Non-Confidential Business Information (Non-CBI)

Certification Test Report

Kuma Stoves Inc

K250 Series

Models: Ashwood LE, Wood Classic LE, Cambridge LE, Cascade LE

Prepared for:	Kuma Stoves 50145 N Old Hwy 95 Rathdrum ID 83858
Prepared by:	OMNI-Test Laboratories, Inc. 13327 NE Airport Way Portland, OR 97230 (503) 643-3788
Test Period:	November 27, 2018 – November 29, 2018
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Report Number:	0123WM012E

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AUTHORIZED SIGNATORIES

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

Evaluator:



Bruce Davis, Testing Manager
OMNI-Test Laboratories, Inc.

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Section 1

Sampling Procedures and Test Results

INTRODUCTION

Kuma Stoves retained *OMNI* to perform U.S. Environmental Protection Agency (EPA) certification testing on the K250 Series wood stove. The K250 Series wood stove is a Catalytic Hybrid-type room heater. The firebox is constructed of mild steel. Usable firebox volume was measured to be 2.5 cubic feet and the stove is vented through 6" flue collar located on the stove top.

Testing was performed at Myren Consulting. The altitude of the laboratory is 1650 feet above sea level. The unit was received in good condition and logged in on 11/26/2018, then assigned and labeled with *OMNI* ID #2330. *OMNI* representative Bruce Davis conducted the certification testing and completed all testing by 11/29/2018.

This report is organized in accordance with the EPA-recommended outline and is summarized in the Table of Contents immediately preceding this section. The results in this report are limited to the item submitted.

SAMPLING PROCEDURE

The K250 Series wood stove was tested in accordance with the U.S. EPA 40 CFR Part 60, Subpart AAA – Standards of Performance for New Residential Wood Heaters using EPA Method 28R, ASTM E2515 and EPA Alt-125, ASTM E3053. Particulate emissions were measured using sampling trains consisting of two Teflon coated 47mm filters (front and back). See Appendix A for details on EPA Alt-125.

The model K250 Series was tested for thermal efficiency and carbon monoxide (CO) emissions in accordance with CSA B415.1-10 using Western Larch cordwood.

SUMMARY OF RESULTS

The weighted average emissions of the three test runs included in the results indicate a particulate emission rate of 1.13 grams per hour. A fan confirmation test was not required by the test standard. Particulate emissions were sampled on only one of the high burn fuel loads, test 3 was conducted to generate a coal bed for test number 4. The K250 Series results are within the emission limit of 2.5 g/h for affected facilities tested with cordwood, manufactured on or after May 15, 2020.

The proportionality results for all 3 test runs were acceptable. Quality check results for each test run are presented in Section 2 of this report.

INDIVIDUAL RUN SUMMARIES

Run 1 - Test procedures were followed to produce a high burn rate with a primary air setting of fully open. Observed burn rate was calculated at 2.76 kg/hr. Emissions results were calculated using particulate sampling from kindling, start-up fuel, and test fuel load combined (cold to hot). Burn rate, and efficiency were calculated using data from the test fuel load only (hot to hot).
No anomalies occurred, this test run was determined to be valid and appropriate for inclusion in the weighted average.

Run 2 - Test procedures were followed to produce a low burn rate with a primary air setting of full closed, this setting creates a cross sectional area of 0.410" primary air opening (see drawings). Observed burn rate was calculated at 0.82 kg/hr. Emissions and efficiency results were calculated using a hot to hot burn cycle, a coal bed generated by the high burn conducted in test one was used. After 11 hours and 50 minutes of test time, and over 60% of test load was consumed, the fuel load was adjusted due to zero weight loss after 10 minutes. No sampling anomalies occurred, this test run was determined to be valid and appropriate for inclusion in the weighted average.

Run 3 - Test procedures were followed to produce a high burn rate with a primary air setting of fully open. Emissions and efficiency data were not collected during this test.

Run 4 - Test procedures were followed to produce a medium high burn rate with a primary air setting 3/32" from full closed, this creates an air opening of 7/16" (see drawings). Observed burn rate was calculated at 1.01 kg/hr. Emissions and efficiency results were calculated using a hot to hot burn cycle, a coal bed generated by the high burn procedure was used. No sampling anomalies occurred, this test run was determined to be valid and appropriate for inclusion in the weighted average.

Table 1 – Particulate Emissions

Run	**Burn Rate** Calculated from a Hot to Hot burn cycle (kg/hr dry)	**ASTM E2515 Emissions** (g/h)	**ASTM E3053 Weighting Factor** (%)	**ASTM E3053 Weighted Emissions** (g/hr)
1	2.48	[1] 2.89	20	0.578
2	0.82	0.39	40	0.156
4	1.01	0.99	40	0.396
		The sum of weighted particulate emission of 3 test runs: **1.13** grams per hour.		

1. Based on a cold start including kindling and start-up fuel.

Table 2 – Particulate Emissions (First Hour)

Run	**ASTM E2515 Emissions – First Hour** (g/h)
1	3.35
2	1.99
4	5.38

Table 3 – B415.1 Efficiency and CO Emissions

Run	Heat Output (BTU/hr)	HHV Efficiency (%)	LHV Efficiency (%)	CO Emissions (g/MJ Output)	CO Emissions (g/kg Dry Fuel)	CO Emissions (g/min)
1	30,308	73.2	79.4	0.56	7.25	0.3002
2	11,196	81.4	88.2	0.43	6.12	0.0842
4	13,636	80.6	87.4	0.69	9.72	0.1643
Weighted average HHV efficiency of 3 test runs: 79.44%. Average CO Emissions of three tests: 0.1829 g/min						

Table 4 – Test Facility Conditions

Run	Room Temperature (°F)		Barometric Pressure (Hg)		Air Velocity (ft/min)	
	Before	**After**	**Before**	**After**	**Before**	**After**
1	62	75	28.15	28.19	<50	<50
2	72	70	28.19	28.22	<50	<50
3	76	75	28.04	28.14	<50	<50

Table 5 – Kindling and Start-up Fuel Description Summary

Run	**Kindling Weight Wet Basis** (lbs.)	**Start-up Fuel Weight Wet Basis** (lbs.)	**Residual Start-up fuel weight (lbs.)**
1	4.93	7.61	3.2
3	5.19	7.77	3.1

Note: Test 3 was a high burn used to create a coal bed for test number 4, no particulate sampling occurred during this test.

Table 6 – Fuel Measurement and Cordwood Description Summary – TEST

Run	**Test Fuel Wet Basis** (lbs)	**Firebox Volume** (ft^3)	**Fuel Loading Density Wet Basis** (lbs/ft^3)	**Test Fuel Dry Basis** (lbs)	**Test Fuel Consumed During Test Dry Basis (lbs)**	**Piece Length** (in)
1	25.75	2.5	10.1	21.19	19.05	5@18
2	30.39	2.5	12.0	24.8	24.8	5@18
3	25.95	2.5	10.2	21.45	19.37	5@18
4	30.11	2.5	11.9	24.56	24.56	5@18

Table 7 – 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)	**Temperature** (°F)
1	277	18.82	191.2	105
2	820	18.70	197.5	84
4	660	18.90	197.3	88

Table 10 – Test Configurations

Run	Startup Procedures	Combustion Air
1	Fuel Loading: Kindling and start-up fuel loaded together, a torch was used for 25 seconds to establish a fire. At 67 minutes placed fuel load into the firebox and closed the loading door. Loading required less than 1 minute to complete. Door: For kindling and start-up fuel, loading door was cracked open 1" for 40 seconds, then closed. Test fuel load; fuel loading door was closed within 15 seconds after loading. Primary Air: Air control fully open for the entire test. Secondary: No user control for secondary air. Fan: Fan was turned off during kindling and start up fuel segment, then turned to high 5 minutes after test fuel was loaded and remained on high for the remainder of the test. Bypass: Open for first 15 minutes during kindling/startup load. Was opened for 75 seconds after fuel load was loaded then closed.	Fully open for entire test.
2	Fuel Loading: Test fuel loaded onto coal bed generated by test number 1 in 1 minute and 45 seconds. Door: Closed 5 seconds after fuel loading was completed. Primary Air: Fully open, then set to full closed by 16 minutes and 10 seconds. Secondary: No user control for secondary air. Fan: Fan turned to high from off at 30 minutes. Bypass: Open until 111 seconds then closed.	Fully open for first 16 minutes 10 seconds, then set to full closed.
3	Fuel Loading: Kindling and start-up fuel loaded together, a torch was used for 20 seconds to establish a fire. At 75 minutes placed fuel load into the firebox and closed the loading door. Loading required less than 3 minutes to complete. Door: For kindling and start-up fuel, loading door was open for 36 seconds, then closed. Test fuel load; fuel loading door was closed 3 minutes and 18 seconds after loading. Primary Air: Air control fully open for the entire test. Secondary: No user control for secondary air. Fan: Fan was turned off during kindling and start up fuel segment, then turned to high 5 minutes after test fuel was loaded and remained on high for the remainder of the test. Bypass: Open for first 15 minutes during kindling/startup load. Was opened for 3 minutes and 18 seconds after fuel load was loaded, then closed.	Fully open for entire test.
4	Fuel Loading: Test fuel loaded onto coal bed generated by test number 3 in 105 seconds. Door: Open for 2 minutes 09 seconds, then closed. Primary Air: Fully open, then set to 7/16" from full closed by 16 minutes and 10 seconds. Secondary: No user control for secondary air. Fan: Fan turned to high from off at 30 minutes. Bypass: Open until 2 minutes and 09 seconds then closed.	Fully open for first 16 minutes 10 seconds, then set to 3/32" from full closed.

Section 2

Photographs/Appliance Description/Drawings

Kuma Stoves
K250 Series







Kuma Stoves
K250 Series

Run 1 – Start-up fuel



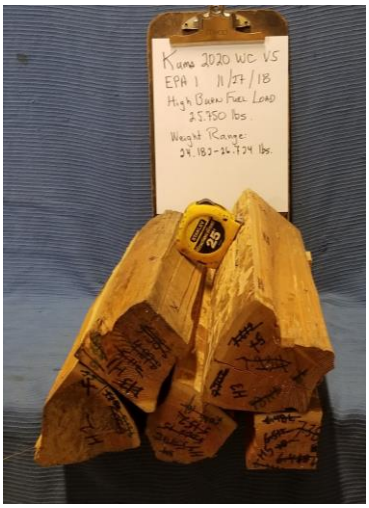
Run 1 – Kindling and start-up fuel



Run 1 – Kindling and start-up fuel



Run 1 – Fuel load



Kuma Stoves
K250 Series

Run 1 – Test Fuel Load In Stove



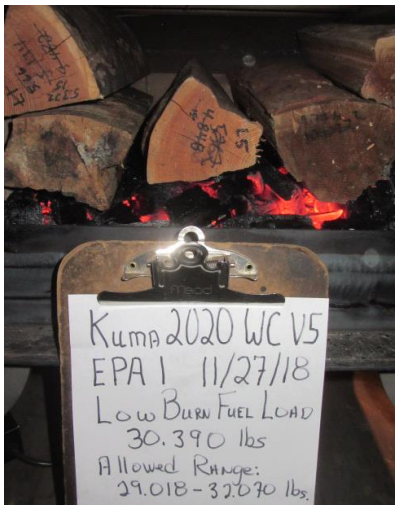
Run 1 – Remaining Coal bed



Run 2 – Test Fuel Load



Run 2 – Test Fuel Loaded into Stove



Run 2 – Prior to adjustment



Run 2 – After adjustment, Remaining coal bed



Run 3 – Kindling and start-up fuel



Run 3 – Test Fuel Load



Run 3 – Kindling and start-up fuel



Run 3 – Test Fuel Loaded into Stove



Run 3 – Remaining Coal Bed



Run 4 – Test Fuel Load



Run 4 – Test Fuel Loaded into Stove



WOOD HEATER DESCRIPTION

Appliance Manufacturer: Kuma Stoves

Wood Stove Model: K250 Series – See design drawings for model simalarities

Type: Wood Burning Freestanding Catalytic Hybrid

WOOD HEATER INFORMATION

Materials of Construction: The unit is constructed primarily of mild steel. The firebox is lined with fire brick that measures 4.50" x 9.0". The feed door has a 15.01" x 10.23" viewing area and 0.63" diameter fiberglass rope gasket.

Air Introduction System: Air is introduced into two different areas of the fire chamber and is controlled by one sliding control rod. Secondary air is introduced into the rear of the fire box through the bottom, it is then channeled up into the secondary air tubes located under the baffle. Air wash air is introduced through an opening in the bottom of the fire box near the front. It is then channeled up to a manifold across the top of the door, air is directed down across the glass and into the fire chamber.

Combustion Control Mechanisms: Combustion air control mechanism is a sliding rod with flat plates attached that cover and uncover air inlets when the rod is pushed in or pulled out.

Combustor: Catalyst is a metal alloy composition manufactured by Applied Ceramics, model ACI-5M. The component has an outside dimension of 13.0 x 2.0 x 2.5. An Interram gasket is wrapped around the outside and then the assembly is inserted into a metal can.

Internal Baffles: A steel baffle is mounted near the top of the fire chamber, a 1" thick 6 pound density ceramic blanket is placed on top. A flue bypass is incorporated into the baffle, when opened it allow products of combustion to bypass the catalyst and flow directly to the flue outlet. When closed products of combustion are directed through the catalyst mounted near the front of the baffle system.

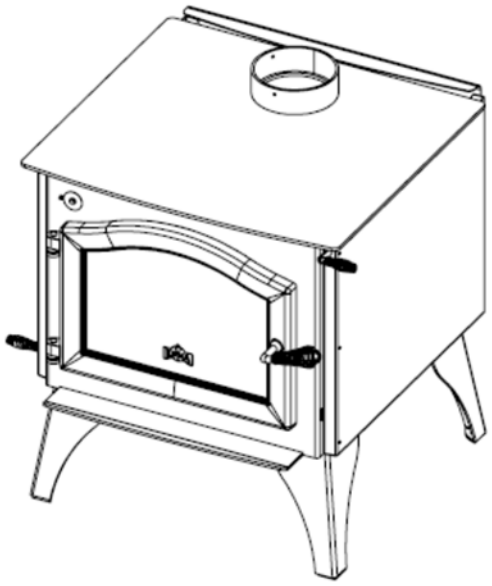
Other Features: Optional room air fan model DC3-C1011-4GS97 manufactured by Revcor is rated at 160 CFM. Freestanding version is offered with either legs or a pedestal and an ashpan. Decorative surround panels are offered for the Insert version of the K250 series.

Flue Outlet: The 6" diameter flue outlet is located at the rear of the top of the appliance.

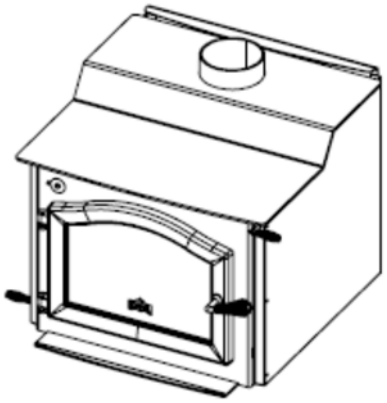
WOOD HEATER OPERATING INSTRUCTIONS

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

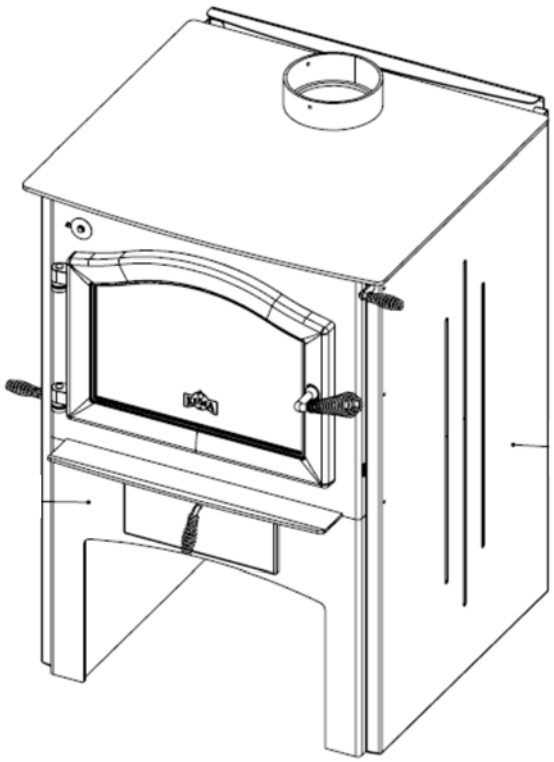
Kuma K-250 Series Model Variations



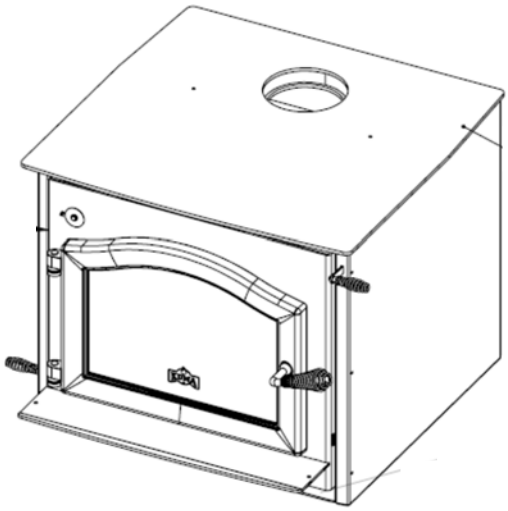
Model ASHWOOD: The tested unit. A pedestal base with an ash drawer can be bolted on in lieu of the legs.



Model WOOD CLASSIC: This unit receives a decorative step at the back of the top plate. The firebox remains flat to match the tested unit and the flue collar is extended through to the top of the step. The position of the flue collar is unchanged from the tested unit.



Model CAMBRIDGE: This unit receives a pre-installed pedestal and extensions to the decorative panels to meet with the base of the pre-installed pedestal. The configuration of the firebox remains unchanged from the pedestal mounting position and up.



Model CASCADE: This unit receives a top and a bottom convection panel for use in a fireplace insert. The side panels remain unchanged. The firebox configuration remains unchanged from the tested unit.

Section 3

Test Data by Run

Kuma Stoves, INC

50245 N. Old Hwy 95

Rathdrum, ID 83858

(888)-714-5294

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22 November 2018
Revised 22 June 2021 to add clarity - No values were changed.

RE: Operating Instructions for the Kuma 2020 Wood Classic Hybrid Stove (v5)

K-250 Series

Nominal Fuel Piece Length: 18”

Primary Air Control:

The Primary air control (PAC) is located on the left side of the stove. Pull the PAC control rod out to increase the amount of air entering the stove. Push the PAC control rod in to reduce the amount of primary air entering the stove.

Kindling Cold Start (KS) Setting: Pull the rod all the way out until the primary air inlet orifice is 3.00” open. This results in the Primary Air Inlet Orifice inside the stove being 3.00” open. See blueprints section for primary air orifice drawing.

High Burn Setting: Pull the rod all the way out until the primary air inlet orifice is 3.00” open. This results in the Primary Air Inlet Orifice inside the stove being 3.00” open. The rod should already be in this position at the end of the KS test segment, i.e., no adjustment is/ should be required.

Medium Burn Setting: At the end of the 90% High Burn test, push the rod in until the stop on the primary air control rod touches the side of the stove then pull the rod 3/32” open from the full closed position. The end of the primary air control rod will measure 1.46875” (1-15/32 from the side of the stove. This results in the Primary Air Inlet Orifice inside the stove being 7/16” open. See blueprints section for primary air orifice drawing.

Low Burn Setting: At the end of the 90% High Burn test, push the rod in until the stop on the primary air control rod touches the side of the stove. This is the full closed position. This results in the Primary Air Inlet Orifice inside the stove being open 11/32”. See blueprints section for primary air orifice drawing.

DOOR:

KS Cold Start: Once the fuel pile has been ignited, close the door to a cracked open position of about 1/8 to 1/16” open until it is certain the fuel pile will keep burning. Then close the door. If the fire starts to falter/ die back, immediately reopen the door to the cracked position for 15-30 seconds to get the fire going again. Close the door once the fire had reestablished itself.

High, Medium and Low Burns: Close the door as soon as the High, Medium or Low Burn fuel load has been loaded. If the fire is slow

to ignite, reopen the door to the cracked open position to get the fire going. Once the fire is going, close the door.

COAL BED:

KS/ High Burn Transition: At the end of KS Cold Start Segment, pull as many of the burning coals forward as possible, leveling the coal bed. Make certain that any E/W pieces that are still “solid” are rotated 90 degrees and nestled between the pieces that are parallel to the sides.

High/ Medium Transition: At the end of the 90% High Burn test, adjust the PAC setting to the Medium Burn setting and leave the coals burn in place, i.e., no adjustments to the coal bed, unless one or more pieces seem to “hang up” and not be burning properly. If that is the case, then, when and as necessary, rake the coal bed and pull the piece(s) in question to in front of the LPAO. At the start of the Medium Burn test, open the door and level the coal bed, Lower Primary Air Orifice (LPAO) as possible.

High/ Low Transition: At the end of the 90% High Burn test, adjust the PAC setting to the Low Burn setting and leave the coals burn in place, i.e., no adjustments to the coal bed, unless one or more pieces seem to “hang up” and not be burning properly. If that is the case, then, when and as necessary, rake the coal bed and pull the piece(s) in question to in front of the LPAO. At the start of the Low Burn test, open the door and level the coal bed, pulling as many hot/ orange/ red coals forward to in front of the Lower Primary Air Orifice (LPAO) as possible.

Lower Primary air Orifice (LPAO):

Always clean the coals away from in front of the holes in the LPAO.

FAN:

Kindling Cold Start Segment: Leave Fan off for the entire segment.

High Burn Test: Turn the fan on High @ 5:00 into the test.

Medium and Low Burn Tests: Turn the fan off at the start of the test. Turn the fan on High @ 30 minutes into the test.

BYPASS:

Kindling Cold Start Segment: Leave the bypass open for the first 15 minutes.

High, Medium and Low Burn Tests: Opening the bypass when adjusting the coal bed before and when loading the High, Medium and Low burn fuel loads is optional.

If you have any questions, feel free to contact me anytime.

Mark Freeman

KUMA Stoves

KUMA 250 AGING DATA

The KUMA 250 was aged on 10/29/18 through 11/21/2018. The first two of the following 4 pages contain the various temperatures recorded during the Aging Process, i.e., Firebox, Secondary Burn, Post Cat, Pre Cat and Stack temperature at (nominally) 8 feet. Pages three and four contain the fuel piece weights and the moisture content readings (%DB). The moisture readings were taken using the same procedures specified in ASTM E3053 for the cord wood used as test fuel.

Unit Kuma 2020 WC V
Date 10/29 - 11/20/18
Technicians ATM ESS
Page 1 of 2
WST5-Form3, Rev 12/09

Catalytic Combustor Aging Data
OR
Stove Aging Data
Woodstove Test Data Sheet #25

Hr. #	Date (2018)	Time	T/C# Firebox Temp	T/C# Secondary Burn Temp	T/C# Post Cat	T/C# In Cat	Stack @ B1	Comments
1	10/29	1105	839	1060	875	873	480	Fire started 955
2		1205	777	1240	1125	1042	504	Bypass Closed 1005
3		1305	910	1093	994	818	411	25.5 lbs loaded @ 1125 Ld 1
4		1405	752	780	721	819	264	29.6 lbs loaded @ 1500 Ld 2
5		1505	580	622	519	550	270	
6	11/1	1201	470	1063	1358	1170	576	Fire started @ 1046
7		1301	793	1144	1139	925	451	Bypass Closed @ 1101
8		1401	698	672	576	543	206	Fuel loaded @ 1150 24.5 lbs Ld 3
9		1501	396	601	588	791	261	Fuel loaded @ 1406 29.6 lbs Ld 4
10		1601	343	601	498	680	222	
11		1701	342	633	519	743	227	
12		1801	409	918	1021	956	297	
13		1901	576	862	645	688	210	
14		2001	523	712	507	544	158	
15		2101	541	703	494	546	151	
16		2201	475	643	452	524	145	
17		2301	448	613	420	500	139	
18		0001	388	543	392	479	133	
19	11/2	1255	514	1195	1297	1106	472	Fire started @ 1140
20		1355	753	1061	1127	965	418	Bypass Closed @ 1155
21		1455	786	863	1026	902	379	24.0 lbs added @ 1240
22		1555	586	578	519	535	180	29.7 lbs added @ 1555
23		1655	359	327	623	884	249	Load 5
24		1755	490	593	1226	1067	289	Load 6
25		1855	524	973	1087	1037	295	
26		1955	548	766	994	940	248	
27		2055	571	678	624	642	184	
28		2155	574	647	551	572	162	
29		2255	574	628	509	542	151	
30		2355	557	609	488	525	143	

Operated for 50 hours at a medium burn setting.

Unit Kuma 2020 WC II
Date 10/29 - 11/20/18
Technicians AM ESS

WST5-Form3, Rev 12/09

Catalytic Combustor Aging Data
OR
Stove Aging Data
Woodstove Test Data Sheet #25

		T/C#	7	8	17	16	1
Hr. #	2018 Date	Time	Firebox Temp	Secondary Burn Temp	Post Cat	In Pre Cat	Stack Temp Comments
31	11/3	0055	516	590	465	496	141
32		0155	486	554	432	467	135
33		0255	464	530	402	444	128 (Load 7)
34	11/16	1307	654	1135	985	933	457 24.4 lbs loaded @ 1312
35		1407	367	862	710	854	377 Fire started @ 1152
36		1507	408	1136	948	983	417 Bypass Closed @ 1207
37		1607	723	961	966	1017	402
38		1707	876	924	812	822	363
39	11/20	1253	482	1211	845	919	418 Fire started @ 1138 Bypass Closed @ 1153
40		1353	439	858	1014	969	401 Added 25.4 lbs @ 1215
41		1453	451	710	633	891	377 (Load 8)
42		1553	934	656	734	1068	400
43		1653	818	938	810	797	350 Loaded 29.4 lbs @
44		1753	609	480	386	369	220 17:25 (Load 9)
45		1853	381	599	511	724	221
46		1953	354	624	522	750	214
47		2053	370	629	542	739	214
48		2153	420	627	658	900	245
49		2253	405	643	666	884	236
50		2353	424	654	1029	789	256
51	11/21	0053	441	622	615	695	193

Operated for 50 hours at a medium burn setting.

WOODHEATER AGING DATA UNIT: Tuma 2020 WC V PAGE 1 of 2 Rev 2 2.28.16

Load #	Tech	Date	Pc. #	Pc. Wt. (lbs.)	Moisture Readings %DB End	Center	End	Pc. Avg.	Comments:
1	ATM	10/29/18	1	6.950	23.0	(24.8)	24.6	24.533	Loaded @ 1105 10/29/18
Wood Temp			2	4.992	23.2	23.2	22.8	24.367	
57 F	D. Fir		3	4.758	21.5	21.7	21.1	22.733	
Correction			4	3.590	18.3	20.0	18.9	20.367	Load Total Wt.
+0.3			5	5.216	20.5	19.2	18.8	20.800	25.500 lbs.
2	ATM	10/29/18	1	5.094	19.4	19.3	19.5	20.400	Loaded @ 1500 10/29/18
Wood Temp			2	4.578	20.0	20.6	19.2	20.933	
60 F	D Fir		3	5.232	23.8	21.9	21.5	23.400	
Correction			4	8.232	21.3	20.9	24.3	23.167	Load Total Wt.
+1.0			5	6.424	25.0	24.6	23.8	25.467	29.560 lbs.
3	ATM	11/1/18	1	5.400	23.2	22.6	21.8	23.085	Loaded @ 1150 11/1/18
Wood Temp			2	4.236	19.1	20.2	17.3	22.750	
64.5 F	D. Fir		3	4.480	16.7	19.2	19.0	18.850	
Correction			4	6.876	18.3	(26.2)	23.0	23.050	Load Total Wt.
+0.55			5	3.578	21.0	22.5	24.2	23.883	24.570 lbs.
4	ATM	11/1/18	1	3.808	21.3	22.1	17.5	20.400	Loaded @ 1406 11/1/18
Wood Temp			2	5.060	21.0	21.6	21.6	21.500	
69 F	D. Fir		3	8.596	18.3	19.2	24.2	20.667	
Correction			4	5.884	19.8	24.2	22.4	22.233	Load Total Wt.
+0.1			5	6.276	18.2	20.0	22.3	20.767	29.624 lbs.
5	ATM	11/2/18	1	3.458	18.8	20.4	18.1	19.500	Loaded @ 1240 11/2/18
Wood Temp			2	4.656	21.5	21.5	23.3	22.500	
56 F	D. Fir		3	4.100	20.6	20.1	20.5	20.800	
Correction			4	6.854	24.0	25.8	26.2	25.733	Load Total Wt.
+0.4			5	4.944	21.2	25.5	22.2	23.367	24.012 lbs.
6	ATM	11/2/18	1	8.230	20.0	(20.4)	25.1	22.133	Loaded @ 1555 11/2/18
Wood Temp			2	5.048	21.5	21.5	24.4	22.567	
59 F	D. Fir		3	5.078	19.9	19.7	20.2	20.033	
Correction			4	6.570	27.2	29.0	24.2	26.900	Load Total Wt.
+.1			5	4.574	19.9	21.3	20.3	20.600	29.700 lbs.

WOODHEATER AGING DATA UNIT: Kuma 2020 WCV PAGE 2 of 2 Rev 2 2.28.16

Load #	Tech	Date	Pc. #	Pc. Wt. (lbs.)	Moisture Readings %DB End	Center	End	Pc. Avg.	Comments:
7	ATM	11/16/18	1	5.188	20.6	19.3	19.3	22.133	Loaded @ 1312
Wood Temp			2	6.638	21.7	20.4	23.5	24.267	11/16/18
46	F	W LARCH	3	5.366	22.9	21.2	24.3	25.200	
Correction			4	4.122	21.7	20.0	20.2	23033	Load Total Wt.
+2.4			5	3.082	20.3	21.0	26.9	25.133	24.396 lbs.
8	ATM	11/20/18	1	2.928	18.3	21.0	25.4	21.567	Loaded @ 1258
Wood Temp			2	4.778	19.8	23.2	24.6	22.533	11/20/18
55	F	W, LARCH	3	5.662	23.1	23.7	27.3	24.700	
Correction			4	6.768	21.3	22.7	25.5	23.167	Load Total Wt.
+05			5	5.276	22.0	25.0	26.8	24.600	25.412 lbs.
9	ATM	11/20/18	1	5.868	27.1	24.1	23.7	24.967	Loaded @ 1725
Wood Temp			2	6.110	24.8	23.2	24.9	24.300	11/20/18
57	F	W. LARCH	3	7.154	26.6	24.9	22.0	24.500	
Correction			4	6.008	24.6	23.7	22.3	23.533	Load Total Wt.
+03			5	4.250	12.4	12.3	25.6	23.433	24.890 lbs.
___	___	___	1						Loaded @ ___
Wood Temp			2						
___	F		3						
Correction			4						Load Total Wt.
___			5						___ lbs.
___	___	___	1						Loaded @ ___
Wood Temp			2						
___	F		3						
Correction			4						Load Total Wt.
___			5						___ lbs.
___	___	___	1						Loaded @ ___
Wood Temp			2						
___	F		3						
Correction			4						Load Total Wt.
___			5						___ lbs.

Run 1

High Burn 1-minute data

Emissions Results (Cold to Hot Cycle)

Wood Heater Test Data
Hign Burn Emissions Data

Run: 1

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 27-Nov-18
Beginning Clock Time: 11:11

Total Sampling Time: 277 min
Recording Interval: 1 min
Background Sample Volume: 36.649 cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) 0.998 (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.15		28.19	28.17 0

OMNI Equipment Numbers:

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: 18.82 ft/sec.
Initial Tunnel Flow: 199.9 scfm
Average Tunnel Flow: 191.2 scfm
Post-Test Leak Check (1): 0.000 cfm @ 14 in. Hg
Post-Test Leak Check (2): 0.000 cfm @ 15 in. Hg
Average Test Piece Fuel Moisture: 19.78 Dry Basis %

Technician Signature:

Velocity Traverse Data	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.072	0.074	0.074	0.072	0.072	0.078	0.070	0.070	0.074	"H2O
Temp:	69	69	69	69	70	70	70	69	69	°F

V_{strav} 18.47 ft/sec V_{scent} 18.61 ft/sec F_p 0.993

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)													Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
0	0.000	0.000			1.92	66	-0.56	1.57	66	-1.4	71	0.072			12.4		63	59	60	61	60	61	62	67	82	57	81	57	62	-0.018	0.06	-0.01
1	0.114	0.143	0.11	0.14	1.75	66	-0.26	1.33	66	-1.5	78	0.072	81	94	12.3	-0.025391	82	60	60	61	60	65	526	67	83	56	82	56	62	-0.059	0.73567	0
2	0.259	0.295	0.15	0.15	1.73	67	-0.68	1.31	66	-1.6	76	0.072	102	99	12.3	-0.028687	97	60	60	61	61	68	559	67	82	56	82	56	62	-0.054	3.01134	0.05
3	0.404	0.445	0.15	0.15	1.71	67	-0.68	1.32	66	-1.6	75	0.072	102	98	12.3	-0.032897	102	60	61	62	61	69	496	66	81	57	82	56	62	-0.047	2.657	0.06
4	0.547	0.596	0.14	0.15	1.66	67	-0.25	1.30	66	-1.5	77	0.072	101	99	12.2	-0.075867	112	60	61	62	62	71	515	66	81	57	82	56	63	-0.058	2.70267	0.05
5	0.689	0.745	0.14	0.15	1.65	67	-0.66	1.29	66	-1.5	82	0.072	101	98	12.1	-0.116821	137	60	62	63	63	77	749	66	81	57	82	56	63	-0.071	3.34834	0.07
6	0.831	0.894	0.14	0.15	1.65	67	-0.26	1.26	66	-1.5	87	0.072	101	98	12.0	-0.050721	190	60	63	64	64	88	1034	66	82	57	82	56	63	-0.078	4.77401	0.14
7	0.973	1.043	0.14	0.15	1.64	67	-0.39	1.25	66	-1.6	93	0.072	102	99	11.9	-0.099426	229	60	64	65	65	97	1088	66	83	57	82	56	63	-0.085	5.26968	0.18
8	1.113	1.190	0.14	0.15	1.62	67	-0.36	1.24	66	-1.4	96	0.072	100	98	11.9	-0.078918	246	60	65	66	66	101	1047	66	83	57	82	57	63	-0.087	5.55534	0.14
9	1.254	1.341	0.14	0.15	1.66	67	-0.49	1.35	66	-1.8	98	0.072	101	101	11.8	-0.095337	253	60	67	68	68	103	979	66	83	57	82	57	63	-0.086	5.73101	0.15
10	1.396	1.495	0.14	0.15	1.66	67	-0.74	1.33	66	-1.8	98	0.072	102	103	11.6	-0.124207	266	60	69	70	70	107	955	66	83	57	82	57	63	-0.087	5.64668	0.13
11	1.538	1.647	0.14	0.15	1.64	67	-0.74	1.33	66	-1.7	104	0.072	103	102	11.5	-0.109009	286	60	72	72	73	113	946	66	83	57	82	57	63	-0.095	6.22235	0.17
12	1.680	1.799	0.14	0.15	1.64	67	-0.33	1.31	66	-1.6	110	0.072	103	102	11.4	-0.156616	312	60	75	74	75	119	984	66	83	58	82	57	63	-0.097	7.08801	0.19
13	1.820	1.950	0.14	0.15	1.59	67	-0.73	1.29	67	-1.8	116	0.072	102	102	11.2	-0.197571	327	60	80	77	78	124	908	3218	83	58	82	58	63	-0.103	7.66368	0.23
14	1.959	2.099	0.14	0.15	1.58	67	-0.7	1.27	67	-1.7	125	0.072	102	101	11.0	-0.180725	339	60	84	79	82	129	901	655	83	58	82	58	63	-0.105	8.78935	0.29
15	2.097	2.248	0.14	0.15	1.57	67	-0.76	1.23	67	-1.7	127	0.072	102	102	10.8	-0.170257	359	61	89	82	85	135	942	680	83	58	83	58	63	-0.107	9.55502	0.28
16	2.237	2.398	0.14	0.15	1.62	67	-0.62	1.31	67	-1.9	105	0.072	101	100	10.7	-0.154633	329	61	95	86	90	132	641	452	84	58	82	58	63	-0.084	9.63069	0.32
17	2.377	2.549	0.14	0.15	1.60	67	-0.79	1.28	67	-2.1	103	0.072	101	101	10.5	-0.146515	315	61	103	91	95	133	666	415	83	58	82	58	63	-0.085	9.70635	0.11
18	2.516	2.698	0.14	0.15	1.58	67	-0.85	1.31	67	-2.3	102	0.072	100	99	10.4	-0.168182	314	61	112	96	102	137	723	417	83	58	81	59	63	-0.086	11.252	0.09
19	2.655	2.849	0.14	0.15	1.56	67	-0.53	1.28	67	-2.4	100	0.072	100	101	10.2	-0.153656	320	61	123	103	110	143	770	422	83	59	81	59	63	-0.087	11.6177	0.06
20	2.794	2.998	0.14	0.15	1.60	67	-0.77	1.26	67	-2.4	102	0.072	100	99	10.0	-0.186249	333	62	134	111	118	152	819	432	82	59	82	59	63	-0.087	12.3634	0.06
21	2.934	3.146	0.14	0.15	1.59	67	-0.66	1.26	67	-2.2	102	0.072	101	99	9.9	-0.136261	345	62	145	119	127	160	812	435	83	59	82	59	63	-0.088	12.399	0.05
22	3.073	3.294	0.14	0.15	1.57	67	-0.87	1.26	67	-2.3	100	0.072	100	99	9.7	-0.15802	358	62	156	127	137	168	827	436	83	59	83	59	63	-0.087	12.2647	0.05
23	3.211	3.443	0.14	0.15	1.57	67	-0.58	1.30	67	-2.5	100	0.072	99	99	9.6	-0.148376	371	62	167	135	146	176	828	434	83	59	83	60	63	-0.087	11.8004	0.04
24	3.350	3.594	0.14	0.15	1.57	67	-0.8	1.29	67	-2.4	100	0.072	100	101	9.4	-0.147644	383	63	178	144	155	185	815	437	84	59	83	60	63	-0.088	11.836	0.04
25	3.489	3.744	0.14	0.15	1.57	67	-0.94	1.30	67	-2.3	101	0.072	100	100	9.3	-0.147004	393	63	189	152	165	192	813	436	84	59	83	60	64	-0.087	11.6517	0.04
26	3.627	3.895	0.14	0.15	1.56	68	-0.85	1.29	67	-2.4	102	0.072	99	101	9.2	-0.113617	403	64	199	160	174	200	822	435	84	60	83	60	64	-0.088	11.3974	0.05
27	3.765	4.045	0.14	0.15	1.57	68	-0.51	1.29	67	-2.5	102	0.072	99	100	9.0	-0.162353	412	64	209	169	183	207	821	433	84	60	83	60	64	-0.087	11.243	0.04
28	3.903	4.195	0.14	0.15	1.57	68	-0.93	1.28	67	-2.5	103	0.072	99	100	8.9	-0.141327	421	65	218	177	192	215	827	435	84	60	83	60	64	-0.087	11.4287	0.05
29	4.040	4.344	0.14	0.15	1.55	68	-0.57	1.29	67	-2.4	102	0.072	99	99	8.7	-0.167206	430	66	228	185	200	222	829	438	84	60	83	61	64	-0.087	11.3944	0.05
30	4.178	4.494	0.14	0.15	1.57	68	-0.87	1.27	67	-2.5	103	0.072	99	100	8.5	-0.163879	438	67	237	192	208	228	845	442	84	60	83	61	64	-0.089	11.02	0.04
31	4.317	4.643	0.14	0.15	1.74	68	-0.72	1.27	67	-2.5	103	0.072	100	100	8.4	-0.128876	451	68	246	200	216	236	912	454	83	60	83	61	64	-0.090	12.6957	0.05
32	4.457	4.792	0.14	0.15	1.62	68	-1.07	1.26	67	-2.4	103	0.072	101	100	8.2	-0.171936	463	69	254	207	224	243	907	456	83	60	83	61	64	-0.089	11.8514	0.04
33	4.598	4.941	0.14	0.15	1.62	68	-0.64	1.30	67	-2.6	105	0.072	102	100	8.1	-0.157349	473	70	262	214	232	250	941	461	83	60	83	61	64	-0.090	12.047	0.05
34	4.739	5.092	0.14	0.15	1.61	68	-1.03	1.30	67	-2.7	105	0.072	102	101	7.9	-0.193389	485	71	270	222	239	257	946	470	83	61	83	61	64	-0.091	13.2027	0.06

Wood Heater Test Data
Hign Burn Emissions Data

Run: 1

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 27-Nov-18
Beginning Clock Time: 11:11

Total Sampling Time: 277 min
Recording Interval: 1 min
Background Sample Volume: 36.649 cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) 0.998 (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.15		28.19	28.17 0

OMNI Equipment Numbers:

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: 18.82 ft/sec.
Initial Tunnel Flow: 199.9 scfm
Average Tunnel Flow: 191.2 scfm
Post-Test Leak Check (1): 0.000 cfm @ 14 in. Hg
Post-Test Leak Check (2): 0.000 cfm @ 15 in. Hg
Average Test Piece Fuel Moisture: 19.78 Dry Basis %

Technician Signature:

Velocity Traverse Data	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.072	0.074	0.074	0.072	0.072	0.078	0.070	0.070	0.074	"H2O
Temp:	69	69	69	69	70	70	70	69	69	°F

V_{strav} 18.47 ft/sec V_{scent} 18.61 ft/sec F_p 0.993

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)												Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
35	4.879	5.242	0.14	0.15	1.60	68	-0.68	1.28	67	-2.5	106	0.072	101	100	7.7	-0.18454	495	73	277	229	246	264	947	470	83	61	83	61	64	-0.091	12.3484	0.05
36	5.019	5.393	0.14	0.15	1.60	68	-0.96	1.28	67	-2.5	106	0.072	101	101	7.5	-0.196839	509	74	284	237	253	271	972	480	83	61	83	62	64	-0.092	13.924	0.06
37	5.159	5.542	0.14	0.15	1.61	68	-0.72	1.28	68	-2.5	107	0.072	101	100	7.3	-0.173156	519	76	290	244	259	278	1000	491	83	61	83	62	64	-0.094	13.8397	0.05
38	5.299	5.692	0.14	0.15	1.61	68	-0.72	1.29	68	-2.5	108	0.072	101	100	7.1	-0.199402	534	77	296	251	266	285	1008	496	83	61	83	62	64	-0.093	15.2154	0.08
39	5.438	5.842	0.14	0.15	1.58	68	-1.07	1.27	68	-2.5	108	0.072	101	100	7.0	-0.1745	544	79	302	258	272	291	1001	492	83	61	83	62	64	-0.094	13.701	0.06
40	5.578	5.991	0.14	0.15	1.60	68	-1.02	1.27	68	-2.7	109	0.072	101	100	6.8	-0.189331	552	82	307	265	277	297	994	492	83	61	83	62	64	-0.093	13.4267	0.06
41	5.718	6.140	0.14	0.15	1.61	68	-1.07	1.27	68	-2.7	109	0.072	101	100	6.6	-0.147491	560	85	313	272	283	303	998	492	83	61	83	62	64	-0.094	13.5424	0.06
42	5.858	6.290	0.14	0.15	1.59	68	-0.98	1.27	68	-2.5	108	0.072	101	100	6.4	-0.195374	566	87	320	280	287	308	989	489	83	61	83	62	64	-0.092	13.4381	0.06
43	5.996	6.439	0.14	0.15	1.59	68	-1.13	1.26	68	-2.6	109	0.072	100	100	6.2	-0.234558	573	90	327	287	291	314	1025	492	83	61	83	62	64	-0.094	13.8737	0.08
44	6.135	6.588	0.14	0.15	1.59	69	-0.85	1.27	68	-2.7	109	0.072	100	100	6.0	-0.14328	583	94	334	294	296	320	1066	501	83	62	83	63	64	-0.094	14.6794	0.08
45	6.274	6.736	0.14	0.15	1.57	69	-0.66	1.26	68	-2.5	110	0.072	101	99	5.9	-0.158936	593	97	342	301	301	327	1070	506	83	62	83	63	64	-0.094	14.7451	0.07
46	6.413	6.886	0.14	0.15	1.56	69	-1.1	1.26	68	-2.5	110	0.072	101	101	5.7	-0.144287	594	100	349	308	305	331	994	495	83	62	83	63	65	-0.092	12.9707	0.06
47	6.551	7.036	0.14	0.15	1.58	69	-1.14	1.28	68	-2.8	109	0.072	100	101	5.6	-0.148712	595	105	357	314	310	336	989	489	83	62	84	63	65	-0.093	13.0464	0.05
48	6.690	7.186	0.14	0.15	1.55	69	-1.13	1.27	68	-2.7	111	0.072	101	101	5.4	-0.15982	595	108	365	320	314	340	966	487	83	62	84	63	65	-0.092	12.7021	0.05
49	6.827	7.335	0.14	0.15	1.56	69	-1.13	1.28	68	-2.8	110	0.072	99	100	5.3	-0.146729	598	112	373	326	319	346	997	486	83	62	84	63	65	-0.092	13.1377	0.07
50	6.966	7.486	0.14	0.15	1.57	69	-0.81	1.28	68	-2.6	111	0.072	101	101	5.1	-0.17572	603	116	380	332	324	351	1029	488	83	62	84	64	65	-0.092	13.9634	0.11
51	7.104	7.635	0.14	0.15	1.54	69	-1.05	1.27	68	-2.8	110	0.072	100	100	4.9	-0.162354	609	120	387	337	328	356	1050	496	83	62	84	64	65	-0.092	14.1491	0.08
52	7.242	7.784	0.14	0.15	1.60	69	-0.77	1.31	68	-2.7	112	0.072	100	100	4.8	-0.123413	611	125	395	343	334	362	1012	496	83	62	84	64	65	-0.092	13.7947	0.05
53	7.382	7.935	0.14	0.15	1.60	69	-0.74	1.30	68	-2.9	109	0.072	101	101	4.7	-0.127807	610	129	402	349	338	366	984	489	83	62	84	64	65	-0.091	13.2704	0.04
54	7.521	8.086	0.14	0.15	1.57	69	-0.81	1.30	68	-2.7	111	0.072	101	101	4.6	-0.138764	608	132	409	354	343	369	963	484	84	62	84	64	65	-0.091	12.6061	0.05
55	7.660	8.238	0.14	0.15	1.59	69	-0.85	1.28	68	-2.7	107	0.072	100	102	4.4	-0.139984	604	137	416	359	347	373	932	481	84	62	84	64	65	-0.090	12.0817	0.04
56	7.800	8.388	0.14	0.15	1.59	69	-0.97	1.30	68	-2.8	111	0.072	101	101	4.3	-0.12735	600	142	424	364	352	376	922	477	83	62	83	64	65	-0.090	12.0574	0.03
57	7.940	8.539	0.14	0.15	1.59	69	-0.72	1.29	69	-2.7	108	0.072	101	101	4.2	-0.109314	596	146	431	369	356	380	917	474	83	62	83	64	65	-0.088	12.0431	0.03
58	8.079	8.690	0.14	0.15	1.58	69	-1.03	1.28	68	-2.7	108	0.072	100	101	4.1	-0.121643	592	150	438	374	361	383	906	470	82	63	83	64	65	-0.089	11.9087	0.03
59	8.218	8.841	0.14	0.15	1.59	69	-0.89	1.30	69	-2.8	109	0.072	100	101	3.9	-0.138214	587	155	445	378	366	386	894	465	81	63	82	64	65	-0.089	11.7744	0.03
60	8.358	8.992	0.14	0.15	1.57	69	-1.08	1.29	69	-2.8	109	0.072	101	101	3.8	-0.109039	584	159	452	382	370	389	900	465	81	63	82	64	65	-0.088	11.7901	0.03
61	8.500	9.143	0.14	0.15	2.06	69	-0.78	1.29	69	-2.8	107	0.072	102	101	3.7	-0.127899	580	163	458	387	375	393	884	463	81	63	82	64	65	-0.089	11.6357	0.03
62	8.653	9.293	0.15	0.15	1.57	69	-0.54	1.30	69	-2.7	107	0.072	110	100	3.6	-0.088013	575	168	464	391	380	396	874	459	80	63	82	64	65	-0.088	11.5114	0.03
63	8.792	9.444	0.14	0.15	1.56	69	-0.16	1.29	69	-2.8	108	0.072	100	101	3.5	-0.110657	572	172	470	394	385	399	877	457	81	63	82	64	66	-0.087	11.5071	0.03
64	8.930	9.595	0.14	0.15	1.58	70	-0.23	1.29	69	-2.9	109	0.072	100	101	3.4	-0.086975	569	179	475	398	389	402	866	453	82	63	82	65	66	-0.086	11.3227	0.03
65	9.070	9.745	0.14	0.15	1.57	70	-0.64	1.30	69	-2.7	108	0.072	101	100	3.3	-0.12558	565	185	480	402	393	405	856	449	82	63	82	65	66	-0.086	11.2384	0.02
66	9.208	9.896	0.14	0.15	1.55	70	-0.26	1.28	69	-2.8	107	0.072	99	101	3.2	-0.024902	561	189	484	405	397	407	857	448	82	63	82	65	66	-0.088	11.3041	0.02
67	9.346	10.045	0.14	0.15	1.53	70	-0.23	1.26	69	-2.8	224	0.072	109	109	28.7	25.44913	562	214	490	409	401	415	764	560	83	63	83	65	66	-0.103	11.6397	0.1
68	9.484	10.194	0.14	0.15	1.55	70	-0.48	1.24	69	-2.8	126	0.072	101	101	28.5	-0.186706	546	211	495	412	404	414	674	445	84	63	83	65	66	-0.088	5.25542	0.16
69	9.620	10.342	0.14	0.15	1.53	70	-0.19	1.23	69	-2.8	120	0.072	99	100	28.4	-0.125061	549	212	498	415	406	416	915	465	84	63	83	65	66	-0.092	9.69108	0.05

Wood Heater Test Data
Hign Burn Emissions Data

Run: 1

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 27-Nov-18
Beginning Clock Time: 11:11

Total Sampling Time: 277 min
Recording Interval: 1 min
Background Sample Volume: 36.649 cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) 0.998 (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.15		28.19	28.17 0

OMNI Equipment Numbers:

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: 18.82 ft/sec.
Initial Tunnel Flow: 199.9 scfm
Average Tunnel Flow: 191.2 scfm
Post-Test Leak Check (1): 0.000 cfm @ 14 in. Hg
Post-Test Leak Check (2): 0.000 cfm @ 15 in. Hg
Average Test Piece Fuel Moisture: 19.78 Dry Basis %

Technician Signature:

Velocity Traverse Data	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.072	0.074	0.074	0.072	0.072	0.078	0.070	0.070	0.074	"H2O
Temp:	69	69	69	69	70	70	70	69	69	°F

V_{strav} 18.47 ft/sec V_{scent} 18.61 ft/sec F_p 0.993

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)												Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
70	9.758	10.488	0.14	0.15	1.55	70	-0.23	1.23	69	-3	115	0.072	100	98	28.2	-0.154786	553	217	499	417	407	419	930	470	84	63	83	65	66	-0.091	10.3268	0.05
71	9.897	10.638	0.14	0.15	1.58	70	-0.62	1.26	69	-3.1	116	0.072	101	101	28.1	-0.171081	555	225	498	418	408	421	942	473	84	63	83	65	66	-0.090	10.1324	0.05
72	10.036	10.786	0.14	0.15	1.57	70	-0.38	1.25	69	-3	110	0.072	100	99	27.9	-0.162537	541	231	497	418	407	419	931	473	84	63	83	65	66	-0.091	10.8281	0.04
73	10.175	10.937	0.14	0.15	1.58	70	-0.73	1.28	69	-3.1	109	0.072	100	101	27.8	-0.120666	526	234	486	417	405	414	932	465	84	63	83	65	66	-0.091	10.3538	0.05
74	10.315	11.086	0.14	0.15	1.59	70	-0.73	1.28	69	-3.2	109	0.072	101	100	27.6	-0.191345	515	238	473	416	403	409	921	459	85	63	84	65	66	-0.090	10.3394	0.04
75	10.454	11.236	0.14	0.15	1.57	70	-0.24	1.27	69	-3.3	109	0.072	100	100	27.5	-0.124085	505	241	457	415	400	404	925	455	85	63	84	65	66	-0.089	10.5051	0.04
76	10.593	11.385	0.14	0.15	1.59	70	-0.74	1.26	69	-3.2	107	0.072	100	99	27.3	-0.147827	498	246	443	414	397	400	928	450	85	63	84	65	67	-0.089	10.4508	0.04
77	10.733	11.535	0.14	0.15	1.58	70	-0.54	1.27	69	-3.3	107	0.072	101	100	27.2	-0.153076	490	248	429	413	394	395	924	448	85	63	85	65	67	-0.088	10.4964	0.04
78	10.872	11.683	0.14	0.15	1.57	70	-0.27	1.27	69	-3.4	106	0.072	100	99	27.0	-0.110962	485	250	417	412	391	391	933	445	85	63	85	65	67	-0.089	10.8821	0.04
79	11.011	11.833	0.14	0.15	1.58	70	-0.29	1.25	69	-3.4	105	0.072	100	100	26.9	-0.108704	480	251	405	410	388	387	930	444	85	63	85	65	68	-0.088	10.4478	0.04
80	11.150	11.984	0.14	0.15	1.59	70	-0.38	1.29	69	-3.6	106	0.072	100	101	26.8	-0.115112	476	251	394	408	385	383	931	441	85	63	85	66	68	-0.088	9.63343	0.05
81	11.290	12.134	0.14	0.15	1.56	70	-0.46	1.27	69	-3.6	105	0.072	101	100	26.7	-0.120544	472	253	384	406	382	379	938	441	85	63	85	66	68	-0.088	9.0891	0.06
82	11.429	12.282	0.14	0.15	1.58	70	-0.34	1.25	69	-3.6	105	0.072	100	99	26.6	-0.109925	468	251	375	403	378	375	925	438	85	63	85	66	69	-0.087	8.79477	0.06
83	11.568	12.430	0.14	0.15	1.59	70	-0.69	1.26	69	-3.7	105	0.072	100	99	26.5	-0.09729	462	252	366	400	375	371	910	434	85	63	85	66	69	-0.087	8.79043	0.05
84	11.707	12.578	0.14	0.15	1.58	70	-0.71	1.22	69	-3.7	106	0.072	100	99	26.4	-0.107788	457	252	357	398	371	367	904	431	85	63	85	66	69	-0.087	8.7361	0.05
85	11.846	12.722	0.14	0.14	1.57	70	-0.29	1.16	69	-3.9	104	0.072	100	96	26.3	-0.129455	452	251	350	394	368	363	900	428	85	63	85	66	69	-0.086	8.73177	0.04
86	11.985	12.870	0.14	0.15	1.57	70	-0.31	1.24	69	-4.6	104	0.072	100	99	26.2	-0.079529	446	253	342	391	365	359	891	425	85	63	85	66	69	-0.086	8.58744	0.04
87	12.125	13.019	0.14	0.15	1.58	71	-0.31	1.24	70	-5.2	104	0.072	100	99	26.1	-0.124085	441	251	336	388	362	356	887	423	85	63	85	66	69	-0.086	8.5831	0.05
88	12.263	13.167	0.14	0.15	1.56	71	-0.24	1.23	70	-6	104	0.072	99	98	25.9	-0.119079	437	250	329	385	359	352	890	423	85	63	85	66	69	-0.086	8.71877	0.05
89	12.402	13.316	0.14	0.15	1.58	71	-0.25	1.23	70	-7.1	104	0.072	100	99	25.8	-0.1026	433	250	323	382	356	349	891	424	85	63	85	66	69	-0.086	8.83444	0.05
90	12.542	13.464	0.14	0.15	1.57	71	-0.37	1.28	70	-8.8	104	0.072	100	98	25.7	-0.083741	430	250	318	379	353	346	894	423	85	64	85	66	69	-0.086	8.88011	0.04
91	12.680	13.612	0.14	0.15	1.56	71	-0.45	1.20	70	-11.1	103	0.072	99	98	25.6	-0.118286	427	247	313	376	350	343	896	422	85	63	85	67	69	-0.085	8.88578	0.05
92	12.820	13.753	0.14	0.14	1.58	71	-0.29	1.05	70	-12.4	103	0.072	100	94	25.5	-0.111328	425	248	309	373	348	341	899	422	85	64	85	67	69	-0.085	8.89144	0.05
93	12.959	13.884	0.14	0.13	1.57	71	-0.26	1.10	70	-12.2	104	0.072	100	87	25.4	-0.102661	423	245	305	370	345	338	905	422	85	64	85	67	69	-0.085	8.84711	0.05
94	13.097	14.034	0.14	0.15	1.55	71	-0.26	1.29	70	-1.5	105	0.072	99	100	25.3	-0.122192	422	242	301	367	342	335	912	423	85	64	84	67	69	-0.085	8.74278	0.05
95	13.237	14.184	0.14	0.15	1.57	71	-0.71	1.29	70	-1.7	104	0.072	100	100	25.2	-0.103577	421	241	297	365	340	333	914	423	85	64	85	66	69	-0.085	8.64845	0.05
96	13.376	14.336	0.14	0.15	1.55	71	-0.29	1.30	70	-1.5	102	0.072	100	101	25.1	-0.113892	419	241	293	362	337	330	899	421	84	64	86	66	69	-0.085	8.73412	0.05
97	13.515	14.487	0.14	0.15	1.56	71	-0.54	1.30	70	-1.5	103	0.072	100	100	25.0	-0.087585	416	241	290	359	335	328	893	419	84	64	86	66	69	-0.084	8.81978	0.04
98	13.653	14.638	0.14	0.15	1.57	71	-0.75	1.29	70	-1.7	103	0.072	99	100	24.9	-0.116883	414	238	287	357	332	326	889	418	84	64	87	66	69	-0.084	8.72545	0.05
99	13.793	14.790	0.14	0.15	1.56	71	-0.74	1.30	70	-1.7	103	0.072	100	101	24.8	-0.094116	412	236	283	355	330	323	888	417	84	64	87	66	69	-0.085	8.67112	0.05
100	13.931	14.941	0.14	0.15	1.55	71	-0.28	1.30	70	-1.6	103	0.072	99	100	24.7	-0.086242	410	235	281	353	328	321	885	415	84	64	87	66	69	-0.083	8.69679	0.04
101	14.070	15.092	0.14	0.15	1.56	71	-0.56	1.29	70	-1.5	103	0.072	100	100	24.6	-0.115418	408	236	278	351	326	320	887	413	83	64	87	66	69	-0.083	8.66245	0.05
102	14.209	15.244	0.14	0.15	1.57	71	-0.68	1.30	70	-1.7	102	0.072	100	101	24.5	-0.085876	407	234	275	349	324	318	897	415	83	64	87	66	69	-0.084	8.63812	0.05
103	14.348	15.395	0.14	0.15	1.54	71	-0.25	1.30	70	-1.5	103	0.072	100	100	24.4	-0.123352	408	233	273	347	322	317	912	417	83	64	87	66	69	-0.085	8.52379	0.06
104	14.486	15.547	0.14	0.15	1.56	71	-0.73	1.29	70	-1.5	102	0.072	99	101	24.3	-0.113709	407	232	270	345	320	315	909	418	83	64	86	66	69	-0.085	8.47946	0.05

Wood Heater Test Data
Hign Burn Emissions Data

Run: 1

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 27-Nov-18
Beginning Clock Time: 11:11

Total Sampling Time: 277 min
Recording Interval: 1 min
Background Sample Volume: 36.649 cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) 0.998 (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.15		28.19	28.17 0

OMNI Equipment Numbers:

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: 18.82 ft/sec.
Initial Tunnel Flow: 199.9 scfm
Average Tunnel Flow: 191.2 scfm
Post-Test Leak Check (1): 0.000 cfm @ 14 in. Hg
Post-Test Leak Check (2): 0.000 cfm @ 15 in. Hg
Average Test Piece Fuel Moisture: 19.78 Dry Basis %

Technician Signature:

Velocity Traverse Data	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.072	0.074	0.074	0.072	0.072	0.078	0.070	0.070	0.074	"H2O
Temp:	69	69	69	69	70	70	70	69	69	°F

V_{strav} 18.47 ft/sec V_{scent} 18.61 ft/sec F_p 0.993

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)												Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
105	14.625	15.698	0.14	0.15	1.57	71	-0.65	1.31	70	-1.6	103	0.072	100	100	24.2	-0.064636	406	231	268	343	318	313	905	418	83	64	84	66	69	-0.085	8.45513	0.05
106	14.764	15.850	0.14	0.15	1.54	71	-0.62	1.29	70	-1.5	103	0.072	100	101	24.1	-0.08844	405	232	266	342	316	312	902	416	83	64	83	66	69	-0.085	8.48079	0.05
107	14.902	16.001	0.14	0.15	1.56	71	-0.32	1.29	70	-1.6	103	0.072	99	100	24.0	-0.1026	404	230	264	340	315	311	903	415	83	64	83	66	69	-0.085	8.50646	0.05
108	15.041	16.152	0.14	0.15	1.57	71	-0.75	1.30	70	-1.7	101	0.072	99	100	23.9	-0.100647	403	229	262	338	313	309	905	415	83	64	84	66	69	-0.084	8.59213	0.05
109	15.180	16.304	0.14	0.15	1.54	71	-0.74	1.30	70	-1.7	102	0.072	100	101	23.8	-0.129517	402	228	261	337	312	308	901	415	83	63	84	66	69	-0.084	8.6778	0.05
110	15.318	16.455	0.14	0.15	1.56	71	-0.53	1.29	70	-1.5	103	0.072	99	100	23.7	-0.097595	401	228	259	335	310	307	902	415	83	63	84	66	70	-0.083	8.78347	0.05
111	15.457	16.607	0.14	0.15	1.57	71	-0.32	1.31	70	-1.7	103	0.072	100	101	23.6	-0.083984	401	227	258	334	309	306	908	415	83	63	84	66	69	-0.083	8.94913	0.05
112	15.595	16.759	0.14	0.15	1.54	71	-0.25	1.29	70	-1.6	102	0.072	99	101	23.4	-0.148621	401	227	256	332	308	305	909	416	83	63	84	66	69	-0.083	9.2048	0.05
113	15.734	16.910	0.14	0.15	1.56	71	-0.48	1.29	70	-1.6	102	0.072	100	100	23.3	-0.119446	401	227	256	331	307	304	903	414	83	63	83	65	69	-0.083	9.54047	0.04
114	15.873	17.061	0.14	0.15	1.57	71	-0.76	1.30	70	-1.7	103	0.072	100	100	23.2	-0.157043	402	226	256	330	306	304	908	414	83	62	83	65	69	-0.083	10.1661	0.04
115	16.013	17.213	0.14	0.15	1.62	71	-0.59	1.30	70	-1.7	103	0.072	100	101	23.0	-0.134216	404	225	256	330	305	304	926	417	83	62	83	65	69	-0.082	11.0618	0.04
116	16.153	17.363	0.14	0.15	1.61	71	-0.59	1.29	71	-1.7	104	0.072	100	100	22.9	-0.165162	409	225	257	330	305	305	952	425	83	62	83	65	69	-0.084	11.9375	0.04
117	16.295	17.515	0.14	0.15	1.63	71	-0.76	1.30	71	-1.5	104	0.072	102	101	22.7	-0.165588	416	226	259	331	305	307	973	430	83	62	83	65	69	-0.084	12.8031	0.03
118	16.436	17.666	0.14	0.15	1.63	72	-0.62	1.29	71	-1.7	105	0.072	101	100	22.5	-0.189514	426	227	261	333	306	311	1021	437	83	62	83	65	69	-0.086	14.1788	0.08
119	16.577	17.817	0.14	0.15	1.63	72	-0.34	1.29	71	-1.6	104	0.072	101	100	22.4	-0.153015	438	226	265	335	307	314	1043	443	83	62	83	65	69	-0.086	14.9845	0.07
120	16.718	17.968	0.14	0.15	1.61	72	-0.82	1.28	71	-1.6	105	0.072	101	100	22.2	-0.14679	449	225	270	336	309	318	1052	447	83	62	83	64	70	-0.085	14.2901	0.03
121	16.859	18.119	0.14	0.15	1.63	72	-0.36	1.30	71	-1.5	105	0.072	101	100	22.1	-0.143127	459	227	276	337	313	322	1045	448	83	62	83	64	70	-0.086	13.6758	0.03
122	17.001	18.270	0.14	0.15	1.63	72	-0.69	1.29	71	-1.5	104	0.072	102	100	21.9	-0.13617	465	227	281	339	316	326	1029	447	83	62	83	64	70	-0.086	13.2315	0.03
123	17.143	18.422	0.14	0.15	1.63	72	-0.57	1.29	71	-1.6	105	0.072	102	101	21.8	-0.161865	471	227	287	339	319	329	1027	448	83	61	83	64	70	-0.086	13.0471	0.02
124	17.284	18.573	0.14	0.15	1.60	72	-0.38	1.30	71	-1.7	105	0.072	101	100	21.6	-0.151855	475	225	292	340	323	331	1029	448	83	61	83	64	70	-0.086	12.9928	0.03
125	17.425	18.724	0.14	0.15	1.62	72	-0.82	1.29	71	-1.6	105	0.072	101	100	21.5	-0.151368	479	227	298	340	326	334	1023	448	83	61	84	64	70	-0.085	12.8285	0.03
126	17.566	18.875	0.14	0.15	1.63	72	-0.32	1.29	71	-1.5	105	0.072	101	100	21.3	-0.133667	481	224	302	340	329	335	1021	449	83	61	84	64	70	-0.087	12.6142	0.03
127	17.708	19.026	0.14	0.15	1.62	72	-0.62	1.29	71	-1.5	106	0.072	102	100	21.2	-0.131652	484	225	307	340	332	338	1020	453	83	61	84	64	70	-0.087	12.0598	0.05
128	17.849	19.177	0.14	0.15	1.62	72	-0.43	1.30	71	-1.5	105	0.072	101	100	21.1	-0.127381	485	225	310	340	335	339	997	449	83	61	84	64	70	-0.086	11.8655	0.05
129	17.990	19.329	0.14	0.15	1.60	72	-0.63	1.29	71	-1.7	105	0.072	101	101	20.9	-0.127624	483	225	313	340	337	340	973	446	83	61	84	64	70	-0.087	11.6312	0.04
130	18.131	19.480	0.14	0.15	1.63	72	-0.55	1.29	71	-1.6	105	0.072	101	100	20.8	-0.164612	480	225	316	340	339	340	967	444	83	61	84	64	70	-0.086	11.5868	0.03
131	18.272	19.631	0.14	0.15	1.63	72	-0.81	1.29	71	-1.6	106	0.072	101	100	20.7	-0.104736	478	225	318	340	341	340	964	442	83	61	84	64	70	-0.086	11.5625	0.03
132	18.413	19.782	0.14	0.15	1.62	72	-0.35	1.28	71	-1.7	106	0.072	101	100	20.5	-0.141419	477	225	320	340	343	341	969	440	83	61	84	63	70	-0.086	11.4782	0.03
133	18.554	19.933	0.14	0.15	1.61	72	-0.67	1.30	71	-1.5	105	0.072	101	100	20.4	-0.109009	476	224	321	340	345	341	970	441	83	61	84	63	70	-0.086	11.4438	0.03
134	18.695	20.085	0.14	0.15	1.61	72	-0.37	1.29	71	-1.5	106	0.072	101	101	20.3	-0.146606	474	225	321	340	346	341	970	441	83	60	84	63	71	-0.085	11.4195	0.03
135	18.836	20.236	0.14	0.15	1.62	72	-0.58	1.29	71	-1.5	105	0.072	101	100	20.1	-0.149597	473	225	321	340	347	341	966	440	83	60	84	63	71	-0.085	11.5652	0.03
136	18.978	20.386	0.14	0.15	1.60	72	-0.67	1.29	71	-1.6	105	0.072	102	100	20.0	-0.089905	473	226	320	340	348	341	976	440	83	60	84	63	71	-0.085	11.6108	0.03
137	19.118	20.538	0.14	0.15	1.60	72	-0.53	1.30	71	-1.7	105	0.072	100	101	19.9	-0.132019	474	226	320	340	349	342	1000	442	83	60	84	63	71	-0.085	11.4865	0.04
138	19.259	20.689	0.14	0.15	1.61	72	-0.79	1.28	71	-1.6	105	0.072	101	100	19.8	-0.125794	477	226	319	339	350	342	1006	441	84	60	84	63	71	-0.085	11.3822	0.04
139	19.400	20.840	0.14	0.15	1.61	72	-0.69	1.29	71	-1.6	104	0.072	101	100	19.7	-0.119079	478	227	317	339	350	342	999	442	83	60	84	63	71	-0.085	11.2678	0.04

Wood Heater Test Data
Hign Burn Emissions Data

Run: 1

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 27-Nov-18
Beginning Clock Time: 11:11

Total Sampling Time: 277 min
Recording Interval: 1 min
Background Sample Volume: 36.649 cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) 0.998 (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.15		28.19	28.17 0

OMNI Equipment Numbers:

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: 18.82 ft/sec.
Initial Tunnel Flow: 199.9 scfm
Average Tunnel Flow: 191.2 scfm
Post-Test Leak Check (1): 0.000 cfm @ 14 in. Hg
Post-Test Leak Check (2): 0.000 cfm @ 15 in. Hg
Average Test Piece Fuel Moisture: 19.78 Dry Basis %

Technician Signature:

Velocity Traverse Data	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.072	0.074	0.074	0.072	0.072	0.078	0.070	0.070	0.074	"H2O
Temp:	69	69	69	69	70	70	70	69	69	°F

V_{strav} 18.47 ft/sec V_{scent} 18.61 ft/sec F_p 0.993

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)												Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
140	19.542	20.992	0.14	0.15	1.62	72	-0.57	1.28	71	-1.7	105	0.072	102	101	19.6	-0.105957	478	226	316	339	351	342	987	443	83	60	84	63	71	-0.085	11.1835	0.04
141	19.683	21.143	0.14	0.15	1.59	72	-0.71	1.29	71	-1.5	105	0.072	101	100	19.4	-0.143372	478	226	316	339	351	342	984	442	84	60	84	63	71	-0.085	11.0892	0.04
142	19.823	21.294	0.14	0.15	1.61	72	-0.72	1.30	71	-1.6	105	0.072	100	100	19.3	-0.101257	478	226	315	338	351	342	974	441	84	60	84	63	71	-0.085	11.0748	0.04
143	19.964	21.446	0.14	0.15	1.62	72	-0.53	1.28	71	-1.5	104	0.072	101	101	19.2	-0.119385	476	225	314	338	351	341	963	439	84	60	84	63	71	-0.085	11.0605	0.03
144	20.106	21.596	0.14	0.15	1.61	72	-0.74	1.29	71	-1.6	105	0.072	102	100	19.0	-0.170776	474	225	314	338	352	341	960	437	84	60	84	62	71	-0.085	11.1362	0.03
145	20.247	21.747	0.14	0.15	1.61	72	-0.82	1.30	71	-1.6	105	0.072	101	100	18.9	-0.086121	472	225	314	338	353	340	953	437	84	60	84	62	71	-0.084	11.1818	0.03
146	20.387	21.899	0.14	0.15	1.60	72	-0.33	1.29	71	-1.7	105	0.072	100	101	18.8	-0.133789	470	225	313	338	353	340	951	435	84	60	84	62	71	-0.084	11.2675	0.03
147	20.528	22.050	0.14	0.15	1.62	72	-0.63	1.28	72	-1.7	105	0.072	101	100	18.7	-0.129944	469	226	313	338	354	340	949	434	84	60	84	62	71	-0.085	11.3332	0.03
148	20.669	22.201	0.14	0.15	1.62	72	-0.81	1.30	72	-1.6	105	0.072	101	100	18.6	-0.096863	468	225	314	338	355	340	946	433	84	60	84	62	71	-0.084	11.4188	0.03
149	20.810	22.353	0.14	0.15	1.61	72	-0.54	1.29	72	-1.6	105	0.072	101	101	18.4	-0.140197	466	225	314	338	356	340	940	433	84	60	84	62	71	-0.086	11.4545	0.03
150	20.950	22.504	0.14	0.15	1.60	72	-0.63	1.29	72	-1.7	105	0.072	100	100	18.3	-0.121277	465	226	314	338	357	340	938	432	84	59	84	62	71	-0.086	11.4802	0.03
151	21.091	22.655	0.14	0.15	1.61	73	-0.57	1.30	72	-1.5	105	0.072	101	100	18.2	-0.145691	464	226	315	339	358	340	938	433	84	60	84	62	71	-0.085	11.4858	0.03
152	21.232	22.806	0.14	0.15	1.62	73	-0.77	1.28	72	-1.7	105	0.072	101	100	18.1	-0.103211	464	227	316	339	359	341	937	433	84	59	84	62	71	-0.086	11.6115	0.03
153	21.374	22.957	0.14	0.15	1.61	73	-0.33	1.29	72	-1.5	105	0.072	102	100	17.9	-0.156311	464	226	317	340	360	341	937	433	84	59	84	62	71	-0.086	11.7272	0.03
154	21.514	23.108	0.14	0.15	1.60	73	-0.82	1.29	72	-1.7	105	0.072	100	100	17.8	-0.116821	464	226	319	340	361	342	938	435	84	59	84	62	71	-0.087	11.8229	0.03
155	21.655	23.260	0.14	0.15	1.61	73	-0.43	1.29	72	-1.5	105	0.072	101	101	17.7	-0.133911	464	227	321	341	363	343	941	434	84	59	84	62	72	-0.086	11.9085	0.03
156	21.795	23.411	0.14	0.15	1.61	73	-0.33	1.28	72	-1.7	105	0.072	100	100	17.5	-0.130859	464	227	323	341	364	344	941	434	84	59	84	62	72	-0.086	11.9642	0.03
157	21.936	23.562	0.14	0.15	1.60	73	-0.52	1.29	72	-1.6	104	0.072	101	100	17.4	-0.095459	464	228	326	342	366	345	940	435	84	59	84	62	71	-0.087	12.0099	0.03
158	22.076	23.713	0.14	0.15	1.58	73	-0.34	1.29	72	-1.5	105	0.072	100	100	17.3	-0.160096	464	228	329	343	368	346	936	434	84	59	84	62	72	-0.086	12.0355	0.03
159	22.216	23.864	0.14	0.15	1.59	73	-0.72	1.28	72	-1.5	105	0.072	100	100	17.2	-0.105774	463	228	332	344	369	347	936	434	84	59	84	62	72	-0.086	12.0312	0.03
160	22.356	24.016	0.14	0.15	1.58	73	-0.77	1.29	72	-1.5	106	0.072	100	101	17.0	-0.111816	463	228	334	345	371	348	930	432	84	59	84	61	72	-0.085	11.9569	0.03
161	22.495	24.166	0.14	0.15	1.56	73	-0.7	1.28	72	-1.6	105	0.072	99	99	16.9	-0.14154	462	229	337	346	373	349	926	431	84	59	84	61	72	-0.085	11.8525	0.02
162	22.634	24.317	0.14	0.15	1.58	73	-0.35	1.29	72	-1.6	104	0.072	99	100	16.8	-0.12262	461	230	340	346	374	350	921	431	84	59	84	61	72	-0.085	11.7082	0.02
163	22.773	24.469	0.14	0.15	1.59	73	-0.44	1.28	72	-1.5	105	0.072	99	101	16.7	-0.123657	460	231	343	347	376	351	923	431	84	59	84	61	72	-0.086	11.6639	0.02
164	22.912	24.620	0.14	0.15	1.55	73	-0.74	1.29	72	-1.6	105	0.072	99	100	16.5	-0.122315	460	231	346	348	378	353	923	430	84	59	84	61	72	-0.084	11.6095	0.02
165	23.051	24.771	0.14	0.15	1.57	73	-0.4	1.29	72	-1.5	105	0.072	99	100	16.4	-0.101013	459	230	348	349	379	353	924	430	84	59	84	61	72	-0.085	11.5852	0.02
166	23.191	24.922	0.14	0.15	1.58	73	-0.46	1.28	72	-1.6	104	0.072	100	100	16.3	-0.11731	458	231	350	350	380	354	924	430	84	59	84	61	72	-0.085	11.5109	0.02
167	23.331	25.073	0.14	0.15	1.58	73	-0.35	1.29	72	-1.6	105	0.072	100	100	16.2	-0.089172	458	231	352	351	382	355	924	429	84	59	84	61	72	-0.085	11.4265	0.02
168	23.469	25.224	0.14	0.15	1.56	73	-0.64	1.29	72	-1.7	104	0.072	99	100	16.1	-0.15918	457	233	354	351	383	356	920	429	84	59	84	61	71	-0.084	11.2922	0.02
169	23.609	25.375	0.14	0.15	1.58	73	-0.37	1.29	72	-1.7	104	0.072	100	100	16.0	-0.095398	455	234	356	352	385	356	914	428	84	59	84	61	72	-0.084	11.1979	0.02
170	23.749	25.526	0.14	0.15	1.57	73	-0.36	1.29	72	-1.7	104	0.072	100	100	15.9	-0.092956	454	233	358	353	386	357	909	427	84	59	84	61	72	-0.084	11.1235	0.02
171	23.887	25.678	0.14	0.15	1.57	73	-0.37	1.29	72	-1.6	104	0.072	99	101	15.8	-0.095093	453	235	359	353	387	357	905	425	84	59	84	61	72	-0.083	11.0592	0.02
172	24.027	25.829	0.14	0.15	1.58	73	-0.41	1.28	72	-1.5	104	0.072	100	100	15.7	-0.126343	451	235	360	354	389	358	902	424	84	59	84	61	72	-0.082	10.9849	0.02
173	24.167	25.980	0.14	0.15	1.59	73	-0.73	1.30	72	-1.5	104	0.072	100	100	15.6	-0.110595	450	236	361	354	390	358	905	423	84	58	84	61	72	-0.083	10.9405	0.02
174	24.306	26.132	0.14	0.15	1.56	73	-0.83	1.28	72	-1.5	104	0.072	99	101	15.5	-0.091675	449	237	362	355	391	359	911	422	84	58	84	61	72	-0.083	10.8962	0.02

Wood Heater Test Data
Hign Burn Emissions Data

Run: 1

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 27-Nov-18
Beginning Clock Time: 11:11

Total Sampling Time: 277 min
Recording Interval: 1 min
Background Sample Volume: 36.649 cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) 0.998 (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.15		28.19	28.17 0

OMNI Equipment Numbers:

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: 18.82 ft/sec.
Initial Tunnel Flow: 199.9 scfm
Average Tunnel Flow: 191.2 scfm
Post-Test Leak Check (1): 0.000 cfm @ 14 in. Hg
Post-Test Leak Check (2): 0.000 cfm @ 15 in. Hg
Average Test Piece Fuel Moisture: 19.78 Dry Basis %

Technician Signature:

Velocity Traverse Data	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.072	0.074	0.074	0.072	0.072	0.078	0.070	0.070	0.074	"H2O
Temp:	69	69	69	69	70	70	70	69	69	°F

V_{strav} 18.47 ft/sec V_{scent} 18.61 ft/sec F_p 0.993

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)												Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
175	24.445	26.283	0.14	0.15	1.58	73	-0.63	1.29	72	-1.7	103	0.072	99	100	15.3	-0.124329	449	239	362	355	392	359	912	422	84	58	84	61	72	-0.083	10.8819	0.02
176	24.585	26.434	0.14	0.15	1.58	73	-0.4	1.29	72	-1.5	104	0.072	100	100	15.2	-0.104614	448	239	363	356	393	360	909	421	84	58	84	60	72	-0.084	10.9075	0.02
177	24.725	26.586	0.14	0.15	1.58	73	-0.36	1.29	72	-1.6	105	0.072	100	101	15.1	-0.087158	447	239	363	356	394	360	911	421	84	58	84	60	72	-0.084	10.9232	0.02
178	24.864	26.737	0.14	0.15	1.56	73	-0.45	1.29	73	-1.6	103	0.072	99	100	15.0	-0.109314	447	240	364	357	394	360	909	421	84	58	84	60	72	-0.084	10.8689	0.02
179	25.003	26.888	0.14	0.15	1.58	73	-0.82	1.29	73	-1.6	103	0.072	99	100	15.0	-0.074402	446	242	364	357	395	361	911	421	84	58	84	60	72	-0.084	10.8345	0.02
180	25.143	27.040	0.14	0.15	1.57	73	-0.5	1.29	73	-1.6	103	0.072	100	100	14.8	-0.112915	447	242	364	358	396	361	916	421	84	58	84	60	72	-0.084	10.7902	0.02
181	25.282	27.191	0.14	0.15	1.57	73	-0.51	1.29	73	-1.5	104	0.072	99	100	14.8	-0.096069	447	243	365	358	396	362	920	422	84	58	84	60	72	-0.084	10.7359	0.03
182	25.422	27.342	0.14	0.15	1.58	73	-0.79	1.30	73	-1.7	103	0.072	100	100	14.6	-0.115845	447	245	365	359	397	363	919	423	84	58	84	60	72	-0.085	10.6416	0.02
183	25.562	27.494	0.14	0.15	1.58	74	-0.7	1.28	73	-1.6	103	0.072	100	100	14.6	-0.075806	446	245	366	359	397	363	914	422	84	58	84	60	72	-0.083	10.5872	0.03
184	25.701	27.645	0.14	0.15	1.56	74	-0.6	1.29	73	-1.5	103	0.072	99	100	14.5	-0.099609	446	247	366	359	398	363	926	423	84	58	84	60	72	-0.084	10.4929	0.03
185	25.840	27.796	0.14	0.15	1.58	74	-0.38	1.29	73	-1.7	105	0.072	99	100	14.4	-0.072144	448	248	367	360	398	364	942	426	84	58	84	60	72	-0.084	10.2986	0.04
186	25.979	27.948	0.14	0.15	1.58	74	-0.43	1.29	73	-1.5	103	0.072	99	100	14.3	-0.11792	449	248	367	360	398	364	947	427	85	58	85	60	72	-0.084	10.1042	0.04
187	26.119	28.099	0.14	0.15	1.57	74	-0.75	1.29	73	-1.7	104	0.072	100	100	14.2	-0.089721	450	250	366	361	398	365	953	429	84	58	85	60	72	-0.085	10.0799	0.04
188	26.258	28.250	0.14	0.15	1.57	74	-0.78	1.30	73	-1.6	105	0.072	99	100	14.1	-0.080445	451	252	366	361	397	365	956	429	85	58	85	60	72	-0.084	10.0056	0.05
189	26.397	28.402	0.14	0.15	1.58	74	-0.84	1.28	73	-1.7	105	0.072	99	101	14.0	-0.095398	452	252	365	362	397	366	959	431	85	58	85	60	72	-0.084	9.91123	0.05
190	26.537	28.553	0.14	0.15	1.57	74	-0.38	1.28	73	-1.6	104	0.072	100	100	13.9	-0.096008	452	254	365	362	396	366	958	431	85	58	85	60	72	-0.084	9.9269	0.05
191	26.675	28.704	0.14	0.15	1.55	74	-0.55	1.30	73	-1.7	104	0.072	98	100	13.8	-0.070251	451	254	364	362	396	365	954	430	85	58	85	59	72	-0.084	9.91256	0.05
192	26.815	28.856	0.14	0.15	1.62	74	-0.85	1.29	73	-1.5	103	0.072	100	100	13.7	-0.10907	451	255	362	362	396	365	952	430	85	57	85	59	72	-0.084	9.86823	0.05
193	26.957	29.007	0.14	0.15	1.62	74	-0.52	1.28	73	-1.6	104	0.072	101	100	13.7	-0.065918	450	256	361	362	396	365	951	431	85	57	84	59	72	-0.084	9.7339	0.05
194	27.098	29.158	0.14	0.15	1.62	74	-0.9	1.30	73	-1.7	104	0.072	101	100	13.6	-0.099182	449	257	360	362	396	365	947	429	85	57	85	59	72	-0.084	9.62957	0.05
195	27.239	29.310	0.14	0.15	1.60	74	-0.42	1.28	73	-1.5	104	0.072	101	100	13.5	-0.099121	447	258	359	362	396	364	942	428	85	57	85	59	72	-0.083	9.57523	0.05
196	27.380	29.461	0.14	0.15	1.61	74	-0.67	1.29	73	-1.7	104	0.072	101	100	13.4	-0.084961	445	258	357	362	396	364	934	427	85	57	85	59	72	-0.084	9.4809	0.04
197	27.520	29.612	0.14	0.15	1.62	74	-0.43	1.29	73	-1.6	104	0.072	100	100	13.3	-0.078919	443	259	356	362	396	363	928	426	85	57	85	59	72	-0.083	9.42657	0.04
198	27.662	29.764	0.14	0.15	1.61	74	-0.68	1.28	73	-1.5	103	0.072	101	100	13.2	-0.085998	440	260	355	361	396	362	923	424	85	57	85	59	72	-0.083	9.38224	0.04
199	27.802	29.915	0.14	0.15	1.59	74	-0.67	1.28	73	-1.6	104	0.072	100	100	13.1	-0.100525	438	262	354	361	397	362	918	423	85	57	85	59	72	-0.083	9.33791	0.04
200	27.943	30.066	0.14	0.15	1.60	74	-0.91	1.30	73	-1.7	103	0.072	100	100	13.0	-0.083557	436	262	353	361	397	362	916	421	85	57	85	59	72	-0.083	9.28357	0.04
201	28.084	30.218	0.14	0.15	1.61	74	-0.82	1.29	73	-1.5	105	0.072	101	101	13.0	-0.075928	433	262	351	360	397	361	915	419	85	57	85	59	72	-0.084	9.22924	0.04
202	28.224	30.369	0.14	0.15	1.60	74	-0.74	1.28	73	-1.7	104	0.072	100	100	12.9	-0.05835	432	263	350	360	397	360	916	421	85	57	85	59	72	-0.083	9.09491	0.04
203	28.365	30.520	0.14	0.15	1.59	74	-0.51	1.30	73	-1.7	104	0.072	101	100	12.8	-0.078186	430	263	349	360	397	360	912	420	85	57	85	59	72	-0.082	9.05058	0.04
204	28.505	30.672	0.14	0.15	1.60	74	-0.71	1.28	73	-1.7	104	0.072	100	100	12.7	-0.075927	428	264	349	360	398	360	909	419	85	57	85	59	72	-0.083	9.00625	0.04
205	28.646	30.823	0.14	0.15	1.60	74	-0.43	1.29	73	-1.6	103	0.072	100	100	12.7	-0.067627	426	264	348	359	398	359	904	418	85	57	85	59	72	-0.082	9.00191	0.04
206	28.787	30.974	0.14	0.15	1.60	74	-0.8	1.29	73	-1.7	104	0.072	101	100	12.6	-0.089295	424	266	347	359	398	359	903	416	85	57	85	59	72	-0.082	8.97758	0.04
207	28.926	31.126	0.14	0.15	1.59	74	-0.57	1.29	73	-1.6	103	0.072	99	100	12.5	-0.091369	422	267	346	358	398	358	899	415	85	57	85	59	72	-0.082	8.94325	0.04
208	29.067	31.277	0.14	0.15	1.60	74	-0.49	1.29	73	-1.6	102	0.072	100	100	12.4	-0.059815	419	268	345	358	398	358	895	414	85	57	85	59	72	-0.082	8.93892	0.04
209	29.208	31.429	0.14	0.15	1.58	74	-0.71	1.30	73	-1.6	104	0.072	101	100	12.4	-0.080749	418	267	344	358	398	357	896	413	85	57	85	59	72	-0.082	8.92458	0.03

Wood Heater Test Data
Hign Burn Emissions Data

Run: 1

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 27-Nov-18
Beginning Clock Time: 11:11

Total Sampling Time: 277 min
Recording Interval: 1 min
Background Sample Volume: 36.649 cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) 0.998 (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.15		28.19	28.17 0

OMNI Equipment Numbers:

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: 18.82 ft/sec.
Initial Tunnel Flow: 199.9 scfm
Average Tunnel Flow: 191.2 scfm
Post-Test Leak Check (1): 0.000 cfm @ 14 in. Hg
Post-Test Leak Check (2): 0.000 cfm @ 15 in. Hg
Average Test Piece Fuel Moisture: 19.78 Dry Basis %

Technician Signature:

Velocity Traverse Data	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.072	0.074	0.074	0.072	0.072	0.078	0.070	0.070	0.074	"H2O
Temp:	69	69	69	69	70	70	70	69	69	°F

V_{strav} 18.47 ft/sec V_{scent} 18.61 ft/sec F_p 0.993

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)												Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
210	29.348	31.580	0.14	0.15	1.57	74	-0.54	1.28	73	-1.6	104	0.072	100	100	12.3	-0.080506	416	268	343	357	398	356	896	412	85	57	85	58	72	-0.081	8.92025	0.04
211	29.488	31.731	0.14	0.15	1.58	74	-0.59	1.28	73	-1.8	103	0.072	100	100	12.2	-0.065674	415	270	342	357	398	356	895	412	85	57	85	58	72	-0.083	8.91592	0.04
212	29.628	31.883	0.14	0.15	1.58	74	-0.45	1.29	73	-1.7	103	0.072	100	100	12.1	-0.093078	414	270	342	356	398	356	895	411	85	57	86	58	72	-0.082	8.91159	0.04
213	29.769	32.034	0.14	0.15	1.59	74	-0.75	1.29	73	-1.5	103	0.072	100	100	12.1	-0.042969	412	270	341	356	398	355	893	411	86	57	86	58	72	-0.082	8.89726	0.03
214	29.909	32.186	0.14	0.15	1.57	74	-0.69	1.28	73	-1.7	103	0.072	100	100	12.0	-0.103149	411	269	340	356	399	355	891	411	85	57	86	58	72	-0.083	8.89292	0.03
215	30.048	32.337	0.14	0.15	1.58	74	-0.62	1.30	73	-1.6	104	0.072	99	100	11.9	-0.058228	410	271	340	355	399	355	891	410	85	57	86	58	72	-0.083	8.89859	0.03
216	30.188	32.488	0.14	0.15	1.59	74	-0.92	1.29	73	-1.7	104	0.072	100	100	11.8	-0.088684	409	272	339	355	399	355	892	410	86	57	86	58	72	-0.082	8.92426	0.03
217	30.328	32.639	0.14	0.15	1.59	74	-0.84	1.28	73	-1.7	103	0.072	100	100	11.8	-0.0672	408	273	339	355	399	355	894	409	85	57	86	58	72	-0.081	8.92993	0.03
218	30.468	32.791	0.14	0.15	1.57	74	-0.79	1.29	73	-1.5	102	0.072	100	100	11.7	-0.085205	407	272	338	355	399	354	896	410	85	56	85	58	72	-0.081	8.9756	0.03
219	30.608	32.942	0.14	0.15	1.59	74	-0.56	1.29	73	-1.7	102	0.072	100	100	11.6	-0.05365	407	274	338	355	400	355	901	410	84	56	85	58	72	-0.081	9.02126	0.03
220	30.748	33.093	0.14	0.15	1.58	74	-0.43	1.28	73	-1.6	103	0.072	100	100	11.5	-0.08667	407	274	337	354	400	354	906	410	83	56	85	58	72	-0.081	9.04693	0.04
221	30.888	33.245	0.14	0.15	1.56	74	-0.86	1.29	73	-1.8	104	0.072	100	100	11.5	-0.07727	408	275	337	354	400	355	909	412	83	56	85	58	72	-0.082	8.9926	0.04
222	31.027	33.396	0.14	0.15	1.57	74	-0.45	1.29	73	-1.7	103	0.072	99	100	11.4	-0.07605	408	276	337	354	401	355	911	415	83	56	85	58	72	-0.081	8.98827	0.04
223	31.167	33.547	0.14	0.15	1.59	74	-0.57	1.28	73	-1.8	104	0.072	100	100	11.3	-0.085449	408	276	337	354	401	355	913	414	82	56	85	58	72	-0.081	8.98394	0.04
224	31.307	33.698	0.14	0.15	1.58	74	-0.55	1.29	73	-1.5	103	0.072	100	100	11.2	-0.092346	409	277	336	354	401	355	917	415	82	56	85	58	72	-0.082	8.9696	0.04
225	31.446	33.849	0.14	0.15	1.57	74	-0.91	1.29	73	-1.7	103	0.072	99	100	11.1	-0.080017	410	278	336	354	402	356	922	415	82	56	85	58	72	-0.081	8.94527	0.04
226	31.585	34.001	0.14	0.15	1.58	75	-0.7	1.28	73	-1.5	105	0.072	99	101	11.1	-0.057068	411	279	336	354	402	356	926	417	82	56	85	58	73	-0.081	8.94094	0.04
227	31.725	34.152	0.14	0.15	1.58	74	-0.59	1.27	73	-1.5	103	0.072	100	100	11.0	-0.098938	412	279	335	354	402	356	933	418	82	56	85	58	72	-0.081	8.95661	0.05
228	31.864	34.303	0.14	0.15	1.56	75	-0.93	1.29	74	-1.7	103	0.072	99	100	10.9	-0.071961	414	278	335	354	402	357	936	419	82	56	85	58	72	-0.082	8.95227	0.05
229	32.003	34.454	0.14	0.15	1.57	75	-0.48	1.28	74	-1.6	104	0.072	99	100	10.8	-0.085022	415	280	335	354	402	357	936	419	83	56	85	58	72	-0.082	8.92794	0.05
230	32.143	34.606	0.14	0.15	1.56	75	-0.81	1.28	74	-1.5	104	0.072	100	100	10.7	-0.086334	415	281	334	354	402	357	934	419	83	56	85	58	72	-0.082	8.88361	0.05
231	32.281	34.757	0.14	0.15	1.55	75	-0.58	1.29	74	-1.6	104	0.072	98	100	10.6	-0.086487	415	281	334	354	402	357	934	419	84	56	85	58	72	-0.082	8.84928	0.05
232	32.420	34.908	0.14	0.15	1.57	75	-0.77	1.29	74	-1.7	103	0.072	99	100	10.6	-0.042206	415	281	334	354	402	357	932	419	84	56	85	58	72	-0.082	8.81495	0.05
233	32.560	35.059	0.14	0.15	1.55	75	-0.63	1.28	74	-1.7	104	0.072	100	100	10.5	-0.096038	416	280	333	354	402	357	933	419	84	56	85	58	72	-0.082	8.79061	0.04
234	32.701	35.210	0.14	0.15	1.63	75	-0.68	1.29	74	-1.7	103	0.072	100	100	10.5	-0.038422	416	281	333	355	402	357	932	420	84	56	85	58	72	-0.082	8.77628	0.05
235	32.842	35.362	0.14	0.15	1.62	75	-0.99	1.29	74	-1.6	104	0.072	100	100	10.4	-0.040527	416	281	332	355	402	357	933	419	84	56	85	58	72	-0.081	8.77195	0.05
236	32.985	35.514	0.14	0.15	1.62	75	-1.03	1.29	74	-1.6	105	0.072	102	100	10.3	-0.129578	416	281	332	355	402	357	936	418	84	56	85	58	72	-0.082	8.76762	0.05
237	33.127	35.666	0.14	0.15	1.64	75	-0.76	1.30	74	-1.6	104	0.072	101	100	10.2	-0.049164	417	282	332	355	402	358	933	419	84	56	85	58	72	-0.082	8.76329	0.05
238	33.270	35.817	0.14	0.15	1.63	75	-0.59	1.29	74	-1.7	104	0.072	102	100	10.1	-0.086395	417	282	331	355	402	357	936	419	84	56	85	58	72	-0.082	8.78895	0.05
239	33.411	35.969	0.14	0.15	1.63	75	-0.61	1.28	74	-1.7	104	0.072	100	100	10.0	-0.101959	418	282	331	355	402	358	940	419	84	56	85	58	72	-0.082	8.84462	0.05
240	33.553	36.121	0.14	0.15	1.61	75	-0.78	1.30	74	-1.8	105	0.072	101	100	10.0	-0.068116	419	282	331	356	403	358	948	421	84	56	85	58	72	-0.083	8.71029	0.05
241	33.695	36.273	0.14	0.15	1.62	75	-0.73	1.29	74	-1.5	104	0.072	101	100	9.9	-0.065277	420	282	330	356	403	358	950	422	84	56	85	57	72	-0.083	8.64596	0.05
242	33.836	36.425	0.14	0.15	1.63	75	-0.83	1.30	74	-1.6	104	0.072	100	100	9.8	-0.138794	421	283	330	356	402	358	955	424	84	56	85	58	72	-0.084	8.64162	0.05
243	33.978	36.577	0.14	0.15	1.62	75	-1.04	1.28	74	-1.8	105	0.072	101	100	9.6	-0.182434	418	286	330	356	403	359	895	420	84	56	85	58	73	-0.083	11.5273	0.02
244	34.119	36.728	0.14	0.15	1.58	75	-0.96	1.28	74	-1.6	105	0.072	100	100	9.5	-0.14151	422	288	330	357	404	360	979	427	85	56	85	58	72	-0.084	15.193	0.02

Wood Heater Test Data
Hign Burn Emissions Data

Run: 1

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 27-Nov-18
Beginning Clock Time: 11:11

Total Sampling Time: 277 min
Recording Interval: 1 min
Background Sample Volume: 36.649 cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) 0.998 (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.15		28.19	28.17 0

OMNI Equipment Numbers:

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: 18.82 ft/sec.
Initial Tunnel Flow: 199.9 scfm
Average Tunnel Flow: 191.2 scfm
Post-Test Leak Check (1): 0.000 cfm @ 14 in. Hg
Post-Test Leak Check (2): 0.000 cfm @ 15 in. Hg
Average Test Piece Fuel Moisture: 19.78 Dry Basis %

Technician Signature:

Velocity Traverse Data	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.072	0.074	0.074	0.072	0.072	0.078	0.070	0.070	0.074	"H2O
Temp:	69	69	69	69	70	70	70	69	69	°F

V_{strav} 18.47 ft/sec V_{scent} 18.61 ft/sec F_p 0.993

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)													Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
245	34.259	36.879	0.14	0.15	1.58	75	-1.03	1.28	74	-1.8	106	0.072	100	100	9.3	-0.182739	433	287	330	359	407	363	1029	440	85	56	85	58	73	-0.087	17.3086	0.4
246	34.398	37.030	0.14	0.15	1.55	75	-0.67	1.29	74	-1.6	108	0.072	99	100	9.0	-0.223206	446	288	332	363	412	368	1036	447	85	56	85	57	72	-0.087	17.3943	0.38
247	34.535	37.180	0.14	0.15	1.40	75	-0.75	1.27	74	-1.6	108	0.072	98	99	8.9	-0.151947	461	289	334	367	417	374	1070	452	85	56	85	58	73	-0.088	17.72	0.89
248	34.660	37.331	0.13	0.15	1.19	75	-1.42	1.25	74	-1.6	108	0.072	89	100	8.7	-0.178985	476	288	337	372	422	379	1080	455	84	56	85	58	73	-0.088	17.8956	1.19
249	34.776	37.480	0.12	0.15	1.06	75	-1.52	1.26	74	-1.6	107	0.072	83	99	8.5	-0.190766	489	289	340	378	428	385	1076	458	84	56	85	58	73	-0.088	17.4913	0.94
250	34.905	37.630	0.13	0.15	1.57	75	-2.4	1.29	74	-1.9	108	0.072	92	99	8.3	-0.181335	502	288	344	384	434	390	1077	459	84	56	85	57	73	-0.088	17.657	0.63
251	35.042	37.781	0.14	0.15	1.56	75	-2.77	1.28	74	-1.9	108	0.072	98	100	8.2	-0.164673	513	291	348	390	440	396	1074	458	84	56	85	58	73	-0.088	17.4326	0.58
252	35.180	37.931	0.14	0.15	1.52	75	-3.49	1.29	74	-1.7	107	0.072	98	99	8.0	-0.15567	522	290	351	397	446	401	1066	457	84	56	85	58	74	-0.088	17.0283	0.55
253	35.319	38.083	0.14	0.15	1.53	75	-3.75	1.28	74	-1.7	107	0.072	99	101	7.9	-0.12558	529	290	355	403	452	406	1054	456	84	56	85	58	74	-0.088	16.724	0.43
254	35.456	38.234	0.14	0.15	1.54	75	-3.86	1.28	74	-1.9	108	0.072	98	100	7.8	-0.122589	533	289	359	410	457	410	1042	453	84	56	85	58	74	-0.088	16.3496	0.32
255	35.595	38.385	0.14	0.15	1.56	75	-4.42	1.29	74	-1.7	107	0.072	99	100	7.6	-0.138885	537	290	363	416	462	414	1029	450	84	56	85	58	74	-0.088	15.6953	0.22
256	35.733	38.536	0.14	0.15	1.53	75	-4.55	1.28	74	-1.7	107	0.072	98	100	7.5	-0.108674	538	289	367	423	467	417	1017	447	84	56	85	58	74	-0.087	15.211	0.11
257	35.870	38.686	0.14	0.15	1.55	75	-4.53	1.28	74	-1.9	106	0.072	98	99	7.4	-0.14212	537	288	370	429	471	419	996	442	84	56	85	58	75	-0.086	14.6466	0.04
258	36.009	38.838	0.14	0.15	1.56	75	-4.96	1.28	74	-1.6	107	0.072	99	101	7.2	-0.135864	535	287	373	435	476	421	986	440	84	56	85	58	74	-0.086	14.2523	0.02
259	36.147	38.988	0.14	0.15	1.52	75	-4.88	1.29	74	-1.7	107	0.072	98	99	7.2	-0.089111	533	287	375	440	480	423	976	436	84	56	85	58	74	-0.086	13.858	0.02
260	36.286	39.139	0.14	0.15	1.57	75	-4.96	1.28	74	-1.6	106	0.072	99	100	7.1	-0.104737	530	285	377	445	484	424	968	433	84	56	85	58	75	-0.085	13.4836	0.01
261	36.426	39.291	0.14	0.15	1.56	75	-4.99	1.27	74	-1.9	106	0.072	100	100	7.0	-0.092346	527	286	378	450	487	426	963	430	84	56	85	58	75	-0.085	13.1193	0.02
262	36.565	39.441	0.14	0.15	1.54	75	-4.92	1.29	74	-1.7	105	0.072	99	99	6.9	-0.110291	524	286	380	455	490	427	959	428	84	56	85	58	75	-0.084	12.985	0.01
263	36.703	39.592	0.14	0.15	1.55	75	-5.27	1.28	74	-1.7	106	0.072	98	100	6.7	-0.106231	521	285	380	458	494	428	955	428	84	56	85	58	75	-0.084	12.9006	0.02
264	36.842	39.744	0.14	0.15	1.53	75	-5.09	1.28	74	-1.9	106	0.072	99	100	6.7	-0.093231	518	284	381	462	497	428	954	425	84	56	85	58	75	-0.084	12.8663	0.01
265	36.980	39.894	0.14	0.15	1.52	75	-5.28	1.29	74	-1.8	106	0.072	98	99	6.6	-0.086396	516	286	381	465	501	430	957	424	84	56	85	58	75	-0.084	12.862	0.01
266	37.119	40.046	0.14	0.15	1.57	75	-5.29	1.28	74	-1.8	106	0.072	99	100	6.5	-0.105011	514	286	381	468	503	430	955	422	84	56	85	58	75	-0.083	12.8677	0.01
267	37.259	40.197	0.14	0.15	1.63	75	-6	1.28	74	-1.8	106	0.072	100	100	6.4	-0.087127	513	286	381	471	506	431	960	422	84	56	85	58	75	-0.084	12.9133	0.02
268	37.400	40.347	0.14	0.15	1.59	75	-5.9	1.28	74	-1.6	106	0.072	101	99	6.3	-0.085541	512	286	381	473	508	432	959	422	84	56	85	58	75	-0.083	12.619	0.01
269	37.539	40.499	0.14	0.15	1.58	75	-5.89	1.29	74	-1.6	105	0.072	99	100	6.2	-0.098816	510	284	380	476	511	432	950	422	84	56	85	58	75	-0.084	12.1647	0.01
270	37.680	40.650	0.14	0.15	1.60	75	-5.99	1.28	74	-1.7	105	0.072	100	100	6.1	-0.071198	507	287	380	478	513	433	936	419	84	56	85	58	75	-0.083	12.0103	0
271	37.821	40.801	0.14	0.15	1.58	75	-5.99	1.29	74	-1.9	105	0.072	100	100	6.0	-0.089355	504	285	379	480	516	433	929	418	84	56	85	58	75	-0.083	12.056	0
272	37.960	40.953	0.14	0.15	1.55	75	-6.03	1.28	74	-1.7	106	0.072	99	100	5.9	-0.099365	501	285	379	481	518	433	924	416	84	56	85	58	75	-0.083	12.1017	0
273	38.098	41.104	0.14	0.15	1.49	75	-5.89	1.28	74	-1.7	105	0.072	98	100	5.9	-0.067658	499	286	379	483	520	433	935	414	84	57	85	58	75	-0.083	12.1573	0.01
274	38.236	41.254	0.14	0.15	1.56	75	-6.01	1.29	74	-1.8	106	0.072	98	99	5.8	-0.067932	500	288	378	484	523	435	958	416	84	57	85	58	75	-0.083	11.653	0
275	38.374	41.406	0.14	0.15	1.54	75	-6.02	1.28	74	-1.6	105	0.072	98	100	5.7	-0.059143	498	287	377	485	525	434	940	414	84	57	85	58	75	-0.083	10.8487	0
276	38.512	41.557	0.14	0.15	1.55	75	-6.4	1.28	74	-1.9	104	0.072	98	100	5.7	-0.043457	495	287	376	486	527	434	930	413	84	57	85	58	75	-0.082	10.5743	0
277	38.650	41.708	0.14	0.15	1.50	75	-6.33	1.29	74	-1.7	103	0.072	98	100	5.7	0.008694	492	288	374	487	528	434	921	410	84	57	85	58	75	-0.083	10.37	0
Avg/Tot	38.650	41.708	0.14	0.15	1.59	72		1.28	71		105	0.072	100	100								373.2				59	84	61	69	-0.085		

Wood Heater Lab Data

Manufacturer:	Kuma Stoves	Equipment Numbers:	
Model:	K250 Series		
Tracking No.:	2330		
Project No.:	0123WN012E		
Run #:	1		
Date:	11/27/18		

TRAIN 1 (First Hour emissions)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	T76S	87.4	85.1	2.3
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe				0.0
E. Filter seals catch*	Seals				0.0

Sub-Total Total Particulate, mg: 2.3

TRAIN 1 (Post First Hour Change-out)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	T71AP	189.1	183.1	6.0
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe	21	114393.1	114391.8	1.3
E. Filter seals catch*	Seals	R685	3391.7	3391.6	0.1

Sub-Total Total Particulate, mg: 7.4

Train 1 Aggregate Total Particulate, mg: **9.7**

TRAIN 2

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	T71BP	186.9	183.0	3.9
B. Rear filter catch	Filter	T77S	89.6	85.0	4.6
C. Probe catch*	Probe	22	114345.0	114343.8	1.2
D. Filter seals catch*	Seals	R686	3384.7	3384.8	0.0

Total Particulate, mg: **9.7**

AMBIENT

Sample Component	Reagent	Filter # or Probe #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch*	Filter	D579	121.3	121.0	0.3

Total Particulate, mg: **0.3**

*Particulate catch that results in a negative number, is assumed to be zero for probes and seals, negative numbers for filters are assumed to be part of the seal weight.

Component	Equations:
A. Front filter catch	Final (mg) - Tare (mg) = Particulate, mg
B. Rear filter catch	Final (mg) - Tare (mg) = Particulate, mg
C. Probe catch	Final (mg) - Tare (mg) = Particulate, mg

Technician Signature: 

Wood Heater Test Results

Manufacturer: Kuma Stoves
Model: K250 Series
Project No.: 0123WN012E
Tracking No.: 2330
Run: 1
Test Date: 11/27/18

Average Tunnel Temperature	105	degrees Fahrenheit
Average Gas Velocity in Dilution Tunnel - vs	18.82	feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	11469.2	dscf/hour
Average Delta p	0.072	inches H20
Total Time of Test	277	minutes

	AMBIENT	SAMPLE TRAIN 1	SAMPLE TRAIN 2	FIRST HOUR FILTER (TRAIN 1)
Total Sample Volume - Vm	36.649 cubic feet	38.650 cubic feet	41.708 cubic feet	8.358 cubic feet
Average Gas Meter Temperature	69 degrees Fahrenheit	72 degrees Fahrenheit	71 degrees Fahrenheit	68 degrees Fahrenheit
Total Sample Volume (Standard Conditions) - Vmstd	34.328 dscf	36.159 dscf	38.426 dscf	7.878 dscf
Total Particulates - m_n	0.3 mg	9.7 mg	9.7 mg	2.3 mg
Particulate Concentration (dry-standard) - C_f/C_s	0.000009 grams/dscf	0.00027 grams/dscf	0.00025 grams/dscf	0.00029 grams/dscf
Total Particulate Emissions - E_T	0.46 grams	13.74 grams	12.90 grams	3.35 grams
Particulate Emission Rate	0.10 grams/hour	2.98 grams/hour	2.80 grams/hour	3.35 grams/hour
Emissions Factor		1.16 g/kg	1.09 g/kg	1.03 g/kg
Difference from Average Total Particulate Emissions		0.42 grams	0.42 grams	

Dual Train Comparison Results Are Acceptable

FINAL AVERAGE RESULTS

Complete Test Run	
Total Particulate Emissions - E_T	13.32 grams
Particulate Emission Rate	**2.89 grams/hour**
Emissions Factor	1.12 grams/kg
First Hour Emissions	
Total Particulate Emissions - E_T	3.35 grams
Particulate Emission Rate	3.35 grams/hour
Emissions Factor	1.03 grams/kg
7.5% of Average Total Particulate Emissions	1.00 grams

QUALITY CHECKS

Filter Temps < 90 °F	OK
Filter Face Velocity (47 mm)	OK
Dryer Exit Temp < 80F	OK
Leakage Rate	OK
Ambient Temp (55-90°F)	OK
Negative Probe Weight Eval.	OK
Pro-Rate Variation	OK
Gram per Kilogram <0.50	0.07
Train Precision ≤ 7.5%	4.72

Technician Signature:_____

Adjunct to ASTM E XXXX Wood Heater Cordwood Test Method - May 10, 2017 Version

Cordwood Fuel Load Calculators - 10 lb/ft^3 Nominal Load Density

Core 45-65% of Total Load Weight, Remainder 35-55% of Total Load Weight

Values to be input manually

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For All Usable Firebox Volumes - High Fire Test Only

Nominal Required Load Density (wet basis)	10	lb/ft^3				
Usable Firebox Volume	2.54	ft^3				
Total Nom. Load Wt. Target	25.40	lb				
Total Load Wt. Allowable Range	24.10	to	26.70	lb		
Core Target Wt. Allowable Range	11.40	to	16.50	lb		
Remainder Load Wt. Allowable Range	8.90	to	14.00	lb		
						Mid-Point
Core Load Pc. Wt. Allowable Range	3.80	to	6.40	lb		5.10
Remainder Load Pc. Wt. Allowable Range	2.50	to	14.00	lb		8.25
	Pc. #					
Core Load Piece Wt. Actual	1	4.97	lb	In Range		
	2	5.16	lb	In Range		
	3	5.04	lb	In Range		
Core Load Total. Wt. Actual		15.16	lb	In Range		
	Pc. #					
Remainder Load Piece Wt.	1	7.20	lb	In Range		
(1 to 3 Pcs.)	2	3.39	lb	In Range		
	3		lb	NA		
Remainder Load Tot. Wt. Act		10.59	lb	In Range		
Total Load Wt. Actual		25.75	lb	In Range		
Core % of Total Wt.		59%		In Range	45-65%	
Remainder % of Total Wt.		41%		In Range	35-55%	
Actual Load % of Nominal Target		101%		In Range	95-105%	
Actual Fuel Load Density		10.1	lb/ft^3			
Kindling and Start-up Fuel						
Maximim Kindling Wt. (20% of Tot. Load Wt.)		5.15	lb			
Actual Kindling Wt.		4.93	lb	In Range	19.2%	
Maximum Start-up Fuel Wt. (30% of Tot. Load Wt.)		7.73	lb			
Actual Start-up Fuel Wt.		7.61	lb	In Range	29.5%	
Allowable Residual Start-up Fuel Wt. Range	2.6	to	5.2	lb		Mid-Point
Actual Residual Start-up Fuel Wt.		3.2	lb	In Range		3.9
Total Wt. All Fuel Added (wet basis)		38.29	lb			
High Fire Test Run End Point Range	Low		High			Mid-Point
Based on Fuel Load Wt. (w/tares)	2.3	to	2.8	lb		2.6
Actual Fuel Load Ending Wt.		2.6	lb	In Range		

Fuel Piece Moisture Reading (%-dry basis)

1	2	3	Ave.		Pc. Wt. Dry Basis			
21.7	20.7	20.5	21.0	In Range	4.11	lb	1.86	kg
24	21.6	21.5	22.4	In Range	4.22	lb	1.91	kg
21.3	21.7	21.1	21.4	In Range	4.15	lb	1.88	kg
22.6	21	21.9	21.8	In Range	5.91	lb	2.68	kg
20.8	21.5	19.4	20.6	In Range	2.81	lb	1.27	kg
			NA	NA	NA	lb	NA	kg

Total Load Ave. MC (%-dry basis)	21.5	In Range		
Total Load Ave. MC % (wet basis)	17.7			
Total Test Load Weight (dry basis) →			21.19 lb	9.61 kg

Kindling Moisture (%-dry basis)

11.21	11.21	11.21	11.2	In Range	4.43	lb	2.01	kg

Start-up Fuel Moisture Readings (%-dry basis)

20.13	20.13	20.13	20.1	In Range	6.33	lb	2.87	kg

Total Wt. All Fuel Added (dry basis) →			31.96 lb	14.50 kg
Total Wt. All Fuel Burned (dry basis) →			26.2 lb	11.9 kg

OMNI-Test Laboratories, Inc.

Wood Heater Run Sheets

Client: Kuma Stoves Project Number: 0123WN012E Run Number: 1
Model: K250 Series Tracking Number: 2330 Date: 11/27/18
Test Crew: D Dau. S
OMNI Equipment ID numbers: 132, Smallscale, Fuelscale, 650, 2434, 371, 372, 410, 359, 592, 420, 637

Wood Heater Supplemental Data

Start Time: 11:11 Booth #: N/A
Stop Time: 15:48

Stack Gas Leak Check:
Initial: good Final: good

Sample Train Leak Check:
A: 0.0 @ 14 "Hg
B: 0.0 @ 15 "Hg

Calibrations: Span Gas CO_2: 12.4 CO: 2.48

	Pre Test		Post Test	
	Zero	Span	Zero	Span
Time	0954	0954	16:13	1614
CO_2	0.00	12.42	1.20	13.2
CO	0.000	2.484	-0.027	2.447

Air Velocity (ft/min): Initial: <50 Final: <50
Scale Audit (lbs): Initial: 10.0 Final: 10.0
Pitot Tube Leak Test: Initial: good Final: good
Stack Diameter (in): 6"
Induced Draft: 0.0
% Smoke Capture: 100 %
Flue Pipe Cleaned Prior to First Test in Series:
Date: 11/21/18 Initials: DN

	Initial	Middle	Ending
P_b (in/Hg)	28.15		28.19
RH (%)	53 ~~58~~ %		40 %
Ambient (°F)	62		75

Background Filter Volume: 39.649

Tunnel Traverse		
Microtector Reading	dP (in H_2O)	T(°F)
	.072	69
	.074	69
	.074	69
	.072	69
	~~.072~~ ~~.070~~	~~70~~ ~~69~~
	.078	70
	.070	70
	.070	69
Center:		
	.074	69

Tunnel Static Pressure (in H_2O):	
Beginning of Test	End of Test
-.110	-.110

Technician Signature: Date: 1/30/19

OMNI-Test Laboratories, Inc.

Wood Heater Run Sheets

Client: Kuma Stoves Project Number: 0123WN012E Run Number: 1
Model: K250 Series Tracking Number: 2330 Date: 11/27/14
Test Crew: BD Davis
OMNI Equipment ID numbers:

Wood Heater Run Notes

Air Control Settings

Primary: Fully open

Secondary: fixed

Tertiary/Pilot: N/A

Fan: on High

Preburn Notes

Time	Notes
0	Torch used for 25 seconds
40 sec	door closed.
15 min	bypass closed
	FAN off during handling and start up fuel load.

Test Notes

Sketch test fuel configuration:

See photo

Start up procedures & Timeline:

Bypass: open 1:15
Fuel loaded by: Loaded by 60 seconds
Door closed at: 1:15
Primary air: Fully open

Notes: FAN turned on High 5 min after fuel loaded.

Time	Notes
60	Changed Front filter in tray A
67	loaded fuel load
72	FAN on.
94	Changed Front Filter in tray B

Technician Signature: BD Davis Date: 1/30/15

Run 1

High Burn 1-minute data

Efficiency and Heat Output Results
Kindling and start-up fuel removed from calculations

Wood Heater Test Data
High Burn Efficiency Data

Run: 1

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 27-Nov-18
Beginning Clock Time: 11:11

Total Sampling Time: 209 min
Recording Interval: 1 min
Background Sample Volume: _____ cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) _____ (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.15		28.19	28.17

OMNI Equipment Numbers: _____

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: #DIV/0! ft/sec.
Initial Tunnel Flow: 199.9 scfm
Average Tunnel Flow: #DIV/0! scfm
Post-Test Leak Check (1): _____ cfm @ _____ in. Hg
Post-Test Leak Check (2): _____ cfm @ _____ in. Hg
Average Test Piece Fuel Moisture: 21.42 Dry Basis %

Technician Signature: _____

Velocity Traverse Data	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.072	0.074	0.074	0.072	0.072	0.078	0.070	0.070	0.074	"H2O
Temp:	69	69	69	69	70	70	70	69	69	°F

V_{strav} 18.47 ft/sec V_{scent} 18.61 ft/sec F_p 0.993

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)													Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
0															23.2		546	211	495	412	404	414	674	445					66	-0.088	5.26	0.16
1															23.0		549	212	498	415	406	416	915	465					66	-0.092	9.69	0.05
2															22.8		553	217	499	417	407	419	930	470					66	-0.091	10.33	0.05
3															22.7		555	225	498	418	408	421	942	473					66	-0.090	10.13	0.05
4															22.5		541	231	497	418	407	419	931	473					66	-0.091	10.83	0.04
5															22.3		526	234	486	417	405	414	932	465					66	-0.091	10.35	0.05
6															22.2		515	238	473	416	403	409	921	459					66	-0.090	10.34	0.04
7															22.0		505	241	457	415	400	404	925	455					66	-0.089	10.51	0.04
8															21.9		498	246	443	414	397	400	928	450					67	-0.089	10.45	0.04
9															21.8		490	248	429	413	394	395	924	448					67	-0.088	10.50	0.04
10															21.6		485	250	417	412	391	391	933	445					67	-0.089	10.88	0.04
11															21.5		480	251	405	410	388	387	930	444					68	-0.088	10.45	0.04
12															21.4		476	251	394	408	385	383	931	441					68	-0.088	9.63	0.05
13															21.3		472	253	384	406	382	379	938	441					68	-0.088	9.09	0.06
14															21.2		468	251	375	403	378	375	925	438					69	-0.087	8.79	0.06
15															21.0		462	252	366	400	375	371	910	434					69	-0.087	8.79	0.05
16															21.0		457	252	357	398	371	367	904	431					69	-0.087	8.74	0.05
17															20.8		452	251	350	394	368	363	900	428					69	-0.086	8.73	0.04
18															20.7		446	253	342	391	365	359	891	425					69	-0.086	8.59	0.04
19															20.6		441	251	336	388	362	356	887	423					69	-0.086	8.58	0.05
20															20.5		437	250	329	385	359	352	890	423					69	-0.086	8.72	0.05
21															20.4		433	250	323	382	356	349	891	424					69	-0.086	8.83	0.05
22															20.3		430	250	318	379	353	346	894	423					69	-0.086	8.88	0.04
23															20.2		427	247	313	376	350	343	896	422					69	-0.085	8.89	0.05
24															20.1		425	248	309	373	348	341	899	422					69	-0.085	8.89	0.05
25															20.0		423	245	305	370	345	338	905	422					69	-0.085	8.85	0.05
26															19.9		422	242	301	367	342	335	912	423					69	-0.085	8.74	0.05
27															19.7		421	241	297	365	340	333	914	423					69	-0.085	8.65	0.05
28															19.6		419	241	293	362	337	330	899	421					69	-0.085	8.73	0.05
29															19.5		416	241	290	359	335	328	893	419					69	-0.084	8.82	0.04
30															19.4		414	238	287	357	332	326	889	418					69	-0.084	8.73	0.05
31															19.3		412	236	283	355	330	323	888	417					69	-0.085	8.67	0.05
32															19.2		410	235	281	353	328	321	885	415					69	-0.083	8.70	0.04
33															19.1		408	236	278	351	326	320	887	413					69	-0.083	8.66	0.05
34															19.0		407	234	275	349	324	318	897	415					69	-0.084	8.64	0.05

Wood Heater Test Data
High Burn Efficiency Data

Run: 1

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 27-Nov-18
Beginning Clock Time: 11:11

Total Sampling Time: 209 min
Recording Interval: 1 min
Background Sample Volume: _____ cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) _____ (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.15		28.19	28.17 0

OMNI Equipment Numbers: _____

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: #DIV/0! ft/sec.
Initial Tunnel Flow: 199.9 scfm
Average Tunnel Flow: #DIV/0! scfm
Post-Test Leak Check (1): _____ cfm @ _____ in. Hg
Post-Test Leak Check (2): _____ cfm @ _____ in. Hg
Average Test Piece Fuel Moisture: 21.42 Dry Basis %

Technician Signature: _____

Velocity Traverse Data	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.072	0.074	0.074	0.072	0.072	0.078	0.070	0.070	0.074	"H2O
Temp:	69	69	69	69	70	70	70	69	69	°F

V_{strav} 18.47 ft/sec V_{scent} 18.61 ft/sec F_p 0.993

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)												Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
35															18.9		408	233	273	347	322	317	912	417					69	-0.085	8.52	0.06
36															18.8		407	232	270	345	320	315	909	418					69	-0.085	8.48	0.05
37															18.7		406	231	268	343	318	313	905	418					69	-0.085	8.46	0.05
38															18.6		405	232	266	342	316	312	902	416					69	-0.085	8.48	0.05
39															18.6		404	230	264	340	315	311	903	415					69	-0.085	8.51	0.05
40															18.5		403	229	262	338	313	309	905	415					69	-0.084	8.59	0.05
41															18.4		402	228	261	337	312	308	901	415					69	-0.084	8.68	0.05
42															18.2		401	228	259	335	310	307	902	415					70	-0.083	8.78	0.05
43															18.1		401	227	258	334	309	306	908	415					69	-0.083	8.95	0.05
44															18.0		401	227	256	332	308	305	909	416					69	-0.083	9.20	0.05
45															17.9		401	227	256	331	307	304	903	414					69	-0.083	9.54	0.04
46															17.8		402	226	256	330	306	304	908	414					69	-0.083	10.17	0.04
47															17.6		404	225	256	330	305	304	926	417					69	-0.082	11.06	0.04
48															17.5		409	225	257	330	305	305	952	425					69	-0.084	11.94	0.04
49															17.3		416	226	259	331	305	307	973	430					69	-0.084	12.80	0.03
50															17.2		426	227	261	333	306	311	1021	437					69	-0.086	14.18	0.08
51															17.0		438	226	265	335	307	314	1043	443					69	-0.086	14.98	0.07
52															16.8		449	225	270	336	309	318	1052	447					70	-0.085	14.29	0.03
53															16.7		459	227	276	337	313	322	1045	448					70	-0.086	13.68	0.03
54															16.5		465	227	281	339	316	326	1029	447					70	-0.086	13.23	0.03
55															16.4		471	227	287	339	319	329	1027	448					70	-0.086	13.05	0.02
56															16.2		475	225	292	340	323	331	1029	448					70	-0.086	12.99	0.03
57															16.1		479	227	298	340	326	334	1023	448					70	-0.085	12.83	0.03
58															15.9		481	224	302	340	329	335	1021	449					70	-0.087	12.61	0.03
59															15.8		484	225	307	340	332	338	1020	453					70	-0.087	12.06	0.05
60															15.7		485	225	310	340	335	339	997	449					70	-0.086	11.87	0.05
61															15.5		483	225	313	340	337	340	973	446					70	-0.087	11.63	0.04
62															15.4		480	225	316	340	339	340	967	444					70	-0.086	11.59	0.03
63															15.2		478	225	318	340	341	340	964	442					70	-0.086	11.56	0.03
64															15.1		477	225	320	340	343	341	969	440					70	-0.086	11.48	0.03
65															15.0		476	224	321	340	345	341	970	441					70	-0.086	11.44	0.03
66															14.9		474	225	321	340	346	341	970	441					71	-0.085	11.42	0.03
67															14.7		473	225	321	340	347	341	966	440					71	-0.085	11.57	0.03
68															14.6		473	226	320	340	348	341	976	440					71	-0.085	11.61	0.03
69															14.5		474	226	320	340	349	342	1000	442					71	-0.085	11.49	0.04

Wood Heater Test Data
High Burn Efficiency Data

Run: 1

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 27-Nov-18
Beginning Clock Time: 11:11

Total Sampling Time: 209 min
Recording Interval: 1 min
Background Sample Volume: _____ cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) _____ (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.15		28.19	28.17

0

OMNI Equipment Numbers: _____

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: #DIV/0! ft/sec.
Initial Tunnel Flow: 199.9 scfm
Average Tunnel Flow: #DIV/0! scfm
Post-Test Leak Check (1): _____ cfm @ _____ in. Hg
Post-Test Leak Check (2): _____ cfm @ _____ in. Hg
Average Test Piece Fuel Moisture: 21.42 Dry Basis %

Technician Signature: _____

Velocity Traverse Data	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.072	0.074	0.074	0.072	0.072	0.078	0.070	0.070	0.074	"H2O
Temp:	69	69	69	69	70	70	70	69	69	°F

V_{strav} 18.47 ft/sec V_{scent} 18.61 ft/sec F_p 0.993

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)												Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
70															14.4		477	226	319	339	350	342	1006	441					71	-0.085	11.38	0.04
71															14.2		478	227	317	339	350	342	999	442					71	-0.085	11.27	0.04
72															14.1		478	226	316	339	351	342	987	443					71	-0.085	11.18	0.04
73															14.0		478	226	316	339	351	342	984	442					71	-0.085	11.09	0.04
74															13.9		478	226	315	338	351	342	974	441					71	-0.085	11.07	0.04
75															13.8		476	225	314	338	351	341	963	439					71	-0.085	11.06	0.03
76															13.6		474	225	314	338	352	341	960	437					71	-0.085	11.14	0.03
77															13.5		472	225	314	338	353	340	953	437					71	-0.084	11.18	0.03
78															13.4		470	225	313	338	353	340	951	435					71	-0.084	11.27	0.03
79															13.3		469	226	313	338	354	340	949	434					71	-0.085	11.33	0.03
80															13.1		468	225	314	338	355	340	946	433					71	-0.084	11.42	0.03
81															13.0		466	225	314	338	356	340	940	433					71	-0.086	11.45	0.03
82															12.9		465	226	314	338	357	340	938	432					71	-0.086	11.48	0.03
83															12.8		464	226	315	339	358	340	938	433					71	-0.085	11.49	0.03
84															12.6		464	227	316	339	359	341	937	433					71	-0.086	11.61	0.03
85															12.5		464	226	317	340	360	341	937	433					71	-0.086	11.73	0.03
86															12.4		464	226	319	340	361	342	938	435					71	-0.087	11.82	0.03
87															12.2		464	227	321	341	363	343	941	434					72	-0.086	11.91	0.03
88															12.1		464	227	323	341	364	344	941	434					72	-0.086	11.96	0.03
89															12.0		464	228	326	342	366	345	940	435					71	-0.087	12.01	0.03
90															11.9		464	228	329	343	368	346	936	434					72	-0.086	12.04	0.03
91															11.7		463	228	332	344	369	347	936	434					72	-0.086	12.03	0.03
92															11.6		463	228	334	345	371	348	930	432					72	-0.085	11.96	0.03
93															11.5		462	229	337	346	373	349	926	431					72	-0.085	11.85	0.02
94															11.4		461	230	340	346	374	350	921	431					72	-0.085	11.71	0.02
95															11.2		460	231	343	347	376	351	923	431					72	-0.086	11.66	0.02
96															11.1		460	231	346	348	378	353	923	430					72	-0.084	11.61	0.02
97															11.0		459	230	348	349	379	353	924	430					72	-0.085	11.59	0.02
98															10.9		458	231	350	350	380	354	924	430					72	-0.085	11.51	0.02
99															10.8		458	231	352	351	382	355	924	429					72	-0.085	11.43	0.02
100															10.7		457	233	354	351	383	356	920	429					71	-0.084	11.29	0.02
101															10.5		455	234	356	352	385	356	914	428					72	-0.084	11.20	0.02
102															10.4		454	233	358	353	386	357	909	427					72	-0.084	11.12	0.02
103															10.3		453	235	359	353	387	357	905	425					72	-0.083	11.06	0.02
104															10.2		451	235	360	354	389	358	902	424					72	-0.082	10.98	0.02

Wood Heater Test Data
High Burn Efficiency Data

Run: 1

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 27-Nov-18
Beginning Clock Time: 11:11

Total Sampling Time: 209 min
Recording Interval: 1 min
Background Sample Volume: _____ cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) _____ (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.15		28.19	28.17

0

OMNI Equipment Numbers: _____

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: #DIV/0! ft/sec.
Initial Tunnel Flow: 199.9 scfm
Average Tunnel Flow: #DIV/0! scfm
Post-Test Leak Check (1): _____ cfm @ _____ in. Hg
Post-Test Leak Check (2): _____ cfm @ _____ in. Hg
Average Test Piece Fuel Moisture: 21.42 Dry Basis %

Technician Signature: _____

Velocity Traverse Data	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.072	0.074	0.074	0.072	0.072	0.078	0.070	0.070	0.074	"H2O
Temp:	69	69	69	69	70	70	70	69	69	°F

V_{strav} 18.47 ft/sec V_{scent} 18.61 ft/sec F_p 0.993

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)												Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
105															10.1		450	236	361	354	390	358	905	423					72	-0.083	10.94	0.02
106															10.0		449	237	362	355	391	359	911	422					72	-0.083	10.90	0.02
107															9.9		449	239	362	355	392	359	912	422					72	-0.083	10.88	0.02
108															9.8		448	239	363	356	393	360	909	421					72	-0.084	10.91	0.02
109															9.7		447	239	363	356	394	360	911	421					72	-0.084	10.92	0.02
110															9.6		447	240	364	357	394	360	909	421					72	-0.084	10.87	0.02
111															9.5		446	242	364	357	395	361	911	421					72	-0.084	10.83	0.02
112															9.4		447	242	364	358	396	361	916	421					72	-0.084	10.79	0.02
113															9.3		447	243	365	358	396	362	920	422					72	-0.084	10.74	0.03
114															9.2		447	245	365	359	397	363	919	423					72	-0.085	10.64	0.02
115															9.1		446	245	366	359	397	363	914	422					72	-0.083	10.59	0.03
116															9.0		446	247	366	359	398	363	926	423					72	-0.084	10.49	0.03
117															8.9		448	248	367	360	398	364	942	426					72	-0.084	10.30	0.04
118															8.8		449	248	367	360	398	364	947	427					72	-0.084	10.10	0.04
119															8.7		450	250	366	361	398	365	953	429					72	-0.085	10.08	0.04
120															8.6		451	252	366	361	397	365	956	429					72	-0.084	10.01	0.05
121															8.6		452	252	365	362	397	366	959	431					72	-0.084	9.91	0.05
122															8.5		452	254	365	362	396	366	958	431					72	-0.084	9.93	0.05
123															8.4		451	254	364	362	396	365	954	430					72	-0.084	9.91	0.05
124															8.3		451	255	362	362	396	365	952	430					72	-0.084	9.87	0.05
125															8.2		450	256	361	362	396	365	951	431					72	-0.084	9.73	0.05
126															8.1		449	257	360	362	396	365	947	429					72	-0.084	9.63	0.05
127															8.0		447	258	359	362	396	364	942	428					72	-0.083	9.58	0.05
128															7.9		445	258	357	362	396	364	934	427					72	-0.084	9.48	0.04
129															7.8		443	259	356	362	396	363	928	426					72	-0.083	9.43	0.04
130															7.8		440	260	355	361	396	362	923	424					72	-0.083	9.38	0.04
131															7.7		438	262	354	361	397	362	918	423					72	-0.083	9.34	0.04
132															7.6		436	262	353	361	397	362	916	421					72	-0.083	9.28	0.04
133															7.5		433	262	351	360	397	361	915	419					72	-0.084	9.23	0.04
134															7.4		432	263	350	360	397	360	916	421					72	-0.083	9.09	0.04
135															7.4		430	263	349	360	397	360	912	420					72	-0.082	9.05	0.04
136															7.3		428	264	349	360	398	360	909	419					72	-0.083	9.01	0.04
137															7.2		426	264	348	359	398	359	904	418					72	-0.082	9.00	0.04
138															7.1		424	266	347	359	398	359	903	416					72	-0.082	8.98	0.04
139															7.0		422	267	346	358	398	358	899	415					72	-0.082	8.94	0.04

Wood Heater Test Data
High Burn Efficiency Data

Run: 1

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 27-Nov-18
Beginning Clock Time: 11:11

Total Sampling Time: 209 min
Recording Interval: 1 min
Background Sample Volume: _____ cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) _____ (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.15		28.19	28.17

0

OMNI Equipment Numbers: _____

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: #DIV/0! ft/sec.
Initial Tunnel Flow: 199.9 scfm
Average Tunnel Flow: #DIV/0! scfm
Post-Test Leak Check (1): _____ cfm @ _____ in. Hg
Post-Test Leak Check (2): _____ cfm @ _____ in. Hg
Average Test Piece Fuel Moisture: 21.42 Dry Basis %

Technician Signature: _____

Velocity Traverse Data	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.072	0.074	0.074	0.072	0.072	0.078	0.070	0.070	0.074	"H2O
Temp:	69	69	69	69	70	70	70	69	69	°F

V_{strav} 18.47 ft/sec V_{scent} 18.61 ft/sec F_p 0.993

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)												Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
140															7.0		419	268	345	358	398	358	895	414					72	-0.082	8.94	0.04
141															6.9		418	267	344	358	398	357	896	413					72	-0.082	8.92	0.03
142															6.8		416	268	343	357	398	356	896	412					72	-0.081	8.92	0.04
143															6.7		415	270	342	357	398	356	895	412					72	-0.083	8.92	0.04
144															6.7		414	270	342	356	398	356	895	411					72	-0.082	8.91	0.04
145															6.6		412	270	341	356	398	355	893	411					72	-0.082	8.90	0.03
146															6.5		411	269	340	356	399	355	891	411					72	-0.083	8.89	0.03
147															6.4		410	271	340	355	399	355	891	410					72	-0.083	8.90	0.03
148															6.4		409	272	339	355	399	355	892	410					72	-0.082	8.92	0.03
149															6.3		408	273	339	355	399	355	894	409					72	-0.081	8.93	0.03
150															6.2		407	272	338	355	399	354	896	410					72	-0.081	8.98	0.03
151															6.1		407	274	338	355	400	355	901	410					72	-0.081	9.02	0.03
152															6.1		407	274	337	354	400	354	906	410					72	-0.081	9.05	0.04
153															6.0		408	275	337	354	400	355	909	412					72	-0.082	8.99	0.04
154															5.9		408	276	337	354	401	355	911	415					72	-0.081	8.99	0.04
155															5.8		408	276	337	354	401	355	913	414					72	-0.081	8.98	0.04
156															5.7		409	277	336	354	401	355	917	415					72	-0.082	8.97	0.04
157															5.7		410	278	336	354	402	356	922	415					72	-0.081	8.95	0.04
158															5.6		411	279	336	354	402	356	926	417					73	-0.081	8.94	0.04
159															5.5		412	279	335	354	402	356	933	418					72	-0.081	8.96	0.05
160															5.4		414	278	335	354	402	357	936	419					72	-0.082	8.95	0.05
161															5.3		415	280	335	354	402	357	936	419					72	-0.082	8.93	0.05
162															5.3		415	281	334	354	402	357	934	419					72	-0.082	8.88	0.05
163															5.2		415	281	334	354	402	357	934	419					72	-0.082	8.85	0.05
164															5.1		415	281	334	354	402	357	932	419					72	-0.082	8.81	0.05
165															5.0		416	280	333	354	402	357	933	419					72	-0.082	8.79	0.04
166															5.0		416	281	333	355	402	357	932	420					72	-0.082	8.78	0.05
167															4.9		416	281	332	355	402	357	933	419					72	-0.081	8.77	0.05
168															4.9		416	281	332	355	402	357	936	418					72	-0.082	8.77	0.05
169															4.7		417	282	332	355	402	358	933	419					72	-0.082	8.76	0.05
170															4.7		417	282	331	355	402	357	936	419					72	-0.082	8.79	0.05
171															4.6		418	282	331	355	402	358	940	419					72	-0.082	8.84	0.05
172															4.5		419	282	331	356	403	358	948	421					72	-0.083	8.71	0.05
173															4.4		420	282	330	356	403	358	950	422					72	-0.083	8.65	0.05
174															4.4		421	283	330	356	402	358	955	424					72	-0.084	8.64	0.05

Wood Heater Test Data
High Burn Efficiency Data

Run: 1

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 27-Nov-18
Beginning Clock Time: 11:11

Total Sampling Time: 209 min
Recording Interval: 1 min
Background Sample Volume: _____ cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) _____ (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.15		28.19	28.17

0

OMNI Equipment Numbers: _____

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: #DIV/0! ft/sec.
Initial Tunnel Flow: 199.9 scfm
Average Tunnel Flow: #DIV/0! scfm
Post-Test Leak Check (1): _____ cfm @ _____ in. Hg
Post-Test Leak Check (2): _____ cfm @ _____ in. Hg
Average Test Piece Fuel Moisture: 21.42 Dry Basis %

Technician Signature: _____

Velocity Traverse Data	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.072	0.074	0.074	0.072	0.072	0.078	0.070	0.070	0.074	"H2O
Temp:	69	69	69	69	70	70	70	69	69	°F

V_{strav} 18.47 ft/sec V_{scent} 18.61 ft/sec F_p 0.993

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)												Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
175															4.2		418	286	330	356	403	359	895	420					73	-0.083	11.53	0.02
176															4.0		422	288	330	357	404	360	979	427					72	-0.084	15.19	0.02
177															3.9		433	287	330	359	407	363	1029	440					73	-0.087	17.31	0.4
178															3.7		446	288	332	363	412	368	1036	447					72	-0.087	17.39	0.38
179															3.5		461	289	334	367	417	374	1070	452					73	-0.088	17.72	0.89
180															3.4		476	288	337	372	422	379	1080	455					73	-0.088	17.90	1.19
181															3.2		489	289	340	378	428	385	1076	458					73	-0.088	17.49	0.94
182															3.0		502	288	344	384	434	390	1077	459					73	-0.088	17.66	0.63
183															2.8		513	291	348	390	440	396	1074	458					73	-0.088	17.43	0.58
184															2.6		522	290	351	397	446	401	1066	457					74	-0.088	17.03	0.55
185															2.5		529	290	355	403	452	406	1054	456					74	-0.088	16.72	0.43
186															2.4		533	289	359	410	457	410	1042	453					74	-0.088	16.35	0.32
187															2.2		537	290	363	416	462	414	1029	450					74	-0.088	15.70	0.22
188															2.1		538	289	367	423	467	417	1017	447					74	-0.087	15.21	0.11
189															2.0		537	288	370	429	471	419	996	442					75	-0.086	14.65	0.04
190															1.8		535	287	373	435	476	421	986	440					74	-0.086	14.25	0.02
191															1.7		533	287	375	440	480	423	976	436					74	-0.086	13.86	0.02
192															1.6		530	285	377	445	484	424	968	433					75	-0.085	13.48	0.01
193															1.5		527	286	378	450	487	426	963	430					75	-0.085	13.12	0.02
194															1.4		524	286	380	455	490	427	959	428					75	-0.084	12.98	0.01
195															1.3		521	285	380	458	494	428	955	428					75	-0.084	12.90	0.02
196															1.2		518	284	381	462	497	428	954	425					75	-0.084	12.87	0.01
197															1.1		516	286	381	465	501	430	957	424					75	-0.084	12.86	0.01
198															1.0		514	286	381	468	503	430	955	422					75	-0.083	12.87	0.01
199															0.9		513	286	381	471	506	431	960	422					75	-0.084	12.91	0.02
200															0.8		512	286	381	473	508	432	959	422					75	-0.083	12.62	0.01
201															0.7		510	284	380	476	511	432	950	422					75	-0.084	12.16	0.01
202															0.6		507	287	380	478	513	433	936	419					75	-0.083	12.01	0
203															0.6		504	285	379	480	516	433	929	418					75	-0.083	12.06	0
204															0.5		501	285	379	481	518	433	924	416					75	-0.083	12.10	0
205															0.4		499	286	379	483	520	433	935	414					75	-0.083	12.16	0.01
206															0.3		500	288	378	484	523	435	958	416					75	-0.083	11.65	0
207															0.3		498	287	377	485	525	434	940	414					75	-0.083	10.85	0
208															0.2		495	287	376	486	527	434	930	413					75	-0.082	10.57	0
209															0.0		492	288	374	487	528	434	921	410					75	-0.083	10.37	0

Wood Heater Test Data
High Burn Efficiency Data

Run: 1

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 27-Nov-18
Beginning Clock Time: 11:11

Total Sampling Time: 209 min
Recording Interval: 1 min
Background Sample Volume: _____ cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) _____ (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.15		28.19	28.17 0

OMNI Equipment Numbers: _____

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: #DIV/0! ft/sec.
Initial Tunnel Flow: 199.9 scfm
Average Tunnel Flow: #DIV/0! scfm
Post-Test Leak Check (1): _____ cfm @ _____ in. Hg
Post-Test Leak Check (2): _____ cfm @ _____ in. Hg
Average Test Piece Fuel Moisture: 21.42 Dry Basis %

Technician Signature: _____

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.072	0.074	0.074	0.072	0.072	0.078	0.070	0.070	0.074	"H2O
Temp:	69	69	69	69	70	70	70	69	69	°F

V_{strav} 18.47 ft/sec V_{scent} 18.61 ft/sec F_p 0.993

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)													Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
Avg/Tot	0.000	0.000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!	#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!								20.2				#DIV/0!	#DIV/0!	#DIV/0!	71	-0.085		

Wood Heater Test Results

Manufacturer:	Kuma Stoves
Model:	K250 Series
Project No.:	0123WN012E
Tracking No.:	2330
Run:	1
Test Date:	11/27/18

Burn Rate	**2.48 kg/hr dry**

Technician Signature: _____

Adjunct to ASTM E XXXX Wood Heater Cordwood Test Method - May 10, 2017 Version

Cordwood Fuel Load Calculators - 10 lb/ft^3 Nominal Load Density

Core 45-65% of Total Load Weight, Remainder 35-55% of Total Load Weight

Values to be input manually

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For All Usable Firebox Volumes - High Fire Test Only

Nominal Required Load Density (wet basis)	10 lb/ft^3					
Usable Firebox Volume	2.54 ft^3					
Total Nom. Load Wt. Target	25.40 lb					
Total Load Wt. Allowable Range	24.10	to	26.70 lb			
Core Target Wt. Allowable Range	11.40	to	16.50 lb			
Remainder Load Wt. Allowable Range	8.90	to	14.00 lb			
						Mid-Point
Core Load Pc. Wt. Allowable Range	3.80	to	6.40 lb			5.10
Remainder Load Pc. Wt. Allowable Range	2.50	to	14.00 lb			8.25
	Pc. #					
Core Load Piece Wt. Actual	1	4.97 lb		In Range		
	2	5.16 lb		In Range		
	3	5.04 lb		In Range		
Core Load Total. Wt. Actual		15.16 lb		In Range		
	Pc. #					
Remainder Load Piece Wt.	1	7.20 lb		In Range		
(1 to 3 Pcs.)	2	3.39 lb		In Range		
	3	lb		NA		
Remainder Load Tot. Wt. Act		10.59 lb		In Range		
Total Load Wt. Actual		25.75 lb		In Range		
Core % of Total Wt.		59%		In Range		45-65%
Remainder % of Total Wt.		41%		In Range		35-55%
Actual Load % of Nominal Target		101%		In Range		95-105%
Actual Fuel Load Density		10.1 lb/ft^3				
Kindling and Start-up Fuel						
Maximim Kindling Wt. (20% of Tot. Load Wt.)		5.15 lb				
Actual Kindling Wt.		4.93 lb		In Range		19.2%
Maximum Start-up Fuel Wt. (30% of Tot. Load Wt.)		7.73 lb				
Actual Start-up Fuel Wt.		7.61 lb		In Range		29.5%
Allowable Residual Start-up Fuel Wt. Range	2.6	to	5.2 lb			Mid-Point
Actual Residual Start-up Fuel Wt.		3.2 lb		In Range		3.9
Total Wt. All Fuel Added (wet basis)		38.29 lb				
High Fire Test Run End Point Range	Low		High			Mid-Point
Based on Fuel Load Wt. (w/tares)	2.3	to	2.8 lb			2.6
Actual Fuel Load Ending Wt.		2.6 lb		In Range		

Fuel Piece Moisture Reading (%-dry basis)

1	2	3	Ave.		Pc. Wt. Dry Basis	
21.7	20.7	20.5	21.0	In Range	4.11 lb	1.86 kg
24	21.6	21.5	22.4	In Range	4.22 lb	1.91 kg
21.3	21.7	21.1	21.4	In Range	4.15 lb	1.88 kg
22.6	21	21.9	21.8	In Range	5.91 lb	2.68 kg
20.8	21.5	19.4	20.6	In Range	2.81 lb	1.27 kg
			NA	NA	NA lb	NA kg

Total Load Ave. MC (%-dry basis)	21.5	In Range	
Total Load Ave. MC % (wet basis)	17.7		
Total Test Load Weight (dry basis) →			21.19 lb 9.61 kg

Kindling Moisture (%-dry basis)

11.21	11.21	11.21	11.2	In Range	4.43 lb 2.01 kg

Start-up Fuel Moisture Readings (%-dry basis)

20.13	20.13	20.13	20.1	In Range	6.33 lb 2.87 kg

Total Wt. All Fuel Added (dry basis) →	31.96 lb 14.50 kg
Total Wt. All Fuel Burned (dry basis) →	26.2 lb 11.9 kg

Wood Heater Efficiency Results - CSA B415.1

Manufacturer: Kuma Stoves
Model: K250 Series
Date: 11/27/18
Run: 1
Control #: 0123WN012E
Test Duration: 209
Output Category: IV

Technician Signature: 

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	73.2%	79.4%
Combustion Efficiency	99.5%	99.5%
Heat Transfer Efficiency	74%	79.8%

Output Rate (kJ/h)	31,950	30,308	**(Btu/h)**
Burn Rate (kg/h)	2.48	5.47	**(lb/h)**
Input (kJ/h)	43,659	41,415	**(Btu/h)**

Test Load Weight (dry kg)	8.65	19.07	**dry lb**
MC wet (%)	17.64124526		
MC dry (%)	21.42		
Particulate (g)	#DIV/0!		
CO (g)	63		
Test Duration (h)	3.48		

Emissions	**Particulate**	**CO**
g/MJ Output	#DIV/0!	0.56
g/kg Dry Fuel	#DIV/0!	7.25
g/h	#DIV/0!	18.01
lb/MM Btu Output	#DIV/0!	1.31

Air/Fuel Ratio (A/F)	10.38

VERSION: **2.2** **12/14/2009**

VERSION: 2.2 12/14/2009

Manufacturer: Kuma Stoves
Model: K250 Series
Date: 11/27/2018
Run: 1
Control #: 0123WN012E
Test Duration: 209
Output Category: IV

Appliance Type: Cat

Temp. Units F (F or C)
Weight Units lb (kg or lb)

Wood Moisture (% wet): 17.64
Load Weight (lb wet): 23.15
Burn Rate (dry kg/h): 2.48
Total Particulate Emissions: #DIV/0! g

Fuel Data

	D. Fir	
HHV	17,580	kj/kg
%C	50.54	
%H	6.36	
%O	42.40	
%ASH	0.70	

Averages		**0.07**	**10.81**	**#DIV/0!**	**429.17**	**71.24**
					Temp. (ºF)	
Elapsed Time (min)	**Fuel Weight Remaining (lb)**	**Flue Gas Composition (%) CO**	**CO_2**	**O_2**	**Flue Gas**	**Room Temp**
0	23.15	0.16	5.26		445.0	66.0
1	22.96	0.05	9.69		465.0	66.0
2	22.84	0.05	10.33		470.0	66.0
3	22.68	0.05	10.13		473.0	66.0
4	22.51	0.04	10.83		473.0	66.0
5	22.35	0.05	10.35		465.0	66.0
6	22.23	0.04	10.34		459.0	66.0
7	22.04	0.04	10.51		455.0	66.0
8	21.91	0.04	10.45		450.0	67.0
9	21.77	0.04	10.50		448.0	67.0
10	21.61	0.04	10.88		445.0	67.0
11	21.50	0.04	10.45		444.0	68.0
12	21.39	0.05	9.63		441.0	68.0
13	21.28	0.06	9.09		441.0	68.0
14	21.16	0.06	8.79		438.0	69.0
15	21.05	0.05	8.79		434.0	69.0
16	20.95	0.05	8.74		431.0	69.0
17	20.84	0.04	8.73		428.0	69.0
18	20.71	0.04	8.59		425.0	69.0
19	20.63	0.05	8.58		423.0	69.0
20	20.51	0.05	8.72		423.0	69.0
21	20.39	0.05	8.83		424.0	69.0
22	20.29	0.04	8.88		423.0	69.0

23	20.20	0.05	8.89		422.0	69.0
24	20.09	0.05	8.89		422.0	69.0
25	19.97	0.05	8.85		422.0	69.0
26	19.87	0.05	8.74		423.0	69.0
27	19.75	0.05	8.65		423.0	69.0
28	19.65	0.05	8.73		421.0	69.0
29	19.53	0.04	8.82		419.0	69.0
30	19.44	0.05	8.73		418.0	69.0
31	19.33	0.05	8.67		417.0	69.0
32	19.23	0.04	8.70		415.0	69.0
33	19.15	0.05	8.66		413.0	69.0
34	19.03	0.05	8.64		415.0	69.0
35	18.95	0.06	8.52		417.0	69.0
36	18.82	0.05	8.48		418.0	69.0
37	18.71	0.05	8.46		418.0	69.0
38	18.64	0.05	8.48		416.0	69.0
39	18.56	0.05	8.51		415.0	69.0
40	18.45	0.05	8.59		415.0	69.0
41	18.35	0.05	8.68		415.0	69.0
42	18.22	0.05	8.78		415.0	70.0
43	18.13	0.05	8.95		415.0	69.0
44	18.04	0.05	9.20		416.0	69.0
45	17.89	0.04	9.54		414.0	69.0
46	17.77	0.04	10.17		414.0	69.0
47	17.62	0.04	11.06		417.0	69.0
48	17.48	0.04	11.94		425.0	69.0
49	17.32	0.03	12.80		430.0	69.0
50	17.15	0.08	14.18		437.0	69.0
51	16.96	0.07	14.98		443.0	69.0
52	16.81	0.03	14.29		447.0	70.0
53	16.66	0.03	13.68		448.0	70.0
54	16.52	0.03	13.23		447.0	70.0
55	16.38	0.02	13.05		448.0	70.0
56	16.22	0.03	12.99		448.0	70.0
57	16.07	0.03	12.83		448.0	70.0
58	15.92	0.03	12.61		449.0	70.0
59	15.78	0.05	12.06		453.0	70.0
60	15.65	0.05	11.87		449.0	70.0
61	15.53	0.04	11.63		446.0	70.0
62	15.40	0.03	11.59		444.0	70.0
63	15.23	0.03	11.56		442.0	70.0
64	15.13	0.03	11.48		440.0	70.0
65	14.99	0.03	11.44		441.0	70.0

66	14.88	0.03	11.42		441.0	71.0
67	14.73	0.03	11.57		440.0	71.0
68	14.58	0.03	11.61		440.0	71.0
69	14.49	0.04	11.49		442.0	71.0
70	14.36	0.04	11.38		441.0	71.0
71	14.23	0.04	11.27		442.0	71.0
72	14.11	0.04	11.18		443.0	71.0
73	14.01	0.04	11.09		442.0	71.0
74	13.87	0.04	11.07		441.0	71.0
75	13.76	0.03	11.06		439.0	71.0
76	13.64	0.03	11.14		437.0	71.0
77	13.47	0.03	11.18		437.0	71.0
78	13.39	0.03	11.27		435.0	71.0
79	13.25	0.03	11.33		434.0	71.0
80	13.12	0.03	11.42		433.0	71.0
81	13.03	0.03	11.45		433.0	71.0
82	12.89	0.03	11.48		432.0	71.0
83	12.77	0.03	11.49		433.0	71.0
84	12.62	0.03	11.61		433.0	71.0
85	12.52	0.03	11.73		433.0	71.0
86	12.36	0.03	11.82		435.0	71.0
87	12.24	0.03	11.91		434.0	72.0
88	12.11	0.03	11.96		434.0	72.0
89	11.98	0.03	12.01		435.0	71.0
90	11.88	0.03	12.04		434.0	72.0
91	11.72	0.03	12.03		434.0	72.0
92	11.62	0.03	11.96		432.0	72.0
93	11.51	0.02	11.85		431.0	72.0
94	11.36	0.02	11.71		431.0	72.0
95	11.24	0.02	11.66		431.0	72.0
96	11.12	0.02	11.61		430.0	72.0
97	11.00	0.02	11.59		430.0	72.0
98	10.89	0.02	11.51		430.0	72.0
99	10.78	0.02	11.43		429.0	72.0
100	10.69	0.02	11.29		429.0	71.0
101	10.53	0.02	11.20		428.0	72.0
102	10.43	0.02	11.12		427.0	72.0
103	10.34	0.02	11.06		425.0	72.0
104	10.25	0.02	10.98		424.0	72.0
105	10.12	0.02	10.94		423.0	72.0
106	10.01	0.02	10.90		422.0	72.0
107	9.92	0.02	10.88		422.0	72.0
108	9.79	0.02	10.91		421.0	72.0

109	9.69	0.02	10.92		421.0	72.0
110	9.60	0.02	10.87		421.0	72.0
111	9.49	0.02	10.83		421.0	72.0
112	9.42	0.02	10.79		421.0	72.0
113	9.30	0.03	10.74		422.0	72.0
114	9.21	0.02	10.64		423.0	72.0
115	9.09	0.03	10.59		422.0	72.0
116	9.02	0.03	10.49		423.0	72.0
117	8.92	0.04	10.30		426.0	72.0
118	8.84	0.04	10.10		427.0	72.0
119	8.73	0.04	10.08		429.0	72.0
120	8.64	0.05	10.01		429.0	72.0
121	8.56	0.05	9.91		431.0	72.0
122	8.46	0.05	9.93		431.0	72.0
123	8.37	0.05	9.91		430.0	72.0
124	8.29	0.05	9.87		430.0	72.0
125	8.19	0.05	9.73		431.0	72.0
126	8.12	0.05	9.63		429.0	72.0
127	8.02	0.05	9.58		428.0	72.0
128	7.92	0.04	9.48		427.0	72.0
129	7.84	0.04	9.43		426.0	72.0
130	7.76	0.04	9.38		424.0	72.0
131	7.67	0.04	9.34		423.0	72.0
132	7.57	0.04	9.28		421.0	72.0
133	7.49	0.04	9.23		419.0	72.0
134	7.41	0.04	9.09		421.0	72.0
135	7.35	0.04	9.05		420.0	72.0
136	7.28	0.04	9.01		419.0	72.0
137	7.20	0.04	9.00		418.0	72.0
138	7.13	0.04	8.98		416.0	72.0
139	7.04	0.04	8.94		415.0	72.0
140	6.95	0.04	8.94		414.0	72.0
141	6.89	0.03	8.92		413.0	72.0
142	6.81	0.04	8.92		412.0	72.0
143	6.73	0.04	8.92		412.0	72.0
144	6.66	0.04	8.91		411.0	72.0
145	6.57	0.03	8.90		411.0	72.0
146	6.53	0.03	8.89		411.0	72.0
147	6.43	0.03	8.90		410.0	72.0
148	6.37	0.03	8.92		410.0	72.0
149	6.28	0.03	8.93		409.0	72.0
150	6.21	0.03	8.98		410.0	72.0
151	6.13	0.03	9.02		410.0	72.0

152	6.07	0.04	9.05		410.0	72.0
153	5.99	0.04	8.99		412.0	72.0
154	5.91	0.04	8.99		415.0	72.0
155	5.83	0.04	8.98		414.0	72.0
156	5.75	0.04	8.97		415.0	72.0
157	5.65	0.04	8.95		415.0	72.0
158	5.57	0.04	8.94		417.0	73.0
159	5.52	0.05	8.96		418.0	72.0
160	5.42	0.05	8.95		419.0	72.0
161	5.35	0.05	8.93		419.0	72.0
162	5.26	0.05	8.88		419.0	72.0
163	5.17	0.05	8.85		419.0	72.0
164	5.09	0.05	8.81		419.0	72.0
165	5.05	0.04	8.79		419.0	72.0
166	4.95	0.05	8.78		420.0	72.0
167	4.91	0.05	8.77		419.0	72.0
168	4.87	0.05	8.77		418.0	72.0
169	4.74	0.05	8.76		419.0	72.0
170	4.69	0.05	8.79		419.0	72.0
171	4.61	0.05	8.84		419.0	72.0
172	4.50	0.05	8.71		421.0	72.0
173	4.44	0.05	8.65		422.0	72.0
174	4.37	0.05	8.64		424.0	72.0
175	4.23	0.02	11.53		420.0	73.0
176	4.05	0.02	15.19		427.0	72.0
177	3.91	0.40	17.31		440.0	73.0
178	3.73	0.38	17.39		447.0	72.0
179	3.50	0.89	17.72		452.0	73.0
180	3.35	1.19	17.90		455.0	73.0
181	3.17	0.94	17.49		458.0	73.0
182	2.98	0.63	17.66		459.0	73.0
183	2.80	0.58	17.43		458.0	73.0
184	2.63	0.55	17.03		457.0	74.0
185	2.48	0.43	16.72		456.0	74.0
186	2.35	0.32	16.35		453.0	74.0
187	2.23	0.22	15.70		450.0	74.0
188	2.09	0.11	15.21		447.0	74.0
189	1.98	0.04	14.65		442.0	75.0
190	1.84	0.02	14.25		440.0	74.0
191	1.70	0.02	13.86		436.0	74.0
192	1.62	0.01	13.48		433.0	75.0
193	1.51	0.02	13.12		430.0	75.0
194	1.42	0.01	12.98		428.0	75.0

195	1.31	0.02	12.90		428.0	75.0
196	1.20	0.01	12.87		425.0	75.0
197	1.11	0.01	12.86		424.0	75.0
198	1.02	0.01	12.87		422.0	75.0
199	0.92	0.02	12.91		422.0	75.0
200	0.83	0.01	12.62		422.0	75.0
201	0.74	0.01	12.16		422.0	75.0
202	0.65	0.00	12.01		419.0	75.0
203	0.57	0.00	12.06		418.0	75.0
204	0.49	0.00	12.10		416.0	75.0
205	0.39	0.01	12.16		414.0	75.0
206	0.32	0.00	11.65		416.0	75.0
207	0.25	0.00	10.85		414.0	75.0
208	0.19	0.00	10.57		413.0	75.0
209	0.00	0.00	10.37		410.0	75.0

OMNI-Test Laboratories, Inc.

Wood Heater Run Sheets

Client: Kuma Stoves Project Number: 0123WN012E Run Number: 1
Model: K250 Series Tracking Number: 2330 Date: 11/27/18
Test Crew: D Dau. S
OMNI Equipment ID numbers: 132, Smallscale, Fuelscale, 650, 2434, 371, 372, 410, 359, 592, 420, 637

Wood Heater Supplemental Data

Start Time: 11:11 Booth #: N/A
Stop Time: 15:48

Stack Gas Leak Check:
Initial: good Final: good

Sample Train Leak Check:
A: 0.0 @ 14 "Hg
B: 0.0 @ 15 "Hg

Calibrations: Span Gas CO_2: 12.4 CO: 2.48

	Pre Test		Post Test	
	Zero	Span	Zero	Span
Time	0954	0954	16:13	1614
CO_2	0.00	12.42	1.20	13.2
CO	0.000	2.484	-0.027	2.447

Air Velocity (ft/min): Initial: <50 Final: <50
Scale Audit (lbs): Initial: 10.0 Final: 10.0
Pitot Tube Leak Test: Initial: good Final: good
Stack Diameter (in): 6"
Induced Draft: 0.0
% Smoke Capture: 100 %
Flue Pipe Cleaned Prior to First Test in Series:
Date: 11/21/18 Initials: DN

	Initial	Middle	Ending
P_b (in/Hg)	28.15		28.19
RH (%)	53 ~~58~~ %		40 %
Ambient (°F)	62		75

Background Filter Volume: 39.649

Tunnel Traverse		
Microtector Reading	dP (in H_2O)	T(°F)
	.072	69
	.074	69
	.074	69
	.072	69
	~~.072~~ ~~.070~~	~~70~~ ~~69~~
	.078	70
	.070	70
	.070	69
Center:		
	.074	69

Tunnel Static Pressure (in H_2O):	
Beginning of Test	End of Test
-.110	-.110

Technician Signature: Date: 1/30/19

OMNI-Test Laboratories, Inc.

Wood Heater Run Sheets

Client: Kuma Stoves Project Number: 0123WN012E Run Number: 1
Model: K250 Series Tracking Number: 2330 Date: 11/27/14
Test Crew: BD Davis
OMNI Equipment ID numbers:

Wood Heater Run Notes

Air Control Settings

Primary:

Fully open

Secondary: fixed

Tertiary/Pilot: N/A

Fan: on High

Preburn Notes

Time	Notes
0	Torch used for 25 seconds
40 sec	door closed.
15 min	bypass closed
	FAN off during handling and start up fuel load.

Test Notes

Sketch test fuel configuration:

See photo

Start up procedures & Timeline:

Bypass: open 1:15
Fuel loaded by: Loaded by 60 seconds
Door closed at: 1:15
Primary air: Fully open

Notes: FAN turned on High 5 min after fuel loaded.

Time	Notes
60	Changed Front filter in tray A
67	loaded fuel load
72	FAN on.
94	Changed Front Filter in tray B

Technician Signature: BD Davis Date: 1/30/15

Run 2

Low Burn

Wood Heater Test Data
Low Burn Emissions Data

Run: 2

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 27-Nov-18
Beginning Clock Time: 16:25

Total Sampling Time: 820 min
Recording Interval: 10 min
Background Sample Volume: 117.349 cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) 0.998 (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.19		28.22	28.21 0

OMNI Equipment Numbers:

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: 18.70 ft/sec.
Initial Tunnel Flow: 196.7 scfm
Average Tunnel Flow: 197.5 scfm
Post-Test Leak Check (1): 0.000 cfm @ 10 in. Hg
Post-Test Leak Check (2): 0.000 cfm @ 12 in. Hg
Average Test Piece Fuel Moisture: 22.31 Dry Basis %

Technician Signature:

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.072	0.074	0.076	0.072	0.070	0.076	0.070	0.072	0.074	"H2O
Temp:	87	88	88	88	88	88	88	88	88	°F

V_{strav} 18.78 ft/sec V_{scent} 18.92 ft/sec F_p 0.992

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)													Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
0	0.000	0.000			1.67	75	-0.23	1.46	75	-1.4	86	0.074			30.4		289	341	297	414	441	356	565	191	80	57	87	57	72	-0.044	7.24	0.07
10	1.384	1.507	0.14	0.15	1.58	75	-0.37	1.29	75	-1.4	104	0.074	101	102	29.2	-1.212769	409	300	325	384	415	367	927	422	85	53	82	53	71	-0.080	10.1646	0.06
20	2.772	3.012	0.14	0.15	1.55	75	-0.43	1.27	75	-1.6	95	0.074	100	101	28.1	-1.095337	510	304	320	355	405	379	850	325	82	53	84	55	71	-0.071	7.06927	0.01
30	4.171	4.518	0.14	0.15	1.59	75	-0.69	1.28	75	-1.4	93	0.074	101	101	27.5	-0.608948	473	300	307	334	396	362	824	293	83	54	84	55	71	-0.067	7.8339	0.02
40	5.571	6.023	0.14	0.15	1.60	75	-0.69	1.28	75	-1.4	89	0.074	100	100	26.8	-0.726928	385	286	236	314	379	320	853	266	84	55	85	56	71	-0.065	8.92854	0.03
50	6.971	7.527	0.14	0.15	1.58	75	-0.64	1.27	75	-1.5	87	0.074	100	100	26.1	-0.698548	354	273	204	297	371	300	834	257	83	55	85	56	70	-0.064	9.34317	0.03
60	8.370	9.029	0.14	0.15	1.57	75	-0.67	1.27	75	-1.4	86	0.074	100	100	25.3	-0.768615	348	262	188	282	368	290	839	257	83	55	86	56	70	-0.063	10.0878	0.02
70	9.780	10.530	0.14	0.15	1.59	76	-0.49	1.27	75	-1.6	87	0.074	101	100	24.5	-0.825989	350	251	179	271	370	284	853	258	83	56	86	56	71	-0.063	10.5324	0.03
80	11.185	12.032	0.14	0.15	1.59	76	-0.57	1.27	75	-1.5	88	0.074	101	100	23.7	-0.78595	355	244	174	264	374	282	863	260	83	56	86	57	71	-0.064	10.8571	0.02
90	12.591	13.542	0.14	0.15	1.60	76	-0.48	1.29	75	-1.7	88	0.074	101	100	22.8	-0.878418	360	238	171	259	387	283	885	265	83	56	87	57	71	-0.064	11.6817	0.02
100	13.996	15.051	0.14	0.15	1.60	76	-0.6	1.28	75	-1.7	88	0.074	101	100	21.9	-0.875793	363	234	170	257	410	287	880	263	83	57	87	57	72	-0.064	11.9263	0.01
110	15.401	16.560	0.14	0.15	1.57	76	-0.61	1.28	75	-1.7	89	0.074	101	100	21.0	-0.900452	382	228	171	255	436	294	936	270	83	57	88	57	72	-0.065	12.961	0.02
120	16.803	18.069	0.14	0.15	1.60	76	-0.19	1.28	76	-1.7	90	0.074	100	100	20.1	-0.96936	407	226	175	254	460	304	973	278	86	58	86	58	73	-0.065	13.9956	0.02
130	18.205	19.577	0.14	0.15	1.59	77	-0.69	1.27	76	-1.6	90	0.074	100	100	19.1	-0.927063	426	223	178	256	485	314	975	278	86	58	86	58	73	-0.065	13.9102	0.02
140	19.606	21.085	0.14	0.15	1.57	77	-0.18	1.28	76	-1.5	90	0.074	100	100	18.3	-0.856568	412	221	180	258	505	315	926	269	86	59	86	59	73	-0.064	13.3449	0.02
150	21.009	22.593	0.14	0.15	1.59	77	-0.23	1.27	76	-1.7	90	0.074	100	100	17.4	-0.851623	412	221	183	261	521	320	951	270	86	59	86	59	73	-0.064	14.1895	0.02
160	22.409	24.101	0.14	0.15	1.59	77	-0.69	1.27	76	-1.7	90	0.074	100	100	16.5	-0.916138	439	220	187	263	533	328	1018	280	86	60	86	60	73	-0.065	16.0641	0.02
170	23.811	25.608	0.14	0.15	1.57	77	-0.54	1.27	77	-1.6	90	0.074	100	100	15.4	-1.065368	475	220	194	268	545	340	1051	290	86	60	86	60	73	-0.065	18.5288	1.27
180	25.212	27.116	0.14	0.15	1.57	77	-0.67	1.27	77	-1.6	91	0.074	100	100	14.6	-0.833558	518	220	202	276	540	351	1031	283	86	61	85	61	74	-0.064	14.6234	0.06
190	26.615	28.627	0.14	0.15	1.57	78	-0.4	1.28	77	-1.6	91	0.074	100	100	13.9	-0.684814	451	221	206	283	522	337	920	261	86	61	86	61	74	-0.061	13.598	0.04
200	28.018	30.138	0.14	0.15	1.59	78	-0.24	1.28	77	-1.4	90	0.074	100	100	13.3	-0.622742	421	222	208	287	509	329	904	254	86	61	86	60	74	-0.060	13.9427	0.04
210	29.422	31.650	0.14	0.15	1.58	78	-0.23	1.28	77	-1.5	90	0.074	100	100	12.7	-0.642456	409	226	211	289	501	327	897	250	86	60	86	59	74	-0.059	14.2473	0.04
220	30.825	33.163	0.14	0.15	1.59	78	-0.7	1.28	77	-1.6	89	0.074	100	100	12.1	-0.601318	403	225	214	290	496	326	890	246	86	59	86	58	74	-0.058	14.252	0.04
230	32.230	34.676	0.14	0.15	1.58	78	-0.29	1.29	78	-1.6	89	0.074	100	100	11.4	-0.625549	400	228	218	294	493	327	884	243	86	58	86	57	74	-0.057	14.0666	0.03
240	33.635	36.195	0.14	0.15	1.58	78	-0.19	1.29	78	-1.6	89	0.074	100	100	10.8	-0.599244	400	230	221	297	490	328	900	242	86	58	86	56	73	-0.057	14.3312	0.03
250	35.040	37.714	0.14	0.15	1.59	79	-0.61	1.29	78	-1.4	88	0.074	100	100	10.3	-0.543579	395	231	226	300	487	328	857	235	86	57	86	56	73	-0.056	13.8759	0.03
260	36.448	39.232	0.14	0.15	1.60	79	-0.62	1.28	78	-1.7	88	0.074	100	100	9.8	-0.502258	384	234	232	301	486	327	853	231	85	56	85	55	73	-0.055	14.0605	0.03
270	37.855	40.749	0.14	0.15	1.59	79	-0.5	1.29	78	-1.6	87	0.074	100	100	9.3	-0.524231	385	235	238	303	486	329	861	231	85	56	85	55	73	-0.056	14.3951	0.02
280	39.263	42.266	0.14	0.15	1.60	79	-0.19	1.29	78	-1.7	87	0.074	100	100	8.8	-0.485229	387	237	246	306	483	332	847	229	85	56	85	55	73	-0.055	14.0898	0.02
290	40.671	43.782	0.14	0.15	1.59	79	-0.38	1.29	78	-1.4	87	0.074	100	100	8.3	-0.519471	382	238	252	309	479	332	847	226	85	56	85	54	73	-0.055	14.0544	0.02
300	42.079	45.299	0.14	0.15	1.61	79	-0.46	1.28	78	-1.7	86	0.074	100	100	7.8	-0.444519	369	240	257	312	474	330	807	221	85	55	85	54	73	-0.053	13.429	0.02
310	43.487	46.815	0.14	0.15	1.58	79	-0.55	1.28	78	-1.5	86	0.074	100	100	7.4	-0.387024	359	240	259	314	469	328	797	216	85	55	85	54	72	-0.053	13.3137	0.02
320	44.896	48.332	0.14	0.15	1.60	79	-0.3	1.29	78	-1.4	86	0.074	100	100	7.0	-0.398071	352	241	260	315	463	326	782	212	85	55	85	54	72	-0.051	13.1083	0.02
330	46.305	49.848	0.14	0.15	1.58	79	-0.52	1.28	78	-1.5	86	0.074	100	100	6.7	-0.367859	344	241	261	317	458	324	768	206	85	55	85	54	72	-0.050	13.0529	0.02

Wood Heater Test Data
Low Burn Emissions Data

Run: 2

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 27-Nov-18
Beginning Clock Time: 16:25

Total Sampling Time: 820 min
Recording Interval: 10 min
Background Sample Volume: 117.349 cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) 0.998 (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.19		28.22	28.21 0

OMNI Equipment Numbers:

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: 18.70 ft/sec.
Initial Tunnel Flow: 196.7 scfm
Average Tunnel Flow: 197.5 scfm
Post-Test Leak Check (1): 0.000 cfm @ 10 in. Hg
Post-Test Leak Check (2): 0.000 cfm @ 12 in. Hg
Average Test Piece Fuel Moisture: 22.31 Dry Basis %

Technician Signature:

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.072	0.074	0.076	0.072	0.070	0.076	0.070	0.072	0.074	"H2O
Temp:	87	88	88	88	88	88	88	88	88	°F

V_{strav} 18.78 ft/sec V_{scent} 18.92 ft/sec F_p 0.992

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)													Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
340	47.714	51.365	0.14	0.15	1.60	79	-0.45	1.28	78	-1.4	86	0.074	100	100	6.3	-0.337463	338	242	262	317	454	323	759	203	85	55	85	54	72	-0.049	12.9676	0.02
350	49.125	52.883	0.14	0.15	1.59	79	-0.27	1.28	78	-1.5	85	0.074	100	100	6.0	-0.297852	329	242	263	318	448	320	734	198	85	55	85	54	73	-0.048	12.4722	0.01
360	50.534	54.399	0.14	0.15	1.58	79	-0.69	1.29	78	-1.7	85	0.074	100	100	5.7	-0.3013	319	244	263	319	439	317	708	192	85	55	85	54	74	-0.046	12.2168	0.01
370	51.944	55.915	0.14	0.15	1.60	79	-0.41	1.29	78	-1.5	85	0.074	100	100	5.5	-0.259613	308	244	262	321	428	313	685	188	85	55	85	54	74	-0.045	11.9415	0.01
380	53.355	57.432	0.14	0.15	1.61	79	-0.7	1.28	78	-1.7	85	0.074	100	100	5.2	-0.251709	300	245	262	321	419	309	671	184	85	55	85	54	74	-0.044	11.8361	0.01
390	54.764	58.949	0.14	0.15	1.59	79	-0.2	1.28	78	-1.6	85	0.074	100	100	5.0	-0.211182	295	246	262	322	413	308	674	181	85	55	86	54	74	-0.044	12.0207	0.01
400	56.174	60.465	0.14	0.15	1.61	79	-0.47	1.28	78	-1.5	85	0.074	100	100	4.8	-0.20996	290	246	261	322	408	305	656	178	86	55	86	54	74	-0.044	11.6154	0.01
410	57.586	61.983	0.14	0.15	1.59	79	-0.6	1.29	78	-1.7	85	0.074	100	100	4.6	-0.205903	283	247	260	320	402	302	642	174	85	55	85	54	74	-0.042	11.4	0.01
420	58.996	63.501	0.14	0.15	1.59	79	-0.7	1.28	78	-1.6	84	0.074	100	100	4.4	-0.152099	276	248	259	319	397	300	622	170	85	55	85	54	73	-0.042	10.8646	0
430	60.408	65.019	0.14	0.15	1.61	79	-0.27	1.29	78	-1.4	84	0.074	100	100	4.3	-0.132141	267	248	257	317	391	296	607	166	85	55	85	54	73	-0.041	10.4793	0
440	61.820	66.537	0.14	0.15	1.59	79	-0.29	1.28	78	-1.4	83	0.074	100	100	4.1	-0.157349	261	248	255	315	384	293	594	163	85	55	84	54	73	-0.040	10.3039	0
450	63.231	68.055	0.14	0.15	1.59	79	-0.44	1.29	78	-1.4	82	0.074	100	100	4.0	-0.127594	256	248	253	313	378	290	590	161	85	56	84	54	72	-0.040	10.2585	0
460	64.644	69.575	0.14	0.15	1.61	79	-0.57	1.28	78	-1.7	81	0.074	100	100	3.9	-0.091583	252	247	251	310	372	286	579	159	84	56	84	54	72	-0.039	10.0532	0
470	66.057	71.094	0.14	0.15	1.59	79	-0.42	1.28	78	-1.7	81	0.074	100	100	3.8	-0.13971	248	247	250	307	368	284	574	157	84	56	84	54	72	-0.039	10.0078	0
480	67.469	72.614	0.14	0.15	1.58	79	-0.25	1.30	78	-1.6	81	0.074	100	100	3.7	-0.127105	245	245	248	304	365	281	568	156	84	56	83	54	72	-0.039	9.93244	0
490	68.883	74.135	0.14	0.15	1.59	79	-0.34	1.29	78	-1.5	80	0.074	100	100	3.5	-0.104431	243	244	247	301	362	279	571	154	83	56	83	54	72	-0.038	10.1171	0
500	70.297	75.657	0.14	0.15	1.61	79	-0.5	1.29	78	-1.5	80	0.074	100	100	3.4	-0.146607	241	244	248	298	360	278	568	154	84	56	84	55	71	-0.038	9.85171	0
510	71.711	77.178	0.14	0.15	1.61	79	-0.31	1.28	78	-1.5	80	0.074	100	100	3.3	-0.081665	240	243	247	295	357	276	568	155	84	56	84	55	71	-0.039	8.95634	0
520	73.124	78.699	0.14	0.15	1.60	79	-0.19	1.29	78	-1.4	79	0.074	100	100	3.2	-0.113647	235	241	243	291	350	272	550	153	84	57	84	55	71	-0.039	8.48098	0
530	74.537	80.218	0.14	0.15	1.59	78	-0.21	1.29	78	-1.6	79	0.074	100	100	3.1	-0.102539	231	241	238	287	343	268	544	151	84	57	84	55	71	-0.038	8.46561	0
540	75.949	81.738	0.14	0.15	1.61	78	-0.53	1.28	77	-1.5	80	0.074	100	100	3.0	-0.094849	228	238	235	283	339	265	540	150	84	57	84	55	72	-0.038	8.32024	0
550	77.363	83.258	0.14	0.15	1.61	78	-0.6	1.29	77	-1.5	80	0.074	100	100	2.9	-0.139496	225	236	232	279	335	261	532	149	84	57	84	55	72	-0.038	8.10488	0
560	78.774	84.777	0.14	0.15	1.58	78	-0.18	1.28	77	-1.6	80	0.074	100	100	2.8	-0.078491	222	234	229	275	331	258	525	147	84	57	85	55	72	-0.037	8.03951	0
570	80.185	86.297	0.14	0.15	1.60	78	-0.3	1.29	77	-1.6	80	0.074	100	100	2.7	-0.094391	219	232	226	271	328	255	521	146	84	58	85	56	72	-0.037	7.98415	0
580	81.597	87.815	0.14	0.15	1.61	78	-0.47	1.29	77	-1.6	80	0.074	100	100	2.6	-0.084259	218	231	224	267	326	253	520	145	84	58	85	56	72	-0.037	7.94878	0
590	83.009	89.334	0.14	0.15	1.58	78	-0.45	1.29	77	-1.6	80	0.074	100	100	2.5	-0.09079	215	229	223	264	323	251	510	143	84	58	84	56	72	-0.037	7.62341	0
600	84.418	90.854	0.14	0.15	1.60	78	-0.69	1.30	77	-1.4	80	0.074	100	100	2.4	-0.08725	212	227	221	260	319	248	506	143	84	58	84	57	72	-0.037	7.57805	0
610	85.829	92.373	0.14	0.15	1.58	78	-0.32	1.29	77	-1.6	80	0.074	100	100	2.4	-0.059539	209	224	218	256	315	244	498	141	84	59	84	57	71	-0.038	7.13268	0.01
620	87.240	93.893	0.14	0.15	1.59	78	-0.28	1.29	77	-1.4	79	0.074	100	100	2.3	-0.117157	203	223	213	251	308	240	483	140	83	59	84	57	71	-0.037	6.76732	0
630	88.652	95.414	0.14	0.15	1.59	78	-0.2	1.29	77	-1.5	79	0.074	100	100	2.2	-0.070191	200	222	209	247	302	236	482	138	83	59	83	58	71	-0.037	6.87195	0
640	90.063	96.936	0.14	0.15	1.61	78	-0.55	1.30	77	-1.6	79	0.074	100	100	2.1	-0.092926	198	220	208	242	297	233	478	137	84	60	85	58	71	-0.036	6.84659	0.01
650	91.475	98.456	0.14	0.15	1.59	78	-0.4	1.29	77	-1.6	79	0.074	100	100	2.0	-0.06073	196	218	207	238	293	230	475	136	84	60	85	58	71	-0.035	6.73122	0.01
660	92.885	99.976	0.14	0.15	1.59	78	-0.2	1.29	77	-1.5	79	0.074	100	100	2.0	-0.077301	193	217	206	234	290	228	470	135	84	60	85	59	71	-0.035	6.66585	0.01
670	94.296	101.495	0.14	0.15	1.61	78	-0.41	1.29	77	-1.7	79	0.074	100	100	1.9	-0.088165	190	216	204	231	286	225	465	133	84	61	85	59	72	-0.035	6.49049	0

Wood Heater Test Data
Low Burn Emissions Data

Run: 2

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 27-Nov-18
Beginning Clock Time: 16:25

Total Sampling Time: 820 min
Recording Interval: 10 min
Background Sample Volume: 117.349 cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) 0.998 (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.19		28.22	28.21 0

OMNI Equipment Numbers:

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: 18.70 ft/sec.
Initial Tunnel Flow: 196.7 scfm
Average Tunnel Flow: 197.5 scfm
Post-Test Leak Check (1): 0.000 cfm @ 10 in. Hg
Post-Test Leak Check (2): 0.000 cfm @ 12 in. Hg
Average Test Piece Fuel Moisture: 22.31 Dry Basis %

Technician Signature:

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.072	0.074	0.076	0.072	0.070	0.076	0.070	0.072	0.074	"H2O
Temp:	87	88	88	88	88	88	88	88	88	°F

V_{strav} 18.78 ft/sec V_{scent} 18.92 ft/sec F_p 0.992

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)													Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
680	95.707	103.016	0.14	0.15	1.58	78	-0.3	1.29	77	-1.6	79	0.074	100	100	1.8	-0.090576	188	213	202	228	281	222	465	132	84	61	85	59	72	-0.034	6.63512	0.01
690	97.117	104.537	0.14	0.15	1.60	78	-0.43	1.29	77	-1.7	79	0.074	100	100	1.7	-0.080628	187	212	199	225	277	220	463	131	84	61	85	59	72	-0.034	6.59976	0.01
700	98.529	106.057	0.14	0.15	1.59	78	-0.58	1.28	77	-1.5	78	0.074	100	100	1.6	-0.051636	185	210	197	222	273	217	458	130	84	62	85	60	71	-0.034	6.45439	0.01
710	99.939	107.577	0.14	0.15	1.58	78	-0.21	1.29	77	-1.5	81	0.074	100	100	1.5	-0.142791	178	210	197	219	270	215	302	163	84	62	85	60	72	-0.035	2.24902	0.56
720	101.349	109.096	0.14	0.15	1.60	78	-0.33	1.29	77	-1.5	79	0.074	100	100	1.3	-0.167755	182	208	190	222	268	214	515	127	84	62	85	60	72	-0.033	10.7437	0.08
730	102.759	110.616	0.14	0.15	1.59	78	-0.57	1.29	77	-1.4	79	0.074	100	100	1.2	-0.16391	199	208	183	232	268	218	543	131	84	62	85	61	72	-0.034	10.5783	0.05
740	104.168	112.136	0.14	0.15	1.59	78	-0.57	1.29	77	-1.6	78	0.074	99	100	1.0	-0.146851	211	208	180	243	269	222	567	134	84	63	85	61	71	-0.035	10.4429	0.05
750	105.578	113.656	0.14	0.15	1.60	78	-0.63	1.29	77	-1.5	78	0.074	100	100	0.9	-0.162414	217	209	179	252	270	225	572	136	84	63	84	61	71	-0.035	10.5576	0.04
760	106.988	115.176	0.14	0.15	1.59	78	-0.58	1.29	77	-1.6	78	0.074	100	100	0.7	-0.117951	221	214	179	260	271	229	575	138	83	63	84	61	71	-0.035	10.4922	0.03
770	108.397	116.696	0.14	0.15	1.60	78	-0.53	1.29	77	-1.5	78	0.074	99	100	0.6	-0.134216	223	214	180	266	273	231	573	138	83	63	84	61	71	-0.036	10.0368	0.02
780	109.808	118.216	0.14	0.15	1.59	78	-0.61	1.30	77	-1.5	77	0.074	100	100	0.5	-0.117676	222	214	180	271	272	232	563	139	83	63	84	62	70	-0.037	9.51146	0.02
790	111.218	119.738	0.14	0.15	1.58	77	-0.61	1.30	77	-1.5	77	0.074	100	100	0.4	-0.114532	220	213	178	275	271	231	556	138	83	64	84	62	70	-0.037	9.4061	0.02
800	112.628	121.261	0.14	0.15	1.61	77	-0.47	1.29	77	-1.6	77	0.074	100	100	0.3	-0.102936	217	212	177	277	269	230	547	138	83	64	83	62	70	-0.038	9.00073	0.01
810	114.038	122.783	0.14	0.15	1.60	77	-0.52	1.29	77	-1.6	77	0.074	100	100	0.1	-0.133301	214	210	175	278	267	229	540	136	83	64	84	62	70	-0.037	8.93537	0.01
820	115.448	124.306	0.14	0.15	1.59	77	-0.53	1.30	77	-1.5	77	0.074	100	100	0.0	-0.094421	212	207	173	278	264	227	541	136	83	64	84	62	70	-0.037	9.23	0.01
Avg/Tot	115.448	124.306	0.14	0.15	1.59	78		1.29	77		84	0.074	100	100								129.6				58	85	57	72	-0.047		

Wood Heater Lab Data

Manufacturer:	Kuma Stoves	Equipment Numbers:	
Model:	K250 Series		
Tracking No.:	2330		
Project No.:	0123WN012E		
Run #:	2		
Date:	11/27/18		

TRAIN 1 (First Hour emissions)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	T78S	86.1	84.8	1.3
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe				0.0
E. Filter seals catch*	Seals				0.0

Sub-Total	Total Particulate, mg:	1.3

TRAIN 1 (Post First Hour Change-out)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	T72AP	180.1	178.3	1.8
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe	23	114077.2	114076.8	0.4
E. Filter seals catch*	Seals	R687	4104.8	4104.7	0.1

Sub-Total	Total Particulate, mg:	2.3

Train 1 Aggregate	Total Particulate, mg:	**3.6**

TRAIN 2

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	T72BP	182.4	179.0	3.4
B. Rear filter catch	Filter				0.0
C. Probe catch*	Probe	24	114127.2	114126.5	0.7
D. Filter seals catch*	Seals	R688	3324.8	3324.6	0.2

	Total Particulate, mg:	**4.3**

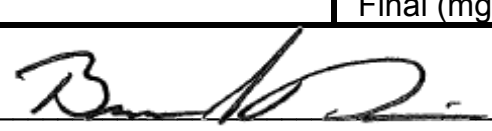
AMBIENT

Sample Component	Reagent	Filter # or Probe #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch*	Filter	D580	121.4	121.2	0.2

	Total Particulate, mg:	**0.2**

*Particulate catch that results in a negative number, is assumed to be zero for probes and seals, negative numbers for filters are assumed to be part of the seal weight.

Component	Equations:
A. Front filter catch	Final (mg) - Tare (mg) = Particulate, mg
B. Rear filter catch	Final (mg) - Tare (mg) = Particulate, mg
C. Probe catch	Final (mg) - Tare (mg) = Particulate, mg

Technician Signature: 

Wood Heater Test Results

Manufacturer: Kuma Stoves
Model: K250 Series
Project No.: 0123WN012E
Tracking No.: 2330
Run: 2
Test Date: 11/27/18

Burn Rate	**0.82 kg/hr dry**
Average Tunnel Temperature	84 degrees Fahrenheit
Average Gas Velocity in Dilution Tunnel - vs	18.70 feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	11851.7 dscf/hour
Average Delta p	0.074 inches H20
Total Time of Test	820 minutes

	AMBIENT	SAMPLE TRAIN 1	SAMPLE TRAIN 2	FIRST HOUR FILTER (TRAIN 1)
Total Sample Volume - Vm	117.349 cubic feet	115.448 cubic feet	124.306 cubic feet	8.370 cubic feet
Average Gas Meter Temperature	72 degrees Fahrenheit	78 degrees Fahrenheit	77 degrees Fahrenheit	78 degrees Fahrenheit
Total Sample Volume (Standard Conditions) - Vmstd	109.515 dscf	106.922 dscf	113.357 dscf	7.752 dscf
Total Particulates - m_n	0.2 mg	3.5 mg	4.1 mg	1.3 mg
Particulate Concentration (dry-standard) - C_f/C_s	0.000002 grams/dscf	0.00003 grams/dscf	0.00004 grams/dscf	0.00017 grams/dscf
Total Particulate Emissions - E_T	0.30 grams	5.01 grams	5.56 grams	1.99 grams
Particulate Emission Rate	0.02 grams/hour	0.37 grams/hour	0.41 grams/hour	1.99 grams/hour
Emissions Factor		0.45 g/kg	0.49 g/kg	1.05 g/kg
Difference from Average Total Particulate Emissions		0.28 grams	0.28 grams	

Dual Train Comparison Results Are Acceptable

FINAL AVERAGE RESULTS

Complete Test Run	
Total Particulate Emissions - E_T	5.28 grams
Particulate Emission Rate	**0.39 grams/hour**
Emissions Factor	0.47 grams/kg
First Hour Emissions	
Total Particulate Emissions - E_T	1.99 grams
Particulate Emission Rate	1.99 grams/hour
Emissions Factor	1.05 grams/kg
7.5% of Average Total Particulate Emissions	0.40 grams

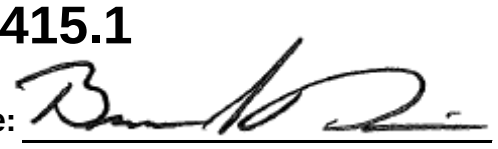
QUALITY CHECKS

Filter Temps < 90 °F	OK
Filter Face Velocity (47 mm)	OK
Dryer Exit Temp < 80F	OK
Leakage Rate	OK
Ambient Temp (55-90°F)	OK
Negative Probe Weight Eval.	OK
Pro-Rate Variation	OK
Gram per Kilogram <0.50	0.05
Train Precision ≤ 7.5%	7.90

Technician Signature:_____

Wood Heater Efficiency Results - CSA B415.1

Manufacturer: Kuma Stoves
Model: K250 Series
Date: 11/27/18
Run: 2
Control #: 0123WN012E
Test Duration: 820
Output Category: II

Technician Signature: 

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	81.4%	88.2%
Combustion Efficiency	99.5%	99.5%
Heat Transfer Efficiency	82%	88.7%

Output Rate (kJ/h)	11,802	11,196	**(Btu/h)**
Burn Rate (kg/h)	0.83	1.82	**(lb/h)**
Input (kJ/h)	14,506	13,761	**(Btu/h)**

Test Load Weight (dry kg)	11.28	24.86	**dry lb**
MC wet (%)	18.23830808		
MC dry (%)	22.31		
Particulate (g)	0.40		
CO (g)	69		
Test Duration (h)	13.67		

Emissions	Particulate	CO
g/MJ Output	0.00	0.43
g/kg Dry Fuel	0.04	6.12
g/h	0.03	5.05
lb/MM Btu Output	0.01	0.99

Air/Fuel Ratio (A/F)	10.60

VERSION: **2.2** **12/14/2009**

Adjunct to ASTM E XXXX Wood Heater Cordwood Test Method - May 10, 2017 Version

Cordwood Fuel Load Calculators - 12 lb/ft^3 Nominal Load Density

Core 45-65% of Total Load Weight, Remainder 35-55% of Total Load Weight

Values to be input manually

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For Usable Firebox Volumes up to 3.0 ft^3 - Low and Medium Fire

Nominal Required Load Density (wet basis)	12	lb/ft^3				
Usable Firebox Volume	2.54	ft^3				
Total Nom. Load Wt. Target	30.48	lb				
Total Load Wt. Allowable Range	28.96	to	32.00	lb		
Core Target Wt. Allowable Range	13.716	to	19.81	lb		
Remainder Load Wt. Allowable Range	10.67	to	16.76	lb		
						Mid-Point
Core Load Fuel Pc. Wt. Allowable Range	4.57	to	7.62	lb		6.10
Remainder Load Pc. Wt. Allowable Range	3.05	to	9.14	lb		6.10
	Pc. #					
Core Load Piece Wt. Actual	1	6.63	lb		In Range	
	2	5.34	lb		In Range	
	3	4.94	lb		In Range	
Core Load Total. Wt. Actual		16.92	lb		In Range	
	Pc. #					
Remainder Load Piece Wt.	1	9.00	lb		In Range	
(2 or 3 Pcs.)	2	4.48	lb		In Range	
	3		lb		NA	
Remainder Load Piece Weight Ratio - Small/Large		50%			In Range	≤ 67%
Remainder Load Tot. Wt. Act		13.47	lb		In Range	
Total Load Wt. Actual		30.39	lb		In Range	
Core % of Total Wt.		56%			In Range	45-65%
Remainder % of Total Wt.		44%			In Range	35-55%
Actual Load % of Nominal Target		100%			In Range	95-105%
Actual Fuel Load Density		12.0	lb/ft^3			
Allowable Charcoal Bed Wt. Range (lb)	3.1	to	6.0			Mid-Point
Actual Charcoal Bed Wt.		5.8	lb		In Range	4.6
Actual Fuel Load Ending Wt.		0.0	lb		Valid Test	≥ 90%
Total Wt. of Fuel Burned During Test Run lb.		30.4	lb			

Fuel Piece Moisture Reading (%-dry basis)

1	2	3	Ave.		Pc. Wt. Dry Basis			
19.6	24.3	18.7	20.9	In Range	5.49	lb	2.49	kg
19.1	22.9	21.2	21.1	In Range	4.41	lb	2.00	kg
19.5	31.6	20.7	23.9	In Range	3.99	lb	1.81	kg
28.2	23.1	22.6	24.6	In Range	7.22	lb	3.27	kg
20.4	24	18.7	21.0	In Range	3.70	lb	1.68	kg
			NA	NA	NA	lb	NA	kg

Total Load Ave. MC % (dry basis)	22.5	In Range			
Total Load Ave. MC % (wet basis)	18.4				
Total Test Load Weight (dry basis) →			24.80	lb	11.25 kg
Total Fuel Weight Burned During Test Run (dry basis)			24.8	lb	11.25 kg

VERSION: 2.2 12/14/2009

Manufacturer:	Kuma Stoves	**Appliance Type:**	Cat
Model:	K250 Series		
Date:	11/27/2018	**Temp. Units**	F (F or C)
Run:	2	**Weight Units**	lb (kg or lb)
Control #:	0123WN012E		
Test Duration:	820		
Output Category:	II		

		Fuel Data		
			D. Fir	
Wood Moisture (% wet):	18.24	**HHV**	17,580	kj/kg
Load Weight (lb wet):	30.40	**%C**	50.54	
Burn Rate (dry kg/h):	0.82	**%H**	6.36	
Total Particulate Emissions:	0.39 g	**%O**	42.40	
		%ASH	0.70	

Averages	**0.04**	**10.59**	**#DIV/0!**	**195.24**	**72.06**	
				Temp. (ºF)	
Elapsed Time (min)	**Fuel Weight Remaining (lb)**	**Flue Gas Composition (%) CO**	**CO_2**	**O_2**	**Flue Gas**	**Room Temp**
0	30.40	0.07	7.24		191.0	72.0
10	29.19	0.06	10.16		422.0	71.0
20	28.09	0.01	7.07		325.0	71.0
30	27.48	0.02	7.83		293.0	71.0
40	26.76	0.03	8.93		266.0	71.0
50	26.06	0.03	9.34		257.0	70.0
60	25.29	0.02	10.09		257.0	70.0
70	24.46	0.03	10.53		258.0	71.0
80	23.68	0.02	10.86		260.0	71.0
90	22.80	0.02	11.68		265.0	71.0
100	21.92	0.01	11.93		263.0	72.0
110	21.02	0.02	12.96		270.0	72.0
120	20.05	0.02	14.00		278.0	73.0
130	19.13	0.02	13.91		278.0	73.0
140	18.27	0.02	13.34		269.0	73.0
150	17.42	0.02	14.19		270.0	73.0
160	16.50	0.02	16.06		280.0	73.0
170	15.44	1.27	18.53		290.0	73.0
180	14.60	0.06	14.62		283.0	74.0
190	13.92	0.04	13.60		261.0	74.0
200	13.29	0.04	13.94		254.0	74.0
210	12.65	0.04	14.25		250.0	74.0

220	12.05	0.04	14.25		246.0	74.0
230	11.43	0.03	14.07		243.0	74.0
240	10.83	0.03	14.33		242.0	73.0
250	10.28	0.03	13.88		235.0	73.0
260	9.78	0.03	14.06		231.0	73.0
270	9.26	0.02	14.40		231.0	73.0
280	8.77	0.02	14.09		229.0	73.0
290	8.25	0.02	14.05		226.0	73.0
300	7.81	0.02	13.43		221.0	73.0
310	7.42	0.02	13.31		216.0	72.0
320	7.02	0.02	13.11		212.0	72.0
330	6.65	0.02	13.05		206.0	72.0
340	6.32	0.02	12.97		203.0	72.0
350	6.02	0.01	12.47		198.0	73.0
360	5.72	0.01	12.22		192.0	74.0
370	5.46	0.01	11.94		188.0	74.0
380	5.21	0.01	11.84		184.0	74.0
390	4.99	0.01	12.02		181.0	74.0
400	4.78	0.01	11.62		178.0	74.0
410	4.58	0.01	11.40		174.0	74.0
420	4.43	0.00	10.86		170.0	73.0
430	4.29	0.00	10.48		166.0	73.0
440	4.14	0.00	10.30		163.0	73.0
450	4.01	0.00	10.26		161.0	72.0
460	3.92	0.00	10.05		159.0	72.0
470	3.78	0.00	10.01		157.0	72.0
480	3.65	0.00	9.93		156.0	72.0
490	3.55	0.00	10.12		154.0	72.0
500	3.40	0.00	9.85		154.0	71.0
510	3.32	0.00	8.96		155.0	71.0
520	3.20	0.00	8.48		153.0	71.0
530	3.10	0.00	8.47		151.0	71.0
540	3.01	0.00	8.32		150.0	72.0
550	2.87	0.00	8.10		149.0	72.0
560	2.79	0.00	8.04		147.0	72.0
570	2.70	0.00	7.98		146.0	72.0
580	2.61	0.00	7.95		145.0	72.0
590	2.52	0.00	7.62		143.0	72.0
600	2.43	0.00	7.58		143.0	72.0
610	2.37	0.01	7.13		141.0	71.0
620	2.26	0.00	6.77		140.0	71.0
630	2.19	0.00	6.87		138.0	71.0

640	2.09	0.01	6.85		137.0	71.0
650	2.03	0.01	6.73		136.0	71.0
660	1.95	0.01	6.67		135.0	71.0
670	1.87	0.00	6.49		133.0	72.0
680	1.78	0.01	6.64		132.0	72.0
690	1.70	0.01	6.60		131.0	72.0
700	1.64	0.01	6.45		130.0	71.0
710	1.50	0.56	2.25		163.0	72.0
720	1.33	0.08	10.74		127.0	72.0
730	1.17	0.05	10.58		131.0	72.0
740	1.02	0.05	10.44		134.0	71.0
750	0.86	0.04	10.56		136.0	71.0
760	0.74	0.03	10.49		138.0	71.0
770	0.61	0.02	10.04		138.0	71.0
780	0.49	0.02	9.51		139.0	70.0
790	0.38	0.02	9.41		138.0	70.0
800	0.27	0.01	9.00		138.0	70.0
810	0.14	0.01	8.94		136.0	70.0
820	0.05	0.01	9.23		136.0	70.0

OMNI-Test Laboratories, Inc.

Wood Heater Run Sheets

Client: Kuma Stoves Project Number: 0123WN012E Run Number: 2
Model: K250 Series Tracking Number: 2330 Date: 11/27/18
Test Crew: B Davis
OMNI Equipment ID numbers: 133, Small scale, Fuel scale, 650, 243A, 371, 372, 410, 659, 592, 420, 637

Wood Heater Supplemental Data

Start Time: 16:25 11/27/18 Booth #: N/A
Stop Time: 0605 11/28/18

Stack Gas Leak Check:
Initial: good Final: good

Sample Train Leak Check:
A: 0.0 @ 10 "Hg
B: 0.0 @ 12 "Hg

Calibrations: Span Gas CO_2: 12.4 CO: 2.48

	Pre Test		Post Test	
	Zero	Span	Zero	Span
Time	1621	1621	0609	0609
CO_2	0.00	12.4	-0.03	11.2
CO	0.000	2.42	-0.030	2.37

Air Velocity (ft/min): Initial: <50 Final: <50
Scale Audit (lbs): Initial: 10.0 Final: 10.0
Pitot Tube Leak Test: Initial: good Final: good
Stack Diameter (in): 6"
Induced Draft: 0.0
% Smoke Capture: 100%
Flue Pipe Cleaned Prior to First Test in Series:
Date: 11/21/18 Initials: BZ

	Initial	Middle	Ending
P_b (in/Hg)	28.19		28.22
RH (%)	40%		41%
Ambient (°F)	72		72

Tunnel Traverse

Microtector Reading	dP (in H_2O)	T(°F)
	.072	87
	.074	88
	.076	88
	.072	88
	.070	88
	.076	88
	.070	88
	.072	88
Center:		
	~~.074~~ .074	88

Tunnel Static Pressure (in H_2O):	
Beginning of Test	End of Test
-.110	-.110

Background Filter Volume: 117.3479

Technician Signature: [signature] Date: 1/30/19

OMNI-Test Laboratories, Inc.

Wood Heater Run Sheets

Client: Kuma Stoves Project Number: 0123WN012E Run Number: 2
Model: K250 Series Tracking Number: 2330 Date: 11/27/18
Test Crew: B Davis
OMNI Equipment ID numbers:

Wood Heater Run Notes

Air Control Settings

Primary:

N/A Fully closed = 0.410" cross section Area

Secondary: N/A

Tertiary/Pilot: N/A

Fan: N/A

Preburn Notes

Time	Notes
N/A	

Test Notes

Sketch test fuel configuration:

See photo

Start up procedures & Timeline:

Bypass: Open until 1:51
Fuel loaded by: 1:45
Door closed at: 1:50
Primary air: fully open until 16:10 min
Notes: Fan off until 30 min

Time	Notes
60	Changed front filter in train A.
11:50	Adjusted fuel load after 10 min. without weight Loss.

Technician Signature: Date: 1/30/19

Run 3
Non-Particulate Sampling High Burn

Wood Heater Test Data
Non Sampling Hign Burn Data

Run: 3

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 29-Nov-18
Beginning Clock Time: 10:43

Total Sampling Time: 313 min
Recording Interval: 1 min
Background Sample Volume: 36.649 cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) 0.998 (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.15		28.19	28.17 0

OMNI Equipment Numbers:

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: #DIV/0! ft/sec.
Initial Tunnel Flow: #DIV/0! scfm
Average Tunnel Flow: #DIV/0! scfm
Post-Test Leak Check (1): cfm @ in. Hg
Post-Test Leak Check (2): cfm @ in. Hg
Average Test Piece Fuel Moisture: 19.78 Dry Basis %

Technician Signature:

Velocity Traverse Data										
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP										"H2O
Temp:										°F

V_{strav} ft/sec V_{scent} ft/sec F_p

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)													Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
0															13.0		66	63	63	64	63	64		71					65	-0.007		
1			1.00												12.8	-0.123291	110	63	63	64	64	73		217					65	-0.048		
2			1.00												12.8	-0.06781	151	63	64	64	64	81		266					65	-0.051		
3			1.00												12.7	-0.045044	179	63	64	64	64	87		286					65	-0.052		
4			1.00												12.7	-0.06781	197	63	65	65	65	91		309					65	-0.058		
5			1.00												12.6	-0.067688	210	63	66	66	67	94		346					66	-0.061		
6			1.00												12.5	-0.102661	238	63	67	67	68	101		384					66	-0.067		
7			1.00												12.4	-0.086548	267	63	68	69	70	107		442					66	-0.073		
8			1.00												12.3	-0.099426	298	63	69	71	72	115		460					66	-0.073		
9			1.00												12.2	-0.078247	325	63	71	73	74	121		488					66	-0.080		
10			1.00												12.1	-0.114929	355	63	73	76	77	129		553					66	-0.084		
11			1.00												12.0	-0.142761	388	63	76	79	80	137		595					66	-0.087		
12			1.00												11.8	-0.18396	416	63	79	82	83	145		648					66	-0.091		
13			1.00												11.6	-0.193604	445	63	84	86	87	153		690					66	-0.095		
14			1.00												11.4	-0.202881	472	63	92	90	91	162		706					66	-0.095		
15			1.00												11.2	-0.216858	488	63	102	95	96	169		705					66	-0.094		
16			1.00												10.9	-0.235687	438	64	114	100	101	163		495					66	-0.075		
17			1.00												10.8	-0.131866	410	64	128	107	108	163		449					67	-0.073		
18			1.00												10.6	-0.15091	396	64	140	115	115	166		430					67	-0.073		
19			1.00												10.5	-0.111053	392	64	153	124	124	171		427					67	-0.073		
20			1.00												10.4	-0.151428	392	64	166	133	132	177		418					67	-0.072		
21			1.00												10.3	-0.119812	392	65	179	141	141	184		418					67	-0.072		
22			1.00												10.2	-0.114716	395	65	191	150	149	190		416					67	-0.072		
23			1.00												10.0	-0.136658	399	66	204	159	157	197		412					67	-0.071		
24			1.00												9.9	-0.095062	401	66	217	167	165	203		408					67	-0.071		
25			1.00												9.8	-0.136047	405	67	230	175	172	210		411					67	-0.071		
26			1.00												9.7	-0.13089	410	67	243	183	179	216		413					67	-0.072		
27			1.00												9.5	-0.136353	417	68	254	190	186	223		423					67	-0.073		
28			1.00												9.4	-0.137604	423	68	265	198	193	229		424					67	-0.073		
29			1.00												9.2	-0.130249	428	69	275	205	199	235		423					67	-0.072		
30			1.00												9.1	-0.138458	435	70	285	212	206	242		428					67	-0.074		
31			1.00												9.0	-0.13443	436	70	286	213	207	242		429					67	-0.086		
32			1.00												8.8	-0.151642	443	71	295	220	214	249		431					67	-0.086		
33			1.00												8.7	-0.131836	448	72	303	227	220	254		434					67	-0.087		
34			1.00												8.5	-0.144897	455	73	311	234	227	260		435					67	-0.086		

Wood Heater Test Data
Non Sampling Hign Burn Data

Run: 3

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 29-Nov-18
Beginning Clock Time: 10:43

Total Sampling Time: 313 min
Recording Interval: 1 min
Background Sample Volume: 36.649 cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) 0.998 (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.15		28.19	28.17 0

OMNI Equipment Numbers:

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: #DIV/0! ft/sec.
Initial Tunnel Flow: #DIV/0! scfm
Average Tunnel Flow: #DIV/0! scfm
Post-Test Leak Check (1): cfm @ in. Hg
Post-Test Leak Check (2): cfm @ in. Hg
Average Test Piece Fuel Moisture: 19.78 Dry Basis %

Technician Signature:

Velocity Traverse Data										
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP										"H2O
Temp:										°F

V_{strav} ft/sec V_{scent} ft/sec F_p

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)												Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
35			1.00												8.4	-0.140442	462	74	319	241	233	266		437					68	-0.086		
36			1.00												8.3	-0.147705	470	75	327	248	239	272		443					68	-0.088		
37			1.00												8.1	-0.164215	486	77	334	254	245	279		455					68	-0.089		
38			1.00												7.9	-0.146454	497	78	341	261	251	286		459					68	-0.089		
39			1.00												7.8	-0.143982	506	80	348	268	256	292		460					68	-0.089		
40			1.00												7.6	-0.175049	513	81	356	275	262	297		461					68	-0.089		
41			1.00												7.5	-0.129486	521	83	363	282	267	303		461					68	-0.089		
42			1.00												7.4	-0.133545	528	85	370	289	272	309		463					68	-0.089		
43			1.00												7.2	-0.13919	535	87	377	295	277	314		462					68	-0.088		
44			1.00												7.1	-0.162598	541	89	384	302	281	319		464					69	-0.088		
45			1.00												6.9	-0.131805	545	92	391	307	285	324		463					69	-0.088		
46			1.00												6.8	-0.174805	547	94	398	313	290	328		463					68	-0.088		
47			1.00												6.6	-0.158447	551	97	405	319	295	333		466					69	-0.089		
48			1.00												6.5	-0.142945	554	100	412	324	301	338		465					69	-0.088		
49			1.00												6.3	-0.164581	558	104	419	330	308	344		467					69	-0.089		
50			1.00												6.1	-0.146088	568	107	426	335	315	350		475					69	-0.091		
51			1.00												6.0	-0.146667	575	110	433	339	322	356		478					69	-0.090		
52			1.00												5.8	-0.162384	578	114	440	344	329	361		477					69	-0.089		
53			1.00												5.7	-0.136231	582	118	447	349	336	366		475					69	-0.089		
54			1.00												5.5	-0.158111	584	121	453	353	342	371		474					69	-0.089		
55			1.00												5.4	-0.145508	587	125	460	358	349	376		474					69	-0.089		
56			1.00												5.3	-0.122437	590	129	466	363	355	381		473					69	-0.090		
57			1.00												5.1	-0.140045	593	133	472	368	361	385		473					69	-0.088		
58			1.00												5.0	-0.134063	594	137	478	373	366	390		471					69	-0.088		
59			1.00												4.9	-0.138978	594	141	484	377	372	394		471					70	-0.088		
60			1.00												4.7	-0.139007	596	146	490	382	377	398		472					70	-0.089		
61			1.00												4.6	-0.127625	597	150	496	386	382	402		471					70	-0.088		
62			1.00												4.5	-0.106994	596	155	501	391	387	406		466					69	-0.087		
63			1.00												4.4	-0.11615	593	159	505	394	391	408		463					69	-0.087		
64			1.00												4.2	-0.124725	591	164	509	398	395	411		461					70	-0.087		
65			1.00												4.1	-0.132355	589	169	513	402	399	414		461					69	-0.087		
66			1.00												4.0	-0.108429	589	174	516	405	402	417		461					70	-0.087		
67			1.00												3.9	-0.11911	589	178	518	408	405	420		461					69	-0.087		
68			1.00												3.8	-0.081299	588	182	521	412	408	422		458					69	-0.087		
69			1.00												3.7	-0.129212	586	187	523	415	411	424		455					69	-0.086		

Wood Heater Test Data
Non Sampling Hign Burn Data

Run: 3

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 29-Nov-18
Beginning Clock Time: 10:43

Total Sampling Time: 313 min
Recording Interval: 1 min
Background Sample Volume: 36.649 cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) 0.998 (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.15		28.19	28.17 0

OMNI Equipment Numbers:

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: #DIV/0! ft/sec.
Initial Tunnel Flow: #DIV/0! scfm
Average Tunnel Flow: #DIV/0! scfm
Post-Test Leak Check (1): cfm @ in. Hg
Post-Test Leak Check (2): cfm @ in. Hg
Average Test Piece Fuel Moisture: 19.78 Dry Basis %

Technician Signature:

Velocity Traverse Data										
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP										"H2O
Temp:										°F

V_{strav} ft/sec V_{scent} ft/sec F_p

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)													Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
70			1.00												3.6	-0.108551	584	193	525	418	414	427		453					69	-0.086		
71			1.00												3.5	-0.094207	583	198	527	421	417	429		451					69	-0.085		
72			1.00												3.4	-0.071015	580	203	529	424	420	431		447					69	-0.084		
73			1.00												3.3	-0.10794	577	207	531	427	423	433		443					69	-0.081		
74			1.00												3.2	-0.045533	575	213	533	430	426	435		439					70	-0.081		
75			1.00												3.2	-0.097747	571	217	534	433	429	437		435					70	-0.081		
76			1.00												26.0	22.79878	566	225	536	436	431	439		444					70	-0.094		
77			1.00												25.0	-0.97406	554	248	538	441	434	443		489					70	-0.091		
78			1.00												24.8	-0.208008	535	260	539	444	436	443		459					70	-0.084		
79			1.00												24.6	-0.200989	517	266	540	446	439	442		393					70	-0.089		
80			1.00												24.3	-0.270568	513	255	540	448	443	440		417					70	-0.085		
81			1.00												24.1	-0.200074	526	258	538	448	444	443		458					70	-0.088		
82			1.00												23.9	-0.209411	526	262	534	448	443	443		483					70	-0.090		
83			1.00												23.7	-0.195496	535	265	519	447	440	441		493					70	-0.091		
84			1.00												23.5	-0.207886	542	269	506	445	437	440		491					70	-0.091		
85			1.00												23.3	-0.212402	547	273	493	444	434	438		492					70	-0.091		
86			1.00												23.1	-0.205872	554	276	480	442	430	436		492					70	-0.091		
87			1.00												22.9	-0.20581	562	277	469	441	427	435		491					70	-0.090		
88			1.00												22.6	-0.21051	566	279	460	440	423	434		490					70	-0.089		
89			1.00												22.4	-0.200013	572	280	452	439	420	433		490					70	-0.089		
90			1.00												22.2	-0.233215	578	281	444	438	416	431		491					70	-0.089		
91			1.00												22.0	-0.213196	584	281	438	437	413	431		492					70	-0.089		
92			1.00												21.8	-0.231323	589	281	432	436	410	430		492					70	-0.089		
93			1.00												21.6	-0.194275	596	282	427	435	407	429		493					70	-0.089		
94			1.00												21.4	-0.192932	602	281	424	434	405	429		494					70	-0.090		
95			1.00												21.2	-0.208252	608	281	421	433	403	429		493					71	-0.090		
96			1.00												21.0	-0.191284	613	280	420	433	401	429		496					71	-0.089		
97			1.00												20.8	-0.18457	618	280	419	432	399	430		496					71	-0.089		
98			1.00												20.6	-0.24524	621	278	419	432	397	429		495					71	-0.089		
99			1.00												20.4	-0.163025	624	277	419	432	395	429		495					71	-0.090		
100			1.00												20.2	-0.19049	627	277	418	432	393	429		494					71	-0.089		
101			1.00												20.0	-0.191468	628	275	418	432	392	429		493					71	-0.089		
102			1.00												19.8	-0.170715	630	275	418	432	391	429		491					71	-0.089		
103			1.00												19.6	-0.222351	631	275	418	433	389	429		490					71	-0.089		
104			1.00												19.4	-0.167053	630	272	417	433	388	428		488					71	-0.088		

Wood Heater Test Data
Non Sampling Hign Burn Data

Run: 3

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 29-Nov-18
Beginning Clock Time: 10:43

Total Sampling Time: 313 min
Recording Interval: 1 min
Background Sample Volume: 36.649 cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) 0.998 (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.15		28.19	28.17 0

OMNI Equipment Numbers:

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: #DIV/0! ft/sec.
Initial Tunnel Flow: #DIV/0! scfm
Average Tunnel Flow: #DIV/0! scfm
Post-Test Leak Check (1): cfm @ in. Hg
Post-Test Leak Check (2): cfm @ in. Hg
Average Test Piece Fuel Moisture: 19.78 Dry Basis %

Technician Signature:_____

Velocity Traverse Data	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP										"H2O
Temp:										°F

V_{strav} _____ ft/sec V_{scent} _____ ft/sec F_p _____

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)												Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
105			1.00												19.3	-0.176453	629	273	417	434	386	428		486					71	-0.088		
106			1.00												19.1	-0.175537	627	271	417	434	385	427		485					71	-0.088		
107			1.00												18.9	-0.183777	625	270	417	435	384	426		483					71	-0.088		
108			1.00												18.8	-0.138611	623	270	417	435	383	426		481					71	-0.088		
109			1.00												18.6	-0.160583	619	268	417	436	383	425		479					71	-0.087		
110			1.00												18.5	-0.159729	615	267	417	436	382	423		475					72	-0.087		
111			1.00												18.3	-0.14148	610	266	417	437	382	422		471					71	-0.086		
112			1.00												18.2	-0.160095	604	265	417	437	381	421		468					72	-0.086		
113			1.00												18.0	-0.149292	600	264	416	438	381	420		466					72	-0.086		
114			1.00												17.9	-0.139343	595	263	415	438	380	418		464					72	-0.085		
115			1.00												17.7	-0.148377	592	261	414	438	379	417		464					72	-0.085		
116			1.00												17.6	-0.133239	589	261	413	438	379	416		463					72	-0.085		
117			1.00												17.4	-0.16626	586	261	412	439	378	415		463					72	-0.085		
118			1.00												17.3	-0.146851	583	260	411	438	377	414		461					72	-0.085		
119			1.00												17.1	-0.139831	579	258	411	438	376	412		460					72	-0.085		
120			1.00												17.0	-0.155518	576	258	410	438	375	411		458					72	-0.085		
121			1.00												16.9	-0.116821	573	257	409	438	375	410		457					73	-0.084		
122			1.00												16.7	-0.109741	569	256	408	438	373	409		457					72	-0.084		
123			1.00												16.6	-0.156189	566	256	408	438	372	408		456					72	-0.084		
124			1.00												16.5	-0.12555	563	255	407	438	371	407		454					72	-0.084		
125			1.00												16.3	-0.139953	560	254	406	438	370	406		452					73	-0.084		
126			1.00												16.2	-0.130066	558	255	405	437	369	405		452					72	-0.084		
127			1.00												16.1	-0.14447	556	252	404	437	369	404		452					72	-0.083		
128			1.00												15.9	-0.12378	553	253	403	437	368	403		451					72	-0.083		
129			1.00												15.8	-0.144287	552	252	402	437	367	402		449					72	-0.083		
130			1.00												15.7	-0.112671	550	252	402	437	366	401		450					72	-0.083		
131			1.00												15.6	-0.116211	548	252	401	437	365	401		448					73	-0.083		
132			1.00												15.4	-0.131714	546	250	401	436	365	400		447					73	-0.083		
133			1.00												15.3	-0.133239	544	250	400	436	364	399		448					73	-0.083		
134			1.00												15.2	-0.134217	542	250	400	435	363	398		445					73	-0.082		
135			1.00												15.0	-0.10913	540	249	400	435	362	397		445					73	-0.083		
136			1.00												14.9	-0.11908	538	249	401	435	362	397		444					73	-0.083		
137			1.00												14.8	-0.119019	536	249	401	434	361	396		444					73	-0.083		
138			1.00												14.7	-0.138794	534	249	401	434	361	396		443					73	-0.082		
139			1.00												14.6	-0.098693	530	248	401	434	360	395		440					73	-0.082		

Wood Heater Test Data
Non Sampling Hign Burn Data

Run: 3

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 29-Nov-18
Beginning Clock Time: 10:43

Total Sampling Time: 313 min
Recording Interval: 1 min
Background Sample Volume: 36.649 cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) 0.998 (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.15		28.19	28.17

OMNI Equipment Numbers: 0

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: #DIV/0! ft/sec.
Initial Tunnel Flow: #DIV/0! scfm
Average Tunnel Flow: #DIV/0! scfm
Post-Test Leak Check (1): cfm @ in. Hg
Post-Test Leak Check (2): cfm @ in. Hg
Average Test Piece Fuel Moisture: 19.78 Dry Basis %

Technician Signature:

Velocity Traverse Data	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP										"H2O
Temp:										°F

V_{strav} ft/sec V_{scent} ft/sec F_p

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)													Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
140			1.00												14.4	-0.138367	525	248	402	434	360	394		437					73	-0.081		
141			1.00												14.4	-0.075501	520	247	404	433	360	393		435					73	-0.081		
142			1.00												14.2	-0.122497	516	248	406	433	360	393		434					73	-0.081		
143			1.00												14.1	-0.11499	512	248	407	432	360	392		433					73	-0.081		
144			1.00												14.0	-0.089051	508	247	409	432	360	391		432					73	-0.082		
145			1.00												13.9	-0.111999	504	248	411	431	360	391		430					73	-0.081		
146			1.00												13.8	-0.092407	500	247	412	431	360	390		430					73	-0.080		
147			1.00												13.7	-0.117005	496	247	413	430	360	389		428					73	-0.080		
148			1.00												13.6	-0.093872	493	246	414	430	360	389		427					73	-0.082		
149			1.00												13.5	-0.120605	490	246	415	429	359	388		425					73	-0.080		
150			1.00												13.4	-0.109192	486	247	415	429	359	387		424					73	-0.080		
151			1.00												13.3	-0.09314	483	247	415	428	359	386		424					73	-0.080		
152			1.00												13.2	-0.087097	481	247	416	428	359	386		424					73	-0.080		
153			1.00												13.1	-0.133545	479	247	416	428	358	386		422					73	-0.080		
154			1.00												12.9	-0.151794	477	247	417	428	358	385		422					73	-0.080		
155			1.00												12.8	-0.132203	476	248	417	428	357	385		423					73	-0.081		
156			1.00												12.6	-0.144226	479	248	416	428	356	385		428					73	-0.082		
157			1.00												12.5	-0.116516	487	248	414	429	356	387		434					73	-0.083		
158			1.00												12.4	-0.121521	494	248	411	431	356	388		436					73	-0.081		
159			1.00												12.3	-0.132263	499	249	408	433	355	389		436					73	-0.082		
160			1.00												12.2	-0.090515	504	249	404	436	355	390		436					73	-0.081		
161			1.00												12.1	-0.129211	507	248	400	438	354	389		435					73	-0.081		
162			1.00												12.0	-0.090149	510	249	396	441	354	390		435					73	-0.081		
163			1.00												11.9	-0.094178	513	249	392	443	353	390		434					73	-0.081		
164			1.00												11.8	-0.10382	515	249	388	445	352	390		434					73	-0.081		
165			1.00												11.7	-0.11261	516	250	384	447	352	390		433					73	-0.081		
166			1.00												11.6	-0.097412	517	249	381	449	351	389		432					73	-0.081		
167			1.00												11.5	-0.081238	516	249	377	450	351	389		430					73	-0.080		
168			1.00												11.4	-0.092835	515	250	374	452	350	388		428					73	-0.081		
169			1.00												11.3	-0.093567	513	250	371	453	349	387		428					73	-0.080		
170			1.00												11.2	-0.11267	511	249	368	454	349	386		426					73	-0.080		
171			1.00												11.1	-0.084534	509	249	365	455	348	385		426					73	-0.080		
172			1.00												11.0	-0.081665	507	250	362	455	348	384		424					73	-0.080		
173			1.00												10.9	-0.087097	504	250	359	456	347	383		423					73	-0.079		
174			1.00												10.8	-0.088501	502	249	357	457	346	382		422					73	-0.079		

Wood Heater Test Data
Non Sampling Hign Burn Data

Run: 3

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 29-Nov-18
Beginning Clock Time: 10:43

Total Sampling Time: 313 min
Recording Interval: 1 min
Background Sample Volume: 36.649 cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) 0.998 (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.15		28.19	28.17 0

OMNI Equipment Numbers:

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: #DIV/0! ft/sec.
Initial Tunnel Flow: #DIV/0! scfm
Average Tunnel Flow: #DIV/0! scfm
Post-Test Leak Check (1): cfm @ in. Hg
Post-Test Leak Check (2): cfm @ in. Hg
Average Test Piece Fuel Moisture: 19.78 Dry Basis %

Technician Signature:_____

Velocity Traverse Data										
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP										"H2O
Temp:										°F

V_{strav} _____ ft/sec V_{scent} _____ ft/sec F_p _____

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)												Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
175			1.00												10.7	-0.098267	499	249	355	457	345	381		421					73	-0.079		
176			1.00												10.6	-0.103821	497	250	352	458	344	380		421					73	-0.079		
177			1.00												10.5	-0.08966	495	250	350	459	343	379		420					73	-0.079		
178			1.00												10.5	-0.081238	493	250	348	459	342	378		420					73	-0.079		
179			1.00												10.4	-0.083679	492	250	346	460	342	378		419					73	-0.079		
180			1.00												10.3	-0.098511	490	250	344	460	341	377		417					73	-0.078		
181			1.00												10.2	-0.11023	488	250	342	461	340	376		416					73	-0.079		
182			1.00												10.1	-0.07434	487	250	341	461	340	376		416					73	-0.079		
183			1.00												10.0	-0.102234	485	250	339	462	339	375		417					73	-0.079		
184			1.00												9.9	-0.080994	484	250	338	462	338	374		416					73	-0.078		
185			1.00												9.9	-0.052063	483	250	336	462	337	374		416					73	-0.077		
186			1.00												9.8	-0.088257	481	250	335	463	337	373		417					73	-0.079		
187			1.00												9.7	-0.090027	480	250	334	463	336	373		417					73	-0.079		
188			1.00												9.6	-0.089782	479	251	332	463	336	372		416					73	-0.078		
189			1.00												9.5	-0.069031	477	250	331	463	335	371		415					73	-0.080		
190			1.00												9.4	-0.1026	476	251	330	464	335	371		414					73	-0.078		
191			1.00												9.3	-0.084168	475	251	329	464	334	371		414					73	-0.078		
192			1.00												9.3	-0.060058	473	250	327	465	334	370		413					73	-0.078		
193			1.00												9.2	-0.102051	472	251	326	466	333	370		412					73	-0.078		
194			1.00												9.1	-0.066834	471	251	325	466	333	369		412					73	-0.078		
195			1.00												9.0	-0.113708	468	251	324	467	332	368		411					73	-0.078		
196			1.00												8.9	-0.07544	467	251	323	468	331	368		410					73	-0.078		
197			1.00												8.8	-0.075927	465	251	322	470	331	368		409					73	-0.078		
198			1.00												8.8	-0.079773	463	252	321	471	330	367		407					73	-0.078		
199			1.00												8.7	-0.075257	460	252	320	472	329	367		407					74	-0.077		
200			1.00												8.6	-0.086181	457	252	318	474	329	366		405					73	-0.077		
201			1.00												8.5	-0.070435	454	252	317	476	328	365		404					73	-0.077		
202			1.00												8.4	-0.084594	452	252	316	479	328	365		403					74	-0.077		
203			1.00												8.3	-0.101868	450	252	315	482	327	365		402					74	-0.076		
204			1.00												8.2	-0.09314	448	252	314	485	326	365		403					73	-0.076		
205			1.00												8.2	-0.085876	448	252	313	489	326	366		403					73	-0.077		
206			1.00												8.1	-0.091736	448	253	312	492	325	366		404					73	-0.078		
207			1.00												8.0	-0.076782	450	253	311	496	325	367		406					73	-0.077		
208			1.00												7.9	-0.107239	451	253	310	501	324	368		408					73	-0.077		
209			1.00												7.8	-0.060486	454	253	309	505	324	369		409					74	-0.078		

Wood Heater Test Data
Non Sampling Hign Burn Data

Run: 3

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 29-Nov-18
Beginning Clock Time: 10:43

Total Sampling Time: 313 min
Recording Interval: 1 min
Background Sample Volume: 36.649 cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) 0.998 (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.15		28.19	28.17 0

OMNI Equipment Numbers:

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: #DIV/0! ft/sec.
Initial Tunnel Flow: #DIV/0! scfm
Average Tunnel Flow: #DIV/0! scfm
Post-Test Leak Check (1): cfm @ in. Hg
Post-Test Leak Check (2): cfm @ in. Hg
Average Test Piece Fuel Moisture: 19.78 Dry Basis %

Technician Signature:

Velocity Traverse Data	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP										"H2O
Temp:										°F

V_{strav} ft/sec V_{scent} ft/sec F_p

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)												Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
210			1.00												7.7	-0.088226	456	253	308	510	323	370		410					74	-0.078		
211			1.00												7.6	-0.093293	457	253	307	516	323	371		409					73	-0.078		
212			1.00												7.6	-0.053894	457	255	306	521	323	372		407					74	-0.077		
213			1.00												7.5	-0.081909	455	254	306	526	322	373		406					74	-0.077		
214			1.00												7.5	-0.020874	453	253	305	531	322	373		403					73	-0.077		
215			1.00												7.4	-0.070343	450	253	304	537	322	373		402					73	-0.077		
216			1.00												7.3	-0.090881	446	254	304	541	321	373		399					73	-0.076		
217			1.00												7.3	-0.037994	442	255	303	546	321	373		397					73	-0.076		
218			1.00												7.2	-0.057557	438	255	303	549	321	373		395					73	-0.076		
219			1.00												7.2	-0.066314	434	254	302	552	320	372		394					73	-0.076		
220			1.00												7.1	-0.046204	431	255	302	555	320	373		393					74	-0.076		
221			1.00												7.0	-0.069855	428	255	302	557	320	372		392					74	-0.075		
222			1.00												7.0	-0.041076	426	255	301	558	319	372		393					74	-0.076		
223			1.00												7.0	-0.043976	424	255	300	559	319	371		392					74	-0.075		
224			1.00												6.9	-0.074677	422	255	300	559	318	371		391					74	-0.075		
225			1.00												6.8	-0.042663	419	255	299	558	318	370		389					74	-0.075		
226			1.00												6.8	-0.066834	416	255	298	558	317	369		388					74	-0.075		
227			1.00												6.7	-0.030945	414	255	298	557	317	368		388					74	-0.075		
228			1.00												6.7	-0.051727	410	255	297	558	316	367		385					74	-0.075		
229			1.00												6.7	-0.033203	405	255	296	557	316	366		379					74	-0.074		
230			1.00												6.6	-0.068115	400	255	296	556	315	364		375					74	-0.073		
231			1.00												6.6	-0.028656	395	255	295	555	315	363		371					74	-0.073		
232			1.00												6.5	-0.068756	390	255	294	555	314	362		368					74	-0.073		
233			1.00												6.5	-0.028534	385	255	294	553	314	360		365					74	-0.072		
234			1.00												6.4	-0.072663	380	255	293	552	313	359		363					74	-0.072		
235			1.00												6.4	-0.019409	376	256	292	551	313	358		361					74	-0.072		
236			1.00												6.3	-0.046234	372	255	291	550	312	356		360					74	-0.072		
237			1.00												6.3	-0.04071	368	256	291	549	311	355		359					74	-0.071		
238			1.00												6.2	-0.056183	365	255	290	547	311	354		357					74	-0.071		
239			1.00												6.2	-0.014069	361	256	289	546	310	352		356					74	-0.071		
240			1.00												6.2	-0.042267	358	257	289	545	310	352		355					74	-0.071		
241			1.00												6.1	-0.048645	355	257	288	544	309	351		353					74	-0.070		
242			1.00												6.1	-0.036621	352	257	288	543	309	350		352					74	-0.070		
243			1.00												6.0	-0.051697	349	257	287	542	308	349		351					74	-0.070		
244			1.00												6.0	-0.020477	346	257	287	540	308	348		350					74	-0.070		

Wood Heater Test Data
Non Sampling Hign Burn Data

Run: 3

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 29-Nov-18
Beginning Clock Time: 10:43

Total Sampling Time: 313 min
Recording Interval: 1 min
Background Sample Volume: 36.649 cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) 0.998 (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.15		28.19	28.17 0

OMNI Equipment Numbers:

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: #DIV/0! ft/sec.
Initial Tunnel Flow: #DIV/0! scfm
Average Tunnel Flow: #DIV/0! scfm
Post-Test Leak Check (1): cfm @ in. Hg
Post-Test Leak Check (2): cfm @ in. Hg
Average Test Piece Fuel Moisture: 19.78 Dry Basis %

Technician Signature:

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP										"H2O
Temp:										°F

V_{strav} ft/sec V_{scent} ft/sec F_p

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)													Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
245			1.00												5.9	-0.072571	344	257	286	539	307	347		350					74	-0.070		
246			1.00												5.9	-0.033325	342	257	286	538	307	346		349					74	-0.070		
247			1.00												5.9	-0.06076	340	258	286	537	306	345		349					74	-0.070		
248			1.00												5.8	-0.0224	338	257	285	536	306	344		349					74	-0.070		
249			1.00												5.8	-0.079285	337	258	285	535	305	344		349					74	-0.070		
250			1.00												5.7	-0.012726	335	258	285	534	304	343		349					74	-0.070		
251			1.00												5.7	-0.062774	334	259	285	533	304	343		349					74	-0.070		
252			1.00												5.6	-0.063202	333	259	285	532	304	343		348					74	-0.070		
253			1.00												5.6	-0.044495	332	258	285	531	303	342		348					74	-0.070		
254			1.00												5.5	-0.038422	332	260	285	531	303	342		348					74	-0.070		
255			1.00												5.5	-0.051818	332	260	285	530	303	342		349					74	-0.070		
256			1.00												5.4	-0.04535	331	259	285	530	302	341		349					74	-0.070		
257			1.00												5.4	-0.07788	331	260	285	529	302	341		350					74	-0.070		
258			1.00												5.3	-0.074189	332	260	286	529	302	342		351					74	-0.004		
259			1.00												5.3	-0.02658	332	261	287	529	301	342		351					74	-0.003		
260			1.00												5.2	-0.059266	332	261	287	529	301	342		351					74	-0.004		
261			1.00												5.2	-0.024383	333	261	288	529	301	342		351					74	-0.004		
262			1.00												5.1	-0.062226	333	262	289	528	301	343		352					74	-0.005		
263			1.00												5.1	-0.023651	334	263	290	528	300	343		353					74	-0.006		
264			1.00												5.0	-0.082916	334	262	291	529	300	343		353					74	-0.007		
265			1.00												5.0	-0.025116	335	263	291	528	300	343		353					74	-0.008		
266			1.00												4.9	-0.049103	335	264	292	529	300	344		354					74	-0.009		
267			1.00												4.9	-0.053405	335	263	293	528	300	344		355					74	-0.010		
268			1.00												4.8	-0.070008	336	263	294	528	300	344		355					74	-0.010		
269			1.00												4.8	-0.018066	337	265	295	528	300	345		355					74	-0.011		
270			1.00												4.7	-0.089111	337	265	296	528	300	345		356					74	-0.011		
271			1.00												4.7	-0.034943	338	265	297	528	300	346		357					74	-0.012		
272			1.00												4.6	-0.033142	338	265	298	527	300	346		359					74	-0.012		
273			1.00												4.6	-0.079437	339	266	298	527	300	346		359					74	-0.012		
274			1.00												4.5	-0.007721	340	266	299	527	300	346		360					74	-0.012		
275			1.00												4.5	-0.075989	341	266	299	526	300	346		360					74	-0.012		
276			1.00												4.4	-0.050965	342	266	300	526	301	347		361					74	-0.012		
277			1.00												4.4	-0.039917	343	267	300	525	301	347		361					74	-0.011		
278			1.00												4.3	-0.047393	344	267	301	525	301	348		363					74	-0.011		
279			1.00												4.2	-0.079865	345	267	301	525	301	348		362					74	-0.011		

Wood Heater Test Data
Non Sampling Hign Burn Data

Run: 3

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 29-Nov-18
Beginning Clock Time: 10:43

Total Sampling Time: 313 min
Recording Interval: 1 min
Background Sample Volume: 36.649 cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) 0.998 (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.15		28.19	28.17 0

OMNI Equipment Numbers:

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: #DIV/0! ft/sec.
Initial Tunnel Flow: #DIV/0! scfm
Average Tunnel Flow: #DIV/0! scfm
Post-Test Leak Check (1): cfm @ in. Hg
Post-Test Leak Check (2): cfm @ in. Hg
Average Test Piece Fuel Moisture: 19.78 Dry Basis %

Technician Signature:

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP										"H2O
Temp:										°F

V_{strav} ft/sec V_{scent} ft/sec F_p

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)												Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
280			1.00												4.2	-0.072265	346	268	301	524	302	348		364					74	-0.012		
281			1.00												4.1	-0.028107	346	268	302	524	302	348		364					74	-0.012		
282			1.00												4.1	-0.064636	347	268	302	523	302	348		365					74	-0.012		
283			1.00												4.0	-0.039917	348	269	302	523	302	349		365					74	-0.012		
284			1.00												4.0	-0.044922	349	270	302	522	303	349		364					74	-0.013		
285			1.00												4.0	-0.046478	349	268	303	521	303	349		365					74	-0.014		
286			1.00												3.9	-0.047974	350	270	303	521	303	349		366					74	-0.015		
287			1.00												3.9	-0.042511	350	270	303	520	303	349		366					74	-0.015		
288			1.00												3.8	-0.049744	350	269	304	520	304	349		366					74	-0.015		
289			1.00												3.8	-0.044433	350	270	304	519	304	349		365					74	-0.016		
290			1.00												3.7	-0.045441	350	270	304	519	304	349		365					74	-0.016		
291			1.00												3.6	-0.077179	350	270	304	518	305	349		365					74	-0.016		
292			1.00												3.6	-0.042175	350	270	304	518	305	349		365					74	-0.016		
293			1.00												3.5	-0.058808	350	270	305	517	306	350		365					74	-0.016		
294			1.00												3.5	-0.03482	350	270	305	517	306	350		366					74	-0.016		
295			1.00												3.5	-0.059265	351	270	305	516	307	350		366					74	-0.016		
296			1.00												3.4	-0.030671	350	271	305	516	307	350		366					74	-0.016		
297			1.00												3.4	-0.056762	350	270	305	515	308	350		366					74	-0.017		
298			1.00												3.3	-0.044586	350	271	305	514	308	350		365					74	-0.018		
299			1.00												3.3	-0.047028	350	271	306	514	309	350		366					74	-0.072		
300			1.00												3.2	-0.053864	350	272	306	513	310	350		366					74	-0.077		
301			1.00												3.2	-0.038757	349	271	306	513	311	350		366					74	-0.077		
302			1.00												3.1	-0.042267	349	271	306	512	311	350		366					74	-0.077		
303			1.00												3.1	-0.068603	348	271	306	512	312	350		364					75	-0.077		
304			1.00												3.0	-0.034699	348	271	306	511	312	350		364					75	-0.077		
305			1.00												3.0	-0.047699	347	272	306	511	313	350		364					74	-0.077		
306			1.00												2.9	-0.051574	347	272	305	510	314	350		363					74	-0.077		
307			1.00												2.9	-0.055268	347	272	305	510	315	350		365					74	-0.077		
308			1.00												2.8	-0.0289	347	271	305	509	315	349		365					74	-0.077		
309			1.00												2.8	-0.055725	347	272	305	509	316	350		366					75	-0.077		
310			1.00												2.8	-0.032898	349	270	305	508	318	350		367					74	-0.078		
311			1.00												2.7	-0.054596	349	272	305	508	318	350		366					75	-0.077		
312			1.00												2.6	-0.065277	350	272	305	507	319	351		367					75	-0.077		
313			1.00												2.6	-0.021606	349	272	305	507	320	351		367					74	-0.077		
Avg/Tot	313.000	0.000	1.00	#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!	#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!								286.8				#DIV/0!	#DIV/0!	#DIV/0!	72	-0.071		

Wood Heater Test Data
Non Sampling Hign Burn Data

Run: 3

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 29-Nov-18
Beginning Clock Time: 10:43

Total Sampling Time: 313 min
Recording Interval: 1 min
Background Sample Volume: 36.649 cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) 0.998 (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.15		28.19	28.17 0

OMNI Equipment Numbers:

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.110 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: #DIV/0! ft/sec.
Initial Tunnel Flow: #DIV/0! scfm
Average Tunnel Flow: #DIV/0! scfm
Post-Test Leak Check (1): cfm @ in. Hg
Post-Test Leak Check (2): cfm @ in. Hg
Average Test Piece Fuel Moisture: 19.78 Dry Basis %

Technician Signature:_____

Velocity Traverse Data	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP										"H2O
Temp:										°F

V_{strav} _____ ft/sec V_{scent} _____ ft/sec F_p _____

	Particulate Sampling Data													Fuel Weight (lb)		Temperature Data (°F)														Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)

Wood Heater Test Results

Manufacturer:	Kuma Stoves
Model:	K250 Series
Project No.:	0123WN012E
Tracking No.:	2330
Run:	3
Test Date:	11/29/18

Burn Rate	**2.28 kg/hr dry**

Technician Signature:_____

Adjunct to ASTM E XXXX Wood Heater Cordwood Test Method - May 10, 2017 Version

Cordwood Fuel Load Calculators - 10 lb/ft^3 Nominal Load Density

Core 45-65% of Total Load Weight, Remainder 35-55% of Total Load Weight

Values to be input manually

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For All Usable Firebox Volumes - High Fire Test Only

Nominal Required Load Density (wet basis)	10 lb/ft^3					
Usable Firebox Volume	2.54 ft^3					
Total Nom. Load Wt. Target	25.40 lb					
Total Load Wt. Allowable Range	24.10	to	26.70 lb			
Core Target Wt. Allowable Range	11.40	to	16.50 lb			
Remainder Load Wt. Allowable Range	8.90	to	14.00 lb			
						Mid-Point
Core Load Pc. Wt. Allowable Range	3.80	to	6.40 lb			5.10
Remainder Load Pc. Wt. Allowable Range	2.50	to	14.00 lb			8.25
	Pc. #					
Core Load Piece Wt. Actual	1	3.80 lb		In Range		
	2	4.95 lb		In Range		
	3	5.05 lb		In Range		
Core Load Total. Wt. Actual		13.80 lb		In Range		
	Pc. #					
Remainder Load Piece Wt.	1	7.34 lb		In Range		
(1 to 3 Pcs.)	2	4.81 lb		In Range		
	3	lb		NA		
Remainder Load Tot. Wt. Act		12.15 lb		In Range		
Total Load Wt. Actual		25.95 lb		In Range		
Core % of Total Wt.		53%		In Range		45-65%
Remainder % of Total Wt.		47%		In Range		35-55%
Actual Load % of Nominal Target		102%		In Range		95-105%
Actual Fuel Load Density		10.2 lb/ft^3				
Kindling and Start-up Fuel						
Maximim Kindling Wt. (20% of Tot. Load Wt.)		5.19 lb				
Actual Kindling Wt.		5.19 lb		In Range		20.0%
Maximum Start-up Fuel Wt. (30% of Tot. Load Wt.)		7.79 lb				
Actual Start-up Fuel Wt.		7.77 lb		In Range		29.9%
Allowable Residual Start-up Fuel Wt. Range	2.6	to	5.2 lb			Mid-Point
Actual Residual Start-up Fuel Wt.		3.1 lb		In Range		3.9
Total Wt. All Fuel Added (wet basis)		38.91 lb				
High Fire Test Run End Point Range	Low		High			Mid-Point
Based on Fuel Load Wt. (w/tares)	2.3	to	2.9 lb			2.6
Actual Fuel Load Ending Wt.		2.6 lb		In Range		

Fuel Piece Moisture Reading (%-dry basis)

1	2	3	Ave.		Pc. Wt. Dry Basis	
19.3	18.9	19.7	19.3	In Range	3.19 lb	1.44 kg
19.1	22	21	20.7	In Range	4.10 lb	1.86 kg
20.2	21.4	20.3	20.6	In Range	4.18 lb	1.90 kg
19.8	19.8	19.4	19.7	In Range	6.14 lb	2.78 kg
22.9	21.2	31.7	25.3	In Range	3.84 lb	1.74 kg
			NA	NA	NA lb	NA kg

Total Load Ave. MC (%-dry basis)	21.0	In Range	
Total Load Ave. MC % (wet basis)	17.4		
Total Test Load Weight (dry basis) →			21.45 lb 9.73 kg

Kindling Moisture (%-dry basis)

9.661	9.661	9.661	9.7	In Range	4.73 lb 2.15 kg

Start-up Fuel Moisture Readings (%-dry basis)

20.13	20.13	20.13	20.1	In Range	6.46 lb 2.93 kg

Total Wt. All Fuel Added (dry basis) →	32.64 lb 14.81 kg
Total Wt. All Fuel Burned (dry basis) →	26.9 lb 12.2 kg

Run 4

Medium Burn

Wood Heater Test Data
Low Burn Emissions Data

Run: 4

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 29-Nov-18
Beginning Clock Time: 16:35

Total Sampling Time: 660 min
Recording Interval: 10 min
Background Sample Volume: 96.546 cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) 0.998 (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.04		28.14	28.09 0

OMNI Equipment Numbers:

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.120 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: 18.90 ft/sec.
Initial Tunnel Flow: 194.7 scfm
Average Tunnel Flow: 197.3 scfm
Post-Test Leak Check (1): 0.000 cfm @ 5 in. Hg
Post-Test Leak Check (2): 0.000 cfm @ 5 in. Hg
Average Test Piece Fuel Moisture: 22.44 Dry Basis %

Technician Signature:

Velocity Traverse Data	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.076	0.078	0.072	0.070	0.072	0.080	0.070	0.072	0.072	"H2O
Temp:	104	104	104	104	104	104	104	104	104	°F

V_{strav} 19.19 ft/sec V_{scent} 18.99 ft/sec F_p 1.010

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)													Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
0	0.000	0.000			-0.02	78	1.64	0.00	77	1.4	94	0.072			30.1		334	295	305	456	377	353	675	223	83	64	84	65	76	-0.053	10.08	0.05
10	1.361	1.496	0.14	0.15	1.55	78	-0.32	1.29	78	-1.7	108	0.072	98	99	28.6	-1.54773	431	268	332	434	360	365	906	415	82	60	83	58	76	-0.085	9.22	0.07
20	2.759	3.004	0.14	0.15	1.59	78	-0.22	1.32	78	-1.7	99	0.072	100	99	27.7	-0.817749	463	271	319	407	339	360	696	314	83	59	82	58	75	-0.073	5.50	0.03
30	4.172	4.533	0.14	0.15	1.57	78	-0.64	1.30	78	-1.7	95	0.072	101	100	27.3	-0.490478	399	267	304	382	324	335	677	266	82	59	82	58	76	-0.067	6.32	0.23
40	5.582	6.055	0.14	0.15	1.59	79	-0.62	1.29	78	-1.5	91	0.072	100	99	26.8	-0.486694	294	258	233	357	304	289	646	222	82	59	83	57	75	-0.060	6.53	0.42
50	6.987	7.581	0.14	0.15	1.56	79	-0.2	1.30	78	-1.7	89	0.072	100	100	26.2	-0.520874	266	248	201	334	288	267	692	213	84	58	83	57	75	-0.058	7.20	0.42
60	8.390	9.107	0.14	0.15	1.56	79	-0.36	1.30	78	-1.5	89	0.072	100	100	25.6	-0.618226	270	239	184	313	274	256	754	222	84	58	82	56	74	-0.060	8.47	0.36
70	9.805	10.630	0.14	0.15	1.57	79	-0.39	1.30	78	-1.5	90	0.072	101	99	24.9	-0.755676	297	231	174	297	263	252	824	248	84	58	84	56	74	-0.064	9.90	0.11
80	11.217	12.153	0.14	0.15	1.60	80	-0.47	1.29	79	-1.8	90	0.072	100	99	24.2	-0.707763	325	224	169	289	256	253	864	263	84	58	84	56	74	-0.067	10.78	0.08
90	12.629	13.678	0.14	0.15	1.58	80	-0.2	1.30	79	-1.7	91	0.072	100	99	23.3	-0.835328	356	220	168	284	253	256	919	276	84	58	85	56	75	-0.069	11.97	0.08
100	14.038	15.201	0.14	0.15	1.56	80	-0.67	1.29	79	-1.5	91	0.072	100	99	22.4	-0.879638	387	217	171	284	252	262	955	287	84	57	85	56	75	-0.070	12.63	0.08
110	15.448	16.721	0.14	0.15	1.59	80	-0.57	1.29	79	-1.5	92	0.072	100	99	21.6	-0.811707	387	214	175	288	253	263	899	282	84	57	85	56	74	-0.070	11.90	0.07
120	16.857	18.241	0.14	0.15	1.59	80	-0.53	1.28	79	-1.5	91	0.072	100	99	20.8	-0.839599	381	212	182	294	256	265	900	282	84	57	85	56	74	-0.070	11.95	0.07
130	18.266	19.760	0.14	0.15	1.57	80	-0.66	1.28	79	-1.5	91	0.072	100	99	20.0	-0.805603	377	212	188	301	259	267	890	280	84	57	84	56	74	-0.070	11.93	0.07
140	19.675	21.279	0.14	0.15	1.56	80	-0.67	1.29	79	-1.5	91	0.072	100	99	19.2	-0.794922	373	212	193	308	263	270	881	278	84	57	84	56	75	-0.070	12.19	0.06
150	21.082	22.797	0.14	0.15	1.56	80	-0.21	1.27	79	-1.6	91	0.072	100	99	18.4	-0.846314	378	212	200	317	268	275	898	280	84	58	85	56	75	-0.069	13.20	0.06
160	22.489	24.314	0.14	0.15	1.57	80	-0.48	1.29	79	-1.8	92	0.072	100	99	17.5	-0.874573	399	215	209	329	274	285	933	284	85	58	85	56	75	-0.071	13.50	0.06
170	23.894	25.831	0.14	0.15	1.57	80	-0.54	1.28	79	-1.6	92	0.072	100	99	16.6	-0.847045	412	217	219	337	279	293	934	287	85	58	85	57	75	-0.069	13.35	0.06
180	25.300	27.347	0.14	0.15	1.57	80	-0.24	1.29	79	-1.8	92	0.072	100	99	15.9	-0.755921	417	218	227	343	284	298	932	282	85	58	85	57	75	-0.070	12.91	0.06
190	26.705	28.864	0.14	0.15	1.58	80	-0.46	1.28	79	-1.7	92	0.072	100	99	15.1	-0.762878	410	220	235	348	287	300	921	281	85	59	85	57	75	-0.069	13.15	0.05
200	28.110	30.381	0.14	0.15	1.56	80	-0.66	1.29	79	-1.8	91	0.072	100	99	14.3	-0.783631	411	223	243	355	290	304	917	281	84	59	85	57	75	-0.069	13.42	0.05
210	29.515	31.897	0.14	0.15	1.57	80	-0.18	1.28	79	-1.7	91	0.072	100	99	13.6	-0.724609	402	225	249	364	293	307	883	275	84	59	85	58	75	-0.068	12.87	0.05
220	30.920	33.414	0.14	0.15	1.56	80	-0.39	1.29	79	-1.6	90	0.072	100	99	12.9	-0.73822	394	228	254	374	295	309	872	272	84	59	84	58	75	-0.068	13.02	0.05
230	32.326	34.935	0.14	0.15	1.55	80	-0.22	1.28	79	-1.6	90	0.072	100	99	12.1	-0.731446	395	229	262	385	297	314	890	272	84	59	85	58	75	-0.068	13.61	0.05
240	33.730	36.456	0.14	0.15	1.57	80	-0.51	1.29	79	-1.6	91	0.072	100	99	11.4	-0.782836	411	232	273	396	301	323	920	277	85	60	85	58	75	-0.067	14.51	0.05
250	35.134	37.974	0.14	0.15	1.55	80	-0.17	1.28	79	-1.7	91	0.072	100	99	10.6	-0.789612	424	235	286	407	306	332	921	279	85	60	85	58	76	-0.068	14.75	0.05
260	36.536	39.490	0.14	0.15	1.57	81	-0.36	1.28	79	-1.6	94	0.072	100	99	9.7	-0.84906	442	238	288	417	310	339	974	285	85	60	84	59	76	-0.070	16.88	0.34
270	37.938	41.004	0.14	0.15	1.57	81	-0.67	1.28	79	-1.7	93	0.072	99	99	8.9	-0.790894	478	240	287	427	319	350	975	285	85	61	84	59	76	-0.070	16.47	0.06
280	39.341	42.521	0.14	0.15	1.56	81	-0.2	1.33	79	-1.9	92	0.072	99	99	8.2	-0.687744	476	241	287	432	328	353	968	280	85	61	84	60	76	-0.067	15.36	0.05
290	40.748	44.068	0.14	0.15	1.58	81	-0.46	1.33	80	-1.7	92	0.072	100	101	7.6	-0.62439	452	242	289	436	335	351	915	269	85	61	85	60	76	-0.065	14.73	0.04
300	42.164	45.616	0.14	0.15	1.60	81	-0.7	1.33	80	-1.8	91	0.072	100	101	7.1	-0.515808	429	245	290	439	340	349	891	261	84	62	84	60	76	-0.064	14.52	0.04
310	43.581	47.164	0.14	0.15	1.58	81	-0.7	1.34	80	-1.9	90	0.072	100	101	6.6	-0.461914	399	250	291	441	344	345	812	245	84	62	84	60	76	-0.061	13.06	0.03
320	44.998	48.713	0.14	0.15	1.61	81	-0.67	1.34	80	-1.7	90	0.072	100	101	6.2	-0.396088	375	252	291	440	346	341	789	238	84	62	84	61	76	-0.060	12.44	0.03
330	46.416	50.263	0.14	0.16	1.61	81	-0.57	1.33	80	-1.8	88	0.072	100	101	5.9	-0.298248	352	255	290	438	344	336	735	226	84	62	83	61	76	-0.057	11.78	0.03
340	47.835	51.813	0.14	0.16	1.60	81	-0.31	1.33	80	-1.9	87	0.072	100	101	5.7	-0.26181	328	259	288	437	342	331	696	214	83	63	83	61	75	-0.055	11.59	0.03

Wood Heater Test Data
Low Burn Emissions Data

Run: 4

Manufacturer: Kuma Stoves
Model: K250 Series
Tracking No.: 2330
Project No.: 0123WN012E
Test Date: 29-Nov-18
Beginning Clock Time: 16:35

Total Sampling Time: 660 min
Recording Interval: 10 min
Background Sample Volume: 96.546 cubic feet

Meter Box Y Factor: 0.997 (1) 0.981 (2) 0.998 (Amb)

Barometric Pressure:	Begin	Middle	End	Average
	28.04		28.14	28.09

0

OMNI Equipment Numbers:

PM Control Modules: 371, 372
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.120 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: 18.90 ft/sec.
Initial Tunnel Flow: 194.7 scfm
Average Tunnel Flow: 197.3 scfm
Post-Test Leak Check (1): 0.000 cfm @ 5 in. Hg
Post-Test Leak Check (2): 0.000 cfm @ 5 in. Hg
Average Test Piece Fuel Moisture: 22.44 Dry Basis %

Technician Signature:

Velocity Traverse Data	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.076	0.078	0.072	0.070	0.072	0.080	0.070	0.072	0.072	"H2O
Temp:	104	104	104	104	104	104	104	104	104	°F

V_{strav} 19.19 ft/sec V_{scent} 18.99 ft/sec F_p 1.010

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)												Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Catalyst Exit	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
350	49.255	53.365	0.14	0.16	1.60	81	-0.24	1.33	80	-1.8	86	0.072	100	101	5.4	-0.258698	312	259	287	437	339	327	674	206	83	63	82	61	75	-0.053	11.38	0.03
360	50.675	54.917	0.14	0.16	1.61	81	-0.47	1.34	80	-1.9	86	0.072	100	101	5.2	-0.224517	301	261	286	438	337	325	657	200	84	63	83	61	75	-0.052	11.27	0.03
370	52.095	56.468	0.14	0.16	1.59	80	-0.43	1.34	79	-1.7	85	0.072	100	101	5.0	-0.241517	293	264	286	439	335	323	651	197	84	63	83	62	74	-0.051	11.20	0.03
380	53.515	58.020	0.14	0.16	1.59	80	-0.38	1.34	79	-1.6	84	0.072	100	101	4.7	-0.214355	288	265	289	441	333	323	642	195	83	63	83	62	76	-0.051	10.85	0.03
390	54.935	59.572	0.14	0.16	1.61	80	-0.5	1.34	79	-1.8	84	0.072	100	101	4.5	-0.19281	284	265	289	440	332	322	637	192	83	64	83	62	76	-0.050	10.69	0.03
400	56.355	61.124	0.14	0.16	1.61	80	-0.33	1.34	79	-1.9	84	0.072	100	101	4.3	-0.20874	281	265	289	439	332	321	635	191	84	64	85	62	76	-0.050	10.72	0.03
410	57.775	62.680	0.14	0.16	1.61	80	-0.31	1.34	79	-1.7	84	0.072	100	101	4.1	-0.234619	282	266	287	435	332	320	647	191	84	64	85	62	76	-0.050	11.01	0.03
420	59.195	64.236	0.14	0.16	1.62	80	-0.7	1.34	79	-1.7	84	0.072	100	101	3.9	-0.23288	282	263	287	429	333	319	644	191	84	64	85	62	76	-0.050	10.66	0.03
430	60.615	65.793	0.14	0.16	1.61	80	-0.69	1.35	79	-1.6	84	0.072	100	101	3.6	-0.226654	281	264	287	425	334	318	633	190	84	64	85	62	75	-0.050	10.38	0.03
440	62.035	67.350	0.14	0.16	1.61	80	-0.23	1.35	79	-1.7	83	0.072	100	101	3.4	-0.215515	279	264	285	419	337	317	632	190	84	64	85	63	76	-0.050	10.43	0.03
450	63.456	68.907	0.14	0.16	1.61	80	-0.21	1.34	79	-1.6	83	0.072	100	101	3.2	-0.251465	284	266	281	414	340	317	656	192	84	65	85	63	75	-0.050	10.60	0.03
460	64.876	70.463	0.14	0.16	1.61	80	-0.33	1.34	79	-1.6	84	0.072	100	101	2.9	-0.233338	286	264	277	409	345	316	655	192	84	65	85	63	75	-0.051	10.52	0.03
470	66.296	72.017	0.14	0.16	1.60	80	-0.32	1.34	79	-1.7	84	0.072	100	101	2.7	-0.228881	284	265	274	406	351	316	643	190	85	65	85	63	76	-0.050	10.48	0.03
480	67.715	73.567	0.14	0.16	1.61	80	-0.52	1.33	79	-1.6	84	0.072	100	100	2.5	-0.180756	279	263	273	402	356	315	628	186	85	65	85	63	76	-0.048	10.35	0.03
490	69.134	75.117	0.14	0.16	1.61	80	-0.24	1.33	79	-1.8	84	0.072	100	100	2.3	-0.186279	273	264	273	399	360	314	612	183	85	65	85	63	76	-0.048	10.12	0.03
500	70.553	76.667	0.14	0.16	1.59	80	-0.69	1.34	79	-1.6	84	0.072	100	100	2.2	-0.169678	268	264	273	397	362	313	603	180	85	65	85	63	76	-0.047	9.95	0.03
510	71.972	78.216	0.14	0.15	1.60	80	-0.21	1.34	79	-1.8	84	0.072	100	100	2.0	-0.146484	265	262	270	394	364	311	599	179	85	65	85	63	76	-0.047	9.59	0.03
520	73.391	79.767	0.14	0.16	1.60	80	-0.68	1.34	79	-1.8	83	0.072	100	100	1.9	-0.141877	263	262	266	390	365	309	601	178	85	66	85	64	75	-0.046	9.69	0.03
530	74.811	81.319	0.14	0.16	1.61	80	-0.5	1.33	78	-1.6	83	0.072	100	101	1.7	-0.16217	262	262	262	387	366	308	600	177	84	64	85	62	75	-0.046	9.58	0.03
540	76.231	82.869	0.14	0.16	1.61	80	-0.65	1.33	78	-1.6	82	0.072	100	100	1.6	-0.166504	260	260	258	383	366	305	597	176	84	62	85	59	75	-0.047	9.36	0.03
550	77.651	84.420	0.14	0.16	1.60	80	-0.67	1.33	78	-1.7	82	0.072	100	100	1.4	-0.146271	258	259	256	380	366	304	594	176	84	60	84	57	75	-0.047	9.25	0.03
560	79.072	85.972	0.14	0.16	1.59	80	-0.31	1.34	78	-1.7	82	0.072	100	101	1.3	-0.119964	256	258	254	376	366	302	589	175	84	58	84	56	75	-0.046	9.16	0.03
570	80.492	87.524	0.14	0.16	1.59	80	-0.19	1.34	78	-1.6	82	0.072	100	101	1.1	-0.159058	254	260	253	372	366	301	583	174	84	57	85	55	75	-0.046	9.05	0.03
580	81.911	89.074	0.14	0.16	1.59	80	-0.2	1.34	78	-1.6	83	0.072	100	101	1.0	-0.15094	252	257	251	370	365	299	579	172	84	56	85	54	75	-0.046	8.92	0.03
590	83.330	90.623	0.14	0.15	1.59	80	-0.37	1.34	78	-1.8	83	0.072	100	100	0.9	-0.13031	250	258	252	367	364	298	573	171	85	55	85	53	75	-0.045	8.59	0.03
600	84.749	92.174	0.14	0.16	1.60	80	-0.61	1.35	78	-1.7	83	0.072	100	101	0.7	-0.135986	245	257	253	362	363	296	565	169	85	55	85	53	75	-0.045	8.45	0.03
610	86.168	93.725	0.14	0.16	1.59	80	-0.65	1.33	79	-1.6	84	0.072	100	100	0.6	-0.123627	242	258	253	356	362	294	561	168	85	55	85	53	75	-0.045	8.44	0.03
620	87.586	95.276	0.14	0.16	1.59	80	-0.34	1.33	79	-1.7	84	0.072	100	100	0.5	-0.129181	240	259	253	351	361	293	560	167	86	54	86	52	75	-0.044	8.47	0.03
630	89.005	96.826	0.14	0.16	1.60	80	-0.57	1.33	79	-1.7	85	0.072	100	101	0.3	-0.143463	238	259	253	346	360	291	555	165	86	54	86	52	76	-0.044	8.19	0.03
640	90.423	98.377	0.14	0.16	1.60	80	-0.44	1.33	79	-1.6	84	0.072	100	100	0.2	-0.111938	236	260	252	341	359	290	552	164	86	54	86	52	75	-0.044	7.97	0.03
650	91.842	99.928	0.14	0.16	1.60	80	-0.69	1.33	79	-1.6	84	0.072	100	100	0.1	-0.131989	234	260	251	336	356	287	547	163	86	54	85	52	75	-0.044	7.70	0.03
660	93.261	101.480	0.14	0.16	1.60	80	-0.19	1.34	79	-1.6	84	0.072	100	101	0.0	-0.109436	231	258	250	331	354	285	541	162	85	54	85	52	75	-0.043	7.53	0.03
Avg/Tot	93.261	101.480	0.14	0.15	1.56	80		1.30	79		88	0.072	100	100								68.6				60	84	58	75	-0.058		

Wood Heater Lab Data

Manufacturer:	Kuma Stoves	Equipment Numbers:	
Model:	K250 Series		
Tracking No.:	2330		
Project No.:	0123WN012E		
Run #:	4		
Date:	11/29/18		

TRAIN 1 (First Hour emissions)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	T79S	88.8	85.3	3.5
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe				0.0
E. Filter seals catch*	Seals				0.0

Sub-Total Total Particulate, mg: 3.5

TRAIN 1 (Post First Hour Change-out)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	T73AP	185.3	182.2	3.1
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe	25	114299.2	114298.3	0.9
E. Filter seals catch*	Seals	R689	3302.7	3302.7	0.0

Sub-Total Total Particulate, mg: 4.0

Train 1 Aggregate Total Particulate, mg: **7.5**

TRAIN 2

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	T73BP	187.4	180.7	6.7
B. Rear filter catch	Filter				0.0
C. Probe catch*	Probe	27	114274.0	114273.3	0.7
D. Filter seals catch*	Seals	R690	3321.6	3321.4	0.2

Total Particulate, mg: **7.6**

AMBIENT

Sample Component	Reagent	Filter # or Probe #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch*	Filter	D578	120.8	120.7	0.1

Total Particulate, mg: **0.1**

*Particulate catch that results in a negative number, is assumed to be zero for probes and seals, negative numbers for filters are assumed to be part of the seal weight.

Component	Equations:
A. Front filter catch	Final (mg) - Tare (mg) = Particulate, mg
B. Rear filter catch	Final (mg) - Tare (mg) = Particulate, mg
C. Probe catch	Final (mg) - Tare (mg) = Particulate, mg

Technician Signature: 

Wood Heater Test Results

Manufacturer: Kuma Stoves
Model: K250 Series
Project No.: 0123WN012E
Tracking No.: 2330
Run: 4
Test Date: 11/29/18

Burn Rate	**1.01 kg/hr dry**
Average Tunnel Temperature	88 degrees Fahrenheit
Average Gas Velocity in Dilution Tunnel - vs	18.90 feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	11838.0 dscf/hour
Average Delta p	0.072 inches H20
Total Time of Test	660 minutes

	AMBIENT	SAMPLE TRAIN 1	SAMPLE TRAIN 2	FIRST HOUR FILTER (TRAIN 1)
Total Sample Volume - Vm	96.546 cubic feet	93.261 cubic feet	101.480 cubic feet	8.390 cubic feet
Average Gas Meter Temperature	75 degrees Fahrenheit	80 degrees Fahrenheit	79 degrees Fahrenheit	80 degrees Fahrenheit
Total Sample Volume (Standard Conditions) - Vmstd	89.198 dscf	85.672 dscf	91.853 dscf	7.707 dscf
Total Particulates - m_n	0.1 mg	7.5 mg	7.6 mg	3.5 mg
Particulate Concentration (dry-standard) - C_f/C_s	0.000001 grams/dscf	0.00009 grams/dscf	0.00008 grams/dscf	0.00045 grams/dscf
Total Particulate Emissions - E_T	0.15 grams	11.25 grams	10.63 grams	5.38 grams
Particulate Emission Rate	0.01 grams/hour	1.02 grams/hour	0.97 grams/hour	5.38 grams/hour
Emissions Factor		1.01 g/kg	0.95 g/kg	3.24 g/kg
Difference from Average Total Particulate Emissions		0.31 grams	0.31 grams	

Dual Train Comparison Results Are Acceptable

FINAL AVERAGE RESULTS

Complete Test Run	
Total Particulate Emissions - E_T	10.94 grams
Particulate Emission Rate	**0.99 grams/hour**
Emissions Factor	0.98 grams/kg
First Hour Emissions	
Total Particulate Emissions - E_T	5.38 grams
Particulate Emission Rate	5.38 grams/hour
Emissions Factor	3.24 grams/kg
7.5% of Average Total Particulate Emissions	0.82 grams

QUALITY CHECKS

Filter Temps < 90 °F	OK
Filter Face Velocity (47 mm)	OK
Dryer Exit Temp < 80F	OK
Leakage Rate	OK
Ambient Temp (55-90°F)	OK
Negative Probe Weight Eval.	OK
Pro-Rate Variation	OK
Gram per Kilogram <0.50	0.06
Train Precision ≤ 7.5%	4.29

Technician Signature:_____

Adjunct to ASTM E XXXX Wood Heater Cordwood Test Method - May 10, 2017 Version

Cordwood Fuel Load Calculators - 12 lb/ft^3 Nominal Load Density

Core 45-65% of Total Load Weight, Remainder 35-55% of Total Load Weight

Values to be input manually

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For Usable Firebox Volumes up to 3.0 ft^3 - Low and Medium Fire

Nominal Required Load Density (wet basis)	12	lb/ft^3				
Usable Firebox Volume	2.54	ft^3				
Total Nom. Load Wt. Target	30.48	lb				
Total Load Wt. Allowable Range	28.96	to	32.00	lb		
Core Target Wt. Allowable Range	13.716	to	19.81	lb		
Remainder Load Wt. Allowable Range	10.67	to	16.76	lb		
						Mid-Point
Core Load Fuel Pc. Wt. Allowable Range	4.57	to	7.62	lb		6.10
Remainder Load Pc. Wt. Allowable Range	3.05	to	9.14	lb		6.10
	Pc. #					
Core Load Piece Wt. Actual	1	6.48	lb		In Range	
	2	5.00	lb		In Range	
	3	6.50	lb		In Range	
Core Load Total. Wt. Actual		17.98	lb		In Range	
	Pc. #					
Remainder Load Piece Wt.	1	7.96	lb		In Range	
(2 or 3 Pcs.)	2	4.17	lb		In Range	
	3		lb		NA	
Remainder Load Piece Weight Ratio - Small/Large		52%			In Range	≤ 67%
Remainder Load Tot. Wt. Act		12.13	lb		In Range	
Total Load Wt. Actual		30.11	lb		In Range	
Core % of Total Wt.		60%			In Range	45-65%
Remainder % of Total Wt.		40%			In Range	35-55%
Actual Load % of Nominal Target		99%			In Range	95-105%
Actual Fuel Load Density		11.9	lb/ft^3			
Allowable Charcoal Bed Wt. Range (lb)	3.1	to	6.0			Mid-Point
Actual Charcoal Bed Wt.		4.9	lb		In Range	4.5
Actual Fuel Load Ending Wt.		0.0	lb		Valid Test	≥ 90%
Total Wt. of Fuel Burned During Test Run lb.		30.1	lb			

Fuel Piece Moisture Reading (%-dry basis)

1	2	3	Ave.		Pc. Wt. Dry Basis			
21.1	23.1	20.6	21.6	In Range	5.33	lb	2.42	kg
20.4	27.8	18.2	22.1	In Range	4.09	lb	1.86	kg
25.3	21.4	20.1	22.3	In Range	5.31	lb	2.41	kg
23.9	25.3	23.6	24.3	In Range	6.41	lb	2.91	kg
20.3	25.3	20.2	21.9	In Range	3.42	lb	1.55	kg
			NA	NA	NA	lb	NA	kg
Total Load Ave. MC % (dry basis)			22.6	In Range				
Total Load Ave. MC % (wet basis)			18.4					
Total Test Load Weight (dry basis) →					24.56	lb	11.14	kg
Total Fuel Weight Burned During Test Run (dry basis)					24.6	lb	11.14	kg

Wood Heater Efficiency Results - CSA B415.1

Manufacturer: Kuma Stoves
Model: K250 Series
Date: 11/29/18
Run: 4
Control #: 0123WN012E
Test Duration: 660
Output Category: II

Technician Signature: 

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	80.6%	87.4%
Combustion Efficiency	99.5%	99.5%
Heat Transfer Efficiency	81%	87.9%

Output Rate (kJ/h)	14,374	13,636	**(Btu/h)**
Burn Rate (kg/h)	1.01	2.24	**(lb/h)**
Input (kJ/h)	17,832	16,916	**(Btu/h)**

Test Load Weight (dry kg)	11.16	24.59	**dry lb**
MC wet (%)	18.32734401		
MC dry (%)	22.44		
Particulate (g)	0.99		
CO (g)	108		
Test Duration (h)	11.00		

Emissions	**Particulate**	**CO**
g/MJ Output	0.01	0.69
g/kg Dry Fuel	0.09	9.72
g/h	0.09	9.86
lb/MM Btu Output	0.01	1.59

Air/Fuel Ratio (A/F)	10.27

VERSION: **2.2** **12/14/2009**

VERSION: 2.2 12/14/2009

Manufacturer:	Kuma Stoves	**Appliance Type:**	Cat
Model:	K250 Series		
Date:	11/29/2018	**Temp. Units**	F (F or C)
Run:	4	**Weight Units**	lb (kg or lb)
Control #:	0123WN012E		
Test Duration:	660		
Output Category:	II		

		Fuel Data		
			D. Fir	
Wood Moisture (% wet):	18.33	**HHV**	17,580	kj/kg
Load Weight (lb wet):	30.11	**%C**	50.54	
Burn Rate (dry kg/h):	1.01	**%H**	6.36	
Total Particulate Emissions:	0.99 g	**%O**	42.40	
		%ASH	0.70	

Averages	**0.07**	**10.93**	**#DIV/0!**	**227.55**	**75.25**	
				Temp. (ºF)		
Elapsed Time (min)	**Fuel Weight Remaining (lb)**	**Flue Gas Composition (%) CO**	**CO_2**	**O_2**	**Flue Gas**	**Room Temp**
0	30.11	0.05	10.08		223.0	76.0
10	28.56	0.07	9.22		415.0	76.0
20	27.74	0.03	5.50		314.0	75.0
30	27.25	0.23	6.32		266.0	76.0
40	26.77	0.42	6.53		222.0	75.0
50	26.25	0.42	7.20		213.0	75.0
60	25.63	0.36	8.47		222.0	74.0
70	24.87	0.11	9.90		248.0	74.0
80	24.16	0.08	10.78		263.0	74.0
90	23.33	0.08	11.97		276.0	75.0
100	22.45	0.08	12.63		287.0	75.0
110	21.64	0.07	11.90		282.0	74.0
120	20.80	0.07	11.95		282.0	74.0
130	19.99	0.07	11.93		280.0	74.0
140	19.20	0.06	12.19		278.0	75.0
150	18.35	0.06	13.20		280.0	75.0
160	17.48	0.06	13.50		284.0	75.0
170	16.63	0.06	13.35		287.0	75.0
180	15.87	0.06	12.91		282.0	75.0
190	15.11	0.05	13.15		281.0	75.0
200	14.33	0.05	13.42		281.0	75.0
210	13.60	0.05	12.87		275.0	75.0

220	12.86	0.05	13.02		272.0	75.0
230	12.13	0.05	13.61		272.0	75.0
240	11.35	0.05	14.51		277.0	75.0
250	10.56	0.05	14.75		279.0	76.0
260	9.71	0.34	16.88		285.0	76.0
270	8.92	0.06	16.47		285.0	76.0
280	8.23	0.05	15.36		280.0	76.0
290	7.61	0.04	14.73		269.0	76.0
300	7.09	0.04	14.52		261.0	76.0
310	6.63	0.03	13.06		245.0	76.0
320	6.24	0.03	12.44		238.0	76.0
330	5.94	0.03	11.78		226.0	76.0
340	5.67	0.03	11.59		214.0	75.0
350	5.42	0.03	11.38		206.0	75.0
360	5.19	0.03	11.27		200.0	75.0
370	4.95	0.03	11.20		197.0	74.0
380	4.74	0.03	10.85		195.0	76.0
390	4.54	0.03	10.69		192.0	76.0
400	4.33	0.03	10.72		191.0	76.0
410	4.10	0.03	11.01		191.0	76.0
420	3.87	0.03	10.66		191.0	76.0
430	3.64	0.03	10.38		190.0	75.0
440	3.42	0.03	10.43		190.0	76.0
450	3.17	0.03	10.60		192.0	75.0
460	2.94	0.03	10.52		192.0	75.0
470	2.71	0.03	10.48		190.0	76.0
480	2.53	0.03	10.35		186.0	76.0
490	2.34	0.03	10.12		183.0	76.0
500	2.17	0.03	9.95		180.0	76.0
510	2.03	0.03	9.59		179.0	76.0
520	1.89	0.03	9.69		178.0	75.0
530	1.72	0.03	9.58		177.0	75.0
540	1.56	0.03	9.36		176.0	75.0
550	1.41	0.03	9.25		176.0	75.0
560	1.29	0.03	9.16		175.0	75.0
570	1.13	0.03	9.05		174.0	75.0
580	0.98	0.03	8.92		172.0	75.0
590	0.85	0.03	8.59		171.0	75.0
600	0.71	0.03	8.45		169.0	75.0
610	0.59	0.03	8.44		168.0	75.0
620	0.46	0.03	8.47		167.0	75.0
630	0.32	0.03	8.19		165.0	76.0

640	0.21	0.03	7.97		164.0	75.0
650	0.07	0.03	7.70		163.0	75.0
660	-0.03	0.03	7.53		162.0	75.0

OMNI-Test Laboratories, Inc.

Wood Heater Run Sheets

Client: Kuma Stoves Project Number: 0123WN012E Run Number: 4
Model: K250 Series Tracking Number: 2330 Date: 11/29/18
Test Crew: D Davis
OMNI Equipment ID numbers: 132, Small scale, Fuel scale, 650, 2134, 371, 372, 414 559, 592, 420, 637

Wood Heater Supplemental Data

Start Time: 16:35 11/29/18 Booth #: n/a
Stop Time: 0335 11/30/18

Stack Gas Leak Check:
Initial: good Final: good

Sample Train Leak Check:
A: 0.0 @ 5 "Hg
B: 0.0 @ 5 "Hg

Calibrations: Span Gas CO_2: 12.4 CO: 2.48

	Pre Test		Post Test	
	Zero	Span	Zero	Span
Time	15:51	15:51	0344	0344
CO_2	0.00	12.42	1.35	13.34
CO	0.000	2.48	-0.002	2.430

Air Velocity (ft/min): Initial: ≤50 Final: ≤50
Scale Audit (lbs): Initial: 10.0 Final: 10.0
Pitot Tube Leak Test: Initial: good Final: good
Stack Diameter (in): 6"
Induced Draft: 0.0
% Smoke Capture: 100%
Flue Pipe Cleaned Prior to First Test in Series:
Date: 11/21/18 Initials: BB

	Initial	Middle	Ending
P_b (in/Hg)	28.04		28.14
RH (%)	43%		34%
Ambient (°F)	76		75

Tunnel Traverse

Microtector Reading	dP (in H_2O)	T(°F)
	.076	104
	.078	104
	.072	104
	.070	104
	.072	104
	.080	104
	.070	104
	.072	104
Center:		
	.072	104

Tunnel Static Pressure (in H_2O):	
Beginning of Test	End of Test
-.120	-.120

Background Filter Volume: 96.546

Technician Signature: [signature] Date: 1/30/19

OMNI-Test Laboratories, Inc.

Wood Heater Run Sheets

Client: Kuma Stoves Project Number: 0123WN012E Run Number: 4
Model: K250 Series Tracking Number: 2330 Date: 11/29/18
Test Crew:
OMNI Equipment ID numbers:

Wood Heater Run Notes

Air Control Settings

Primary:

~~7/16" from full closed~~
3/32" from full closed = an Air Setting of 7/16"

Secondary: fixed

Tertiary/Pilot: N/A

Fan:

Preburn Notes

Time	Notes
N/A	

Test Notes

Sketch test fuel configuration:

See photo

Start up procedures & Timeline:

Bypass: closed by 2:09
Fuel loaded by: 1:45
Door closed at: 2:09
Primary air: fully open until 16:10 then set to 7/16" from full closed.

Notes: FAN turned off until 30 min. then turned to high

Time	Notes
60	Changed front filter in frame A.

Technician Signature: [signature] Date: 1/30/19

Section 4

Quality Assurance/Quality Control

QUALITY ASSURANCE/QUALITY CONTROL

OMNI follows the guidelines of ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories," and the quality assurance/quality control (QA/QC) procedures found in *OMNI*'s Quality Assurance Manual.

OMNI's scope of accreditation includes, but is not limited to, the following:

- ANSI (American National Standards Institute) for certification of product to safety standards.
- To perform product safety testing by the International Accreditation Service, Inc. (formerly ICBO ES) under accreditation as a testing laboratory designated TL-130.
- To perform product safety testing as a "Certification Organization" by the Standards Council of Canada (SCC).
- Serving as a testing laboratory for the certification of wood heaters by the U.S. Environmental Protection Agency.

This report is issued within the scope of *OMNI*'s accreditation. Accreditation certificates are available upon request.

The manufacturing facilities and quality control system for the production of the K250 Series at Kuma Stoves were evaluated to determine if sufficient to maintain conformance with OMNI's requirements for product certification. OMNI has concluded that the manufacturing facilities, processes, and quality control system are adequate to produce the appliance congruous with the standards and model codes to which it was evaluated.

This report shall not be reproduced, except in full, without the written approval of OMNI-Test Laboratories, Inc.

Sample Analysis

Analysis Worksheets

Tared Filter, Probe, and O-Ring Data

OMNI-Test Laboratories, Inc.

Wood Heater Run Sheets

Client: Kuma Stoves Project Number: 0123WN012E Run Number: 1
Model: K250 Series Tracking Number: 2330 Date: 11/27/18
Test Crew: B Davis
OMNI Equipment ID numbers: 637, 592, 283A

ASTM E2515 Lab Sheet

Assembled By: B Davis

Date/Time in Dessicator: 12/4/18 0800

	Weighing #1	Weighing #2	Weighing #3	Weighing #4	Weighing #5
Date/Time:	12/5/18 0430	12/6/18	12/10/18	12/13/18	
R/H %:	9.4	8.7	8.3	9.4	
Temp:	63.1	64.5	62.2	63.1	
200 mg Audit:	200.1	200.1	N/A	N/A	
2 g Audit:	2000.2	2000.2	2000.2	2000.2	
100 g Audit:	99997.9	99998.0	N/A	N/A	
Initials:	BC	BC	BC	BC	

Train	Element	ID #	Tare (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)
A (First Hour)	Front Filter	T76S	85.1	87.4	87.4	✓		
	Rear Filter							
	Probe							
	O-Ring Set							
A (Remainder)	Front Filter	T71AP	183.1	189.2	189.1	✓		
	Rear Filter	~~T71AP~~						
	Probe	21	114391.8	114393.0	114393.1	✓		
	O-Ring Set	R685	3391.6	3392.8	3392.1	3391.6	3391.7	✓
B	Front Filter	T71BP	183.0	187.0	186.9	✓		
	Rear Filter	~~T71BP~~						
	Probe	22	114343.8	114345.0	114345.0	✓		
	O-Ring Set	R686	3384.8	3386.2	3385.4	3384.8	3384.7	✓
BG	Filter	D579	121.0	121.3	121.3	✓		
B		T77S	85.0	89.6	89.6	✓		

Technician Signature: BC Date: 1/30/19

OMNI-Test Laboratories, Inc.

Wood Heater Run Sheets

Client: Kuma Stoves | Project Number: 0123WN012E | Run Number: 2
Model: K250 Series | Tracking Number: 2330 | Date: 11/27/18
Test Crew: B Davis
OMNI Equipment ID numbers: 637, 572, 243A

ASTM E2515 Lab Sheet

Assembled By:

B Davis

Date/Time in Dessicator:

12/4/18 0800

	Weighing #1	Weighing #2	Weighing #3	Weighing #4	Weighing #5
	Date/Time: 12/5/18 0835	Date/Time:	Date/Time:	Date/Time:	Date/Time:
	R/H %: 9.4	R/H %:	R/H %:	R/H %:	R/H %:
	Temp: 63.1	Temp:	Temp:	Temp:	Temp:
	200 mg Audit: 200.1	200 mg Audit:	200 mg Audit:	200 mg Audit:	200 mg Audit:
	2 g Audit: 2000.2	2 g Audit:	2 g Audit:	2 g Audit:	2 g Audit:
	100 g Audit: 99997.9	100 g Audit	100 g Audit	100 g Audit	100 g Audit
	Initials: BA	Initials:	Initials:	Initials:	Initials:

Train	Element	ID #	Tare (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)
A (First Hour)	Front Filter	T78S	848	86.2	86.1 ✓			
	Rear Filter							
	Probe							
	O-Ring Set							
A (Remainder)	Front Filter	T72AP	178.3	180.2	180.1 ✓			
	Rear Filter	~~T72AP~~						
	Probe	23	1140768	114077.1	114077.2 ✓			
	O-Ring Set	R687	4104.7	4105.2	4104.8	4104.7 ✓		
B	Front Filter	T72BP	179.0	182.6	182.4 ✓			
	Rear Filter	~~T72BP~~						
	Probe	24	114126.5	114127.2	114127.2 ✓			
	O-Ring Set	R688	3324.6	3325.4	3324.8	3324.6 ✓		
BG	Filter	D580	121.2	121.4	121.4 ✓			

Technician Signature: B Davis Date: 1/30/19

OMNI-Test Laboratories, Inc.

Wood Heater Run Sheets

Client: Kuma Stoves | Project Number: 0123WN012E | Run Number: 4B
Model: K250 Series | Tracking Number: 2330 | Date: 11/29/18
Test Crew: B Davis
OMNI Equipment ID numbers: 637, 592, 283A

ASTM E2515 Lab Sheet

Assembled By:

B Davis

Date/Time in Dessicator:

12/4/18 0800

	Weighing #1	Weighing #2	Weighing #3	Weighing #4	Weighing #5
Date/Time:	12/5/18 0835	12/6/18	12/10/18		
R/H %:	9.4	8.7	8.3		
Temp:	63.1	64.5	62.2		
200 mg Audit:	200.1	200.1	N/A		
2 g Audit:	2000.2	2000.2	2000.2		
100 g Audit:	99997.9	99998.0	N/A		
Initials:	BZ	BZ	BL		

Train	Element	ID #	Tare (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)
A (First Hour)	Front Filter	T79S	85.3	89.1	88.8			
	Rear Filter							
	Probe							
	O-Ring Set							
A (Remainder)	Front Filter	T73AP	182.2	185.4	185.3	✓		
	Rear Filter	I73AP						
	Probe	25	114298.3	114299.2	114299.2	✓		
	O-Ring Set	R689	3302.7	3303.3	3303.0	3302.7 ✓		
B	Front Filter	T73BP	180.7	187.6	187.4	✓		
	Rear Filter	~~F73BP~~						
	Probe	27	114273.3	114274.0	114274.0	✓		
	O-Ring Set	R690	3321.4	3321.9	3321.5	3321.6 ✓		
BG	Filter	D578	120.7	120.9	120.8	✓		

Technician Signature: B Davis | Date: 1/30/19

Tare Sheet: (check one) **Probes**____ **47mm Filters** ✓ **100mm Filters**____ **O-Ring Pair**____

Prepared By: B Davis Balance ID #: omni-00637 Thermohygrometer ID #: omni-00592 Audit Weight ID #/Mass: omni-00283A / 200 mg

Placed in Dessicator: Date: 11/10/18 Time: 12:10	Date: 11/6/18 Time: 0945 RH %: 15.3 T (°F): 71.9 Audit: 200.1	Date: 11/7/18 Time: 0925 RH %: 17.6 T (°F): 71.8 Audit: 200.1	Date: Time: RH %: T (°F): Audit:	Date: Time: RH %: T (°F): Audit:	Date Used	Project Number	Run No.
ID #							
T71AP	183.2	183.1	✓		11/27/18	0123WW012E	1
T71BP	183.1	183.0	✓		↓		↓
T72AP	178.4	178.3	✓		↓		2
T72BP	179.1	179.0	✓		↓		↓
T73AP	182.2	182.2	✓		11/29/18		4
T73BP	180.7	180.7	✓		↓		↓
T74AP	179.4	179.2	✓				
T74BP	183.1	183.2	✓				
T75AP	184.3	184.1	✓				
T75BP	176.9	176.8	✓				
T76S	85.2	85.1	✓				
T77S	85.0	85.0	✓				
T78S	84.7	84.8	✓				
T79S	85.3	85.3	✓				
T80S	85.2	85.3	✓				
T81S	85.3	85.3	✓				
T82S	85.0	85.0	✓				
T83S	85.7	85.5	✓				
T84S	85.8	85.8	✓				
T85S	85.7	85.7	✓				
	Initials: BR	Initials: BR	Initials:	Initials:			

Final Technician Signature: [signature] Date: 11/15/18 Evaluator signature: [signature]

Tare Sheet: (check one) **Probes** ✓ **47mm Filters**____ **100mm Filters**____ **O-Ring Pair**____

Prepared By: DDavis Balance ID #: Omni-00637 Thermohygrometer ID #: Omni-00592 Audit Weight ID #/Mass: Omni-00283A / 100g

Placed in Dessicator: Date: ____ Time: ____ ID #	Date: 11-6-18 Time: 1000 RH %: 17.4 T (°F): 71.9 Audit: 99997.7	Date: 11/7/18 Time: 0940 RH %: 17.6 T (°F): 71.8 Audit: 99997.6	Date: 11/15/18 Time: 0843 RH %: 18.9 T (°F): 66 Audit: 99997.7	Date: Time: RH %: T (°F): Audit:	Date Used	Project Number	Run No.
21	114392.0	114391.8	✓		11/27/18	0123WN012E	1
22	114343.9	114343.8	✓				1
23	114076.7	114076.8	✓				2
24	114127.0	114126.6	114126.5	✓			2
25	114298.5	114298.3	✓		11/29/18		4
27	114273.3	114273.3	✓				4
28	114750.4	114750.2	✓				
29	114278.1	114278.0	✓				
30	114328.0	114328.2	✓				
31	114367.8	114367.6	✓				
	Initials: BR	Initials: AL	Initials: BR	Initials:			

Final Technician Signature: [signature] Date: 11/15/18 Evaluator signature: [signature]

Tare Sheet: (check one) **Probes** ✓ **47mm Filters**____ **100mm Filters**____ **O-Ring Pair**____

Prepared By: MLindenburger Balance ID #: omni-00637 Thermohygrometer ID #: omni-00592 Audit Weight ID #/Mass: omni-002834 / 5g

Placed in Dessicator: Date: 10/11/2018 Time: 4:30

ID #	Date: 11/6/18 Time: 0942 RH %: 14.4 T (°F): 71.9 Audit: 5000.0	Date: 11/7/18 Time: 0933 RH %: 17.6 T (°F): 71.8 Audit: 4999.9	Date: Time: RH %: T (°F): Audit:	Date: Time: RH %: T (°F): Audit:	Date Used	Project Number	Run No.
R685	3391.4	3391.6	✓		11/27/18	0123 WN 012E	1
R686	3384.6	3384.8	✓				1
R687	4104.6	4104.7	✓				2
R688	3324.4	3324.6	✓				2
R689	3302.9	3302.7	✓		11/29/18		4
R690	3321.3	3321.4	✓				4
R691	4095.4	4095.3	✓				
R692	3306.6	3306.7	✓				
R693	3343.9	3343.8	✓				
R694	3335.2	3335.2	✓				
	Initials: BR	Initials: BR	Initials:	Initials:			

Final Technician Signature: [signature] Date: 11/15/18 Evaluator signature: [signature]

Calibrations

Methods EPA 28R, ASTM E2515, ASTM E3053

ID #	Lab Name/Purpose	Log Name	Attachment Type
132	10 lb Weight	Weight Standard, 10 lb.	Calibration Certificate
South Scale	Platform Scale	Weight Indicator, Panther 1000 pound by 0.1 resolution	Calibration Certificate
Fuel Scale	Ohaus Ranger fuel scale	24 pound capacity by 0.002 pound resolution.	Calibration Certificate
650	Barometer	Barometer – Digital	Calibration Certificate
283A	Audit Weights	Troemner 21pc Msas Set	Calibration Certificate
371	Sample Box / Dry Gas Meter	Apex Automated Emissions Sampling Box	Calibration Log
372	Sample Box / Dry Gas Meter	Apex Automated Emissions Sampling Box	Calibration Log
410	Microtector	Dwyer Microtector	Calibration Certificate
559	Vaneometer	Dwyer Vaneometer	Equipment Record
592	Thermohygrometer	Omega Digital Thermohygrometer	Calibration Log
420	Combustion Gas Analyzer	CAI Gas Analyzer	See Run Sheet
637	Milligram Balance	Analytical Balance - Mettler - Toledo	Calibration Certificate

SCALE WEIGHT CALIBRATION DATA SHEET

Weight to be calibrated: 10 pounds

ID Number: OMNI-00132

Standard Calibration Weight: 10 pounds

ID Number: OMNI-00255

Scale Used: MTW-150K

ID Number: OMNI-00353

Date: 2/23/2018 By: B. Davis

Standard Weight (A) (Lb.)	Weight Verified (B) (Lb.)	Difference (A - B)	% Error
10.0	10.0	0.0	0

*Acceptable tolerance is 1%.

This calibration is traceable to NIST using calibrated standard weights.

Technician signature: _____ Date: 2/23/18

Becherini Scale Center, Inc.
317 E. Sprague
Spokane, WA 99202

SCALE CALIBRATION RECORD

Customer: MYREIN | Date: 9/1/17

Work Order Number: 49320 | PO Number:

Equipment Mfg.	Serial Number	Specifications	Weight used	Initial Readings	Final Readings
1. PANTHER	4466459	1000 x .1	Ø		
	Pass...Fail		50		
			100		
			300		
			500		
			Ø		

Notes:
DOA
will be new Scale deck

Equipment Mfg.	Serial Number	Specifications	Weight used	Initial Readings	Final Readings
2. PANTHER	00155556CH	5K x 1	Ø		
	Pass...Fail		50		
			100		
			300		
			500		
			Ø		

Notes:
DNF
SPARE Readout

Equipment Mfg.	Serial Number	Specifications	Weight used	Initial Readings	Final Readings
3. PANTHER	00025736AJ	1000 x .1	Ø	Ø	Ø
	Pass...Fail		50	50	50
			100	99.9	100
			300	299.6	300
			500	498.8	500
			Ø	Ø	Ø

Notes: SCALE CALIBRATED W/CERT. WEIGHTS.
SOUTH Scale ✓

Equipment Mfg.	Serial Number	Specifications	Weight used	Initial Readings	Final Readings
4. PANTHER	00926516KL	1000 x .1	Ø	Ø	
	Pass...Fail		50	50	
			100	100	
			300	300	
			500	500	
			Ø	Ø	

Notes: SCALE CHECKS GOOD
Center Scale

Additional Comments:

Last Checked: 11/16 | Next Check Due: —

Weights Certified: 10/16 | Technician: BB

Calibration checked LAW NIST handbook 44

Becherini Scale Center, Inc.
317 E. Sprague
Spokane, WA 99202

SCALE CALIBRATION RECORD

Customer: MYREN | Date: 9/1/17

Work Order Number: 49320 | PO Number:

Equipment Mfg.	Serial Number	Specifications	Weight used	Initial Readings	Final Readings
1. SARTORIUS	25359106	15K x .5	0	0	0
CTSL1-4	Pass...Fail		50	50	50
Notes: STRAIN TEST w/ 926 lbs			500	499	500
CALIBRATED w/ 3926 lbs			1000	998	1000
SCALE CHECKS GOOD			~~2000~~ 926	~~3000~~ 926	3926
			0	0	0

Equipment Mfg.	Serial Number	Specifications	Weight used	Initial Readings	Final Readings
2. OHAUS	2350003	24 x .002	0	0	0
RANGER	Pass...Fail		.5	.5	.5
Notes: LEVELED SCALE, SCALE			4	4	4
CHECKS GOOD.			20	20.002	20
			24	24.002	24
			0	0	0

Equipment Mfg.	Serial Number	Specifications	Weight used	Initial Readings	Final Readings
3.					
	Pass...Fail				
Notes:					

Equipment Mfg.	Serial Number	Specifications	Weight used	Initial Readings	Final Readings
4.					
	Pass...Fail				
Notes:					

Additional Comments:

Last Checked: 11/16 | Next Check Due: —

Weights Certified: 10/16 | Technician: BB

Calibration checked IAW NIST handbook 44

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

ACCREDITED
A2LA Certificate No. 1750.01
Calibration

Cert. No.: 6530-9263396

Traceable® Certificate of Calibration for Digital Barometer

Manufactured for and distributed by : Control Company "Drawer 58307,Houston,TX,77258,USA"

Instrument Identification:

Model: 6530, S/N: 181062211 Manufacturer: Control Company

Standards/Equipment:

Description	Serial Number	Due Date	NIST Traceable Reference
Digital Barometer	D4540001	09 Oct 2018	1000415948
Digital Thermometer	130070752	02 Mar 2018	4000-8360837
Chilled Mirror Hygrometer	44654/2H3737	02 Nov 2019	15478
Climate Chamber	W613.0046		

Certificate Information:

Technician: 57 Procedure: CAL-31 Cal Date: 26 Feb 2018 Cal Due Date: 26 Feb 2020

Test Conditions: 54.9%RH 22.83°C 1023mBar

Calibration Data: (New Instrument)

Unit(s)	Nominal	As Found	In Tol	Nominal	As Left	In Tol	Min	Max	±U	TUR
%RH	N.A.	N.A.		51.21	52	Y	49	55	0.74	>4:1
°C	N.A.	N.A.		24.55	24.3	Y	24.15	24.96	0.051	>4:1
mb/hPa	N.A.	N.A.		1010.30	1010	Y	1007	1015	0.62	>4:1
mb/hPa	N.A.	N.A.		806.75	806	Y	803	811	0.62	>4:1
mb/hPa	N.A.	N.A.		908.50	908	Y	905	913	0.62	>4:1

This certificate indicates Traceability to standards provided by (NIST) National Institute of Standards and Technology and/or a National Standards Laboratory.

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

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

Nicol Rodriguez, Quality Manager

Aaron Judice, Technical Manager

Maintaining Accuracy:

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

Recalibration:

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

CONTROL COMPANY 12554 Galveston RD Suite B230 Webster TX USA 77598
Phone 281 482-1714 Fax 281 482-9448 sales@control3.com www.control3.com

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

Traceable® is a registered trademark of Control Company

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Certificate of Calibration

Certificate Number: **685888**

JJ Calibrations, Inc.
7007 SE Lake Rd
Portland, OR 97267-2105
Phone 503.786.3005
FAX 503.786.2994

Omni-Test Laboratories
13327 NE Airport Way
Portland, OR 97230

ACCREDITED
0723.01
Calibration

PO: **180188**
Order Date: 10/09/2018
Authorized By: **N/A**

Property #: OMNI-00283A
User: N/A
Department: N/A
Make: Troemner Inc
Model: 1mg-100g (Class F)
Serial #: 47883
Description: Mass Set, 21pc
Procedure: DCN 500901
Accuracy: Class F

Calibrated on: 10/26/2018
*Recommended Due: 10/26/2023
Environment: 20 °C 57 % RH
* As Received: Within Tolerance
* As Returned: Within Tolerance
Action Taken: Calibrated
Technician: **139**

Remarks: * Many factors may cause the unit to drift out of calibration before the recommended due date. Any reported error is the absolute value between the reference and the unit. Uncertainties include the effects of the unit.

This set meets Class F specifications.
Received and returned eight (8) masses in a black case secured by a rubber band.

Standards Used

Std ID	Manufacturer	Model	Nomenclature	Due Date	Trace ID
723A	Rice Lake	1mg-200g (Class 0)	Mass Set,	03/23/2019	668240
800A	Sartorius	MSA225W100DI	Analytical Balance	12/11/2018	663857

Measurement Data

Parameter / Measurement Description	Range Unit	Reference	Min	Max	[k]Error	UUT	Uncertainty Accredited = ✓
Before/After							
Mass							
Dot	200 mg	200.00030	199.4603	200.5403	0.0500	200.0503 mg	6.2E-01 ✓
	1 g	1.00000880	0.9991088	1.0009088	0.0000000	1.0000088 g	1E-03 ✓
	2 g	2.00001470	1.9989147	2.0011147	0.0003250	2.0003397 g	1.3E-03 ✓
	5 g	5.00000840	4.9985084	5.0015084	0.0000400	4.9999684 g	1.7E-03 ✓
	10 g	10.0000100	9.998010	10.002010	0.000245	9.999765 g	2.3E-03 ✓
Dot	20 g	20.0000140	19.996014	20.004014	0.000990	20.001004 g	4.6E-03 ✓
	50 g	49.9999660	49.989966	50.009966	0.000595	49.999371 g	1.1E-02 ✓
	100 g	100.000000	99.98000	100.02000	0.00194	99.99806 g	2.3E-02 ✓

JJ Calibrations, Inc. certifies that this instrument has been calibrated in accordance with the JJ Calibrations Quality Assurance Manual with the stated procedure using standards that are traceable to the National Institute of Standards and Technology (NIST), or other National Measurement Institutes (NMI's), or by using natural physical constants, intrinsic standards or ratio calibration techniques. The quality system and this certificate are in compliance with ANSI/NCSL Z540-1-1994, ISO/IEC 17025-2005, ISO 10012-1, the ISO 9000 family and QS 9000. The expanded uncertainties of measurements for this calibration are based upon 95% (2 sigma) confidence limits. Unless otherwise stated, a test accuracy ratio (TAR) of 4:1, if achievable, is maintained. The results reported herein apply only to the calibration of the item described above. This report may not be reproduced, except in full, without prior written consent of JJ Calibrations, Inc.
JJ Calibrations, Inc. quality system has been assessed and accredited to ISO/IEC 17025:2005.

Reviewer

3 Issued 10/29/2018 Rev # 15

Inspector

Thermal Metering System Calibration
Y Factor

Manufacturer:	Apex
Model:	XC-60-EP
Serial Number:	0702003
OMNI Tracking No.:	OMNI-00371
Calibrated Orifice:	[redacted]

Previous Calibration Comparision

Date	1/16/2018	Acceptable Deviation (5%)	Deviation
y Factor	0.997	0.04985	0.014
Acceptance	Acceptable		

Average Gas Meter y Factor	Orifice Meter dH@
0.983	N/A

Calibration Date:	07/16/18	
Calibrated by:	B. Davis	
Calibration Frequency:	6 months	
Next Calibration Due:	1/16/2019	
Instrument Range:	1.000	cfm
Standard Temp.:	68	oF
Standard Press.:	29.92	"Hg
Barometric Press., Pb:	30.08	"Hg
Signature/Date:		7/16/2018

Current Calibration

Acceptable y Deviation	0.020
Maximum y Deviation	0.007
Acceptable dH@ Deviation	N/A
Maximum dH@ Deviation	N/A
Acceptance	Acceptable

Reference Standard *			
Standard Calibrator	Model	Standard Test Meter	
	S/N	OMNI-00001	
	Calib. Date	30-Oct-17	
	Calib. Value	0.9977	y factor (ref)

Calibration Parameters	Run 1	Run 2	Run 3
Reference Meter Pressure ("H2O), Pr	0.00	0.00	0.00
DGM Pressure ("H2O), Pd	3.00	1.70	1.00
Initial Reference Meter	534.8	524	529.6
Final Reference Meter	540.302	529.514	534.7
Initial DGM	0	0	0
Final DGM	5.505	5.593	5.22
Temp. Ref. Meter (°F), Tr	85.0	82.0	81.0
Temperature DGM (°F), Td	85.0	83.0	84.0
Time (min)	28.8	35.5	47.8
Net Volume Ref. Meter, Vr	5.502	5.514	5.100
Net Volume DGM, Vd	5.505	5.593	5.22
Gas Meter y Factor =	**0.990**	**0.981**	**0.978**
Gas Meter y Factor Deviation (from avg.)	0.007	0.002	0.005
Orifice dH@	**N/A**	**N/A**	**N/A**
Orifice dH@ Deviation (from avg.)	N/A	N/A	N/A

where:

1. Deviation = |Average value for all runs - current run value|
** 2. y = [Vr x (y factor (ref)) x (Pb + (Pr/ 13.6)) x (Td + 460)]/ [Vd x (Pb + (Pd / 13.6)) x (Tr + 460)]
** 3. dH@ = 0.0317 x Pd / (Pb (Td + 460)) x [(Tr + 460) x time) / Vr]^2

* Reference calibration is traceable to NIST through NIST Test # 40674, Kimble ASTM E1272, or NIST traceable laboratory

** Equations come from EPA Method 5

The uncertainty of measurement is ±0.14 ft^3/min. This is based on the reference standard having a TAR (Test Accuracy Ratio) of at least 4:1.

DIFFERENTIAL PRESSURE GAUGE CALIBRATION DATA SHEET

Instrument to be calibrated: Pressure Transducer

Maximum Range: 0-2" WC ID Number: OMNI-00371

Calibration Instrument: Digital Manometer ID Number: OMNI-00395

Date: 7/16/18 By: B. Davis

This form is to be used only in conjunction with Standard Procedure C-SPC.

Range of Calibration Point ("WC)	Digital Manometer Input ("WC)	Pressure Gauge Response ("WC)	Difference (Input - Response)	% Error of Full Span*
0-20% Max. Range 0 - 0.4	0.231	0.223	0.008	0.4
20-40% Max. Range 0.4 - 0.8	0.571	0.564	0.007	0.35
40-60% Max. Range 0.8 – 1.2	0.991	0.985	0.006	0.3
60-80% Max. Range 1.2 – 1.6	1.228	1.219	0.009	0.45
80-100% Max. Range 1.6 – 2.0	1.840	1.827	0.013	0.65

*Acceptable tolerance is 4%.

The uncertainty of measurement is ±0.4" WC. This is based on the reference standard having a TAR (Test Accuracy Ratio) of at least 4:1.

Technician signature: _____ Date: 7/16/18

Reviewed by: _____ Date: 7/20/2018

Temperature Calibration
EPA Method 28R, ASTM 2515

Booth:	Temperature Monitor Type:	Equipment Number:
Mobile	National Instruments Logger	00371, 00372

Reference Meter Equipment Number: 00373	Calibration Due Date: 8/02/17

Calibration Performed By:	Date:	Ambient Temperature:	Barometric Pressure:
B. Davis	7/17/18	76	30.12

Input Temperature (F)	Ambient	Meter A	Meter B	Filter A	Filter B	Tunnel	FB Interior
0	0	0	0	0	0	1	1
100	100	100	100	100	100	101	100
300	299	300	300	300	299	300	300
500	499	500	500	499	499	500	500
700	699	700	700	699	699	700	700
1000	999	1000	1000	999	999	1000	1000

Input (F)	FB Top	FB Bottom	FB Back	FB Left	FB Right	Imp A	Imp B	Cat	Stack
0	1	1	1	1	1	-1	-1	-1	1
100	101	101	101	100	100	99	99	99	101
300	300	300	300	300	300	299	299	299	300
500	500	500	500	500	500	499	499	499	500
700	700	700	700	700	700	699	699	699	700
1000	1000	1000	1000	1000	1000	999	999	999	1000
1500								1499	
2000								1999	

Technician signature: _____ Date: 7/17/18

Reviewed By: _____ Date: 7/20/18

Thermal Metering System Calibration
Y Factor

Manufacturer:	Apex
Model:	XC-60-EP
Serial Number:	0702004
OMNI Tracking No.:	OMNI-00372
Calibrated Orifice:	[redacted]

Previous Calibration Comparision

Date	1/17/2018	Acceptable Deviation (5%)	Deviation
y Factor	0.981	0.04905	0.007
Acceptance	Acceptable		

Average Gas Meter y Factor	**Orifice Meter dH@**
0.974	**N/A**

Calibration Date:	07/16/18	
Calibrated by:	B. Davis	
Calibration Frequency:	6 months	
Next Calibration Due:	1/16/2019	
Instrument Range:	1.000	cfm
Standard Temp.:	68	oF
Standard Press.:	29.92	"Hg
Barometric Press., Pb:	30.08	"Hg
Signature/Date:		7/16/2018

Current Calibration

Acceptable y Deviation	0.020
Maximum y Deviation	0.008
Acceptable dH@ Deviation	N/A
Maximum dH@ Deviation	N/A
Acceptance	Acceptable

Reference Standard *			
Standard Calibrator	Model	Standard Test Meter	
	S/N	OMNI-00001	
	Calib. Date	27-Oct-16	
	Calib. Value	0.9977	y factor (ref)

Calibration Parameters	Run 1	Run 2	Run 3
Reference Meter Pressure ("H2O), Pr	0.00	0.00	0.00
DGM Pressure ("H2O), Pd	3.00	1.30	0.80
Initial Reference Meter	540.8	547.1	627.2
Final Reference Meter	547.004	552.102	633.4
Initial DGM	0	0	0
Final DGM	6.244	5.121	6.353
Temp. Ref. Meter (°F), Tr	86.0	88.0	88.0
Temperature DGM (°F), Td	85.0	87.0	87.0
Time (min)	27.5	34.5	56.5
Net Volume Ref. Meter, Vr	6.204	5.002	6.200
Net Volume DGM, Vd	6.244	5.121	6.353
Gas Meter y Factor =	**0.982**	**0.970**	**0.970**
Gas Meter y Factor Deviation (from avg.)	0.008	0.004	0.004
Orifice dH@	**N/A**	**N/A**	**N/A**
Orifice dH@ Deviation (from avg.)	N/A	N/A	N/A

where:

1. Deviation = |Average value for all runs - current run value|

** 2. $y = [Vr \times (y \text{ factor (ref)}) \times (Pb + (Pr/ 13.6)) \times (Td + 460)]/ [Vd \times (Pb + (Pd / 13.6)) \times (Tr + 460)]$

** 3. $dH@ = 0.0317 \times Pd / (Pb (Td + 460)) \times [(Tr + 460) \times time) / Vr]^2$

* Reference calibration is traceable to NIST through NIST Test # 40674, Kimble ASTM E1272, or NIST traceable laboratory

** Equations come from EPA Method 5

The uncertainty of measurement is ±0.14 ft^3/min. This is based on the reference standard having a TAR (Test Accuracy Ratio) of at least 4:1.

DIFFERENTIAL PRESSURE GAUGE CALIBRATION DATA SHEET

Instrument to be calibrated: Pressure Transducer

Maximum Range: 0-2" WC ID Number: OMNI-00372

Calibration Instrument: Digital Manometer ID Number: OMNI-00395

Date: 7/16/18 By: B. Davis

This form is to be used only in conjunction with Standard Procedure C-SPC.

Range of Calibration Point ("WC)	Digital Manometer Input ("WC)	Pressure Gauge Response ("WC)	Difference (Input - Response)	% Error of Full Span*
0-20% Max. Range 0 - 0.4	0.037	0.042	0.005	0.25
20-40% Max. Range 0.4 - 0.8	0.512	0.509	0.003	0.15
40-60% Max. Range 0.8 – 1.2	1.169	1.164	0.005	0.25
60-80% Max. Range 1.2 – 1.6	1.540	1.533	0.007	0.35
80-100% Max. Range 1.6 – 2.0	1.772	1.776	0.004	0.20

*Acceptable tolerance is 4%.

The uncertainty of measurement is ±0.4" WC. This is based on the reference standard having a TAR (Test Accuracy Ratio) of at least 4:1.

Technician signature: _____ Date: 7/16/18

Reviewed by: _____ Date: 7/20/2018

Temperature Calibration
EPA Method 28R, ASTM 2515

Booth:	Temperature Monitor Type:	Equipment Number:
Mobile	National Instruments Logger	00371, 00372

Reference Meter Equipment Number: 00373	Calibration Due Date: 8/02/17

Calibration Performed By:	Date:	Ambient Temperature:	Barometric Pressure:
B. Davis	7/17/18	76	30.12

Input Temperature (F)	Ambient	Meter A	Meter B	Filter A	Filter B	Tunnel	FB Interior
0	0	0	0	0	0	1	1
100	100	100	100	100	100	101	100
300	299	300	300	300	299	300	300
500	499	500	500	499	499	500	500
700	699	700	700	699	699	700	700
1000	999	1000	1000	999	999	1000	1000

Input (F)	FB Top	FB Bottom	FB Back	FB Left	FB Right	Imp A	Imp B	Cat	Stack
0	1	1	1	1	1	-1	-1	-1	1
100	101	101	101	100	100	99	99	99	101
300	300	300	300	300	300	299	299	299	300
500	500	500	500	500	500	499	499	499	500
700	700	700	700	700	700	699	699	699	700
1000	1000	1000	1000	1000	1000	999	999	999	1000
1500								1499	
2000								1999	

Technician signature: _____ Date: 7/17/18

Reviewed By: _____ Date: 7/20/18

Certificate of Calibration

Certificate Number: **686722**

JJ Calibrations, Inc.
7007 SE Lake Rd
Portland, OR 97267-2105
Phone 503.786.3005
FAX 503.786.2994

Omni-Test Laboratories
13327 NE Airport Way
Portland, OR 97230

0723.01
Calibration

PO: **180192**
Order Date: 10/22/2018
Authorized By: **N/A**

Property #: OMNI-00410
User: N/A
Department: N/A
Make: Dwyer
Model: 1430
Serial #: OMNI-00410
Description: Microtector
Procedure: DCN 500908
Accuracy: ±0.00025" WC

Calibrated on: 10/30/2018
*Recommended Due: 10/30/2019
Environment: 22 °C 44 % RH
* As Received: Limited
* As Returned: Limited
Action Taken: Calibrated
Technician: **111**

Remarks: * Many factors may cause the unit to drift out of calibration before the recommended due date. Any reported error is the absolute value between the reference and the unit. Uncertainties include the effects of the unit.

Previous limitation of micrometer head calibrated only continued. .001" reading micrometer head ±.001" (LSD) tolerance applied.

Standards Used

Std ID	Manufacturer	Model	Nomenclature	Due Date	Trace ID
541A	Select	E8FED2	Gage Block Set, 8pc	12/18/2018	663864

Measurement Data

Parameter / Measurement Description	Range Unit	Reference	Min	Max	ᵏError	UUT	Uncertainty Accredited = ✓
Before/After							
Length							
	Inch	0.1300	0.129	0.131	0.001	0.129 Inch	1.1E-03 ✓
	Inch	0.3850	0.384	0.386	0.001	0.384 Inch	1.1E-03 ✓
	Inch	0.6150	0.614	0.616	0.001	0.614 Inch	1.1E-03 ✓
	Inch	0.8700	0.869	0.871	0.001	0.869 Inch	1.1E-03 ✓
	Inch	1.0000	0.999	1.001	0.001	0.999 Inch	1.1E-03 ✓

JJ Calibrations, Inc. certifies that this instrument has been calibrated in accordance with the JJ Calibrations Quality Assurance Manual with the stated procedure using standards that are traceable to the National Institute of Standards and Technology (NIST), or other National Measurement Institutes (NMI's), or by using natural physical constants, intrinsic standards or ratio calibration techniques. The quality system and this certificate are in compliance with ANSI/NCSL Z540-1-1994, ISO/IEC 17025-2005, ISO 10012-1, the ISO 9000 family and QS 9000. The expanded uncertainties of measurements for this calibration are based upon 95% (2 sigma) confidence limits. Unless otherwise stated, a test accuracy ratio (TAR) of 4:1, if achievable, is maintained. The results reported herein apply only to the calibration of the item described above. This report may not be reproduced, except in full, without prior written consent of JJ Calibrations, Inc.
JJ Calibrations, Inc. quality system has been assessed and accredited to ISO/IEC 17025:2005.

Reviewer

3 Issued 10/31/2018 Rev # 15

Inspector

Calibration Service Record			
Date	**By**	**Results**	**Date of next Calibration**
7/12/2018	B. Davis	Installed a new Vane as per manufacturer's instructions.	1/12/2019

VWR Temperature Hygrometer Calibration Procedure and Data Sheet

Frequency: Every Two Years

Step 1: Locate NIST traceable standard.

Step 2: Place unit to be calibrated, tracking No. OMNI- 00592 , inside OMNI desiccate box on the same shelf with the NIST traceable standard.

Step 3: After a period of not less than four hours record the temperature and humidity of both units in the spaces provide below.

Step 4: If the unit to be calibrated matches the NIST standard within ± 4%, it is acceptable. If not, the unit needs to be sent to a repair company or replaced.

Verification Data:

Date: 1/8/2018 Technician: B Davis

Time in desiccate: 0910 Recording time: 1335

NIST Standard Temperature: 28.3 °F NIST Standard Humidity: 74.5

Test Unit Temperature Reading: 25.4 °F Test Unit Humidity Reading: 74.3

Test unit OMNI- 00592 is X or was not ___ within acceptable limits.

Technician Signature: [signature]

Comments: Full scale of OMNI-00592 is 90% RH, with a difference of 2.9 this gives a error percentage of 3.22 %. This value is within the allowable 4%.

ZRE NDIR/O_2



USER'S MANUAL

1312 West Grove Avenue
Orange, CA 92865-4134
Phone: 714-974-5560 Fax: 714-921-2531
www.gasanalyzers.com

Certificate of Calibration

Certificate Number: **681844**

JJ Calibrations, Inc.
7007 SE Lake Rd
Portland, OR 97267-2105
Phone 503.786.3005
FAX 503.786.2994

Omni-Test Laboratories
13327 NE Airport Way
Portland, OR 97230

OnSite

0723.01
Calibration

PO: **180176**
Order Date: **08/07/2018**
Authorized By: **N/A**

Property #: **OMNI-00637**
User: **N/A**
Department: **N/A**
Make: **Mettler Toledo**
Model: **MS104TS/00**
Serial #: **B729400181**
Description: **Analytical Scale, 120g**
Procedure: **DCN 500887**
Accuracy: **±0.0005g**

Calibrated on: **08/07/2018**
*Recommended Due: **02/07/2019**
Environment: **22** °C **38** % RH
* As Received: **Out of Tolerance**
* As Returned: **Within Tolerance**
Action Taken: **Adjusted**
Technician: **111**

Remarks: * Many factors may cause the unit to drift out of calibration before the recommended due date. Any reported error is the absolute value between the reference and the unit. Uncertainties include the effects of the unit.

Balance went into over range at max capacity. Adjusted balance to bring all points back into tolerance.

Standards Used

Std ID	Manufacturer	Model	Nomenclature	Due Date	Trace ID
256A	Rice Lake	W0133K	Mass Set,	05/30/2019	660578

Measurement Data

Parameter / Measurement Description	Range Unit	Reference	Min	Max	*Error	UUT	Uncertainty
Before							Accredited = ✓
Force							
	g	10.00000	9.9995	10.0005	0.0004	10.0004 g	5.7E-04 ✓
	g	30.00000	29.9995	30.0005	0.0004	30.0004 g	5.7E-04 ✓
	g	60.00000	59.9995	60.0005	0.0004	60.0004 g	5.7E-04 ✓
	g	90.00000	89.9995	90.0005	0.0005	90.0005 g	5.7E-04 ✓
	g	120.00000	119.9995	120.0005	120.0000	0.0000 g	5.7E-04 ✓
After		Reference	Min	Max	*Error		Accredited = ✓
	g	10.00000	9.9995	10.0005	0.0000	10.0000 g	5.7E-04 ✓
	g	30.00000	29.9995	30.0005	0.0001	29.9999 g	5.7E-04 ✓
	g	60.00000	59.9995	60.0005	0.0001	60.0001 g	5.7E-04 ✓
	g	90.00000	89.9995	90.0005	0.0002	89.9998 g	5.7E-04 ✓
	g	120.00000	119.9995	120.0005	0.0002	119.9998 g	5.7E-04 ✓

JJ Calibrations, Inc. certifies that this instrument has been calibrated in accordance with the JJ Calibrations Quality Assurance Manual with the stated procedure using standards that are traceable to the National Institute of Standards and Technology (NIST), or other National Measurement Institutes (NMI's), or by using natural physical constants, intrinsic standards or ratio calibration techniques. The quality system and this certificate are in compliance with ANSI/NCSL Z540-1-1994, ISO/IEC 17025-2005, ISO 10012-1, the ISO 9000 family and QS 9000. The expanded uncertainties of measurements for this calibration are based upon 95% (2 sigma) confidence limits. Unless otherwise stated, a test accuracy ratio (TAR) of 4:1, if achievable, is maintained. The results reported herein apply only to the calibration of the item described above. This report may not be reproduced, except in full, without prior written consent of JJ Calibrations, Inc.
JJ Calibrations, Inc. quality system has been assessed and accredited to ISO/IEC 17025:2005.

Reviewer

3 Issued 08/09/2018 Rev # 15

Inspector

Example Calculations

Equations and Sample Calculations

Manufacturer:	Kuma Stoves
Model:	K250 Series
Run:	2
Category:	1

Equations used to calculate the parameters listed below are described in this appendix. Sample calculations are provided for each equation. The raw data and printout results from a sample run are also provided for comparison to the sample calculations.

M_{Sdb} – Weight of test fuel spacers, dry basis, kg

M_{Cdb}– Weight of test fuel crib, excluding nails and spacers, dry basis, kg

D_{Cdb} - Density of fuel crib, excluding spacers and nails, dry basis, lbs/ft^3

M_{FTAdb} - Total weight of fuel crib excluding nails, dry basis, kg

BR – Dry burn rate, kg/hr

V_s – Average gas velocity in the dilution tunnel, ft/sec

Q_{sd} – Average gas flow rate in dilution tunnel, dscf/hr

$V_{m(std)}$ – Volume of gas sampled, corrected to dry standard conditions, dscf

m_n – Total particulate matter collected, mg

C_s - Concentration of particulate matter in tunnel gas, dry basis, corrected to standard conditions, g/dscf

E_T – Total particulate emissions, g

PR - Proportional rate variation

PM_R – Particulate emissions for test run, g/hr

PM_F – Particulate emission factor for test run, g/dry kg of fuel burned

BR – dry burn rate, kg/hr

$$BR = \frac{60\ M_{FTAdb}}{\theta}$$

Where,

θ = Total length of test run, min

Sample Calculation:

M_{Bdb} = 11.25 kg

θ = 820 min

$$BR = \frac{60 \times 11.3}{820}$$

BR = **0.82** kg/hr

V_s – Average gas velocity in the dilution tunnel, ft/sec
ASTM E2515 equations (9)

$$v_s = F_P \times k_p \times C_p \times (\sqrt{\Delta P})_{avg} \times \sqrt{\frac{T_{s(avg)}}{P_s \times M_s}}$$

Where:

F_p = Adjustment factor for center of tunnel pitot tube placement, $Fp = \frac{V_{strav}}{V_{scent}}$, ASTM E2515 Equation (1)

v_{scent} = Dilution tunnel velocity calculated after the multi-point pitot traverse at the center, ft/sec

v_{strav} = Dilution tunnel velocity calculated after the multi-point pitot traverse, ft/sec

k_p = Pitot tube constant, 85.49

C_p = Pitot tube coefficient: 0.99, unitless

ΔP* = Velocity pressure in the dilution tunnel, in H_2O

T_s = Absolute average gas temperature in the dilution tunnel, °R; (°R = °F + 460)

P_s = Absolute average gas static pressure in dilution tunnel, = $P_{bar} + P_g$, in Hg

P_{bar} = Barometric pressure at test site, in. Hg

P_g = Static pressure of tunnel, in. H_20; (in Hg = in H_20/13.6)

M_s = **The dilution tunnel wet molecular weight; M_s = 28.78 assuming a dry weight of 29 lb/lb-mole

Sample calculation:

$$Fp = \frac{18.78}{18.92} = 0.992$$

$$V_s = 0.992 \times 85.49 \times 0.99 \times 0.272 \times \left(\frac{84.0 + 460}{\left(28.21 + \frac{-0.11}{13.6}\right) \times 28.78} \right)^{1/2}$$

V_s = **18.70** ft/s

*The ASTM test standard mistakenly has the square root of the average delta p instead of the average of the square root of delta p. The current EPA Method 2 is also incorrect. This was verified by Mike Toney at EPA.

**The ASTM test standard mistakenly identifies Ms as the dry molecular weight. It should be the wet molecular weight as indicated in EPA Method 2.

Q_{sd} – Average gas flow rate in dilution tunnel, dscf/hr
ASTM E2515 equation (3)

$$Q_{sd} = 3600 \times (1 - B_{ws}) \times v_s \times A \times \frac{T_{std}}{T_{s(avg)}} \times \frac{P_s}{P_{std}}$$

Where:

3600	=	Conversion from seconds to hours (ASTM method uses 60 to convert in minutes)
B_{ws}	=	Water vapor in gas stream, proportion by volume; assume 2%
A	=	Cross sectional area of dilution tunnel, ft^2
T_{std}	=	Standard absolute temperature, 528 °R
P_s	=	Absolute average gas static pressure in dilution tunnel, = $P_{bar} + P_g$, in Hg
$T_{s(avg)}$	=	Absolute average gas temperature in the dilution tunnel, °R; (°R = °F + 460)
P_{std}	=	Standard absolute pressure, 29.92 in Hg

Sample calculation:

$$Q_{sd} = 3600 \times (1 - 0.02) \times 18.70 \times 0.196 \times \frac{528}{84.0 + 460} \times \frac{28.2 + \frac{-0.11}{13.6}}{29.92}$$

Q_{sd} = **11851.7** dscf/hr

$V_{m(std)}$ – Volume of Gas Sampled Corrected to Dry Standard Conditions, dscf
ASTM E2515 equation (6)

$$V_{m(std)} = K_1 \, V_m \, Y \frac{P_{bar} + \left(\frac{\Delta H}{13.6}\right)}{T_m}$$

Where:

K_1	=	17.64 °R/in. Hg
V_m	=	Volume of gas sample measured at the dry gas meter, dcf
Y	=	Dry gas meter calibration factor, dimensionless
P_{bar}	=	Barometric pressure at the testing site, in. Hg
ΔH	=	Average pressure differential across the orifice meter, in. H_2O
T_m	=	Absolute average dry gas meter temperature, °R

Sample Calculation:

Using equation for Train 1:

$$V_{m(std)} = 17.64 \times 115.448 \times 0.997 \times \frac{\left(28.21 + \frac{1.59}{13.6}\right)}{(77.8 + 460)}$$

$V_{m(std)}$ = **106.922** dscf

Using equation for Train 2:

$$V_{m(std)} = 17.64 \times 124.306 \times 0.981 \times \frac{\left(28.21 + \frac{1.29}{13.6}\right)}{(77.0 + 460)}$$

$V_{m(std)}$ = **113.357** dscf

Using equation for ambient train:

$$V_{m(std)} = 17.64 \times 117.35 \times 0.998 \times \frac{\left(\underline{28.21} + \frac{0.00}{13.6}\right)}{(72.1 + 460)}$$

$V_{m(std)}$ = **109.515** dscf

m_n – Total Particulate Matter Collected, mg
ASTM E2515 Equation (12)

$$m_n = m_p + m_f + m_g$$

Where:

m_p = mass of particulate matter from probe, mg

m_f = mass of particulate matter from filters, mg

m_g = mass of particulate matter from filter seals, mg

Sample Calculation:

Using equation for Train 1 (first hour):

m_n = 0.0 + 1.3 + 0.0

m_n = 1.3 mg

Using equation for Train 1 (post-first hour):

m_n = 0.4 + 1.8 + 0.1

m_n = 2.3 mg

Train 1 aggregate:

m_n = 1.3 + 2.3

m_n = **3.6** mg

Using equation for Train 2:

m_n = 0.7 + 3.4 + 0.2

m_n = **4.3** mg

C_s - Concentration of particulate matter in tunnel gas, corrected to standard conditions, g/dscf
ASTM E2515 equation (13)

$$C_s = K_2 \times \frac{m_n}{V_{m(std)}}$$

Where:

K_2	=	Constant, 0.001 g/mg
m_n	=	Total mass of particulate matter collected in the sampling train, mg
$V_{m(std)}$	=	Volume of gas sampled corrected to dry standard conditions, dscf

Sample calculation:

For Train 1:

$$C_s = 0.001 \times \frac{3.6}{106.92}$$

C_s = **0.00003** g/dscf

For Train 2

$$C_s = 0.001 \times \frac{4.3}{113.36}$$

C_s = **0.00004** g/dscf

For Ambient Train

$$C_r = 0.001 \times \frac{0.2}{109.52}$$

C_r = **0.000002** g/dscf

E_T – Total Particulate Emissions, g
ASTM E2515 equation (15)

$$E_T = (C_s - C_r) \times Q_{std} \times \theta$$

Where:

C_s	=	Concentration of particulate matter in tunnel gas, g/dscf
C_r	=	Concentration particulate matter room air, g/dscf
Q_{std}	=	Average dilution tunnel gas flow rate, dscf/hr
θ	=	Total time of test run, minutes

Sample calculation:

For Train 1

E_T = (0.000034 - 0.000002) x 11851.7 x 820 /60

E_T = 5.16 g

For Train 2

E_T = (0.000038 - 0.000002) x 11851.7 x 820 /60

E_T = 5.85 g

Average

E = 5.50 g

Total emission values shall not differ by more than 7.5% from the total average emissions

7.5% of the average =	0.41
Train 1 difference =	0.35
Train 2 difference =	0.35

PR - Proportional Rate Variation
ASTM E2515 equation (16)

$$PR = \left[\frac{\theta \times V_{mi} \times V_s \times T_m \times T_{si}}{\theta_i \times V_m \times V_{si} \times T_{mi} \times T_s} \right] \times 100$$

Where:

θ = Total sampling time, min

θ_i = Length of recording interval, min

V_{mi} = Volume of gas sample measured by the dry gas meter during the “ith” time interval, dcf

V_m = Volume of gas sample as measured by dry gas meter, dcf

V_{si} = Average gas velocity in the dilution tunnel during the "ith" time interval, ft/sec

V_s = Average gas velocity in the dilution tunnel, ft/sec

T_{mi} = Absolute average dry gas meter temperature during the "ith" time interval, ^oR

T_m = Absolute average dry gas meter temperature, ^oR

T_{si} = Absolute average gas temperature in the dilution tunnel during the "ith" time interval, ^oR

T_s = Absolute average gas temperature in the dilution tunnel, ^oR

Sample calculation (for the first 1 minute interval of Train 1):

$$PR = \left(\frac{820 \times 1.384 \times 18.70 \times (104.0 + 460) \times (77.8 + 460)}{10 \times 115.4 \times 19.05 \times (84.0 + 460) \times (75.0 + 460)} \right) \times 100$$

PR = 101 %

PM_R – Particulate emissions for test run, g/hr

$$PM_R = 60 (E_T/\theta)$$

Where,

E_T = Total particulate emissions, grams

θ = Total length of full integrated test run, min

Sample Calculation:

E_T (Dual train average) = 5.50 g

θ = 820 min

$PM_R = 60 \times (5.50 / 820)$

PM_R = **0.40** g/hr

PM_F – Particulate emission factor for test run, g/dry kg of fuel burned

$$PM_F = E_T/M_{FTAdb}$$

Sample Calculation:

E_T (Dual train average) = 5.50 g

M_{Bdb} = 11.25 kg

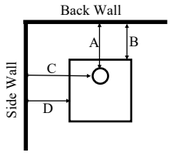
PM_F = 5.50 / 11.25

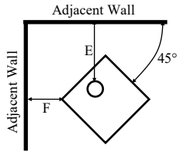
PM_F = **0.49** g/kg

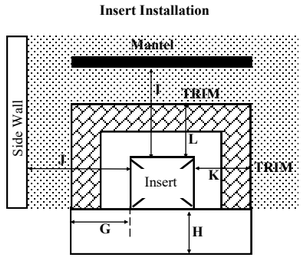
Section 5

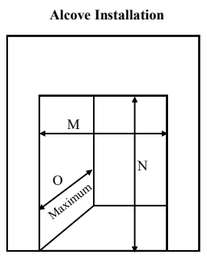
Labeling & Owner's Manual

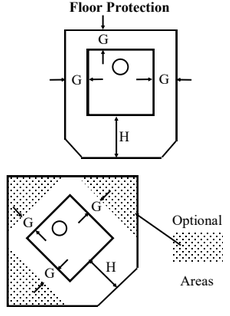
Installation	Clearance	Connector	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Residential	Standard	Single Wall															
Residential or Mobile home	Reduced	Double Wall															
Insert	Standard	UL 1777 Liner															
Alcove	Reduced	Double Wall															MAX.











INSTALL AND USE ONLY IN ACCORDANCE WITH KUMA STOVES' INSTALLATION AND OPERATION INSTRUCTIONS. CONTACT LOCAL BUILDING OR FIRE OFFICIALS ABOUT RESTRICTIONS AND INSTALLATION INSPECTION IN YOUR AREA. REFER TO INSTALLATION INSTRUCTIONS FOR PRECAUTIONS REQUIRED FOR PASSING A CHIMNEY THROUGH A COMBUSTIBLE WALL OR CEILING.

ROOM HEATER, SOLID FUEL TYPE, ALSO FOR USE IN MOBILE HOMES. FOR USE WITH SOLID FUEL ONLY. USE ONLY SEASONED CORDWOOD. DO NOT CONNECT THIS UNIT TO A FLUE SERVICING ANOTHER APPLIANCE. DO NOT USE GRATE OR ELEVATE FIRE - BUILD WOOD FIRE DIRECTLY ON FIREBRICK. REPLACE GLASS ONLY WITH 5mm CERAMIC. ATTACH LEGS OR PEDESTAL USING INSTALLTION INSTRUCTIONS. BLOWER ELECTRICAL RATING: 115 VOLT, 18 WATT, 60 HERTZ. DO NOT ROUTE POWER CORD BENEATH HEATER.

USE ONLY LISTED CHIMNEY SYSTEMS THAT ARE 6" DIAMETER U.L. 103 TYPE HT, ALL FUEL, OR SOLID FUEL. MASONRY CHIMNEY SHOULD BE LISTED TO UL 1777. ONLY INSTALL INSERT INTO MASONRY OR UL127 FACTORY BUILT FIREPLACE. INSERT INSTALLATION MUST USE LISTED STAINLESS STEEL LINER. USE ONLY 24 MSG BLACK OR 25 MSG BLUED STEEL SINGLE WALL CONNECTOR FOR STANDARD CLEARANCE. USE ONLY LISTED DOUBLE WALL CONNECTOR FOR REDUCED CLEARANCE AND MOBILE HOMES. SEE DIAGRAMS FOR STANDARD AND REDUCED CLEARANCE DIMENSIONS. USE ONLY U.L. 1618 TYPE 1 (EMBER PROTECTION) OR TYPE 2 (R-VALUE 1.0) HEARTH PAD OR EQUIVALENT. SEE DIAGRAM FOR HEARTH DIMENSIONS.

This wood heater needs periodic inspection and repair for proper operation. Consult the owner's manual for further information. It is against federal regulations to operate this wood heater in a manner inconsistent with the operating instruction in the owner's manual

OMNI-Test Laboratories Inc.
Portland OR, USA

MANUFACTURED BY:
KUMA STOVES INC
50145 N OLD HWY 95
RATHDRUM ID 83858

MODEL NAME: K-250

Serial Number

Emissions Test Report #: 0123WM012E Safety Test Report # 0123WS012S



CAUTION: HOT WHILE IN OPERATION - DO NOT TOUCH - KEEP CHILDREN AND CLOTHING AWAY - CONTACT MAY CAUSE SKIN BURNS. SEE NAMEPLATE AND INSTRUCTIONS. KEEP FURNISHINGS AND OTHER COMBUSTIBLE MATERIALS A CONSIDERABLE DISTANCE FROM THE APPLIANCE. DO NOT OVERFIRE - IF HEATER OR CHIMNEY CONNECTOR GLOWS, YOU ARE OVERFIRING. INSPECT AND CLEAN CHIMNEY FREQUENTLY - UNDER CERTAIN CONDITIONS OF USE, CREOSOTE BUILDUP MAY OCCUR RAPIDLY. DO NOT PASS CONNECTOR PIPE THROUGH COMBUSTIBLE WALLS OR CEILINGS. DO NOT OBSTRUCT BENEATH THE HEATER.

☐ JAN ☐ FEB ☐ MAR ☐ APR ☐ MAY ☐ JUN ☐ JUL ☐ AUG ☐ SEP ☐ OCT ☐ NOV ☐ DEC ☐ 2019 ☐ 2020 ☐ 2021 ☐ 2022

U.S. ENVIRONMENTAL PROTECTION AGENCY: Certified to comply with 2020 particulate emission standards using cord wood. 1.13 Grams per hour. Tested to ASTM 3053-2017.

Model # K-250:

Wood Classic LE, Ashwood LE, Cascade LE, Cambridge LE

Tested and listed by OMNI-Test Laboratories Inc.
Portland OR, USA

Emissions tested to: ASTM 3053-2017
Report# 0123WM012E

Safety tested to UL 1482
Report # 0123WS012S

INSTALLATION AND OPERATING INSTRUCTIONS

SAVE THESE INSTRUCTIONS

This manual describes the installation and operation of the Kuma Model K-250 Catalytic equipped wood heater. This heater meets the 2020 U.S. Environmental Protection Agency's cord wood emission limits for wood heaters sold after May 15, 2020. Under specific test conditions (ASTM 3053-2017) this heater has been shown to deliver heat at rates ranging from 11,196 to 30,308 Btu/hr. and an efficiency of 79.4% (High Heating Value). Please visit https://www.kumastoves.com/content/page/EPA for a detailed explanation of stove efficiencies. Particulate emissions are 1.13 grams per hour and average CO emissions are 0.1813 grams per minute.

Please read the safety precautions and the entire installation and operation instructions carefully. Failure to properly install and maintain your wood stove can result in an unsafe condition.

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SECTION 2 - SPECIFCATIONS

SECTION 3 - INSTALLATION INSTRUCTIONS

SECTION 4 - OPERATING INSTRUCTIONS

SECTION 5 - CATALYST INFORMATION

SECTION 6 - MAINTENANCE

SECTION 7 - TROUBLESHOOTING

SECTION 8 - WARRANTY

SECTION 1 - SAFETY PRECAUTIONS

WARNING

- If this stove is not properly installed, a house fire can occur. For your protection, follow the installation instructions provided. We recommend contacting local building or fire officials regarding restrictions and installation inspection requirements in your area. **We also recommend that your Kuma stove be installed by a properly trained and licensed installer, preferably an NFI (National Fireplace Institute) expert.**
- **DO NOT CONNECT THIS UNIT TO A CHIMNEY FLUE SERVICING ANOTHER APPLIANCE.**
- **Do not burn garbage or flammable fluids such as gasoline, naptha or engine oil**. Do not use charcoal lighter fluid or similar liquids to start or "freshen up" a fire in this heater. Keep all such fluids well away from the heater while in use. Storing these fluids near a stove could cause a fire.
- **DO NOT CONNECT TO ANY AIR DISTRIBUTION OR DUCT SYSTEM.**
- **DO NOT OVERFIRE.** If any part of the stove or chimney glows, the stove is in an over fire condition. If this happens, shut the air control off immediately. Over firing can cause damage.
- **WARNING: DO NOT INSTALL IN A SLEEPING ROOM.**
- **An improperly drafting stove can cause smoke and carbon monoxide to enter the home. Smoke detectors and carbon monoxide monitors are recommended to be installed in the same room as this heater.**
- **CAUTION: THE STRUCTURAL INTEGRITY OF THE FLOOR, WALLS, ROOF/CEILING, AND VAPOR BARRIERS MUST BE MAINTAINED.**
- **DO NOT USE SINGLE WALL PIPE OR CONNECTOR PIPE FOR ANY CHIMNEY APPLICATION, EXTERIOR OR THROUGH THE WALL OR CEILING.** Single wall pipe may only be used as a connection between the stove and an approved masonry or stainless steel chimney. **Single wall pipe may not be used as a connector in mobile homes.**
- When installing into an existing masonry or metal chimney, examine the chimney system carefully. If you have any questions, seek professional advice. We recommend having existing chimneys cleaned and inspected by a qualified professional prior to the installation of your new stove.
- **NOTE ALL MINIMUM CLEARANCE REQUIREMENTS TO COMBUSTIBLES.** Installation must comply with minimum clearances as listed in this manual. (see section 2) **Clearances may only be reduced by means approved by the regulatory authority.**
- Do not operate this stove with the door in an open position, except for cracking open during start-up. Continued operation with the door open can cause overheating of the unit, and expose embers to nearby combustibles.
- **Do not operate with broken glass. Do not abuse glass such as striking or slamming the door.**
- This stove must be connected to a minimum 6" diameter listed chimney that complies with U.L. type 103HT factory built chimney or a code approved masonry chimney. If the masonry chimney does not meet code, a U.L. 1777 approved liner must be installed.
- When connecting single wall or double wall connector pipe to the stove and chimney, use 3 screws per pipe joint including 3 screws securing the pipe to the stove. Depending on the type of double wall pipe you are using, it may also be necessary to fasten it at the chimney. Simpson Duravent's DVL double wall uses a snap lock connector and does not need screws.
- Use only approved components for Chimney and Connector. Field fabricated or "makeshift" components are not allowed and can cause a fire.
- **DO NOT USE THIS STOVE WITHOUT THE BAFFLE BOARDS AND CERAMIC INSULATION PACKAGED WITH YOUR STOVE.**
- When connecting this stove to a masonry chimney, make sure you observe all applicable clearances including walls, ceilings and other combustible material. A masonry chimney must be minimum 6" diameter and constructed with a liner according to NFPA code 211. If you have any questions about the condition or the code compliance of your masonry chimney, please speak with a qualified professional.
- HOT WHILE IN OPERATION. KEEP CHILDREN, CLOTHING AND FURNITURE AWAY. CONTACT MAY CAUSE SKIN BURNS.

SECTION 2 - SPECIFICATIONS

Listing Tag:

Installation	Clearance	Connector	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Residential	Standard	Single Wall															
Residential or Mobile home	Reduced	Double Wall															
Insert	Standard	UL 1777 Liner															
Alcove	Reduced	Double Wall															

Adjacent Wall
Side Wall
Back Wall
Adjacent Wall
Side Wall
Insert Installation
Mantel
TRIM
Insert
TRIM
Alcove Installation
Mantel
Floor Protection
Optional Areas

INSTALL AND USE ONLY IN ACCORDANCE WITH KUMA STOVES' INSTALLATION AND OPERATION INSTRUCTIONS. CONTACT LOCAL BUILDING OR FIRE OFFICIALS ABOUT RESTRICTIONS, INSTALLATION, INSPECTION AND PERMIT REQUIREMENTS IN YOUR AREA. REFER TO INSTALLATION INSTRUCTIONS FOR PRECAUTIONS REQUIRED FOR PASSING A CHIMNEY THROUGH A COMBUSTIBLE WALL OR CEILING.

ROOM HEATER, SOLID FUEL TYPE. ALSO FOR USE IN MOBILE HOMES. FOR USE WITH SOLID FUEL ONLY. USE ONLY SEASONED CORDWOOD. DO NOT CONNECT THIS UNIT TO A FLUE SERVICING ANOTHER APPLIANCE. DO NOT USE CHARCOAL. KEEP DOOR CLOSED DURING NORMAL OPERATION. DIRECTLY ON FIREBRICK, REFRACTORY, GLASS ONLY WITH CERAMIC. ATTACH LEGS OR PEDESTAL USING INSTALLATION INSTRUCTIONS. BLOWER ELECTRICAL RATING: 115 VOLT, 18 WATT, 60 HERTZ. DO NOT ROUTE POWER CORD BENEATH HEATER.

USE ONLY LISTED CHIMNEY SYSTEMS THAT ARE 6" DIAMETER UL 103 TYPE HT, ALL FUEL, OR SOLID FUEL, MASONRY CHIMNEY SYSTEMS. ONLY INSTALL FACTORY BUILT FIREPLACE INSERT INSTALLATION OR UL 1777 FACTORY BUILT FIREPLACE INSERT INSTALLATION MUST USE LISTED STAINLESS STEEL LINER. USE ONLY 24 MSG BLACK OR 25 MSG BLUED STEEL SINGLE WALL CONNECTOR FOR STANDARD CLEARANCE. USE ONLY DOUBLE WALL CONNECTOR FOR REDUCED CLEARANCE AND MOBILE HOMES. SEE DIAGRAMS FOR STANDARD AND REDUCED CLEARANCE DIMENSIONS. USE ONLY U.L. 1618 TYPE 1 (EMBER PROTECTION) OR TYPE 2 (R-VALUE 10) HEARTH PAD OR EQUIVALENT. SEE DIAGRAM FOR HEARTH DIMENSIONS.

This wood heater needs periodic inspection and repair for proper operation. Consult the owner's manual for further information. It is against federal regulations to operate this wood heater in a manner inconsistent with the operating instructions in the owner's manual.

OMNI-Test Laboratories Inc.
Portland OR.
USA

MANUFACTURED BY:
KUMA STOVES
5054N OLD HWY 95
RATHDRUM ID 83858

Emissions Test Report #: 0123WM012E Safety Test Report #: 0123WS012S

MODEL NAME:
K-250

Serial Number

CAUTION: HOT WHILE IN OPERATION - DO NOT TOUCH - KEEP CHILDREN AND CLOTHING AWAY - CONTACT MAY CAUSE SKIN BURNS. SEE NAMEPLATE AND INSTRUCTIONS. KEEP FURNISHINGS AND OTHER COMBUSTIBLE MATERIALS A CONSIDERABLE DISTANCE FROM THE APPLIANCE. DO NOT OVERFIRE - IF HEATER OR CHIMNEY CONNECTOR GLOWS, YOU ARE OVERFIRING. INSPECT AND CLEAN CHIMNEY FREQUENTLY - UNDER CERTAIN CONDITIONS OF USE, CREOSOTE BUILDUP MAY OCCUR RAPIDLY. DO NOT PASS CONNECTOR PIPE THROUGH COMBUSTIBLE WALLS OR CEILINGS. DO NOT OBSTRUCT BENEATH THE HEATER.

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	2019	2020	2021	2022
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

U.S. ENVIRONMENTAL PROTECTION AGENCY: Certified to comply with 2020 particulate emission standards using cord wood. 1.13 Grams per hour. Tested to ASTM 3053-2017.

Dimensional Drawing TBD

SECTION 3 — INSTALLATION INSTRUCTIONS

WARNING
• Install and use this stove in accordance with the manufacturer's installation and operating instructions. It is highly recommended that this stove is installed by a qualified professional certified by the National Fireplace Institute. • The structural integrity of the floor, walls and ceiling/roof must be maintained. Use additional bracing if required. Never cut a load bearing wall or engineered truss. • NEVER INSTALL A STOVE IN A SLEEPING ROOM • This stove is heavy: Get help from another person and use proper lifting techniques

STOVE ASSEMBLY

Uncrate the stove. Each piece of the stove will be included in a separate box. Follow the instructions located in each box to install the components of the stove. Assemble the stove in the following order:

1. Lay the stove on to its back
2. Install the Ash Pan Kit (optional)
3. Install the Legs or Pedestal Kit
4. Carefully set the stove upright
5. Install the door
6. Install the blower (optional)

FLOOR PROTECTION REQUIREMENTS

TBD

MINIMUM CLEARANCE REQUIREMENTS

TBD

CHIMNEY AND CONNECTOR PIPE REQUIREMENTS

A properly installed and maintained venting system is critical to the safe operation of your wood stove. This stove may be connected to a factory built **all fuel chimney system** that has been safety tested to the UL-103HT standard or to a lined **masonry chimney** that meets the standards of NFPA 211. The **connector pipe** is the portion of the venting system that connects the stove to the chimney system. Chimney connector must be 24ga. single wall black stove pipe or a listed double wall connector pipe. Listed double wall connector pipe is required for mobile home installation.

When choosing the location for your stove, decide on a central location in the main living area of the home. Uninhabited areas of the home such as an uninsulated basement or a garage would be an inefficient location for the heater. Also consider not placing the chimney too close to your neighbors or in a valley that would cause a nuisance or unhealthy outdoor air quality. For proper draft, the chimney must exit the roof a minimum of 3 feet and at least 2 feet above any portion of the roof that is within 10 feet of the chimney.

Minimum Flue Height Recommendations	
No offsets in the chimney	14 ft
30° or 45° offsets in the chimney	15 ft
90° offsets in the chimney	16 ft.
90° offsets with 2-3 feet of horizontal run	20 ft.
90° offsets into exterior chimney	22 ft.

WHEN CONNECTING TO AN ALL FUEL CHIMNEY SYSTEM

WARNING

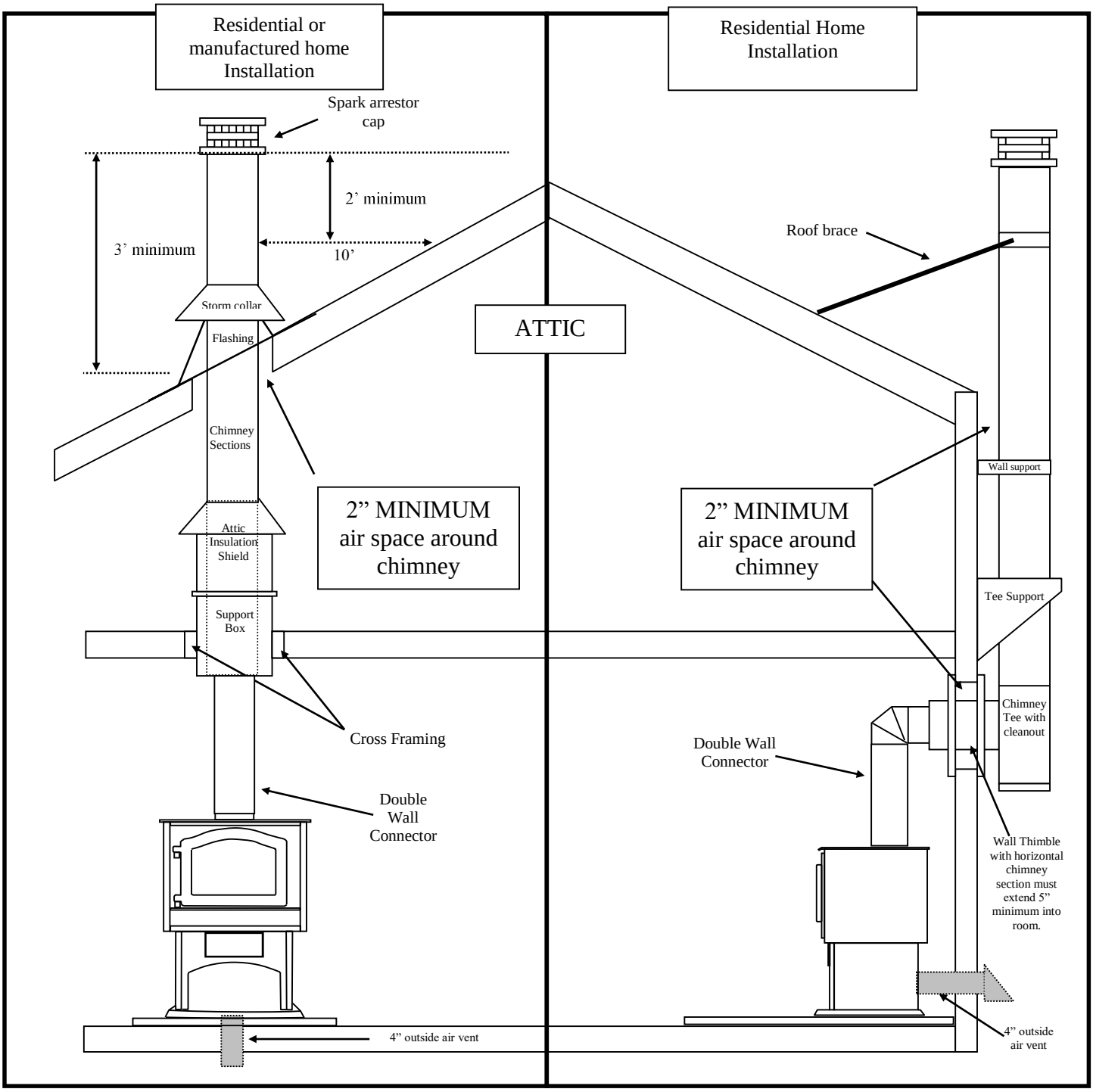
- For complete installation instructions, carefully follow the installation manual that came with your all fuel chimney system.
- Your chimney must meet the UL-103HT standard. Do not mix different brands of chimney parts.
- Do not use connector pipe to pass through an attic, closet, wall, floor or ceiling.
- Use only pre-fabricated listed chimney and connector pipe. Field fabricated or "makeshift" parts could result in a chimney or house fire.
- Inspect all chimney parts for damage. Do not use any damaged chimney parts

An all fuel chimney system consists of prefabricated metal chimney parts that have been designed and tested for use with modern wood stoves. Examples include:

- **DuraTech manufactured by DuraVent**
- **Excel manufactured by ICC Chimney**
- **Ultra Temp manufactured by Selkirk**
- **Temp/Guard manufactured by Metal-Fab**

When choosing a location for your chimney you will need to study the clearance requirements for both the stove and the chimney. Many chimney systems require a 2" air space around the pipe. Refer to the clearance diagrams in section 2 for minimum clearances around this stove. You will need to install supports, braces, shielding and firestops according to the chimney manufacturer's recommendations. When passing the chimney through an attic space an insulation shield must be used to ensure that no insulation can contact the chimney. For safety, the chimney must penetrate the roof a minimum of 3 feet AND must be at least 2 feet higher than any part of the roof that is within 10 feet of the chimney. For proper draft, the venting system (chimney + connector pipe) should be at least 14 feet from the stove top to the venting cap. If you live in a snowy region and you have a metal roof, consider adding snow breaks or diverters to your roof to prevent damage from sliding snow and ice.

Typical installation of an all fuel chimney system



ADDITIONAL REQUIREMENTS FOR MANUFACTURED (MOBILE) HOMES

WARNING

- The structual integrity of the mobile home floor, wall and ceiling/roof must be maintained.
- Do not install in a sleeping room of a mobile home.

- An outside air kit (KA OA 1) is required for all mobile home installations. Follow the instructions located in the box.
- Double wall connector pipe is required for all mobile homes.
- Using 8 gauge ground wire and appropriate connectors, you must drill through the hearth and connect the stove to the metal frame underneath the mobile home.
- When required by local code, you will need to fasten the stove to the floor of the mobile home.

WHEN CONNECTING TO A MASONRY CHIMNEY

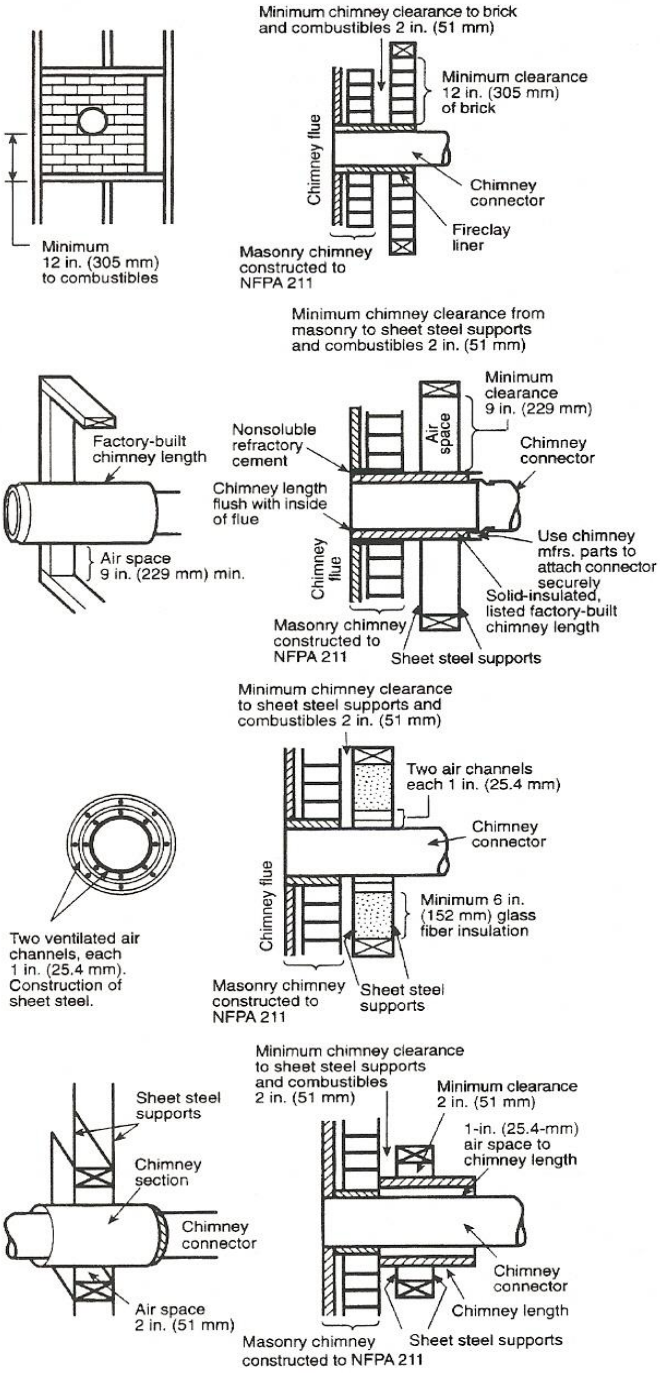
WARNING

- WHEN PENETRATING A COMBUSTIBLE WALL TO CONNECT TO AN OUTSIDE MASONRY CHIMNEY YOU MUST BE CERTAIN THAT THE WALL PASS THROUGH IS A SAFE AND LISTED METHOD.
- The connection between your chimney and this stove must be constructed according to the NFPA 211 standard. See Figure 6-7.5 from the **NFPA 211-2016, *Standard for Chimneys*** below

Your masonry chimney must be built according to the NFPA 211 standard. Visit nfpa.org for free access to the standard. Have a certified chimney sweep clean and inspect your chimney to make sure that there are no cracks, damaged mortar joints, or blockages. Your chimney must have a 5/8" thick fireclay liner. If your chimney does not have a 5/8" thick fireclay liner or it is damaged, you must install an insulated chimney liner that will meet the UL 1777 standard for chimney liners. Kuma recommends that an insulated chimney liner always be installed into a masonry chimney for improved performance and ease of cleaning.

FIGURE 6-7.5 Chimney connector systems and clearances from combustible walls for residential heating appliances.

System		Clearance (in.)/(mm)
A	Minimum 3.5 in. (90 mm) thick brick masonry wall framed into combustible wall with a minimum of 12-in. (305-mm) brick separation from clay liner to combustibles. Fireclay liner (ASTM C 315, *Standard Specification for Clay Fire Linings*, or equivalent), minimum ⅝-in. (16-mm) wall thickness, shall run from outer surface of brick wall to, but not beyond, the inner surface of chimney flue liner and shall be firmly cemented in place.	12/305
B	Solid-insulated, listed factory-built chimney length of the same inside diameter as the chimney connector and having 1 in. (25.4 mm) or more of insulation with a minimum 9-in. (229-mm) air space between the outer wall of the chimney length and combustibles. The inner end of the chimney length shall be flush with the inside of the masonry chimney flue and shall be sealed to the flue and to the brick masonry penetration with non-water-soluble refractory cement. Supports shall be securely fastened to wall surfaces on all sides. Fasteners between supports and the chimney length shall not penetrate the chimney liner.	9/229
C	Sheet steel chimney connector, minimum 24 gauge [0.024 in. (0.61 mm)] in thickness, with a ventilated thimble, minimum 24 gauge [0.024 in. (0.61 mm)] in thickness, having two 1-in. (25.4-mm) air channels, separated from combustibles by a minimum of 6 in. (152 mm) of glass fiber insulation. Opening shall be covered, and thimble supported with a sheet steel support, minimum 24 gauge [0.024 in. (0.61 mm)] in thickness. Supports shall be securely fastened to wall surfaces on all sides and shall be sized to fit and hold chimney section. Fasteners used to secure chimney section shall not penetrate chimney flue liner.	6/152
D	Solid-insulated, listed factory-built chimney length with an inside diameter 2 in. (51 mm) larger than the chimney connector and having 1 in. (25 mm) or more of insulation, serving as a pass-through for a single wall sheet steel chimney connector of minimum 24 gauge [0.024 in. (0.61 mm)] thickness, with a minimum 2-in. (51-mm) air space between the outer wall of chimney section and combustibles. Minimum length of chimney section shall be 12 in. (305 mm). Chimney section concentric with and spaced 1 in. (25.4 mm) away from connector by means of sheet steel support plates on both ends of chimney section. Opening shall be covered, and chimney section supported on both sides with sheet steel supports of minimum 24 gauge [0.024 in. (0.61 mm)] thickness. Supports shall be securely fastened to wall surfaces on all sides and shall be sized to fit and hold chimney section. Fasteners used to secure chimney section shall not penetrate chimney flue liner.	2/51



Additional requirements:

1. Insulation material used as part of wall pass-through system shall be of noncombustible material and shall have a thermal conductivity of 1.0 Btu-in./hr-ft^2-°F (4.88 kg-cal/hr-m^2-°C) or less.
2. All clearances and thicknesses are minimums; larger clearances and thicknesses shall be permitted.
3. Any material used to close up an opening for the connector shall be of noncombustible material.
4. A connector to a masonry chimney, except for System B, shall extend in one continuous piece through the wall pass-through system and the chimney wall to the inner face of the flue liner, but not beyond.

Reprinted with permission from NFPA 211-2016, *Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances*, Copyright © 2015, National Fire Protection Association, Quincy, MA. This reprinted material is not the complete and official position of the NFPA on the referenced subject, which is represented only by the standard in its entirety which may be obtained through the NFPA website at www.nfpa.org.

WHEN CONNECTING TO A MASONRY FIREPLACE

WARNING
This stove must be connected to a code approved (e.g. NFPA 211) masonry chimney with a 6" flue liner. If the masonry chimney does not meet code, a U.L. 1777 approved liner must be installed.

This section to be completed after the safety testing certification is complete.

SECTION 4 - OPERATING INSTRUCTIONS

WARNING

- NEVER USE FLAMMABLE LIQUIDS TO START OR FRESHEN UP A FIRE
- Do not leave the stove unattended with the door open.
- DO NOT OVERFIRE THIS HEATER – Attempts to achieve heat output rates that exceed heater design specifications can result in permanent damage to the heater and to the catalytic combustor.

SELECTING WOOD

The leading cause for creosote build-up in the stove or chimney is moisture in the wood. Wood should be protected from rain and seasoned for 1 full year prior to being used. Your wood must have a moisture content of 20% or less. You will need to use a moisture meter to determine the moisture content of the wood. The recommended wood length for this heater is 18". This heater is designed to burn natural wood only. Higher efficiencies and lower emissions generally result when burning air dried seasoned hardwoods, as compared to softwoods or to green or freshly cut hardwoods.

DO NOT BURN:

a. Garbage;
b. Lawn clippings or yard waste;
c. Materials containing rubber, including tires;
d. Materials containing plastic;
e. Waste petroleum products, paints or paint thinners, or asphalt products;
f. Materials containing asbestos;
g. Construction or demolition debris;
h. Railroad ties or pressure-treated wood;
i. Manure or animal remains;
j. Salt water driftwood or other previously salt water saturated materials;
k. Unseasoned wood; or
l. Paper products, cardboard, plywood, or particleboard.

Burning these materials may result in release of toxic fumes or render the heater ineffective and cause smoke. The prohibition against burning these materials does not prohibit the use of fire starters made from paper, cardboard, saw dust, wax and similar substances.

UNDERSTANDING DRAFT

Draft is the force which moves exhaust from the appliance up through the chimney. Factors that can affect the way you stove drafts are:

- **The length of your chimney** can create excessive or inadequate draft.
- **Wind** can create excessive or inadequate draft.
- **Creosote buildup** in your chimney can create inadequate draft.
- **Nearby obstructions** or geographical features can create inadequate draft.
- **A cold chimney** can create inadequate draft.
- **Air density and moisture** in the air can create inadequate draft.

Too much draft may cause excessive temperatures in the appliance and may damage the internal components of the stove. An uncontrollable burn or excessive temperature indicates excessive draft.

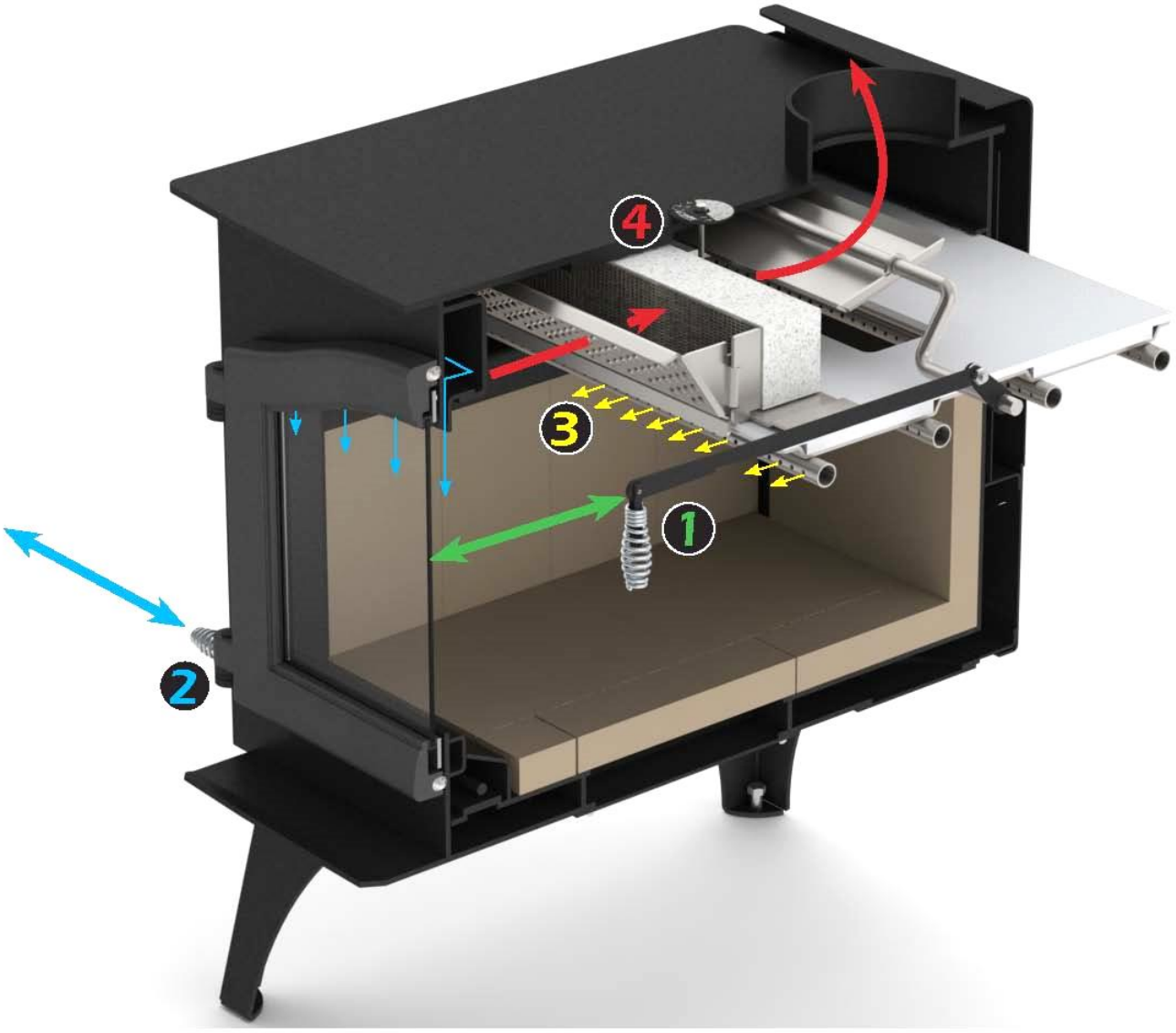
Inadequate draft may cause back puffing into the room and creosote formation in the chimney. Inadequate draft will cause the appliance to leak smoke and carbon monoxide into the room through appliance and chimney connector joints.

UNDERSTANDING HYBRID WOOD STOVE TECHNOLOGY

This stove's burn system combines the features of non-catalytic technology with the clean efficient burn of catalytic wood stove to create an easy to use, ultra-low emission hybrid appliance. Read about each feature below to help you operate your stove efficiently and beautifully

1 Bypass Control

2 Primary Air Control



3 Secondary Burn System

4 Catalytic & Catalytic Thermometer

1. **Bypass Control** – Located in the upper right side of the stove, the bypass control allows smoke and heat to temporarily bypass the hybrid burn system. This helps to quickly heat the chimney and prevent any smoke from coming into the room when the door is open. Pulling the lever towards you then down will open the bypass plate. Lifting up then pushing in will close the bypass plate.

    a. Only open the bypass when starting or re-fueling your stove. During normal operation, the bypass remains closed.

    b. Never open the wood loading door unless you have opened the bypass plate first. If you do this, smoke will spill into the room.

2. **Primary Air Control** – Located on the lower right side of the stove, this control changes the rate of burn for the stove. Slide out for high heat output and slide in for low heat output. You can operate the stove at any burn rate in between high and low.

    a. Always set the air control to high for 20 to 30 minutes when starting or refueling your stove. This allows the stove and chimney to quickly come up to operating temperature.

    b. When set to high, the primary air washes the glass as it feeds the fire to help keep it clean. If your glass has built up any smoke deposits from slow burning, set the air control to high for 20 to 30 minutes.

    c. Never over fire the stove by leaving the air control on high for too long (see Catalytic and Catalytic Thermometer below).

3. **Secondary Burn System** – There are no controls for this system. The stove will automatically draw air into the secondary burn tubes to re-burn smoke before it reaches the catalyst.

4. **Catalytic & Catalytic Thermometer** – The catalytic is a metal honeycomb shaped device that cleans up most of the remaining smoke before it travels up the chimney. The catalytic thermometer shows you the correct temperature to operate the stove at.

    a. Always operate the stove in the active range.

    b. There is a caution symbol on the probe warning you that your catalytic combustor is approaching the "too hot" zone

    c. Use the Primary Air Control to change the temperature of the stove.

    d. As your stove cools there is an "R" reminding you to reload your stove before the catalytic combustor becomes inactive.



LIGHTING A FIRE

1. Start by sliding the air control out to fully open.
2. Pull open the bypass control to the **Start/Reload Position** (A short pull forward **(about ¾")** and down will engage the bypass in the Start/Reload Position). Open the wood loading door.



3. Do not use a grate or elevate the fire – Build the wood fire directly on the fire brick. Start by loading larger pieces of wood into the firebox bottom then stack progressively smaller pieces so that the kindling pieces are at the top of the stack. You may use a fire starter such as shredded paper on top of the kindling. When starting a fire you should never use un-split pieces of wood unless they are small, such as twigs and branches.
4. Light the Fire, you can optionally leave the door slightly cracked open to aid in the start-up of your stove. Close the door once the fire is well lit. Do not leave the stove unattended with the door open.
5. After 15 minutes or Once the catalytic thermometer 1st reaches the active range, close the bypass control to the **Run Position** engaging the combustor (Simply lift the bypass control and you will feel it return to the run position).
6. Leave the air control open for 20-30 minutes so that the fire becomes well established. If you shut the stove down too soon, it may go out or the combustor may stop working.
7. Begin to regulate the heat output and burn rate by sliding in the primary air control. Use the following table to adjust your rate of burn.

Desired Burn Rate	Position of the air control	Approximate Burn Time
Low Burn	Fully Closed	10-12 hours
Medium Burn	3/32" Open*	6-8 hours
Start Up	Fully Open	2-3 hours

*This is a very small pull from the fully closed position. You will find that the most significant range in heat output and burn time happens in the 1st ½" of stroke on the primary air control.

ADDING MORE WOOD TO THE FIRE

1. Slide the air control to fully open and pull open the bypass to the **Start/Reload Position.** Wait 5 minutes to allow the coals to become active and to allow the smoke to draft up the chimney.
2. Slowly open the wood loading door and rake the coals breaking up any larger pieces. Add wood then shut the door.
3. As soon as the catalytic thermometer is in or near the active range, close the bypass control to the **Run Position** engaging the combustor.
4. Leave the air control open for 10-20 minutes so that the fire becomes well established then begin to adjust your rate of burn.

ADDITIONAL TIPS FOR BURNING EFFICIENTLY

Burning wood produces both visible emissions (e.g. particulate matter or smoke) as well as invisible

emissions (e.g. Carbon Monoxide). When operating your stove, periodically check for visible emissions coming from the chimney and adjust the burn rate and fuel load to reduce emissions. Remember to let your stove burn open for 20-30 minutes each time you reload it with wood. Shutting the air control prematurely can cause excessive creosote in the chimney. This wood heater has a manufacturer-set minimum low burn rate that must not be altered. It is against federal regulations to alter this setting or otherwise operate this wood heater in a manner inconsistent with operating instructions in this manual. Small hot fires produce less creosote than long, low smoldering fires. When you start your stove or reload your stove with more wood, open the draft fully and burn the stove at high burn for 10-30 minutes to heat up the chimney and secondary burn system. This ensures that when the draft control is pushed in for a lower, longer burn, the stove will burn cleaner.

SECTION 5 - CATALYST INFORMATION

TAMPER WARNING

This wood heater contains a catalytic combustor which needs periodic inspection and replacement for proper operation. It is against federal regulations to operate this wood stove in a manner inconsistent with the operating instructions in this manual, or if the catalytic element is deactivated or removed.

CATALYST TYPE

The combustor supplied with this wood stove is an Applied Catalysts ACI-5M combustor. Please refer to section 6 for catalyst maintenance. Refer to section 7 for catalyst troubleshooting. Refer to section 8 for catalyst warranty information.

CATALYST MONITORING

It is important to periodically monitor the operation of the catalytic combustor to ensure that it is functioning properly and to determine when it needs to be replaced. A non-functioning combustor will result in a loss of heating efficiency, and an increase in creosote and emissions. Following is a list of items that should be checked on a periodic basis:

1. Combustors should be visually inspected at least three times during the heating season to determine if physical degradation has occurred. Actual removal of the combustor is not recommended unless more detailed inspection is warranted because of decreased performance. If any of these conditions exists, refer to Catalyst Troubleshooting section of this owner's manual.
2. This hybrid heater is equipped with a temperature probe to monitor catalyst operation. Properly functioning combustors typically maintain temperatures in excess of 500°F, and often reach temperatures in excess of 1,000°F. If catalyst temperatures are not in excess of 500°F, refer to the Catalyst Troubleshooting section of this owner's manual.
3. You can get an indication of whether the catalyst is working by comparing the amount of smoke leaving the chimney when the smoke is going through the combustor and catalyst light-off has been achieved, to the amount of smoke leaving the chimney when the smoke is not routed through the combustor (bypass mode).
    - Step 1—Light stove in accordance with instructions in section 4.
    - Step 2—With smoke routed through the catalyst, go outside and observe the emissions leaving the chimney.
    - Step 3—Engage the bypass mechanism and again observe the emissions leaving the chimney.
    - Significantly more smoke will be seen when the exhaust is not routed through the combustor (bypass mode).

READING THE CATALYST PROBE

Follow the instructions in section 4 to build and maintain a fire. During normal operation the probe should read in the active range. If, during normal operation, the probe reads less than the active range, the stove should be refueled following the instruction in section 4. If the probe is climbing above the active range, you need to decrease the primary air control so that you do not over-fire the stove or catalyst.

SECTION 6 - MAINTENANCE

WARNING
This wood heater needs periodic inspection and repair for proper operation.

FIRE EXTINGUISHER

Every home should have a type A:B:C fire extinguisher that is checked and maintained on a regular basis. The National Fire Protection Agency (nfpa.org) recommends having an extinguisher on each floor of your home. The location of the extinguisher should be known to everyone in the house.

ASH DISPOSAL

Empty the ashes when they get 3" to 4" deep. Make sure that the fire is out - Never try to empty the ashes when the stove has an active or full fire, doing so will over heat the stove. Always wear gloves while handling hot ashes. The ashes may be removed by pulling out the ash drawer (if equipped) or scooping out the loading door of the stove. Leave 1" of ash in the bottom of the stove to help maintain a hot charcoal bed. Dump the ashes into a metal container with a tight-fitting lid and keep away from the house. **NEVER EMPTY ASHES INTO A COMBUSTIBLE CONTAINER SUCH AS A PLASTIC BUCKET OR PAPER BAG. NEVER LEAVE ASHES NEAR THE HOUSE OR GARAGE.** Before replacing the ash drawer, check to see if any ashes need to be removed from the ash pan plenum. If any ashes remain in the ash plenum it will prevent the ash pan from sliding all the way in and it may not seal, resulting in air entering the ash grate which will produce a runaway fire.

CHIMNEY INSPECTION AND CLEANING

Inspect the chimney regularly. Slow exhaust and a cool chimney can cause creosote to stick to the walls of the chimney. If creosote has accumulated the chimney must be cleaned immediately. We recommend having the chimney cleaned and inspected by a licensed, professional chimney sweep. Failure to remove creosote can result in a chimney fire which can damage both the chimney and the stove. If the chimney is damaged, it must be replaced.

GASKET INSPECTION AND REPLACEMENT

Inspect the gaskets around the door, glass and ash pan (if equipped) at least once a year. Check for areas that are frayed or missing. Press the gasket with your finger to see if the gasket is somewhat soft. Gaskets that are hard will not conform to the stove and may leak air. When the stove is cold, check to see if the glass moves up and down or left to right. If the glass moves, you may need to tighten the screws around the retaining ring or replace the gasket. Replacement gaskets and service are available through your local dealer or by visiting kumastoves.com.

GLASS CLEANING AND REPLACEMENT

Never clean the glass when it is hot. Your stove is equipped with an air wash system that will self-clean. Burn the stove on high for 20 to 30 minutes every time you add fuel to the fire. This will reduce the creosote on the glass. If needed, clean the glass with a soft cloth and stove glass cleaner. Do not use steel wool, sandpaper or abrasive cleaners. If you close the door on a piece of wood that is too long, you will break the glass. If the glass breaks in your stove, shut off the primary air control and let the fire burn out. Do not leave the stove unattended with a broken glass. To replace broken glass:

1. Carefully lift the door from the stove and place it on a clean soft work area.
2. Using a Phillips screw driver, remove the retaining ring screws and the retaining ring.
3. Carefully discard the broken glass. CAUTION: BROKEN GLASS WILL BE SHARP.
4. Clean the door and set the new piece of glass into the door so that the logo reads correctly from the front side of the door. Kuma replacement glass will have the gasket pre-installed.
5. Replace the retaining ring and screws. Be careful to tighten the screws evenly and tighten just enough to hold the glass firmly

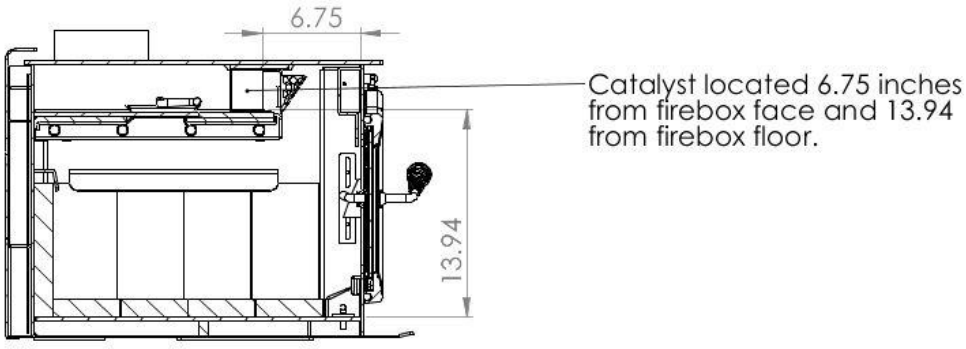
SECONDARY BURN TUBE REPLACEMENT

The burn tubes are one of two burn systems that causes your stove to operate efficiently, this stove also uses a catalyst to clean some of the remaining smoke before it leaves the stove. If your burn tubes are not physically degraded (falling apart, crushed or excessively warped) then they are functioning and will not need replacement. To remove a burn tube, un-bolt the tube using a 7/16" wrench. Pull the tube to the right then down and out of the stove. Replace the tube and re-install the bolt the holds the tube in place.

CATALYST INSPECTION, CLEANING AND REPLACEMENT

The catalyst is one of two burn systems that causes your stove to operate efficiently, this stove also uses secondary burn tubes to re-burn smoke before it reaches the catalyst. To inspect your catalyst, unhook the flame deflector from the face of the baffle by lifting up and pulling forward. If your catalyst has not physically degraded (falling apart, crushed or excessively warped) then it is likely functioning and will not need replacement. If your Catalytic combustor becomes plugged with ash, clean the catalyst **in place** using a soft brush or for deeper cleaning use a slight to moderate (~20-30 psi.) amount of air pressure blowing any ash through the cells of the catalyst. To replace the catalyst:

1. Unhook the flame deflector from the face of the baffle by lifting up and pulling forward. Set aside.
2. Pull the catalyst out using the 2 handles that the flame deflector was hooked to. You may need to wiggle the catalyst to loosen the gasket material.
3. Remove any gasket material that was left in the baffle cavity.
4. Your new catalyst will be wrapped in a gasket material that is held in place with masking tape. Do not remove the tape
5. Slide the new catalyst into the cavity until it stops. If you see any significant gaps around the sides or top of the catalyst you will need to slide the catalyst out and wrap those areas with additional gasket material (you can use masking tape to hold it in place). The gasket provided will expand 2-3 times it's original thickness once heated to seal any minor gaps



BRICK AND CERAMIC INSULATION REPLACEMENT

Bricks and ceramic insulation should be inspected and replaced if necessary at least once a year. Cracked bricks are fine as long as they remain in place. Bricks that are crumbling or falling out need to be replaced. The ceramic insulation is located on the top of the stove's baffle and is designed to keep heat in the stove and increase efficiency. As long as the insulation is in place it can be left alone. If the insulation becomes torn during cleaning, simply lay it back together tightly in that area. If the insulation tears to multiple pieces, it should be replaced. To replace the ceramic insulation, remove the 4 burn tubes allowing the entire baffle to come down and out of the stove. Mark or otherwise note the order of the tubes so they can be replaced in the same location. Lay the 2 smaller strips of insulation into the valleys of the corrugated baffle plate and lay the large piece over the entire baffle aligning the edges of the insulation with the edges of the baffle plate. Re-install the baffle and the 4 burn tubes.

MAINTENANCE PARTS LIST AND DIAGRAMS

TBD

SECTION 7 - TROUBLESHOOTING

STOVE BURNS LAZY AT START UP.

1. The chimney is still cool, allow more time to warm up.
2. Wood is not seasoned (still green). Wood should sit for about 1 year, split and loosely stacked if it was cut green.
3. Wood is well seasoned but has a lot of surface moisture. Your wood supply must be covered. Check your tarps or other covering to see that no rain or snow is getting to your wood. Wood should be covered on top, but open on the sides to allow air movement to aid in drying.
4. Stove is being shut down too soon. Leave the air open for longer. (do not leave the stove unattended with door open) See Section 4 for lighting instructions.

STOVE BACK-PUFFS OR SMOKES INTO THE ROOM AT START UP.

1. Chimney is cold. Cold chimneys can produce a "reverse draft" where cold air is rushing down the chimney into the stove. Open a door or a window for about 5 minutes to equalize pressure in the house then try restarting with small strips of newspaper. Using small strips of newspaper or an approved fast burning fire starter and small pieces of kindling will create heat faster to help reverse the cold air.
2. Chimney and/or the chimney cap needs to be cleaned. Your chimney should be checked and cleaned if necessary every few months. Even a small amount of buildup can cause a draft restriction, for example: ¼ inch of buildup on the side wall of an 8" chimney reduces the effective area of the chimney by about 20%. Pay close attention to the chimney cap, especially if it has a screen. Screened chimney caps can become blocked enough to restrict flow in just a few weeks.

STOVE SMOKES OUT THE DOOR WHEN IT IS OPEN.

1. The door was opened before the bypass rod was pulled open. Open the bypass for 1 minute before opening the door.
2. The door was opened too quickly. Crack the door open just a small amount and let the stove "breathe" a few seconds before opening all the way.
3. Chimney and/or the chimney cap needs to be cleaned. Your chimney should be checked and cleaned if necessary every few months. Even a small amount of buildup can cause a draft restriction, for example: ¼ inch of buildup on the side wall of a 6" chimney reduces the effective area of the chimney by about 20%. Pay close attention to the chimney cap, especially if it has a screen. Screened chimney caps can become blocked enough to restrict flow in just a few weeks.

STOVE WON'T SHUT DOWN.

1. Check the main door gasket and glass gasket for proper seal. See section 6 for instructions on checking your gaskets.

STOVE WON'T BURN HOT ENOUGH. LAZY BURN.

1. Wood is not seasoned (still green). Wood should sit for about 1 year, split and loosely stacked if it was cut green.
2. Wood is well seasoned but has a lot of surface moisture. Your wood supply must be covered. Check your tarps or other covering to see that no rain or snow is getting to your wood. Wood should be covered on top, but open on the sides to allow air movement to aid in drying.
3. Chimney and/or the chimney cap needs to be cleaned. Your chimney should be checked and cleaned if necessary every few months. Even a small amount of buildup can cause a draft restriction, for example:

¼ inch of buildup on the side wall of an 8" chimney reduces the effective area of the chimney by about 20%. Pay close attention to the chimney cap, especially if it has a screen. Screened chimney caps can become blocked enough to restrict flow in just a few weeks.

4. Catalytic combustor is plugged with ash. Clean the catalyst in place using a slight to moderate (~20-30 psi.) amount of air pressure blown through the baffle grid removing ash from the catalyst cells.
5. Atmospheric conditions. Occasionally, barometric episodes occur that affect draft, thereby affecting stove performance. If your stove has been working fine and performance drops suddenly, this is most likely the cause, and will usually go away within a few days.
6. Your fuel load may be too small or the wood size too large for the coal bed. A small bed of coals requires re-kindling to build up the heat, only put large chunks of wood on a very hot and active bed of coals.

BURN TIME TOO SHORT.

1. Your fuel load may be too small or the wood size too large for the coal bed. A small bed of coals requires re-kindling to build up the heat, only put large chunks of wood on a very hot and active bed of coals. If there are large chunks of charred wood left after the fire has gone out, the coal bed was not hot enough.
2. Fuel quality. Harder, denser woods produce longer burn times. Likewise, softer woods produce shorter burn times.
3. Check the main door gasket and glass gasket for proper seal. See for instructions on checking your gaskets.

CATALYST TROUBLESHOOTING.

Problem	Cause	Solution
Catalyst plugged with creosote	Burning wet wood or pushing in the bypass rod too soon.	Burn only dry, seasoned natural wood. Burn a hot fire with the bypass rod partially open to burn off the creosote buildup.
Catalyst masked with soot or fly ash.	Pushing in the bypass rod too soon. Burning improper material such as cardboard, coal or wrapping paper.	Burn a hot fire with the bypass rod partially open to burn off the creosote buildup. Burn only dry seasoned natural wood.
Lower Efficiency	Flames contacting the catalyst from excessive draft. Poisoning	Use less wood or lower the air to the stove. Install a damper to reduce draft. Do not burn material that will poison the catalyst such as colored paper, cardboard, paneling, painted or treated wood.
Catalyst is plugged with fly ash	Pushing in the bypass rod too soon. Burning material that produces fly ash and char. See section 4 for a list of improper materials	Make sure you achieve catalyst light off (see section 4) Burn only dry, seasoned natural wood.

SECTION 8 - WARRANTY

Our Promise:

If any maintenance items wear out in the first three years, we will supply you with the parts to fix it. For as long as you own your stove, if you ever have a defect in the material or workmanship of your stove's firebox, we will repair or replace it for you. See full details below:

Items Covered	Parts Coverage Period	Labor Coverage Period
Maintenance Items: Bricks, gasket, ceramic insulation and paint.	3 Years	No Labor Coverage
Blowers, ash grate, brick supports, Baffle plate and burn tubes.	5 Years	3 Years
Stove firebox, legs, glass (thermal breakage) and door casting.	Forever	3 Years

Catalyst Warranty: The combustor supplied with this heater is an Applied Catalysts ACI-5M, Long Life Combustor. Following is the catalytic combustor warranty supplied with this wood heater. Catalyst warranty claims should be addressed to: Kuma Stoves 50145 N. Old Highway 95 Rathdrum ID, 83858. Ph. 888-714-5294. All warranty claims must meet the following conditions: 1. warranty has been registered proving the date of purchase. 2. You return the catalyst to Kuma stoves. 3. The catalyst has not been abused by over-firing or using unauthorized fuels. If the catalyst loses its structural integrity within 6 years of purchase, Kuma stoves will replace the catalyst at no charge. For the next 6 years, a replacement catalyst is available for purchase from Kuma Stoves at a 50% discount from MSRP. The above 3 conditions apply when qualifying for the discounted rate. All replacement catalysts will have a 90 day warranty coverage.

Warranty Coverage:

To ensure warranty coverage, it is very important that you register your Kuma Stove warranty within 30 days of purchase at kumastoves.com or fill out and return the warranty registration in your owner's packet. Operation of this stove in a manner inconsistent with the owner's manual, especially the burning of materials for which this unit is not certified by the EPA, will void the warranty. This warranty covers your new Kuma Stove from defects in material and workmanship for the period outlined in this warranty. Kuma Stoves reserves the right to replace, repair or authorize repair of any defective part at its sole discretion. This warranty is not transferrable and covers the original owner of the product from the time of purchase. All parts that have been replaced under this warranty will have a 90 day warranty coverage. The maximum value of this warranty is the original purchase price of the product. This warranty is subject to the conditions and limitations outlined below. This warranty covers stoves purchased from an authorized Kuma Stoves dealer.

Warranty Instructions:

Please contact the dealer where you purchased your stove. You may also contact Kuma stoves directly at 50145 N. Old Highway 95, Rathdrum ID 83858 or by phone at 1-888-714-5294 or contact us online at kumastoves.com. When calling, you will need to have your proof of purchase, the model name, and the serial number of your stove. When calling please remember that shipping and handling costs are not covered under this warranty.

Warranty Exclusions:

This Warranty does not cover: 1. Changes in the color of the surface of the stove as this naturally happens during the firing of the stove and is considered normal. 2. Damage to plating due to chemical cleaners, fingerprints, or scratching. 3. Shattered glass caused from wood impact. 4. Discoloration of plating or glass. 5. Expansion and contraction of the firebox causing noise. 6. Damage caused from: power surges, unauthorized modifications, using incorrect fuel and/or accelerants, shipping/handling, failure to follow the manufacturer's installation instructions, failure to follow any local building codes. 7. Damages to any product not manufactured by Kuma Stoves. 8. Any stoves ability to heat a specific area. Heating capacity is given as a guideline and is not guaranteed. 9. Shipping costs or travel time. Please talk with an authorized dealer or Kuma representative about the potential

charges for travel or shipping. 10. This warranty is void in the case of abuse, over firing, unauthorized repair, alterations, improper installation and/or service.

Appendix A
Alt-125 E3053 Letter

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

FEB 2 8 2018

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

Mr. Justin White
Hearthstone QHPP, Inc.
#17 Stafford Ave.
Morrisville, VT 05661

Dear Mr. White,

I am writing in response to your letter dated January 12, 2018, regarding wood heaters manufactured by Hearthstone QHPP, Inc. (Hearthstone). This response, dated February 28, 2018, supercedes our previous response (dated February 26, 2018) to correct an inaccuracy regarding required changes to ASTM E3053-17.

You are requesting to use an alternative test method, using cord wood, as referenced in section 60.532(c) of 40 CFR part 60, Subpart AAA, Standards of Performance for New Residential Wood Heaters (Subpart AAA) to meet the 2020 cord wood alternative compliance option. The 2020 cord wood alternative compliance option states that each affected wood heater manufactured or sold at retail for use in the United States on or after May 15, 2020, must not discharge into the atmosphere any gases that contain particulate matter in excess of 2.5 g/hr. Compliance must be determined by a cord wood test method approved by the Administrator along with the procedures in 40 CFR 60.534. You have requested approval to use the procedures and specifications found in ASTM Method E3053-17, a cord wood test method titled, "Standard Test Method for Determining Particulate Matter Emissions from Wood Heaters using Cordwood Test Fuel," in conjunction with ASTM E2515-11 and Canadian Standards Administration (CSA) Method CSA-B415.1-10, which are specified in 40 CFR 60.534.

We understand that Hearthstone is also requesting that the alternative method proposed above be approved to apply broadly to all wood heaters manufactured by Hearthstone meeting the requirements of Subpart AAA, from the approval date of this request until such time that Subpart AAA is revised or replaced to require a different cord wood certification method, providing all requirements of section 60.533 of Subpart AAA are met.

With the caveats set forth below, we approve your alternative test method request for certifying wood heaters using ASTM E3053-17 in conjunction with section 60.534 of Subpart AAA to meet the 2020 cord wood compliance option until such time that Subpart AAA is revised or replaced to require a different cord wood certification method. We also approve application of this alternative method to all wood heaters manufactured by Hearthstone meeting the requirements of Subpart AAA.

As required in Subpart AAA, section 60.354(d), you or your approved test laboratory must also measure the first hour of particulate matter emissions for each test run using a separate filter in one of the two parallel sampling trains. These results must be reported separately and also included in the total particulate matter emissions per run. Also, as required by Subpart AAA, section 60.534(e), you must have your approved laboratory measure the efficiency, heat output, and carbon monoxide emissions of the tested wood heater using CSA-B415.1-10. For measurement of particulate matter emission concentrations, ASTM 2515-11 must be used.

The following change to ASTM E3053-17 must be followed:

1. Coal bed conditions prior to loading test fuel. The coal bed shall be a level plane without valleys or ridges for all test runs in the high, low, and medium burn rate categories.

The following changes to ASTM E2515-11 must be followed:

1. The filter temperature must be maintained between 80 and 90 degrees F during testing.

2. Filters must be weighed in pairs to reduce weighing error propagation; see ASTM 2515-11, Section 10.2.1 Analytical Procedure.

3. Sample filters must be Pall TX-40 or equivalent Teflon-coated glass fiber, and of 47 mm, 90 mm, 100 mm, or 110 mm in diameter.

4. Only one point is allowed outside the +/- 10 percent proportionality range per test run.

A copy of this letter must be included in each certification test report where this alternative test method is utilized.

It is reasonable that this alternative test method approval be broadly applicable to all wood heaters subject to the requirements of 40 CFR part 60, Subpart AAA. For this reason, we will post this letter as ALT-125 on our website at *http://www3.epa.gov/ttn/emc/approalt.html* for use by other interested parties. As noted earlier in this letter, this alternative method approval is valid until such time that Subpart AAA is revised or replaced to require a different cord wood certification method, and at such time, this alternative will be reconsidered and possibly withdrawn.

If you have additional questions regarding this approval, please contact Michael Toney of my staff at 919-541-5247 or toney.mike@epa.gov.

Sincerely,

Steffan M. Johnson, Group Leader
Measurement Technology Group

cc: Amanda Aldridge, EPA/OAQPS/OID
Adam Baumgart-Getz, EPA/OAQPS/OID
Rafael Sanchez, EPA/OECA
Michael Toney, EPA/OAQPS/AQAD

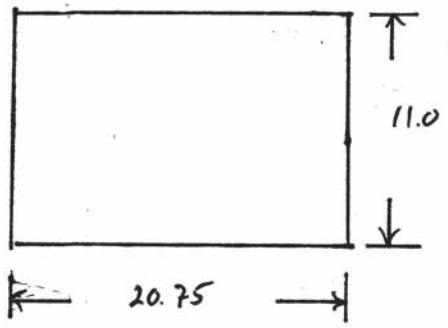
Appendix B
Firebox Volume

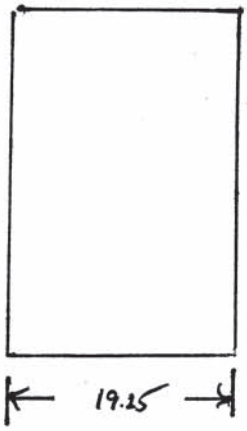
KUMA K 250 series

0123WM012E

B Davis
O-TL

H	W	D
11.0	19.25	20.75 - 2.54 ft^3





Appendix C
Revision History

Date	Project No.	Tech. & Evaluator	Report Sect.	Summary of Changes
3/9/21	0123WM012E Edition 5	Bruce Davis	Appendix B	Firebox volume drawing added on page 172.
			1	Individual run summary on page 6 was updated to clarify low burn setting was conducted at full closed.
			1	An error was corrected on page 6 and 10 to replace an incorrect 3/32" with a correct 7/16" air setting for the medium burn.
			3	Catalyst aging data was added to page 25 of the report.
			1	Verified fuel species was shown on page 5 and 8, no changes were made.
			Appendix B	Added revision history page.
7/1/21	0123WM012E Edition 6	Bruce Davis	Cover	Updated for new addition
			1	Individual run summary updated to clarify air setting used for tests 2 and 4. Table 6 fuel loading density updated due to revised firebox volume (See fuel sheets section 3). Table 10 updated to clarify air setting for tests 2 and 4.
			3	Operating instructions updated on page 22 – 24 to clarify air setting used for tests 2 and 4. Conditioning data updated on pages 26 – 27 to clarify operation at a medium burn rate. Fuel data sheets updated on pages 41, 53, 70, 88, and 94 to correct firebox volume; previous version used 2.50 cubic feet. Corrected to 2.54.
			5	Manual page 156 updated to clarify air setting used for medium burn rates.