LOKEE TESTING Laboratory

United States
Environmental Protection Agency
Wood Heater Certification Test Report

JOTUL U.S.A., INC.

F100

Volume 1

13235 Prairie Circle East, Sumner, Washington 98390
Telephone: 360-897-9685 Website: www.lokeetl.com

United States
Environmental Protection Agency
Wood Heater Certification Test Report

Jotul U.S.A., Inc.
400 Riverside Street
Portland, ME 04104

F100

Volume 1

Report By:

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October 15, 2001

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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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TEST SERIES INFORMATION

Unit name and model number: F100

Type of unit: Wood Heater

Manufacturer: Jotul U.S.A., Inc.
Address: 400 Riverside Steet
Portland, ME 04104

Contact: Roger Purington
Phone Number: 1-800-797-5912
Fax Number: 207-772-0523

Observers: N/A

Date Rcv'd: 09/05/01 **Aged**: 09/07-12/01 **Dates Tested**: 10/04-09/01

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

Test Location: 13235 Prairie Circle East
Sumner, WA 98390-7250
Test Site Elevation: 500 feet above sea level

LoKee's Field Team

Team Members: Chip Wadington
Deborah Wadington
Joy 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.

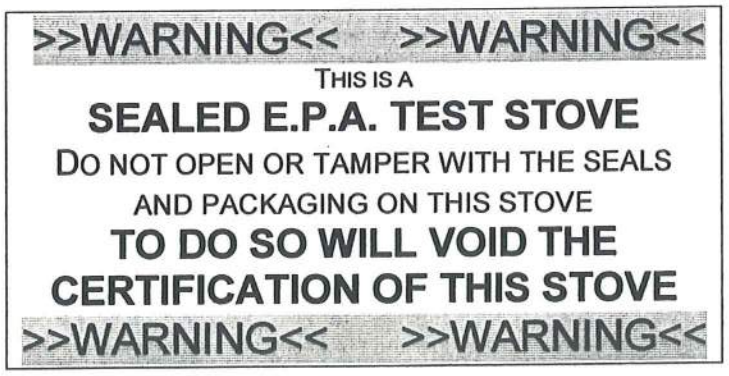
STOVE STORAGE INFORMATION

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.



JOTUL U.S.A., INC.
F100

AGING DATA SHEET

UNIT : Jotul F100 DATE: 9-7-01

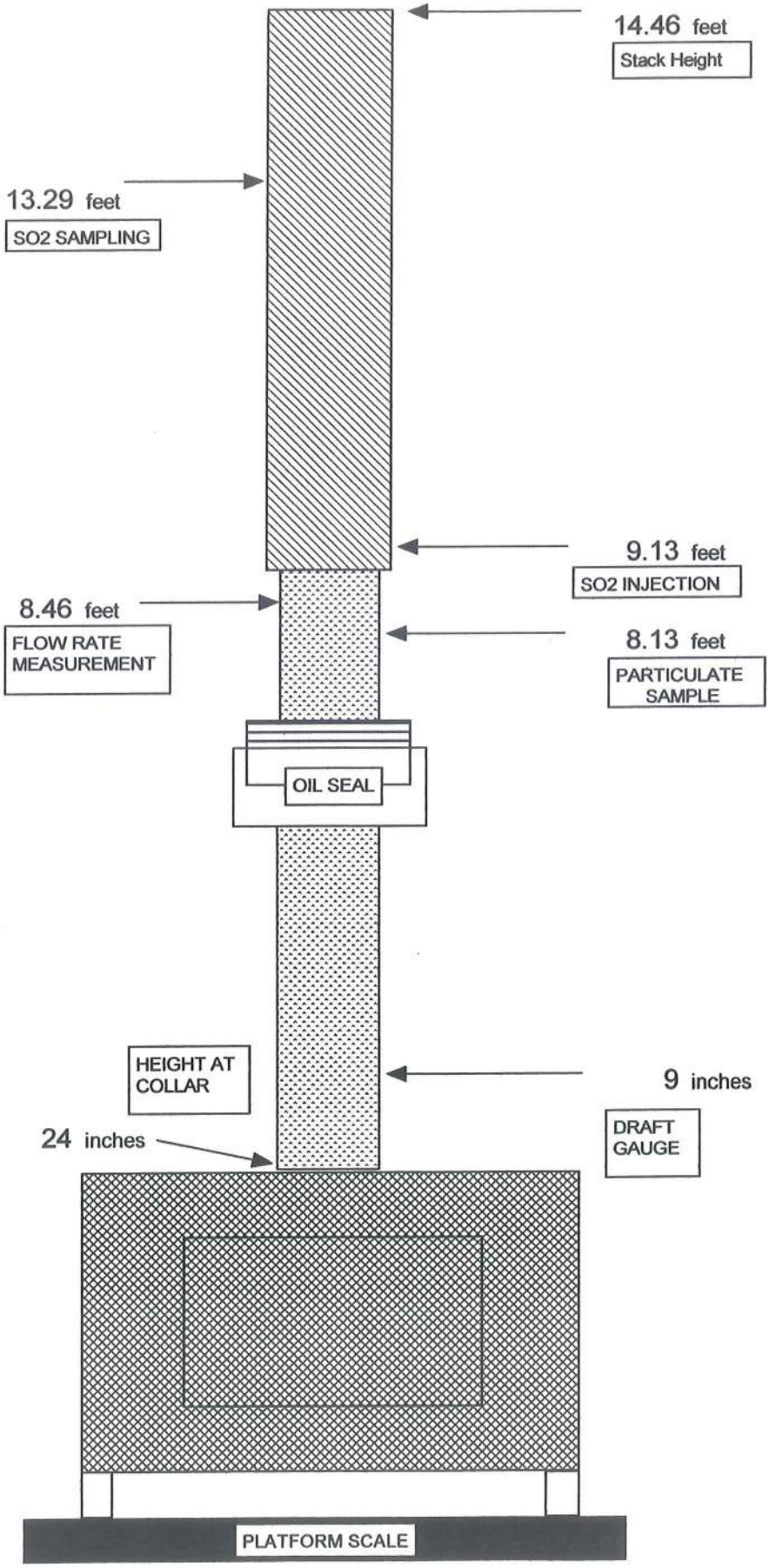
Hr #	DATE	TIME	TEMP 1 TOP	TEMP FIRE box 2
1	9-7-01	1310	670	963
2	9-7-01	1410	282	625
3	9-7-01	1510	301	354
4	9-7-01	1610	257	604
5	9-10-01	1515	612	1017
6	9-10-01	1615	466	812
7	9-10-01	1715	617	818
8	9-12-01	1555	388	1021
9	9-12-01	1655	323	667
10	9-12-01	1755	249	669
11				
12				
13				
14				
15				
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:

9-7-01 Stove lit 1015
9-10-01 " " 1205
9-12-01 " " 1230

Model: F100 **Date:** 09/12/01



LOKEE TESTING LABORATORY.
13235 PRAIRIE CIRCLE EAST, SUMNER, WA 98390-7250
Phone (360)-897-9685

To: Robert C. Marshall, Jr., US EPA
From: Chip Wadington, LoKee Testing Laboratory
Subject: Wood Stove Certification Test Notification

This is to notify EPA that:

Manufacturer's Name: **JOTUL USA INC.**
Address: **400 Riverside Street**
Portland, Maine 04104

Contact: **Shawn Malloy**
Phone: **1-207-797-5912**

has scheduled the **F-100** for certification testing at LoKee according to the following:

Dates Scheduled	Date Notification Sent	Date Notification Canceled	Testing Activity (if any)
10/1-5/01	8/27/01	-	Cert. Start
10/8-12/01	8/27/01	-	Cert. End
10/15-19/01	8/27/01	-	None
10/22-26/01	8/27/01	-	None
10/29-11/2/01	8/27/01	-	none

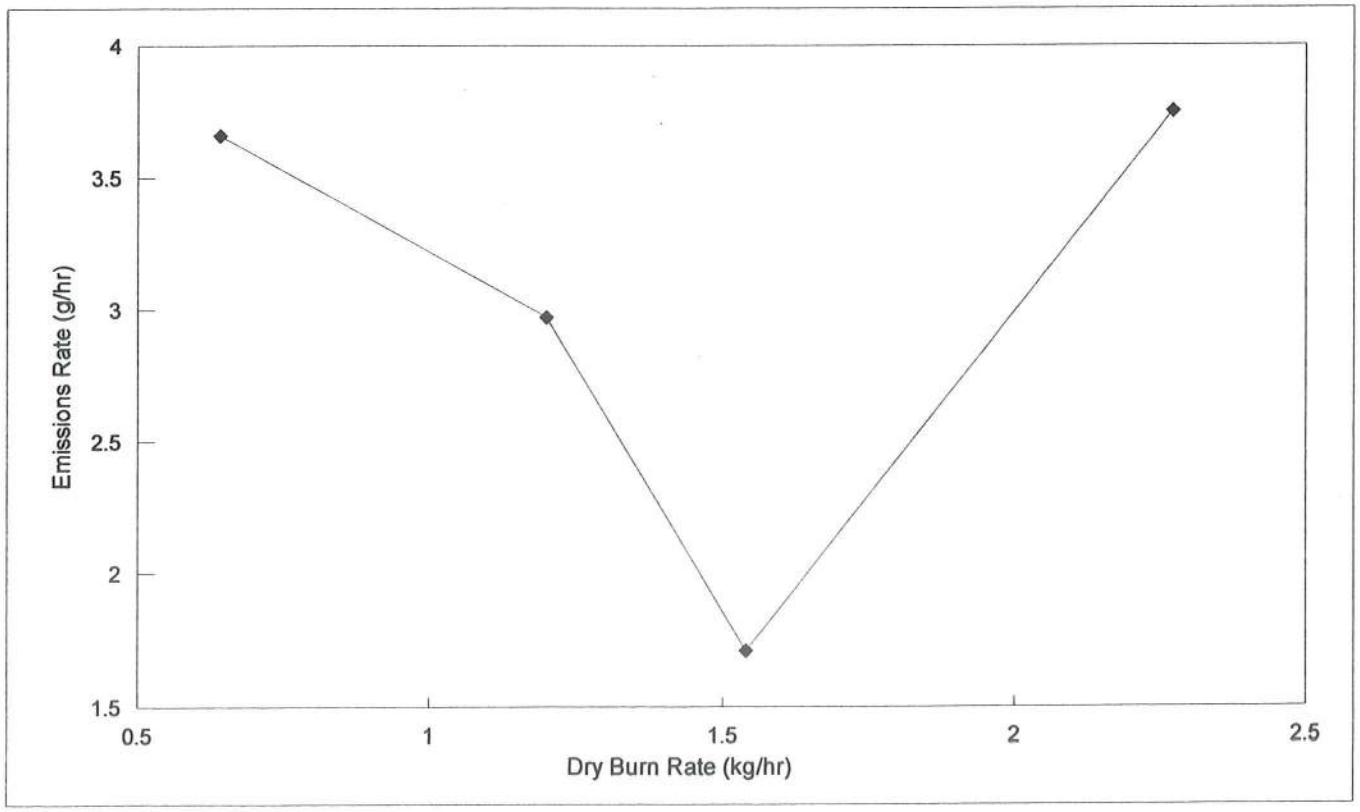
DATA
SUMMARY

Wood Heater Emission Test Summary

Laboratory/Wood Heater Information

Stove Manufacturer:	**Jotul**
Model Identification:	**F100**
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:	**10/04/01 – –10/09/01**
Test Methods Used	
Method 28/Other:	**28**
Sampling Method:	**5H**

Run no.	Burn Rate (kg/hr)	Emission Rate (g/hr)	Heat Output (Btu/hr)	Wtd Avg (g/hr) 3.00
2	0.64	3.66	7717	
1	1.20	2.97	14470	
3	1.54	1.71	18570	
4	2.27	3.75	27372	



DATA SUMMARY

Unit : Jotul F100

	RUN #	2	1	3	4				
Particulate Emissions:									
Concentration:	grains/dscf:	.1944	.1135	.0497	.0842				
Emissions Rate	grams/hr:	3.66	2.97	1.71	.0055				
Emissions Factor	grams/kg:	5.76	2.49	1.11	1.65				
Front Half Catch	% of total	59.32	69.50	42.87	66.70				
Total Mass Captured	total catch:	.7889	.2495	.0849	.0892				
Heat Output (EPA Default):	BTU/hr	7657.0	14301.0	18521.4	27420.3				
Fuel Burn Rates:									
Average kg/hr (dry)	Kg/hr	0.64	1.20	1.54	2.27				
Fuel Moisture Content:									
Kindling (wet basis)	%	13.644	12.306	13.545	14.040				
Pretest Fuel (wet basis)	%	16.551	16.751	19.614	18.545				
Test Fuel (wet basis)	%	18.197	16.836	18.677	17.950				
Air to Fuel Ratio	N/A	N/A	N/A	N/A	N/A				
Average Stack Gas									
Avg CO_2		5.55	8.33	8.33	9.97				
Avg O_2	%	N/A	N/A	N/A	N/A				
Avg CO	%	.99	1.00	.77	.63				
Avg Moisture	%	4.84	6.08	6.80	10.09				
Avg Stack Gas Emissions:									
CO	g/Kg	152.47	112.84	89.17	63.77				
	g/hr	96.82	134.96	136.97	145.02				

Unit : Jotul F100

	RUN #	2	1	3	4				
Avg Stack Gas Flow Rate									
EPA CMB	dscfm	4.85	6.74	8.85	11.46				
Tracer Gas	dscfm	5.329	6.598	9.786	8.958				
Draft (static)	in H_2O	-.033	-.045	-.059	-.066				
Proportionality Average	%	100	100	100	100	100	100	100	100
Average Temperatures									
Stack Gas	°F	207	295	404	454				
Firebox	°F	540	864	796	1068				
Secondary	°F	708	947	1034	1092				
Catalytic Combustor	°F	N/A	N/A	N/A	N/A				
Top	°F	252	319	381	399				
Left Side	°F	302	401	504	531				
Back	°F	324	403	510	622				
Right Side	°F	294	396	476	517				
Bottom	°F	245	289	374	379				
Temperature Change	°F	-21.4	+17.4	-86.6	-2.8				
Test Chamber Enviroment									
Average Barometer	in. Hg	29.94	30.09	30.14	30.33				
Average Temperature	°F	83	80	84	85				
Ambient Moisture	% H_2O	1.4	1.55	1.8	1.5				
Relative Humidity	%RH	45.5	52	44	43.5				
Air Velocity	m/sec	0	0	0	0	0	0	0	0
Fuel Weight and Burn Time									
Density (dry basis)	gm/cm^3	N/A	N/A	N/A	N/A				
Coal Bed Weight	lbs	1.4	1.3	1.3	1.4				
Pre Test Fuel (inc kindling)	lbs	27.2	19.8	34.4	21.1				
Test Fuel	lbs	5.7	5.5	5.9	5.6				
Burn Time	min	200	105	85	55				

MINIMUM
DBR

COMPUTER INPUT DATA SHEET #1

Client: Jotul USA

Address: 400 Riverside St. P.O. Box 1157

Portland, ME 04104

Phone: 207-797-5912 Fax: 207-818-5481

Run No.: 2 Date of Test: 10-5-01 Burn Rate: .635

Model No.: Jotul F100 ☒ min ☐ min-1.25 ☐ fan

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

Dry Gas Meter: Y Factor: 1.021 (0.000) (Data Sheet #2) Post Leak Rate: .010 cfm (.000) (Data Sheet #2) Time: 200 min. (000) (Data Sheet #2)

Dry Gas Meter Volume: 63.503 cf (00.000) (Data Sheet #2)

Stack Flow: 5.329 dscfm (00.000) (Data Sheet #2) Δ H: .154 in. H_2O (.000) (Data Sheet #2)

Barometric Pressure: 29.94 in. Hg (00.00) (Data Sheet #2)

H_2O Captured: 67.8 g (00.0) (Data Sheet #3)

Total Particulate Catch: .7889 g (0.0000) (Data Sheet #6)

Flue Gas Moisture: 4.8488 % (00.000) (Data Sheet #7)

Particulate Emission: .1944 gr/dscf (0.0000) (Data Sheet #7)

Ambient Moisture: 1.4 % (0.00) (Data Sheet #8)

Stove Weight: — lbs (000) (Data Sheet #8)

Total Fuel Consumed During Burn: 5.7 lbs (00.0) (Data sheet #8)

Fuel Higher Heating Value (dry): — BTU/lb (0000) (Data Sheet #8)

Fuel % Moisture (dry): 22.244 % (wet): 18.197 % (00.00) (Data Sheet #10)

Stack Static Pressure: -.033 in. H_2O (0.000) (Data Sheet #12)

Temperature (Average Room) Combustion Air: 83 °F (00) Data Sheet #14)

Stove Temperature Change: -21.4 °F (00.0) (Data Sheet #14)

TABLE 1 ----- RAW DATA

CLIENT : Jotul TEST No. : 2

MODEL: F100 DATE: 05-Oct-01

TIME (MIN.)	METER READING (C F)	DELTA H (IN. H2O)	METER TEMP. (DEG. F)	PERCENT CO (%)	PERCENT CO2 (%)	SO2 COCENTR. PPM
0	835.500	0.150	84	0.63	1.90	650
5	837.000	0.190	84	0.56	4.10	575
10	838.745	0.150	84	0.63	4.30	650
15	840.290	0.140	85	0.87	4.80	675
20	841.782	0.120	85	1.04	4.60	725
25	843.172	0.110	85	1.14	5.10	750
30	844.516	0.120	85	1.09	6.00	725
35	845.905	0.150	85	1.94	4.40	650
40	847.455	0.150	85	0.89	7.70	650
45	849.005	0.190	86	0.50	9.60	575
50	850.763	0.200	86	0.49	9.20	550
55	852.601	0.220	86	0.51	10.80	525
60	854.527	0.220	86	0.54	8.70	525
65	856.452	0.220	86	0.37	10.20	525
70	858.377	0.200	86	0.56	8.80	550
75	860.215	0.220	86	0.49	8.60	525
80	862.141	0.220	87	0.43	10.50	525
85	864.073	0.220	87	0.41	9.00	525
90	866.006	0.200	87	0.56	8.10	550
95	867.850	0.190	87	0.48	8.10	575
100	869.615	0.190	87	0.63	8.00	575
105	871.380	0.170	87	1.12	5.60	600
110	873.071	0.160	87	1.25	4.80	625
115	874.695	0.170	87	1.41	4.60	600
120	876.386	0.160	87	1.35	4.30	625
125	878.009	0.160	87	1.35	4.30	625
130	879.633	0.160	87	1.43	4.10	625
135	881.257	0.160	87	1.47	4.10	625
140	882.881	0.130	87	1.45	4.00	700
145	884.331	0.120	88	1.37	3.70	700
150	885.786	0.120	88	1.31	3.50	725
155	887.191	0.120	88	1.30	3.40	725
160	888.596	0.110	88	1.24	3.40	750
165	889.955	0.110	88	1.24	3.30	750
170	891.313	0.100	88	1.19	3.20	775
175	892.627	0.100	88	1.22	3.20	775

180	893.942	0.100	88	1.24	3.20	800
185	895.217	0.100	88	1.30	3.20	800
190	896.492	0.100	88	1.25	3.20	800
195	897.767	0.090	88	1.23	2.90	825
200	899.003	0.090	88	1.28	3.10	825
205						
210						
215						

TABLE 2---RAW DATA

CLIENT : Jotul TEST No. 2

MODEL: F100 DATE: 05-Oct-01

****

METER CAL. FACTOR (Y)	------ 1.021		Wt. WOOD BURNED(LB)	------- 5.7	Lbs
BAROMETRIC PRESS.(Pb)	------ 29.94	in Hg	WET,FUEL MOISTURE %	------- 18.197	%
LEAK RATE POST (Lp)	------ 0.010	cfm	Wt. PART. COLLECTED	------- 0.7889	g
WATER VOL. (V1c)	------ 67.8	Ml	METER VOLUME Vm	------- 63.503	mcf
TEST TIME (MIN)	------ 200	min	HC MOLE FRACTION	------- 0.0132	

TABLE 3 -----FIELD DATA AVERAGES

CLIENT :Jotul TEST No. 2

MODEL: F100 DATE: 05-Oct-01

****

AVG DELTA H	-------	0.15 in H2O		AVG PRCNT CO	-------	0.99	%
AVG METER TEMP. Tm	-------	87 deg F		AVG PRCNT CO2	-------	5.55	%
AVG PPM SO2	-------	655	PPM	AVG BAL CO2/CO	-------	5.58	%

TABLE 4 ----- CALCULATIONS

CLIENT : Jotul TEST No. 2

MODEL: F100 DATE: 05-Oct-01

****

STD SAMPLE VOL. Vm(std) -----	62.70	dscf	STACK GAS FLOW Qsd -------	290.811	dscf/Hr
				4.85	& dscf/min
VOL. WATER VAPOR Vw(std) ----	3.191	scf	PARTICULATE CONCTRT. Cs ------	0.0126	g/dscf
PRCNT MSTR Bws -------	4.84	%	PARTC.EMISS. RATE E -------	3.66	g/Hr
BURN RATE BR -------	0.64	Kg/Hr	MOLES OF GAS PER Lb WOOD Nt --	0.54	Lb-mole/Lb
CO EMISSION RATE -------	96.82	g/Hr	PART.EMISS. RATE ------	5.76	g/Kgdry fuel
	152.47	& g/Kgdry fuel			

TABLE 5 ----- PROPORTIONAL RATE VARIATION

CLIENT : Jotul TEST No. : 2

MODEL: F100 DATE: 05-Oct-01

TIME INTEVAL Ti	PPM * Vm	PROPRTN. RATE VAR. PR		PROPRTN RATE VAR. AVERAGE	
5	967.4	97		100	
10	995.6	100			
15	995.5	100			
20	997.4	100			
25	997.9	100			
30	998.2	100			
35	997.2	100			
40	997.8	100			
45	996.9	100			
50	999.4	100			
55	999.4	100			
60	999.7	100			
65	999.2	100			
70	999.2	100			
75	999.4	100			
80	998.8	100			
85	1001.0	100			
90	1001.5	100			
95	1000.9	100			
100	1001.5	100			
105	1001.5	100			
110	1001.2	100			
115	1001.5	100			
120	1001.2	100			
125	1000.9	100			
130	1001.5	100			
135	1001.5	100			
140	1000.6	100			
145	999.6	100			
150	1003.1	100			
155	1003.2	100			
160	1003.2	100			
165	1003.8	100			
170	1003.0	100			
175	1002.9	100			
180	1003.6	100			
185	1004.5	100			
190	1004.5	100			
195	1004.5	100			
200	1004.2	100			
205					
210					

METER BOX DATA SHEET PAGE # 2

Page: 1 of 2

UNIT: Jotol F100 RUN: 2 DATE: 10-5-01

Meter Box: SH Y Factor: 1.021

Leak checks: 15 " Hg @ .008 cfm _____ " Hg @ _____ cfm

15 " Hg @ .010 cfm _____ " Hg @ _____ cfm

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

ROTO: PRESS: .19 SAMPLING RATIO: 17.5 : 1 BP: 29.95

MIN	TIME	METER READING	SAMPLE MDCF	STACK DSCFM	DELTA H	METER TEMP	SO2 PPM	ROTO TEMP	PUMP VACC
0	1445	835.500	—	5,282	.15	84	690	84	1.0
5	50	837.000	—	5.971	.19	84	575	84	2.0
10	55	838.745	838.745	5.282	.15	84	650	84	1.0
15	1500	840.290	840.290	5,077	.14	85	675	85	1.0
20	05	841.782	841.782	4.727	.12	85	725	85	1.0
25	10	843.172	843.172	4.569	.11	85	750	85	1.0
30	15	844.516	844.516	4.727	.12	85	725	85	1.0
35	20	845.905	845.905	5.272	.15	85	650	85	1.0
40	25	847.455	847.455	5,272	.15	85	650	85	1.0
45	30	849.005	849.005	5.949	.19	86	575	86	1.0
50	35	850.763	850.763	6.219	.20	86	550	86	1.0
55	40	852.601	852.601	6.516	.22	86	525	86	1.0
ROTO PRESS: .18			TOTALS:	64.863	1.89	1020	BP.: 29,95		
60	1545	854.527	854,527	6.515	.22	86	525	86	1.0
65	50	856.452	856.452	6.515	.22	86	525	86	1.0
70	55	858.377	858.377	6.219	.20	86	550	86	1.0
75	1600	860.215	860.215	6.515	.22	86	525	86	1.0
80	05	862.141	862.141	6.503	.22	87	525	87	1.0
85	10	864.073	864.073	6.503	.22	87	525	87	1.0
90	15	866.006	866.006	6.208	.20	87	550	87	1.0
95	20	867.850	867.850	5.938	.19	87	575	87	1.0
100	25	869.615	869.615	5.938	.19	87	575	87	1.0
105	30	871.380	871.380	5.691	.17	87	600	87	1.0
110	35	873.071	873.071	5.463	.16	87	625	87	1.0
115	40	874.695	874.695	5.691	.17	87	600	87	1.0
			TOTALS:	73,699	2.38	1040	MAX VACC =		
TOTAL Cu Ft.			TOTALS:	138.562	4.27	2060	AVG. BP:		

METER BOX DATA SHEET PAGE # 2

Page: 2 of 2

UNIT: Jotul F100 RUN: 2 DATE: 10-5-01

Meter Box: SH Y Factor: 1.021

Leak checks: 15 " Hg @ .008 cfm _____ " Hg @ _____ cfm

15 " Hg @ .010 cfm _____ " Hg @ _____ cfm

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

ROTO: PRESS: .18			SAMPLING RATIO: 17.5 : 1				BP: 29.95		
MIN	TIME	METER READING	SAMPLE MDCF	STACK DSCFM	DELTA H	METER TEMP	SO2 PPM	ROTO TEMP	PUMP VACC
120	1645	876.386	876.386	5.463	.16	87	625	87	1.0
125	50	878.009	878.009	5.463	.16	87	625	87	1.0
130	55	879.633	879.633	5.463	.16	87	625	87	1.0
135	1700	881.257	881.257	5.463	.16	87	625	87	1.0
140	05	882.881	882.881	4.878	.13	87	700	87	1.0
145	10	884.331	884.331	4.869	.12	88	700	88	1.0
150	15	885.786	885.786	4.701	.12	88	725	88	1.0
155	20	887.191	887.191	4.701	.12	88	725	88	1.0
160	25	888.596	888.596	4.544	.11	88	750	88	1.0
165	30	889.955	889.955	4.544	.11	88	750	88	1.0
170	35	891.313	891.313	4.398	.10	88	775	88	1.0
175	40	892.627	892.627	4.398	.10	88	775	88	1.0
ROTO PRESS: .18			TOTALS:	58.885	1.55	1051	BP.: 29.92		
180	1745	893.942	893.942	4.256	.10	88	800	88	1.0
185	50	895.217	895.217	4.256	.10	88	800	88	1.0
190	55	896.492	896.492	4.256	.10	88	800	88	1.0
195	1800	897.767	897.767	4.127	.09	88	825	88	1.0
200	05	899.003	899.003	4.127	.09	88	825	88	1.0
205									
210				21.022	.48	440			
215									
220				79.907	2.03	1491			
225									
230								841	
235						3551			
			TOTALS:	218.469	6.300	87	MAX VACC =		2.0
TOTAL Cu Ft.		63.503	TOTALS:	5329	.154	549	AVG. BP: 29.94		

PARTICULATE CATCH / MOISTURE DATA SHEET # 3

UNIT : F100 RUN : 2 DATE : 10-5-01

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	645.0	599.3	514.8	910.0
INITIAL WT	592.7	595.2	513.2	900.2
NET WT GRAMS	52.3	4.1	1.6	9.8

TOTAL CATCH : 67.8 GRAMS H_2O

FRONT HALF

FILTER #	72F	
FINAL WT g	1.0786	
INITIAL WT g	.6785	-
NET WT g	.4001	=

BEAKER #	96
DESC.	ACETONE
FINAL WT g	104.0602
INITIAL WT g	103.9916
NET WT g	.0686
VOL. DESC. ml	120

BACK HALF

FILTER #	72B	
FINAL WT g	.4707	
INITIAL WT g	.4277	-
NET WT g	.0430	=

BEAKER #	97	98	99	100	
DESC.	ACETONE	METHCHLOR	H_2O	H_2O	
FINAL WT g	100.1850	105.0685	104.9878	106.7866	
INITIAL WT g	99.9935	105.0329	104.9665	106.7534	
NET WT g	.1915	.0356	.0213	.0332	.0545
VOL. DESC ml	175	75	150	140	290

FILTER TARE WEIGHTS DATA SHEET #4-1

Into Dessicator : Date : 9-17-01 Time : 1000 By : C. Washington

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

Back Size: 8.2 cm Lot No. : ZB911

	DATE: 9-26	BY: [illegible]	DATE: 9-27	BY: JEV	DATE:	BY:
FILTER #	FIRST WEIGHT	TIME	SECOND WEIGHT	TIME	THIRD WEIGHT	TIME
71F	.6778	1318	.6773	9:30	JOTUL F500 R#1	
72F	.6789	1319	.6785	9:31	" " R#2	
73F	.6692	1320	.6688	9:32	" " R#3	
74F	.6681	1321	.6682	9:33	" " R#4	
75F	.6724	1322	.6722	9:34		
76F	.6670	1323	.6674	9:35		
77F	.6707	1324	.6705	9:36		
78F	.6645	1325	.6645	9:37		
79F	.6748	1326	.6753	9:38		
80F	.6745	1327	.6747	9:39		
71B	.4264	1329	.4262	9:40	JOTUL F500 R#1	
72B	.4282	1330	.4277	9:41	" " R#2	
73B	.4309	1331	.4304	9:42	" " R#3	
74B	.4365	1332	.4363	9:43	" " R#4	
75B	.4200	1333	.4199	9:45		
76B	.4224	1334	.4227	9:46		
77B	.4223	1335	.4226	9:47		
78B	.4169	1336	.4165	9:48		
79B	.4181	1337	.4185	9:49		
80B	.4224	1338	.4222	9:50		

Checked by: C. Washington Date: 9-27-01 Time: 1020

BALANCE ROOM ENVIRONMENTAL CONDITIONS

DATE	TIME	BY	WB	DB	% RH
9-26	1315	CLP	5	74	49
9-27	9:30	JEV		72	45.

BEAKER TARE WEIGHTS DATA SHEET #4-2

Into Dessicator: Date : 08-17-01 Time : 1215 By : [signature]

	DATE: 8-29	BY: Clp	DATE: 8-30	BY: Clp	DATE:	BY:
BEAKER #	FIRST WEIGHT	TIME	SECOND WEIGHT	TIME	THIRD WEIGHT	TIME
76	103.8106	2135	103.8101	1150	-	
77	107.3956	2136	107.3956	1151	-	
78	94.5034	2137	94.5030	1152	- HERITAGE MK 1	
79	97.6274	2138	97.6271	1153	- R#5	
80	109.1338	2139	109.1342	1155	-	
81	101.4706	2141	101.4703	1157	-	
82	97.4853	2142	97.4852	1158	-	
83	98.3339	2143	98.3341	1159	- R&D	
84	105.5609	2144	105.5606	1200	-	
85	98.0013	2145	98.0014	1201	-	
86	104.7505	2147	104.7510	1202	-	
87	105.9223	2148	105.9226	1203	- R&D	
88	100.0093	2149	100.0090	1204	-	
89	120.6787	2150	120.6786	1206	-	
90	106.4104	2152	106.4102	1207	-	
91	95.0611	2153	95.0615	1208	-	
92	96.6869	2155	96.6864	1209	- JOHL F100	
93	107.8956	2156	107.8953	1210	- R#1	
94	106.3855	2157	106.3854	1211	-	
95	107.4205	2158	107.4202	1212	-	
96	103.9921	2200	103.9916	1213	-	
97	99.9938	2202	99.9935	1215	- JOHL F100	
98	105.0328	2203	105.0329	1216	- R#2	
99	104.9461	2204	104.9665	1217	-	
100	106.7533	2205	106.7534	1218	-	

BALANCE ROOM ENVIRONMENTAL CONDITIONS

DATE	TIME	BY	WB	DB	% RH	
8-29	2130	Clp		76	49	Checked by : [signature]
8-30	1130	Clp		76	49	Date : 08-30-01
						Time : 1130

WOODSTOVE DATA SHEET # 4-3 : CONSTANT WEIGHTS

UNIT : F100 **RUN :** 2 **DATE :** 10-5-01

Beaker #	Date	Time	By	First Weight	Date	Time	By	Second Weight	Date	Time	By	Third Weight	Date	Time	By
96	10/6	1420	JEW	104.0606	10-7	2201		104.0602	10-8	0741					
97	10/6	1420	JEW	100.1867	10-7	2202		100.1851	10-8	0742		100.1850	10-9	1208	
98	10-7	2145		105.0669	10-9	1209		105.0684	10-9	1803		105.0685	10-10	1904	
99	10/6	1420	JEW	104.9883	10-7	2203		104.9878	10-8	0743					
100	10/6	1420	JEW	106.7864	10-7	2204		106.7866	10-8	0744					

Filter #	Date	Time	By	First Weight	Date	Time	By	Second Weight	Date	Time	By	Third Weight	Date	Time	By
72F	10-5	1820		1.0845	10-6	1425	JEW	1.0828	10-7	2205		1.0801	10-8	0746	
				1.0791	10-9	1210		1.0786	10-9	1804					
72B	10-5	1820		.4746	10-6	1426	JEW	.4711	10-7	2206		.4707	10-8	0747	

SCALE ROOM ENVIRONMENTAL CONDITIONS

Weighing Session	Date	Time	By	WB	DB	%RH
1	10-6	1420	JEW		68	49
2	10-7	2150			78	47
3	10-8	0730			74	49
4	10-9	1205			78	48

Weighing Session	Date	Time	By	WB	DB	%RH
5	10-9	1800			77	49
6	10-10	1900			75	49
7						
8						

Dates: From 12-15-2000
Through 08-26-2001

WOODSTOVE DATA SHEET #4-4
SCALE QA SHEET

Scale: Sartorius
Model: A1205
SN : 37010004

100g weight	10 g weight	1.0 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	Wet Bulb	%.RH
100.0000	10.0001	1.0000	.0999		12-15	1215	73		40
100.0000	10.0000	1.0001	.0999		12-15	2055	72		40
100.0000	10.0001	.9999	.0999		12-16	1615	76		42
100.0001	10.0000	.9999	.0999		1-12	1230	73		44
99.9998	9.9999	1.0000	.1000		1-13	1720	73		44
100.0000	10.0001	1.0000	.0998		1-15	1105	75		45
99.9999	10.0000	.9999	.0999		1-20	2015	71		48
100.0000	9.9999	1.0000	.0998		1-21	1310	77		43
100.0001	10.0001	1.0000	.0997		1-22	1305	74		47
100.0000	10.0001	1.0000	.0998		1-23	1730	74		47
100.0001	9.9996	1.0000	.0999		1-24	0955	73		47
100.0000	9.9999	1.0000	.0999		1-25	1125	74		42
100.0000	9.9999	.9998	.1000		1-25	1515	76		43
100.0002	10.0001	.9999	.0998		2-21	1020	75		47
100.0001	10.0001	1.0002	.1000		2-22	1035	76		43
100.0001	9.9999	.9998	.0998		02-23	1235	76		45
99.9997	10.0000	.9999	.0999		02-24	2130	77		40
100.0000	9.9999	1.0000	.0998		02-25	1435	75		43
100.0000	10.0001	1.0001	.1000		02-25	2205	77		40
100.0000	9.9998	1.0000	.0999		02-26	1035	75		35
99.9999	9.9997	1.0000	.1002		04-27	1815	76		47
100.0000	10.0001	1.0000	.0999		04-29	1710	76		47
100.0002	9.9998	1.0000	.0999		04-30	0935	74		49
99.9997	10.0001	.9999	.0999		04-30	2125	77		48
99.9996	9.9997	.9997	.0999		05-01	2140	77		44
99.9997	10.0000	1.0000	.0998		05-02	2045	77		46
99.9998	10.0001	.9999	.0999		05-04	1435	74		46
99.9999	10.0001	.9998	.1000		05-05	2215	74		46
99.9998	9.9999	1.0000	.0998		05-07	0910	75		44
99.9998	10.0001	1.0000	.0999		05-11	2115	77		48
99.9999	9.9999	1.0001	.1000		05-13	2005	76		48
100.0001	9.9999	1.0000	.1000		05-14	1950	77		49
100.0000	9.9998	1.0000	.1001		05-15	1910	78		47
99.9999	9.9997	.9999	.1000		05-24	2020	78		48
99.9999	9.9997	.9999	.1000		05-30	1515	78		49
99.9999	9.9998	.9999	.1001		05-30	2215	78		49
100.0000	10.0001	1.0000	.0999		08-24	2125	78		49
100.0001	10.0001	1.0001	.0999		08-26	1000	78		49

Dates: From 8-28-01
Through 10-28-01

WOODSTOVE DATA SHEET #4-4
SCALE QA SHEET

Scale: Sartorius
Model: A1205
SN : 37010004

100g weight	10 g weight	1.0 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	Wet Bulb	%.RH
100.0000	10.0002	.9999	.0999	CJ	8-28	1900	75		49
100.0000	10.0005	1.0001	.1000	CJ	8-29	2130	76		49
100.0000	9.9999	1.0000	.0995	CJ	8-30	1130	76		49
100.0000	10.0000	.9999	.0998	CJ	8-31	1930	75		49
100.0004	10.0002	.9998	.1000	CJ	9-1	1445	77		49
100.0003	10.0001	.9999	.1000	JEW	9-3	2105	74		49
99.9999	10.0002	1.0000	.1001	JEW	9-4	1830	78		49
100.0001	10.0001	.9998	.1000	JEW	9-5	1230	75		49
100.0004	10.0000	.9999	.0999	CJ	9-26	1315	74		49
100.0000	10.0000	1.0000	.0998	JEW	9-27	9:30	73		46
100.0000	9.9999	1.0000	.0998	JEW	9-28	10:50	76		49
100.0000	10.0000	.9998	.0997	JEW	10-1	910	76		49
100.0000	9.9999	.9999	.0998	JEW	10-2	9:49	70		46
100.0000	10.0000	1.0000	.0995	JEW	10-3	9:21	76		46
99.9999	10.0000	1.0001	.1000	JEW	10-5	1240	78		48
99.9997	10.0000	1.0001	.1000	JEW	10-6	1420	68		49
99.9997	10.0000	1.0000	.0998	JEW	10-7	2150	78		47
10.0001	10.0002	1.0001	.1000	JEW	10-8	0730	74		49
9.9998	10.0000	1.0000	.0999	JEW	10-9	1205	78		48
100.0002	10.0001	.9997	.0996	JEW	10-9	1800	77		49
100.0001	10.0002	.9999	.0998	JEW	10-10	900	76		49
99.9999	9.9998	.9997	.0999	JEW	10-11	1125	77		48
100.0000	10.0001	.9997	.0998	JEW	10-11	1550	78		47
99.9999	10.0000	1.0000	.0999	JEW	10-11	1925	78		47
100.0000	10.0003	1.0000	.0998	JEW	10-14	2200	78		48
100.0000	10.0000	1.0001	.1001	JEW	10-15	1040	74		49
100.0002	10.0001	1.0000	.0999	JEW	10-19	2000	78		47
99.9997	10.0002	1.0002	.1001	JEW	10-22	0830	78		47
100.0001	10.0000	1.0000	.0998	JEW	10-22	1145	78		46
99.9998	10.0000	1.0000	.0997	JEW	10-23	1030	76		47
100.0000	10.0001	1.0001	.1000	JEW	10-23	1055	77		47
99.9999	10.0001	.9999	.1000	JEW	10-24	1025	76		48
100.0000	10.0000	.9999	.0999	JEW	10-25	1650	77		49
99.9999	9.9999	1.0001	.0997	JEW	10-25	2335	78		47
100.0000	9.9999	.9999	.0999	JEW	10-26	2125	78		47
100.0002	10.0001	1.0000	.0998	JEW	10-27	1155	77		46
99.9998	10.0000	1.0000	.1000	JEW	10-27	1645	77		46
100.0003	10.0001	.9999	.0996	JEW	10-28	1305	74		46

BLANK PROCESSING DATA SHEET # 5

UNIT : JOTUL F100 RUN : 2 DATE : 10-5-01

BLANKS DONE : 2-22-01

BEAKER	A	B	C
	200 ml ACETONE	75 ml DICHLOR	200 ml WATER
	FISHER OPTIMA LOT # 906481	FISHER OPTIMA LOT # 886589	BONNEAU PRODUCTS CERTIFIED DISTILLED
FINAL WEIGHT	108.9018	106.3086	106.9675
TARE WEIGHT	108.9007	106.3066	106.9672
NET WEIGHT	.0011 ✓	.0020 ✓	.0003 ✓

TARE BEAKERS INTO DESC : TIME : 1130 DATE : 02-19-01

DATE : 02/21 BY : [illegible] DATE : 02/22 BY : [illegible] DATE : BY :

BEAKER	1 ST WT	TIME	2 ND WT	TIME	3 RD WT	TIME
A	108.9012	1046	108.9007	1106	✓	
B	106.3069	1047	106.3066	1107	✓	
C	106.9677	1048	106.9672	1108	✓	

FINAL BEAKERS INTO DESC : TIME : 1630 DATE : 02/23/01

DATE : 02/24 BY : [illegible] DATE : 02/25 BY : [illegible] DATE : BY :

BEAKER	1 ST WT	TIME	2 ND WT	TIME	3 RD WT	TIME
A	108.9017	2135	108.9018	1440	✓	
B	106.3087	2136	106.3086	1441	✓	
C	106.9672	2137	106.9675	1442	✓	

TARE QC

DATE	TIME	BY	WB	DB	%
02/21	1020	[illegible]		75	47
02/22	1035	[illegible]		76	43

FINAL QC

DATE	TIME	BY	WB	DB	%
02/24	2130	[illegible]		77	40
02/25	1435	[illegible]		75	43

NET PARTICULATE CATCH CALCULATION DATA SHEET #6

UNIT: JOTUL F100 RUN: 2 DATE: 10-5-01

BLANK CALCULATIONS

Acetone: .0011 g ÷ 200 ml = .000006 g/ml
Dicholoromethane: .0020 g ÷ 75 ml = .000027 g/ml
Distilled Water: .0003 g ÷ 200 ml = .000002 g/ml

FRONT HALF CATCH

FILTERS: .4001 (Total Catch) g - 1 (# of Filters) (.0000 g) (Blank Value / Filter) = .4001 g

BEAKERS: .0686 (Total Catch) g - 120 (ml Acetone) (.000006 g) (Blank Value / ml Acetone) = .0679 g

TOTAL FRONT HALF CATCH: .4680 g

BACK HALF CATCH

FILTERS: .0430 (Total Catch) g - 1 (# of Filters) (.0000 g) (Blank Value / Filter) = .0430 g

BEAKERS:

Acetone: .1915 (Total Catch) g - 175 (ml Acetone) (.000006 g) (Blank Value / ml Acetone) = .1904 g

Extract: .0356 (Total Catch) g - 75 (ml Dichloromethane) (.000027 g) (Blank Value / Dichloromethane) = .0336 g

Water: .0545 (Total Catch) g - 290 (ml Water) (.000002 g) (Blank Value / Water) = .0539 g

TOTAL BACK HALF CATCH: .3209 g

TOTAL CATCH: .7889 g

% FRONT HALF: 59.32 %

CALCULATIONS DATA SHEET # 7

UNIT: Jotul F 100 RUN: 2 DATE: 10-5-01

1) Vm (std) = $\dfrac{(63.503\ \text{Vm})(17.64)(1.021\ \text{mcf})\left(29.94\ \text{"Hg} + \dfrac{.154\ \text{"}H_2O}{13.6}\right)}{(547\ \text{TmA})}$ = $\dfrac{62.6249}{000.0000}$ dscf

(29.9513)

2) Vw (std) = (.04707)(67.8 ml H_2O) = $\dfrac{3.1913}{00.0000}$ scf

3) Asw = $\dfrac{(3.1913\ \text{scf})}{(3.1913\ \text{scf} + 62.6249\ \text{dscf})}$ = $\dfrac{.0485}{.0000}$ Bws × 100 = $\dfrac{4.8488}{00.0000}$ % H_2O

65.8162

4) Cs = $\dfrac{(.7889\ \text{g.})}{(62.6249\ \text{dscf})}$ (15.43) = $\dfrac{.1944}{0.0000}$ gr / dscf

5) Estimated g / hr = $\dfrac{(.7889\ \text{g.})}{(62.6249\ \text{dscf})}$ ($\dfrac{5.329}{00.0000}$ dscfm)(60) = $\dfrac{4.0278}{00.0000}$ 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 F100 RUN: 2 DATE: 10-5-01

Test Chamber Air Velocity Start: 0 Stop: 0 Avg.: 0

Wet Bulb / Dry Bulb

Pre : WB: 60 DB: 78 = 33 % RH 1.1 % H_2O

Post : WB: 65 DB: 75 = 58 % RH 1.7 % H_2O

Average: 45.5 %RH 1.4 % H_2O

Empty Stove Weight (lbs): _____ w/ stack & oil seal : Wet: _____ Dry: 259.2

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

Preburn Fuel Weight: 5.1 + 9.0 + 5.3 + 6.1 Total: 25.5

Kindling & Preburn Fuel Weight (wood only) (lbs): Total: 27.2

Coal Bed Wt Range (lbs): 1.4 - 1.2 Scale: 260.6 - 260.4

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: 1.4

Maximum Coal Bed Removal (lbs): ((1.4 (Upper) + 1.2 (Lower)) + 2) .25 = .3

Test Fuel (.75" x 1.5" x 5" spacers) = 12 pcs

Dimensions	Length in inches	No. Pcs	Weight in lbs	% of Load
2" x 4"	14	3	5.7	100%
4" x 4"	—	—	—	—

Test Fuel Weight: 5.7 lbs

Estimated Dry Burn Rate: $\frac{5.7 - (5.7 \times .18197)}{2.2046} \times \frac{60}{\frac{200}{\text{TIME}}} = .635$ kg / hr (1.0372)

Estimated BTU's/hr: $19{,}140 \times \frac{63}{100} \times \frac{.635}{\text{DBR}} = 7657.0$ BTU's/hr

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

WOOD STOVE OPERATING DATA PAGE #9

Unit : Jotul F 100 Run : 2 Date : 10-5-01

FIRE STARTED: 0845

WARM UP AND PREBURN:

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

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

CHARCOAL BED PREPARATION :

Raked and leveled prior to each warm-up / preburn charge. At 1 ½ min. prior to loading last fuel, raked and leveled. In stove 15 sec.

TEST:

DOOR wide open during loading 0 min. 35 sec.

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

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 14 or 8 inches.

1st warm up / pre-burn fuel charge (5.[lbs.) added at 0925

2nd warm up / pre-burn fuel charge (9.0 lbs.) added at 1010

3rd warm up / pre-burn fuel charge (5.3 lbs.) added at 1110

4th warm up / pre-burn fuel charge (6.1 lbs.) added at 1210

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

TEST DATA SHEET #10

Unit: Total F/on Run: 2 Date: 10-5-01

Room Temperature: 71 °F Correction Factor: Ø

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

Time Test Fuel moisture reading taken: 1320

Calibration Checks: X ✓ Y ✓ 12.0 12.1 22.0 22.1

pc #	Dimen.	Use	TOP		BOTTOM		SIDE		Avg Corrected
			Uncor	Cor.	Uncor.	Cor.	Uncor.	Cor.	
1	2"×4"×8'	K	16.5	17.6°	14.0	14.9°	14.0	14.9°	15,800
2									
3									
4	2"×4"×8'	P	18.0	19.2°	18.0	19.2°	18.0	19.2°	19,200
5	2"×4"×8'	P	18.0	19.2°	18.5	19.8°	18.5	19.8°	19,600
6	2"×4"×8'	P	19.0	20.3°	19.5	20.9°	19.5	20.9°	20,700
7	2"×4"×8'	P							59,500
8	2"×4"×8'	P							
9									
10									
11	2×4×14	T	18.0	19.2°	18.5	19.8°	18.0	19.2°	19,400
12	"	T	21.5	23.1°	22.0	23.7°	22.5	24.1°	23,633
13	"	T	22.0	23.7°	22.0	23.7°	22.0	23.7°	23,700
14									66,733
15									
16									
17									
18									
19									
20	Spacers	T	18.0	19.2°	18.0	19.2°	18.5	19.8°	19,400

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

	KINDLING	PRETEST FUEL	TEST FUEL
Dry Moisture %:	15,800 %	19,833 %	22,244 %
Wet Moisture %:	13,644 %	16,551 %	18,197 %

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°

EIGHT: 260.6

GAS DATA SHEET # 12

NIT: Jotul F100 RUN: 2 DATE: 10-5-01 PAGE: 1 of 2

TIME	SCALE	FUEL	DROP	V.	CO_2	V.	O_2	V.	CO	BAL	WB	DB	% H_2O	CAL WB	STACK	STATIC	SO_2 PPM
2 1445	266.3	5.7	-	.078	1.9	.727	18.2	.063	.63	3.0					161	.025	650
5 50	266.2	5.6	.1	.164	4.1	.657	16.5	.056	.56	7.3					241	.033	575
10 55	266.1	5.5	.1	.175	4.3	.646	16.2	.063	.63	6.9					188	.030	650
15 1500	266.1	5.5	0	.194	4.8	.624	15.7	.087	.87	5.5					175	.030	675
20 05	265.9	5.3	.2	.187	4.6	.630	15.8	.104	1.04	4.5					175	.030	725
25 10	265.6	5.0	.3	.204	5.1	.611	15.3	.114	1.14	4.4					174	.030	750
30 15	265.3	4.7	.3	.240	6.0	.571	14.3	.109	1.09	5.5					181	.030	725
35 20	265.1	4.5	.2	.179	4.4	.622	15.6	.194	1.94	2.3					199	.035	650
40 25	264.7	4.1	.4	.307	7.7	.500	12.5	.089	.89	8.6					205	.035	650
45 30	264.4	3.7	.3	.386	9.6	.427	10.6	.050	.50	19.4					234	.040	575
50 35	264.1	3.5	.2	.370	9.2	.437	11.0	.049	.49	19.0					253	.040	550
55 40	263.8	3.2	.3	.431	10.8	.388	9.7	.051	.51	21.2					269	.042	525
TOTAL	-----	----	----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2455	.400	-----
60 1545	263.5	2.9	.3	.350	8.7	.452	11.3	.054	.54	16.3					265	.043	525
65 50	263.2	2.6	.3	.407	10.2	.409	10.2	.037	.37	27.7					273	.045	525
70 55	262.8	2.2	.4	.352	8.8	.450	11.3	.056	.56	15.7					268	.045	550
75 1600	262.6	2.0	.2	.346	8.6	.458	11.5	.049	.49	17.7					263	.045	525
80 05	262.3	1.7	.3	.420	10.5	.399	10.0	.043	.43	24.7					273	.045	525
85 10	262.1	1.5	.2	.362	9.0	.434	10.9	.041	.41	22.2					276	.045	525
90 15	261.9	1.3	.2	.324	8.1	.475	11.9	.056	.56	14.5					265	.045	550
95 20	261.7	1.1	.2	.325	8.1	.476	12.0	.048	.48	17.0					261	.045	575
100 25	261.5	.9	.2	.316	8.0	.480	12.0	.063	.63	12.5					256	.043	575
105 30	261.4	.8	.1	.225	5.6	.566	14.2	.112	1.12	5.0					244	.045	600
110 35	261.3	.7	.1	.193	4.8	.596	15.0	.125	1.25	3.8					225	.044	625
115 40	261.2	.6	.1	.187	4.6	.598	15.0	.141	1.41	3.3					214	.042	600
TOTAL	-----	----	----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	3083	.532	-----
TOTAL	-----	----	----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5538	.932	-----

VEIGHT: 260.6

NIT: Jotul F100

GAS DATA SHEET # 12

RUN: 2 DATE: 10-5-01 PAGE: 2 of 2

TIME	SCALE	FUEL	DROP	V.	CO_2	V.	O_2	V.	CO	BAL	WB	DB	% H_2O	CAL WB	STACK	STATIC	SO_2 PPM
120 1645	261.2	.6	0	.174	4.3	.617	15.5	.135	1.35	3.2					203	-.035	625
125 50	261.1	.5	.1	.172	4.3	.619	15.5	.135	1.35	3.2					196	-.035	625
130 55	261.1	.5	0	.164	4.1	.625	15.7	.143	1.43	2.8					276	-.032	625
135 1700	261.0	.4	.1	.164	4.1	.626	15.7	.147	1.47	2.8					185	-.030	625
140 1705	261.0	.4	0	.161	4.0	.627	15.7	.145	1.45	2.8					178	-.030	700
145 1710	261.0	.4	0	.148	3.7	.639	16.0	.137	1.37	2.7					198	-.025	700
150 1715	261.0	.4	0	.143	3.5	.648	16.3	.131	1.31	2.7					170	-.025	725
155 20	260.9	.3	1	.139	3.4	.651	16.3	.130	1.30	2.6					167	-.025	725
160 25	260.9	.3	0	.138	3.4	.653	16.4	.124	1.24	2.7					162	-.023	750
165 30	260.9	.3	0	.133	3.3	.657	16.5	.124	1.24	2.6					161	-.023	750
170 35	260.9	.3	0	.131	3.2	.662	16.6	.119	1.19	2.7					158	-.020	775
175 40	260.8	.2	.1	.128	3.2	.664	16.7	.122	1.22	2.6					155	-.020	775
TOTAL	-----	----	----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2209	-.323	-----
180 45	260.8	.2	0	.128	3.2	.665	16.7	.124	1.24	2.6					152	-.020	800
185 50	260.8	.2	0	.128	3.2	.663	16.6	.130	1.30	2.4					150	-.020	800
190 55	260.7	.1	.1	.128	3.2	.668	16.8	.125	1.25	2.5					149	-.020	800
195 1800	260.7	.1	0	.117	2.9	.674	16.9	.123	1.23	2.3					148	-.020	825
200 05	260.6	0	.1	.124	3.1	.668	16.8	.128	1.28	2.4					149	-.020	825
															748	-.100	
															2957	-.423	-.41
TOTAL	-----	----	----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	8495	1.355	-----
TOTAL	-----	----	----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	207	-.033	-----

PREBURN DATA SHEET #13

UNIT: Jotul F100 RUN: 2 DATE: 10-5-01 PAGE: 1 of 1

TIME	SCALE	DROP	STACK	TOP	LF SIDE	BACK	RT SIDE	BOTTOM	FIREBOX	SEC/CAT	AMBIENT	STATIC	COMMENTS
0 / 1340	261.3	—	328	329	456	440	444	337	836	915	85	.046	PREBURN START: # .7 UP
5 / 45	261.3	0	243	321	428	424	425	332	768	847	84	.036	COAL BED SCALE RANGE:
10 / 50	261.2	.1	227	309	406	410	407	327	736	766	84	.035	260.6 → 260.4 lb
15 / 55	261.2	0	213	299	380	391	386	321	689	724	83	.033	PRIMARY AIR: 1.75"
20 / 1400	261.1	.1	206	291	363	376	370	317	661	706	83	.031	SECONDARY AIR: N/A
25 / 05	261.1	0	198	272	346	363	353	311	635	664	82	.031	FAN: OFF
30 / 10	261.1	0	192	266	334	352	341	307	620	638	83	.029	PUMPS ON AT: 1410
35 / 15	261.1	0	185	248	317	332	328	300	605	592	87	.028	CHECK WB/DB: N/A
40 / 20	261.0	.1	178	243	306	328	317	293	592	558	82	.026	
45 / 25	261.0	0	173	237	296	322	309	286	591	541	82	.025	
50 / 30	261.0	0	167	228	285	313	298	280	575	522	81	.024	281
55 / 35	260.7	0	165	216	273	299	288	272	494	493	82	.023	TOOK OUT .3 @ 1430
*****	*****	***	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	
60 / 1440	260.7	0	164	214	268	293	282	266	467	475	83	.022	
65 / 45	260.6	.1	161	208	260	280	272	262	433	454	82	.025	256.4 ΔT
70 / 50													
75 / 55													
80 / 1500													
/													
/													
/													
/													
/													
/													
/													
/													
/													

TEMPERATURE DATA SHEET # 14

UNIT: Jotul F100 RUN: 2 DATE: 10-5-01 PAGE 1 of 2

TIME	TOP	LT SIDE	BACK	RT SIDE	BOTTOM	FIREBOX	SEC/CAT	AMBIENT	FURNACE	SAMPLE	SAMP IMP	C-GAS	GAS IMP	SO_2 IMP	2564
0 1445	208	260	280	272	262	433	454	82	1320	244	59	248	37	36	
5 50	198	244	260	252	251	345	624	82	1326	241	49	246	37	37	
10 55	198	239	254	242	247	349	576	82	1326	238	49	245	36	35	
15 1500	194	233	245	230	240	356	615	82	1327	237	50	245	37	38	
20 05	181	230	222	225	228	356	590	82	1325	247	51	243	35	36	
25 10	176	229	239	216	229	402	611	81	1324	232	51	243	32	33	
30 15	190	234	241	215	228	436	744	81	1323	236	51	242	33	34	
35 20	195	240	244	215	225	344	649	81	1321	232	51	240	34	35	
40 25	204	235	258	221	224	521	765	81	1320	235	51	242	33	34	
45 30	216	271	269	228	223	546	865	82	1319	237	52	239	37	38	
50 35	231	289	276	232	223	535	939	82	1318	231	51	239	35	36	
55 40	253	307	291	243	228	542	957	82	1317	230	51	236	35	36	
TOTAL	2444	3011	3079	2791	2808	5165	8386	980	*****	*****	*****	*****	*****	*****	
60 1545	270	326	307	267	224	436	925	82	1318	240	51	240	38	37	
65 50	286	334	324	298	224	529	995	83	1318	230	51	240	33	34	
70 55	271	351	339	319	229	700	1048	84	1318	229	51	240	33	34	
75 1600	305	359	353	323	232	715	819	84	1318	230	51	240	34	33	
80 05	324	380	367	334	294	683	936	84	1318	229	51	240	33	34	
85 10	326	394	377	343	236	661	940	85	1318	229	52	241	34	35	
90 15	342	398	389	357	248	732	1085	85	1320	229	52	240	34	35	
95 20	342	395	400	361	247	720	957	85	1322	228	52	240	37	36	
100 25	346	387	425	400	251	810	920	86	1316	235	52	235	37	36	
105 30	344	383	412	378	256	650	838	86	1326	228	54	233	38	37	
110 35	344	374	400	381	268	780	779	86	1324	228	53	240	37	36	
115 40	318	361	393	374	263	729	755	86	1332	228	54	233	36	35	
TOTAL	3818	4444	4486	4135	2972	8145	10997	1016	*****	*****	*****	*****	*****	*****	
TOTAL	6462	7455	7565	6926	5780	13310	19383	1996	*****	*****	*****	*****	*****	*****	

TEMPERATURE DATA SHEET # 14

UNIT: Jotul F10D RUN: 2 DATE: 10-5-01 PAGE 2 of 2

TIME	TOP	LT SIDE	BACK	RT SIDE	BOTTOM	FIREBOX	SEC/CAT	AMBIENT	FURNACE	SAMPLE	SAMP IMP	C-GAS	GAS IMP	SO_2 IMP	
120/1645	304	344	392	366	285	702	727	85	1333	227	54	239	33	34	
125/50	291	333	392	376	268	740	1070	85	1333	227	54	239	35	36	
130/55	331	386	348	356	266	687	659	85	1334	226	53	237	34	35	
135/1700	263	320	370	340	265	671	645	85	1334	226	53	238	35	36	
140/1705	344	383	371	334	264	642	633	86	1335	227	51	239	36	35	
145/1710	246	303	364	348	276	538	598	84	1338	229	51	239	35	36	
150/1715	240	297	304	313	268	414	576	83	1331	231	52	238	36	34	
155/1720	234	266	350	303	254	488	566	83	1340	231	52	243	37	36	
160/1725	191	282	338	294	251	486	548	83	1340	233	52	245	35	36	
165/30	221	275	335	288	247	486	527	86	1342	234	54	245	35	36	
170/35	215	259	328	281	243	469	526	81	1341	234	54	246	34	35	
175/40	208	273	321	272	239	443	508	81	1343	239	54	247	36	37	
TOTAL	3088	3721	4213	3871	3126	6766	7183	1007	*****	*****	*****	*****	*****	*****	
180/45	205	238	314	264	233	439	500	79	1344	236	54	247	35	36	
185/50	200	250	310	258	228	428	498	78	1344	236	54	247	36	37	
190/55	198	247	301	258	224	416	490	78	1344	236	55	248	35	36	
195/1800	194	243	300	248	221	391	482	78	1345	236	55	248	36	37	
200/05	187	238	294	241	215	394	480	78	1343	239	55	254	36	37	
	984	1216	1519	1269	1121	2068	2450	391							
											256.4				
											235.0				
											-21.4				
	4072	4937	5732	5140	4247	8834	9633	1398	÷41						
TOTAL	10334	12392	13297	12066	10027	22144	29016	3394	*****	*****	*****	*****	*****	*****	
TC⁻¹	252	302	324	294	245	540	708	83	*****	*****	*****	*****	*****	*****	

ZERO / SPAN CHECK DATA SHEET #15-1

Date : 10-5-01 Analyte : CO_2 (15-1)

Source : Jotul F100 Run # : 2

Zero Cyl. # : 038TAC 1-A Conc. : 0.00 % CO_2 Cyl. Press. : 1730 PSI

Certified by : AIR LIQUIDE Date : 02-07-01

Span Cyl. # : CC52330 Conc. : 12.44 % CO_2 Cyl. Press. : 1810 PSI

Certified by : AIR LIQUIDE Date : 01-19-01

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 : 1250 Temp : 80 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.1	.001	-.028	-.028	-.111
SPAN	49.8	.498	12.44	49.9	.499	12.471	+.031	+.124

POST RUN Audit : by : D. Washington Time : 1820 Temp : 76 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.1	.001	-.028	-.028	-.111
SPAN	49.8	.498	12.44	50.0	.500	12.496	+.056	+.224

± 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 : 10-5-01 Analyte : O_2 (15-2)

Source : Total F100 Run # : 2

Zero Cyl. # : 038TAC 1-A Conc. : 0.00 % O_2 Cyl. Press. : 1730 PSI

Certified by : AIR LIQUIDE Date : 02-07-01

Span Cyl. # : CC85322 Conc. : 12.45 % O_2 Cyl. Press. : 1810 PSI

Certified by : AIR LIQUIDE Date : 01-19-01

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. Wadmgton Time : 1250 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	-.040	-.040	-.159
SPAN	12.45	.498	12.45	12.5	.499	12.514	.064	.254

POST RUN Audit : by : D. Washington Time : 1820 Temp : 76 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.1	.001	-.015	-.015	-.059
SPAN	12.45	.498	12.45	12.56	.501	12.564	+.114	+.455

± 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 : 10-5-01 Analyte : CO (15-3)

Source : Jotul F 100 Run # : 2

Zero Cyl. # : 038TAC 1-A Conc. : 0.00 % CO Cyl. Press. : 1730 PSI

Certified by : AIR LIQUIDE Date : 02-07-01

Span Cyl. # : CC85322 Conc. : 4.98 % CO Cyl. Press. : 1810 PSI

Certified by : AIR LIQUIDE Date : 01-19-01

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 : 1250 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	-.004	-004	-.037
SPAN	49.8	.498	4.98	49.9	.499	4.997	+.017	+.175

POST RUN Audit : by : D. Washington Time : 1820 Temp : 76 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	-.001	-.014	-.014	-.137
SPAN	49.8	.498	4.98	49.9	.499	4.997	+.017	+.175

± 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 : 10-5-01 Analyte : SO_2 (15-4)

Source : Jotul F 100 Run # : 2

Zero Cyl. # : 038TAC 1-A Conc. : 0.00 ppm SO_2 Cyl. Press. : 1730 PSI

Certified by : AIR LIQUIDE Date : 02-07-01

Span Cyl. # : CC62184 Conc. : 1290 ppm SO_2 Cyl. Press. : 1800 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. Walmsley Time : 1250 Temp : 80 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	PPM	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.1	.001	6.196	6.196	.248
SPAN	51.6	.516	1290	51.3	.513	1283.929	-6.071	-.243

POST RUN Audit : by : A. Ubaldi Time : 1825 Temp : 75 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	PPM	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.3	.003	11.187	+11.187	+.447
SPAN	51.6	.516	1290	51.8	.518	1296.407	+6.407	+.256

± 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 F 100 RUN : 2 DATE : 10-05-01

Thermocouple Check :

T/C # 1	— °F	T/C # 13	53.8 °F
T/C # 2	— °F	T/C # 14	51.3 °F
T/C # 3	53.7 °F	T/C # 15	54.3 °F
T/C # 4	51.0 °F	T/C # 16	13.8 °F
T/C # 5	50.8 °F	T/C # 17	14.0 °F
T/C # 6	50.7 °F	T/C # 18	57.3 °F
T/C # 7	50.6 °F	T/C # 19	51.1 °F
T/C # 8	50.7 °F	T/C # 20	— °F
T/C # 9	51.3 °F	T/C # 21	— °F
T/C # 10	51.4 °F	T/C # 22	— °F
T/C # 11	49.1 °F	T/C # 23	51.4 °F
T/C # 12	60.3 °F	T/C # 24	— °F

Thermocouple Readout :

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

ZERO : 1.4 °F Adj. to 0.0 °F — ZERO 1.5 °F Difference .075 %

SPAN : 1996.2 °F Adj. to 2000.0 °F — SPAN 2003.2 °F Difference .160 %.

Thermocouple Readout Pretest Linearity Check

0	= 0.0 °F	200	= 201.7 °F	400	= 399.0 °F
600	= 601.3 °F	800	= 801.5 °F	1000	= 1000.6 °F
1200	= 1198.7 °F	1400	= 1399.2 °F	1600	= 1599.8 °F
1800	= 1800.0 °F	2000	= 2000.0 °F		

Sample Train Leak Check	Pre ✓	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 ✓

Scale Check Pre : 272.6 − 262.6 .

Post : 270.3 − 260.3 .

Stack Cleaned Prior to Test Run : YES _____ NO X

COMPUTER INPUT DATA SHEET #1

Client: Jotul USA

Address: 400 Riverside St. P.O. Box 1157
Portland, ME 04104

Phone: 207-797-5912 Fax: 207-818-5481

Run No.: 1 Date of Test: 10-04-01 Burn Rate: 1.186

Model No.: F100 ☐ min ☒ min-1.25 ☐ fan

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

Dry Gas Meter: Y Factor: 1.021 (0.000) (Data Sheet #2) Post Leak Rate: .011 cfm (.000) (Data Sheet #2) Time: 105 min. (000) (Data Sheet #2)

Dry Gas Meter Volume: 33.983 cf (00.000) (Data Sheet #2)

Stack Flow: 6.598 dscfm (00.000) (Data Sheet #2) Δ H: .162 in. H_2O (.000) (Data Sheet #2)

Barometric Pressure: 30.09 in. Hg (00.00) (Data Sheet #2)

H_2O Captured: 46.7 g (00.0) (Data Sheet #3)

Total Particulate Catch: .2495 g (0.0000) (Data Sheet #6)

Flue Gas Moisture: 6.0845 % (00.000) (Data Sheet #7)

Particulate Emission: .1135 gr/dscf (0.0000) (Data Sheet #7)

Ambient Moisture: 1.55 % (0.00) (Data Sheet #8)

Stove Weight: — lbs (000) (Data Sheet #8)

Total Fuel Consumed During Burn: 5.5 lbs (00.0) (Data sheet #8)

Fuel Higher Heating Value (dry): — BTU/lb (0000) (Data Sheet #8)

Fuel % Moisture (dry): 20.244 % (wet): 16.836 % (00.00) (Data Sheet #10)

Stack Static Pressure: -.045 in. H_2O (0.000) (Data Sheet #12)

Temperature (Average Room) Combustion Air: 80 °F (00) Data Sheet #14)

Stove Temperature Change: +17.4 °F (00.0) (Data Sheet #14)

TABLE 1 ----- RAW DATA

CLIENT : Jotul TEST No. : 1

MODEL: F100 DATE: 04-Oct-01

TIME (MIN.)	METER READING (C F)	DELTA H (IN. H2O)	METER TEMP. (DEG. F)	PERCENT CO (%)	PERCENT CO2 (%)	SO2 COCENTR. PPM
0	800.500	0.150	81	1.35	4.50	550
5	802.000	0.250	81	0.95	8.40	425
10	803.977	0.150	82	1.00	8.50	550
15	805.510	0.130	82	1.24	10.00	575
20	806.977	0.160	82	0.65	10.90	525
25	808.584	0.160	82	0.85	12.80	525
30	810.191	0.160	82	0.89	12.90	525
35	811.798	0.130	82	1.10	13.00	575
40	813.265	0.180	82	0.43	11.80	500
45	814.952	0.200	83	0.27	11.20	475
50	816.734	0.180	83	0.49	12.10	500
55	818.427	0.150	85	0.96	12.60	550
60	819.966	0.180	83	0.46	11.30	500
65	821.660	0.180	83	0.54	7.80	500
70	823.355	0.150	84	1.39	5.20	550
75	824.901	0.160	84	1.39	4.80	525
80	826.520	0.160	84	1.42	4.40	525
85	828.140	0.160	84	1.45	4.20	525
90	829.760	0.160	84	1.48	4.40	525
95	831.379	0.140	85	1.42	4.40	550
100	832.931	0.140	85	1.50	4.20	550
105	834.483	0.140	85	1.68	3.90	550
110						

TABLE 2---RAW DATA

CLIENT : Jotul TEST No. 1

MODEL: F100 DATE: 04-Oct-01

****

METER CAL. FACTOR (Y)	1.021		Wt. WOOD BURNED(LB)	5.5	Lbs
BAROMETRIC PRESS.(Pb)	30.09	in Hg	WET,FUEL MOISTURE %	16.836	%
LEAK RATE POST (Lp)	0.011	cfm	Wt. PART. COLLECTED	0.2495	g
WATER VOL. (V1c)	46.7	Ml	METER VOLUME Vm	33.983	mcf
TEST TIME (MIN)	105	min	HC MOLE FRACTION	0.0132	

TABLE 3 -----FIELD DATA AVERAGES

CLIENT :Jotul TEST No. 1

MODEL: F100 DATE: 04-Oct-01

****

AVG DELTA H	-------	0.16 in H2O	AVG PRCNT CO	-------	1.00	%
AVG METER TEMP. Tm	-------	83 deg F	AVG PRCNT CO2	-------	8.33	%
AVG PPM SO2	-------	526 PPM	AVG BAL CO2/CO	-------	8.36	%

TABLE 4 ----- CALCULATIONS

CLIENT : Jotul TEST No. 1

MODEL: F100 DATE: 04-Oct-01

****

STD SAMPLE VOL. Vm(std) -----	33.94	dscf	STACK GAS FLOW Qsd -------	404.597	dscf/Hr
				6.74	& dscf/min
VOL. WATER VAPOR Vw(std) ----	2.198	scf	PARTICULATE CONCTRT. Cs ------	0.0074	g/dscf
PRCNT MSTR Bws -------	6.08	%	PARTC.EMISS. RATE E -------	2.97	g/Hr
BURN RATE BR -------	1.20	Kg/Hr	MOLES OF GAS PER Lb WOOD Nt --	0.40	Lb-mole/Lb
CO EMISSION RATE -------	134.96	g/Hr	PART.EMISS. RATE ------	2.49	g/Kgdry fuel
	112.84	& g/Kgdry fuel			

TABLE 5 ----- PROPORTIONAL RATE VARIATION

CLIENT : Jotul TEST No. : 1

MODEL: F100 DATE: 04-Oct-01

TIME INTEVAL Ti	PPM * Vm	PROPRTN. RATE VAR. PR		PROPRTN RATE VAR. AVERAGE	
5	827.2	98		100	
10	841.9	100			
15	843.8	100			
20	844.2	100			
25	844.4	100			
30	844.4	100			
35	844.4	100			
40	844.2	100			
45	843.5	100			
50	845.7	100			
55	844.1	100			
60	844.0	100			
65	846.2	100			
70	845.9	100			
75	847.9	100			
80	847.6	100			
85	848.1	100			
90	848.1	100			
95	846.8	100			
100	849.6	101			
105	849.6	101			
110					
115					

METER BOX DATA SHEET PAGE # 2

Page: 1 of 1

UNIT: Jotol F100 RUN: 1 DATE: 10-04-01

Meter Box: SH Y Factor: 1.021

Leak checks: 15 " Hg @ .006 cfm _____ " Hg @ _____ cfm

15 " Hg @ .011 cfm _____ " Hg @ _____ cfm

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

ROTO: PRESS: .19			SAMPLING RATIO:			: 1	BP: 30.10		
MIN	TIME	METER READING	SAMPLE MDCF	STACK DSCFM	DELTA H	METER TEMP	SO2 PPM	ROTO TEMP	PUMP VACC
0	1415	800.500	—	6.308	.15	81	550	81	1.0
5	20	802.000	—	8.164	.25	81	475	81	3.0
10	25	803.977	803.977	6.297	.15	82	550	82	1.0
15	30	805.510	805.510	6.023	.13	82	575	82	1.0
20	35	806.977	806.977	6.596	.16	82	525	82	1.0
25	40	808.584	808.584	6.596	.16	82	525	82	1.0
30	45	810.191	810.191	6.596	.16	82	525	82	1.0
35	50	811.798	811.798	6.023	.13	82	575	82	1.0
40	55	813.265	813.265	6.926	.18	82	500	82	1.0
45	1500	814.952	814.952	7.277	.20	83	475	83	1.0
50	05	816.734	816.734	6.914	.18	83	500	83	1.0
55	10	818.427	818.427	6.285	.15	85	550	83	1.0
ROTO PRESS: .18			TOTALS:	80.005	2.0	987	BP.: 30.08		
60	1515	819.966	819.966	6.909	.18	83	500	83	1.0
65	20	821.660	821.660	6.909	.18	83	500	83	1.0
70	25	823.355	823.355	6.296	.15	84	550	84	1.0
75	30	824.901	824.901	6.568	.16	84	525	84	1.0
80	35	826.520	826.520	6.568	.16	84	525	84	1.0
85	40	828.140	828.140	6.568	.16	84	525	84	1.0
90	45	829.760	829.760	6.568	.16	84	525	84	1.0
95	50	831.379	831.379	6.258	.14	85	550	85	1.0
100	55	832.931	832.931	6.258	.14	85	550	85	1.0
105	1600	834.483	834.483	6.258	.14	85	550	85	1.0
110	05					841			1.0
115	10			65.160	1.57	1828	÷22		
			TOTALS:	145.165	3.57	83	MAX VACC =		3.0
TOTAL Cu Ft.		33.983	TOTALS:	6.598	.162	543	AVG. BP:	30.09	

PARTICULATE CATCH / MOISTURE DATA SHEET # 3

UNIT: Total F100 RUN: 1 DATE: 10-4-01

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	652.8	590.9	484.8	901.1
INITIAL WT	616.6	587.8	483.5	895.0
NET WT GRAMS	36.2 ✓	3.1 ✓	1.3 ✓	6.1 ✓

TOTAL CATCH: 46.7 ✓ GRAMS H_2O

FRONT HALF

FILTER #	71F	
FINAL WT g	.8066 ✓	
INITIAL WT g	.6773 ✓	
NET WT g	.1293 ✓	

BEAKER #	91
DESC.	ACETONE
FINAL WT g	95.1061
INITIAL WT g	95.0615 ✓
NET WT g	.0446
VOL. DESC. m	85

BACK HALF

FILTER #	71B	
FINAL WT g	.4351 ✓	
INITIAL WT g	.4262 ✓	
NET WT g	.0089 ✓	

BEAKER #	92	93	94	95	
DESC.	ACETONE	METHCHLOR	H_2O	H_2O	
FINAL WT g	96.7280	107.9069	106.3926	107.4302	
INITIAL WT g	96.6864	107.8953	106.3854	107.4202	
NET WT g	.0416	.0116	.0072	.0100	.0172
VOL. DESC ml	120	75	125	135	260

FILTER TARE WEIGHTS DATA SHEET #4-1

Into Dessicator : Date : 9-17-01 Time : 1000 By : C. Washington

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

Back Size: 8.2 cm Lot No. : ZB911

	DATE: 9-26	BY: [illegible]	DATE: 9-27	BY: JEU	DATE:	BY:
FILTER #	FIRST WEIGHT	TIME	SECOND WEIGHT	TIME	THIRD WEIGHT	TIME
71F	.6778	1318	.6773	9:30	JOTUL F400 R#1	
72F	.6789	1319	.6785	9:31	" " R#2	
73F	.6692	1320	.6688	9:32	" " R#3	
74F	.6681	1321	.6682	9:33	" " R#4	
75F	.6724	1322	.6722	9:34		
76F	.6620	1323	.6674	9:35		
77F	.6707	1324	.6705	9:36		
78F	.6645	1325	.6645	9:37		
79F	.6748	1326	.6753	9:38		
80F	.6745	1327	.6747	9:39		
71B	.4264	1329	.4262	9:40	JOTUL F400 R#1	
72B	.4282	1330	.4277	9:41	" " R#2	
73B	.4309	1331	.4304	9:42	" " R#3	
74B	.4365	1332	.4363	9:43	" " R#4	
75B	.4200	1333	.4199	9:45		
76B	.4224	1334	.4227	9.46		
77B	.4223	1335	.4226	9.47		
78B	.4169	1336	.4165	9:48		
79B	.4181	1337	.4185	9:49		
80B	.4224	1338	.4222	9:50		

Checked by: C. Washington Date: 9-27-01 Time: 1020

BALANCE ROOM ENVIRONMENTAL CONDITIONS

DATE	TIME	BY	WB	DB	% RH
9-26	1315	CLP		74	49
9-27	9:30	JEU		72	45.

BEAKER TARE WEIGHTS DATA SHEET #4-2

Into Dessicator: Date : 08-17-01 Time : 1215 By : [illegible]

	DATE: 8-29	BY: Clp	DATE: 8-30	BY: Clp	DATE:	BY:
BEAKER #	FIRST WEIGHT	TIME	SECOND WEIGHT	TIME	THIRD WEIGHT	TIME
76	103.8106	2135	103.8101	1150	-	
77	107.3956	2136	107.3956	1151	-	
78	94.5034	2137	94.5030	1152	- HERITAGE MK1	
79	97.6274	2138	97.6271	1153	- R#5	
80	109.1338	2139	109.1342	1155	-	
81	101.4706	2141	101.4703	1157	-	
82	97.4853	2142	97.4852	1158	-	
83	98.3339	2143	98.3341	1159	- R+D	
84	105.5609	2144	105.5606	1200	-	
85	98.0013	2145	98.0014	1201	-	
86	104.7505	2147	104.7510	1202	-	
87	105.9223	2148	105.9226	1203	- R+D	
88	100.0093	2149	100.0090	1204	- R+D	
89	120.6787	2150	120.6786	1206	-	
90	106.4104	2152	106.4102	1207	-	
91	95.0611	2153	95.0615	1208	-	
92	96.6869	2155	96.6864	1209	- JOEL F100	
93	107.8956	2156	107.8953	1210	- R#1	
94	106.3855	2157	106.3854	1211	-	
95	107.4205	2158	107.4202	1212	-	
96	103.9921	2200	103.9916	1213	-	
97	99.9938	2202	99.9935	1215	- JOEL F100	
98	105.0328	2203	105.0329	1216	- R#2	
99	104.9461	2204	104.9665	1217	-	
100	106.7533	2205	106.7534	1218	-	

BALANCE ROOM ENVIRONMENTAL CONDITIONS

DATE	TIME	BY	WB	DB	% RH	
8-29	2130	Clp		76	49	Checked by : [illegible]
8-30	1130	Clp		76	49.	Date : 08-30-01
						Time : 1300

WOODSTOVE DATA SHEET # 4-3 : CONSTANT WEIGHTS

UNIT : Jotul F100 **RUN :** 1 **DATE :** 10-4-01

Beaker #	Date	Time	By	First Weight	Date	Time	By	Second Weight	Date	Time	By	Third Weight	Date	Time	By
91	10-5	1000	CP	95.1064	10-7	2154		95.1061	10-8	0735					
92	10-5	1650		96.7283	10-7	2155		96.7280	10-8	0736					
93	10-5	1650		107.9070	10-7	2156		107.9069	10-8	0737					
94	10-5	1000	CP	106.3928	10-7	2157		106.3926	10-8	0738					
95	10-5	1000	CP	107.4299	10-7	2158		107.4302	10-8	0739					

Filter #	Date	Time	By	First Weight	Date	Time	By	Second Weight	Date	Time	By	Third Weight	Date	Time	By
71F	10-4	1700	CP	.8075	10-5	1243		.8068	10-6	1423	JEW	.8066	10-7	2159	
71B	10-4	1700	CP	.4388	10-5	1244		.4365	10-6	1424	JEW	.4353	10-7	2200	
				.4351	10-8	0740									

SCALE ROOM ENVIRONMENTAL CONDITIONS

Weighing Session	Date	Time	By	WB	DB	%RH
1	10-5	1240			78	48
2	10-6	1420	JEW		68	49
3	10-7	2150			78	47
4	10-8	0730			74	49

Weighing Session	Date	Time	By	WB	DB	%RH
5						
6						
7						
8						

Dates: From 12-15-2000
Through 08-26-2001

WOODSTOVE DATA SHEET #4-4
SCALE QA SHEET

Scale: Sartorius
Model: A1205
SN : 37010004

100g weight	10 g weight	1.0 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	Wet Bulb	%.RH
100.0000	10.0001	1.0000	.0999		12-15	1215	73		40
100.0000	10.0000	1.0001	.0999		12-15	2055	72		40
100.0000	10.0001	.9999	.0999		12-16	1615	76		42
100.0001	10.0000	.9999	.0999		1-12	1230	73		44
99.9998	9.9999	1.0000	.1000		1-13	1720	73		44
100.0000	10.0001	1.0000	.0998		1-15	1105	75		45
99.9999	10.0100	.9999	.0999		1-20	2015	71		48
100.0000	9.9999	1.0000	.0998		1-21	1310	77		43
100.0001	10.0001	1.0000	.0997		1-22	1305	74		47
100.0000	10.0001	1.0000	.0998		1-23	1730	74		47
100.0001	9.9998	1.0000	.0999		1-24	0955	73		47
100.0000	9.9999	1.0000	.0999		1-25	1125	74		42
100.0000	9.9999	.9998	.1000		1-25	1515	76		43
100.0002	10.0001	.9999	.0998		2-21	1020	75		47
100.0001	10.0001	1.0002	.1000		2-22	1035	76		43
100.0001	9.9999	.9998	.0998		02-23	1235	76		45
99.9997	10.0000	.9999	.0999		02-24	2130	77		40
100.0000	9.9999	1.0000	.0998		02-25	1435	75		43
100.0000	10.0001	1.0001	.1000		02-25	2205	77		40
100.0000	9.9998	1.0000	.0999		02-26	1035	75		35
99.9999	9.9997	1.0000	.1002		04-27	1815	76		47
100.0000	10.0001	1.0000	.0999		04-29	1710	76		47
100.0002	9.9998	1.0000	.0999		04-30	0935	74		49
99.9997	10.0001	.9999	.0999		04-30	2125	77		48
99.9996	9.9997	.9997	.0999		05-01	2140	77		44
99.9997	10.0000	1.0000	.0998		05-02	2045	77		46
99.9998	10.0001	.9999	.0999		05-04	1435	74		46
99.9999	10.0001	.9998	.1000		05-05	2215	74		46
99.9998	9.9999	1.0000	.0998		05-07	0910	75		44
99.9998	10.0001	1.0000	.0999		05-11	2115	77		48
99.9999	9.9999	1.0001	.1000		05-13	2005	76		48
100.0001	9.9999	1.0000	.1000		05-14	1950	77		49
100.0000	9.9998	1.0000	.1001		05-15	1910	78		47
99.9999	9.9997	.9999	.1000		05-24	2020	78		48
99.9999	9.9997	.9999	.1000		05-30	1515	78		49
99.9999	9.9998	.9999	.1001		05-30	2215	78		49
100.0000	10.0001	1.0000	.0999		08-24	225	78		49
100.0001	10.0000	1.0001	.0999		08-26	1000	78		49

Dates: From 8-28-01
Through 10-28-01

WOODSTOVE DATA SHEET #4-4
SCALE QA SHEET

Scale: Sartorius
Model: A1205
SN : 37010004

100g weight	10 g weight	1.0 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	Wet Bulb	%.RH
100.0000	10.0002	.9999	.0999	CD	8-28	1900	75		49
100.0000	10.0005	1.0001	.1000	CD	8-29	2130	76		49
100.0000	9.9999	1.0000	.0995	CD	8-30	1130	76		49
100.0000	10.0000	.9999	.0998	CD	8-31	1930	75		49
100.0004	10.0002	.9998	.1000	CD	9-1	1445	77		49
100.0003	10.0001	.9999	.1000	DEW	9-3	2105	74		49
99.9999	10.0002	1.0000	.1001	DEW	9-4	1830	78		49
100.0001	10.0001	.9998	.1000	DEW	9-5	1230	75		49
100.0004	10.0000	.9999	.0999	CD	9-26	1315	74		49
100.0000	10.0000	1.0000	.0998	JEW	9-27	9:30	73		46
100.0000	9.9999	1.0000	.0998	JEW	9-28	10:50	76		49
100.0000	10.0000	.9998	.0997	JEW	10-1	910	76		49
100.0000	9.9999	.9999	.0998	JEW	10-2	9:49	70		46
100.0000	10.0000	1.0000	.0995	JEW	10-3	9:21	76		46
99.9999	10.0000	1.0001	.1000	DEW	10-5	1240	78		48
99.9997	10.0000	1.0001	.1000	JEW	10-6	1420	68		49
99.9997	10.0000	1.0001	.0998	DEW	10-7	2150	78		47
10.0001	10.0002	1.0001	.1000	DEW	10-8	0730	74		49
9.9998	10.0000	1.0000	.0999	DEW	10-9	1205	78		48
100.0002	10.0001	.9997	.0996	DEW	10-9	1800	77		49
100.0001	10.0002	.9999	.0998	DEW	10-10	900	76		49
99.9999	9.9998	.9997	.0999	DEW	10-11	1125	77		48
100.0000	10.0001	.9997	.0998	DEW	10-11	1550	78		47
99.9999	10.0000	1.0000	.0999	DEW	10-11	1925	78		47
100.0000	10.0003	1.0000	.0998	DEW	10-14	2200	78		48
100.0000	10.0001	1.0001	.1001	DEW	10-15	1040	74		49
100.0002	10.0001	1.0000	.0999	DEW	10-19	2000	78		47
99.9997	10.0002	1.0002	.1001	DEW	10-22	0830	78		47
100.0001	10.0000	1.0000	.0998	DEW	10-22	1145	78		46
99.9998	10.0000	1.0000	.0997	DEW	10-23	1030	76		47
100.0000	10.0001	1.0001	.1000	DEW	10-23	1055	77		47
99.9999	10.0001	.9999	.1000	DEW	10-24	1025	76		48
100.0000	10.0000	.9999	.0999	DEW	10-25	1650	77		49
99.9999	9.9999	1.0001	.0997	DEW	10-25	2335	78		47
100.0000	9.9999	.9999	.0999	DEW	10-26	2125	78		47
100.0002	10.0001	1.0000	.0998	DEW	10-27	1155	77		46
99.9998	10.0000	1.0000	.1000	DEW	10-27	1645	77		46
100.0003	10.0001	.9999	.0996	DEW	10-28	1305	74		46

BLANK PROCESSING DATA SHEET # 5

UNIT : Jomil F100 RUN : 1 DATE : 10-04-01

BLANKS DONE : 2-22-01

BEAKER	A	B	C
	200 ml ACETONE	75 ml DICHLOR	200 ml WATER
	FISHER OPTIMA LOT # 906481	FISHER OPTIMA LOT # 886589	BONNEAU PRODUCTS CERTIFIED DISTILLED
FINAL WEIGHT	108.9018	106.3086	106.9675
TARE WEIGHT	108.9007	106.3066	106.9672
NET WEIGHT	.0011 ✓	.0020 ✓	.0003 ✓

TARE BEAKERS INTO DESC : TIME : 1130 DATE : 02-19-01

DATE : 02/21 BY : [illegible] DATE : 02/22 BY : [illegible] DATE : ____ BY : ____

BEAKER	1 ST WT	TIME	2 ND WT	TIME	3 RD WT	TIME
A	108.9012	1046	108.9007	1106	✓	
B	106.3069	1047	106.3066	1107	✓	
C	106.9677	1048	106.9672	1108	✓	

FINAL BEAKERS INTO DESC : TIME : 1630 DATE : 02/23/01

DATE : 02/24 BY : [illegible] DATE : 02/25 BY : [illegible] DATE : ____ BY : ____

BEAKER	1 ST WT	TIME	2 ND WT	TIME	3 RD WT	TIME
A	108.9017	2135	108.9018	1440	✓	
B	106.3087	2136	106.3086	1441	✓	
C	106.9672	2137	106.9675	1442	✓	

TARE QC

DATE	TIME	BY	WB	DB	%
02/21	1020	[illegible]		75	47
02/22	1035	[illegible]		76	43

FINAL QC

DATE	TIME	BY	WB	DB	%
02/24	2130	[illegible]		77	40
02/25	1435	[illegible]		75	43

NET PARTICULATE CATCH CALCULATION DATA SHEET #6

UNIT : JOTUL F/00 RUN : 1 DATE : 10-04-01

BLANK CALCULATIONS

Acetone : .0011 g ÷ 200 ml = .000006 g/ml
Dicholoromethane : 0020 g ÷ 75 ml = .000027 g/ml
Distilled Water : .0003 g ÷ 200 ml = .000002 g/ml

FRONT HALF CATCH

FILTERS : .1293 (Total Catch) g - 1 (# of Filters) (.0000 g) (Blank Value / Filter) = .1293 g

BEAKERS : .0446 (Total Catch) g - 85 (ml Acetone) (.000006 g) (Blank Value / ml Acetone) = .0441 g

TOTAL FRONT HALF CATCH : .1734 g

BACK HALF CATCH

FILTERS : .0089 (Total Catch) g - 1 (# of Filters) (.0000 g) (Blank Value / Filter) = .0089 g

BEAKERS :
Acetone : .0416 (Total Catch) g - 120 (ml Acetone) (.000006 g) (Blank Value / ml Acetone) = .0409 g

Extract : .0116 (Total Catch) g - 75 (ml Dichloromethane) (.000027 g) (Blank Value / Dichloromethane) = .0096 g

Water : .0172 (Total Catch) g - 260 (ml Water) (.000002 g) (Blank Value / Water) = .0167 g

TOTAL BACK HALF CATCH : .0761 g

TOTAL CATCH : .2495 g

% FRONT HALF : 69.50 %

CALCULATIONS DATA SHEET # 7

UNIT : Jotul F 100 RUN : 1 DATE : 10-04-01

1) Vm (std) = $\dfrac{(33.983\ \text{Vm})(17.64)(1.021\ \text{mcf})\left(30.09\text{" Hg} + \dfrac{.162\text{" } H_2O}{13.6}\right)}{(543\ \text{TmA})}$ = $\dfrac{33.9297}{000.0000}$ dscf

30.1019

2) Vw (std) = (.04707)(46.7 ml H_2O) = $\dfrac{2.1982}{00.0000}$ scf

3) Asw = $\dfrac{(2.1982\ \text{scf})}{(2.1982\ \text{scf} + 33.9297\ \text{dscf})}$ = $\dfrac{.0608}{.0000}$ Bws × 100 = $\dfrac{6.0845}{00.0000}$ % H_2O

36.1279

4) Cs = $\dfrac{(.2495\ \text{g.})}{(33.9297\ \text{dscf})}$ (15.43) = $\dfrac{.1135}{0.0000}$ gr / dscf

5) Estimated g / hr = $\dfrac{(.2495\ \text{g.})}{(33.9297\ \text{dscf})}$ ($\dfrac{6.598}{00.0000}$ dscfm) (60) = $\dfrac{2.9111}{00.0000}$ 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 F100 RUN : 1 DATE : 10-04-01

Test Chamber Air Velocity Start : 0 Stop : 0 Avg.: 0

Wet Bulb / Dry Bulb

Pre : WB : 65 DB : 75 = 58 % RH 1.7 % H_2O

Post : WB : 61 DB : 74 = 46 % RH 1.4 % H_2O

Average : 52 %RH 1.55 % H_2O

Empty Stove Weight (lbs) : _____ w/ stack & oil seal : Wet : _____ Dry : 259.2

Kindling Weight (lbs) : Paper : .2 Wood : 2.1

Preburn Fuel Weight : 5.8 + 5.0 + 6.9 Total : 17.7

Kindling & Preburn Fuel Weight (wood only) (lbs) : Total : 19.8

Coal Bed Wt Range (lbs) : 1.3 - 1.1 Scale : 260.5 - 260.3

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 : 1.3

Maximum Coal Bed Removal (lbs) : ((1.3 (Upper) + 1.1 (Lower)) ÷ 2) .25 = .3

Test Fuel (.75" x 1.5" x 5" spacers) = 12 pcs

Dimensions	Length in inches	No. Pcs	Weight in lbs	% of Load
2" x 4"	14	3	5.5	100.0
4" x 4"	—	—	—	—

Test Fuel Weight : 5.5 lbs

Estimated Dry Burn Rate : 9260

$$\frac{5.5 - (5.5 \times .16836)}{2.2046} \times \frac{60}{\underset{\text{TIME}}{105}} = 1.186 \text{ kg / hr}$$

Estimated BTU's/hr : 19,140 $\times \frac{63}{100} \times \frac{1.186}{\text{DBR}} =$ 14301.0 BTU's/hr

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

WOOD STOVE OPERATING DATA PAGE #9

Unit : Jotul F 100 Run : 1 Date : 10-04-01

FIRE STARTED: 0945

WARM UP AND PREBURN:

PRIMARY AIR : Set wide open for all warm-up / preburn fuel charges. Then set to 2" 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 ½ min. prior to loading last fuel, raked and leveled. In stove 15 sec.

TEST:

DOOR wide open during loading 0 min. 40 sec.

PRIMARY AIR : Opened full for first 5 min., then set to run setting of 2".

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 OFF

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 14 or 9 inches.

1st warm up / pre-burn fuel charge (5.8 lbs.) added at 1025

2nd warm up / pre-burn fuel charge (5.0 lbs.) added at 1120

3rd warm up / pre-burn fuel charge (6.9 lbs.) added at 1155

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 F 100 Run : 1 Date : 10 - 4 -01

Room Temperature : 69 °F Correction Factor : 9

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

Time Test Fuel moisture reading taken : 1145

Calibration Checks : X ✓ Y ✓ 12.0 12.1 22.0 22.1

pc #	Dimen.	Use	TOP		BOTTOM		SIDE		Avg Corrected
			Uncor	Cor.	Uncor.	Cor.	Uncor.	Cor.	
1	2"×4"×8'	K	14.5	15.5	12.5	13.3	12.5	13.3	14.033 ✓
2									
3									
4	2"×4"×8'	P	18.0	19.2	18.5	19.8	18.0	19.2	19,400 -
5	2"×4"×8'	P	18.0	19.2	18.0	19.2	18.0	19.2	19,200 -
6	2"×4"×8'	P	21.0	22.5	20.0	21.4	20.0	21.4	21,767 -
7	2"×4"×8'	P							60,367 -
8	2"×4"×8'	P							
9									
10									
11	2x4x14	T	18.0	19.2	18.0	19.2	18.0	19.2	19,200 -
12	"	T	18.0	19.2	18.0	19.2	18.0	19.2	19,200 -
13	"	T	21.0	22.5	20.5	22.0	21.0	22.5	22,333 -
14									60,733 -
15									
16									
17									
18									
19									
20	Spacers	T	18.0	19.2	17.5	18.7	18.5	19.8	19,233 ✓

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

	KINDLING	PRETEST FUEL	TEST FUEL
Dry Moisture % :	14.033 - %	20.122 - %	20,244 - %
Wet Moisture % :	12.306 - %	16,751 - %	16,836 - %

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°

WEIGHT: 260.5

UNIT: Jotul F100

GAS DATA SHEET # 12

RUN: 1 DATE: 10-04-01 PAGE: 1 of 1

TIME	SCALE	FUEL	DROP	V.	CO_2	V.	O_2	V.	CO	BAL	WB	DB	% H_2O	CAL WB	STACK	STATIC	SO_2 PPM
0 1415	266.0	5.5	-	.183	4.5	.616	15.5	.135	1.35	3.4					210	-.032	550
5 20	265.6	5.1	.4	.338	8.4	.437	11.0	.095	.95	8.9					309	.045	425
10 25	265.3	4.8	.3	.342	8.5	.446	11.2	.100	1.00	8.5					272	.043	550
15 30	264.9	4.4	.4	.400	10.0	.379	9.5	.124	1.24	8.1					295	.046	575
20 35	264.4	3.9	.5	.436	10.9	.366	9.2	.065	.65	16.8					332	.050	525
25 40	263.9	3.4	.5	.513	12.8	.304	7.6	.085	.85	15.1					352	.051	525
30 45	263.4	2.9	.5	.517	12.9	.298	7.5	.089	.89	14.6					359	.052	525
35 50	262.9	2.4	.5	.519	13.0	.288	7.2	.110	1.10	11.8					364	.054	575
40 55	262.5	2.0	.4	.473	11.8	.328	8.2	.043	.43	27.7					355	.051	500
45 1500	262.2	1.7	.3	.449	11.2	.351	8.8	.027	.27	42.0					344	.051	475
50 05	261.9	1.4	.3	.483	12.1	.323	8.1	.049	.49	24.8					344	.051	500
55 10	261.6	1.1	.3	.503	12.6	.291	7.3	.096	.96	13.1					351	.051	550
TOTAL	*****	****	****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	3887	.577	*****
60 1515	261.3	.8	.3	.451	11.3	.332	8.3	.046	.46	24.7					343	.051	500
65 20	261.2	.7	.1	.312	7.8	.464	11.6	.054	.54	14.5					318	.048	500
70 25	261.0	.5	.2	.209	5.2	.579	14.5	.139	1.39	3.7					286	.045	550
75 30	261.0	.5	0	.192	4.8	.597	15.0	.139	1.39	3.4					268	.042	525
80 35	260.9	.4	.1	.176	4.4	.614	15.4	.142	1.42	3.1					254	.040	525
85 40	260.8	.3	.1	.171	4.2	.617	15.5	.145	1.45	2.9					244	.038	525
90 45	260.7	.2	.1	.176	4.4	.614	15.4	.148	1.48	2.9					235	.038	525
95 50	260.6	.1	.1	.179	4.4	.613	15.4	.142	1.42	3.1					228	.038	550
100 55	260.6	.1	0	.170	4.2	.621	15.6	.150	1.50	2.8					221	.036	550
105 1600	260.5	0	.1	.158	3.9	.629	15.8	.168	1.68	2.3					215	.035	550
110 05																	
115 10															2612	.411	.22
TOTAL	*****	****	****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	6499	.988	*****
TOTAL	*****	****	****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	295	.045	*****

PREBURN DATA SHEET #13

UNIT: Jotul F100 RUN: 1 DATE: 10-04-01 PAGE: 1 of 1

TIME	SCALE	DROP	STACK	TOP	LF SIDE	BACK	RT SIDE	BOTTOM	FIREBOX	SEC/CAT	AMBIENT	STATIC	COMMENTS
0 1245	261.5	—	458	449	585	556	553	379	1151	1183	84	-.056	PREBURN START: # 1.0 UP
5 50	261.4	.1	326	439	544	527	543	372	1000	982	84	-.046	COAL BED SCALE RANGE:
10 55	261.4	0	293	409	510	497	512	367	940	914	84	-.041	260.5 - 260.3
15 1300	261.3	.1	278	389	486	478	490	365	915	891	83	-.039	PRIMARY AIR: 2"
20 05	261.2	.1	265	369	462	457	467	361	892	874	84	-.037	SECONDARY AIR: N/A
25 10	261.2	0	255	344	442	442	448	357	875	848	83	-.036	FAN: OFF
30 15	261.1	.1	247	332	427	430	437	354	860	846	84	-.035	PUMPS ON AT: 1315
35 20	261.0	.1	236	318	407	414	417	348	837	810	81	-.034	CHECK WB/DB: N/A
40 25	261.0	0	231	301	393	402	405	344	820	828	80	-.033	
45 30	260.9	.1	229	300	388	398	398	341	802	862	80	-.033	
50 35	260.9	0	225	286	377	393	388	336	784	851	79	-.032	
55 40	260.9	0	223	277	370	384	382	334	772	742	80	-.033	
*****	****	***	****	*****	*****	****	*****	*****	*****	*****	*****	****	
60 1345	260.8	.1	217	272	364	374	374	332	755	718	79	-.032	
65 50	260.7	.1	212	263	358	364	363	326	734	712	79	-.032	
70 55	260.7	0	208	256	353	358	356	326	712	704	79	-.031	
75 1400	260.7	0	215	249	347	354	348	322	696	665	79	-.032	
80 05	260.6	.1	212	246	342	358	337	315	678	666	78	-.032	
85 10	260.5	.1	213	238	339	359	329	308	669	656	78	-.034	
90 15	260.5	0	210	240	335	357	328	307	659	648	78	-.032	313.4 ΔT

TEMPERATURE DATA SHEET # 14

UNIT: Jotul F100 RUN: 1 DATE: 10-04-01 PAGE 1 of 1

TIME	TOP	LT SIDE	BACK	RT SIDE	BOTTOM	FIREBOX	SEC/CAT	AMBIENT	FURNACE	SAMPLE	SAMP IMP	C-GAS	GAS IMP	SO_2 IMP	313.4
0/1415	240	335	357	328	307	659	648	78	1301	234	56	246	36	35	
5/20	231	312	327	312	302	939	939	78	1304	234	49	248	36	37	
10/25	238	303	326	309	294	809	906	77	1304	235	49	248	36	37	
15/30	251	297	329	314	284	1007	1025	77	1305	235	49	250	37	37	
20/35	270	306	341	336	273	930	1015	77	1308	235	49	249	34	36	
25/40	296	339	357	371	269	1005	1089	78	1311	235	49	249	35	36	
30/45	314	364	378	393	265	1019	1140	79	1314	235	49	249	35	36	
35/50	338	393	405	420	268	997	1177	79	1320	236	50	248	36	36	
40/55	353	436	425	438	270	969	1146	80	1325	236	50	249	37	36	
45/1500	366	462	435	445	272	952	1160	81	1330	236	50	248	37	35	
50/05	377	478	441	454	278	969	1152	81	1333	236	50	248	37	35	
55/10	384	494	444	469	282	1074	1116	81	1334	236	50	247	36	35	
TOTAL	3658	4519	4565	4589	3364	11329	12513	946	*****	*****	*****	*****	*****	*****	
60/1515	393	504	449	480	288	1050	1160	82	1337	237	51	247	37	36	
65/20	392	503	460	484	294	909	1102	82	1340	236	51	247	37	38	
70/25	379	482	451	460	298	830	926	82	1334	237	50	246	37	36	
75/30	366	460	444	436	303	786	847	82	1328	237	51	246	37	37	
80/35	343	436	433	416	304	751	793	81	1324	237	51	246	38	37	
85/40	326	416	421	397	307	720	761	82	1321	237	51	246	38	37	
90/45	310	394	415	379	305	682	721	82	1316	237	51	245	37	37	
95/50	295	381	413	366	303	664	699	80	1312	237	51	245	37	36	
100/5	278	365	407	353	294	649	665	80	1307	237	51	245	36	35	
105/1600	267	352	401	345	289	638	648	80	1305	237	52	244	35	35	
110/05															
115/10	3349	4293	4294	4116	2985	7679	8322	813	1322						313.4 -
TOTAL	7007	8812	8859	8705	6349	19008	20835	1759	*****	*****	*****	*****	*****	*****	330.8 -
TOTAL	319	401	403	396	289	864	947	80	*****	*****	*****	*****	*****	*****	+ 17.4 ΔT

ZERO / SPAN CHECK DATA SHEET #15-1

Date : 10-04-01 Analyte : CO_2 (15-1)

Source : Jotul F100 Run # : 1

Zero Cyl. # : 038TAC 1-A Conc. : 0.00 % CO_2 Cyl. Press. : 1730 PSI

Certified by : AIR LIQUIDE Date : 02-07-01

Span Cyl. # : CC52330 Conc. : 12.44 % CO_2 Cyl. Press. : 1810 PSI

Certified by : AIR LIQUIDE Date : 01-19-01

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 : D Washington Time : 1230 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	-.053	-.053	-.211
SPAN	49.8	.498	12.44	49.8	.498	12.446	+.006	+.023

POST RUN Audit : by : D. Washington Time : 1620 Temp : 80 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.2	.002	-.003	-.003	-.011
SPAN	49.8	.498	12.44	50.1	.501	12.521	+.081	+.325

± 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 : 10-04-01 Analyte : O_2 (15-2)

Source : Total F100 Run # : 1

Zero Cyl. # : 038TAC 1-A Conc. : 0.00 % O_2 Cyl. Press. : 1730 PSI

Certified by : AIR LIQUIDE Date : 02-07-01

Span Cyl. # : CC85322 Conc. : 12.45 % O_2 Cyl. Press. : 1810 PSI

Certified by : AIR LIQUIDE Date : 01-19-01

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 : D. Washington Time : 1230 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	-.040	-.040	-.159
SPAN	12.45	.498	12.45	12.49	.498	12.488	+.038	+.153

POST RUN Audit : by : D. Washington Time : 1620 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	.001	-.015	-.015	-.059
SPAN	12.45	.498	12.45	12.51	.499	12.514	+.064	+.254

± 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 : 10-04-01 Analyte : CO (15-3)

Source : Jotul F 100 Run # : 1

Zero Cyl. # : 038TAC 1-A Conc. : 0.00 % CO Cyl. Press. : 1730 PSI

Certified by : AIR LIQUIDE Date : 02-07-01

Span Cyl. # : CC85322 Conc. : 4.98 % CO Cyl. Press. : 1810 PSI

Certified by : AIR LIQUIDE Date : 01-19-01

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 : D. Washington Time : 1230 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	-.004	-.004	-.037
SPAN	49.8	.498	4.98	49.8	.498	4.987	+.007	+.074

POST RUN Audit : by : D. Washington Time : 1620 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	-.004	-.004	-.037
SPAN	49.8	.498	4.98	49.9	.499	4.997	+.017	+.175

± 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 : 10-04-01 Analyte : SO_2 (15-4)

Source : Jotul F100 Run # : 1

Zero Cyl. # : 038TAC 1-A Conc. : 0.00 ppm SO_2 Cyl. Press. : 1730 PSI

Certified by : AIR LIQUIDE Date : 02-07-01

Span Cyl. # : CC62184 Conc. : 1290 ppm SO_2 Cyl. Press. : 1800 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 : D. Wadington Time : 1235 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	3.700	+3.700	+.148
SPAN	51.6	.516	1290	51.6	.516	1291.415	+1.415	+.057

POST RUN Audit : by : D. Wadington Time : 1620 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	.001	1.205	+1.205	+.048
SPAN	51.6	.516	1290	51.8	.518	1296.407	+6.407	+.256

± 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 F100 RUN: 1 DATE: 10-04-01

Thermocouple Check:

T/C # 1	— °F	T/C # 13	59.6 °F
T/C # 2	— °F	T/C # 14	59.2 °F
T/C # 3	58.7 °F	T/C # 15	59.6 °F
T/C # 4	55.2 °F	T/C # 16	50.2 °F
T/C # 5	54.8 °F	T/C # 17	50.5 °F
T/C # 6	54.7 °F	T/C # 18	61.5 °F
T/C # 7	54.7 °F	T/C # 19	56.9 °F
T/C # 8	54.5 °F	T/C # 20	— °F
T/C # 9	54.6 °F	T/C # 21	— °F
T/C # 10	55.0 °F	T/C # 22	— °F
T/C # 11	54.1 °F	T/C # 23	57.0 °F
T/C # 12	63.2 °F	T/C # 24	— °F

Thermocouple Readout:
Pretest zero and span check and calibration

ZERO: −.3 °F Adj. to 0.0 °F

SPAN: 2000.0 °F Adj. to 2000.0 °F

post test zero and span — % difference

ZERO 3.4 °F Difference .170 %

SPAN 2002.3 °F Difference .115 %

Thermocouple Readout Pretest Linearity Check

0	= 0.0 °F	200	= 201.6 °F	400	= 399.0 °F
600	= 601.3 °F	800	= 801.5 °F	1000	= 1000.6 °F
1200	= 1198.1 °F	1400	= 1399.2 °F	1600	= 1599.6 °F
1800	= 1800.0 °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 ✓

Scale Check Pre: 270.9 −260.9 ✓

Post: 270.3 − 260.3 ✓

Stack Cleaned Prior to Test Run: YES X NO ____

COMPUTER INPUT DATA SHEET #1

Client: Jotul USA

Address: 400 Riverside St. P.O. Box 1157
Portland, ME 04104

Phone: 207-797-5912 Fax: 207-818-5481

Run No.: 3 Date of Test: 10-08-01 Burn Rate: 1.536

Model No.: F100 ☐ min ☐ min-1.25 ☐ fan

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

Dry Gas Meter: Y Factor: 1.021 (0.000) (Data Sheet #2) Post Leak Rate: .007 cfm (.000) (Data Sheet #2) Time: 85 min. (000) (Data Sheet #2)

Dry Gas Meter Volume: 26.725 cf (00.000) (Data Sheet #2)

Stack Flow: 9.786 dscfm (00.000) (Data Sheet #2) Δ H: .154 in. H_2O (.000) (Data Sheet #2)

Barometric Pressure: 30.14 in. Hg (00.00) (Data Sheet #2)

H_2O Captured: 40.8 g (00.0) (Data Sheet #3)

Total Particulate Catch: .0849 g (0.0000) (Data Sheet #6)

Flue Gas Moisture: 6.7960 % (00.000) (Data Sheet #7)

Particulate Emission: .0497 gr/dscf (0.0000) (Data Sheet #7)

Ambient Moisture: 1.8 % (0.00) (Data Sheet #8)

Stove Weight: — lbs (000) (Data Sheet #8)

Total Fuel Consumed During Burn: 5.9 lbs (00.0) (Data sheet #8)

Fuel Higher Heating Value (dry): — BTU/lb (0000) (Data Sheet #8)

Fuel % Moisture (dry): 22.967 % (wet): 18.677 % (00.00) (Data Sheet #10)

Stack Static Pressure: -.059 in. H_2O (0.000) (Data Sheet #12)

Temperature (Average Room) Combustion Air: 84 °F (00) Data Sheet #14)

Stove Temperature Change: -86.6 °F (00.0) (Data Sheet #14)

TABLE 1 ----- RAW DATA

CLIENT : Jotul TEST No. : 3

MODEL: F100 DATE: 08-Oct-01

TIME (MIN.)	METER READING (C F)	DELTA H (IN. H2O)	METER TEMP. (DEG. F)	PERCENT CO (%)	PERCENT CO2 (%)	SO2 COCENTR. PPM
0	899.500	0.150	87	0.78	6.80	350
5	901.000	0.300	88	1.13	10.20	250
10	903.166	0.120	88	0.78	13.60	400
15	904.521	0.120	89	0.78	12.90	400
20	905.880	0.130	90	0.58	13.00	375
25	907.336	0.150	90	0.16	13.00	350
30	908.895	0.150	91	0.16	12.30	350
35	910.460	0.150	92	0.21	10.50	350
40	912.031	0.150	93	0.44	10.40	350
45	913.608	0.150	93	0.21	9.20	350
50	915.184	0.150	93	0.70	6.60	350
55	916.761	0.150	93	0.81	6.10	350
60	918.337	0.150	93	1.18	5.00	350
65	919.915	0.150	93	1.23	4.50	350
70	921.492	0.150	93	1.27	4.20	350
75	923.070	0.150	93	1.18	4.10	350
80	924.647	0.150	93	1.14	3.90	350
85	926.225	0.150	93	1.13	3.70	350
90						

TABLE 2---RAW DATA

CLIENT : Jotul TEST No. 3

MODEL: F100 DATE: 08-Oct-01

****

METER CAL. FACTOR (Y)	1.021		Wt. WOOD BURNED(LB)	5.9	Lbs
BAROMETRIC PRESS.(Pb)	30.14	in Hg	WET,FUEL MOISTURE %	18.677	%
LEAK RATE POST (Lp)	0.007	cfm	Wt. PART. COLLECTED	0.0849	g
WATER VOL. (V1c)	40.8	Ml	METER VOLUME Vm	26.725	mcf
TEST TIME (MIN)	85	min	HC MOLE FRACTION	0.0132	

TABLE 3 -----FIELD DATA AVERAGES

CLIENT :Jotul TEST No. 3

MODEL: F100 DATE: 08-Oct-01

****

AVG DELTA H	-------	0.15 in H2O		AVG PRCNT CO	-------	0.77	%
AVG METER TEMP. Tm	-------	91 deg F		AVG PRCNT CO2	-------	8.33	%
AVG PPM SO2	-------	351	PPM	AVG BAL CO2/CO	-------	10.81	%

TABLE 4 ----- CALCULATIONS

CLIENT : Jotul TEST No. 3

MODEL: F100 DATE: 08-Oct-01

****

STD SAMPLE VOL. Vm(std) -----	26.34	dscf	STACK GAS FLOW Qsd -------	530.784	dscf/Hr & 8.85 dscf/min
VOL. WATER VAPOR Vw(std) ----	1.920	scf	PARTICULATE CONCTRT. Cs ------	0.0032	g/dscf
PRCNT MSTR Bws -------	6.80	%	PARTC.EMISS. RATE E -------	1.71	g/Hr
BURN RATE BR -------	1.54	Kg/Hr	MOLES OF GAS PER Lb WOOD Nt --	0.41	Lb-mole/Lb
CO EMISSION RATE -------	136.97 g/Hr & 89.17	g/Kgdry fuel	PART.EMISS. RATE ------	1.11	g/Kgdry fuel

TABLE 5 ----- PROPORTIONAL RATE VARIATION

CLIENT : Jotul TEST No. : 3

MODEL: F100 DATE: 08-Oct-01

TIME INTEVAL Ti	PPM * Vm	PROPRTN. RATE VAR. PR		PROPRTN RATE VAR. AVERAGE	
5	521.0	97		100	
10	537.1	100			
15	536.9	100			
20	537.5	100			
25	539.4	100			
30	538.6	100			
35	539.6	100			
40	540.7	100			
45	542.3	101			
50	542.0	100			
55	542.3	101			
60	542.0	100			
65	542.7	101			
70	542.3	101			
75	542.7	101			
80	542.3	101			
85	542.7	101			
90					
95					

METER BOX DATA SHEET PAGE # 2

Page: 1 of 1

UNIT: Jotol F100 RUN: 3 DATE: 10-08-01

Meter Box: SH Y Factor: 1.021

Leak checks: 15 " Hg @ .015 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: .18 SAMPLING RATIO: 32 : 1 BP: 30.15

MIN	TIME	METER READING	SAMPLE MDCF	STACK DSCFM	DELTA H	METER TEMP	SO2 PPM	ROTO TEMP	PUMP VACC
0	1410	899.500	—	9,820	.15	87	350	87	1.0
5	15	901.000	—	13,723	.30	88	250	88	2.0
10	20	903.166	903.166	8.577	.12	88	400	88	1.0
15	25	904.521	904.521	8.561	.12	89	400	89	1.0
20	30	905.880	905.880	9,116	.13	90	375	90	1.0
25	35	907.336	907.336	9,767	.15	90	350	90	2.0
30	40	908.895	908.895	9,749	.15	91	350	91	2.0
35	45	910.460	910.460	9,731	.15	92	350	92	2.0
40	50	912.031	912.031	9,714	.15	93	350	93	2.0
45	55	913.608	913.608	9,714	.15	93	350	93	2.0
50	1500	915.184	915.184	9,714	.15	93	350	93	2.0
55	05	916.761	916.761	9,714	.15	93	350	93	2.0
ROTO PRESS: .17			TOTALS:	117,900	1.87	1087	BP.: 30.13		
60	1510	918.337	918.337	9,707	.15	93	350	93	2.0
65	15	919.915	919.915	9,707	.15	93	350	93	2.0
70	20	921.492	921.492	9,707	.15	93	350	93	2.0
75	25	923.070	923.070	9,707	.15	93	350	93	2.0
80	30	924.647	924.647	9,707	.15	93	350	93	2.0
85	35	926.225	926.225	9,707	.15	93	350	93	2.0
90									
95				58.242	.90	558			
100									
105									
110									
115				176,142	2.77	1645	~.18"		
			TOTALS:	-		91	MAX VACC =		2.0
TOTAL Cu Ft.		26,725	TOTALS:	9,786	.154	551	AVG. BP:	30.14	

PARTICULATE CATCH / MOISTURE DATA SHEET # 3

UNIT : F100 RUN : 3 DATE : 10-8-00

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	663.5	613.6	484.5	913.4
INITIAL WT	630.3	610.8	483.7	909.4
NET WT GRAMS	33.2	28	.8	4.0

TOTAL CATCH : 40.8 GRAMS H_2O

FRONT HALF

FILTER #	73F	
FINAL WT g	.6922	
INITIAL WT g	.6688	
NET WT g	.0234	

BEAKER #	101
DESC.	ACETONE
FINAL WT g	95.6170
INITIAL WT g	95.6037
NET WT g	.0133
VOL. DESC. m	50

BACK HALF

FILTER #	73B	
FINAL WT g	.4371	
INITIAL WT g	.4304	
NET WT g	.0067	

BEAKER #	102	103	104	105	
DESC.	ACETONE	METHCHLOR	H_2O	H_2O	
FINAL WT g	96.4056	102.3762	106.2250	107.0791	
INITIAL WT g	96.3785	102.3668	106.2204	107.0750	
NET WT g	.0271	.0094	.0046	.0041	.0087
VOL. DESC ml	125	75	125	175	(300)

FILTER TARE WEIGHTS DATA SHEET #4-1

Into Dessicator : Date : 9-17-01 Time : 1000 By : C. Waddington

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

Back Size: 8.2 cm Lot No. : ZB911

	DATE: 9-26	BY: [illegible]	DATE: 9-27	BY: JEV	DATE:	BY:
FILTER #	FIRST WEIGHT	TIME	SECOND WEIGHT	TIME	THIRD WEIGHT	TIME
71 F	.6778	1318	.6773	9:30	JOTUL F100 R#1	
72 F	.6789	1319	.6785	9:31	" " R#2	
73 F	.6692	1320	.6688	9:32	" " R#3	
74 F	.6681	1321	.6682	9 33	" " R#4	
75 F	.6724	1322	.6722	9:34		
76 F	.6620	1323	.6674	9:35		
77 F	.6707	1324	.6705	9:36		
78 F	.6645	1325	.6645	9:37		
79 F	.6748	1326	.6753	9:38		
80 F	.6745	1327	.6747	9:39		
71 B	.4264	1329	.4262	9:40	JOTUL F100 R#1	
72 B	.4282	1330	.4277	9:41	" " R#2	
73 B	.4309	1331	.4304	9.42	" " R#3	
74 B	.4365	1332	.4363	9:43	" " R#4	
75 B	.4200	1333	.4199	9:45		
76 B	.4224	1334	.4227	9.46		
77 B	.4223	1335	.4226	9.47		
78 B	.4169	1336	.4165	9.48		
79 B	.4181	1337	.4185	9:49		
80 B	.4224	1338	.4222	9.50		

Checked by: C. Waddington Date: 9-27-01 Time: 1020

BALANCE ROOM ENVIRONMENTAL CONDITIONS

DATE	TIME	BY	WB	DB	% RH
9-26	1315	CLP		74	49
9-27	9:30	JEV		72	45.

BEAKER TARE WEIGHTS DATA SHEET #4-2

Into Dessicator: Date : 09-10-01 Time : 1030 By : AKW

	DATE: 9-26	BY: JEW	DATE: 9-27	BY: JEW	DATE: 9-28	BY: JEW
BEAKER #	FIRST WEIGHT	TIME	SECOND WEIGHT	TIME	THIRD WEIGHT	TIME
101	95.6037	1340	95.6037	9:30	✓	
102	96.3790	1341	96.3785	9:31	✓ JOTUL F100	
103	102.3665	1342	102.3668	9:32	✓ R#3	
104	106.2207	1343	106.2204	9:33	✓	
x 105	107.0733	1344	107.0754	9:34	107.0750	10:50
x 106	96.7229	1345	96.7236	9:35	96.7240	1051
x 107	107.3478	1346	107.3472	9:36	107.3470	1052
x 108	104.9547	1347	104.9563	9:37	104.9561	1053
109	98.8797	1348	98.8794	9:38	✓ JOTUL F100	
110	104.0244	1349	104.0246	9:39	✓ R#4	
1	104.9185	1350	104.9181	9:40	✓	
2	106.2548	1351	106.2550	9:41	✓	
x 3	107.7790	1352	107.7780	9:42	107.7776	1054
4	108.7750	1353	108.7745	9:43	✓	
x 5	97.4365	1354	97.4400	9:44	97.4401	1055
x 6	91.2161	1354	91.2154	9:45	91.2159	1056
7	97.1384	1355	97.1389	9:46	✓	
8	108.6358	1356	108.6360	9:47	✓	
x 9	108.0967	1357	108.0966	9:48	✓	
10	105.7302	1358	105.7306	9:49	✓	
11	104.7886	1359	104.7881	9:50	✓	
x 12	98.2303	1400	98.2307	9:51	✓	
x 13	104.1762	1401	104.1750	9:52	104.1754	1057
x 14	97.9816	1402	97.9807	9:53	97.9807	1058
x 15	104.7649	1403	104.7644	9:54	✓	

BALANCE ROOM ENVIRONMENTAL CONDITIONS

DATE	TIME	BY	WB	DB	% RH	
9-26	1315	CJC		74	49	Checked by C Wadsworth
9-27	9:30	JEW		74	49	Date : 9-28-01
9-28	10:50	JEW		76	49	Time : 1210

WOODSTOVE DATA SHEET # 4-3 : CONSTANT WEIGHTS

UNIT : F100 RUN : 3 DATE : 10-8-01

Beaker #	Date	Time	By	First Weight	Date	Time	By	Second Weight	Date	Time	By	Third Weight	Date	Time	By
101	10-9	1220		95.6195	1040	1905		95.6179	10-11	1127		95.6168	10-11	1554	
				(95.6170)	10-11	1927									
102	10-9	1355		96.4075	10-10	1906		96.4058	10-11	1128		(96.4056)	10-11	1553	
103	10-9	1220		102.3783	10-10	1907		102.3770	10-11	1130		102.3759	10-11	1556	
				(102.3762)	10-11	1929									
104	10-9	1220		106.2264	10-10	1908		106.2248	10-11	1131		(106.2250)	10-11	1557	
105	10-9	1220		107.0803	10-10	1910		107.0786	10-11	1132		107.0795	10-11	1559	
				(107.0791)	10-11	1930									

Filter #	Date	Time	By	First Weight	Date	Time	By	Second Weight	Date	Time	By	Third Weight	Date	Time	By
73F	10-8	1630		.6925	10-9	1210		.6919	10-9	1805		(.6922)	10-10	1911	
73B	10-8	1630		.4373	10-9	1212		.4369	10-9	1806		(.4371)	10-10	1912	

SCALE ROOM ENVIRONMENTAL CONDITIONS

Weighing Session	Date	Time	By	WB	DB	%RH
1	10-9	1205			78	48
2	10-9	1800			77	49
3	10-10	1900			75	49
4	10-11	1125			77	48

Weighing Session	Date	Time	By	WB	DB	%RH
5	10-11	1550			78	47
6	10-11	1925			78	47
7						
8						

Dates: From 12-15-2000
Through 08-26-2001

WOODSTOVE DATA SHEET #4-4
SCALE QA SHEET

Scale: Sartorius
Model: A1205
SN : 37010004

100g weight	10 g weight	1.0 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	Wet Bulb	%.RH
100.0000	10.0001	1.0000	.0999		12-15	1215	73		40
100.0000	10.0000	1.0001	.0999		12-15	2055	72		40
100.0000	10.0001	.9999	.0999		12-16	1615	76		42
100.0001	10.0000	.9999	.0999		1-12	1230	73		44
99.9998	9.9999	1.0000	.1000		1-13	1720	73		44
100.0000	10.0000	1.0000	.0998		1-15	1105	75		45
99.9999	10.0000	.9999	.0999		1-20	2015	71		48
100.0000	9.9999	1.0000	.0998		1-21	1310	77		43
100.0001	10.0001	1.0000	.0997		1-22	1305	74		47
100.0000	10.0001	1.0000	.0998		1-23	1730	74		47
100.0001	9.9998	1.0000	.0999		1-24	0955	73		47
100.0000	9.9999	1.0000	.0999		1-25	1125	74		42
100.0000	9.9999	.9998	.1000		1-25	1515	76		43
100.0002	10.0001	.9999	.0998		2-21	1020	75		47
100.0001	10.0001	1.0002	.1000		2-22	1035	76		43
100.0001	9.9999	.9998	.0998		02-23	1235	76		45
99.9997	10.0000	.9999	.0999		02-24	2130	77		40
100.0000	9.9999	1.0000	.0998		02-25	1435	75		43
100.0000	10.0001	1.0001	.1000		02-25	2205	77		40
100.0000	9.9998	1.0000	.0999		02-26	1035	75		35
99.9999	9.9997	1.0000	.1002		04-27	1815	76		47
100.0000	10.0001	1.0000	.0999		04-29	1710	76		47
100.0002	9.9998	1.0000	.0999		04-30	0935	74		49
99.9997	10.0001	.9999	.0999		04-30	2125	77		48
99.9996	9.9997	.9997	.0999		05-01	2140	77		44
99.9997	10.0000	1.0000	.0998		05-02	2045	77		46
99.9998	10.0001	.9999	.0999		05-04	1435	74		46
99.9999	10.0001	.9998	.1000		05-05	2215	74		46
99.9998	9.9999	1.0000	.0998		05-07	0910	75		44
99.9998	10.0001	1.0000	.0999		05-11	2115	77		48
99.9999	9.9999	1.0001	.1000		05-13	2005	76		48
100.0001	9.9999	1.0000	.1000		05-14	1950	77		49
100.0000	9.9998	1.0000	.1001		05-15	1910	78		47
99.9999	9.9997	.9999	.1000		05-24	2020	78		48
99.9999	9.9997	.9999	.1000		05-30	1515	78		49
99.9999	9.9998	.9999	.1001		05-30	2215	78		49
100.0000	10.0001	1.0000	.0999		08-24	225	78		49
100.0001	10.0000	1.0001	.0999		08-26	1000	78		49

Dates: From 8-28-01
Through 10-28-01

WOODSTOVE DATA SHEET #4-4
SCALE QA SHEET

Scale: Sartorius
Model: A1205
SN : 37010004

100g weight	10 g weight	1.0 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	Wet Bulb	%.RH
100.0000	10.0002	.9999	.0999	CD	8-28	1900	75		49
100.0000	10.0005	1.0001	.1000	CD	8-29	2130	76		49
100.0000	9.9999	1.0000	.0995	CD	8-30	1130	76		49
100.0000	10.0000	.9999	.0998	CD	8-31	1930	75		49
100.0004	10.0002	.9998	.1000	CD	9-1	1445	77		49
100.0003	10.0001	.9999	.1000	DEW	9-3	2105	74		49
99.9999	10.0002	1.0000	.1001	DEW	9-4	1830	78		49
100.0001	10.0001	.9998	.1000	DEW	9-5	1230	75		49
100.0004	10.0000	.9999	.0999	CD	9-26	1315	74		49
100.0000	10.0000	1.0000	.0998	JEW	9-27	9:30	73		46
100.0000	9.9999	1.0000	.0998	JEW	9-28	10:50	76		49
100.0000	10.0000	.9998	.0997	JEW	10-1	910	76		49
100.0000	9.9999	.9999	.0998	JEW	10-2	9:49	70		46
100.0000	10.0000	1.0000	.0995	JEW	10-3	9:21	76		46
99.9999	10.0000	1.0001	.1000	DEW	10-5	1240	78		48
99.9997	10.0000	1.0001	.1000	DEW	10-6	1420	68		49
99.9997	10.0000	1.0001	.0998	DEW	10-7	2150	78		47
10.0001	10.0002	1.0001	.1000	DEW	10-8	0730	74		49
9.9998	10.0000	1.0000	.0999	DEW	10-9	1205	78		48
100.0002	10.0001	.9997	.0996	DEW	10-9	1800	77		49
100.0001	10.0002	.9999	.0998	DEW	10-10	900	76		49
99.9999	9.9998	.9997	.0999	DEW	10-11	1125	77		48
100.0000	10.0001	.9997	.0998	DEW	10-11	1550	78		47
99.9999	10.0000	1.0000	.0999	DEW	10-11	1925	78		47
100.0000	10.0003	1.0000	.0998	DEW	10-14	2200	78		48
100.0000	10.0000	1.0001	.1001	DEW	10-15	1040	74		49
100.0002	10.0001	1.0000	.0999	DEW	10-19	2000	78		47
99.9997	10.0002	1.0002	.1001	DEW	10-22	0830	78		47
100.0001	10.0000	1.0000	.0998	DEW	10-22	1145	78		48
99.9998	10.0000	1.0000	.0997	DEW	10-23	1030	76		47
100.0000	10.0001	1.0001	.1000	DEW	10-23	1055	77		47
99.9999	10.0001	.9999	.1000	DEW	10-24	1025	76		48
100.0000	10.0000	.9999	.0999	DEW	10-25	1650	77		49
99.9999	9.9999	1.0001	.0997	DEW	10-25	2335	78		47
100.0000	9.9999	.9999	.0999	DEW	10-26	2125	78		47
100.0002	10.0001	1.0000	.0998	DEW	10-27	1155	77		46
99.9998	10.0000	1.0000	.1000	DEW	10-27	1645	77		46
100.0003	10.0001	.9999	.0996	DEW	10-28	1305	74		46

BLANK PROCESSING DATA SHEET # 5

UNIT : JOTUL F100 RUN : 3 DATE : 10-08-01

BLANKS DONE : 2-22-01

BEAKER	A	B	C
	200 ml ACETONE	75 ml DICHLOR	200 ml WATER
	FISHER OPTIMA LOT # 906481	FISHER OPTIMA LOT # 886589	BONNEAU PRODUCTS CERTIFIED DISTILLED
FINAL WEIGHT	108.9018	106.3086	106.9675
TARE WEIGHT	108.9007	106.3066	106.9672
NET WEIGHT	.0011 ✓	.0020 ✓	.0003 ✓

TARE BEAKERS INTO DESC : TIME : 1130 DATE : 02-19-01

DATE : 02/21 BY : [illegible] DATE : 02/22 BY : [illegible] DATE : ____ BY : ____

BEAKER	1 ST WT	TIME	2 ND WT	TIME	3 RD WT	TIME
A	108.9012	1046	108.9007	1106	✓	
B	106.3069	1047	106.3066	1107	✓	
C	106.9677	1048	106.9672	1108	✓	

FINAL BEAKERS INTO DESC : TIME : 1630 DATE : 02/23/01

DATE : 02/24 BY : [illegible] DATE : 02/25 BY : [illegible] DATE : ____ BY : ____

BEAKER	1 ST WT	TIME	2 ND WT	TIME	3 RD WT	TIME
A	108.9017	2135	108.9018	1440	✓	
B	106.3087	2136	106.3086	1441	✓	
C	106.9672	2137	106.9675	1442	✓	

TARE QC

DATE	TIME	BY	WB	DB	%
02/21	1020	[illegible]	(	75	47
02/22	1035	[illegible]	)	76	43

FINAL QC

DATE	TIME	BY	WB	DB	%
02/24	2130	[illegible]	(	77	40
02/25	1435	[illegible]	)	75	43

NET PARTICULATE CATCH CALCULATION DATA SHEET #6

UNIT: JOTUL F100 RUN: 3 DATE: 10-08-01

BLANK CALCULATIONS

Acetone: .0011 g ÷ 200 ml = .000006 g/ml
Dicholoromethane: .0020 g ÷ 75 ml = .000027 g/ml
Distilled Water: .0003 g ÷ 200 ml = .000002 g/ml

FRONT HALF CATCH

FILTERS: .0234 (Total Catch) g - 1 (# of Filters) (.0000 g) (Blank Value / Filter) = .0234 g

BEAKERS: .0133 (Total Catch) g - 50 (ml Acetone) (.0003 .000006 g) (Blank Value / ml Acetone) = .0130 g

TOTAL FRONT HALF CATCH: .0364 g

BACK HALF CATCH

FILTERS: .0067 (Total Catch) g - 1 (# of Filters) (.0000 g) (Blank Value / Filter) = .0067 g

BEAKERS:

Acetone: .0271 (Total Catch) g - 125 (ml Acetone) (.0008 .000006 g) (Blank Value / ml Acetone) = .0263 g

Extract: .0094 (Total Catch) g - 75 (ml Dichloromethane) (.0020 .000027 g) (Blank Value / Dichloromethane) = .0074 g

Water: .0087 (Total Catch) g - 300 (ml Water) (.0006 .000002 g) (Blank Value / Water) = .0081 g

TOTAL BACK HALF CATCH: .0485 g

TOTAL CATCH: .0849 g

% FRONT HALF: 42.87 %

CALCULATIONS DATA SHEET # 7

UNIT : Jotul F 100 RUN : 3 DATE : 10-08-01

1) Vm (std) = $\dfrac{(26.725\ \text{Vm})(17.64)(1.021\ \text{mcf})\left(30.14\ \text{"Hg} + \dfrac{.154\ \text{"}H_2O}{13.6}\right)}{(551\ \text{TmA})}$ = $\dfrac{26.3388}{000.0000}$ dscf

(30,1513)

2) Vw (std) = (.04707)(40.8 ml H_2O) = $\dfrac{1.9205}{00.0000}$ scf

3) Asw = $\dfrac{(1.9205\ \text{scf})}{(1.9205\ \text{scf} + 26.3388\ \text{dscf})}$ = $\dfrac{.0680}{.0000}$ Bws × 100 = $\dfrac{6.7960}{00.0000}$ % H_2O

(28.2593)

4) Cs = $\dfrac{(.0849\ \text{g.})}{(26.3388\ \text{dscf})}$ (15.43) = $\dfrac{.0497}{0.0000}$ gr / dscf

5) Estimated g / hr = $\dfrac{(.0849\ \text{g.})}{(26.3388\ \text{dscf})}$ ($\dfrac{9.786}{00.0000}$ dscfm) (60) = $\dfrac{1.8926}{00.0000}$ 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 F100 RUN: 3 DATE: 10-8-01

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

Wet Bulb / Dry Bulb

Pre : WB: 71 DB: 87 = 45 % RH 1.9 % H_2O

Post : WB: 68 DB: 84 = 43 % RH 1.7 % H_2O

Average: 44 %RH 1.8 % H_2O

Empty Stove Weight (lbs): _____ w/ stack & oil seal : Wet: — Dry: 259.2

Kindling Weight (lbs): Paper: 1.2 Wood: 2.2

Preburn Fuel Weight: 9.0 + 8.5 + 8.9 + 5.8 Total: 32.2

Kindling & Preburn Fuel Weight (wood only) (lbs): Total: 34.4

Coal Bed Wt Range (lbs): 1.4 - 1.2 Scale: 260.4 - 260.4

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: 1.3

Maximum Coal Bed Removal (lbs): ((1.4 (Upper) + 1.2 (Lower)) ÷ 2) .25 = .3

Test Fuel (.75" x 1.5" x 5" spacers) = 12 pcs

Dimensions	Length in inches	No. Pcs	Weight in lbs	% of Load
2" x 4"	14	3	5.9	100.0
4" x 4"	—	—	—	—

Test Fuel Weight: 5.9 lbs

Estimated Dry Burn Rate: 1.1019

$$\frac{5.9 - (5.9 \times .1867)}{2.2046} \times \frac{60}{\frac{85}{\text{TIME}}} = 1.536 \text{ kg / hr}$$

Estimated BTU's/hr: 19,140 x $\frac{63}{100}$ x $\frac{1.536}{\text{DBR}}$ = 18521.4 BTU's/hr

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

WOOD STOVE OPERATING DATA PAGE #9

Unit : Jotul F100 Run : 3 Date : 10-8-01

FIRE STARTED: 0800

WARM UP AND PREBURN:

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

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

CHARCOAL BED PREPARATION :

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

TEST:

DOOR wide open during loading 0 min. 45 sec.

PRIMARY AIR : Opened full for first _____ 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 N/A

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 14 or 8 inches.

1st warm up / pre-burn fuel charge (0820 lbs.) added at 9.0

2nd warm up / pre-burn fuel charge (0945 lbs.) added at 8.5

3rd warm up / pre-burn fuel charge (1115 lbs.) added at 8.9

4th warm up / pre-burn fuel charge (1245 lbs.) added at 5.8

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

TEST DATA SHEET #10

Unit : Total F 100 Run : 3 Date : 10 - 8 - 01

Room Temperature : 69 °F Correction Factor : 0

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

Time Test Fuel moisture reading taken : 1210

Calibration Checks : X ✓ Y ✓ 12.0 12.0 22.0 22.2

pc #	Dimen.	Use	TOP		BOTTOM		SIDE		Avg Corrected
			Uncor	Cor.	Uncor.	Cor.	Uncor.	Cor.	
1	2"×4"×8'	K	14.5	15.5	15.0	16.0	14.5	15.5	15.667
2									
3									
4	2"×4"×8'	P	21.5	23.1	22.0	23.7	22.0	23.7	23.500
5	2"×4"×8'	P	23.5	25.2	23.5	25.2	23.5	25.2	25.200
6	2"×4"×8'	P	22.5	24.1	23.0	24.7	23.0	24.7	24.500
7	2"×4"×8'	P							73.200
8	2"×4"×8'	P							
9									
10									
11	2×4×14	T	22.0	23.7	22.0	23.7	22.0	23.7	23.700
12	"	T	23.0	24.7	23.0	24.7	23.0	24.7	24.700
13	"	T	19.0	20.3	19.5	20.9	19.0	20.3	20.500
14	"	T							68.900
15		T							
16									
17									
18									
19									
20	Spacers	T	17.5	18.7	18.0	19.2	18.0	19.2	19.033

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

	KINDLING	PRETEST FUEL	TEST FUEL
Dry Moisture % :	15.667 %	24.400 %	22.969 %
Wet Moisture % :	13.545 %	19.614 %	18.677 %

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°

WEIGHT: 260.5

GAS DATA SHEET # 12

UNIT: Jotul F 100 RUN: 3 DATE: 10-08-01 PAGE: 1 of 1

TIME	SCALE	FUEL	DROP	V.	CO_2	V.	O_2	V.	CO	BAL	WB	DB	% H_2O	CAL WB	STACK	STATIC	SO_2 PPM
0 1410	266.4	5.9	—	.274	6.8	.523	13.1	.078	.78	8.8					358	-.055	350
5 15	265.7	5.2	.7	.408	10.2	.387	9.7	.113	1.13	9.0					415	-.060	250
10 20	264.9	4.4	.8	.545	13.6	.287	7.2	.078	.78	17.5					464	-.065	400
15 25	264.2	3.7	.7	.515	12.9	.312	7.8	.078	.78	16.5					478	-.065	400
20 30	263.5	3.0	.7	.520	13.0	.313	7.8	.088	.88	22.5					482	-.067	375
25 35	262.9	2.5	.5	.523	13.0	.316	7.9	.016	.16	33.3					480	-.065	350
30 40	262.4	2.0	.5	.493	12.3	.339	8.4	.016	.16	12.3					480	-.065	350
35 45	262.0	1.6	.4	.421	10.5	.392	9.8	.021	.21	50.8					414	-.065	350
40 50	261.6	1.2	.4	.418	10.4	.388	9.7	.044	.44	23.9					465	-.065	350
45 55	261.5	1.1	.1	.370	9.2	.432	10.8	.021	.21	44.6					451	-.064	350
50 1500	261.2	.8	.3	.264	6.6	.537	13.5	.010	.10	9.4					417	-.060	350
55 5	261.0	.6	.2	.247	6.1	.555	13.9	.081	.81	7.6					397	-.060	350
TOTAL	-----	----	----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5301	-.756	-----
60 15 10	260.9	.4	.2	.200	5.0	.599	15.0	.118	1.18	4.2					366	-.056	350
65 15	260.8	.3	.1	.182	4.5	.618	15.5	.123	1.23	3.7					345	-.054	350
70 20	260.7	.2	.1	.168	4.2	.632	15.9	.127	1.27	3.3					331	-.052	350
75 25	260.7	.2	0	.165	4.1	.638	16.0	.118	1.18	3.5					319	-.051	350
80 30	260.6	.1	.1	.157	3.9	.647	16.2	.114	1.14	3.4					307	-.050	350
85 35	260.5	0	.1	.148	3.7	.655	16.4	.113	1.13	3.2					299	-.048	350
90 40																	
95 45																	
100 50																	
105 55																	
110 1600																	
115 05															1967	-.311	-.18
TOTAL	-----	----	----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	7268	-1.067	-----
TOTAL	-----	----	----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	404	-.059	-----

PREBURN DATA SHEET #13

UNIT: Jotul F100 RUN: 3 DATE: 10 - 08 - 01 PAGE: 1 of 1

TIME	SCALE	DROP	STACK	TOP	LF SIDE	BACK	RT SIDE	BOTTOM	FIREBOX	SEC/CAT	AMBIENT	STATIC	COMMENTS
0 1300	266.5	—	386	408	501	572	548	446	955	963	88	-.057	PREBURN START: # 5.9 UP
5 5	266.0	.5	487	393	524	545	520	442	859	984	88	-.060	COAL BED SCALE RANGE:
10 10	265.2	.8	511	410	414	529	482	433	793	863	88	-.065	260.6 - 260.4
15 15	264.5	.7	505	399	521	526	466	423	681	1043	89	-.066	PRIMARY AIR: WIDE OPEN
20 20	263.6	.9	504	411	539	505	478	427	870	1194	90	-.066	SECONDARY AIR: N/A
25 25	263.1	.5	502	430	515	503	491	419	899	1126	90	-.066	FAN: N/A
30 30	262.5	.6	425	575	508	506	446	418	908	1073	90	-.065	PUMPS ON AT: 1330
35 35	262.0	.5	474	440	569	525	520	409	659	1213	90	-.065	CHECK WB/DB: N/A
40 40	261.6	.4	468	430	565	510	536	402	944	1180	91	-.065	
45 45	261.3	.3	434	427	492	533	540	418	946	1166	91	-.060	
50 50	261.1	.2	410	411	566	545	533	422	954	1138	91	-.060	
55 55	261.0	.1	404	536	555	542	421	418	986	1045	90	-.050	
*****	****	***	****	*****	*****	****	*****	*****	*****	*****	*****	****	
60 1400	261.0	0	379	508	549	516	419	514	853	958	91	-.050	
65 5	260.7	.3	364	367	551	551	506	424	810	933	90	-.050	
70 10	2605	.2	358	362	516	552	497	425	867	929	90	-.055	470.4 ΔT.
75													

TEMPERATURE DATA SHEET # 14

UNIT: Jotul F100 RUN: 3 DATE: 10-08-01 PAGE 1 of 1

TIME	TOP	LT SIDE	BACK	RT SIDE	BOTTOM	FIREBOX	SEC/CAT	AMBIENT	FURNACE	SAMPLE	SAMP IMP	C-GAS	GAS IMP	SO_2 IMP	470.4
0/1410	362	516	552	497	425	867	929	90	1324	242	65	242	33	32	
5/15	344	455	469	457	413	748	904	88	1351	246	39	239	34	33	
10/20	329	454	456	431	402	666	1206	87	1340	248	39	240	33	34	
15/25	349	480	472	444	385	755	1271	87	1354	247	40	243	34	35	
20/30	373	518	494	472	376	956	1268	87	1353	247	41	245	36	35	
25/35	404	539	518	505	369	718	1263	89	1345	245	41	245	36	35	
30/40	403	575	529	526	367	836	1228	90	1348	245	41	245	34	35	
35/45	583	576	536	520	370	804	1192	90	1348	248	41	246	34	35	
40/50	411	580	536	540	369	978	1246	80	1349	243	42	244	34	36	
45/55	425	571	527	541	373	994	1234	83	1346	242	42	237	35	36	
50/1500	410	555	517	537	372	927	1057	82	1345	242	42	236	35	36	
55/05	390	536	515	526	375	894	1004	81	1340	242	42	235	35	35	
TOTAL	4783	6355	6121	5996	4596	10143	13802	1040	*****	*****	*****	*****	*****	*****	
60/1510	505	522	500	372	373	813	892	80	1333	241	43	232	37	36	
65/15	346	471	524	476	366	769	852	80	1329	241	43	231	36	36	
70/20	332	458	519	458	361	723	810	79	1326	240	43	233	37	36	
75/25	310	437	511	438	355	671	772	78	1322	239	43	235	36	37	
80/30	297	415	504	418	346	622	748	77	1317	239	44	234	37	36	
85/35	281	399	496	404	339	580	730	78	1320	239	44	235	36	36	
90/40															
95/45															
100/50												470.4	·		
105/55												383.8	·		
110/1600												-86.6	·ΔT		
115/05	2071	2710	3054	2506	2140	4178	4804	472	×.18 ·						
TOTAL	6854	9065	9175	8562	6736	14321	18006	1512	*****	*****	*****	*****	*****	*****	
TOTAL	381	504	510	476	374	796	1034	84	*****	*****	*****	*****	*****	*****	

ZERO / SPAN CHECK DATA SHEET #15-1

Date : 10-08-01 Analyte : CO_2 (15-1)

Source : Jotul F100 Run # : 3

Zero Cyl. # : 038TAC 1-A Conc. : 0.00 % CO_2 Cyl. Press. : 1730 PSI

Certified by : AIR LIQUIDE Date : 02-07-01

Span Cyl. # : CC57330 Conc. : 12.44 % CO_2 Cyl. Press. : 1810 PSI

Certified by : AIR LIQUIDE Date : 01-19-01

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 : 1230 Temp : 73 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.3	.003	.022	+.022	+.090
SPAN	49.8	.498	12.44	49.9	.499	12.471	+.031	+.124

POST RUN Audit : by : D. Washington Time : 1550 Temp : 77 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.2	.002	-.003	-.003	-.011
SPAN	49.8	.498	12.44	50.0	.500	12.496	+.056	+.224

± 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 : 10-08-01 Analyte : O_2 (15-2)

Source : Total F100 Run # : 3

Zero Cyl. # : 038TAC 1-A Conc. : 0.00 % O_2 Cyl. Press. : 1730 PSI

Certified by : AIR LIQUIDE Date : 02-07-01

Span Cyl. # : CC85322 Conc. : 12.45 % O_2 Cyl. Press. : 1810 PSI

Certified by : AIR LIQUIDE Date : 01-19-01

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. Wadmark Time : 1230 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	-.065	-.065	-.260
SPAN	12.45	.498	12.45	12.5	.497	12.463	+.013	+.053

POST RUN Audit : by : D. Wadmark Time : 1550 Temp : 77 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	-.040	-.040	-.159
SPAN	12.45	.498	12.45	12.5	.500	12.539	+.089	+.355

± 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 : 10-08-01 Analyte : CO (15-3)

Source : Jotul F 100 Run # : 3

Zero Cyl. # : 038TAC 1-A Conc. : 0.00 % CO Cyl. Press. : 1730 PSI

Certified by : AIR LIQUIDE Date : 02-07-01

Span Cyl. # : CC85322 Conc. : 4.98 % CO Cyl. Press. : 1810 PSI

Certified by : AIR LIQUIDE Date : 01-19-01

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

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

Flow : 1.5 SCFH Measured by : Rotameter

EPA Span Value = 10.0 % CO

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

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

PRE RUN Audit : by : C. Wadington Time : 1230 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	-.004	-.004	-.037
SPAN	49.8	.498	4.98	49.9	.499	4.997	+.017	+.175

POST RUN Audit : by : D. Wadington Time : 1550 Temp : 77 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.1	.001	.006	+.006	+.063
SPAN	49.8	.498	4.98	50.0	.500	5.007	+.027	+.275

± 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 : 10-08-01 Analyte : SO_2 (15-4)

Source : Jotul F100 Run # : 03

Zero Cyl. # : 038TAC 1-A Conc. : 0.00 ppm SO_2 Cyl. Press. : 1730 PSI

Certified by : AIR LIQUIDE Date : 02-07-01

Span Cyl. # : CC62184 Conc. : 1290 ppm SO_2 Cyl. Press. : 1800 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. Wadmyer Time : 1230 Temp : 73 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	PPM	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.2	.002	8.691	8.691	.348
SPAN	51.6	.516	1290	51.5	.515	1288.920	-1.080	-.043

POST RUN Audit : by : D Washington Time : 1550 Temp : 77 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	PPM	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	-.002	-1.291	-1.291	-.052
SPAN	51.6	.516	1290	51.5	.515	1288.920	-1.080	-.043

± 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 F100 RUN: 3 DATE: 10-8-01

Thermocouple Check:

T/C # 1	— °F	T/C # 13	65.2 °F
T/C # 2	— °F	T/C # 14	64.5 °F
T/C # 3	65.1 °F	T/C # 15	65.5 °F
T/C # 4	61.2 °F	T/C # 16	59.6 °F
T/C # 5	60.5 °F	T/C # 17	59.2 °F
T/C # 6	60.4 °F	T/C # 18	68.8 °F
T/C # 7	60.5 °F	T/C # 19	62.6 °F
T/C # 8	60.2 °F	T/C # 20	— °F
T/C # 9	60.5 °F	T/C # 21	— °F
T/C # 10	60.7 °F	T/C # 22	— °F
T/C # 11	60.1 °F	T/C # 23	62.9 °F
T/C # 12	68.8 °F	T/C # 24	— °F

Thermocouple Readout:

Pretest zero and span check and calibration

ZERO: .6 °F Adj. to 0.0 °F

SPAN: 2000.2 °F Adj. to 2000.0 °F

post test zero and span % difference

ZERO 1.2 °F Difference .060 %

SPAN 2004.8 °F Difference .240 %

Thermocouple Readout Pretest Linearity Check

0	= 0.0 °F	200	= 201.7 °F	400	= 399.0 °F
600	= 601.3 °F	800	= 801.5 °F	1000	= 1000.6 °F
1200	= 1198.2 °F	1400	= 1399.2 °F	1600	= 1599.7 °F
1800	= 1800.0 °F	2000	= 2000.0 °F		

Sample Train Leak Check	Pre X	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: 277.8 - 267.8

Post: 270.3 - 260.3

Stack Cleaned Prior to Test Run: YES _____ NO X

COMPUTER INPUT DATA SHEET #1

Client: Jotul USA

Address: 400 Riverside St. P.O. Box 1157
Portland ME 04104

Phone: 207-797-5912 Fax: 207-818-5481

Run No.: 4 Date of Test: 10-09-01 Burn Rate: 2.274 ✓

Model No.: JOTUL F100 ☐ min ☐ min-1.25 ☐ fan

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

Dry Gas Meter: Y Factor: 1.021 (0.000) (Data Sheet #2) Post Leak Rate: .007 ✓ cfm (.000) (Data Sheet #2) Time: 55 ✓ min. (000) (Data Sheet #2)

Dry Gas Meter Volume: 16.301 cf (00.000) (Data Sheet #2)

Stack Flow: 8,958 dscfm (00.000) (Data Sheet #2) Δ H: .138 in. H_2O (.000) (Data Sheet #2)

Barometric Pressure: 30.33 in. Hg (00.00) (Data Sheet #2)

H_2O Captured: 39.0 g (00.0) (Data Sheet #3)

Total Particulate Catch: .0892 g (0.0000) (Data Sheet #6)

Flue Gas Moisture: 10.0975 ✓ % (00.000) (Data Sheet #7)

Particulate Emission: .0842 ✓ gr/dscf (0.0000) (Data Sheet #7)

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

Stove Weight: — lbs (000) (Data Sheet #8)

Total Fuel Consumed During Burn: 5.6 lbs (00.0) (Data sheet #8)

Fuel Higher Heating Value (dry): — BTU/lb (0000) (Data Sheet #8)

Fuel % Moisture (dry): 21.878 % (wet): 17.950 % (00.00) (Data Sheet #10)

Stack Static Pressure: -.066 in. H_2O (0.000) (Data Sheet #12)

Temperature (Average Room) Combustion Air: 85 °F (00) Data Sheet #14)

Stove Temperature Change: -2.8 °F (00.0) (Data Sheet #14)

TABLE 1 ----- RAW DATA

CLIENT : Jotul TEST No. : 4

MODEL: F100 DATE: 09-Oct-01

TIME (MIN.)	METER READING (C F)	DELTA H (IN. H2O)	METER TEMP. (DEG. F)	PERCENT CO (%)	PERCENT CO2 (%)	SO2 COCENTR. PPM
0	927.500	0.150	80	0.72	3.60	375
5	929.000	0.170	81	0.86	10.80	350
10	930.628	0.120	82	1.06	15.00	425
15	931.973	0.100	82	1.14	15.10	450
20	933.244	0.120	83	0.80	14.70	425
25	934.595	0.130	85	0.42	14.40	400
30	936.041	0.150	85	0.07	11.90	375
35	937.583	0.150	86	0.06	9.30	375
40	939.130	0.140	87	0.45	6.70	375
45	940.683	0.140	88	0.60	6.30	375
50	942.242	0.140	88	0.68	6.00	375
55	943.801	0.140	88	0.70	5.80	375
60						

TABLE 2---RAW DATA

CLIENT : Jotul TEST No. 4

MODEL: F100 DATE: 09-Oct-01

****

METER CAL. FACTOR (Y)	1.021		Wt. WOOD BURNED(LB)	5.6	Lbs
BAROMETRIC PRESS.(Pb)	30.33	in Hg	WET,FUEL MOISTURE %	17.95	%
LEAK RATE POST (Lp)	0.007	cfm	Wt. PART. COLLECTED	0.0892	g
WATER VOL. (V1c)	39	Ml	METER VOLUME Vm	16.301	mcf
TEST TIME (MIN)	55	min	HC MOLE FRACTION	0.0132	

TABLE 3 -----FIELD DATA AVERAGES

CLIENT :Jotul TEST No. 4

MODEL: F100 DATE: 09-Oct-01

****

AVG DELTA H	------- 0.14 in H2O		AVG PRCNT CO	------- 0.63	%
AVG METER TEMP. Tm	------- 85 deg F		AVG PRCNT CO2	------- 9.97	%
AVG PPM SO2	------- 390 PPM		AVG BAL CO2/CO	------- 15.82	%

TABLE 4 ----- CALCULATIONS

CLIENT : Jotul TEST No. 4

MODEL: F100 DATE: 09-Oct-01

****

STD SAMPLE VOL. Vm(std) -----	16.37	dscf	STACK GAS FLOW Qsd -------	687.372	dscf/Hr & 11.46 dscf/min
VOL. WATER VAPOR Vw(std) ----	1.836	scf	PARTICULATE CONCTRT. Cs ------	0.0055	g/dscf
PRCNT MSTR Bws -------	10.09	%	PARTC.EMISS. RATE E -------	3.75	g/Hr
BURN RATE BR -------	2.27	Kg/Hr	MOLES OF GAS PER Lb WOOD Nt --	0.36	Lb-mole/Lb
CO EMISSION RATE -------	145.02 g/Hr & 63.77	g/Kgdry fuel	PART.EMISS. RATE ------	1.65	g/Kgdry fuel

TABLE 5 ----- PROPORTIONAL RATE VARIATION

CLIENT : Jotul TEST No. : 4

MODEL: F100 DATE: 09-Oct-01

TIME INTEVAL Ti	PPM * Vm	PROPRTN. RATE VAR. PR		PROPRTN RATE VAR. AVERAGE	
5	569.0	98		100	
10	575.4	99			
15	576.6	100			
20	576.4	100			
25	577.1	100			
30	580.2	100			
35	579.6	100			
40	580.4	100			
45	581.6	101			
50	583.3	101			
55	583.3	101			
60					
65					

METER BOX DATA SHEET PAGE # 2

Page: 1 of 1

UNIT: Jotol F100 RUN: 4 DATE: 10-09-01

Meter Box: SH Y Factor: 1.021

Leak checks: 15 " Hg @ .003 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: .19 SAMPLING RATIO: 31 : 1 BP: 30.33

MIN	TIME	METER READING	SAMPLE MDCF	STACK DSCFM	DELTA H	METER TEMP	SO2 PPM	ROTO TEMP	PUMP VACC
0	1030	927.500	—	9.340	.15	80	375	80	1.0
5	35	929.000	—	9.989	.17	81	350	81	2.0
10	40	930.628	930.628	8.211	.12	82	425	82	2.0
15	45	931.973	931.973	7.755	.10	82	450	82	2.0
20	50	933.244	933.244	8.196	.12	83	425	83	2.0
25	55	934.595	934.595	8.676	.13	85	400	85	2.0
30	1100	936.041	936.041	9.254	.15	85	375	85	2.0
35	05	937.583	937.583	9.237	.15	86	375	86	2.0
40	10	939.130	939.130	9.220	.14	87	375	87	2.0
45	15	940.683	940.683	9.204	.14	88	375	88	2.0
50	20	942.242	942.242	9.204	.14	88	375	88	2.0
55	25	943.801	943.801	9.204	.14	88	375	88	2.0
ROTO PRESS:			TOTALS:	107,490	1.65	1015	BP.:		
60	1130								
65	35								
70	40								
75									
80									
85									
90									
95									
100									
105									
110									
115						1015	.12		
			TOTALS:	107,490	1.65	85	MAX VACC =		2.0
TOTAL Cu Ft.		16,301	TOTALS:	8,958	.138	545	AVG. BP:	30.33	

PARTICULATE CATCH / MOISTURE DATA SHEET # 3

UNIT : F100 RUN : 4 DATE : 10-9-01

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	634.9	587.4	484.4	916.0
INITIAL WT	600.7	586.5	483.8	912.7
NET WT GRAMS	34.2	.9	.6	3.3

TOTAL CATCH : 39.0 GRAMS H_2O

FRONT HALF

FILTER #	74F	
FINAL WT g	.7114	
INITIAL WT g	.6682	
NET WT g	.0432	

BEAKER #	106
DESC.	ACETONE
FINAL WT g	96.7408
INITIAL WT g	96.7240
NET WT g	.0168
VOL. DESC. m	75

BACK HALF

FILTER #	74B	
FINAL WT g	.4395	
INITIAL WT g	.4363	
NET WT g	.0032	

BEAKER #	107	108	109	110	
DESC.	ACETONE	METHCHLOR	H_2O	H_2O	
FINAL WT g	107.3707	104.9593	98.8816	104.0254	
INITIAL WT g	107.3470	104.9561	98.8794	104.0246	
NET WT g	.0237	.0032	.0022	.0008	.0080
VOL. DESC ml	150	75	150	90	240

FILTER TARE WEIGHTS DATA SHEET #4-1

Into Dessicator : Date : 9-17-01 Time : 1000 By : C. Livingston

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

Back Size: 8.2 cm Lot No. : ZB911

	DATE: 9-26	BY:	DATE: 9-27	BY: JEV	DATE:	BY:
FILTER #	FIRST WEIGHT	TIME	SECOND WEIGHT	TIME	THIRD WEIGHT	TIME
71F	.6778	1318	.6773	9:30	JOEL F400 R#1	
72F	.6789	1319	.6785	9:31	" " R#2	
73F	.6692	1320	.6688	9:32	" " R#3	
74F	.6681	1321	.6682	9:33	" " R#4	
75F	.6724	1322	.6722	9:34		
76F	.6670	1323	.6674	9:35		
77F	.6707	1324	.6705	9:36		
78F	.6645	1325	.6645	9:37		
79F	.6748	1326	.6753	9:38		
80F	.6745	1327	.6747	7:39		
71B	.4264	1329	.4262	9:40	JOEL F400 R#1	
72B	.4282	1330	.4277	9:41	" " R#2	
73B	.4309	1331	.4304	9:42	" " R#3	
74B	.4365	1332	.4363	9:43	" " R#4	
75B	.4200	1333	.4199	9:45		
76B	.4224	1334	.4227	9:46		
77B	.4223	1335	.4226	9:47		
78B	.4169	1336	.4165	9:48		
79B	.4181	1337	.4185	9:49		
80B	.4224	1338	.4222	9:50		

Checked by: C. Livingston Date: 9-27-01 Time: 1020

BALANCE ROOM ENVIRONMENTAL CONDITIONS

DATE	TIME	BY	WB	DB	% RH
9-26	1315	CL		74	49
9-27	9:30	JEV		72	45.

BEAKER TARE WEIGHTS DATA SHEET #4-2

Into Dessicator: Date : 09-10-01 Time : 1030 By : AKW

	DATE: 9-26	BY: JEU	DATE: 9-27	BY: JEU	DATE: 9-28	BY: JEU
BEAKER #	FIRST WEIGHT	TIME	SECOND WEIGHT	TIME	THIRD WEIGHT	TIME
101	95.6037	1340	95.6037	9:30	✓	
102	96.3790	1341	96.3785	9:31	✓ JOULE #100	
103	102.3665	1342	102.3668	9:32	✓ R#3	
104	106.2207	1343	106.2204	9:33	✓	
x 105	107.0733	1344	107.0754	9:34	107.0750	10:50
x 106	96.7229	1345	96.7236	9:35	96.7240	1051 ✓
x 107	107.3478	1346	107.3472	9:36	107.3470	1052 ✓
x 108	104.9547	1347	104.9563	9:37	104.9561	1053 ✓
109	98.8797	1348	98.8794	9:38	✓ JOULE #100	
110	104.0244	1349	104.0246	9:39	✓ R#4	
1	104.9185	1350	104.9181	9:40	✓	
2	106.2548	1351	106.2550	9:41	✓	
x 3	107.7790	1352	107.7780	9:42	107.7776	1054 ✓
4	108.7750	1353	108.7745	9:43	✓	
x 5	97.4365	1354	97.4400	9:44	97.4401	1055 ✓
x 6	91.2161	1354	91.2154	9:45	91.2159	1056 ✓
7	97.1384	1355	97.1389	9:46	✓	
8	108.6358	1356	108.6360	9:47	✓	
x 9	108.0967	1357	108.0966	9:48	✓	
10	105.7302	1358	105.7306	9:49	✓	
11	104.7886	1359	104.7881	9:50	✓	
12	98.2303	1400	98.2307	9:51	✓	
x 13	104.1762	1401	104.1750	9:52	104.1754	1057 ✓
x 14	97.9816	1402	97.9807	9:53	97.9807	1058 ✓
x 15	104.7649	1403	104.7644	9:54	✓	

BALANCE ROOM ENVIRONMENTAL CONDITIONS

DATE	TIME	BY	WB	DB	% RH
9-26	1315	CP		74	49
9-27	9:30	JEU		74	49
9-28	10:50	JEU		76	49

Checked by CW

Date : 9-28-01

Time : 1210

WOODSTOVE DATA SHEET # 4-3 : CONSTANT WEIGHTS

UNIT : F100 **RUN :** 4 **DATE :** 10-9-01

Beaker #	Date	Time	By	First Weight	Date	Time	By	Second Weight	Date	Time	By	Third Weight	Date	Time	By
106	10-10	1920		96.7408	10-11	1931		96.7408	10-14	2203		-			
107	10-10	1920		107.3712	10-11	1932		107.3707	10-14	2204		-			
108	10-10	1920		104.9602	10-11	1933		104.9589	10-14	2205		104.9593	10-15	1043	
109	10-10	1920		98.8825	10-11	1934		98.8818	10-14	2206		98.8816	10-15	1044	
110	10-10	1920		104.0258	10-11	1935		104.0254	10-14	2207		-			

Filter #	Date	Time	By	First Weight	Date	Time	By	Second Weight	Date	Time	By	Third Weight	Date	Time	By
74F	10-9	1200	Clp	.7113	10-9	1808		.7114	10-10	1913		-			
74B	10-9	1200	Clp	.4400	10-9	1809		.4395	10-10	1915		-			

SCALE ROOM ENVIRONMENTAL CONDITIONS

Weighing Session	Date	Time	By	WB	DB	%RH
1	10-9	1800			77	49
2	10-10	1900			75	49
3	10-11	1925			78	47
4	10-14	2200			78	48

Weighing Session	Date	Time	By	WB	DB	%RH
5						
6						
7						
8						

Dates: From 12-15-2000
Through 08-26-2001

WOODSTOVE DATA SHEET #4-4
SCALE QA SHEET

Scale: Sartorius
Model: A1205
SN : 37010004

100g weight	10 g weight	1.0 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	Wet Bulb	%.RH
100.0000	10.0001	1.0000	.0999	[illegible]	12-15	1215	73		40
100.0000	10.0000	1.0001	.0999	[illegible]	12-15	2055	72		40
100.0000	10.0001	.9999	.0999	[illegible]	12-16	1615	76		42
100.0001	10.0000	.9999	.0999	[illegible]	1-12	1230	73		44
99.9998	9.9999	1.0000	.1000	[illegible]	1-13	1720	73		44
100.0000	10.0000	1.0000	.0998	[illegible]	1-15	1105	75		45
99.9999	10.0000	.9999	.0999	[illegible]	1-20	2015	71		48
100.0000	9.9999	1.0000	.0998	[illegible]	1-21	1310	77		43
100.0001	10.0001	1.0000	.0997	[illegible]	1-22	1305	74		47
100.0000	10.0001	1.0000	.0998	[illegible]	1-23	1730	74		47
100.0001	9.9998	1.0000	.0999	[illegible]	1-24	0955	73		47
100.0000	9.9999	1.0000	.0999	[illegible]	1-25	1125	74		42
100.0000	9.9999	.9998	.1000	[illegible]	1-25	1515	76		43
100.0002	10.0001	.9999	.0998	[illegible]	2-21	1020	75		47
100.0001	10.0001	1.0002	.1000	[illegible]	2-22	1035	76		43
100.0001	9.9999	.9998	.0998	[illegible]	02-23	1235	76		45
99.9997	10.0000	.9999	.0999	[illegible]	02-24	2130	77		40
100.0000	9.9999	1.0000	.0998	[illegible]	02-25	1435	75		43
100.0000	10.0001	1.0001	.1000	[illegible]	02-25	2205	77		40
100.0000	9.9998	1.0000	.0999	[illegible]	02-26	1035	75		35
99.9999	9.9997	1.0000	.1002	[illegible]	04-27	1815	76		47
100.0000	10.0001	1.0000	.0999	[illegible]	04-29	1710	76		47
100.0002	9.9998	1.0000	.0999	[illegible]	04-30	0935	74		49
99.9997	10.0001	.9999	.0999	[illegible]	04-30	2125	77		48
99.9996	9.9997	.9997	.0999	[illegible]	05-01	2140	77		44
99.9997	10.0000	1.0000	.0998	[illegible]	05-02	2045	77		46
99.9998	10.0001	.9999	.0999	[illegible]	05-04	1435	74		46
99.9999	10.0001	.9998	.1000	[illegible]	05-05	2215	74		46
99.9998	9.9999	1.0000	.0998	[illegible]	05-07	0910	75		44
99.9998	10.0001	1.0000	.0999	[illegible]	05-11	2115	77		48
99.9999	9.9999	1.0001	.1000	[illegible]	05-13	2005	76		48
100.0001	9.9999	1.0000	.1000	[illegible]	05-14	1950	77		49
100.0000	9.9998	1.0000	.1001	[illegible]	05-15	1910	78		47
99.9999	9.9997	.9999	.1000	[illegible]	05-24	2020	78		48
99.9999	9.9997	.9999	.1000	[illegible]	05-30	1515	78		49
99.9999	9.9998	.9999	.1001	[illegible]	05-30	2215	78		49
100.0000	10.0001	1.0000	.0999	[illegible]	08-24	2125	78		49
100.0001	10.0000	1.0001	.0999	[illegible]	08-26	1000	78		49

Dates: From 8-28-01
Through 10-28-01

WOODSTOVE DATA SHEET #4-4
SCALE QA SHEET

Scale: Sartorius
Model: A1205
SN : 37010004

100g weight	10 g weight	1.0 g weight	100 mg weight	Tech	Date	Time	Dry Bulb	Wet Bulb	%.RH
100.0000	10.0002	.9999	.0994	CJ	8-28	1900	75		49
100.0000	10.0005	1.0001	.1000	CJ	8-29	2130	76		49
100.0000	9.9999	1.0000	.0995	CJ	8-30	1130	76		49
100.0000	10.0000	.9999	.0998	CJ	8-31	1930	75		49
100.0004	10.0002	.9998	.1000	CJ	9-1	1445	77		49
100.0003	10.0001	.9999	.1000	AKW	9-3	2105	74		49
99.9999	10.0002	1.0000	.1001	AKW	9-4	1830	78		49
100.0001	10.0001	.9998	.1000	AKW	9-5	1230	75		49
100.0004	10.0000	.9999	.0999	CJ	9-26	1315	74		49
100.0000	10.0000	1.0000	.0998	JRW	9-27	9:30	73		46
100.0000	9.9999	1.0000	.0998	JRW	9-28	10:50	76		49
100.0000	10.0000	.9998	.0997	JRW	10-1	910	76		49
100.0000	9.9999	.9999	.0998	JRW	10-2	9:49	70		46
100.0000	10.0000	1.0000	.0995	JRW	10-3	9:21	76		46
99.9999	10.0000	1.0001	.1000	AKW	10-5	1240	78		48
99.9997	10.0000	1.0001	.1000	JRW	10-6	1420	68		49
99.9997	10.0000	1.0001	.0998	AKW	10-7	2150	78		47
10.0001	10.0002	1.0001	.1000	AKW	10-8	0730	74		49
9.9998	10.0000	1.0000	.0999	AKW	10-9	1205	78		48
100.0002	10.0001	.9997	.0996	AKW	10-9	1800	77		49
100.0001	10.0002	.9999	.0998	AKW	10-10	900	76		49
99.9999	9.9998	.9997	.0999	AKW	10-11	1125	77		48
100.0000	10.0001	.9997	.0998	AKW	10-11	1550	78		47
99.9999	10.0000	1.0000	.0999	AKW	10-11	1925	78		47
100.0000	10.0003	1.0000	.0998	AKW	10-14	2200	78		48
100.0000	10.0000	1.0001	.1001	AKW	10-15	1040	74		49
100.0002	10.0001	1.0000	.0999	AKW	10-19	2000	78		47
99.9997	10.0002	1.0002	.1001	AKW	10-22	0830	78		47
100.0001	10.0000	1.0000	.0998	AKW	10-22	1145	78		48
99.9998	10.0000	1.0000	.0997	AKW	10-23	1030	76		47
100.0000	10.0001	1.0001	.1000	AKW	10-23	1055	77		47
99.9999	10.0001	.9999	.1000	AKW	10-24	1025	76		48
100.0000	10.0000	.9999	.0999	AKW	10-25	1650	77		49
99.9999	9.9999	1.0001	.0997	AKW	10-25	2335	78		47
100.0000	9.9999	.9999	.0999	AKW	10-26	2125	78		47
100.0002	10.0001	1.0000	.0998	AKW	10-27	1155	77		46
99.9998	10.0000	1.0000	.1000	AKW	10-27	1645	77		46
100.0003	10.0001	.9999	.0996	AKW	10-28	1305	74		46

BLANK PROCESSING DATA SHEET # 5

UNIT : JOTUL F100 RUN : 4 DATE : 10-09-01

BLANKS DONE : 2-22-01

BEAKER	A	B	C
	200 ml ACETONE	75 ml DICHLOR	200 ml WATER
	FISHER OPTIMA LOT # 906481	FISHER OPTIMA LOT # 886589	BONNEAU PRODUCTS CERTIFIED DISTILLED
FINAL WEIGHT	108.9018	106.3086	106.9675
TARE WEIGHT	108.9007	106.3066	106.9672
NET WEIGHT	.0011 ✓	.0020 ✓	.0003 ✓

TARE BEAKERS INTO DESC : TIME : 1130 DATE : 02-19-01

DATE : 02/21 BY : KAW DATE : 02/22 BY : KAW DATE : ____ BY : ____

BEAKER	1 ST WT	TIME	2 ND WT	TIME	3 RD WT	TIME
A	108.9012	1046	108.9007	1106	✓	
B	106.3069	1047	106.3066	1107	✓	
C	106.9677	1048	106.9672	1108	✓	

FINAL BEAKERS INTO DESC : TIME : 1630 DATE : 02/23/01

DATE : 02/24 BY : KAW DATE : 02/25 BY : KAW DATE : ____ BY : ____

BEAKER	1 ST WT	TIME	2 ND WT	TIME	3 RD WT	TIME
A	108.9017	2135	108.9018	1440	✓	
B	106.3087	2136	106.3086	1441	✓	
C	106.9672	2137	106.9675	1442	✓	

TARE QC

DATE	TIME	BY	WB	DB	%
02/21	1020	KAW		75	47
02/22	1035	KAW		76	43

FINAL QC

DATE	TIME	BY	WB	DB	%
02/24	2130	KAW		77	40
02/25	1435	KAW		75	43

NET PARTICULATE CATCH CALCULATION DATA SHEET #6

UNIT: JOTUL F100 RUN: 4 DATE: 10-09-01

BLANK CALCULATIONS

Acetone: .0011 g ÷ 200 ml = .000006 g/ml
Dicholoromethane: .0020 g ÷ 75 ml = .000027 g/ml
Distilled Water: .0003 g ÷ 200 ml = .000002 g/ml

FRONT HALF CATCH

FILTERS: .0432 g (Total Catch) - 1 (# of Filters) (.0000 g) (Blank Value / Filter) = .0432 g

BEAKERS: .0168 g (Total Catch) - 75 (ml Acetone) (.0005 .000006 g) (Blank Value / ml Acetone) = .0163 g

TOTAL FRONT HALF CATCH: .0595 g

BACK HALF CATCH

FILTERS: .0032 g (Total Catch) - 1 (# of Filters) (.0000 g) (Blank Value / Filter) = .0032 g

BEAKERS:

Acetone: .0237 g (Total Catch) - 150 (ml Acetone) (.0009 .000006 g) (Blank Value / ml Acetone) = .0228 g

Extract: .0032 g (Total Catch) - 75 (ml Dichloromethane) (.0020 .000027 g) (Blank Value / Dichloromethane) = .0012 g

Water: .0030 g (Total Catch) - 240 (ml Water) (.0005 .000002 g) (Blank Value / Water) = .0025 g

TOTAL BACK HALF CATCH: .0297 g

TOTAL CATCH: .0892 g

% FRONT HALF: 66.70 %

CALCULATIONS DATA SHEET # 7

UNIT : Jotul F 100 RUN : 4 DATE : 10-04-01

1) Vm (std) = $\dfrac{(16.301\ \text{Vm})(17.64)(1.021\ \text{mcf})\left(30.33\ \text{" Hg} + \dfrac{.138\ \text{" } H_2O}{13.6}\right)}{(545\ \text{TmA})}$ = $\dfrac{16.3440}{000.0000}$ dscf

30.3401

2) Vw (std) = (.04707) (39.0 ml H_2O) = $\dfrac{1.8357}{00.0000}$ scf

3) Asw = $\dfrac{(1.8357\ \text{scf})}{(1.8357\ \text{scf} + 16.3440\ \text{dscf})}$ = $\dfrac{.1010}{.0000}$ Bws × 100 = $\dfrac{10.0975}{00.0000}$ % H_2O

18.1797

4) Cs = $\dfrac{(.0892\ \text{g.})}{(16.3440\ \text{dscf})}$ (15.43) = $\dfrac{.0842}{0.0000}$ gr / dscf

5) Estimated g / hr = $\dfrac{(.0892\ \text{g.})}{(16.3440\ \text{dscf})}$ ($\dfrac{8.958}{00.0000}$ dscfm) (60) = $\dfrac{2.9334}{00.0000}$ 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 F100 RUN: 4 DATE: 10-09-01

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

Wet Bulb / Dry Bulb

Pre : WB: 62 DB: 75 = 47 ~ % RH 1.4 ~ % H_2O

Post : WB: 67 DB: 84 = 40 ~ % RH 1.6 % H_2O

Average: 43.5 ✓ %RH 1.5 ~ % H_2O

Empty Stove Weight (lbs): _____ w/ stack & oil seal : Wet: _____ Dry: 259.2

Kindling Weight (lbs): Paper: .2 Wood: 1.9

Preburn Fuel Weight: 6.5 ~ + 6.0 ~ + 6.7 ~ Total: 19.2 ~

Kindling & Preburn Fuel Weight (wood only) (lbs): Total: 21.1 ~

Coal Bed Wt Range (lbs): 1.4 ~ - 1.2 ~ Scale: 260.6 ~ - 260.4 ~

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: 1.4 ~

Maximum Coal Bed Removal (lbs): ((1.4 ~ (Upper) + 1.2 ~ (Lower)) ÷ 2) .25 = .3 ~

Test Fuel (.75" x 1.5" x 5" spacers) = 12 pcs

Dimensions	Length in inches	No. Pcs	Weight in lbs	% of Load
2" x 4"	14	3	5.6	100
4" x 4"	—	—	—	—

Test Fuel Weight: 5.6 lbs

Estimated Dry Burn Rate: 1.0052

$$\frac{5.6 \sim - (5.6 \sim \times .17950 \checkmark)}{2.2046} \times \frac{60}{\underset{\text{TIME}}{55 \checkmark}} = 2.274 \sim \text{ kg / hr}$$

Estimated BTU's/hr: 19,140 × $\frac{63 \checkmark}{100}$ × $\frac{2.274 \sim}{\text{DBR}}$ = 27420.3 ~ BTU's/hr

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

WOOD STOVE OPERATING DATA PAGE #9

Unit : Jotul F 100 Run : 4 Date : 10-09-01

FIRE STARTED: 0645

WARM UP AND PREBURN:

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

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

CHARCOAL BED PREPARATION :

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

TEST:

DOOR wide open during loading 0 min. 35 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 OFF

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 14 or 8 inches.

1st warm up / pre-burn fuel charge (6.5 lbs.) added at 0710

2nd warm up / pre-burn fuel charge (6.0 lbs.) added at 0810

3rd warm up / pre-burn fuel charge (6.7 lbs.) added at 0915

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 F 100 Run : 4 Date : 10-09-01

Room Temperature : 69 °F Correction Factor : Ø

Uncorrected Values are corrected for room temperature : Yes _____ No X

Time Test Fuel moisture reading taken : 0930

Calibration Checks : X ✓ Y ✓ 12.0 12.1 22.0 22.1

pc #	Dimen.	Use	TOP		BOTTOM		SIDE		Avg Corrected
			Uncor	Cor.	Uncor.	Cor.	Uncor.	Cor.	
1	2"×4"×8'	K	15.5	16.5	16.0	17.0	14.5	15.5	16.333
2									
3									
4	2"×4"×8'	P	18.5	19.8	19.0	20.3	19.0	20.3	20.133
5	2"×4"×8'	P	22.0	23.7	22.0	23.7	22.0	23.7	23.700
6	2"×4"×8'	P	23.5	25.2	22.5	24.1	22.5	24.1	24.467
7	2"×4"×8'	P							68.300
8	2"×4"×8'	P							
9									
10									
11	2×4×14	T	19.0	20.3	19.0	20.3	19.0	20.3	20.300
12	"	T	19.0	20.3	19.0	20.3	18.5	19.8	20.133
13	"	T	23.5	25.2	23.5	25.2	23.5	25.2	25.200
14									65.633
15									
16									
17									
18									
19									
20	Spacers	T	18.5	19.8	18.0	19.2	17.5	18.7	19.233

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

	KINDLING	PRETEST FUEL	TEST FUEL
Dry Moisture % :	16.333 %	22.767 %	21.878 %
Wet Moisture % :	14.040 %	18.545 %	17.950 %

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°

WEIGHT: 260.6

GAS DATA SHEET # 12

UNIT: Jotul F 100 RUN: 4 DATE: 10-09-01 PAGE: 1 of 1

TIME	SCALE	FUEL	DROP	V.	CO_2	V.	O_2	V.	CO	BAL	WB	DB	% H_2O	CAL WB	STACK	STATIC	SO_2 PPM
0 1030	266.2	5.6	—	.145	3.6	.680	17.1	.072	.72	5.0					361	-.057	375
5 35	265.3	4.7	.9	.433	10.8	.372	9.3	.086	.86	12.6					504	-.066	350
10 40	264.3	3.7	1.0	.598	15.0	.232	5.8	.106	1.06	14.1					527	-.074	425
15 45	263.4	2.8	.9	.605	15.1	.227	5.7	.114	1.14	13.3					530	-.074	450
20 50	262.5	1.9	.9	.587	14.7	.243	6.1	.080	.80	18.4					522	-.074	425
25 55	261.9	1.3	.6	.574	14.4	.253	6.3	.042	.42	34.4					511	-.071	400
30 1100	261.3	.7	.6	.475	11.9	.344	8.6	.007	.07	179.8					498	-.070	375
35 05	261.0	.4	.3	.323	9.3	.420	10.5	.006	.06	166.2					455	-.066	375
40 10	260.9	.3	.1	.269	6.7	.532	13.3	.045	.45	15.0					412	-.063	375
45 15	260.8	.2	.1	.255	6.3	.555	13.9	.060	.60	10.6					389	-.060	375
50 20	260.7	.1	.1	.241	6.0	.572	14.4	.068	.68	8.8					373	-.059	375
55 25	260.6	0	.1	.235	5.8	.587	14.7	.070	.70	8.4					360	-.057	375
TOTAL	-----	----	----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5442	-.791	-----
60 1130																	
65 35																	
70 40																	
75 45																	
80 50																	
85 55																	
90 1200																	
95 05																	
100 10																	
105 15																	
110 20																	
115 25																	÷12
TOTAL	-----	----	----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5442	-.791	-----
TOTAL	-----	----	----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	454	-.066	-----

PREBURN DATA SHEET #13

UNIT: Jotul F100 RUN: 4 DATE: 10-09-01 PAGE: 1 of 1

TIME	SCALE	DROP	STACK	TOP	LF SIDE	BACK	RT SIDE	BOTTOM	FIREBOX	SEC/CAT	AMBIENT	STATIC	COMMENTS
0 0920	267.6	—	310	326	462	448	444	447	823	736	69	-.053	PREBURN START: # 7.0 UP
5 25	267.1	.5	324	301	411	446	406	425	793	762	68	-.055	COAL BED SCALE RANGE:
10 30	266.6	.5	322	286	381	451	379	402	760	1012	69	-.055	260.6 - 260.4
15 35	265.8	.8	379	281	363	462	368	388	849	972	70	-.058	PRIMARY AIR: wide open
20 40	265.0	.8	513	296	378	483	371	376	951	969	72	-.069	SECONDARY AIR: N/A
25 45	264.1	.9	561	336	424	529	405	371	1039	1091	71	-.076	FAN: N/A
30 50	263.2	.9	562	360	455	555	433	370	1008	1111	75	-.075	PUMPS ON AT: 0950
35 55	262.4	.8	569	391	513	583	488	379	1160	1329	77	-.075	CHECK WB/DB: N/A
40 1000	261.9	.5	497	407	553	556	525	376	1044	1361	78	-.071	
45 05	261.5	.4	472	418	576	553	542	376	1037	1139	81	-.070	
50 10	261.3	.2	449	417	583	563	547	381	1028	1222	79	-.066	
55 15	261.0	.3	415	407	571	559	544	390	994	1112	81	-.063	
*****	****	***	****	*****	*****	****	*****	*****	*****	*****	*****	****	
60 1120	260.9	.1	395	392	555	552	539	401	967	1078	80	-.061	
65 25	260.8	.1	372	374	534	548	524	406	909	1075	81	-.060	
70 30	260.6	.2	361	358	514	543	506	412	878	1039	82	-.057	466.6 ΔT
—													

TEMPERATURE DATA SHEET # 14

UNIT: Jotul F100 RUN: 4 DATE: 10-09-01 PAGE 1 of 1

TIME	TOP	LT SIDE	BACK	RT SIDE	BOTTOM	FIREBOX	SEC/CAT	AMBIENT	FURNACE	SAMPLE	SAMP IMP	C-GAS	GAS IMP	SO_2 IMP	466.6
0 / 1030	358	514	543	506	412	878	1039	82	1254	228	66	243	37	37	
5 / 35	345	455	555	447	402	1085	1026	82	1261	234	43	247	36	37	
10 / 40	367	444	595	441	386	1062	1108	80	1266	236	44	253	37	36	
15 / 45	391	460	634	464	375	1076	1160	83	1274	237	44	250	38	37	
20 / 50	415	494	666	497	368	1146	1191	84	1286	238	44	250	35	37	
25 / 55	423	561	702	537	365	1142	1213	85	1303	240	44	249	36	37	
30 / 1100	441	601	706	567	364	1164	1198	86	1323	243	44	254	34	36	
35 / 05	449	613	697	581	366	1152	1178	86	1337	244	44	254	35	36	
40 / 10	427	599	644	575	369	1093	1074	87	1343	242	44	249	35	34	
45 / 15	407	569	603	553	377	1059	1018	87	1341	241	44	243	35	35	
50 / 20	391	543	568	532	378	1010	969	87	1339	240	45	241	35	35	
55 / 25	372	513	545	509	380	944	931	85	1337	239	45	242	36	35	
TOTAL	4780	6366	7458	6209	4542	12811	13105	1014	*****	*****	*****	*****	*****	*****	
60 / 1130															
65 / 35															
70 / 40															
75 / 45															
80 / 50															
85 / 55															
90 / 1200											466.6	.			
95 / 05											463.8	.			
100 / 10											-2.8	ΔT			
105 / 15															
110 / 20															
115 / 25									÷12						
TOTAL	4786	6366	7458	6209	4542	12811	13105	1014	*****	*****	*****	*****	*****	*****	
TOTAL	399	531	622	517	379	1068	1092	85	*****	*****	*****	*****	*****	*****	

ZERO / SPAN CHECK DATA SHEET #15-1

Date : 10-09-01 Analyte : CO_2 (15-1)

Source : Jotul F100 Run # : 4

Zero Cyl. # : 038TAC 1-A Conc. : 0.00 % CO_2 Cyl. Press. : 1730 PSI

Certified by : AIR LIQUIDE Date : 02-07-01

Span Cyl. # : CC52330 Conc. : 12.44 % CO_2 Cyl. Press. : 1810 PSI

Certified by : AIR LIQUIDE Date : 01-19-01

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 : D. Washington Time : 0935 Temp : 70 ° F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.2	.002	.003	-.003	-.011
SPAN	49.8	.498	12.44	50.1	.501	12.521	+.081	+.325

POST RUN Audit : by : D. Washington Time : 1120 Temp : 84 ° F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.3	.003	.022	+.022	+.090
SPAN	49.8	.498	12.44	50.1	.501	12.521	+.081	+.325

± 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 : 10-09-01 Analyte : O_2 (15-2)

Source : Total F100 Run # : 4

Zero Cyl. # : 038TAC 1-A Conc. : 0.00 % O_2 Cyl. Press. : 1730 PSI

Certified by : AIR LIQUIDE Date : 02-07-01

Span Cyl. # : CC85322 Conc. : 12.45 % O_2 Cyl. Press. : 1810 PSI

Certified by : AIR LIQUIDE Date : 01-19-01

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 : D. Wadington Time : 0935 Temp : 70 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.002	-.090	-.090	-.361
SPAN	12.45	.498	12.45	12.60	.502	12.589	+.139	+.556

POST RUN Audit : by : D. Wadington Time : 1120 Temp : 84 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.001	.065	.065	-.260
SPAN	12.45	.498	12.45	12.54	.500	12.539	+.089	+.355

± 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 : 10-09-01 Analyte : CO (15-3)

Source : Jotul F 100 Run # : 4

Zero Cyl. # : 038TAC 1-A Conc. : 0.00 % CO Cyl. Press. : 1730 PSI

Certified by : AIR LIQUIDE Date : 02-07-01

Span Cyl. # : CC85322 Conc. : 4.98 % CO Cyl. Press. : 1810 PSI

Certified by : AIR LIQUIDE Date : 01-19-01

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 : D. Washington Time : 0935 Temp : 70 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.1	.001	.006	+.006	+.063
SPAN	49.8	.498	4.98	50.1	.501	5.018	+.038	+.375

POST RUN Audit : by : D. Washington Time : 1120 Temp : 84 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	%	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	-.004	-.004	-.037
SPAN	49.8	.498	4.98	50.0	.500	5.007	+.027	+.275

± 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 : 10-09-01 Analyte : SO_2 (15-4)

Source : Jotul F100 Run # : 4

Zero Cyl. # : 038TAC 1-A Conc. : 0.00 ppm SO_2 Cyl. Press. : 1730 PSI

Certified by : AIR LIQUIDE Date : 02-07-01

Span Cyl. # : CC62184 Conc. : 1290 ppm SO_2 Cyl. Press. : 1810 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 : D. Wadsworth Time : 0935 Temp : 70 °F

AUDIT RESULTS

Point #	Expected Response			Actual Response			± Conc. Difference	Δ %
	Meter	DVM	PPM	Meter	DVM	%		
ZERO	00.0	.000	00.0	00.0	.000	3.700	+3.700	+.148
SPAN	51.6	.516	1290	51.8	.518	1296.407	+6.407	+.256

POST RUN Audit : by : D. Wadsworth Time : 1120 Temp : 84 °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	1.205	+1.205	+.048
SPAN	51.6	.516	1290	51.7	.517	1293.911	+3.911	+.156

± 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 F100 RUN: 4 DATE: 10-09-01

Thermocouple Check: —

T/C # 1	— °F	T/C # 13	66.6 °F
T/C # 2	— °F	T/C # 14	64.5 °F
T/C # 3	66.2 °F	T/C # 15	67.6 °F
T/C # 4	61.1 °F	T/C # 16	57.1 °F
T/C # 5	60.6 °F	T/C # 17	57.5 °F
T/C # 6	60.4 °F	T/C # 18	71.2 °F
T/C # 7	60.3 °F	T/C # 19	61.6 °F
T/C # 8	60.2 °F	T/C # 20	— °F
T/C # 9	60.2 °F	T/C # 21	— °F
T/C # 10	61.2 °F	T/C # 22	— °F
T/C # 11	58.8 °F	T/C # 23	62.2 °F
T/C # 12	74.4 °F	T/C # 24	— °F

Thermocouple Readout:

Pretest zero and span check and calibration

ZERO: -.7 °F Adj. to 0.0 °F

SPAN: 2001.6 °F Adj. to 2000.0 °F

post test zero and span / % difference

ZERO 2.0 °F Difference .100 %

SPAN 2003.3 °F Difference .165 %

Thermocouple Readout Pretest Linearity Check

0	= 0.0 °F	200	= 201.8 °F	400	= 399.2 °F
600	= 601.4 °F	800	= 801.6 °F	1000	= 1000.6 °F
1200	= 1198.2 °F	1400	= 1399.2 °F	1600	= 1599.7 °F
1800	= 1800.0 °F	2000	= 2000.0 °F		

Sample Train Leak Check	Pre X	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: 277.8 - 267.8

Post: 270.3 - 260.3

Stack Cleaned Prior to Test Run: YES ____ NO X

Inspection Certificate

Phillips Morris Scale Company
934 Elliott Avenue W.
Seattle, WA 98119
Ph#(206)284-6090
Fax#(206)282-6612

Customer: LOKEE TESTING
Address: 13235 Prairie Circle E
Sumner, WA 98390
Technician: P. McClellan
Authorization Signature:

Date of Inspection: 4-19-01
Next Inspection Due: '02

Certification Type
- ✓ Standard
- __ ISO 9000
- __ MIL STD-45662

Equipment Tested

Indicator

Make: Weightronix
Model: WI-110
SR#: 16409
Class: III
Cap.: 1000 lbs

Base

4479A

Options Installed

Printer
Score Board
Computer
Other

Pre-test

Ø
999.0

Post-test

Ø
500.0
1000.0

Manufacturer Tolerance

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)

T6-15 T6-16

Any changes to document or scale not authorized by Phillips & Morris Scale Company VOIDS this certificate.

Oregon
John A. Kitzhaber, M.D., Governor

JUN - 5 2000

Department of Agriculture
635 Capitol Street NE
Salem, OR 97301-2532



Calibration Report
STATE TEST NO: OR-00-74-F

Calibration Items: Twenty-two 500 lb cast weights
Tolerance Class: NIST (NBS) Class F

Submitted by:
Phillips Morris Scale Company
934 Elliot Ave. W
Seattle, WA 98119

Serial No.'s: T6-15 T6-16 T15-12 T15-13 T15-14 T15-15 T15-16 T15-17 T15-18 T15-19 T15-20
T15-21 T15-22 T15-23 T15-24 T15-25 T15-26 T15-27 T15-28 T15-29 T15-30 T15-31

Method and Traceability:
The procedure used by this laboratory is NIST Handbook 145 Standard Operating Procedure (SOP) 8 Modified Substitution Weighing Design. Standards used for comparison are traceable to the National Institute of Standards and Technology (reports on file) and are part of a comprehensive measurement assurance program for ensuring continued accuracy and traceability within the level of uncertainty reported by this laboratory. Traceability to National Standards is through the State Test No. above.

Uncertainty Statement:
The uncertainty conforms to the ISO Guide to the Expressions of Uncertainty in Measurement. Uncertainty as reported is based on a coverage factor K=2 for an approximate 95 percent level of uncertainty. Uncertainty components include the within process and between process standard deviations and the uncertainty of the standard along with any environmental corrections. The user must consider the corrections and uncertainties as reported to determine overall system uncertainty in use.

Result: Weights were found to be within or were adjusted to NIST (NBS) Class F Tolerance. Actual corrections are not reported for tolerance testing.

Uncertainty: Uncertainty is less than 10% NIST Class F Tolerance.

Balance Used: RUSSELL **Standard Used:** 500 lb Working Gold

NIST Class F Tolerance: 0.05 lb

Condoition of Items Upon Receipt: Items were received in good condition on May 31, 2000.

Gregory Houser, Metrologist
Measurement Standards Division
PHONE: (503) 986-4672
FAX: (503) 986-4784
TDD: (503) 986-4762

Date Report Prepared: May 31, 2000
Date Tested: May 31, 2000

This document shall not be reproduced except in full, without written approval.
Client must not use this document to claim product endorsement by this laboratory.

QUALITY CONTROL SERVICES Inc.

2340 S.E. 11Th. Avenue Portland, Oregon 97214-5306
(503) 236-2712 / FAX:(503) 235-2535

CERTIFICATE OF CALIBRATION

Customer and Contact

Lokee Testing Labs
13235 Prairie Circle East
Sumner, WA. 98390
Chip Wadington

Report Number: EESPC37010004010430

INSTRUMENT INFORMATION

Item	Make	Model	Serial Number	Customer ID	Location	SOP Used
Balance	Sartorius	A120S	37010004	N/A	Lab	QC012

Units	Readability	Range Calibrated	Tolerance Used	Cal. Date	Last Cal.	Cal. Due
Grams	0.0001	0-100	Factory	04/30/2001	11/07/2000	11/2001

Functional Checks

Cornerload ☑ Linearity 0 - 1/2 - Full Capacity ☑ Reproduceability ☑

CALIBRATION DATA

Standard	As Found Instrument	Tolerance +/-	As Left Instrument
100	99.9999	0.0002	100.0000
50	49.9998	0.0002	50.0000
20	20.0000	0.0002	20.0000
10	10.0000	0.0002	10.0000
5	5.0000	0.0002	5.0000
1	1.0000	0.0002	1.0000

CALIBRATION STANDARDS

Item	Make	Model	Serial Number	Units	Cal. Date	Cal. Due	Traceable ID#
Weight Set	R.L./Troemner	5MG-25KG	A45	Grams	12/11/2000	12/2001	A45-2000

Comments / Info Concerning This Calibration:

Permanent Information Concerning This Instrument:
5/00 CUSTOMER REQUESTED SPECIFIC 6 POINT CHECK.100,50,20,10,5,1

Technician:D.Deleasa
Signature: D. Deleasa

THE COMBINED EXPANDED UNCERTAINTY FOR THIS MEASUREMENT PROCESS IS BETTER THAN A 4:1 RATIO OF UNCERTAINTY TO TOLERANCE (UNLESS OTHERWISE STATED IN THE COMMENTS SECTION). THE UNCERTAINTY IS CALCULATED ACCORDING TO THE ISO GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT (ANSI/NCSL Z540-2-1997) AND INCLUDES THE UNCERTAINTY OF THE MEASUREMENT PROCESS, THE UNCERTAINTY OF THE STANDARDS USED, AND THE OBSERVED STANDARD DEVIATION OF THE BALANCE. THE UNCERTAINTY IS EXPANDED WITH A K FACTOR OF 2 FOR A 95% LEVEL OF CONFIDENCE. EXPANDED UNCERTAINTY DATA IS MAINTAINED ON FILE AT QUALITY CONTROL SERVICES, INC. AND IS AVAILABLE ON REQUEST.

CALIBRATIONS ARE PERFORMED UNDER AMBIENT CONDITIONS USING MANUFACTURER'S OR CUSTOMERS SPECIFICATIONS FOR THE PASS/FAIL RESULTS. RESULTS MAY BE INFLUENCED BY THE AGE OF THE INSTRUMENT AND ENVIRONMENTAL CONDITIONS. CALIBRATION DATA SHOULD BE REVIEWED TO INSURE THAT THE INSTRUMENT IS PERFORMING TO ITS INTENDED ACCURACY. CALIBRATIONS CONFORM TO ISO/IEC GUIDE 25-1990(17025) AND ANSI / NCSL Z540-1-1994 SPECIFICATIONS.

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

QUALITY CONTROL SERVICES Inc.

2340 S.E. 11Th. Avenue Portland, Oregon 97214-5306
(503) 236-2712 / FAX:(503) 235-2535

CERTIFICATE OF CALIBRATION

Customer and Contact

Lokee Testing Labs
13235 Prairie Circle East
Sumner, WA. 98390
Chip Wadington

Report Number: EESPC37010004001107

INSTRUMENT INFORMATION

Item	Make	Model	Serial Number	Customer ID	Location	SOP Used
Balance	Sartorius	A120S	37010004	N/A	Lab	QC012

Units	Readability	Range Calibrated	Tolerance Used	Cal. Date	Last Cal.	Cal. Due
Grams	0.0001	0-100	Factory	11/07/2000	05/19/2000	05/2001

Functional Checks

Cornerload ☑ Linearity 0 - 1/2 - Full Capacity ☑ Reproduceability ☑

CALIBRATION DATA

Standard	As Found Instrument	Tolerance +/-	As Left Instrument
100	99.9998	0.0002	100.0000
50	49.9999	0.0002	50.0000
20	20.0001	0.0002	20.0000
10	10.0001	0.0002	10.0000
5	5.0000	0.0002	5.0000
1	1.0000	0.0002	1.0000

CALIBRATION STANDARDS

Item	Make	Model	Serial Number	Units	Cal. Date	Cal. Due	Traceable ID#
Weight Set	R.L./Troemner	5MG-25KG	A45	Grams	03/16/2000	03/2001	A45-2000

Comments / Info Concerning This Calibration:

Permanent Information Concerning This Instrument:
5/00 CUSTOMER REQUESTED SPECIFIC 6 POINT CHECK.100,50,20,10,5,1

Technician:D.Deleasa

Signature: D. Deleasa

CALIBRATIONS ARE PERFORMED UNDER AMBIENT CONDITIONS USING MANUFACTURER'S SPECIFICATIONS FOR THE PASS/FAIL RESULTS. RESULTS MAY BE INFULENCED BY THE AGE OF THE INSTRUMENT AND ENVIRONMENTAL CONDITIONS. CALIBRATION DATA SHOULD BE REVIEWED TO INSURE THAT THE INSTRUMENT IS PERFORMING TO ITS INTENDED ACCURACY. CALIBRATIONS CONFORM TO ANSI / NCSL Z540-1-1994 SPECIFICATIONS.

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

for 6-1- to 1-1-2000

QUALITY CONTROL SERVICES Inc.

2340 S.E. 11Th. Avenue Portland, Oregon 97214-5306
(503) 236-2712 / FAX:(503) 235-2535

CERTIFICATE OF CALIBRATION

Customer and Contact

Lokee Testing Labs
13235 Prairie Circle East
Sumner, WA. 98390
Chip Wadington

Report Number: QCS-00005116

INSTRUMENT INFORMATION

Item	Make	Model	Serial Number	Units	Cal. Date	Last Cal.	Cal. Due
Balance	Sartorius	A120S	37010004	Grams	05/19/2000	12/13/1999	11/2000

Readability	Range Calibrated	Location	Customer ID	SOP Used	Tolerance Used
0.0001	0-100	Lab	N/A	QC004	Factory

Functional Checks

Cornerload ☑ Linearity 0 - 1/2 - Full Capacity ☑ Reproduceability ☑

CALIBRATION DATA

Standard	As Found Instrument	Tolerance +/-	As Left Instrument
100	99.9992	0.0002	100.0000
50	49.9996	0.0002	50.0000
20	19.9999	0.0002	20.0000
10	9.9999	0.0002	10.0000
5	5.0000	0.0002	5.0000
1	1.0000	0.0002	1.0000

CALIBRATION STANDARDS

Item	Make	Model	Serial Number	Units	Cal. Date	Cal. Due	NIST Traceable ID#
Weight Set	R.L./Troemner	5MG-25KG	A45	Grams	03/16/2000	03/2001	A45-2000

Comments / Info Concerning This Calibration:

Permanent Information Concerning This Instrument:
5/00 CUSTOMER REQUESTED SPECIFIC 6 POINT CHECK.

Technician: D.Deleasa

Signature: D. Deleasa

CALIBRATIONS ARE PERFORMED UNDER AMBIENT CONDITIONS USING MANUFACTURER'S SPECIFICATIONS FOR THE PASS/FAIL RESULTS. RESULTS MAY BE INFULENCED BY THE AGE OF THE INSTRUMENT AND ENVIRONMENTAL CONDITIONS. CALIBRATION DATA SHOULD BE REVIEWED TO INSURE THAT THE INSTRUMENT IS PERFORMING TO ITS INTENDED ACCURACY. CALIBRATIONS CONFORM TO ANSI / NCSL Z540-1-1994 SPECSIFICATIONS.

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 70.0
Barometric Pressure 30.18
DATE: 4-13-01

TC	Location	Ice Bath Temp	Boiling Water Temp
1	Wet Bulb	32.0	211.8
2	Dry Bulb	32.0	211.8
3	Stack	32.4	211.7
4	Stove Top	32.5	211.9
5	Left Side	32.2	212.0
6	Back	32.0	211.7
7	Right Side	32.6	211.9
8	Bottom	32.2	212.0
9	Firebox	32.1	212.0
10	Secondary/Cat	32.4	211.6
11	Ambient	32.3	211.8
12	Tube Furnace	32.0	212.0
13	Sample Box	32.0	211.7
14	Impinger Out	32.2	211.7
15	C. Gas Box	32.4	211.9
16	C. Gas Out	32.1	211.8
17	SO2 Out	32.0	212.0
18	Upper Ambient	32.1	211.9
19			
20			
21			
22			
23	Calibrator	32.1	211.9
24	Oven	32.0	211.5

Thermocouple Readout Semi-Annual Calibration Data Sheet

Date: 4-13-01
Ambient Temperature: 70
Technician: ckp

Thermocouple Number: T/C Readout
Barometric Pressure: 30.17
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	ϕ
212	Boiling Water	212.0	211.9	.047
250	Omega	250.0	250.2	-.080
300	Omega	300.0	299.9	.033
400	Omega	400.0	401.0	-.250
500	Omega	500.0	500.8	-.160
600	Omega	600.0	599.8	.033
700	Omega	700.0	700.0	ϕ
800	Omega	800.0	799.9	.013
900	Omega	900.0	900.6	-.067
1000	Omega	1000.0	1000.7	-.070
1200	Omega	1200.0	1198.8	.017
1400	Omega	1400.0	1399.6	.029
1600	Omega	1600.0	1598.8	.013
1800	Omega	1800.0	1800.0	ϕ
2000	Omega	2000.0	2000.0	ϕ

[a] Every 50°F for each reference point
[b] Type of Calibration System Used
[c] $\frac{\text{(reference temperature) - (thermocouple temperature)}}{\text{reference temperature}} * 100$

TRACEABILITY DOCUMENTATION Semi-Annual

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

DATE: 4-13-01

SO^2 INJECTION ROTAMETER

FISHER SN 9123454

NIST Traceable

Actual	°C = °F	°F
0.0	32.0	32.0
18.8	65.8	65.6
45.6	114.1	114.0
65.0	149.0	149.1

DRY GAS METER THERMOCOUPLES

Actual	°C = °F	5H in	5H out	KK
Ø	32.0	32.2	32.2	32.2
20.2	68.4	68.4	68.3	68.1
43.0	109.4	109.6	109.6	109.4
61.6	142.9	142.5	142.6	142.8

SLING PSYCHROMETER

Actual	°C = °F	Wet Bulb	Dry Bulb
Ø	32.0	32.0	32.0
20.3	68.5	68.6	68.6
25.7	78.3	78.2	78.4
33.3	91.9	92.0	91.8

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 F 100 DATE: 10-11-01

TEST DATA

RUN #	1	2	3	4	5	6	7	8	9	10
AVG. ΔH	.162	.154	.154	.138						
MAX VAC	3.0	2.0	2.0	2.0						

Avg. Test Series ΔH: .152 in H_2O Test Series Max Vac: 3.0 in Hg

Audit Dry Gas Meter: K2 Correction (Y) Factor: 1.014 (mcf)

Test Dry Gas Meter: H Correction (Y) Factor: 1.021 (mcf)

AUDIT DATA

		Audit # 1	Audit #2	Audit #3
BP		30.22	30.22	30.27
VAC		3.0	3.0	3.0
AUDIT METER:				
VOL.	Final	633.155	638.344	643.643
(Vw)	Initial	624.000	633.155	638.344
	Vol.	9.155	5.189	5.299
TEMP (°F)	Initial	76	82	84
(Tw)	Mid	79	83	84
	Final	82	84	84
(°F / °A)	Avg.	539	543	544
ΔH	Initial	.154	.154	.154
	Mid	.154	.154	.154
	Final	.154	.154	.154
	Avg.	.154	.154	.154
DRY GAS METER:				
VOL.	Final	953.800	959.100	964.500
(Vd)	Initial	944.500	953.800	959.106
	Vol.	9.300	5.300	5.394
TEMP (°F)	Initial	75	76	76
(Tm)	Mid	76	76	76
	Final	76	76	76
(°F / °A)	Avg.	536	536	536

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

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

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

RUN 1

$$Y = \frac{(9.155)(1.014)(30.22)(536)}{(9.300)\left(30.22 + \frac{.154}{13.6}\right)(539)} = \frac{150368.05}{151540.56} = .992$$

$$\Delta\% = \frac{(.992 - 1.001)}{1.001} \times 100 = -.899\ \%$$

RUN 2

$$Y = \frac{(5.189)(1.014)(30.22)(536)}{(5.300)\left(30.22 + \frac{.154}{13.6}\right)(543)} = \frac{85227.72}{87002.73} = .980$$

$$\Delta\% = \frac{(.980 - 1.001)}{1.001} \times 100 = -2.098\ \%$$

RUN 3

$$Y = \frac{(5.299)(1.014)(30.22)(536)}{(5.394)\left(30.22 + \frac{.154}{13.6}\right)(544)} = \frac{87034.44}{88708.86} = .981$$

$$\Delta\% = \frac{(.981 - 1.001)}{1.001} \times 100 = -1.998\ \%$$

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

INTERPOLATED Y FACTOR

$\frac{.1}{(A)}$ inch H_2O ΔH = $\frac{1.017}{(C)}$ Calculated calibration Y factor from calibrations

$\frac{.2}{(B)}$ inch H_2O ΔH = $\frac{1.014}{(D)}$ Calculated calibration Y factor from calibrations

$\frac{.2}{(B)} - \frac{.1}{(A)} = .1 \times 100 = \frac{10}{(E)}$

$\frac{1.014}{(D)} - \frac{1.017}{(C)} = -.003 \div \frac{10}{(E)} = \frac{-.0003}{(F)}$

$\frac{.154}{\text{Avg}\Delta H} \div \frac{.1}{(A)} = .054 \times 100 = \frac{5.4}{(G)}$

$\left[\frac{-.0003}{(F)} \times \frac{5.4}{(G)}\right] + \frac{1.017}{(C)} = \frac{1.001}{\text{Interpolated Y factor}}$

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

DRY GAS METER CALIBRATION

DATE: 4-13-2001 DRY GAS METER: H BOX: 5

BAROMETRIC PRESSURE 30.14 in. Hg.				Wet Test Meter Correction Factor Y= 1.014			
Orifice Manometer Setting, ΔH, in. H_2O		.1	.2	.3	.5	.75	1.0
Gas Volume Wet Test Meter Vw ft^3	Final	500.120	510.305	520.505	530.715	540.947	551.186
	Initial	490.000	500.120	510.305	520.505	530.715	540.947
	Vw ft^3	10.120	10.185	10.200	10.210	10.232	10.239
Gas Volume Dry Test Meter Vd ft^3	Final	665.000	675.000	685.000	695.000	705.000	715.000
	Initial	655.000	665.000	675.000	685.000	695.000	705.000
	Vw ft^3	10.000	10.000	10.000	10.000	10.000	10.000
Wet Test Meter Temperature tw	Initial	82	92	92	92	92	92
	Middle	87	92	92	92	92	92
	Final	92	92	92	92	92	92
	Average	87 547	92 552	92 552	552	552	552
Dry Test Meter Temperature tm	Initial	83	81	83	84	86	87
	Middle	82	82	84	85	87	88
	Final	81	83	84	86	87	88
	Average	82 542	82 542	84 544	545	547	548
$Y = \frac{(W_{mcf})(Vw)(Pb)(tm)}{Vd\left(Pb + \frac{\Delta H}{13.6}\right)(tw)}$		1.017	1.014	1.019	1.021	1.026	1.028

Average Y= 1.021

METER BOX CALIBRATION

Date : 04/15/00
Calibrated By : J.C.
Dry Gas Meterbox ID : K2

Barometric Pressure, Pb = 27.58 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		60.102	65.245	70.410	75.588	80.760	85.920
M Initial		55.000	60.102	65.245	70.410	75.588	80.760
Vd, cu. ft.		5.102	5.143	5.165	5.178	5.172	5.160
Wet Test Meter							
tw Deg F		68	69	70	71	71	71
tw Deg A		528	529	530	531	531	531
Dry Gas Meter Outlet, tmo	1)	74	78	82	85	86	87
	2)	76	81	84	86	87	88
	3)	78	83	85	87	88	89
Dry Gas Meter Inlet tmi	1)	85	96	104	110	108	109
	2)	93	103	108	110	109	110
	3)	96	104	110	112	110	110
Mean tm, Deg F		84	91	96	98	98	99
Mean tm, Deg A		544	551	556	558	558	559
Results :	**Y =**	1.009	1.012	1.014	1.015	1.016	1.019

1.014 ✓

Averages : **Y =** **1.014**

METER BOX CALIBRATION

Date : 04/15/00
Calibrated By : J.C.
Dry Gas Meterbox ID : K2

Barometric Pressure, Pb = 27.58 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		91.015	96.142	101.294	106.464	111.642	116.827
M Initial		85.920	91.015	96.142	101.294	106.464	111.642
Vd, cu. ft.		5.095	5.127	5.152	5.170	5.178	5.185
Wet Test Meter							
tw Deg F		68	69	70	71	71	71
tw Deg A		528	529	530	531	531	531
Dry Gas Meter Outlet, tmo	1)	74	78	82	85	86	87
	2)	76	81	84	86	87	88
	3)	78	83	85	87	88	89
Dry Gas Meter Inlet tmi	1)	85	96	103	107	109	110
	2)	93	103	106	108	110	110
	3)	96	104	108	110	110	111
Mean tm, Deg F		84	91	95	97	98	99
Mean tm, Deg A		544	551	555	557	558	559
Results :	Y =	1.011	1.015	1.015	1.014	1.015	1.015
Averages :	Y =	1.014					

METER BOX CALIBRATION

Date : 04/15/00
Calibrated By : J.C.
Dry Gas Meterbox ID : K2

Barometric Pressure, Pb = 27.58 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		121.915	127.037	132.168	137.308	142.457	147.623
M Initial		116.827	121.915	127.037	132.168	137.308	142.457
Vd, cu. ft.		5.088	5.122	5.131	5.140	5.149	5.166
Wet Test Meter							
tw Deg F		68	69	70	71	71	71
tw Deg A		528	529	530	531	531	531
Dry Gas Meter Outlet, tmo	1)	74	78	82	85	86	87
	2)	76	81	84	86	87	88
	3)	78	83	85	87	88	89
Dry Gas Meter Inlet tmi	1)	85	94	98	101	104	106
	2)	93	97	100	102	105	107
	3)	95	99	102	104	107	109
Mean tm, Deg F		84	89	92	94	96	98
Mean tm, Deg A		544	549	552	554	556	558
Results :	**Y =**	1.012	1.012	1.014	1.014	1.016	1.016
Averages :	**Y =**	1.014					

METER BOX CALIBRATION

Date : 04/15/00
Calibrated By : J.C.
Dry Gas Meterbox ID : K2

Barometric Pressure, Pb = 27.58 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		152.697	157.796	162.918	168.059	173.219	178.395
M Initial		147.623	152.697	157.796	162.918	168.059	173.219
Vd, cu. ft.		5.074	5.099	5.122	5.141	5.160	5.176
Wet Test Meter							
tw Deg F		68	69	70	71	71	71
tw Deg A		528	529	530	531	531	531
Dry Gas Meter Outlet, tmo	1)	74	78	82	85	86	87
	2)	76	81	84	86	87	88
	3)	78	83	85	87	88	89
Dry Gas Meter Inlet tmi	1)	85	90	94	99	103	106
	2)	88	92	96	102	105	107
	3)	91	94	99	104	107	109
Mean tm, Deg F		82	86	90	94	96	98
Mean tm, Deg A		542	546	550	554	556	558
Results :	Y =	1.010	1.011	1.012	1.013	1.013	1.013

Averages : Y = **1.012**

METER BOX CALIBRATION

Date : 04/15/00
Calibrated By : J.C.
Dry Gas Meterbox ID : K2

Barometric Pressure, Pb = 27.58 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		214.168	219.271	224.397	229.537	234.686	239.847
M Initial		209.099	214.168	219.271	224.397	229.537	234.686
Vd, cu. ft.		5.069	5.103	5.126	5.140	5.149	5.161
Wet Test Meter							
tw Deg F		68	69	70	71	71	71
tw Deg A		528	529	530	531	531	531
Dry Gas Meter Outlet, tmo	1)	74	78	82	85	86	87
	2)	76	81	84	86	87	88
	3)	78	83	85	87	88	89
Dry Gas Meter Inlet tmi	1)	85	96	100	103	106	108
	2)	93	98	102	105	107	109
	3)	96	101	104	106	108	109
Mean tm, Deg F		84	90	93	95	97	98
Mean tm, Deg A		544	550	553	555	557	558
Results :	**Y =**	1.014	1.015	1.015	1.015	1.016	1.016
Averages :	**Y =**	**1.015**					

Valid 4/1/ 4-16-2000

Wet Test Meter Serial Number AA455 Date 4/16/99

Range of Wet Test Meter Flow Rate 0 - 0.25

Volume of Test Flask Va= 37.850 liters

Satisfactory Leak Check? YES

Ambient Temperature of Equilibrate Liquid in Wet Test Meter and Reservoir 69 deg. F

Test Number	Manometer Reading, a mm H20	Final Volume (Vf), l	Initial Volume (Vi), l	Total Volume (Vm),b l	Flask Volume (Va), l	Percent Error, c %
1	0	3.0 (12 revs)	0*	3.0	3.012	0.408
2	0	3.0 (12 revs)	0*	3.0	3.008	0.288
3	0	3.0 (12 revs)	0*	3.0	3.014	0.478

*Reset for each test

a - Must be less than 10 mm H20 (0.4 "H20)

Calculations:

b - Vm - Vf - Vi

c - % error = 100(Vm - Va)/Va = $\frac{(100)(3.012-3.000)}{3.000}$ (±1%) = 0.40%

WET TEST METER CALIBRATION LOG

WET TEST METER CALIBRATION LOG

SO_2 ROTAMETER CALIBRATION

Last Cal. : 10-9-2000 By : CW Date : 4-13-2001 By : CW

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

Barometric Pressure : 30.13 " Hg Temperature : 67

RUN #	50 CC/MINUTE DIGICAL VOLUME	100 CC/MINUTE DIGICAL VOLUME	150 CC/MINUTE DIGICAL VOLUME
1	55.6	128.7	185.5
2	55.1	129.0	185.9
3	55.5	128.7	186.0
4	55.7	128.8	185.8
5	55.5	128.9	186.1
6	54.9	128.3	186.0
7	55.7	128.8	185.7
8	55.2	129.0	186.0
9	55.8	129.0	185.9
10	55.6	128.8	185.8
AVERAGE	55.5 cc/min	128.8 cc/min	185.9 cc/min

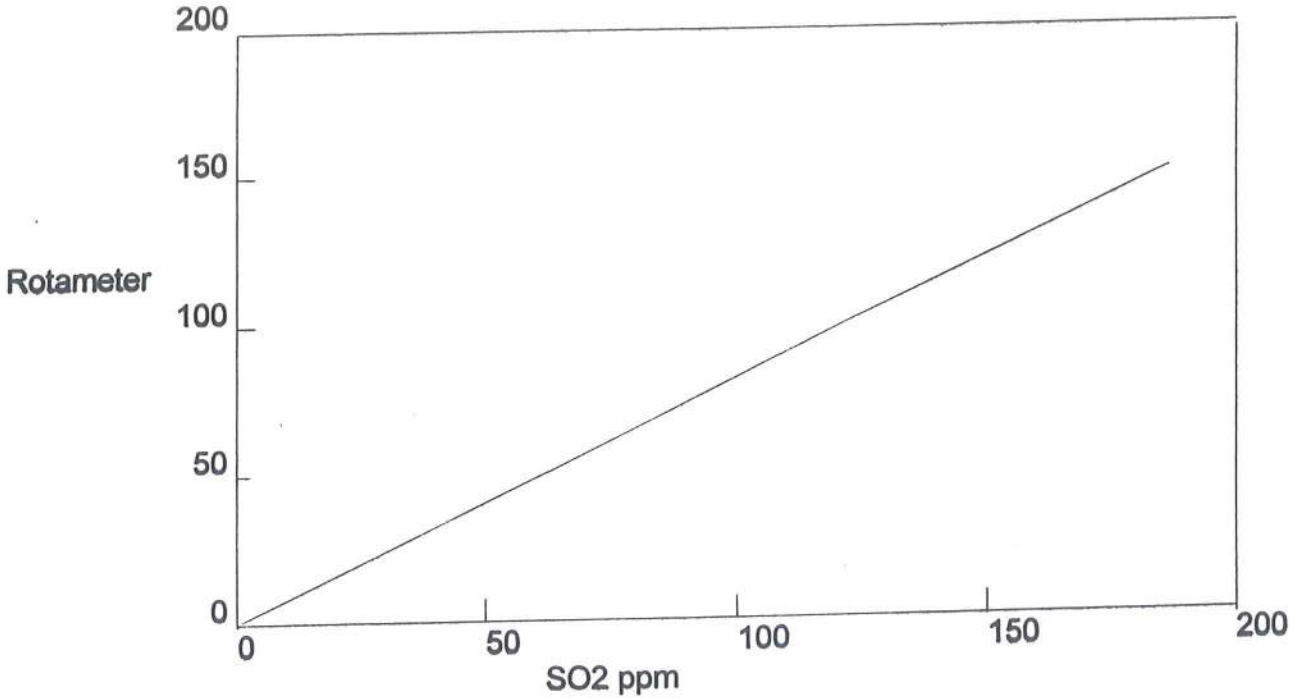
SETTING	cc/min
0	
50	55.5
100	128.8
150	185.9

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

100 CC / MINUTE = 80.89

SO2 Rotameter

04/~~15~~/01
13



Regression Output:

Constant	-2.1
Std Err of Y Est	5.4055527007
R Squared	0.997073096
No. of Observations	4
Degrees of Freedom	2
X Coefficient(s)	1.262
Std Err of Coef.	0.0483487332

TRACER GAS TRAIN RESPONSE TIME

DATE: 4-13-2001

Elapsed Time	SO_2 Conc. (v.)	SO_2 Conc. (v.)	SO_2 Conc. (v.)
00 sec	.504	.505	.505
15	.366	.350	.372
30	.157	.170	.166
45	.069	.072	.070
60	.038	.037	.040
75	.021	.021	.019
90	.011	.013	.013
105	.007	.007	.006
120	.004	.003	.004
135	.001	.000	.000
150	.000		
165			
180			
Initial Response	14	13	14
95 % Response	70	70	69
Flow Rate	1.5	1.5	1.5

1025

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	.512	.512	.512	.508	.508	.508	.475	.475	.475
15	.468	.470	.465	.596	.590	.601	.201	.195	.200
30	.255	.260	.260	.730	.732	.730	.040	.042	.038
45	.130	.135	.130	.808	.810	.805	.011	.013	.017
60	.045	.045	.043	.820	.822	.822	.004	.005	.004
75	.021	.025	.022	.828	.829	.828	.001	.002	.001
90	.011	.014	.014	.830	.831	.831	.000	.000	.000
105	.007	.008	.008	.832	.832	.832			
120	.004	.005	.005						
135	.002	.003	.002						
150	.001	.001	.001						
165	.000	.000	.000						
180									
Initial Response	11	12	10	12	12	12	10	10	10
95 % Response	70	74	73	55	55	55	35	35	35
Flow Rate	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5

1026

ORSAT ANALYSIS DATA SHEET

DATE : 4-13-2001

Gas	1	2	3	AVE	CONC	TANK ID
CO_2	0	0	0	Ø	N_2	038TAC 1-A
O_2	0	0	0	Ø	N_2	
CO	0	0	0	Ø	N_2	
CO_2	12.4	12.4	12.4	12.40	12.44	CC85322
O_2	12.4	12.4	12.5	12.43	12.45	
CO	5.0	5.0	5.0	5.0	4.98	
CO_2	21.2	21.3	21.2	21.23	21.23	CC55904
O_2	21.1	21.1	21.1	21.10	21.10	
CO	8.60	8.60	8.6	8.60	8.60	
CO_2	6.2	6.3	6.3	6.27	6.25	AAL 21084
O_2	6.3	6.2	6.2	6.23	6.24	
CO	2.0	2.0	2.0	2.0	2.01	
CO_2						
O_2						
CO						

F100

CO_2 ANALYZER
MULTIPOINT CALIBRATION REPORT FORM

Date: 10-2-01

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

Calibration by: C. Wadington

Cal Gas Flow: 1.5 SCFH Measured by: Rotameter

BP: 30.20 Instrument ID: PRINCO

Temp: 70 Instrument ID: TR

Cylinders:

1. # 038TAC 1-A Concentration: 00.00 % CO_2 Cyl. Press.: 1730 PSI
   Certified by: Air Liquide Date: 2-7-01
2. # CC85322 Concentration: 12.44 % CO_2 Cyl. Press.: 1810 PSI
   Certified by: Air Liquide Date: 01-19-01
3. # CC55904 Concentration: 21.23 % CO_2 Cyl. Press.: 1190 PSI
   Certified by: Air Liquide Date: 2-14-2000
4. # AAL 21084 Concentration: 6.25 % CO_2 Cyl. Press.: 910 PSI
   Certified by: Scott Specialty Gases Date: 5-15-97

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	0.00	.000	00.0	-.004	00.0	.000
2	2	12.44	49.8	.498	50.4	.504	49.8	.498
3	3	21.23	84.9	.849	84.7	.847		
4	4	6.25	25.0	.250	25.4	.254		
5	1	0.00	0.00	.000	00.0	.000		

.5 = 12.496

CO_2 Linear Regression Results:

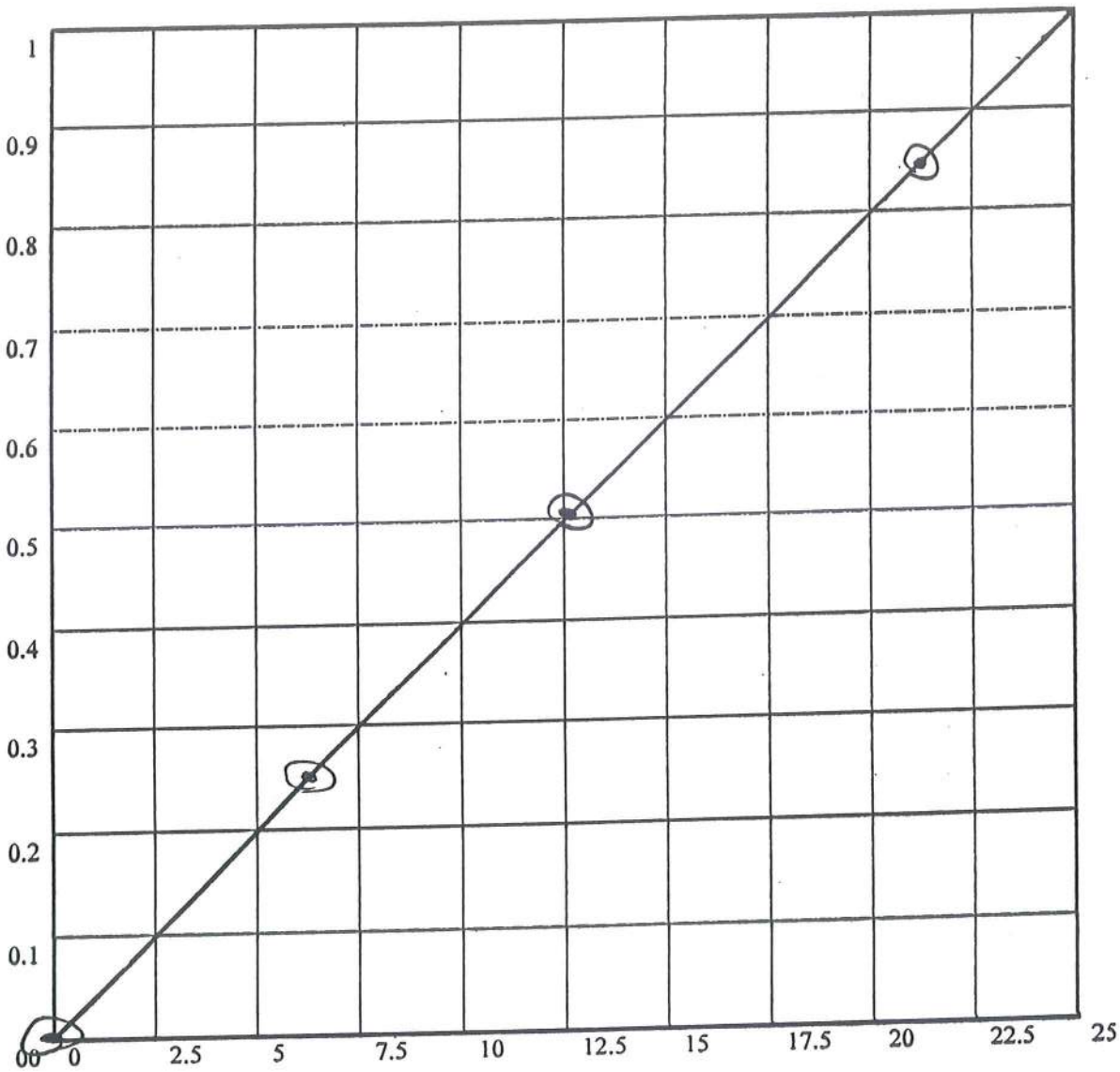
Y = MX +B

Slope (M) = .0021186

Y Intercept (B) = .0398428

Correlation Coefficient (r) = .9999825

r^2 = .9999649

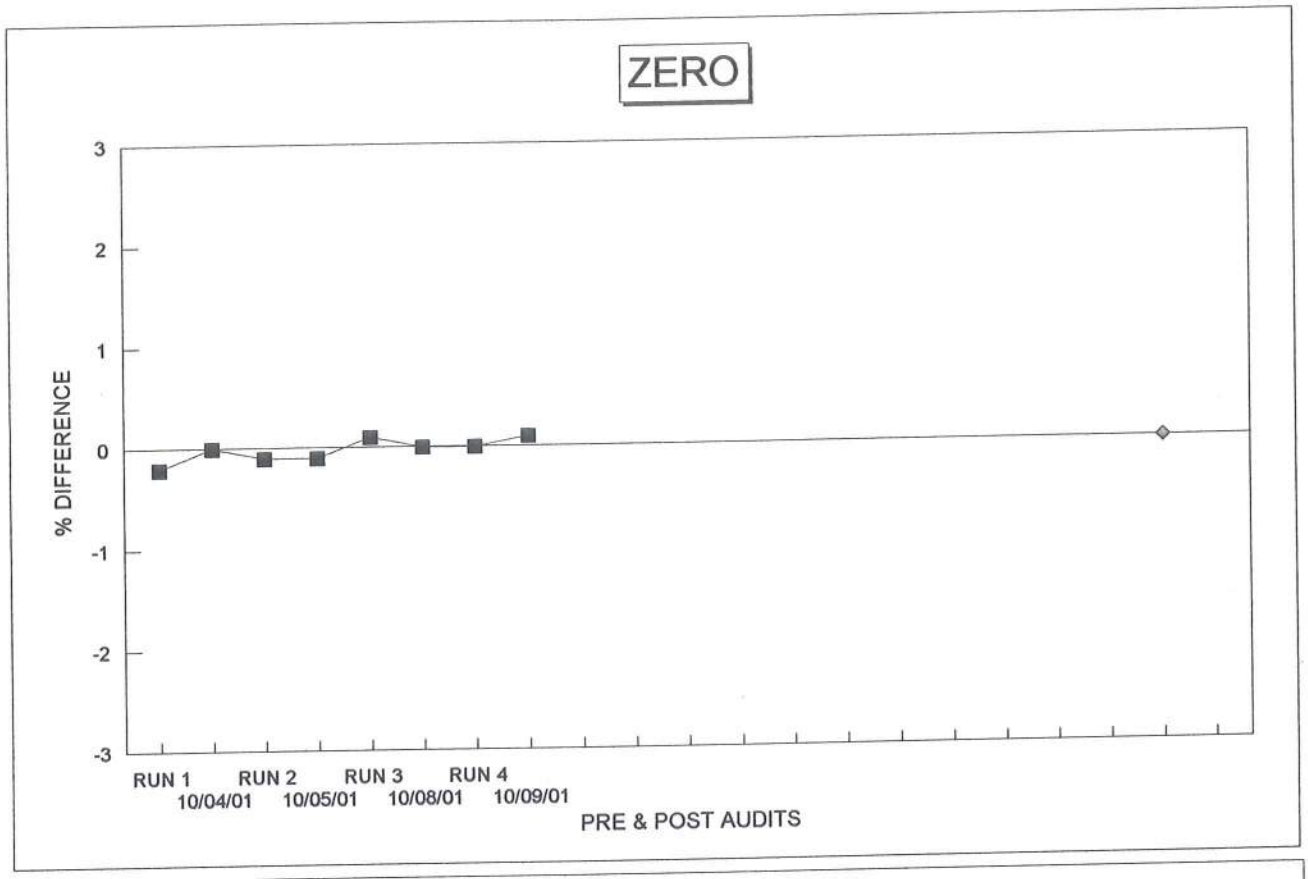


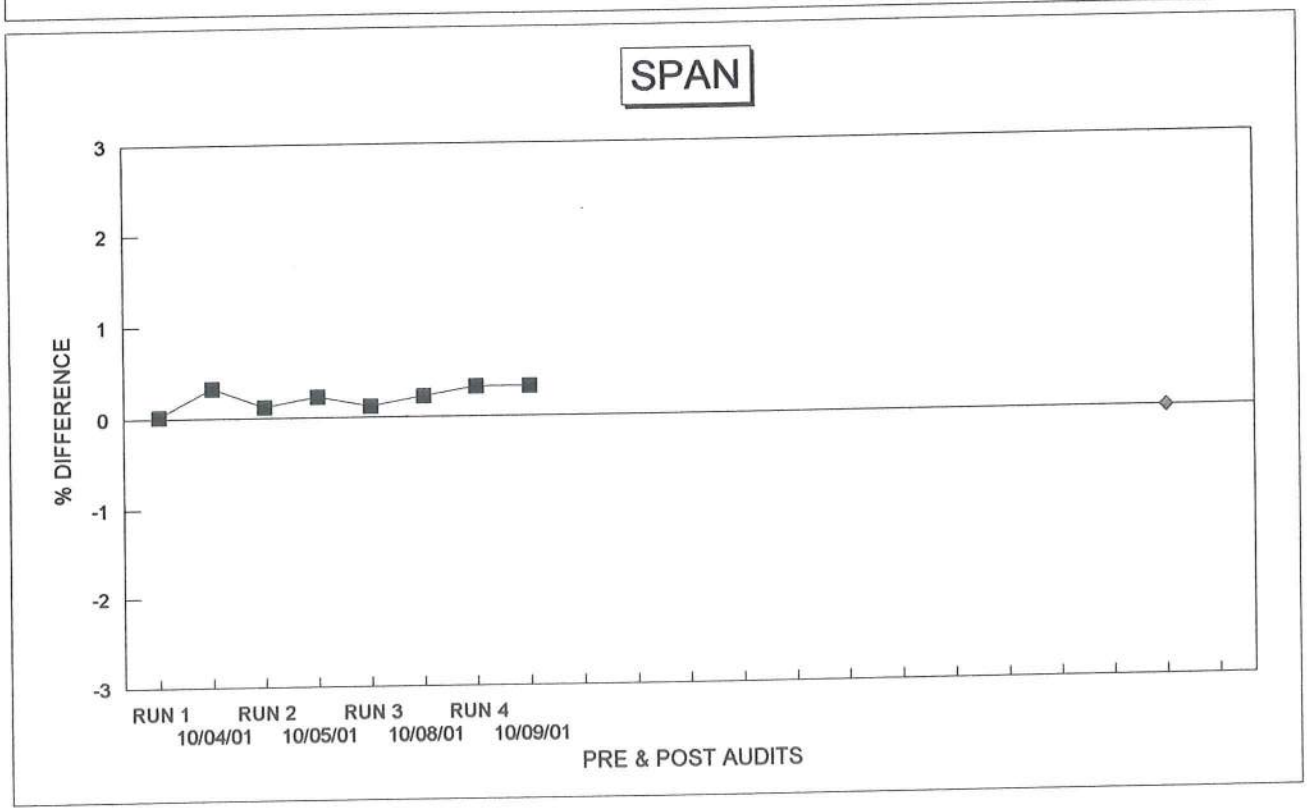
EPA Span Value = ± 2.0% of 25% CO_2 = ± .5%

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

High Volts .847 = 21.158 - 21.23 = -.072 = -.288

Low .234 = 6.345 - 6.25 = .095 = .380


ZERO
3
2
1
0
-1
-2
-3
% DIFFERENCE
RUN 1
10/04/01
RUN 2
10/05/01
RUN 3
10/08/01
RUN 4
10/09/01
PRE & POST AUDITS


SPAN
3
2
1
0
-1
-2
-3
% DIFFERENCE
RUN 1
10/04/01
RUN 2
10/05/01
RUN 3
10/08/01
RUN 4
10/09/01
PRE & POST AUDITS

O_2 ANALYZER
MULTIPOINT CALIBRATION REPORT FORM

Date: 10-2-01

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

Calibration by: C. Wadington

Cal Gas Flow: 1.5 SCFH

Measured by: Rotameter

BP: 30.20

Instrument ID: PRINCO

Temp: 70

Instrument ID: TR

Cylinders:

1. # 038T AC 1-A Concentration: 00.00% O_2 Cyl. Press.: 1730 PSI
   Certified by: Air Liquide Date: 2-7-01
2. # CC BS 322 Concentration: 12.45 % O_2 Cyl. Press.: 1810 PSI
   Certified by: Air Liquide Date: 01-19-01
3. # CC 55904 Concentration: 21.10 % O_2 Cyl. Press.: 1190 PSI
   Certified by: Air Liquide Date: 2-14-2000
4. # AAL 21084 Concentration: 6.24 % O_2 Cyl. Press.: 910 PSI
   Certified by: Scott Specialty Gases Date: 5-15-97

Analyzer: **Calibrated Range:** 0-25.0 % **Output:** 0-1.0 V.
Flow: 1.5 SCFH **Measured by:** Rotameter

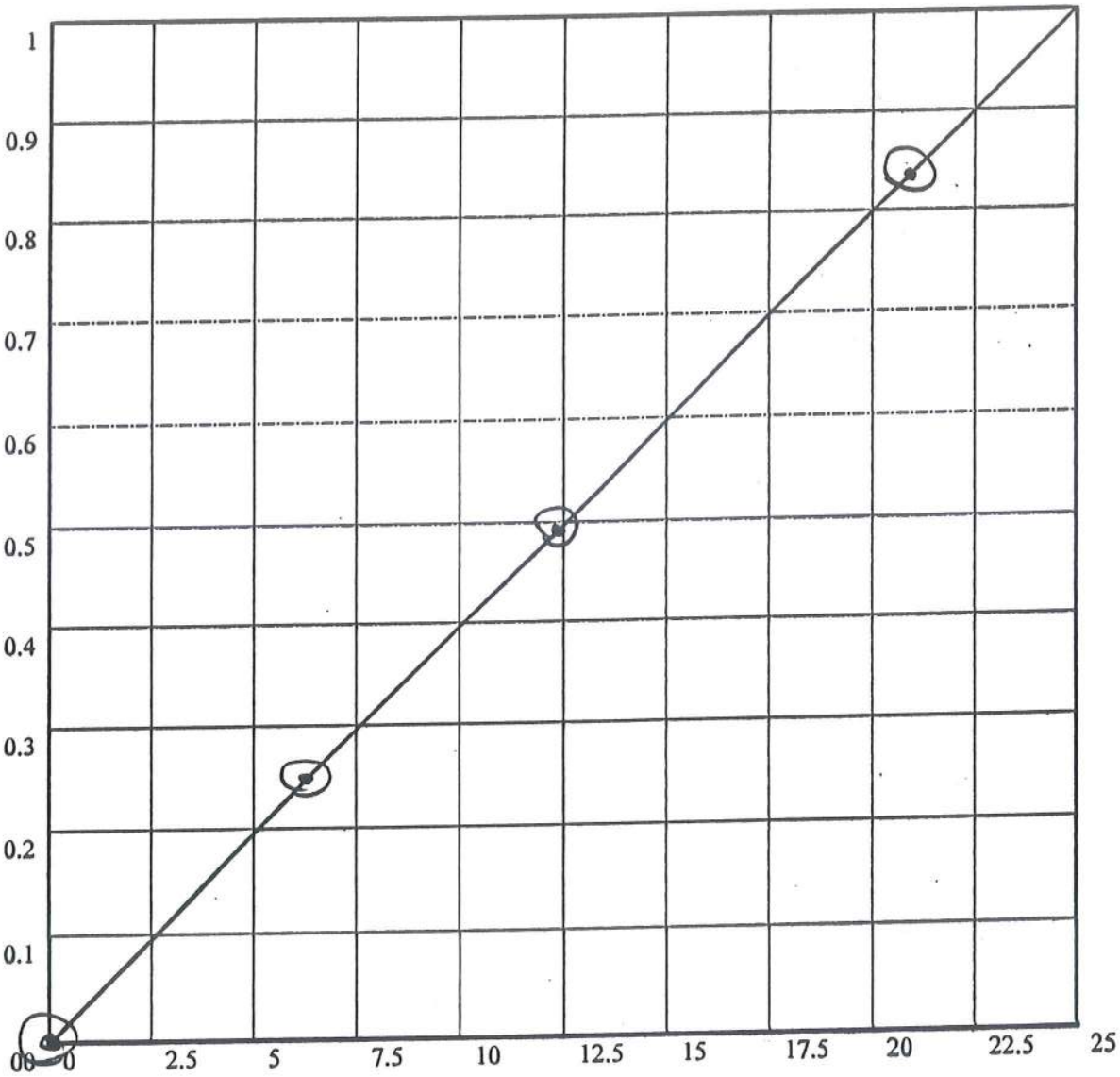
Calibration Results

Point #	CYL. #	% O2	EXPECTED METER	EXPECTED DVM	ACTUAL METER	ACTUAL DVM	ADJ. METER	ADJ. DVM
1	1	0.00	00.0	.000	00.0	-.002	00.0	.000
2	2	12.45	12.45	.498	12.7	.505	12.5	.498
3	3	21.10	21.1	.844	21.0	.839		
4	4	6.24	6.24	.250	6.20	.251		
5	1	0.00	00.0	.000	00.0	.000		

.5 = 12.539

O_2 Linear Regression Results:

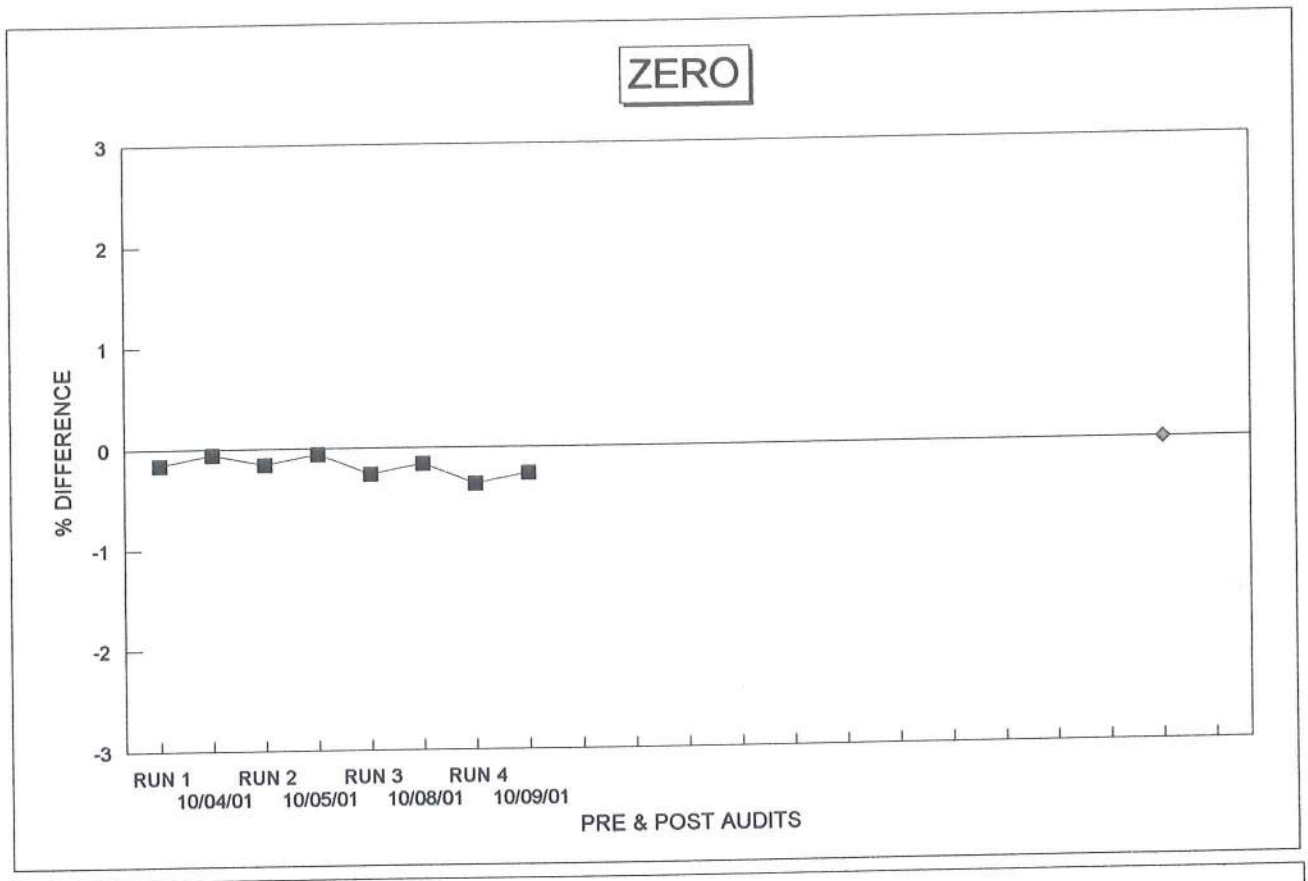
Y = MX +B
Slope (M) = .0015917
Y Intercept (B) = .0397495
Correlation Coefficient (r) = .9999890
r^2 = .9999780

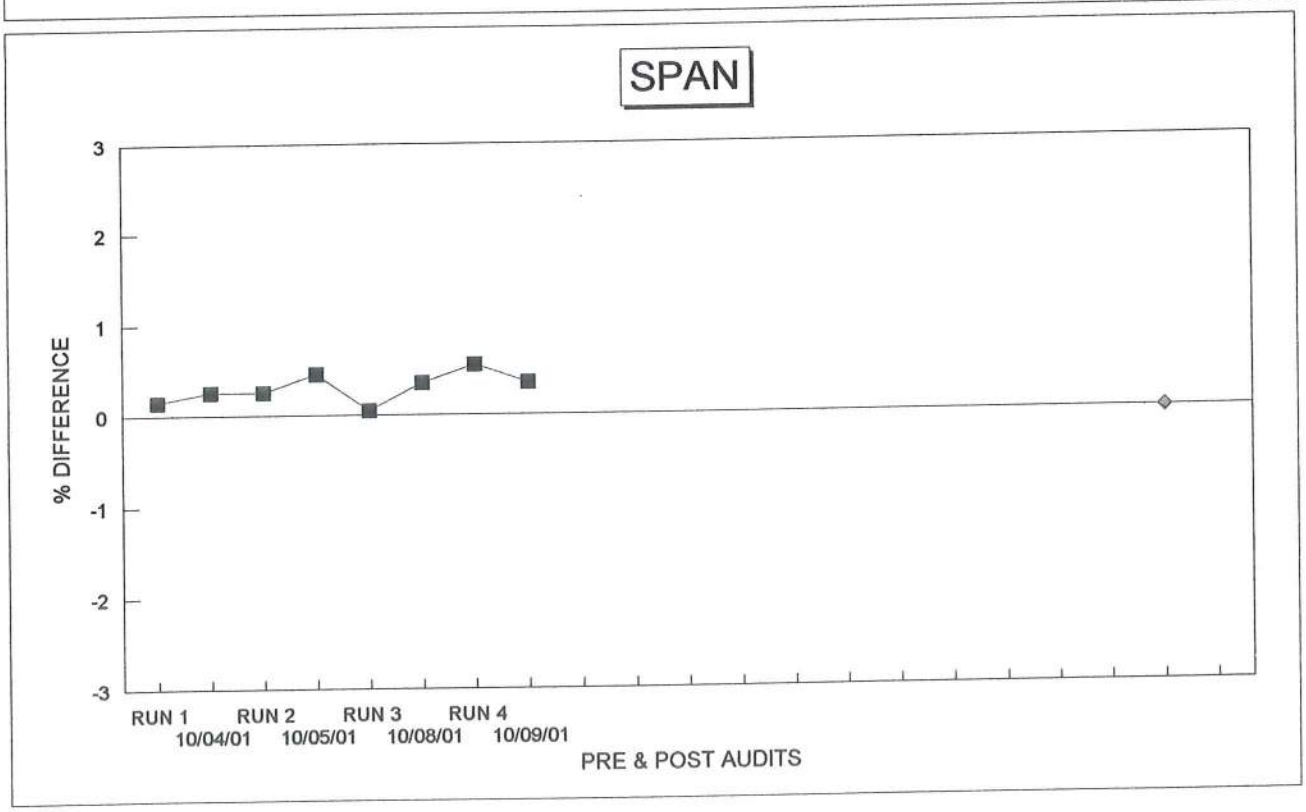


EPA Span Value = ± 2.0% of 25% CO_2 = ± .5%
Cal Volts = Cal Volt Conc - Std Conc = ± Conc Diff = ± Δ %

.839 = 20.975 - 21.100 = -.125 = -.500

.251 = 6.275 - 6.24 = .035 = .140


ZERO
3
2
1
0
-1
-2
-3
% DIFFERENCE
RUN 1
10/04/01
RUN 2
10/05/01
RUN 3
10/08/01
RUN 4
10/09/01
PRE & POST AUDITS


SPAN
3
2
1
0
-1
-2
-3
% DIFFERENCE
RUN 1
10/04/01
RUN 2
10/05/01
RUN 3
10/08/01
RUN 4
10/09/01
PRE & POST AUDITS

CO ANALYZER
MULTIPOINT CALIBRATION REPORT FORM

Date: 10-2-01

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

Calibration by: C. Wadington

Cal Gas Flow: 1.5 SCFH Measured by: Rotameter

BP: 30.20 Instrument ID: PRINCO

Temp: 70 Instrument ID: TR

Cylinders:

1. # 038TAC 1-A Concentration: 00.00 % CO Cyl. Press.: 1730 PSI
   Certified by: Air Liquide Date: 2-7-01
2. # CC85322 Concentration: 4.98 % CO Cyl. Press.: 1810 PSI
   Certified by: Air Liquide Date: _____
3. # CC55904 Concentration: 8.60 % CO Cyl. Press.: 1190 PSI
   Certified by: Air Liquide Date: 2-14-2000
4. # AAL 21084 Concentration: 2.01 % CO Cyl. Press.: 910 PSI
   Certified by: Scott Specialty Gases Date: 5-15-97

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	.000	—	—
2	2	4.98	49.8	.498	49.8	.498	—	—
3	3	8.60	86.0	.860	85.8	.858		
4	4	2.01	20.1	.201	20.1	.201		
5	1	0.00	00.0	.000	00.0	.000		

5 = 5.007

CO Linear Regression Results:

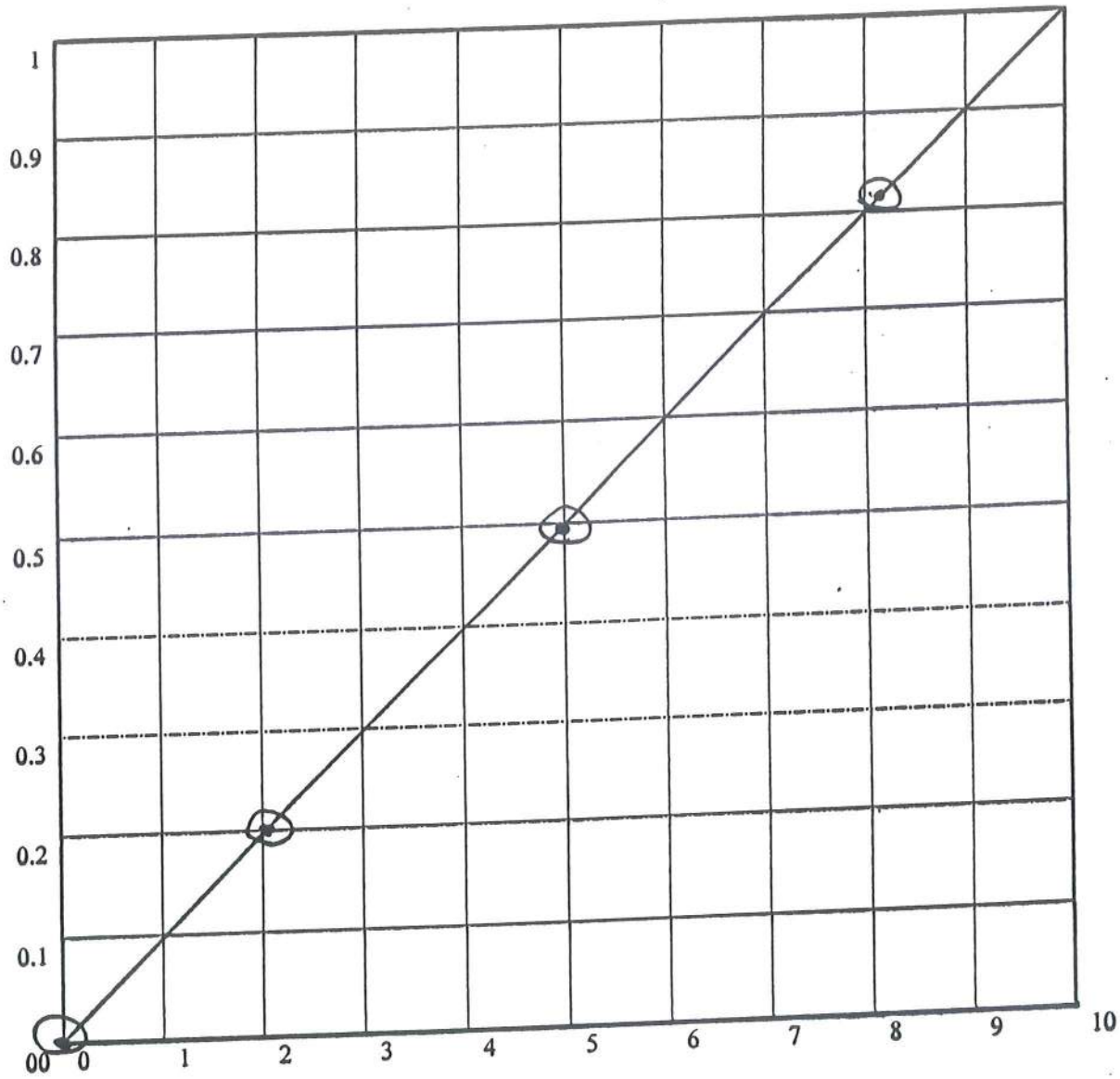
Y = MX +B

Slope (M) = .0003720

Y Intercept (B) = .0997763

Correlation Coefficient (r) = .9999989

r^2 = .9999979

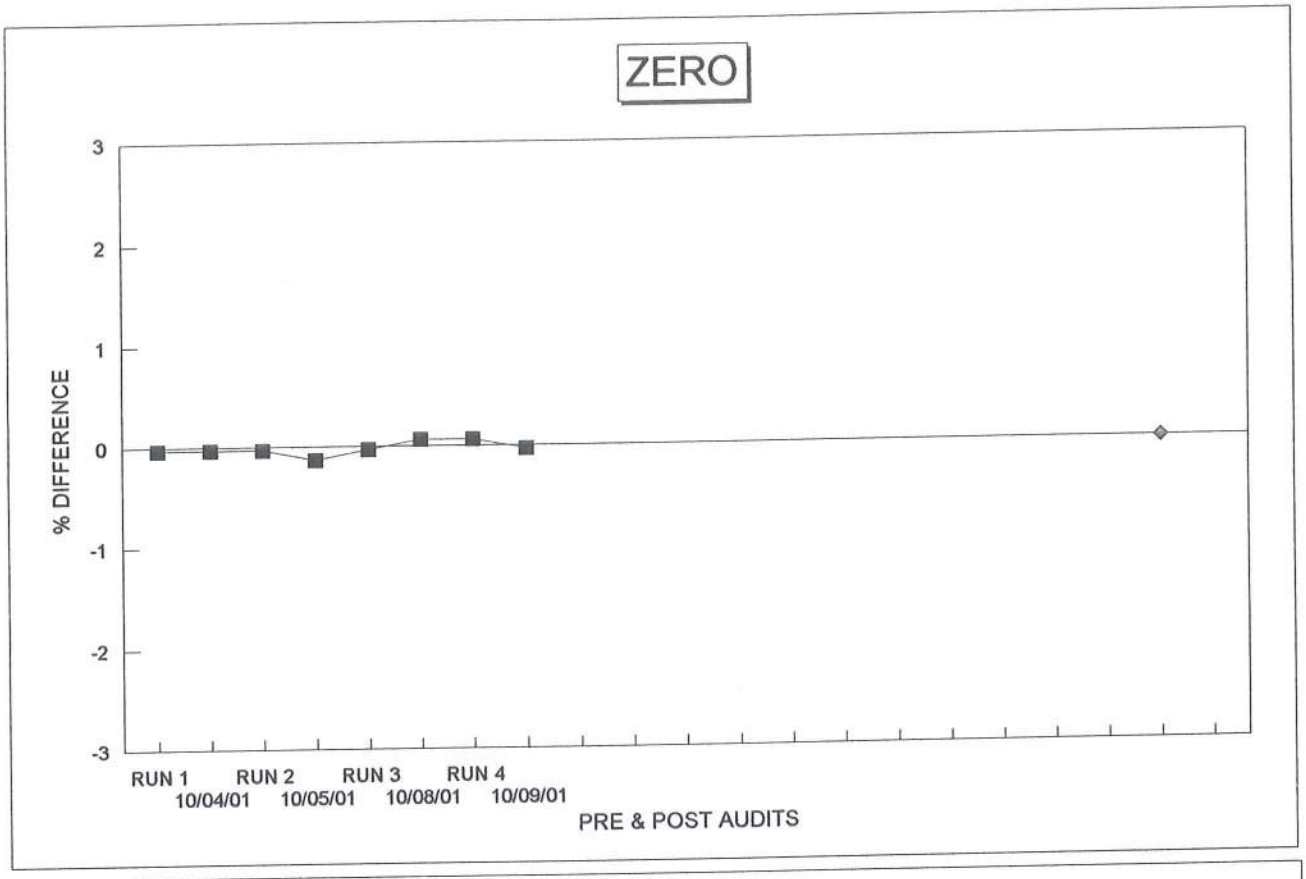


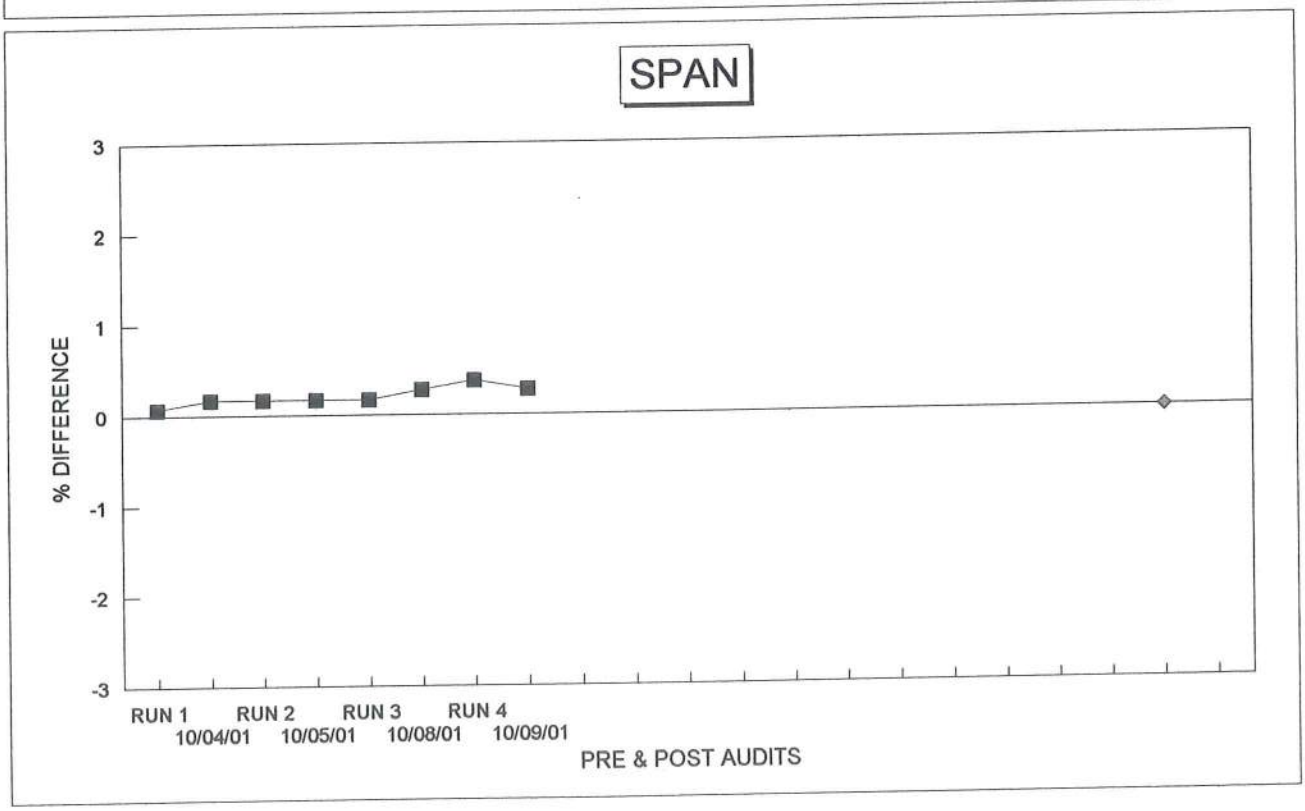
EPA Span Value = ± 2.0% of 10% CO = ± .2%

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

.858 = 8.58 - 8.60 = -.020 = -.200

.201 = 2.01 - 2.01 = Ø = Ø


ZERO
3
2
1
0
-1
-2
-3
% DIFFERENCE
RUN 1
10/04/01
RUN 2
10/05/01
RUN 3
10/08/01
RUN 4
10/09/01
PRE & POST AUDITS


SPAN
3
2
1
0
-1
-2
-3
% DIFFERENCE
RUN 1
10/04/01
RUN 2
10/05/01
RUN 3
10/08/01
RUN 4
10/09/01
PRE & POST AUDITS

SO_2 ANALYZER
MULTIPOINT CALIBRATION REPORT FORM

Date: 10-2-01

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

Calibration by: C. Wadington

Cal Gas Flow: 1.5 SCFH Measured by: Rotameter

BP: 30.20 Instrument ID: PRINCO

Temp: 70 Instrument ID: TR

Cylinders:

1. # 038TAC I-A Concentration: 00.00 % SO_2 Cyl. Press.: 1730 PSI
   Certified by: Air Liquide Date: 2-7-01
2. # CC62184 Concentration: 1290 % SO_2 Cyl. Press.: 1800 PSI
   Certified by: Air Liquide Date: 1-29-01
3. # ALMO 49127 Concentration: 1770 % SO_2 Cyl. Press.: 1020 PSI
   Certified by: Scott Specialty Gases Date: 5-1597
4. # ALMO 52285 Concentration: 506 % SO_2 Cyl. Press.: 880 PSI
   Certified by: Scott Specialty Gases Date: 5-1597

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	-.002	00.0	.000
2	2	1290	51.6	.516	52.6	.526	51.6	.516
3	3	1770	70.8	.708	70.8	.708		
4	4	506	20.2	.202	19.9	.199		
5	1	0.00	00.0	.000	00.0	.000		

.5 = 1251.486

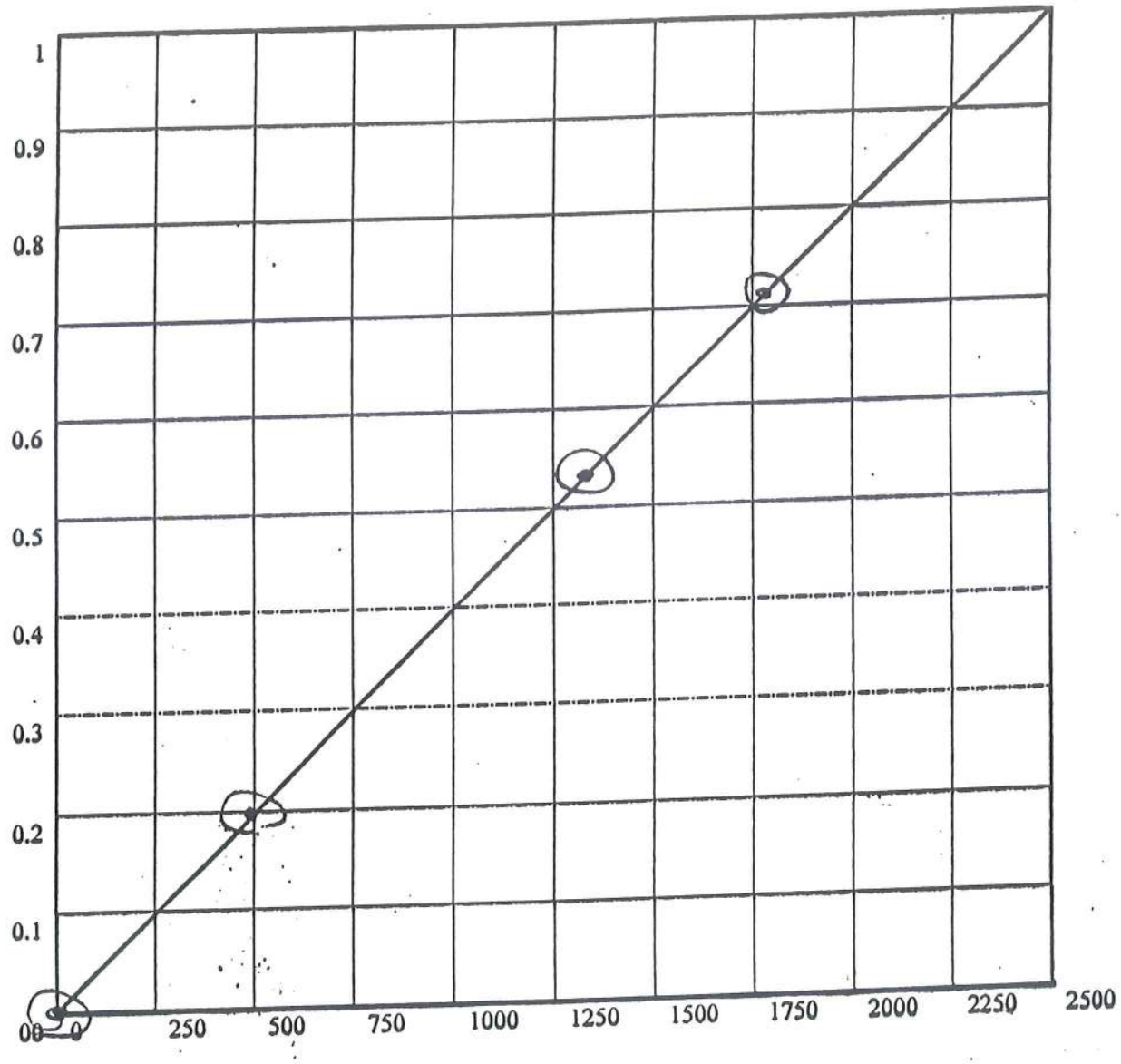
SO_2 Linear Regression Results:

Y = MX +B
Slope (M) = -.0014735

Y Intercept (B) = .0004007

Correlation Coefficient (r) = .9999871

r^2 = .9999747

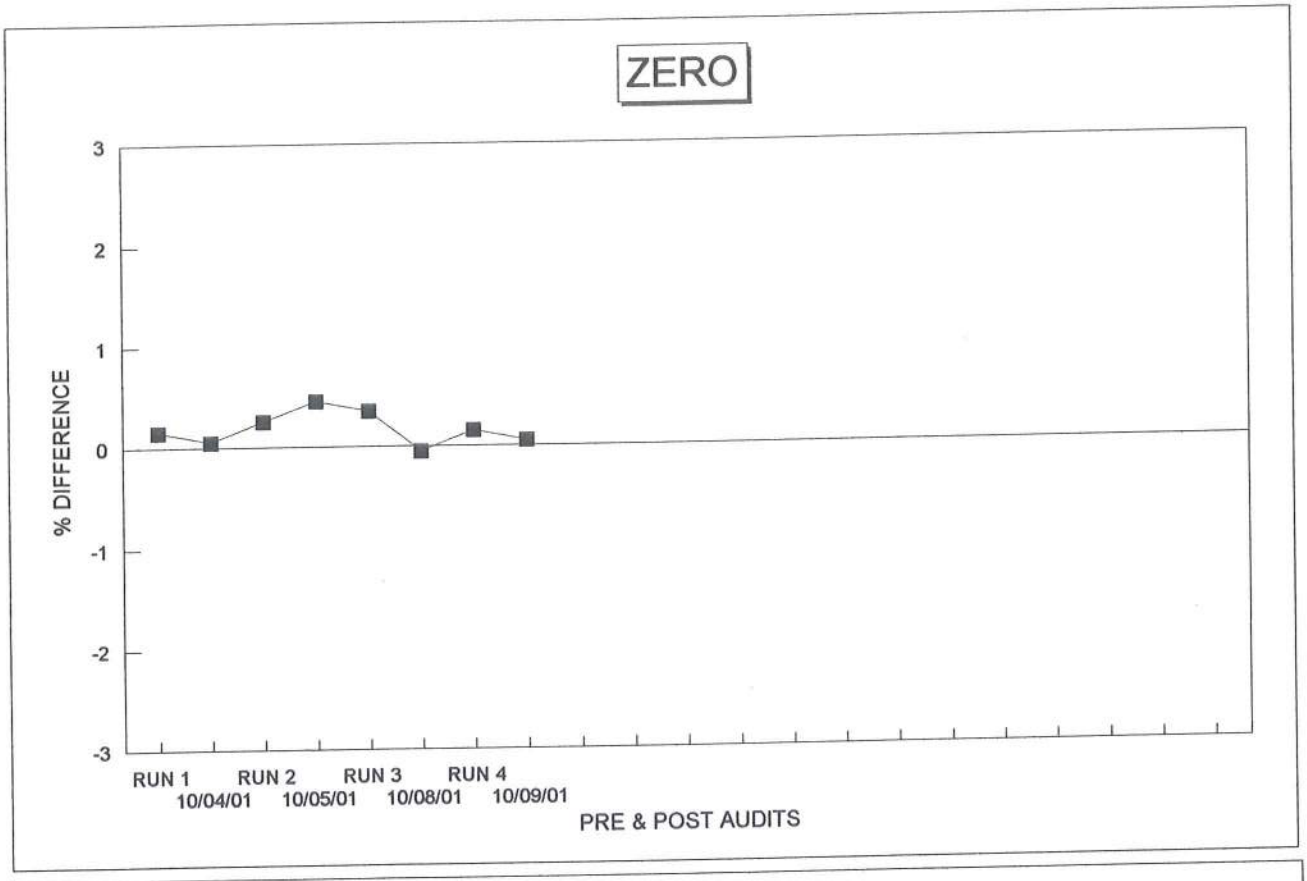


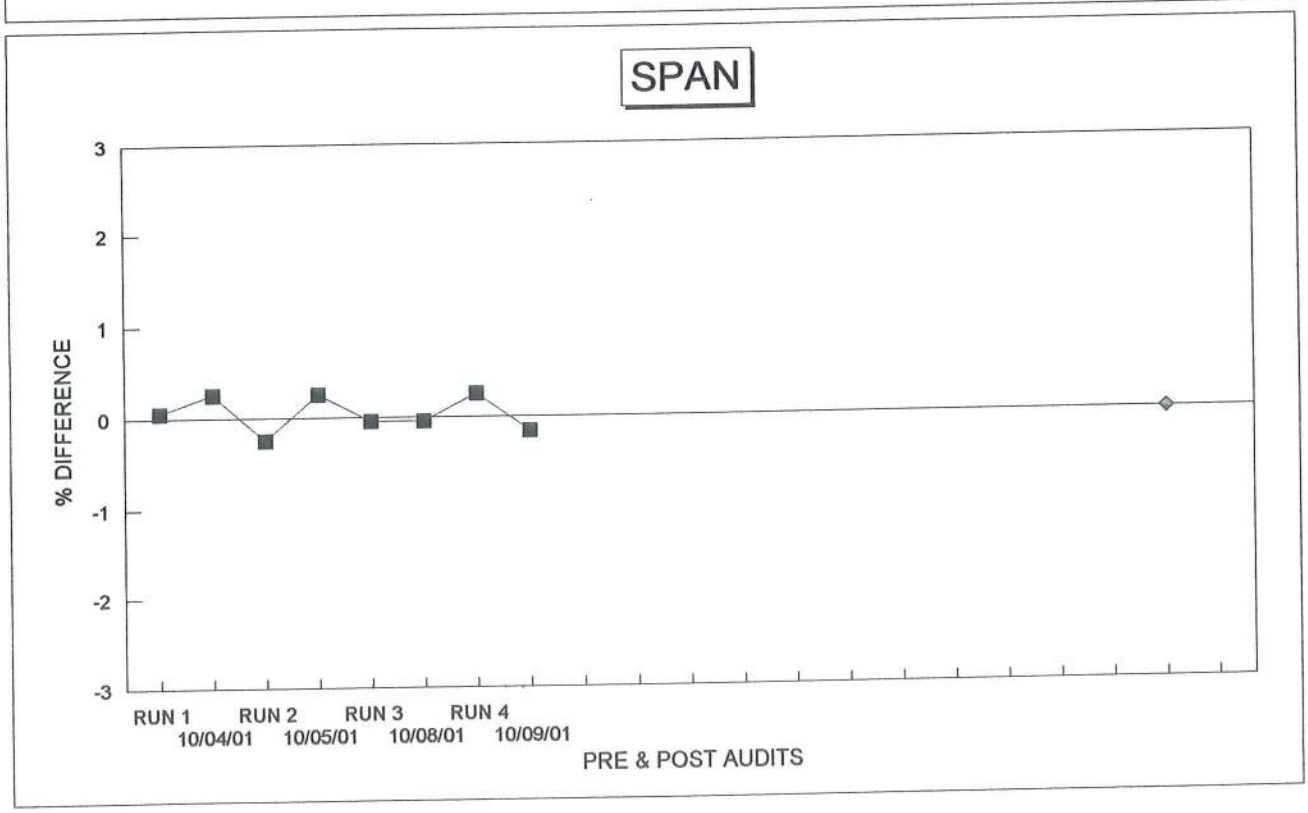
EPA Span Value = ± 2.0% of 2500 PPM SO2 = ± 50 PPM

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

.708 = 1770 - 1770 = ϕ = ϕ

.199 497.5 - 500.0 = -8.500 = -.340


ZERO
3
2
1
0
-1
-2
-3
% DIFFERENCE
RUN 1
10/04/01
RUN 2
10/05/01
RUN 3
10/08/01
RUN 4
10/09/01
PRE & POST AUDITS


SPAN
3
2
1
0
-1
-2
-3
% DIFFERENCE
RUN 1
10/04/01
RUN 2
10/05/01
RUN 3
10/08/01
RUN 4
10/09/01
PRE & POST AUDITS

Scott Specialty Gases

Shipped From: 500 WEAVER PARK RD
LONGMONT CO 80501
Phone: 303-442-4700 Fax: 303-772-7673

CERTIFICATE OF ANALYSIS

ENERGY & ENV MEASUREMENT

C/O ED WADINGTON
3730 N. PELLEGRINO DR.
TUCSON AZ 85749

PROJECT #: 08-34135-005
PO#: VERBAL
ITEM #: 08024520 4AL
DATE: 4/24/97

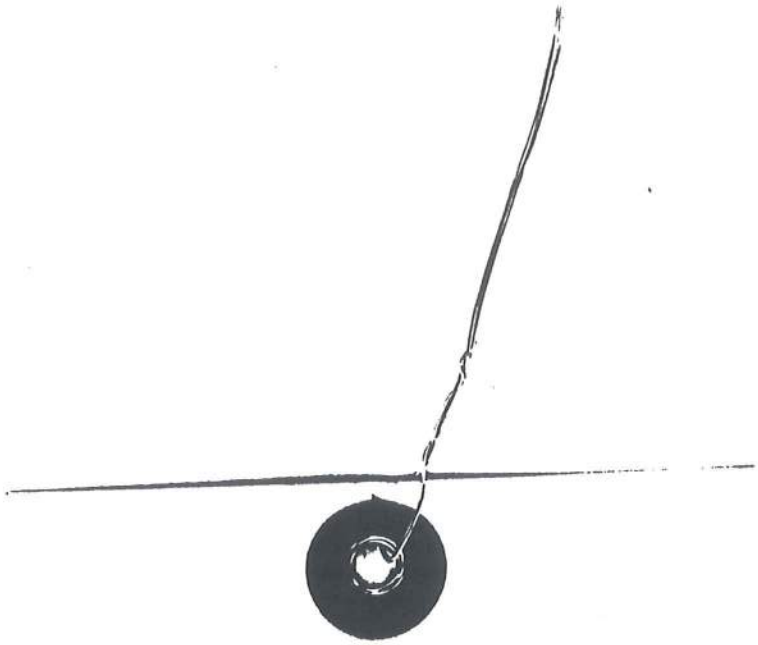
CYLINDER #: AAL21084
FILL PRESSURE: 2015 PSIA
BLEND TYPE : CERTIFIED MASTER GAS

ANALYTICAL ACCURACY: +/-2%
PRODUCT EXPIRATION: 4/24/2000

COMPONENT	REQUESTED GAS CONC MOLES	ANALYSIS (MOLES)
CARBON DIOXIDE	6.25 %	6.25 %
CARBON MONOXIDE	2. %	2.01 %
OXYGEN	6.25 %	6.24 %
NITROGEN	BALANCE	BALANCE

CGA 590 2015 PSIA

ANALYST: Diana Beehler
DIANA BEEHLER



AIR LIQUIDE

GASES FOR RESEARCH AND DEVELOPMENT

CYL # CC55904 CGA 590

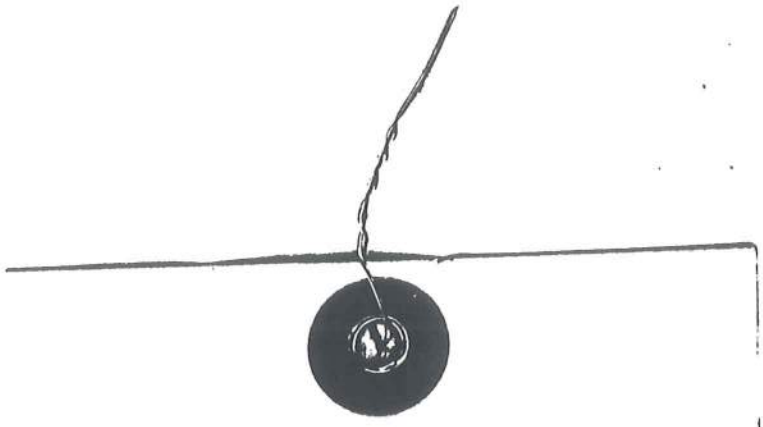
PRES 1650 VOL 150 cf

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



AIR LIQUIDE

GASES FOR RESEARCH AND DEVELOPMENT

CYL # CC85322 CGA 590

PRES 1650 VOL 150 CF

TEST # 01901 DATE 01-19-01

Analytical Method GC / PARAMAGNETIC

	Requested	Analyzed
Hydrogen		
Nitrogen	Bal.	Bal.
Argon		
Air		
Carbon Monoxide	5%	4.98%
Methane		
Oxygen	12.5%	12.45%
Helium		
Carbon Dioxide	12.5%	12.44%

SIGNED

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)

First Triad Analysis

SULFUR DIOXIDE *

Date: 04/14/97	Response Unit: PPM	
Z1 = 0.3947	R1 = 487.72	T1 = 505.77
R2 = 488.79	Z2 = 1.8201	T2 = 505.99
Z3 = 1.8435	T3 = 505.76	R3 = 488.99
Avg. Concentration:	505.8	PPM

Second Triad Analysis

Date: 04/21/97	Response Unit: PPM	
Z1 = 0.3241	R1 = 488.29	T1 = 506.43
R2 = 488.83	Z2 = 1.8096	T2 = 505.75
Z3 = 0.8340	T3 = 505.74	R3 = 488.69
Avg. Concentration:	505.8	PPM

Calibration Curve

Concentration = A + B x + C x² + D x³ + E x⁴
r = 0.999999
Constants: A = 0.000000 B = 1.000000 C = 0.000000 D = 0.000000 E = 0.000000

Special Notes:

ANALYST: Devon VonFeldt
Devon VonFeldt

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

*Mixture is valid only to 150 psig

COMPONENT Name	REQUESTED Concentration	ASSAY Concentration
Sulfur Dioxide	1260 ppm	1290 ± 20 ppm
Nitrogen	Balance	Balance

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

GAS ANALYZER EMPLOYED — Sulfur Dioxide

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
04/13/01

Vm(std)	1.500			
mcf	1.021		dscf=	1.515
Hg	30.10			
DH	0.12			
temp	77	537	ppm =	508
ml BA ++	179			
Normality	0.0101		Run1	500
			Run 2	508
			Run3	505
Tank I.D. #	ALMO52285		avg.	504

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/6220/AAB9400251	03/20/97	Scott Enhanced FTIR

ANALYZER READINGS

(Z = Zero Gas R = Reference Gas T = Test Gas r = Correlation Coefficient)

SULFUR DIOXIDE *

First Tried 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 Tried Analysis

Date: 04/21/97	Response Unit: PPM	
Z1 = 0.4020	R1 = 3126.8	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 + B x + C x2 + D x3 + E x4	
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
04/13/01

Vm(std)	1.500			
mcf	1.021		dscf=	1.518
Hg	30.10			
DH	0.12			
temp	76	536	ppm =	1775
ml BA ++	627			
Normality	0.0101			
			Run1	1766
			Run 2	1771
			Run3	1775
Tank I.D. #	ALMO49127		avg.	1771

Certificate of Analysis

ANALYTICAL CONTROL LABORATORY ANALYSIS

ACETONE - OPTIMA

Catalog No.: A-929

Lot No.: 972630

January 13, 1997

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:

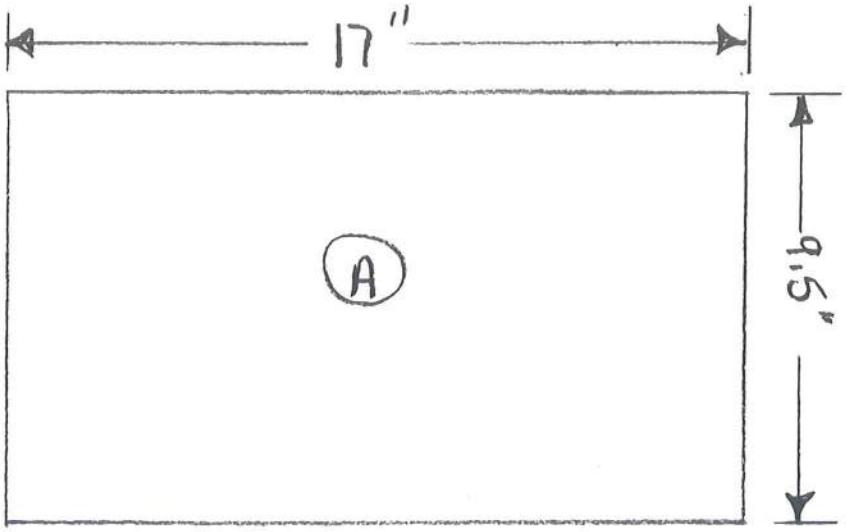
TESTS	ACTUAL ANALYSIS
Aldehyde	0.0005%
Assay	99.6%
Color	5 APHA
Density (g/mL) at 25°C	0.7851
Description	Clear, Colorless Liquid
Fluorescence Background (as Quinine Sulfate)	Not More Than 1 PPB
Identification	Pass Test
Isopropyl Alcohol	0.01%
Methanol	0.03%
Optical Absorbance at 350nm	0.001
at 340nm	0.05
at 330nm	0.69
Pesticide Residue Analysis (as Heptachlor Epoxide)	Not More Than 10 ng/L
Refractive Index at 25°C	1.3560
Residue after Evaporation	0.3 PPM
Solubility in Water	Pass Test
Substances Reducing Permanganate	Pass Test
Titratable Acid	0.0003 Meq/g.
Titratable Base	0.0001 Meq/g.
Water (H_2O)	0.4%

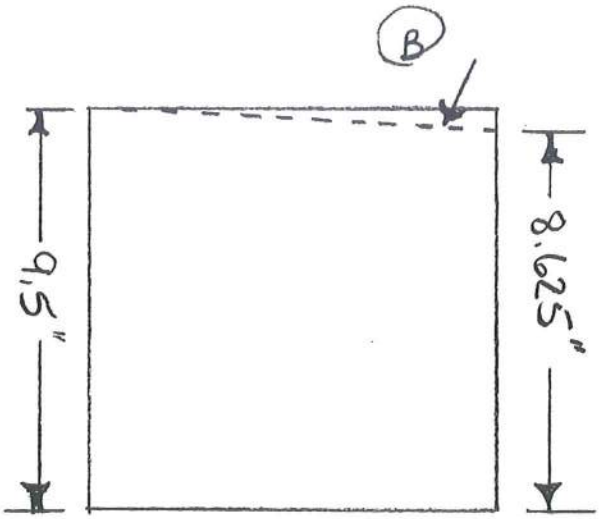
Approved By: Robert Dowd

Robert Dowd
Q.C. Laboratory Manager

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

Firebox calculations and fuel load calculations for Jotul F100





$A = 17 \times 9.5 \times 9.5 = 1534.250$

$-B = .5(17 \times 9.5 \times .875") = -70.656$

$1463.594\ in^3$

$.847\ ft^3$

Fuel load

ideal

5.4 — 5.929 — 6.5

JØTUL®
JØTUL NORTH AMERICA

JØTUL U.S.A., INC.
P.O. Box 1167
Portland, Maine 04104
Tel: (207) 797-5912
Fax: (207) 772-0523
Email: jotul@ime.net

September 21, 2001

Mr. Chip Wadington
Lokee Testing Labs
13235 Prairie Circle East
Sumner, WA. 98390-7250

Dear Mr. Wadington,

Jotul is providing the following air control operational information to assist you in achieving tests in the applicable burn rate categories.

The setting information is based on a measurement taken from the left side of the air inlet to the left side of the air control handle.

Burn Rate

Low: The control is open 1.75" from the fully closed position.

Med: The control is open 2" from the fully closed position.

Med High: Adjust to above 2" open.

High: Air control in full open position.

The suggested air control settings are based on our laboratory experience. You may have to make adjustments to these settings in order to obtain burn rates in the necessary categories.

Sincerely,

Roger W Purinton

Roger W. Purinton
Project Engineer

APPENDIX
A

EXAMPLE CALIBRATION/DATA FLOW

All individual test run raw data sheets are organized in a manner that would allow a data reviewer to follow the data as it is being calculated in a step by step fashion. In many cases, the equations used to calculate a specific required data are given on the raw data sheets themselves.

For example, the particulate emission rate in g/dscf is calculated on Data Sheet #7. However, the data used to derive this data begins on Data Sheet #2 (Meterbox Data Sheet) where the meter volume (cubic feet), average meter temperature (°F), average ΔH (in. H_2O), and average Barometric pressure (in. Hg) are recorded and averaged. Each of the averages for these parameters are used in equation 1 on P. 7 where the volume (MCF) is converted to dscf.

The moisture catch total (g. H_2O) on the Particulate Catch/Moisture Data sheet (p. 3) is transferred to P. 7 and the percent stack moisture is calculated in equations 2 and 3.

The gross and net gravimetric (g) particulate catches are determined and calculated on PP. 3-6. Pages 4-1, 4-2 and 4-3 show the initial (tare) constant weights for filters (p. 4-1) and beakers (p. 4-2) and the final constant weights (p. 4-3) for those filters and beakers used for each run. Final and tare weight data is transferred to P. 3 and the gross gravimetric (g) catch for each filter and beaker is calculated. On P. 5 the gravimetric catch for each blank is calculated. The gross gravimetric catch for each filter and beaker is transferred to P. 6 and the net gravimetric catch (g) is calculated, as well as front half and back half catch totals. The net gravimetric catch (g) is transferred to P. 7 and the grain loading/dscf is calculated in equation 4.

Some data sheet specific information is listed below on a page by page basis.

P. 8 The % ambient moisture is determined by interpolating from psychrometric charts which are contained in the State of Oregon Department of Environmental Quality's "Standard Method for Measuring the Emissions and Efficiencies of Woodstoves".

The % relative humidity is determined from the wet bulb/dry bulb temperature readings using the tables found in Section 3.1.2.4 of the State of Montana Air Quality Bureau's Quality Assurance Manual.

P. 10 The uncorrected moisture meter readings are corrected for pin insulation and may or may not be corrected for ambient (wood) temperatures. All corrections are based upon the correction equations or tables supplied by the moisture meter manufacturer. (These are standard, known corrections.)

P. 11 The moisture meter readings are corrected as discussed above.

P. 12 The gas concentrations shown for each gas monitored (CO_2, O_2, CO and SO_2) are determined by converting the analyzer's voltage output recorded on P. 12 to the concentration shown using the analyzer's current calibration curve. The SO_2 concentration is determined using the manufacturer's calibration curve and the current calibration curve.

The cal. W/B (calculated wet bulb) temperature is obtained by first determining the % moisture in the extracted flue gas stream using the temperature data from thermocouples 1 (Wet Bulb) and 2 (Dry Bulb). Then based upon the stack temperature (thermocouple 3) and the % moisture in the extracted gas stream, a calculated wet bulb temperature is determined. All data is derived from the psychrometric tables found in the State of Oregon's "Standard Method for Measuring the Emissions and Efficiencies of Woodstoves".

The following pages contain the equations used to generate the data on Tables 3-5 on the computer printouts:

Dry Gas Volume (standard):

$$V_{m(std)} = \frac{V_m * 17.65 * mcf * \left(P_{bar} + \frac{\Delta H}{13.6} \right)}{T_m}$$

Volume of Water:

$$V_{w(std)} = (0.04707)(ml\ H_2O)$$

Moisture Content:

$$B_{ws} = \left(\frac{V_w}{V_w + V_{m(std)}} \right) * 100$$

Dry Burn Rate:

$$Br = \left(\frac{Wwt - (Wwt * \%\ H_2O)}{2.2046} \right) * \frac{60}{\theta}$$

Carbon Balance (N_t):

$$Nt = \frac{K_3 Nc}{(YCO_2 + YCO + YHC)}$$

Stack Flow Rate (Q_{sd}):

$$Q_{sd} = K_4 N_t Br$$

Particulate Concentration (C_s):

$$C_s = \frac{M_n}{V_{m(std)}}$$

Particulate Emission Rate (E):

$$E = C_s Q_{sd}$$

Proportional Rate Variation (Pr):

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

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.

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.