

Model: Northstar A
Hearth and Home Technologies (Aladdin Hearth Products)
1445 North Highway
Colville, WA 99114

Certification Test Report

Hearth and Home Technologies (Aladdin
Hearth Products)

Built-In Room Heater
Model: Northstar A

Also for
Constitution

Prepared for: Hearth and Home Technologies (Aladdin Hearth Products)
1445 North Highway
Colville, WA 99114

Prepared by: OMNI-Test Laboratories, Inc.
5465 SW Western Avenue, Suite G
Beaverton, Oregon 97005
(503) 643-3788

Test Period: December 18, 2002 – December 20, 2002

Report Date: January 2003

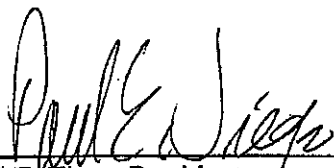
Project Number: 061-S-50-3

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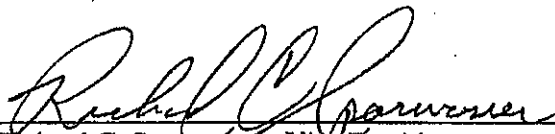
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AUTHORIZED SIGNATORIES

This report has been reviewed and approved by the following authorized signatories.



Paul E. Tiegs, President
OMNI-Test Laboratories, Inc.



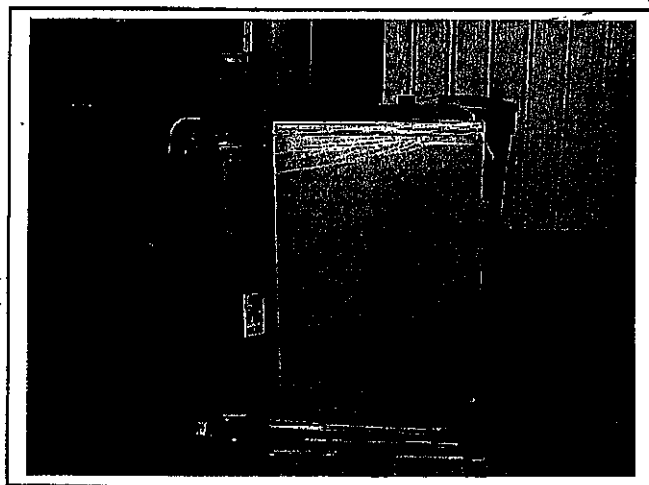
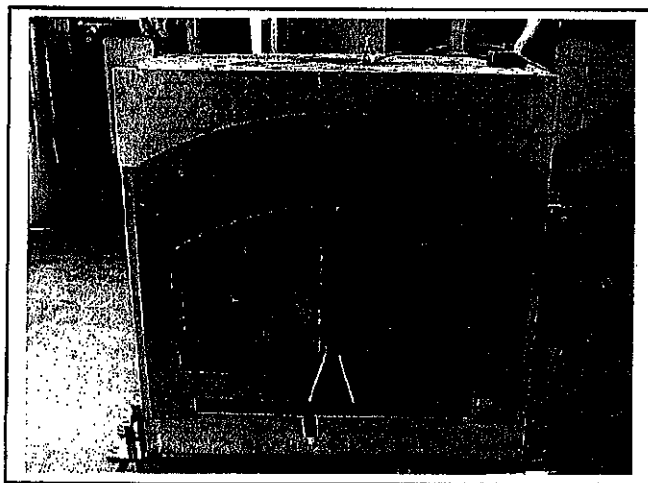
Richard C. Sparwasser, Vice President
OMNI-Test Laboratories, Inc.

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Model: Northstar A

Test Dates: December 18, 2002 – December 20, 2002



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INTRODUCTION

Hearth and Home Technologies (Aladdin Hearth Products) retained OMNI-Test Laboratories, Inc. (O-TL) to perform U.S. Environmental Protection Agency (EPA) certification testing on the model Northstar A. The Northstar A is a non-catalytic, built-in room heater. The firebox is constructed of mild steel. The usable firebox volume was measured to be 2.70 cubic feet. The room heater is vented through an 8" diameter flue collar located at the top of the unit.

The testing was performed at the Hearth and Home Technologies (Aladdin Hearth Products) laboratory in Colville, Washington. The tested unit was in good condition and assigned tracking number OMNI ID #419 on December 18, 2002. O-TL representative, Bruce Davis, conducted the certification testing and completed all testing by December 20, 2002. The EPA was notified of the testing dates in a letter dated December 18, 2002. A testing contract, including provisions for Random Compliance Audit (RCA) testing, has been signed by Daniel S. Henry of Hearth and Home Technologies (Aladdin Hearth Products) and is on file at O-TL.

The Northstar A room heater was tested in accordance with the U.S. EPA 40 CFR Part 60, Subpart AAA – Standard of Performance for Residential Wood Heaters (Appendix A, Methods 28 and 5H). Particulate emissions were measured using a Method 5H sampling train consisting of a heated front filter, an iced impinger train, and a rear filter. The weighted average emissions of the four test runs indicate a particulate emission level of 3.25 grams per hour. Test runs were conducted in each of three burn rate categories (0.80-1.25 kg/hr, 1.25-1.90 kg/hr, and maximum). Emissions for each of their individual test runs did not exceed the cap. The Northstar A results are within the emission limit of 7.5 grams per hour for non-catalytic affected facilities manufactured on or after July 1, 1990, or sold at retail on or after July 1, 1992.

The wood heater was sealed after completion of testing in compliance with the EPA regulation as follows:

- "DO NOT TAMPER" labels were placed on the door and all other openings;
- Plastic material sealed with "DO NOT TAMPER" labels and tape was wrapped around the unit;
- The unit was sealed in a wood box constructed for the unit and secured with steel banding; and
- "DO NOT TAMPER" labels were placed on all outer surfaces of the box.

This report is organized in accordance with the EPA-recommended outline and is summarized in the Table of Contents immediately preceding this report.

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Table 1.1 – Particulate Emissions

Run	Burn Rate (kg/hr dry)	Method 5H Emissions (g/hr)
1	0.94	1.69
2	1.13	1.73
3	4.25	8.12
4	1.34	2.31
Weighted particulate emission average of four test runs: 3.25 grams per hour.		

Table 1.2 – Test Facility Conditions

Run	Room Temperature (°F)		Barometric Pressure (in Hg)		Air Velocity (ft/min)	
	Before	After	Before	After	Before	After
1	74	72	28.46	28.53	<50	<50
2	77	73	28.59	28.45	<50	<50
3	78	82	28.32	28.32	<50	<50
4	68	81	28.32	28.35	<50	<50

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Table 1.3.1 – Fuel Measurement and Crib Description Summary – PRETEST

Run	Pretest Fuel Weight (Starting weight)	Pretest Moisture (Dry basis - %)	Coal Bed Weight (lb)
1	4.5	19.1	4.1
2	4.8	20.4	4.3
3	21.2	22.0	3.6
4	7.0	21.0	4.4

Table 1.3.2 – Fuel Measurement and Crib Description Summary – TEST

Run	Test Fuel Wet Basis (lb)	Firebox Volume (ft ³)	Fuel Loading Density Wet Basis (lb/ft ³)	Fuel Moisture Content Dry (%)	Piece Length (in)	2x4s Used	4x4s Used
1	17.4	2.70	6.44	20.0	20	3	2
2	17.4	2.70	6.44	19.8	20	3	2
3	17.8	2.70	6.59	20.1	20	3	2
4	18.3	2.70	6.78	19.8	20	3	2

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Table 1.4 – Dilution Tunnel Gas Measurements and Sampling Data Summary

Run	Length of Test (min)	Average Dilution Tunnel Gas Measurements		
		Velocity (ft/sec)	Flow Rate (dscf/min)	Temp (°F)
1	420	14.4	145.8	101.42
2	350	15.1	152.0	107.31
3	95	16.3	138.4	205.80
4	310	14.3	139.9	118.09

Table 1.5 - Heater Operation Data (Average Temperature Data)

Run	Beginning Surface Temp Average ^a	Ending Surface Temp Average ^a	Surface Delta T ^b
1	243	140	10
2	247	190	57
3	505	509	5
4	316	233	83
a. All temperatures are in degrees F.			
b. Surface Delta T represents the difference between beginning and ending average surface temperature.			

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Table 1.6 – Pretest Configuration

Run	Combustion Air (in)	Fuel Added	Fuel Removed	Time (min)
1	fully closed	4.5 lbs. at start; no addition; coal bed 4.1 lbs.	N/A	90
2	0.125" open	4.8 lbs. at start; no addition; coal bed 4.3 lbs.	N/A	80
3	fully open	21.2 lbs. at start; no addition; coal bed 3.6 lbs.	N/A	75
4	0.5" open	7.0 lbs. at start; no addition; coal bed 4.4 lbs.	0.6 lbs.	70

Table 1.7 – Run Data

Run	Average Dry Burn Rate (kg/hr)	Initial (Induced) Draft (in H ₂ O)	Primary Air Setting (in)	Run Time (min)	Average Draft (in H ₂ O)
1	0.94	0	fully closed	420	-0.02
2	1.13	0	0.125" open	350	-0.02
3	4.25	0	fully open	95	-0.07
4	1.34	0	0.5" open	310	-0.03

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Table 1.8 – Test Configuration

Run	Five-Minute Startup	Combustion Air
1	<u>Bypass:</u> N/A. <u>Fuel Loading:</u> Loaded by 32 seconds. <u>Door:</u> Closed by 40 seconds. <u>Primary Air:</u> Fully open for 4 minutes 55 seconds, then set to test setting. <u>Other:</u> When the air slide is fully open, it activates a two hour timer that allows additional air into the unit until the timer closes it. The air slide was fully opened for this run. <u>Secondary:</u> Fixed. <u>Tertiary:</u> N/A. <u>Fan:</u> Off for first 30 minutes, then set to high.	fully closed
2	<u>Bypass:</u> N/A. <u>Fuel Loading:</u> Loaded by 30 seconds. <u>Door:</u> Closed by 50 seconds. <u>Primary Air:</u> Fully open for 4 minutes 55 seconds, then set to test setting. <u>Other:</u> Air slide fully opened, which activated the two-hour timer. <u>Secondary:</u> Fixed. <u>Tertiary:</u> N/A. <u>Fan:</u> Off for first 30 minutes, then set to high.	0.125" open
3	<u>Bypass:</u> N/A. <u>Fuel Loading:</u> Loaded by 20 seconds. <u>Door:</u> Closed by 26 seconds. <u>Primary Air:</u> Fully open. <u>Other:</u> Air slide fully opened, which activated the two-hour timer. <u>Secondary:</u> Fixed. <u>Tertiary:</u> N/A. <u>Fan:</u> On high.	fully open
4	<u>Bypass:</u> N/A. <u>Fuel Loading:</u> Loaded by 30 seconds. <u>Door:</u> Closed by 43 seconds. <u>Primary Air:</u> Fully open for 4 minutes 55 seconds, then set to test setting. <u>Other:</u> Air slide fully opened, which activated the two-hour timer. <u>Secondary:</u> Fixed. <u>Tertiary:</u> N/A. <u>Fan:</u> Off for first 30 minutes, then set to high.	0.5" open

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TEST RESULTS AND DISCUSSION

A total of four test runs were conducted in the following categories: two in the 0.80 to 1.25 kg/hr dry category; one in the 1.26 to 1.90 kg/hr dry category; and one at maximum.

During test run number one at 391 minutes, the fuel-loading door was opened to reposition remaining fuel pieces. This was done following three consecutive data points with no fuel weight loss. Less than 15 seconds elapsed between opening and closing the fuel-loading door.

During test run number two at 291 minutes, the fuel-loading door was opened to reposition remaining fuel pieces. This was done following a 10 minute time period with no fuel weight loss. Less than 15 seconds elapsed between opening and closing the fuel-loading door.

The weighted particulate emission level was measured to be 3.25 grams per hour.

The proportionality results for all four test runs were acceptable. Quality check results for each test run are presented Section 2 of this report.

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APPLIANCE DESCRIPTION

Appliance Manufacturer: Hearth and Home Technologies (Aladdin Hearth Products)

Room Heater Model: Northstar A

Type: Built-in room heater

WOOD HEATER DESCRIPTION:

Materials of Construction: The entire unit is constructed of mild steel.

Air Introduction System: Air enters the firebox through an opening located at the front of the appliance above the fuel-loading door. Secondary air enters the appliance through the bottom/back and is channeled internally to both sides of the firebox supplying three 7/8" outer diameter tubes.

Combustion Control Mechanisms: The combustion air inlet is controlled by a handle located above the fuel-loading door in the center of the appliance.

Combustor: NA.

Internal Baffles: A ceramic fiber baffle is mounted in the upper portion of the firebox. The flame path is forced to the front of the firebox where it travels up through the opening between the baffle and primary air manifold.

Other Features: An automatic combustion air control is located below the fuel-loading door. This air is activated when the manual combustion air slide is fully open, which causes a second combustion air orifice to open. Activation of this second air source sets a mechanical timer that holds the air control open until two hours have elapsed. The manual air control can be set to any position during the two hour time period, but acts independently of the timed air source.

Each appliance is produced with an air circulation blower as standard equipment.

Flue Outlet: The 8" diameter flue outlet is located in the top of the unit.

WOOD HEATER OPERATING INSTRUCTIONS

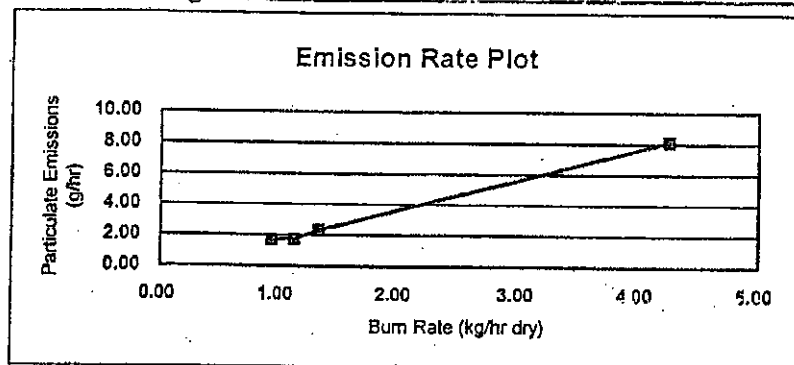
Specific written instructions: See Section 4 of this report. All markings and instruction materials were reviewed for content prior to printing.

EPA Weighted Average Emissions

EPA Method 28

Client: Aladdin Hearth Produ Status: final
 Stove Model: Northstar a Stove Type: Non-Catalytic Stove
 Test Dates: 12/18/02 - 12/20/02
 Project Number: 061-S-50-3
 Tracking Number: 419
 Signature/Date: *B.D. 1-3-03*

Weighted Average (g/hr) 3.25



Run #	1	
Burn Rate (dry kg/hr)	0.94	
Category	2	
Overall Efficiency (%)	63%	
Emissions (g/hr)	1.69	
Cap (g/hr)	15	
Weighting Factor	0.478	28.58%
Heat Output (BTU/hr)	11359	

Run #	2	
Burn Rate (dry kg/hr)	1.13	
Category	2	
Overall Efficiency (%)	63%	
Emissions (g/hr)	1.73	
Cap (g/hr)	15	
Weighting Factor	0.325	19.42%
Heat Output (BTU/hr)	13654	

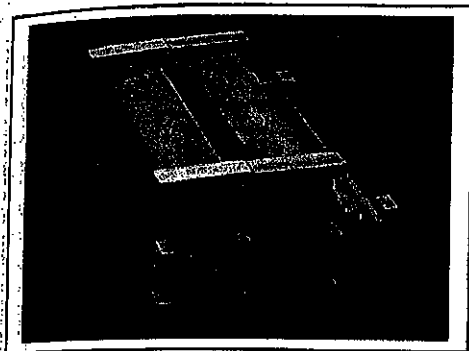
Run #	4	
Burn Rate (dry kg/hr)	1.34	
Category	3	
Overall Efficiency (%)	63%	
Emissions (g/hr)	2.31	
Cap (g/hr)	15	
Weighting Factor	0.517	30.91%
Heat Output (BTU/hr)	16192	

Run #	3	
Burn Rate (dry kg/hr)	4.25	
Category	4	
Overall Efficiency (%)	63%	
Emissions (g/hr)	8.12	
Cap (g/hr)	18	
Weighting Factor	0.353	21.09%
Heat Output (BTU/hr)	51355	

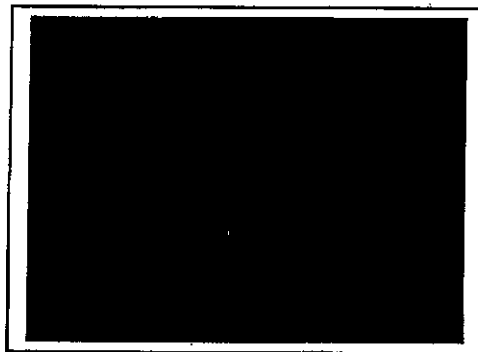
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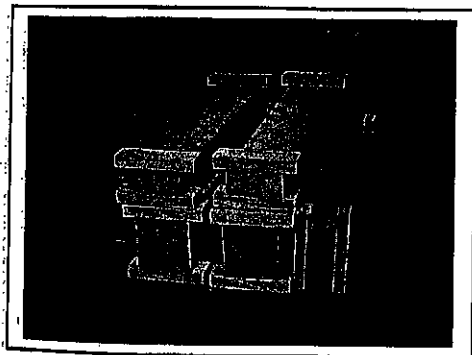
Run 1 - Fuel



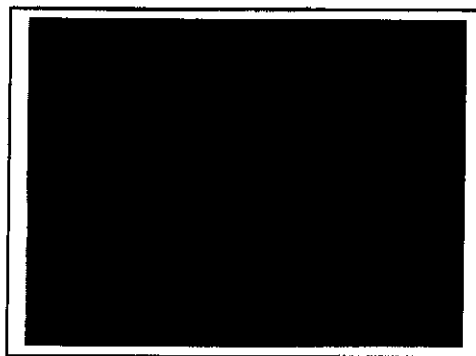
Run 1 - Newly Loaded Room Heater



Run 2 - Fuel



Run 2 - Newly Loaded Room Heater



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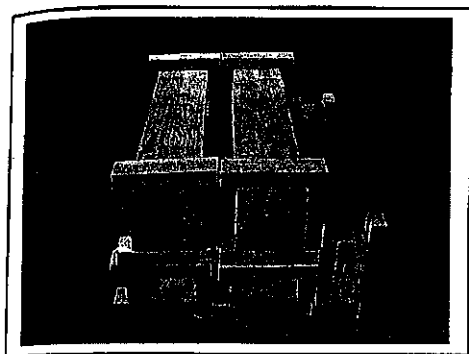
Certification Test Report dated 1/17/03: \\Omni02\users\Testing\Aladdin\061-S-50-3 Aladdin HNG Northstar\061-S-50-3.doc

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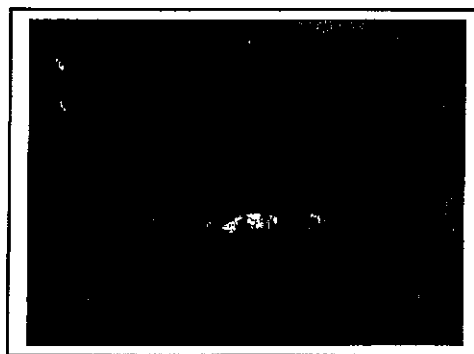
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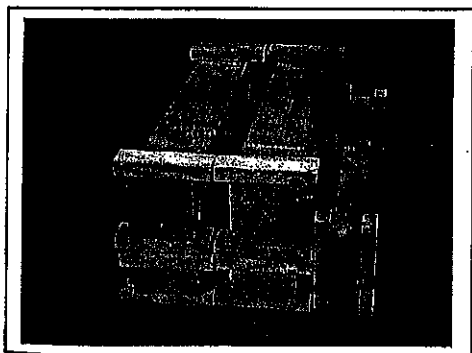
Run 3 - Fuel



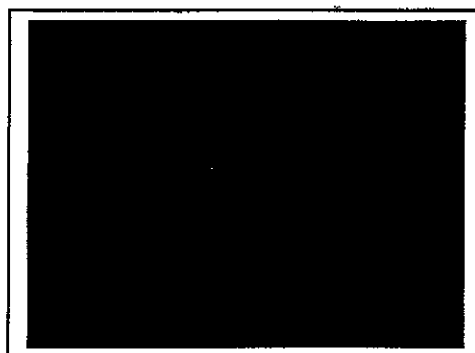
Run 3 - Newly Loaded Room Heater



Run 4 - Fuel



Run 4 - Newly Loaded Room Heater



Wood Heater Test Data
EPA Method 5H

Run Number 1

Manufacturer: Hearth & Home Tech
 Serial Number: 061-S-50-3
 Test Date: 12-Dec-02
 Test Start Time: 14:45
 Reporting Method: 10
 Test Sampling Time: 420

Sample Rate Control Module Number: 21
 Test Meter ID: 0.992
 Onflow ID: 1.527
 Pilot Tube ID: 0.99
 Average Barometric Pressure: 29.49
 Average Fuel Moisture (dry basis): 20.03
 DUW Equipment Numbers:

Dilution Tunnel Velocity Traverse Data										Dilution Tunnel Flow
	PL1	PL2	PL3	PL4	PL5	PL6	PL7	PL8		
Initial IP	0.038	0.044	0.048	0.038	0.040	0.046	0.048	0.032	H ₂ O	145.8
Initial Temp	96	96	96	96	96	96	96	96	oF	act/minute

Signature/Date: *[Signature]* 1-7-03

Post-Test Leak Check: 005.65 cfm @ 74g

Initial/Assumed Values			
Dilution	1/10 to 1/100	28.56	Amount CO ₂ (%) 0.034
Tunnel	20.00	4.00	Designated Flow Sampling Rate (cfm) 0.24

Flue Gas	
Imponder Liquid, Vol (g)	130.3
Volume of Water Vapor, Vol (std) (ft ³)	8.14
Moisture Content, Btu	0.068

Elapsed Time	Particulate Sampling System								Fuel Weight		Stove Flue-Gas Conditions						Stove Temperatures (oF)						Dilution Tunnel				Laboratory
	Orifice Meter Reading (cfm)	Sample Rate (cfm)	Coarse dH (microg/m ³)	Proportional Rate (%)	Flue Gas Meter Temperature (F)	Sample Train Vacuum (inches Hg)	Transfer Bell Temperature (F)	Flue Gas Temperature (F)	Scale Reading (lbs)	Weight Change (lbs)	Static Pressure (inches Hg)	CO ₂ (%)	CO (%)	CH ₄ (%)	Temperature (F)	Air to Fuel Ratio (lb/lb)	Face of Top	Face of Front	Face of Back	Face of Left	Face of Right	Average Surface Temperature (F)	Flow Rate (cfm)	Flow Rate (cfm)	Flow Rate (cfm)	Flow Rate (cfm)	
0	531.300	0.15	100.0	56	0	56	238	17.4	-0.11	-0.011	17.7	2.5	0.77	134	26.4	204	249	244	209	310	243	96	0.042	-0.48	0.210	74	
10	533.380	0.258	0.22	100.0	56	2	58	237	18.5	-0.9	-0.030	17.8	2.6	0.40	198	28.1	302	249	241	245	328	273	107	0.042	-0.48	0.260	72
20	536.330	0.301	0.33	97.4	58	2	57	231	15.8	-0.7	-0.032	16.7	3.9	0.43	195	21.5	332	244	237	247	331	278	104	0.042	-0.48	0.450	73
30	540.450	0.358	0.39	95.8	91	2	56	231	14.2	-1.6	-0.051	12.7	8.2	0.44	292	12.2	561	242	233	254	332	324	125	0.042	-0.48	1.010	72
40	544.330	0.388	0.50	96.4	94	2	56	230	12.3	-1.9	-0.056	12.2	8.5	0.28	338	12.0	648	239	236	221	254	328	136	0.042	-0.48	1.190	73
50	548.750	0.442	0.53	97.1	97	2	55	234	10.4	-1.9	-0.059	11.5	10.2	0.29	359	10.3	700	253	254	238	282	345	141	0.042	-0.48	1.470	74
60	553.250	0.450	0.56	98.2	98	2	55	238	8.8	-1.6	-0.055	13.3	7.6	0.31	340	13.2	674	265	270	252	281	348	146	0.042	-0.48	1.140	75
70	557.790	0.454	0.41	94.8	99	2	55	230	7.5	-1.3	-0.056	12.3	8.8	0.31	329	11.7	644	278	287	273	281	353	132	0.042	-0.48	1.120	75
80	561.850	0.406	0.48	98.9	98	2	56	233	6.0	-1.5	-0.054	11.4	9.2	0.32	345	11.2	705	294	309	301	284	379	135	0.042	-0.48	1.290	75
90	566.170	0.432	0.48	98.1	98	2	56	230	4.6	-1.4	-0.052	12.1	8.2	0.21	342	12.5	712	310	330	326	289	383	134	0.042	-0.48	1.130	75
100	570.500	0.433	0.53	98.1	98	2	55	233	3.7	-0.9	-0.051	14.0	8.5	0.21	315	15.0	841	329	350	341	266	391	126	0.042	-0.48	0.950	75
110	574.980	0.448	0.43	97.3	99	2	57	235	3.1	-0.8	-0.042	14.8	5.0	0.37	251	18.2	513	342	367	347	309	378	112	0.042	-0.48	0.650	74
120	579.250	0.427	0.32	102.6	99	2	57	234	2.8	-0.3	-0.031	15.5	4.4	0.99	224	18.1	453	348	369	341	310	364	104	0.042	-0.48	0.500	74
130	582.870	0.362	0.22	100.3	98	2	56	235	2.5	-0.2	-0.030	14.9	4.5	1.33	200	16.7	396	343	363	325	310	347	99	0.042	-0.48	0.440	67
140	586.180	0.331	0.18	109.0	97	2	56	230	2.5	-0.1	-0.021	15.5	3.9	1.83	174	17.6	349	337	355	309	304	331	95	0.042	-0.48	0.340	68
150	588.980	0.280	0.18	103.2	97	2	55	238	2.4	-0.1	-0.020	15.4	3.7	1.67	160	18.0	308	321	341	289	295	311	93	0.042	-0.48	0.320	68
160	591.770	0.279	0.12	103.8	97	2	55	239	2.2	-0.2	-0.020	14.8	4.8	1.67	154	15.5	294	309	330	277	288	300	93	0.042	-0.48	0.340	69
170	594.010	0.224	0.11	101.2	97	2	56	238	2.1	-0.1	-0.018	14.8	4.5	1.74	148	16.0	282	297	317	265	281	288	94	0.042	-0.48	0.310	70
180	596.330	0.232	0.13	108.4	98	2	56	237	1.9	-0.2	-0.018	15.4	4.0	1.60	146	17.5	270	285	303	253	273	277	96	0.042	-0.48	0.300	70
190	598.750	0.242	0.11	104.0	99	2	56	238	1.8	-0.1	-0.012	15.1	4.1	1.69	145	17.0	260	274	290	245	272	268	98	0.042	-0.48	0.290	71
200	601.080	0.233	0.11	108.3	100	2	55	231	1.7	-0.1	-0.012	15.3	3.9	1.72	144	17.4	252	265	278	235	267	259	98	0.042	-0.48	0.280	75
210	603.130	0.205	0.11	92.7	101	2	55	230	1.6	-0.1	-0.011	15.5	3.9	1.51	142	18.0	247	258	269	228	255	253	96	0.042	-0.48	0.270	78
220	606.430	0.230	0.10	107.8	101	2	56	228	1.5	-0.1	-0.011	15.7	3.7	1.61	140	18.2	241	251	261	221	262	247	98	0.042	-0.48	0.250	78
230	607.610	0.218	0.11	105.5	101	2	56	234	1.4	-0.1	-0.011	15.2	3.9	1.72	140	17.4	239	245	253	214	256	242	98	0.042	-0.48	0.270	78
240	609.850	0.224	0.10	104.5	101	2	56	235	1.3	-0.1	-0.011	15.5	4.0	1.79	140	17.0	237	239	246	207	254	237	97	0.042	-0.48	0.270	78
250	612.000	0.215	0.10	102.7	101	2	55	235	1.2	-0.1	-0.010	15.3	4.1	1.84	139	16.6	235	235	238	201	252	232	98	0.042	-0.48	0.270	79
260	614.180	0.218	0.11	106.6	100	2	55	235	1.1	-0.1	-0.013	15.5	3.9	1.65	138	17.6	233	231	229	194	254	228	92	0.042	-0.48	0.270	78
270	616.370	0.219	0.11	101.4	99	2	55	237	1.0	-0.1	-0.012	16.0	3.6	1.58	136	18.6	229	228	221	188	256	224	90	0.042	-0.48	0.250	76
280	618.570	0.220	0.09	102.6	99	2	56	234	0.9	-0.1	-0.011	16.0	3.5	1.57	134	18.9	220	224	212	182	253	218	93	0.042	-0.48	0.230	75
290	620.520	0.205	0.08	102.6	98	2	56	237	0.8	-0.1	-0.010	16.4	3.3	1.56	133	19.6	215	221	206	177	251	214	93	0.042	-0.48	0.210	75
300	622.610	0.199	0.08	104.5	99	2	56	238	0.7	-0.1	-0.010	16.4	3.2	1.62	131	19.7	208	215	199	172	248	208	94	0.042	-0.48	0.200	75
310	624.580	0.197	0.08	106.0	99	2	54	235	0.6	-0.1	-0.010	16.7	3.0	1.40	128	21.1	200	210	191	167	244	202	92	0.042	-0.48	0.190	75
320	626.560	0.198	0.08	105.8	99	2	54	238	0.5	-0.1	-0.010	16.9	2.8	1.47	126	21.6	192	203	184	161	244	195	92	0.042	-0.48	0.180	75
330	628.540	0.198	0.07	105.3	99	2	55	241	0.4	-0.1	-0.010	17.2	2.6	1.34	122	23.0	183	195	178	155	244	186	91	0.042	-0.48	0.160	75
340	630.450	0.191	0.06	106.8	98	2	55	235	0.4	0.0	-0.010	17.5	2.4	1.20	120	24.6	178	191	173	152	244	182	90	0.042	-0.48	0.140	75
350	632.125	0.167	0.06	104.5	98	2	55	237	0.4	0.0	-0.010	17.6	2.4	1.25	115	24.4	170	184	170	149	205	176	90	0.042	-0.48	0.140	75
360	633.770	0.164	0.05	102.5	97	2	55	240	0.3	-0.1	-0.009	17.7	2.3	1.11	112	25.6	162	176	167	146	156	169	89	0.042	-0.48	0.130	75

Wood Heater Test Data EPA Method 5H

Run Number 1

Manufacturer	Hearth & Home Tech	Sample Rate Control Module Number	21
Stove Model, Tracking Number	Normstar 3	Test Meter	0.992
Stove Type (oil, coal, wood)	coal	Onflow	1.587
Prop. #	06-11-30-02	Pilot Tube Co.	0.99
Test Date	12-Dec-02	Average Barometric Pressure	29.49
Test Start Time	14:45	Average Fuel Moisture (dry basis, %)	20.03
Recording Interval (minutes)	10	OMM Equipment Numbers	
Total Sampling Time (minutes)	420		

Dilution Tunnel Velocity Traverse Data									Dilution Tunnel Flow
	PL1	PL2	PL4	PL5	PL6	PL7	PL8		Initial
Initial dP	0.038	0.044	0.038	0.040	0.045	0.048	0.032	H ₂ O	145.8
Initial Temp	96	96	96	96	96	96	96	°F	scfm/minute

Signature: BSG Date: 1-7-03

Post-Test Leak Check: 005.35 cfm @ 14"Hg

Initial/Assumed Values			
Dilution	VW (lb/lb-mol)	28.56	Ambient CO ₂ (%) 0.034
Tunnel	W (lb)	4.00	Engineered Initial Sampling Rate (scfm/minute) 0.24

Flue Gas	
Impinger Liquid, V _{ic} (g)	150.0
Volume of Water Vapor, V _w (ft ³)	6.14
Moisture Content, Bws	0.058

Particulate Sampling System										Fuel Weight		Stack Conditions					Stove Temperatures (oF)							Dilution Tunnel				Laboratory
Elapsed Time	Impinger Gas Meter Reading (cf)	Sample Rate (cfm)	Onflow dH (inches wc)	Proportional Rate (%)	Impinger Gas Meter Temperature (oF)	Sample Train Vacuum (inches Hg)	Impinger Exit Temperature (oF)	Hot Box Temperature (oF)	Scale Reading (lbs)	Weight Change (lbs)	Flue Draft Pressure (inches w.c.)	CO ₂ (%)	CO (%)	Temperature (oF)	Air to Fuel Ratio (lb/lb)	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Average Surface Temperature (oF)	Temperature (oF)	dP Velocity Pressure (inches w.c.)	Static Pressure (inches w.c.)	DP (oF)	Ambient Temperature (oF)		
370	635.280	0.151	0.06	99.8	97	2	96	238	0.3	0.0	-0.008	18.1	1.00	108	28.1	158	169	162	141	186	183	88	0.042	-0.48	0.120	75		
380	636.800	0.152	0.07	97.1	97	2	96	237	0.3	0.0	-0.008	18.8	0.97	105	31.2	144	161	157	137	177	155	85	0.042	-0.48	0.110	73		
390	638.430	0.163	0.06	93.8	96	2	96	239	0.3	0.0	-0.007	19.1	0.72	101	36.4	135	154	152	132	169	148	84	0.042	-0.48	0.090	72		
400	640.070	0.164	0.05	103.5	95	2	96	239	0.2	-0.1	-0.007	17.3	2.13	99	18.8	131	147	148	127	162	143	82	0.042	-0.48	0.140	72		
410	641.631	0.156	0.06	109.4	94	2	96	230	0.1	-0.1	-0.008	16.0	2.37	102	17.5	141	140	141	124	157	141	81	0.042	-0.48	0.180	71		
420	643.165	0.153	0.07	82.9	94	2	97	229	0.0	-0.1	-0.009	16.2	2.28	104	17.7	145	136	139	123	159	140	81	0.042	-0.48	0.190	72		
Total Sampling Time (minutes)	Total Sample Volume (cf)	Average Sampling Rate (cfm)	Average Onflow dH (inches wc)	Average Proportional Rate (%)	Average Meter Temp (oF)	Maximum Sample Train Vacuum (inches Hg)	Average Impinger Exit Temperature (oF)	Average Hot Box Interior Temp (oF)	Total Fuel Burned (lbs)	Average Sample Interval Weight Change	Average Flue Draft (inches wc)	Average Oxygen (% O ₂)	Average Carbon Monoxide (% CO)	Average Flue Temp (oF)	Average Air to Fuel Ratio (lb/lb)	Average Firebox Top Temp (oF)	Average Firebox Bottom Temp (oF)	Average Firebox Back Temp (oF)	Average Firebox Left Side Temp (oF)	Average Firebox Right Side Temp (oF)	Difference in (Beg./End) Stove Surface Temps (oF)	Average Dilution Tunnel Temp (oF)	Average Dilution Tunnel dP (inches wc)	Average Dilution Tunnel Static Pressure (inches wc)	Average Dilution Tunnel CO ₂ (%)	Average Laboratory Ambient Temp (oF)		
420	111.965	0.266	0.13	101.65	97.1	2.00	96.16	234.91	17.40	-0.41	-0.02	15.57	1.21	177.86	19.33	1319.50	243.74	246.42	220.72	257.93	10	101.42	0.04	-0.48	2.42	73.84		

Wood Heater Calculation Data EPA Method 5H

Run	1
Manufacturer	Hearth & Home Tech
Model/Tracing No.	Northstar 8
Test Date	18-Dec-02
Report Number	061-S-50-3

Burn Rate (dry kg/hour) = 0.94

Emission Rate (grams/hour) = 1.69

Note: When using the CO2 tracer-gas method, 1/Cf (by tracer gas) = Si

Elapsed Time (minutes)	Dilution Tunnel Velocity (feet/second actual)	Fo (1.00 to 1.12)	Qf by carbon balance (scf/minute)	Qt-new (scf/minute)	Qf by tracer gas (scf/minute)	1/Cf by tracer gas (Si)	Volume Sampled (dscf)	Si * Volume Sampled	Proportional Sample Rate	dH new
10.0	14.5	1.10	28.4	145.1	12.8	0.078	2.358	0.227	100.0	0.222
20.0	14.4	1.02	16.9	145.5	15.7	0.064	2.751	0.215	97.4	0.332
30.0	14.7	0.97	21.9	142.7	17.1	0.059	3.243	0.207	95.8	0.392
40.0	14.9	1.01	25.6	141.5	19.3	0.052	3.516	0.206	96.4	0.500
50.0	14.9	0.91	21.9	140.9	19.9	0.050	3.985	0.206	97.1	0.528
60.0	15.0	0.98	23.6	140.3	20.5	0.049	4.035	0.203	96.2	0.560
70.0	14.8	0.96	17.0	142.0	17.6	0.057	4.064	0.198	94.8	0.411
80.0	14.8	1.01	18.9	141.6	18.9	0.053	3.627	0.206	98.9	0.477
90.0	14.8	1.06	19.6	141.7	19.0	0.053	3.866	0.204	98.1	0.482
100.0	14.7	1.03	15.1	142.7	19.9	0.050	3.875	0.204	98.1	0.527
110.0	14.6	1.17	12.2	144.4	17.9	0.056	4.010	0.201	97.3	0.426
120.0	14.4	1.09	6.1	145.5	15.5	0.064	3.814	0.213	102.6	0.320
130.0	14.4	1.12	3.8	146.1	13.0	0.077	3.233	0.208	100.3	0.225
140.0	14.3	1.12	2.0	146.6	11.6	0.086	2.961	0.228	109.0	0.180
150.0	14.3	1.18	2.0	146.9	11.5	0.087	2.509	0.216	103.2	0.175
160.0	14.3	1.07	3.5	146.9	9.4	0.106	2.500	0.218	103.8	0.119
170.0	14.3	1.12	1.8	146.8	9.1	0.110	2.007	0.213	101.2	0.110
180.0	14.3	1.13	3.9	146.5	9.8	0.102	2.078	0.229	108.4	0.128
190.0	14.4	1.15	1.9	146.3	9.2	0.109	2.184	0.220	104.0	0.113
200.0	14.4	1.15	2.0	146.3	9.3	0.107	2.080	0.226	106.3	0.115
210.0	14.4	1.12	2.0	146.3	8.9	0.112	1.827	0.196	92.7	0.105
220.0	14.4	1.13	2.1	146.3	8.6	0.116	2.046	0.229	107.8	0.098
230.0	14.4	1.17	2.0	146.3	8.9	0.112	1.939	0.225	105.8	0.105
240.0	14.4	1.09	1.9	146.4	8.7	0.115	1.992	0.223	104.6	0.100
250.0	14.4	1.10	1.9	146.3	8.5	0.118	1.912	0.220	102.7	0.095
260.0	14.3	1.12	2.0	147.0	9.0	0.111	1.939	0.228	106.6	0.107
270.0	14.3	1.10	2.1	147.3	8.9	0.112	1.951	0.217	101.4	0.106
280.0	14.3	1.12	2.1	146.9	8.3	0.120	1.964	0.220	102.6	0.092
290.0	14.3	1.09	2.2	146.9	7.9	0.126	1.830	0.220	102.8	0.083
300.0	14.3	1.10	2.2	146.8	7.7	0.130	1.779	0.225	104.5	0.079
310.0	14.3	1.11	2.4	147.0	7.7	0.129	1.758	0.228	106.0	0.079
320.0	14.3	1.11	2.4	147.0	7.8	0.129	1.767	0.228	105.8	0.080
330.0	14.3	1.11	2.6	147.2	7.2	0.138	1.767	0.228	105.3	0.069
340.0	14.3	1.11	0.0	147.3	6.6	0.152	1.705	0.236	108.8	0.058
350.0	14.3	1.08	0.0	147.3	6.6	0.152	1.498	0.227	104.5	0.058
360.0	14.3	1.10	2.9	147.4	6.2	0.160	1.471	0.223	102.5	0.052
370.0	14.2	1.10	0.0	147.6	6.5	0.155	1.352	0.217	99.6	0.056
380.0	14.2	1.08	0.0	148.0	7.2	0.139	1.361	0.211	97.1	0.069
390.0	14.2	1.07	0.0	148.1	6.6	0.153	1.460	0.203	93.8	0.057
400.0	14.2	0.97	2.2	148.4	5.9	0.169	1.472	0.225	103.5	0.047
410.0	14.2	1.09	2.0	148.5	6.8	0.146	1.403	0.238	109.4	0.063
420.0	14.2	1.07	2.0	148.5	7.3	0.137	1.381	0.202	92.9	0.072
Totals	14.4	1.08	6.8	145.8	11.1	0.105	2.387	0.202	101.6	0.192

Woodstove Type

Yhco1=cat,2=ncat,3=pellet
EPA's Hydrocarbon Constant (%)

2

1.32

Fuel Data

Test Charge (as fired lbs)
Average Moisture (% dry basis)
Average Moisture (% wet basis)

17.4

20.03

16.69

Run Parameters

DGM initial reading (cf)
DGM final reading (cf)
Pb (inches Hg)
Tm (avg oF)
dH (avg inches wc)
Vm (scf)
Qf by carbon balance (avg dscf/minute)

531.300

643.165

28.49

97.14

0.19

100.201

6.79

Analytical Data

Probe/Front Wash (mg)
Front Filter (mg)
Impinger PM (mg)
Back Filter (mg)
Total Weight (mg)

34.8

55.6

244.0

80.6

415.0

Emission Results

Cs (g/dscf)
ER (g/hour)

0.0041

1.69

Final Laboratory Report - Method 5H Dilution Tunnel Particulate Calculations

Client Name: Aladdin Hearth Products

Equipment Numbers: _____

Run No.: 1Model: Northstar aDate: 12/18/02Project No.: 061-S-50-3Tracking No.: 419

PARTICULATE COMPONENTS

Sample Component	Reagent	Filter # or Volume, ml	Weights			
			Final, mg	Tare, mg	Blank, mg/ml	Particulate, mg
A. Front filter catch	Filter	M139	649.8	594.2		55.6
B. Rear filter catch	Filter	C826	199.7	119.1		80.6
C. Rinse of probe and filter assembly (FRONT)	Acetone	120	100469.9	100435.1	0.0000	34.8
D. Rinse of Impinger Set	Distilled Water	325	109913.8	109819.8	0.0000	94.0
E. Rinse of Impinger Set	Dichloromethane	150	103902.7	103852.1	0.0000	50.6
F. Rinse of filter assembly and gas train (BACK)	Acetone	220	104306.9	104207.5	0.0000	99.4
Total Particulate, mg :						415.0

Component	Equations:
A. Front filter catch	Final (mg) - Tare (mg) = Particulate, mg
B. Rear filter catch	Final (mg) - Tare (mg) = Particulate, mg
C. Rinse of probe and filter assembly (FRONT)	(Final, mg - Tare, mg) - (Blank, mg/ml x Volume, ml) = Particulate, mg
D. Rinse of Impinger Set	(Final, mg - Tare, mg) - (Blank, mg/ml x Volume, ml) = Particulate, mg
E. Rinse of Impinger Set	(Final, mg - Tare, mg) - (Blank, mg/ml x Volume, ml) = Particulate, mg
F. Rinse of filter assembly and gas train (BACK)	(Final, mg - Tare, mg) - (Blank, mg/ml x Volume, ml) = Particulate, mg

CONDENSED WATER		Weights		
IMPINGERS	Final, g	Initial, g	Net, g	
1	731.1	640.5	90.6	
2	582.8	566.7	16.1	
3	548.6	546.7	1.9	
4	851.7	830.0	21.7	
		TOTAL, g:	130.3	

Analyst: BDDate: 1-3-03

2-7 of 2-42

EPA Method 4 Analysis Worksheet

Client/Location: Aladdin Natshae A Project #: 061-S-50-3

Test Date: 12-18-02 Test Crew: B.O Run #: 1

Sample Train #: A Assembled by: B.O Cleaned by: B.R

Filter Identification

Front Filter	1st Filter # <u>M139</u>	Back Filter	1st Filter # <u>C826</u>
2nd Filter #	___	2nd Filter #	___
3rd Filter #	___	3rd Filter #	___

Gravimetric Analysis—Condensed Water

Impingers:	1	2	3	4	Total	By
Final:	<u>731.1</u>	<u>582.8</u>	<u>548.6</u>	<u>851.7</u>		
Initial:	<u>640.5</u>	<u>566.7</u>	<u>546.7</u>	<u>830.0</u>		
Net Weight (grams):	<u>90.6</u>	<u>16.1</u>	<u>1.9</u>	<u>21.7</u>	<u>130.3</u>	

STOVE TEMPERATURE TEST DATA - METHOD 5G

Page 1 of 1

Client/Model: Aladdin No. 115000 A Project #: 061-S-50-3 Tracking #: 419

Date: 12-18-02 Test Crew: B. Davis Run #: 1

OMNI Equipment ID #: _____

Preburn ☒		Coal Bed:		Data:		0 = ∅		Range: 3.5 - 4.3		Actual:		Coal Bed: 4.1	
Test ☐													

FUEL DATA

Client / Model: A/addin Northstar Tracking #: 419 Project #: 061-S-50-3

Date: 12-18-02 Test Crew: B Davis Run #: 1

OMNI Equipment ID #: _____

FUEL LOAD PREPARED BY: B Davis

FUEL: DOUGLAS-FIR SPECIES, UNTREATED, AIR-DRIED, STANDARD GRADE OR BETTER, DIMENSIONAL LUMBER.

PRE-BURN FUEL					
MOISTURE CONTENT (METER -- DRY BASIS)					
CALIBRATION:	Cal Value (1) = 12%	Actual Reading		<u>12</u>	
	Cal Value (2) = 22%	Actual Reading		<u>22</u>	
Piece	Length	Readings			Type
1	<u>8</u> ft	<u>11.7</u>	<u>18.8</u>	<u>19.1</u>	<u>2x4</u>
2	<u>8</u> ft	<u>11.8</u>	<u>19.3</u>	<u>19.1</u>	<u>2x4</u>
3	ft				
Length of cut pieces: <u>4 @ 20</u> inches		Pre-Burn Fuel Average Moisture: <u>19.1</u>			
Time (clock): <u>10:40</u>		Room Temperature (F): <u>70</u>		Initials: <u>BD</u>	

TEST FUEL				
FUEL TYPE AND AMOUNT:		<u>2x4</u>	<u>3</u>	<u>4x4</u> <u>2</u>
CALCULATED LOAD WEIGHT:		<u>18.9</u>	ACTUAL LOAD WEIGHT: <u>8.1</u> (2x4)	
			<u>9.3</u> <u>9.2</u> (4x4)	
FUEL PIECE LENGTH: <u>20</u>		Total <u>17.84</u>		
MOISTURE CONTENT (METER -- DRY BASIS)				
PIECE	READINGS			TYPE
1	<u>19.1</u>	<u>19.9</u>	<u>19.2</u>	<u>2x4</u>
2	<u>20.0</u> <u>18.7</u>	<u>20.6</u> <u>19.3</u>	<u>19.5</u> <u>19.4</u>	<u>2x4</u>
3	<u>19.3</u>	<u>20.1</u>	<u>20.6</u>	<u>2x4</u>
4	<u>20.1</u>	<u>20.3</u>	<u>21.4</u>	<u>4x4</u>
5	<u>20.0</u>	<u>18.7</u>	<u>21.6</u>	<u>4x4</u>
6				
7				
8				
9				
10				
OVERALL TEST FUEL LOAD MOISTURE AVERAGE: <u>20.03</u>				
Time (clock): <u>10:20</u>		Room Temperature (F): <u>70</u>		Initials: <u>BD</u>

Technician signature: B.D. Date: 1-2-03

Run Notes

Client/Model: A/Adm Northstar A

Project #: 061-S-60.3

Tracking Number: 419

Run #: 1

Date: 12-18-02

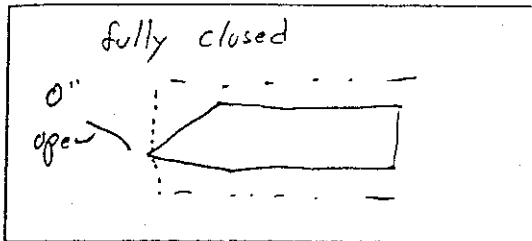
Test Crew: B. Davis

OMNI Equipment ID Numbers: _____

PREBURN

DESCRIBE OR SKETCH AIR OR THERMOMSTAT SETTINGS BELOW:
(SETTINGS MUST BE ACCURATE AND REPRODUCIBLE)

PRIMARY:



SECONDARY: fixed

TERTIARY: NA

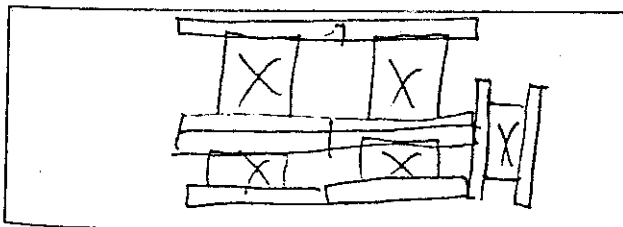
FAN: on high

PREBURN SETTINGS AND ACTIVITIES

TIME	AIR (THERMO) CHANGES PRIMARY/SECONDARY/TERTIARY	FAN SETTING CHANGE	ADD FUEL + WT.	ADD FUEL - WT.	RAKE COAL	COMMENT
0 45	Test setting				X	

TEST

TEST FUEL CONFIGURATION SKETCH
(INDICATE VIEW ANGLE)



START UP PROCEDURES

BYPASS: NA

FUEL LOADING by 32 sec.

DOOR: closed by 40 sec.

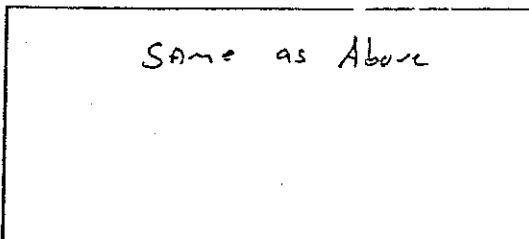
PRIMARY AIR: fully open until 4:55
Then set to test setting

OTHER:

When the Airslide is fully open it activates
a 2 hour timer that allows additional
Air until the timer closes it.

DESCRIBE OR SKETCH TEST SETTINGS BELOW:
(SETTINGS MUST BE ACCURATE AND REPRODUCIBLE)

PRIMARY:



@ 391 m.w
Adjusted fuel
load after
(3) zero weight
losses

SECONDARY: fixed

TERTIARY: NA

FAN:

off for first 20 min;
then set to high air

Technician signature: B. Davis

Date: 1-2-03

Supplemental Data EPA 5G/5H

Client / Model: Aladdin Northstar A Project No.: 041-S - 50 - 3
Tracking No.: 419 Date: 12-18-02 Run No.: 1 Booth: 1
Test Crew: B. Davis Start Time: 17:45 Stop Time: 20:45 ^{21:45}
OMNI Equipment #'s: _____

Gas Analyzer Train Leak Check:

Stack:

Dilution Tunnel (Method 5G Only):

Initial: good

Initial: _____

Final: good

Final: _____

Calibrations: Span Gas CO₂: 9.96 O₂: 10.6 CO: 1.23 CO₂(DT): 1.26

Time	N ₂ Span		N ₂ Span		N ₂ Span	N ₂ Span	N ₂ Span	N ₂ Span
	<u>0</u>		EOT					
O ₂	10.6	0.0	10.5	0.0				
CO ₂	9.9	0.0	10.3	0.0				
CO	1.23	0.00	1.26	0.00				
CO ₂ (DT)	1.26	0.00	1.25	0.0				

Stack Diameter (inches): 8"

Air Velocity (ft/min): Initial: 450 ft/min Final: 450 ft/min

Scale Audit (lbs.): Pretest: 10.0 Post Test: 10.0

Induced Draft: 0.0 @ %Smoke Capture: 100%

Pitot Tube Leak Test: Pre: 0.0 @ 3.0 Post: 0.0 @ 3.1

Flue Pipe Cleaned Prior to First Test in Series: Date: 12-17-02 Initials: BD

	Initial	Middle	Ending
Pb (in. Hg)	28.46	28.49	28.53
Room Temp (°F)	75.74	70	72

Technician signature: B. Davis Date: 1-2-03

Wood Heater Test Data EPA Method 5H

Run Number 2

Manufacturer: Hearth & Home Tech
Stove Model: Tracking Number: Northstar a
Stove Type: Cat. No.: ncal
Project Number: 051-S-50-3
Test Date: 19-Dec-02
Test Start Time: 12:40
Reporting Period: 10
Type Sampling Time: 350

Sample Rate Control Module Number: 21
Test Meter ID: 0.992
Orifice ID: 1.537
Pilot Tube Co: 0.99
Average Barometric Pressure: 29.55
Average Fuel Moisture (dry basis %): 19.78
OMNI Equipment Numbers:

Dilution Tunnel Velocity Traverse Data										Dilution Tunnel Flow
	PL1	PL2	PL3	PL4	PL5	PL6	PL7	PL8		Initial
Initial SP	0.044	0.050	0.052	0.044	0.044	0.051	0.052	0.022	120	153.4
Initial Temp	95	95	95	95	95	95	95	95	0F	act/minute

Signature/Date: *[Signature]* 1-7-03

Post-Test Leak Check: 008 @ 15 cfm @ 14g

Initial/Assumed Values			
Dilution Tunnel	VW (lb/b-mol)	29.55	Ambient CO2 (%)
	-20 (°F)	4.00	Properly Initial Sampling Rate (act/minute)
			0.27

Flue Gas	
Imaging Liquid, Visc (g)	97.7
Volume of Water Vapor, Vw (std) (ft3)	4.61
Moisture Content, Bws	0.061

Elapsed Time	Particulate Sampling System								Fuel Weight		Stove Flue-Gas Conditions						Stove Temperatures (oF)						Dilution Tunnel				Laboratory Temperature
	Low Gas Meter Reading (cfm)	Sample Rate (cfm)	Orifice dH (inches wc)	Proportional Rate (%)	Dry Gas Meter Temperature (F)	Sample Train Vacuum (inches Hg)	Impinger Exit Temperature (F)	Flue Box Temperature (F)	Scale Reading (lbs)	Weight Change (lbs)	Initial Pressure (inches Hg)	CO (ppm)	CO2 (ppm)	CO (ppm)	Temperature (F)	Air to Fuel Ratio (lb/lb)	Exhaust Top	Exhaust Bottom	Exhaust Back	Exhaust Left	Exhaust Right	Average Surface Temperature (F)	Temperature (F)	DP Velocity Pressure (inches wc)	Static Pressure (inches Hg)	CO (ppm)	
0	543.700	0.265	0.19	100.0	86	0	85	235	17.4	-0.010	-0.010	18.2	1.9	0.82	129	30.0	196	256	243	219	319	247	95	0.046	-0.43	0.410	77
10	545.350	0.265	0.25	100.0	87	2	68	239	16.9	-0.5	-0.021	18.0	2.4	0.32	153	30.1	217	257	241	249	331	259	100	0.046	-0.43	0.590	72
20	549.180	0.281	0.37	95.3	90	2	67	238	15.7	-1.2	-0.041	14.7	5.7	0.39	240	18.4	421	246	233	251	328	298	118	0.046	-0.43	1.670	70
30	552.580	0.352	0.28	98.8	92	2	67	237	14.2	-1.5	-0.054	11.3	8.8	0.75	306	11.1	540	244	236	260	325	321	133	0.046	-0.43	2.310	70
40	555.760	0.308	0.26	96.8	94	2	67	237	12.1	-2.1	-0.056	10.4	10.4	0.28	353	10.1	580	237	241	227	288	335	142	0.046	-0.43	2.620	71
50	558.720	0.296	0.26	96.3	95	2	66	235	10.3	-1.8	-0.058	10.1	10.9	0.26	362	9.8	703	246	260	240	275	345	163	0.046	-0.43	2.780	71
60	561.740	0.302	0.22	100.4	97	2	65	235	8.8	-1.7	-0.052	10.7	9.7	0.30	344	10.7	585	256	285	266	277	356	142	0.046	-0.43	2.280	78
70	564.540	0.280	0.25	99.3	98	2	65	235	7.1	-1.5	-0.052	10.2	9.8	0.28	342	10.7	701	284	307	289	284	373	142	0.046	-0.43	2.410	80
80	567.750	0.321	0.24	107.4	101	2	65	238	5.5	-1.6	-0.051	9.7	10.5	0.31	349	10.0	728	308	334	318	294	396	145	0.046	-0.43	2.540	82
90	570.400	0.265	0.24	90.9	102	2	64	235	4.2	-1.3	-0.050	10.2	9.7	0.19	349	10.8	734	325	356	341	301	412	145	0.046	-0.43	2.370	84
100	573.350	0.295	0.24	100.0	101	2	64	234	3.3	-0.9	-0.048	13.3	6.8	0.28	307	14.5	613	348	375	357	314	401	132	0.046	-0.43	1.640	75
110	575.300	0.295	0.22	100.8	99	2	65	230	2.9	-0.4	-0.042	14.0	5.8	0.58	275	15.8	537	357	360	358	321	391	122	0.046	-0.43	1.340	74
120	579.350	0.305	0.15	107.9	97	2	65	234	2.6	-0.3	-0.032	14.6	5.3	0.81	233	16.3	449	366	383	349	329	375	110	0.046	-0.43	1.000	70
130	581.750	0.240	0.11	103.8	97	2	65	230	2.4	-0.2	-0.028	14.6	5.1	1.01	205	16.3	391	367	379	336	336	362	106	0.046	-0.43	0.840	70
140	583.930	0.216	0.08	107.7	96	2	65	234	2.2	-0.2	-0.022	14.7	4.9	1.14	184	16.5	352	360	370	320	331	347	103	0.046	-0.43	0.730	70
150	585.950	0.202	0.09	110.1	96	2	66	238	2.1	-0.1	-0.021	14.9	4.8	1.28	173	16.4	322	349	356	302	318	329	100	0.046	-0.43	0.710	74
160	587.910	0.196	0.06	106.9	97	2	66	237	1.9	-0.2	-0.021	14.9	4.7	1.25	185	16.6	305	336	344	288	309	316	99	0.046	-0.43	0.650	76
170	589.870	0.176	0.07	102.7	96	2	67	236	1.8	-0.1	-0.021	14.8	4.8	1.39	158	16.1	295	323	331	278	305	308	98	0.046	-0.43	0.630	77
180	591.350	0.166	0.06	103.0	96	2	67	232	1.7	-0.1	-0.020	14.8	4.7	1.41	159	16.3	291	312	319	265	298	297	98	0.046	-0.43	0.660	76
190	593.200	0.185	0.06	105.4	96	2	67	236	1.5	-0.2	-0.019	15.1	4.3	1.52	153	16.9	282	299	306	254	292	287	95	0.046	-0.43	0.590	74
200	595.000	0.190	0.06	105.0	99	2	68	231	1.4	-0.1	-0.017	15.5	4.0	1.46	145	17.8	272	282	297	246	285	276	95	0.046	-0.43	0.560	75
210	596.830	0.183	0.06	104.5	99	2	65	229	1.3	-0.1	-0.017	15.6	3.8	1.59	144	18.0	263	279	289	236	278	269	94	0.046	-0.43	0.520	75
220	598.600	0.177	0.07	103.6	99	2	65	229	1.2	-0.1	-0.013	16.0	3.7	1.42	139	18.8	247	269	275	225	259	257	94	0.046	-0.43	0.480	75
230	700.370	0.177	0.06	109.4	98	2	64	234	1.1	-0.1	-0.011	16.5	3.1	1.57	136	20.2	232	259	263	216	250	246	94	0.046	-0.43	0.390	75
240	702.050	0.168	0.07	108.6	99	2	64	236	1.1	0.0	-0.011	16.7	2.5	1.34	133	23.4	219	251	254	209	253	237	94	0.046	-0.43	0.350	75
250	703.610	0.156	0.07	91.6	98	2	65	234	1.0	-0.1	-0.011	16.8	2.5	1.28	128	23.7	207	241	243	200	244	227	93	0.046	-0.43	0.350	76
260	705.250	0.184	0.09	96.5	99	2	65	230	1.0	0.0	-0.010	16.9	2.5	1.35	128	23.4	200	231	233	192	235	218	93	0.046	-0.43	0.380	75
270	707.250	0.200	0.10	107.0	100	2	65	234	0.9	-0.1	-0.010	17.1	2.4	1.28	127	24.2	192	221	221	184	223	208	92	0.046	-0.43	0.390	75
280	709.250	0.200	0.10	99.5	100	2	66	232	0.8	-0.1	-0.010	17.1	2.4	1.25	125	24.3	186	215	211	179	215	201	92	0.046	-0.43	0.380	75
290	711.010	0.176	0.10	90.4	100	2	66	230	0.8	0.0	-0.010	16.6	2.6	1.35	123	22.9	181	209	202	174	208	195	91	0.046	-0.43	0.410	75
300	713.100	0.209	0.21	106.3	100	2	67	235	0.6	-0.2	-0.009	16.1	2.4	1.26	121	24.3	174	202	195	169	203	189	91	0.046	-0.43	0.540	75
310	716.140	0.304	0.07	106.2	100	2	66	236	0.4	-0.2	-0.010	15.2	4.4	1.03	122	17.9	179	193	190	166	204	186	92	0.046	-0.43	0.570	74
320	717.890	0.175	0.07	106.4	97	2	66	230	0.3	-0.1	-0.010	15.4	4.3	1.13	124	17.9	184	188	186	166	209	187	92	0.046	-0.43	0.550	74
330	719.500	0.171	0.06	105.9	97	2	65	228	0.2	-0.1	-0.010	15.5	4.4	1.09	123	17.8	187	184	189	167	217	189	90	0.046	-0.43	0.530	74
340	721.250	0.165	0.06	106.3	91	2	66	230	0.1	-0.1	-0.010	15.6	4.3	1.13	123	17.9	188	182	189	167	222	190	89	0.046	-0.43	0.520	73
350	722.907	0.166	0.06	109.2	91	2	66	234	0.0	-0.1	-0.009	15.8	4.3	0.93	122	18.5	188	179	188	168	227	190	89	0.046	-0.43	0.520	73

2-14-03-42

Wood Heater Test Data EPA Method 5H

Run Number 2

Manufacturer: Hearth & Home Tech
Stove Model, Tracking Number: Northstar a
Stove Type: cat, coal, or pellet: coal
Project Number: 061-S-55-3
Test Date: 19-Dec-02
Test Start Time: 12:40
Recording Interval (minutes): 10
Total Sampling Time (minutes): 350

Sample Rate Control Module Number: 21
Test Meter ID: 0 992
Orifice ID #: 1 587
Pilot Tube ID: 0 99
Average Barometric Pressure: 29.53
Average Fuel Moisture (dry basis): 15.73
OMNI Exhaust Numbers:

Dilution Tunnel Velocity Traverse Data										Dilution Tunnel Flow
	PL1	PL2	PL3	PL4	PL5	PL6	PL7	PL8		Initial
Initial dP	0.044	0.050	0.052	0.044	0.044	0.051	0.052	0.032	H ₂ O	153.4
Initial Temp	95	95	95	95	95	95	95	95	oF	scf/minute

Signature: *[Signature]* Date: 1-7-03

Post-Test Leak Check: 008 @ 15 cfm @ 14g

Initial/Assumed Values			
Dilution Tunnel	WW (lb/burned)	28.58	Ambient CO ₂ (%)
	H ₂ O (%)	4.00	Prater's Initial Sampling Rate (cfm)
			0.27

Flue Gas	
Impinger Liquid, Vc (g)	37.7
Volume of Water Vapor, Vw (std) (ft ³)	4.51
Moisture Content, Bws	0.061

Elapsed Time	Particulate Sampling System								Fuel Weight		Stove Flue-Gas Conditions						Stove Temperatures (oF)							Dilution Tunnel				Laboratory Ambient Temperature (oF)
	Dry Gas Meter Reading (cf)	Sample Rate (cfm)	Orifice dH (inches wc)	Proportional Rate (%)	Dry Gas Meter Temperature (oF)	Sample Train Vacuum (inches Hg)	Impinger Exit Temperature (oF)	Hot Box Temperature (oF)	Scale Reading (lbs)	Weight Change (lbs)	Draft Pressure (inches wc)	O ₂ (%)	CO (%)	CO ₂ (%)	Temperature (oF)	Air to Fuel Ratio (lb/lb)	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Average Surface Temperature (oF)	Difference in (Beg./End) Stove Surface Temps (oF)	Average Dilution Tunnel Temp (oF)	Average Dilution Tunnel dP (inches wc)	Average Dilution Tunnel Static Pressure (inches wc)	Average Dilution Tunnel CO ₂ (%)	
	Total Sampling Time (minutes)	Total Sample Volume (cf)	Average Sampling Rate (cfm)	Average Orifice dH (inches wc)	Average Proportional Rate (%)	Average Meter Temp (oF)	Maximum Sample Train Vacuum (inches Hg)	Average Impinger Exit Temperature (oF)	Average Hot Box Interior Temp (oF)	Total Fuel Burned (lbs)	Average Sample Interval Weight Change	Average Flue Draft (inches wc)	Average Oxygen (% O ₂)	Average Carbon Dioxide (% CO ₂)	Average Carbon Monoxide (% CO)	Average Flue Temp (oF)	Average Air to Fuel Ratio (lb/lb)	Average Firebox Top Temp (oF)	Average Firebox Bottom Temp (oF)	Average Firebox Back Temp (oF)	Average Firebox Left Side Temp (oF)	Average Firebox Right Side Temp (oF)						
350	79.207	0.225	0.14	102.75	96.8	2.00	56.25	233.81	17.40	-0.50	-0.02	14.56	5.13	0.97	194.81	17.85	353.92	268.01	275.17	245.25	273.95	57	107.31	0.05	-0.43	1.01	74.58	

2-1582-42

Wood Heater Calculation Data EPA Method 5H

Burn Rate (dry kg/hour) =

1.13

Emission Rate (grams/hour) =

1.73

Run

2

Manufacturer: Hearth & Home Tech.

Model/Tracking No.: Northstar a

Test Date: 19-Dec-02

Project Number: 061-S-50-3

Note: When using the CO2 tracer-gas method, 1/Qf (by tracer gas) = Si

Elapsed Time (minutes)	Dilution Tunnel Velocity (feet/second actual)	Fo (1.00 to 1.12)	Qf by carbon balance (scf/minute)	Qt-new (scf/minute)	Qf by tracer gas (scf/minute)	1/Qf by tracer gas (Si)	Volume Sampled (dscf)	Si * Volume Sampled	Proportional Sample Rate	dH new
0	15.0	1.12		153.4	30.9	0.032				
10	15.1	1.13	16.9	152.9	35.9	0.028	2.427	0.078	100.0	0.252
20	15.3	1.05	22.1	150.5	43.5	0.023	2.569	0.071	95.3	0.366
30	15.5	1.03	18.7	148.6	38.2	0.026	3.202	0.074	98.8	0.281
40	15.6	1.00	23.9	147.5	36.8	0.027	2.791	0.073	98.6	0.261
50	15.9	0.98	19.7	145.0	36.6	0.027	2.672	0.073	98.3	0.258
60	15.6	1.04	20.5	147.5	34.3	0.029	2.721	0.074	100.4	0.225
70	15.6	1.08	18.0	147.5	35.9	0.028	2.514	0.073	99.3	0.246
80	15.6	1.05	18.0	147.1	35.2	0.028	2.877	0.080	107.4	0.236
90	15.6	1.09	15.8	147.1	35.6	0.028	2.362	0.067	90.9	0.240
100	15.5	1.09	14.6	148.8	35.3	0.028	2.625	0.074	100.0	0.237
110	15.3	1.13	7.1	150.0	34.0	0.029	2.630	0.074	100.8	0.220
120	15.2	1.10	5.5	151.6	27.8	0.036	2.729	0.080	107.9	0.148
130	15.1	1.11	3.7	152.1	24.2	0.041	2.154	0.077	103.8	0.112
140	15.1	1.12	3.7	152.5	21.8	0.046	1.957	0.081	107.7	0.091
150	15.1	1.09	1.8	152.9	21.7	0.046	1.816	0.083	110.1	0.090
160	15.0	1.11	3.8	153.1	20.2	0.049	1.762	0.081	106.9	0.078
170	15.0	1.10	1.8	153.2	19.2	0.052	1.580	0.078	102.7	0.070
180	15.0	1.11	1.8	153.2	20.6	0.049	1.505	0.079	103.0	0.081
190	15.0	1.13	3.8	153.6	20.0	0.050	1.657	0.081	105.4	0.077
200	15.0	1.12	2.0	153.6	20.4	0.049	1.613	0.081	105.0	0.079
210	15.0	1.13	2.0	153.8	19.8	0.050	1.637	0.080	104.5	0.075
220	15.0	1.10	2.1	153.8	18.7	0.053	1.583	0.080	103.6	0.067
230	15.0	1.11	2.3	153.8	17.9	0.056	1.583	0.085	109.4	0.061
240	15.0	1.27	0.0	153.8	19.7	0.051	1.505	0.084	108.6	0.074
250	15.0	1.25	2.7	153.9	19.7	0.051	1.395	0.071	91.6	0.074
260	15.0	1.21	0.0	153.9	21.6	0.046	1.469	0.074	96.5	0.089
270	14.9	1.21	2.7	154.0	23.2	0.043	1.789	0.083	107.0	0.102
280	14.9	1.21	2.7	154.0	22.5	0.044	1.785	0.077	99.5	0.097

Woodstove Type

Yhc>1=cat,2=ncat,3=pellet

EPA's Hydrocarbon Constant (%)

Fuel Data

Test Charge (as fired lbs)

Average Moisture (% dry basis)

Average Moisture (% wet basis)

Run Parameters

DGM initial reading (cf)

DGM final reading (cf)

Pb (inches Hg)

Tm (avg oF)

dH (avg inches wc)

Vm (scf)

Qf by carbon balance (avg dscf/minute)

Analytical Data

Probe/Front Wash (mg)

Front Filter (mg)

Impinger PM (mg)

Back Filter (mg)

Total Weight (mg)

Emission Results

Cs (g/dscf)

ER (g/hour)

OMNI-Test Laboratories

290	14.9	1.26	0.0	154.2	22.6	0.044	1.571	0.070	90.4	0.097
300	14.9	1.48	5.5	154.2	33.0	0.030	1.866	0.083	106.8	0.207
310	14.9	1.14	4.0	154.0	18.9	0.053	2.715	0.082	106.2	0.068
320	14.9	1.12	2.0	154.0	18.6	0.054	1.562	0.083	106.4	0.066
330	14.9	1.08	2.0	154.3	17.5	0.057	1.535	0.082	105.9	0.059
340	14.9	1.08	2.0	154.5	17.6	0.057	1.481	0.084	108.3	0.060
350	14.9	1.06	2.1	154.5	17.6	0.057	1.503	0.085	109.2	0.060
Averages/Totals	15.1	1.13	7.3	152.0	26.0	0.042	2.033		102.8	0.140

2-17082-42

Final Laboratory Report - Method 5H Dilution Tunnel Particulate Calculations

Client Name: Aladdin Hearth Products Equipment Numbers: _____ Run No.: 2
 Model: Northstar a Date: 12/19/02
 Project No.: 061-S-50-3
 Tracking No.: 419

PARTICULATE COMPONENTS

Sample Component	Reagent	Filter # or Volume, ml	Weights			
			Final, mg	Tare, mg	Blank, mg/ml	Particulate, mg
A. Front filter catch	Filter	M140	652.8	607.0		45.8
B. Rear filter catch	Filter	C827	171.5	120.1		51.4
C. Rinse of probe and filter assembly (FRONT)	Acetone	125	107228.1	107194.4	0.0000	33.7
D. Rinse of Impinger Set	Distilled Water	300	216746.8	216684.6	0.0000	62.2
E. Rinse of Impinger Set	Dichloromethane	150	104958.8	104928.6	0.0000	30.2
F. Rinse of filter assembly and gas train (BACK)	Acetone	155	92001.2	91944.4	0.0000	56.8
Total Particulate, mg :						280.1

Component	Equations:
A. Front filter catch	Final (mg) - Tare (mg) = Particulate, mg
B. Rear filter catch	Final (mg) - Tare (mg) = Particulate, mg
C. Rinse of probe and filter assembly (FRONT)	(Final, mg - Tare, mg) - (Blank, mg/ml x Volume, ml) = Particulate, mg
D. Rinse of Impinger Set	(Final, mg - Tare, mg) - (Blank, mg/ml x Volume, ml) = Particulate, mg
E. Rinse of Impinger Set	(Final, mg - Tare, mg) - (Blank, mg/ml x Volume, ml) = Particulate, mg
F. Rinse of filter assembly and gas train (BACK)	(Final, mg - Tare, mg) - (Blank, mg/ml x Volume, ml) = Particulate, mg

CONDENSED WATER

IMPINGERS	Weights		
	Final, g	Initial, g	Net, g
1	721.2	644.9	76.3
2	576.2	568.5	7.7
3	542.1	541.5	0.6
4	864.8	851.7	13.1
TOTAL, g:			97.7

Analyst: B. D.

Date: 1-3-03

2-18-02-42

EPA Method 4 Analysis Worksheet

Client Location: Aladdin Northstar A

Project #: 061-S-50-3

Test Date: 12-19-02

Test Crew: B. Davis

Run #: 2

Sample Train #: A

Assembled by: B. Davis

Cleaned by: BP

Filter Identification

Front Filter	1st Filter # <u>m140</u>	Back Filter	1st Filter # <u>C827</u>
2nd Filter #	___	2nd Filter #	___
3rd Filter #	___	3rd Filter #	___

Gravimetric Analysis—Condensed Water

Impingers:	1	2	3	4	Total	By
Final:	<u>721.2</u>	<u>576.2</u>	<u>542.1</u>	<u>864.8</u>		
Initial:	<u>644.9</u>	<u>568.5</u>	<u>541.5</u>	<u>851.7</u>		<u>BP</u>
Net Weight (grams):	<u>76.3</u>	<u>7.7</u>	<u>0.6</u>	<u>13.1</u>	<u>97.7</u>	

STOVE TEMPERATURE TEST DATA - METHOD 5G

Page 1 of 1

Client/Model: Aladdin Northstar A Project #: 061-5-50-3 Tracking #: 419

Date: 12-19-02 Test Crew: B. Davis Run #: 2

OMNI Equipment ID #: _____

Preburn ☒		Coal Bed:		Range: <u>3.5 - 4.3</u>							Actual:	
Test ☐		Data: <u>0 = 0</u>		TEMPERATURES (oF)							Coal Bed: <u>4.3</u>	
Time	Fuel Weight	Delta Weight	Stack Draft	Ambient	Top	Left	Right	Back	Bottom	Flue	Catalyst	
0	4.8		-0.17	69	470	453	442	379	509	282	NA	
10	4.7	0.1	-0.25	75	397	447	428	372	505	197		
20	4.6	0.1	-0.21	74	335	414	393	346	470	176		
30	4.6	0.0	-0.20	74	300	383	360	324	444	165		
40	4.5	0.1	-0.17	75	272	354	328	305	420	155		
50	4.4	0.1	-0.15	74	249	331	305	272	404	148		
60	4.4	0.0	-0.12	75	232	309	284	270	380	141		
70	4.3	0.1	-0.11	75	216	287	266	247	353	135		
80	4.3	0.0	-0.11	76	197	260	244	221	321	129		
90												
00												
10												
20												
30												
40												
50												
60												
70												
80												
90												
AVG											✓	

Technician signature: B. Davis Date: 1-2-03

2-2002-42

295

FUEL DATA

Client / Model: Aladdin Northern A Tracking #: 419 Project #: 061-S-50-3
Date: 12-19-02 Test Crew: B. Davis Run #: 2
OMNI Equipment ID #: _____

FUEL LOAD PREPARED BY: B. Davis

FUEL: DOUGLAS-FIR SPECIES, UNTREATED, AIR-DRIED, STANDARD GRADE OR BETTER,
DIMENSIONAL LUMBER.

PRE-BURN FUEL							
MOISTURE CONTENT (METER -- DRY BASIS)							
CALIBRATION:		Cal Value (1) = 12%	Actual Reading	<u>12.0</u>			
		Cal Value (2) = 22%	Actual Reading	<u>22</u>			
Piece	Length		Readings		Type	WT	Time
1	<u>8</u> ft	<u>20.3</u>	<u>20.4</u>	<u>19.8</u>	<u>2x4</u>	1	11.5
2	<u>8</u> ft	<u>21.6</u>	<u>19.6</u>	<u>21.6</u>	<u>2x4</u>		7:10
3	<u>4 @ 20"</u>						
Length of cut pieces: <u>8 @ 12"</u> inches		<u>20.3</u>	<u>16.3</u>			2	11.5
				Pre-Burn Fuel Average Moisture:	<u>20.4</u>		8:25
Time (clock): <u>7:10</u>		Room Temperature (F): <u>70</u>	Initials: <u>B/D</u>				

TEST FUEL					
FUEL TYPE AND AMOUNT:		<u>2x4</u>	<u>3</u>	<u>4x4</u>	<u>2</u>
CALCULATED LOAD WEIGHT:		<u>18.7</u>	ACTUAL LOAD WEIGHT:		<u>8.5</u> (2x4)
					<u>8.9</u> (4x4)
FUEL PIECE LENGTH: <u>20</u>					<u>17.4</u> Total
MOISTURE CONTENT (METER -- DRY BASIS)					
PIECE	READINGS			TYPE	
1	<u>20.1</u>	<u>20.6</u>	<u>19.2</u>	<u>4x4</u>	
2	<u>19.3</u>	<u>18.9</u>	<u>21.7</u>	<u>4x4</u>	
3	<u>19.4</u>	<u>19.2</u>	<u>19.4</u>	<u>2x4</u>	
4	<u>20.1</u>	<u>20.0</u>	<u>19.8</u>	<u>2x4</u>	
5	<u>20.3</u>	<u>19.3</u>	<u>19.4</u>	<u>2x4</u>	
6					
7					
8					
9					
10					
OVERALL TEST FUEL LOAD MOISTURE AVERAGE: <u>19.78</u>					
Time (clock): <u>09:15</u>		Room Temperature (F): <u>70</u>	Initials: <u>B/D</u>		

Technician signature: B. Davis Date: 1-2-03

Supplemental Data EPA 5G/5H

Client / Model: Aladdin North Project No.: 061-S-50-3
Tracking No.: 419 Date: 12-19-02 Run No.: 2 Booth: 1
Test Crew: B. Davis Start Time: 12:40 Stop Time: 18:30
OMNI Equipment #'s: _____

Gas Analyzer Train Leak Check:

Stack:

Dilution Tunnel (Method 5G Only):

Initial: good

Initial: _____

Final: good

Final: _____

Calibrations: Span Gas CO₂: 9.96 O₂: 10.6 CO: 1.23 CO₂(DT): 1.26

Time	N ₂ Span		N ₂ Span		N ₂ Span	N ₂ Span	N ₂ Span	N ₂ Span
	Ø		EOT					
O ₂	0.0	10.6	-0.1	10.6				
CO ₂	0.0	9.9	0.0	9.7				
CO	0.00	1.13	0.0	1.22				
CO ₂ (DT)	0.00	1.26	0.00	1.28				

Stack Diameter (inches): 8

Air Velocity (ft/min): Initial: < 50 ft/min Final: < 50 ft/min

Scale Audit (lbs.): Pretest: 10.0 Post Test: 10.0

Induced Draft: 0.0 %Smoke Capture: 100%

Pitot Tube Leak Test: Pre: 0.0 @ 3.0 Post: 0.0 @ 3.0

Flue Pipe Cleaned Prior to First Test in Series: Date: 12-17-02 Initials: B.D.

	Initial	Middle	Ending
Pb (in. Hg)	28.59	28.52	28.45
Room Temp (°F)	77	77	37 73 ok

Technician signature: B.D. Date: 1-2-03

Run Number 3

Manufacturer: Hearth & Home Tech
 Stove Model, Tracking Number: Northstar a
 Stove Type (cat, coal, or pellet): coal
 Project Number: 061-S-50-3
 Test Date: 20-Dec-02
 Test Start Time: 10:30
 Recording Interval (minutes): 5
 Total Sampling Time (minutes): 95

Sample Rate Control Module Number: 21
 Test Meter ID: 0992
 OnSite ID #: 1587
 Prol Tube ID: 099
 Average Barometric Pressure: 30.32
 Average Fuel Adjusted Dry Basis: 20.25
 QMN Equipment Numbers:

Wood Heater Test Data EPA Method 5H

Dilution Tunnel Velocity Traverse Data										Dilution Tunnel Flow
	PL1	PL2	PL3	PL4	PL5	PL6	PL7	PL8		Initial
Initial dP	0.048	0.046	0.048	0.034	0.042	0.048	0.052	0.042	7.20	141.0
Initial Temp	173	173	173	173	173	173	173	173	oF	act/minute

Signature/Date: B.D. 1-7-03

Post-Test Leak Check: 0.010 @ 12 cm Hg

Initial/Assumed Values			
Dilution	AW (lb/d-mol)	28.58	Ambient CO2 (%)
Tunnel	-20 (%)	4.30	Preferred Initial Sampling Rate (l/min)
			0.24

Flue Gas	
Impinger Liquid, Vc (g)	73.4
Volume of Water Vapor, Vw (std) (ft3)	3.46
Moisture Content, Bws	0.121

Elapsed Time	Particulate Sampling System								Fuel Weight		Stove Flue-Gas Conditions						Stove Temperatures (oF)						Dilution Tunnel				Laboratory
	Dry Gas Meter Reading (cf)	Sample Rate (cfm)	OnSite dH (inches wc)	Proportional Rate (%)	Dry Gas Meter Temperature (F)	Sample Train Vacuum (inches Hg)	Impinger Exit Temperature (F)	Hot Box Temperature (F)	Scale Reading (lbs)	Weight Change (lbs)	Draft Pressure (inches wc)	O2 (%)	CO2 (%)	CO (%)	Temperature (F)	Air to Fuel Ratio (lb/lb)	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Average Surface Temperature (F)	Temperature (F)	dP Velocity (inches wc)	Static Pressure (inches wc)	CO2 (%)	Ambient Temperature (F)
0	723.400	0.254	0.15	100.0	76	0	79	235	17.8	-0.050	-0.050	16.1	4.3	0.56	315	19.3	488	506	513	448	370	505	173	0.045	-0.55	0.790	78
5	724.670	0.254	0.25	100.0	78	2	58	235	18.2	-1.8	-0.080	6.3	14.7	1.51	530	8.9	598	485	491	425	349	530	220	0.045	-0.55	3.540	79
10	726.170	0.300	0.28	94.8	80	2	67	241	14.4	-1.8	-0.082	5.8	13.7	1.74	623	7.2	905	468	474	413	341	560	263	0.045	-0.55	3.580	79
15	727.770	0.320	0.31	97.1	83	2	67	243	12.1	-2.3	-0.082	6.8	13.0	1.62	651	7.6	1009	452	480	398	337	571	277	0.045	-0.55	3.590	81
20	729.530	0.352	0.30	101.1	86	2	67	238	9.8	-2.3	-0.082	7.1	12.5	1.60	665	7.8	1037	444	457	393	339	574	278	0.045	-0.55	3.460	81
25	731.200	0.334	0.33	96.2	88	2	66	234	8.1	-1.7	-0.084	7.4	12.0	1.21	672	8.3	1023	443	459	397	338	572	280	0.045	-0.55	3.480	82
30	733.000	0.360	0.29	98.9	90	2	65	241	8.5	-1.6	-0.081	8.5	11.2	0.59	636	9.3	978	448	467	411	336	568	271	0.045	-0.55	3.050	84
35	734.540	0.328	0.27	95.8	92	2	56	245	5.3	-1.2	-0.079	9.3	10.3	0.79	571	8.8	937	458	479	428	333	567	247	0.045	-0.55	2.560	83
40	736.280	0.328	0.25	99.2	93	2	56	238	4.2	-1.1	-0.071	10.5	9.5	0.33	509	10.9	878	471	495	453	331	566	224	0.045	-0.55	2.300	85
45	737.770	0.298	0.22	95.2	94	2	56	239	3.5	-0.7	-0.070	11.5	8.5	0.21	487	12.1	824	482	510	477	330	565	208	0.045	-0.55	1.930	83
50	739.270	0.300	0.21	100.9	95	2	67	241	2.9	-0.6	-0.064	13.8	5.4	0.20	422	15.4	751	502	524	498	330	561	190	0.045	-0.55	1.400	83
55	740.740	0.294	0.20	101.5	96	2	67	236	2.5	-0.4	-0.060	13.9	5.3	0.24	398	15.5	688	513	531	503	327	552	180	0.045	-0.55	1.330	82
60	742.220	0.296	0.18	104.5	96	2	67	242	2.1	-0.4	-0.060	13.9	5.5	0.24	386	15.1	650	516	532	501	320	544	175	0.045	-0.55	1.330	83
65	743.570	0.270	0.19	98.2	96	2	57	238	1.7	-0.4	-0.060	13.6	6.6	0.23	381	14.9	622	517	531	497	313	536	173	0.045	-0.55	1.250	82
70	744.980	0.282	0.17	102.2	97	2	65	241	1.3	-0.4	-0.057	13.4	6.6	0.26	371	14.9	602	518	528	491	306	529	169	0.045	-0.55	1.280	83
75	746.250	0.254	0.16	96.9	97	2	65	240	1.0	-0.3	-0.055	13.6	6.5	0.29	361	15.0	583	516	526	485	306	523	165	0.045	-0.55	1.240	82
80	747.550	0.260	0.16	100.8	97	2	64	238	0.7	-0.3	-0.056	13.5	6.5	0.31	355	15.0	567	516	524	480	309	519	163	0.045	-0.55	1.230	83
85	748.870	0.264	0.16	102.7	97	2	64	240	0.5	-0.2	-0.055	14.0	6.2	0.36	345	15.4	548	514	522	475	313	514	149	0.045	-0.55	1.160	82
90	750.170	0.260	0.16	101.2	97	2	64	238	0.2	-0.3	-0.051	13.9	5.7	0.44	340	16.3	536	512	522	471	321	512	157	0.045	-0.55	1.080	83
95	751.469	0.260	0.15	100.8	98	2	65	238	0.0	-0.2	-0.050	14.4	5.6	0.52	334	16.3	518	509	520	466	324	508	154	0.045	-0.55	1.040	82
Total Sampling Time (minutes)	Total Sample Volume (cf)	Average Sampling Rate (cfm)	Average OnSite dH (inches wc)	Average Proportional Rate (%)	Average Meter Temp (oF)	Maximum Sample Train Vacuum (inches Hg)	Average Impinger Exit Temperature (F)	Average Hot Box Interior Temp (oF)	Total Fuel Burned (lbs)	Average Sample Interval Weight Change	Average Flue Draft (inches wc)	Average Oxygen (%) O2	Average Carbon Dioxide (%) CO2	Average Carbon Monoxide (%) CO	Average Flue Temp (oF)	Average Air to Fuel Ratio (lb/lb)	Average Firebox Top Temp (oF)	Average Firebox Bottom Temp (oF)	Average Firebox Back Temp (oF)	Average Firebox Left Side Temp (oF)	Average Firebox Right Side Temp (oF)	Difference in (Bag/End) Stove Surface Temps (oF)	Average Dilution Tunnel Temp (oF)	Average Dilution Tunnel dP (inches wc)	Average Dilution Tunnel Static Pressure (inches wc)	Average Dilution Tunnel CO2 (%)	Average Laboratory Ambient Temp (oF)
95	28.089	0.296	0.22	99.34	91.3	2.00	66.50	239.10	17.80	-0.94	-0.07	11.36	6.53	0.87	466.80	12.85	742.00	489.80	503.25	455.45	529.25	5	205.80	0.04	-0.55	2.04	82.00

Wood Heater Calculation Data EPA Method 5H

Run	3
Manufacturer:	Hearth & Home Tech.
Tracking No.:	Northstar a
Test Date:	20-Dec-02
Project Number:	061-S-50-3

Burn Rate (dry kg/hour) = 4.25

Emission Rate (grams/hour) = 8.12

Note: When using the CO2 tracer-gas method, 1/Qf (by tracer gas) = Si

Time (minutes)	Dilution Tunnel Velocity (feet/second actual)	Fo (1.00 to 1.12)	Qf by carbon balance (scf/minute)	Qt-new (scf/minute)	Qf by tracer gas (scf/minute)	1/Qf by tracer gas (Si)	Volume Sampled (dscf)	Si * Volume Sampled	Proportional Sample Rate	dH new
0	16.5	1.03		141.0	25.0	0.040				
5	16.5	0.95	24.9	136.7	32.7	0.031	1.175	0.047	100.0	0.254
10	17.0	1.03	29.3	132.6	34.4	0.029	1.383	0.042	94.8	0.280
15	17.2	1.03	39.3	131.3	36.0	0.028	1.470	0.043	97.1	0.305
20	17.2	1.04	40.6	131.2	36.1	0.028	1.608	0.045	101.1	0.304
25	17.2	1.07	31.9	131.0	37.7	0.026	1.518	0.042	96.2	0.332
30	17.1	1.08	33.3	131.8	35.6	0.028	1.630	0.043	98.9	0.295
35	16.8	1.08	26.3	134.1	34.3	0.029	1.479	0.042	95.8	0.272
40	16.5	1.07	26.9	136.3	32.6	0.031	1.474	0.043	99.2	0.246
45	16.3	1.09	19.0	137.9	30.9	0.032	1.337	0.041	95.2	0.220
50	16.1	1.09	20.6	139.8	30.0	0.033	1.343	0.043	100.9	0.207
55	16.0	1.09	13.9	140.9	29.1	0.034	1.314	0.044	101.5	0.195
60	15.9	1.06	13.5	141.5	28.4	0.035	1.320	0.045	104.5	0.185
65	15.9	1.09	13.4	141.7	28.4	0.035	1.204	0.042	98.2	0.185
70	15.8	1.11	13.3	142.1	27.0	0.037	1.258	0.044	102.2	0.167
75	15.8	1.10	10.1	142.6	26.6	0.038	1.131	0.042	96.9	0.162
80	15.8	1.11	10.1	142.8	26.4	0.038	1.158	0.044	100.6	0.160
85	15.6	1.08	6.9	144.5	26.4	0.038	1.175	0.044	102.7	0.160
90	15.7	1.18	11.0	143.5	26.5	0.038	1.158	0.044	101.2	0.161
95	15.7	1.10	7.3	143.9	26.0	0.038	1.157	0.044	100.6	0.155
Test Completion	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet
No Further Data Input	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet
No Further Data Input	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet
No Further Data Input	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet
No Further Data Input	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet
No Further Data Input	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet	No Data Yet
Averages/Totals	16.3	1.07	20.6	138.4	30.5	0.033	1.331		99.3	0.224

Woodstove Type

Yhc=1=cat,2=ncat,3=pellet

EPA's Hydrocarbon Constant (%)

Fuel Data

Test Charge (as fired lbs)

Average Moisture (% dry basis)

Average Moisture (% wet basis)

Run Parameters

DGM initial reading (cf)

DGM final reading (cf)

Pb (inches Hg)

Tm (avg oF)

dH (avg inches wc)

Vm (scf)

Qf by carbon balance (avg dscf/minute)

Analytical Data

Probe/Front Wash (mg)

Front Filter (mg)

Impinger PM (mg)

Back Filter (mg)

Total Weight (mg)

Emission Results

Cs (g/dscf)

ER (g/hour)

Final Laboratory Report - Method 5H

Dilution Tunnel Particulate Calculations

Client Name: Aladdin Hearth Products Equipment Numbers: _____ Run No.: 3
 Model: Northstar a _____ Date: 12/20/02
 Project No.: 061-S-50-3 _____
 Tracking No.: 419 _____

PARTICULATE COMPONENTS

Sample Component	Reagent	Filter # or Volume, ml	Weights			
			Final, mg	Tare, mg	Blank, mg/ml	Particulate, mg
A. Front filter catch	Filter	M141	642.1	605.5		36.6
B. Rear filter catch	Filter	C828	138.0	120.6		17.4
C. Rinse of probe and filter assembly (FRONT)	Acetone	180	105115.3	105072.3	0.0000	43.0
D. Rinse of Impinger Set	Distilled Water	275	125618.4	125598.1	0.0000	20.3
E. Rinse of Impinger Set	Dichloromethane	150	105918.9	105896.9	0.0000	22.0
F. Rinse of filter assembly and gas train (BACK)	Acetone	150	107145.9	107119.4	0.0000	26.5
Total Particulate, mg :						165.8

Component	Equations:
A. Front filter catch	Final (mg) - Tare (mg) = Particulate, mg
B. Rear filter catch	Final (mg) - Tare (mg) = Particulate, mg
C. Rinse of probe and filter assembly (FRONT)	(Final, mg - Tare, mg) - (Blank, mg/ml x Volume, ml) = Particulate, mg
D. Rinse of Impinger Set	(Final, mg - Tare, mg) - (Blank, mg/ml x Volume, ml) = Particulate, mg
E. Rinse of Impinger Set	(Final, mg - Tare, mg) - (Blank, mg/ml x Volume, ml) = Particulate, mg
F. Rinse of filter assembly and gas train (BACK)	(Final, mg - Tare, mg) - (Blank, mg/ml x Volume, ml) = Particulate, mg

CONDENSED WATER

IMPINGERS	Weights		
	Final, g	Initial, g	Net, g
1	704.7	650.0	54.7
2	570.8	565.8	5.0
3	543.8	543.4	0.4
4	867.2	853.9	13.3
TOTAL, g:			73.4

Analyst: BDRDate: 1-3-03

EPA Method 4 Analysis Worksheet

Client/Location: Aladdin Nw/Stone a Project #: 041-S-52-3

Test Date: 12-10-02 Test Crew: BR Run #: 3

Sample Train #: A Assembled by: BR Cleaned by: BR

Filter Identification

Front Filter	1st Filter # <u>M141</u>	Back Filter	1st Filter # <u>C 828</u>
2nd Filter #	___	2nd Filter #	___
3rd Filter #	___	3rd Filter #	___

Gravimetric Analysis—Condensed Water

Impingers:	1	2	3	4	Total	By
Final:	<u>704.7</u>	<u>570.8</u>	<u>543.8</u>	<u>867.2</u>		
Initial:	<u>650.0</u>	<u>565.8</u>	<u>543.4</u>	<u>853.9</u>		
Net Weight (grams):	<u>54.7</u>	<u>5.0</u>	<u>0.4</u>	<u>13.3</u>	<u>73.4</u>	<u>BR</u>

STOVE TEMPERATURE TEST DATA - METHOD 5G

Client/Model: Aladdin Northstar Project #: OK1-S-60-3 Page 1 of 1
 Date: 12-20-02 Test Crew: B. Davis Tracking #: 419
 OMNI Equipment ID #: _____ Run #: 3

Preburn Test		Fuel Weight		Delta Weight	Stack Draft	Coal Bed: Data: 0 = $\emptyset$					Range: 36 - 44				Actual: Coal Bed: 36	
Time						Ambient	Top	Left	Right	Back	Bottom	Flue	Catalyst			
TEMPERATURES (oF)																
0		21.2			-0.42	71	487	439	488	503	665	265	NA			
10		18.1	3.1		-0.70	70	776	429	430	429	594	575				
20		14.1	4.0		-0.82	70	990	435	441	396	560	672				
30		9.9	4.2		-0.81	82	1050	459	465	395	568	640				
40		6.6	3.3		-0.80	81	1044	484	502	418	595	631				
50		4.6	2.0		-0.70	73	885	517	544	457	620	488				
60		4.0	0.6		-0.56	69	625	537	552	481	616	366				
70		3.8	0.2		-0.51	76	523	540	528	460	585	324				
75		3.6	0.2		-0.50	78	494	509	516	448	573	315				
90																
00																
10																
20																
30																
40																
50																
60																
70																
80																
90																
AVG																

Technician signature: B. Davis Date: 1-2-03

2-2902-42

FUEL DATA

Client / Model: Aladdin No. 115A A Tracking #: 419 Project #: 061-S-50-3

Date: 12-20-02 Test Crew: B. Davis Run #: 3

OMNI Equipment ID #: _____

FUEL LOAD PREPARED BY: B. Davis

FUEL: DOUGLAS-FIR SPECIES, UNTREATED, AIR-DRIED, STANDARD GRADE OR BETTER,
DIMENSIONAL LUMBER.

PRE-BURN FUEL

MOISTURE CONTENT (METER -- DRY BASIS)

CALIBRATION: Cal Value (1) = 12% Actual Reading 12
Cal Value (2) = 22% Actual Reading 22

Piece	Length	Readings	Type
1	<u>2</u> ft	<u>22.8</u>	<u>2x4</u>
2	<u>2</u> ft	<u>22.4</u>	<u>2x4</u>
3	<u>ft</u>	<u></u>	<u></u>

Length of cut pieces: 4 @ 20" inches Pre-Burn Fuel Average Moisture: 22.0

Time (clock): 0740 Room Temperature (F): 70 Initials: BD

TEST FUEL

FUEL TYPE AND AMOUNT: 2x4 3 4x4 2
CALCULATED LOAD WEIGHT: 15.9 ACTUAL LOAD WEIGHT: 8.2 (2x4)

FUEL PIECE LENGTH: 20 7.6 (4x4)
17.8 Total

MOISTURE CONTENT (METER -- DRY BASIS)

PIECE	READINGS	TYPE
1	<u>20.9</u> <u>21.9</u> <u>21.7</u>	<u>4x4</u>
2	<u>20.1</u> <u>19.2</u> <u>19.4</u>	<u>4x4</u>
3	<u>19.0</u> <u>19.5</u> <u>19.3</u>	<u>2x4</u>
4	<u>18.9</u> <u>20.1</u> <u>19.0</u>	<u>2x4</u>
5	<u>21.7</u> <u>20.6</u> <u>19.4</u>	<u>2x4</u>
6	<u></u> <u></u> <u></u>	<u></u>
7	<u></u> <u></u> <u></u>	<u></u>
8	<u></u> <u></u> <u></u>	<u></u>
9	<u></u> <u></u> <u></u>	<u></u>
10	<u></u> <u></u> <u></u>	<u></u>

OVERALL TEST FUEL LOAD MOISTURE AVERAGE: 20.05

Time (clock): 0740 Room Temperature (F): 70 Initials: BD

Technician signature: BD Date: 1-2-03

Run Notes

Client/Model: Aladdin Northstar A

Project #: 061-S-80-3

Tracking Number: 419

Run #: 3

Date: 12-20-02

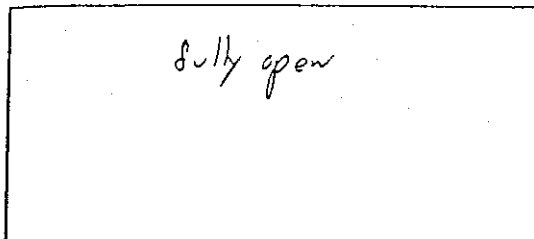
Test Crew: B.D.

OMNI Equipment ID Numbers: _____

PREBURN

DESCRIBE OR SKETCH AIR OR THERMOMSTAT SETTINGS BELOW:
(SETTINGS MUST BE ACCURATE AND REPRODUCIBLE)

PRIMARY:



SECONDARY: fixed

TERTIARY: NA

FAN: on High

PREBURN SETTINGS AND ACTIVITIES

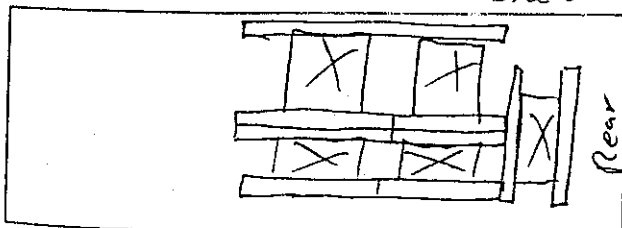
TIME	AIR (THERMO) CHANGES PRIMARY/SECONDARY/TERTIARY	FAN SETTING CHANGE	ADD FUEL + WT.	ADD FUEL - WT.	RAKE COAL	COMMENT
0 61	Test setting				X	

TEST

TEST FUEL CONFIGURATION SKETCH

(INDICATE VIEW ANGLE)

side view



START UP PROCEDURES

BYPASS: NA

FUEL LOADING: closed by 26 sec

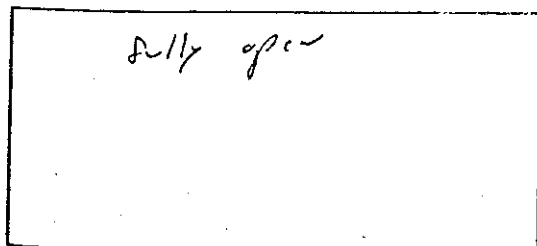
DOOR: loaded by 20 sec

PRIMARY AIR: fully open

OTHER: 2hr time out when air
slide opened fully.

DESCRIBE OR SKETCH TEST SETTINGS BELOW:
(SETTINGS MUST BE ACCURATE AND REPRODUCIBLE)

PRIMARY:



SECONDARY: fixed

TERTIARY: NA

FAN: on High

Technician signature: B.D.

Date: 1-2-03

2-31 of 2-42

Supplemental Data EPA 5G/5H

Client / Model: Aladdin Northstar Project No.: 061-S-50-3

Tracking No.: 419 Date: 12-20-02 Run No.: 3 Booth: 1

Test Crew: B Davis Start Time: 10:30 Stop Time: 12:05

OMNI Equipment #'s: _____

Gas Analyzer Train Leak Check:

Stack:

Dilution Tunnel (Method 5G Only):

Initial: good

Initial: _____

Final: good

Final: _____

Calibrations: Span Gas CO₂: 9.96 O₂: 10.6 CO: 1.23 CO₂(DT): 1.26

Time	N ₂ Span		N ₂ Span		N ₂ Span	N ₂ Span	N ₂ Span	N ₂ Span
	Ø		EUF					
O ₂	0.0	10.6	0.1	10.5				
CO ₂	0.0	9.9	0.0	9.9				
CO	0.00	1.23	0.00	1.24				
CO ₂ (DT)	0.00	1.26	0.01	1.25				

Stack Diameter (inches): 8"

Air Velocity (ft/min): Initial: 250 ft/min Final: 250 ft/min

Scale Audit (lbs.): Pretest: 10.6 Post Test: 10.0

Induced Draft: 0.0 %Smoke Capture: 100%

Pitot Tube Leak Test: Pre: 0.0 @ 3.1 Post: 0.0 @ 3.0

Flue Pipe Cleaned Prior to First Test in Series: Date: 12-17-02 Initials: B/D

	Initial	Middle	Ending
Pb (in. Hg)	28.32	28.32	28.32
Room Temp (°F)	78	84	82

Technician signature: B.D. Date: 1-2-03

Wood Heater Test Data EPA Method 5H

Number 4

Manufacturer
Serial Number
Date of Test
Test Date
Test Start Time
Recording Interval (minutes)
Test Duration (minutes)

Hearth & Home Tech.
Northstar
ncat
081-S-50-3
25-Dec-02
14:43
10
310

Sample Rate Control Module Number 21
Test Meter Y 0.992
Orifice #H 3 1.587
Pilot Type Co 0.99
Average Barometric Pressure 29.34
Average Fuel Moisture (dry basis) 19.33
Gauge Equipment Numbers

Dilution Tunnel Velocity Traverse Data										Dilution Tunnel Flow
	PL1	PL2	PL3	PL4	PL5	PL6	PL7	PL8		Initial
Initial SP	0.038	0.044	0.046	0.044	0.032	0.034	0.044	0.038	H2O	142.4
Initial Temp	99	99	99	99	99	99	99	99	oF	scf/minute

Signature/Date: *B. D. ... 1-7-03*

Post-Test Leak Check: 005.03 cfm @ 14.7"

Initial/Assumed Values			
Dilution	WV (lb/b-mol)	29.56	Ambient CO2 (%) 0.034
Tunnel	H2O (%)	4.00	Assumed Initial Sampling Rate (cfm/min)
			0.24

Flue Gas	
Impinger Liquid, Vol (g)	141.1
Volume of Water Vapor, Vw (std) (ft3)	6.85
Moisture Content, Bws	0.073

Particulate Sampling System		Fuel Weight		Stove Flue-Gas Conditions										Stove Temperatures (oF)										Dilution Tunnel				Laboratory
Elapsed Time	Dry Gas Meter Reading (cf)	Sample Rate (cfm)	Orifice dH (inches wc)	Proportional Rate (%)	Dry Gas Meter Temperature (oF)	Sample Train Vacuum (inches Hg)	Impinger Exit Temperature (oF)	Hot Box Temperature (oF)	Scale Reading (lbs)	Weight Change (lbs)	Draft Pressure (inches wc)	CO2 (%)	CO (%)	CO (%)	Temperature (oF)	Air to Fuel Ratio (lb/lb)	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Average Surface Temperature (oF)	Temperature (oF)	DP Velocity (feet/min)	Static Pressure (inches wc)	CO2 (%)	Ambient Temperature (oF)	
0	752.500	0.255	0.15	100.0	82	0	85	234	18.3	-1.2	-0.021	17.3	2.9	0.80	182	24.2	262	364	321	272	353	316	99	0.040	-0.44	0.350	58	
10	755.150	0.255	0.15	100.0	85	2	87	241	17.1	-1.2	-0.042	14.1	3.4	0.51	252	14.8	391	299	295	253	326	315	125	0.040	-0.44	0.750	69	
20	757.360	0.271	0.24	103.0	89	2	85	241	15.4	-1.7	-0.080	12.8	7.9	0.42	349	12.6	643	298	288	295	362	377	151	0.040	-0.44	1.210	70	
30	751.500	0.364	0.72	103.8	94	2	85	235	12.9	-2.5	-0.084	13.4	7.3	0.17	431	13.9	901	309	294	321	372	439	177	0.040	-0.44	1.950	71	
40	757.580	0.618	0.73	100.8	96	2	84	234	10.7	-2.2	-0.082	14.2	3.5	0.10	420	15.2	875	318	309	295	342	428	173	0.040	-0.44	1.770	72	
50	773.940	0.626	0.70	100.6	102	2	85	232	9.0	-1.7	-0.061	14.2	3.3	0.12	396	15.7	795	321	322	299	332	414	167	0.040	-0.44	1.660	72	
60	779.450	0.551	0.59	90.8	105	2	85	236	7.3	-1.7	-0.080	14.7	8.3	0.10	383	15.8	778	340	335	311	329	418	162	0.040	-0.44	1.520	72	
70	784.430	0.498	0.49	90.4	104	2	84	235	5.8	-1.5	-0.057	14.9	3.1	0.18	368	16.0	750	352	349	327	326	421	158	0.040	-0.44	1.340	72	
80	788.820	0.439	0.32	89.0	103	2	84	233	4.7	-1.1	-0.051	15.2	5.0	0.18	332	16.3	662	365	364	344	324	412	148	0.040	-0.44	1.070	71	
90	792.350	0.373	0.36	93.7	101	2	84	234	3.9	-0.8	-0.050	15.2	5.1	0.21	312	18.4	597	391	375	356	317	407	129	0.040	-0.44	0.950	70	
100	796.270	0.372	0.32	89.8	100	2	85	232	3.3	-0.6	-0.048	15.9	4.8	0.45	292	18.5	541	371	380	357	314	383	132	0.040	-0.44	0.850	69	
110	800.070	0.380	0.23	97.5	100	2	85	233	3.0	-0.3	-0.040	16.0	4.1	0.76	252	18.6	473	367	382	351	313	377	122	0.040	-0.44	0.810	75	
120	803.200	0.313	0.19	96.5	100	2	84	232	2.7	-0.3	-0.032	16.1	3.5	0.88	218	20.9	403	361	378	343	313	360	122	0.040	-0.44	0.500	76	
130	805.920	0.272	0.15	91.6	98	2	84	231	2.6	-0.1	-0.030	16.2	3.8	1.06	199	19.6	366	353	372	332	300	346	108	0.040	-0.44	0.460	77	
140	808.490	0.258	0.15	96.8	96	2	85	237	2.5	-0.1	-0.022	16.5	3.2	1.22	180	21.1	331	344	363	320	302	332	101	0.040	-0.44	0.390	74	
150	811.230	0.275	0.15	106.0	96	2	86	235	2.3	-0.2	-0.021	16.6	2.7	1.74	171	21.0	303	331	349	304	298	315	98	0.040	-0.44	0.330	76	
160	813.630	0.240	0.14	93.9	95	2	86	231	2.2	-0.1	-0.021	16.6	2.7	1.87	167	20.5	288	322	340	294	291	305	99	0.040	-0.44	0.320	78	
170	816.210	0.258	0.12	104.2	98	2	86	233	2.0	-0.2	-0.021	15.4	4.1	1.20	166	18.3	289	314	334	284	279	300	100	0.040	-0.44	0.450	79	
180	818.570	0.236	0.10	99.7	97	2	85	234	1.8	-0.2	-0.020	15.3	4.4	1.24	165	17.4	292	302	323	271	276	293	100	0.040	-0.44	0.440	80	
190	820.810	0.224	0.11	104.1	93	2	85	231	1.6	-0.2	-0.022	15.8	4.1	1.26	160	18.7	296	292	315	260	260	287	103	0.040	-0.44	0.380	81	
200	823.000	0.219	0.09	100.4	93	2	86	234	1.4	-0.2	-0.022	16.1	3.9	1.26	154	18.3	290	285	309	253	280	281	104	0.040	-0.44	0.360	83	
210	825.010	0.201	0.09	96.1	89	2	86	231	1.3	-0.1	-0.020	16.2	3.7	1.24	159	18.5	274	282	303	249	273	277	104	0.040	-0.44	0.380	84	
220	826.970	0.196	0.09	97.2	91	2	85	235	1.1	-0.2	-0.020	16.0	3.9	1.31	155	19.8	264	280	297	243	274	272	102	0.040	-0.44	0.350	83	
230	829.010	0.204	0.12	100.1	92	2	85	237	1.0	-0.1	-0.020	16.3	3.2	1.59	155	20.8	264	280	297	243	274	272	102	0.040	-0.44	0.350	84	
240	831.100	0.209	0.12	92.0	94	2	86	237	0.8	-0.2	-0.020	16.1	3.2	1.48	154	20.1	258	277	289	236	269	266	102	0.040	-0.44	0.350	84	
250	833.180	0.208	0.10	91.5	95	2	86	231	0.7	-0.1	-0.018	16.1	3.5	1.65	152	18.7	253	272	282	231	263	261	101	0.040	-0.44	0.360	82	
260	835.350	0.217	0.10	101.0	96	2	86	233	0.6	-0.1	-0.013	16.3	3.1	1.54	150	20.3	249	267	276	227	269	258	101	0.040	-0.44	0.320	83	
270	837.550	0.220	0.11	102.9	96	2	84	235	0.4	-0.2	-0.018	16.4	3.0	1.64	147	20.3	242	259	271	222	271	253	100	0.040	-0.44	0.320	82	
280	839.890	0.234	0.16	105.6	96	2	84	231	0.3	-0.1	-0.017	17.0	2.6	1.54	144	22.1	232	251	267	218	273	248	99	0.040	-0.44	0.310	82	
290	842.380	0.249	0.10	94.1	97	2	84	230	0.2	-0.1	-0.016	16.6	3.0	1.48	148	20.8	233	243	262	212	275	245	99	0.040	-0.44	0.290	82	
300	844.830	0.225	0.10	105.0	97	2	84	233	0.1	-0.1	-0.014	16.3	2.8	1.57	144	21.2	226	236	254	207	271	239	98	0.040	-0.44	0.260	81	
310	846.965	0.224	0.08	104.6	97	2	85	238	0.0	-0.1	-0.015	17.0	2.6	1.52	139	22.2	217	234	247	204	263	233	98	0.040	-0.44	0.260	81	
Total Sampling Time (minutes)	Total Sample Volume (cf)	Average Sampling Rate (cfm)	Average Orifice dH (inches wc)	Average Proportional Rate (%)	Average Meter Temp (oF)	Maximum Sample Train Vacuum (inches Hg)	Average Impinger Exit Temperature (oF)	Average Hot Box Interior Temp (oF)	Total Fuel Burned (lbs)	Average Sample Interval Weight Change	Average Flue Draft (inches wc)	Average Oxygen (% O2)	Average Carbon Dioxide (% CO2)	Average Carbon Monoxide (% CO)	Average Flue Temp (oF)	Average Air to Fuel Ratio (lb/lb)	Average Firebox Top Temp (oF)	Average Firebox Bottom Temp (oF)	Average Firebox Back Temp (oF)	Average Firebox Left Side Temp (oF)	Average Firebox Right Side Temp (oF)	Difference in (Bag/End) Stove Surface Temps (oF)	Average Dilution Tunnel Temp (oF)	Average Dilution Tunnel dP (inches wc)	Average Dilution Tunnel Static Pressure (inches wc)	Average Dilution Tunnel CO2 (%)	Average Laboratory Ambient Temp (oF)	
310	94.265	0.304	0.23	98.26	95.9	2.00	85.53	234.03	18.30	-0.59	-0.03	15.71	4.28	1.01	224.78	18.75	413.78	309.19	317.59	279.91	301.00	83	118.09	0.04	-0.44	0.57	78.88	

2-34 of 2-42

Wood Heater Calculation Data EPA Method 5H

Run	4
Manufacturer:	Hearth & Home Tech.
Model/Tracking No.:	Northstar a
Test Date:	20-Dec-02
Project Number:	061-S-50-3

Burn Rate (dry kg/hour) = 1.34

Emission Rate (grams/hour) = 2.31

Note: When using the CO2 tracer-gas method, 1/Qf (by tracer gas) = Si

Elapsed Time (minutes)	Dilution Tunnel Velocity (feet/second actual)	Fo (1.00 to 1.12)	Qf by carbon balance (scf/minute)	Qt-new (scf/minute)	Qf by tracer gas (scf/minute)	1/Qf by tracer gas (Si)	Volume Sampled (dscf)	Si * Volume Sampled	Proportional Sample Rate	dH new
0	14.1	1.08		142.4	15.7	0.064				
10	14.4	1.02	19.9	138.9	15.6	0.064	2.335	0.149	100.0	0.145
20	14.7	1.00	24.1	136.0	20.3	0.049	2.468	0.158	103.0	0.244
30	15.0	1.02	38.8	133.2	35.1	0.028	3.291	0.162	103.6	0.723
40	15.0	1.01	37.4	133.6	35.3	0.028	5.544	0.158	100.8	0.726
50	14.9	1.05	30.0	134.3	34.8	0.029	5.576	0.158	100.6	0.701
60	14.8	0.98	30.1	134.8	32.0	0.031	4.872	0.140	90.8	0.587
70	14.8	0.97	26.9	135.3	29.1	0.034	4.379	0.137	90.4	0.488
80	14.7	0.94	20.1	136.6	23.7	0.042	3.866	0.133	89.0	0.324
90	14.4	1.09	16.5	138.5	25.1	0.040	3.289	0.139	93.7	0.363
100	14.5	1.00	12.5	138.2	23.7	0.042	3.292	0.131	89.8	0.324
110	14.4	1.09	6.6	139.4	19.7	0.051	3.369	0.142	97.5	0.226
120	14.4	1.17	7.1	139.4	18.2	0.055	2.774	0.141	96.5	0.192
130	14.2	1.08	2.2	141.3	16.0	0.063	2.411	0.132	91.6	0.149
140	14.1	1.13	2.4	142.0	16.0	0.063	2.277	0.142	98.6	0.149
150	14.1	1.16	4.7	142.3	15.8	0.063	2.454	0.154	106.0	0.146
160	14.1	1.15	2.3	142.2	15.3	0.066	2.142	0.136	93.9	0.136
170	14.1	1.15	4.1	142.1	14.5	0.069	2.303	0.151	104.2	0.123
180	14.1	1.10	3.9	142.1	13.2	0.076	2.099	0.144	99.7	0.102
190	14.1	1.07	4.1	142.1	13.5	0.074	1.995	0.151	104.1	0.107
200	14.1	1.05	4.2	141.7	12.7	0.079	1.965	0.146	100.4	0.094
210	14.1	1.08	2.2	141.6	12.6	0.079	1.803	0.142	98.1	0.095
220	14.1	1.07	4.2	141.6	12.7	0.079	1.771	0.141	97.2	0.118
230	14.1	1.13	2.2	141.8	14.2	0.071	1.837	0.145	100.1	0.117
240	14.1	1.18	4.5	141.8	14.2	0.071	1.879	0.133	92.0	0.104
250	14.1	1.09	2.1	142.0	13.4	0.075	1.863	0.132	91.5	0.102
260	14.1	1.16	2.3	142.0	13.2	0.076	1.940	0.145	101.0	0.110
270	14.1	1.15	4.6	142.1	13.7	0.073	1.963	0.148	102.9	0.157
280	14.1	1.13	2.5	142.2	16.4	0.061	2.088	0.152	105.6	

Woodstove Type

Yhc>1=cat,2=ncat, 3=pellet
EPA's Hydrocarbon Constant (%)

2
1.32

Fuel Data

Test Charge (as fired lbs)
Average Moisture (% dry basis)
Average Moisture (% wet basis)

18.3
19.83
16.55

Run Parameters

DGM initial reading (cf)
DGM final reading (cf)
Pb (inches Hg)
Tm (avg oF)
dH (avg inches wc)
Vm (scf)
Qf by carbon balance (avg dscf/minute)

752.600
846.865
28.34
95.94
0.23
84.162
10.64

Analytical Data

Probe/Front Wash (mg)
Front Filter (mg)
Impinger PM (mg)
Back Filter (mg)
Total Weight (mg)

25.5
51.8
168.0
59.3
304.6

Emission Results

Cs (g/dscf)
ER (g/hour)

0.0036
2.31

Environmental Laboratories

290	14.1	1.13	2.4	142.2	13.2	0.076	2.222	0.135	94.1	0.102
300	14.1	1.23	2.4	142.3	13.2	0.076	2.004	0.151	105.0	0.101
310	14.1	1.13	2.5	142.3	12.5	0.080	1.991	0.151	104.6	0.092
Averages/Totals	14.3	1.09	10.6	139.9	18.6	0.060	2.712		98.3	0.233

Final Laboratory Report - Method 5H

Dilution Tunnel Particulate Calculations

Client Name: Aladdin Hearth Products Equipment Numbers: _____ Run No.: 4
 Model: Northstar a Date: 12/20/02
 Project No.: 061-S-50-3
 Tracking No.: 419

PARTICULATE COMPONENTS

Sample Component	Reagent	Filter # or Volume, ml	Weights			
			Final, mg	Tare, mg	Blank, mg/ml	Particulate, mg
A. Front filter catch	Filter	M146	652.5	600.7		51.8
B. Rear filter catch	Filter	C830	179.1	119.8		59.3
C. Rinse of probe and filter assembly (FRONT)	Acetone	80	110170.4	110144.9	0.0000	25.5
D. Rinse of Impinger Set	Distilled Water	325	132469.0	132383.6	0.0000	85.4
E. Rinse of Impinger Set	Dichloromethane	150	100722.3	100689.2	0.0000	33.1
F. Rinse of filter assembly and gas train (BACK)	Acetone	170	99661.2	99611.7	0.0000	49.5
Total Particulate, mg :						304.6

Component	Equations:
A. Front filter catch	Final (mg) - Tare (mg) = Particulate, mg
B. Rear filter catch	Final (mg) - Tare (mg) = Particulate, mg
C. Rinse of probe and filter assembly (FRONT)	(Final, mg - Tare, mg) - (Blank, mg/ml x Volume, ml) = Particulate, mg
D. Rinse of Impinger Set	(Final, mg - Tare, mg) - (Blank, mg/ml x Volume, ml) = Particulate, mg
E. Rinse of Impinger Set	(Final, mg - Tare, mg) - (Blank, mg/ml x Volume, ml) = Particulate, mg
F. Rinse of filter assembly and gas train (BACK)	(Final, mg - Tare, mg) - (Blank, mg/ml x Volume, ml) = Particulate, mg

CONDENSED WATER		Weights		
IMPINGERS		Final, g	Initial, g	Net, g
1		748.9	647.7	101.2
2		585.4	566.4	19.0
3		545.0	541.9	3.1
4		885.0	867.2	17.8
		TOTAL, g:		141.1

Analyst: B.D. Date: 1-3-03

EPA Method 4 Analysis Worksheet

Client/Location: Aladdin Nullstar A Project #: 061-S-50-3

Test Date: 12-20-02 Test Crew: BD Run #: 4

Sample Train #: A Assembled by: BR Cleaned by: BR

Filter Identification

Front Filter	1st Filter # <u>M146</u>	Back Filter	1st Filter # <u> </u>
2nd Filter # <u> </u>		2nd Filter # <u> </u>	
3rd Filter # <u> </u>		3rd Filter # <u> </u>	

Gravimetric Analysis—Condensed Water

Impingers:	1	2	3	4	Total	By
Final:	<u>748.9</u>	<u>585.4</u>	<u>545.0</u>	<u>885.0</u>		
Initial:	<u>647.7</u> <u>566.7</u>	<u>566.4</u>	<u>541.9</u>	<u>867.2</u>		
Net Weight (grams):	<u>101.2</u>	<u>19.0</u>	<u>3.1</u>	<u>17.8</u>	<u>141.1</u>	

STOVE TEMPERATURE TEST DATA - METHOD 5G

Page 1 of 1

Client/Model: Ala 111-1 No. 11111111 Project #: 061-1-50-3 Tracking #: 419

Date: 12-10-01 Test Crew: B. D. Adams Run #: 4

OMNI Equipment ID #: _____

Preburn ☒		Coal Bed:		Data:		0 = $\emptyset$		Range: 3.7 - 4.5		Actual:	
Test ☐										Coal Bed: 4.4	
								TEMPERATURES (oF)			
Time	Fuel Weight	Delta Weight	Stack Draft	Ambient	Top	Left	Right	Back	Bottom	Flue	Catalyst
0	7.0		-0.070	90	975	503	508	467	494	470	NA
10	6.1	0.9	-0.044	74	724	514	515	416	504	304	
20	5.8	0.3	-0.031	72	526	477	477	393	465	246	
30	5.5	0.3	-0.030	71	440	445	445	371	438	224	
40	5.4	0.1	-0.025	70	371	411	407	344	415	203	
50	4.6	0.8	-0.023	70	317	382	377	322	405	188	
60	4.5	0.1	-0.021	69	289	356	351	300	391	172	
70	4.4	0.1	-0.021	69	265	329	325	276	368	163	
80											
90											
00											
10											
20											
30											
40											
50											
60											
70											
80											
90											
AVG											

361
337
313

2-3902-42

Technician signature: B. D. Adams Date: 1-2-03

FUEL DATA

Client / Model: Aladdin Northstar Tracking #: 417 Project #: 001-3-5003

Date: 12-10-02 Test Crew: B Davis Run #: 4

OMNI Equipment ID #: _____

FUEL LOAD PREPARED BY: B Davis

FUEL: DOUGLAS-FIR SPECIES, UNTREATED, AIR-DRIED, STANDARD GRADE OR BETTER,
DIMENSIONAL LUMBER.

PRE-BURN FUEL

MOISTURE CONTENT (METER -- DRY BASIS)

CALIBRATION: Cal Value (1) = 12% Actual Reading 12
Cal Value (2) = 22% Actual Reading 22

Piece	Length	Readings	Type
1	<u>8</u> ft	<u>19.5</u>	<u>2x4</u>
2	<u>8</u> ft	<u>22.4</u>	<u>2x4</u>
3	<u>8</u> ft	<u>21.8</u>	<u>2x4</u>

Length of cut pieces: 4 x 20 inches

Pre-Burn Fuel Average Moisture: 21.0

Time (clock): 12:15 Room Temperature (F): 75 Initials: BR

TEST FUEL

FUEL TYPE AND AMOUNT: 2x4 3 4x4 2
CALCULATED LOAD WEIGHT: 18.9 ACTUAL LOAD WEIGHT: 8.2 (2x4)
10.1 (4x4)

FUEL PIECE LENGTH: 20 18.3 Total

MOISTURE CONTENT (METER -- DRY BASIS)

PIECE	READINGS	TYPE
1	<u>19.9</u>	<u>19.3</u>
2	<u>19.1</u>	<u>19.3</u>
3	<u>19.8</u>	<u>19.1</u>
4	<u>20.5</u>	<u>18.6</u>
5	<u>19.2</u>	<u>20.9</u>
6		
7		
8		
9		
10		

OVERALL TEST FUEL LOAD MOISTURE AVERAGE: 19.83

Time (clock): 13:15 Room Temperature (F): 75 Initials: BR

Technician signature: B Davis Date: 1-2-03

Run Notes

Client/Model: Aladdin Northstar A

Tracking Number: 417

Date: 12-20-02

OMNI Equipment ID Numbers: _____

Project #: 061.5-50-3

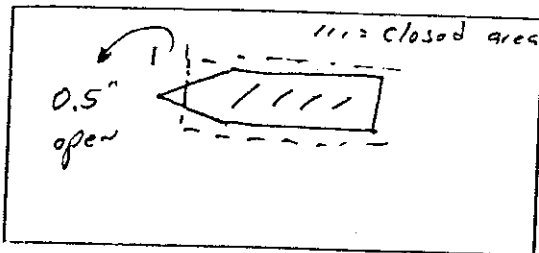
Run #: 4

Test Crew: B. Davis

PREBURN

DESCRIBE OR SKETCH AIR OR THERMOMETER SETTINGS BELOW:
(SETTINGS MUST BE ACCURATE AND REPRODUCIBLE)

PRIMARY:



SECONDARY: fixed

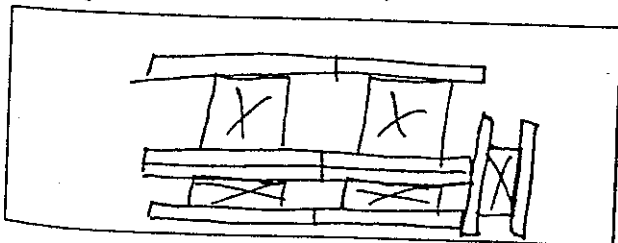
TERTIARY: NA

FAN: on high

PREBURN SETTINGS AND ACTIVITIES

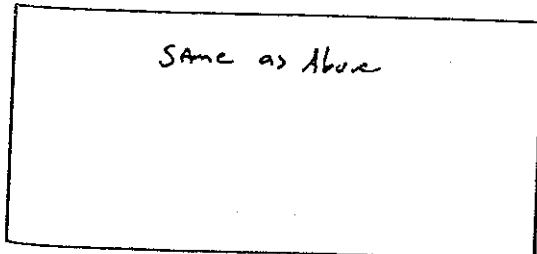
TIME	AIR (THERMO) CHANGES PRIMARY/SECONDARY/TERTIARY	FAN SETTING CHANGE	ADD FUEL + WT.	ADD FUEL - WT.	RAKE COAL	COMMENT
0	Test setting					
45				0.616	X	

TEST FUEL CONFIGURATION SKETCH
(INDICATE VIEW ANGLE)



DESCRIBE OR SKETCH TEST SETTINGS BELOW:
(SETTINGS MUST BE ACCURATE AND REPRODUCIBLE)

PRIMARY:



TEST

START UP PROCEDURES

BYPASS: NA

FUEL LOADING by 30 sec

DOOR: closed by 43 sec

PRIMARY AIR: fully open until 4:55 PM
set to test setting

OTHER: 2 hour timer set when Air
is fully opened.

SECONDARY: fixed

TERTIARY: NA

FAN: off for first 30 min
then set to High

Technician signature: B. Davis

Date: 1-2-03

Supplemental Data EPA 5G/5H

Client / Model: Aladdin Nuthouse A Project No.: 01-5-50-3
Tracking No.: 419 Date: 12-20-02 Run No.: 4 Booth: 1
Test Crew: BD Start Time: 14:40 Stop Time: 19:50
OMNI Equipment #'s: _____

Gas Analyzer Train Leak Check:

Stack:

Initial: good
Final: good

Dilution Tunnel (Method 5G Only):

Initial: _____
Final: _____

Calibrations: Span Gas CO₂: 9.96 O₂: 10.6 CO: 1.23 CO₂(DT): 1.26

	N ₂ Span		N ₂ Span		N ₂ Span	N ₂ Span	N ₂ Span	N ₂ Span
Time	<u>Ø</u>		<u>EOT</u>					
O ₂	<u>0.0</u>	<u>10.6</u>	<u>-0.1</u>	<u>10.5</u>				
CO ₂	<u>0.0</u>	<u>9.9</u>	<u>0.0</u>	<u>10.0</u>				
CO	<u>0.00</u>	<u>1.23</u>	<u>0.00</u>	<u>1.26</u>				
CO ₂ (DT)	<u>0.00</u>	<u>1.26</u>	<u>0.01</u>	<u>1.25</u>				

Stack Diameter (inches): 8"

Air Velocity (ft/min): Initial: 450 ft/min Final: 450 ft/min

Scale Audit (lbs.): Pretest: 10.0 Post Test: 10.0

Induced Draft: 0.11 %Smoke Capture: 100%

Pitot Tube Leak Test: Pre: 0.0 @ 3.2 Post: 0.0 @ 3.0

Flue Pipe Cleaned Prior to First Test in Series: Date: 12-19-02 Initials: BD

	Initial	Middle	Ending
Pb (in. Hg)	<u>28.32</u>	<u>28.34</u>	<u>28.35</u>
Room Temp (°F)	<u>68</u>	<u>75</u>	<u>81</u>

Technician signature: BD Date: 1-2-03