	7-5-11	1000	73	47
99.9999	10.0001	1.0000	.0999	CP	7-6-11	0930	76	49
100.0000	9.9997	1.0000	.0997	CP	9-22-11	1700	77	46
100.0000	10.0001	1.0000	.0999	CP	9-24-11	1700	77	49
100.0000	9.9998	1.0001	.1000	CP	9-25-11	1300	76	49
100.0000	9.9999	1.0001	.0998	CP	9-27-11	1000	77	49
99.9996	9.9999	1.0000	.0998	CP	9-29-11	0840	72	42
99.9997	9.9998	.9999	.1000	CP	9-30-11	1000	70	48
99.9996	9.9998	1.0000	.0999	CW	10-1-11	1520	70	45
99.9998	10.0002	1.0000	.0997	CP	10-2-11	1430	74	47
99.9995	10.0001	1.0000	.0999	CP	10-5-11	1510	71	49
100.0000	9.9999	1.0000	.0998	CP	10-6-11	1000	78	40
100.0000	9.9999	1.0000	.0999	CP	10-9-11	1130	75	48
100.0000	10.0001	1.0000	.0998	CP	10-16-11	1540	68	47
100.0000	10.0000	1.0000	.0998	CP	11-4-11	1230	72	46
100.0000	10.0002	.9998	.0998	CP	11-11-11	0815	70	45
99.9999	10.0000	1.0000	.0996	CP	11-15-11	1200	75	45
99.9995	10.0001	.9999	.0999	CR	11-16-11	1400	70	44
99.9999	10.0001	.9999	.0998	CP	11-20-11	1600	73	43
99.9998	9.9999	.9999	.0999	CP	11-21-11	1715	74	47
100.0000	10.0000	1.0000	.0999	CP	11-22-11	1600	65	48
100.0000	10.0000	1.0000	.0999	CW	1-9-12	1030	70	48
100.0000	9.9999	1.0001	.1000	CP	1-11-12	0920	65	48
100.0000	10.0001	1.0000	.0997	CP	1-13-12	1036	72	46

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates:		Scale:	Model:	SN:
From 11-11-10	Through 4-7-11	Sartorius	A 120 S	37010004

100 g weight	10 g weight	1 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	% RH
100.0000	10.0002	1.0000	.0998	cp	11-11	0840	67	42
100.0000	10.0000	1.0001	.1000	cp	11-15	0930	70	48
100.0000	10.0001	1.0000	.0999	cp	11-19	0930	65	48
100.0000	10.0000	1.0000	.1000	cp	11-23	1400	66	45
100.0000	9.9997	1.0000	.0998	cp	11-24	1400	65	48
100.0000	10.0000	.9999	.0998	cp	11-26	1100	67	46
100.0000	10.0001	1.0001	.0997	cp	12-14	1000	75	41
100.0001	10.0003	1.0000	.0999	cp	12-16	1100	75	48
100.0000	10.0002	1.0000	.0999	cp	12-18	1000	77	46
100.0000	10.0000	1.0000	.0999	cp	12-21	1100	66	49
100.0000	10.0004	1.0000	.0997	cp	12-22	1400	72	48
100.0000	10.0001	1.0000	.1001	cp	12-23	1100	76	38
100.0000	10.0000	.9999	.0999	cp	12-24	1000	67	46
100.0000	10.0001	1.0001	.0999	cp	12-25	1100	70	49
100.0000	10.0000	1.0000	.0999	cp	1-19-11	0930	66	49
100.0000	9.9999	1.0000	.0999	cp	1-21-11	1400	77	44
99.9996	10.0000	1.0000	.0998	cp	1-25-11	0900	75	48
100.0000	10.0002	1.0001	.1000	cp	1-26-11	1400	74	44
100.0000	10.0001	.9998	.0998	cp	1-27-11	1200	65	48
100.0000	10.0002	1.0000	.0999	cp	1-28-11	1630	70	48
100.0000	10.0001	1.0001	.0999	cp	1-29-11	1200	68	48
100.0000	10.0002	1.0000	.0999	cp	1-30-11	1500	66	49
100.0000	9.9999	1.0000	.0999	cp	2-15-11	0930	75	41
100.0000	10.0000	1.0001	.1000	cp	2-16-11	0930	66	49
100.0000	10.0002	1.0000	.0999	cp	2-22-11	1000	70	48
100.0000	10.0001	1.0002	.0999	cp	3-4-11	1200	69	47
100.0000	10.0004	.9999	.1000	cp	3-5-11	1000	70	48
100.0000	10.0001	1.0000	.0999	cp	3-8-11	1000	74	47
100.0000	10.0000	1.0000	.1000	cp	3-9-11	1600	67	46
100.0000	10.0002	0.9999	.0999	cp	3-10-11	1600	66	49
100.0000	10.0000	1.0000	.0999	cp	3-12-11	1530	73	47
100.0000	10.0001	.9999	.0998	cp	3-13-11	1200	65	48
100.0000	10.0001	1.0000	.0999	cp	3-29-11	1120	76	49
100.0000	10.0000	.9999	.0998	cp	3-30-11	0800	74	47
100.0000	10.0001	1.0000	.0999	cp	3-31-11	1000	70	48
100.0000	10.0002	.9998	.0999	cp	4-4-11	0800	74	47
100.0000	10.0003	1.0000	.1000	cp	4-5-11	1130	73	47
100.0000	9.9999	1.0001	.0999	cp	4-6-11	1030	77	49
100.0000	10.0000	9.9999	.1001	cp	4-7-11	1000	78	40

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates: From 2-26-2010 Through 11-10-2010	Scale: Sartorius	Model: A 120 S	SN: 37010004

100 g weight	10 g weight	1 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	% RH
100.0001	10.0004	.9999	.0999	cp	2-26-10	0840	72	46
100.0001	9.9999	.9999	.0999	cp	2-27-10	1045	72	46
100.0000	10.0000	1.0000	.0999	cp	2-28	1100	70	48
100.0000	10.0000	1.0000	.0999	cp	3-1	0900	66	49
100.0000	10.0002	.9998	.1002	cp	3-5	1200	70	48
100.0001	9.9999	.9999	.0998	cp	3-7	1330	68	47
100.0000	9.9999	.9999	.0999	cp	3-9	1130	70	41
100.0000	10.0001	1.0000	.0999	cp	3-10	1200	70	44
100.0000	10.0001	.9999	.0999	cp	3-11	0900	66	49
99.9999	9.9999	.9999	.0999	AH	3-15	1000	70	48
100.0000	10.0000	1.0000	.0998	cp	3-17	0900	72	46
100.0000	9.9998	1.0001	.1000	cp	4-8	1930	76	49
99.9999	10.0001	1.0000	.0999	cp	4-10	1630	73	47
99.9999	10.0001	1.0001	.1000	cp	4-11	1430	74	47
100.0000	10.0002	1.0000	.1000	cp	4-21	1830	77	49
100.0000	10.0000	1.0000	.0999	cp	4-22	1130	74	47
100.0000	10.0001	1.0000	.0999	cp	4-23	1015	74	44
100.0002	9.9999	1.0000	.1000	cp	4-24	0930	68	47
100.0000	9.9999	.9999	.1000	cp	4-25	0930	73	47
100.0000	9.9999	1.0001	.0999	cp	4-26	0900	76	42
100.0000	10.0002	1.0000	.0999	cp	4-30	1320	78	43
99.9998	10.0000	1.0002	.0999	cp	8-26	0845	78	49
100.0000	9.9998	1.0001	.0999	cp	8-27	0955	78	43
100.0000	10.0000	1.0000	.1000	cp	8-28	1600	73	47
99.9998	10.0000	.9999	.1000	cp	8-29	1400	70	48
100.0000	10.0000	1.0000	.0999	cp	8-31	0720	72	46
100.0001	10.0000	1.0000	.1000	cp	9-1	1330	76	49
100.0000	10.0001	1.0000	.0999	cp	9-2	1300	68	47
100.0000	10.0000	1.0000	.1000	cp	9-3	1130	72	46
100.0000	10.0001	1.0000	.0999	cp	10-26	0750	70	48
100.0000	10.0000	.9998	.0997	cp	10-27	1250	74	47
100.0000	9.9999	1.0000	.0999	cp	10-29	1400	71	49
100.0000	9.9999	1.0000	.0999	cp	11-1	1000	78	49
100.0000	10.0000	.9999	.0999	cp	11-2	0715	70	48
100.0000	10.0000	1.0000	.0999	cp	11-3	0900	70	48
100.0000	10.0001	.9999	.1000	cp	11-5	1320	76	42
100.0000	10.0001	.9999	.1000	cp	11-8	1230	70	48
100.0000	10.0001	1.0000	.0998	cp	11-9	1015	71	41
100.0000	10.0000	.9999	.0995	cp	11-10	0900	70	44

BLANK PROCESSING DATA SHEET # 5

UNIT : ES2100 RUN : 5 DATE : 9-5-12

BLANKS DONE : 8-31-2010

BEAKER	A	B	C
	200 ml ACETONE	75 ml DICHLOR	200 ml WATER
	FISHER OPTIMA LOT # 023283	FISHER OPTIMA LOT # 066390	DWNA, Inc Sparkletts Distilled
FINAL WEIGHT	108.9019	106.3074	106.9680
TARE WEIGHT	108.9001	106.3058	106.9640
NET WEIGHT	.0018	.0016	.0040

TARE BEAKERS INTO DESC : TIME : 1410 DATE : 8-7-2010

DATE 8-26 BY : Cp DATE 8-27 BY : Cp DATE : BY :

BEAKER	1 ST WT	TIME	2 ND WT	TIME	3 RD WT	TIME
A	108.8999	0935	108.9001	1050		
B	106.3061	0936	106.3058	1051		
C	106.9641	0937	106.9640	1052		

FINAL BEAKERS INTO DESC : TIME : 8-28 DATE : 0820

DATE 8-29 BY : Cp DATE 8-31 BY Cp DATE : BY :

BEAKER	1 ST WT	TIME	2 ND WT	TIME	3 RD WT	TIME
A	108.9019	1501	108.9019	0742		
B	106.3076	1502	106.3074	0743		
C	106.9676	1503	106.9680	0744		

TARE QC

DATE	TIME	BY	WB	DB	%
8-26-10	0845	Cp		78	49
8-27-10	0955	Cp		78	43

FINAL QC

DATE	TIME	BY	WB	DB	%
8-29	1400	Cp		70	48
8-31	0720	Cp		72	46

NET PARTICULATE CATCH CALCULATION DATA SHEET #6

UNIT : ES2100 RUN : 5 DATE : 9-5-12

BLANK CALCULATIONS

Acetone :	.0018 g ÷	200 ml =	.000009	g/ml
Dicholoromethane :	.0016 g ÷	75 ml =	.000021	g/ml
Distilled Water :	.0040 g ÷	200 ml =	.000020	g/ml

FRONT HALF CATCH

FILTERS : .1240 (Total Catch) g - 1 (# of Filters) (.0000 g) (Blank Value / Filter) = .1240 g

BEAKERS : .0541 (Total Catch) g - 170 (ml Acetone) .0011 (.000009 g) (Blank Value / ml Acetone) = .0530 g

TOTAL FRONT HALF CATCH : .1770 g

BACK HALF CATCH

FILTERS : .0329 (Total Catch) g - 1 (# of Filters) (.0000 g) (Blank Value / Filter) = .0329 g

BEAKERS :

Acetone : .0492 (Total Catch) g - 150 (ml Acetone) .0014 (.000009 g) (Blank Value / ml Acetone) = .0478 g

Extract : .0097 (Total Catch) g - 75 (ml Dichloromethane) .0016 (.000021 g) (Blank Value / Dichloromethane) = .0081 g

Water : .0472 (Total Catch) g - 300 (ml Water) .0060 (.000020 g) (Blank Value / Water) = .0412 g

TOTAL BACK HALF CATCH : .1300 g

TOTAL CATCH : .3070 g

% FRONT HALF : 57.7 %

CALCULATIONS DATA SHEET # 7

UNIT : ES2100 RUN : 5 DATE : 9 - 5 - 2012

1) Vm (std) = $\dfrac{(74.820 \text{ Vm})(17.64)(.935 \text{ mcf})\left(30.06 \text{ " Hg} + \dfrac{.219 \text{ " } H_2O}{13.6}\right)}{(542 \text{ TmA})} = \dfrac{68.4779}{000.0000}$ dscf

2) Vw (std) = (.04707) (123.8 ml H_2O) = $\dfrac{5.8273}{00.0000}$ scf

3) Asw = $\dfrac{(5.8273 \text{ scf})}{(5.8273 \text{ scf} + 68.4779 \text{ dscf})} = \dfrac{.0784}{.0000}$ Bws × 100 = $\dfrac{7.8424}{00.0000}$ % H_2O

4) Cs = $\dfrac{(.3070 \text{ g.})}{(68.4779 \text{ dscf})}$ (15.43) = $\dfrac{.0692}{0.0000}$ gr / dscf

5) Estimated g / hr = $\dfrac{(.3070 \text{ g.})}{(68.4779 \text{ dscf})}\left(\dfrac{10.423}{00.0000} \text{ dscfm}\right)(60) = \dfrac{2.8037}{00.0000}$ g / hr

Vm =	total cubic feet pulled on meter box during test	(p. 2)	(000.000 Vm)
mcf =	meter correction factor (Y factor) of meter box used for test	(p. 2)	(0.000 mcf)
" Hg =	average barometric pressure during test	(p. 2)	(00.00 " Hg)
" H_2O =	average delta H for test	(p. 2)	(.000 " H_2O)
TmA =	average meter temperature for test in degrees Absolute	(p. 2)	(000 TmA)
ml H_2O =	total water caught during test	(p. 3)	(000.0 ml H_2O)
g. =	total particulate catch for test	(p. 6)	(00.0000 g.)
dscfm =	average stack flow during test	(p. 2)	(00.000 dscf)

TEST DATA SHEET # 8

UNIT : ES 2100 RUN : 5 DATE : 9-5-2012

Test Chamber Air Velocity Start : Ø Stop : Ø Avg.: Ø

Wet Bulb / Dry Bulb

Pre : WB : 63 DB : 76 = 48.0 % RH 1.5 % H_2O

Post : WB : 68 DB : 83 = 46.0 % RH 1.8 % H_2O

Average : 47.0 % RH 1.65 % H_2O

Empty Stove Weight (lbs) : — w/ stack & oil seal : Wet : — Dry : 0.0

Kindling Weight (lbs) : Paper : .1 Wood : 1.6

Preburn Fuel Weight : 19.0 + 14.8 Total : 33.8

Kindling & Preburn Fuel Weight (wood only) (lbs) : **Total** : 35.4

Coal Bed Wt Range (lbs) : 3.4 - 2.8 **Scale** : 3.4 - 2.8

Upper : .25 × fuel weight : Always round DOWN to nearest tenth

Lower : .20 × fuel weight : Always round UP to nearest tenth

Actual Coal Bed Weight : 3.2

Maximum Coal Bed Removal (lbs) : ((3.4 (Upper) + 28 (Lower)) ÷ 2) .25 = .7 (round down to nearest tenth)

Test Fuel (.75" × 1.5" × 5" spacers) = 16 pcs

Dimensions	Length in inches	No. Pcs	Weight in lbs	% of Load
2" × 4"	16	3	5.2	37.4
4" × 4"	16	2	8.7	62.6

Test Fuel Weight : 13.9 lbs

Estimated Dry Burn Rate :

$$\frac{13.9 - (13.9 \times .15981)}{2.2046} \times \frac{60}{\underset{\text{TIME}}{200}} = 1.589 \text{ kg / hr}$$

Estimated BTU's/hr : $19{,}140 \times \frac{63}{100} \times \frac{1.589}{\text{DBR}} = 19160.5$ BTU's/hr

EPA Default Efficiencies : Non-cat : 63 Cat : 72 Pellet : 78

120

WOOD STOVE OPERATING DATA PAGE #9

Unit : ES 2100 Run : 5 Date : 9-5-2012

FIRE STARTED: 0715

WARM UP AND PREBURN:

PRIMARY AIR : Set wide open for all warm-up / preburn fuel charges. Then set to 3.5" (1.75") at start of preburn.

SECONDARY AIR : N/A CAT BYPASS : N/A

CHARCOAL BED PREPARATION :

Raked and leveled prior to each warm-up / preburn charge. At 1 1/2 min. prior to loading last fuel, raked and leveled. In stove 20 sec.

TEST:

DOOR wide open during loading Ø min. 30 sec.

PRIMARY AIR : Opened full for first 5 min., then set to run setting of 3.5" (1.75").

SECONDARY AIR : N/A CAT BYPASS : N/A

FAN:

ON / OFF during warm-up

ON / OFF first 30 minutes of test

Fan speed set at Low

ON / OFF during preburn

ON / OFF balance of test run

WOOD DATA: KINDLING: A mix of the grades listed below:

	SIZE	MILL	GRADE	SPECIES
PREBURN:	2x4	Manke/Tacoma	Std. or better	s. grn D fir
TEST:	2x4	Packwood	# 2 or better	s. grn D fir
	4x4	Packwood	# 2 or better	s. grn D fir

PELLET FUEL MANUFACTURER : N/A BRAND : N/A

All Grades WCLB rules:

WARM UP INFORMATION:

All pre-burn / warm up fuel pieces were either 16 or 16 inches.

1st warm up / pre-burn fuel charge (19.0 lbs.) added at 0721

2nd warm up / pre-burn fuel charge (14.8 lbs.) added at 0723

3rd warm up / pre-burn fuel charge (____ lbs.) added at ____

4th warm up / pre-burn fuel charge (____ lbs.) added at ____

5th warm up / pre-burn fuel charge (____ lbs.) added at ____

TEST DATA SHEET #10

Unit : BS2100 Run : 5 Date : 9-5-2012

Room Temperature : 74 °F Temperature Correction Set? Yes No

Calibration Check: 12.0% + or – 0.2%? Yes No

Time Test Fuel moisture reading taken : 0930

pc #	Dimen.	Use	TOP	BOTTOM	SIDE	Avg Corrected
1	2"×4"×8'	K	12.7	11.9	12.6	12.400
2						
3						
4	2"×4"×8'	P	18.2	18.1	18.1	18.1
5	2"×4"×8'	P	19.0	18.8	19.1	19.0
6	2"×4"×8'	P	17.9	18.4	18.0	18.1
7	2"×4"×8'	P				55.2
8	2"×4"×8'	P				
9						
10						
11						
12	2x4x16"	T	20.2	21.0	17.2	19.5
13	"	T	20.2	18.5	22.0	20.2
14	"	T	19.2	17.6	19.0	18.6
15	4x4x16"	T	17.6	18.5	20.2	18.8
16	"	T	18.0	17.9	18.1	18.0
17						95.1
18						
19						
20	Spacers	T	22.1	20.7	21.9	21.567

Key for Use : K = Kindling P = Pretest Fuel T = Test Fuel

	KINDLING	PRETEST FUEL	TEST FUEL
Dry Moisture % :	12.400 %	18.400 %	19.020 %
Wet Moisture % :	11.032 %	15.541 %	15.981 %

To obtain Wet from Dry : $\frac{100 \times \text{\% Dry Reading}}{100 + \text{\%Dry Reading}}$ = % Moisture, Wet Basis

Acceptable Ranges : 16 - 20 % wet: 19 - 25 % dry (17.5 - 22.5 on Meter Uncor. reading) at 70°

PREBURN DATA SHEET #13

UNIT : ES2100 RUN : 5 DATE : 9-5-2012 PAGE : 1 of

TIME	SCALE	DROP	STACK	TOP	LF SIDE	BACK	RT SIDE	BOTTOM	FIREBOX	SEC/CAT	AMBIENT	STATIC	COMMENTS
0 0935	4.9	—	438	452	407	337	395	411			74	-.053	PREBURN START : # 1.5 UP
5 40	4.6	.3	360	439	411	334	384	409			74	-.050	COAL BED SCALE RANGE :
10	4.4	.2	319	415	410	328	372	410			75	-.047	3.4 → 2.8
15 50	4.2	.2	290	393	401	318	357	402			75	-.045	PRIMARY AIR : 3.5" (1.75)
20	4.1	.1	266	369	389	308	351	405			74	-.043	SECONDARY AIR : N/A
25 1000	4.0	.1	251	345	363	301	337	400			74	-.041	FAN : Low
30	3.9	.1	239	323	363	295	327	397			75	-.040	PUMPS ON AT :
35 10	3.9	Ø	230	303	349	288	318	393			75	-.039	CHECK WB/DB : N/A
40	3.9	Ø	219	294	358	288	323	393			73	-.037	
45 20	3.8	.1	212	282	331	287	309	389			72	-.037	
50	3.6	.2	208	271	324	286	305	387			73	-.035	
55 30	3.6	Ø	204	262	322	283	304	386			73	-.035	
*****	****	***	****	*****	*****	****	*****	*****	*****	*****	*****	****	
60 1035	3.5	.1	200	254	317	281	299	385			73	-.035	
65 40	3.4	.1	197	247	315	280	295	383			73	-.034	
70	3.3	.1	195	240	307	279	290	381			73	-.034	
75	3.2	.1	210	236	323	280	312	380			73	-.034	
80													
85													
90													

GAS DATA SHEET #12

WEIGHT: 3.2

DATE: 9 - 5 -2012

UNIT: ES2100

RUN: 5

PAGE: 1 OF 2

TIME	SCALE	FUEL	DROP	V.	CO_2	V.	O_2	V.	CO	STATIC	SO_2PPM
0 / 10:50	17.1	13.9	—	.043	1.1	045	19.1	.058	.58	-.031	400
5 / 55	16.8	13.6	.3	.202	5.1	205	15.5	.019	.19	-.040	175
10 / 00	16.4	13.2	.4	.263	6.6	264	13.8	.036	.36	-.045	275
15 / 05	15.6	12.4	.8	.383	9.6	384	10.9	.021	.21	-.05	250
20 / 10	14.7	11.5	.9	.510	12.8	511	7.4	.06	.60	-.055	325
25 / 15	13.8	10.6	.9	.540	13.5	539	6.5	.076	.76	-.057	400
30 / 20	12.8	9.6	1.0	.563	14.1	563	5.3	.138	1.38	-.058	475
35 / 25	11.9	8.7	.9	.564	14.1	563	6.1	.058	.58	-.060	375
40 / 30	11.0	7.8	.9	.568	14.2	567	5.9	.070	.70	-.060	375
45 / 35	10.1	6.9	.9	.565	14.1	563	5.6	.106	1.06	-.058	450
50 / 40	9.3	6.1	.8	.561	14.0	559	6.4	.031	.31	-.060	325
55 / 45	8.6	5.4	.7	.456	11.4	456	9.3	.006	.06	-.057	275
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-.631	*****
60 / 50	8.0	4.8	.6	.436	10.9	436	9.8	.008	.08	-.055	275
65 / 55	7.4	4.2	.6	.419	10.5	420	10.2	.008	.08	-.055	300
70 / 00	7.0	3.8	.4	.397	9.9	396	10.8	.009	.09	-.054	300
75 / 05	6.5	3.3	.5	.363	9.1	364	11.5	.011	.11	-.052	300
[illegible] / 10	6.1	2.9	.4	.338	8.5	340	12.1	.013	.13	-.051	300
85 / 15	5.8	2.6	.3	.339	8.5	340	12.2	.010	.10	-.050	300
90 / 20	5.5	2.3	.3	.325	8.1	324	12.5	.011	.11	-.05	300
95 / 25	5.2	2.0	.3	.294	7.4	296	13.1	.026	.26	-.048	325
100 / 30	4.9	1.7	.3	.268	6.7	268	13.8	.028	.28	-.045	350
105 / 35	4.7	1.5	.2	.259	6.5	260	14.0	.028	.28	-.044	350
110 / 40	4.6	1.4	.1	.250	6.3	252	14.2	.025	.25	-.042	350
115 / 45	4.5	1.3	.1	.248	6.2	248	14.3	.026	.26	-.041	350
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-.587	*****
120 / 50	4.4	1.2	.1	.186	4.7	189	15.7	.033	.33	-.041	325
125 / 55	4.3	1.1	.1	.184	4.6	185	15.6	.054	.54	-.040	325
130 / 00	4.3	1.1	Ø	.183	4.6	185	15.5	.066	.66	-.039	325
135 / 05	4.2	1.0	.1	.182	4.6	185	15.5	.069	.69	-.036	350
140 / 10	4.1	.9	.1	.181	4.5	181	15.5	.076	.76	-.036	350
145 / 15	4.0	.8	.1	.181	4.5	181	15.4	.087	.87	-.035	350
150 / 20	3.9	.7	.1	.181	4.5	181	15.4	.082	.82	-.035	350
155 / 25	3.8	.6	.1	.179	4.5	181	15.4	.086	.86	-.036	350
160 / 30	3.7	.5	.1	.161	4.0	161	15.9	.087	.87	-.035	350
165 / 35	3.6	.4	.1	.137	3.4	137	16.2	.118	1.18	-.033	375
[illegible] / 40	3.6	.4	Ø	.126	3.2	129	16.3	.127	1.27	-.033	375
175 / 45	3.5	.3	.1	.121	3.0	121	16.4	.135	1.35	-.032	375
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-.431	*****
TOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-1.649	*****

GAS DATA SHEET #12

WEIGHT:______

DATE: 9-5-2012

UNIT:

RUN:

PAGE: 2 OF 2

TIME	SCALE	FUEL	DROP	V.	CO_2	V.	O_2	V.	CO	STATIC	SO_2PPM
180 / 50	3.4	.2	.1	.116	2.9	117	16.7	.120	1.20	-.032	375
185 / 55	3.4	.2	Ø	.123	3.1	125	16.5	.119	1.19	-.031	400
190 / 00	3.3	.1	.1	.126	3.2	129	16.4	.113	1.13	-.030	375
195 / 05	3.3	.1	Ø	.129	3.2	129	16.5	.108	1.08	-.030	400
200 / 10	3.2	Ø	.1	.129	3.2	129	16.6	.092	.92	-.030	400
205											
210											
215											
220											
225											
230											
235											
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-.153	*****
240											
245											
250											
255											
260											
265											
270											
275											
280											
285											
290											
295											
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****		*****
300											
305											
310											
315											
320											
325											
330											
335											
340											
345											
350											
355											
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****		*****
TOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-1.802	*****

.158

Avg - -.044

Lennox-ES2100

Temperature Data Sheet 14

Run 5
9/5/12

Time	Stack	Top	LT Side	Back	Rt Side	Bottom	Firebox	Sec/Cat	Ambient	Tube Furn	Smpl Box	Smpl Out	C-Gas Box	C-Gas Out	SO2 Out
********	Chn 103	Chn 104	Chn 105	Chn 106	Chn 107	Chn 108	Chn 109	Chn 110	Chn 111	Chn 112	Chn 113	Chn 114	Chn 115	Chn 116	Chn 117
0	210	236	323	280	312	380	######	######	74	1334	246	53	229	33	35
5	270	230	308	299	283	380	######	######	74	1319	246	40	229	33	35
10	284	241	284	312	258	380	######	######	74	1305	247	40	230	33	35
15	338	275	278	321	248	378	######	######	75	1293	248	40	232	34	36
20	400	326	273	325	247	373	######	######	75	1283	247	41	234	34	36
25	436	391	276	326	254	368	######	######	75	1276	247	42	237	34	36
30	451	449	284	335	263	362	######	######	77	1270	246	43	241	34	36
35	458	498	293	301	276	357	######	######	77	1266	246	43	245	34	37
40	461	527	310	291	287	353	######	######	78	1262	245	42	246	35	36
45	453	554	327	287	301	349	######	######	78	1259	246	43	247	35	37
50	449	564	344	284	312	347	######	######	79	1256	246	44	247	35	37
55	428	557	343	283	321	345	######	######	79	1254	247	44	248	35	37
60	411	534	354	288	327	343	######	######	80	1252	245	45	247	35	38
65	401	517	364	289	335	342	######	######	80	1250	244	45	247	35	38
70	387	500	370	293	341	341	######	######	80	1250	245	46	247	35	38
75	366	483	375	302	341	339	######	######	80	1251	246	47	245	34	38
80	350	464	376	309	345	338	######	######	80	1251	243	48	242	34	38
85	341	447	376	319	345	337	######	######	80	1252	241	49	240	34	37
90	334	432	381	327	343	337	######	######	80	1253	239	50	238	34	37
95	319	415	378	335	344	337	######	######	80	1257	238	50	238	34	37
100	303	396	390	345	346	338	######	######	81	1262	239	49	238	34	37
105	293	378	381	351	344	338	######	######	81	1266	239	50	239	33	37
110	282	362	370	354	342	340	######	######	82	1271	240	50	239	33	37
115	276	348	380	355	343	341	######	######	82	1275	241	51	239	33	36
120	267	335	376	352	340	343	######	######	81	1278	241	52	239	33	36
125	256	322	373	351	333	344	######	######	82	1282	241	52	239	33	36
130	248	310	374	342	325	346	######	######	82	1284	241	53	237	33	36
135	241	299	353	332	317	347	######	######	82	1286	241	53	237	33	36
140	236	289	360	322	311	348	######	######	81	1288	241	53	237	33	35
145	233	280	344	315	304	347	######	######	82	1289	241	53	236	32	35
150	230	273	350	310	298	348	######	######	81	1291	241	53	236	32	35
155	227	266	342	305	297	347	######	######	82	1293	241	53	236	32	35
160	223	260	337	300	293	347	######	######	81	1294	240	53	235	32	35
165	216	254	338	296	287	347	######	######	81	1294	240	54	234	32	35
170	211	248	329	293	281	346	######	######	82	1295	240	54	234	32	34

Lennox-ES2100 Temperature Data Sheet 14 Run 5 9/5/12

175	205	242	316	288	273	345	######	######	81	1295	240	54	234	31	34
180	201	235	314	284	271	343	######	######	81	1295	240	54	234	31	34
185	197	230	308	281	266	341	######	######	82	1296	239	56	234	31	34
190	194	224	311	279	261	339	######	######	82	1295	240	56	233	31	33
195	193	219	294	276	254	337	######	######	82	1295	239	59	233	31	33
200	191	215	289	276	255	334	######	######	82	1295	239	59	232	31	33

TEMPERATURE DATA SHEET #14A

		TEST TIME	200		
STACK AVG	304	TOP AVG	357	LT SIDE AVG	338
BACK AVG	310	RT SIDE AVG	303	BOTTOM AVG	348
FIREBOX AVG	########	SEC/CAT AVG	########	AMBIENT AVG	80

END	273.9	
START	306.0	
	-32.1	DELTA T

CIRCLE: LOSS / GAIN

ZERO / SPAN CHECK DATA SHEET #15-1

Date : 9 - 5 -2012 Analyte : CO_2 (15-1)

Unit : ES2100 Run # : 5

Zero Cyl. # : 168TAC 3-A Conc. : 0.00 % CO_2 Cyl. Press. : 400 PSI

Certified by : AIR LIQUIDE Date : 04-19-04

Span Cyl. # : 487905 Conc. : 12.20 % CO_2 Cyl. Press. : 1300 PSI

Certified by : AIR LIQUIDE Date : 11-1-07

Analyzer : Make : HORIBA Model : PIR-2000 SN : 407069

Range : 0 - 25.0 % CO_2 Analyzer Output : 0 - 1.0 v.

Flow : 1.5 SCFH Measured by : Rotameter

EPA Span Value = 25.0 % CO_2

EPA Control Limits = ± 2.5% of 25.0 % CO_2 = ± 0.625 % CO_2

Method 28 A = ± .2 % of 25.0 % CO_2 = ± .05 % CO_2

PRE RUN Audit : by : C Washington Time : 0920 Temp : 78 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	.018	.018	.072
SPAN	48.8	.488	12.20	48.8	.488	12.21	.010	.039

POST RUN Audit : by : C Washington Time : 1500 Temp : 81 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	-.001	-.007	-.007	-.028
SPAN	48.8	.488	12.20	48.6	.486	12.160	-.040	-.161

± Conc. Difference = Act % - Exp (Std) %

$$\text{Zero \% Difference} = \frac{\text{Act \% (ppm) - Exp \% (ppm)}}{\text{Full Scale Value}} \times 100$$

$$\text{Span \% Difference} = \frac{\text{Act \% (ppm) - Exp \% (ppm)}}{\text{Full Scale Value}} \times 100$$

ZERO / SPAN CHECK DATA SHEET #15-2

Date : 9-5 -2012 Analyte : O_2 (15-2)

Unit : ES2100 Run # : 5

Zero Cyl. # : 168TAC 3-A Conc. : 0.00 % O_2 Cyl. Press. : 400 PSI

Certified by : AIR LIQUIDE Date : 04-19-04

Span Cyl. # : 487905 Conc. : 12.60 % O_2 Cyl. Press. : 1300 PSI

Certified by : AIR LIQUIDE Date : 11-1-07

Analyzer : Make : TELEDYNE Model : 320 A SN : 37400

Range : 0 - 25.0 % O_2 Analyzer Output : 0 - 1.0 v.

Flow : 1.5 SCFH Measured by : Rotameter

EPA Span Value = 25.0 % O_2

EPA Control Limits = ± 2.5% of 25.0 % O_2 = ± 0.625 % O_2

Method 28 A = ± .2 % of 25.0 % O_2 = ± .05 % O_2

PRE RUN Audit : by : C. Wadley Time : 0920 Temp : 75 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	-.035	-.035	-.142
SPAN	12.60	.504	12.6	12.6	.504	12.617	.017	.070

POST RUN Audit : by : C. Wadley Time : 1500 Temp : 81 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.001	-.010	-.010	-.042
SPAN	12.60	.504	12.6	12.6	.505	12.643	.043	.170

± Conc. Difference = Act % - Exp (Std) %

Zero % Difference = $\frac{\text{Act \% (ppm) - Exp \% (ppm)}}{\text{Full Scale Value}}$ X 100

Span % Difference = $\frac{\text{Act \% (ppm) - Exp \% (ppm)}}{\text{Full Scale Value}}$ X100

ZERO / SPAN CHECK DATA SHEET #15-3

Date : 9-5-2012 Analyte : CO (15-3)

Unit : ES2100 Run # : 5

Zero Cyl. # : 168TAC 3-A Conc. : 0.00 % CO Cyl. Press. : 400 PSI

Certified by : AIR LIQUIDE Date : 04-19-04

Span Cyl. # : 1487905 Conc. : 4.90 % CO Cyl. Press. : 1300 PSI

Certified by : AIR LIQUIDE Date : 11-1-07

Analyzer : Make : HORIBA Model : PIR-2000 SN : 408005

Range : 0 - 10.0 % CO Analyzer Output : 0 - 1.0 v.

Flow : 1.5 SCFH Measured by : Rotameter

EPA Span Value = 10.0 % CO
EPA Control Limits = ± 2.5% of 10.0 % CO = ± 0. 25 % CO
Method 28 A = ± .2 % of 10.0 % CO = ± .02 % CO

PRE RUN Audit : by : C. Watling Time : 0926 Temp : 75 ° F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	-.006	-.006	-.056
SPAN	49.0	.490	4.90	49.0	.490	4.911	.011	.110

POST RUN Audit : by : C. Watling Time : 1500 Temp : 81 ° F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	-.006	-.006	-.056
SPAN	49.0	.490	4.90	49.1	.491	4.921	.021	.210

± Conc. Difference = Act % - Exp (Std) %

Zero % Difference = $\frac{\text{Act \% (ppm) - Exp \% (ppm)}}{\text{Full Scale Value}}$ X 100

Span % Difference = $\frac{\text{Act \% (ppm) - Exp \% (ppm)}}{\text{Full Scale Value}}$ X100

ZERO / SPAN CHECK DATA SHEET #15-4

Date : 9 · 5 -2012 Analyte : SO_2 (15-4)

Unit : ES2100 Run # : 5

Zero Cyl. # : 168TAC 3-A Conc. : 0.00 ppm SO_2 Cyl. Press. : 400 PSI

Certified by : AIR LIQUIDE Date : 04-19-04

Span Cyl. # : CC82089 Conc. : 1250 ppm SO_2 Cyl. Press. : 1690 PSI

Certified by : AIR LIQUIDE Date : 01-3-2007

Analyzer : Make : HORIBA Model : PIR-2000 SN : 403019

Range : 0 - 2500 ppm SO_2 Analyzer Output : 0 - 1.0 v.

Flow : 1.5 SCFH Measured by : Rotameter

EPA Span Value = 2500 ppm SO_2

EPA Control Limits = ± 2.5% of 2500 ppm SO_2 = ± 62.5 ppm SO_2

PRE RUN Audit : by : C. Watkins Time : 0920 Temp : 75 ° F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	PPM	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	-1.954	-1.954	-.078
SPAN	50.0	.500	1250	50.0	.500	1252.95	2.950	.118

POST RUN Audit : by : C. Watkins Time : 1500 Temp : 81 ° F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	PPM	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	-.003	-9.483	-9.483	-.379
SPAN	50.0	.500	1250	49.8	.498	1247.9	-2.100	-.084

± Conc. Difference = Act % - Exp (Std) %

Zero % Difference = $\dfrac{\text{Act \% (ppm) - Exp \% (ppm)}}{\text{Full Scale Value}}$ X 100

Span % Difference = $\dfrac{\text{Act \% (ppm) - Exp \% (ppm)}}{\text{Full Scale Value}}$ X100

QUALITY CHECKS DATA SHEET # 16

UNIT : ES2100 RUN : 5 DATE : 9-5-2012

Thermocouple Check:

T/C # 1	— °F	T/C # 13	68.7 °F
T/C # 2	— °F	T/C # 14	67.0 °F
T/C # 3	67.5 °F	T/C # 15	69.4 °F
T/C # 4	65.6 °F	T/C # 16	59.4 °F
T/C # 5	65.5 °F	T/C # 17	48.1 °F
T/C # 6	65.7 °F	T/C # 18	69.9 °F
T/C # 7	65.4 °F	T/C # 19	— °F
T/C # 8	65.8 °F	T/C # 20	— °F
T/C # 9	— °F	T/C # 21	— °F
T/C # 10	— °F	T/C # 22	— °F
T/C # 11	61.8 °F	T/C # 23	— °F
T/C # 12	74.3 °F	T/C # 24	— °F

Thermocouple Readout:

Pretest zero and span check and calibration — post test zero and span — % difference

ZERO .2 °F	Adj. to 0.0 °F	ZERO 0.0 °F	Difference 0.0 %
SPAN 2000.0 °F	Adj. to 2000.0 °F	SPAN 2000.7 °F	Difference .035 %

Thermocouple Readout Pretest Linearity Check:

0	= 0.0 °F	200	= 200.3 °F	400	= 400.1 °F
600	= 600.0 °F	800	= 800.0 °F	1000	= 1000.0 °F
1200	= 1200.0 °F	1400	= 1399.8 °F	1600	= 1599.8 °F
1800	= 1800.0 °F	2000	= 2000.0 °F		

Sample Train Leak Check	Pre ✓	Post ✓
C-gas Train Leak Check	Pre ✓	Post ✓
SO_2 Train Leak Check	Pre ✓	Post ✓
Static Gauge Zero Check	Pre ✓	Post ✓

Scale Check Pre : 13.6 — 3.6 = 10.0

Post : 12.9 − 2.9 = 10.0

Stack Cleaned Prior to Test Run : YES ______ NO X

MAY YBR

TABLE 1 ---- RAW DATA

CLIENT : Lennox TEST No. : 3

MODEL: ES2100 DATE: 03-Sep-12

****

TIME (MIN.)	METER READING (C F)	DELTA H (IN. H2O)	METER TEMP. (DEG. F)	PERCENT CO (%)	PERCENT CO2 (%)	SO2 COCENTR. PPM
0	550.500	0.150	83	0.20	6.90	300
5	552.000	0.150	86	0.33	6.90	300
10	553.547	0.180	86	0.22	9.90	275
15	555.234	0.100	87	0.61	12.60	375
20	556.476	0.100	87	0.69	14.30	375
25	557.718	0.110	89	0.63	15.10	350
30	559.058	0.210	89	0.27	14.50	250
35	560.934	0.260	89	0.16	13.00	225
40	563.018	0.260	89	0.12	11.20	225
45	565.102	0.330	89	0.11	11.50	200
50	567.445	0.330	89	0.05	9.90	200
55	569.789	0.330	89	0.07	8.60	200
60	572.132	0.330	89	0.18	7.00	200
65	574.475	0.330	89	0.21	6.40	200
70	576.819	0.330	89	0.19	6.40	200
75	579.162	0.330	89	0.16	6.60	200
80	581.506	0.330	89	0.19	6.40	200
85	583.849	0.330	89	0.20	5.50	200
90	586.193	0.330	89	0.24	5.60	200
95	588.536	0.330	89	0.35	5.00	200
100	590.879	0.330	89	0.46	4.80	200
105	593.223	0.330	89	0.56	4.50	200
110	595:566	0.330	89	0.58	4.30	200
115	597.910	0.330	89	0.76	3.80	200
120	600.253	0.330	89	0.74	3.80	200
125	602.597	0.330	89	0.78	3.70	200
130						

TABLE 2---RAW DATA

CLIENT :	Lennox	TEST No.	3
MODEL:	ES2100	DATE:	03-Sep-12

****

METER CAL. FACTOR (Y) -------	0.935		Wt. WOOD BURNED(LB) -------	14.0	Lbs
BAROMETRIC PRESS.(Pb) -------	30.18	in Hg	WET,FUEL MOISTURE % -------	17.205	%
LEAK RATE POST (Lp) -------	0.000	cfm	Wt. PART. COLLECTED -------	0.1923	g
WATER VOL. (V1c) -------	81.4	Ml	METER VOLUME Vm -------	52.097	mcf
TEST TIME (MIN) -------	125	min	HC MOLE FRACTION -------	0.0132	

TABLE 3 -----FIELD DATA AVERAGES

CLIENT : Lennox

TEST No. 3

MODEL: ES2100

DATE: 03-Sep-12

****

AVG DELTA H	-------	0.27 in H_2O	AVG PRCNT CO	-------	0.35	%
AVG METER TEMP. Tm	-------	88 deg F	AVG PRCNT CO_2	-------	8.01	%
AVG PPM SO_2	-------	234 PPM	AVG BAL CO_2/CO	-------	22.98	%

TABLE 5 ----- PROPORTIONAL RATE VARIATION

CLIENT : Lennox TEST No. : 3

MODEL: ES2100 DATE: 03-Sep-12

	TIME INTEVAL Ti	PPM * Vm	PROPRTN. RATE VAR. PR		PROPRTN RATE VAR. AVERAGE	
	5	411.8	97		100	
	10	423.5	100			
	15	423.0	100			
	20	424.2	100			
	25	423.4	100			
	30	425.6	100			
	35	425.7	100			
	40	425.7	100			
	45	425.7	100			
	50	425.5	100			
	55	425.6	100			
	60	425.5	100			
	65	425.5	100			
	70	425.6	100			
	75	425.5	100			
	80	425.6	100			
	85	425.5	100			
	90	425.6	100			
	95	425.5	100			
	100	425.5	100			
	105	425.6	100			
	110	425.5	100			
	115	425.6	100			
	120	425.5	100			
	125	425.6	100			
	130					

COMPUTER INPUT DATA SHEET #1

Client: Lennox Hearth Products

Address: 1502 14th Street NW

Auburn, WA 98001

Phone: 253-735-1100 Fax: 253-931-1221

Run No.: 3 Date of Test: 9-3-2012 Burn Rate: 2.524 3.62

Model No.: ES2100 ☐ min ☐ min-1.25 ☐ fan

Stove Type: ☐ Cat ☒ Non Cat ☐ Pellet ☐ 1.25-1.9 ☒ max ☐ insert

Dry Gas Meter Y Factor: .935 (0.000) (Data Sheet #2) Post Leak Rate: 0.000 cfm (.000) (Data Sheet #2) Time: 125 min. (000) (Data Sheet #2)

Dry Gas Meter Volume: 52.097 cf (00.000) (Data Sheet #2)

Stack Flow: 15.357 dscfm (00.000) (Data Sheet #2) Δ H: .274 in. H_2O (.000) (Data Sheet #2)

Maximum Vac.: 2.0 (0.0) (Data Sheet #2) Barometric Pressure: 30.18 in. Hg (00.00) (Data Sheet #2)

H_2O Captured: 81.4 g (00.0) (Data Sheet #3)

Front Half Catch % Of Total: 55.6 % (00.0) (Data Sheet #6) Total Particulate Catch: .1923 g (0.0000) (Data Sheet #6)

Flue Gas Moisture: 7.4856 % (00.000) (Data Sheet #7)

Particulate Emission: .0627 gr/dscf (0.0000) (Data Sheet #7)

Relative Humidity: 45.0 % RH (00.0) (Data Sheet #8) Ambient Moisture: 1.5 % H_2O (0.00) (Data Sheet #8)

Preburn Fuel Wt.: 32.2 lbs. (00.0) (Data Sheet #8) Coal Bed Wt.: 2.9 lbs. (00.0) (Data sheet #8) Test Fuel Wt.: 14.0 lbs. (00.0) (Data sheet #8)

Heat Output (EPA Default): 30435.0 BTU/hr (00,000.0) (Data Sheet #8)

Kindling Fuel % Moisture (wet): 11.164 % (00.000) (Data Sheet #10) Pretest Fuel % Moisture (wet): 15.660 % (00.000) (Data Sheet #10)

Test Fuel % Moisture (dry): 20.780 % (00.000) (Data Sheet #10 [wood stove] or #11 [pellet stove]) Test Fuel % Moisture (wet): 17.205 %

Fuel Higher Heating Value (dry): ——— BTU/lb. (0000) (Data Sheet #11)

Stack Static Pressure: -.051 in. H_2O (+/- .000) (Data Sheet #12)

Average Ambient Temperature: 79 °F (00) (Data Sheet #14) Stove Temperature Change: -73.1 °F (+/- 000.0) (Data Sheet #14)

Test Start 1240 meter temp 548

End 1445

METER BOX DATA SHEET PAGE # 2

Page: 1 of 2

UNIT : ES2100 RUN : 3 DATE : 9-3-2012

Meter Box: 5H Y Factor: .935

Leak checks: 15 " Hg @ 0.000 cfm ______ " Hg @ ____ cfm

15 " Hg @ 0.000 cfm ______ " Hg @ ____ cfm

Inject SO² @ 100 cc/min. Nozzle: Probe @ 3/8 " od Initial Volume: 1.500

ROTO: PRESS: .18			SAMPLING RATIO: 38 : 1				BP: 30.18		
MIN	TIME	METER READING	SAMPLE MDCF	STACK DSCFM	DELTA H	METER TEMP	SO2 PPM	ROTO TEMP	PUMP VACC
0	1240	550.500	———	11.553	.15	83	300	83	2.0
5	45	552.000	———	11.489	.15	86	300	86	2.0
10	50	553.547	553.547	12.534	.18	86	275	86	2.0
15	55	555.234	555.234	9.175	.10	87	375	87	2.0
20	1300	556.476	556.476	9.175	.10	87	375	87	2.0
25	05	557.718	557.718	9.794	.11	89	350	89	2.0
30	10	559.058	559.058	13.712	.21	89	250	89	2.0
35	15	560.934	560.934	15.235	.26	89	225	89	2.0
40	20	563.018	563.018	15.235	.26	89	225	89	2.0
45	25	565.102	565.102	17.140	.33	89	200	89	2.0
50	30	567.445	567.445	17.140	.33	89	200	89	2.0
55	35	569.789	569.789	17.140	.33	89	200	89	2.0
ROTO PRESS:	.18		TOTALS:	159.322	2.51	1052	BP.: 30.18		
60	1340	572.132	572.132	17.140	.33	89	200	89	2.0
65	45	574.475	574.475	17.140	.33	89	200	89	2.0
70	50	576.819	576.819	17.140	.33	89	200	89	2.0
75	55	579.162	579.162	17.140	.33	89	200	89	2.0
80	1400	581.506	581.506	17.140	.33	89	200	89	2.0
85	05	583.849	583.849	17.140	.33	89	200	89	2.0
90	10	586.193	586.193	17.140	.33	89	200	89	2.0
95	15	588.536	588.536	17.140	.33	89	200	89	2.0
100	20	590.879	590.879	17.140	.33	89	200	89	2.0
105	25	593.223	593.223	17.140	.33	89	200	89	2.0
110	30	595.566	595.566	17.140	.33	89	200	89	2.0
115	35	597.910	597.910	17.140	.33	89	200	89	2.0
			TOTALS:	205.680	3.96	1068	MAX VACC =		
TOTAL Cu Ft.			TOTALS:	365.002	6.47	2120	AVG. BP:		

METER BOX DATA SHEET PAGE # 2

UNIT: ES2100 RUN: 3 DATE: 9-3-2012

Meter Box: SH Y Factor: .935

Leak checks: 15 " Hg @ .000 cfm ____ " Hg @ ____ cfm

15 " Hg @ .000 cfm ____ " Hg @ ____ cfm

Inject SO^2 @ 100 cc/min. Nozzle : Probe @ 3/8 " od Initial Volume: 1.500

ROTO: PRESS: .18			SAMPLING RATIO: 38 : 1				BP: 30.18		
MIN	TIME	METER READING	SAMPLE MDCF	STACK DSCFM	DELTA H	METER TEMP	SO2 PPM	ROTO TEMP	PUMP VACC
120	1440	600.253	600.253	17.140	.33	89	200	89	2.0
125	45	602.597	602.597	17.140	.33	89	200	89	2.0
130	50			34.280	.66	178			
135									
140									
145									
150									
155									
160									
165									
170									
175									
ROTO PRESS:			TOTALS:				BP.:		
180									
185									
190									
195									
200									
205									
210									
215									
220									
225									
230				399.282		2298			
235					7.13				
			TOTALS:			88	MAX VACC =		2.0
TOTAL Cu Ft.		52.097	TOTALS:	15.357	.274	548	AVG. BP:	30.18	

÷26

PARTICULATE CATCH / MOISTURE DATA SHEET # 3

UNIT : GS2100 RUN : 3 DATE : 9-3-12

SCALE CHECK	LEVEL	ZEROED
INITIAL :	✓	✓
FINAL :	✓	✓

SCALE	WEIGHT
295.0 g	295.0
590.0 g	590.0
885.0 g	885.0

IMPINGER	# 1	# 2	# 3	# 4
FINAL WT	666.0	586.3	486.4	906.6
INITIAL WT	603.5	581.2	484.9	894.3
NET WT GRAMS	62.5	5.1	1.5	12.3

TOTAL CATCH : 81.4 GRAMS H_2O

FRONT HALF

FILTER #	54F	
FINAL WT g	.7007	
INITIAL WT g	.6290	
NET WT g	.0717	

BEAKER #	16
DESC.	ACETONE
FINAL WT g	95.7647
INITIAL WT g	95.7287
NET WT g	.0360
VOL. DESC. ml	85

BACK HALF

FILTER #	54B	
FINAL WT g	.3079	
INITIAL WT g	.2811	
NET WT g	.0268	

BEAKER #	17	18	19	20	
DESC.	ACETONE	METHCHLOR	H_2O	H_2O	
FINAL WT g	104.6340	108.8582	106.5471	108.5975	
INITIAL WT g	104.5845	108.8519	106.5331	108.5818	
NET WT g	.0495	.0063	.0140	.0157	.0297
VOL. DESC ml	125	75	125	140	265

FILTER TARE WEIGHTS DATA SHEET #4-1

Into Dessicator : Date : 1-6-12 Time : 1000 By CD

Manufacturer S & S Grade : # 25 Glass Front Size : 11 cm Lot No. : 393580

Back Size: 8.2 cm Lot No. : 4642541

FILTER #	DATE: 1-13-12 FIRST WEIGHT	BY: CD TIME	DATE: 1-14-12 SECOND WEIGHT	BY: CD TIME	DATE: THIRD WEIGHT	BY: TIME
51F	.6325	1055	.6330	1320	✓	
52F	.6313	1056	.6313	1321	✓	
53F	.6317	1057	.6318	1322	✓	
54F	.6294	1058	.6290	1323	← R-3	
55F	.6330	1059	.6329	1324	✓	
56F	.6285	1100	.6287	1325	✓	
57F	.6261	1101	.6258	1326	✓	
58F	.6327	1102	.6326	1327	✓	
59F	.6298	1103	.6297	1328	✓	
60F	.6303	1104	.6300	1329	✓	

51B	.2812	1105	.2810	1330	✓	
52B	.2829	1106	.2830	1331	✓	
53B	.2825	1107	.2825	1332	✓	
54B	.2811	1108	.2811	1333	✓ ← R-3	
55B	.2804	1109	.2803	1334	✓	
56B	.2837	1110	.2839	1335	✓	
57B	.2831	1111	.2829	1336	✓	
58B	.2831	1112	.2829	1337	✓	
59B	.2836	1113	.2838	1338	✓	
60B	.2833	1114	.2834	1339	✓	

Checked by: Armando Verdy Date: 01-16-2012 Time: 0950

BALANCE ROOM ENVIRONMENTAL CONDITIONS

DATE	TIME	BY	WB	DB	% RH
1-13-12	1036	CJ	S	72	46
1-14-12	1312	CJ		70	48

BEAKER TARE WEIGHTS DATA SHEET #4-2

Into Dessicator: Date : 10-1-11 Time : 1100 By : CJ

BEAKER #	FIRST WEIGHT (DATE: 10-5-11, BY: CJ)	TIME	SECOND WEIGHT (DATE: 10-6-11, BY: CJ)	TIME	THIRD WEIGHT (DATE: ____, BY: ____)	TIME
1	104.9129	1315	104.9133	1005	✓	
2	106.2505	1316	106.2506	1006	✓	
3	107.7718	1317	107.7719	1007	✓	
4	108.7694	1318	108.7690	1008	✓	
5	97.4307	1319	97.4304	1009	✓	
6	91.2030	1320	91.2026	1010	✓	
7	97.1326	1321	97.1322	1011	✓	
8	108.6309	1322	108.6309	1012	✓	
9	108.0904	1323	108.0901	1013	✓	
10	105.7240	1324	105.7235	1014	✓	
11	104.7777	1325	104.7775	1015	✓	
12	98.2142	1326	98.2137	1016	✓	
13	104.1677	1327	104.1675	1017	✓	
14	97.9658	1328	97.9655	1018	✓	
15	104.7508	1329	104.7511	1019	✓	
16	95.7284	1330	95.7287	1020	✓	
17	104.5845	1331	104.5845	1021	✓	
18	108.8518	1332	108.8519	1022	✓ R-3	
19	106.5332	1333	106.5331	1023	✓	
20	108.5821	1334	108.5818	1024	✓	
21	108.2201	1335	108.2205	1025	✓	
22	105.9186	1336	105.9189	1026	✓	
23	104.5747	1337	104.5748	1027	✓	
24	106.3950	1338	106.3951	1028	✓	
25	99.6593	1339	99.6595	1029	✓	

BALANCE ROOM ENVIRONMENTAL CONDITIONS

DATE	TIME	BY	WB	DB	% RH
10-5-11	1310	CW	-	71	49
10-6-11	1000	CW	-	78	40
		CW	-		

Checked by : A.V.
Date : Oct - 6 - 2011
Time : 11:10

WOODSTOVE DATA SHEET # 4-3 : CONSTANT WEIGHTS

UNIT : ES210 RUN : 3 DATE : 9-3-12

Beaker #	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By
16	9-4	1400	gp	95.7644	9-5	1001	gp	95.7647	9-6	1140	gp				
17	9-4	1400	gp	104.6335	9-5	1002	gp	104.6340	9-6	1141	gp				
18	9-4	1400	gp	108.8582	9-5	1003	gp	108.8582	9-6	1142	gp				
19	9-4	1400	gp	106.5469	9-5	1004	gp	106.5471	9-6	1143	gp				
20	9-4	1400	gp	108.5974	9-5	1005	gp	108.5975	9-6	1144	gp				

Filter #	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By
5HF	9-3	1600	gp	.7012	9-4	1018	gp	.7007	9-5	0958	gp				
5HB	9-3	1600	gp	.3098	9-4	1020	gp	.3081	9-5	1000	gp	.3079	9-6	1138	gp

SCALE ROOM ENVIRONMENTAL CONDITIONS

Weighing Session	Date	Time	By	DB	%RH
1	9-4-12	1000	gp	77	48
2	9-5-12	0945	gp	78	46
3	9-6-12	1130	gp	76	49
4					
5					

Weighing Session	Date	Time	By	DB	%RH
6					
7					
8					
9					
10					

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates: From 1-14-2012 Through	Scale: Sartorius	Model: A 120 S	SN: 37010004

100 g weight	10 g weight	1 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	% RH
100.0000	10.0000	1.0000	.0999	[illegible]	1-14-12	1310	70	48
100.0002	10.0001	1.0001	.1000	[illegible]	1-15-12	1330	68	47
99.9997	10.0000	1.0001	.1000	[illegible]	1-17-12	1030	73	47
99.9997	10.0001	1.0000	.1000	[illegible]	1-18-12	0915	74	44
99.9999	10.0002	1.0001	.1001	[illegible]	1-19-12	1015	70	44
100.0001	10.0001	1.0001	.0998	[illegible]	1-25-12	1600	72	46
99.9999	9.9998	1.0001	.1000	[illegible]	1-26-12	1500	70	48
99.9995	9.9999	1.0000	.0999	[illegible]	1-28-12	1400	70	41
100.0000	10.0000	1.0000	.0999	[illegible]	2-4-12	1500	73	60
100.0000	10.0003	.9999	.0999	[illegible]	2-6-12	1200	69	44
100.0000	10.0000	.9999	.0998	[illegible]	2-7-12	1030	67	42
100.0000	9.9999	1.0001	.0999	[illegible]	2-10-12	1630	78	49
100.0000	10.0001	1.0000	.1000	[illegible]	2-11-12	1630	72	46
99.9997	10.0002	1.0000	.1001	[illegible]	2-12-12	1530	73	47
100.0000	10.0000	.9999	.0999	[illegible]	2-13-12	1100	78	46
99.9995	10.0000	.9999	.0999	[illegible]	2-14-12	1000	76	45
100.0000	9.9999	.9999	.1000	[illegible]	2-15-12	1120	70	44
99.9999	10.0000	1.0000	.0999	[illegible]	2-17-12	1415	73	47
99.9999	10.0000	1.0000	.0998	[illegible]	2-19-12	1600	70	44
99.9997	9.9999	1.0000	.0999	[illegible]	2-20-12	1200	70	48
100.0004	10.0001	1.0000	.1000	[illegible]	2-23-12	1000	73	47
100.0000	9.9997	1.0000	.0999	[illegible]	2-24-12	1015	78	46
100.0000	10.0000	1.0000	.1001	[illegible]	2-25-12	1715	65	48
100.0000	9.9996	1.0000	.0999	[illegible]	2-27-12	1000	70	44
100.0000	10.0000	1.0001	.1002	[illegible]	2-28-12	1125	75	41
99.9997	10.0000	1.0000	.1000	[illegible]	2-29-12	1110	68	43
99.9995	9.9999	.9999	.0997	[illegible]	3-1-12	1330	68	47
99.9996	10.0000	1.0000	.0998	[illegible]	3-2-12	1430	71	45
99.9995	9.9999	1.0000	.0999	[illegible]	3-3-12	1430	72	42
99.9999	10.0000	.9999	.0999	[illegible]	9-2-12	0945	77	46
100.0000	10.0000	1.0000	.1000	[illegible]	9-3-12	1030	71	49
100.0002	9.9999	1.0000	.0998	[illegible]	9-4-12	1000	77	49
100.0000	10.0000	1.0000	.0999	[illegible]	9-5-12	0945	78	46
100.0000	10.0002	1.0000	.0999	[illegible]	9-6-12	1130	76	49
99.9997	10.0001	1.0002	.0999	[illegible]	9-7-12	1400	76	49
100.0000	10.0001	1.0000	.0999	[illegible]	9-8-12	1200	71	49

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates: From 4-13-2011 Through 1-13-2012	Scale: Sartorius	Model: A 120 S	SN: 37010004

100 g weight	10 g weight	1 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	% RH
100.0000	10.0001	1.0000	.0998	CJ	4-13-11	1030	66	49
100.0001	10.0002	1.0000	.0999	CJ	4-15-11	1330	75	48
100.0004	10.0000	.9999	.0998	CJ	4-19-11	1600	79	44
100.0003	10.0000	1.0000	.0999	CJ	4-20-11	1815	72	46
100.0000	10.0001	.9999	.1000	CJ	6-16-11	0900	76	39
99.9997	9.9999	.9998	.0999	CJ	6-18-11	1530	74	44
99.9996	10.0002	1.0000	.0999	CJ	6-20-11	1600	73	47
100.0000	10.0000	.9998	.0999	CJ	6-21-11	1400	73	47
100.0000	10.0000	1.0001	.0999	CJ	6-22-11	1200	72	46
99.9999	9.9998	1.0000	.1000	CJ	6-23-11	1700	76	49
100.0000	10.0002	1.0000	.0999	CJ	6-24-11	1400	75	48
100.0000	10.0000	1.0000	.0999	CJ	6-27-11	1230	78	46
100.0001	10.0002	.9999	.0998	CJ	6-30-11	1030	78	46
99.9995	10.0000	.9999	.0999	CJ	7-1-11	1030	70	48
99.9999	9.9999	1.0000	.1000	CJ	7-2-11	1145	75	45
100.0000	9.9999	.9999	.0999	CJ	7-5-11	1000	73	47
99.9999	10.0001	1.0000	.0999	CJ	7-6-11	0930	76	49
100.0000	9.9997	1.0000	.0997	CJ	9-22-11	1700	77	46
100.0000	10.0001	1.0000	.0999	CJ	9-24-11	1700	77	49
100.0000	9.9998	1.0001	.1000	CJ	9-25-11	1300	76	49
100.0000	9.9999	1.0001	.0998	CJ	9-27-11	1000	77	49
99.9996	9.9999	1.0000	.0998	CJ	9-29-11	0840	72	42
99.9997	9.9998	.9999	.1000	CJ	9-30-11	1000	70	48
99.9996	9.9998	1.0000	.0999	CW	10-1-11	1520	70	45
99.9998	10.0002	1.0000	.0997	CJ	10-2-11	1430	74	47
99.9995	10.0001	1.0000	.0999	CJ	10-5-11	1510	71	49
100.0000	9.9999	1.0000	.0998	CJ	10-6-11	1000	78	40
100.0000	9.9999	1.0000	.0999	CJ	10-9-11	1130	75	45
100.0000	10.0001	1.0000	.0998	CJ	10-16-11	1540	68	47
100.0000	10.0000	1.0000	.0998	CJ	11-9-11	1230	72	46
100.0000	10.0002	.9998	.0998	CJ	11-11-11	0815	70	48
99.9999	10.0000	1.0000	.0996	CJ	11-15-11	1200	75	45
99.9995	10.0001	.9999	.0999	CJ	11-16-11	1400	70	44
99.9999	10.0001	.9999	.0998	CJ	11-20-11	1600	73	43
99.9998	9.9999	.9999	.0999	CJ	11-21-11	1715	74	47
100.0000	10.0000	1.0000	.0999	CJ	11-22-11	1600	65	48
100.0000	10.0000	1.0000	.0999	CW	1-9-12	1030	70	48
100.0000	9.9999	1.0001	.1000	CJ	1-11-12	1720	65	48
100.0000	10.0001	1.0000	.0997	CJ	1-13-12	1030	72	46

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates: From 11-11-10 Through 4-7-11	Scale: Sartorius	Model: A 120 S	SN: 37010004

100 g weight	10 g weight	1 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	% RH
100.0000	10.0002	1.0000	.0998	cp	11-11	0840	67	42
100.0000	10.0000	1.0001	.1000	cp	11-15	0930	70	48
100.0000	10.0001	1.0000	.0999	cp	11-19	0930	65	48
100.0000	10.0000	1.0000	.1000	cp	11-23	1400	66	45
100.0000	9.9997	1.0000	.0998	cp	11-24	1400	65	48
100.0000	10.0000	.9999	.0998	cp	11-26	1100	67	46
100.0000	10.0001	1.0001	.0997	cp	12-14	1000	75	41
100.0001	10.0003	1.0000	.0999	cp	12-16	1100	75	48
100.0000	10.0002	1.0000	.0999	cp	12-18	1000	77	46
100.0000	10.0000	1.0000	.0999	cp	12-21	1100	66	49
100.0000	10.0004	1.0000	.0997	cp	12-22	1400	72	48
100.0000	10.0001	1.0000	.1001	cp	12-23	1100	76	38
100.0000	10.0000	.9999	.0999	cp	12-24	1000	67	46
100.0000	10.0001	1.0001	.0999	cp	12-25	1100	73	49
100.0000	10.0000	1.0000	.0999	cp	1-19-11	0930	66	49
100.0000	9.9999	1.0000	.0999	cp	1-21-11	1400	77	44
99.9996	10.0000	1.0000	.0998	cp	1-25-11	0900	75	48
100.0000	10.0002	1.0001	.1000	cp	1-26-11	1400	74	44
100.0000	10.0001	.9998	.0998	cp	1-27-11	1200	65	48
100.0000	10.0002	1.0000	.0999	cp	1-28-11	1630	70	48
100.0000	10.0001	1.0001	.0999	cp	1-29-11	1200	68	48
100.0000	10.0002	1.0000	.0999	cp	1-30-11	1500	66	49
100.0000	9.9999	1.0000	.0999	cp	2-15-11	0930	75	41
100.0000	10.0000	1.0001	.1000	cp	2-16-11	0930	66	49
100.0000	10.0002	1.0000	.0999	cp	2-22-11	1000	70	48
100.0000	10.0001	1.0002	.0999	cp	3-4-11	1200	69	47
100.0000	10.0004	.9999	.1000	cp	3-5-11	1000	70	48
100.0000	10.0001	1.0000	.0999	cp	3-8-11	1000	74	47
100.0000	10.0000	1.0000	.1000	cp	3-9-11	1600	67	46
100.0000	10.0002	0.9999	.0999	cp	3-10-11	1600	66	49
100.0000	10.0000	1.0000	.0999	cp	3-12-11	1530	73	47
100.0000	10.0001	.9999	.0998	cp	3-13-11	1200	65	48
100.0000	10.0001	1.0000	.0999	cp	3-29-11	1120	76	49
100.0000	10.0000	.9999	.0998	cp	3-30-11	0800	74	47
100.0000	10.0001	1.0000	.0999	cp	3-31-11	1050	70	48
100.0000	10.0002	.9998	.0999	cp	4-4-11	0830	74	47
100.0000	10.0003	1.0000	.1000	cp	4-5-11	1130	73	47
100.0000	9.9999	1.0001	.0999	cp	4-6-11	1030	77	49
100.0000	10.0000	9.9999	.1001	cp	4-7-11	1000	78	40

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates: From 2-26-2010 Through 11-10-2010	Scale: Sartorius	Model: A 120 S	SN: 37010004

100 g weight	10 g weight	1 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	% RH
100.0001	10.0004	.9999	.0999	cp	2-26-10	0840	72	46
100.0001	9.9999	.9999	.0999	cp	2-27-10	1045	72	46
100.0000	10.0000	1.0000	.0999	cp	2-28	1100	70	48
100.0000	10.0000	1.0000	.0999	cp	3-1	0900	66	49
100.0000	10.0002	.9998	.1002	cp	3-5	1200	70	48
100.0001	9.9999	.9999	.0998	cp	3-7	1330	68	47
100.0000	9.9999	.9999	.0999	cp	3-9	1130	70	41
100.0000	10.0001	1.0000	.0999	cp	3-10	1200	70	44
100.0000	10.0001	.9999	.0999	cp	3-11	0900	66	49
99.9999	9.9999	.9999	.0999	AV	3-15	1000	70	48
100.0000	10.0000	1.0000	.0998	cp	3-17	0900	72	46
100.0000	9.9998	1.0001	.1000	cp	4-8	1930	76	49
99.9999	10.0001	1.0000	.0999	cp	4-10	1630	73	42
99.9999	10.0001	1.0001	.1000	cp	4-11	1430	74	40
100.0000	10.0002	1.0000	.1000	cp	4-21	1830	77	49
100.0000	10.0000	1.0000	.0999	cp	4-22	1130	74	47
100.0000	10.0001	1.0000	.0999	cp	4-23	1015	74	44
100.0002	9.9999	1.0000	.1000	cp	4-24	0930	68	47
100.0000	9.9999	.9999	.1000	cp	4-25	0930	73	47
100.0000	9.9999	1.0001	.0999	cp	4-26	0900	76	42
100.0000	10.0002	1.0000	.0999	cp	4-30	1320	78	43
99.9998	10.0000	1.0002	.0999	cp	8-26	0845	78	49
100.0000	9.9998	1.0001	.0999	cp	8-27	0955	78	43
100.0000	10.0000	1.0000	.1000	cp	8-28	1600	73	47
99.9998	10.0000	.9999	.1000	cp	8-29	1400	70	48
100.0000	10.0000	1.0000	.0999	cp	8-31	0720	72	46
100.0001	10.0000	1.0000	.1000	cp	9-1	1330	76	49
100.0000	10.0001	1.0000	.0999	cp	9-2	1300	68	47
100.0000	10.0000	1.0000	.1000	cp	9-3	1130	72	46
100.0000	10.0001	1.0000	.0999	cp	10-26	0750	70	48
100.0000	10.0000	.9998	.0997	cp	10-27	1250	74	47
100.0000	9.9999	1.0000	.0999	cp	10-29	1400	71	49
100.0000	9.9999	1.0000	.0999	cp	11-1	1000	78	49
100.0000	10.0000	.9999	.0999	cp	11-2	0715	70	48
100.0000	10.0000	1.0000	.0999	cp	11-3	0900	70	48
100.0000	10.0001	.9999	.1000	cp	11-5	1320	76	42
100.0000	10.0001	.9999	.1000	cp	11-8	1230	70	48
100.0000	10.0001	1.0000	.0998	cp	11-9	1015	71	41
100.0000	10.0000	.9999	.0995	cp	11-10	0900	70	44

BLANK PROCESSING DATA SHEET # 5

UNIT : ES2100 RUN : 3 DATE : 9-3-12

BLANKS DONE : 8-31-2010

BEAKER	A	B	C
	200 ml ACETONE	75 ml DICHLOR	200 ml WATER
	FISHER OPTIMA LOT # 023283	FISHER OPTIMA LOT # 066390	DWNA, Inc Sparklettes Distilled
FINAL WEIGHT	108.9019	106.3074	106.9680
TARE WEIGHT	108.9001	106.3058	106.9640
NET WEIGHT	.0018	.0016	.0040

TARE BEAKERS INTO DESC : TIME : 1410 DATE : 8-7-2010

DATE : 8-26 BY : Cp DATE : 8-27 BY : Cp DATE : ____ BY : ____

BEAKER	1 ST WT	TIME	2 ND WT	TIME	3 RD WT	TIME
A	108.8999	0935	108.9001	1050		
B	106.3061	0936	106.3058	1051		
C	106.9641	0937	106.9640	1052		

FINAL BEAKERS INTO DESC : TIME : 8-28 DATE : 0820

DATE 8-29 BY : Cp DATE 8-31 BY : Cp DATE : ____ BY : ____

BEAKER	1 ST WT	TIME	2 ND WT	TIME	3 RD WT	TIME
A	108.9019	1501	108.9019	0742		
B	106.3076	1502	106.3074	0743		
C	106.9676	1503	106.9680	0744		

TARE QC

DATE	TIME	BY	WB	DB	%
8-26-10	0845	Cp		78	49
8-27-10	0955	Cp		78	43

FINAL QC

DATE	TIME	BY	WB	DB	%
8-29	1400	Cp		70	48
8-31	0720	Cp		72	46

NET PARTICULATE CATCH CALCULATION DATA SHEET #6

UNIT : ES2100 RUN : 3 DATE : 9-3-12

BLANK CALCULATIONS

Acetone : .0018 g ÷ 200 ml = .000009 g/ml
Dicholoromethane : .0016 g ÷ 75 ml = .000021 g/ml
Distilled Water : .0040 g ÷ 200 ml = .000020 g/ml

FRONT HALF CATCH

FILTERS : .0717 (Total Catch) g - 1 (# of Filters) (.0000 g) (Blank Value / Filter) = .0717 g

BEAKERS : .0360 (Total Catch) g - 85 (ml Acetone) (.000009 g) (Blank Value / ml Acetone) .0008 = .0352 g

TOTAL FRONT HALF CATCH : .1069 g

BACK HALF CATCH

FILTERS : .0268 (Total Catch) g - 1 (# of Filters) (.0000 g) (Blank Value / Filter) = .0268 g

BEAKERS :

Acetone : .0495 (Total Catch) g - 125 (ml Acetone) (.000009 g) (~~Blank Value~~ / ml Acetone) .0011 = .0484 g

Extract : .0065 (Total Catch) g - 75 (ml Dichloromethane) (.000021 g) (Blank Value / Dichloromethane) (.0016) = .0049 g

Water : .0297 (Total Catch) g - 265 (ml Water) (.000020 g) (Blank Value / Water) = .0053 g

TOTAL BACK HALF CATCH : .0854 g

TOTAL CATCH : .1923 g

% FRONT HALF : 55.6 %

CALCULATIONS DATA SHEET # 7

UNIT : ES2100 RUN : 3 DATE : 9 - 3 -2012

1) Vm (std) = $\dfrac{(52.097 \text{ Vm})(17.64)(.935 \text{ mcf})\left(30.18 \text{ " Hg} + \dfrac{.274 \text{ " } H_2O}{13.6}\right)}{(548 \text{ TmA})}$ = $\dfrac{47.3534}{000.0000}$ dscf

2) Vw (std) = (.04707) (81.4 ml H_2O) = $\dfrac{3.8315}{00.0000}$ scf

3) Asw = $\dfrac{(3.8315 \text{ scf})}{(3.8315 \text{ scf} + 47.3534 \text{ dscf})}$ = $\dfrac{.0749}{.0000}$ Bws × 100 = $\dfrac{7.4856}{00.0000}$ % H_2O

4) Cs = $\dfrac{(.1923 \text{ g.})}{(47.3534 \text{ dscf})}$ (15.43) = $\dfrac{.0627}{0.0000}$ gr / dscf

5) Estimated g / hr = $\dfrac{(.1923 \text{ g.})}{(47.3534 \text{ dscf})}$ ($\dfrac{15.357}{00.0000}$ dscfm) (60) = $\dfrac{3.7418}{00.0000}$ g / hr

Vm =	total cubic feet pulled on meter box during test	(p. 2)	(000.000 Vm)
mcf =	meter correction factor (Y factor) of meter box used for test	(p. 2)	(0.000 mcf)
" Hg =	average barometric pressure during test	(p. 2)	(00.00 " Hg)
" H_2O =	average delta H for test	(p. 2)	(.000 " H_2O)
TmA =	average meter temperature for test in degrees Absolute	(p. 2)	(000 TmA)
ml H_2O =	total water caught during test	(p. 3)	(000.0 ml H_2O)
g. =	total particulate catch for test	(p. 6)	(00.0000 g.)
dscfm =	average stack flow during test	(p. 2)	(00.000 dscf)

TEST DATA SHEET # 8

UNIT : ES 2100 RUN : 3 DATE : 9-3-2012

Test Chamber Air Velocity Start : Ø Stop : Ø Avg.: Ø

Wet Bulb / Dry Bulb

Pre : WB : 65.0 DB : 80 = 44.0 % RH 1.5 % H_2O

Post : WB : 64 DB : 78 = 46.0 % RH 1.5 % H_2O

Average : 45.0 % RH 1.5 % H_2O

Empty Stove Weight (lbs) : —— w/ stack & oil seal : Wet : —— Dry : 0.0

Kindling Weight (lbs) : Paper : .1 Wood : 1.5

Preburn Fuel Weight : 16.2 + 14.5 Total : 30.7

Kindling & Preburn Fuel Weight (wood only) (lbs) : **Total** : 32.2

Coal Bed Wt Range (lbs) : 3.5 - 2.8 **Scale** : 3.5 - 2.8

Upper : .25 × fuel weight : Always round DOWN to nearest tenth

Lower : .20 × fuel weight : Always round UP to nearest tenth

Actual Coal Bed Weight : 2.9

Maximum Coal Bed Removal (lbs) : ((3.5 (Upper) + 2.8 (Lower)) ÷ 2) .25 = .7 (round down to nearest tenth)

Test Fuel (.75" × 1.5" × 5" spacers) = 16 pcs

Dimensions	Length in inches	No. Pcs	Weight in lbs	% of Load
2" × 4"	16	3	5.0	35.7
4" × 4"	16	2	9.0	64.3

Test Fuel Weight : 14.0 lbs

Estimated Dry Burn Rate :

$$\frac{14.0 - (14.0 \times .17205)}{2.2046} \times \frac{60}{125} = 2.524 \text{ kg / hr}$$

TIME

Estimated BTU's/hr : $19{,}140 \times \frac{63}{100} \times \frac{2.524}{\text{DBR}} = 30435.0$ BTU's/hr

EPA Default Efficiencies : Non-cat : 63 Cat : 72 Pellet : 78

WOOD STOVE OPERATING DATA PAGE #9

Unit : ES 2400 Run : 3 Date : 9-3-2012

FIRE STARTED: 1018

WARM UP AND PREBURN:

PRIMARY AIR : Set wide open for all warm-up / preburn fuel charges. Then set to wide open at start of preburn.

SECONDARY AIR : N/A CAT BYPASS : N/A

CHARCOAL BED PREPARATION :

Raked and leveled prior to each warm-up / preburn charge. At 1 1/2 min. prior to loading last fuel, raked and leveled. In stove 20 sec.

TEST:

DOOR wide open during loading 0 min. 30 sec.

PRIMARY AIR : Opened full for first 5 min., then set to run setting of wide open

SECONDARY AIR : N/A CAT BYPASS : N/A

FAN:

ON / OFF during warm-up

ON / OFF first ALL minutes of test

Fan speed set at High

ON / OFF during preburn

ON / OFF balance of test run

WOOD DATA: KINDLING: A mix of the grades listed below:

	SIZE	MILL	GRADE	SPECIES
PREBURN:	2x4	Manke/Tacoma	Std. or better	s. grn D fir
TEST:	2x4	Packwood	# 2 or better	s. grn D fir
	4x4	Packwood	# 2 or better	s. grn D fir

PELLET FUEL MANUFACTURER : N/A BRAND : N/A

All Grades WCLB rules:

WARM UP INFORMATION:

All pre-burn / warm up fuel pieces were either 16 or 16 inches.

1st warm up / pre-burn fuel charge (16.2 lbs.) added at 1035

2nd warm up / pre-burn fuel charge (14.5 lbs.) added at 1125

3rd warm up / pre-burn fuel charge (____ lbs.) added at ____

4th warm up / pre-burn fuel charge (____ lbs.) added at ____

5th warm up / pre-burn fuel charge (____ lbs.) added at ____

TEST DATA SHEET #10

Unit : ES2100 Run : 3 Date : 9-3-2012

Room Temperature : 72 °F Temperature Correction Set? Yes No

Calibration Check: 12.0% + or – 0.2%? Yes No

Time Test Fuel moisture reading taken : 1045

pc #	Dimen.	Use	TOP	BOTTOM	SIDE	Avg Corrected
1	2"×4"×8'	K	12.6	13.2	11.9	12.567
2						
3						
4	2"×4"×8'	P	18.1	18.1	18.2	18.1
5	2"×4"×8'	P	19.7	19.0	19.1	19.3
6	2"×4"×8'	P	17.9	18.6	18.4	18.3
7	2"×4"×8'	P				55.7
8	2"×4"×8'	P				
9						
10						
11						
12	2x4x16"	T	20.2	20.5	20.4	20.4
13	"	T	23.0	22.7	22.8	22.8
14	"	T	22.0	22.0	22.1	22.1
15	4x4x16"	T	19.0	18.9	19.0	19.0
16	"	T	19.5	19.6	19.6	19.6
17						103.9
18						
19						
20	Spacers	T	22.1	23.6	22.4	22.700

Key for Use : K = Kindling P = Pretest Fuel T = Test Fuel

	KINDLING	PRETEST FUEL	TEST FUEL
Dry Moisture % :	12.567 %	18.567 %	20.780 %
Wet Moisture % :	11.164 %	15.665 %	17.205 %

To obtain Wet from Dry : $\frac{100 \times \text{\% Dry Reading}}{100 + \text{\%Dry Reading}}$ = % Moisture, Wet Basis

Acceptable Ranges : 16 - 20 % wet: 19 - 25 % dry (17.5 - 22.5 on Meter Uncor. reading) at 70°

GAS DATA SHEET #12

WEIGHT: 2.9

DATE: 9-3-2012

UNIT: ES2100

RUN: 3

PAGE: 1 OF 1

TIME	SCALE	FUEL	DROP	V.	CO_2	V.	O_2	V.	CO	STATIC	SO_2PPM
0 / 1240	16.9	14.0	—	.267	6.9	.551	13.8	.020	.20	-.045	300
5	16.5	13.6	.4	.274	6.9	.538	13.5	.033	.33	-.048	300
10 / 50	15.5	12.6	1.0	.396	9.9	.427	10.7	.022	.22	-.051	275
15	14.5	11.6	1.0	.505	12.6	.300	7.5	.061	.61	-.053	375
20 / 1300	13.1	10.2	1.4	.572	14.3	.229	5.7	.069	.69	-.055	375
25	12.0	9.1	1.1	.605	15.1	.198	4.9	.063	.63	-.057	350
30 / 10	10.7	7.8	1.3	.581	14.5	.236	5.9	.027	.27	-.059	250
35	9.9	7.0	.8	.521	13.0	.301	7.5	.016	.16	-.059	225
40 / 20	8.9	6.0	1.0	.449	11.2	.375	9.4	.012	.12	-.057	225
45	8.0	5.1	.9	.461	11.5	.366	9.2	.011	.11	-.057	200
50 / 30	7.1	4.2	.9	.395	9.9	.430	10.8	.005	.05	-.056	200
55	6.5	3.6	.6	.343	8.6	.481	12.0	.007	.07	-.055	200
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-.652	*****
60 / 1340	6.0	3.1	.5	.281	7.0	.538	13.5	.018	.18	-.053	200
65	5.6	2.7	.4	.257	6.4	.561	14.1	.021	.21	-.051	200
70 / 50	5.2	2.3	.4	.257	6.4	.562	14.1	.019	.19	-.050	200
[illegible]5	4.8	1.9	.4	.262	6.6	.558	14.0	.016	.16	-.050	200
[illegible] / 1400	4.5	1.6	.3	.258	6.4	.563	14.1	.019	.19	-.050	200
85	4.2	1.3	.3	.221	5.5	.601	15.1	.020	.20	-.049	200
90 / 10	3.9	1.0	.3	.225	5.6	.596	14.9	.024	.24	-.048	200
95	3.8	.9	.1	.200	5.0	.617	15.5	.035	.35	-.047	200
100 / 20	3.6	.7	.2	.190	4.8	.622	15.6	.046	.46	-.046	200
105	3.5	.6	.1	.181	4.5	.623	15.6	.056	.56	-.046	200
110 / 30	3.3	.4	.2	.173	4.3	.634	15.9	.058	.58	-.045	200
115	3.2	.3	.1	.150	3.8	.644	16.1	.076	.76	-.044	200
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-.579	*****
120 / 1440	3.0	.1	.2	.153	3.8	.645	16.1	.074	.74	-.043	200
125	2.9	0	.1	.148	3.7	.651	16.3	.078	.78	-.042	200
130 / 50										-.085	
135											
140											
145											
150											
155											
160											
[illegible]5											
[illegible]										-1.316	
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****		*****
TOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-.051	*****

.22

PREBURN DATA SHEET #13

UNIT: ES2100 RUN: 3 DATE: 9-3-2012 PAGE: 1 of

TIME	SCALE	DROP	STACK	TOP	LF SIDE	BACK	RT SIDE	BOTTOM	FIREBOX	SEC/CAT	AMBIENT	STATIC	COMMENTS
0 / 1125	17.0	—	475	512	438	425	422	413			70	-.048	PREBURN START: # 13.5 UP
5 / 30	15.0	2.0	665	530	422	304	402	439			70	-.054	COAL BED SCALE RANGE:
10	12.9	2.1	719	575	416	283	396	455			71	-.055	3.5 → 2.8
15 / 40	10.9	2.0	736	610	414	271	398	459			71	-.057	PRIMARY AIR: wide open
20	9.2	1.7	730	631	422	271	405	457			73	-.057	SECONDARY AIR: N/A
25 / 50	7.7	1.5	715	645	434	273	417	453			75	-.057	FAN: High
30	6.2	1.5	693	649	444	278	436	450			76	-.057	PUMPS ON AT: 1200
35 / 1200	5.3	.9	612	624	452	280	446	447			77	-.054	CHECK WB/DB: N/A
40	4.7	.6	538	601	469	281	456	443			77	-.052	
45 / 10	4.3	.4	489	553	461	280	450	440			77	-.051	
50	3.9	.4	455	491	455	279	443	437			77	-.050	
55 / 20	3.6	.3	432	464	448	277	436	436			78	-.048	
*****	****	***	****	*****	*****	****	*****	*****	*****	*****	*****	****	
60 / 1225	3.4	.2	412	428	459	276	434	434			78	-.047	
65 / 30	3.2	.2	397	401	456	275	426	434			77	-.046	
70 / 35	3.0	.2	384	374	452	274	421	435			78	-.045	
75 / 40	2.9	.1	372	359	449	289	420	437			79	-.045	
80													
85													
90													

Lennox-ES2100

Temperature Data Sheet 14

Run 1
9/3/12

Time	Stack	Top	LT Side	Back	Rt Side	Bottom	Firebox	Sec/Cat	Ambient	Tube Furn	Smpl Box	Smpl Out	C-Gas Box	C-Gas Out	SO2 Out
********	Chn 103	Chn 104	Chn 105	Chn 106	Chn 107	Chn 108	Chn 109	Chn 110	Chn 111	Chn 112	Chn 113	Chn 114	Chn 115	Chn 116	Chn 117
0	372	359	449	289	420	437	######	######	79	1442	245	52	242	38	35
5	398	342	436	286	392	438	######	######	78	1430	243	42	241	38	35
10	482	356	415	271	362	439	######	######	79	1419	243	43	242	38	36
15	551	389	390	259	346	436	######	######	79	1409	243	43	245	38	36
20	604	440	397	254	344	430	######	######	80	1403	244	44	248	39	37
25	636	496	399	248	348	422	######	######	80	1399	246	45	247	39	37
30	632	542	408	246	357	414	######	######	80	1395	244	45	245	39	38
35	592	551	432	247	375	408	######	######	79	1394	243	45	241	39	38
40	553	538	443	249	379	403	######	######	80	1393	242	45	237	39	38
45	543	521	439	251	386	400	######	######	81	1392	242	46	234	39	38
50	513	507	445	258	396	398	######	######	81	1392	241	47	232	39	37
55	484	485	463	262	406	395	######	######	80	1394	242	47	235	39	37
60	446	457	454	265	401	392	######	######	80	1397	240	48	236	39	37
65	414	425	444	270	397	390	######	######	80	1400	239	48	236	39	37
70	401	398	449	272	395	388	######	######	79	1402	238	49	237	38	36
75	398	378	447	275	384	387	######	######	79	1404	237	49	236	38	36
80	393	364	420	280	374	387	######	######	79	1407	236	50	236	38	36
85	371	351	435	287	373	387	######	######	79	1409	234	50	235	38	35
90	360	335	428	287	363	387	######	######	78	1412	233	50	234	39	35
95	351	323	424	286	356	388	######	######	79	1415	232	50	232	39	35
100	334	308	424	283	351	390	######	######	77	1418	231	50	233	39	34
105	321	294	415	273	347	390	######	######	78	1420	230	51	232	39	34
110	313	282	399	266	341	392	######	######	77	1421	228	51	231	39	34
115	299	271	385	259	338	391	######	######	78	1422	231	52	231	39	34
120	291	260	375	254	328	391	######	######	77	1422	234	52	230	39	34
125	284	250	367	257	323	390	######	######	77	1423	235	52	230	39	35

TEMPERATURE DATA SHEET #14A

		TEST TIME	125		
STACK AVG	436	TOP AVG	393	LT SIDE AVG	422
BACK AVG	267	RT SIDE AVG	368	BOTTOM AVG	403
FIREBOX AVG	########	SEC/CAT AVG	########	AMBIENT AVG	79

END	317.6	
START	390.7	
	-73.1	DELTA T

CIRCLE: LOSS / GAIN

ZERO / SPAN CHECK DATA SHEET #15-1

Date : 9 - 3 -2012 Analyte : CO_2 (15-1)

Unit : ES 2100 Run # : 3

Zero Cyl. # : 168TAC 3-A Conc. : 0.00 % CO_2 Cyl. Press. : 400 PSI

Certified by : AIR LIQUIDE Date : 04-19-04

Span Cyl. # : 487905 Conc. : 12.20 % CO_2 Cyl. Press. : 1300 PSI

Certified by : AIR LIQUIDE Date : 11-1-07

Analyzer : Make : HORIBA Model : PIR-2000 SN : 407069

Range : 0 - 25.0 % CO_2 Analyzer Output : 0 - 1.0 v.

Flow : 1.5 SCFH Measured by : Rotameter

EPA Span Value = 25.0 % CO_2

EPA Control Limits = ± 2.5% of 25.0 % CO_2 = ± 0.625 % CO_2

Method 28 A = ± .2 % of 25.0 % CO_2 = ± .05 % CO_2

PRE RUN Audit : by : C Watkins Time : 1015 Temp : 68 ° F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	.018	.018	.072
SPAN	48.8	.488	12.20	48.8	.488	12.21	.010	.039

POST RUN Audit : by : C Watkins Time : 1520 Temp : 74 ° F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.1	.001	.043	.043	.172
SPAN	48.8	.488	12.20	48.7	.487	12.185	-.015	-.061

± Conc. Difference = Act % - Exp (Std) %

Zero % Difference = $\frac{\text{Act \% (ppm) - Exp \% (ppm)}}{\text{Full Scale Value}}$ X 100

Span % Difference = $\frac{\text{Act \% (ppm) - Exp \% (ppm)}}{\text{Full Scale Value}}$ X100

ZERO / SPAN CHECK DATA SHEET #15-2

Date : 9-3-2012 Analyte : O_2 (15-2)

Unit : ES2100 Run # : 3

Zero Cyl. # : 168TAC 3A Conc. : 0.00 % O_2 Cyl. Press. : 400 PSI

Certified by : AIR LIQUIDE Date : 04-19-04

Span Cyl. # : 487905 Conc. : 12.60 % O_2 Cyl. Press. : 1300 PSI

Certified by : AIR LIQUIDE Date : 11-1-07

Analyzer : Make : TELEDYNE Model : 320 A SN : 37400

Range : 0 - 25.0 % O_2 Analyzer Output : 0 - 1.0 v.

Flow : 1.5 SCFH Measured by : Rotameter

EPA Span Value = 25.0 % O_2

EPA Control Limits = ± 2.5% of 25.0 % O_2 = ± 0.625 % O_2

Method 28 A = ± .2 % of 25.0 % O_2 = ± .05 % O_2

PRE RUN Audit : by : C. Watling Jr. Time : 1015 Temp : 68 ° F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	-.035	-.035	-.142
SPAN	12.60	.504	12.6	12.6	.504	12.617	.017	.070

POST RUN Audit : by : C. Watling Jr. Time : 1520 Temp : 74 ° F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.1	.003	.040	.040	.159
SPAN	12.60	.504	12.6	12.5	.502	12.567	-.033	-.131

± Conc. Difference = Act % - Exp (Std) %

Zero % Difference = $\frac{\text{Act \% (ppm) - Exp \% (ppm)}}{\text{Full Scale Value}}$ X 100

Span % Difference = $\frac{\text{Act \% (ppm) - Exp \% (ppm)}}{\text{Full Scale Value}}$ X100

ZERO / SPAN CHECK DATA SHEET #15-3

Date : 9-3-2012 Analyte : CO (15-3)

Unit : ES2100 Run # : 3

Zero Cyl. # : 168TAC 3-A Conc. : 0.00 % CO Cyl. Press. : 400 PSI

Certified by : AIR LIQUIDE Date : 04-19-04

Span Cyl. # : 1487905 Conc. : 4.90 % CO Cyl. Press. : 1300 PSI

Certified by : AIR LIQUIDE Date : 11-1-07

Analyzer : Make : HORIBA Model : PIR-2000 SN : 408005

Range : 0 - 10.0 % CO Analyzer Output : 0 - 1.0 v.

Flow : 1.5 SCFH Measured by : Rotameter

EPA Span Value = 10.0 % CO

EPA Control Limits = ± 2.5% of 10.0 % CO = ± 0. 25 % CO

Method 28 A = ± .2 % of 10.0 % CO = ± .02 % CO

PRE RUN Audit : by : C. Wadington Time : 1015 Temp : 18 ° F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	-.006	-.006	-.056
SPAN	49.0	.490	4.90	49.0	.490	4.911	.011	.110

POST RUN Audit : by : C. Wadington Time : 1520 Temp : 74 ° F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	-.006	-.006	-.056
SPAN	49.0	.490	4.90	49.1	.491	4.921	.021	.210

± Conc. Difference = Act % - Exp (Std) %

$$\text{Zero \% Difference} = \frac{\text{Act \% (ppm) - Exp \% (ppm)}}{\text{Full Scale Value}} \times 100$$

$$\text{Span \% Difference} = \frac{\text{Act \% (ppm) - Exp \% (ppm)}}{\text{Full Scale Value}} \times 100$$

QUALITY CHECKS DATA SHEET # 16

UNIT : ES2100 RUN : 3 DATE : 9-3-2012

Thermocouple Check:

T/C # 1	— °F	T/C # 13	63.2 °F
T/C # 2	— °F	T/C # 14	63.2 °F
T/C # 3	63.8 °F	T/C # 15	62.8 °F
T/C # 4	59.1 °F	T/C # 16	52.1 °F
T/C # 5	58.8 °F	T/C # 17	52.1 °F
T/C # 6	58.8 °F	T/C # 18	67.0 °F
T/C # 7	58.8 °F	T/C # 19	— °F
T/C # 8	58.8 °F	T/C # 20	— °F
T/C # 9	— °F	T/C # 21	— °F
T/C # 10	— °F	T/C # 22	— °F
T/C # 11	58.8 °F	T/C # 23	— °F
T/C # 12	66.4 °F	T/C # 24	— °F

Thermocouple Readout:

Pretest zero and span check and calibration — post test zero and span — % difference

ZERO .4 °F Adj. to 0.0 °F ZERO .1 °F Difference .005 %

SPAN 1998.4 °F Adj. to 2000.0 °F SPAN 1999.7 °F Difference -.015 %

Thermocouple Readout Pretest Linearity Check:

0	= 0.0 °F	200	= 200.4 °F	400	= 400.1 °F
600	= 600.0 °F	800	= 799.9 °F	1000	= 999.9 °F
1200	= 1199.8 °F	1400	= 1399.6 °F	1600	= 1599.6 °F
1800	= 1799.9 °F	2000	= 2000.0 °F		

Sample Train Leak Check	Pre ✓	Post ✓
C-gas Train Leak Check	Pre ✓	Post ✓
SO_2 Train Leak Check	Pre ✓	Post ✓
Static Gauge Zero Check	Pre ✓	Post ✓

Scale Check Pre : 13.0 — 3.0 = 10.0

Post : 12.7 — 2.7 = 10.0

Stack Cleaned Prior to Test Run : YES ______ NO X

Fan Cong

TABLE 1 ----- RAW DATA

CLIENT : Lennox

TEST No. : 4

MODEL: ES2100

DATE: 04-Sep-12

TIME (MIN.)	METER READING (C F)	DELTA H (IN. H2O)	METER TEMP. (DEG. F)	PERCENT CO (%)	PERCENT CO2 (%)	SO2 COCENTR. PPM
0	603.000	0.150	74	0.92	4.30	375
5	604.500	0.700	74	0.10	12.30	175
10	607.711	0.200	77	0.38	2.50	325
15	609.463	0.150	77	0.50	2.90	375
20	610.982	0.130	78	0.57	3.30	400
25	612.412	0.150	78	0.44	7.20	375
30	613.937	0.230	78	0.28	8.10	300
35	615.843	0.280	78	0.13	8.70	275
40	617.921	0.280	78	0.12	8.40	275
45	619.999	0.280	79	0.17	7.70	275
50	622.085	0.230	80	0.22	6.90	300
55	624.004	0.170	80	0.56	5.90	350
60	625.650	0.230	80	0.20	10.40	300
65	627.570	0.230	80	0.09	9.00	300
70	629.489	0.230	80	0.17	8.40	300
75	631.409	0.150	80	0.40	6.50	375
80	632.945	0.120	80	0.68	5.50	425
85	634.301	0.130	80	0.63	5.60	400
90	635.741	0.150	80	0.33	8.80	375
95	637.277	0.150	80	0.21	9.40	375
100	638.814	0.170	80	0.15	9.20	350
105	640.460	0.150	81	0.22	8.10	375
110	642.002	0.150	81	0.19	7.80	375
115	643.543	0.150	81	0.16	7.40	375
120	645.085	0.150	81	0.16	7.80	375
125	646.627	0.130	81	0.25	6.50	400
130	648.073	0.120	81	0.43	6.10	425
135	649.434	0.100	81	0.39	5.90	450
140	650.719	0.120	81	0.30	6.30	425
145	652.080	0.120	81	0.27	6.80	425
150	653.441	0.120	81	0.38	5.60	425
155	654.801	0.100	81	0.49	4.60	450
160	656.087	0.120	81	0.60	4.40	425
165	657.448	0.100	81	0.66	4.40	450
170	658.733	0.100	81	0.71	4.30	450
175	660.018	0.100	81	0.74	4.30	450

180	661.303	0.100	81	0.76	4.30	450
185	662.589	0.100	81	0.80	4.30	450
190	663.874	0.090	81	0.91	4.20	475
195	665.092	0.100	81	0.99	4.20	450
200	666.377	0.090	81	1.01	4.20	475
205	667.595	0.090	81	1.06	4.30	475
210	668.812	0.090	81	1.02	4.00	475
215	670.030	0.090	81	1.07	3.80	475
220	671.248	0.090	81	1.27	3.80	475
225	672.465	0.090	81	1.36	3.70	475
230	673.683	0.090	81	1.36	3.80	475
235	674.901	0.080	81	1.52	3.60	500
240	676.058	0.090	81	1.46	3.50	475
245	677.277	0.080	81	1.49	3.40	500
250	678.435	0.080	81	1.54	3.40	500
255	679.594	0.080	81	1.62	3.30	500
260	680.752	0.080	81	1.42	3.30	500
265	681.911	0.080	81	1.42	3.30	500
270	683.069	0.080	81	1.38	3.20	500
275	684.227	0.080	81	1.37	3.10	525
280	685.331	0.080	81	1.39	3.00	525
285	686.434	0.080	81	1.22	3.10	500
290	687.593	0.080	81	1.26	3.10	500

TABLE 2---RAW DATA

CLIENT : Lennox

TEST No. 4

MODEL: ES2100

DATE: 04-Sep-12

***

METER CAL. FACTOR (Y) -------	0.935	Wt. WOOD BURNED(LB) -------	13.9 Lbs
BAROMETRIC PRESS.(Pb) -------	30.21 in Hg	WET,FUEL MOISTURE % -------	16.985 %
LEAK RATE POST (Lp) -------	0.000 cfm	Wt. PART. COLLECTED -------	0.4705 g
WATER VOL. (V1c) -------	125.7 Ml	METER VOLUME Vm -------	84.592 mcf
TEST TIME (MIN) -------	290 min	HC MOLE FRACTION -------	0.0132

TABLE 3 -----FIELD DATA AVERAGES

CLIENT : Lennox

TEST No. 4

MODEL: ES2100

DATE: 04-Sep-12

****

AVG DELTA H	-------	0.14 in H2O		AVG PRCNT CO	-------	0.71	%
AVG METER TEMP. Tm	-------	80 deg F		AVG PRCNT CO2	-------	5.51	%
AVG PPM SO2	-------	414	PPM	AVG BAL CO2/CO	-------	7.76	%

TABLE 4 ----- CALCULATIONS

CLIENT : Lennox　　　　TEST No. 4

MODEL: ES2100　　　　DATE: 04-Sep-12

****

STD SAMPLE VOL. Vm(std) d) ------	78.10 dscf	STACK GAS FLOW Qsd -------	517.245 dscf/Hr & 8.62 dscf/min
VOL. WATER VAPOR Vw(s td) -----	5.917 scf	PARTICULATE CONCTRT. C s ------	0.0060 g/dscf
PRCNT MSTR Bws -------	7.04 %	PARTC.EMISS. RATE E -------	3.12 g/Hr
BURN RATE BR -------	1.08 Kg/Hr	MOLES OF GAS PER Lb WOOD Nt ----	0.56 Lb-mole/Lb
CO EMISSION RATE -------	123.01 g/Hr & 113.58 g/Kgdry fuel	PART.EMISS. RATE ------	2.88 g/Kgdry fuel

TABLE 5 ----- PROPORTIONAL RATE VARIATION

CLIENT : Lennox | TEST No. : 4

MODEL: ES2100 | DATE: 04-Sep-12

	TIME INTEVAL Ti	PPM * Vm	PROPRTN. RATE VAR. PR		PROPRTN RATE VAR. AVERAGE	
	5	525.3	99		100	
	10	524.0	98			
	15	528.9	99			
	20	528.5	99			
	25	530.2	100			
	30	530.1	100			
	35	530.2	100			
	40	529.9	100			
	45	529.4	99			
	50	530.5	100			
	55	531.8	100			
	60	532.1	100			
	65	532.1	100			
	70	531.8	100			
	75	532.1	100			
	80	532.0	100			
	85	532.2	100			
	90	532.0	100			
	95	532.0	100			
	100	532.3	100			
	105	531.6	100			
	110	533.1	100			
	115	532.7	100			
	120	533.1	100			
	125	533.1	100			
	130	533.2	100			
	135	533.2	100			
	140	533.0	100			
	145	533.2	100			
	150	533.2	100			
	155	532.8	100			
	160	533.4	100			
	165	533.2	100			
	170	533.0	100			
	175	533.0	100			
	180	533.0	100			

185	533.4	100
190	533.0	100
195	533.3	100
200	533.0	100
205	533.3	100
210	532.8	100
215	533.3	100
220	533.3	100
225	532.8	100
230	533.3	100
235	533.3	100
240	533.2	100
245	533.7	100
250	533.7	100
255	534.1	100
260	533.7	100
265	534.1	100
270	533.7	100
275	533.7	100
280	534.2	100
285	533.7	100
290	534.1	100

COMPUTER INPUT DATA SHEET #1

Client: Lennox Hearth Products

Address: 1502 14th Street NW
Auburn, WA 98001

Phone: 253-735-1100 Fax: 253-931-1271

3.12

Run No.: 4 Date of Test: 9 - 4 -2012 Burn Rate: 1.083

Model No.: ES2100

☐ min ☐ min-1.25 ☒ fan ☐ 1.25-1.9 ☐ max ☐ insert

Stove Type: ☐ Cat ☒ Non Cat ☐ Pellet

Dry Gas Meter Y Factor: .935
(0.000) (Data Sheet #2)

Post Leak Rate: .000 cfm
(.000) (Data Sheet #2)

Time: 290 min.
(000) (Data Sheet #2)

Dry Gas Meter Volume: 84.592 cf
(00.000) (Data Sheet #2)

Stack Flow: 8.809 dscfm
(00.000) (Data Sheet #2)

Δ H: .141 in. H_2O
(.000) (Data Sheet #2)

Maximum Vac.: 6.0
(0.0) (Data Sheet #2)

Barometric Pressure: 30.21 in. Hg
(00.00) (Data Sheet #2)

H_2O Captured: 125.7 g
(00.0) (Data Sheet #3)

Front Half Catch % Of Total: 35.6 %
(00.0) (Data Sheet #6)

Total Particulate Catch: .4705 g
(0.0000) (Data Sheet #6)

Flue Gas Moisture: 7.0439 %
(00.000) (Data Sheet #7)

Particulate Emission: .0930 gr/dscf
(0.0000) (Data Sheet #7)

Relative Humidity: 50.0 % RH
(00.0) (Data Sheet #8)

Ambient Moisture: 1.5 % H_2O
(0.00) (Data Sheet #8)

Preburn Fuel Wt.: 33.7 lbs.
(00.0) (Data Sheet #8)

Coal Bed Wt.: 2.9 lbs.
(00.0) (Data sheet #8)

Test Fuel Wt.: 13.9 lbs.
(00.0) (Data sheet #8)

Heat Output (EPA Default): 13059.0 BTU/hr
(00,000.0) (Data Sheet #8)

Kindling Fuel % Moisture (wet): 9.964 %
(00.000) (Data Sheet #10)

Pretest Fuel % Moisture (wet): 15.517 %
(00.000) (Data Sheet #10)

Test Fuel % Moisture (dry): 20.460 %
(00.000) (Data Sheet #10 [wood stove] or #11 [pellet stove])

Test Fuel % Moisture (wet): 16.985 %

Fuel Higher Heating Value (dry): BTU/lb.
(0000) (Data Sheet #11)

Stack Static Pressure: -.036 in. H_2O
(+/- .000) (Data Sheet #12)

Average Ambient Temperature: 76 °F
(00) (Data Sheet #14)

Stove Temperature Change: -69.1 °F
(+/- 000.0) (Data Sheet #14)

Test Start 1050

meter temp 540

End 1540

METER BOX DATA SHEET PAGE # 2

UNIT : ES2100 RUN : 4 DATE : 9-4-2012

Meter Box: 5H Y Factor: .935

Leak checks: 15 " Hg @ .001 cfm ______ " Hg @ ______ cfm

15 " Hg @ .000 cfm ______ " Hg @ ______ cfm

Inject SO^2 @ 100 cc/min. Nozzle: Probe @ 3/8 " od Initial Volume: 1.500

ROTO: PRESS: .18			SAMPLING RATIO: 31 : 1				BP: 30.22		
MIN	TIME	METER READING	SAMPLE MDCF	STACK DSCFM	DELTA H	METER TEMP	SO2 PPM	ROTO TEMP	PUMP VACC
0	1050	603.000	———	9.410	.15	74	375	74	2.0
5	55	604.500	———	20.165	.70	74	175	74	6.0
10	1100	607.711	607.711	10.798	.20	77	325	77	2.0
15	05	609.463	609.463	9.358	.15	77	375	77	2.0
20	10	610.982	610.982	8.757	.13	78	400	78	2.0
25	15	612.412	612.412	9.341	.15	78	375	78	2.0
30	20	613.937	613.937	11.676	.23	78	300	78	2.0
35	25	615.843	615.843	12.737	.28	78	275	78	2.0
40	30	617.921	617.921	12.737	.28	78	275	78	3.0
45	35	619.999	619.999	12.713	.28	79	275	79	3.0
50	40	622.085	622.085	11.632	.23	80	300	80	3.0
55	45	624.004	624.004	9.971	.17	80	350	80	3.0
ROTO PRESS: .18			TOTALS:	139.285	2.95	931	BP.: 30.22		
60	1150	625.650	625.650	11.632	.23	80	300	80	3.0
65	55	627.570	627.570	11.632	.23	80	300	80	3.0
70	1200	629.489	629.489	11.632	.23	80	300	80	3.0
75	05	631.409	631.409	9.306	.15	80	375	80	3.0
80	10	632.945	632.945	8.211	.12	80	425	80	3.0
85	15	634.301	634.301	8.724	.13	80	400	80	3.0
90	20	635.741	635.741	9.306	.15	80	375	80	3.0
95	25	637.277	637.277	9.306	.15	80	375	80	3.0
100	30	638.814	638.814	9.971	.17	80	350	80	3.0
105	35	640.460	640.460	9.289	.15	81	375	81	3.0
110	40	642.002	642.002	9.289	.15	81	375	81	3.0
115	45	643.543	643.543	9.289	.15	81	375	81	3.0
			TOTALS:	117.587	2.01	963	MAX VACC =		
TOTAL Cu Ft.			TOTALS:	256872	4.96	1894	AVG. BP:		

Page: 2 of 3

METER BOX DATA SHEET PAGE # 2

UNIT: ES2100 RUN: 4 DATE: 9-4-2012

Meter Box: SH Y Factor: .935

Leak checks: 15 " Hg @ .000 cfm ______ " Hg @ ______ cfm

15 " Hg @ .000 cfm ______ " Hg @ ______ cfm

Inject SO^2 @ 100 cc/min. Nozzle : Probe @ 3/8 " od Initial Volume: 1.500

ROTO: PRESS: .18			SAMPLING RATIO: 31 : 1				BP: 30.22		
MIN	TIME	METER READING	SAMPLE MDCF	STACK DSCFM	DELTA H	METER TEMP	SO2 PPM	ROTO TEMP	PUMP VACC
120	1250	645.085	645.085	9.289	.15	81	375	81	3.0
125	55	646.627	646.627	8.708	.13	81	400	81	3.0
130	1300	648.073	648.073	8.196	.12	81	425	81	3.0
135	05	649.434	649.434	7.741	.10	81	450	81	3.0
140	10	650.719	650.719	8.196	.12	81	425	81	3.0
145	15	652.080	652.080	8.196	.12	81	425	81	3.0
150	20	653.441	653.441	8.196	.12	81	425	81	3.0
155	25	654.801	654.801	7.741	.10	81	450	81	3.0
160	30	656.087	656.087	8.196	.12	81	425	81	3.0
165	35	657.448	657.448	7.741	.10	81	450	81	3.0
170	40	658.733	658.733	7.741	.10	81	450	81	3.0
175	45	660.018	660.018	7.741	.10	81	450	81	3.0
			TOTALS:	97.682	1.38	972	BP.: 30.22		
ROTO PRESS:	.18								
180	1350	661.303	661.303	7.741	.10	81	450	81	3.0
185	55	662.589	662.589	7.741	.10	81	450	81	3.0
190	1400	663.874	663.874	7.333	.09	81	475	81	3.0
195	05	665.092	665.092	7.741	.10	81	450	81	3.0
200	10	666.377	666.377	7.333	.09	81	475	81	3.0
205	15	667.595	667.595	7.333	.09	81	475	81	3.0
210	20	668.812	668.812	7.333	.09	81	475	81	3.0
215	25	670.030	670.030	7.333	.09	81	475	81	3.0
220	30	671.248	671.248	7.333	.09	81	475	81	3.0
225	35	672.465	672.465	7.333	.09	81	475	81	3.0
230	40	673.683	673.683	7.333	.09	81	475	81	3.0
235	45	674.901	674.901	6.967	.08	81	500	81	3.0
			TOTALS:	88.854	1.10	972	MAX VACC =		
TOTAL Cu Ft.			TOTALS:	186.536	2.48	1944	AVG. BP:		

METER BOX DATA SHEET PAGE # 2

Page: 3 of 3

UNIT : ES2100 RUN : 4 DATE : 9-4-2012

Meter Box: 5H Y Factor: .935

Leak checks: 15 " Hg @ .000 cfm ________ " Hg @ ____ cfm

15 " Hg @ .000 cfm ________ " Hg @ ____ cfm

Inject SO² @ 100 cc/min. Nozzle: Probe @ 3/8 " od Initial Volume: 1.500

ROTO: PRESS: .18			SAMPLING RATIO: 31	: 1			BP: 30.18		
MIN	TIME	METER READING	SAMPLE MDCF	STACK DSCFM	DELTA H	METER TEMP	SO2 PPM	ROTO TEMP	PUMP VACC
240	1450	676.058	676.058	7.324	.09	81	475	81	2.0
245	55	677.277	677.277	6.957	.08	81	500	81	2.0
250	1500	678.435	678.435	6.957	.08	81	500	81	2.0
255	05	679.594	679.594	6.957	.08	81	500	81	2.0
260	10	680.752	680.752	6.957	.08	81	500	81	2.0
265	15	681.911	681.911	6.957	.08	81	500	81	2.0
270	20	683.069	683.069	6.957	.08	81	500	81	2.0
275	25	684.227	684.227	6.626	.08	81	525	81	2.0
280	30	685.331	685.331	6.626	.08	81	525	81	2.0
285	35	686.434	686.434	6.957	.08	81	500	81	2.0
290	40	687.593	687.592	6.957	.08	81	500	81	2.0
295				76.323	.89	891			
ROTO PRESS:			TOTALS:				BP.:		
300									
305									
310									
315									
320									
325									
330									
335									
340									
345				519.731	8.33	4729			
350									
355						80			
			TOTALS:				MAX VACC =		6.0
TOTAL Cu Ft.	84.592		TOTALS:	8.809	.141	540	AVG. BP:	30.21	

.59

CALCULATIONS DATA SHEET # 7

UNIT : ES2100 RUN : 4 DATE : 9-4-2012

1) Vm (std) = $\dfrac{(84.592\ Vm)(17.64)(.935\ mcf)\left(30.21\text{" Hg} + \dfrac{.141\text{" } H_2O}{13.6}\right)}{(540\ TmA)}$ = $\dfrac{78.0810}{000.0000}$ dscf

2) Vw (std) = (.04707) (125.7 ml H_2O) = $\dfrac{5.9167}{00.0000}$ scf

3) Asw = $\dfrac{(5.9167\ scf)}{(5.9167\ scf + 78.0810\ dscf)}$ = $\dfrac{.0704}{.0000}$ Bws × 100 = $\dfrac{7.0439}{00.0000}$ % H_2O

4) Cs = $\dfrac{(.4705\ g.)}{(78.0810\ dscf)}$ (15.43) = $\dfrac{.0930}{0.0000}$ gr / dscf

5) Estimated g / hr = $\dfrac{(.4705\ g.)}{(78.0810\ dscf)}$ ($\dfrac{8.809}{00.0000}$ dscfm) (60) = $\dfrac{3.1849}{00.0000}$ g / hr

Vm =	total cubic feet pulled on meter box during test	(p. 2)	(000.000 Vm)
mcf =	meter correction factor (Y factor) of meter box used for test	(p. 2)	(0.000 mcf)
" Hg =	average barometric pressure during test	(p. 2)	(00.00 " Hg)
" H_2O =	average delta H for test	(p. 2)	(.000 " H_2O)
TmA =	average meter temperature for test in degrees Absolute	(p. 2)	(000 TmA)
ml H_2O =	total water caught during test	(p. 3)	(000.0 ml H_2O)
g. =	total particulate catch for test	(p. 6)	(00.0000 g.)
dscfm =	average stack flow during test	(p. 2)	(00.000 dscf)

PARTICULATE CATCH / MOISTURE DATA SHEET # 3

UNIT : ES2100 RUN : 4 DATE : 9-4-12

SCALE CHECK	LEVEL	ZEROED
INITIAL :	✓	✓
FINAL :	✓	✓

SCALE	WEIGHT
295.0 g	295.0
590.0 g	590.0
885.0 g	885.0

IMPINGER	# 1	# 2	# 3	# 4
FINAL WT	703.4	603.4	486.8	872.7
INITIAL WT	604.4	596.7	484.6	854.9
NET WT GRAMS	99.0	6.7	2.2	17.8

TOTAL CATCH : 125.7 GRAMS H_2O

FRONT HALF

FILTER #	55F	
FINAL WT g	.7158	
INITIAL WT g	.6329	
NET WT g	.0829	

BEAKER #	21
DESC.	ACETONE
FINAL WT g	108.3058
INITIAL WT g	108.2205
NET WT g	.0853
VOL. DESC. ml	100

BACK HALF

FILTER #	55B	
FINAL WT g	.3455	
INITIAL WT g	.2803	
NET WT g	.0652	

BEAKER #	22	23	24	25	
DESC.	ACETONE	METHCHLOR	H_2O	H_2O	
FINAL WT g	106.0453	104.5880	106.4365	99.7265	
INITIAL WT g	105.9189	104.5748	106.3951	99.6595	
NET WT g	.1264	.0132	.0414	.0670	.1084
VOL. DESC ml	150	75	150	200	350

FILTER TARE WEIGHTS DATA SHEET #4-1

Into Dessicator : Date : 1-6-12 Time : 1000 By : CJ

Manufacturer S & S Grade : # 25 Glass Front Size : 11 cm Lot No. : 393580

Back Size: 8.2 cm Lot No. : 4642541

FILTER #	DATE: 1-13-12 FIRST WEIGHT	BY: CJ TIME	DATE: 1-14-12 SECOND WEIGHT	BY: CJ TIME	DATE: THIRD WEIGHT	BY: TIME
51F	.6325	1055	.6330	1320	✓	
52F	.6313	1056	.6313	1321	✓	
53F	.6317	1057	.6318	1322	✓	
54F	.6294	1058	.6290	1323	✓	
55F	.6330	1059	.6329	1324	✓ R-4	
56F	.6285	1100	.6287	1325	✓	
57F	.6261	1101	.6258	1326	✓	
58F	.6327	1102	.6326	1327	✓	
59F	.6298	1103	.6297	1328	✓	
60F	.6303	1104	.6300	1329	✓	
51B	.2812	1105	.2810	1330	✓	
52B	.2829	1106	.2830	1331	✓	
53B	.2825	1107	.2825	1332	✓	
54B	.2811	1108	.2811	1333	✓	
55B	.2804	1109	.2803	1334	← R4	
56B	.2837	1110	.2839	1335	✓	
57B	.2831	1111	.2829	1336	✓	
58B	.2831	1112	.2829	1337	✓	
59B	.2836	1113	.2838	1338	✓	
60B	.2833	1114	.2834	1339	✓	

Checked by: Armando Verdy Date: 01-16-2012 Time: 0950

BALANCE ROOM ENVIRONMENTAL CONDITIONS

DATE	TIME	BY	WB	DB	% RH
1-13-12	1030	Cj	S	72	46
1-14-12	130	Cj		70	48

BEAKER TARE WEIGHTS DATA SHEET #4-2

Into Dessicator: Date : 10-1-11 Time : 1100 By : Cg

BEAKER #	DATE: 10-5-11 FIRST WEIGHT	BY: Cg TIME	DATE: 10-6-11 SECOND WEIGHT	BY: Cg TIME	DATE: THIRD WEIGHT	BY: TIME
1	104.9129	1315	104.9133	1005	✓	
2	106.2505	1316	106.2506	1006	✓	
3	107.7718	1317	107.7719	1007	✓	
4	108.7694	1318	108.7690	1008	✓	
5	97.4307	1319	97.4304	1009	✓	
6	91.2030	1320	91.2026	1010	✓	
7	97.1326	1321	97.1322	1011	✓	
8	108.6309	1322	108.6309	1012	✓	
9	108.0904	1323	108.0901	1013	✓	
10	105.7240	1324	105.7235	1014	✓	
11	104.7777	1325	104.7775	1015	✓	
12	98.2142	1326	98.2137	1016	✓	
13	104.1677	1327	104.1675	1017	✓	
14	97.9658	1328	97.9655	1018	✓	
15	104.7508	1329	104.7511	1019	✓	
16	95.7284	1330	95.7287	1020	✓	
17	104.5845	1331	104.5845	1021	✓	
18	108.8518	1332	108.8519	1022	✓	
19	106.5332	1333	106.5331	1023	✓	
20	108.5821	1334	108.5818	1024	✓	
21	108.2201	1335	108.2205	1025	✓	
22	105.9186	1336	105.9189	1026	✓ R-4	
23	104.5747	1337	104.5748	1027	✓	
24	106.3950	1338	106.3951	1028	✓	
25	99.6593	1339	99.6595	1029		

BALANCE ROOM ENVIRONMENTAL CONDITIONS

DATE	TIME	BY	WB	DB	% RH
10-5-11	1310	CW	-	71	49
10-6-11	1000	CW	-	78	40
		CW	-		

Checked by : A.V.
Date : Oct - 6 - 2011
Time : 11:10

WOODSTOVE DATA SHEET # 4-3 : CONSTANT WEIGHTS

UNIT : ES 2100 RUN : 4 DATE : 9-4-12 Page : ___ of ___

Beaker #	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By
21	9-5	1000	Cp	108.3077	9-6	1147	Cp	108.3062	9-7	1407	Cp	108.3058	9-8	1205	Cp
22	9-5	1000	Cp	106.0458	9-6	1148	Cp	106.0453	9-7	1408	Cp				
23	9-5	1000	Cp	104.5896	9-6	1149	Cp	104.5885	9-7	1409	Cp	104.5880	9-8	1206	Cp
24	9-5	1000	Cp	106.4382	9-6	1150	Cp	106.4370	9-7	1410	Cp	106.4365	9-8	1207	Cp
25	9-5	1000	Cp	99.7280	9-6	1151	Cp	99.7270	9-7	1411	Cp	99.7265	9-8	1208	Cp

Filter #	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By
55F	9-4	1600	Cp	.7185	9-5	1006	Cp	.7153	9-6	1145	Cp	.7158	9-7	1405	Cp
55B	9-4	1600	Cp	.3485	9-5	1007	Cp	.3459	9-6	1146	Cp	.3455	9-7	1406	Cp

SCALE ROOM ENVIRONMENTAL CONDITIONS

Weighing Session	Date	Time	By	DB	%RH
1	9-5-12	0945	Cp	78	46
2	9-6-12	1130	Cp	76	49
3	9-7-12	1400	Cp	76	49
4	9-8-12	1200	Cp	71	49
5					

Weighing Session	Date	Time	By	DB	%RH
6					
7					
8					
9					
10					

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates: From 1-14-2012 Through	Scale: Sartorius	Model: A 120 S	SN: 37010004

100 g weight	10 g weight	1 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	% RH
100.0000	10.0000	1.0000	.0999	CP	1-14-12	1300	70	48
100.0002	10.0001	1.0001	.1000	CP	1-15-12	1330	68	47
99.9997	10.0000	1.0001	.1000	CP	1-17-12	1030	73	47
99.9997	10.0001	1.0000	.1000	CP	1-18-12	0915	74	44
99.9999	10.0002	1.0001	.1001	CP	1-19-12	1015	70	44
100.0001	10.0001	1.0001	.0998	CP	1-25-12	1600	72	46
99.9999	9.9998	1.0001	.1000	CP	1-26-12	1500	70	48
99.9995	9.9999	1.0000	.0999	CP	1-28-12	1400	70	41
100.0000	10.0000	1.0000	.0999	CP	2-4-12	1500	73	60
100.0000	10.0003	.9999	.0999	CP	2-6-12	1200	69	44
100.0000	10.0000	.9999	.0998	CP	2-7-12	1030	67	42
100.0000	9.9999	1.0001	.0999	CP	2-10-12	1630	78	49
100.0000	10.0001	1.0000	.1000	CP	2-11-12	1130	72	46
99.9997	10.0002	1.0000	.1001	CP	2-12-12	1530	73	47
100.0000	10.0000	.9999	.0999	CP	2-13-12	1100	78	46
99.9995	10.0000	.9999	.0999	CP	2-14-12	1000	76	45
100.0000	9.9999	.9999	.1000	CP	2-15-12	1120	70	44
99.9999	10.0000	1.0000	.0999	CP	2-17-12	1415	73	47
99.9999	10.0000	1.0000	.0998	CP	2-19-12	1600	70	44
99.9997	9.9999	1.0000	.0999	CP	2-20-12	1200	70	48
100.0004	10.0001	1.0000	.1000	CP	2-23-12	1000	73	47
100.0000	9.9997	1.0000	.0999	CP	2-24-12	1015	78	46
100.0000	10.0000	1.0000	.1001	CP	2-25-12	1715	65	49
100.0000	9.9996	1.0000	.0999	CP	2-27-12	1000	70	44
100.0000	10.0000	1.0001	.1002	CP	2-28-12	1125	75	41
99.9997	10.0000	1.0000	.1000	CP	2-29-12	1110	68	43
99.9995	9.9999	.9999	.0997	CP	3-1-12	1330	68	47
99.9996	10.0000	1.0000	.0998	CP	3-2-12	1430	71	45
99.9995	9.9999	1.0000	.0999	CP	3-3-12	1430	72	42
99.9999	10.0000	.9999	.0999	CP	9-2-12	0945	77	46
100.0000	10.0000	1.0000	.1000	CP	9-3-12	1030	71	49
100.0002	9.9999	1.0000	.0998	CP	9-4-12	1000	77	49
100.0000	10.0000	1.0000	.0999	CP	9-5-12	0945	78	46
100.0000	10.0002	1.0000	.0999	CP	9-6-12	1130	76	49
99.9997	10.0001	1.0002	.0999	CP	9-7-12	1400	76	49
100.0000	10.0001	1.0000	.0999	CP	9-8-12	1200	71	49

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates: From 4-13-2011 Through 1-13-2012	Scale: Sartorius	Model: A 120 S	SN: 37010004

100 g weight	10 g weight	1 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	% RH
100.0000	10.0001	1.0000	.0998	CJ	4-13-11	1030	66	49
100.0001	10.0002	1.0000	.0999	CJ	4-15-11	1330	75	48
100.0004	10.0000	.9999	.0998	CJ	4-19-11	1600	74	44
100.0003	10.0000	1.0000	.0999	CJ	4-20-11	1815	72	46
100.0000	10.0001	.9999	.1000	CJ	6-16-11	0900	76	39
99.9997	9.9999	.9998	.0999	CJ	6-19-11	1530	74	44
99.9996	10.0002	1.0000	.0999	CJ	6-20-11	1600	73	47
100.0000	10.0000	.9998	.0999	CJ	6-21-11	1400	73	47
100.0000	10.0000	1.0001	.0999	CJ	6-22-11	1200	72	46
99.9999	9.9998	1.0000	.1000	CJ	6-23-11	1700	76	49
100.0000	10.0002	1.0000	.0999	CJ	6-24-11	1400	75	48
100.0000	10.0000	1.0000	.0995	CJ	6-27-11	1230	78	46
100.0001	10.0002	.9999	.0998	CJ	6-30-11	1030	78	46
99.9995	10.0000	.9999	.0999	CJ	7-1-11	1030	70	48
99.9999	9.9999	1.0000	.1000	CJ	7-2-11	1145	75	45
100.0000	9.9999	.9999	.0999	CJ	7-5-11	1000	73	47
99.9999	10.0001	1.0000	.0999	CJ	7-6-11	0930	76	49
100.0000	9.9997	1.0000	.0997	CJ	9-22-11	1700	77	46
100.0000	10.0001	1.0000	.0999	CJ	9-24-11	1700	77	49
100.0000	9.9998	1.0001	.1000	CJ	9-25-11	1300	76	49
100.0000	9.9999	1.0001	.0998	CJ	9-27-11	1000	77	49
99.9996	9.9999	1.0000	.0998	CJ	9-29-11	0840	72	42
99.9997	9.9998	.9999	.1000	CJ	9-30-11	1000	70	48
99.9996	9.9998	1.0000	.0999	CW	10-1-11	1520	70	45
99.9998	10.0002	1.0000	.0997	CJ	10-2-11	1430	74	47
99.9995	10.0001	1.0000	.0999	CJ	10-5-11	1510	71	49
100.0000	9.9999	1.0000	.0998	CJ	10-6-11	1000	78	40
100.0000	9.9999	1.0000	.0999	CJ	10-9-11	1130	75	45
100.0000	10.0001	1.0000	.0998	CJ	10-16-11	1540	68	47
100.0000	10.0000	1.0000	.0998	CJ	11-9-11	1230	72	46
100.0000	10.0002	.9998	.0998	CJ	11-11-11	0815	70	45
99.9999	10.0000	1.0000	.0996	CJ	11-15-11	1200	75	45
99.9995	10.0001	.9999	.0999	CJ	11-16-11	1400	70	44
99.9999	10.0001	.9999	.0998	CJ	11-20-11	1600	73	43
99.9998	9.9999	.9999	.0999	CJ	11-21-11	1715	74	47
100.0000	10.0000	1.0000	.0999	CJ	11-22-11	1600	65	48
100.0000	10.0000	1.0000	.0999	CW	1-9-12	1030	76	48
100.0000	9.9999	1.0001	.1000	CJ	1-11-12	0920	65	48
100.0000	10.0001	1.0000	.0997	CJ	1-13-12	1030	72	46

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates: From 11-11-10 Through 4-7-11	Scale: Sartorius	Model: A 120 S	SN: 37010004

100 g weight	10 g weight	1 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	% RH
100.0000	10.0002	1.0000	.0998	cp	11-11	0840	67	42
100.0000	10.0000	1.0001	.1000	cp	11-15	0930	70	48
100.0000	10.0001	1.0000	.0999	cp	11-19	0930	65	48
100.0000	10.0000	1.0000	.1000	cp	11-23	1400	66	45
100.0000	9.9997	1.0000	.0998	cp	11-24	1400	65	48
100.0000	10.0000	.9999	.0998	cp	11-26	1100	67	46
100.0000	10.0001	1.0001	.0997	cp	12-14	1000	75	41
100.0001	10.0003	1.0000	.0999	cp	12-16	1100	75	48
100.0000	10.0002	1.0000	.0999	cp	12-18	1000	77	46
100.0000	10.0000	1.0000	.0999	cp	12-21	1100	66	49
100.0000	10.0004	1.0000	.0997	cp	12-22	1400	72	48
100.0000	10.0001	1.0000	.1001	cp	12-23	1100	76	38
100.0000	10.0000	.9999	.0999	cp	12-24	1000	67	46
100.0000	10.0001	1.0001	.0999	cp	12-25	1100	70	49
100.0000	10.0000	1.0000	.0999	cp	1-19-11	0930	66	49
100.0000	9.9999	1.0000	.0999	cp	1-21-11	1400	77	44
99.9996	10.0000	1.0000	.0998	cp	1-25-11	0900	75	48
100.0000	10.0002	1.0001	.1000	cp	1-26-11	1400	74	44
100.0000	10.0001	.9998	.0998	cp	1-27-11	1200	65	48
100.0000	10.0002	1.0000	.0999	cp	1-28-11	1630	70	48
100.0000	10.0001	1.0001	.0999	cp	1-29-11	1200	68	48
100.0000	10.0002	1.0000	.0999	cp	1-30-11	1500	66	49
100.0000	9.9999	1.0000	.0999	cp	2-15-11	0930	75	41
100.0000	10.0000	1.0001	.1000	cp	2-16-11	0930	66	49
100.0000	10.0002	1.0000	.0999	cp	2-22-11	1000	70	48
100.0000	10.0001	1.0002	.0999	cp	3-4-11	1200	69	47
100.0000	10.0004	.9999	.1000	cp	3-5-11	1000	70	48
100.0000	10.0001	1.0000	.0999	cp	3-8-11	1000	74	47
100.0000	10.0000	1.0000	.1000	cp	3-9-11	1600	67	46
100.0000	10.0002	0.9999	.0999	cp	3-10-11	1600	66	49
100.0000	10.0000	1.0000	.0999	cp	3-12-11	1530	73	47
100.0000	10.0001	.9999	.0998	cp	3-13-11	1200	65	48
100.0000	10.0001	1.0000	.0999	cp	3-29-11	1120	76	49
100.0000	10.0000	.9999	.0998	cp	3-30-11	0800	74	47
100.0000	10.0001	1.0000	.0999	cp	3-31-11	1000	70	48
100.0000	10.0002	.9998	.0999	cp	4-4-11	0830	74	47
100.0000	10.0003	1.0000	.1000	cp	4-5-11	1130	73	47
100.0000	9.9999	1.0001	.0999	cp	4-6-11	1030	77	49
100.0000	10.0000	9.9999	.1001	cp	4-7-11	1000	78	40

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates: From 2-26-2010 Through 11-10-2010	Scale: Sartorius	Model: A 120 S	SN: 37010004

100 g weight	10 g weight	1 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	% RH
100.0001	10.0004	.9999	.0999	Cp	2-26-10	0840	72	46
100.0001	9.9999	.9999	.0999	Cp	2-27-10	1045	72	46
100.0000	10.0000	1.0000	.0999	Cp	2-28	1100	70	48
100.0000	10.0000	1.0000	.0999	Cp	3-1	0900	66	49
100.0000	10.0002	.9998	.1002	Cp	3-5	1200	70	48
100.0001	9.9999	.9999	.0998	Cp	3-7	1330	68	47
100.0000	9.9999	.9999	.0999	Cp	3-9	1130	70	41
100.0000	10.0001	1.0000	.0999	Cp	3-10	1200	70	44
100.0000	10.0001	.9999	.0999	Cp	3-11	0900	66	49
99.9999	9.9999	.9999	.0999	AN	3-15	1000	70	48
100.0000	10.0000	1.0000	.0998	Cp	3-17	0900	72	46
100.0000	9.9998	1.0001	.1000	Cp	4-8	1930	76	49
99.9999	10.0001	1.0000	.0999	Cp	4-10	1630	73	42
99.9999	10.0001	1.0001	.1000	Cp	4-11	1430	74	47
100.0000	10.0002	1.0000	.1000	Cp	4-21	1830	77	49
100.0000	10.0000	1.0000	.0999	Cp	4-22	1130	74	47
100.0000	10.0001	1.0000	.0999	Cp	4-23	1015	74	44
100.0002	9.9999	1.0000	.1000	Cp	4-24	0930	68	47
100.0000	9.9999	.9999	.1000	Cp	4-25	0930	73	47
100.0000	9.9999	1.0001	.0999	Cp	4-26	0900	76	42
100.0000	10.0002	1.0000	.0999	Cp	4-30	1320	78	43
99.9998	10.0000	1.0002	.0999	Cp	8-26	0845	78	49
100.0000	9.9998	1.0001	.0999	Cp	8-27	0955	78	43
100.0000	10.0000	1.0000	.1000	Cp	8-28	1600	73	47
99.9998	10.0000	.9999	.1000	Cp	8-29	1400	70	48
100.0000	10.0000	1.0000	.0999	Cp	8-31	0720	72	46
100.0001	10.0000	1.0000	.1000	Cp	9-1	1330	76	49
100.0000	10.0001	1.0000	.0999	Cp	9-2	1300	68	47
100.0000	10.0000	1.0000	.1000	Cp	9-3	1130	72	46
100.0000	10.0001	1.0000	.0999	Cp	10-26	0750	70	48
100.0000	10.0000	.9998	.0997	Cp	10-27	1250	74	47
100.0000	9.9999	1.0000	.0999	Cp	10-29	1400	71	49
100.0000	9.9999	1.0000	.0999	Cp	11-1	1000	78	49
100.0000	10.0000	.9999	.0999	Cp	11-2	0715	70	48
100.0000	10.0000	1.0000	.0999	Cp	11-3	0900	70	48
100.0000	10.0001	.9999	.1000	Cp	11-5	1320	76	42
100.0000	10.0001	.9999	.1000	Cp	11-8	1230	70	48
100.0000	10.0001	1.0000	.0998	Cp	11-9	1015	71	41
100.0000	10.0000	.9999	.0999	Cp	11-10	0900	70	44

BLANK PROCESSING DATA SHEET # 5

UNIT : ES2100 RUN : 4 DATE : 9-4-12

BLANKS DONE : 8-31-2010

BEAKER	A	B	C
	200 ml ACETONE	75 ml DICHLOR	200 ml WATER
	FISHER OPTIMA LOT # 023283	FISHER OPTIMA LOT # 066390	DWNA, Inc Sparkletts Distilled
FINAL WEIGHT	108.9019	106.3074	106.9680
TARE WEIGHT	108.9001	106.3058	106.9640
NET WEIGHT	.0018	.0016	.0040

TARE BEAKERS INTO DESC : TIME : 1410 DATE : 8-7-2010

DATE 8-26 BY : Cp DATE 8-27 BY : Cp DATE : ____ BY : ____

BEAKER	1 ST WT	TIME	2 ND WT	TIME	3 RD WT	TIME
A	108.8999	0935	108.9001	1050		
B	106.3061	0936	106.3058	1051		
C	106.9641	0937	106.9640	1052		

FINAL BEAKERS INTO DESC : TIME : 8-28 DATE : 0820

DATE 8-29 BY : Cp DATE 8-31 BY Cp DATE : ____ BY : ____

BEAKER	1 ST WT	TIME	2 ND WT	TIME	3 RD WT	TIME
A	108.9019	1501	108.9019	0742		
B	106.3076	1502	106.3074	0743		
C	106.9676	1503	106.9680	0744		

TARE QC

DATE	TIME	BY	WB	DB	%
8-26-10	0845	Cp		78	49
8-27-10	0955	Cp		78	43

FINAL QC

DATE	TIME	BY	WB	DB	%
8-29	1400	Cp		70	48
8-31	0720	Cp		72	46

NET PARTICULATE CATCH CALCULATION DATA SHEET #6

UNIT : ES2100 RUN : 4 DATE : 9-4-12

BLANK CALCULATIONS

Acetone : .0018 g ÷ 200 ml = .000009 g/ml

Dicholoromethane : .0016 g ÷ 75 ml = .000021 g/ml

Distilled Water : .0040 g ÷ 200 ml = .000020 g/ml

FRONT HALF CATCH

FILTERS : .0829 (Total Catch) g - 1 (# of Filters) (.0000 g) (Blank Value / Filter) = .0829 g

BEAKERS : .0853 (Total Catch) g - 100 (ml Acetone) .0009 (.000009 g) (Blank Value / ml Acetone) = .0844 g

TOTAL FRONT HALF CATCH : .1673 g

BACK HALF CATCH

FILTERS : .0652 (Total Catch) g - 1 (# of Filters) (.0000 g) (Blank Value / Filter) = .0652 g

BEAKERS :

Acetone : .1264 (Total Catch) g - 150 (ml Acetone) .0014 (.000009 g) (~~Blank Value~~ / ml Acetone) = .1250 g

Extract : .0132 (Total Catch) g - 75 (ml Dichloromethane) .0016 (.000021 g) (Blank Value / Dichloromethane) = .0116 g

Water : .1084 (Total Catch) g - 350 (ml Water) .0070 (.000020 g) (Blank Value / Water) = .1014 g

TOTAL BACK HALF CATCH : .3032 g

TOTAL CATCH : .4705 g

% FRONT HALF : 35.6 %

TEST DATA SHEET # 8

UNIT : ES 2100 RUN : 4 DATE : 9-4-2012

Test Chamber Air Velocity Start : Ø Stop : Ø Avg.: Ø

Wet Bulb / Dry Bulb

Pre : WB : 62 DB : 72 = 56.0 % RH 1.5 % H_2O

Post : WB : 65 DB : 79 = 44.0 % RH 1.5 % H_2O

Average : 50.0 % RH 1.5 % H_2O

Empty Stove Weight (lbs) : —— w/ stack & oil seal : Wet : —— Dry : 0.0

Kindling Weight (lbs) : Paper : .1 Wood : 1.6

Preburn Fuel Weight : 18.6 + 13.5 Total : 32.1

Kindling & Preburn Fuel Weight (wood only) (lbs) : **Total** : 33.7

Coal Bed Wt Range (lbs) : 3.4 - 2.8 **Scale** : 3.4 - 2.8

Upper : .25 x fuel weight : Always round DOWN to nearest tenth

Lower : .20 x fuel weight : Always round UP to nearest tenth

Actual Coal Bed Weight : 2.9

Maximum Coal Bed Removal (lbs) : ((3.4 (Upper) + 2.8 (Lower)) ÷ 2) .25 = .7 (round down to nearest tenth)

Test Fuel (.75" x 1.5" x 5" spacers) = 16 pcs

Dimensions	Length in inches	No. Pcs	Weight in lbs	% of Load
2" x 4"	16	3	5.2	37.4
4" x 4"	16	2	8.7	62.6

Test Fuel Weight : 13.9 lbs

Estimated Dry Burn Rate :

$$\frac{13.9 - (13.9 \times .1985)}{2.2046} \times \frac{60}{290 \text{ (TIME)}} = 1.083 \text{ kg / hr}$$

Estimated BTU's/hr : $19{,}140 \times \frac{63}{100} \times \frac{1.083}{\text{DBR}} = 13059.0$ BTU's/hr

EPA Default Efficiencies : Non-cat : 63 Cat : 72 Pellet : 78

255

WOOD STOVE OPERATING DATA PAGE #9

Unit : ES 2100 Run : 4 Date : 9-4-2012

FIRE STARTED: 0730

WARM UP AND PREBURN:

PRIMARY AIR : Set wide open for all warm-up / preburn fuel charges. Then set to 1" at start of preburn.

SECONDARY AIR : N/A CAT BYPASS : N/A

CHARCOAL BED PREPARATION :

Raked and leveled prior to each warm-up / preburn charge. At 1 1/2 min. prior to loading last fuel, raked and leveled. In stove 20 sec.

TEST:

DOOR wide open during loading 0 min. 35 sec.

PRIMARY AIR : Opened full for first 5 min., then set to run setting of 1".

SECONDARY AIR : N/A CAT BYPASS : N/A

FAN:

ON / OFF during warm-up

ON / OFF first 30 minutes of test

Fan speed set at Low

ON / OFF during preburn

ON / OFF balance of test run

WOOD DATA: KINDLING: A mix of the grades listed below:

	SIZE	MILL	GRADE	SPECIES
PREBURN:	2x4	Manke/Tacoma	Std. or better	s. grn D fir
TEST:	2x4	Packwood	# 2 or better	s. grn D fir
	4x4	Packwood	# 2 or better	s. grn D fir

PELLET FUEL MANUFACTURER : N/A BRAND : N/A

All Grades WCLB rules:

WARM UP INFORMATION:

All pre-burn / warm up fuel pieces were either 16 or 16 inches.

1st warm up / pre-burn fuel charge (18.6 lbs.) added at 0740

2nd warm up / pre-burn fuel charge (13.5 lbs.) added at 0900

3rd warm up / pre-burn fuel charge (____ lbs.) added at ____

4th warm up / pre-burn fuel charge (____ lbs.) added at ____

5th warm up / pre-burn fuel charge (____ lbs.) added at ____

TEST DATA SHEET #10

Unit : ES2100 Run : 4 Date : 9-4-2012

Room Temperature : 69 °F Temperature Correction Set? Yes No

Calibration Check: 12.0% + or – 0.2%? Yes No

Time Test Fuel moisture reading taken : 0915

pc #	Dimen.	Use	TOP	BOTTOM	SIDE	Avg Corrected
1	2"×4"×8'	K	11.7	10.6	10.9	11.067
2						
3						
4	2"×4"×8'	P	18.1	18.3	18.3	18.2
5	2"×4"×8'	P	18.0	18.1	17.9	18.0
6	2"×4"×8'	P	19.0	18.9	18.7	18.9
7	2"×4"×8'	P				55.1
8	2"×4"×8'	P				
9						
10						
11						
12	2×4×16"	T	19.5	20.6	20.0	20.0
13	"	T	20.4	19.9	20.1	20.1
14	"	T	20.3	21.3	20.8	20.8
15	4×4×16"	T	20.5	20.4	20.0	20.3
16	"	T	20.7	21.3	21.4	21.1
17						102.3
18						
19						
20	Spacers	T	23.1	22.9	21.6	22.5

Key for Use : K = Kindling P = Pretest Fuel T = Test Fuel

	KINDLING	PRETEST FUEL	TEST FUEL
Dry Moisture % :	11.067 %	18.367 %	20.460 %
Wet Moisture % :	9.964 %	15.517 %	16.985 %

To obtain Wet from Dry : $\frac{100 \times \%\text{ Dry Reading}}{100 + \%\text{Dry Reading}}$ = % Moisture, Wet Basis

Acceptable Ranges : 16 - 20 % wet: 19 - 25 % dry (17.5 - 22.5 on Meter Uncor. reading) at 70°

GAS DATA SHEET #12

WEIGHT: 2.9

DATE: 9-4-2012

UNIT: ES2100

RUN: 4

PAGE: 1 OF 2

TIME	SCALE	FUEL	DROP	V.	CO_2	V.	O_2	V.	CO	STATIC	SO_2PPM
0 / 10:50	16.9	14.0	—	.170	4.26	623	15.6	.092	.92	-.030	375
5 / 55	16.0	13.1	.9	.49	12.26	490	8.4	.01	.10	-.045	175
10 / 00	15.6	12.7	.4	.10	2.5	101	17.9	.038	.38	-.035	325
15 / 05	15.4	12.5	.2	.117	2.9	117	17.4	.05	.50	-.035	375
20 / 10	15.1	12.2	.3	.133	3.3	133	16.9	.057	.57	-.035	400
25 / 15	14.8	11.9	.3	.286	7.2	288	13.1	.044	.44	-.040	375
30 / 20	14.3	11.4	.5	.323	8.1	324	12.4	.028	.28	-.040	300
35 / 25	13.7	10.8	.6	.347	8.7	348	11.9	.013	.13	-.045	275
40 / 30	13.2	10.3	.5	.334	8.4	336	12.2	.012	.12	-.045	275
45 / 35	12.7	9.8	.5	.309	7.7	308	12.9	.017	.17	-.045	275
50 / 40	12.3	9.4	.4	.274	6.9	276	13.6	.022	.22	-.045	300
55 / 45	11.9	9.0	.4	.234	5.9	236	14.3	.056	.56	-.045	350
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-.485	*****
60 / 50	11.4	8.5	.5	.415	10.4	416	10.2	.020	.20	-.045	300
65 / 55	10.9	8.0	.5	.359	9.0	360	11.7	.009	.09	-.050	300
70 / 0	10.4	7.5	.5	.335	8.4	336	12.2	.017	.17	-.045	300
75 / 05	9.9	7.0	.5	.261	6.5	260	13.9	.040	.40	-.045	375
10	9.6	6.7	.3	.219	5.5	220	14.6	.068	.68	-.040	425
85 / 15	9.3	6.4	.3	.224	5.6	224	14.5	.063	.63	-.040	400
90 / 20	8.9	6.0	.4	.352	8.8	352	11.6	.033	.33	-.045	375
95 / 25	8.4	5.5	.5	.374	9.4	376	11.1	.021	.21	-.045	375
100 / 30	7.9	5.0	.5	.366	9.2	368	11.4	.015	.15	-.045	350
105 / 35	7.5	4.6	.4	.323	8.1	324	12.4	.022	.22	-.045	375
110 / 40	7.1	4.2	.4	.312	7.8	312	12.8	.019	.19	-.045	375
115 / 45	6.7	3.8	.4	.297	7.4	296	13.2	.016	.16	-.045	375
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-.535	*****
120 / 50	6.4	3.5	.3	.310	7.8	312	12.8	.016	.16	-.045	375
125 / 55	6.1	3.2	.3	.259	6.5	260	14.0	.025	.25	-.040	400
130 / 0	5.9	3.0	.2	.244	6.1	244	14.2	.043	.43	-.040	425
135 / 05	5.6	2.7	.3	.237	5.9	236	14.5	.039	.39	-.040	450
140 / 10	5.4	2.5	.2	.253	6.3	252	14.2	.030	.30	-.040	425
145 / 15	5.2	2.3	.2	.273	6.8	272	13.7	.027	.27	-.040	425
150 / 20	5.0	2.1	.2	.225	5.6	224	14.8	.038	.38	-.040	425
155 / 25	4.9	2.0	.1	.184	4.6	185	15.7	.049	.49	-.035	450
160 / 30	4.8	1.9	.1	.174	4.4	177	15.8	.060	.60	-.035	425
165 / 35	4.7	1.8	.1	.176	4.4	177	15.7	.066	.66	-.035	450
40	4.7	1.8	Ø	.171	4.3	173	15.7	.071	.71	-.035	450
45	4.6	1.7	.1	.170	4.3	173	15.7	.074	.74	-.030	450
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-.455	*****
TOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-1.475	*****

GAS DATA SHEET #12

WEIGHT:______ DATE: 9-4-2012

UNIT: RUN: PAGE: 2 OF 2

TIME	SCALE	FUEL	DROP	V.	CO_2	V.	O_2	V.	CO	STATIC	SO_2PPM
180 50	4.5	1.6	.1	.172	4.3	173	15.7	.076	.76	-.035	450
185 55	4.5	1.6	Ø	.172	4.3	173	15.7	.080	.80	-.030	450
190 00	4.4	1.5	.1	.168	4.2	169	15.6	.091	.91	-.030	475
195 05	4.3	1.4	.1	.166	4.2	169	15.6	.099	.99	-.030	450
200 10	4.2	1.3	.1	.169	4.2	169	15.5	.101	1.01	-.030	475
205 15	4.1	1.2	.1	.173	4.3	173	15.4	.106	1.06	-.030	475
210 20	4.0	1.1	.1	.158	4.0	161	15.7	.102	1.02	-.030	475
215 25	4.0	1.1	Ø	.152	3.8	153	15.9	.107	1.07	-.030	475
220 30	3.9	1.0	.1	.152	3.8	153	15.7	.127	1.27	-.030	475
225 35	3.8	0.9	.1	.147	3.7	149	15.7	.136	1.36	-.030	475
230 40	3.8	0.9	Ø	.151	3.8	153	15.6	.136	1.36	-.030	475
235 45	3.7	0.8	.1	.142	3.6	145	15.6	.152	1.52	-.030	500
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-0.365	*****
240 50	3.6	0.7	.1	.140	3.5	141	15.8	.146	1.46	-.030	475
245 55	3.5	0.6	.1	.134	3.4	137	15.9	.149	1.49	-.030	500
250 00	3.5	0.6	Ø	.134	3.4	137	15.8	.154	1.54	-.030	500
255 05	3.4	0.5	.1	.130	3.3	133	15.8	.162	1.62	-.030	500
260 10	3.3	0.4	.1	.130	3.3	133	15.8	.142	1.42	-.030	500
265 15	3.3	0.4	Ø	.130	3.3	133	15.8	.142	1.42	-.025	500
270 20	3.2	0.3	.1	.127	3.2	129	16.2	.138	1.38	-.030	500
275 25	3.1	0.2	.1	.123	3.1	125	16.3	.137	1.37	-.025	525
280 30	3.1	0.2	Ø	.121	3.0	121	16.4	.139	1.39	-.025	525
285 35	3.0	0.1	.1	.122	3.1	125	16.4	.122	1.22	-.025	500
290 40	2.9	0.0	.1	.122	3.1	125	16.4	.126	1.26	-.025	500
295 45											
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	.305	*****
300											
305											
310											
315											
320											
325											
330											
335											
340											
345											
350											
355											
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****		*****
TOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	.67	*****

Avg -.036 -2.145 total

PREBURN DATA SHEET #13

UNIT: ES2100 3 4 5 6 RUN: 4 DATE: 9-4-2012 PAGE: 1 of

TIME	SCALE	DROP	STACK	TOP	LF SIDE	BACK	RT SIDE	BOTTOM	FIREBOX	SEC/CAT	AMBIENT	STATIC	COMMENTS
0 0940	4.4	—	577	574	466	335	415	455			70	-.054	PREBURN START: # 10 UP
5	4.0	.4	370	530	456	500	408	455			72	-.047	COAL BED SCALE RANGE:
10 50	3.8	.2	338	507	456	501	404	452			70	-.045	3.4 → 2.8
15	3.7	.1	308	470	446	496	390	450			71	-.04	PRIMARY AIR: 1"
20 1000	3.6	.1	287	438	430	486	375	446			71	-.04	SECONDARY AIR: N/A
25	3.5	.1	268	410	420	471	361	440			71	-.035	FAN: Low
30 10	3.4	.1	256	386	408	456	350	434			72	-.035	PUMPS ON AT:
35	3.4	Ø	241	363	389	444	339	427			71	-.035	CHECK WB/DB: N/A
40 20	3.3	.1	233	348	371	434	327	421			71	-.035	
45	3.2	.1	225	332	362	428	318	416			72	-.035	
50 30	3.1	.1	218	320	353	421	314	411			71	-.035	364
55	3.1	Ø	213	309	348	414	305	406			71	-.035	
*****	****	***	****	*****	*****	****	*****	*****	*****	*****	*****	****	
60 1040	3.0	.1	208	295	345	409	300	402			71	-.030	
65	2.9	.1	205	286	345	405	297	398			71	-.030	
70 50	2.9	Ø	211	229	344	409	295	394			71	-.030	
75													
80													
85													
90													

Lennox- ES2100

Temperature Data Sheet 14

Run 4
9/4/12

175	214	290	331	393	263	306	######	######	77	1284	245	47	244	32	39
180	210	285	324	388	260	308	######	######	77	1284	246	47	243	32	39
185	207	277	321	385	257	309	######	######	77	1283	245	47	242	32	39
190	205	272	321	383	254	311	######	######	77	1283	245	49	242	32	38
195	203	270	317	381	253	312	######	######	77	1282	244	49	241	32	39
200	201	264	315	380	251	313	######	######	77	1282	244	50	241	32	39
205	200	259	322	382	254	314	######	######	78	1282	245	50	241	32	39
210	198	256	317	383	251	315	######	######	78	1282	245	51	240	31	39
215	196	252	308	383	248	316	######	######	78	1282	245	51	241	31	39
220	194	249	302	382	244	316	######	######	77	1282	245	51	240	31	39
225	193	246	302	379	244	316	######	######	78	1282	245	51	240	31	39
230	191	244	306	377	243	316	######	######	77	1282	245	52	240	31	39
235	190	241	300	374	238	316	######	######	78	1282	245	51	240	31	39
240	189	241	293	370	240	316	######	######	78	1281	245	52	239	31	39
245	186	236	292	367	235	316	######	######	78	1282	245	53	239	30	39
250	185	234	290	364	236	316	######	######	78	1281	244	53	238	30	39
255	183	233	289	361	233	315	######	######	78	1281	243	53	237	30	39
260	182	230	286	359	228	316	######	######	78	1281	243	53	237	30	39
265	180	227	286	356	229	315	######	######	78	1281	244	53	237	30	39
270	180	225	283	355	225	316	######	######	78	1280	244	54	237	30	39
275	178	223	285	353	226	316	######	######	78	1280	243	54	237	30	39
280	177	220	277	351	223	315	######	######	78	1280	243	55	237	30	39
285	175	219	277	350	220	315	######	######	78	1279	243	55	237	30	39
290	175	218	276	348	219	315	######	######	78	1279	243	55	236	30	39

TEMPERATURE DATA SHEET #14A

		TEST TIME	290		
STACK AVG	244	TOP AVG	308	LT SIDE AVG	302
BACK AVG	359	RT SIDE AVG	246	BOTTOM AVG	321
FIREBOX AVG	########	SEC/CAT AVG	########	AMBIENT AVG	76

END	275.1	
START	344.2	
	-69.1	DELTA T

CIRCLE: LOSS / GAIN

ZERO / SPAN CHECK DATA SHEET #15-1

Date : 9 - 4 -2012 Analyte : CO_2 (15-1)

Unit : ES2100 Run # : 4

Zero Cyl. # : 168TAC 3-A Conc. : 0.00 % CO_2 Cyl. Press. : 400 PSI

Certified by : AIR LIQUIDE Date : 04-19-04

Span Cyl. # : 487905 Conc. : 12.20 % CO_2 Cyl. Press. : 1300 PSI

Certified by : AIR LIQUIDE Date : 11-1-07

Analyzer : Make : HORIBA Model : PIR-2000 SN : 407069

Range : 0 - 25.0 % CO_2 Analyzer Output : 0 - 1.0 v.

Flow : 1.5 SCFH Measured by : Rotameter

EPA Span Value = 25.0 % CO_2

EPA Control Limits = ± 2.5% of 25.0 % CO_2 = ± 0.625 % CO_2

Method 28 A = ± .2 % of 25.0 % CO_2 = ± .05 % CO_2

PRE RUN Audit : by : C Watkins Time : 0915 Temp : 69 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	.018	.018	.072
SPAN	48.8	.488	12.20	48.8	.488	12.21	.010	.039

POST RUN Audit : by : C Watkins Time : 1610 Temp : 73 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.002	.068	.068	.272
SPAN	48.8	.488	12.20	48.6	.486	12.160	-.040	-.161

± Conc. Difference = Act % - Exp (Std) %

Zero % Difference = $\frac{\text{Act \% (ppm) - Exp \% (ppm)}}{\text{Full Scale Value}}$ X 100

Span % Difference = $\frac{\text{Act \% (ppm) - Exp \% (ppm)}}{\text{Full Scale Value}}$ X100

ZERO / SPAN CHECK DATA SHEET #15-2

Date : 9-4-2012 Analyte : O_2 (15-2)

Unit : ES2100 Run # : 4

Zero Cyl. # : 168TAC 3A Conc. : 0.00 % O_2 Cyl. Press. : 400 PSI

Certified by : AIR LIQUIDE Date : 04-19-04

Span Cyl. # : 487905 Conc. : 12.60 % O_2 Cyl. Press. : 1300 PSI

Certified by : AIR LIQUIDE Date : 11-1-07

Analyzer : Make : TELEDYNE Model : 320 A SN : 37400

Range : 0 - 25.0 % O_2 Analyzer Output : 0 - 1.0 v.

Flow : 1.5 SCFH Measured by : Rotameter

EPA Span Value = 25.0 % O_2

EPA Control Limits = ± 2.5% of 25.0 % O_2 = ± 0.625 % O_2

Method 28 A = ± .2 % of 25.0 % O_2 = ± .05 % O_2

PRE RUN Audit : by : C. Watkins Jr. Time : 0915 Temp : 69 ° F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	-.035	-.035	-.142
SPAN	12.60	.504	12.6	12.6	.504	12.617	.017	.070

POST RUN Audit : by : C. Watkins Jr. Time : 1010 Temp : 73 ° F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.1	.003	.040	.040	.159
SPAN	12.60	.504	12.6	12.6	.505	12.643	.043	.170

± Conc. Difference = Act % - Exp (Std) %

$$\text{Zero \% Difference} = \frac{\text{Act \% (ppm)} - \text{Exp \% (ppm)}}{\text{Full Scale Value}} \times 100$$

$$\text{Span \% Difference} = \frac{\text{Act \% (ppm)} - \text{Exp \% (ppm)}}{\text{Full Scale Value}} \times 100$$

ZERO / SPAN CHECK DATA SHEET #15-3

Date : 9-4 -2012 Analyte : CO (15-3)

Unit : ES2100 Run # : 4

Zero Cyl. # : 168TAC 3-A Conc. : 0.00 % CO Cyl. Press. : 400 PSI

Certified by : AIR LIQUIDE Date : 04-19-04

Span Cyl. # : 487905 Conc. : 4.90 % CO Cyl. Press. : 1300 PSI

Certified by : AIR LIQUIDE Date : 11-1-07

Analyzer : Make : HORIBA Model : PIR-2000 SN : 408005

Range : 0 - 10.0 % CO Analyzer Output : 0 - 1.0 v.

Flow : 1.5 SCFH Measured by : Rotameter

EPA Span Value = 10.0 % CO

EPA Control Limits = ± 2.5% of 10.0 % CO = ± 0. 25 % CO

Method 28 A = ± .2 % of 10.0 % CO = ± .02 % CO

PRE RUN Audit : by : C. Wadding Time : 0915 Temp : 69 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	-.006	-.006	-.056
SPAN	49.0	.490	4.90	49.0	.490	4.911	.011	.110

POST RUN Audit : by : C. Wadding Time : 1110 Temp : 73 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	-.006	-.006	-.056
SPAN	49.0	.490	4.90	49.1	.491	4.921	.021	.210

± Conc. Difference = Act % - Exp (Std) %

$$\text{Zero \% Difference} = \frac{\text{Act \% (ppm)} - \text{Exp \% (ppm)}}{\text{Full Scale Value}} \times 100$$

$$\text{Span \% Difference} = \frac{\text{Act \% (ppm)} - \text{Exp \% (ppm)}}{\text{Full Scale Value}} \times 100$$

ZERO / SPAN CHECK DATA SHEET #15-4

Date : 9 - 4 -2012 Analyte : SO_2 (15-4)

Unit : ES2100 Run # : 4

Zero Cyl. # : 168TAC 3-A Conc. : 0.00 ppm SO_2 Cyl. Press. : 400 PSI

Certified by : AIR LIQUIDE Date : 04-19-04

Span Cyl. # : CC82089 Conc. : 1250 ppm SO_2 Cyl. Press. : 1690 PSI

Certified by : AIR LIQUIDE Date : 01-3-2007

Analyzer : Make : HORIBA Model : PIR-2000 SN : 403019

Range : 0 - 2500 ppm SO_2 Analyzer Output : 0 - 1.0 v.

Flow : 1.5 SCFH Measured by : Rotameter

EPA Span Value = 2500 ppm SO_2

EPA Control Limits = ± 2.5% of 2500 ppm SO_2 = ± 62.5 ppm SO_2

PRE RUN Audit : by : C. Watkins Time : 0915 Temp : 69 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	PPM	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	-1.954	-1.954	-.078
SPAN	50.0	.500	1250	50.0	.500	1252.95	2.950	.118

POST RUN Audit : by : C. Watkins Time : 1610 Temp : 73 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	PPM	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	-.003	-9.483	-9.483	-.379
SPAN	50.0	.500	1250	50.1	.501	1255.5	5.500	.220

± Conc. Difference = Act % - Exp (Std) %

$$\text{Zero \% Difference} = \frac{\text{Act \% (ppm)} - \text{Exp \% (ppm)}}{\text{Full Scale Value}} \times 100$$

$$\text{Span \% Difference} = \frac{\text{Act \% (ppm)} - \text{Exp \% (ppm)}}{\text{Full Scale Value}} \times 100$$

QUALITY CHECKS DATA SHEET # 16

UNIT : ES2100 RUN : 4 DATE : 9-4-2012

Thermocouple Check:

T/C # 1	—	°F	T/C # 13	63.0	°F
T/C # 2	—	°F	T/C # 14	62.0	°F
T/C # 3	62.1	°F	T/C # 15	63.5	°F
T/C # 4	60.5	°F	T/C # 16	50.0	°F
T/C # 5	60.4	°F	T/C # 17	49.9	°F
T/C # 6	60.8	°F	T/C # 18	64.3	°F
T/C # 7	60.4	°F	T/C # 19	—	°F
T/C # 8	60.7	°F	T/C # 20	—	°F
T/C # 9	—	°F	T/C # 21	—	°F
T/C # 10	—	°F	T/C # 22	—	°F
T/C # 11	57.2	°F	T/C # 23	—	°F
T/C # 12	67.8	°F	T/C # 24	—	°F

Thermocouple Readout:

Pretest zero and span check and calibration — post test zero and span — % difference

ZERO -.4 °F Adj. to 0.0 °F ZERO -.1 °F Difference -.005 %

SPAN 2001.6 °F Adj. to 2000.0 °F SPAN 2000.2 °F Difference .010 %

Thermocouple Readout Pretest Linearity Check:

0	= 0.0 °F	200	= 200.4 °F	400	= 400.2 °F
600	= 600.0 °F	800	= 799.8 °F	1000	= 999.9 °F
1200	= 1199.8 °F	1400	= 1399.5 °F	1600	= 1599.6 °F
1800	= 1799.8 °F	2000	= 2000.0 °F		

Sample Train Leak Check	Pre ✓	Post ✓
C-gas Train Leak Check	Pre ✓	Post ✓
SO_2 Train Leak Check	Pre ✓	Post ✓
Static Gauge Zero Check	Pre ✓	Post ✓

Scale Check Pre : 13.4 — 3.4 = 10.0

Post : 12.9 — 2.9 = 10.0

Stack Cleaned Prior to Test Run : YES ______ NO X

Calibration Data

INSPECTION CERTIFICATE

Phillips Morris Scale Company
Partners in Weighing Systems
934 Elliott Avenue W.
Seattle, WA 98119
Ph#(206)284-6090
Fax#(206)282-6612

CUSTOMER: LOKEE TESTING
ADDRESS: 13235 Prarie Circle
Sumner WA 98390
TECHNICIAN: Patrick McLellan
AUTHORIZATION SIGNATURE:

DATE OF INSPECTION: 11-26-02
NEXT INSPECTION DUE: 5-03
CERTIFICATION TYPE
✓ STANDARD
__ ISO 9000
__ MIL STD-45662

EQUIPMENT TESTED

INDICATOR

	Indicator	Base
MAKE	weightronix	
MODEL	WI-110	
SR#	16409	
CLASS	III	
CAP.	1000 lbs	

OPTIONS INSTALLED

PRINTER ____
SCORE BOARD ____
COMPUTER ____
OTHER ____

PRE-TEST	POST-TEST	MANUFACTURER TOLERANCE
Ø	Ø	
	499.9	
998.7	1000.0	

CORNER TEST P ✓ F __
SHIFT TEST P ✓ F __
STATIC TEST 2 MIN. __ ✓ 5 MIN. __

WEIGHT KIT# ________ NIST# ________

SERIAL NUMBERS OF WEIGHTS USED (OR COPY OF CERTIFICATE)

T23-13 T23-14

ANY CHANGES TO DOCUMENT OR SCALE NOT AUTHORIZED BY PHILLIPS & MORRIS SCALE COMPANY VOIDS THIS CERTIFICATE.

WASHINGTON STATE DEPARTMENT OF **AGRICULTURE**

METROLOGY LABORATORY

Receipt Date:	January 29, 2002	State Test Number:	L2017-1
Test Date:	February 13, 2002	Group ID:	SHOP
Report Date:	February 13, 2002	Due Date:	February 13, 2004

CALIBRATION REPORT

Phillips Morris Scale Company		Item(s) Submitted:	See Table Below
934 Elliott Ave. W		Specification:	NIST HB 105-1, Class F
Seattle, WA 98119-3608		Condition:	Good
Contact:	Todd Mackie	Temperature:	21.0 °C
Phone:	206-284-6090	Pressure:	762.0 mmHg
PO Number:	2-2-009237	Humidity:	35 % RH
SOP:	8	Technician ID:	DW

Description	Value / Range	Qty	Material	Manufacture	Serial Number
Test Weight	1000 lb	5	Cast Iron	Rice Lake	OFT0, OFT1, OFT2, ~~OFSY, OFSZ~~
Test Weight	500 lb	12	Cast Iron	Rice Lake	T23-13 to T23-16, T23-20, T23-24, T23-26, T23-28 to T23-32
Test Weight	50 lb	30	Cast Iron	Rice Lake	877B, N1039, N1041, T23-1 to T23-10, T23-19 to T23-28, WA171-0, WA1712-0 to WA172-2, WA173-2, WA237, X694
Test Weight	25 lb	2	Cast Iron	Rice Lake	WA238, T23-11
Weight Set, 7 pc	10 lb - 8 oz	1	Stainless Steel	Rice Lake	WA177-7
Weight Set, 12 pc	5 kg - 200 g	1	Stainless Steel	Rice Lake	SK

The item(s) listed above have been found and/or left within the stated tolerances for the specification stated above, except as noted. The item(s) listed above have been compared to the Standards of the State of Washington, which are currently in control. These standards values are traceable to the National Institute of Standards and Technology (NIST) through NIST Test Numbers 822/264514-01 and Minnesota Metrology Laboratory Report Number 307 430. Calibration processes were monitored and found to be in control. The expanded uncertainty (k=2) for each item listed in this report is less than 1/3 of the appropriate tolerance. Results apply to items identified in this report only. This report may not be reproduced, except in full, unless permission for the publication of an abstract is obtained in writing from the calibrating organization issuing this report.

LABORATORY SERVICES DIVISION
WEIGHTS AND MEASURES PROGRAM

Dan Wright
DAN WRIGHT
STATE METROLOGIST

MAR 0 8 2002

NVLAP

NVLAP LAB CODE 200446-(

2747 29th Avenue Southwest ▼ Tumwater, Washington 98512 ▼ (360) 753-5042 ▼ (360) 586-4728 fax

Established 1974

QUALITY CONTROL SERVICES

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ACCREDITED
Calibration Services
Certificate Number: 1550.01
Laboratory code: 115953

.okee Testing Labs
13235 Prairie Circle East
Bonney Lake, WA 98390

Report Number: LOKT0137010004111208

CERTIFICATE OF CALIBRATION WITH DATA

INSTRUMENT INFORMATION

Item	Make	Model	Serial Number	Customer ID	Location
Balance	Sartorius	A120S	37010004	N/A	Lab
Units	**Readability**	**SOP**	**Cal Date**	**Last Cal Date**	**Cal Due Date**
g	0.0001	QC012	12/8/11	6/9/11	6/2012

FUNCTIONAL CHECKS

ECCENTRICITY	LINEARITY	REPEATABILITY
Test Wt: 100 Tol: 0.0003	Test Wt: 50x2 Tol: 0.0004	Test Wt: 100 Tol: 0.0001
As-Found: Pass: ☑ Fail: ☐	As-Found: Pass: ☑ Fail: ☐	As-Found: Pass: ☑ Fail: ☐
As-Left: Pass: ☑ Fail: ☐	As-Left: Pass: ☑ Fail: ☐	As-Left: Pass: ☑ Fail: ☐

CALIBRATION DATA

Standard	As-Found	As-Left
100	99.9998	100.0000
70	69.9999	70.0000
50	49.9999	50.0000
20	20.0000	20.0000
10	10.0000	10.0000
5	5.0000	5.0000

CALIBRATION STANDARDS

Item	Make	Model	Serial Number	Cal Date	Cal Due Date	NIST ID
Weight Set	R.L./Troemner	1MG-25KG	A45	9/28/11	9/2012	822/274334-07

ermanent Information Concerning this Equipment:

Comments/Info Concerning this Calibration:

nician: D. Deleasa

Signature: D. Deleasa

nstruments listed above were calibrated using standards traceable to the National Institute of Standards and Technology (NIST). Calibration data reflect results at the time and location of calibration. Calibration data should be reviewed to insure that the instrument is performing to its required accuracy.

QUALITY CONTROL SERVICES

Established 1974

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2340 SE 11TH Ave. Portland, Oregon 97214 · Box 14831 Portland, Oregon 97293
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Lokee Testing Labs
13235 Prairie Circle East
Bonney Lake, WA 98390

Report Number: LOKT0137010004110609

CERTIFICATE OF CALIBRATION WITH DATA

INSTRUMENT INFORMATION

Item	Make	Model	Serial Number	Customer ID	Location
Balance	Sartorius	A120S	37010004	N/A	Lab

Units	Readability	SOP	Cal Date	Last Cal Date	Cal Due Date
g	0.0001	QC012	6/9/11	12/3/10	6/2012

FUNCTIONAL CHECKS

ECCENTRICITY	LINEARITY	REPEATABILITY
Test Wt: 100 Tol: 0.0003	Test Wt: 50x2 Tol: 0.0004	Test Wt: 100 Tol: 0.0001
As-Found: Pass: ☑ Fail: ☐	As-Found: Pass: ☑ Fail: ☐	As-Found: Pass: ☑ Fail: ☐
As-Left: Pass: ☑ Fail: ☐	As-Left: Pass: ☑ Fail: ☐	As-Left: Pass: ☑ Fail: ☐

CALIBRATION DATA

Standard	As-Found	As-Left
100	100.0002	99.9999
70	70.0001	70.0000
50	50.0001	50.0000
20	20.0000	20.0000
10	10.0000	10.0000
5	5.0000	5.0000

CALIBRATION STANDARDS

Item	Make	Model	Serial Number	Cal Date	Cal Due Date	NIST ID
Weight Set	R.L./Troemner	1MG-25KG	A45	10/18/10	10/2011	822/274334-07

ermanent Information Concerning this Equipment:

Comments/Info Concerning this Calibration:

hnician: D. Deleasa

Signature: D. Deleasa

ıstruments listed above were calibrated using standards traceable to the National Institute of Standards and Technology (NIST). Calibration data reflect results at the time and location of calibration. Calibration data should be reviewed to insure that the instrument is performing to its required accuracy.

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13235 Prairie Circle East
Sumner, WA 98390

Report Number: LOKT0137010004100616

CERTIFICATE OF CALIBRATION WITH DATA

INSTRUMENT INFORMATION

Item	Make	Model	Serial Number	Customer ID	Location
Balance	Sartorius	A120S	37010004	N/A	Lab

Units	Readability	SOP	Cal Date	Last Cal Date	Cal Due Date
g	0.0001	QC012	6/16/10	12/3/09	12/2010

FUNCTIONAL CHECKS

ECCENTRICITY	LINEARITY	REPEATABILITY
Test Wt: 100 Tol: 0.0003	Test Wt: 50x2 Tol: 0.0004	Test Wt: 100 Tol: 0.0001
As-Found: Pass: ☑ Fail: ☐	As-Found: Pass: ☑ Fail: ☐	As-Found: Pass: ☑ Fail: ☐
As-Left: Pass: ☑ Fail: ☐	As-Left: Pass: ☑ Fail: ☐	As-Left: Pass: ☑ Fail: ☐

CALIBRATION DATA

Standard	As-Found	As-Left
100	99.9999	99.9999
70	70.0000	70.0000
50	50.0000	50.0000
20	20.0000	20.0000
10	10.0000	10.0000
5	5.0000	5.0000

CALIBRATION STANDARDS

Item	Make	Model	Serial Number	Cal Date	Cal Due Date	NIST ID
Weight Set	R.L./Troemner	1MG-25KG	A45	10/12/09	10/2010	822/274334-07

Permanent Information Concerning this Equipment:

Comments/Info Concerning this Calibration:

Technician: D. Deleasa

Signature: D. Deleasa

Instruments listed above were calibrated using standards traceable to the National Institute of Standards and Technology (NIST). Calibration data reflect results at the time and location of calibration. Calibration data should be reviewed to insure that the instrument is performing to its required accuracy. Calibrations comply with ISO/IEC 17025 and ANSI/Z540-1-1994 quality standards.

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Thermocouple Calibration Record Semi-Annual

Thermocouples Check against
Reference Thermometer serial number 9123454
Ice Water Bath 32.0
Boiling Water 212.0
Room Temperature 74
Barometric Pressure 30.10
DATE: 8-29-2012

TC	Location	Ice Bath Temp	Boiling Water Temp
1	Wet Bulb	32.1	211.9
2	Dry Bulb	32.0	211.7
3	Stack	32.3	211.9
4	Stove Top	32.0	212.1
5	Left Side	32.2	212.0
6	Back	32.1	211.3
7	Right Side	32.0	211.6
8	Bottom	32.0	212.1
9	Firebox	32.3	211.1
10	Secondary/Cat	32.4	211.8
11	Ambient	32.2	211.9
12	Tube Furnace	32.1	211.8
13	Sample Box	32.0	211.3
14	Impinger Out	32.1	211.9
15	C. Gas Box	32.2	211.9
16	C. Gas Out	32.3	211.8
17	SO2 Out	32.1	211.3
18	Upper Ambient	32.0	212.0
19			
20			
21			
22			
23	Calibrator	32.0	212.0
24	Oven	32.2	211.9

Thermocouple Readout Semi-Annual Calibration Data Sheet

Date: 8-28-2012
Ambient Temperature: 74
Technician: gp

Thermocouple Number: T/C Readout
Barometric Pressure: 30.10
Reference: Mercury in glass FISHER #9123454
Other: OMEGA CL-300

Reference Point No. [a]	Source [b]	Reference Thermometer Temperature °F	Thermocouple Potentiometer Temperature °F	Difference (%)[c]
32	Ice Water	32.0	32.0	Ø
212	Boiling Water	212.0	211.9	.047
250	Omega	250.0	249.8	.080
300	Omega	300.0	299.8	.017
400	Omega	400.0	399.7	.075
500	Omega	500.0	499.7	.060
600	Omega	600.0	599.6	.067
700	Omega	700.0	699.8	.029
800	Omega	800.0	799.7	.038
900	Omega	900.0	899.7	.033
1000	Omega	1000.0	999.6	.040
1200	Omega	1200.0	1199.6	.033
1400	Omega	1400.0	1399.7	.021
1600	Omega	1600.0	1599.7	.019
1800	Omega	1800.0	1899.6	.022
2000	Omega	2000.0	2000.0	Ø

[a] Every 50°F for each reference point
[b] Type of Calibration System Used
[c] $\frac{\text{(reference temperature)} - \text{(thermocouple temperature)}}{\text{reference temperature}} * 100$

c:\winword\report\cal.doc

TRACEABILITY DOCUMENTATION Semi-Annual

S02 INJECTION ROTAMETER, DRY GAS METER AND SLING PSYCHROMETER THERMOMETERS IN LAB. CHECKED AGAINST FISHER SN 9123454 (NIST).

DATE: 8-28-2012

SO^2 INJECTION ROTAMETER

FISHER SN 9123454

NIST Traceable

Actual	°C = °F	°F
0.0	32.0	32.0
18.0	64.4	64.4
32.2	90.0	90.0
45.6	82.1	82.1

DRY GAS METER THERMOCOUPLES

Actual	°C = °F	5H in	5H out	KK
0.0				
17.8	64.0	64.1	64.0	
31.4	88.5	88.6	88.5	
44.2	111.6	111.8	111.7	

SLING PSYCHROMETER

Actual	°C = °F	Wet Bulb	Dry Bulb
0.0	32.0	32.0	32.0
17.8	64.0	64.0	64.0
30.8	87.4	87.4	87.4
43.4	110.1	110.0	110.1

Conversions = $°F = (°C \times 1.8) + 32$ $°C = (°F-32) \div 1.8$

VANEOMETER CALIBRATION

LoKee Testing Lab uses a Dwyer Model #480 Vaneometer to measure test chamber air velocity. The manufacturer's specifications for accuracy are ± 5.0% to 100 FPM and ± 10% from FPM to top of scale. LoKee Testing Lab insures that the instrument is level and clean prior to taking each reading. According to EPA personnel (Westlin, RTP) no further calibration of the instrument is necessary.

DRAFT GAUGE CALIBRATION

LoKee Testing Lab uses a Dwyer model 115-AV 0-0.25" inclined water manometer (readability resolution ± 0.001" of water) to measure the static pressure in the stack. Once leveled and zeroed as per the manufacturer's written operating instructions, the Dwyer manometer is a primary standard and requires no additional calibration.

The manometer is leveled and zeroed at the start of each test run, checked as necessary during the run to verify the settings have not changed and again at the end of each test run. The results of each check are recorded on Data Sheet #16 in each test run.

BAROMETER CALIBRATION

LoKee Testing Lab uses a Princo Model 469 NOVA Mercury Barometer to measure barometric pressure. When installed and maintained as per the manufacturer's written operating instruction, the Princo Model 469 Mercury Barometer is a primary standard and needs no further calibration.

MOISTURE METER CALIBRATION

The Delmhorst Model RC-1C, SN 16152 Moisture Meter is calibrated each time the meter is used by adjusting the zero and span calibration. The potentiometers of each calibration point (X = zero, Y = span) are adjusted until the meter is calibrated correctly. The meter is then checked against a calibration block (Delmhorst Model MCS-1, moisture content standard at 12.0% and 22.0%) in its normal operating range of 11-25%.

LoKee Testing Lab also has a second moisture meter, Delmhorst Model G-30, SN 2477 to use as a backup.

APEX INSTRUMENTS METHOD 5 PRE-TEST CONSOLE CALIBRATION
USING CALIBRATED CRITICAL ORIFICES
5-POINT ENGLISH UNITS

Meter Console Information	
Console Model Number	H
Console Serial Number	
DGM Model Number	
DGM Serial Number	

Calibration Conditions			
Date	Time	28-Aug-12	13:00
Barometric Pressure		30.1	in Hg
Theoretical Critical Vacuum[1]		14.2	in Hg
Calibration Technician		CW	

Factors/Conversions		
Std Temp	528	°R
Std Press	29.92	in Hg
K_1	17.647	oR/in Hg

[1]For valid test results, the Actual Vacuum should be 1 to 2 in. Hg greater than the Theoretical Critical Vacuum shown above.

[2]The Critical Orifice Coefficient, K', must be entered in English units, $(ft^{3}*°R^{1/2})/(in.Hg*min)$.

Calibration Data

Run Time	Metering Console					Critical Orifice				
Elapsed	DGM Orifice ΔH	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final	Serial Number	Coefficient	Amb Temp Initial	Amb Temp Final	Actual Vacuum
(Θ)	(P_m)	(V_{mi})	(V_{mf})	(t_{mi})	(t_{mf})		K'	(t_{amb})	(t_{amb})	
min	in H_2O	cubic feet	cubic feet	°F	°F		see above2	°F	°F	in Hg
15.0	0.4	332.000	337.000	81	85	GX-40	0.2333	81	83	25
10.3	0.5	337.000	342.000	85	86	GX-48	0.3392	83	85	24
7.9	0.6	342.000	347.000	86	85	GX-55	0.4457	85	86	22
6.0	0.6	347.000	352.000	84	84	GX-63	0.5870	85	86	21
4.5	0.7	352.000	357.000	84	83	GX-73	0.8091	86	87	18

Results

Standardized Data				Dry Gas Meter				
Dry Gas Meter		Critical Orifice		Calibration Factor		Flowrate	ΔH @	
				Value	Variation	Std & Corr	0.75 SCFM	Variation
$(V_{m(std)})$	$(Q_{m(std)})$	$(Vcr_{(std)})$	$(Q_{cr(std)})$	(Y)	(ΔY)	$(Q_{m(std)(corr)})$	(ΔH@)	(ΔΔH@)
cubic feet	cfm	cubic feet	cfm			cfm	in H2O	
4.896	0.326	4.525	0.302	0.924	-0.011	0.302	2.426	1.286
4.874	0.472	4.522	0.438	0.928	-0.007	0.438	1.376	0.237
4.875	0.614	4.561	0.574	0.935	0.001	0.574	0.916	-0.223
4.890	0.815	4.539	0.756	0.928	-0.006	0.756	0.607	-0.532
4.895	1.088	4.688	1.042	0.958	0.023	1.042	0.371	-0.768
				0.935	Y Average		1.139	ΔH@ Average

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.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the Precision Wet Test Meter # 11AE6, which in turn was calibrated using the American Bell Prover # 3785, certificate # F107, which is traceable to the National Bureau of Standards (N.I.S.T.).

Signature ______________________ Date ______________________

SO_2 ROTAMETER CALIBRATION

Last Cal. : 1-4-2012 By : Cp Date : 8-28-12 By : Cp

Manufacturer : SKC-WEST
SKC ACCUFLOW Digital Flow Calibrator: Model 712 SN : 311325

Barometric Pressure : 30.10 " Hg Temperature : 75

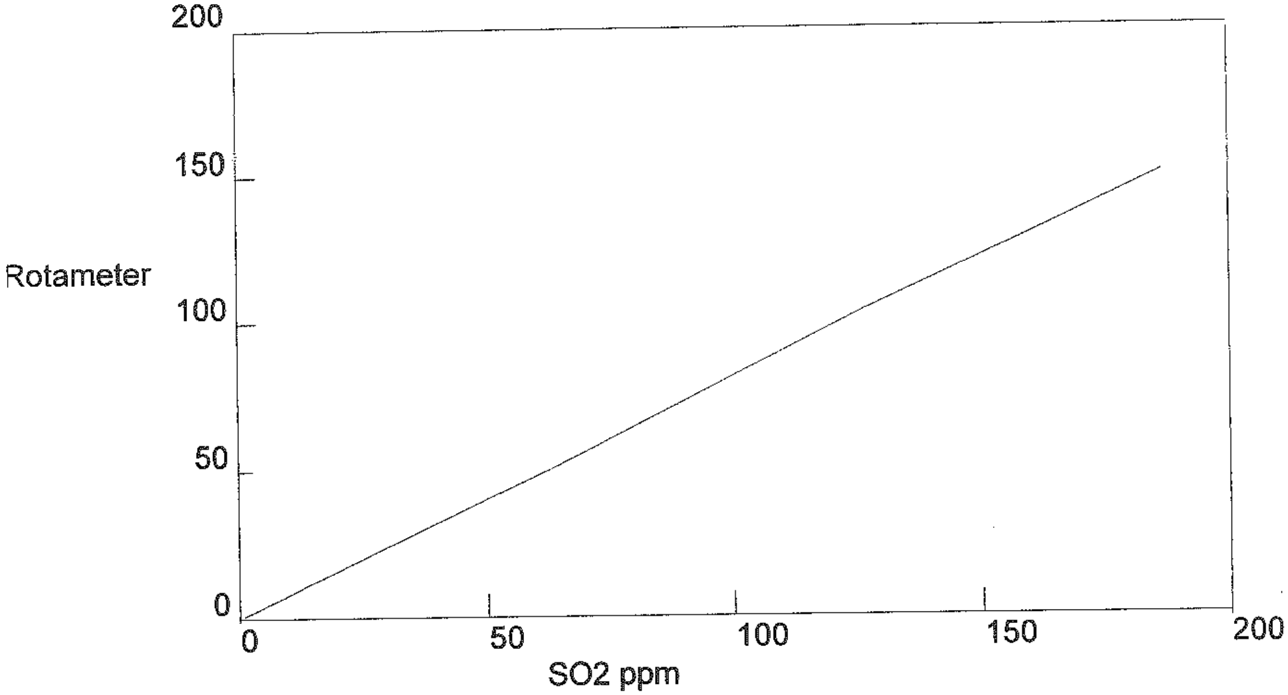
RUN #	50 CC/MINUTE DIGICAL VOLUME	100 CC/MINUTE DIGICAL VOLUME	150 CC/MINUTE DIGICAL VOLUME
1	56.1	120.3	173.7
2	56.0	120.2	174.0
3	55.9	120.5	173.1
4	55.7	119.7	173.5
5	56.1	121.2	174.2
6	56.0	120.7	173.0
7	56.2	120.2	172.9
8	56.3	121.0	172.9
9	55.7	120.5	173.7
10	56.0	120.2	173.9
AVERAGE	56.0 cc/min	120.5 cc/min	173.5 cc/min

SETTING	cc/min
0	0.0
50	56.0
100	120.5
150	173.5

Rotometer setting for 100 cc/minute based on regression with this data.

100 CC / MINUTE = 85.7

SO2 Rotameter
08/28/12



Regression Output:

Constant	-0.25
Std Err of Y Est	3.335416016
R Squared	0.9987013745
No. of Observations	4
Degrees of Freedom	2

X Coefficient(s)	1.17
Std Err of Coef.	0.0298328678

range-analyze-regression

0	0
50	56
100	120.5
150	173.5

TRACER GAS TRAIN RESPONSE TIME

DATE : 8-28-12

Elapsed Time	SO_2 Conc. (v.)	SO_2 Conc. (v.)	SO_2 Conc. (v.)
00 sec	.515	.514	.515
15	.299	.305	.305
30	.185	.188	.185
45	.135	.136	.138
60	.087	.090	.088
75	.065	.065	.063
90	.042	.044	.041
105	.025	.025	.028
120	.017	.018	.017
135	.011	.012	.011
150	.007	.007	.006
165	.003	.004	.003
180	.001	.002	.001
Initial Response	12	12	12
95 % Response	104	104	105
Flow Rate	1.5	1.5	1.5

CEM GAS TRAIN RESPONSE TIME

Elapsed Time	CO_2 Conc. (v.)	CO_2 Conc. (v.)	CO_2 Conc. (v.)	O_2 Conc. (v.)	O_2 Conc. (v.)	O_2 Conc. (v.)	CO Conc. (v.)	CO Conc. (v.)	CO Conc. (v.)
00 sec	.499	.501	.501	.000	.000	.001	.499	.500	.500
15	.485	.482	.480	.431	.440	.438	.250	.240	.240
30	.342	.345	.340	.742	.743	.745	.050	.045	.050
45	.148	.150	.150	.801	.811	.810	.019	.018	.015
60	.082	.080	.083	.827	.824	.824	.007	.006	.004
75	.039	.037	.036	.824	.826	.825	.002	.002	.001
90	.020	.021	.022	.827	.828	.827	Ø	Ø	Ø
105	.013	.014	.014						
120	.007	.008	.007						
135	.004	.005	.002						
150	.002	.002	.001						
165	.001	.001	.000						
180	Ø	Ø							
Initial Response	14	14	14	8	9	8	7	6	6
95 % Response	85	85	85	60	60	58	40	40	40
Flow Rate	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5

ORSAT ANALYSIS DATA SHEET

DATE : 8-28-12

Gas	1	2	3	AVE	CONC	TANK ID
CO_2	Ø	Ø	Ø	Ø	Ø	168TAC 3A
O_2	Ø	Ø	Ø	Ø	Ø	
CO	Ø	Ø	Ø	Ø	Ø	
CO_2						487905
O_2						NEW 11-01-07
CO						Exp 10-31-2012
CO_2	21.0	21.1	21.1	21.1	21.1	CA 06641
O_2	20.9	20.9	20.9	20.9	20.9	
CO	8.6	8.6	8.6	8.6	8.63	
CO_2	6.2	6.2	6.2	6.2	6.22	CC-12730
O_2	6.2	6.3	6.2	6.23	6.25	
CO	2.0	2.0	2.0	2.0	1.98	
CO_2						
O_2						
CO						

CO_2 ANALYZER
MULTIPOINT CALIBRATION REPORT FORM

Date: 8-30-2012

Analyzer: Make: HORIBA Model: PIR 2000 SN: 407069

Calibration by: CW

Cal Gas Flow: 1.5 SCFH

Measured by: Rotameter

BP: 30.07

Instrument ID: PRINCO

Temp: 66

Instrument ID: TR

Cylinders:

1. # 168TAC 3-A Concentration: 00.00 % CO_2 Cyl. Press.: 400 PSI
   Certified by: AIR LIQUIDE Date: 04-19-04
2. # 487905 Concentration: 12.20 % CO_2 Cyl. Press.: 1320 PSI
   Certified by: AIR LIQUIDE Date: 11-1-07
3. # CA06641 Concentration: 21.1 % CO_2 Cyl. Press.: 1370 PSI
   Certified by: AIR LIQUIDE Date: 1-5-2007
4. # CC-12731 Concentration: 6.22 % CO_2 Cyl. Press.: 1050 PSI
   Certified by: AIR LIQUIDE Date: 03-13-03

Analyzer: **Calibrated Range:** 0-25.0 % **Output:** 0-1.0 V.
Flow: 1.5 SCFH **Measured by:** Rotameter

Calibration Results

Point #	CYL. #	% CO2	EXPECTED METER	EXPECTED DVM	ACTUAL METER	ACTUAL DVM	ADJ. METER	ADJ. DVM
1	1	0.00	00.0	.000	00.0	-.004	00.0	.000
2	2	12.20	48.8	.488	49.5	.495	488	.488
3	3	21.1	84.4	.844	84.4	.844		
4	4	6.22	24.9	.249	24.7	.247		
5	1	0.00	00.0	.000	00.0	.000		

.5 = 12.509

CO_2 Linear Regression Results:

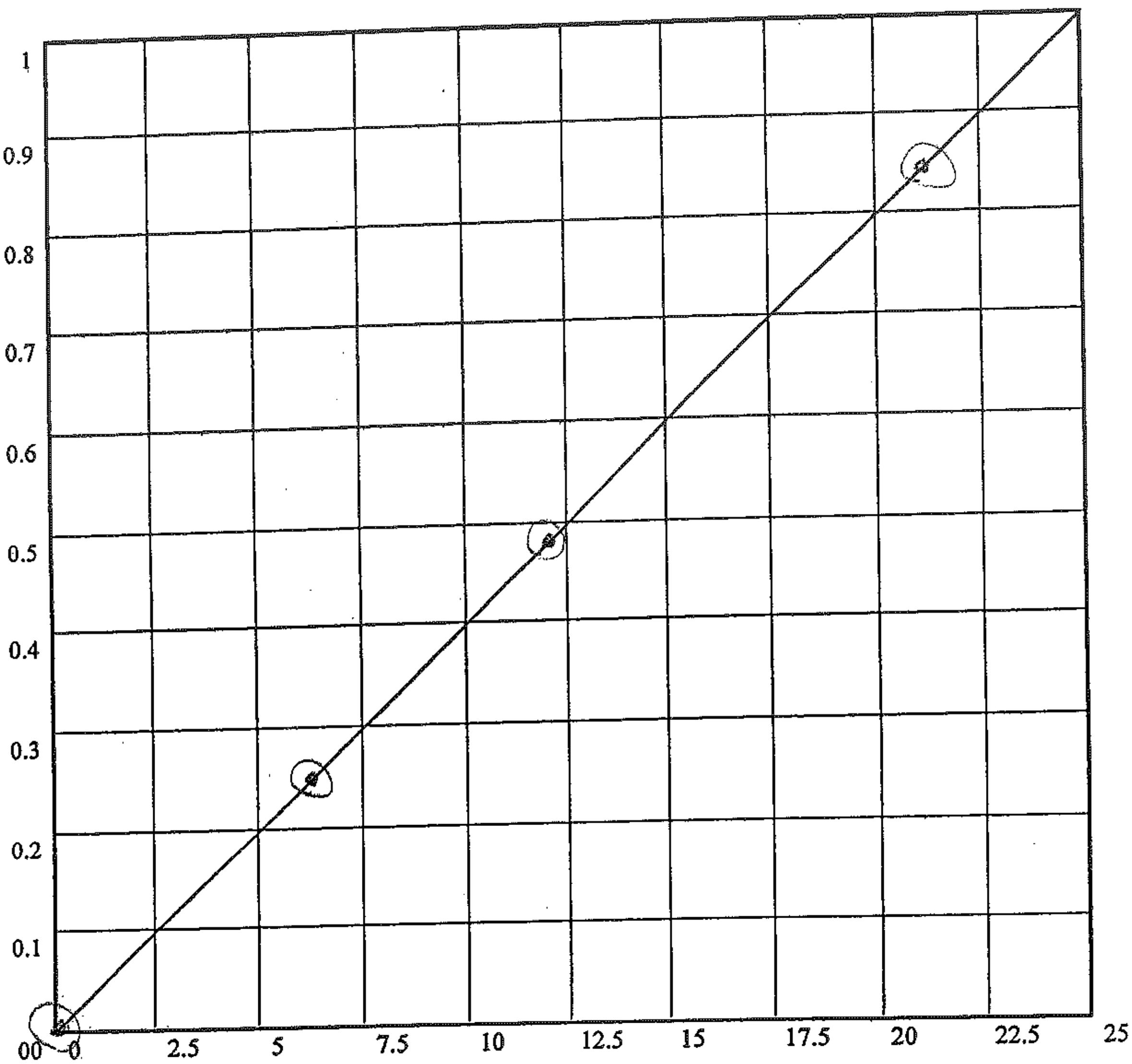
Y = MX +B

Slope (M) = -.0007187

Y Intercept (B) = .0400272

Correlation Coefficient (r) = .9999971

r^2 = .9999942



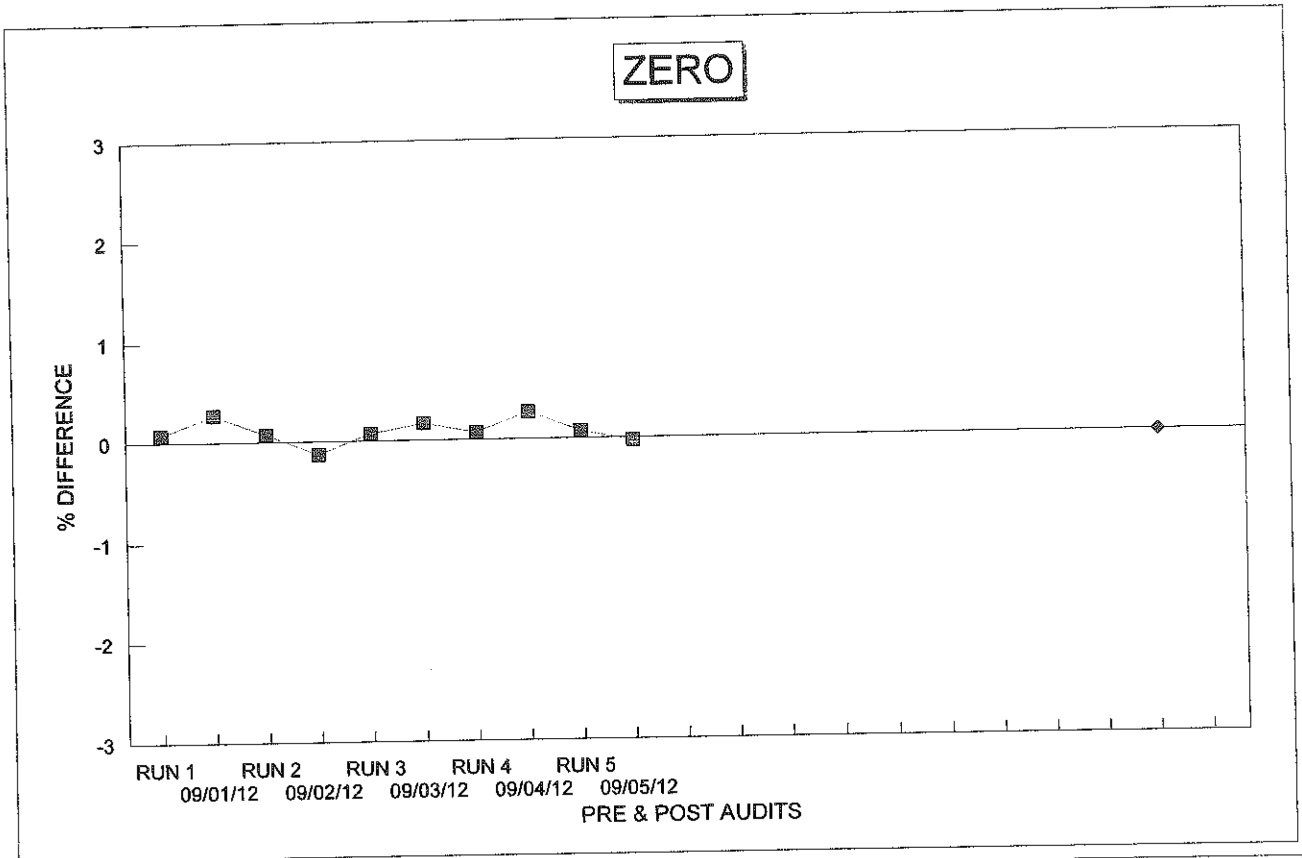
EPA Span Value = ± 2.0% of 25% CO_2 = ± .5%

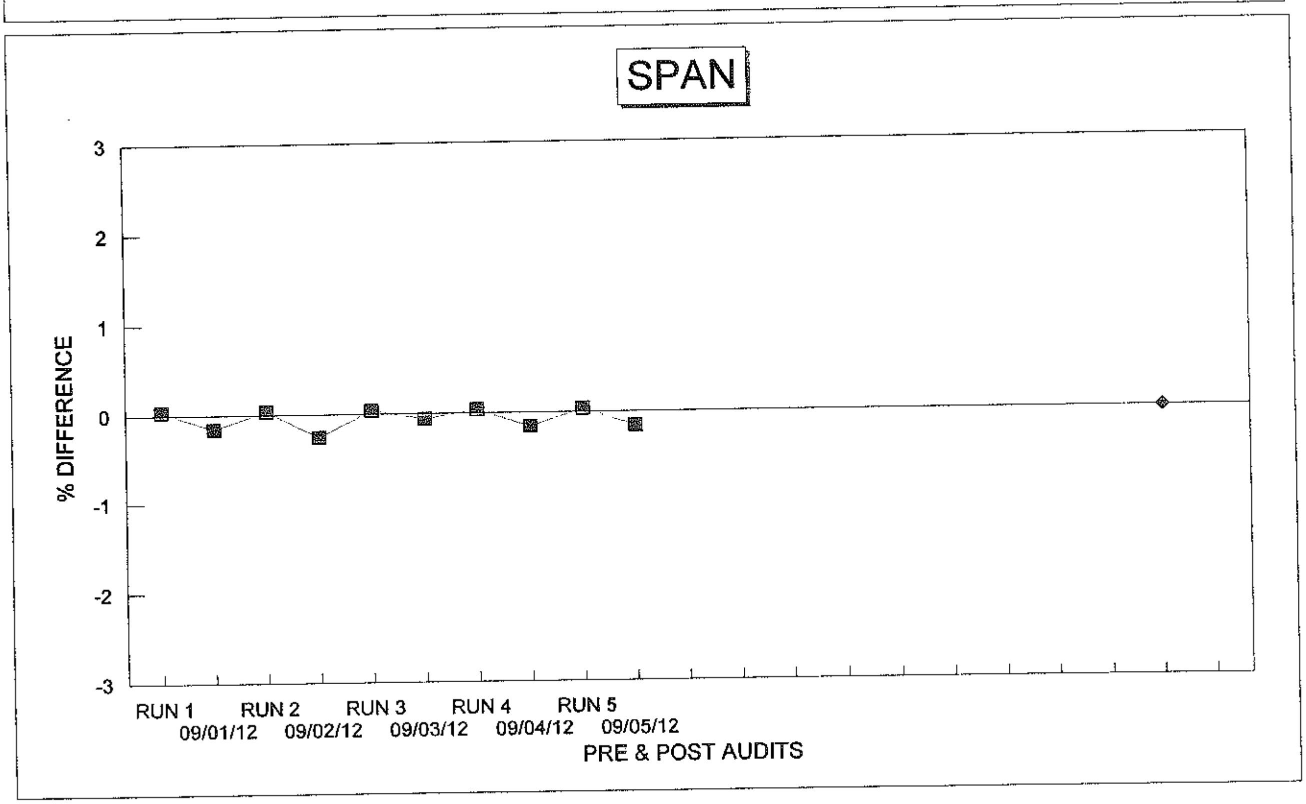
Cal Volts = Cal Volt Conc - Std Conc = ± Conc Diff = ± Δ %

HIGH VOLTS	.844 =	21.1 -	21.1 =	Ø =	Ø
LOW VOLTS	.247 =	6.175 -	6.22 =	-.045 =	-.180

CO2

Lennox-ES2100





O_2 ANALYZER
MULTIPOINT CALIBRATION REPORT FORM

Date: 8-30-2012

Analyzer: Make: TELEDYNE Model: 320A SN: 37400

Calibration by: CW

Cal Gas Flow: 1.5 SCFH

BP: 30.07

Temp: 66

Measured by: Rotameter

Instrument ID: PRINCO

Instrument ID: TR

Cylinders:

1. # 168TAC 3-A Concentration: 00.00 % O_2 Cyl. Press.: 400 PSI
   Certified by: AIR LIQUIDE Date: 04-19-04
2. # 487905 Concentration: 12. 0 % O_2 Cyl. Press.: 1320 PSI
   Certified by: AIR LIQUIDE Date: 11-1-07
3. # CA06641 Concentration: 20.9 % O_2 Cyl. Press.: 1370 PSI
   Certified by: AIR LIQUIDE Date: 1-5-2007
4. # CC-12731 Concentration: 6.25 % O_2 Cyl. Press.: 1050 PSI
   Certified by: AIR LIQUIDE Date: 03-13-03

Analyzer: **Calibrated Range:** 0-25.0 %
Flow: 1.5 SCFH

Output: 0-1.0 V.
Measured by: Rotameter

Calibration Results

Point #	CYL. #	% O2	EXPECTED		ACTUAL		ADJ.	
			METER	DVM	METER	DVM	METER	DVM
1	1	0.00	00.0	.000	00.1	.003	00.0	.000
2	2	12.60	12.60	.504	12.7	.508	12.6	.504
3	3	20.9	20.9	.836	20.8	.833		
4	4	6.25	6.25	.250	6.3	.252		
5	1	0.00	00.0	.000	00.0	.000		

.5 = 12.517

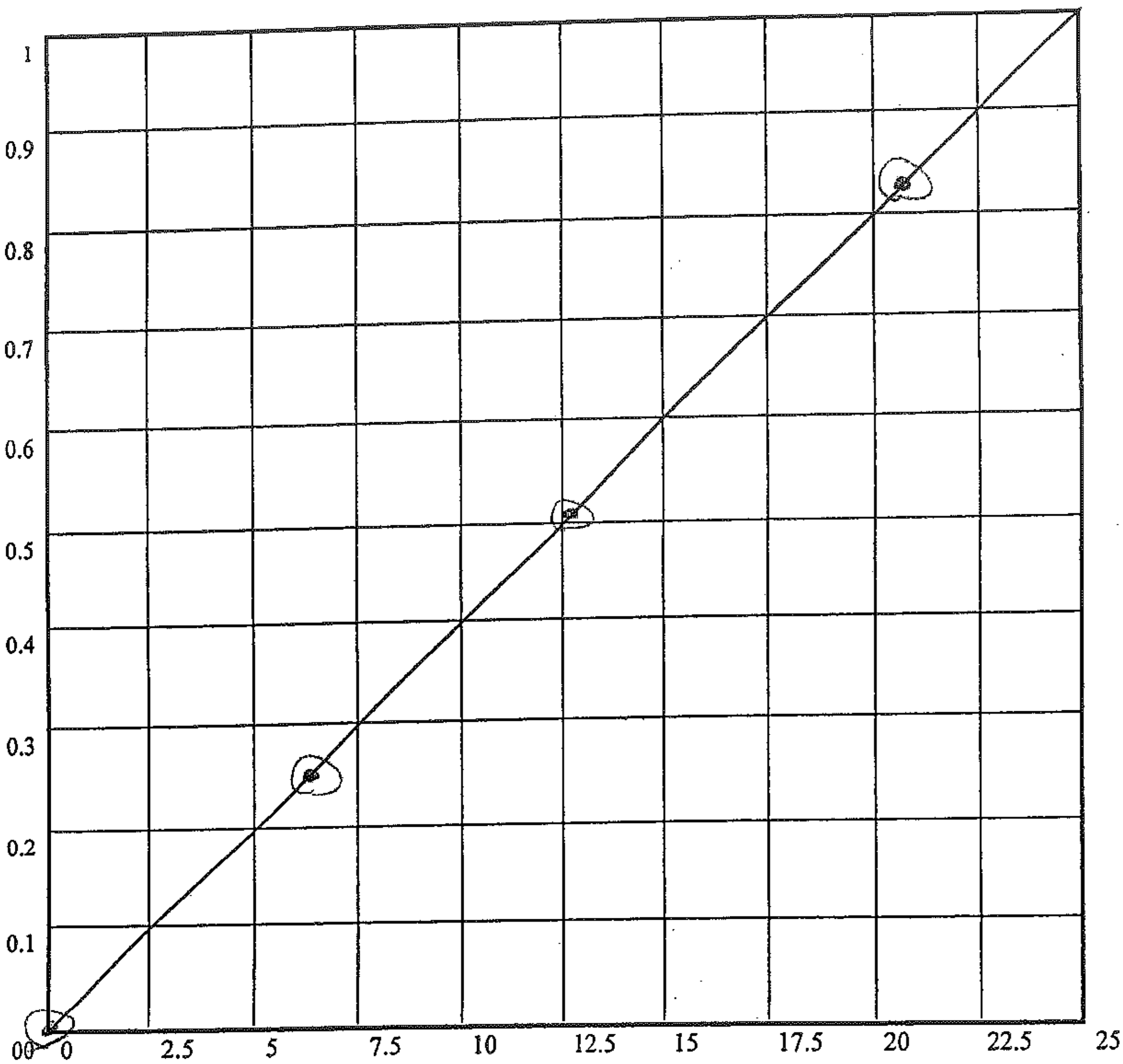
O_2 Linear Regression Results:

Y = MX +B
Slope (M) = .0014198

Y Intercept (B) = .0398320

Correlation Coefficient (r) = .9999921

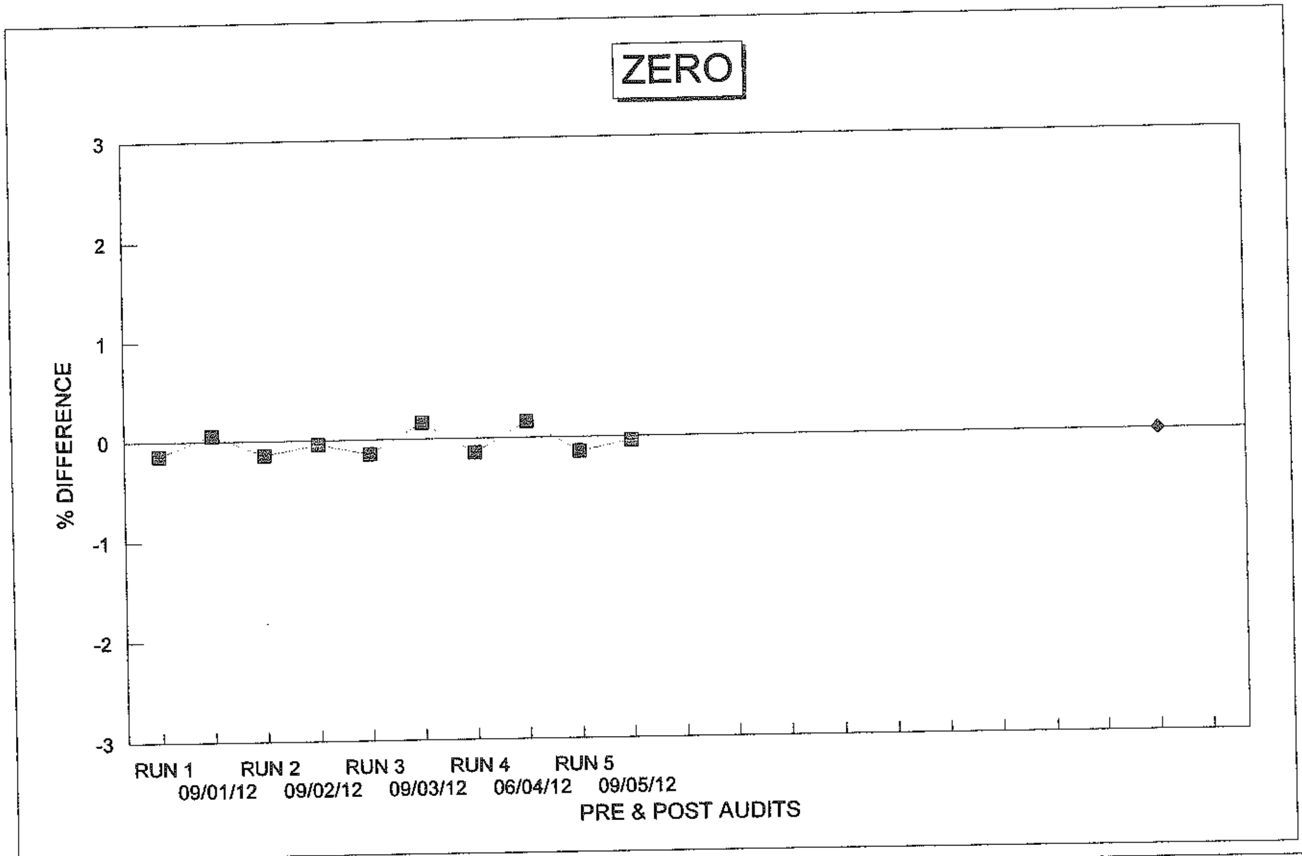
r^2 = .9999843

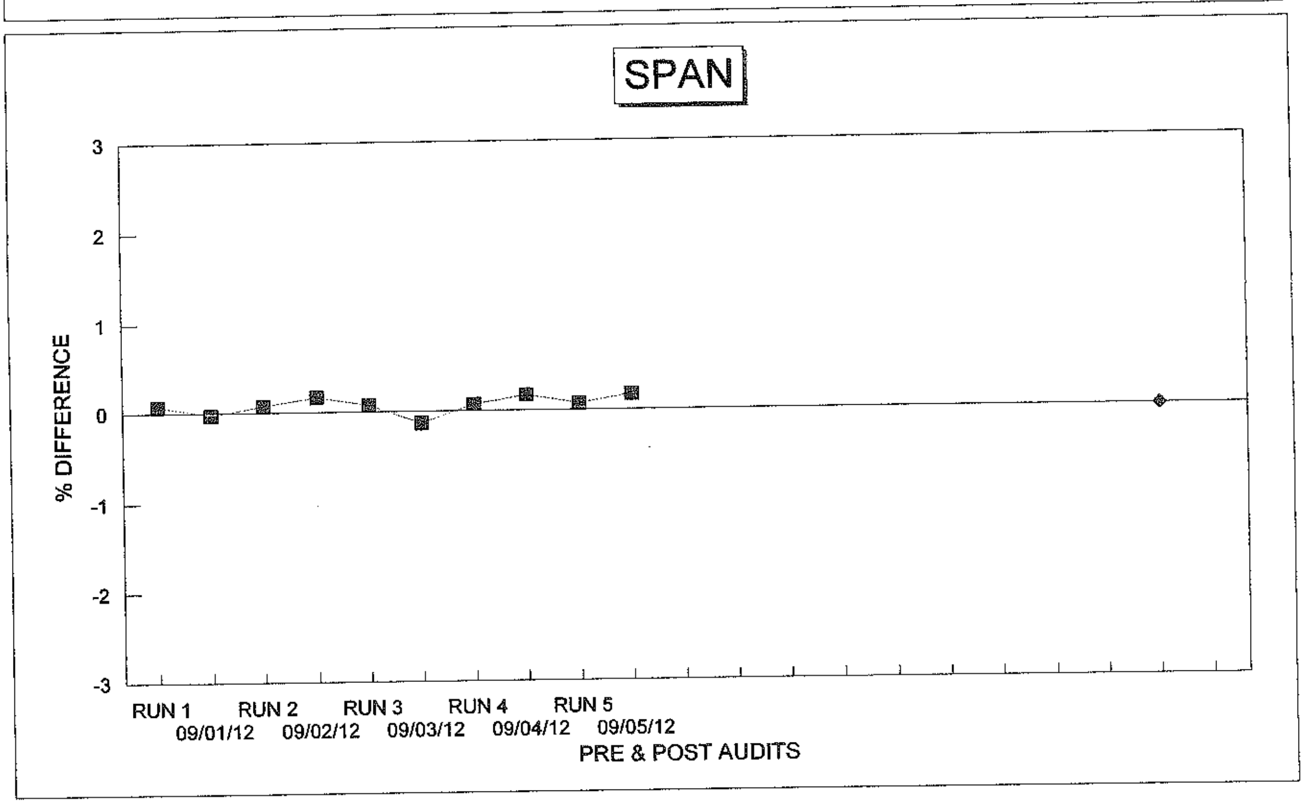


EPA Span Value = ± 2.0% of 25% O_2 = ± .5%

Cal Volts = Cal Volt Conc - Std Conc = ± Conc Diff = ± Δ %

HIGH VOLTS	.833	=	20.825	-	20.9	=	-.075	=	-.300
LOW VOLTS	.252	=	6.300	-	6.25	=	.050	=	.200


ZERO
% DIFFERENCE
3
2
1
0
-1
-2
-3
RUN 1
09/01/12
RUN 2
09/02/12
RUN 3
09/03/12
RUN 4
06/04/12
RUN 5
09/05/12
PRE & POST AUDITS


SPAN
% DIFFERENCE
3
2
1
0
-1
-2
-3
RUN 1
09/01/12
RUN 2
09/02/12
RUN 3
09/03/12
RUN 4
09/04/12
RUN 5
09/05/12
PRE & POST AUDITS

CO ANALYZER
MULTIPOINT CALIBRATION REPORT FORM

Date: 8-30-2012

Analyzer: Make: HORIBA Model: PIR 2000 SN: 408005

Calibration by: Chr.

Cal Gas Flow: 1.5 SCFH Measured by: Rotameter

BP: 30.07 Instrument ID: PRINCO

Temp: 66 Instrument ID: TR

Cylinders:

1. # 168TAC 3-A Concentration: 00.00 % **CO** Cyl. Press.: 400 PSI
   Certified by: AIR LIQUIDE Date: 04-19-04
2. # 487905 Concentration: 4.90 % **CO** Cyl. Press.: 1320 PSI
   Certified by: AIR LIQUIDE Date: 11-1-07
3. # CA06641 Concentration: 8.63 % **CO** Cyl. Press.: 1320 PSI
   Certified by: AIR LIQUIDE Date: 1-5-2007
4. # CC-12731 Concentration: 1.98 % **CO** Cyl. Press.: 1050 PSI
   Certified by: AIR LIQUIDE Date: 03-13-03

Analyzer: **Calibrated Range:** 0-10.0 % **Output:** 0-1.0 V.
Flow: 1.5 SCFH **Measured by:** Rotameter

Calibration Results

Point #	CYL. #	% CO	EXPECTED		ACTUAL		ADJ.	
			METER	DVM	METER	DVM	METER	DVM
1	1	0.00	00.0	.000	00.0	-.002	00.0	.000
2	2	4.90	49.0	.490	47.7	.477	49.0	.490
3	3	8.63	86.3	.863	8.60	.860		
4	4	1.98	19.8	.198	19.8	.198		
5	1	0.00	00.0	.000	00.0	.000		

.5 = 5.011

CO Linear Regression Results:

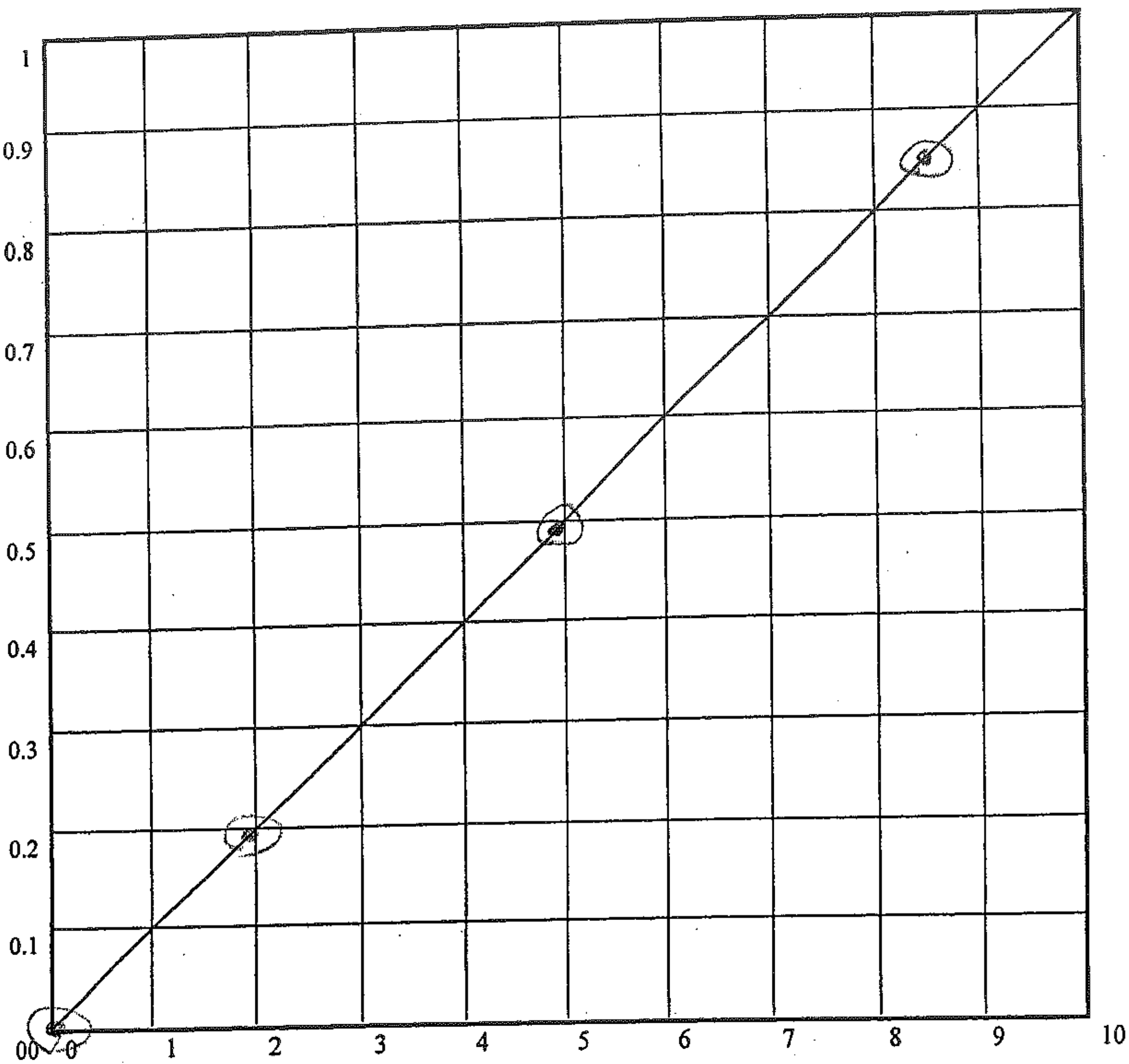
Y = MX +B

Slope (M) = .0005579

Y Intercept (B) = .0996627

Correlation Coefficient(r) = .9999977

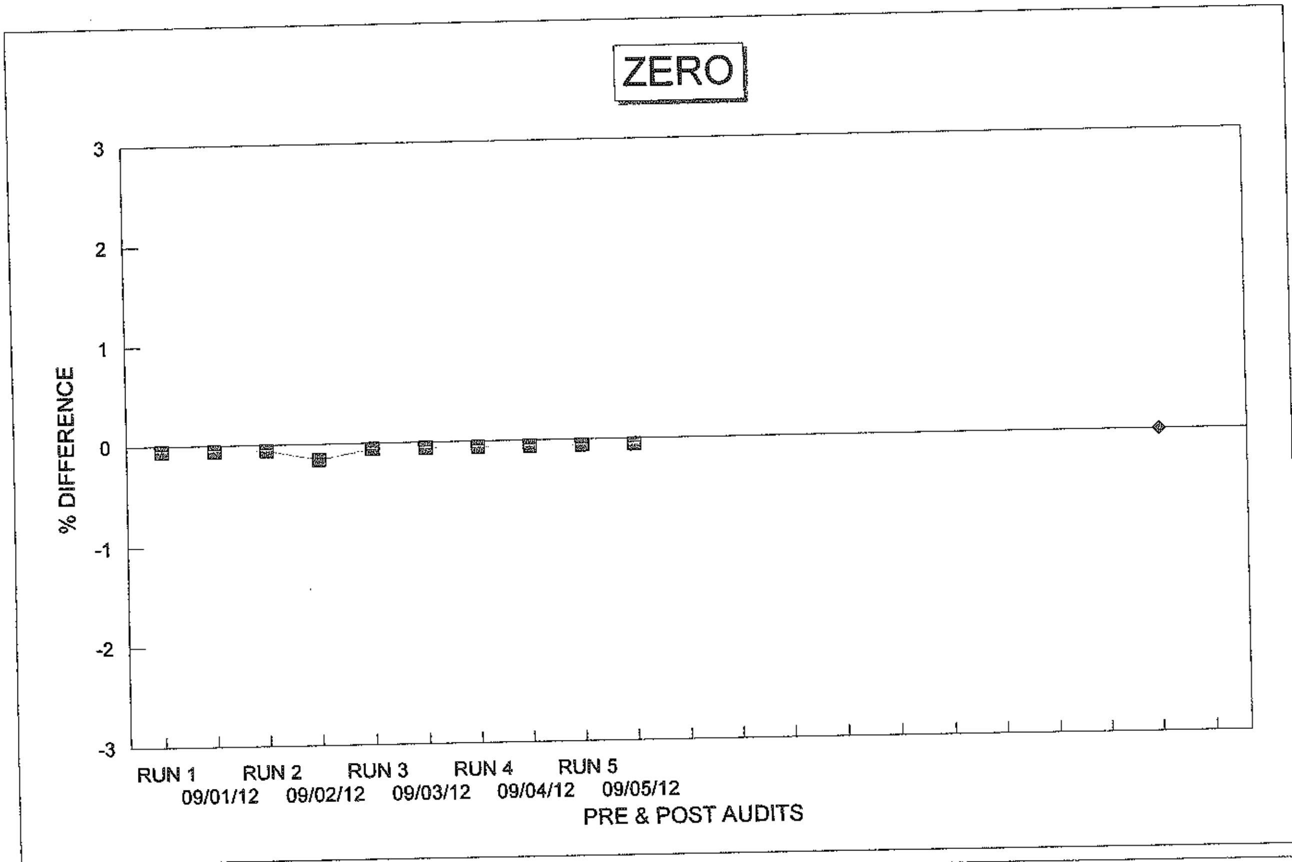
r^2 = .9999954

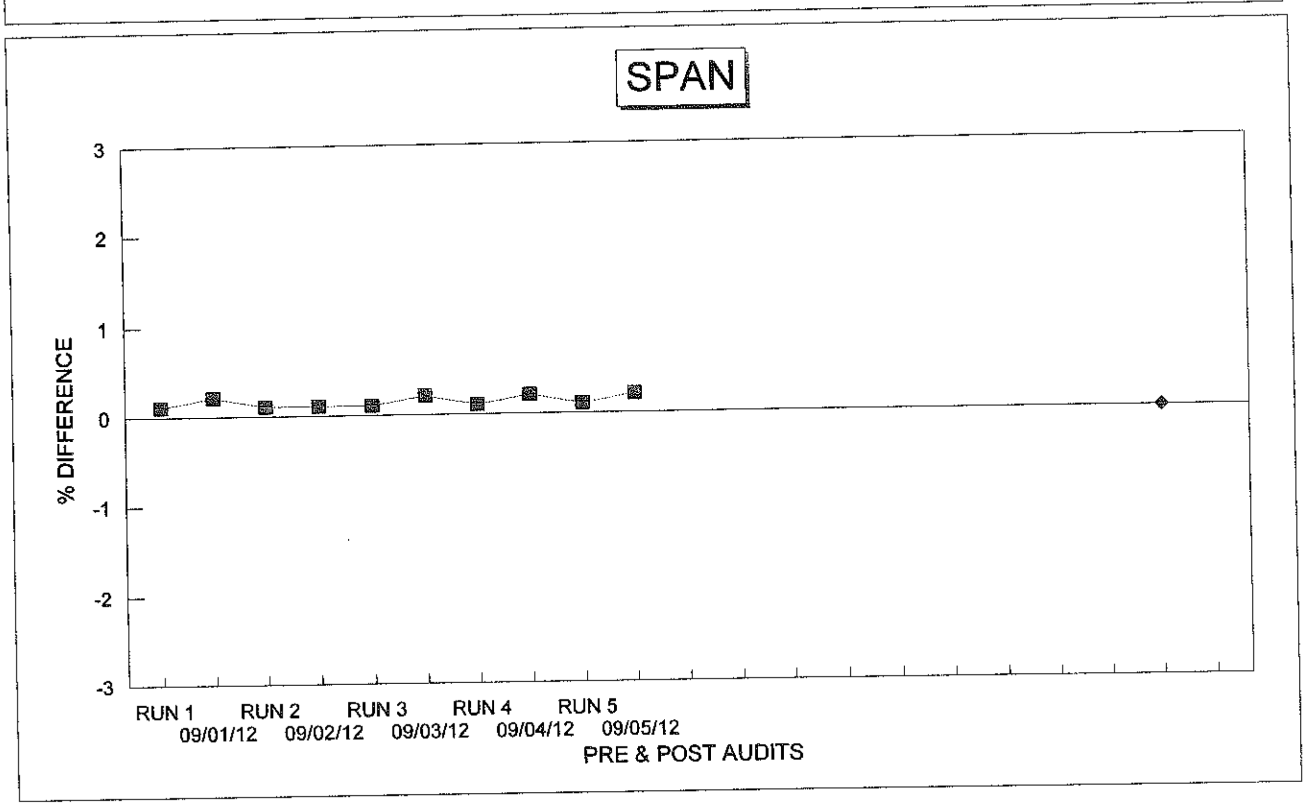


EPA Span Value = ± 2.0% of 10% CO = ± .2%

Cal Volts = Cal Volt Conc - Std Conc = ± Conc Diff = ± Δ %

HIGH VOLTS	.860	= .860	- 8.63	= -.030	= -.300
LOW VOLTS	.198	= 1.98	- 1.98	= ∅	= ∅


ZERO
3
2
1
0
-1
-2
-3
% DIFFERENCE
RUN 1
09/01/12
RUN 2
09/02/12
RUN 3
09/03/12
RUN 4
09/04/12
RUN 5
09/05/12
PRE & POST AUDITS


SPAN
3
2
1
0
-1
-2
-3
% DIFFERENCE
RUN 1
09/01/12
RUN 2
09/02/12
RUN 3
09/03/12
RUN 4
09/04/12
RUN 5
09/05/12
PRE & POST AUDITS

SO_2 ANALYZER
MULTIPOINT CALIBRATION REPORT FORM

Date: 8-30-2012

Analyzer: Make: HORIBA Model: PIR 2000 SN: 403019

Calibration by: C Lowly

Cal Gas Flow: 1.5 SCFH Measured by: Rotameter

BP: 30.07 Instrument ID: PRINCO

Temp: 66 Instrument ID: TR

Cylinders:

1. # 168TAC 3A Concentration: 00.00 % SO_2 Cyl. Press.: 400 PSI
   Certified by: AIR LIQUIDE Date: 04-19-04
2. # CC82089 Concentration: 1250 % SO_2 Cyl. Press.: 1700 PSI
   Certified by: AIR LIQUIDE Date: 1-3-2007
3. # ALMO 49127 Concentration: 1770 % SO_2 Cyl. Press.: 700 PSI
   Certified by: SCOTT SPECIALTY GASES Date: 05-15-97
4. # ALMO 52285 Concentration: 506 % SO_2 Cyl. Press.: 520 PSI
   Certified by: SCOTT SPECIALTY GASES Date: 05-15-97

Analyzer: **Calibrated Range:** 0-2500 PPM **Output:** 0-1.0 V.
Flow: 1.5 SCFH **Measured by:** Rotameter

Calibration Results

Point #	CYL. #	PPM SO2	EXPECTED		ACTUAL		ADJ.	
			METER	DVM	METER	DVM	METER	DVM
1	1	0.00	00.0	.000	00.0	.000	00.0	.000
2	2	1250	50.0	.500	49.6	.496	50.0	.500
3	3	1770	70.8	.708	70.5	.705		
4	4	506	20.2	.202	20.3	.203		
5	1	0.00	00.0	.000	00.0	.000		

.5 = 1252.952

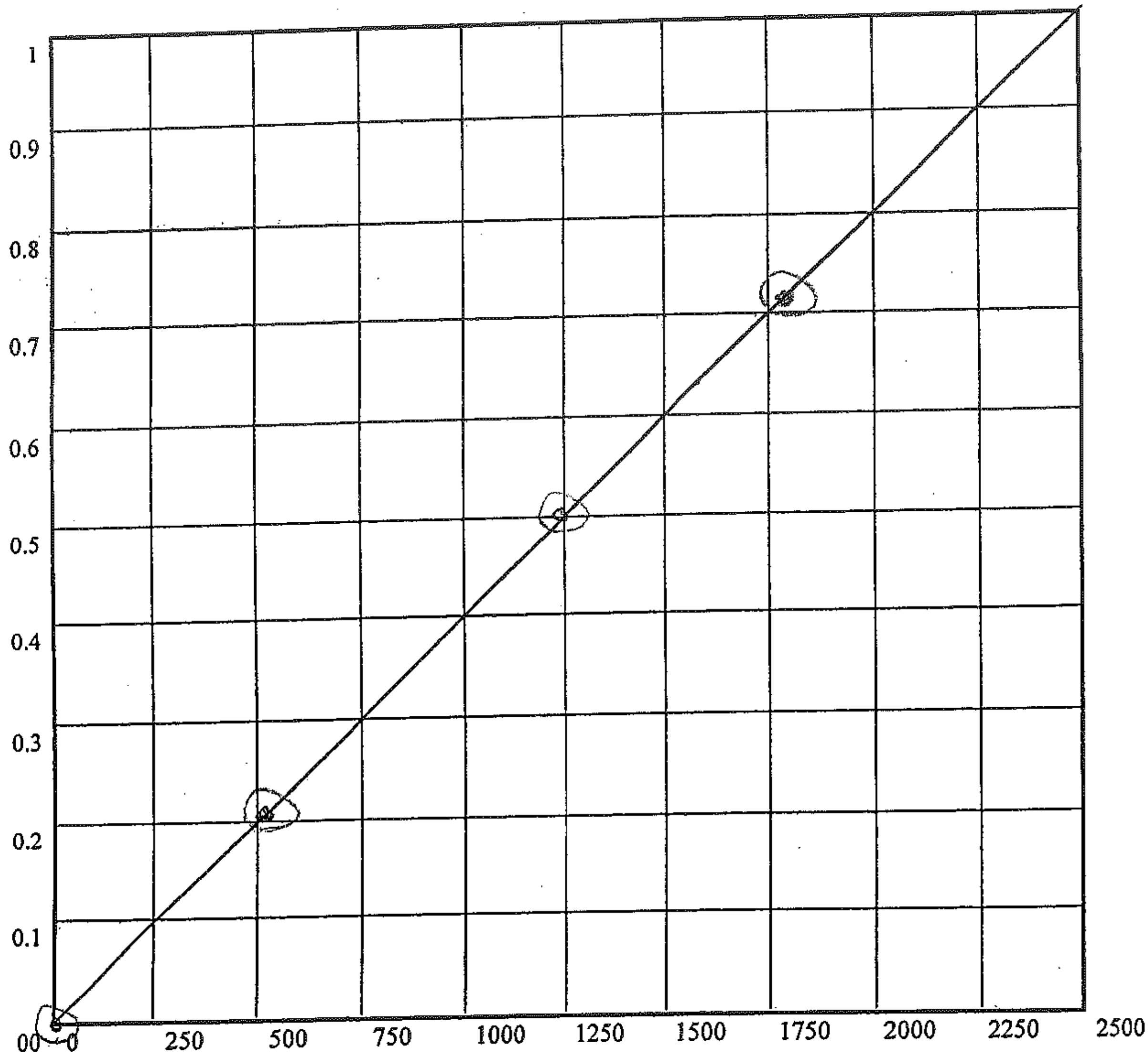
SO_2 Linear Regression Results:

Y = MX +B
Slope (M) = .0007825

Y Intercept (B) = .0063984

Correlation Coefficient (r) = .9999942

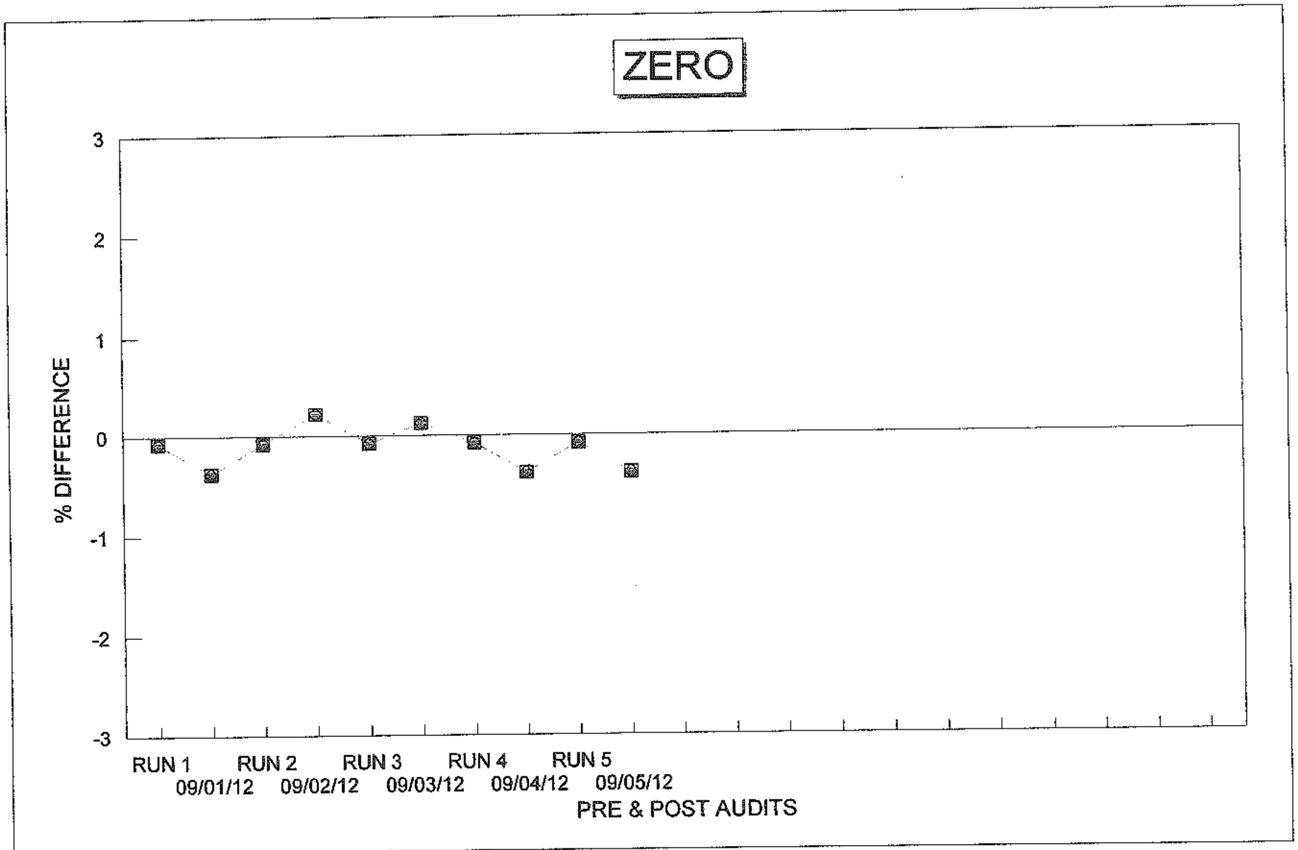
r^2 = .9999884

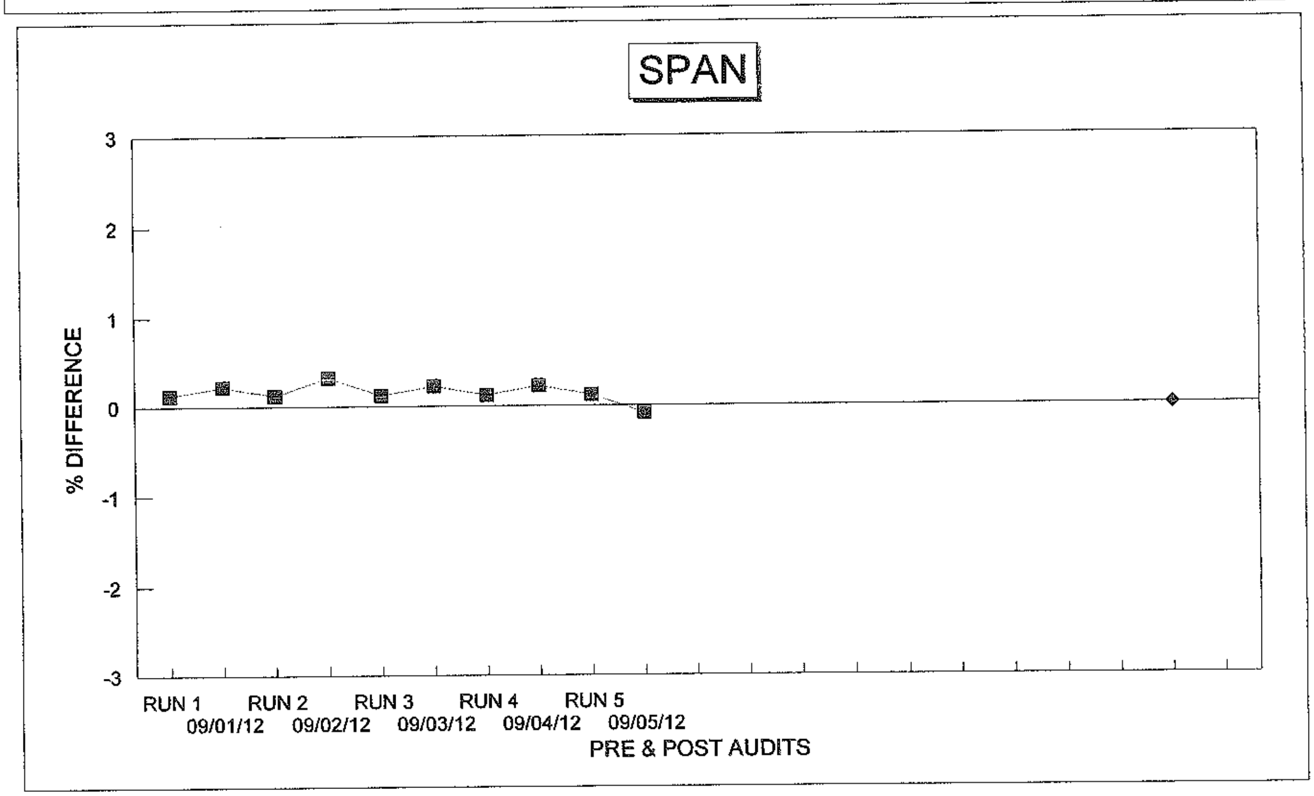


EPA Span Value = ± 2.0% of 2500 PPM SO_2 = ± 50 PPM
Cal Volts = Cal Volt Conc - Std Conc = ± Conc Diff = ± Δ%

HIGH VOLTS	.705	= 1762.5	- 1770.0	= -7.500	= -.300
LOW VOLTS	.203	= 507.5	- 506.0	= 1.500	= .060

SO2


ZERO
3
2
1
0
-1
-2
-3
% DIFFERENCE
RUN 1
09/01/12
RUN 2
09/02/12
RUN 3
09/03/12
RUN 4
09/04/12
RUN 5
09/05/12
PRE & POST AUDITS


SPAN
3
2
1
0
-1
-2
-3
% DIFFERENCE
RUN 1
09/01/12
RUN 2
09/02/12
RUN 3
09/03/12
RUN 4
09/04/12
RUN 5
09/05/12
PRE & POST AUDITS

LOW SPAN

AIR LIQUIDE

GASES FOR RESEARCH AND DEVELOPMENT

CYL # CC-12731 CGA 590

PRES 1665 VOL 130c.f

TEST # 07203 DATE 03-13-03

Analytical Method GC/Paramagnetic

	Requested	Analyzed
Hydrogen		
Nitrogen	Bal.	Bal.
Argon		
Air		
Carbon Monoxide	2%	1.98%
Methane		
Oxygen	6.25%	6.25%
Helium		
Carbon Dioxide	6.25%	6.22%

SIGNED [signature]

AIR LIQUIDE

1451 THORNE RD.
TACOMA, WA 98421
TEL: (253) 383-3637

THE ONLY LIABILITY OF THIS COMPANY FOR GAS WHICH FAILS TO COMPLY WITH THE ANALYSIS SHALL BE REPLACEMENT THEREOF BY THE COMPANY WITHOUT EXTRA COST.

DO NOT REMOVE THIS TAG

AIR LIQUIDE™

CERTIFICATE OF ANALYSIS

Customer : Pacifice Rim Oxygen Service

.O. Number : 200159

Document # : 23639406-1A

ix/Lot # : SFS103795

Item Number : SFS103795

/alid Until : 4 January, 2012

Specification : CUSTOM CERTIFIED

Phase : GAS

Cyl. Size : 30AL Valve : CGA 590

Pressure : 1667

Volume : 120 SCF

Cylinder Number: **CAO6641**

Component	Requested Concentrations MOLE	Actual Concentration MOLE	% Analytical Uncertainty	Equipment Used: Scale	Analyt. Inst.	Calibration Standard
NITROGEN	Balance	Balance		2		
CARBON MONOXIDE	8.6 %	8.63 %		2	4620	PQ
OXYGEN	21 %	20.9 %		2	4620	TB
CARBON DIOXIDE	21 %	21.1 %		2	4620	PD
7001-30AL						

T is mixture was certified by analysis using one or more calibration standards prepared with scales certified against weights traceable to N.I.S.T.

Comments:

Dewpoint calculated to 40° F, unless otherwise stated. Improper storage or use may affect the accuracy of this standard.
Reported impurities are approximate and should not be used for calibration purposes.

Prepared by [signature] Date: 5-Jan-2007

8832 Dice Road -- Santa Fe Springs, CA 90670

Phone (562) 945-1383 **Fax** (562) 696-7903

ISO: 9001-2000

A-L WELDING PRODUCTS
A Division of Pacific Rim Oxygen Services, Inc.
15700 Nelson Road South • Tukwila, Washington 98188
Telephone (425) 228-2218 • Fax (425) 228-2397

Certificate of Analysis

Customer: AL Welding Products
Product: 5% CO, 12.5% CO2, 12.5% O2, balance Nitrogen
Grade: Certified Standard
Cylinder Number: 487905
Product Code: 2505COOXCDNTHC
Lot Number: K3171302

11-01-07

CGA 590
Pressure: 1650 psig
Contents: 175 ft^3

Mixture Analysis

Component	Specification	Concentration	Analytical Method
Oxygen	12.5%	12.6%	MTIGC-TCD
CO2	12.5%	12.2%	Varian
CO	5.0%	4.9%	MTIGC-TCD
Nitrogen	Balance	Balance	MTI GC-TCD

I certify the above referenced cylinder was analyzed and found to contain the listed concentrations.

Thomas M Chesser
Thomas M Chesser, Chemist

11-01-07
Date

Scott Specialty Gases

500 WEAVER PARK RD,LONGMONT,CO 80501 Phone: 303-442-4700 Fax: 303-772-7673

CERTIFICATE OF ANALYSIS: Interference-Free™ Multi-Component EPA Protocol Gas

Project No.: 08-34135-001
P.O. No.: VERBAL

Customer
ENERGY & ENV MEASUREMENT

C/O ED WADINGTON
3730 N. PELLEGRINO DR.
TUCSON,AZ 85749

Assay Laboratory
SCOTT SPECIALTY GASES
500 WEAVER PARK RD
LONGMONT,CO 80501

ANALYTICAL INFORMATION

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure #G1; September, 1993.

Cylinder Number: ALM052285 Certification Date: 4/21/97 Exp. Date: 4/21/2000
Cylinder Pressure***: 1996 PSIG

COMPONENT	CERTIFIED CONCENTRATION		ANALYTICAL ACCURACY**
SULFUR DIOXIDE *	506	PPM	+/- 1% NIST Traceable
NITROGEN	--	BALANCE	

*** Do not use when cylinder pressure is below 150 psig.
** Analytical accuracy is inclusive of usual known error sources which at least include precision of the measurement processes.
Product certified as +/- 1% analytical accuracy is directly traceable to NIST standards.
* This Protocol has been certified using corrected NIST SO2 standard values, per EPA guidance dated 7/24/96 and will not correlate with Uncorrected Protocols.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NTRM 1661	9/27/98	ALM059505	488.5 PPM	SO2/N2

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	LAST DATE CALIBRATED	ANALYTICAL PRINCIPLE
FTIR System/8220/AAB9400251	03/20/97	Scott Enhanced FTIR

ANALYZER READINGS

(Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

SULFUR DIOXIDE *

First Triad Analysis

Date: 04/14/97	Response Unit: PPM	
Z1=0.3847	R1=487.72	T1=505.77
R2=488.78	Z2=1.8201	T2=505.69
Z3=1.8428	T3=506.78	R3=488.95
Avg. Concentration:	505.8	PPM

Second Triad Analysis

Date: 04/21/97	Response Unit: PPM	
Z1=0.3241	R1=488.29	T1=505.43
R2=488.83	Z2=1.8098	T2=505.78
Z3=0.5340	T3=505.74	R3=488.66
Avg. Concentration:	505.6	PPM

Calibration Curve

Concentration = A + Bx + Cx2 + Dx3 + Ex4	
r=0.999990	
Constants:	A=0.000000
B=1.000000	C=0.000000
D=0.000000	E=0.000000

Special Notes:

ANALYST: Devon VonFeldt
Devon VonFeldt

SO2 concentration analysis
08/28/12

Vm(std)	1.500			
			dscf=	1.500
mcf	1.004			
Hg	30.11			
DH	0.12			
temp	75	528	ppm =	515
ml BA ++	180			
Normality	0.0101		Run1	501
			Run 2	507
			Run3	515
Tank I.D. #	ALMO52285		avg.	508

AIR LIQUIDE™

CERTIFICATE OF ANALYSIS

Customer : Pacific Rim Oxygen Service Inc
P.O. Number : 200160
Document # : 23540983-1A
Mix/Lot # : SFS103340
Item Number : SFS103340
Valid Until : 2 January, 2010

Specification : CUSTOM CERTIFIED
Phase : GAS
Cyl. Size : 30AL Valve : CGA 660
Pressure : 2000
Volume : 144 SCF

Cylinder Number: **CC82089**

Component	Requested Concentrations MOLE	Actual Concentration MOLE	% Analytical Uncertainty	Equipment Used: Scale	Equipment Used: Analyt. Inst.	Equipment Used: Calibration Standard
NITROGEN	Balance	Balance		4		
SULFUR DIOXIDE	1250 PPM	1250 PPM	+/- 2%	4	4503	GL
6154-30AL						

This mixture was certified by analysis using one or more calibration standards prepared with scales ertified against weights traceable to N.I.S.T.

Comments:

Dewpoint calculated to 40° F, unless otherwise stated. Improper storage or use may affect the accuracy of this standard.
eported impurities are approximate and should not be used for calibration purposes.

Prepared by ______________________ Date: 3-Jan-2007

8832 Dice Road -- Santa Fe Springs, CA 90670
Phone (562) 945-1383 **Fax** (562) 696-7903
ISO: 9001-2000

Scott Specialty Gases

500 WEAVER PARK RD,LONGMONT,CO 80501 Phone: 303-442-4700 Fax: 303-772-7673

CERTIFICATE OF ANALYSIS: EPA PROTOCOL GAS

Customer
ENERGY & ENV MEASUREMENT

C/O ED WADINGTON
3730 N. PELLEGRINO DR.
TUCSON,AZ 85749

Assay Laboratory

SCOTT SPECIALTY GASES
500 WEAVER PARK RD
LONGMONT,CO 80501

Project No.: 08-34135-003
P.O. No.: VERBAL

ANALYTICAL INFORMATION

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure #G1; September, 1993.

Cylinder Number: ALM049127 Certification Date: 4/21/97 Exp. Date: 4/21/2000
Cylinder Pressure***: 1860 PSIG

COMPONENT	CERTIFIED CONCENTRATION		ANALYTICAL ACCURACY**
SULFUR DIOXIDE *	1,770	PPM	+/- 1% NIST TRACEABLE
NITROGEN		BALANCE	

*** Do not use when cylinder pressure is below 150 psig.
** Analytical accuracy is inclusive of usual known error sources which at least include precision of the measurement processes.
Product certified as +/- 1% analytical accuracy is directly traceable to NIST standards.
* This Protocol has been certified using corrected NIST SO2 standard values, per EPA guidance dated 7/24/96 and will not correlate with uncorrected Protocols.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NTRM-R-1696	7/03/98	ALM057797	3131. PPM	SULFUR DIOXIDE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	LAST DATE CALIBRATED	ANALYTICAL PRINCIPLE
FTIR System/8220/AAB9400251	03/20/97	Scott Enhanced FTIR

ANALYZER READINGS

(Z = Zero Gas R = Reference Gas T = Test Gas r = Correlation Coefficient)

SULFUR DIOXIDE *

First Triad Analysis

Date: 04/14/97	Response Unit: PPM	
Z1 = 0.7210	R1 = 3127.7	T1 = 1767.1
R2 = 3131.7	Z2 = 4.6770	T2 = 1768.1
Z3 = 4.6770	T3 = 1768.1	R3 = 3133.7
Avg. Concentration:	1768.	PPM

Second Triad Analysis

Date: 04/21/97	Response Unit: PPM	
Z1 = 0.4020	R1 = 3125.6	T1 = 1770.2
R2 = 3132.3	Z2 = 6.6540	T2 = 1769.3
Z3 = 4.9410	T3 = 1770.9	R3 = 3134.9
Avg. Concentration:	1770.	PPM

Calibration Curve

Concentration = A + Bx + Cx2 + Dx3 + Ex4	
r = 0.999990	1696
Constants:	A = 0.00000
B = 1.00000	C = 0.00000
D = 0.00000	E = 0.00000

Special Notes:

ANALYST: Devon VonFeldt
DEVON VONFELDT

SO2 concentration analysis
08/28/12

Vm(std)	1.500			
mcf	1.004		dscf=	1.500
Hg	30.11			
DH	0.12			
temp	75	535	ppm =	1778
ml BA ++	621			
Normality	0.0101		Run1	1781
			Run 2	1767
			Run3	1778
Tank I.D. #	ALMO49127		avg.	1775

Certificate of Analysis

ANALYTICAL CONTROL LABORATORY ANALYSIS
METHYLENE CHLORIDE - OPTIMA

Catalog No. D151
Lot No. 035941

July 23, 2003

This is to certify that this lot was tested and found to comply with the specifications for this product. The following are the actual analytical results obtained:

TESTS		ACTUAL ANALYSIS
Assay		99.9%
Color		5 APHA
Description		Clear, Colorless Liquid
Free Halogens		Pass Test
Identification		Pass Test
Fluorescence Background (as Quinine Sulfate)		Not more than 1 ppb
Certified for EPA Test #1625		Pass Test
Pesticide Residue Analysis (as Heptachlor Epoxide)		Not more than 10ng/l
Density (g/ml) at 25°C		1.317
Optical Absorbance	At 254 nm	0.002
	At 240 nm	0.10
	At 233 nm	0.54
Refractive Index at 25°C		1.4209
Residue after Evaporation		0.4 ppm
Titratable Acid		0.00004 Meq/g.
Preservative (Amylene)		64 ppm
Water (H_2O)		0.008%

Fisher Scientific

Chemical Division
1 Reagent Lane
Fair Lawn, N.J. 07410
201-796-7100

Approved By: Edgar E. Hess

Edgar E Hess
Q.C. Laboratory Manager

Certificate of Analysis

ANALYTICAL CONTROL LABORATORY ANALYSIS
METHYLENE CHLORIDE - OPTIMA

Catalog No. D151
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	At 240 nm	0.10
	At 233 nm	0.54
Refractive Index at 25°C		1.4209
Residue after Evaporation		0.4 ppm
Titratable Acid		0.00004 Meq/g.
Preservative (Amylene)		64 ppm
Water (H_2O)		0.008%

Fisher Scientific
Chemical Division
1 Reagent Lane
Fair Lawn, N.J. 07410
201-796-7100

Approved By: Edgar E. Hess
Edgar E Hess
Q.C. Laboratory Manager

KEITHLEY

Keithley Instruments, Inc.
28775 Aurora Road
Cleveland, Ohio 44139
(440) 248-0400
Telefax: (440) 248-6168

Certificate of Calibration

Model 2700 **Serial No** 0872585 **Date** 13 Mar 2002

This notification serves to certify that the unit described above has been inspected and tested in accordance with specifications published by Keithley Instruments, Inc.

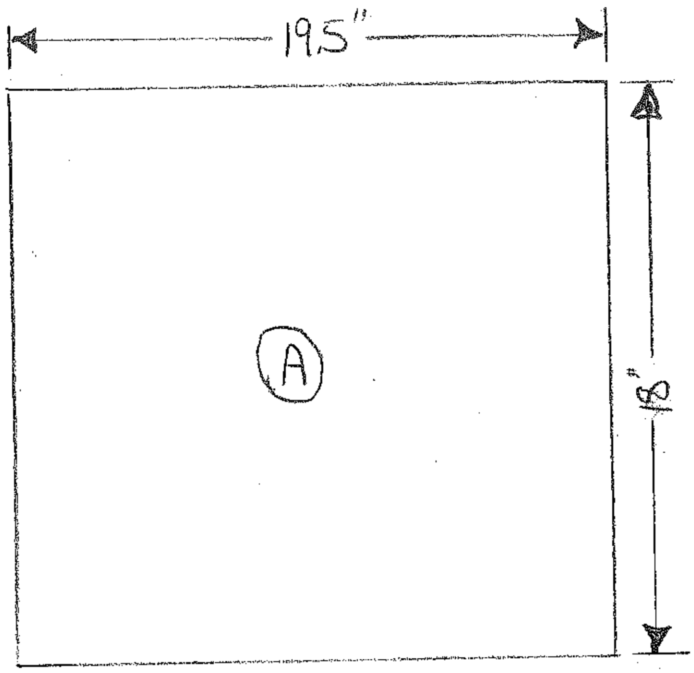
The accuracy and calibration of this instrument are traceable through reference standards that are compared, at planned intervals, to national standards maintained by the National Institute of Standards and Technology (NIST), by comparison to natural physical constants or self-calibrating ratio type measurements.

The measurement standards which support this calibration are calibrated on a schedule to maintain required accuracy level.

James A. Crane

James A. Crane
Metrology Services

Firebox Volume and Fuel Load Calculations For the Lennox ES 2100



Baffle Ht. = 10.625"

Tube area 7.5 × 1 × 19.5

$$A = 19.5 \times 18 \times 10.625 = 3729.375$$
$$-B = 7.5 \times 1 \times 19.5 = -146.250$$
$$= 3583.125\ in^3$$
$$= 2.074\ ft^3$$

Fuel Load

Low	IDEAL	High
13.1	14.515	15.9

08/20/12

Chip,

Here are the draft/damper settings that I have found to work for the burn rates that we need. Also, for low burns, turn the fan on at 30 minutes. For high burns, keep the fan on for the full duration of the test.

Low- 7/8" open

Medium Low- 1" open

Medium High- 1 ¼" open

High- full open

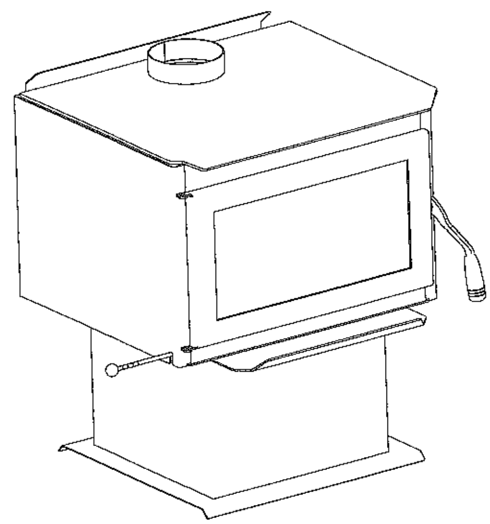
Thanks Chip

Manuel

EARTH STOVE™
THE ONE AND ONLY

Installation and Operation Instructions

Free-Standing EPA Certified Wood-Burning Stove



P/N 507108-01, Rev. NC, 08/2012

A French manual is available upon request. Order P/N 506223-52.

Ce manuel d'installation est disponible en francais, simplement en faire la demande. Numéro de la pièce 506223-52.

NATIONAL FIREPLACE INSTITUTE
NFI
CERTIFIED
www.nficertified.org

We recommend that our woodburning hearth products be installed and serviced by professionals who are certified in the U.S. by the National Fireplace Institute® (NFI) as NFI Woodburning Specialists or who are certified in Canada by Wood Energy Technical Training (WETT).

Wood Energy Technical Training
www.wettinc.ca

Save These Instructions For Future Reference

MODEL ES2100

⚠ WARNINGS

- **Hot! Do not touch! The glass and surfaces of this appliance will be hot during operation and will retain heat for a while after shutting off the appliance. Severe burns may result.**
- **Carefully supervise children in the same room as appliance.**

c ETL LISTED us
Intertek

Report # 100854192PRT-001

IMPORTANT SAFETY AND WARNING INFORMATION

READ THIS MANUAL IN ITS ENTIRETY AND UNDERSTAND THESE RULES TO FOLLOW FOR SAFETY.

1. When this room heater is not properly installed, a house fire may result. To reduce the risk of fire, follow the installation instructions. Contact local building or fire officials about restrictions and installation inspection requirements in your area.
2. Wear gloves during installation to avoid injury from sharp edges on the stove and/or its parts.
3. This unit is designed and engineered to burn only dry, well-seasoned wood. Burning wet wood will greatly reduce the stove's efficiency, produce excessive amounts of smoke and can cause dangerous chimney fires due to creosote build-up.
4. Before opening the door, the draft control must be fully open to avoid possible combustion flash (ignition of hot volatile gases as the door is opened).
5. Never use gasoline, gasoline-type lantern fuel, kerosene, charcoal lighter fluid, or similar liquids to start or 'freshenup' a fire in this heater. Keep all such liquids well away from the heater while it is in use. DO NOT USE CHEMICALS OR FLUIDS TO START THE FIRE.
6. While burning, fuel utilizes oxygen from the air in the room. Be sure to allow an adequate amount of fresh air into the room where the stove is burning.
7. The outside surface of the stove will be hot while burning properly and can set items like clothing and curtains on fire. Keep furnishings and other combustible materials away from the stove. Using the heat from the stove to dry wet clothing can be hazardous if clothes are placed too near the surface of the stove.
8. HOT WHILE IN OPERATION. KEEP CHILDREN, CLOTHING FURNISHINGS AND COMBUSTIBLE MATERIAL A CONSIDERABLE DISTANCE AWAY. CONTACT MAY CAUSE SKIN BURNS. Do not allow children to play near the stove without close supervision. Do not touch the stove while it is burning. Use extreme caution while the unit is in use. Surface temperatures become dangerously hot and can cause serious burns.
9. Do not allow anyone to operate the stove who is not familiar with the operating instructions.
10. Attempts to achieve heat output rates that exceed stove design specifications can result in permanent damage to the stove. Never leave your stove unattended on high burn rates. This may cause overfiring. Overfiring the stove may cause a house fire. If the stove glows, you are overfiring.
11. Keep a water hose or hand-operated fire extinguisher close for safety.
12. Smoke Detectors - Since there are always several potential sources of fire in any home, we recommend installing smoke detectors. If possible, install the smoke detector in a hallway adjacent to the room (to reduce the possibility of occasional false activation from the heat produced by the stove). If your local code requires a smoke detector be installed within the same room, you must follow the requirements of your local code. Check with your local building department for requirements in your area.
13. Inspect your chimney at least once a month during the burning season to check for soot and creosote accumulations. Any accumulations over 1/8" thick should be removed by a professional chimney sweep. Do not attempt to burn out heavy creosote accumulations with a hot fire. If large accumulations are occurring, review your burning procedures.
14. If a creosote fire should develop, the fire department should be called immediately and then attempts should be made to control the fire until assistance arrives. If a "runaway" fire should develop causing over-heating of the stove, the door and draft regulators should be closed immediately. The fire should die down once deprived of oxygen. After a severe chimney fire, the complete chimney system should be checked before further use.
15. Do Not Use Grate Or Elevate Fire - Build Wood Fire Directly On Hearth (firebrick). Do not use andirons or other methods of supporting the fuel.
16. Please read this entire manual before you install and use your new room heater. Failure to follow instructions may result in property damage, bodily injury, or even death.
17. Check all local building and safety codes before installation. The installation instructions and appropriate code requirements must be followed exactly and without compromise. In the absence of local codes the following standards and codes must be followed.
18. In the U.S.A, install in accordance with the National Fire Protection Association's Code, NFPA 211, Standards for Chimneys, Fireplaces, Vents and Solid-Fuel-Burning Appliances, or similar regulations, may apply to the installation of a Solid-Fuel-Burning appliance in your area. In Canada, the guideline is established by the CSA Standard, CAN/CSA-B365-M93, Installation Code for Solid-Fuel-Burning Appliances and Equipment.
19. DO NOT CONNECT TO OR USE IN CONJUNCTION WITH ANY AIR DISTRIBUTION DUCTWORK UNLESS SPECIFICALLY APPROVED FOR SUCH INSTALLATIONS.
20. WARNING: BURNING IMPROPER FUEL (I.E. CHARCOAL) CAN RESULT IN CARBON MONOXIDE POISONING, WHICH MAY LEAD TO DEATH!
21. Carbon Monoxide Poisoning – Early signs of carbon monoxide poisoning resemble the flu with headaches, dizziness, or nausea. If you have these signs, get fresh air at once! Have the heater inspected by a qualified service technician. Some people are more affected by carbon monoxide than others. These include pregnant women, people with heart or lung disease or anemia, those under the influence of alcohol, and those at high altitudes.
22. Failure to use manufacturer provided parts, variations in techniques and construction materials or practices other than those described in this manual may create a fire hazard and void the limited warranty.
23. Do not make any make-shift compromises during installation. Any modification or alteration may result in damage to the appliance or dwelling and will void the warranty, certification and listings of this unit.
24. These appliances are designed as supplemental heaters. Therefore, it is advisable to have an alternate heat source when installed in a dwelling.
25. Do Not Overfire – If Heater or Chimney Connector Glows, You Are Overfiring.
26. DO NOT CONNECT THIS UNIT TO A CHIMNEY FLUE SERVING ANOTHER APPLIANCE.
27. DO NOT BURN GARBAGE OR FLAMMABLE FLUIDS SUCH AS GASOLINE, NAPHTHA OR ENGINE OIL.

Chimney Height Requirements

The chimney must extend 3' (.92m) above the level of roof penetration and a minimum of 2' (.61m) higher than any roof surface within 10' (3m) *(see **Figure 1**).* Check with your local building officials for additional requirements for your area.

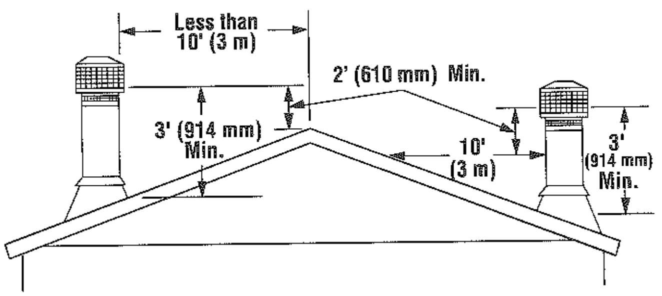


***Figure 1** - Chimney Height Requirements*

To pass inspection in nearly any jurisdiction, the chimney must meet both safety and exhaust flow requirements. The (3' by) 2' by 10' rule applies to both masonry and factory-built chimneys.

**** Ref. USA - National Standard, NFPA 211-latest edition and Canada National Standard CSA B365-01-latest edition. Vents installed with a listed cap shall terminate in accordance with the terms of the cap's listings.***

NEGATIVE PRESSURE WARNING

This appliance is not designed to be operated in a negative pressure. In very airtight homes with large kitchen exhaust fans, furnace cold air returns, fresh air exchange systems and any other air system in close proximity to the heating appliance may create a negative pressure in the same room as the heating appliance. This can create dangerous back drafting of the stove and chimney joints, drawing combustion by-products into the home. Be sure your home has adequate makeup air to eliminate negative pressures caused by the above-mentioned sources. Outside air connected to the appliance probably will not resolve such a problem as the stove or fireplace insert is not the source of negative pressure. LHP accepts no liability for damages resulting from negative pressures described here.

Ventilation Requirements - Provide adequate air for combustion. The fresh air requirements of this appliance must be met within the space where it will be installed. Ventilation is essential when using a Solid-Fuel-Burning heater. In well insulated and weather tight homes, it may be difficult to establish a good draft up the chimney (caused by a shortage of air in the home). The lack of air is caused by many common household appliances which exhaust air from the home (such as a furnace, heat pump, air conditioner, clothes dryer, exhaust fans, fireplaces, and other fuel burning appliances). Also, the combustion process of this heater uses oxygen from inside the dwelling. If the available fresh air delivery in the dwelling is insufficient to support the demands of these appliances, problems can result (i.e. excessive negative pressure can develop in the dwelling which will affect the rate at which this appliance can draft thus resulting in performance problems. To correct this problem it may help to open a window (preferably on the windward side of the house) or install an optional outside air kit.

INSTALLATION CLEARANCES - REFER TO *FIGURES 2, 3 AND 4*

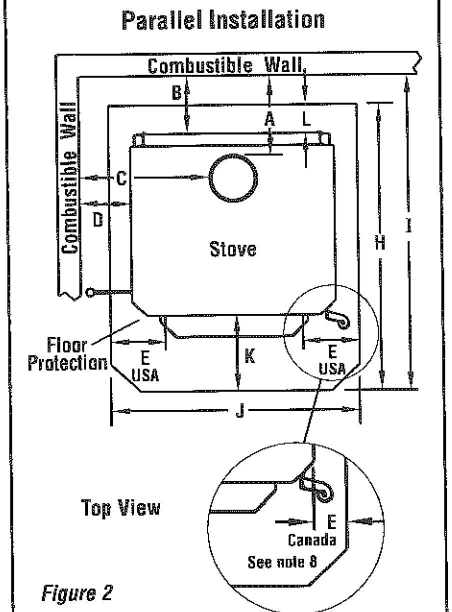


Figure 2

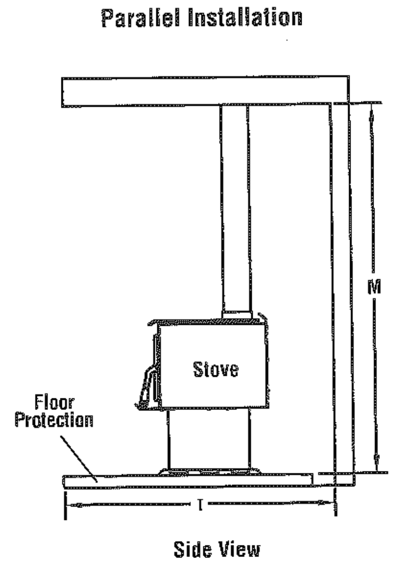


Figure 3

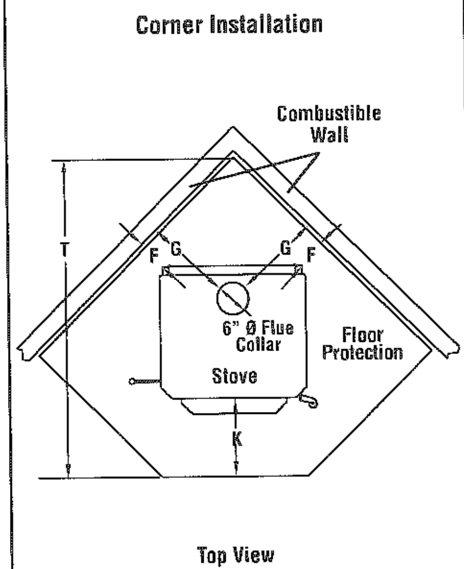


Figure 4

USA - inches (millimeters)

PIPE	INSTALLATION	A (3)	B (1)	C (3)	D (1)	E (8)	F (1)	G (3)	H (2)	I (6)	J (2)	K (7)	L (5)	M	T (6)
Single Wall	Residential	14-1/4 (362)	11-1/2 (292)	23 (584)	13-3/8 (340)	8 (200)	9 (229)	18 (457)	37-5/8 (956)	49 (1245)	34-7/8 (886)	16 (406)	0 (0)	96 (2438)	61-1/2 (1562)
Double Wall	Residential or Mobile Home	12 (305)	9-1/8 (232)	19-1/2 (495)	9-5/8 (245)	8 (200)	6 (152)	15 (381)	37-5/8 (956)	46-3/4 (1188)	34-7/8 (886)	16 (406)	0 (0)	96 (2438)	57-1/2 (1461)

CANADA - inches (millimeters)

PIPE	INSTALLATION	A (3)	B (1)	C (3)	D (1)	E (8)	F (1)	G (3)	H (2)	I (6)	J (2)	K (7)	L (5)	M	T (6)
Single Wall	Residential	14-1/4 (362)	11-1/2 (292)	23 (584)	13-3/8 (340)	8 (200)	9 (229)	18 (457)	47-5/8 (1210)	51 (1295)	40-7/8 (1038)	18 (450)	8 (200)	96 (2438)	63-1/2 (1613)
Double Wall	Residential or Mobile Home	12 (305)	9-1/8 (232)	19-1/2 (495)	9-5/8 (245)	8 (200)	6 (152)	15 (381)	47-5/8 (1210)	48-3/4 (1238)	40-7/8 (1038)	18 (450)	8 (200)	96 (2438)	59-1/2 (1511)

Footnotes:

1- These dimensions to the stove body are for reference only. Actual distances should be measured from the stove's flue collar.

2- Minimum noncombustible hearth pad dimensions.

3- Clearances to connector pipe shall be measured from the flue collar of the stove.

5- In corner applications, when installed at minimum back wall clearances, the required floor protection is dimensioned off the back plane of the stove, therefore the floor protection required off the back corners (at a 45 degree angle) only needs to extend to the wall. This situation will only occur in CANADA installations.

6- Reference dimension only, to assist in planning the installation.

7- Measured from front of floor protection to the front of firebox.

8- USA=8" (200mm) from door opening, Canada=8" (200mm) from sides and back of unit.

TYPICAL INSTALLATIONS

Single Wall Pipe
Using 6" Diameter Single Wall Connector Pipe

INSTALL VENTING SYSTEM PER VENT MANUFACTURERS INSTRUCTIONS!

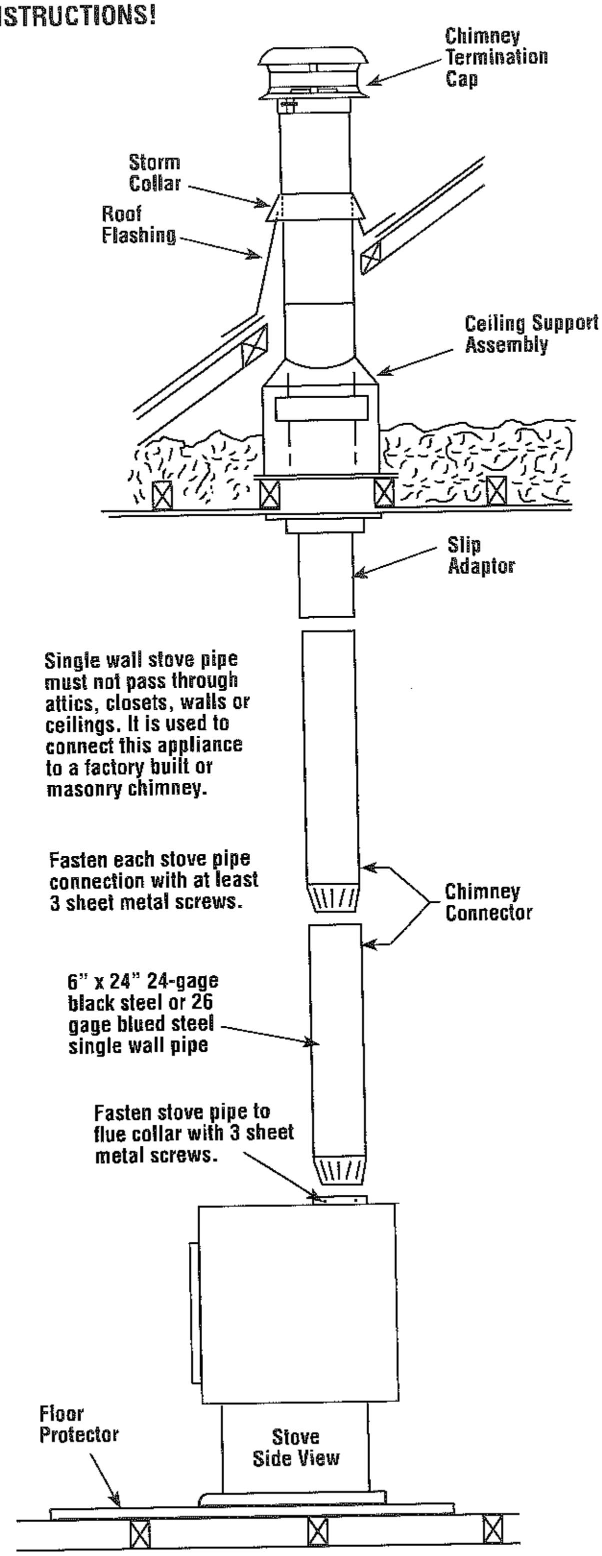


Figure 6 - Typical Installation

NOTE: DIAGRAMS & ILLUSTRATIONS ARE NOT TO SCALE.

Chimney Connector Systems and Clearances from Combustible Walls for Residential Heating Appliances (NFPA 211) - Refer to *Figure 9*

System A. Minimum 3.5 in. (90 mm) thick brick masonry wall framed into combustible wall with a minimum of 12 in. (305 mm) brick separation from clay liner to combustibles. Fireclay liner (ASTM C 315, Standard Specification for Clay Flue Linings, or equivalent), minimum 5/8 in. (16 mm) wall thickness, shall run from outer surface of brick wall to, but not beyond, the inner surface of chimney flue liner and shall be firmly cemented in place.

Clearance: 12 in. (305 mm)

System B. Solid-insulated, listed factory-built chimney length of the same inside diameter as the chimney connector and having 1 in. (25.4 mm) or more of insulation with a minimum 9 in. (229 mm) air space between the outer wall of the chimney length and combustibles.

The inner end of the chimney length shall be flush with the inside of the masonry chimney flue and shall be sealed to the flue and to the brick masonry penetration with non-water-soluble refractory cement. Supports shall be securely fastened to wall surfaces on all sides.

Fasteners between supports and the chimney length shall not penetrate the chimney liner.

Clearance: 9 in. (229 mm)

System C. Sheet steel chimney connector, minimum 24 gage [0.024 in. (0.61 mm)] in thickness, with a ventilated thimble, minimum 24 gage [0.024 in. (0.61 mm)] in thickness, having two 1 in. (25.4 mm) air channels, separated from combustibles by a minimum of 6 in. (152 mm) of glass fiber insulation. Opening shall be covered, and thimble supported with a sheet steel support, minimum 24 gage [0.024 in. (0.61 mm)] in thickness.

Supports shall be securely fastened to wall surfaces on all sides and shall be sized to fit and hold chimney section. Fasteners used to secure chimney section shall not penetrate chimney flue liner.

Clearance: 6 in. (152 mm)

System D. Solid-insulated, listed factory-built chimney length with an inside diameter 2 in. (51 mm) larger than the chimney connector and having 1 in. (25.4 mm) or more of insulation, serving as a pass-through for a single wall sheet steel chimney connector of minimum 24 gage [0.024 in. (0.61 mm)] thickness, with a minimum 2 in. (51 mm) air space between the outer wall of chimney section and combustibles. Minimum length of chimney section shall be 12 in. (305 mm). Chimney section concentric with and spaced 1 in. (25.4 mm) away from connector by means of sheet steel support plates on both ends of chimney section. Opening shall be covered, and chimney section supported on both sides with sheet steel supports of minimum 24 gage [0.024 in. (0.61 mm)] thickness.

Supports shall be securely fastened to wall surfaces on all sides and shall be sized to fit and hold chimney section. Fasteners used to secure chimney section shall not penetrate chimney flue liner.

Clearance: 2 in. (51 mm)

Additional requirements:

1. **Insulation material used as part of wall pass-through system shall be of noncombustible material and shall have a thermal conductivity of 1.0 Btu-in./hr-ft² - °F (4.88 kg-cal/hr-m² - °C) or less.**
2. **All clearances and thicknesses are minimums; larger clearances and thicknesses shall be permitted.**
3. **Any material used to close up an opening for the connector shall be of noncombustible material.**
4. **A connector to a masonry chimney, except for System B, shall extend in one continuous piece through the wall pass-through system and the chimney wall to the inner face of the flue liner, but not beyond.**

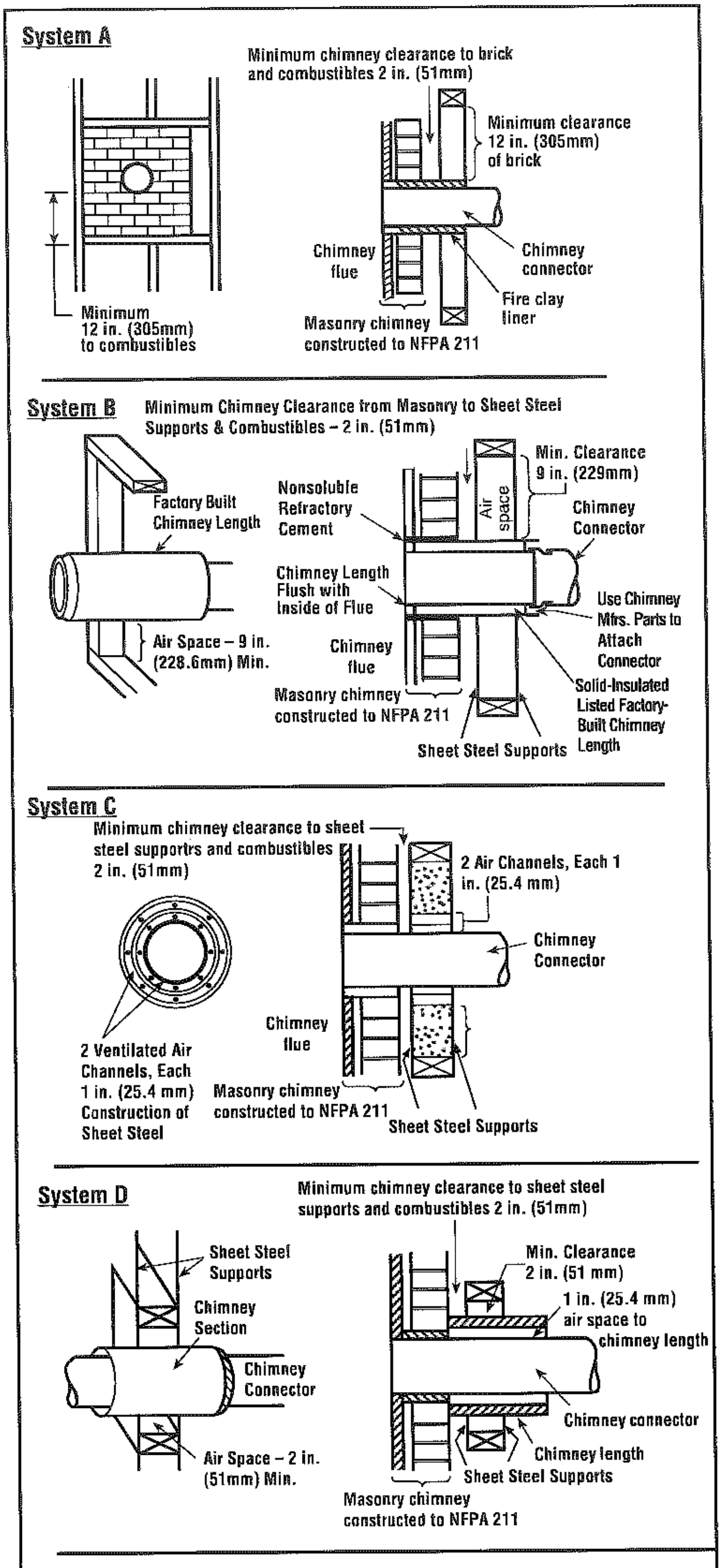
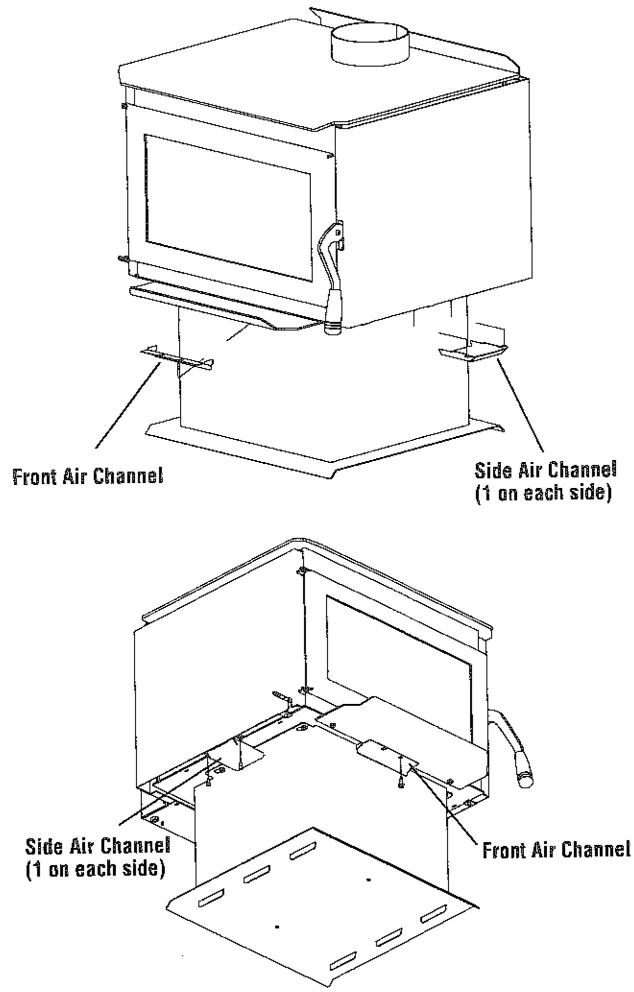


***Figure 9** - Chimney Connector Systems and Clearances from Combustible Walls*

NOTE: DIAGRAMS & ILLUSTRATIONS ARE NOT TO SCALE.



Using the existing screws on the stove, install the front and side air channels as shown here.

Figure 14 - Install Front and Side Air Channels

BRICK INSTALLATION

CAUTION: Wear gloves during brick installation in case of sharp edges inside the stove.

Measure bricks before installing, as per list of dimensions in ***Figure 15***.

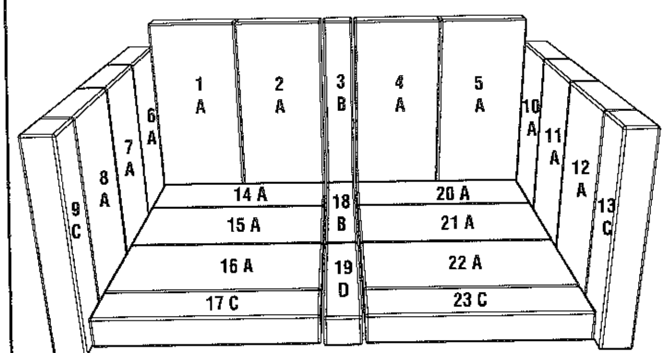
1. Install the brick as shown in ***Figure 15***.
2. The baffle boards are pre-installed. Ensure that they have not moved during shipping. Make sure all three baffle boards are resting on top of the secondary tubes, placed edge to edge, and positioned fully against the rear of the unit.

   CAUTION: It is critical that baffle boards are fully against the rear of the unit.

   These brick sizes may be slightly smaller to adjust for steel and firebrick tolerances beyond our control. Be sure to measure and mark bricks with their numbers when removing.

WARNING: IF THE BRICKS ARE NOT INSTALLED EXACTLY AS SHOWN, THEY COULD FALL OUT OF PLACE DURING REFUELING OR BURNING OF THE STOVE CAUSING SERIOUS INJURY.

Firebox Brick Layout as Viewed from the Front



Brick Sizes	
A = 4-1/2"x 9"	C = 2-1/8"x 9"
B = 1-1/2"x 9"	D = 1-1/2"x 6-3/4"

* Bricks 6 and 10 fit up against the back of the firebox.

Figure 15

Side Cut-A-Way View of Firebox

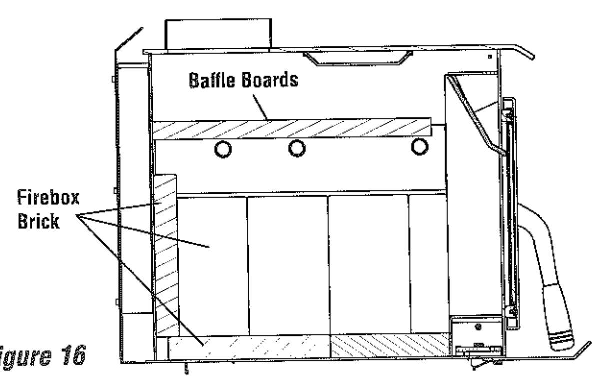


Figure 16

NOTE: DIAGRAMS & ILLUSTRATIONS ARE NOT TO SCALE.

PAINT CURING

Do not close the door tightly during the "Burn-In Period." Also, open the door frequently (every 5-10 minutes) to keep the gasket from adhering to the curing paint. Ventilate the house well during these first firings as the paint gives off carbon dioxide and unpleasant odors. It is recommended that persons sensitive to an imbalance in the indoor air quality avoid the stove or fireplace insert during the curing process.

Your new appliance is painted with a high temperature paint that cures during the first few firings. We recommend that you put your stove or fireplace insert through a regimen of three burns. The first two should last for 20 minutes each at 250 degrees (the stove or fireplace insert should be allowed to cool completely between each burn). The third should be a burn of at least 450 degrees F. for 45-60 minutes. The paint will become soft, gummy and emit non-toxic smoke during these burns. After the stove or fireplace insert cools down for the third time, the paint will harden. **DO NOT BUILD A LARGE ROARING FIRE UNTIL THIS CURING EFFECT IS COMPLETE OR YOU MAY DAMAGE THE FINISH OF YOUR STOVE.** Spray can touch-ups should be done only with a high temperature stove paint (cat. no. H8159), available from all Earth Stove™ dealers.

OPERATING HINTS

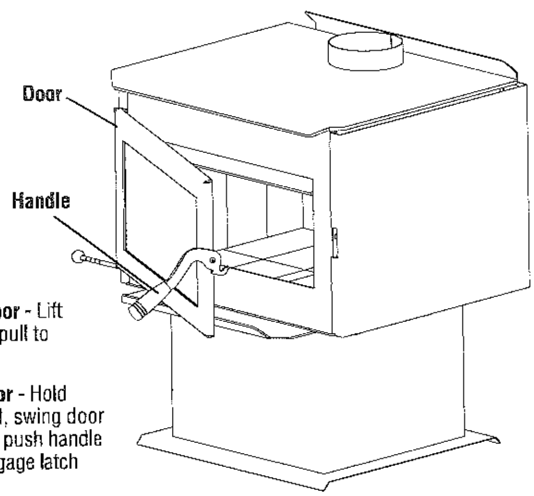
1. Burn only dry, well-seasoned cord wood. In some states it is illegal to burn wet wood or anything other than clean, dry wood products.
2. Your stove or fireplace insert is designed to operate with the door closed! Operate only with the door shut tightly at all times except when loading wood and possibly on start up to establish a draft. Never leave the unit unattended while the front door is opened.
3. **DO NOT** contact or move the baffle boards while loading wood. Occasionally check the baffle to assure that the boards are in there correct location.
4. **CAUTION: THE DRAFT CONTROL MUST BE FULLY OPEN BEFORE OPENING THE DOOR TO AVOID POSSIBLE COMBUSTION FLASH!!** (Ignition of hot volatile gases as the door is opened).
5. Feeding excessive amounts of fuel to the stove or fireplace insert should be avoided. It is important to supply it with sufficient draft and fuel to maintain a moderately hot fire. If, during overnight burns, heavy creosote deposits develop inside your stove and on the door, the draft is set too low - review your burning habits!

DOOR OPERATION

Do not operate the appliance with the door open or ajar other than possibly during start up to create a draft (Do not leave the unit unattended while the front door is slightly open during start up). Operating the appliance with the door open other than in initial start up if needed will produce extreme temperatures within the appliance. Damage caused from over-firing is not covered under the manufacturers limited warranty.

⚠ WARNING

Be careful not to abuse door assembly by striking or slamming it. If the door assembly or glass is broken or damaged, they must be replaced with factory original parts before heater can be safely operated. Use only components provided by the manufacturer as replacement parts.



Opening Door - Lift handle and pull to open door

Closing Door - Hold handle lifted, swing door closed then push handle down to engage latch

Figure 18

NOTE: DIAGRAMS & ILLUSTRATIONS ARE NOT TO SCALE.

5. Once kindling is burning well, larger pieces of wood may be added, then the door should be fully closed if there was the need to keep it slightly open during start up.
6. For best results, use smaller pieces of wood to get the stove or fireplace insert temperature very high before loading larger wood for sustained burns. If necessary, crack the door to allow ignition of the fuel charge. Now you can add larger pieces of wood and after several minutes of high burn, set the left control for the desired heat output. Check the exhaust in about 15 to 20 minutes *(see **Figure 22**)*. Large amounts of smoke indicate an improper burn setting (either too high or too low). Adjust and recheck in 5 to 10 minutes.

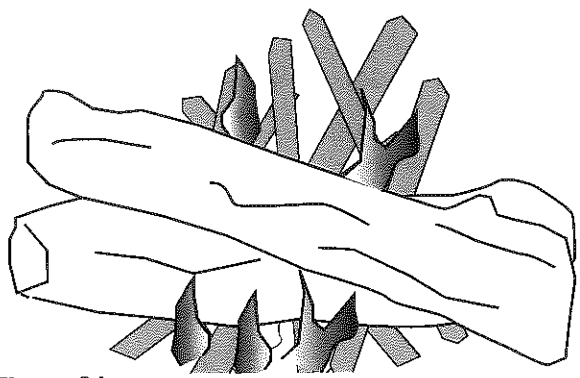


Figure 21

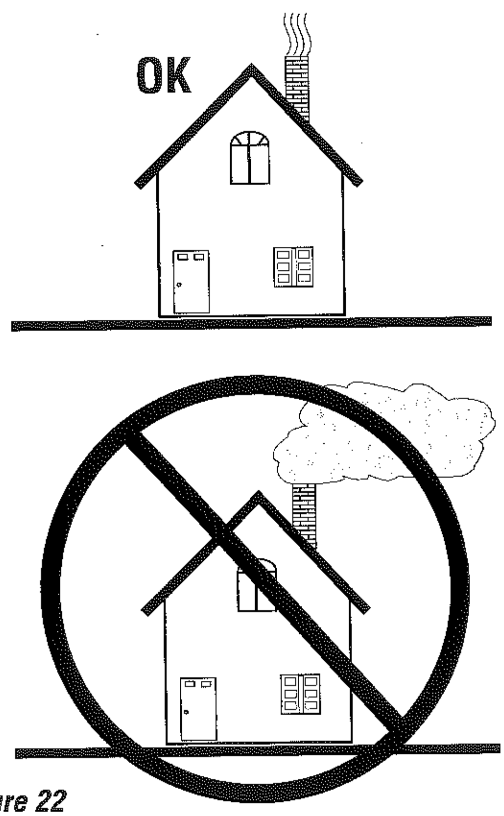


Figure 22

FUEL

This appliance is designed and engineered to burn, dry, well-seasoned wood only.

Dry, seasoned wood is that which has been cut, split and allowed to dry under a covered area where air is free to flow and circulate under and around the wood (not under a tarp or plastic). Make sure wood is not stacked directly on the ground, it may absorb moisture from the ground. It should be allowed to dry in these conditions for a minimum of six months, preferably one year or more. **IT MUST BE UNDERSTOOD THAT WOOD CANNOT BE LEFT IN ANY KIND OF WET OR DAMP AREA OR IT WILL NEVER BECOME COMPLETELY SEASONED.**

Your stove will not operate at the level that it is meant to unless you use seasoned, dry wood. Do not burn driftwood or wood that has been in salt water, doing so will void your warranty. Do not burn incorrect fuels such as flammable liquids, grease, treated wood, coal, garbage, cardboard, solvents, or colored paper. Burning treated wood, garbage, solvents, or colored paper may result in the release of toxic fumes. This type of burning will also void your warranty.

Do Not store fuel within space heater installation clearances or within the space required for refueling and ash removal.

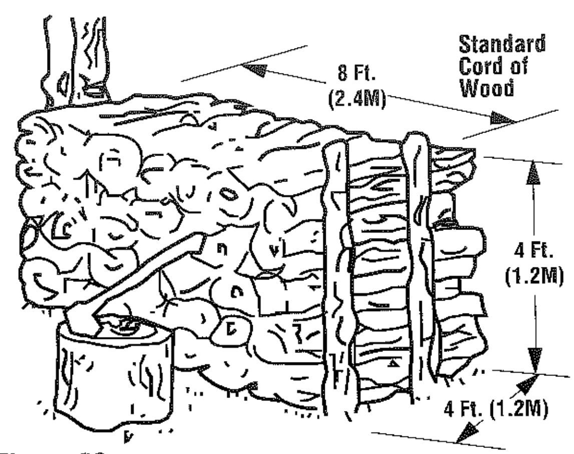


Figure 23

What does "Well-Seasoned" mean?

When a tree is cut down, the wood is green, full of sap and moisture. This moisture content can exceed 80%, which must be reduced to less than 20%. Wood properly seasoned is then capable of generating the heat the stove was designed to provide.

Green wood does not burn easily. Attempting to burn green wood often results in a lot of smoke and very little fire. Time is the most important factor in seasoning wood. Ideally the moisture content should be reduced to 11-20%. ***NOTE: The use of a firewood moisture meter is recommended to ensure the firewood contains less than 20% moisture.***

Seasoning Guide
Softwoods – 6 months to 18 months
Hardwoods – 12 months to 24 months

Logs that are 5" diameter across or larger should be split in half, three pieces if over 8 inches, and four pieces when over a foot across. If a tree has been dead for 2 – 4 years it still needs to be cut, split, and seasoned for 6 to 24 months depending on the wood.

OPTIONAL BLOWER KIT

The optional blower is controlled by a Dial-a-Temp *(see **Figure 24**)*. It contains an On/Off line switch with variable speed control from low to high.

1) Install the optional blower kit per the instructions provided in the blower kit.
2) Plug the blower power cord into the receptacle on the bottom of the Dial-A-Temp.
3) Plug the connected Dial-A-Temp into a properly grounded, 120 VAC wall outlet.
4) To operate, rotate the dial on the Dial-A-Temp clockwise until it clicks on. Rotate the dial further clockwise for a lower speed, then counter-clockwise for a higher speed.

NOTE: Turn blower off before opening the door to load the fuel.

⚠WARNING

The blower must be plugged directly into a properly grounded three-prong receptacle, 120 VAC, 60 Hz, single phase. Do not cut or remove the grounding prong from this plug. Do not route power cord under or in front of appliance.

Installation must be in accordance with National Electrical Code, ANSI/NFPA 70 - latest edition. In Canada, the current CSA C22.1 Canadian Electrical Code - latest edition.

DANGER: Disconnect power before servicing blower.

OPTIONAL BLOWER KIT

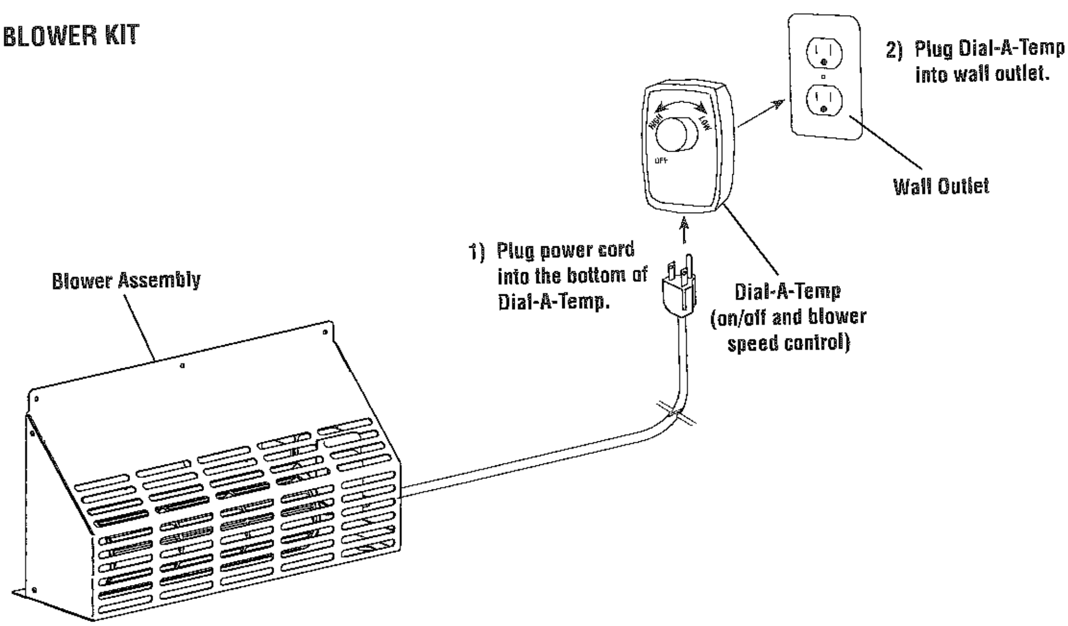


Figure 24

⚠WARNING

In the event that you remove the blower for any reason, the rear heatshield must be returned to its original condition or replaced before using the heater. Excessive rear wall temperatures will result if the stove is burned with the blower opening unobstructed.

MAINTENANCE

DOOR HINGES: If door hinges need lubricating, use an anti-seize compound (never use oil) available from your Earth Stove™ dealer.

DOOR LATCH: Adjustment Instructions -

1. Using a 5/32" hex wrench, remove the side heat shield by removing 3 screws on the back, 2 screws on the bottom, and 1 screw at the top-front corner.
2. With the door open, loosen the latch nuts using a 3/8" wrench. Slide the latch assembly forward to loosen the door and backward to tighten the door.
3. Secure the nuts in place and test the door. If more adjustment is required, repeat step 2.
4. Replace the heat shield before burning the stove.

The hinge side of the door can also be adjusted if necessary. Repeat the procedure above on the hinge side of the stove.

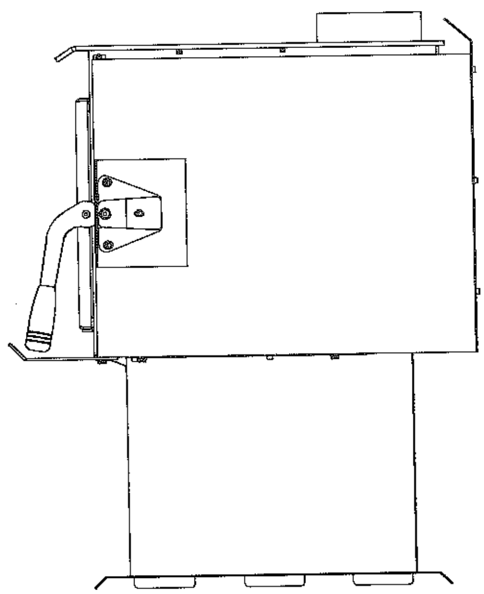


Figure 27

DOOR GASKET: Periodically check gasket to make sure it is not over-compressed. If compressed, replace with a special woven door rope. (Don't try substituting rope, only use LHP door rope).

BAFFLE BOARDS: Your baffle boards should be inspected during every chimney cleaning. If either board is damaged then replace baffle boards.

GLASS CLEANING GUIDELINES
WARNING: DO NOT CLEAN GLASS WHEN APPLIANCE IS HOT!
Glass on any wood stove will not stay perfectly clean. Here are some guidelines for cleaning and caring for the glass:

- **Ensure the stove is cold prior to cleaning glass.**
- This appliance is designed to provide a flow of air over the inside of the glass, where along with high heat helps inhibit build-up on the glass. When build-up occurs, a commercial glass cleaner designed for stoves is recommended. Regular household glass cleaners will not clean creosote.
- Do not use abrasives such as steel pads, steel wool or oven cleaner as they will scratch the glass. Never scrape glass with a razor blade as this may pit the glass and make it impossible to clean in the future.
- Do not use chemical glass cleaners as they may damage the gaskets or painted surfaces.

TIPS FOR KEEPING THE GLASS CLEAN

- Burn only dry seasoned cord wood. **Wet wood = Dirty glass.**
- A short, hot fire (15 - 20 minutes) may help to clean off some of the normal buildup. **Lower burns = more build-up. Higher burns = less build-up.**
- Keep freshly loaded wood away from the glass.
- After reloading, allow all the wood to catch flame before dampering down the stove.

CREOSOTE FORMATION AND NEED FOR REMOVAL

When wood is burned slowly, it produces tar and other organic vapors, which combine with expelled moisture to form creosote. The creosote vapors condense in the relatively cool chimney flue of a slow-burning fire. As a result, creosote residue accumulates on the flue lining. When ignited, this creosote makes an extremely hot fire.

The chimney and chimney connector should be inspected at least once monthly during the heating season to determine if a creosote buildup has occurred. If creosote has accumulated (1/8" [3 mm] or more), it should be removed to reduce the risk of a chimney fire.

Establish a routine for the fuel, wood burner and firing technique. Check daily for creosote build-up until experience shows how often you need to clean to be safe. Be aware that the hotter the fire the less creosote is deposited, and weekly cleaning may be necessary in mild weather even though monthly cleaning may be enough in the coldest months. Contact your local municipal or provincial fire authority for information on how to handle a chimney fire. Have a clearly understood plan to handle a chimney fire.

DISPOSAL OF ASHES

Ashes should be scooped out of a cool stove or fireplace insert with a small metal shovel. Ashes should be placed in a steel container with a tight fitting lid and moved outdoors immediately. Other waste shall not be placed in this container. The closed container of ashes should be placed on a non-combustible floor or on the ground, well away from all combustible materials, pending final disposal. If the ashes are disposed of by burial in soil or otherwise locally dispersed, they should be retained in the closed container until all the cinders have thoroughly cooled. Ashes can ignite up to 72 hours after removal from the appliance.

⚠ CAUTION

Cleaning Glass: Ensure appliance is cold prior to cleaning glass. A commercial glass cleaner designed for stoves is recommended. Do not use abrasive cleaners. Do not clean with any materials, which may scratch or otherwise damage the glass. Scratches on the glass can develop into cracks or break. Inspect the glass regularly. If you detect a crack, extinguish the fire and contact your dealer for a replacement.

⚠ WARNINGS

Inspect and clean chimney and connector frequently. Under certain conditions of use, creosote buildup may occur rapidly.

REPLACEMENT PARTS - MODEL ES2100

Contact an Earth Stove™ dealer to obtain any of these parts. Never use substitute materials. Use of non-approved parts can result in poor performance and safety hazards.

Cat. No	Description
H8890	Right side heat shield
H8891	Left side heat shield
H8892	Back heat shield
H8893	Door back w/pins
H8894	Door channels w/nuts
H8895	Glass
H5640	Glass gasket kit (8' 4")
H5639	Door rope kit, 7/8" dia. (6' 2")
H8897	Baffles
H8898	Secondary burn tubes w/clamps
H5650	Draft rod knob
H8899	Ash lip w/hardware
H8900	Pedestal
H8901	Door handle w/hardware
H8902	Door latch w/hardware
H8896	Complete Firebrick kit

VENTING COMPONENTS - MODEL ES2100

Security Chimneys™ Pipe

Tubinox Components 6" Rigid Stainless Steel Liner			
Cat. No.	Model	Description	Pc. / Container
6LL6	6LL6	LENGTH 6" X 6"	4
6LL12	6LL12	LENGTH 6" X 12"	4
6LL24	6LL24	LENGTH 6" X 24"	4
6LL36	6LL36	LENGTH 6" X 36"	4
6LL48	6LL48	LENGTH 6" X 48"	4
6L7A	6L7A	ADJUSTABLE LENGTH (7 to 11)	4
6LT	6LT	SPLIT BASE TEE	4
6LTCS	6LTCS	TEE CAP	10
6LTC	6LTC	TWIST LOCK TEE CAP	4
6LE30	6LE30	ELBOW 30 DEGREE	4
6LE45	6LE45	ELBOW 45 DEGREE	4
6LE90	6LE90	ELBOW 90 DEGREE	4
6LST	6LST	FLASHING	5
6LSTSS	6LSTSS	FLASHING STAINLESS	1
6LSA	6LSA	SUPPORT ASSEMBLY	5
6LSB	6LSB	INTERIOR SUPPORT	5
6LAAM	6LAAM	ADAPTOR FLEX PIPE (MALE)	4
6LAAF	6LAAF	ADAPTOR FLEX PIPE (FEMALE)	4
6LLFLEX	6LLFLEX	STAINLESS FLEXIBLE LENGTH (6"X60")	4
6LMA	6LMA	MASONRY ADAPTOR	1
6LLR5	6LLR5	REDUCER LENGTH (6"-5")	4
6LLW7	6LLW7	INCREASER LENGTH (6"-7")	4
6LCC	6LCC	DELUXE RAIN CAP	1
6LCS	6LCS	REGULAR RAIN CAP	1
6LRSMI	6LRSMI	ADJUSTABLE INSULATION WALL THIMBLE 6" - 12"	1

Secure Black™ Single Wall Stove Pipe 6" SW Pipe and Accessories			
Cat. No.	Model	Description	Pc. / Container
6SWL6	6SWL6	LENGTH 6" X 6"	10
6SWL12	6SWL12	LENGTH 6" X 12"	5
6SWL24	6SWL24	LENGTH 6" X 24"	10
6SWL36	6SWL36	LENGTH 6" X 36"	2
6SWL48	6SWL48	LENGTH 6" X 48"	5
6SWLT	6SWLT	TELESCOPIC LENGTH 6" (42"-66")	1
6SWLA	6SWLA	ADJUSTABLE LENGTH 6" (3"- 9")	5
6SWMA	6SWMA	SINGLE WALL MASONRY ADAPTOR 6"	1
6SWT	6SWT	TEE 6" (TEE CAP INCLUDED)	2
6SWE45	6SWE45	ELBOW 45 DEGREE 6"	4
6SWE90	6SWE90	ELBOW 90 DEGREE 6"	4
6SWE90A	6SWE90A	SWIVEL 90 DEGREE ELBOW 6"	10
6UP	6UP	FLUE EXTENSION 6"	10
6SWAB	6SWAB	STOVE ADAPTOR 6"	8
6SWIN7	6SWIN7	8LLW7 (6"- 7")	4
6SWIN8	6SWIN8	INCREASER LENGTH (6"- 8")	4
6SWOA	6SWOA	OVAL TO ROUND ADAPTOR 6"	5
6SWLK	6SWLK	DAMPER UNIT 6"	4
6PB	6PB	DECORATIVE COLLAR 6" (ASHT)	25
6PF	6PF	TRIM COLLAR 6" (ASHT)	5

Double Wall Black Stove Pipe 6" DL Pipe and Accessories			
Cat. No.	Model	Description	Pc. / Container
6DL6	6DL6	LENGTH 6" X 6"	8
6DL12	6DL12	LENGTH 6" X 12"	4
6DL24	6DL24	LENGTH 6" X 24"	2
6DL36	6DL36	LENGTH 6" X 36"	2
6DL42A	6DL42A	TELESCOPIC LENGTH (42" 66")	1
6DL3A	6DL3A	ADJUSTABLE LENGTH (3"- 9")	4
6DL36A	6DL36A	ADJUSTABLE LENGTH (3"-34")	2
6DT	6DT	TEE (TEE CAP INCLUDED)	4
6DE45	6DE45	ELBOW 45 DEGREE	4
6DE90	6DE90	ELBOW 90 DEGREE	4
6DMA	6DMA	MASONRY ADAPTOR	1
6UP	6UP	FLUE EXTENSION	10
6DAB	6DAB	STOVE ADAPTOR	8
6DLW7	6DLW7	INCREASER LENGTH (6"- 7")	4
6DLW8	6DLW8	INCREASER LENGTH (6"- 8")	4
6DLK	6DLK	DAMPER UNIT DL 6"	4
6DQDH	6DQDH	DECORATIVE COLLAR	25
6DQ	6DQ	TRIM COLLAR	10

WARRANTY

Your wood appliance is covered by a limited warranty (provided with the appliance). Please read the warranty to be familiar with its coverage.

Retain this manual. File it with your other documents for future reference.

REPLACEMENT PARTS

See *Page 23* for a complete replacement parts list. Use only parts supplied from the manufacturer.

Normally, all parts should be ordered through your Earth Stove™ distributor or dealer. Parts will be shipped at prevailing prices at time of order.

When ordering repair parts, always give the following information:

1. The model number of the appliance.
2. The serial number of the appliance.
3. The part number.
4. The description of the part.
5. The quantity required.
6. The installation date of the appliance.

If you encounter any problems or have any questions concerning the installation or application of this system, please contact your dealer.

LHP
1508 Elm Hill Pike, Suite 108
Nashville, TN 37210
Site web : www.EarthStove.com
1-800-655-2008

PRODUCT REFERENCE INFORMATION

We recommend that you record the following important information about your appliance. If you did not purchase your appliance directly from a Earth Stove dealer, then please call 1-800-655-2008 for the name and phone number of your nearest Earth Stove dealer who will answer your questions or address your concerns.

Your Appliance's Model Number ____________________

Your Appliance's Serial Number ____________________

The Date On Which Your Appliance Was Installed ____________________

Your Dealer's Name ____________________

NATIONAL FIREPLACE INSTITUTE NFI CERTIFIED www.nficertified.org

We recommend that our woodburning hearth products be installed and serviced by professionals who are certified in the U.S. by the National Fireplace Institute® (NFI) as NFI Woodburning Specialists or who are certified in Canada by Wood Energy Technical Training (WETT).

Wood Energy Technical Training www.wettinc.ca

NATIONAL FIREPLACE INSTITUTE NFI CERTIFIED www.nficertified.org

Nous recommandons que nos pôeles à bois soient installés et que l'entretien soit effectué par des professionnels certifiés, aux Etats-Unis par le National Fireplace Institute® (NFI) et au Canada, par le Wood Energy Technical Training (WETT).

Wood Energy Technical Training www.wettinc.ca

LHP reserves the right to make changes at any time, without notice, in design, materials, specifications, and prices, and also to discontinue colors, styles, and products. Consult your local distributor for fireplace code information.

Appendix A

EXAMPLE CALIBRATION/DATA FLOW

All individual test run raw data sheets are organized in a manner that would allow a data reviewer to follow the data as it is being calculated in a step by step fashion. In many cases, the equations used to calculate a specific required data are given on the raw data sheets themselves.

For example, the particulate emission rate in g/dscf is calculated on Data Sheet #7. However, the data used to derive this data begins on Data Sheet #2 (Meterbox Data Sheet) where the meter volume (cubic feet), average meter temperature (°F), average ΔH (in. H_2O), and average Barometric pressure (in. Hg) are recorded and averaged. Each of the averages for these parameters are used in equation 1 on P. 7 where the volume (MCF) is converted to dscf.

The moisture catch total (g. H_2O) on the Particulate Catch/Moisture Data sheet (p. 3) is transferred to P. 7 and the percent stack moisture is calculated in equations 2 and 3.

The gross and net gravimetric (g) particulate catches are determined and calculated on PP. 3-6. Pages 4-1, 4-2 and 4-3 show the initial (tare) constant weights for filters (p. 4-1) and beakers (p. 4-2) and the final constant weights (p. 4-3) for those filters and beakers used for each run. Final and tare weight data is transferred to P. 3 and the gross gravimetric (g) catch for each filter and beaker is calculated. On P. 5 the gravimetric catch for each blank is calculated. The gross gravimetric catch for each filter and beaker is transferred to P. 6 and the net gravimetric catch (g) is calculated, as well as front half and back half catch totals. The net gravimetric catch (g) is transferred to P. 7 and the grain loading/dscf is calculated in equation 4.

Some data sheet specific information is listed below on a page by page basis.

P. 8 The % ambient moisture is determined by interpolating from psychrometric charts which are contained in the State of Oregon Department of Environmental Quality's "Standard Method for Measuring the Emissions and Efficiencies of Woodstoves".

The % relative humidity is determined from the wet bulb/dry bulb temperature readings using the tables found in Section 3.1.2.4 of the State of Montana Air Quality Bureau's Quality Assurance Manual.

P. 10 The uncorrected moisture meter readings are corrected for pin insulation and may or may not be corrected for ambient (wood) temperatures. All corrections are based upon the correction equations or tables supplied by the moisture meter manufacturer. (These are standard, known corrections.)

P. 11 The moisture meter readings are corrected as discussed above.

P. 12 The gas concentrations shown for each gas monitored (CO_2, O_2, CO and SO_2) are determined by converting the analyzer's voltage output recorded on P. 12 to the concentration shown using the analyzer's current calibration curve. The SO_2 concentration is determined using the manufacturer's calibration curve and the current calibration curve.

The cal. W/B (calculated wet bulb) temperature is obtained by first determining the % moisture in the extracted flue gas stream using the temperature data from thermocouples 1 (Wet Bulb) and 2 (Dry Bulb). Then based upon the stack temperature (thermocouple 3) and the % moisture in the extracted gas stream, a calculated wet bulb temperature is determined. All data is derived from the psychrometric tables found in the State of Oregon's "Standard Method for Measuring the Emissions and Efficiencies of Woodstoves".

The following pages contain the equations used to generate the data on Tables 3-5 on the computer printouts:

Dry Gas Volume (standard):

$$V_{m(std)} = \frac{V_m * 17.65 * mcf * \left(P_{bar} + \frac{\Delta H}{13.6} \right)}{T_m}$$

Volume of Water:

$$V_{w(std)} = (0.04707)(ml\ H_2O)$$

Moisture Content:

$$B_{ws} = \left(\frac{V_w}{V_w + V_{m(std)}} \right) * 100$$

Dry Burn Rate:

$$Br = \left(\frac{Wwt - (Wwt * \%\ H_2O)}{2.2046} \right) * \frac{60}{\theta}$$

Carbon Balance (N_t):

$$Nt = \frac{K_3 Nc}{(YCO_2 + YCO + YHC)}$$

Stack Flow Rate (Q_{sd}):

$$Q_{sd} = K_4 N_t Br$$

Particulate Concentration (C_s):

$$C_s = \frac{M_n}{V_{m(std)}}$$

Particulate Emission Rate (E):

$$E = C_s Q_{sd}$$

Proportional Rate Variation (Pr):

$$Pr = \left(\frac{\theta\, S_i * V_{mi(std)}}{10 \sum_{i=1}^{n} \left[S_i * V_{mi(std)} \right]} \right) * 100$$

Where:

Br =	dry wood burn rate, kg/hr.
B_{ws} =	Water vapor in the gas stream, proportion by volume.
c_s =	Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, g/dscm (g/dscf).
E =	Particulate Emission Rate, g/hr.
ΔH =	Average pressure differential across the orifice meter (see Figure 5-2), mm H_20 (in. H_20).
K_3 =	1.0 lb/lb (English) 1000 g/kg (metric)
K_4 =	0.02406 dsm^3/g-mole(metric) 384.8 dscf/lb-mole (English)

m_n =	Total amount of particulate matter collected, mg.
mcf =	Dry gas meter correction factor.
N_c =	Gram atoms of carbon/gram of dry fuel (lb/lb), equal to 0.0425.
N_t =	Total dry moles of exhaust gas/Kg of dry wood burned.
P_r =	Percent of proportional sampling rate.
P_{bar} =	Barometric pressure at the sampling site, mm Hg (in. Hg).
Q_{sd} =	Total gas flow rate, dscf/hr.
S_i =	Concentration measured at the SO_2 analyzer for the "i^{th}" 5 minute interval, ppm.
S_1 =	Concentration measured at the SO_2 analyzer for the first 5 minute interval, ppm
T_m =	Absolute average DGM temperature (see Figure 5-2), °K (°R).
T_{std} =	Standard absolute temperature, 293°K (528°R).
V_m =	Volume of gas sample as measured by dry gas meter, dcm (dcf).
$V_{m(std)}$ =	Volume of gas sample measured by the dry gas meter, corrected to standard conditions, dscm (dscf).
$V_{w(std)}$ =	Volume of water vapor in the gas sample, corrected to standard conditions, scm (scf).
W_{wt} =	Wet wood weight.
Y =	Dry gas meter calibration factor.
Y_{CO} =	Measured mole fraction of CO (dry).
Y_{CO2} =	Measured mole fraction of CO_2 (dry).
Y_{HC} =	Assumed mole fraction of HC (dry); =0.0088 for catalytic woodheaters =0.0132 for noncatalytic woodheaters =0.0080 for pellet fired woodheaters
θ =	Total sampling time, min.
13.6 =	Specific gravity of mercury.
60 =	Sec/min.
100 =	Conversion to percent.

M5H PARTICULATE SAMPLING TRAIN

1. Probe

   3/8" seamless SS-20" long. Outlet end of probe is attached to a SS outlet fitting with a Sweglock SS union. The probe is unheated except for the portion that is in the stack and the heated filter box. The probe is sealed to the stack with a washer.

2. Filter Holder

   A 3" or 4" standard M5 filter holder. A SS filter support with gasket.

3. Filters

   3" or 4" fiber glass (#25 glass) manufactured by Schleicher and Schuell.

4. Front Half Filter Heater

   A box containing a fan for air circulation and a cone heater. The temperature in the box is monitored with a type K thermocouple and adjusted with a voltage regulator to maintain a temperature below 248 °F.

5. Desiccant

   Indicating silica gel, 6-20 mesh. The silica gel is changed as needed.

6. Filter (Back Half) Holder

   Same as front half 3" or 4" filter.

7. Impinger Gas

   Type K thermocouple threaded into the exit "arm" of the impinger. Ice is added to the cooler whenever necessary to maintain an exit gas temperature less than 68 °F.

8. Meterbox

   RAC Stack Sampler modified by EEMC

   Ranges: 0-1.0" inclined water manometer

   0-10.0" vertical water manometer

   Accuracy: Dry gas Meter 0-999.999 cu ft ±1.0%

   Temperatures are monitored using two type K thermocouples.

App B

SAMPLING PROCEDURES AND INSTALLATION DESCRIPTION

This section is broken into two major parts. The first contains a brief description of the sampling and procedures used by LoKee Testing Laboratory when performing a test using EPA Methods 28, 28A and 5H. The second section contains a complete listing of all equipment in each of the major sampling trains and a diagram of each major train.

LoKee Testing Laboratory uses EPA M5H for the particulate sampling procedure and collects the required data so that efficiency of a unit can be calculated using the Oregon Method.

TEST FACILITY AND WOOD HEATER EQUIPMENT LIST

1. Flue Pipe

The diameter of the 24 gauge black steel flue pipe used for each stove varies with the size of the stove's flue collar, e.g., 6" flue pipe is used with a 6" flue collar. The joint at the flue collar is sealed with mortar. The pipe is attached to the stove at the flue collar with three sheet metal screws. All sampling ports are sized for the sampling probes and sealed using washers.

2. Insulated Flue Pipe

The diameter of the insulated flue pipe matches the diameter of the flue collar on the stove. The 6", 7" and 8" pipe meet the requirements of UL 103 HT. The SO_2 injection loop port is sealed with high temperature silicone sealant.

3. Liquid Seal

The liquid (oil) seal used by LoKee varies in size with the flue pipe. The seals are made of 12 gauge steel. The liquid sealant is mineral oil. The cooler consists of 3/8" copper tubing which is coiled in the bottom of the lower half of the seal. Ambient air is pumped through this line when necessary to cool the seal.

4. Supports

The lower half of the seal and the 24 gauge steel black flue pipe is supported by the stove. The upper half of the seal and the insulated flue pipe are hung from wooden supports.

5. Platform Scale

Platform (30" X 30" deck)

Manufacturer: Weightronics

Model: platform: DS-014/SN 4479 readout: W1-110/SN 016409

Type: Electronic

Range: 0-1000 lb.

Capacity:	1000 lb.
Resolution:	±0.1 lb.
Accuracy:	±0.1%

6. Fuel Balance Scale

LoKee uses the platform scale listed above to weigh the fuel charges.

7. Fuel Storage Area

LoKee stores the fuel in a humidity and temperature regulated room.

8. Moisture Meter

LoKee has two moisture meters which it uses to determine wood moisture levels.

The primary meter is:

Manufacturer: Delmhorst Instrument Co.

Model: RC-1C/SN 16152 with 26-E probe and #496 insulated pins.

Type: Electrical Resistance

Resolution: ±0.1% moisture

Ranges: 6-11%, 11-25%, 25-80%

Accuracy:

Moisture	Content Accuracy
6-12%	±0.5%
12-20%	±1.0%
20%-saturation point	±2.0%

Type of Calibration: The RC-1C is equipped with two potentiometers (Zero and Span) which are checked and adjusted on a daily basis. The unit is also checked with a calibration block.

Electrode and Pin Type: 26-E probe and #496 insulated pins

The backup moisture meter:

Manufacturer: Delmhorst Instrument Co.

Model: G-30SN/2477 with 26-E probe and #496 insulated pins

Type: Electrical Resistance

Resolution: ±0.1% moisture

Accuracy:

Moisture	Content Accuracy
6-12%	±0.5%
12-20%	±1.0%
20%-saturation point	±2.0%

Type of Calibration: Calibration is accomplished with an internal calibration point and a potentiometer. The calibration can also be checked against a calibration block.

Description of Operation: The pins are pounded into the wood to be sampled. The meter reading is recorded on Data Sheet #10 (Wood Moisture) or Data Sheet #11 (Density Determination). This is the uncorrected reading which is then corrected for pin insulation and, as needed, temperature using the correction tables for each parameter supplied by the manufacturer.

9. Temperature Monitors

The temperatures are monitored with Type K thermocouples. Each thermocouple's calibration is checked prior to use.

The thermocouple readout is an Omega Model 410B-K/SN 05/4475, with a range of -58 °F to 1999 °F (type K) and an accuracy of ±0.9 °C, which can be read at ±0.1 °F. EEMC reads and rounds to 1.0 °F. The single channel readout is interfaced with a manually operated selector switch that allows 24 channels to be monitored with the same readout. The thermocouples are attached to the test unit with sheet metal screws. The thermocouples monitoring internal stove temperature are sealed at the point of entry with sealant.

10. Draft Gauge

Manufacturer:	Dwyer
Model:	
Type:	Inclined Water Manometer
Range:	0-0.25" water
Resolution:	0.001" water
Accuracy:	±0.001" water (readability)

11. Anemometer

Manufacturer:	Dwyer
Model:	480 Vaneometer/SN S 222 D
Range:	0-400 FPM
Accuracy:	±5% of full scale from 0-1 FPM

12. Humidity Gauge

Manufacturer:	Bacharach
Model:	SAC
Type:	Sling Psychrometer
Range:	Wet Bulb: 30-110 °F
Dry Bulb:	30-110 °F
Resolution:	±1 °F
Accuracy:	±1 °F

13. Barometer

Manufacturer:	Princo Instruments, Inc.
Model:	NOVA 469

Type:	Mercury Barometer
Range:	20-32" Hg
Resolution:	0.01" Hg
Accuracy:	±0.01" when calibrated and installed as per the manufacturer's written operating instructions.

Equation 6.3.1a of the "Standard Methods for Measuring the Emissions and Efficiencies of Residential Wood Stoves" and equation #1 are programmed into a Hewlett Packard 15C calculator which first calculates stack gas flow rate and then the ΔH. The stack gas flow rate and ΔH are both recorded on Data sheet #2. The ΔH is used to set the flow rate through the dry gas meter at 5 minute intervals during the test.

In order to successfully maintain the correct sampling ratio, the following data is recorded on Data Sheet #2 (Meter Box Data Sheet): temperature (°F) at the SO_2 injection rotameter (Tr), pressure (inches H_2O) at the SO_2 injection rotameter (Pr), SO_2 injection rate (cc/min), barometric pressure (BP) (inches Hg), stack gas SO_2 concentration (ppm SO_2), sampling ratio (Sr), and the average dry gas meter temperature (°F). This data is entered into the HP15C, which is used to first calculate a stack gas flow rate (dscf) and then a ΔH for every sampling interval. The flow rate through the dry gas meter is adjusted and maintained by maintaining the appropriate ΔH.

CEM MONITORS

1. <u>Calibration Gases</u>

   LoKee uses vendor certified (±2.0%) calibration gases for each CEM. The concentrations purchased coincide with ranges specified in M5H. Upon receipt of the cylinder, the concentrations are verified with Method 3 (ORSAT) analysis.

2. <u>Flow Regulators</u>

   LoKee uses a variety of standard gas flow regulators to meter the flow of calibration gases from the cylinders.

3. <u>Point of Injection</u>

   Calibration gases are injected directly into the end of the probe. The line carrying the calibration gases from the cylinders is connected to the probe with a short piece of rubber tubing.

4. <u>Sample Gas Conditioning System</u>

   The combustion gas is conditioned with a train that is a duplicate of a M5H train. It contains the following components:

   SS probe

   Glass 4" M5H filter and holder in a heated box

4 1000 ml glass impingers

Glass 4" M5H filter and holder

Indicating silica gel

Type K thermocouple to monitor exit gas temperature

Thomas pump

5. Filters

The filters used are the same as EPA M5H filters.

6. Manifold and Exhaust

The gas stream is delivered to each analyzer through a manifold and flowmeter with the excess gases being routed to an exhaust.

7. CO Analyzer

Horiba PIR 2000/SN 408005

Nondispersive infrared (NDIR)

The gas stream flow is controlled by a SS flowmeter downstream of the analyzer. The calibrated range used is 0-10.0% by volume. The resolution is 0.01% CO. The manufacturer's specification given for linearity is ±1.0%.

8. CO_2 Analyzer

Horiba PIR 2000/SN 407069

The CO_2 analyzer is also a NDIR and is operated in exactly the same manner as the CO analyzer. The range of the CO_2 analyzer is 0-25.0% CO_2.

COMBUSTION GAS ANALYZER TRAIN OPERATING INSTRUCTIONS

A. Pretest Preparation, Checks and Audit Procedures

1. Clean the probe with acetone and a brush. Seal the end of the probe for a leak check.
2. Remove the filter holder from the sample box and change the filter.
3. Empty water from all the impingers in the train. Clean all impingers and fill the first 2 with 100 ml of water.
4. Remove the second filter holder from the train and change the filter.
5. Visually check the indicating silica gel in the fourth impinger. If it is visibly impacted by water, replace the silica gel with dry silica gel.
6. Turn on the pump and perform a leak check on the entire train. This is done by placing the exhaust line in water. A successful leak check is accomplished when no bubbles are detected.
7. Slowly release the plug from the probe to prevent any back flushing.
8. Turn off the pump.

9. Turn on the heat in the sample box. Adjust Variac voltage controller so that temperature in the sample box does not exceed 248 °F.
10. Open the bypass valve on the pump.
11. Connect the probe to the zero/span gas delivery line.
12. Turn on the zero gas and adjust the flow rate to 1.5 SCFH.
13. Wait until the zero gas has completely flushed the train and a stable reading is obtained.
14. Record the zero gas readings of the DVM on Data Sheets #15.
15. Turn off the zero gas at the cylinder.
16. Disconnect the zero/span gas delivery line from the zero gas cylinder.
17. Connect the zero/span gas delivery line to the span gas source for each analyzer.
18. Turn on the span gas and adjust the flow rate to 1.5 SCFH. Wait until a stable reading is obtained on each analyzer. Repeat until all three analyzers are spanned properly.
19. Record the span gas readings of the DVM. Record the analyzer's output and all other pertinent information Data Sheets #15.
20. Turn off the span gas at the cylinder.
21. Disconnect the probe from the zero/span gas delivery line.
22. Insert the probe in the stack.
23. Close the bypass valve on the pumps.
24. Approximately 15-20 minutes before the actual start of the test, turn on the pump and adjust the flow through each analyzer until the flow rate is 1.5 SCFH.

B. Operation During Testing

1. Monitor the flow rate to the analyzers periodically to maintain a flow rate of 1.5 SCFH. Make any necessary adjustments.
2. Record data as follows:
   a. At the start of each 5 minute data cycle, record the scale weight, wet bulb/dry bulb, stack gas temperature and static pressure on Data Sheet #12 (Gas Data).
   b. Record the combustion gas (CO_2, O_2 and CO) analyzer data and the SO_2 analyzer data on Data Sheet #12.
   c. Record the remainder of the temperature data.

C. Post Test Checks and Audit Procedures

1. Remove the probe from the stack. (Be careful when handling the probe as it can be quite hot.)
2. Seal the end of the probe.
3. Perform a leak check on the entire train.
4. Slowly release the plug from the end of the probe to prevent any back flushing.
5. Turn off the pump.

6. Open the bypass valve on the pump.
7. Connect the probe to the zero/span gas delivery line.
8. Turn on the zero gas and adjust the flow rate through each analyzer to 1.5 SCFH.
9. Wait until the zero gas has completely flushed the train and a stable reading is obtained from each analyzer.
10. Record the zero gas reading. Record each analyzer's output and all other pertinent information on Data Sheets #15.
11. Turn off the zero gas at the cylinder.
12. Disconnect the zero/span gas delivery line from the zero gas cylinder.
13. Connect the zero/span gas delivery line to the span gas source for each analyzer.
14. Turn on the span gas and adjust until the flow rate through each analyzer to 1.5 SCFH. Wait until the span gas has completely flushed the train and a stable reading is obtained on each analyzer.
15. Record the span gas reading. Record each analyzer's output and all other pertinent information on Data Sheets #15.
16. Turn off the span gas at the cylinder.
17. Disconnect the probe from the zero/span gas delivery line.

D. <u>Determination of the Combustion Gas Train's Response Time</u>

1. The response time of the combustion gas analyzer train is to be determined using the following procedures. It is best to determine the combustion gas analyzer train response time during the "charcoal phase" of a test burn so that CO levels are relatively stable.
    a. Leak check the combustion gas (CEM) analyzer train.
    b. Zero the CO analyzer using ambient air.
    c. Calibrate the CO analyzer.
    d. Insert the probe for the combustion gas analyzer train in the stack.
    e. Sample flue gas until a stable reading is obtained.
    f. Remove the probe from the stack, note the exact CO concentration as measured on the DVM and start a stop watch at the exact time of removal.
    g. Observe the stop watch and DVM. Record the length of time to initial response, i.e., when the CO levels begin to decline.
    h. Continue observing the stop watch and DVM. Record the time when the analyzer's output equals zero (0.000 v).
    i. Repeat steps d-h 2 or 3 times to verify results.

E. Calibration and Audit Procedures for the Combustion Gas Analyzers

1. Calibrate by presenting zero and span gases to each analyzer at the probe and through the entire sampling train. (See Sections 6.7.2 and 6.9 [M5H].) Record the responses on the appropriate calibration forms.
2. Immediately prior to and after each test run, present the zero and span gases to the analyzers through the entire sampling train as is discussed in section C. Record each analyzer's response on Data Sheets #15.
3. Calculate the ± concentration difference and the actual percent difference as follows using the zero and span gas values obtained in #2 above. All calculations are to be based upon the actual gas concentrations involved.

$$\pm \text{ Concentration Difference} = \text{Actual Conc (\%)} - \text{Std Conc (\%)}$$

$$\text{Zero \% Difference} = \frac{\text{Act Conc (\% or ppm)} - \text{Std Conc (\% or ppm)}}{\text{Full Scale Value (\% or ppm)}} * 100$$

$$\text{Span Act \% Difference} = \frac{\text{Act Response (\% or ppm)} - \text{Exp Response (\% or ppm)}}{\text{Full Scale Value (\% or ppm)}} * 100$$

Then refer to Section 4.2 and 4.3 (M5H) to determine whether the audits are acceptable or not.

TRACER GAS (SO_2) EQUIPMENT

1. SO_2 Injection Probe
   A circular SS loop about 4" in diameter is positioned in the center of the stack. The loop extends outside the stack and is connected to the line leading from the SO_2 injection rotameter with Sweglock fittings. The loop is inserted in the stack at 9.5 ±0.5 ft above the top of the scale.
2. Rotameter
   A rotameter that has been calibrated with a bubble tube. The rotameter is all glass, stainless steel and Teflon. The rotameter has a flow control mechanism which is set to the calibrated flow.
3. Temperature
   The temperature at the injection rotameter is measured with a type K thermocouple.
4. Injection Gas
   Pure SO_2, 99.999% pure, released from the cylinder through a SS regulator and shut off valve.

5. Calibration Gases

LoKee uses vendor certified calibration gases with traceability established in accordance with EPA Protocol #1 as specified in Section 3.3.1 and verified using EPA Method 6.

6. Sample Probe

3/8" SS tubing inserted at 13.5 ±0.5 feet above the platform scale. No obstructions are in the stack between the injection and sample probes.

7. Combustor

Lindberg tube furnace, Model 55035/SN 800125, range 0-2000 °F. The temperature in the tube furnace is monitored with a type K thermocouple and controlled with a Variac voltage regulator. Power adjustments are made as necessary to maintain temperature at 1425 °F ±25 °F.

8. Sample Condenser

The sample condenser consists of 3 modified M5 impingers immersed in a freezer.

A filter assembly

The exit gas temperature is monitored with a type K thermocouple.

9. Filter

A standard EPA M5H 3" or 4" filter.

10. SO_2 Analyzer

Horiba, PIR 2000/SN 403019

Nondispersive infrared (NDIR)

The analyzer is operated as per the manufacturer's instructions at a flow rate of 1.5 SCFH. The calibration range is 0-2500 ppm SO_2 at a resolution of ±25.0 ppm. The manufacturer's specification for linearity is ±1.0%. The voltage response is displayed on a DVM which is converted to ppm using the manufacturer's calibration curves.

11. Flow Control

Flow through the tracer gas sampling train is controlled by a SS flowmeter.

TRACER GAS TRAIN OPERATING INSTRUCTIONS

A. Pretest Preparation and Checks and Audit Procedures

1. Clean the probe with a brush. After cleaning, seal the end of the probe.

   Note: Do Not Use Acetone Or Other Organic Solvents To Clean The Probe Immediately Prior To Running A Test Or Conducting A Leak Check.

2. Turn on the tube furnace in order to insure that the unit is at the correct operating temperature (1425 °F) at the start of the test.

3. Remove all water and clean the impingers.

4. Change the filter.

5. Turn on the pump.
6. Perform a leak check on the entire tracer gas train. This is done by placing the SO_2 exhaust line in water. A successful leak check is accomplished when no bubbles are detected.
7. Slowly remove the plug from the end of the probe to prevent any back flushing.
8. Turn off the pump.
9. Bypass the pump.
10. Connect the probe to the zero/span delivery gas line.
11. Connect the zero/span gas delivery line to the zero gas cylinder and turn on the zero gas and adjust the flow until the flow rate through the SO_2 analyzer is 1.5 SCFH.
12. Wait until the zero gas has completely flushed the train.
13. Record the zero gas reading. Record the SO_2 analyzer's DVM output on Data Sheets #15.
14. Turn off zero gas at the cylinder.
15. Disconnect the zero/span gas delivery line from the zero gas cylinder.
16. Connect the zero/span gas delivery line to the span gas cylinder.
17. Turn on the span gas and adjust the flow until the flow rate through the SO_2 analyzer is 1.5 SCFH. Wait until the span gas has completely flushed the train and a stable reading is obtained on the analyzer.
18. Record the span gas reading. Record the analyzer's output and all other pertinent information on Data Sheets #15.
19. Turn off the span gas at the cylinder.
20. Disconnect the zero/span gas delivery line from the probe.
21. Insert the probe in the stack.
22. Close the bypass on the pump.
23. Approximately 15 to 20 minutes before the actual start of the test, turn on the SO_2 injection train and the pump for the tracer gas train.

B. <u>Operation</u>

1. Turn on the tube furnace to insure furnace is at approximately 1425 °F when the test begins.
2. Approximately 15-20 minutes before the actual start of the test, turn on the cylinder of pure SO_2.
3. Using the rotameter's current calibration, adjust the SO_2 flow rate to the calibrated level.
4. Turn on the pump in the tracer gas train. Adjust the flow rate through the SO_2 analyzer so that it remains at 1.5 SCFH.

5. Monitor the SO_2 concentrations in the stack and stack gas flow rates in order to establish a sampling ratio for the test and a correct ΔH at the start of the test.

6. At the start of the test and every 5 minutes thereafter, record the SO_2 analyzer output in volts and the stack gas SO_2 concentration in order to calculate the stack gas flow rate and determine the correct ΔH for the meter box.

   Also monitor and record the temperature at the Rotameter (Tr), pressure at the Rotameter (Pr), barometric pressure (BP) SO_2 injection rate (cc/min) and static pressure on Data Sheets #2 and #12.

C. Post Test Checks and Audit (Zero/Span) Procedures

1. Remove the probe from the stack. (Be careful when removing the probe from the stack as it can be quite hot.)
2. Plug the end of the probe.
3. Perform a leak check.
4. Slowly remove the plug from the end of the probe to prevent any back flushing.
5. Turn off the pump.
6. Bypass the pump.
7. Connect the probe to the zero/span gas delivery line.
8. Connect the zero/span gas delivery line to the zero gas cylinder. Turn on and adjust until the flow rate through the SO_2 analyzer is 1.5 SCFH.
9. Wait until the zero gas has completely flushed the train.
10. Record the zero gas reading. Record the SO_2 analyzer's DVM output on Data Sheet #15.
11. Turn off zero gas at the cylinder.
12. Disconnect the zero/span gas delivery line from the zero gas cylinder.
13. Connect the zero/span gas delivery line to the span gas cylinder.
14. Turn on the span gas and adjust the flow until the flow rate through the SO_2 analyzer is 1.5 SCFH. Wait until the span gas has completely flushed the train and a stable reading is obtained.
15. Record the span gas reading. Record the analyzer's output and all other pertinent information on Data Sheet #15.
16. Turn off the span gas at the cylinder.
17. Disconnect the zero/span gas delivery line from the probe.

D. Determination of Tracer Gas Train's Response Time

1. Zero and calibrate the SO_2 analyzer.
2. Prepare and leak check the tracer gas train as per A above.
3. Insert the probe in the stack which contains flue gas and SO_2 concentrations in the ranges normally encountered during wood stove testing.

4. Sample flue gas with SO_2 concentrations until a stable reading is obtained. It is best to determine the tracer gas train's response time during the "charcoal phase" of a test burn so that the SO_2 concentrations are as stable as possible.
5. Remove the probe from the stack, noting the exact SO_2 concentration as measured by the DVM and starting a stop watch at the exact time of removal.
6. Observe the stop watch and DVM. Record the length of time to the initial response, i.e., when the SO_2 levels begin to decline.
7. Continue observing the stop watch and DVM. Record the time when the SO_2 analyzer's output equals zero (0.000 v.).
8. Repeat steps 3-7 two or three times to verify results.

E. Calibration and Audit Procedures for the Tracer Gas (SO_2) Analyzer

1. Calibrate by presenting zero and span gases to the analyzer at the probe and through the entire sampling train. Record the responses on the appropriate calibration form.
2. Immediately prior to and after each test run, present the zero and span gases to the analyzer through the entire sampling train as is discussed in Sections A and C. Record the analyzer's response on Data Sheet #15.
3. Calculate the ± concentration differences and actual percent difference as follows using values obtained in #2 above as the expected response. All calculations are to be based upon the actual gas concentration involved.

$$\pm \text{ Concentration Difference} = \text{Actual Conc (\%)} - \text{Std Conc (\%)}$$

$$\text{Zero \% Difference} = \frac{\text{Act Conc (\% or ppm)} - \text{Std Conc (\% or ppm)}}{\text{Full Scale Value (\% or ppm)}} * 100$$

$$\text{Span Act \% Difference} = \frac{\text{Act Response (\% or ppm)} - \text{Exp Response (\% or ppm)}}{\text{Full Scale Value (\% or ppm)}} * 100$$

Then refer to Section 4.2 and 4.3 (M5H) to determine whether the audits are acceptable or not.

TEMPERATURE SENSING OPERATING INSTRUCTIONS

A. Operate the thermocouple readout selector switch and record the temperature for each thermocouple. All the temperature in the test facility should be approximately the same. Repair as necessary.

B. Check the operation and output of the thermocouple readout using the Omega NBS Traceable Thermocouple Simulator. The simulator is hooked up to thermocouple readout #23. Check the readout over its full range at 200 °F intervals. Record the data on Data Sheet #16.

C. One hour before the actual test start record stove temperatures (thermocouple readout #'s 4, 5, 6, 7 and 8), firebox (readout #9), post catalytic combustor or secondary burn chamber (readout #10), and room temperature (readout #11). Record the temperatures every 5 minutes until the start of the test on Data Sheet #13 (Preburn).

D. During the test record the temperatures every 5 minutes for each of the thermocouples on Data Sheets #12 and 14.

FUEL PREPARATION

A. No more than 4 hours prior to use, obtain 3 moisture readings from each piece of wood. Record all moisture readings on Data Sheet #10.

B. Obtain kindling by finely splitting pieces that otherwise cannot be used as test fuel. Weigh the kindling and record the weight on Data Sheet #8.

C. Obtain the pretest fuel by using 2 x 4's. The length of the pretest fuel can be no less than 1/3 the length of the test fuel. Weigh the pretest fuel prior to its being loaded in the stove. Record weights on Data Sheets #8 and #9.

D. Obtain the test fuel by cutting dimensional lumber (either 2 x 4's or 4 x 4's) so that the length is 5/6's the length of the longest usable dimension of the firebox. Use the mix of 2 x 4's and 4 x 4's specified in Section 4.3 M28. The test fuel shall be essentially free of knots, sap seams or rotten areas.

E. The spacers shall measure 1 x 5 x 1" (nominally). The spacers shall be free of knots, sap seams or rotten areas. Nail the spacers to the 2 x 4's and 4 x 4's as described in the regulations.

F. Take a photograph of the assembled fuel charge at a 90° angle from the photograph that will be taken when the fuel charge is loaded in the stove.

WOOD DENSITY DETERMINATION

A. When cutting the test fuel, cut a representative piece of 2 x 4 or 4 x 4 that is approximately 3 to 5-inches in length.

B. Take a moisture reading from the top, bottom and side of the piece. Record readings on Data Sheet #11. Determine the % moisture on a wet and dry basis.

C. Weight the piece on a balance.

D. Take measurements of width, depth and length at the four corners with a micrometer. Determine the volume of the piece. (Length x width x depth = Volume in cubic centimeters)

E. Dry the piece in an oven at 95-100 °C for a minimum of 24 hours.

F. Reweigh the piece on the balance.

G. Calculate % moisture on a dried basis.

$$\%\text{ moisture (dry basis)} = 1 - \frac{\text{dried weight}}{\text{wet weight}} * 100$$

H. Calculate the density.

$$\text{Density (g / cc)} = \frac{\text{dried weight (g)}}{\text{volume (cc)}}$$

BTU'S/LB DETERMINATION

A. When cutting the test fuel (only the test fuel, not the kindling, pretest fuel or spacers), collect a sawdust sample. Place in a clearly marked plastic bag.

B. Forward sample to a commercial laboratory for BTU contents analysis.

STOVE PREPARATION

A. Clean the stove.

B. Weigh the stove, record the weight on Data Sheet #8.

C. Add approximately 0.3 lb. of wadded newspaper to the stove. Record weight of newspaper on Data Sheet #8. Add 4-8 lb. of kindling to the stove, and record the weight of the kindling on Data Sheet #8.

D. Light the paper and kindling, leaving the stove's air draft control(s) wide open and the door cracked until well ignited.

E. Close door.

F. When between 50% - 75% of the weight of the kindling has been burned add the first pretest fuel charge.

G. Continue to add pretest fuel until the stove has thoroughly warmed up. As necessary, rake the coal bed prior to adding additional pretest fuel charges.

H. Remove all material from the firebox after two or more hours of burning on high. Obtain the dry empty stove weight and record on Data Sheet #8.

I. Set the stove's air draft control(s) at the desired setting a minimum of 1 hour before the test run is to begin.

J. As necessary set the heat exchange blower(s) at the specified setting a minimum of one hour before the test is to begin.

K. Record the stove surface temperatures, firebox and post catalytic or secondary burn temperatures and scale weigh for a minimum of one hour before the test run begins. As necessary add fuel, rake the coal bed, level the coal bed and/or remove coals during the first 45 minutes of the hour immediately preceding the start of the test. Record all information concerning raking, fuel additions, etc. on Data Sheet #13.

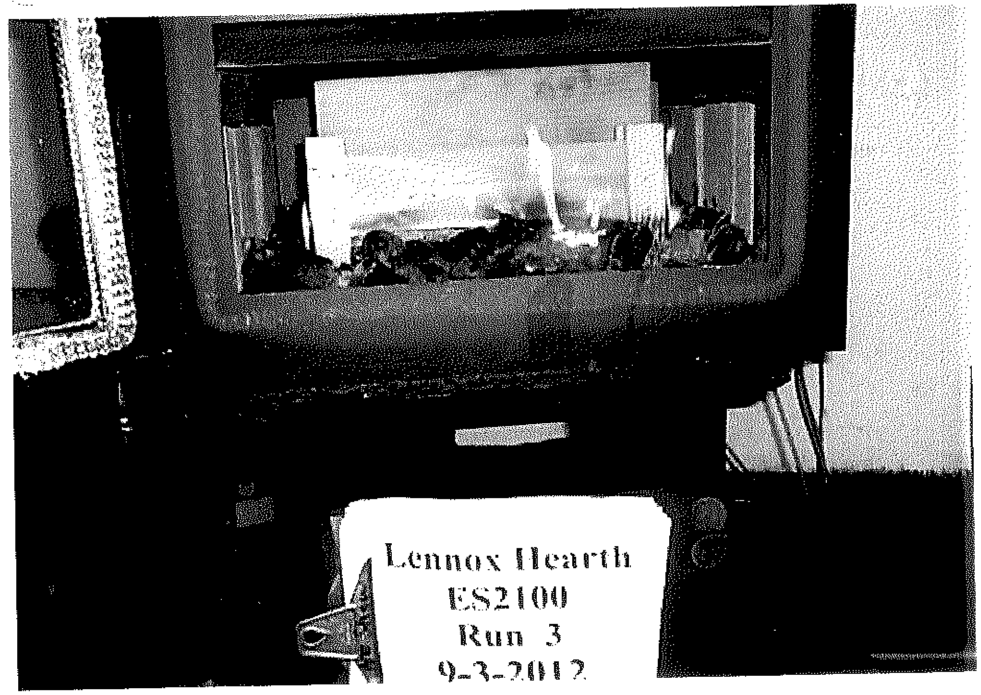
L. If necessary, sometime during the last 15 minutes before the start of the test, open the door and brake up all large pieces and then rake and level the pretest fuel in the stove. At this time, level the coal bed as necessary to accommodate loading the fuel charge into the stove. Close the door. Total time door can be open during the last 15 minutes is 1 minute. No further manipulation of the stove is allowed during the 15 minutes immediately preceding the start of the test.

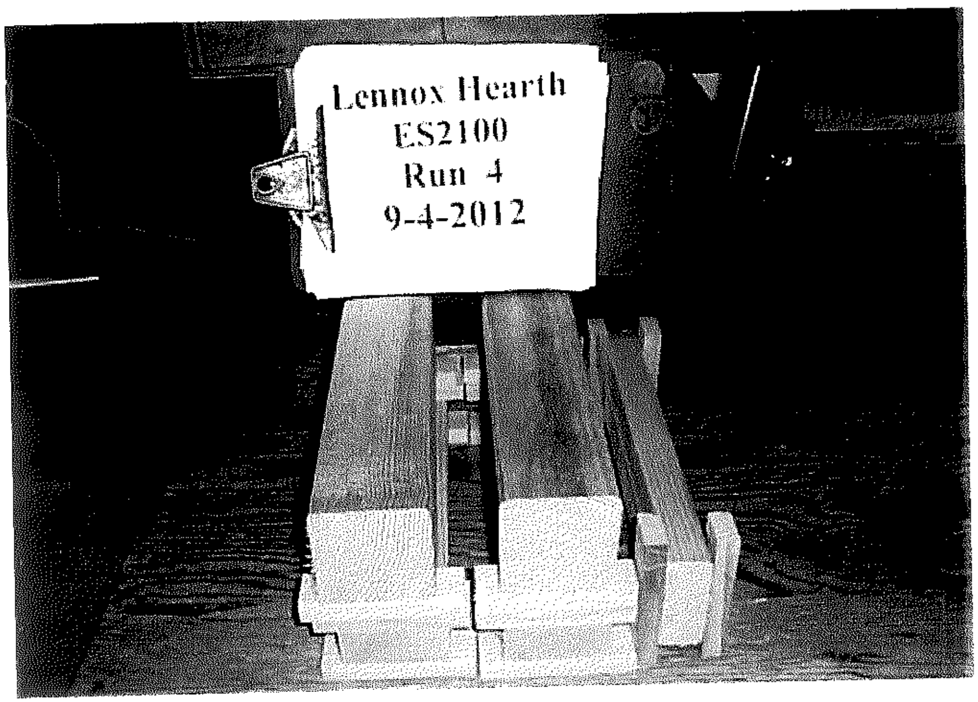
M. When the weight of the coal bed equals 20-25% of the weight of the test fuel charge, load the test fuel. Take a photograph of the fuel load in the stove immediately after loading the fuel. Leave the door open as per the manufacturer's instruction, but no longer than 5 minutes.

N. Document all stove operating data from ignition through loading and test start up on Data Sheet #9.

Photo pages.


Lennox Hearth
ES2100
Run 3
9-3-2012


Lennox Hearth
ES2100
Run 3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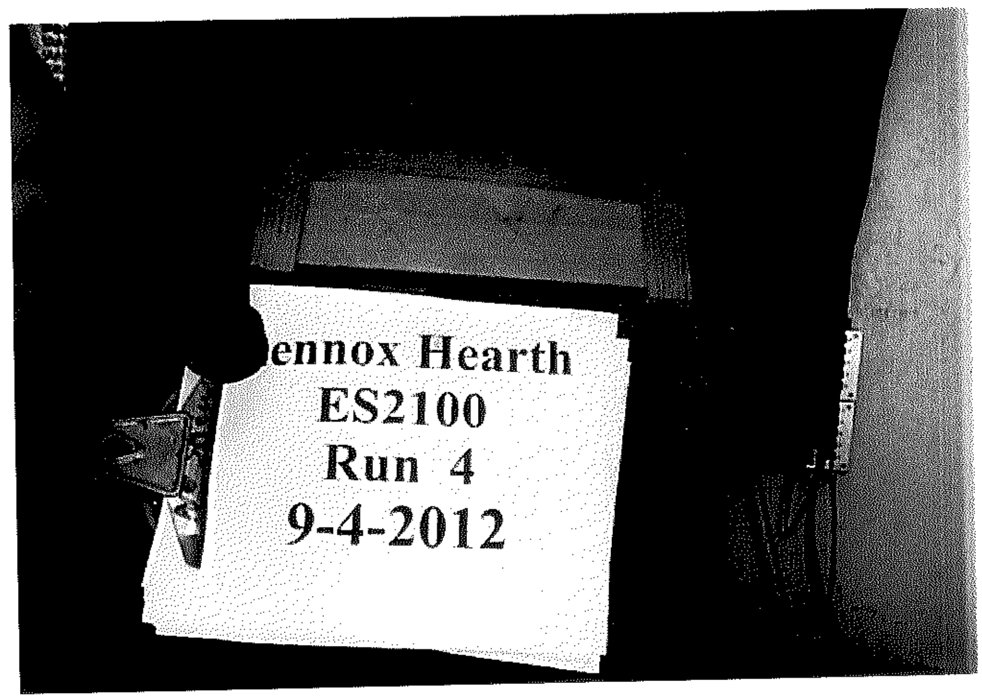
ES2100
Run 4
9-4-2012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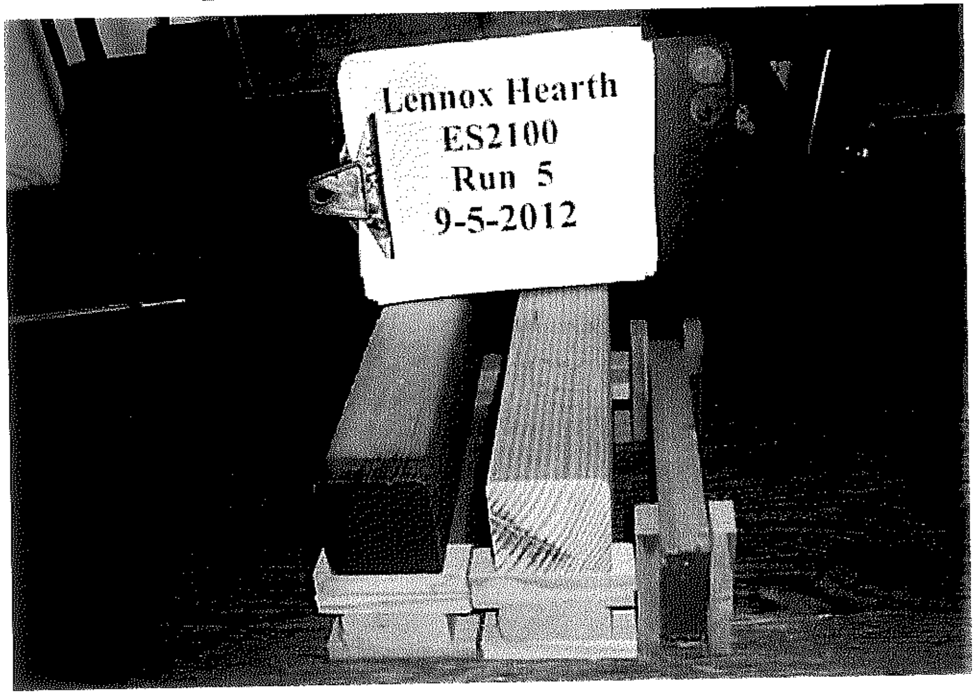
Run 4
9-4-2012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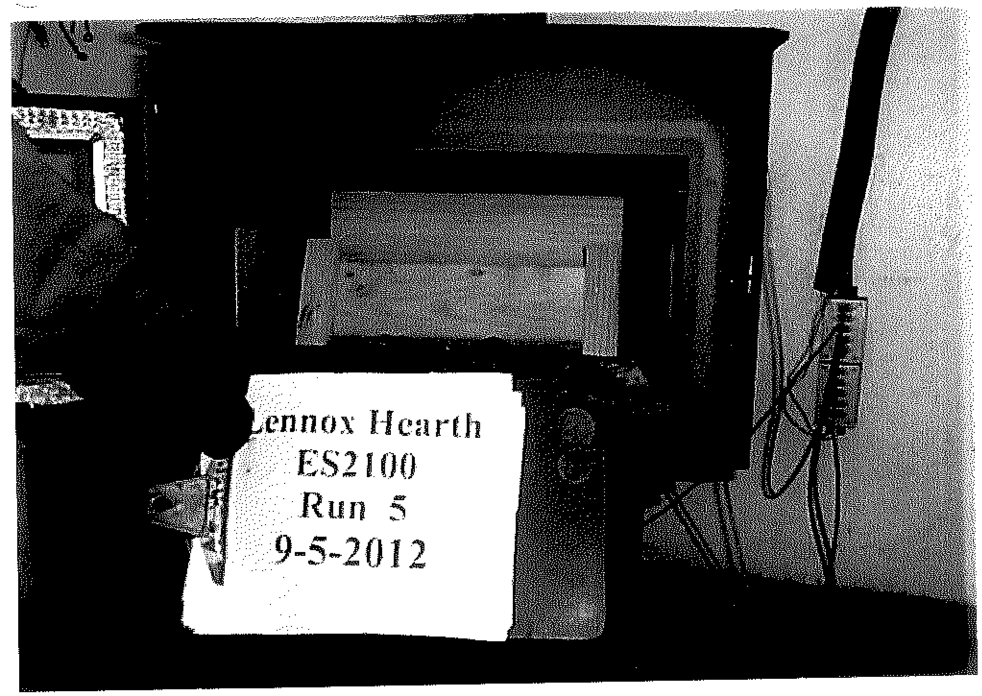
ES2100
Run 5
9-5-2012

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