LOKEE TESTING Laboratory

United States
Environmental Protection Agency
Wood Heater Quality Assurance Test Report

Jotul North America, Inc.
F400

Volume 1 of 1

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United States
Environmental Protection Agency
Wood Heater Quality Assurance Test Report

Jotul North America
55 Hutcherson Drive
Gorham, ME 04038
F400

Volume 1 of 1

Report By:

Chip Wadington
Kent Venton

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11/24/2005

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

A. Computer Printouts

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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
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TEST SERIES INFORMATION

Unit name and model number: F400

Type of unit: Wood Heater

Manufacturer: Jotul North America
Address: 55 Hutcherson Drive
Gorham, ME 04038

Contact: Roger Purinton
Phone Number: 1-207-591-6621
Fax Number: 1-207-772-0523

Observers: None

Date Received: 10/1/2005 Aged: 11/3-4/2005 Dates Tested: 11/11-17/2005

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

Test Location: 13235 Prairie Circle East
Bonney Lake, WA 98391
Test Site Elevation: 500 feet above sea level

LoKee's Field Team

Team Members: Chip Wadington
Kent Venton

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**

   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

SEALED EPA TEST UNIT

DO NOT TAMPER WITH SEALS
TO DO SO WILL VOID CERTIFICATION

JOTUL NORTH AMERICA
F400

AGING DATA SHEET

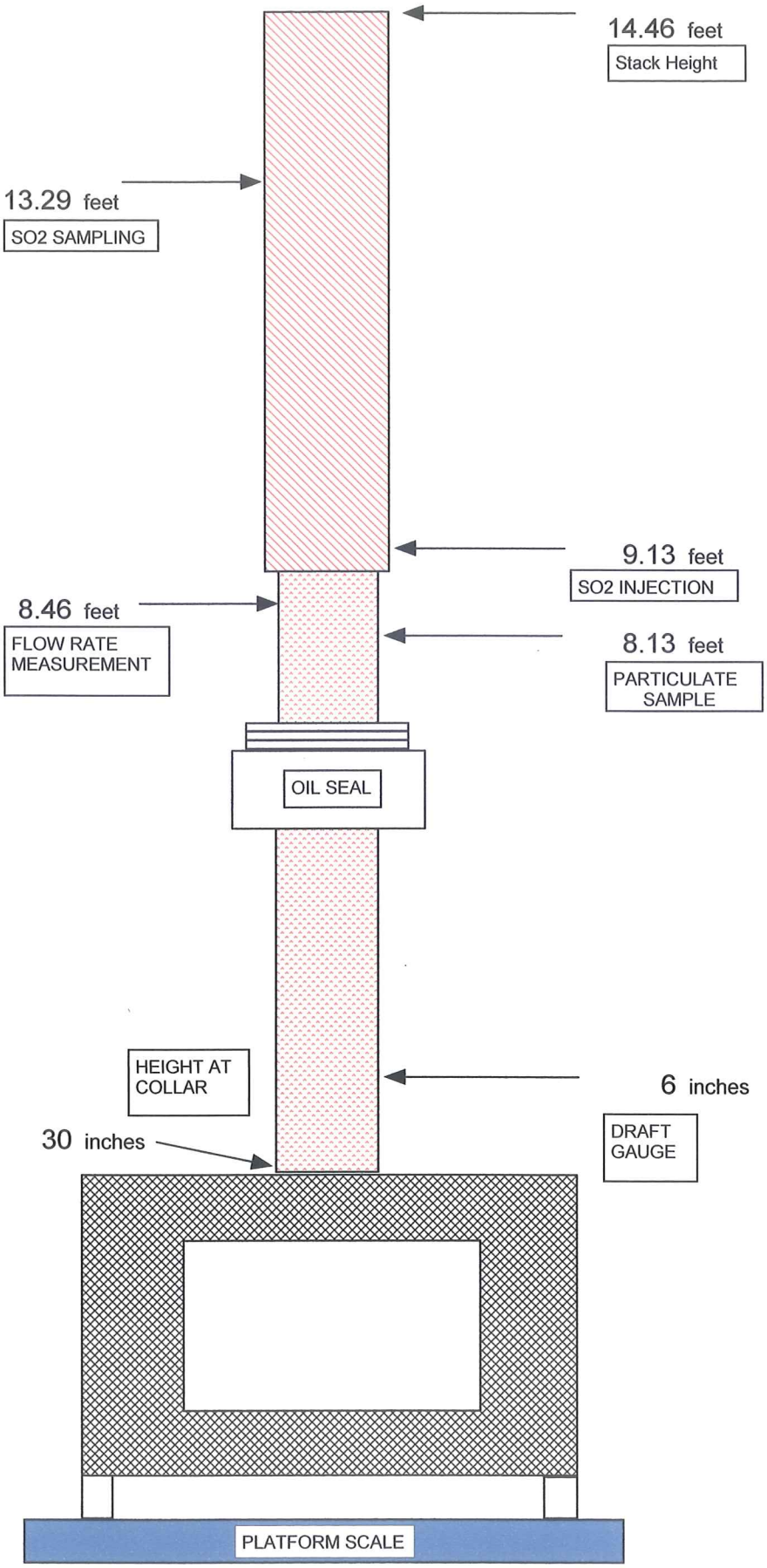
UNIT : Jotul F400 DATE: 11-3-2005

Hr #	DATE	TIME	TEMP Stack 1	TEMP Top 2
1	11-3-05	14:00	210	151
2	"	1500	237	278
3	"	1600	409	558
4	"	1700	268	408
5	"	1800	310	421
6	"	1900	235	340
7	"	2000	249	318
8	"	2100	316	422
9	11-4-05	1000	266	242
10	"	1100	341	442
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				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				

COMMENTS:

Model: Jotul F400 **Date:** 11/05/05



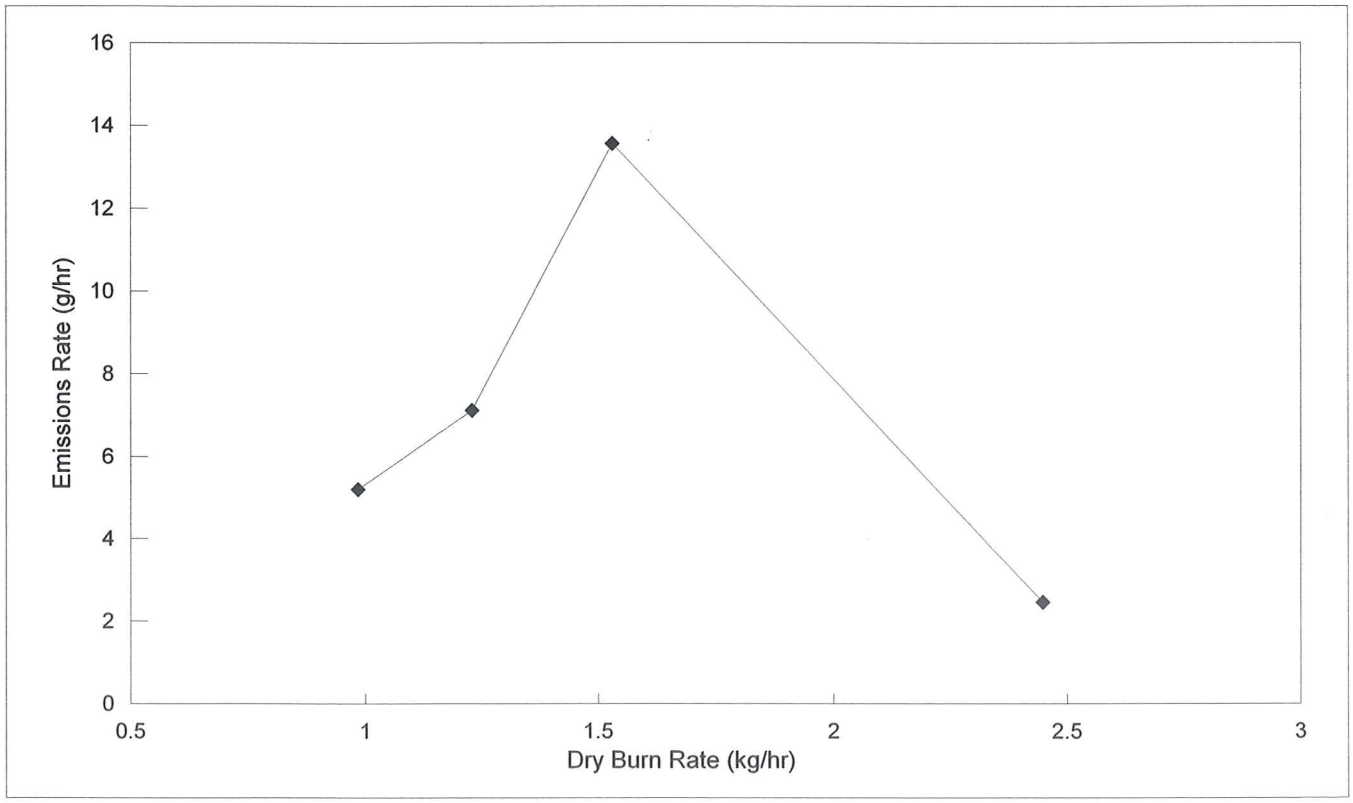
DATA
SUMMARY

Wood Heater Emission Test Summary

Laboratory/Wood Heater Information

Stove Manufacturer:	**Jotul**
Model Identification:	**F400**
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:	**Nov 11-17, 2005**
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) 7.36
1	0.99	5.20	11877	
2	1.23	7.12	14832	
3	1.53	13.56	18449	
4	2.45	2.46	29518	
			NA	
			NA	



DATA SUMMARY

Unit: Jotul-F400

	RUN #	1	2	3	4				
Particulate Emissions:									
Concentration:	grains/dscf:	.2008	.2177	.3493	.0463				
Emissions Rate	grams/hr:	5.2	7.12	13.56	2.46				
Emissions Factor	grams/kg:	5.28	5.81	8.89	1.00				
Front Half Catch	% of total	36.3	42.3	29.6	35.0				
Total Mass Captured	total catch:	1.1323	1.0960	1.5426	.1068				
Heat Output (EPA Default):	BTU/hr	11882.2	14771.3	18400.8	29868.2				
Fuel Burn Rates:									
Average kg/hr (dry)	Kg/hr	.985	1.23	1.53	2.48				
Fuel Moisture Content:									
Kindling (wet basis)	%	13.119	11.190	11.739	12.281				
Pretest Fuel (wet basis)	%	17.679	16.949	18.150	17.611				
Test Fuel (wet basis)	%	17.709	18.461	18.421	18.607				
Air to Fuel Ratio		-	-	-	-				
Average Stack Gas									
Avg CO_2	%	6.64	6.83	7.29	9.23				
Avg O_2	%	-	-	-	-				
Avg CO	%	.91	.59	.56	.29				
Avg Moisture	%	5.385	6.70	8.217	8.625				
Avg Stack Gas Emissions:									
CO	g/Kg	123.98	81.62	73.34	32.68				
	g/hr	122.12	99.98	111.91	80.95				

Unit: Jotul-F400

	RUN #	1	2	3	4				
Avg Stack Gas Flow Rate									
EPA CMB	dscfm	6.66	8.42	9.99	13.71				
Tracer Gas	dscfm	8.40	8.859	9.691	15.204				
Draft (static)	in H_2O	-.035	-.044	-.046	-.056				
Proportionality Average	%	100	100	100	100	100	100	100	100
Average Temperatures									
Stack Gas	°F	191	228	231	383				
Firebox	°F	-	-	-	-				
Secondary	°F	-	-	-	-				
Catalytic Combustor	°F	-	-	-	-				
Top	°F	332	353	380	507				
Left Side	°F	227	238	243	310				
Back	°F	227	234	252	316				
Right Side	°F	257	266	285	340				
Bottom	°F	167	173	197	229				
Temperature Change	°F	-61.3	-49.0	+.8	+1.5				
Test Chamber Enviroment									
Average Barometer	in. Hg	29.95	30.49	30.4	30.4				
Average Temperature	°F	75	73	80	81				
Ambient Moisture	% H_2O	1.15	1.05	1.0	1.3				
Relative Humidity	%RH	37.5	35	31.5	40				
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	2.7	3.0	2.8	2.7				
Pre Test Fuel (inc kindling)	lbs	44.7	47.6	46.0	40.5				
Test Fuel	lbs	13.2	12.7	13.4	12.3				
Burn Time	min	300	230	195	110				

MINIMUM
DBR

TABLE 1 ----- RAW DATA

CLIENT : Jotul

TEST No. : 1

MODEL: F400

DATE: 11-Nov-05

TIME (MIN.)	METER READING (C F)	DELTA H (IN. H2O)	METER TEMP. (DEG. F)	PERCENT CO (%)	PERCENT CO2 (%)	SO2 COCENTR. PPM
0	161.500	0.150	87	0.85	5.90	400
5	163.000	0.230	87	0.51	3.30	325
10	164.910	0.150	88	0.31	1.80	400
15	166.469	0.130	89	0.35	1.80	425
20	167.936	0.130	89	0.42	1.90	425
25	169.403	0.120	89	0.50	2.20	450
30	170.788	0.120	89	0.61	2.50	450
35	172.174	0.110	89	0.69	2.80	475
40	173.486	0.120	89	0.75	3.10	450
45	174.872	0.110	89	0.75	7.00	475
50	176.184	0.190	89	0.46	11.40	350
55	177.965	0.190	89	0.29	12.00	350
60	179.746	0.260	89	0.05	14.70	300
65	181.823	0.230	89	0.16	12.60	325
70	183.740	0.190	89	0.18	12.40	350
75	185.521	0.190	89	0.07	12.60	350
80	187.301	0.190	90	0.03	14.30	350
85	189.095	0.220	90	0.04	13.50	325
90	191.027	0.220	90	0.07	11.70	325
95	192.958	0.220	90	0.06	11.90	325
100	194.889	0.220	91	0.07	12.10	325
105	196.828	0.220	91	0.07	12.20	325
110	198.766	0.190	91	0.35	9.60	350
115	200.567	0.190	91	0.53	9.00	350
120	202.367	0.170	92	0.65	8.90	375
125	204.054	0.170	92	0.73	8.60	375
130	205.740	0.170	92	0.71	8.60	375
135	207.427	0.170	90	0.65	8.80	375
140	209.101	0.190	90	0.57	9.00	350
145	210.895	0.170	90	0.86	7.40	375
150	212.569	0.150	90	1.20	6.30	400
155	214.139	0.130	90	1.24	5.80	425
160	215.617	0.130	90	1.04	6.10	425
165	217.094	0.170	90	0.62	6.40	375
170	218.768	0.150	90	1.12	4.90	400
175	220.338	0.120	90	1.86	4.40	450

180	221.734	0.130	90	1.39	4.70	425
185	223.212	0.120	90	1.35	4.70	450
190	224.607	0.120	90	1.89	5.20	450
195	226.003	0.120	90	1.94	5.10	450
200	227.398	0.130	90	1.34	5.70	425
205	228.876	0.130	90	1.38	5.60	425
210	230.354	0.120	90	1.29	5.70	450
215	231.749	0.120	90	1.40	5.30	450
220	233.145	0.120	90	1.46	5.10	450
225	234.541	0.120	90	1.37	5.30	450
230	235.936	0.120	90	1.57	4.80	450
235	237.332	0.120	90	1.49	4.80	450
240	238.727	0.120	90	1.44	4.70	450
245	240.123	0.100	90	1.41	4.60	475
250	241.445	0.100	90	1.46	4.40	475
255	242.768	0.100	90	1.70	4.30	475
260	244.090	0.100	90	1.29	4.50	475
265	245.412	0.100	90	1.45	4.10	475
270	246.735	0.100	90	1.53	4.00	475
275	248.057	0.100	90	1.52	3.90	475
280	249.379	0.100	90	1.34	4.10	475
285	250.701	0.100	90	1.31	4.10	475
290	252.024	0.100	90	1.08	4.80	475
295	253.346	0.100	90	1.41	4.20	475
300	254.668	0.100	90	1.41	4.00	475
305						

TABLE 2---RAW DATA

CLIENT : Jotul TEST No. 1

MODEL: F400 DATE: 11-Nov-05

****

METER CAL. FACTOR (Y)	-------	0.972		Wt. WOOD BURNED(LB)	-------	13.2	Lbs
BAROMETRIC PRESS.(Pb)	-------	29.95	in Hg	WET,FUEL MOISTURE %	-------	17.709	%
LEAK RATE POST (Lp)	-------	0.007	cfm	Wt. PART. COLLECTED	-------	1.1323	g
WATER VOL. (V1c)	-------	114.4	Ml	METER VOLUME Vm	-------	93.168	mcf
TEST TIME (MIN)	-------	300	min	HC MOLE FRACTION	-------	0.0132	

TABLE 3 -----FIELD DATA AVERAGES

CLIENT : Jotul TEST No. 1

MODEL: F400 DATE: 11-Nov-05

****

AVG DELTA H	-------	0.15 in H2O		AVG PRCNT CO	-------	0.91	%
AVG METER TEMP. Tm	-------	90 deg F		AVG PRCNT CO2	-------	6.64	%
AVG PPM SO2	-------	412	PPM	AVG BAL CO2/CO	-------	7.28	%

TABLE 4 ----- CALCULATIONS

CLIENT : Jotul TEST No. 1

MODEL: F400 DATE: 11-Nov-05

****

STD SAMPLE VOL. Vm(std) d) ------	87.10 dscf		STACK GAS FLOW Qsd -------	399.794	dscf/Hr &
				6.66	dscf/min
VOL. WATER VAPOR Vw(s td) -----	5.385 scf		PARTICULATE CONCTRT. C s ------	0.0130	g/dscf
PRCNT MSTR Bws -------	5.82 %		PARTC.EMISS. RATE E -------	5.20	g/Hr
BURN RATE BR -------	0.99 Kg/Hr		MOLES OF GAS PER Lb WOOD Nt ----	0.48	Lb-mole/Lb
CO EMISSION RATE -------	122.12 g/Hr &		PART.EMISS. RATE ------	5.28	g/Kgdry fuel
	123.98 g/Kgdry fuel				

TABLE 5 ----- PROPORTIONAL RATE VARIATION

CLIENT : Jotul

TEST No. : 1

MODEL: F400

DATE: 11-Nov-05

	TIME INTEVAL Ti	PPM * Vm	PROPRTN. RATE VAR. PR		PROPRTN RATE VAR. AVERAGE	
	5	563.8	96		100	
	10	582.9	99			
	15	584.4	100			
	20	583.7	100			
	25	583.7	100			
	30	583.5	100			
	35	583.9	100			
	40	583.4	100			
	45	583.9	100			
	50	583.4	100			
	55	583.7	100			
	60	583.7	100			
	65	583.5	100			
	70	583.4	100			
	75	583.7	100			
	80	582.8	99			
	85	586.9	100			
	90	586.9	100			
	95	586.6	100			
	100	586.1	100			
	105	588.0	100			
	110	587.7	100			
	115	588.1	100			
	120	587.2	100			
	125	589.1	101			
	130	588.8	101			
	135	590.2	101			
	140	586.7	100			
	145	586.9	100			
	150	586.7	100			
	155	586.9	100			
	160	587.0	100			
	165	586.6	100			
	170	586.7	100			
	175	586.9	100			
	180	587.0	100			

185	587.0	100
190	586.6	100
195	587.0	100
200	586.6	100
205	587.0	100
210	587.0	100
215	586.6	100
220	587.0	100
225	587.0	100
230	586.6	100
235	587.0	100
240	586.6	100
245	587.0	100
250	586.8	100
255	587.2	100
260	586.8	100
265	586.8	100
270	587.2	100
275	586.8	100
280	586.8	100
285	586.8	100
290	587.2	100
295	586.8	100
300	586.8	100
305		

COMPUTER INPUT DATA SHEET #1

Client: Jotul North America, Inc

Address: 55 Hutcherson Drive
Gorham, ME 04038

Phone: 1-207-591-6621 Fax: 1-207-591-6632

Run No.: 1 Date of Test: 11-11-05 Burn Rate: .985

Model No.: F400 ☒ min ☐ min-1.25 ☐ fan

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

.99/5.2

Dry Gas Meter Y Factor: .972 (0.000) (Data Sheet #2)
Post Leak Rate: .007 cfm (.000) (Data Sheet #2)
Time: 300 min. (000) (Data Sheet #2)

Dry Gas Meter Volume: 93.168 cf (00.000) (Data Sheet #2)

Stack Flow: 8.400 dscfm (00.000) (Data Sheet #2)
Δ H: .147 in. H_2O (.000) (Data Sheet #2)

Maximum Vac.: 3.0 (0.0) (Data Sheet #2)
Barometric Pressure: 29.95 in. Hg (00.00) (Data Sheet #2)

H_2O Captured: 114.4 g (00.0) (Data Sheet #3)

Front Half Catch % Of Total: 36.3 % (00.0) (Data Sheet #6)
Total Particulate Catch: 1.1323 g (0.0000) (Data Sheet #6)

Flue Gas Moisture: 5.8274 % (00.000) (Data Sheet #7)

Particulate Emission: .2008 gr/dscf (0.0000) (Data Sheet #7)

Relative Humidity: 37.5 % RH (00.0) (Data Sheet #8)
Ambient Moisture: 1.15 % H_2O (0.00) (Data Sheet #8)

Preburn Fuel Wt.: 44.7 lbs. (00.0) (Data Sheet #8)
Coal Bed Wt.: 2.7 lbs. (00.0) (Data sheet #8)
Test Fuel Wt.: 13.2 lbs. (00.0) (Data sheet #8)

Heat Output (EPA Default): 11,882.2 BTU/hr (00,000.0) (Data Sheet #8)

Kindling Fuel % Moisture (wet): 13.119 % (00.000) (Data Sheet #10)
Pretest Fuel % Moisture (wet): 17.679 % (00.000) (Data Sheet #10)

Test Fuel % Moisture (dry): 21.520 % (00.000) (Data Sheet #10 [wood stove] or #11 [pellet stove])
Test Fuel % Moisture (wet): 17.709 %

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

Stack Static Pressure: -.035 in. H_2O (+/- .000) (Data Sheet #12)

Average Ambient Temperature: 75 °F (00) (Data Sheet #14)
Stove Temperature Change: -61.3 °F (+/- 000.0) (Data Sheet #14)

Test Start = 1315 Avg Meter Temp = 550
End = 1845

300

METER BOX DATA SHEET PAGE # 2

Page: 1 of 3

UNIT: Jotul F400 RUN: 1 DATE: 11-11-05

Meter Box: 5H Y Factor: .972

Leak checks: 15 " Hg @ .1009 cfm _____ " Hg @ _____ cfm

15 " Hg @ .1007 cfm _____ " Hg @ _____ cfm

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

ROTO: PRESS: .17			SAMPLING RATIO: 28 : 1				BP: 29.95		
MIN	TIME	METER READING	SAMPLE MDCF	STACK DSCFM	DELTA H	METER TEMP	SO2 PPM	ROTO TEMP	PUMP VACC
0	1345	161.500	———	8.536	.15	87	400	87	2.0
5	50	163.000	———	10.505	.23	87	325	87	20
10	55	164.910	164.910	8.520	.15	88	400	88	1.0
15	1400	166.469	166.469	8.019	.13	89	425	89	1.0
20	05	167.936	167.936	8.019	.13	89	425	89	1.0
25	10	169.403	169.403	7.573	.12	89	450	89	1.0
30	15	170.788	170.788	7.573	.12	89	450	89	1.0
35	20	172.174	172.174	7.175	.11	89	475	89	1.0
40	25	173.486	173.486	7.573	.12	89	450	89	1.0
45	30	174.872	174.872	7.175	.11	89	475	89	1.0
50	35	176.184	176.184	9.737	.19	89	350	89	3.0
55	40	177.965	177.965	9.737	.19	89	350	89	3.0
ROTO PRESS: .17			TOTALS:	100.142	1.75	1063	BP.: 29.95		
60	1445	179.746	179.746	11.360	.26	89	300	89	3.0
65	50	181.823	181.823	10.486	.23	89	325	89	3.0
70	55	183.740	183.740	9.737	.19	89	350	89	3.0
75	1500	185.521	185.521	9.737	.19	89	350	89	3.0
80	05	187.301	187.301	9.702	.19	90	350	90	3.0
85	10	189.095	189.095	10.448	.22	90	325	90	3.0
90	15	191.027	191.027	10.448	.22	90	325	90	3.0
95	20	192.958	192.958	10.448	.22	90	325	90	3.0
100	25	194.889	194.889	10.429	.22	91	325	91	3.0
105	30	196.828	196.828	10.429	.22	91	325	91	3.0
110	35	198.766	198.766	9.684	.19	91	350	91	3.0
115	40	200.567	200.567	9.684	.19	91	350	91	3.0
			TOTALS:	122.592	2.54	1080	MAX VACC =		
TOTAL Cu Ft.			TOTALS:	222.734	4.29	2143	AVG. BP:		

METER BOX DATA SHEET PAGE # 2

Page: 2 of 3

UNIT : Jotul F400 RUN : 1 DATE : 11-11-05

Meter Box: SH Y Factor: .972

Leak checks: 15 " Hg @ .009 cfm _____ " Hg @ _____ cfm

15 " Hg @ .007 cfm _____ " Hg @ _____ cfm

Inject SO^2 @ 100 cc/min. Nozzle : Probe @ 3/8 " od Initial Volume: 1,500

ROTO: PRESS: .17			SAMPLING RATIO: 28			: 1	BP: 29.95		
MIN	TIME	METER READING	SAMPLE MDCF	STACK DSCFM	DELTA H	METER TEMP	SO2 PPM	ROTO TEMP	PUMP VACC
120	1545	202.367	202.367	9.022	.17	92	375	92	3.0
125	50	204.054	204.054	9.022	.17	92	375	92	3.0
130	55	205.740	205.740	9.022	.17	92	375	92	3.0
135	1600	207.427	207.427	9.055	.17	90	375	90	3.0
140	05	209.101	209.101	9.702	.19	90	350	90	3.0
145	10	210.895	210.895	9.055	.17	90	375	90	3.0
150	15	212.569	212.569	8.489	.15	90	400	90	3.0
155	20	214.139	214.139	7.990	.13	90	425	90	3.0
160	25	215.617	215.617	7.990	.13	90	425	90	3.0
165	30	217.094	217.094	9.055	.17	90	375	90	3.0
170	35	218.768	218.768	8.489	.15	90	400	90	3.0
175	40	220.338	220.338	7.546	.12	90	450	90	3.0
ROTO PRESS: .17			TOTALS:	104.437	1.89	1086	BP.: 29.95		
180	1645	221.734	221.734	7.990	.13	90	425	90	3.0
185	50	223.212	223.212	7.546	.12	90	450	90	3.0
190	55	224.607	224.607	7.546	.12	90	450	90	3.0
195	1700	226.003	226.003	7.546	.12	90	450	90	3.0
200	05	227.398	227.398	7.990	.13	90	425	90	3.0
205	10	228.876	228.876	7.990	.13	90	425	90	3.0
210	15	230.354	230.354	7.546	.12	90	450	90	3.0
215	20	231.749	231.749	7.546	.12	90	450	90	3.0
220	25	233.145	233.145	7.546	.12	90	450	90	3.0
225	30	234.541	234.541	7.546	.12	90	450	90	3.0
230	35	235.936	235.936	7.546	.12	90	450	90	3.0
235	40	237.332	237.332	7.546	.12	90	450	90	3.0
			TOTALS:	91.884	1.47	1080	MAX VACC =		
TOTAL Cu Ft.			TOTALS:	196.321	3.36	2166	AVG. BP:		

METER BOX DATA SHEET PAGE # 2

Page: 3 of 3

UNIT : Jotol F400 RUN : 1 DATE : 11-11-05

Meter Box: 5H Y Factor: .972

Leak checks: 15 " Hg @ .009 cfm _____ " Hg @ _____ cfm

15 " Hg @ .007 cfm _____ " Hg @ _____ cfm

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

ROTO: PRESS: .17			SAMPLING RATIO: 28 : 1				BP: 29.95		
MIN	TIME	METER READING	SAMPLE MDCF	STACK DSCFM	DELTA H	METER TEMP	SO2 PPM	ROTO TEMP	PUMP VACC
240	1745	238.727	238.727	7.546	.12	90	450	90	2.0
245	50	240.123	240.123	7.149	.10	90	475	90	2.0
250	55	241.445	241.445	7.149	.10	90	475	90	2.0
255	1800	242.768	242.768	7.149	.10	90	475	90	2.0
260	05	244.090	244.090	7.149	.10	90	475	90	2.0
265	10	245.412	245.412	7.149	.10	90	475	90	2.0
270	15	246.735	246.735	7.149	.10	90	475	90	2.0
275	20	248.057	248.057	7.149	.10	90	475	90	2.0
280	25	249.379	249.379	7.149	.10	90	475	90	2.0
285	30	250.701	250.701	7.149	.10	90	475	90	2.0
290	35	252.024	252.024	7.149	.10	90	475	90	2.0
295	40	253.346	253.346	7.149	.10	90	475	90	2.0
ROTO PRESS: .17			TOTALS:	86.185	1.22	1080	BP.: 29.95		
300	1845	254.668	254.668	7.149	.10	90	475	90	2.0
305									
310									
315									
320									
325									
330									
335									
340									
345									
350				512.389	8.97	5479			
355									
			TOTALS:			90	MAX VACC =		3.0
TOTAL Cu Ft.		93.168	TOTALS:	8400	.147	+460 (550)	AVG. BP: 29.95		

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PARTICULATE CATCH / MOISTURE DATA SHEET # 3

UNIT : Jotul F400 RUN : 1 DATE : 11-11-05

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	718.4	583.7	486.8	925.4
INITIAL WT	617.6	578.2	483.5	920.6
NET WT GRAMS	100.8	5.5	3.3	4.8

TOTAL CATCH : 114.4 GRAMS H_2O

FRONT HALF

FILTER #	37F	
FINAL WT g	.9947	
INITIAL WT g	.6665	
NET WT g	.3282	

BEAKER #	21
DESC.	ACETONE
FINAL WT g	108.3174
INITIAL WT g	108.2343
NET WT g	.0831
VOL. DESC. ml	75

BACK HALF

FILTER #	37B	
FINAL WT g	.4301	
INITIAL WT g	.3406	
NET WT g	.0895	

BEAKER #	22	23	24	25	
DESC.	ACETONE	METHCHLOR	H_2O	H_2O	
FINAL WT g	106.3087	104.6900	106.4863	99.7546	
INITIAL WT g	105.9320	104.5882	106.4078	99.6731	
NET WT g	.3767	.1018	.0785	.0815	.1600
VOL. DESC ml	200	75	150	155	305

FILTER TARE WEIGHTS DATA SHEET #4-1

Into Dessicator : Date : 9-2-05 Time : 1515 By : C. Washington

Manufacturer S & S Grade : # 25 Glass Front Size : 11 cm Lot No. : ZB921

Back Size: 8.2 cm Lot No. : B1044632

	DATE: 9-19-05	BY: CP	DATE: 9-20-05	BY: CW	DATE:	BY:
FILTER #	FIRST WEIGHT	TIME	SECOND WEIGHT	TIME	THIRD WEIGHT	TIME
31 F	.6696	0825	.6698 ✓	1820		
32 F	.6721	0826	.6723 ✓	1821		
33 F	.6745	0827	.6747 ✓	1823		
34 F	.6732	0828	.6730 ✓	1824		
35 F	.6584	0830	.6585 ✓	1825		
36 F	.6702	0831	.6704 ✓	1826		
37 F	.6667	0832	.6665 ✓	1828		
38 F	.6696	0833	.6695 ✓	1829		
39 F	.6648	0834	.6646 ✓	1830		
40 F	.6677	0835	.6677 ✓	1831		
31 B	.3401	0836	.3400 ✓	1833		
32 B	.3362	0837	.3364 ✓	1834		
33 B	.3388	0839	.3391 ✓	1835		
34 B	.3390	0840	.3392 ✓	1836		
35 B	.3362	0841	.3364 ✓	1837		
36 B	.3373	0842	.3373 ✓	1839		
37 B	.3408	0842	.3406 ✓	1840		
38 B	.3397	0844	.3398 ✓	1841		
39 B	.3403	0845	.3403 ✓	1842		
40 B	.3405	0846	.3406 ✓	1844		

Checked by: KV Date: 10-2-05 Time: 13:00

BALANCE ROOM ENVIRONMENTAL CONDITIONS

DATE	TIME	BY	WB	DB	% RH
9-19	0810	CP	60	74	44
9-20	1810	CW	64	77	49

BEAKER TARE WEIGHTS DATA SHEET #4-2

Into Dessicator: Date : 9-8-05 Time : 1040 By : Cwadington

	DATE: 9-11	BY: CW	DATE: 9-12	BY: CW	DATE:	BY:
BEAKER #	FIRST WEIGHT	TIME	SECOND WEIGHT	TIME	THIRD WEIGHT	TIME
1	104.9161	1306	104.9157	0922	✓	
2	106.2544	1307	106.2539	0923	✓	
3	107.7780	1308	107.7775	0924	✓	
4	108.7746	1309	108.7741	0925	✓	
5	97.4364	1310	97.4360	0926	✓	
6	91.2072	1312	97.2068	0927	✓	
7	97.1381	1313	97.1385	0928	✓	
8	108.6359	1314	108.6360	0929	✓	
9	108.0948	1315	108.0951	0930	✓	
10	105.7286	1315	105.7282	0931	✓	
11	104.7888	1317	104.7886	0932	✓	
12	98.2302	1318	98.2303	0933	✓	
13	104.1750	1319	104.1751	0934	✓	
14	97.9819	1320	97.9823	0936	✓	
15	104.7647	1321	104.7642	0937	✓	
16	95.7433	1322	95.7437	0938	✓	
17	104.5952	1323	104.5947	0939	✓	
18	108.8614	1324	108.8609	0940	✓	
19	106.5451	1325	106.5450	0942	✓	
20	108.5931	1326	108.5932	0943	✓	
21	108.2347	1328	108.2343	0944	✓	
22	105.9324	1331	105.9320	0945	✓	
23	104.5885	1332	104.5882	0946	✓	
24	106.4073	1333	106.4078	0948	✓	
25	99.6727	1334	99.6731	0949	✓	

SCALE ROOM ENVIRONMENTAL CONDITIONS

DATE	TIME	BY	DB	% RH	
9-11	1300	CW	75	44	Checked by : KV
9-12	0920	CW	74	48	Date : 9-13-05
					Time : 12:55 pm

abosyshtn

WOODSTOVE DATA SHEET # 4-3 : CONSTANT WEIGHTS

UNIT : Jotul F400 RUN : 1 DATE : 11-11-05 Page : 1 of 1

Beaker #	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By
21	11-12	1300	Cp	108.3192	11-13	1438	Cp	108.3179	11-15	1504	Cp	108.3174	11-16	0816	KV
22	11-12	1300	Cp	106.3131	11-13	1439	Cp	106.3092	11-15	1510	Cp	106.3087	11-16	0822	KV
23	11-12	1300	Cp	104.7376	11-13	1440	Cp	104.7235	11-15	1511	Cp	104.7201	11-16	0820	KV
				104.7134	11-17	0943	Cp	104.6905	11-18	1615	Cp	104.6900	11-20	1105	Cp
24	11-12	1300	Cp	106.4876	11-13	1441	Cp	106.4868	11-15	1512	Cp	106.4863	11-16	0819	KV
25	11-12	1300	Cp	99.7563	11-13	1442	Cp	99.7551	11-15	1514	Cp	99.7546	11-16	0817	KV

Filter #	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By
37F	11-11	2000	Cp	.9948	11-12	1615	Cp	.9947	11-13	1435	Cp				
37B	11-11	2000	Cp	.4306	11-12	1616	Cp	.4301	11-13	1436	Cp				

SCALE ROOM ENVIRONMENTAL CONDITIONS

Weighing Session	Date	Time	By	DB	%RH
1	11-12	1600	Cp	67	49
2	11-13	1430	Cp	74	47
3	11-15	1500	Cp	72	44
4	11-16	0815	KV	70	44
5	11-17	0930	Cp	72	46

Weighing Session	Date	Time	By	DB	%RH
6	11-18	1600	Cp	72	48
7	11-20	1100	Cp	68	47
8					
9					
10					

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates: From 07/15/05 Through 10-20-2005	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
99.9998	9.9998	.9999	.0998	[illegible]	07/15	2000	78	46
99.9997	9.9998	1.0000	.1000	[illegible]	07/19	2250	78	46
100.0000	9.9999	.9999	.0999	[illegible]	07/20	0740	78	46
100.0000	9.9999	1.0000	.1000	[illegible]	07/21	2100	78	46
99.9998	9.9998	.9999	.1000	[illegible]	07/24	2200	78	46
100.0001	10.0000	1.0000	.1000	[illegible]	07/27	1515	78	49
99.9998	10.0000	.9998	.1000	[illegible]	07/28	0600	78	49
99.9999	10.0001	1.0000	.1000	[illegible]	07/29	1210	78	49
100.0000	10.0000	1.0001	.0998	CW	9-6	0930	74	48
100.0000	9.9998	.9998	.0996	CW	9-7	0955	72	47
99.9999	10.0000	1.0001	.1000	CW	9-8	1010	78	43
99.9999	10.0001	.9999	.0999	CW	9-9	0945	75	48
99.9996	9.9999	1.0000	.1000	CW	9-10	1630	75	48
99.9998	9.9999	1.0000	.0999	CW	9-11	1300	75	44
99.9997	10.0000	1.0000	.0998	CW	9-12	0920	74	48
99.9998	10.0001	.9999	.0999	CW	9-13	0945	74	47
99.9996	10.0001	.9999	.0999	CW	9-14	1400	77	46
99.9997	10.0001	1.0001	.0999	CW	9-15	0815	75	48
99.9996	10.0000	1.0000	.1000	CW	9-16	0955	76	49
99.9998	10.0001	.9999	.0998	CW	9-17	1200	76	45
99.9997	9.9998	.9999	.0998	CW	9-18	1430	73	47
100.0004	10.0002	1.0000	.0998	CW	9-19	0810	74	44
100.0000	10.0000	1.0000	.1000	CW	9-20	1910	77	44
100.0000	10.0000	1.0000	.0998	CW	9-21	1620	78	46
100.0000	10.0001	1.0000	.0999	CP	9-22	1420	76	49
100.0004	10.0003	1.0000	.0997	CP	9-23	1300	72	46
99.9998	10.0001	1.0000	.0999	CP	10-1	1830	74	47
100.0000	10.0000	1.0000	.0999	CP	10-2	1830	69	47
100.0001	10.0001	.9998	.0999	CP	10-5	0840	74	47
99.9998	10.0001	1.0000	.0999	CP	10-6	0930	77	47
99.9998	10.0002	.9999	.1000	CP	10-8	1340	75	45
100.0000	10.0002	.9999	.0997	CP	10-10	1330	76	48
99.9999	10.0000	1.0001	.1000	CP	10-11	1020	77	46
99.9998	10.0002	.9999	.1000	CP	10-12	1000	74	47
100.0001	10.0001	1.0000	.0997	CP	10-13	1020	70	48
99.9999	10.0000	1.0001	.0999	CP	10-14	1000	70	48
100.0000	10.0001	.9999	.0999	CP	10-15	1440	72	46
99.9997	9.9999	1.0000	.1000	CP	10-20	1000	77	49

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates: From 10-21-2005 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
99.9996	9.9998	1.0000	.0999	Cp	10-21	0900	74	44
100.0000	10.0001	1.0000	.0999	Cp	10-22	1630	78	46
99.9998	10.0000	.9998	.0998	Cp	10-23	1130	74	49
99.9996	10.0000	.9998	.0997	KV	10-24	9:00	77	52
100.0000	10.0003	1.0000	.0999	KV	10-25	9:30	76	49
99.9999	10.0001	.9999	.0997	KV	10-26	9:50	70	48
99.9998	10.0000	.9999	.0998	KV	10-27	8:25	75	47
99.9996	10.0003	1.0001	.0999	KV	10-28	10:45	68	47
99.9999	10.0001	1.0000	.1000	Cp	10-29	1900	75	44
99.9998	10.0003	1.0000	.0999	Cp	10-30	1145	72	42
99.9999	10.0000	0.9998	.0998	KV	10-31	9:00	78	44
100.0001	10.0000	0.9997	.1000	KV	11-1	0850	75	42
99.9996	9.9998	.9998	.0996	KV	11-2	0915	72	49
99.9996	10.0000	1.0000	.0998	KV	11-3	1429	73	46
99.9997	10.0000	.9999	.0999	KV	11-4	1100	72	42
100.0002	10.0000	1.0001	.1000	Cp	11-5	1015	69	44
99.9998	10.0001	1.0000	.0999	KV	11-7	0930	75	41
99.9998	10.0000	.9998	.0999	KV	11-9	1111	70	48
100.0002	10.0001	.9999	.1000	KV	11-10	1040	73	47
99.9999	10.0001	.9999	.0998	Cp	11-12	1600	67	49
100.0001	10.0000	1.0000	.0999	Cp	11-13	1430	74	47
99.9999	10.0000	1.0000	.0999	Cp	11-15	1500	72	44
100.0002	10.0000	.9999	.0999	KV	11-16	0815	70	44
100.0005	10.0000	1.0000	.0999	Cp	11-17	0930	72	46
100.0004	10.0002	1.0001	.1000	Cp	11-18	1600	72	48
100.0003	10.0001	.9999	.0999	Cp	11-20	1100	68	47
100.0004	10.0002	1.0000	.1000	Cp	11-21	1200	74	44
100.0002	10.0002	.9999	.0998	Cp	11-22	1030	74	42
99.9999	10.0000	1.0000	.0999	Cp	11-25	1000	69	47
100.0002	10.0001	.9999	.0999	KV	11-26	1330	72	47

BLANK PROCESSING DATA SHEET # 5

UNIT : F400 RUN : 1 DATE : 11-11-05

BLANKS DONE : 10-11-2005

BEAKER	A	B	C
	200 ml ACETONE	75 ml DICHLOR	200 ml WATER
	FISHER OPTIMA LOT # 023283	FISHER OPTIMA LOT # 035941	DWNA, Inc Sparklettes Distilled
FINAL WEIGHT	108.9008	106.3077	106.9670
TARE WEIGHT	108.8995	106.3066	106.9645
NET WEIGHT	.0013	.0011	.0025

TARE BEAKERS INTO DESC : TIME : 1900 DATE : 10-2-2005

DATE : 10-5 BY : CP DATE : 10-6 BY : CP DATE : BY :

BEAKER	1 ST WT	TIME	2 ND WT	TIME	3 RD WT	TIME
A	108.8996	0912	108.8995	1001	✓	
B	106.3065	0913	106.3066	1002	✓	
C	106.9642	0914	106.9645	1003	✓	

FINAL BEAKERS INTO DESC : TIME : 1000 DATE : 10-8-05

DATE : 10-10 BY : CP DATE : 10-11 BY : CP DATE : BY :

BEAKER	1 ST WT	TIME	2 ND WT	TIME	3 RD WT	TIME
A	108.9010	1348	108.9008	1105	✓	
B	106.3076	1349	106.3077	1106	✓	
C	106.9675	1350	106.9670	1109	✓	

TARE QC

DATE	TIME	BY	WB	DB	%
10-5	0840	CP	S	74	44
10-6	0930	CP		77	47

FINAL QC

DATE	TIME	BY	WB	DB	%
10-10	1330	CP	S	76	48
10-11	1020	CP		77	46

NET PARTICULATE CATCH CALCULATION DATA SHEET #6

UNIT : F400 RUN : 1 DATE : 11-11-05

Blank Audit by C Washington 10-14-2005

BLANK CALCULATIONS

Acetone :	.0013	g ÷	200	ml =	.000007	g/ml
Dicholoromethane :	.0011	g ÷	75	ml =	.000015	g/ml
Distilled Water :	.0025	g ÷	200	ml =	.000013	g/ml

FRONT HALF CATCH

FILTERS : .3282 (Total Catch) g - 1 (# of Filters) (.0000 g) (Blank Value / Filter) = .3282 g

BEAKERS : .0831 (Total Catch) g - 75 (ml Acetone) (.000007 g) (Blank Value / ml Acetone) = .0826 g

.0005

TOTAL FRONT HALF CATCH : .4108 g

BACK HALF CATCH

FILTERS : .0895 (Total Catch) g - 1 (# of Filters) (.0000 g) (Blank Value / Filter) = .0895 g

BEAKERS :

Acetone : .3767 (Total Catch) g - 200 (ml Acetone) (.000007 g) (Blank Value / ml Acetone) = .3753 g

.0014

Extract : .1018 (Total Catch) g - 75 (ml Dichloromethane) (.000015 g) (Blank Value / Dichloromethane) = .1007 g

.0011

Water : .1600 (Total Catch) g - 305 (ml Water) (.000013 g) (Blank Value / Water) = .1560 g

.0040

TOTAL BACK HALF CATCH : .7215 g

TOTAL CATCH : 1.1323 g

% FRONT HALF : 36.3 %

CALCULATIONS DATA SHEET # 7

UNIT : F400 RUN : 1 DATE : 11-11-05

1) Vm (std) = $\dfrac{(93.168 \text{ Vm})(17.64)(.972 \text{ mcf})\left[29.95 \text{ " Hg} + \dfrac{.147 \text{ " } H_2O}{13.6}\right]}{(550 \text{ TmA})}$ = $\dfrac{87.0207}{000.0000}$ dscf

2) Vw (std) = (.04707)(114.4 ml H_2O) = $\dfrac{5.3848}{00.0000}$ scf

3) Asw = $\dfrac{(5.3848 \text{ scf})}{(5.3848 \text{ scf} + 87.0207 \text{ dscf})}$ = $\dfrac{.0583}{.0000}$ Bws × 100 = $\dfrac{5.8274}{00.0000}$ % H_2O

4) Cs = $\dfrac{(1.1323 \text{ g.})}{(87.0207 \text{ dscf})}$ (15.43) = $\dfrac{.2008}{0.0000}$ gr / dscf

5) Estimated g / hr = $\dfrac{(1.1323 \text{ g.})}{(87.0207 \text{ dscf})}$ ($\dfrac{8.400}{00.0000}$ dscfm) (60) = $\dfrac{6.5580}{00.0000}$ 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 : Jotul F400 RUN : 1 DATE : 11-11-05

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

Wet Bulb / Dry Bulb

Pre : WB : 59 DB : 75 = 37 % RH 1.1 % H_2O

Post : WB : 60 DB : 76 = 38 % RH 1.2 % H_2O

Average : 37.5 % RH 1.15 % H_2O

Empty Stove Weight (lbs) : N/A w/ stack & oil seal : Wet : — Dry : 397.0

Kindling Weight (lbs) : Paper : 1 Wood : 3.1

Preburn Fuel Weight : 12.1 + 13.4 + 13.1 + 3.0 Total : 41.6

Kindling & Preburn Fuel Weight (wood only) (lbs) : **Total** : 44.7

Coal Bed Wt Range (lbs) : 3.3 - 2.7 **Scale** : 400.3 - 399.7

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** : 2.7

Maximum Coal Bed Removal (lbs) : ((3.3 (Upper) + 2.7 (Lower)) ÷ 2) .25 = .7 (round down to nearest tenth)

Test Fuel (.75" x 1.5" x 5" spacers) = 20 pcs

Dimensions	Length in inches	No. Pcs	Weight in lbs	% of Load
2" x 4"	13	3	6.1	46.2
4" x 4"	13	2	7.1	53.8

Test Fuel Weight : 13.2 lbs

Estimated Dry Burn Rate : 2.3376

$$\frac{13.2 - (13.2 \times .17709)}{2.2046} \times \frac{60}{\underset{\text{TIME}}{300}} = .9854 \text{ kg / hr}$$

Estimated BTU's/hr : 19,140 × 63/100 × .9854/DBR = 11,882.2 BTU's/hr

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

WOOD STOVE OPERATING DATA PAGE #9

Unit : Jotul F400 Run : 1 Date : 11-11-05

FIRE STARTED: 0755

WARM UP AND PREBURN:

PRIMARY AIR : Set wide open for all warm-up / preburn fuel charges. Then set to 1/16" 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 35 sec.

TEST:

DOOR wide open during loading 1 min. 20 sec.

PRIMARY AIR : Opened full for first 5 min., then set to run setting of 1/16".

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

FAN:

ON / OFF during warm-up

ON / OFF during preburn

ON / OFF first ALL minutes of test

ON / OFF balance of test run

Fan speed set at NO FAN

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 12 inches.

1st warm up / pre-burn fuel charge (12.1 lbs.) added at 0811

2nd warm up / pre-burn fuel charge (13.4 lbs.) added at 0945

3rd warm up / pre-burn fuel charge (13.1 lbs.) added at 1100

4th warm up / pre-burn fuel charge (3.0 lbs.) added at 1235

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

TEST DATA SHEET #10

Unit : Jotul F400 Run : 1 Date : 11-11-05

Room Temperature : 69 °F Correction Factor : Ø

Uncorrected Values are corrected for room temperature : Yes ____ No ✓

Time Test Fuel moisture reading taken : 1040

Calibration Checks : X ✓ Y ✓ 12.0 12.2 22.0 22.0

pc #	Dimen.	Use	TOP		BOTTOM		SIDE		Average Corrected
			Uncor.	Cor.	Uncor.	Cor.	Uncor.	Cor.	
1	2"×4"×8'	K	14.0	14.9	14.0	14.9	14.5	15.5	15.1000
2									
3									
4	2"×4"×8'	P	21.0	22.5	22.0	23.7	22.0	23.7	23.300
5	2"×4"×8'	P	18.5	19.8	19.0	20.3	19.0	20.3	20.133
6	2"×4"×8'	P	19.0	20.3	19.0	20.3	19.0	20.3	20.300
7	2"×4"×8'	P	20.5	22.0	21.0	22.5	20.5	22.0	22.167
8	2"×4"×8'	P							85.900
9									
10									
11	2"x4"x13"	T	19.5	20.9	19.5	20.9	19.5	20.9	20.900
12	"	T	19.5	20.9	20.0	21.4	20.0	21.4	21.233
13	"	T	21.5	23.1	22.0	23.7	22.0	23.7	23.500
14	4x4x13"	T	19.5	20.9	19.5	20.9	19.5	20.9	20.900
15	"	T	19.5	20.9	19.5	20.9	20.0	21.4	21.067
16									107.600
17									
18									
19									
20	Spacers	T	21.5	23.1	22.0	23.7	22.0	23.7	23.500

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

	KINDLING	PRETEST FUEL	TEST FUEL
Dry Moisture % :	15.100 %	21.475 %	21.520 %
Wet Moisture % :	13.119 %	17.679 %	17.709 %

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: 399.7 DATE: 11-11-05

UNIT: Jotol F400 RUN: 1 PAGE: 1 OF 2

TIME	SCALE	FUEL	DROP	V.	CO_2	V.	O_2	V.	CO	STATIC	SO_2PPM
0 / 1345	412.9	13.2	—	.236	5.9	.560	14.1	.084	.85	-.035	400
5 / 50	412.5	12.8	.4	.131	3.3	.678	17.0	.050	.51	-.036	325
10 / 55	412.3	12.6	.2	.070	1.8	.745	18.7	.030	.31	-.031	400
15 / 1400	412.2	12.5	.1	.072	1.8	.744	18.7	.034	.35	-.030	425
20 / 5	412.0	12.3	.2	.077	1.9	.737	18.5	.041	.42	-.028	425
25 / 10	411.9	12.2	.1	.087	2.2	.722	18.1	.049	.50	-.027	450
30 / 15	411.7	12.0	.2	.100	2.5	.706	17.7	.060	.61	-.025	450
35 / 20	411.5	11.8	.2	.112	2.8	.690	17.3	.068	.69	-.025	475
40 / 25	411.3	11.6	.2	.122	3.1	.676	17.0	.074	.75	-.025	450
45 / 30	411.0	11.3	.3	.280	7.0	.520	13.1	.074	.75	-.031	475
50 / 35	410.4	10.7	.6	.456	11.4	.356	8.9	.045	.46	-.046	350
55 / 40	409.7	10.0	.7	.479	12.0	.339	8.5	.028	.29	-.048	350
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-.387	*****
60 / 45	408.9	9.2	.8	.589	14.7	.241	6.1	.004	.05	-.052	300
65 / 50	408.3	8.6	.6	.504	12.6	.333	8.3	.015	.16	-.051	325
70 / 55	407.7	8.0	.6	.495	12.4	.328	8.2	.017	.18	-.050	350
75 / 1500	407.2	7.5	.5	.504	12.6	.324	8.1	.006	.07	-.050	350
80 / 5	406.7	7.0	.5	.572	14.3	.258	6.5	.002	.03	-.050	350
85 / 10	406.2	6.5	.5	.540	13.5	.289	7.3	.003	.04	-.051	325
90 / 15	405.7	6.0	.5	.466	11.7	.360	9.0	.006	.07	-.050	325
95 / 20	405.3	5.6	.4	.477	11.9	.352	8.8	.005	.06	-.050	325
100 / 25	404.9	5.2	.4	.485	12.1	.344	8.6	.006	.07	-.050	325
105 / 30	404.5	4.8	.4	.486	12.2	.340	8.5	.006	.07	-.049	325
110 / 35	404.1	4.4	.4	.385	9.6	.433	10.9	.034	.35	-.047	350
115 / 40	403.8	4.1	.3	.361	9.0	.449	11.3	.052	.53	-.046	350
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-.596	*****
120 / 45	403.5	3.8	.3	.354	8.9	.449	11.3	.064	.65	-.045	375
125 / 50	403.2	3.5	.3	.343	8.6	.457	11.5	.072	.73	-.044	375
130 / 55	402.9	3.2	.3	.343	8.6	.458	11.5	.070	.71	-.043	375
135 / 1600	402.7	3.0	.2	.352	8.8	.454	11.4	.064	.65	-.043	375
140 / 5	402.4	2.7	.3	.359	9.0	.448	11.2	.056	.57	-.043	350
145 / 10	402.2	2.5	.2	.294	7.4	.500	12.5	.085	.86	-.042	375
150 / 15	402.0	2.3	.2	.250	6.3	.530	13.3	.120	1.20	-.040	400
155 / 20	401.8	2.1	.2	.233	5.8	.549	13.8	.124	1.24	-.037	425
160 / 25	401.6	1.9	.2	.243	6.1	.545	13.7	.103	1.04	-.036	425
165 / 30	401.5	1.8	.1	.256	6.4	.550	13.8	.061	.62	-.037	375
170 / 35	401.4	1.7	.1	.195	4.9	.589	14.8	.111	1.12	-.036	400
175 / 1640	401.3	1.6	.1	.174	4.4	.580	14.5	.186	1.86	-.033	450
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-.479	*****
TOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-1.462	*****

GAS DATA SHEET #12

WEIGHT: 399.7 DATE: 11-11-05

UNIT: JOTUL F-400 RUN: 1 PAGE: 2 OF 2

TIME	SCALE	FUEL	DROP	V.	CO_2	V.	O_2	V.	CO	STATIC	SO_2PPM
180 / 1645	401.2	1.5	.1	.189	4.7	.587	14.7	.139	1.39	-.032	425
185 / 50	401.1	1.4	.1	.186	4.7	.588	14.8	.135	1.35	-.032	450
190 / 55	401.0	1.3	.1	.207	5.2	.547	13.7	.189	1.89	-.032	450
195 / 1700	400.9	1.2	.1	.202	5.1	.549	13.8	.194	1.94	-.031	450
200 / 5	400.8	1.1	.1	.226	5.7	.549	13.8	.134	1.34	-.031	425
205 / 10	400.7	1.0	.1	.223	5.6	.551	13.8	.138	1.38	-.030	425
210 / 15	400.6	.9	.1	.228	5.7	.551	13.8	.129	1.29	-.030	450
215 / 20	400.6	.9	Ø	.212	5.3	.562	14.1	.140	1.40	-.030	450
220 / 25	400.5	.8	.1	.205	5.1	.568	14.2	.146	1.46	-.030	450
225 / 30	400.5	.8	Ø	.210	5.3	.564	14.1	.137	1.37	-.029	450
230 / 35	400.4	.7	.1	.192	4.8	.575	14.4	.157	1.57	-.028	450
235 / 1740	400.4	.7	Ø	.191	4.8	.579	14.5	.149	1.49	-.028	450
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-.363	*****
240 / 1745	400.3	.6	.1	.186	4.7	.585	14.7	.144	1.44	-.028	450
245 / 50	400.3	.6	Ø	.182	4.6	.590	14.8	.141	1.41	-.028	475
250 / 55	400.2	.5	.1	.177	4.4	.596	14.9	.146	1.46	-.027	475
255 / 1800	400.2	.5	Ø	.172	4.3	.590	14.8	.170	1.70	-.026	475
260 / 5	400.1	.4	.1	.178	4.5	.599	15.0	.129	1.29	-.026	475
265 / 10	400.1	.4	Ø	.164	4.1	.608	15.3	.145	1.45	-.026	475
270 / 15	400.0	.3	.1	.159	4.0	.609	15.3	.153	1.53	-.025	475
275 / 20	400.0	.3	Ø	.156	3.9	.613	15.4	.152	1.52	-.025	475
280 / 25	399.9	.2	.1	.165	4.1	.613	15.4	.134	1.34	-.025	475
285 / 30	399.9	.2	Ø	.163	4.1	.614	15.5	.131	1.31	-.025	475
290 / 35	399.9	.2	Ø	.190	4.8	.595	14.9	.107	1.08	-.024	475
295 / 1840	399.8	.1	.1	.166	4.2	.606	15.2	.141	1.41	-.025	475
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-.310	*****
300 / 1845	399.7	Ø	.1	.160	4.0	.614	15.4	.141	1.41	-.025	475
						%					
						61					
										-.673	
										1.462	
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-.698	*****
TOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	2.16	*****

.035

PREBURN DATA SHEET #13

UNIT: Jotul F400 RUN: 1 DATE: 11-11-05 PAGE: 1 of 1

TIME	SCALE	DROP	STACK	TOP	LF SIDE	BACK	RT SIDE	BOTTOM	FIREBOX	SEC/CAT	AMBIENT	STATIC	COMMENTS
0 / 1235	402.7	—	300	458	355	339	380	273			79	-.048	PREBURN START: # 3.0 UP
5 / 40	402.4	.3	237	416	337	331	369	271			79	-.041	COAL BED SCALE RANGE:
10 / 45	402.2	.2	205	385	317	320	351	266			80	-.038	400.3 → 399.7
15 / 50	401.9	.3	205	386	306	311	343	258			78	-.041	PRIMARY AIR: 1/16 open
20 / 55	401.6	.3	204	380	294	299	333	254			79	-.040	SECONDARY AIR: N/A
25 / 1300	401.3	.3	201	370	289	293	328	245			79	-.040	FAN: N/A
30 / 05	401.0	.3	209	384	283	285	323	238			79	-.042	PUMPS ON AT: 1305
35 / 10	400.8	.2	203	376	278	279	324	232			79	-.038	CHECK WB/DB: 1325
40 / 15	400.6	.2	199	352	277	276	322	226			78	-.038	290.6
45 / 20	400.4	.2	191	343	271	269	317	222			78	-.035	
50 / 25	400.2	.2	189	330	271	266	317	215			78	-.036	279.8
55 / 1330	400.1	.1	188	323	267	260	314	213			77	-.036	
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	
60 / 1335	399.9	.2	187	318	266	260	313	210			78	-.035	
65 / 1340	399.8	.1	187	313	265	258	311	206			77	-.036	
70 / 1345	399.7	.1	209	309	265	256	305	207			78	-.035	

Jotul-F400

Temperature Data Sheet #14

11/11/05
Run 1

Time ********	Stack Chn 103	Top Chn 104	LT Side Chn 105	Back Chn 106	Rt Side Chn 107	Bottom Chn 108	Firebox Chn 109	Sec/Cat Chn 110	Ambient Chn 111	Tube Furn Chn 112	Smpl Box Chn 113	Smpl Out Chn 114	C-Gas Box Chn 115	C-Gas Out Chn 116	SO2 Out Chn 117
0	209	309	265	256	305	207	######	######	78	1336	234	58	245	36	38
5	202	288	259	254	303	198	######	######	79	1358	233	44	245	36	38
10	174	272	247	248	287	194	######	######	78	1375	233	43	245	36	38
15	162	256	236	238	268	191	######	######	77	1382	233	42	245	36	38
20	154	242	223	231	254	187	######	######	77	1382	234	42	244	37	38
25	149	230	213	222	243	181	######	######	76	1375	236	42	243	37	38
30	145	219	206	215	232	177	######	######	76	1366	237	41	243	37	38
35	142	210	201	208	224	173	######	######	75	1360	237	42	244	37	38
40	141	203	197	199	215	170	######	######	75	1356	237	43	244	37	38
45	151	203	193	190	208	167	######	######	74	1349	237	43	243	37	38
50	210	308	187	185	202	164	######	######	73	1337	238	43	243	37	39
55	234	334	188	185	202	162	######	######	73	1333	240	43	245	38	38
60	279	418	189	186	206	159	######	######	73	1329	240	43	246	38	38
65	274	448	199	191	216	157	######	######	74	1328	241	44	247	38	38
70	266	461	207	196	229	156	######	######	74	1327	241	44	247	38	38
75	261	471	213	205	243	157	######	######	73	1328	240	44	247	38	38
80	264	493	221	206	250	155	######	######	75	1330	239	45	247	38	39
85	271	528	226	212	261	155	######	######	74	1337	239	45	246	38	38
90	264	513	235	221	271	156	######	######	73	1337	238	45	246	39	39
95	259	510	240	221	278	156	######	######	75	1334	238	45	246	39	39
100	258	520	244	224	282	157	######	######	76	1332	237	46	246	39	39
105	258	527	250	228	285	158	######	######	76	1330	237	46	246	39	39
110	251	515	252	231	287	160	######	######	77	1329	237	47	246	39	39
115	240	490	256	235	291	159	######	######	77	1330	236	47	247	39	39
120	232	473	256	235	292	160	######	######	77	1330	236	47	246	39	39
125	225	458	256	239	293	162	######	######	76	1330	235	47	246	39	39
130	220	446	257	240	293	164	######	######	76	1329	234	47	245	39	39
135	219	441	255	238	292	166	######	######	77	1328	234	48	244	39	39
140	219	438	254	238	289	168	######	######	77	1329	235	48	245	38	39
145	215	434	255	241	289	170	######	######	76	1332	235	48	245	38	39
150	205	411	253	237	287	172	######	######	77	1333	236	48	244	37	39
155	195	384	251	237	284	172	######	######	77	1332	236	49	244	37	39
160	189	364	247	237	281	174	######	######	74	1329	235	49	244	37	39
165	187	352	246	236	277	171	######	######	76	1326	235	49	243	36	39
170	184	341	242	238	276	174	######	######	75	1327	234	49	243	36	39

175	178	326	241	238	274	173	######	######	74	1327	233	49	242	36	39
180	173	312	236	238	270	175	######	######	73	1326	233	50	242	35	39
185	169	300	233	239	265	175	######	######	72	1332	234	50	243	35	39
190	166	293	230	237	261	175	######	######	73	1334	234	50	243	35	39
195	165	285	228	235	259	174	######	######	73	1333	234	50	242	34	38
200	165	281	229	239	258	170	######	######	73	1333	234	50	242	34	38
205	164	276	228	240	258	168	######	######	73	1331	235	51	242	34	38
210	165	274	228	238	258	166	######	######	75	1330	235	51	243	34	37
215	164	272	226	238	259	165	######	######	75	1329	235	51	243	33	37
220	163	269	226	238	259	164	######	######	75	1329	235	51	243	33	37
225	162	265	224	238	257	163	######	######	74	1327	235	51	243	33	37
230	161	262	225	237	257	162	######	######	75	1326	235	51	243	33	36
235	160	257	224	237	254	162	######	######	75	1326	236	51	244	33	36
240	159	254	221	237	253	162	######	######	75	1326	236	51	243	32	36
245	158	250	219	234	250	162	######	######	75	1325	236	52	243	32	36
250	157	247	219	234	249	161	######	######	74	1325	236	52	244	32	36
255	156	244	217	234	245	161	######	######	74	1326	236	52	244	32	35
260	155	240	215	233	244	161	######	######	75	1326	236	52	244	32	35
265	154	236	212	231	241	160	######	######	76	1328	237	53	244	31	35
270	152	232	211	230	238	161	######	######	75	1331	238	53	244	31	35
275	151	230	209	228	237	161	######	######	75	1332	238	54	244	31	34
280	150	227	206	227	235	161	######	######	74	1333	238	54	244	31	34
285	150	223	205	225	232	161	######	######	75	1333	237	54	244	31	34
290	150	221	203	224	231	161	######	######	74	1332	238	54	244	31	34
295	149	221	205	223	228	161	######	######	74	1334	238	53	244	35	34
300	148	218	205	222	228	161	######	######	74	1335	238	54	244	36	34

TEMPERATURE DATA SHEET #14A

		TEST TIME	300		
STACK AVG	191	TOP AVG	332	LT SIDE AVG	227
BACK AVG	227	RT SIDE AVG	257	BOTTOM AVG	167
FIREBOX AVG	########	SEC/CAT AVG	########	AMBIENT AVG	75

END	207.0	
START	268.3	
	-61.3	DELTA T

CIRCLE: LOSS / GAIN

ZERO / SPAN CHECK DATA SHEET #15-1

Date : 11-11-05 Analyte : CO_2 (15-1)

Unit : Jotul F400 Run # : 1

Zero Cyl. # : 168TAC 3-A Conc. : 0.00 % CO_2 Cyl. Press. : 1580 PSI

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

Span Cyl. # : CC-41627 Conc. : 12.50 % CO_2 Cyl. Press. : 1625 PSI

Certified by : AIR LIQUIDE Date : 11-1-05

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 : KW Time : 1220 Temp : 68 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	0.0	.000	.012	.012	.048
SPAN	50.0	.500	12.50	50.5	.505	12.65	.150	.600

POST RUN Audit : by : KW Time : 1910 Temp : 72 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	0.0	.003	.087	.087	.348
SPAN	50.0	.500	12.50	49.5	.495	12.40	-.100	-.400

± 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 : 11-11-05 Analyte : O_2 (15-2)

Unit : Jotul F400 Run # : 1

Zero Cyl. # : 168TAC 3A Conc. : 0.00 % O_2 Cyl. Press. : 1580 PSI

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

Span Cyl. # : CC-41627 Conc. : 12.50 % O_2 Cyl. Press. : 1625 PSI

Certified by : AIR LIQUIDE Date : 11-1-05

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 : KV Time : 1220 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	.001	.030	.030	.119
SPAN	12.50	.500	12.50	12.5	.500	12.538	.038	.152

POST RUN Audit : by : KV Time : 1910 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	.055	.055	.220
SPAN	12.50	.500	12.50	12.6	.503	12.62	.120	.480

± 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 : 11-11-05 Analyte : CO (15-3)

Unit : Jotol F400 Run # : 1

Zero Cyl. # : 168TAC 3-A Conc. : 0.00 % CO Cyl. Press. : 1580 PSI

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

Span Cyl. # : CC-41627 Conc. : 4.99 % CO Cyl. Press. : 1625 PSI

Certified by : AIR LIQUIDE Date : 11-1-05

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 : KV Time : 1220 Temp : 68 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	0.0	.000	.008	.008	.079
SPAN	49.9	.499	4.99	49.9	.499	4.99	Ø	Ø

POST RUN Audit : by : KV Time : 1910 Temp : 72 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	0.0	.000	.008	.008	.079
SPAN	49.9	.499	4.99	49.9	.499	4.99	Ø	Ø

± 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 : 11-11-05 Analyte : SO_2 (15-4)

Unit : Jotol F400 Run # : 1

Zero Cyl. # : 168TAC 3-A Conc. : 0.00 ppm SO_2 Cyl. Press. : 1580 PSI

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

Span Cyl. # : CC62184 Conc. : 1290 ppm SO_2 Cyl. Press. : 600 PSI

Certified by : AIR LIQUIDE Date : 01-29-01

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 : VV Time : 1220 Temp : 68 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	PPM	Meter	DVM	%		
ZERO	00.0	.000	00.0	0.0	.000	.854	.854	.034
SPAN	51.6	.516	1290	51.1	.511	1276.59	-13.41	-.536

POST RUN Audit : by : VV Time : 1910 Temp : 72 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	PPM	Meter	DVM	%		
ZERO	00.0	.000	00.0	0.0	-.005	-11.63	-11.63	-.465
SPAN	51.6	.516	1290	51.4	.514	1284.08	-5.92	-.237

± 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

QUALITY CHECKS DATA SHEET # 16

UNIT : Jotul F400 RUN : 1 DATE : 11-11-05

Thermocouple Check:

T/C # 1	— °F	T/C # 13	64.4 °F
T/C # 2	— °F	T/C # 14	62.6 °F
T/C # 3	64.2 °F	T/C # 15	65.2 °F
T/C # 4	58.2 °F	T/C # 16	64.8 °F
T/C # 5	56.4 °F	T/C # 17	61.6 °F
T/C # 6	56.4 °F	T/C # 18	66.8 °F
T/C # 7	56.4 °F	T/C # 19	59.2 °F
T/C # 8	55.2 °F	T/C # 20	— °F
T/C # 9	— °F	T/C # 21	— °F
T/C # 10	— °F	T/C # 22	— °F
T/C # 11	54.4 °F	T/C # 23	— °F
T/C # 12	69.7 °F	T/C # 24	— °F

Thermocouple Readout:

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

ZERO -2.9 °F Adj. to 0.0 °F ZERO .9 °F Difference .045 %

SPAN 2004.3 °F Adj. to 2000.0 °F SPAN 2000.2 °F Difference .01 %

Thermocouple Readout Pretest Linearity Check:

0	= 0.0 °F	200	= 200.4 °F	400	= 400.0 °F
600	= 600.0 °F	800	= 799.9 °F	1000	= 999.8 °F
1200	= 1199.8 °F	1400	= 1399.6 °F	1600	= 1599.6 °F
1800	= 1799.6 °F	2000	= 2000.0 °F		

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

Scale Check Pre : 417.7 − 407.7 = 10.0

Post : 409.6 − 399.6 = 10.0

Stack Cleaned Prior to Test Run : YES X NO _____

AVERY

TABLE 1 ----- RAW DATA

CLIENT : Jotul TEST No. : 2

MODEL: F400 DATE: 14-Nov-05

TIME (MIN.)	METER READING (C F)	DELTA H (IN. H2O)	METER TEMP. (DEG. F)	PERCENT CO (%)	PERCENT CO2 (%)	SO2 COCENTR. PPM
0	255.500	0.150	89	0.25	8.70	450
5	257.000	0.300	89	0.46	3.20	325
10	259.120	0.190	90	0.47	1.70	400
15	260.850	0.170	90	0.52	1.80	425
20	262.478	0.170	90	0.59	2.00	425
25	264.107	0.150	90	0.66	2.20	450
30	265.644	0.150	90	0.89	2.40	450
35	267.182	0.170	90	0.79	3.40	425
40	268.811	0.140	90	0.83	2.70	475
45	270.268	0.170	90	0.77	5.00	425
50	271.896	0.220	90	0.33	14.30	375
55	273.741	0.220	90	0.76	8.40	375
60	275.586	0.220	90	0.63	7.10	375
65	277.430	0.200	90	0.63	6.80	400
70	279.158	0.250	90	0.37	9.90	350
75	281.133	0.250	90	0.45	8.90	350
80	283.108	0.250	90	0.47	9.20	350
85	285.083	0.250	90	0.31	9.20	350
90	287.059	0.300	90	0.18	10.00	325
95	289.185	0.300	90	0.13	10.40	325
100	291.312	0.300	90	0.09	10.40	325
105	293.438	0.300	90	0.11	10.50	325
110	295.565	0.300	90	0.09	10.80	325
115	297.691	0.300	90	0.11	10.30	325
120	299.818	0.260	90	0.21	9.20	350
125	301.791	0.260	90	0.25	9.30	350
130	303.765	0.260	90	0.29	8.80	350
135	305.739	0.220	90	0.51	8.40	375
140	307.581	0.220	90	0.56	8.50	375
145	309.424	0.220	90	0.45	8.70	375
150	311.266	0.220	90	0.48	7.30	375
155	313.109	0.220	90	0.55	7.00	375
160	314.951	0.170	90	0.61	7.00	425
165	316.577	0.170	90	0.48	7.30	425
170	318.204	0.200	90	0.69	6.80	400
175	319.931	0.170	90	0.93	5.80	425

180	321.557	0.170	90	0.90	5.60	425
185	323.182	0.170	90	0.92	5.60	425
190	324.807	0.170	90	0.99	5.60	425
195	326.432	0.150	90	1.08	5.40	450
200	327.967	0.150	90	1.08	5.50	450
205	329.502	0.150	90	1.10	5.40	450
210	331.037	0.150	90	0.91	5.00	450
215	332.572	0.150	90	0.94	4.90	450
220	334.107	0.150	90	0.96	4.90	450
225	335.642	0.150	90	0.99	4.80	450
230	337.177	0.150	90	1.02	4.80	450
235						

TABLE 2---RAW DATA

CLIENT : Jotul TEST No. 2

MODEL: F400 DATE: 14-Nov-05

****

METER CAL. FACTOR (Y)	-------	0.972		Wt. WOOD BURNED(LB)	-------	12.7	Lbs
BAROMETRIC PRESS.(Pb)	-------	30.49	in Hg	WET,FUEL MOISTURE %	-------	18.461	%
LEAK RATE POST (Lp)	-------	0.008	cfm	Wt. PART. COLLECTED	-------	1.096	g
WATER VOL. (V1c)	-------	118.5	Ml	METER VOLUME Vm	-------	81.667	mcf
TEST TIME (MIN)	-------	230	min	HC MOLE FRACTION	-------	0.0132	

TABLE 3 -----FIELD DATA AVERAGES

CLIENT : Jotul TEST No. 2

MODEL: F400 DATE: 14-Nov-05

****

AVG DELTA H	-------	0.21 in H2O		AVG PRCNT CO	-------	0.59	%
AVG METER TEMP. Tm	-------	90 deg F		AVG PRCNT CO2	-------	6.83	%
AVG PPM SO2	-------	396	PPM	AVG BAL CO2/CO	-------	11.55	%

TABLE 4 ----- CALCULATIONS

CLIENT : Jotul TEST No. 2

MODEL: F400 DATE: 14-Nov-05

****

STD SAMPLE VOL. Vm(std) d) ------	77.72	dscf	STACK GAS FLOW Qsd -------	504.933	dscf/Hr &
				8.42	dscf/min
VOL. WATER VAPOR Vw(s td) -----	5.578	scf	PARTICULATE CONCTRT. C s ------	0.0141	g/dscf
PRCNT MSTR Bws -------	6.70	%	PARTC.EMISS. RATE E -------	7.12	g/Hr
BURN RATE BR -------	1.23	Kg/Hr	MOLES OF GAS PER Lb WOOD Nt ----	0.49	Lb-mole/Lb
CO EMISSION RATE -------	99.98	g/Hr &	PART.EMISS. RATE ------	5.81	g/Kgdry fuel
	81.62	g/Kgdry fuel			

TABLE 5 ----- PROPORTIONAL RATE VARIATION

CLIENT : Jotul TEST No. : 2

MODEL: F400 DATE: 14-Nov-05

	TIME INTEVAL Ti	PPM * Vm	PROPRTN. RATE VAR. PR		PROPRTN RATE VAR. AVERAGE	
	5	643.4	98		100	
	10	656.3	100			
	15	658.4	100			
	20	658.3	100			
	25	658.7	100			
	30	658.0	100			
	35	658.5	100			
	40	658.7	100			
	45	658.4	100			
	50	658.3	100			
	55	658.4	100			
	60	658.4	100			
	65	658.0	100			
	70	657.7	100			
	75	657.8	100			
	80	657.8	100			
	85	657.8	100			
	90	658.1	100			
	95	657.6	100			
	100	657.9	100			
	105	657.6	100			
	110	657.9	100			
	115	657.6	100			
	120	657.9	100			
	125	657.2	100			
	130	657.5	100			
	135	657.5	100			
	140	657.3	100			
	145	657.6	100			
	150	657.3	100			
	155	657.6	100			
	160	657.3	100			
	165	657.5	100			
	170	657.9	100			
	175	657.3	100			
	180	657.5	100			

185	657.1	100
190	657.1	100
195	657.1	100
200	657.2	100
205	657.2	100
210	657.2	100
215	657.2	100
220	657.2	100
225	657.2	100
230	657.2	100
235		

COMPUTER INPUT DATA SHEET #1

Client: Jotul North America, Inc

Address: 55 Hutcherson Drive
Gorham, ME 04038

Phone: 1-207-591-6621 Fax: 1-207-591-6632

1.23/7.12

Run No.: 2 Date of Test: 11-14-05 Burn Rate: 1.221

Model No.: F400 ☐ min ☒ min-1.25 ☐ fan

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

Dry Gas Meter Y Factor: .972 (0.000) (Data Sheet #2) Post Leak Rate: .008 cfm (.000) (Data Sheet #2) Time: 230 min. (000) (Data Sheet #2)

Dry Gas Meter Volume: 81.667 cf (00.000) (Data Sheet #2)

Stack Flow: 8.859 dscfm (00.000) (Data Sheet #2) Δ H: .207 in. H_2O (.000) (Data Sheet #2)

Maximum Vac.: 3.0 (0.0) (Data Sheet #2) Barometric Pressure: 30.49 in. Hg (00.00) (Data Sheet #2)

H_2O Captured: 118.5 g (00.0) (Data Sheet #3)

Front Half Catch % Of Total: 42.3 % (00.0) (Data Sheet #6) Total Particulate Catch: 1.0960 g (0.0000) (Data Sheet #6)

Flue Gas Moisture: 6.7007 % (00.000) (Data Sheet #7)

Particulate Emission: .2177 gr/dscf (0.0000) (Data Sheet #7)

Relative Humidity: 35 % RH (00.0) (Data Sheet #8) Ambient Moisture: 1.05 % H_2O (0.00) (Data Sheet #8)

Preburn Fuel Wt.: 47.6 lbs. (00.0) (Data Sheet #8) Coal Bed Wt.: 3.0 lbs. (00.0) (Data sheet #8) Test Fuel Wt.: 12.7 lbs. (00.0) (Data sheet #8)

Heat Output (EPA Default): 14,771.3 BTU/hr (00,000.0) (Data Sheet #8)

Kindling Fuel % Moisture (wet): 11.190 % (00.000) (Data Sheet #10) Pretest Fuel % Moisture (wet): 16.949 % (00.000) (Data Sheet #10)

Test Fuel % Moisture (dry): 22.640 % Test Fuel % Moisture (wet): 18.461 % (00.000) (Data Sheet #10 [wood stove] or #11 [pellet stove])

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: 73 °F (00) (Data Sheet #14) Stove Temperature Change: -49.0 °F (+/- 000.0) (Data Sheet #14)

Test Start = 1340 End = 1730 Avg Meter Temp < 550

METER BOX DATA SHEET PAGE # 2

Page: 1 of 2

UNIT : Jotul F400 RUN : 2 DATE : 11-14-05

Meter Box: 5H Y Factor: .972

Leak checks: 15 " Hg @ .011 cfm _____ " Hg @ _____ cfm

45 @ 15 15 " Hg @ .008 cfm _____ " Hg @ _____ cfm

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

ROTO: PRESS: .17			SAMPLING RATIO: 25 : 1				BP: 30.46		
MIN	TIME	METER READING	SAMPLE MDCF	STACK DSCFM	DELTA H	METER TEMP	SO2 PPM	ROTO TEMP	PUMP VACC
0	1340	255.500	———	7.688	.15	89	450	89	2.0
5	45	257.000	———	10.645	.30	89	325	89	3.0
10	50	259.120	259.120	8.633	.19	90	400	90	2.0
15	55	260.850	260.850	8.126	.17	90	425	90	2.0
20	1400	262.478	262.478	8.126	.17	90	425	90	2.0
25	05	264.107	264.107	7.674	.15	90	450	90	2.0
30	10	265.644	265.644	7.674	.15	90	450	90	2.0
35	15	267.182	267.182	8.126	.17	90	425	90	2.0
40	20	268.811	268.811	7.270	.14	90	475	90	2.0
45	25	270.268	270.268	8.126	.17	90	425	90	2.0
50	30	271.896	271.896	9.209	.22	90	375	90	2.0
55	35	273.741	273.741	9.209	.22	90	375	90	2.0
ROTO PRESS: .17			TOTALS:	100.506	2.20	1078	BP.: 30.48		
60	1440	275.586	275.586	9.215	.22	90	375	90	2.0
65	45	277.430	277.430	8.639	.20	90	400	90	2.0
70	50	279.158	279.158	9.873	.25	90	350	90	2.0
75	55	281.133	281.133	9.873	.25	90	350	90	2.0
80	1500	283.108	283.108	9.873	.25	90	350	90	2.0
85	05	285.083	285.083	9.873	.25	90	350	90	2.0
90	10	287.059	287.059	10.633	.30	90	325	90	2.0
95	15	289.185	289.185	10.633	.30	90	325	90	2.0
100	20	291.312	291.312	10.633	.30	90	325	90	2.0
105	25	293.438	293.438	10.633	.30	90	325	90	2.0
110	30	295.565	295.565	10.633	.30	90	325	90	2.0
115	35	297.691	297.691	10.633	.30	90	325	90	2.0
			TOTALS:	121.144	3.22	1080	MAX VACC =		
TOTAL Cu Ft.			TOTALS:	221.650	5.42	2158	AVG. BP:		

METER BOX DATA SHEET PAGE # 2

Page: 2 of 2

UNIT: Jotul F400 RUN: 2 DATE: 11-14-05

Meter Box: 5H Y Factor: .972

Leak checks: 15 " Hg @ .011 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: .17			SAMPLING RATIO: 25 : 1				BP: 30.50		
MIN	TIME	METER READING	SAMPLE MDCF	STACK DSCFM	DELTA H	METER TEMP	SO2 PPM	ROTO TEMP	PUMP VACC
120	1540	299.818	299.818	9.880	.26	90	350	90	2.0
125	45	301.791	301.791	9.880	.26	90	350	90	2.0
130	50	303.765	303.765	9.880	.26	90	350	90	2.0
135	55	305.739	305.739	9.221	.22	90	375	90	2.0
140	1600	307.581	307.581	9.221	.22	90	375	90	2.0
145	05	309.424	309.424	9.221	.22	90	375	90	2.0
150	10	311.266	311.266	9.221	.22	90	375	90	2.0
155	15	313.109	313.109	9.221	.22	90	375	90	2.0
160	20	314.951	314.951	8.136	.17	90	425	90	2.0
165	25	316.577	316.577	8.136	.17	90	425	90	2.0
170	30	318.204	318.204	8.645	.20	90	400	90	2.0
175	35	319.931	319.931	8.136	.17	90	425	90	2.0
ROTO PRESS: .17			TOTALS:	108.798	2.59	1080	BP.: 30.52		
180	1640	321.557	321.557	8.142	.17	90	425	90	2.0
185	45	323.182	323.182	8.142	.17	90	425	90	2.0
190	50	324.807	324.807	8.142	.17	90	425	90	2.0
195	55	326.432	326.432	7.689	.15	90	450	90	2.0
200	1700	327.967	327.967	7.689	.15	90	450	90	2.0
205	05	329.502	329.502	7.689	.15	90	450	90	2.0
210	10	331.037	331.037	7.689	.15	90	450	90	2.0
215	15	332.572	332.572	7.689	.15	90	450	90	2.0
220	20	334.107	334.107	7.689	.15	90	450	90	2.0
225	25	335.642	335.642	7.689	.15	90	450	90	2.0
230	30	337.177	337.177	7.689	.15	90	450	90	2.0
235	35			85.938	1.71	990			
			TOTALS:	194.736	4.30	2070	MAX VACC =		3.0
TOTAL Cu Ft		81.667	TOTALS:	416.386	9.72	4228	AVG. BP:		30.49

8.859 .207 90 550

1.47

PARTICULATE CATCH / MOISTURE DATA SHEET # 3

UNIT : F400 RUN : 2 DATE : 11-14-05

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	718.6	587.4	486.2	928.1
INITIAL WT	612.1	580.9	483.6	925.2
NET WT GRAMS	106.5	6.5	2.6	2.9

TOTAL CATCH : 118.5 GRAMS H_2O

FRONT HALF

FILTER #	38F	
FINAL WT g	1.0165	
INITIAL WT g	.6695	
NET WT g	.3470	

BEAKER #	26
DESC.	ACETONE
FINAL WT g	101.1515
INITIAL WT g	101.0341
NET WT g	.1174
VOL. DESC. ml	100

BACK HALF

FILTER #	38B	
FINAL WT g	.4562	
INITIAL WT g	.3398	
NET WT g	.1164	

BEAKER #	27	28	29	30	
DESC.	ACETONE	METHCHLOR	H_2O	H_2O	
FINAL WT g	106.6190	105.7893	104.5723	107.4756	
INITIAL WT g	106.3735	105.7473	104.4545	107.3586	
NET WT g	.2455	.0420	.1178	.1170	.2348
VOL. DESC ml	200	75	150	150	300

FILTER TARE WEIGHTS DATA SHEET #4-1

Into Dessicator : Date : 9-2-05 Time : 1515 By : C. Washington

Manufacturer S & S Grade : # 25 Glass Front Size : 11 cm Lot No. : ZB921

Back Size: 8.2 cm Lot No. : B1044632

	DATE: 9-19-05	BY: CP	DATE: 9-20-05	BY: CW	DATE:	BY:
FILTER #	FIRST WEIGHT	TIME	SECOND WEIGHT	TIME	THIRD WEIGHT	TIME
31 F	.6696	0825	.6698 ✓	1820		
32 F	.6721	0826	.6723 ✓	1821		
33 F	.6745	0827	.6747 ✓	1823		
34 F	.6732	0828	.6730 ✓	1824		
35 F	.6584	0830	.6585 ✓	1825		
36 F	.6702	0831	.6704 ✓	1826		
37 F	.6667	0832	.6665 ✓	1828		
38 F	.6696	0833	.6695 ✓	1829		
39 F	.6648	0834	.6646 ✓	1830		
40 F	.6677	0835	.6677 ✓	1831		
31 B	.3401	0836	.3400 ✓	1833		
32 B	.3362	0837	.3364 ✓	1834		
33 B	.3388	0839	.3391 ✓	1835		
34 B	.3390	0840	.3392 ✓	1836		
35 B	.3362	0841	.3364 ✓	1837		
36 B	.3373	0842	.3373 ✓	1839		
37 B	.3408	0842	.3406 ✓	1840		
38 B	.3397	0844	.3398 ✓	1841		
39 B	.3403	0845	.3403 ✓	1842		
40 B	.3405	0846	.3406 ✓	1844		

Checked by: [illegible] Date: 10-2-05 Time: 13:00

BALANCE ROOM ENVIRONMENTAL CONDITIONS

DATE	TIME	BY	WB	DB	% RH
9-19	0810	CP	60	74	44
9-20	1810	CW	64	77	49

BEAKER TARE WEIGHTS DATA SHEET #4-2

Into Dessicator: Date : 9/12/2005 Time : 1000 By : Cp Lakshmanan

	DATE: 10-1-2005	BY: Cp	DATE: 10-2-2005	BY: Cp	DATE:	BY:
BEAKER #	FIRST WEIGHT	TIME	SECOND WEIGHT	TIME	THIRD WEIGHT	TIME
26	101.0344	1835	101.0341 ✓	1841		
27	106.3738	1836	106.3735 ✓	1842		
28	105.7478	1837	105.7473 ✓	1843		
29	104.4549	1838	104.4545 ✓	1844		
30	107.3587	1839	107.3586 ✓	1845		
31	95.5493	1840	95.5490 ✓	1846		
32	107.8648	1841	107.8643 ✓	1847		
33	101.1724	1842	101.1719 ✓	1848		
34	106.4619	1843	106.4623 ✓	1849		
35	96.5584	1844	96.5584 ✓	1851		
36	94.4559	1844	94.4560 ✓	1852		
37	106.5998	1846	106.6002 ✓	1853		
38	96.2491	1847	96.2495 ✓	1854		
39	97.1361	1848	97.1365 ✓	1855		
40	106.4679	1849	106.4680 ✓	1858		
41	105.4852	1850	105.4857 ✓	1859		
42	104.6682	1851	104.6683 ✓	1902		
43	107.3541	1852	107.3540 ✓	1903		
44	107.7902	1853	107.7897 ✓	1904		
45	94.9359	1854	94.9360 ✓	1905		
46	106.0464	1855	106.0468 ✓	1906		
47	107.0369	1856	107.0365 ✓	1907		
48	97.7483	1857	97.7480 ✓	1909		
49	108.3563	1858	108.3558 ✓	1910		
50	96.5307	1900	96.5307 ✓	1911		

BALANCE ROOM ENVIRONMENTAL CONDITIONS

DATE	TIME	BY	WB	DB	% RH
10-1	1830	Cp	61	74	47
10-2	1830	Cp	57	69	47

Checked by : KV
Date : 10-23-05
Time : 17:45

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WOODSTOVE DATA SHEET # 4-3 : CONSTANT WEIGHTS

UNIT : F400 RUN : 2 DATE : 11-14-05 Page : 1 of

Beaker #	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By
26	11-15	0900	Cp	101.1518	11-16	0824	KU	101.1515	11-17	0949	Cp				
27	11-16	0830	KU	106.6189	11-17	0950	Cp	106.6190	11-18	1610	Cp				
28	11-16	0830	KU	105.7892	11-17	0951	Cp	105.7893	11-18	1611	Cp				
29	11-15	0900	Cp	104.5724	11-16	0825	KU	104.5723	11-17	0952	Cp				
30	11-15	0900	Cp	107.4756	11-16	0826	KU	107.4756	11-17	0953	Cp				

Filter #	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By
38F	11-14	1830	Cp	1.0192	11-15	1505	Cp	1.0199	11-16	0831	KU	1.0168	11-17	0946	Cp
				1.0165	11-18	1605	Cp								
38B	11-14	1830	Cp	.4709	11-15	1506	Cp	.4717	11-16	0830	KU	.4669	11-17	0947	Cp
				.4629	11-18	1606	Cp	.4559	11-20	1107	Cp	.4562	11-21	1210	Cp

SCALE ROOM ENVIRONMENTAL CONDITIONS

Weighing Session	Date	Time	By	DB	%RH
1	11-15	1500	Cp	72	44
2	11-16	0823	KU	72	46
3	11-17	0930	Cp	72	46
4	11-18	1600	Cp	72	48
5	11-20	1100	Cp	68	47

Weighing Session	Date	Time	By	DB	%RH
6	11-21	1200	Cp	74	44
7					
8					
9					
10					

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates: From 07/15/05 Through 10-20-2005	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
99.9998	9.9999	.9999	.0998	[illegible]	07/15	2000	78	46
99.9997	9.9998	1.0000	.1000	[illegible]	07/19	2250	78	46
100.0000	9.9999	.9999	.0999	[illegible]	07/20	0740	78	46
100.0000	9.9999	1.0000	.1000	[illegible]	07/21	2100	78	46
99.9998	9.9998	.9999	.1000	[illegible]	07/24	2200	78	46
100.0001	10.0000	1.0000	.1000	[illegible]	07/27	1515	78	49
99.9998	10.0000	.9998	.1000	[illegible]	07/28	0600	78	49
99.9999	10.0001	1.0000	.1000	[illegible]	07/29	1210	78	49
100.0000	10.0000	1.0001	.0998	CW	9-6	0930	74	48
100.0000	9.9998	.9998	.0996	CW	9-7	0955	72	47
99.9999	10.0000	1.0001	.1000	CW	9-8	1010	78	43
99.9999	10.0001	.9999	.0999	CW	9-9	0945	75	48
99.9996	9.9999	1.0000	.1000	CW	9-10	1630	75	48
99.9998	9.9999	1.0000	.0999	CW	9-11	1300	75	44
99.9997	10.0000	1.0000	.0998	CW	9-12	0920	74	48
99.9998	10.0001	.9999	.0999	CW	9-13	0945	74	47
99.9996	10.0001	.9999	.0999	CW	9-14	1400	77	46
99.9997	10.0001	1.0001	.0999	CW	9-15	0815	75	48
99.9996	10.0000	1.0000	.1000	CW	9-16	0955	76	49
99.9998	10.0001	.9999	.0998	CW	9-17	1200	76	45
99.9997	9.9998	.9999	.0998	CW	9-18	1430	73	47
100.0004	10.0002	1.0000	.0998	CW	9-19	0810	74	44
100.0000	10.0000	1.0000	.1000	CW	9-20	1810	77	49
100.0000	10.0000	1.0000	.0998	CW	9-21	1620	78	46
100.0000	10.0001	1.0000	.0999	CP	9-22	1420	76	49
100.0004	10.0003	1.0000	.0997	CP	9-23	1300	72	46
99.9998	10.0001	1.0000	.0999	CP	10-1	1830	74	47
100.0000	10.0000	1.0000	.0999	CP	10-2	1830	69	47
100.0001	10.0001	.9998	.0999	CP	10-5	0840	74	44
99.9998	10.0001	1.0000	.0999	CP	10-6	0930	77	47
99.9998	10.0002	.9999	.1000	CP	10-8	1340	75	45
100.0000	10.0002	.9999	.0997	CP	10-10	1330	76	48
99.9999	10.0000	1.0001	.1000	CP	10-11	1020	77	46
99.9998	10.0002	.9999	.1000	CP	10-12	1000	74	44
100.0001	10.0001	1.0000	.0997	CP	10-13	1020	70	48
99.9999	10.0000	1.0001	.0999	CP	10-14	1000	70	48
100.0000	10.0001	.9999	.0999	CP	10-15	1440	72	46
99.9997	9.9999	1.0000	.1000	CP	10-20	1000	77	49

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates: From 10-21-2005 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
99.9996	9.9998	1.0000	.0999	Cp	10-21	0900	74	44
100.0000	10.0001	1.0000	.0999	Cp	10-22	1630	78	46
99.9998	10.0000	.9998	.0998	Cp	10-23	1130	74	49
99.9996	10.0000	.9998	.0997	KV	10-24	9:00	77	52
100.0000	10.0003	1.0000	.0999	KV	10-25	9:30	76	49
99.9999	10.0001	.9999	.0997	KV	10-26	9:50	70	48
99.9998	10.0000	.9999	.0998	KV	10-27	8:25	75	47
99.9996	10.0003	1.0001	.0999	KV	10-28	10:45	68	47
99.9999	10.0001	1.0000	.1000	Cp	10-29	1900	75	44
99.9998	10.0003	1.0000	.0999	Cp	10-30	1145	72	42
99.9999	10.0000	0.9998	.0998	KV	10-31	9:00	78	44
100.0001	10.0000	0.9997	.1000	KV	11-1	0850	75	42
99.9996	9.9998	.9998	.0996	KV	11-2	0915	72	49
99.9996	10.0000	1.0000	.0998	KV	11-3	1429	73	46
99.9997	10.0000	.9999	.0999	KV	11-4	1100	72	42
100.0002	10.0000	1.0001	.1000	Cp	11-5	1015	69	44
99.9998	10.0001	1.0000	.0999	KV	11-7	0930	75	41
99.9998	10.0000	.9998	.0999	KV	11-9	1111	70	48
100.0002	10.0001	.9999	.1000	KV	11-10	1040	73	47
99.9999	10.0001	.9999	.0998	Cp	11-12	1600	67	49
100.0001	10.0000	1.0000	.0999	Cp	11-13	1430	74	47
99.9999	10.0000	1.0000	.0999	Cp	11-15	1500	72	44
100.0002	10.0000	.9999	.0999	KV	11-16	0815	70	44
100.0005	10.0000	1.0000	.0999	Cp	11-17	0930	72	46
100.0004	10.0002	1.0001	.1000	Cp	11-18	1600	72	48
100.0003	10.0001	.9999	.0999	Cp	11-20	1100	68	47
100.0004	10.0002	1.0000	.1000	Cp	11-21	1200	74	44
100.0002	10.0002	.9999	.0998	Cp	11-22	1030	74	42
99.9999	10.0000	1.0000	.0999	Cp	11-25	1000	69	47
100.0002	10.0001	.9999	.0999	KV	11-26	1330	72	47

BLANK PROCESSING DATA SHEET # 5

UNIT : F400 RUN : 2 DATE : 11-14-05

BLANKS DONE : 10-11-2005

BEAKER	A	B	C
	200 ml ACETONE	75 ml DICHLOR	200 ml WATER
	FISHER OPTIMA LOT # 023283	FISHER OPTIMA LOT # 035941	DWNA, Inc Sparklettes Distilled
FINAL WEIGHT	108.9008	106.3077	106.9670
TARE WEIGHT	108.8995	106.3066	106.9645
NET WEIGHT	.0013	.0011	.0025

TARE BEAKERS INTO DESC : TIME : 1900 DATE : 10-2-2005

DATE : 10-5 BY : Cp DATE : 10-6 BY : Cp DATE : BY :

BEAKER	1 ST WT	TIME	2 ND WT	TIME	3 RD WT	TIME
A	108.8996	0912	108.8995	1001	✓	
B	106.3065	0913	106.3066	1002	✓	
C	106.9642	0914	106.9645	1003	✓	

FINAL BEAKERS INTO DESC : TIME : 1000 DATE : 10-8-05

DATE : 10-10 BY : Cp DATE : 10-11 BY : Cp DATE : BY :

BEAKER	1 ST WT	TIME	2 ND WT	TIME	3 RD WT	TIME
A	108.9010	1348	108.9008	1105	✓	
B	106.3076	1349	106.3077	1106	✓	
C	106.9675	1350	106.9670	1109	✓	

TARE QC

DATE	TIME	BY	WB	DB	%
10-5	0840	Cp	S	74	44
10-6	0930	Cp		77	47

FINAL QC

DATE	TIME	BY	WB	DB	%
10-10	1330	Cp	S	76	48
10-11	1020	Cp		77	46

NET PARTICULATE CATCH CALCULATION DATA SHEET #6

UNIT : F400 RUN : 2 DATE : 11-14-05

Blank Audit by C Washington 10-14-2005

BLANK CALCULATIONS

Acetone :	.0013	g ÷	200	ml =	.000007	g/ml
Dicholoromethane :	.0011	g ÷	75	ml =	.000015	g/ml
Distilled Water :	.0025	g ÷	200	ml =	.000013	g/ml

FRONT HALF CATCH

FILTERS : .3470 (Total Catch) g - 1 (# of Filters) (.0000 g) (Blank Value / Filter) = .3470 g

BEAKERS : .1174 (Total Catch) g - 100 (ml Acetone) (.000007 g) (Blank Value / ml Acetone) = .1167 g

.0007

TOTAL FRONT HALF CATCH : .4637 g

BACK HALF CATCH

FILTERS : .1164 (Total Catch) g - 1 (# of Filters) (.0000 g) (Blank Value / Filter) = .1164 g

BEAKERS :

Acetone : .2455 (Total Catch) g - 200 (ml Acetone) (.000007 g) (Blank Value / ml Acetone) = .2441 g

.0014

Extract : .0420 (Total Catch) g - 75 (ml Dichloromethane) (.000015 g) (Blank Value / Dichloromethane) = .0409 g

.0011

Water : .2348 (Total Catch) g - 300 (ml Water) (.000013 g) (Blank Value / Water) = .2309 g

.0039

TOTAL BACK HALF CATCH : .6323 g

TOTAL CATCH : 1.0960 g

% FRONT HALF : 42.3 %

CALCULATIONS DATA SHEET # 7

UNIT : Jotul F400 RUN : 2 DATE : 11-14-05

1) Vm (std) = $\dfrac{(81.667 \text{ Vm})(17.64)(.972 \text{mcf})\left[30.49'' \text{ Hg} + \dfrac{.207'' H_2O}{13.6}\right]}{(550 \text{ TmA})}$ = $\dfrac{77.6646}{000.0000}$ dscf

2) Vw (std) = (.04707)(118.5 ml H_2O) = $\dfrac{5.5778}{00.0000}$ scf

3) Asw = $\dfrac{(5.5778 \text{ scf})}{(5.5778 \text{ scf} + 77.6646 \text{ dscf})}$ = $\dfrac{.0670}{.0000}$ Bws × 100 = $\dfrac{6.7007}{00.0000}$ % H_2O

4) Cs = $\dfrac{(1.0960 \text{ g.})}{(77.6646 \text{ dscf})}$ (15.43) = $\dfrac{.2177}{0.0000}$ gr / dscf

5) Estimated g / hr = $\dfrac{(1.0960 \text{ g.})}{(77.6646 \text{ dscf})}$ ($\dfrac{8.859}{00.0000}$ dscfm) (60) = $\dfrac{7.5011}{00.0000}$ 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 : Jotul F400 RUN : 2 DATE : 11-14-05

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

Wet Bulb / Dry Bulb

Pre : WB : 60 DB : 77 = 36 % RH 1.1 % H_2O

Post : WB : 57 DB : 74 = 34 % RH 1.0 % H_2O

Average : 35 % RH 1.05 % H_2O

Empty Stove Weight (lbs) : N/A w/ stack & oil seal : Wet : — Dry : 396.9

Kindling Weight (lbs) : Paper : .1 Wood : 2.0

Preburn Fuel Weight : 12.8 + 14.0 + 15.3 + 3.5 Total : 45.6

Kindling & Preburn Fuel Weight (wood only) (lbs) : **Total** : 47.6

Coal Bed Wt Range (lbs) : 3.1 - 2.6 **Scale** : 400.0 - 399.5

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

Lower : .20 × fuel weight : Always round UP to nearest tenth **Actual Coal Bed Weight** : 3.0

Maximum Coal Bed Removal (lbs) : ((3.1 (Upper) + 2.6 (Lower)) ÷ 2) .25 = .7 (round down to nearest tenth)

Test Fuel (.75" × 1.5" × 5" spacers) = 20 pcs

Dimensions	Length in inches	No. Pcs	Weight in lbs	% of Load
2" × 4"	13	3	5.7	44.9
4" × 4"	13	2	7.0	55.1

Test Fuel Weight : 12.7 lbs

Estimated Dry Burn Rate :

$$\frac{12.7 - (12.7 \times .18461)}{2.2046} \times \frac{60}{\underset{\text{TIME}}{230}} = 1.225 \text{ kg / hr}$$

Estimated BTU's/hr : $19{,}140 \times \frac{63}{100} \times \frac{1.225}{\text{DBR}} = 14\,771.3$ BTU's/hr

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

225 = 1.24

280 = 1.01

WOOD STOVE OPERATING DATA PAGE #9

Unit : Jotul F400 Run : 2 Date : 11-14-05

FIRE STARTED: 0800

WARM UP AND PREBURN:

PRIMARY AIR : Set wide open for all warm-up / preburn fuel charges. Then set to 1/8" 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 0 min. 55 sec.

PRIMARY AIR : Opened full for first 5 min., then set to run setting of 1/8".

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 NO FAN

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 12 inches.

1st warm up / pre-burn fuel charge (12.8 lbs.) added at 0813

2nd warm up / pre-burn fuel charge (14.0 lbs.) added at 0918

3rd warm up / pre-burn fuel charge (15.3 lbs.) added at 1035

4th warm up / pre-burn fuel charge (3.5 lbs.) added at 1240

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

TEST DATA SHEET #10

Unit : Jotul F400 Run : 2 Date : 11-14-05

Room Temperature : 69 °F Correction Factor : Ø

Uncorrected Values are corrected for room temperature : Yes ____ No ✓

Time Test Fuel moisture reading taken : 1045

Calibration Checks : X ✓ Y ✓ 12.0 12.2 22.0 22.0

pc #	Dimen.	Use	TOP		BOTTOM		SIDE		Average Corrected
			Uncor.	Cor.	Uncor.	Cor.	Uncor.	Cor.	
1	2"×4"×8'	K	12.0	12.8	11.5	12.2	12.0	12.8	12.600
2									
3									
4	2"×4"×8'	P	21.0	22.5	19.5	20.9	19.5	20.9	21.433
5	2"×4"×8'	P	18.0	19.2	18.0	19.2	18.0	19.2	19.200
6	2"×4"×8'	P	20.0	21.4	20.0	21.4	20.5	22.0	21.600
7	2"×4"×8'	P	18.5	19.8	18.0	19.2	18.0	19.2	19.400
8	2"×4"×8'	P							81.633
9									
10									
11	2"x4"x13"	T	22.5	24.1	22.5	24.1	22.0	23.7	23.967
12	"	T	22.0	23.7	22.0	23.7	22.0	23.7	23.700
13	"	T	21.0	22.5	21.0	22.5	21.0	22.5	22.500
14	4x4x13"	T	19.0	20.3	19.5	20.9	19.5	20.9	20.700
15	"	T	21.0	22.5	20.5	22.0	21.0	22.5	22.333
16									113.200
17									
18									
19									
20	Spacers	T	21.5	23.1	22.5	24.1	22.5	24.1	23.767

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

	KINDLING	PRETEST FUEL	TEST FUEL
Dry Moisture % :	12.600 %	20.408 %	22.640 %
Wet Moisture % :	11.190 %	16.949 %	18.461 %

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: 399.9

DATE: 11-14-05

UNIT: Jotol F400

RUN: 2

PAGE: 1 OF

TIME	SCALE	FUEL	DROP	V.	CO_2	V.	O_2	V.	CO	STATIC	SO_2 PPM
0 1340	412.6	12.7	—	.347	8.7	.473	11.9	.024	.25	-.043	450
5 45	412.2	12.3	.4	.128	3.2	.684	17.1	.045	.46	-.048	325
10 50	412.0	12.1	.2	.069	1.7	.743	18.6	.046	.47	-.038	400
15 55	411.9	12.0	.1	.073	1.8	.737	18.5	.051	.52	-.035	425
20 1400	411.7	11.8	.2	.080	2.0	.726	18.2	.058	.59	-.033	425
25 05	411.5	11.6	.2	.086	2.2	.715	17.9	.065	.66	-.032	450
30 10	411.3	11.4	.2	.094	2.4	.698	17.5	.088	.89	-.032	450
35 15	411.1	11.2	.2	.135	3.4	.662	16.6	.078	.79	-.034	425
40 20	410.9	11.0	.2	.108	2.7	.689	17.3	.082	.83	-.032	475
45 25	410.6	10.7	.3	.199	5.0	.599	15.0	.076	.77	-.035	425
50 30	410.1	10.2	.5	.573	14.3	.246	6.2	.032	.33	-.050	375
55 35	409.6	9.7	.5	.334	8.4	.464	11.6	.075	.76	-.047	375
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-.459	*****
60 1440	409.0	9.1	.6	.283	7.1	.521	13.1	.062	.63	-.047	375
65 45	408.6	8.7	.4	.270	6.8	.533	13.4	.062	.63	-.047	400
70 50	408.0	8.1	.6	.394	9.9	.420	10.5	.036	.37	-.051	350
75 55	407.6	7.7	.4	.357	8.9	.457	11.5	.044	.45	-.051	350
80 1500	407.2	7.3	.4	.366	9.2	.444	11.1	.046	.47	-.051	350
85 05	406.7	6.8	.5	.366	9.2	.450	11.3	.030	.31	-.051	350
90 10	406.2	6.3	.5	.401	10.0	.423	10.6	.017	.18	-.052	325
95 15	405.7	5.8	.5	.416	10.4	.410	10.3	.012	.13	-.053	325
100 20	405.3	5.4	.4	.414	10.4	.411	10.3	.008	.09	-.053	325
105 25	404.8	4.9	.5	.420	10.5	.406	10.2	.010	.11	-.053	325
110 30	404.3	4.4	.5	.431	10.8	.395	9.9	.008	.09	-.054	325
115 35	404.0	4.1	.3	.411	10.3	.414	10.4	.010	.11	-.054	325
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-.617	*****
120 1540	403.5	3.6	.5	.364	9.2	.454	11.4	.020	.21	-.052	350
125 45	403.2	3.3	.3	.371	9.3	.449	11.3	.024	.25	-.051	350
130 50	402.9	3.0	.3	.353	8.8	.467	11.7	.028	.29	-.051	350
135 55	402.6	2.7	.3	.337	8.4	.474	11.9	.050	.51	-.050	375
140 1600	402.3	2.4	.3	.340	8.5	.468	11.7	.055	.56	-.050	375
145 05	402.0	2.1	.3	.349	8.7	.465	11.7	.044	.45	-.049	375
150 10	401.7	1.8	.3	.292	7.3	.519	13.0	.047	.48	-.048	375
155 15	401.5	1.6	.2	.281	7.0	.528	13.3	.054	.55	-.046	375
160 20	401.3	1.4	.2	.279	7.0	.526	13.2	.060	.61	-.045	425
165 25	401.1	1.2	.2	.291	7.3	.519	13.0	.047	.48	-.045	425
170 30	401.0	1.1	.1	.273	6.8	.531	13.3	.068	.69	-.045	400
175 35	400.8	.9	.2	.232	5.8	.792	19.9	.092	.93	-.043	425
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-.575	*****
TOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-1.651	*****

20.78
20.79
26.63

ERROR → 14.1

GAS DATA SHEET #12

WEIGHT:_____ DATE: 11-14-05

UNIT: Jotul F400 RUN: 2 PAGE: 2 OF

TIME	SCALE	FUEL	DROP	V.	CO_2	V.	O_2	V.	CO	STATIC	SO_2PPM
180 1640	400.6	.7	.2	.225	5.6	.570	14.3	.089	.90	-.042	425
185 45	400.5	.6	.1	.225	5.6	.569	14.3	.091	.92	-.040	425
190 50	400.4	.5	.1	.223	5.6	.567	14.2	.098	.99	-.039	425
195 55	400.4	.5	ϕ	.214	5.4	.571	14.3	.107	1.08	-.038	450
200 1700	400.3	.4	.1	.221	5.5	.567	14.2	.107	1.08	-.037	450
205 05	400.2	.3	.1	.216	5.4	.570	14.3	.109	1.10	-.037	450
210 10	400.2	.3	ϕ	.202	5.0	.594	14.9	.090	.91	-.036	450
215 15	400.1	.2	.1	.197	4.9	.597	15.0	.093	.94	-.035	450
220 20	400.1	.2	ϕ	.196	4.9	.596	14.9	.095	.96	-.035	450
* 225 25	400.0	.1	.1	.192	4.8	.599	15.0	.098	.99	-.035	450
230 30	399.9	ϕ	.1	.190	4.8	.599	15.0	.101	1.02	-.035	450
235											
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	.409	*****
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****		*****
										2.060	
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****		*****
TOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	.044	*****

20.8

at 399.5 add 2.5 lbs

PREBURN DATA SHEET #13

UNIT: Jotul F400 RUN: 2 DATE: 11-14-05 PAGE: 1 of 1

TIME	SCALE	DROP	STACK	TOP	LF SIDE	BACK	RT SIDE	BOTTOM	FIREBOX	SEC/CAT	AMBIENT	STATIC	COMMENTS
0 / 1240	403.0	—	301	387	345	317	344	244			81	-.049	PREBURN START: # 3.5 UP
5 / 45	402.8	.2	272	368	334	315	337	245			78	-.043	COAL BED SCALE RANGE:
10 / 50	402.5	.3	253	359	312	307	331	242			78	-.045	400.0 → 399.5
15 / 55	402.2	.3	253	365	300	298	320	237			78	-.045	PRIMARY AIR: 1/8"
20 / 1300	402.0	.2	258	371	287	291	315	232			77	-.045	SECONDARY AIR: N/A
25 / 05	401.7	.3	264	378	275	282	312	225			79	-.046	FAN: N/A
30 / 10	401.3	.4	272	389	272	278	312	221			77	-.047	PUMPS ON AT:
35 / 15	401.0	.3	276	402	273	275	312	217			77	-.049	CHECK WB/DB:
40 / 20	400.7	.3	272	417	270	272	314	212			77	-.048	
45 / 25	400.5	.2	272	422	271	271	318	210			77	-.048	
50 / 30	400.2	.3	265	416	274	271	322	207			77	-.048	
55 / 35	400.0	.2	259	410	275	269	319	205			77	-.046	
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	
60 / 1340	399.9	.1	234	375	271	267	318	203			78	-.043	

Jotul-F400

Temperature Data Sheet #14

11/14/05
Run 2

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	234	375	271	267	318	203	######	######	78	1378	238	58	245	38	37
5	244	343	261	264	306	202	######	######	77	1360	238	45	246	38	37
10	211	320	250	256	288	199	######	######	77	1344	238	44	246	38	37
15	196	298	237	246	270	195	######	######	76	1330	237	44	245	38	37
20	189	278	228	237	255	192	######	######	76	1319	237	44	245	39	36
25	181	262	220	227	243	186	######	######	75	1311	237	44	244	39	37
30	179	247	214	218	232	179	######	######	76	1303	237	44	243	39	37
35	180	248	207	210	223	176	######	######	74	1301	237	44	242	39	37
40	173	235	204	204	216	171	######	######	74	1302	237	44	240	38	37
45	181	246	202	198	210	167	######	######	74	1299	236	44	239	38	36
50	214	291	202	193	205	165	######	######	74	1295	236	43	238	38	36
55	239	342	202	192	205	162	######	######	74	1291	237	44	239	38	36
60	237	331	207	193	207	161	######	######	74	1290	237	44	240	38	36
65	228	324	212	192	212	158	######	######	73	1289	237	44	240	38	36
70	252	374	216	194	216	157	######	######	74	1286	237	44	241	38	36
75	255	394	218	195	220	156	######	######	74	1285	238	44	241	38	35
80	255	404	223	195	226	155	######	######	74	1284	238	44	242	38	35
85	257	408	226	197	231	153	######	######	74	1283	238	44	242	37	35
90	263	423	230	201	236	154	######	######	74	1285	239	44	243	37	35
95	271	442	236	206	241	155	######	######	73	1294	239	43	244	37	35
100	275	454	238	211	249	154	######	######	73	1301	240	43	244	37	35
105	277	461	243	216	257	154	######	######	74	1306	240	44	244	37	35
110	281	475	248	221	265	156	######	######	74	1310	241	44	244	37	36
115	281	478	251	227	274	156	######	######	73	1315	241	45	245	36	36
120	275	466	253	232	284	158	######	######	74	1319	241	46	246	36	36
125	272	459	256	236	291	158	######	######	74	1321	241	49	246	36	36
130	267	449	254	240	296	161	######	######	74	1323	241	49	246	36	36
135	260	440	257	244	300	163	######	######	74	1325	241	49	246	36	36
140	255	432	258	247	304	165	######	######	74	1327	240	50	245	36	36
145	253	425	257	250	306	168	######	######	73	1328	240	49	246	36	36
150	247	411	258	252	305	171	######	######	73	1330	240	50	245	36	36
155	237	392	259	254	306	174	######	######	73	1331	239	50	245	36	36
160	230	376	261	256	304	176	######	######	73	1332	239	50	245	35	37
165	229	368	259	258	301	179	######	######	72	1333	239	50	244	35	37
170	227	361	258	259	299	181	######	######	72	1334	239	50	243	35	37

175	219	348	256	262	301	181	######	######	72	1336	238	50	243	35	37
180	213	335	254	263	299	182	######	######	71	1339	238	50	243	35	37
185	207	324	252	262	295	185	######	######	71	1339	237	51	242	35	36
190	201	314	251	262	293	185	######	######	71	1340	237	51	241	34	36
195	198	304	247	259	289	186	######	######	70	1340	236	51	240	34	36
200	196	297	244	259	285	186	######	######	70	1337	235	50	239	34	36
205	200	290	241	257	282	188	######	######	70	1336	234	50	238	34	36
210	198	280	239	256	279	187	######	######	70	1336	234	50	237	33	35
215	195	273	235	255	277	187	######	######	69	1335	233	51	236	33	35
220	192	267	232	253	274	187	######	######	69	1336	233	51	236	33	35
225	189	261	229	252	271	187	######	######	69	1335	232	51	235	33	35
230	188	255	226	250	270	188	######	######	69	1334	231	51	234	33	35

TEMPERATURE DATA SHEET #14A

		TEST TIME	230		
STACK AVG	228	TOP AVG	353	LT SIDE AVG	238
BACK AVG	234	RT SIDE AVG	266	BOTTOM AVG	173
FIREBOX AVG	########	SEC/CAT AVG	########	AMBIENT AVG	73

END	237.8	
START	286.8	
	-49.0	DELTA T

CIRCLE: LOSS / GAIN

ZERO / SPAN CHECK DATA SHEET #15-1

Date : 11-14-05 Analyte : CO_2 (15-1)

Unit : Jotol F400 Run # : 2

Zero Cyl. # : 168TAC 3-A Conc. : 0.00 % CO_2 Cyl. Press. : 1580 PSI

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

Span Cyl. # : CC-41627 Conc. : 12.50 % CO_2 Cyl. Press. : 1625 PSI

Certified by : AIR LIQUIDE Date : 11-1-05

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 : 1205 Temp : 71 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	.012	.012	.048
SPAN	50.0	.500	12.50	50.0	.500	12.520	.020	.082

POST RUN Audit : by : C. Washington Time : 1745 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	.012	.012	.048
SPAN	50.0	.500	12.50	49.8	.498	12.470	-.030	-.118

± 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 #15-2

Date : 11-14-05 Analyte : O_2 (15-2)

Unit : Jotul F400 Run # : 2

Zero Cyl. # : 168TAC 3A Conc. : 0.00 % O_2 Cyl. Press. : 1580 PSI

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

Span Cyl. # : CC-41627 Conc. : 12.50 % O_2 Cyl. Press. : 1625 PSI

Certified by : AIR LIQUIDE Date : 11-1-05

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. Wadington Time : 1205 Temp : 71 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	.005	.005	.019
SPAN	12.50	.500	12.50	12.5	.501	12.563	.063	.253

POST RUN Audit : by : C. Wadington Time : 1745 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	.002	.055	.055	.220
SPAN	12.50	.500	12.50	12.6	.502	12.588	.088	.353

± 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 : 11-14-05 Analyte : CO (15-3)

Unit : Jotol F400 Run # : 2

Zero Cyl. # : 168TAC 3-A Conc. : 0.00 % CO Cyl. Press. : 1580 PSI

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

Span Cyl. # : CC-41627 Conc. : 4.99 % CO Cyl. Press. : 1625 PSI

Certified by : AIR LIQUIDE Date : 11-1-05

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. Wadsworth Time : 1205 Temp : 71 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	.008	.008	.079
SPAN	49.9	.499	4.99	50.2	.502	5.014	.024	.245

POST RUN Audit : by C. Wadsworth Time : 1745 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	.001	.018	.018	.179
SPAN	49.9	.499	4.99	50.0	.500	4.995	.005	.045

± 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 : 11-14-05 Analyte : SO_2 (15-4)

Unit : Jotol F400 Run # : 2

Zero Cyl. # : 168TAC 3-A Conc. : 0.00 ppm SO_2 Cyl. Press. : 1580 PSI

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

Span Cyl. # : CC62184 Conc. : 1290 ppm SO_2 Cyl. Press. : 600 PSI

Certified by : AIR LIQUIDE Date : 01-29-01

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. Washington Time : 1205 Temp : 71 °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	.854	.854	.034
SPAN	51.6	.516	1290	51.7	.517	1291.6	1.600	.640

POST RUN Audit : by : C. Washington Time : 1745 Temp : 68 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	PPM	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	-.001	-1.643	-1.643	-.066
SPAN	51.6	.516	1290	51.8	.518	1294.1	4.100	.164

± 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

QUALITY CHECKS DATA SHEET # 16

UNIT : Jotul F400 RUN : 2 DATE : 11-14-05

Thermocouple Check:

T/C # 1	— °F	T/C # 13	57.5 °F
T/C # 2	— °F	T/C # 14	56.6 °F
T/C # 3	56.4 °F	T/C # 15	58.1 °F
T/C # 4	53.4 °F	T/C # 16	61.6 °F
T/C # 5	52.2 °F	T/C # 17	59.2 °F
T/C # 6	51.8 °F	T/C # 18	58.6 °F
T/C # 7	52.0 °F	T/C # 19	54.6 °F
T/C # 8	51.3 °F	T/C # 20	— °F
T/C # 9	— °F	T/C # 21	— °F
T/C # 10	— °F	T/C # 22	— °F
T/C # 11	50.5 °F	T/C # 23	— °F
T/C # 12	61.8 °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 2.7 °F Difference .135 %

SPAN 1998.5 °F Adj. to 2000.0 °F SPAN 1998.2 °F Difference .090 %

Thermocouple Readout Pretest Linearity Check:

0	= 0.0 °F	200	= 200.3 °F	400	= 400.0 °F
600	= 599.9 °F	800	= 799.8 °F	1000	= 999.8 °F
1200	= 1199.7 °F	1400	= 1399.5 °F	1600	= 1599.5 °F
1800	= 1799.8 °F	2000	= 2000.0 °F		

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

Scale Check Pre : 400.0 – 410.0 = 10.0

Post : 399.5 – 409.5 = 10.0

Stack Cleaned Prior to Test Run : YES _____ NO X

AVERY

TABLE 1 ----- RAW DATA

CLIENT : jotul TEST No. : 3

MODEL: F400 DATE: 16-Nov-05

TIME (MIN.)	METER READING (C F)	DELTA H (IN. H2O)	METER TEMP. (DEG. F)	PERCENT CO (%)	PERCENT CO2 (%)	SO2 COCENTR. C
0	338.000	0.150	88	0.82	4.60	425
5	339.500	0.190	88	0.89	5.00	375
10	341.237	0.220	89	0.45	2.30	350
15	343.104	0.190	89	0.49	2.60	375
20	344.847	0.190	89	0.57	2.90	375
25	346.590	0.170	89	0.67	3.00	400
30	348.224	0.190	89	1.09	4.40	375
35	349.967	0.190	89	0.52	10.80	375
40	351.710	0.170	89	0.41	7.70	400
45	353.344	0.190	89	0.75	6.60	375
50	355.087	0.220	89	0.14	12.70	350
55	356.954	0.250	89	0.22	10.40	325
60	358.964	0.250	89	0.09	11.30	325
65	360.975	0.250	89	0.07	12.40	325
70	362.985	0.250	90	0.04	14.60	325
75	365.003	0.250	90	0.03	13.70	325
80	367.021	0.250	90	0.03	14.10	325
85	369.039	0.250	90	0.08	9.90	325
90	371.057	0.250	90	0.28	8.50	325
95	373.075	0.250	90	0.31	8.30	325
100	375.092	0.220	90	0.36	7.90	350
105	376.966	0.220	90	0.51	7.60	350
110	378.840	0.220	90	0.42	7.70	350
115	380.714	0.220	90	0.42	7.80	350
120	382.588	0.220	91	0.48	7.70	350
125	384.469	0.220	91	0.63	6.80	350
130	386.350	0.170	91	0.74	6.70	400
135	387.996	0.170	91	0.73	6.90	400
140	389.642	0.170	91	0.69	6.90	400
145	391.288	0.170	91	0.74	6.20	400
150	392.934	0.220	91	0.78	6.10	350
155	394.815	0.220	91	0.78	6.00	350
160	396.696	0.220	91	0.81	5.80	350
165	398.576	0.220	91	0.90	5.60	350
170	400.457	0.220	91	0.78	5.40	350
175	402.338	0.220	91	0.83	5.30	350

180	404.219	0.220	91	0.87	5.20	350
185	406.100	0.220	91	0.91	4.90	350
190	407.980	0.220	91	0.95	4.80	350
195	409.861	0.220	91	1.02	4.60	350
200						

TABLE 2---RAW DATA

CLIENT : jotul TEST No. 3

MODEL: F400 DATE: 16-Nov-05

****

METER CAL. FACTOR (Y)	-------	0.972		Wt. WOOD BURNED(LB)	-------	13.4	Lbs
BAROMETRIC PRESS.(Pb)	-------	30.4	in Hg	WET,FUEL MOISTURE %	-------	18.421	%
LEAK RATE POST (Lp)	-------	0.001	cfm	Wt. PART. COLLECTED	-------	1.5426	g
WATER VOL. (V1c)	-------	129.6	Ml	METER VOLUME Vm	-------	71.861	mcf
TEST TIME (MIN)	-------	195	min	HC MOLE FRACTION	-------	0.0132	

TABLE 3 -----FIELD DATA AVERAGES

CLIENT : jotul TEST No. 3

MODEL: F400 DATE: 16-Nov-05

****

AVG DELTA H	-------	0.21 in H2O		AVG PRCNT CO	-------	0.56	%
AVG METER TEMP. Tm	-------	90 deg F		AVG PRCNT CO2	-------	7.29	%
AVG PPM SO2	-------	358	PPM	AVG BAL CO2/CO	-------	13.08	%

TABLE 4 ----- CALCULATIONS

CLIENT : jotul TEST No. 3

MODEL: F400 DATE: 16-Nov-05

****

STD SAMPLE VOL. Vm(std) d) ------	68.18	dscf	STACK GAS FLOW Qsd -------	599.434	dscf/Hr &
				9.99	dscf/min
VOL. WATER VAPOR Vw(s td) -----	6.100	scf	PARTICULATE CONCTRT. C s ------	0.0226	g/dscf
PRCNT MSTR Bws -------	8.21	%	PARTC.EMISS. RATE E -------	13.56	g/Hr
BURN RATE BR -------	1.53	Kg/Hr	MOLES OF GAS PER Lb WOOD Nt ----	0.46	Lb-mole/Lb
CO EMISSION RATE -------	111.91	g/Hr &	PART.EMISS. RATE ------	8.89	g/Kgdry fuel
	73.34	g/Kgdry fuel			

TABLE 5 ----- PROPORTIONAL RATE VARIATION

CLIENT : jotul TEST No. : 3

MODEL: F400 DATE: 16-Nov-05

	TIME INTEVAL Ti	PPM * Vm	PROPRTN. RATE VAR. PR		PROPRTN RATE VAR. AVERAGE	
	5	606.9	98		100	
	10	619.6	100			
	15	621.1	100			
	20	621.2	100			
	25	621.2	100			
	30	621.2	100			
	35	621.2	100			
	40	621.2	100			
	45	621.2	100			
	50	621.2	100			
	55	621.1	100			
	60	620.9	100			
	65	621.3	100			
	70	620.4	100			
	75	622.3	100			
	80	622.3	100			
	85	622.3	100			
	90	622.3	100			
	95	622.3	100			
	100	622.0	100			
	105	622.3	100			
	110	622.3	100			
	115	622.3	100			
	120	621.7	100			
	125	623.5	100			
	130	623.5	100			
	135	623.4	100			
	140	623.4	100			
	145	623.4	100			
	150	623.4	100			
	155	623.5	100			
	160	623.5	100			
	165	623.1	100			
	170	623.5	100			
	175	623.5	100			
	180	623.5	100			

185	623.5	100
190	623.1	100
195	623.5	100
200		

COMPUTER INPUT DATA SHEET #1

Client: Jotul North America, Inc

Address: 55 Hutcherson Drive
Gorham, ME 04038

Phone: 1-207-591-6621 Fax: 1-207-591-6632

Run No.: 3 Date of Test: 11-16-05 Burn Rate: 1.526 1356

Model No.: F400 ☐ min ☐ min-1.25 ☐ fan

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

Dry Gas Meter Y Factor: .972 (0.000) (Data Sheet #2) Post Leak Rate: .001 (.000) (Data Sheet #2) cfm Time: 195 (000) (Data Sheet #2) min.

Dry Gas Meter Volume: 71.861 (00.000) (Data Sheet #2) cf

Stack Flow: 9.691 (00.000) (Data Sheet #2) dscfm Δ H: .213 (.000) (Data Sheet #2) in. H_2O

Maximum Vac.: 2.0 (0.0) (Data Sheet #2) Barometric Pressure: 30.40 (00.00) (Data Sheet #2) in. Hg

H_2O Captured: 129.6 (00.0) (Data Sheet #3) g

Front Half Catch % Of Total: 29.6 (00.0) (Data Sheet #6) % Total Particulate Catch: 1.5426 (0.0000) (Data Sheet #6) g

Flue Gas Moisture: 8.2171 (00.000) (Data Sheet #7) %

Particulate Emission: .3493 (0.0000) (Data Sheet #7) gr/dscf

Relative Humidity: 31.5 (00.0) (Data Sheet #8) % RH Ambient Moisture: 1.0 (0.00) (Data Sheet #8) % H_2O

Preburn Fuel Wt.: 46.0 (00.0) (Data Sheet #8) lbs. Coal Bed Wt.: 2.8 (00.0) (Data sheet #8) lbs. Test Fuel Wt.: 13.4 (00.0) (Data sheet #8) lbs.

Heat Output (EPA Default): 18400.8 (00,000.0) (Data Sheet #8) BTU/hr

Kindling Fuel % Moisture (wet): 11.739 (00.000) (Data Sheet #10) % Pretest Fuel % Moisture (wet): 18.150 (00.000) (Data Sheet #10) %

Test Fuel % Moisture (dry): 22.580 (00.000) (Data Sheet #10 [wood stove] or #11 [pellet stove]) % Test Fuel % Moisture (wet): 18.421 %

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

Stack Static Pressure: -.046 (+/- .000) (Data Sheet #12) in. H_2O

Average Ambient Temperature: 80 (00) (Data Sheet #14) °F Stove Temperature Change: .8 (+/- 000.0) (Data Sheet #14) °F

Test Start = 1225 End = 1540 Avg Meter Temp < 550

METER BOX DATA SHEET PAGE # 2

Page: 1 of 2

UNIT : Jotul F400 RUN : 3 DATE : 11-16-05

Meter Box: 5H Y Factor: .972

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

32 @ 30 15 " Hg @ .1001 cfm _____ " Hg @ _____ cfm

Inject SO^2 @ 100 cc/min. Nozzle: Probe @ 3/8 " od Initial Volume: 1,500

ROTO: PRESS: .17			SAMPLING RATIO: 27			: 1	BP: 30.40		
MIN	TIME	METER READING	SAMPLE MDCF	STACK DSCFM	DELTA H	METER TEMP	SO2 PPM	ROTO TEMP	PUMP VACC
0	1225	338.000	———	8.139	.15	88	425	88	2.0
5	30	339.500	———	9.224	.19	88	375	88	2.0
10	35	341.237	341.237	9.865	.22	89	350	89	2.0
15	40	343.104	343.104	9.208	.19	89	375	89	2.0
20	45	344.847	344.847	9.208	.19	89	375	89	2.0
25	50	346.590	346.590	8.632	.17	89	400	89	2.0
30	55	348.224	348.224	9.208	.19	89	375	89	2.0
35	1300	349.967	349.967	9.208	.19	89	375	89	2.0
40	05	351.710	351.710	8.632	.17	89	400	89	2.0
45	10	353.344	353.344	9.208	.19	89	375	89	2.0
50	15	355.087	355.087	9.865	.22	89	350	89	2.0
55	20	356.954	356.954	10.624	.25	89	325	89	2.0
ROTO PRESS:			TOTALS:	111.021	2.32	1066	BP.: 30.40		
60	1325	358.964	358.964	10.624	.25	89	325	89	2.0
65	30	360.975	360.975	10.624	.25	89	325	89	2.0
70	35	362.985	362.985	10.605	.25	90	325	90	2.0
75	40	365.003	365.003	10.605	.25	90	325	90	2.0
80	45	367.021	367.021	10.605	.25	90	325	90	2.0
85	50	369.039	369.039	10.605	.25	90	325	90	2.0
90	55	371.057	371.057	10.605	.25	90	325	90	2.0
95	1400	373.075	373.075	10.605	.25	90	325	90	2.0
100	05	375.092	375.092	9.847	.22	90	350	90	2.0
105	10	376.966	376.966	9.847	.22	90	350	90	2.0
110	15	378.840	378.840	9.847	.22	90	350	90	2.0
115	20	380.714	380.714	9.847	.22	90	350	90	2.0
			TOTALS:	124.266	2.88	1078	MAX VACC =		
TOTAL Cu Ft.			TOTALS:	235.287	5.20	2144	AVG. BP:		

METER BOX DATA SHEET PAGE # 2

Page: 2 of 2

UNIT : Jotul F400 RUN : 3 DATE : 11-16-05

Meter Box: 5H Y Factor: .972

Leak checks: 15 " Hg @ 1000 cfm _____ " Hg @ _____ cfm

15 " Hg @ 1001 cfm _____ " Hg @ _____ cfm

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

ROTO: PRESS: .17			SAMPLING RATIO: 27 : 1				BP: 30.40		
MIN	TIME	METER READING	SAMPLE MDCF	STACK DSCFM	DELTA H	METER TEMP	SO2 PPM	ROTO TEMP	PUMP VACC
120	1425	382.588	382.588	9.830	.22	91	350	91	2.0
125	30	384.469	384.469	9.830	.22	91	350	91	2.0
130	35	386.350	386.350	8.601	.17	91	400	91	2.0
135	40	387.996	387.996	8.601	.17	91	400	91	2.0
140	45	389.642	389.642	8.601	.17	91	400	91	2.0
145	50	391.288	391.288	8.601	.17	91	400	91	2.0
150	55	392.934	392.934	9.830	.22	91	350	91	2.0
155	1500	394.815	394.815	9.830	.22	91	350	91	2.0
160	05	396.696	396.696	9.830	.22	91	350	91	2.0
165	10	398.576	398.576	9.830	.22	91	350	91	2.0
170	15	400.457	400.457	9.830	.22	91	350	91	2.0
175	20	402.338	402.338	9.830	.22	91	350	91	2.0
ROTO PRESS: .17			TOTALS:	113.014	2.44	1092	BP.: 30.40		
180	1525	404.219	404.219	9.830	.22	91	350	91	2.0
185	30	406.100	406.100	9.830	.22	91	350	91	2.0
190	35	407.980	407.980	9.830	.22	91	350	91	2.0
195	40	409.861	409.861	9.830	.22	91	350	91	2.0
200	45			39.320	.88	364			
205				152.364	3.32	1456			
210									
215									
220									
225									
230									
235				387.651	8.52	3600			
			TOTALS:			90	MAX VACC =		2.0
TOTAL Cu Ft.		71.861	TOTALS:	9.691	.213	550	AVG. BP: 30.40		

.40

PARTICULATE CATCH / MOISTURE DATA SHEET # 3

UNIT : F400 RUN : 3 DATE : 11-16-05

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	717.1	588.0	485.8	877.4
INITIAL WT	614.2	582.2	483.7	858.6
NET WT GRAMS	102.9	5.8	2.1	18.8

TOTAL CATCH : 129.6 **GRAMS H_2O**

FRONT HALF

FILTER #	39F	
FINAL WT g	1.0170	
INITIAL WT g	.6646	
NET WT g	.3524	

BEAKER #	31
DESC.	ACETONE
FINAL WT g	95.6542
INITIAL WT g	95.5490
NET WT g	.1052
VOL. DESC. ml	100

BACK HALF

FILTER #	39B	
FINAL WT g	.5596	
INITIAL WT g	.3403	
NET WT g	.2193	

BEAKER #	32	33	34	35	
DESC.	ACETONE	METHCHLOR	H_2O	H_2O	
FINAL WT g	108.3909	101.2694	106.5793	96.6903	
INITIAL WT g	107.8643	101.1719	106.4623	96.5584	
NET WT g	.5266	.0975	.1170	.1319	.2489
VOL. DESC ml	175	75	160	170	330

FILTER TARE WEIGHTS DATA SHEET #4-1

Into Dessicator : Date : 9-2-05 Time : 1515 By : C. Washington

Manufacturer S & S Grade : # 25 Glass Front Size : 11 cm Lot No. : ZB921

Back Size: 8.2 cm Lot No. : B1044632

	DATE: 9-19-05	BY: CP	DATE: 9-20-05	BY: CW	DATE:	BY:
FILTER #	FIRST WEIGHT	TIME	SECOND WEIGHT	TIME	THIRD WEIGHT	TIME
31 F	.6696	0825	.6698 ✓	1820		
32 F	.6721	0826	.6723 ✓	1821		
33 F	.6745	0827	.6747 ✓	1823		
34 F	.6732	0828	.6730 ✓	1824		
35 F	.6584	0830	.6585 ✓	1825		
36 F	.6702	0831	.6704 ✓	1826		
37 F	.6667	0832	.6665 ✓	1828		
38 F	.6696	0833	.6695 ✓	1829		
39 F	.6648	0834	.6646 ✓	1830		
40 F	.6677	0835	.6677 ✓	1831		
31 B	.3401	0836	.3400 ✓	1833		
32 B	.3362	0837	.3364 ✓	1834		
33 B	.3388	0839	.3391 ✓	1835		
34 B	.3390	0840	.3392 ✓	1836		
35 B	.3362	0841	.3364 ✓	1837		
36 B	.3373	0842	.3373 ✓	1839		
37 B	.3408	0842	.3406 ✓	1840		
38 B	.3397	0844	.3398 ✓	1841		
39 B	.3403	0845	.3403 ✓	1842		
40 B	.3405	0846	.3406 ✓	1844		

Checked by: KW Date: 10-2-05 Time: 13:00

BALANCE ROOM ENVIRONMENTAL CONDITIONS

DATE	TIME	BY	WB	DB	% RH
9-19	0810	CP	60	74	44
9-20	1810	CW	64	77	49

BEAKER TARE WEIGHTS DATA SHEET #4-2

Into Dessicator: Date : 9/12/2005 Time : 1000 By : Cp Lewington

	DATE: 10-1-2005	BY: Cp	DATE: 10-2-2005	BY: Cp	DATE:	BY:
BEAKER #	FIRST WEIGHT	TIME	SECOND WEIGHT	TIME	THIRD WEIGHT	TIME
26	101.0344	1835	101.0341 ✓	1841		
27	106.3738	1836	106.3735 ✓	1842		
28	105.7478	1837	105.7473 ✓	1843		
29	104.4549	1838	104.4545 ✓	1844		
30	107.3587	1839	107.3586 ✓	1845		
31	95.5493	1840	95.5490 ✓	1846		
32	107.8648	1841	107.8643 ✓	1847		
33	101.1724	1842	101.1719 ✓	1848		
34	106.4619	1843	106.4623 ✓	1849		
35	96.5584	1844	96.5584 ✓	1851		
36	94.4559	1844	94.4560 ✓	1852		
37	106.5998	1846	106.6002 ✓	1853		
38	96.2491	1847	96.2495 ✓	1854		
39	97.1361	1848	97.1365 ✓	1855		
40	106.4679	1849	106.4680 ✓	1858		
41	105.4852	1850	105.4857 ✓	1859		
42	104.6682	1851	104.6683 ✓	1902		
43	107.3541	1852	107.3540 ✓	1903		
44	107.7902	1853	107.7897 ✓	1904		
45	94.9359	1854	94.9360 ✓	1905		
46	106.0464	1855	106.0468 ✓	1906		
47	107.0369	1856	107.0365 ✓	1907		
48	97.7483	1857	97.7480 ✓	1909		
49	108.3563	1858	108.3558 ✓	1910		
50	96.5307	1900	96.5307 ✓	1911		

BALANCE ROOM ENVIRONMENTAL CONDITIONS

DATE	TIME	BY	WB	DB	% RH
10-1	1830	Cp	61	74	47
10-2	1830	Cp	57	69	47

Checked by : KV

Date : 10-23-05

Time : 17:45

freezerclean.com

WOODSTOVE DATA SHEET # 4-3 : CONSTANT WEIGHTS

UNIT : F400 RUN : 3 DATE : 11-16-05 Page : 1 of 1

Beaker #	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By
31	11-17	1000	Cp	95.6540	11-18	1617	Cp	95.6542	11-20	1120	Cp				
32	11-17	1000	Cp	108.3921	11-18	1618	Cp	108.3908	11-20	1121	Cp	108.3909	11-21	1216	Cp
33	11-17	1000	Cp	101.2812	11-18	1619	Cp	101.2779	11-20	1122	Cp	101.2765	11-21	1217	Cp
				101.2740	11-22	1040	Cp	101.2689	11-25	1015	Cp	101.2694	11-26	1330	KV
34	11-17	1000	Cp	106.5791	11-18	1620	Cp	106.5793	11-20	1123	Cp				
35	11-17	1000	Cp	96.6901	11-18	1621	Cp	96.6903	11-20	1124	Cp				

Filter #	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By
39F	11-16	1700	Cp	1.0172	11-17	0941	Cp	1.0170	11-18	1625	Cp				
39B	11-16	1700	Cp	.5839	11-17	0942	Cp	.5761	11-18	1626	Cp	.5650	11-20	1110	Cp
				.5601	11-21	1214	Cp	.5596	11-22	1042	Cp				

SCALE ROOM ENVIRONMENTAL CONDITIONS

Weighing Session	Date	Time	By	DB	%RH
1	11-17	0930	Cp	72	46
2	11-18	1600	Cp	72	48
3	11-20	1100	Cp	68	47
4	11-21	1200	Cp	74	44
5	11-22	1030	Cp	74	42

Weighing Session	Date	Time	By	DB	%RH
6	11-25	1000	Cp	69	47
7	11-26	1330	KV	72	47
8					
9					
10					

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates: From 07/15/05 Through 10-20-2005	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
99.9998	9.9998	.9999	.0998	[illegible]	07/15	2000	78	46
99.9997	9.9998	1.0000	.1000	[illegible]	07/19	2250	78	46
100.0000	9.9999	.9999	.0999	[illegible]	07/20	0740	78	46
100.0000	9.9999	1.0000	.1000	[illegible]	07/21	2100	78	46
99.9998	9.9998	.9999	.1000	[illegible]	07/24	2200	78	46
100.0001	10.0000	1.0000	.1000	[illegible]	07/27	1515	78	49
99.9998	10.0000	.9998	.1000	[illegible]	07/28	0600	78	49
99.9999	10.0001	1.0000	.1000	[illegible]	07/29	1210	78	49
100.0000	10.0000	1.0001	.0998	CW	9-6	0930	74	48
100.0000	9.9998	.9998	.0996	CW	9-7	0955	72	47
99.9999	10.0000	1.0001	.1000	CW	9-8	1010	78	43
99.9999	10.0001	.9999	.0999	CW	9-9	0945	75	48
99.9996	9.9999	1.0000	.1000	CW	9-10	1630	75	48
99.9998	9.9999	1.0000	.0999	CW	9-11	1300	75	44
99.9997	10.0000	1.0000	.0998	CW	9-12	0920	74	48
99.9998	10.0001	.9999	.0999	CW	9-13	0945	74	47
99.9996	10.0001	.9999	.0999	CW	9-14	1400	77	46
99.9997	10.0001	1.0001	.0999	CW	9-15	0815	75	48
99.9996	10.0000	1.0000	.1000	CW	9-16	0955	76	49
99.9998	10.0001	.9999	.0998	CW	9-17	1200	76	45
99.9997	9.9998	.9999	.0998	CW	9-18	1430	73	47
100.0004	10.0002	1.0000	.0998	CW	9-19	0810	74	44
100.0000	10.0000	1.0000	.1000	CW	9-20	1810	77	49
100.0000	10.0000	1.0000	.0998	CW	9-21	1620	78	46
100.0000	10.0001	1.0000	.0999	CW	9-22	1420	76	49
100.0004	10.0003	1.0000	.0997	CW	9-23	1300	72	46
99.9998	10.0001	1.0000	.0999	CW	10-1	1830	74	47
100.0000	10.0000	1.0000	.0999	CW	10-2	1830	69	47
100.0001	10.0001	.9998	.0999	CW	10-5	0840	74	44
99.9998	10.0001	1.0000	.0999	CW	10-6	0930	77	47
99.9998	10.0002	.9999	.1000	CW	10-8	1340	75	45
100.0000	10.0002	.9999	.0997	CW	10-10	1330	76	48
99.9999	10.0000	1.0001	.1000	CW	10-11	1020	77	46
99.9998	10.0002	.9999	.1000	CW	10-12	1000	74	44
100.0001	10.0001	1.0000	.0997	CW	10-13	1020	70	48
99.9999	10.0000	1.0001	.0999	CW	10-14	1000	70	48
100.0000	10.0001	.9999	.0999	CW	10-15	1440	72	46
99.9997	9.9999	1.0000	.1000	CW	10-20	1000	77	49

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates: From 10-21-2005 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
99.9996	9.9998	1.0000	.0999	Cp	10-21	0900	74	44
100.0000	10.0001	1.0000	.0999	Cp	10-22	1630	78	46
99.9998	10.0000	.9998	.0998	Cp	10-23	1130	74	49
99.9996	10.0000	.9998	.0997	KV	10-24	9:00	77	52
100.0000	10.0003	1.0000	.0999	KV	10-25	9:30	76	49
99.9999	10.0001	.9999	.0997	KV	10-26	9:50	70	48
99.9998	10.0000	.9999	.0998	KV	10-27	8:25	75	47
99.9996	10.0003	1.0001	.0999	KV	10-28	10:45	68	47
99.9999	10.0001	1.0000	.1000	Cp	10-29	1900	75	44
99.9998	10.0003	1.0000	.0999	Cp	10-30	1145	72	42
99.9999	10.0000	0.9998	.0998	KV	10-31	9:00	78	44
100.0001	10.0000	0.9997	.1000	KV	11-1	0850	75	42
99.9996	9.9998	.9998	.0996	KV	11-2	0915	72	49
99.9996	10.0000	1.0000	.0998	KV	11-3	1429	73	46
99.9997	10.0000	.9999	.0999	KV	11-4	1100	72	42
100.0002	10.0000	1.0001	.1000	Cp	11-5	1015	69	44
99.9998	10.0001	1.0000	.0999	KV	11-7	0930	75	41
99.9998	10.0000	.9998	.0999	KV	11-9	1111	70	48
100.0002	10.0001	.9999	.1000	KV	11-10	1040	73	47
99.9999	10.0001	.9999	.0998	Cp	11-12	1600	67	49
100.0001	10.0000	1.0000	.0999	Cp	11-13	1430	74	47
99.9999	10.0000	1.0000	.0999	Cp	11-15	1500	72	44
100.0002	10.0000	.9999	.0999	KV	11-16	0815	70	44
100.0005	10.0000	1.0000	.0999	Cp	11-17	0930	72	46
100.0004	10.0002	1.0001	.1000	Cp	11-18	1600	72	48
100.0003	10.0001	.9999	.0999	Cp	11-20	1100	68	47
100.0004	10.0002	1.0000	.1000	Cp	11-21	1200	74	44
100.0002	10.0002	.9999	.0998	Cp	11-22	1030	74	42
99.9999	10.0000	1.0000	.0999	Cp	11-25	1000	69	47
100.0002	10.0001	.9999	.0999	KV	11-26	1330	72	47

BLANK PROCESSING DATA SHEET # 5

UNIT : F 400 RUN : 3 DATE : 11-16-05

BLANKS DONE : 10-11-2005

BEAKER	A	B	C
	200 ml ACETONE	75 ml DICHLOR	200 ml WATER
	FISHER OPTIMA LOT # 023283	FISHER OPTIMA LOT # 035941	DWNA, Inc Sparklettes Distilled
FINAL WEIGHT	108.9008	106.3077	106.9670
TARE WEIGHT	108.8995	106.3066	106.9645
NET WEIGHT	.0013	.0011	.0025

TARE BEAKERS INTO DESC : TIME : 1900 DATE : 10-2-2005

DATE : 10-5 BY : Cp DATE : 10-6 BY : Cp DATE : BY :

BEAKER	1 ST WT	TIME	2 ND WT	TIME	3 RD WT	TIME
A	108.8996	0912	108.8995	1001	✓	
B	106.3065	0913	106.3066	1002	✓	
C	106.9642	0914	106.9645	1003	✓	

FINAL BEAKERS INTO DESC : TIME : 1000 DATE : 10-8-05

DATE : 10-10 BY : Cp DATE : 10-11 BY : Cp DATE : BY :

BEAKER	1 ST WT	TIME	2 ND WT	TIME	3 RD WT	TIME
A	108.9010	1348	108.9008	1105	✓	
B	106.3076	1349	106.3077	1106	✓	
C	106.9675	1350	106.9670	1109	✓	

TARE QC

DATE	TIME	BY	WB	DB	%
10-5	0840	Cp	S	74	44
10-6	0930	Cp		77	47

FINAL QC

DATE	TIME	BY	WB	DB	%
10-10	1330	Cp	S	76	48
10-11	1020	Cp		77	46

NET PARTICULATE CATCH CALCULATION DATA SHEET #6

UNIT : F400 RUN : 3 DATE : 11-16-05

Blank Audit by C Washington 10-14-2005

BLANK CALCULATIONS

Acetone :	.0013	g ÷	200	ml =	.000007	g/ml
Dicholoromethane :	.0011	g ÷	75	ml =	.000015	g/ml
Distilled Water :	.0025	g ÷	200	ml =	.000013	g/ml

FRONT HALF CATCH

FILTERS : .3524 (Total Catch) g - 1 (# of Filters) (.0000 g) (Blank Value / Filter) = .3524 g

BEAKERS : .1052 (Total Catch) g - 100 (ml Acetone) (.000007 g) (Blank Value / ml Acetone) = .1045 g

.0007

TOTAL FRONT HALF CATCH : .4569 g

BACK HALF CATCH

FILTERS : .2193 (Total Catch) g - 1 (# of Filters) (.0000 g) (Blank Value / Filter) = .2193 g

BEAKERS :

Acetone : .5266 (Total Catch) g - 175 (ml Acetone) (.000007 g) (Blank Value / ml Acetone) = .5254 g

.0012

Extract : .0975 (Total Catch) g - 75 (ml Dichloromethane) (.000015 g) (Blank Value / Dichloromethane) = .0964 g

.0011

Water : .2489 (Total Catch) g - 330 (ml Water) (.000013 g) (Blank Value / Water) = .2446 g

.0043

TOTAL BACK HALF CATCH : 1.0857 g

TOTAL CATCH : 1.5426 g

% FRONT HALF : 29.6 %

CALCULATIONS DATA SHEET # 7

UNIT : F4W RUN : 3 DATE : 11-16-05

1) $Vm(std) = \dfrac{(71.861\ Vm)(17.64)(.972\ mcf)\left[30.40''\ Hg + \dfrac{.213''\ H_2O}{13.6}\right]}{(550\ TmA)} = \dfrac{68.1385}{000.0000}$ dscf

2) $Vw(std) = (.04707)(129.6\ ml\ H_2O) = \dfrac{6.1003}{00.0000}$ scf

3) $Asw = \dfrac{(6.1003\ scf)}{(6.1003\ scf + 68.1385\ dscf)} = \dfrac{.0822}{.0000}$ Bws $\times 100 = \dfrac{8.2171}{00.0000}$ % H_2O

74.2388

4) $Cs = \dfrac{(1.5426\ g.)}{(68.1385\ dscf)}(15.43) = \dfrac{.3493}{0.0000}$ gr / dscf

5) Estimated g / hr $= \dfrac{(1.5426\ g.)}{(68.1385\ dscf)}\left(\dfrac{9.691}{00.0000}\ dscfm\right)(60) = \dfrac{13.1638}{00.0000}$ 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 : Jotul F400 RUN : 3 DATE : 11-16-05

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

Wet Bulb / Dry Bulb

Pre : WB : 61 DB : 78 = 36 % RH 1.2 % H_2O

Post : WB : 57 DB : 77 = 27 % RH .8 % H_2O

Average : 315 % RH 1.0 % H_2O

Empty Stove Weight (lbs) : N/A w/ stack & oil seal : Wet : — Dry : 397.0

Kindling Weight (lbs) : Paper : .1 Wood : 1.9

Preburn Fuel Weight : 14.6 + 13.3 + 13.1 + 3.1 Total : 44.1

Kindling & Preburn Fuel Weight (wood only) (lbs) : **Total** : 46.0

Coal Bed Wt Range (lbs) : 3.3 - 2.7 **Scale** : 400.3 - 399.7

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

Lower : .20 × fuel weight : Always round UP to nearest tenth **Actual Coal Bed Weight** : 2.8

Maximum Coal Bed Removal (lbs) : ((3.3 (Upper) + 2.7 (Lower)) ÷ 2) .25 = .7 (round down to nearest tenth)

Test Fuel (.75" × 1.5" × 5" spacers) = 20 pcs

Dimensions	Length in inches	No. Pcs	Weight in lbs	% of Load
2" × 4"	13	3	5.8	43.3
4" × 4"	13	2	7.6	56.7

Test Fuel Weight : 13.4 lbs

Estimated Dry Burn Rate :

$$\frac{13.4 - (13.4 \times .18421)}{2.2046} \times \frac{60}{\underset{\text{TIME}}{195}} = 1.526 \text{ kg / hr}$$

Estimated BTU's/hr : 19,140 × $\frac{63}{100}$ × $\frac{1.526}{\text{DBR}}$ = 18400.8 BTU's/hr

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

1.89 = 160

1.26 = 235

WOOD STOVE OPERATING DATA PAGE #9

Unit : Jotul F400 Run : 3 Date : 11-16-05

FIRE STARTED: 0705

WARM UP AND PREBURN:

PRIMARY AIR : Set wide open for all warm-up / preburn fuel charges. Then set to 5/16" 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 1 min. 5 sec.

PRIMARY AIR : Opened full for first 5 min., then set to run setting of 5/16".

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

FAN:

ON / OFF during warm-up ON / OFF during preburn

ON / OFF first ALL minutes of test ON / OFF balance of test run

Fan speed set at NO FAN

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 12 inches.

1st warm up / pre-burn fuel charge (14.6 lbs.) added at 0722

2nd warm up / pre-burn fuel charge (13.3 lbs.) added at 0850

3rd warm up / pre-burn fuel charge (13.1 lbs.) added at 1000

4th warm up / pre-burn fuel charge (3.1 lbs.) added at 1115

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

TEST DATA SHEET #10

Unit : Jotul F400 Run : 3 Date : 11-16-05

Room Temperature : 69 °F Correction Factor : Ø

Uncorrected Values are corrected for room temperature : Yes ____ No ✓

Time Test Fuel moisture reading taken : 1035

Calibration Checks : X ✓ Y ✓ 12.0 12.2 22.0 22.0

pc #	Dimen.	Use	TOP		BOTTOM		SIDE		Average Corrected
			Uncor.	Cor.	Uncor.	Cor.	Uncor.	Cor.	
1	2"×4"×8'	K	12.5	13.3	13.0	13.8	12.0	12.8	13.300
2									
3									
4	2"×4"×8'	P	19.5	20.9	20.0	21.4	19.0	20.3	20.867
5	2"×4"×8'	P	19.0	20.3	19.0	20.3	19.0	20.3	20.300
6	2"×4"×8'	P	23.0	24.7	23.5	25.2	23.5	25.2	25.033
7	2"×4"×8'	P	21.0	22.5	21.0	22.5	21.0	22.5	22.500
8	2"×4"×8'	P							88.700
9									
10									
11	2"×4"×13"	T	19.5	20.9	19.0	20.3	19.5	20.9	20.700
12	"	T	19.5	20.9	19.5	20.9	19.5	20.9	20.900
13	"	T	23.0	24.7	23.0	24.7	23.0	24.7	24.700
14	4×4×13"	T	21.5	23.1	21.0	22.5	21.5	23.1	22.900
15	"	T	22.0	23.7	22.0	23.7	22.0	23.7	23.700
16									112.900
17									
18									
19									
20	Spacers	T	23.0	24.7	23.0	24.7	21.5	23.1	24.167

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

	KINDLING	PRETEST FUEL	TEST FUEL
Dry Moisture % :	13.300 %	22.175 %	22.580 %
Wet Moisture % :	11.739 %	18.150 %	18.421 %

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: 399.8 DATE: 11-16-05

UNIT: Jotol F400 RUN: 3 PAGE: 1 OF

TIME	SCALE	FUEL	DROP	V.	CO_2	V.	O_2	V.	CO	STATIC	SO_2PPM
0 / 1225	413.2	13.4	—	.184	4.6	.613	15.4	.081	.82	-.036	425
5 / 30	412.7	12.9	.5	.199	5.0	.595	14.9	.088	.89	-.042	375
10 / 35	412.4	12.6	.3	.090	2.3	.720	18.1	.044	.45	-.035	350
15 / 40	412.2	12.4	.2	.104	2.6	.706	17.7	.048	.49	-.032	375
20 / 45	412.0	12.2	.2	.117	2.9	.691	17.3	.056	.57	-.032	375
25 / 50	411.7	11.9	.3	.118	3.0	.683	17.1	.066	.67	-.031	400
30 / 55	411.4	11.6	.3	.176	4.4	.611	15.3	.108	1.09	-.031	375
35 / 1300	410.8	11.0	.6	.430	10.8	.378	9.5	.051	.52	-.047	375
40 / 5	410.2	10.4	.6	.307	7.7	.506	12.7	.040	.41	-.049	400
45 / 10	409.6	9.8	.6	.263	6.6	.536	13.5	.074	.75	-.047	375
50 / 15	408.9	9.1	.7	.507	12.7	.317	8.0	.013	.14	-.056	350
55 / 20	408.3	8.5	.6	.414	10.4	.406	10.2	.021	.22	-.056	325
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-.494	*****
60 / 25	407.7	7.9	.6	.450	11.3	.375	9.4	.008	.09	-.057	325
65 / 30	407.1	7.3	.6	.494	12.4	.332	8.3	.006	.07	-.058	325
70 / 35	406.3	6.5	.8	.582	14.6	.207	5.2	.003	.04	-.061	325
75 / 40	405.7	5.9	.6	.547	13.7	.282	7.1	.002	.03	-.061	325
80 / 45	405.0	5.2	.7	.564	14.1	.266	6.7	.002	.03	-.061	325
85 / 50	404.4	4.6	.6	.396	9.9	.431	10.8	.007	.08	-.058	325
90 / 55	404.0	4.2	.4	.338	8.5	.479	12.0	.027	.28	-.055	325
95 / 1400	403.7	3.9	.3	.331	8.3	.486	12.2	.030	.31	-.054	325
100 / 5	403.3	3.5	.4	.314	7.9	.500	12.5	.035	.36	-.052	350
105 / 10	403.0	3.2	.3	.303	7.6	.506	12.7	.050	.51	-.050	350
110 / 15	402.7	2.9	.3	.308	7.7	.506	12.7	.041	.42	-.050	350
115 / 20	402.5	2.7	.2	.310	7.8	.502	12.6	.041	.42	-.050	350
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-.667	*****
120 / 25	401.3	2.5	.2	.308	7.7	.503	12.6	.047	.48	-.049	350
125 / 30	401.9	2.1	.4	.272	6.8	.533	13.4	.062	.63	-.048	350
130 / 35	401.6	1.8	.3	.270	6.7	.533	13.4	.073	.74	-.046	400
135 / 40	401.4	1.6	.2	.276	6.9	.525	13.2	.072	.73	-.046	400
140 / 45	401.2	1.4	.2	.275	6.9	.527	13.2	.068	.69	-.045	400
145 / 50	401.0	1.2	.2	.248	6.2	.553	13.9	.073	.74	-.044	400
150 / 55	400.9	1.1	.1	.243	6.1	.555	13.9	.077	.78	-.043	350
155 / 1500	400.7	.9	.2	.239	6.0	.559	14.0	.077	.78	-.042	350
160 / 05	400.6	.8	.1	.232	5.8	.564	14.2	.080	.81	-.041	350
165 / 10	400.4	.6	.2	.223	5.6	.570	14.3	.089	.90	-.041	350
170 / 15	400.3	.5	.1	.216	5.4	.583	14.6	.077	.78	-.041	350
175 / 20	400.2	.4	.1	.212	5.3	.585	14.7	.082	.83	-.041	350
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	.527	*****
TOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	1.688	*****

GAS DATA SHEET #12

WEIGHT:_____ DATE: 11-16-05

UNIT: Jotul F400 RUN: 3 PAGE: 2 OF

TIME	SCALE	FUEL	DROP	V.	CO_2	V.	O_2	V.	CO	STATIC	SO_2PPM
180 / 1525	400.1	.3	.1	.206	5.2	.587	14.7	.086	.87	-.040	350
185 / 30	400.0	.2	.1	.197	4.9	.598	15.0	.090	.91	-.040	350
190 / 35	399.9	.1	.1	.192	4.8	.600	15.1	.094	.95	-.039	350
195 / 40	399.8	ϕ	.1	.182	4.6	.605	15.2	.101	1.02	-.039	350
200 / 45											
										-.158	
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****		*****
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****		*****
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-1.846	*****
TOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-.046	*****

.46

PREBURN DATA SHEET #13

UNIT: Jotul F400 RUN: 3 DATE: 11-16-05 PAGE: 1 of 1

TIME	SCALE	DROP	STACK	TOP	LF SIDE	BACK	RT SIDE	BOTTOM	FIREBOX	SEC/CAT	AMBIENT	STATIC	COMMENTS
0 / 1115	402.8	—	371	498	375	347	400	241			88	-.047	PREBURN START: # 3.1 UP
5 / 1120	402.7	.1	296	460	355	337	384	240			84	-.045	COAL BED SCALE RANGE:
10 / 1125	402.5	.2	283	423	328	323	358	239			82	-.041	400.3 → 399.7
15 / 1130	402.2	.3	269	421	309	311	337	235			80	-.044	PRIMARY AIR: 5/16"
20 / 35	401.9	.3	268	422	294	300	323	231			78	-.046	SECONDARY AIR: N/A
25 / 40	401.6	.3	278	445	281	290	310	224			79	-.047	FAN: N/A
30 / 45	401.3	.3	274	441	277	283	305	219			79	-.047	PUMPS ON AT: 1145
35 / 50	401.0	.3	223	440	271	276	300	213			78	-.047	CHECK WB/DB: 1205
40 / 55	400.7	.3	228	452	269	272	298	208			78	-.047	
45 / 1200	400.4	.3	232	462	268	267	295	205			78	-.048	299.4
50 / 05	400.2	.2	219	436	263	265	297	202			78	-.044	
55 / 10	400.1	.1	208	408	263	261	294	198			77	-.043	
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	
60 / 15	400.0	.1	198	383	259	258	290	196			78	-.040	
65 / 20	399.9	.1	188	359	255	254	284	195			76	-.037	
70 / 1225	399.8	.1	186	337	248	251	280	194			81	-.036	Δt 262

Jotul-F400

Temperature Data Sheet #14

11/16/05
Run 3

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	186	337	248	251	280	194	######	######	81	1291	238	58	245	36	37
5	212	324	242	247	273	194	######	######	80	1281	238	46	245	36	37
10	184	302	232	240	260	196	######	######	79	1281	237	45	245	36	37
15	172	280	222	232	249	195	######	######	78	1281	236	45	245	36	37
20	166	264	212	224	241	192	######	######	79	1282	236	45	247	36	36
25	161	251	209	215	233	189	######	######	80	1292	235	45	247	36	36
30	163	241	202	209	229	186	######	######	79	1301	234	45	248	36	36
35	210	321	196	206	228	182	######	######	78	1304	234	46	247	35	36
40	219	329	196	203	225	182	######	######	78	1309	235	46	247	35	35
45	223	335	198	201	229	181	######	######	78	1313	236	46	247	35	35
50	268	397	200	203	234	180	######	######	79	1315	236	46	248	35	35
55	278	425	203	207	240	180	######	######	78	1319	237	46	246	36	35
60	287	446	210	211	249	182	######	######	80	1322	239	47	244	36	35
65	300	475	218	218	259	184	######	######	80	1326	240	47	241	36	36
70	331	545	227	225	268	185	######	######	81	1330	242	48	240	36	36
75	342	574	235	234	279	187	######	######	83	1333	243	49	239	36	36
80	335	566	249	241	293	187	######	######	83	1335	244	50	238	37	37
85	316	552	255	250	307	189	######	######	83	1338	245	50	238	37	37
90	293	519	261	254	314	190	######	######	84	1341	246	51	238	37	37
95	277	495	269	258	317	192	######	######	84	1344	246	52	239	37	38
100	265	474	269	260	317	193	######	######	84	1346	246	52	239	37	38
105	254	453	269	262	317	195	######	######	83	1349	246	53	239	37	38
110	248	436	266	264	317	198	######	######	83	1352	246	53	242	37	38
115	243	422	265	266	315	201	######	######	84	1354	246	54	244	37	38
120	242	412	267	270	317	201	######	######	82	1357	245	54	244	37	38
125	234	404	267	271	315	204	######	######	82	1360	245	54	242	37	38
130	226	387	264	272	315	207	######	######	83	1362	245	54	240	37	37
135	221	376	261	276	313	207	######	######	82	1365	244	55	239	37	37
140	220	370	263	279	313	209	######	######	83	1367	244	55	237	37	37
145	213	357	263	282	313	210	######	######	82	1369	244	55	236	37	37
150	208	347	262	284	313	211	######	######	81	1371	243	55	235	37	37
155	204	337	263	286	312	213	######	######	81	1371	243	55	234	37	37
160	202	329	260	287	312	214	######	######	79	1371	242	55	233	37	37
165	199	321	262	288	311	215	######	######	79	1371	242	55	232	36	37
170	196	315	260	288	306	214	######	######	79	1371	242	55	231	36	37

Jotul-F400

Temperature Data Sheet #14

11/16/05
Run 3

175	194	308	259	287	303	214	######	######	78	1370	241	55	230	36	37
180	193	302	254	286	301	213	######	######	78	1370	240	55	229	36	37
185	191	297	252	284	298	210	######	######	79	1369	240	55	228	36	37
190	188	291	248	283	296	209	######	######	77	1368	240	55	227	36	37
195	186	286	246	282	293	207	######	######	78	1368	239	55	227	36	36

Jotul-F400

11/16/05
Run 3

TEMPERATURE DATA SHEET #14A

		TEST TIME	195		
STACK AVG	231	TOP AVG	380	LT SIDE AVG	243
BACK AVG	252	RT SIDE AVG	285	BOTTOM AVG	197
FIREBOX AVG	########	SEC/CAT AVG	########	AMBIENT AVG	80

END	262.8	
START	262.0	
	0.8	DELTA T

CIRCLE: LOSS / GAIN

ZERO / SPAN CHECK DATA SHEET #15-1

Date : 11-16-05 Analyte : CO_2 (15-1)

Unit : Jotul F400 Run # : 3

Zero Cyl. # : 168TAC 3-A Conc. : 0.00 % CO_2 Cyl. Press. : 1580 PSI

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

Span Cyl. # : CC-41627 Conc. : 12.50 % CO_2 Cyl. Press. : 1625 PSI

Certified by : AIR LIQUIDE Date : 11-1-05

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 : 1030 Temp : 78 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	0.0	-.003	-.063	-.063	-.252
SPAN	50.0	.500	12.50	49.9	.499	12.495	-.005	-.018

POST RUN Audit : by : C. Washington 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	-.001	-.013	-.013	-.052
SPAN	50.0	.500	12.50	50.1	.501	12.546	.046	.182

± 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 : 11-16-05 Analyte : O_2 (15-2)

Unit : Jotul F400 Run # : 3

Zero Cyl. # : 168TAC 3A Conc. : 0.00 % O_2 Cyl. Press. : 1580 PSI

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

Span Cyl. # : CC-41627 Conc. : 12.50 % O_2 Cyl. Press. : 1625 PSI

Certified by : AIR LIQUIDE Date : 11-1-05

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 Watlington Time : 1030 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	.005	.005	.019
SPAN	12.50	.500	12.50	12.5	.501	12.563	.063	.253

POST RUN Audit : by : C Watlington 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	.001	.030	.030	.119
SPAN	12.50	.500	12.50	12.4	.498	12.488	-.012	-.048

± 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 : 11-16-05 Analyte : CO (15-3)

Unit : Jotol F400 Run # : 3

Zero Cyl. # : 168TAC 3-A Conc. : 0.00 % CO Cyl. Press. : 1580 PSI

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

Span Cyl. # : CC-41627 Conc. : 4.99 % CO Cyl. Press. : 1625 PSI

Certified by : AIR LIQUIDE Date : 11-1-05

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. Wadsworth Time : 1030 Temp : 78 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	0.0	.000	.008	.008	.079
SPAN	49.9	.499	4.99	50.1	.501	5.005	.015	.145

POST RUN Audit : by : C. Wadsworth 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	.000	.008	.008	.079
SPAN	49.9	.499	4.99	50.0	.500	4.995	.005	.045

± 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 : 11-16-05 Analyte : SO_2 (15-4)

Unit : Jotol F400 Run # : 3

Zero Cyl. # : 168TAC 3-A Conc. : 0.00 ppm SO_2 Cyl. Press. : 1580 PSI

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

Span Cyl. # : CC62184 Conc. : 1290 ppm SO_2 Cyl. Press. : 600 PSI

Certified by : AIR LIQUIDE Date : 01-29-01

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 Watling Time : 1030 Temp : 78 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	PPM	Meter	DVM	%		
ZERO	00.0	.000	00.0	0.0	.000	.854	.854	.034
SPAN	51.6	.516	1290	51.6	.516	1289.1	-.9	-.036

POST RUN Audit : by C Watling 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	0.00	.000	.854	.854	.034
SPAN	51.6	.516	1290	51.8	.518	1294.1	4.100	.164

± 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 : Jotul F400 RUN : 3 DATE : 11-16-05

Thermocouple Check:

T/C # 1	—	°F	T/C # 13	61.6	°F
T/C # 2	—	°F	T/C # 14	61.8	°F
T/C # 3	61.6	°F	T/C # 15	61.5	°F
T/C # 4	54.6	°F	T/C # 16	66.2	°F
T/C # 5	52.9	°F	T/C # 17	62.2	°F
T/C # 6	52.6	°F	T/C # 18	66.2	°F
T/C # 7	52.6	°F	T/C # 19	57.6	°F
T/C # 8	51.7	°F	T/C # 20	—	°F
T/C # 9	—	°F	T/C # 21	—	°F
T/C # 10	—	°F	T/C # 22	—	°F
T/C # 11	53.0	°F	T/C # 23	—	°F
T/C # 12	65.9	°F	T/C # 24	—	°F

Thermocouple Readout:

Pretest zero and span check and calibration			post test zero and span		% difference
ZERO 1.7 °F	Adj. to 0.0 °F		ZERO -1.0 °F	Difference -.050 %	
SPAN 1993.5 °F	Adj. to 2000.0 °F		SPAN 2006.2 °F	Difference .310 %	

Thermocouple Readout Pretest Linearity Check:

0	= 0.0 °F	200	= 200.0 °F	400	= 399.9 °F
600	= 599.8 °F	800	= 799.7 °F	1000	= 999.8 °F
1200	= 1199.8 °F	1400	= 1399.5 °F	1600	= 1599.6 °F
1800	= 1799.9 °F	2000	= 2000.0 °F		

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

Scale Check Pre : 11.7 − 1.7 = 10.0

Post : 399.0 − 409.0 = 10.0

Stack Cleaned Prior to Test Run : YES _____ NO X

TABLE 1 ----- RAW DATA

CLIENT : Jotul TEST No. : 4

MODEL: F400 DATE: 17-Nov-05

TIME (MIN.)	METER READING (C F)	DELTA H (IN. H2O)	METER TEMP. (DEG. F)	PERCENT CO (%)	PERCENT CO2 (%)	SO2 COCENTR. PPM
0	410.500	0.150	89	0.53	5.40	250
5	412.000	0.190	90	0.18	13.30	225
10	413.710	0.190	91	0.28	11.20	225
15	415.425	0.190	92	0.09	14.20	225
20	417.148	0.190	92	0.07	15.20	225
25	418.870	0.190	92	0.06	14.80	225
30	420.592	0.190	92	0.06	14.20	225
35	422.314	0.190	92	0.05	13.50	225
40	424.036	0.190	92	0.08	11.90	225
45	425.758	0.190	92	0.15	9.70	225
50	427.480	0.190	92	0.16	9.20	225
55	429.202	0.190	92	0.34	8.10	225
60	430.924	0.190	92	0.40	7.70	225
65	432.651	0.198	92	0.36	7.70	225
70	434.377	0.190	92	0.37	7.70	225
75	436.104	0.190	92	0.28	7.80	225
80	437.831	0.190	92	0.21	8.10	225
85	439.557	0.190	92	0.19	7.60	225
90	441.284	0.190	92	0.55	5.50	225
95	443.010	0.190	92	0.56	5.00	225
100	444.737	0.190	92	0.54	5.10	225
105	446.464	0.190	92	0.60	4.90	225
110	448.190	0.190	92	0.65	4.60	225

TABLE 2---RAW DATA

CLIENT : Jotul TEST No. 4

MODEL: F400 DATE: 17-Nov-05

****

METER CAL. FACTOR (Y)	-------	0.972		Wt. WOOD BURNED(LB)	-------	12.3	Lbs
BAROMETRIC PRESS.(Pb)	-------	30.4	in Hg	WET,FUEL MOISTURE %	-------	18.607	%
LEAK RATE POST (Lp)	-------	0.007	cfm	Wt. PART. COLLECTED	-------	0.1068	g
WATER VOL. (V1c)	-------	71.4	Ml	METER VOLUME Vm	-------	37.69	mcf
TEST TIME (MIN)	-------	110	min	HC MOLE FRACTION	-------	0.0132	

TABLE 3 -----FIELD DATA AVERAGES

CLIENT : Jotul TEST No. 4

MODEL: F400 DATE: 17-Nov-05

****

AVG DELTA H	-------	0.19 in H2O		AVG PRCNT CO	-------	0.29	%
AVG METER TEMP. Tm	-------	92 deg F		AVG PRCNT CO2	-------	9.23	%
AVG PPM SO2	-------	226	PPM	AVG BAL CO2/CO	-------	31.42	%

TABLE 4 ----- CALCULATIONS

CLIENT : Jotul TEST No. 4

MODEL: F400 DATE: 17-Nov-05

****

STD SAMPLE VOL. Vm(std) d) ------	35.64	dscf	STACK GAS FLOW Qsd -------	822.441	dscf/Hr &
				13.71	dscf/min
VOL. WATER VAPOR Vw(s td) -----	3.361	scf	PARTICULATE CONCTRT. C s ------	0.0030	g/dscf
PRCNT MSTR Bws -------	8.62	%	PARTC.EMISS. RATE E -------	2.46	g/Hr
BURN RATE BR -------	2.48	Kg/Hr	MOLES OF GAS PER Lb WOOD Nt ----	0.39	Lb-mole/Lb
CO EMISSION RATE -------	80.95	g/Hr &	PART.EMISS. RATE ------	1.00	g/Kgdry fuel
	32.68	g/Kgdry fuel			

TABLE 5 ----- PROPORTIONAL RATE VARIATION

CLIENT : Jotul TEST No. : 4

MODEL: F400 DATE: 17-Nov-05

	TIME INTEVAL Ti	PPM * Vm	PROPRTN. RATE VAR. PR		PROPRTN RATE VAR. AVERAGE	
	5	356.0	97		100	
	10	364.7	100			
	15	365.1	100			
	20	366.4	100			
	25	366.2	100			
	30	366.2	100			
	35	366.2	100			
	40	366.2	100			
	45	366.2	100			
	50	366.2	100			
	55	366.2	100			
	60	366.2	100			
	65	367.3	100			
	70	367.1	100			
	75	367.3	100			
	80	367.3	100			
	85	367.1	100			
	90	367.3	100			
	95	367.1	100			
	100	367.3	100			
	105	367.3	100			
	110	367.1	100			

COMPUTER INPUT DATA SHEET #1

Client: Jotul North America, Inc

Address: 55 Hutcherson Drive
Gorham, ME 04038

Phone: 1-207-591-6621 Fax: 1-207-591-6632

Run No.: 4 Date of Test: 11-17-05 Burn Rate: 2.48 / 2.46

Model No.: F400 ☐ min ☐ min-1.25 ☐ fan

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

Dry Gas Meter Y Factor: .972 (0.000) (Data Sheet #2) Post Leak Rate: .007 cfm (.000) (Data Sheet #2) Time: 110 min. (000) (Data Sheet #2)

Dry Gas Meter Volume: 37.690 cf (00.000) (Data Sheet #2)

Stack Flow: 15.204 dscfm (00.000) (Data Sheet #2) Δ H: .188 in. H_2O (.000) (Data Sheet #2)

Maximum Vac.: 3.0 (0.0) (Data Sheet #2) Barometric Pressure: 30.40 in. Hg (00.00) (Data Sheet #2)

H_2O Captured: 71.4 g (00.0) (Data Sheet #3)

Front Half Catch % Of Total: 35.0 % (00.0) (Data Sheet #6) Total Particulate Catch: .1068 g (0.0000) (Data Sheet #6)

Flue Gas Moisture: 8.6248 % (00.000) (Data Sheet #7)

Particulate Emission: .0463 gr/dscf (0.0000) (Data Sheet #7)

Relative Humidity: 40 % RH (00.0) (Data Sheet #8) Ambient Moisture: 1.3 % H_2O (0.00) (Data Sheet #8)

Preburn Fuel Wt.: 40.5 lbs. (00.0) (Data Sheet #8) Coal Bed Wt.: 2.7 lbs. (00.0) (Data sheet #8) Test Fuel Wt.: 12.3 lbs. (00.0) (Data sheet #8)

Heat Output (EPA Default): 29868.2 BTU/hr (00,000.0) (Data Sheet #8)

Kindling Fuel % Moisture (wet): 12.281 % (00.000) (Data Sheet #10) Pretest Fuel % Moisture (wet): 17.611 % (00.000) (Data Sheet #10)

Test Fuel % Moisture (dry): 22.860 % Test Fuel % Moisture (wet): 18.607 % (00.000) (Data Sheet #10 [wood stove] or #11 [pellet stove])

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

Stack Static Pressure: -.056 in. H_2O (+/- .000) (Data Sheet #12)

Average Ambient Temperature: 81 °F (00) (Data Sheet #14) Stove Temperature Change: 1.5 °F (+/- 000.0) (Data Sheet #14)

Test Start = 1340 End = 1530 Avg Meter Temp = 552

METER BOX DATA SHEET PAGE # 2

Page: 1 of _____

UNIT : Jotul F400 RUN : 4 DATE : 11-17-05

Meter Box: 5H Y Factor: .972

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

80 @ 30 15 " Hg @ .007 cfm _____ " Hg @ _____ cfm

Inject SO^2 @ 100 cc/min. Nozzle: Probe @ 3/8 " od Initial Volume: 1,500

ROTO: PRESS: .17			SAMPLING RATIO: 45 : 1				BP: 30.44		
MIN	TIME	METER READING	SAMPLE MDCF	STACK DSCFM	DELTA H	METER TEMP	SO2 PPM	ROTO TEMP	PUMP VACC
0	1340	410.500	———	13.830	.15	89	250	89	2.0
5	45	412.000	———	15.338	.19	90	225	90	3.0
10	50	413.710	413.710	15.310	.19	91	225	91	2.0
15	55	415.425	415.425	15.283	.19	92	225	92	2.0
20	1400	417.148	417.148	15.283	.19	92	225	92	2.0
25	05	418.870	418.870	15.283	.19	92	225	92	2.0
30	10	420.592	420.592	15.283	.19	92	225	92	2.0
35	15	422.314	422.314	15.283	.19	92	225	92	2.0
40	20	424.036	424.036	15.283	.19	92	225	92	2.0
45	25	425.758	425.758	15.283	.19	92	225	92	2.0
50	30	427.480	427.480	15.283	.19	92	225	92	2.0
55	35	429.202	429.202	15.283	.19	92	225	92	2.0
ROTO PRESS: .17			TOTALS:	182.025	2.24	1098	BP.: 30.36		
60	1440	430.924	430.924	15.243	.19	92	225	92	2.0
65	45	432.651	432.651	15.243	.19	92	225	92	2.0
70	50	434.377	434.377	15.243	.19	92	225	92	2.0
75	55	436.104	436.104	15.243	.19	92	225	92	2.0
80	1500	437.831	437.831	15.243	.19	92	225	92	2.0
85	05	439.557	439.557	15.243	.19	92	225	92	2.0
90	10	441.284	441.284	15.243	.19	92	225	92	2.0
95	15	443.010	443.010	15.243	.19	92	225	92	2.0
100	20	444.737	444.737	15.243	.19	92	225	92	2.0
105	25	446.464	446.464	15.243	.19	92	225	92	2.0
110	30	448.190	448.190	15.243	.19	92	225	92	2.0
115				167.673	2.09	1012			
			TOTALS:	349.698	4.33	2110	MAX VACC =		3.0
TOTAL Cu Ft.		37.690	TOTALS:	15.204	.188	92	AVG. BP:	30.40	

552

PARTICULATE CATCH / MOISTURE DATA SHEET # 3

UNIT : Jotul F400 RUN : 4 DATE : 11-17-05

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	663.1	586.0	485.8	885.9
INITIAL WT	604.8	583.2	484.4	877.0
NET WT GRAMS	58.3	2.8	1.4	8.9

TOTAL CATCH : 71.4 **GRAMS H_2O**

FRONT HALF

FILTER #	40F	
FINAL WT g	.6943	
INITIAL WT g	.6677	
NET WT g	.0266	

BEAKER #	36
DESC.	ACETONE
FINAL WT g	94.4673
INITIAL WT g	94.4560
NET WT g	.0113
VOL. DESC. ml	75

BACK HALF

FILTER #	40B	
FINAL WT g	.3491	
INITIAL WT g	.3406	
NET WT g	.0085	

BEAKER #	37	38	39	40	
DESC.	ACETONE	METHCHLOR	H_2O	H_2O	
FINAL WT g	106.6380	96.2587	97.1469	106.4770	
INITIAL WT g	106.6002	96.2495	97.1365	106.4680	
NET WT g	.0378	.0092	.0104	.0090	.0194
VOL. DESC ml	150	75	125	125	250

FILTER TARE WEIGHTS DATA SHEET #4-1

Into Dessicator : Date : 9-2-05 Time : 1515 By : C. Washington

Manufacturer S & S Grade : # 25 Glass Front Size : 11 cm Lot No. : ZB921

Back Size: 8.2 cm Lot No. : B1044632

	DATE: 9-19-05	BY: CP	DATE: 9-20-05	BY: CW	DATE:	BY:
FILTER #	FIRST WEIGHT	TIME	SECOND WEIGHT	TIME	THIRD WEIGHT	TIME
31 F	.6696	0825	.6698 ✓	1820		
32 F	.6721	0826	.6723 ✓	1821		
33 F	.6745	0827	.6747 ✓	1823		
34 F	.6732	0828	.6730 ✓	1824		
35 F	.6584	0830	.6585 ✓	1825		
36 F	.6702	0831	.6704 ✓	1826		
37 F	.6667	0832	.6665 ✓	1828		
38 F	.6696	0833	.6695 ✓	1829		
39 F	.6648	0834	.6646 ✓	1830		
40 F	.6677	0835	.6677 ✓	1831		
31 B	.3401	0836	.3400 ✓	1833		
32 B	.3362	0837	.3364 ✓	1834		
33 B	.3388	0839	.3391 ✓	1835		
34 B	.3390	0840	.3392 ✓	1836		
35 B	.3362	0841	.3364 ✓	1837		
36 B	.3373	0842	.3373 ✓	1839		
37 B	.3408	0842	.3406 ✓	1840		
38 B	.3397	0844	.3398 ✓	1841		
39 B	.3403	0845	.3403 ✓	1842		
40 B	.3405	0846	.3406 ✓	1844		

Checked by: [illegible] Date: 10-2-05 Time: 13:00

BALANCE ROOM ENVIRONMENTAL CONDITIONS

DATE	TIME	BY	WB	DB	% RH
9-19	0810	CP	60	74	44
9-20	1810	CW	64	77	49

BEAKER TARE WEIGHTS DATA SHEET #4-2

Into Dessicator: Date : 9/12/2005 Time : 1000 By : Cp Whitington

	DATE: 10-1-2005	BY: Cp	DATE: 10-2-2005	BY: Cp	DATE:	BY:
BEAKER #	FIRST WEIGHT	TIME	SECOND WEIGHT	TIME	THIRD WEIGHT	TIME
26	101.0344	1835	101.0341 ✓	1841		
27	106.3738	1836	106.3735 ✓	1842		
28	105.7478	1837	105.7473 ✓	1843		
29	104.4549	1838	104.4545 ✓	1844		
30	107.3587	1839	107.3586 ✓	1845		
31	95.5493	1840	95.5490 ✓	1846		
32	107.8648	1841	107.8643 ✓	1847		
33	101.1724	1842	101.1719 ✓	1848		
34	106.4619	1843	106.4623 ✓	1849		
35	96.5584	1844	96.5584 ✓	1851		
36	94.4559	1844	94.4560 ✓	1852		
37	106.5998	1846	106.6002 ✓	1853		
38	96.2491	1847	96.2495 ✓	1854		
39	97.1361	1848	97.1365 ✓	1855		
40	106.4679	1849	106.4680 ✓	1858		
41	105.4852	1850	105.4857 ✓	1859		
42	104.6682	1851	104.6683 ✓	1902		
43	107.3541	1852	107.3540 ✓	1903		
44	107.7902	1853	107.7897 ✓	1904		
45	94.9359	1854	94.9360 ✓	1905		
46	106.0464	1855	106.0468 ✓	1906		
47	107.0369	1856	107.0365 ✓	1907		
48	97.7483	1857	97.7480 ✓	1909		
49	108.3563	1858	108.3558 ✓	1910		
50	96.5307	1900	96.5307 ✓	1911		

BALANCE ROOM ENVIRONMENTAL CONDITIONS

DATE	TIME	BY	WB	DB	% RH	
10-1	1830	Cp	61	74	47	Checked by : KV
10-2	1830	Cp	57	69	47	Date : 10-23-05
						Time : 17:45

freezerdata.com

WOODSTOVE DATA SHEET # 4-3 : CONSTANT WEIGHTS

UNIT : Jotul F400 RUN : 4 DATE : 11-17-05 Page : 1 of

Beaker #	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By
36	11-18	1600	Cp	94.4676	11-20	1126	Cp	94.4673	11-21	1221	Cp				
37	11-18	1600	Cp	106.6385	11-20	1127	Cp	106.6380	11-21	1222	Cp				
38	11-18	1600	Cp	96.2588	11-20	1128	Cp	96.2587	11-21	1223	Cp				
39	11-18	1600	Cp	97.1468	11-20	1129	Cp	97.1469	11-21	1225	Cp				
40	11-18	1600	Cp	106.4771	11-20	1130	Cp	106.4770	11-21	1226	Cp				

Filter #	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By	Weight	Date	Time	By
40F	11-17	1630	Cp	.6939	11-18	1630	Cp	.6943	11-20	1115	Cp				
40B	11-17	1630	Cp	.3495	11-18	1631	Cp	.3491	11-20	1116	Cp				

SCALE ROOM ENVIRONMENTAL CONDITIONS

Weighing Session	Date	Time	By	DB	%RH
1	11-18	1600	Cp	72	48
2	11-20	1100	Cp	68	47
3	11-21	1200	Cp	74	44
4					
5					

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

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates: From 10-21-2005 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
99.9996	9.9998	1.0000	.0999	Cp	10-21	0900	74	44
100.0000	10.0001	1.0000	.0999	Cp	10-22	1630	78	46
99.9998	10.0000	.9998	.0998	Cp	10-23	1130	74	49
99.9996	10.0000	.9998	.0997	KV	10-24	9:00	77	52
100.0000	10.0003	1.0000	.0999	KV	10-25	9:30	76	49
99.9999	10.0001	.9999	.0997	KV	10-26	9:50	70	48
99.9998	10.0000	.9999	.0998	KV	10-27	8:25	75	47
99.9996	10.0003	1.0001	.0999	KV	10-28	10:45	68	47
99.9999	10.0001	1.0000	.1000	Cp	10-29	1900	75	44
99.9998	10.0003	1.0000	.0999	Cp	10-30	1145	72	42
99.9999	10.0000	0.9998	.0998	KV	10-31	9:00	78	44
100.0001	10.0000	0.9997	.1000	KV	11-1	0850	75	42
99.9996	9.9998	.9998	.0996	KV	11-2	0915	72	49
99.9996	10.0000	1.0000	.0998	KV	11-3	1429	73	46
99.9997	10.0000	.9999	.0999	KV	11-4	1100	72	42
100.0002	10.0000	1.0001	.1000	Cp	11-5	1015	69	44
99.9998	10.0001	1.0000	.0999	KV	11-7	0930	75	41
99.9998	10.0000	.9998	.0999	KV	11-9	1111	70	48
100.0002	10.0001	.9999	.1000	KV	11-10	1040	73	47
99.9999	10.0001	.9999	.0998	Cp	11-12	1600	67	49
100.0001	10.0000	1.0000	.0999	Cp	11-13	1430	74	47
99.9999	10.0000	1.0000	.0999	Cp	11-15	1500	72	44
100.0002	10.0000	.9999	.0999	KV	11-16	0815	70	44
100.0005	10.0000	1.0000	.0999	Cp	11-17	0930	72	46
100.0004	10.0002	1.0001	.1000	Cp	11-18	1600	72	48
100.0003	10.0001	.9999	.0999	Cp	11-20	1100	68	47
100.0004	10.0002	1.0000	.1000	Cp	11-21	1200	74	44
100.0002	10.0002	.9999	.0998	Cp	11-22	1030	74	42
99.9999	10.0000	1.0000	.0999	Cp	11-25	1000	69	47
100.0002	10.0001	.9999	.0999	KV	11-26	1330	72	47

WOODSTOVE DATA SHEET #4-4

SCALE QA SHEET

Dates: From 07/15/05 Through 10-20-2005	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
99.9998	9.9998	.9999	.0998	[illegible]	07/15	2000	78	46
99.9997	9.9998	1.0000	.1000	[illegible]	07/19	2250	78	46
100.0000	9.9999	.9999	.0999	[illegible]	07/20	0740	78	46
100.0000	9.9999	1.0000	.1000	[illegible]	07/21	2100	78	46
99.9998	9.9998	.9999	.1000	[illegible]	07/24	2200	78	46
100.0001	10.0000	1.0000	.1000	[illegible]	07/27	1515	78	49
99.9998	10.0000	.9998	.1000	[illegible]	07/28	0600	78	49
99.9999	10.0001	1.0000	.1000	[illegible]	07/29	1210	78	49
100.0000	10.0000	1.0001	.0998	CW	9-6	0930	74	48
100.0000	9.9998	.9998	.0996	CW	9-7	0955	72	47
99.9999	10.0000	1.0001	.1000	CW	9-8	1010	78	43
99.9999	10.0001	.9999	.0999	CW	9-9	0945	75	48
99.9996	9.9999	1.0000	.1000	CW	9-10	1630	75	48
99.9998	9.9999	1.0000	.0999	CW	9-11	1300	75	44
99.9997	10.0000	1.0000	.0998	CW	9-12	0920	74	48
99.9998	10.0001	.9999	.0999	CW	9-13	0945	74	47
99.9996	10.0001	.9999	.0999	CW	9-14	1400	77	46
99.9997	10.0001	1.0001	.0999	CW	9-15	0815	75	48
99.9996	10.0000	1.0000	.1000	CW	9-16	0955	76	49
99.9998	10.0001	.9999	.0998	CW	9-17	1200	76	45
99.9997	9.9998	.9999	.0998	CW	9-18	1430	73	47
100.0004	10.0002	1.0000	.0998	CW	9-19	0810	74	44
100.0000	10.0000	1.0000	.1000	CW	9-20	1810	77	49
100.0000	10.0000	1.0000	.0998	CW	9-21	1620	78	46
100.0000	10.0001	1.0000	.0999	CW	9-22	1420	76	49
100.0004	10.0003	1.0000	.0997	CW	9-23	1300	72	46
99.9998	10.0001	1.0000	.0999	CW	10-1	1830	74	47
100.0000	10.0000	1.0000	.0999	CW	10-2	1830	69	47
100.0001	10.0001	.9998	.0999	CW	10-5	0840	74	47
99.9998	10.0001	1.0000	.0999	CW	10-6	0930	77	47
99.9998	10.0002	.9999	.1000	CW	10-8	1340	75	45
100.0000	10.0002	.9999	.0997	CW	10-10	1330	76	48
99.9999	10.0000	1.0001	.1000	CW	10-11	1020	77	46
99.9998	10.0002	.9999	.1000	CW	10-12	1000	74	44
100.0001	10.0001	1.0000	.0997	CW	10-13	1020	70	48
99.9999	10.0000	1.0001	.0999	CW	10-14	1000	70	48
100.0000	10.0001	.9999	.0999	CW	10-15	1440	72	46
99.9997	9.9999	1.0000	.1000	CW	10-20	1000	77	49

BLANK PROCESSING DATA SHEET # 5

UNIT : F400 RUN : 4 DATE : 11-17-05

BLANKS DONE : 10-11-2005

BEAKER	A	B	C
	200 ml ACETONE	75 ml DICHLOR	200 ml WATER
	FISHER OPTIMA LOT # 023283	FISHER OPTIMA LOT # 035941	DWNA, Inc Sparklettes Distilled
FINAL WEIGHT	108.9008	106.3077	106.9670
TARE WEIGHT	108.8995	106.3066	106.9645
NET WEIGHT	.0013	.0011	.0025

TARE BEAKERS INTO DESC : TIME : 1900 DATE : 10-2-2005

DATE : 10-5 BY : CP DATE : 10-6 BY : CP DATE : BY :

BEAKER	1 ST WT	TIME	2 ND WT	TIME	3 RD WT	TIME
A	108.8996	0912	108.8995	1001	✓	
B	106.3065	0913	106.3066	1002	✓	
C	106.9642	0914	106.9645	1003	✓	

FINAL BEAKERS INTO DESC : TIME : 1000 DATE : 10-8-05

DATE : 10-10 BY : CP DATE : 10-11 BY : CP DATE : BY :

BEAKER	1 ST WT	TIME	2 ND WT	TIME	3 RD WT	TIME
A	108.9010	1348	108.9008	1105	✓	
B	106.3076	1349	106.3077	1106	✓	
C	106.9675	1350	106.9670	1109	✓	

TARE QC

DATE	TIME	BY	WB	DB	%
10-5	0840	CP		74	44
10-6	0930	CP		77	47

FINAL QC

DATE	TIME	BY	WB	DB	%
10-10	1330	CP		76	48
10-11	1020	CP		77	46

NET PARTICULATE CATCH CALCULATION DATA SHEET #6

UNIT : F400 RUN : 4 DATE : 11-17-05

Blank Audit by C Washington 10-14-2005

BLANK CALCULATIONS

Acetone :	.0013	g ÷	200	ml =	.000007	g/ml
Dicholoromethane :	.0011	g ÷	75	ml =	.000015	g/ml
Distilled Water :	.0025	g ÷	200	ml =	.000013	g/ml

FRONT HALF CATCH

FILTERS : .0266 g - 1 (.0000 g) = .0266 g
Total Catch; # of Filters; Blank Value / Filter

BEAKERS : .0113 g - 75 (.000007 g) = .0108 g
Total Catch; ml Acetone; Blank Value / ml Acetone (.0005)

TOTAL FRONT HALF CATCH : .0374 g

BACK HALF CATCH

FILTERS : .0085 g - 1 (.0000 g) = .0085 g
Total Catch; # of Filters; Blank Value / Filter

BEAKERS :

Acetone : .0378 g - 150 (.000007 g) = .0367 g
Total Catch; ml Acetone; Blank Value / ml Acetone (.0011)

Extract : .0092 g - 75 (.000015 g) = .0081 g
Total Catch; ml Dichloromethane; Blank Value / Dichloromethane (.0011)

Water : .0194 g - 250 (.000013 g) = .0161 g
Total Catch; ml Water; Blank Value / Water (.0033)

TOTAL BACK HALF CATCH : .0694 g

TOTAL CATCH : .1068 g

% FRONT HALF : 35.0 %

CALCULATIONS DATA SHEET # 7

UNIT : Jotul F400 RUN : 4 DATE : 11-17-05

1) Vm (std) = (37.690 Vm)(17.64)(.972 mcf) [30.40 " Hg + .188 " H_2O / 13.6] / (552 TmA) = 35.6060 / 000.0000 dscf

2) Vw (std) = (.04707)(71.4 ml H_2O) = 3.3608 / 00.0000 scf

3) Asw = (3.3608 scf) / (3.3608 scf + 35.6060 dscf) = .0862 / .0000 Bws × 100 = 8.6248 / 00.0000 % H_2O

4) Cs = (.1068 g.) / (35.6060 dscf) (15.43) = .0463 / 0.0000 gr / dscf

5) Estimated g / hr = (.1068 g.) / (35.6060 dscf) (15.204 / 00.0000 dscfm) (60) = 2.7363 / 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 : Jotul F400 RUN : 4 DATE : 11-17-05

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

Wet Bulb / Dry Bulb

Pre : WB : 62 DB : 77 = 42 % RH 1.4 % H_2O

Post : WB : 60 DB : 76 = 38 % RH 1.2 % H_2O

Average : 40 % RH 1.3 % H_2O

Empty Stove Weight (lbs) : N/A w/ stack & oil seal : Wet : — Dry : 397.0

Kindling Weight (lbs) : Paper : .1 Wood : 1.7

Preburn Fuel Weight : 16.0 + 13.8 + 9.0 Total : 38.8

Kindling & Preburn Fuel Weight (wood only) (lbs) : **Total** : 40.5

Coal Bed Wt Range (lbs) : 3.0 - 2.5 **Scale** : 400.0 - 399.5

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

Lower : .20 × fuel weight : Always round UP to nearest tenth **Actual Coal Bed Weight** : 2.7

Maximum Coal Bed Removal (lbs) : ((3.0 (Upper) + 2.5 (Lower)) ÷ 2) .25 = .6 (round down to nearest tenth)

Test Fuel (.75" × 1.5" × 5" spacers) = 20 pcs

Dimensions	Length in inches	No. Pcs	Weight in lbs	% of Load
2" × 4"	13	3	4.9	60.2
4" × 4"	13	2	7.4	39.8

Test Fuel Weight : 12.3 lbs

Estimated Dry Burn Rate :

$$\frac{12.3 - (12.3 \times .18607)}{2.2046} \times \frac{60}{\frac{110}{\text{TIME}}} = 2.477 \text{ kg / hr}$$

Estimated BTU's/hr : 19,140 × $\frac{63}{100}$ × $\frac{2.477}{\text{DBR}}$ = 29868.2 BTU's/hr

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

WOOD STOVE OPERATING DATA PAGE #9

Unit : Jotul F400 Run : 4 Date : 11-17-05

FIRE STARTED: 0855

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 25 sec.

TEST:

DOOR wide open during loading Ø min. 48 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 during preburn

ON / OFF first ALL minutes of test

ON / OFF balance of test run

Fan speed set at NO FAN

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 12 inches.

1st warm up / pre-burn fuel charge (16 lbs.) added at 0910

2nd warm up / pre-burn fuel charge (13.8 lbs.) added at 1035

3rd warm up / pre-burn fuel charge (9.0 lbs.) added at 1200

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 : Jotul F400 Run : 4 Date : 11-17-05

Room Temperature : 70 °F Correction Factor : Ø

Uncorrected Values are corrected for room temperature : Yes _____ No Ø ✓

Time Test Fuel moisture reading taken : 1140

Calibration Checks : X ✓ Y ✓ 12.0 12.1 22.0 22.1

pc #	Dimen.	Use	TOP		BOTTOM		SIDE		Average Corrected
			Uncor.	Cor.	Uncor.	Cor.	Uncor.	Cor.	
1	2"×4"×8'	K	12.5	13.3	14.0	14.9	13.0	13.8	14.000
2									
3									
4	2"×4"×8'	P	21.5	23.1	19.5	20.9	19.5	20.9	21.633
5	2"×4"×8'	P	23.0	24.7	23.5	25.2	23.5	25.2	25.033
6	2"×4"×8'	P	18.5	19.8	18.5	19.8	18.0	19.2	19.600
7	2"×4"×8'	P	18.5	19.8	17.5	18.7	18.0	19.2	19.233
8	2"×4"×8'	P							85.499
9									
10									
11	2"x4"x13"	T	22.0	23.7	21.5	23.1	22.0	23.7	23.500
12	"	T	22.0	23.7	22.0	23.7	22.0	23.7	23.700
13	"	T	22.0	23.7	21.5	23.1	21.5	23.1	23.300
14	4x4x13"	T	19.0	20.3	19.0	20.3	19.5	20.9	20.500
15	"	T	21.0	22.5	22.0	23.7	22.0	23.7	23.300
16									114.300
17									
18									
19									
20	Spacers	T	22.5	24.1	22.0	23.7	22.0	23.7	23.833

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

	KINDLING	PRETEST FUEL	TEST FUEL
Dry Moisture % :	14.000 %	21.375 %	22.860 %
Wet Moisture % :	12.281 %	17.611 %	18.607 %

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: 399.7 DATE: 11-17-05

UNIT: Jotol F400 RUN: 4 PAGE: 1 OF 1

TIME	SCALE	FUEL	DROP	V.	CO_2	V.	O_2	V.	CO	STATIC	SO_2PPM
0 1340	412.0	12.3	—	.217	5.4	.593	14.9	.052	.53	-.046	250
5 45	410.9	11.2	1.1	.530	13.3	.292	7.3	.017	.18	-.062	225
10 50	410.0	10.3	.9	.447	11.2	.372	9.3	.027	.28	-.061	225
15 55	408.8	9.1	1.2	.569	14.2	.260	6.5	.008	.09	-.064	225
20 1400	407.3	7.6	1.5	.607	15.2	.220	5.5	.006	.07	-.066	225
25 05	406.5	6.8	.8	.590	14.8	.237	5.9	.005	.06	-.065	225
30 10	405.5	5.8	1.0	.566	14.2	.261	6.5	.005	.06	-.065	225
35 15	404.6	4.9	.9	.540	13.5	.289	7.3	.004	.05	-.064	225
40 20	403.9	4.2	.7	.475	11.9	.352	8.8	.007	.08	-.062	225
45 25	403.2	3.5	.7	.389	9.7	.437	11.0	.014	.15	-.062	225
50 30	402.7	3.0	.5	.367	9.2	.456	11.4	.015	.16	-.059	225
55 35	402.3	2.6	.4	.323	8.1	.493	12.4	.033	.34	-.056	225
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	.732	*****
60 1440	401.9	2.2	.4	.306	7.7	.506	12.7	.039	.40	-.055	225
65 45	401.6	1.9	.3	.309	7.7	.508	12.7	.035	.36	-.054	225
70 50	401.3	1.6	.3	.307	7.7	.508	12.7	.036	.37	-.054	225
75 55	401.0	1.3	.3	.312	7.8	.507	12.7	.027	.28	-.053	225
80 1500	400.7	1.0	.3	.325	8.1	.498	12.5	.020	.21	-.054	225
85 05	400.4	.7	.3	.304	7.6	.519	13.0	.018	.19	-.053	225
90 10	400.1	.4	.3	.218	5.5	.588	14.8	.054	.55	-.050	225
95 15	400.0	.3	.1	.198	5.0	.608	15.2	.055	.56	-.049	225
100 20	399.9	.2	.1	.203	5.1	.605	15.2	.053	.54	-.048	225
105 25	399.8	.1	.1	.196	4.9	.610	15.3	.059	.60	-.047	225
110 30	399.7	.0	.1	.183	4.6	.620	15.6	.064	.65	-.046	225
115											
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-.563	*****
120											
125											
130											
135											
140											
145											
150											
155											
160											
165											
170											
175											
SUBTOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	1.295	*****
TOTAL	*****	*****	*****	*****	*****	*****	*****	*****	*****	-.056	*****

PREBURN DATA SHEET #13

UNIT : Jotul F400 RUN : 4 DATE : 11-17-05 PAGE : 1 of 1

TIME	SCALE	DROP	STACK	TOP	LF SIDE	BACK	RT SIDE	BOTTOM	FIREBOX	SEC/CAT	AMBIENT	STATIC	COMMENTS
0 / 1200	408.8	—	290	463	353	344	383	229			84	-.046	PREBURN START : # UP
5 / 05	408.3	.5	280	446	335	336	362	233			81	-.051	COAL BED SCALE RANGE :
10 / 10	407.6	.7	309	459	318	321	333	231			80	-.057	400.0 → 399.5
15 / 15	407.0	.6	334	486	308	314	317	227			81	-.060	PRIMARY AIR : wide open
20 / 20	406.1	.9	367	524	301	306	305	224			80	-.061	SECONDARY AIR : N/A
25 / 25	405.4	.7	390	558	302	300	300	221			81	-.062	FAN : N/A
30 / 30	404.6	.8	405	585	302	295	301	217			81	-.063	PUMPS ON AT :
35 / 35	403.8	.8	414	612	309	298	305	218			81	-.064	CHECK WB/DB :
40 / 40	403.1	.7	406	607	315	301	315	218			82	-.062	
45 / 45	402.5	.6	396	605	326	301	322	218			82	-.062	
50 / 50	402.0	.5	379	588	334	304	337	221			84	-.061	
55 / 55	401.4	.6	367	569	344	310	354	225			83	-.060	
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	
60 / 1300	401.1	.3	351	554	347	313	361	227			83	-.058	
65 / 05	400.8	.3	333	523	348	315	365	230			84	-.056	
70 / 10	400.6	.2	309	497	344	316	367	230			83	-.053	
75 / 15	400.4	.2	289	468	340	311	365	229			82	-.051	
80 / 20	400.3	.1	276	445	332	306	354	225			82	-.049	
85 / 25	400.1	.2	267	426	324	303	349	223			81	-.049	
90 / 30	400.0	.1	260	407	318	299	339	222			81	-.048	
95 / 35	399.8	.2	254	393	311	292	335	222			80	-.047	
100 / 40	399.7	.1	250	376	306	289	331	225			81	-.046	305.5

Jotul-F400

Temperature Data Sheet #14

11/17/05
Run 4

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	250	376	306	289	331	225	#####	#####	81	1407	245	52	244	35	36
5	456	443	302	288	322	223	#####	#####	81	1422	242	43	243	35	36
10	406	510	294	283	307	229	#####	#####	77	1439	240	43	240	35	36
15	442	566	291	281	296	232	#####	#####	78	1449	240	43	238	35	36
20	495	600	299	283	294	232	#####	#####	78	1464	240	42	237	36	36
25	503	629	308	288	301	231	#####	#####	79	1480	240	42	237	36	36
30	494	635	318	293	311	229	#####	#####	79	1493	240	42	237	36	36
35	481	647	325	301	324	228	#####	#####	79	1505	241	42	236	36	36
40	461	638	326	305	337	225	#####	#####	81	1517	240	42	237	37	36
45	431	609	328	314	353	227	#####	#####	81	1525	240	42	236	37	36
50	407	581	328	320	364	227	#####	#####	81	1534	240	43	236	37	36
55	383	549	325	326	367	229	#####	#####	81	1543	239	43	236	37	36
60	365	521	323	330	365	229	#####	#####	85	1548	239	43	236	37	36
65	354	499	318	334	363	231	#####	#####	84	1548	238	43	235	37	37
70	349	482	316	336	360	233	#####	#####	84	1552	237	43	234	37	37
75	345	468	313	339	362	232	#####	#####	83	1557	237	43	234	37	37
80	345	460	311	342	363	235	#####	#####	83	1566	236	43	234	37	37
85	341	456	307	345	366	233	#####	#####	84	1575	235	43	233	38	37
90	323	436	307	346	363	232	#####	#####	83	1566	236	43	233	38	37
95	310	415	301	339	356	231	#####	#####	83	1558	235	43	232	38	37
100	300	398	296	334	348	229	#####	#####	83	1548	234	43	232	38	37
105	293	383	292	327	340	226	#####	#####	81	1542	234	44	231	38	37
110	281	369	292	319	332	223	#####	#####	80	1537	233	44	230	39	37
115															

TEMPERATURE DATA SHEET #14A

		TEST TIME	110		
STACK AVG	383	TOP AVG	507	LT SIDE AVG	310
BACK AVG	316	RT SIDE AVG	340	BOTTOM AVG	229
FIREBOX AVG	########	SEC/CAT AVG	########	AMBIENT AVG	81

END	307.0	
START	305.5	
	1.5	DELTA T

CIRCLE: LOSS / GAIN

ZERO / SPAN CHECK DATA SHEET #15-1

Date : 11-17-05 Analyte : CO_2 (15-1)

Unit : Jotol F400 Run # : 4

Zero Cyl. # : 168TAC 3-A Conc. : 0.00 % CO_2 Cyl. Press. : 1580 PSI

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

Span Cyl. # : CC-41627 Conc. : 12.50 % CO_2 Cyl. Press. : 1625 PSI

Certified by : AIR LIQUIDE Date : 11-1-05

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. Wardlaw Time : 1150 Temp : 83 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.1	.001	.037	.037	.148
SPAN	50.0	.500	12.50	49.9	.499	12.495	-.005	-.018

POST RUN Audit : by : C. Wardlaw Time : 1545 Temp : 80 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	.012	.012	.048
SPAN	50.0	.500	12.50	50.0	.500	12.520	.020	.082

± 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 #15-2

Date : 11-17-05 Analyte : O_2 (15-2)

Unit : Jotul F400 Run # : 4

Zero Cyl. # : 168TAC 3A Conc. : 0.00 % O_2 Cyl. Press. : 1580 PSI

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

Span Cyl. # : CC-41627 Conc. : 12.50 % O_2 Cyl. Press. : 1625 PSI

Certified by : AIR LIQUIDE Date : 11-1-05

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. Wadsworth Time : 1150 Temp : 83 ° F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.001	.030	.030	.119
SPAN	12.50	.500	12.50	12.5	.500	12.538	.038	.152

POST RUN Audit : by : C. Wadsworth Time : 1545 Temp : 80 ° F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.003	.080	.080	.320
SPAN	12.50	.500	12.50	12.5	.502	12.588	.088	.353

± 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 #15-3

Date : 11-17-05 Analyte : CO (15-3)

Unit : Jotol F400 Run # : 4

Zero Cyl. # : 168TAC 3-A Conc. : 0.00 % CO Cyl. Press. : 1580 PSI

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

Span Cyl. # : CC-41627 Conc. : 4.99 % CO Cyl. Press. : 1625 PSI

Certified by : AIR LIQUIDE Date : 11-1-05

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 Washington Time : 1150 Temp : 83 ° F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	.008	.008	.079
SPAN	49.9	.499	4.99	50.1	.501	5.005	.015	.058

POST RUN Audit : by : C Washington Time : 1545 Temp : 80 ° F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	.008	.008	.079
SPAN	49.9	.499	4.99	50.0	.500	4.995	.005	.045

± 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 : 11-17-05 Analyte : SO_2 (15-4)

Unit : Jotol F400 Run # : 4

Zero Cyl. # : 168TAC 3-A Conc. : 0.00 ppm SO_2 Cyl. Press. : 1580 PSI

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

Span Cyl. # : CC62184 Conc. : 1290 ppm SO_2 Cyl. Press. : 1600 PSI

Certified by : AIR LIQUIDE Date : 01-29-01

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. Waltmyer Time : 1150 Temp : 83 ° F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	PPM	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.1	.001	3.350	3.350	.134
SPAN	51.6	.516	1290	51.7	.517	1291.6	1.600	.064

POST RUN Audit : by : C. Waltmyer Time : 1545 Temp : 80 ° 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	.854	.854	.034
SPAN	51.6	.516	1290	51.5	.515	1286.6	-3.400	.136

± 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

QUALITY CHECKS DATA SHEET # 16

UNIT : Jotul F400 RUN : 4 DATE : 11-17-05

Thermocouple Check:

T/C # 1	— °F	T/C # 13	63.2 °F
T/C # 2	— °F	T/C # 14	62.3 °F
T/C # 3	63.7 °F	T/C # 15	62.3 °F
T/C # 4	56.7 °F	T/C # 16	64.6 °F
T/C # 5	54.9 °F	T/C # 17	62.1 °F
T/C # 6	54.2 °F	T/C # 18	69.1 °F
T/C # 7	54.3 °F	T/C # 19	68.2 °F
T/C # 8	52.7 °F	T/C # 20	— °F
T/C # 9	— °F	T/C # 21	— °F
T/C # 10	— °F	T/C # 22	— °F
T/C # 11	55.0 °F	T/C # 23	— °F
T/C # 12	66.5 °F	T/C # 24	— °F

Thermocouple Readout:

Pretest zero and span check and calibration			post test zero and span	% difference
ZERO -1.0 °F	Adj. to 0.0 °F		ZERO .6 °F	Difference .03 %
SPAN 1999.4 °F	Adj. to 2000.0 °F		SPAN 2002.3 °F	Difference .115 %

Thermocouple Readout Pretest Linearity Check:

0	= 0.0 °F	200	= 200.2 °F	400	= 400.1 °F
600	= 599.8 °F	800	= 799.7 °F	1000	= 999.7 °F
1200	= 1199.6 °F	1400	= 1399.4 °F	1600	= 1599.5 °F
1800	= 1799.7 °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 X	Post ✓

Scale Check Pre : 400.0 – 410.0 = 10.0

Post : 399.6 – 409.6 = 10.0

Stack Cleaned Prior to Test Run : YES _____ NO X

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		BASE	OPTIONS INSTALLED	
MAKE	weightronix		PRINTER	
MODEL	WI-110		SCORE BOARD	
SR#	16409		COMPUTER	
CLASS	III		OTHER	
CAP.	1000 lbs			

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

NVLAP

NVLAP LAB CODE 200446-0

MAR 0 8 2002

W98MR42-01, 11/98

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Established 1974

QUALITY CONTROL SERVICES

LABORATORY AND METROLOGY EQUIPMENT: SALES AND SERVICE
2340 S.E. 11th Avenue • Portland, Oregon 97214
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Lokee Testing Labs
13235 Prairie Circle East
Sumner, WA. 98390
Chip Wadington

Report Number: EESPC37010004050511

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 Used	Cal. Date	Last Cal.	Cal. Due
Grams	0.0001	QC004	05/11/2005	11/05/2004	11/2005

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

Standards	As Found	As Left
100	100.0004	100.0000
70	70.0003	70.0000
50	50.0002	50.0000
20	20.0001	20.0000
10	10.0001	10.0000
5	5.0000	5.0000

CALIBRATION STANDARDS

Item	Make	Model	Serial Number	Cal. Date	Cal. Due	Traceable ID#
Weight Set	R.L./Troemner	1MG-25KG	A45	12/20/2004	12/2005	822/268710-03

Comments / Info Concerning This Calibration:

Permanent Information Concerning This Instrument:

Technician: D.Deleasa

Signature: D. Deleasa

THIS CERTIFICATE SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF QUALITY CONTROL SERVICES, INC.

Thermocouple Calibration Record Semi-Annual

Thermocouples Check against
Reference Thermometer serial number 9123454
Ice Water Bath 32.0
Boiling Water 212.0
Room Temperature 68
Barometric Pressure 30.07
DATE: 11-7-2005

TC	Location	Ice Bath Temp	Boiling Water Temp
1	Wet Bulb	32.1	211.7
2	Dry Bulb	32.0	211.9
3	Stack	32.3	211.9
4	Stove Top	32.2	212.1
5	Left Side	32.0	212.0
6	Back	32.1	211.3
7	Right Side	32.0	211.7
8	Bottom	32.0	212.1
9	Firebox	32.3	211.0
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	211.1
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	32.0	211.3
18	Upper Ambient	32.1	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: 11-7-2005
Ambient Temperature: 69
Technician: Cp

Thermocouple Number: T/C Readout
Barometric Pressure: 30.07
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	.067
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] $\frac{(\text{reference temperature}) - (\text{thermocouple temperature})}{\text{reference temperature}} * 100$

TRACEABILITY DOCUMENTATION Semi-Annual

S02 INJECTION ROTAMETER, DRY GAS METER AND SLING PSYCHROMETER THERMOMETERS IN LAB. CHECKED AGAINST FISHER SN 9123454 (NIST).

DATE: 11-7-2005

SO^2 INJECTION ROTAMETER FISHER SN 9123454

Actual	°C = °F	NIST Traceable °F
0.0	32.0	32.0
25.0	77.0	77.0
33.0	91.4	91.6
48.7	119.7	119.8

DRY GAS METER THERMOCOUPLES

Actual	°C = °F	5H in	5H out	KK
0.0	32.0	32.0	32.0	32.2
24.6	72.3	72.1	72.4	72.3
32.4	90.3	90.1	90.2	90.0
48.0	118.4	118.3	118.4	118.1

SLING PSYCHROMETER

Actual	°C = °F	Wet Bulb	Dry Bulb
0.0	32.0	32.0	32.0
22.0	73.8	73.8	73.8
28.4	83.1	83.0	83.0
32.7	90.8	90.8	90.8

Conversions = °F = (°C × 1.8) + 32 °C = (°F-32)÷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.

POST TEST METER BOX AUDIT DATA SHEET # 32

UNIT: Jotul F400 DATE: 11-22-05

TEST DATA

RUN #	1	2	3	4	5	6	7	8	9	10
AVG. Δ H	.147	.207	.213	.188						
MAX VAC	3.0	3.0	2.0	3.0						

Avg. Test Series Δ H : .189 in H_2O Test Series Max Vac: 3.0 in Hg

Audit Dry Gas Meter : K2 Correction (Y) Factor : 1.063 (mcf)

Test Dry Gas Meter : H Correction (Y) Factor : .972 (mcf)

AUDIT DATA

		Audit # 1	Audit #2	Audit #3
BP		30.20	30.20	30.20
VAC		3.0	3.0	3.0
AUDIT METER :				
VOL.	Final	686.586	691.700	696.546
(Vw)	Initial	681.800	686.586	691.700
	Vol.	4.786	5.114	
TEMP (°F)	Initial	80	88	90
(Tw)	Mid	85	89	91
	Final	90	90	92
(°F / °A)	**Avg.**	85 545	549	551
Δ H	Initial	.189	.189	.189
	Mid	.189	.189	.189
	Final	.189	.189	.189
	Avg.	.189	.189	.189
DRY GAS METER :				
VOL.	Final	453.500	458.800	463.800
(Vd)	Initial	448.500	453.500	458.800
	Vol.	5.000	5.300	5.000
TEMP (°F)	Initial	81	85	87
(Tm)	Mid	83	86	87
	Final	85	87	87
(°F / °A)	**Avg.**	83 543	546	547

$$Y = \frac{(Vw)(mcf)(BP)(Tm)}{(Vd)\left(BP + \frac{DH}{13.6}\right)(Tw)}$$

$$\text{Y Factor \% Diff.} = \frac{Act - Exp}{Exp} \times 100$$

NOTE : mcf = meter correction (Y) factor for Dry Gas Meter used as a transfer standard

RUN 1

$$Y = \frac{(4.786)(1.003)(30.20)(543)}{(5.000)\left(30.20 + \frac{.189}{13.6}\right)(545)} = \frac{78719.2}{82332.9} = .956$$

$$\Delta\% = \frac{(.956 - .963)}{.963} \times 100 = -.727\ \%$$

RUN 2

$$Y = \frac{(\quad)(\quad)(\quad)(\quad)}{(\quad)\left(\quad + \frac{\quad}{13.6}\right)(\quad)} = ____ = ____$$

$$\Delta\% = \frac{(\quad - \quad)}{\quad} \times 100 = ____\ \%$$

RUN 3

$$Y = \frac{(\quad)(\quad)(\quad)(\quad)}{(\quad)\left(\quad + \frac{\quad}{13.6}\right)(\quad)} = ____ = ____$$

$$\Delta\% = \frac{(\quad - \quad)}{\quad} \times 100 = ____\ \%$$

NOTE : The Y factor % difference must be < ± 5.0 % to be acceptable

INTERPOLATED Y FACTOR

.1 (A) inch H_2O ΔH = .955 (C) — Calculated calibration Y factor from calibrations

.2 (B) inch H_2O ΔH = .964 (D) — Calculated calibration Y factor from calibrations

.2 (B) - .1 (A) = .1 X 100 = 10 (E)

.964 (D) - .955 (C) = .009 ÷ 10 (E) .0009 (F)

.189 Avg ΔH - .1 (A) = .089 X 100 = 8.9 (G)

[.0009 (F) X 8.9 (G)] + .955 (C) = .963 Interpolated Y factor

Volume Metering System Leak Check : 0.000 inch H_2O in one minute

DRY GAS METER CALIBRATION

DATE : 11-6-05 DRY GAS METER : H BOX : 5

BAROMETRIC PRESSURE 29.76 in. Hg.				Wet Test Meter Correction Factor Y= 1.003			
Orifice Manometer Setting, ΔH, in. H_2O		.1	.2	.3	.5	.75	1.0
Gas Volume Wet Test Meter Vw ft^3	Final	654.692	659.545	664.448	671.645	676.600	681.550
	Initial	648.500	654.692	659.545	664.448	671.645	676.600
	Vw ft^3	6.192	4.853	4.903	7.197	4.955	4.950
Gas Volume Dry Test Meter Vd ft^3	Final	133.600	138.600	143.600	150.900	155.900	160.900
	Initial	127.100	133.600	138.600	143.600	150.900	155.900
	Vw ft^3	6.500	5.000	5.000	7.300	5.000	5.000
Wet Test Meter Temperature tw	Initial	82	90	94	95	95	95
	Middle	86	92	95	95	95	95
	Final	90	94	95	95	95	95
	Average	86 546	552	555	555	555	555
Dry Test Meter Temperature tm	Initial	85	86	87	88	89	90
	Middle	86	87	88	89	89	90
	Final	86	87	88	89	90	90
	Average	86 546	547	548	549	549	550
$Y = \frac{(W_{mcf})(Vw)(Pb)(tm)}{Vd\left(Pb + \frac{\Delta H}{13.6}\right)(tw)}$		.955	.964	.970	.977	.981	.982

Average Y= .972

METER BOX CALIBRATION

Date : 11/10/05
Calibrated By : J.C.
Dry Gas Meterbox ID : K2

Barometric Pressure, Pb = 28.37 in. Hg
Vacuum = 0.0 in. Hg

Orifice Manometer Setting, Delta H in. H20	0.10	0.10	0.10	0.10	0.10	0.10
Gas Volume Wet Test Meter Vw, cu. ft.	5.000	5.000	5.000	5.000	5.000	5.000
Gas Volume Dry Gas Meter						
M Final	455.032	460.080	465.135	470.200	475.266	480.333
M Initial	450.000	455.032	460.080	465.135	470.200	475.266
Vd, cu. ft.	5.032	5.048	5.055	5.065	5.066	5.067
Wet Test Meter						
tw Deg F	78	78	78	78	78	78
tw Deg A	538	538	538	538	538	538
Dry Gas Meter Outlet, tmo 1)	80	83	84	85	85	86
2)	82	84	84	85	86	86
3)	84	85	85	86	86	87
Dry Gas Meter Inlet tmi 1)	81	84	85	86	87	88
2)	82	85	86	87	87	88
3)	84	86	86	87	87	88
Mean tm, Deg F	82	85	85	86	86	87
Mean tm, Deg A	542	545	545	546	546	547

Results :

Y =	1.001	1.002	1.002	1.002	1.002	1.003

Averages :

Y = **1.002**

Avg = 1.003

METER BOX CALIBRATION

Date : 11/10/05
Calibrated By : J.C.
Dry Gas Meterbox ID : K2

Barometric Pressure, Pb = 28.37 in. Hg
Vacuum = 0.0 in. Hg

Orifice Manometer Setting, Delta H in. H20	0.20	0.20	0.20	0.20	0.20	0.20
Gas Volume Wet Test Meter Vw, cu. ft.	5.000	5.000	5.000	5.000	5.000	5.000
Gas Volume Dry Gas Meter						
M Final	485.422	490.521	495.618	500.720	505.829	510.935
M Initial	480.333	485.422	490.521	495.618	500.720	505.829
Vd, cu. ft.	5.089	5.099	5.097	5.102	5.109	5.106
Wet Test Meter						
tw Deg F	78	78	78	78	78	78
tw Deg A	538	538	538	538	538	538
Dry Gas Meter Outlet, tmo 1)	88	89	89	89	90	90
2)	88	89	89	89	90	90
3)	89	89	89	90	90	90
Dry Gas Meter Inlet tmi 1)	89	90	90	91	92	92
2)	90	91	91	92	92	92
3)	90	91	92	92	93	92
Mean tm, Deg F	89	90	90	91	91	91
Mean tm, Deg A	549	550	550	551	551	551

Results :

Y =	1.002	1.002	1.002	1.002	1.002	1.002

Averages :

Y = 1.002

METER BOX CALIBRATION

Date : 11/10/05
Calibrated By : J.C.
Dry Gas Meterbox ID : K2

Barometric Pressure, Pb = 28.37 in. Hg
Vacuum = 0.0 in. Hg

Orifice Manometer Setting, Delta H in. H20	0.30	0.30	0.30	0.30	0.30	0.30
Gas Volume Wet Test Meter Vw, cu. ft.	5.000	5.000	5.000	5.000	5.000	5.000
Gas Volume Dry Gas Meter						
M Final	516.042	521.144	526.255	531.375	536.501	541.628
M Initial	510.935	516.042	521.144	526.255	531.375	536.501
Vd, cu. ft.	5.107	5.102	5.111	5.120	5.126	5.127
Wet Test Meter						
tw Deg F	78	78	78	78	78	78
tw Deg A	538	538	538	538	538	538
Dry Gas Meter Outlet, tmo 1)	90	90	91	92	92	93
2)	90	91	91	92	92	93
3)	91	91	91	92	93	93
Dry Gas Meter Inlet tmi 1)	90	92	92	93	94	95
2)	91	92	93	94	95	96
3)	92	92	93	94	96	96
Mean tm, Deg F	91	91	92	93	94	94
Mean tm, Deg A	551	551	552	553	554	554

Results :

Y =	1.002	1.003	1.003	1.003	1.003	1.004

Averages :

Y = 1.003

METER BOX CALIBRATION

Date : 11/10/05
Calibrated By : J.C.
Dry Gas Meterbox ID : K2

Barometric Pressure, Pb = 28.37 in. Hg
Vacuum = 0.0 in. Hg

Orifice Manometer Setting, Delta H in. H20	0.50	0.50	0.50	0.50	0.50	0.50
Gas Volume Wet Test Meter Vw, cu. ft.	5.000	5.000	5.000	5.000	5.000	5.000
Gas Volume Dry Gas Meter						
M Final	546.755	551.874	557.001	562.132	567.276	572.421
M Initial	541.628	546.755	551.874	557.001	562.132	567.276
Vd, cu. ft.	5.127	5.119	5.127	5.131	5.144	5.145
Wet Test Meter						
tw Deg F	78	79	79	79	79	79
tw Deg A	538	539	539	539	539	539
Dry Gas Meter Outlet, tmo 1)	93	93	94	95	96	96
2)	93	94	95	96	96	97
3)	94	94	95	96	96	97
Dry Gas Meter Inlet tmi 1)	93	94	95	96	97	97
2)	94	95	96	97	98	98
3)	95	96	98	98	99	100
Mean tm, Deg F	94	94	96	96	97	98
Mean tm, Deg A	554	554	556	556	557	558

Results :

Y =	1.003	1.003	1.004	1.004	1.003	1.004

Averages :

Y = 1.004

METER BOX CALIBRATION

Date : 11/10/05
Calibrated By : J.C.
Dry Gas Meterbox ID : K2

Barometric Pressure, Pb = 28.37 in. Hg
Vacuum = 0.0 in. Hg

Orifice Manometer Setting, Delta H in. H20	0.75	0.75	0.75	0.75	0.75	0.75
Gas Volume Wet Test Meter Vw, cu. ft.	5.000	5.000	5.000	5.000	5.000	5.000
Gas Volume Dry Gas Meter M Final	577.560	582.704	587.855	593.017	598.174	603.330
M Initial	572.421	577.560	582.704	587.855	593.017	598.174
Vd, cu. ft.	5.139	5.144	5.151	5.162	5.157	5.156
Wet Test Meter tw Deg F	79	79	79	79	80	80
tw Deg A	539	539	539	539	540	540
Dry Gas Meter Outlet, tmo 1)	95	96	97	99	99	100
2)	95	96	98	99	99	99
3)	96	97	98	100	100	100
Dry Gas Meter Inlet tmi 1)	95	97	99	100	101	101
2)	97	98	100	100	101	101
3)	100	100	100	101	102	101
Mean tm, Deg F	96	97	99	100	100	100
Mean tm, Deg A	556	557	559	560	560	560

Results :

Y =	1.002	1.003	1.004	1.004	1.004	1.004

Averages :

Y = 1.004

METER BOX CALIBRATION

Date : 11/10/05
Calibrated By : J.C.
Dry Gas Meterbox ID : K2

Barometric Pressure, Pb = 28.37 in. Hg
Vacuum = 0.0 in. Hg

Orifice Manometer Setting, Delta H in. H20	1.00	1.00	1.00	1.00	1.00	1.00
Gas Volume Wet Test Meter Vw, cu. ft.	5.000	5.000	5.000	5.000	5.000	5.000
Gas Volume Dry Gas Meter						
M Final	608.466	613.628	618.799	623.973	629.155	634.343
M Initial	603.330	608.466	613.628	618.799	623.973	629.155
Vd, cu. ft.	5.136	5.162	5.171	5.174	5.182	5.188
Wet Test Meter						
tw Deg F	80	80	80	80	80	80
tw Deg A	540	540	540	540	540	540
Dry Gas Meter Outlet, tmo 1)	98	99	101	102	102	102
2)	99	101	102	102	102	103
3)	101	102	102	102	103	103
Dry Gas Meter Inlet tmi 1)	95	99	102	103	104	105
2)	97	101	102	103	104	106
3)	101	102	103	104	105	106
Mean tm, Deg F	99	101	102	103	103	104
Mean tm, Deg A	559	561	562	563	563	564

Results :

Y =	1.005	1.003	1.004	1.004	1.004	1.004

Averages :

Y = 1.004

WET TEST METER CALIBRATION LOG

Wet Test Meter Serial Number AA 455 Date 9-17-2005

Range of Wet Test Meter Flow Rate 0 - 0.25

Volume of Test Flask Vs 37.850

Satisfactory Leak Check? Yes

Ambient Temperature of Equilibrate Liquid in Wet Test Meter and Reservoir 70

TEST #	MANOMETER READING, *a* mm H_2O	FINAL VOLUME (Vf), l	INITIAL VOLUME (Vi), l	TOTAL VOLUME (Vm), *b* l	FLASK VOLUME (Vs), l	PERCENT ERROR, *c* %
1	Ø	3.0	Ø All reset	3.0	3.001	-.033
2	Ø	3.0	Ø	3.0	3.003	-.100
3	Ø	3.0	Ø	3.0	3.001	-.033

a - Must be less than 10 mm H_2O (0.4 ' H_2O)

Calculations:

b - Vm - Vf - Vi

c - % error = $\frac{100\,(V_m - V_s)}{V_s}$ = -.055 (± 1 %)

SO_2 ROTAMETER CALIBRATION

Last Cal. : 5-8-05 By : CpW. Date : 11-8-05 By : Cp

Manufacturer : SKC-WEST
SKC ACCUFLOW Digital Flow Calibrator: Model 712 SN : 311325

Barometric Pressure : 30.17 " Hg Temperature : 72.

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

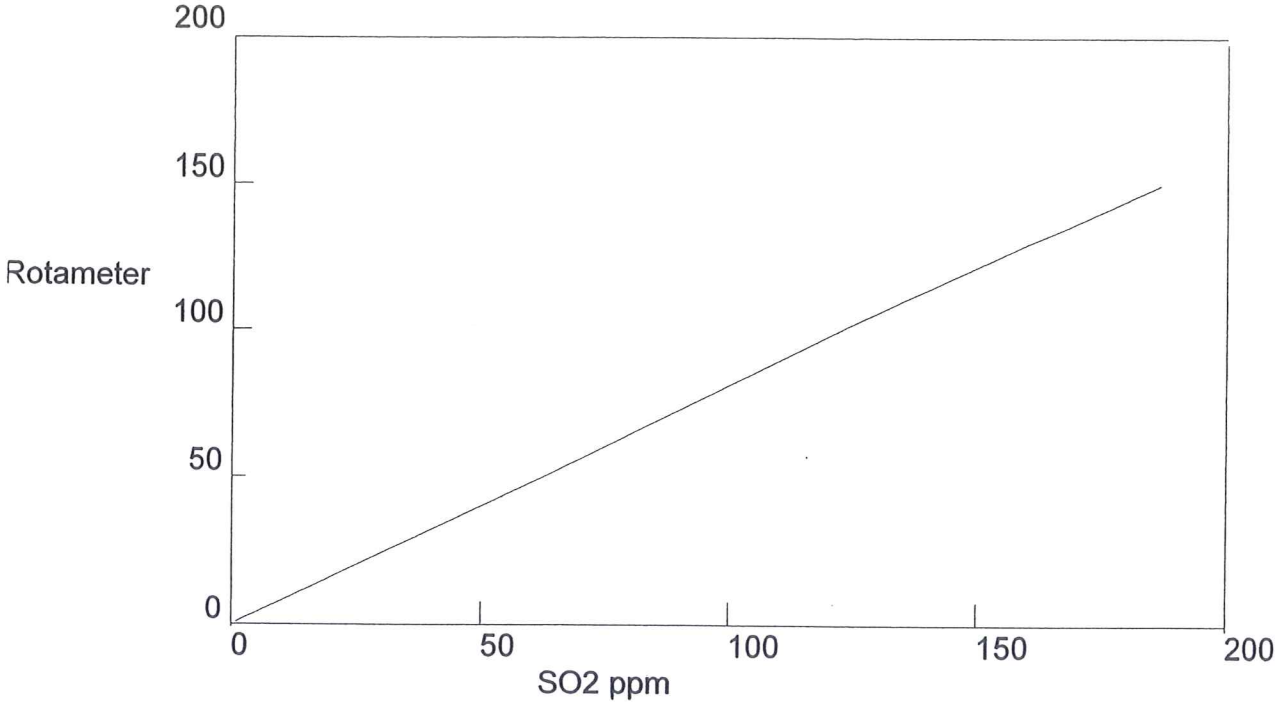
SETTING	cc/min
0	0.0
50	56.0
100	120.5
150	173.5

Rotometer setting for 100 cc/minute based on regression with this data.

100 CC / MINUTE = _____

SO2 Rotameter

11/08/05



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

TRACER GAS TRAIN RESPONSE TIME

DATE : 11-8-2005

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	11
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	.500	.501	.500	.499	.500	.500
15	.485	.482	.480	.590	.595	.591	.250	.240	.240
30	.342	.345	.340	.690	.695	.691	.050	.045	.050
45	.148	.150	.150	.775	.780	.777	.019	.018	.015
60	.082	.080	.083	.814	.815	.810	.007	.006	.004
75	.039	.037	.038	.828	.830	.829	.002	.002	.001
90	.020	.021	.022	.830		.830	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 : 11-8-2005

Gas	1	2	3	AVE	CONC	TANK ID
CO_2	0	0	0	0	N_2	168TAC-3-A
O_2	0	0	0	0	N_2	
CO	0	0	0	0	N_2	
CO_2					12.5	CC-41627
O_2					12.5	NEW
CO					4.99	TANK 11-1-05
CO_2	21.2	21.2	21.2	21.20	21.23	CC55904
O_2	21.1	21.1	21.1	21.10	21.10	
CO	8.6	8.6	8.6	8.6	8.60	
CO_2	6.2	6.2	6.2	6.20	6.22	CC-12731
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: 11-9-05

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

Calibration by: [signature]

Cal Gas Flow: 1.5 SCFH Measured by: Rotameter

BP: 30.08 Instrument ID: PRINCO

Temp: 50 Instrument ID: TR

Cylinders:

1. # 168TAC 3-A Concentration: 00.00 % CO_2 Cyl. Press.: 1580 PSI
   Certified by: AIR LIQUIDE Date: 04-19-04
2. # CC-41627 Concentration: 12.50 % CO_2 Cyl. Press.: 1625 PSI
   Certified by: AIR LIQUIDE Date: 11-1-05
3. # CC55904 Concentration: 21.23 % CO_2 Cyl. Press.: 400 PSI
   Certified by: AIR LIQUIDE Date: 02-14-00
4. # CC-12731 Concentration: 6.22 % CO_2 Cyl. Press.: 1380 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	.000	00.0	.000
2	2	12.40	49.6	.496	50.2	.502	49.6	.496
3	3	21.23	84.9	.849	84.8	.848		
4	4	6.22	24.9	.249	24.7	.247		
5	1	0.00	00.0	.000	0.00	.000		

.5 = 12.520

CO_2 Linear Regression Results:

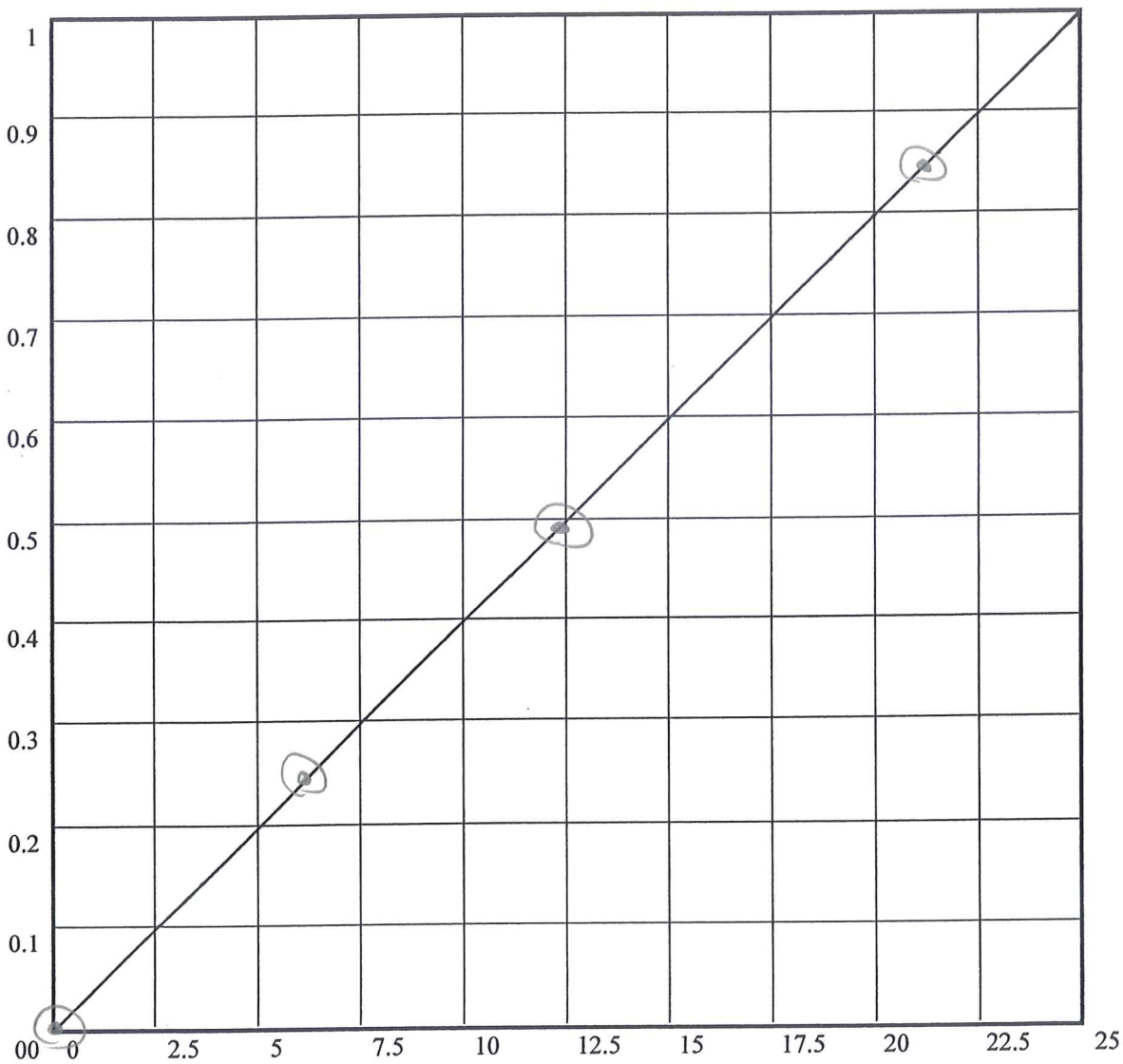
Y = MX +B

Slope (M) = -.0004754

Y Intercept (B) = .0399724

Correlation Coefficient (r) = .9999971

r^2 = .9999943

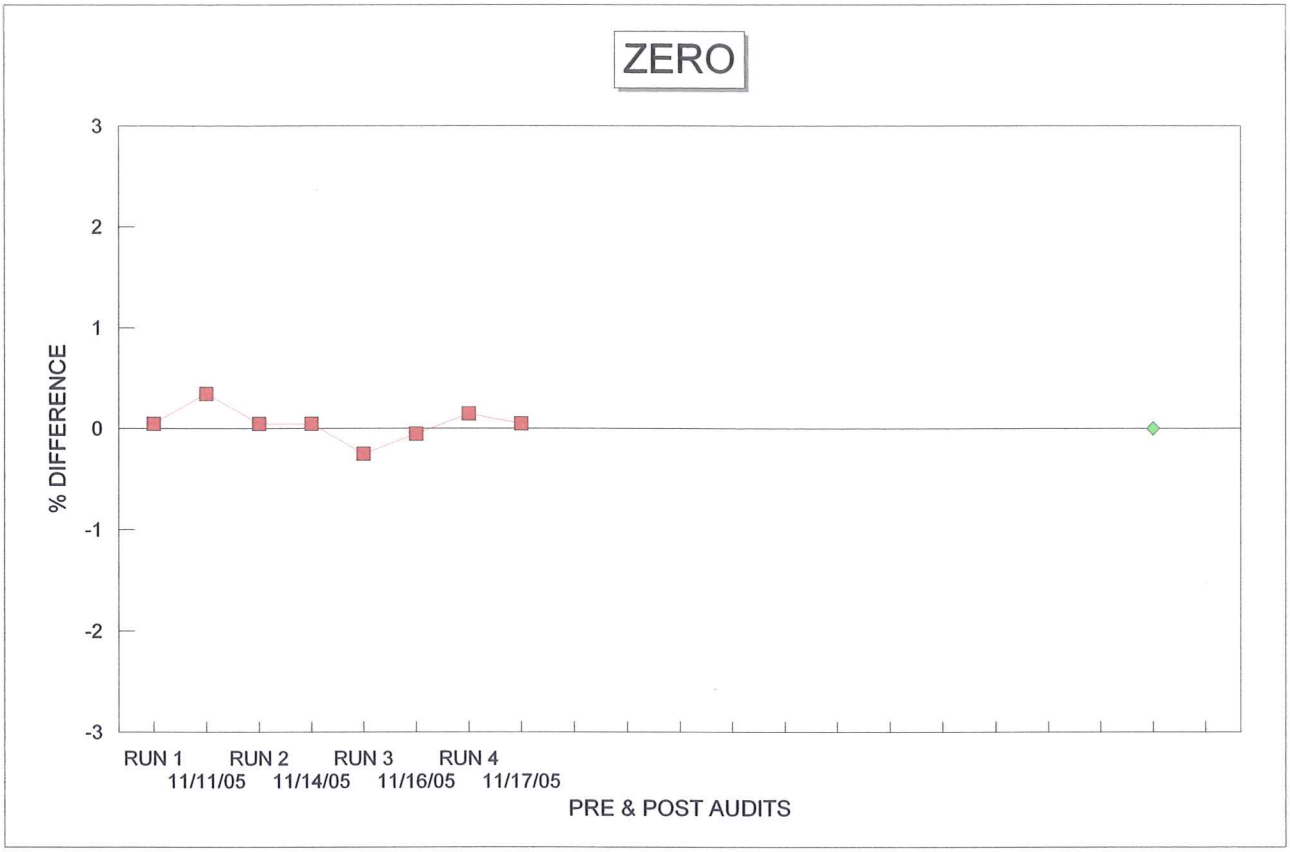


EPA Span Value = ± 2.0% of 25% CO_2 = ± .5%

Cal Volts = Cal Volt Conc - Std Conc = ± Conc Diff = ± Δ %

HIGH VOLTS .848 = 21.20 - 21.23 = -.030 = -.120

LOW VOLTS .247 = 6.175 - 6.22 = -.045 = -.180


ZERO
3
2
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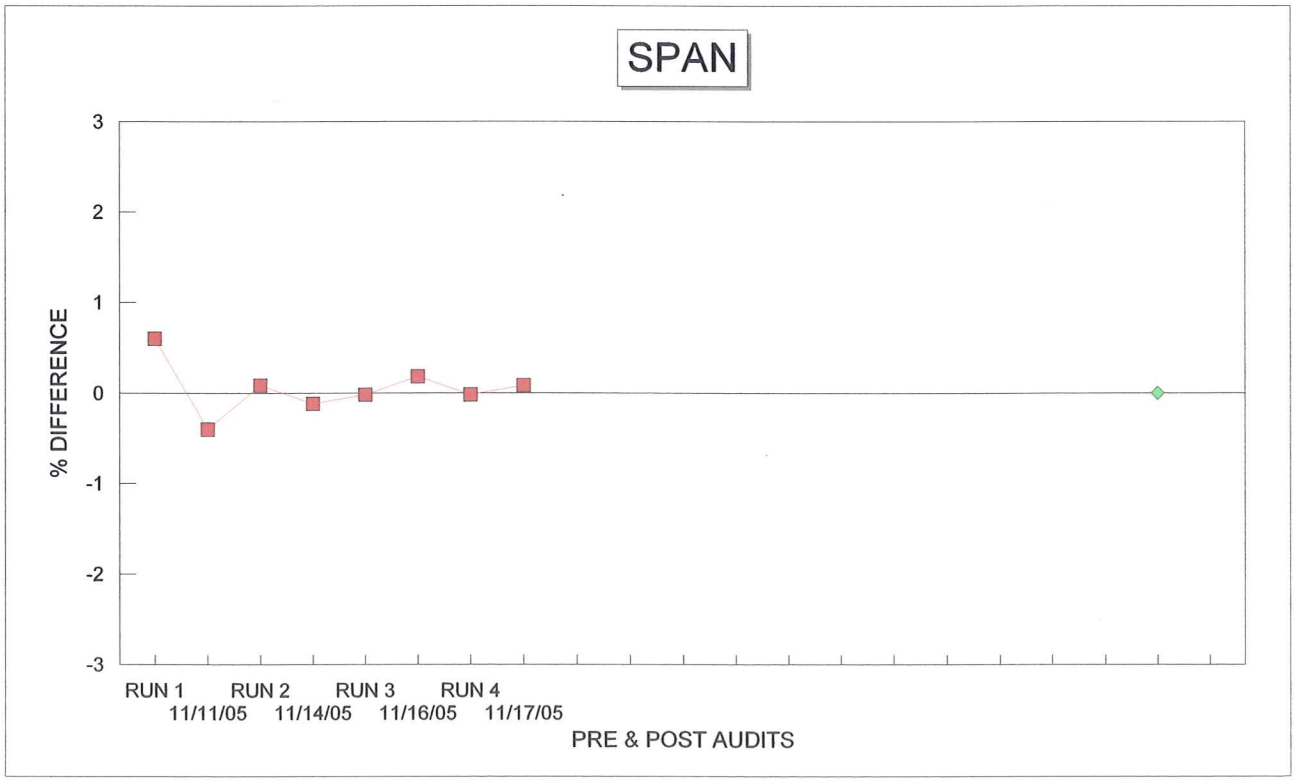
-1
-2
-3
% DIFFERENCE
RUN 1
11/11/05
RUN 2
11/14/05
RUN 3
11/16/05
RUN 4
11/17/05
PRE & POST AUDITS


SPAN
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-1
-2
-3
% DIFFERENCE
RUN 1
11/11/05
RUN 2
11/14/05
RUN 3
11/16/05
RUN 4
11/17/05
PRE & POST AUDITS

O_2 ANALYZER
MULTIPOINT CALIBRATION REPORT FORM

Date: 11-9-05

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

Calibration by: [illegible]

Cal Gas Flow: 1.5 SCFH Measured by: Rotameter

BP: 30.08 Instrument ID: PRINCO

Temp: 50 Instrument ID: TR

Cylinders:

1. # 168TAC 3-A Concentration: 00.00 % O_2 Cyl. Press.: 1580 PSI
   Certified by: AIR LIQUIDE Date: 04-19-04
2. # CC-41627 Concentration: 12.50 % O_2 Cyl. Press.: 1625 PSI
   Certified by: AIR LIQUIDE Date: 11-1-05
3. # CC55901 Concentration: 21.10 % O_2 Cyl. Press.: 400 PSI
   Certified by: AIR LIQUIDE Date: 02-14-00
4. # CC-12731 Concentration: 6.25 % O_2 Cyl. Press.: 1380 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. #	% O2	EXPECTED METER	EXPECTED DVM	ACTUAL METER	ACTUAL DVM	ADJ. METER	ADJ. DVM
1	1	0.00	00.0	.000	00.0	.000	00.0	.000
2	2	12.50	12.50	.500	12.6	.504	12.5	.500
3	3	21.10	21.10	.844	21.0	.841		
4	4	6.25	6.25	.250	6.20	.248		
5	1	0.00	00.0	.000	0.00	.000		

.5 = 12.538

O_2 Linear Regression Results:

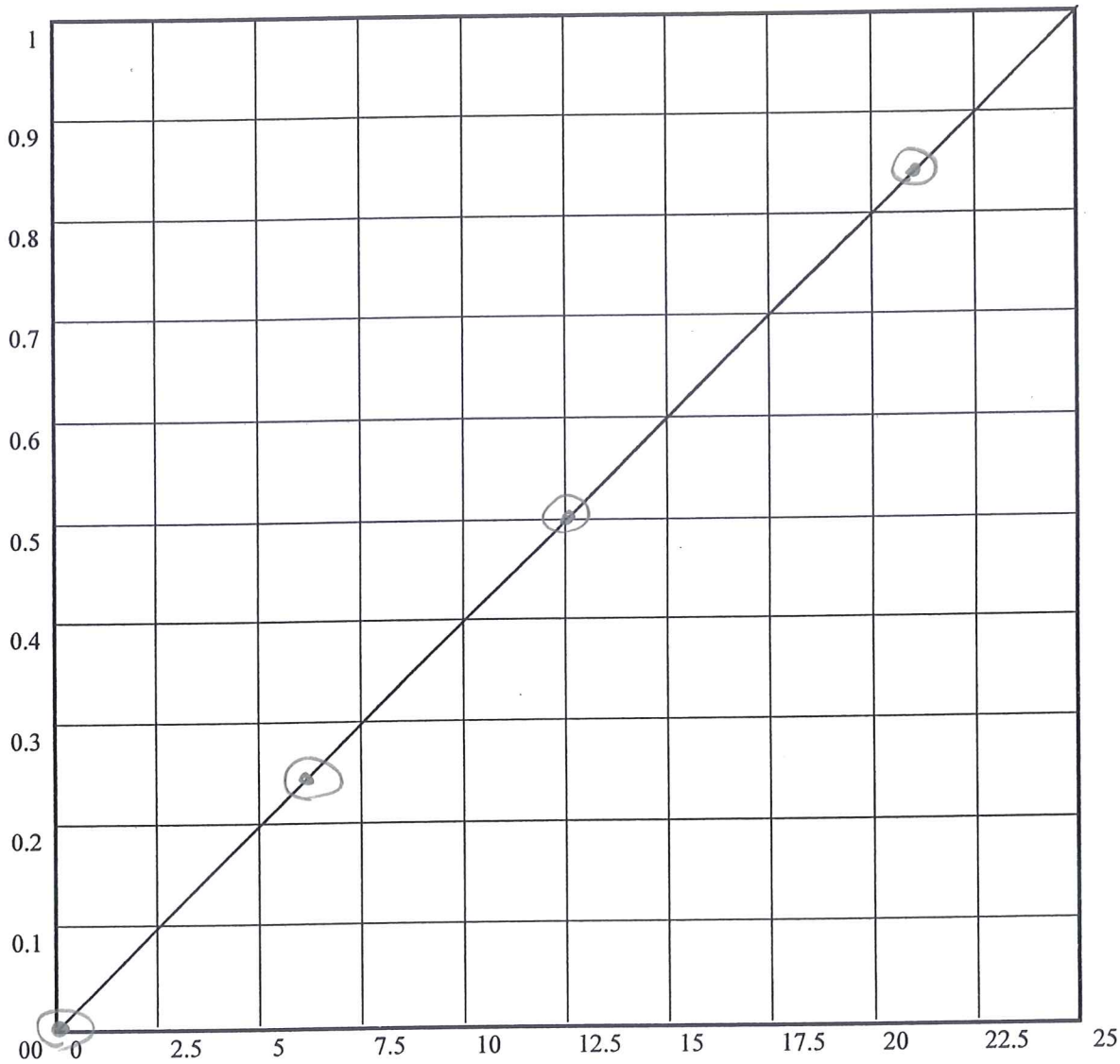
Y = MX +B

Slope (M) = -.0001868

Y Intercept (B) = .0398933

Correlation Coefficient (r) = .9999949

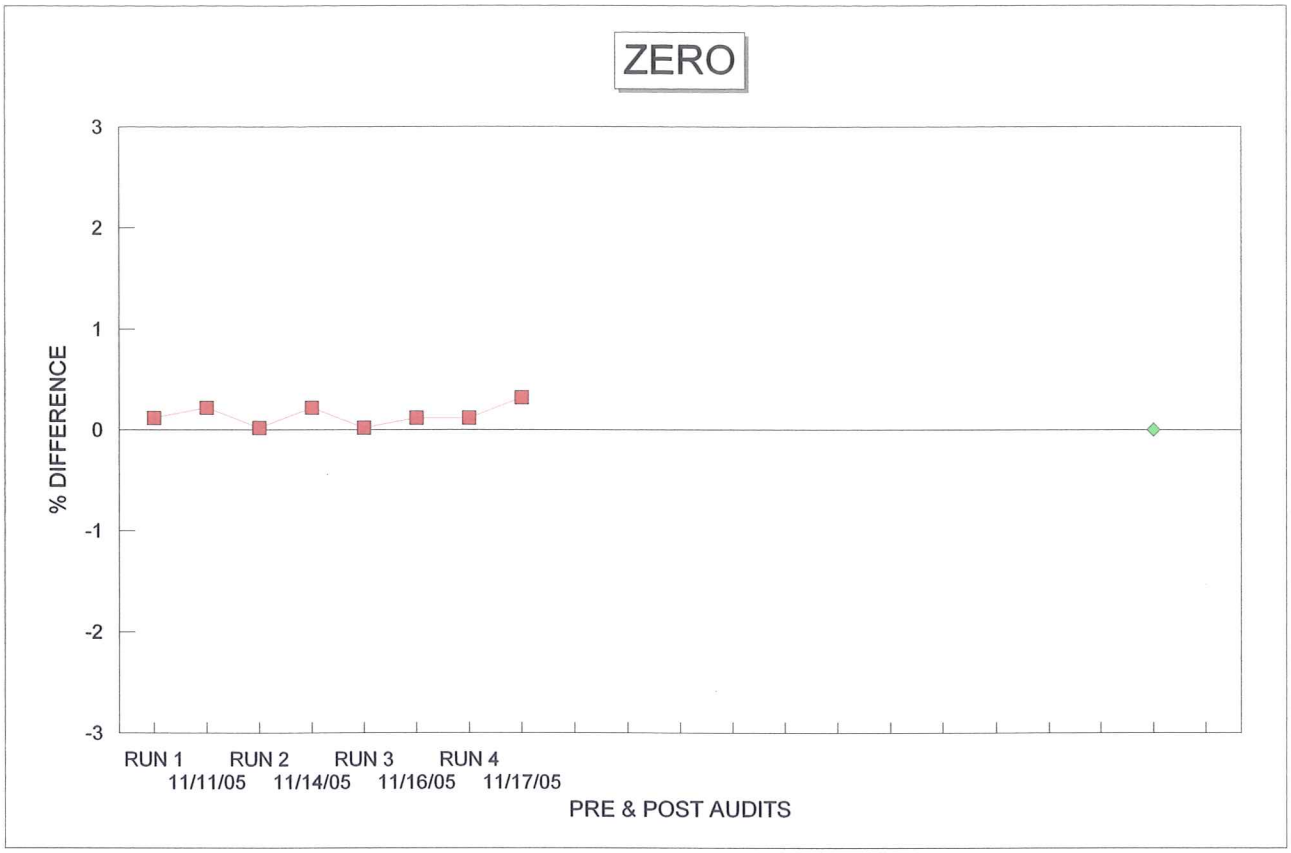
r^2 = .9999897



EPA Span Value = ± 2.0% of 25% O_2 = ± .5%

Cal Volts = Cal Volt Conc - Std Conc = ± Conc Diff = ± Δ %

HIGH VOLTS	.841	=	21.025	-	21.10	=	-.075	=	-.300
LOW VOLTS	.248	=	6.20	-	6.25	=	-.050	=	-.200


ZERO
3
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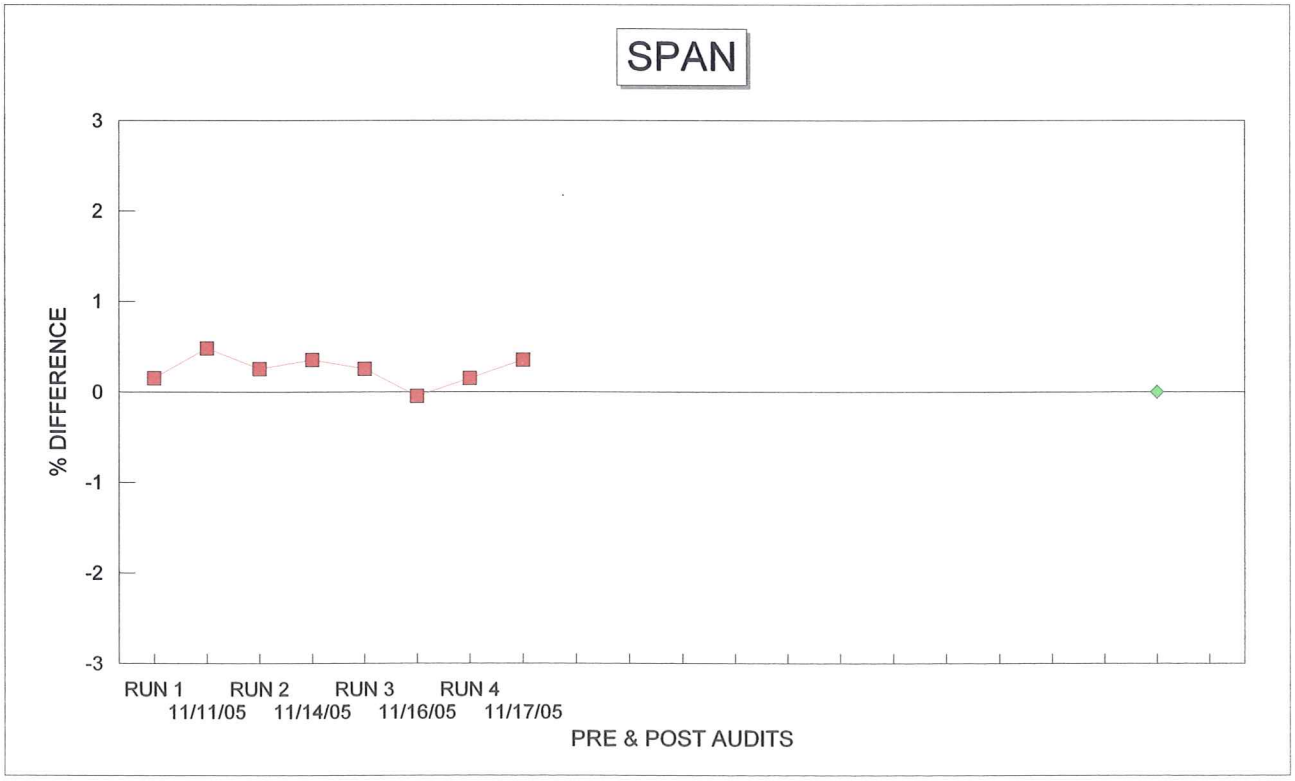
% DIFFERENCE
RUN 1
11/11/05
RUN 2
11/14/05
RUN 3
11/16/05
RUN 4
11/17/05
PRE & POST AUDITS


SPAN
3
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1
0
-1
-2
-3
% DIFFERENCE
RUN 1
11/11/05
RUN 2
11/14/05
RUN 3
11/16/05
RUN 4
11/17/05
PRE & POST AUDITS

CO ANALYZER
MULTIPOINT CALIBRATION REPORT FORM

Date: 11-9-05

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

Calibration by: CP Wadsworth

Cal Gas Flow: 1.5 SCFH Measured by: Rotameter

BP: 30.08 Instrument ID: PRINCO

Temp: 50 Instrument ID: TR

Cylinders:

1. # 168TAC 3-A Concentration: 00.00 % **CO** Cyl. Press.: 1580 PSI
   Certified by: AIR LIQUIDE Date: 04-19-04
2. # CC-41627 Concentration: 4.99 % **CO** Cyl. Press.: 1625 PSI
   Certified by: AIR LIQUIDE Date: 11-1-05
3. # CC55904 Concentration: 8.60 % **CO** Cyl. Press.: 400 PSI
   Certified by: AIR LIQUIDE Date: 02-14-00
4. # CC-12731 Concentration: 1.98 % **CO** Cyl. Press.: 1380 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 METER	EXPECTED DVM	ACTUAL METER	ACTUAL DVM	ADJ. METER	ADJ. DVM
1	1	0.00	00.0	.000	00.0	-.001	00.0	.000
2	2	4.99	49.9	.499	49.9	.499	49.9	.499
3	3	8.60	86.0	.860	86.2	.862		
4	4	1.98	19.8	.198	19.7	.197		
5	1	0.00	00.0	.000	00.0	.000		

.5 = 4.9945

CO Linear Regression Results:

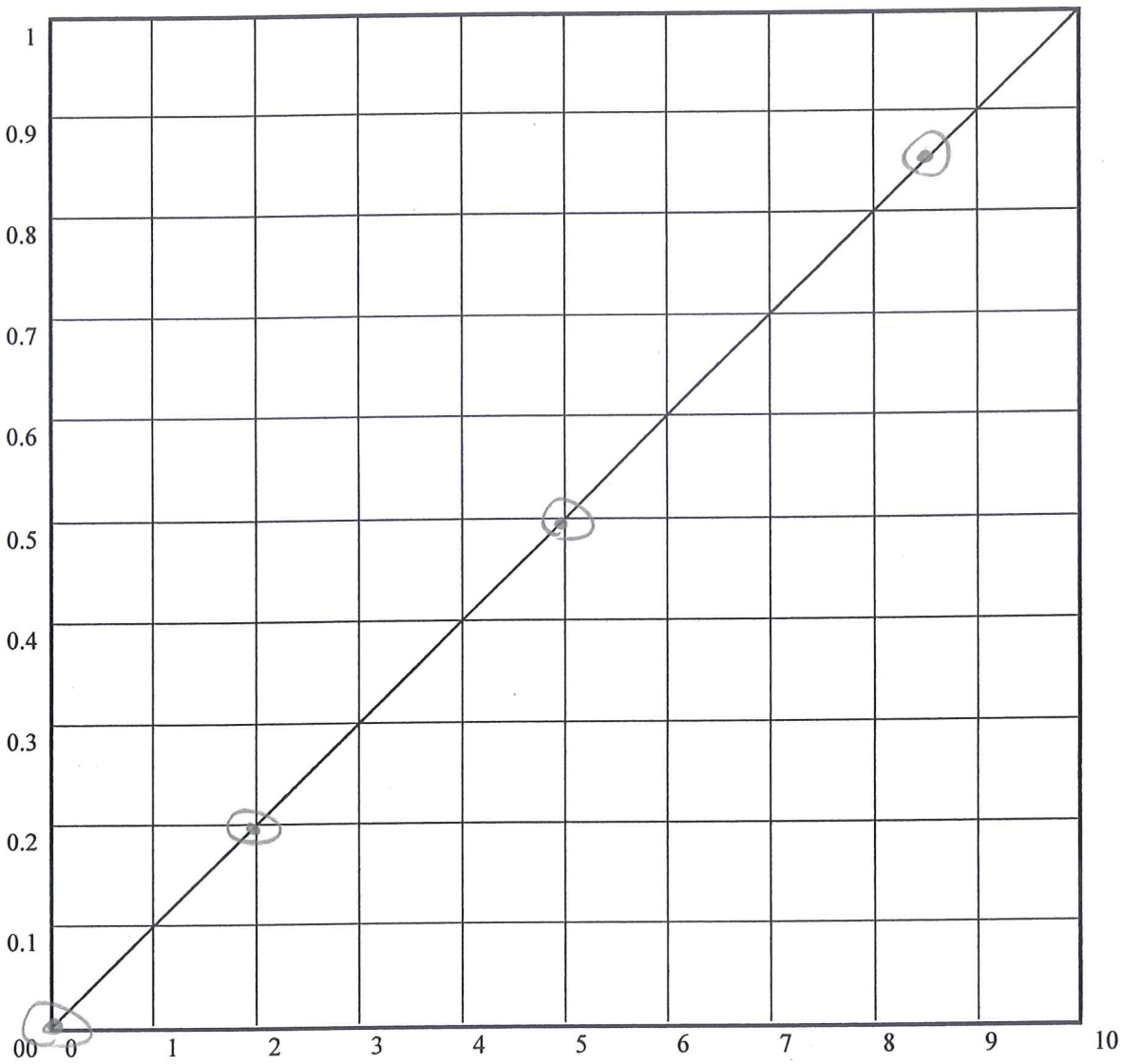
Y = MX +B

Slope (M) = -.0007955

Y Intercept (B) = .1002686

Correlation Coefficient (r) = .9999980

r^2 = .9999960

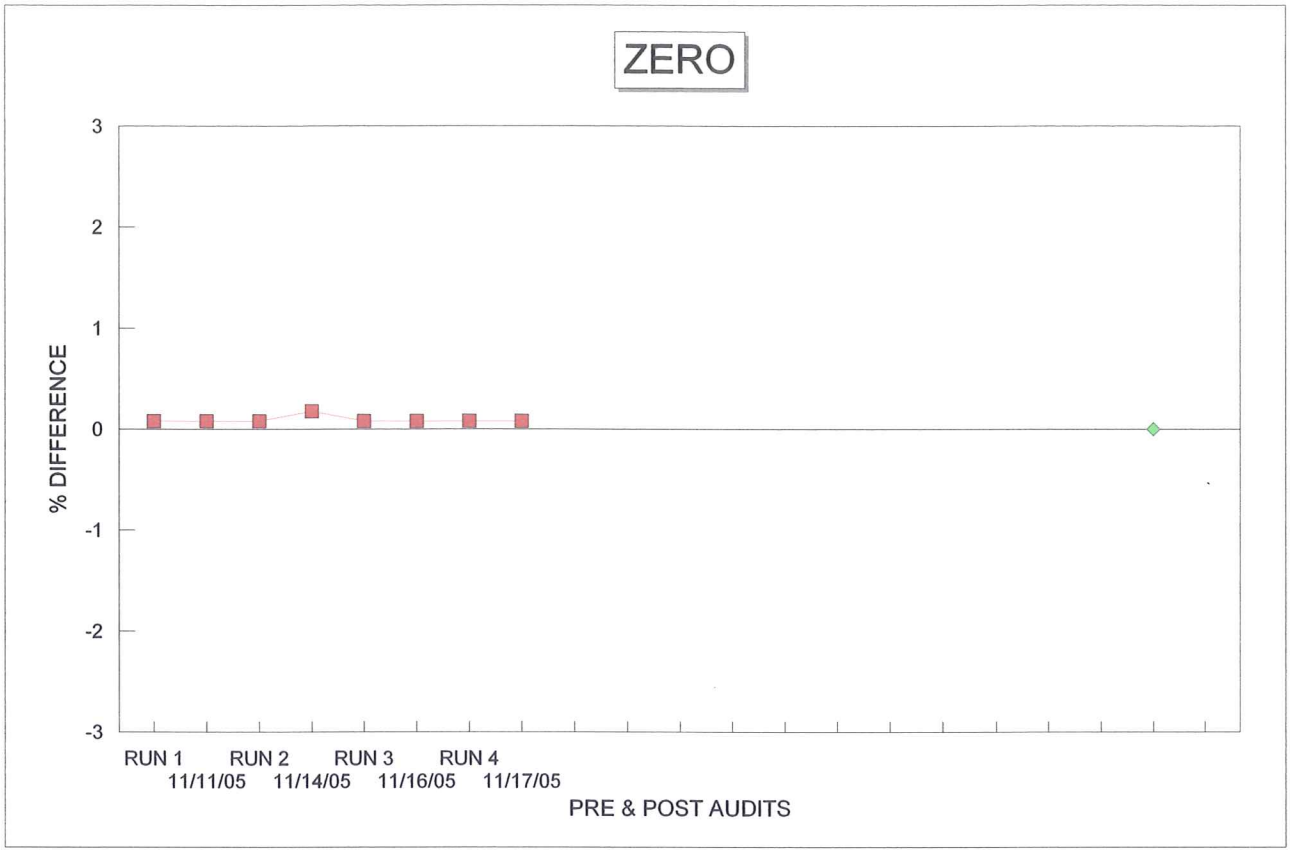


EPA Span Value = ± 2.0% of 10% CO = ± .2%

Cal Volts = Cal Volt Conc - Std Conc = ± Conc Diff = ± Δ %

HIGH VOLTS .862 = 8.62 - 8.60 = .020 = .200

LOW VOLTS .197 = 1.97 - 1.98 = -.010 = -.100


ZERO
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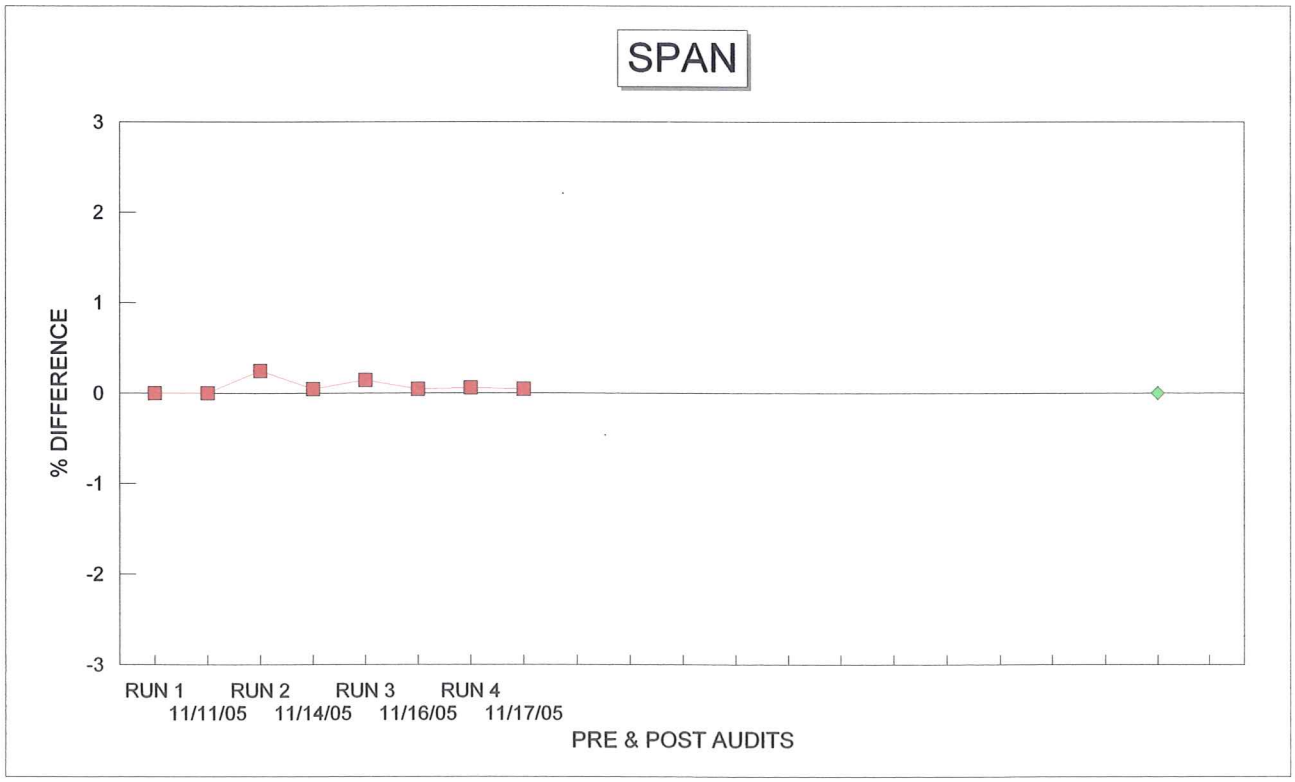
-3
% DIFFERENCE
RUN 1
11/11/05
RUN 2
11/14/05
RUN 3
11/16/05
RUN 4
11/17/05
PRE & POST AUDITS


SPAN
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0
-1
-2
-3
% DIFFERENCE
RUN 1
11/11/05
RUN 2
11/14/05
RUN 3
11/16/05
RUN 4
11/17/05
PRE & POST AUDITS

SO_2 ANALYZER
MULTIPOINT CALIBRATION REPORT FORM

Date: 11-9-05

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

Calibration by: Cp Wadsworth

Cal Gas Flow: 1.5 SCFH Measured by: Rotameter

BP: 30.08 Instrument ID: PRINCO

Temp: 50 Instrument ID: TR

Cylinders:

1. # 168TAC 3A Concentration: 00 00 % SO_2 Cyl. Press.: 1580 PSI
   Certified by: AIR LIQUIDE Date: 04-19-04
2. # CC62181 Concentration: 1290 % SO_2 Cyl. Press.: 600 PSI
   Certified by: AIR LIQUIDE Date: 01-29-01
3. # ALMO 49127 Concentration: 1770 % SO_2 Cyl. Press.: 790 PSI
   Certified by: SCOTT SPECIALTY GASES Date: 05-15-97
4. # ALMO 52285 Concentration: 506 % SO_2 Cyl. Press.: 725 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 METER	EXPECTED DVM	ACTUAL METER	ACTUAL DVM	ADJ. METER	ADJ. DVM
1	1	0.00	00.0	.000	00.0	.000	00.0	.000
2	2	1290	51.6	.516	52.8	.528	51.6	.516
3	3	1770	70.8	.708	70.9	.709		
4	4	506	20.2	.202	20.2	.202		
5	1	0.00	00.0	.000	00.0	.000		

.5 = 1249.132

SO_2 Linear Regression Results:

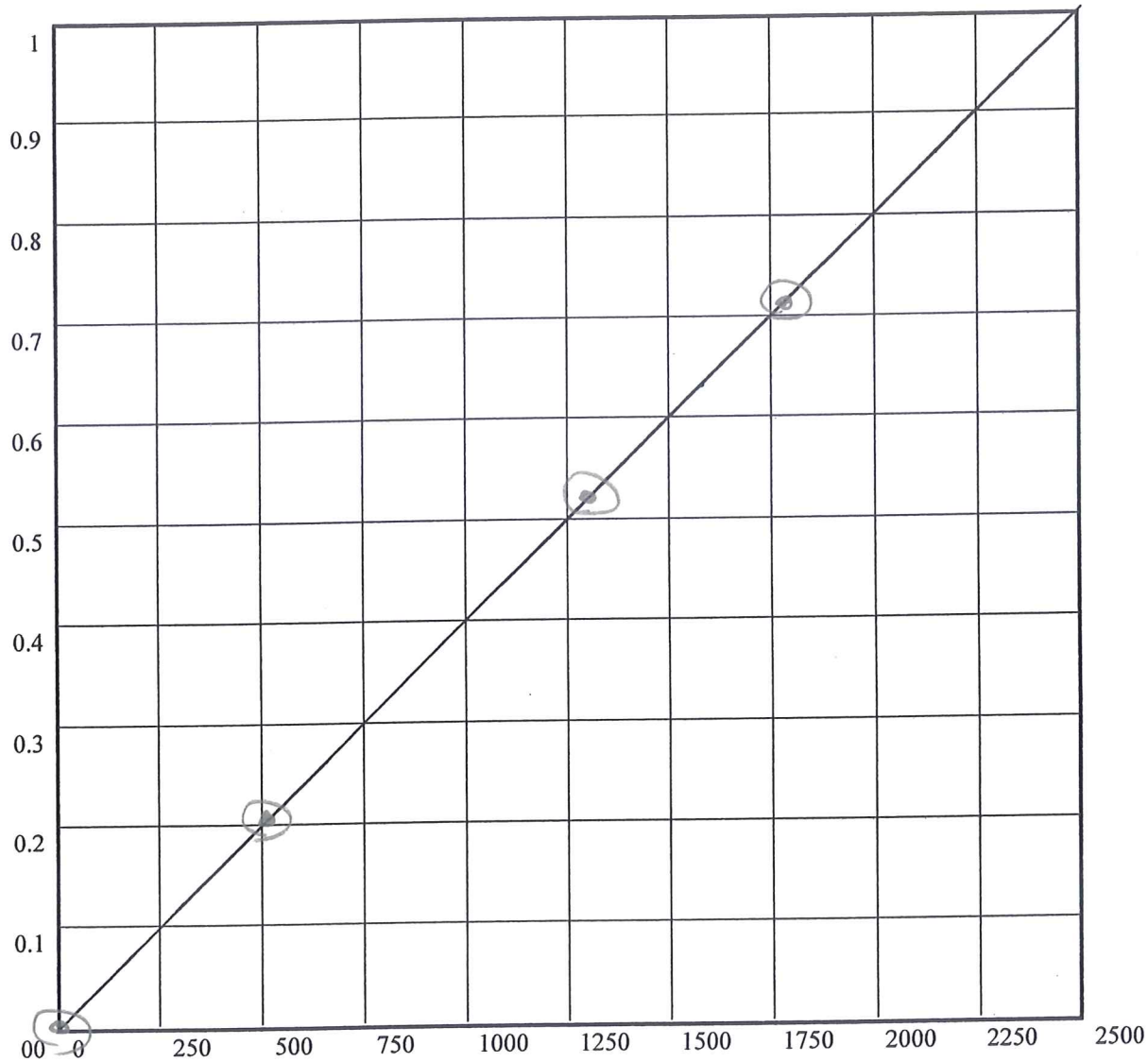
Y = MX +B

Slope (M) = -.0003413

Y Intercept (B) = .0004006

Correlation Coefficient (r) = .9999992

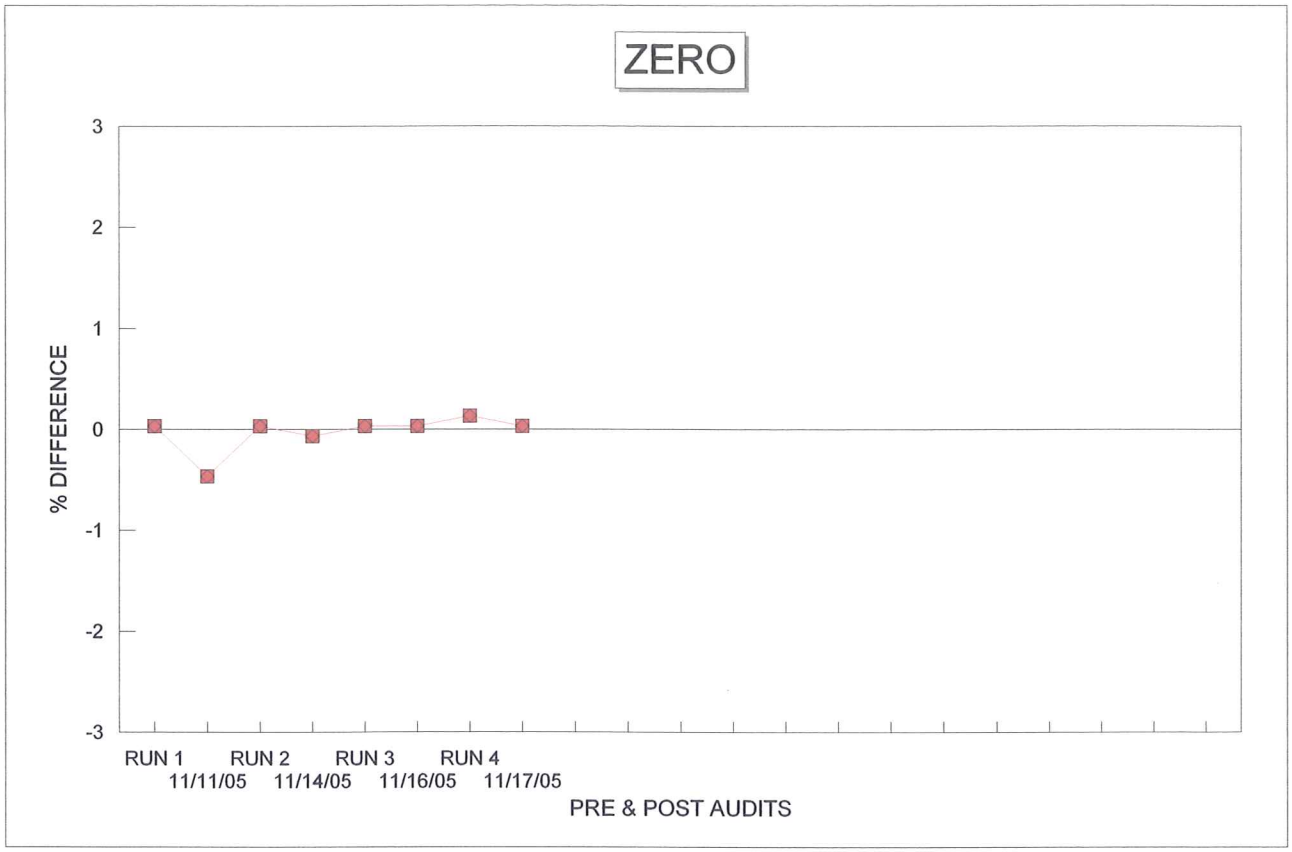
r^2 = .9999983

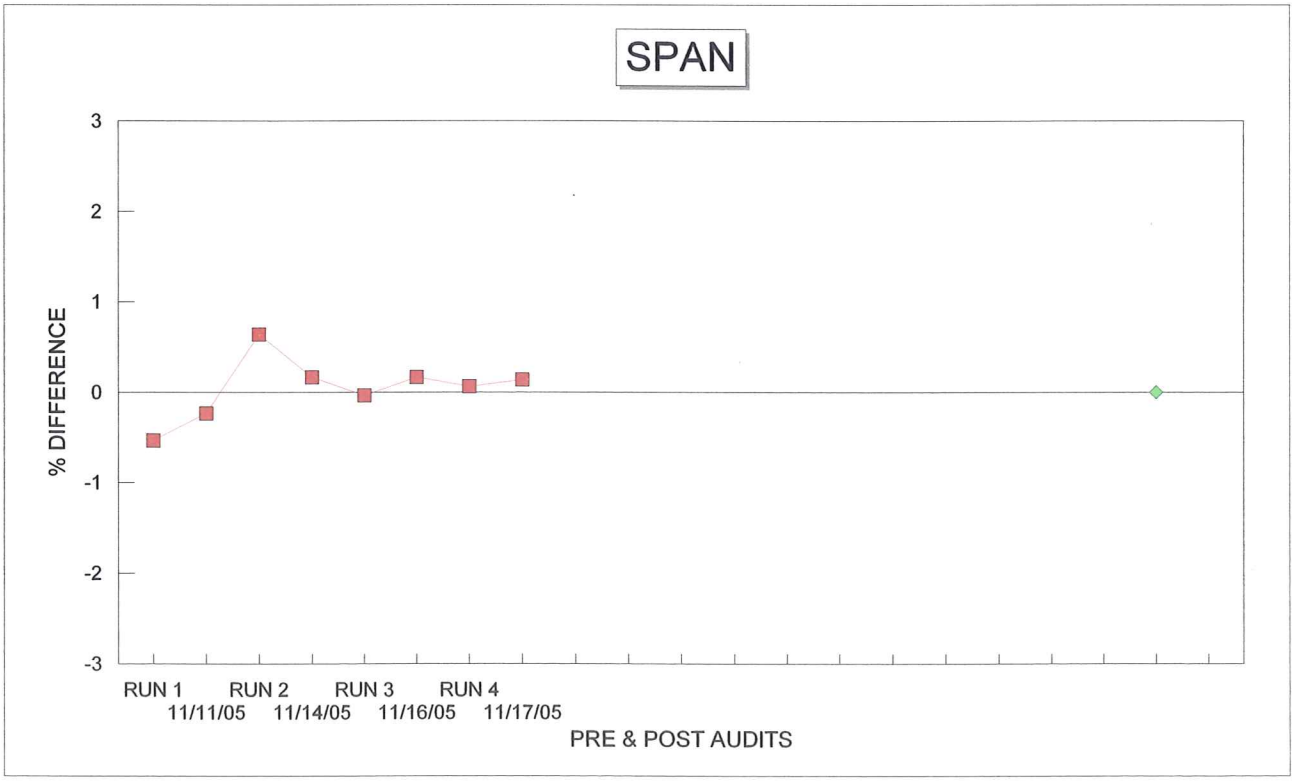


EPA Span Value = ± 2.0% of 2500 PPM SO_2 = ± 50 PPM

Cal Volts = Cal Volt Conc - Std Conc = ± Conc Diff = ± Δ %

HIGH VOLTS	.709	=	1772.5	-	1770.0	=	2.500	=	.100
LOW VOLTS	.202	=	505.0	-	506.0	=	-1.000	=	-.040


ZERO
3
2
1
0
-1
-2
-3
% DIFFERENCE
RUN 1
11/11/05
RUN 2
11/14/05
RUN 3
11/16/05
RUN 4
11/17/05
PRE & POST AUDITS


SPAN
3
2
1
0
-1
-2
-3
% DIFFERENCE
RUN 1
11/11/05
RUN 2
11/14/05
RUN 3
11/16/05
RUN 4
11/17/05
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%

MA

SIGNED

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

GASES FOR RESEARCH AND DEVELOPMENT

CYL # CC55904 CGA 590

PRES 1650 VOL 150 cf

TEST # 04500 DATE 02-14-00

Analytical Method GC / Paramagnetic

	Requested	Analyzed
Hydrogen		
Nitrogen	Bal.	Bal.
Argon		
Air		
Carbon Monoxide	8.5%	8.60%
Methane		
Oxygen	21%	21.10%
Helium		
Carbon Dioxide	21%	21.23%

SIGNED

GRD-1

AIR LIQUIDE

GASES FOR RESEARCH AND DEVELOPMENT

CYL # CC-41627 CGA 590

PRES 1650 VOL 150 SCF

TEST # 30505 DATE 11-01-05

Analytical Method GC/paramagnetic

	Requested	Analyzed
Hydrogen		
Nitrogen	Bal.	Bal.
Argon		
Air		
Carbon Monoxide	5%	4.99%
Methane		
Oxygen	12.5%	12.5%
Helium		
Carbon Dioxide	12.5%	12.5%

SIGNED

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

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

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.: 08-34135-001
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: 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			Second Triad Analysis			Calibration Curve
Date: 04/14/97	Response Unit: PPM		Date: 04/21/97	Response Unit: PPM		Concentration = A + Bx + Cx2 + Dx3 + Ex4
Z1 = 0.3847	R1 = 487.72	T1 = 506.77	Z1 = 0.3241	R1 = 488.29	T1 = 506.43	r = 0.999990
R2 = 488.79	Z2 = 1.6201	T2 = 506.89	R2 = 488.83	Z2 = 1.6098	T2 = 506.75	Constants: A = 0.000000
Z3 = 1.6425	T3 = 506.78	R3 = 488.95	Z3 = 0.5340	T3 = 506.74	R3 = 488.68	B = 1.000000 C = 0.000000
Avg. Concentration:	506.8	PPM	Avg. Concentration:	506.6	PPM	D = 0.000000 E = 0.000000

Special Notes:

ANALYST: Devon VonFeldt
Devon VonFeldt

SO2 concentration analysis
11/07/05

Vm(std)	1.500			
mcf	1.004		dscf=	1.500
Hg	29.85			
DH	0.12			
temp	68	529	ppm =	501
ml BA ++	175			
Normality	0.0101		Run1	507
			Run 2	510
			Run3	501
Tank I.D. #	ALMO52285		avg.	506

AIR LIQUIDE™

8832 DICE ROAD, SANTA FE SPRINGS, CALIFORNIA 90670 (562) 945-1383

CERTIFIED ISO - 9002 INTERTEK CERTIFICATION

CERTIFICATE of ANALYSIS

EPA Protocol Gases

Cyl. Number:	Cyl. Pressure:*	Lot Number:
C 62184	2000PSIG	SFS34489
Assay Date:	**Expiration Date:**	**Document Number:**
01/29/01	01/29/04	7638112
Customer:	**P.O. Number:**	**Item Number:**
AIR LIQUIDE TACOMA, WA	LOKKEE	

COMPONENT Name	REQUESTED Concentration	ASSAY Concentration
Sulfur Dioxide	1250 ppm	1290 ± 20 ppm
Nitrogen	Balance	Balance

*Mixture is valid only to 150 psig

EPA Protocol
Section No. 2.2, Procedure . G-1

Analyst:	Thuan Tran
Approved by:	John Oliveri

REFERENCE STANDARD EMPLOYED FOR ANALYSIS

Concentration	Component	Balance	Cyl. No.	Batch	Exp. Date	Sample No.	Type
1540 ± 10 ppm	Sulfur Dioxide	Nitrogen	CC 62136	L99-029	12/02/01	GL	GMIS

Sulfur Dioxide

GAS ANALYZER EMPLOYED

Manufacturer:	Horiba
Model Number:	CMA-331A
Serial Number:	56674503
MPR Last Calibrated:	01/12/01
Analytical Principle:	NDIR

ANALYSIS SUMMARY

	01/22/01 Triad 1	01/22/01 Triad 2	01/22/01 Triad 3	Sulfur Dioxide Units
Zero	0	0	0	Vdc
Reference	153	153	153	Vdc
Candidate	127	128	128	Vdc
Result	1278	1288	1288	ppm
Evaluation	VALID	VALID	VALID	

MEAN ANALYTICAL RESULT: 1285 ppm

	01/29/01 Triad 4	01/29/01 Triad 5	01/29/01 Triad 6	Sulfur Dioxide Units
Zero	0	0	0	Vdc
Reference	153	153	153	Vdc
Candidate	128	128	128	Vdc
Result	1288	1288	1288	ppm
Evaluation	VALID	VALID	VALID	

MEAN ANALYTICAL RESULT: 1288 ppm

Analyst:	Approved by:

SO2 concentration analysis
11/07/05

Vm(std)	1.500			
mcf	1.004		dscf=	1.500
Hg	29.85			
DH	0.12			
temp	69	529	ppm =	1283
ml BA ++	448			
Normality	0.0101		Run1	1289
			Run 2	1297
			Run3	1283
Tank I.D. #	CC62184		avg.	1290

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 = 3125.8	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
11/07/05

Vm(std)	1.500			
mcf	1.004		dscf=	1.500
Hg	29.85			
DH	0.12			
temp	68	532	ppm =	1767
ml BA ++	617			
Normality	0.0101		Run1	1775
			Run 2	1770
			Run3	1767
Tank I.D. #	ALMO49127		avg.	1771

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
ACETONE - OPTIMA

Catalog No. A929 June 4, 2002

Lot No. 023283

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		99.6%
Color		5 APHA
Description		Clear, Colorless Liquid
Identification		Pass Test
Fluorescence Background (as Quinine Sulfate)		Not More Than 1 ppb
Pesticide Residue Analysis (As Heptachlor Epoxide)		Not More Than 10 ng/L
Substances Reducing Permanganate		Pass Test
Solubility in Water		Pass Test
Aldehyde (as HCHO)		0.0005%
Density (g/ml) @ 25 Degrees C		0.7849
Methanol (CH3OH)		0.03%
Isopropyl Alcohol ((CH3)2CHOH)		0.01%
Optical Absorbance	At 400 - 350 nm	0.001
	At 350 nm	0.004
	At 340 nm	0.05
	At 330 nm	0.67
Refractive Index at 25°C		1.3566
Residue after Evaporation		0.4 ppm
Titratable Acid		0.0003 Meq/g
Titratable Base		<0.0001 Meq/g
Water (H_2O)		0.3%

Approved By: Robert Dowd
Robert Dowd
Q.C. Laboratory Manager

Fisher Scientific
Chemical Division
1 Reagent Lane
Fair Lawn, N.J. 07410
201-796-7100

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

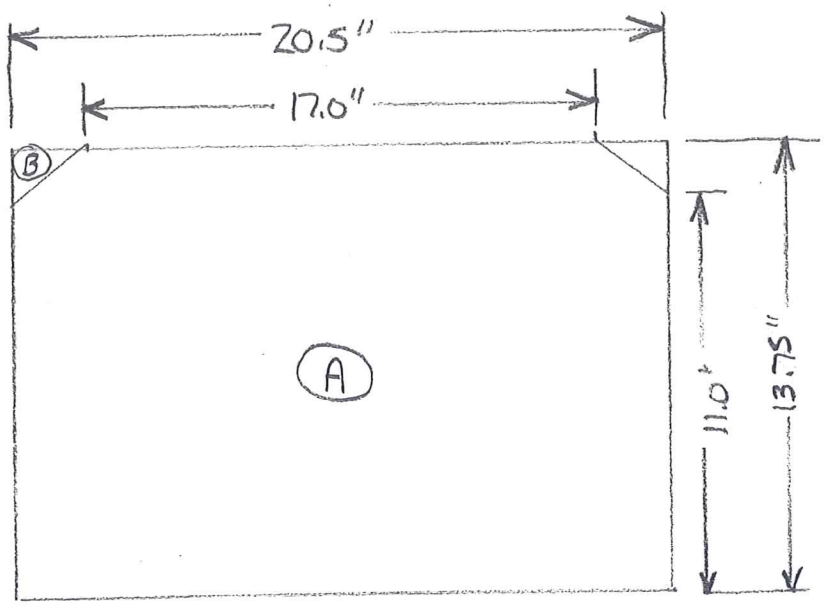
This notification serves to certify that the unit described above has been inspected and tested in accordance with specifications published by Keithley Instruments, Inc.

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
Metrology Services

Jotul F400 Volume and Fuel Load Calculations



A = 13.75 × 20.5 × 11.25 = 3171.094

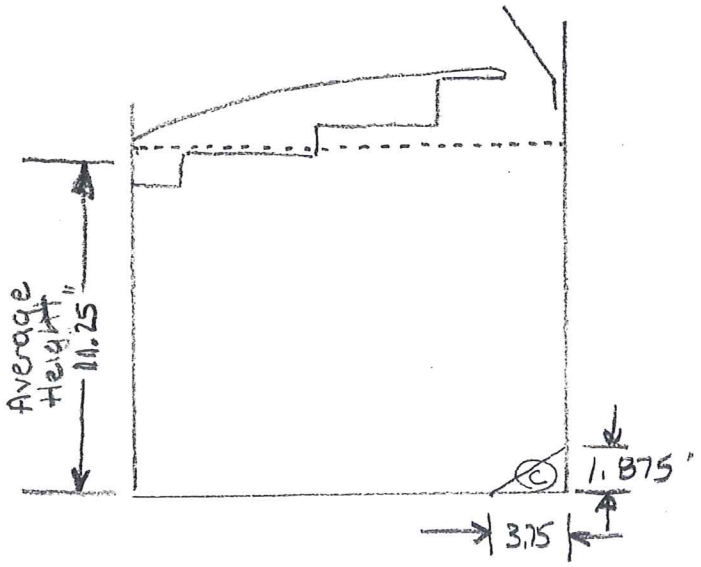
(−2x) B = .5(9 × 1.75 × 2.5) = 19.688

− C = .5(3.75 × 1.875 × 20.5) = 72.070

3059.648

÷ 1728.000

Volume in ft^3 = 1.771



Fuel Load

Low	Ideal	High
11.2	12.394	13.6

Jotul North America
400 Riverside Street
Portland, ME 04104

4/5/2000

Chip Wadington
LoKee Testing Laboratory
13235 Prairie Circle East
Sumner, WA 98390

RE: **Air Settings for the F400**

Dear Chip,

Here are the air settings for the F400. These are approximate.

Low	0"-. 1"
Med-low	. 1"-. 2"
Med high	. 2"-. 5" (possibly higher)
High	Wide open

These measurements are made across the slider gap (opening). I suggest measuring these against the control rod for reference.

Thanks,

Roger Purinton

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):

$$Pr = \left(\frac{\theta S_i * V_{mi(std)}}{10 \sum_{i=1}^{n} [S_i * V_{mi(std)}]} \right) * 100$$

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.

APPENDIX
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. Calibration Gases

   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. Flow Regulators

   LoKee uses a variety of standard gas flow regulators to meter the flow of calibration gases from the cylinders.

3. Point of Injection

   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. Sample Gas Conditioning System

   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. Determination of the Combustion Gas Train's Response Time

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.

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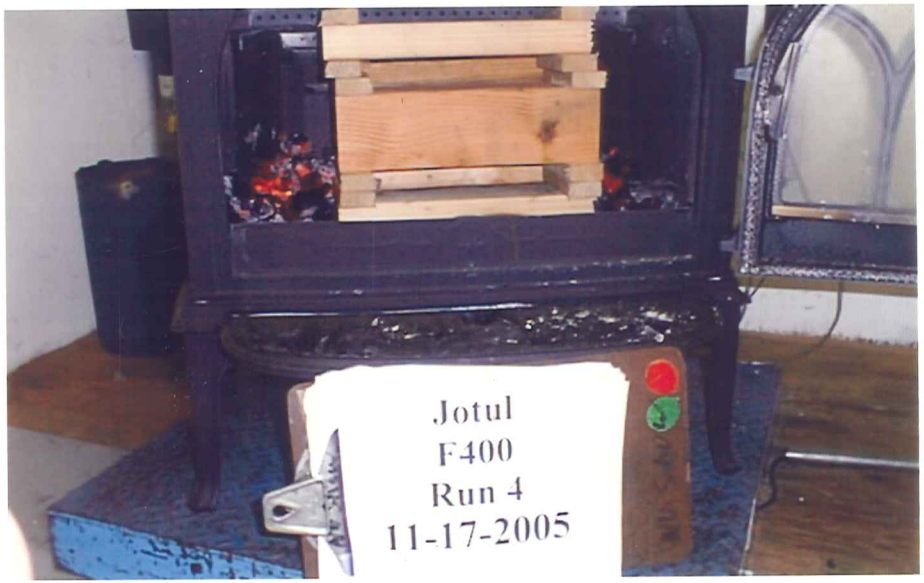
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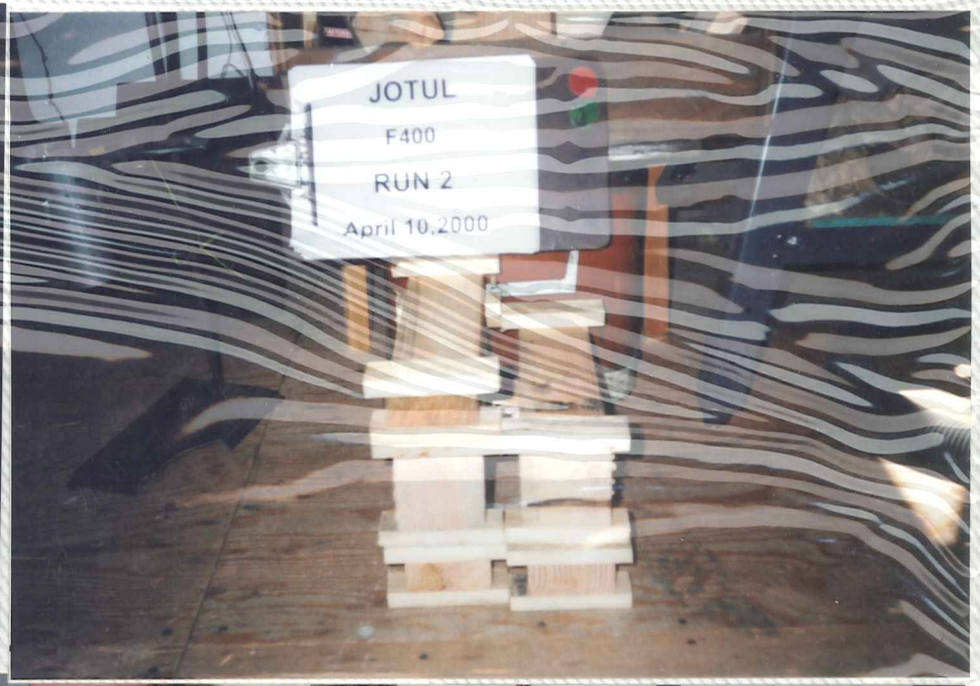
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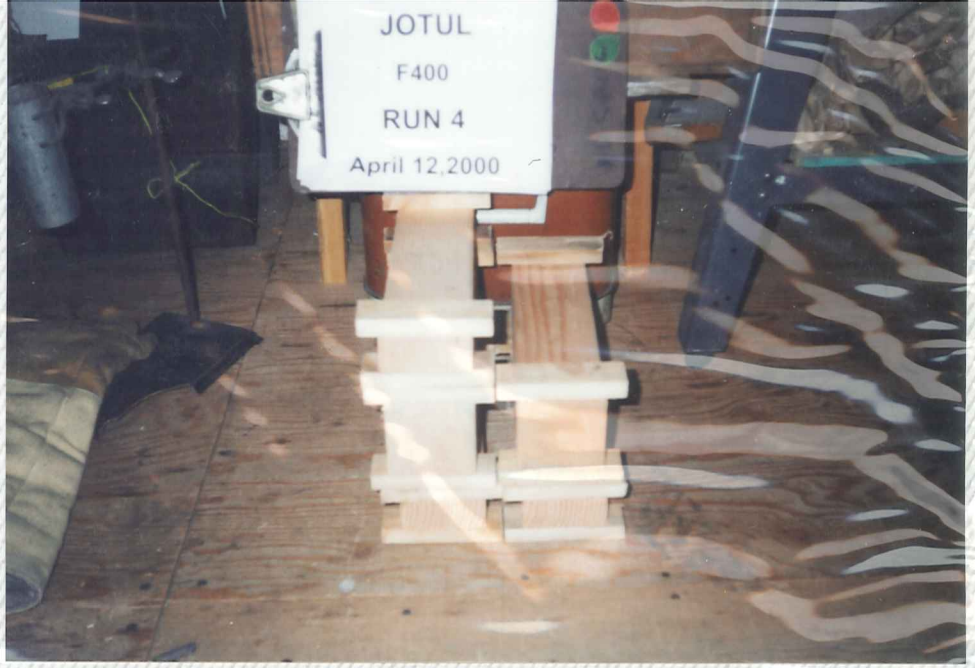
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