



**ENERGY AND ENVIRONMENTAL
MEASUREMENT
CORPORATION**

[206] 859-8318 ■ 1315 S. Central Avenue ■ Unit C ■ Kent, WA 98032

United States
Environmental Protection Agency
Woodstove Certification
Test Report

RSF Energy LTD
Onyx
Non-Catalytic Wood Heater

VOLUME 1

REPORT BY:

BILL NOWAK

TIM KELLY

CONFIDENTIAL

RELEASED ONLY BY
AUTHORIZED PERSONNEL

DATE 11/18/91

EEMC/BILLINGS
1744 Mallowney Lane
Billings, Montana 59101
[406] 252-4450

EEMC/TUCSON
3925 Placita de la Escarpa
Tucson, Arizona 85715
[602] 290-8985

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Photos

This section contains two photographs of the fuel load for each test run and two color photographs (side and front view) of the wood heater tested and any other photographs pertinent to testing the unit.

Photos

vari

Appendicies:

A - Example Calculations

B - Installation Description and Operating Instructions

REPORT CERTIFICATION

The sampling and analysis for the woodstove described in this report was carried out under my direction and supervision.

Date _____ Signature Bill Mowak

Date _____ Signature _____

I have reviewed all of the testing data and results found in this test report and hereby certify that the test report is authentic and accurate.

Date _____ Signature _____

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Cal Data
Cal Data

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- A. Leak Checks
1. Particulate Sampling Train
2. SO₂ Injection System
3. Combustion Gas (CO₂, O₂, CO) (CEM) Train
4. Tracer Gas (SO₂) Train
B. Proportional Checks

Individual Test Runs
Individual Test Runs
Individual Test Runs
Individual Test Runs
Individual Test Runs

P. 1 of Data Sheet #2
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Data Sheet #16
Data Sheet #16
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Computer Printout

16. Sample Calculations

- A. Weighted Average Emission Rate
B. Dry Burn Rate
C. $[V_m] - [V_m(\text{std})]$
D. Total Gas Flow Rate (QSD)
E. Proportionality Rate (PR)
F. Particulate Emission Rate

Data Summary

Individual Test Runs
Individual Test Runs
Individual Test Runs
Individual Test Runs
Individual Test Runs
Individual Test Runs

Weighted Average Calc
Sheets, pp.1-3
Data Sheet #8
Data Sheet #7
(Particulate Calc Sheet)
Table 4
Computer Printout
Table 5
Computer Printout
Table 4
Computer Printout

17. Raw Test Data

Individual Test Runs

Data Sheets 1 - 16

18. Analytical Data

- A. Filter and Beaker Tares
B. Solvent Blanks
C. Particulate Catches
1. Gross
2. Blanks
3. Net
4. Gr/dscf
D. Constant Weight Weighings

Individual Test Runs
Individual Test Runs

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Individual Test Runs
Individual Test Runs
Individual Test Runs
Individual Test Runs
Individual Test Runs

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Data Sheet #4-3

M5H INDIVIDUAL TEST RUN PAGE INDEX
The Data Sheets in the Individual Test Runs
Are Organized in the Following Sequence

A. Computer Printouts

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

B. Raw Data Sheets

	No. of Pages
Data Sheet #1 Computer Input Data	1
Data Sheet #2 Meterbox Data Sheets	variable
Data Sheet #3 Moisture Catch Sheet	1
Data Sheet #4 Scale Sheets	
#4-1 Initial Filter Weights	variable
#4-2 Initial Beaker Weights	variable
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Data Sheet #5 Particulate Catch Processing Sheet	
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#15-1 CO ₂	1
#15-2 O ₂	1
#15-3 CO	1
#15-4 SO ₂	1
Data Sheet #16 Quality Checks	1

TEST SERIES INFORMATION

Unit name and model number: RSF Model ONYX

Type: Cat: Non-cat: XX Pellet:

Manufacturer: RSF Energy, Ltd.

Address: P.O. Box 3637

Smithers, B.C. Canada VOJ 2N0

Contacts: Hans Duerichen

Phone #: 604-847-4301

Observers: Hans Duerichen

Date Recvd: 10/2/91 Aged: 10/2/91 Tested: 10/17-24/91

Tested by: EEMC using EPA methods 28 and 5H
Test Location: 1315 S. Central Unit C Kent, WA 98032
Test Site Elevation: 42 feet

EEMC's Field Team

Supervisor: Bill Nowak

Others: Tim Kelly

Jerry Stoddard

Chad Garza

Darla Kingman

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

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Wood Heater Emission Test Summary

Laboratory/Wood Heater Information

Stove Manufacturer: RSF ENERGY, LTD
 Model Identification: ONYX
 Stove Type> 1=cat,
 2=noncat, 3=pellet: 2

Laboratory Name: EEMC
 Laboratory Contact: Bill Nowak
 Telephone no.: 859-8318

Test Dates: 10/17-24/91

Test Methods Used

Method 28/Other:

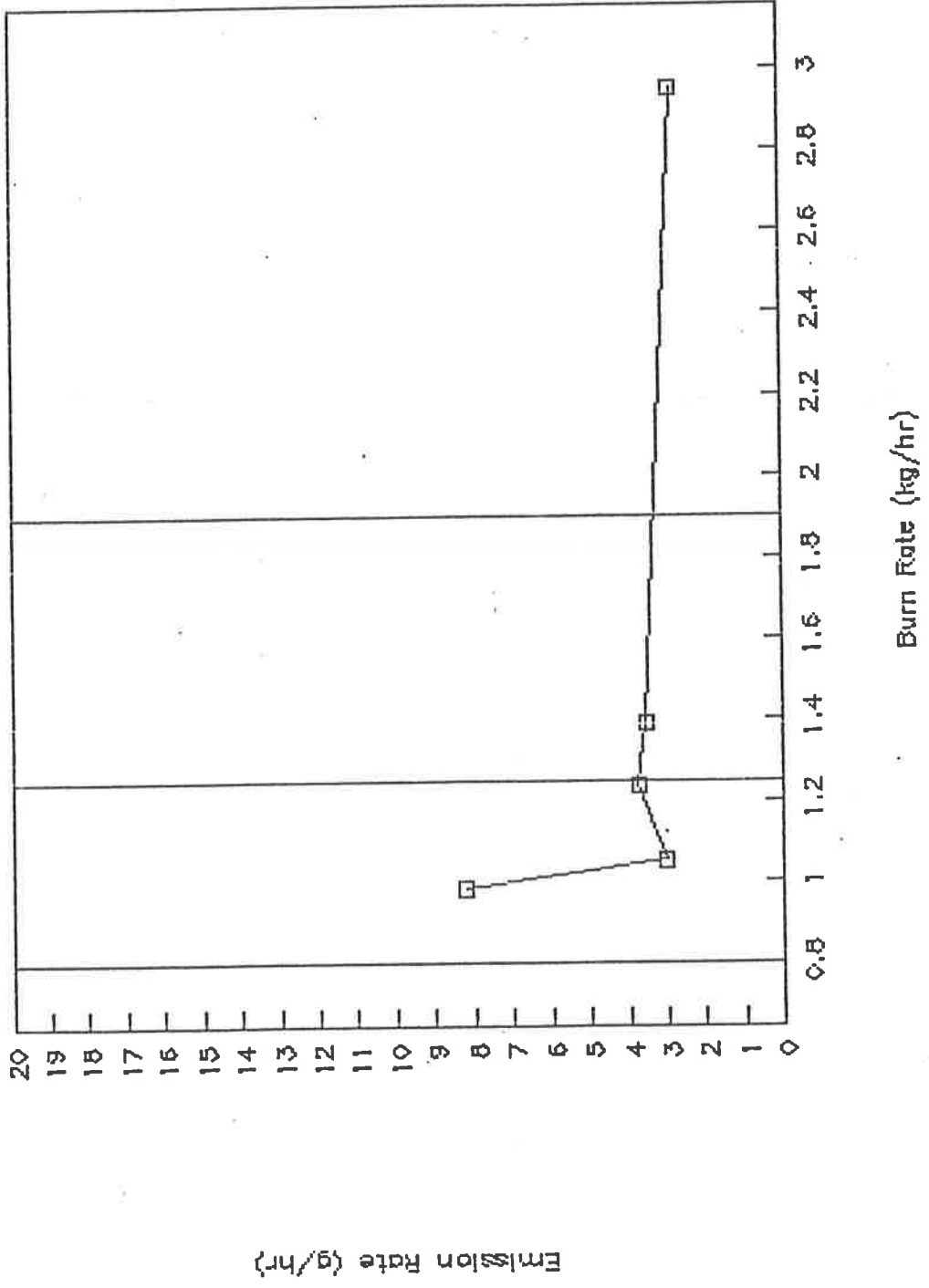
Sampling Method: 5H

=====

Run no.	Burn Rate (kg/hr)	Emission Rate (g/hr)	Heat Output (Btu/hr)	Wtd Avg (g/hr) 4.5
1	0.981	8.224	11829	
3	1.052	3.025	12685	
2	1.235	3.724	14892	
4	1.388	3.541	16737	
6	2.954	2.817	35620	
			NA	
			NA	
			NA	

RSF ENERGY, LTD

ONTX



Handwritten notes and signatures at the bottom of the page, including a signature that appears to read "J. J. ...".

Woodstove Data Summary

	Run #	1	3	2	4	6	5
<u>Particulate Emissions:</u>							
Concentration: grains/dscf:		.2578	.0866	.0992	.0774	.0304	.0680
grams/m ³ :							
Emission Rate: grams/hr:		8.224	3.025	3.724	3.541	2.817	2.522
Emission Factor: gms/kg: (dry fuel weight basis)							
Front Half Catch: % of total		44.83	48.48	43.38	34.91	45.54	30.70
Total Mass Captured:		1557.6	574.5	560.6	380.1	66.1	489.5
Frt & Bck Halves:							
<u>Efficiency Values:</u>							
Overall Appliance Efficiency							%
Combustion Efficiency							%
Heat Transfer Efficiency							%
<u>Heat Output:</u>							BTU/hr
Avg. BTU/hr for test cycle							
<u>Fuel Burn Rates:</u>							
Avg Kg/hr for test cycle (Wet basis)							Kg/hr
Avg Kg/hr for test cycle (Dry basis)		.981	1.052	1.235	1.388	2.954	1.106

RUN #

Fuel Moisture Content:

Kindling (Wet basis)
 Pretest Fuel (Wet basis)
 Test Fuel (Wet basis)

	1	3	2	4	6	5
Kindling (Wet basis)	4.459	8.534	4.762	5.956	9.502	6.977
Pretest Fuel (Wet basis)	18.186	17.677	18.1334	17.801	17.165	16.882
Test Fuel (Wet basis)	18.064	17.241	17.7	17.424	17.745	18.562

Air/Fuel Ratio:

lbs air/lbs fuel

Average Stack Gas Composition:

Avg. % CO₂
 Avg. % O₂
 Avg. % CO
 Avg. % Excess Air
 Avg. % Moisture

Avg. % CO ₂	4.9	5.0	5.7	5.13	5.87	4.99
Avg. % O ₂	.96	.71	.66	.62	.24	.64
Avg. % Excess Air	5.31	4.92	5.6	5.09	5.21	5.19

Average Stack Gas Flow Rate:

Stack flow rate - EPA CMB
 CHO balance
 Tracer Gas
 Draft (Static)
 Proportionality - Average

Stack flow rate - EPA CMB	8.2	8.97	9.65	11.78	23.84	9.54
CHO balance						
Tracer Gas	11.157	10.303	10.450	12.533	18.819	12.178
Draft (Static)	-.036	-.038	-.039	-.044	-.065	-.041
Proportionality - Average	100	100	100	100	100	100

Average Stack Gas Emission Factors:

CO - g/Kg
 g/hr

CO - g/Kg	161.014	121.865	103.245	105.661	38.77	111.580
g/hr	157.955	128.202	127.508	146.658	114.528	123.407

	1	2	3	4	5	6	7
Average Temperatures:							
Stack Gas	284	307	291	322	314	564	OF
Primary Combustion Chamber Gas	628	684	649	692	664	884	OF
Secondary Combustion Chamber Gas	929	1006	945	848	752	1285	OF
Catalytic Combustor Exit Gas							OF
Stove Top	348	366	350	334	366	490	OF
Stove Left Sidewall	357	383	362	372	373	534	OF
Stove Back	358	381	351	303	381	334	OF
Stove Right Sidewall	283	304	301	314	299	476	OF
Stove Bottom	358	377	335	313	361	380	OF
Stove Temperature Change	-31.8	-4.0	-35.2	46.0	-51	-88	OF

	1	2	3	4	5	6	7
Test Chamber Environment:							
Avg. Barometric Pressure	30.37	30.46	29.8	29.84	30.09	29.82	in Hg
Avg. Temperature	74	71	73	72	72	72	OF
Avg. % Ambient Moisture	1.2	1.2	1.25	1.8	1.25	1.3	% H2O
Avg. % Relative Humidity	49	42	47.5	74	48.5	53	%RH
Avg. Air Velocity	0						m/sec
Avg. Dilution Tunnel Draft (If Applicable)	0						in/H2O

	1	2	3	4	5	6	7
Test Fuel Weight and Burn Time:							
Density (Dry basis)	.3596	.4442	.4945	.4092	.3970	.4015	gm/cm ³
Coal Bed Weight	3.6	3.7	3.9	3.6	3.6	3.3	lbs.
Pre Test Fuel Wt (Inc Kindling)	54.7	49.2	53.4	56.2	49.0	49.8	lbs.
Test Fuel Load Weight	14.5	15.4	15.7	14.5	15.2	14.5	lbs.
Total Test Cycle Burn Time	330	330	285	235	305	110	min.