TEST REPORT

REPORT NUMBER: 101516402MID-003b
REPORT DATE: March 25, 2014

EVALUATION CENTER
Intertek Testing Services NA Inc.
8431 Murphy Drive
Middleton, WI 53562

RENDERED TO

PACIFIC ENERGY FIREPLACE PRODUCTS, LTD.
2975 ALLENBY ROAD
DUNCAN, BC V9L 6V8

PRODUCT EVALUATED:
P963 Pellet-Fuel Room Heater

Report of Testing Model P963 Pellet-Fuel Room Heater for compliance with the applicable requirements of the following criteria: EPA Method 28 "Certification and auditing of wood heaters" and Method 5G Determination of particulate matter emissions from wood heaters."

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to copy or distribute this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

TABLE OF CONTENTS

I. INTRODUCTION 4
I.A. PURPOSE OF TEST 4
I.B. LABORATORY 4
I.C. DESCRIPTION OF UNIT 4
I.D. REPORT ORGANIZATION 4

II. SUMMARIZATION 5
II.A PRETEST INFORMATION 5
II.B INFORMATION LOG 5
II.C SUMMARY OF INFORMATION 5
II.D SUMMARY OF OTHER DATA 6

III. PROCESS DESCRIPTION 8
III.A TEST SET UP DESCRIPTION 8
III.B AIR SUPPLY SYSTEM 8
III.C TEST FUEL PROPERTIES 8

IV. SAMPLING SYSTEM 9
IV.A SAMPLING LOCATIONS 9
IV.A.1 DILUTION TUNNEL 10
IV.B. OPERATIONAL DRAWINGS 11
IV.B.1 STACK GAS SAMPLE TRAIN 11
IV.B.2 DILUTION TUNNEL SAMPLE SYSTEM 12

V. SAMPLING METHODS 13
V.A. PARTICULATE SAMPLING 13

VI. QUALITY ASSURANCE 13
VI.A. INSTRUMENT CALIBRATION 13
VI.A.1 DRY GAS METERS 13
VI.A.2 STACK SAMPLE ROTAMETER 13
VI.A.3 GAS ANALYZERS 14
VI.B. TEST METHOD PROCEDURES 14
VI.B.1 LEAK CHECK PROCEDURES 14
VI.B.2 TUNNEL VELOCITY/FLOW MEASUREMENT 14
VI.B.3 PM SAMPLING PROPORTIONALITY 14

VII. CONCLUSION 15
VII.A RESULTS & OBSERVATIONS 15

APPENDICES

Laboratory Operating Procedure ..... A
Data and Calculation Forms ..... B
Calibration Documents C
Unit Drawings and Installation Manual ..... D
Dry Gas Meter Calibration Data..... E
Unit Preburn Documentation ..... F
Pictures ..... G

I. INTRODUCTION

Intertek Testing Services NA (Intertek) has conducted testing for Pacific Energy Fireplace Products, Ltd. on model P963 Pellet Fuel Room Heater, to evaluate all applicable performance requirements included in EPA Method 28 “Certification and auditing of wood heaters” and Method 5G “Determination of particulate matter emissions from wood heaters.”

I.A PURPOSE OF TEST

The test was conducted to determine if the unit is in accordance with U.S EPA requirements under 40 CGR 60 SUBPART AAA, NSPS for Residential Wood Heaters. This evaluation was conducted from March 10, 2014 though March 12, 2014.

I.B LABORATORY

The test on the P963 Pellet Fuel Room Heater was conducted at the Intertek testing Services Laboratory located at 8431 Murphy Drive, Middleton, Wisconsin. The laboratory elevation is 860 feet above sea level and is accredited by the U.S. EPA, Certificate Number 3. The test was conducted by Ken Slater.

I.C DESCRIPTION OF UNIT

The model P963 Pellet Fuel Room Heater is constructed of carbon steel with ceramic inserts on the top and sides of the appliance. The outer dimensions are 21-inches deep, 46.5-inches high, and 22.5-inches wide. The unit has a cover panel, which allows access to the hopper (for loading). A steel door with a ceramic glass light provides access to the firebox.
(See product drawings.)

Proprietary drawings and manufacturing methods are on file at Intertek in Middleton, Wisconsin

I.D REPORT ORGANIZATION

This report includes summaries of all data necessary to determine compliance with the regulations. Raw data, calibration records, intermediate calculations, drawings, specifications and other supporting information are contained in appendices to this report.

II. SUMMARIZATION

II.A PRETEST INFORMATION

A sample was submitted to Intertek directly from the client. The sample was not independently selected for testing. The test unit was received at Intertek in Middleton, Wisconsin on March 6, 2014 and was shipped via the client. The unit was inspected upon receipt and found to be in good condition. The unit was set up following the manufacturer's instructions without difficulty.

Following assembly, the unit was placed on the test stand and instrumented with thermocouples in the specified locations. Prior to beginning the emissions tests the unit was operated for a minimum of 10 hours at high-to-medium burn rates to break in the stove. The unit was found to be operating satisfactory during this break-in. The 10 plus hours of pre-burning were conducted from March 7, 2014 through March 10, 2014. The fuel used for the break-in process Marthwood Pellets with a moisture content of 3.5% wet basis.

Following the pre-burn break-in process the unit was allowed to cool. The unit's chimney system and laboratory dilution tunnels were cleaned using standard wire brush chimney cleaning equipment. On March 10, 2014 the unit was set-up for testing.

II.B INFORMATION LOG

TEST STANDARD

From March 10, 2014 to March 12, 2014 the unit was tested for EPA emissions.

Deviation from Standard Method

No deviations from the standards were performed, however, only the applicable sections from each standard

II.C SUMMARY OF TEST RESULTS

Run #1, category 4, March 10, 2014. The pellet hopper was filled and the unit was allowed to warm up. After the required one hour of preburn, the control board was set to the highest setting, the scale was zeroed, and a class S 25.00 lb. weight was placed on the stove. Flue gas was continuously analyzed and recorded every 10 minutes. Emission samples were taken. After the two-hour test the ending weight was subtracted from the 25-lb. beginning weight to find the fuel consumption. A burn rate of 2.541 kg/hr was obtained for a category 4 test.

Test time: 13:08 to 15:08.

Run #2, category 1, March 11, 2014. The pellet hopper was filled, the control board was set to the 1 of 5 setting and the unit was allowed to warm up. After the required one hour of preburn, the scale was zeroed, and a class S 25.00 lb. weight was placed on the stove. Flue gas was continuously analyzed and recorded every 10 minutes. Emission samples were taken. After the two-hour test the ending weight was subtracted from the 25-lb. beginning weight to find the fuel consumption. A burn rate of 0.669 kg/hr was obtained for a category 1 test.

Test time: 8:17 to 10:17.

Run #3, category 2, March 11, 2014. The pellet hopper was filled, the control board was set to the 2 of 5 setting and the unit was allowed to warm up. After the required one hour of preburn, the scale was zeroed, and a class S 25.00 lb. weight was placed on the stove. Flue gas was continuously analyzed and recorded every 10 minutes. Emission samples were taken. After the two-hour test the ending weight was subtracted from the 25-lb. beginning weight to find the fuel consumption. A burn rate of 1.160 kg/hr was obtained for a category 2 test.

Test time: 13:10 to 15:10.

Run #4, category 3, March 12, 2014. The pellet hopper was filled, the control board was set to the 3 of 5 setting and the unit was allowed to warm up. After the required one hour of preburn, the scale was zeroed, and a class S 25.00 lb. weight was placed on the stove. Flue gas was continuously analyzed and recorded every 10 minutes. Emission samples were taken. After the two-hour test the ending weight was subtracted from the 25-lb. beginning weight to find the fuel consumption. A burn rate of 1.665 kg/hr was obtained for a category 3 test.

Test time: 8:36 to 10:36.

II.D SUMMARY OF OTHER DATA

EMISSIONS

Run Number	Test Date	Burn Rate (kg/hr)	Emission Rate (g/hr)	Adjusted Emission Rate (g/hr)
1	**3/10/14**	**2.541**	**1.973**	**3.198**
2	**3/11/14**	**0.699**	**0.475**	**0.977**
3	**3/11/14**	**1.160**	**1.154**	**2.047**
4	**3/12/14**	**1.665**	**1.454**	**2.482**

WEIGHTED AVERAGE CALCULATION

Test No.	Burn Rate	(E) Average Emission Rate g/hr	Heat Output (Btu/hr)	Probability	(K) Weighting Factor	(KxE)
2	**0.669**	**0.977**	**9987.63**	**0.1320**	**0.5020**	**0.4905**
3	**1.16**	**2.047**	**17317.87**	**0.5020**	**0.6975**	**1.4277**
4	**1.665**	**2.482**	**24857.12**	**0.8295**	**0.4653**	**1.1548**
1	**2.541**	**3.198**	**37935.10**	**0.9673**	**0.1705**	**0.5453**
				Totals:	**1.835**	**3.618**
					Weighted average emission rate:	**1.972**

TEST FACILITY CONDITIONS

Run	Room Temp. °F before	Room Temp °F after	Baro. Pres. In. Hg before	Baro. Pres. In. Hg after	R.H. % before	R.H. % after	Air Vel. Ft/min before	Air Vel. Ft/min after
1	**79**	**78**	**28.57**	**28.56**	**21.6**	**20.7**	**0**	**0**
2	**68**	**72**	**28.62**	**28.69**	**24.7**	**22.1**	**0**	**0**
3	**73**	**74**	**28.69**	**28.73**	**22.4**	**22.9**	**0**	**0**
4	**71**	**73**	**28.87**	**28.87**	**18**	**18.3**	**0**	**0**

DILUTION TUNNEL FLOW RATE MEASUREMENTS AND SAMPLING DATA (5G-3)

Run No.	Burn Time (min)	Velocity (ft/sec)	Volumetric Flow Rate (dscf/min)	Total Temp. (^{o}R)	Sample		Particulate Catch (mg)	
					1	2	1	2
1	**120**	**13.35**	**135.89**	**559.81**	**26.74**	**27.75**	**6.1**	**7.1**
2	**120**	**13.05**	**139.72**	**533.91**	**27.64**	**28.64**	**1.2**	**2.0**
3	**120**	**13.64**	**145.33**	**537.32**	**27.25**	**28.47**	**3.1**	**4.3**
4	**120**	**13.26**	**140.82**	**542.14**	**27.32**	**28.43**	**4.5**	**5.1**

DILUTION TUNNEL DUAL TRAIN PRECISION

Run No.	Sample Ratios		Total Emissions (g)		% Deviation	% Deviation of 7.5% of 7.5 grams[1]	Deviation g/kg[2]
	Train 1	Train 2	Train 1	Train 2			
1	**609.73**	**587.60**	**3.72**	**4.17**	**9.52%**	**4.06%**	**NA**
2	**606.66**	**585.44**	**0.73**	**1.17**	**38.94%**	**5.07%**	**NA**
3	**640.01**	**612.47**	**1.98**	**2.63**	**23.40%**	**6.39%**	**NA**
4	**618.50**	**594.36**	**2.78**	**3.03**	**7.08%**	**NA**	**NA**

1) As described in Method 5G-3 section 16.2.5
2) Per ASTM E2515 section 11.7.

GENERAL SUMMARY OF RESULTS

Run No.	Burn Rate (kg/hr)	Average Surface Temp (^oF)	Change In Surface Temp (^oF)	Initial Draft (in/H_2O)	Run Time (min)	Average Draft (in/H_2O)
1	**2.541**	**584.01**	**28.71**	**0.027**	**120**	**0.029**
2	**0.699**	**244.23**	**-32.75**	**0.012**	**120**	**0.012**
3	**1.160**	**349.89**	**26.09**	**0.012**	**120**	**0.015**
4	**1.665**	**440.62**	**50.08**	**0.016**	**120**	**0.020**

III. PROCESS DESCRIPTION

III.A TEST SET-UP DESCRIPTON

A standard 6” diameter single wall pipe and insulated chimney system was installed to 15’ above floor level. The unit controls were set to the lowest setting during the test.

III.B AIR SUPPLY SYSTEM

Blower induced combustion air enters through a 2 inch opening in the back of the stove. Working under a slight negative pressure in the firebox, air is drawn through the unit’s fire pot. The products of combustion exit the top of the firebox, pass through the heat exchanger and are then forced out of the rear through a 3-inch flue connection. Convection air is drawn from the top of the unit, through the heat exchanger, and out through the louvers located below the door.

III.C TEST FUEL PROPERTIES

The pellets used had a moisture content of 3.5 % using the wet basis and 3.6 % on the dry basis.

IV. SAMPLING SYSTEMS

IV.A. SAMPLING LOCATIONS

Particulate samples are collected from the dilution tunnel at a point 20 feet from the tunnel entrance. The tunnel has two elbows and two mixing baffles in the system ahead of the sampling section. (See Figure 3.) The sampling section is a continuous 13 foot section of 6 inch diameter pipe straight over its entire length. Tunnel velocity pressure is determined by a standard Pitot tube located 60 inches from the beginning of the sampling section. The dry bulb thermocouple is located six inches downstream from the Pitot tube. Tunnel samplers are located 60 inches downstream of the Pitot tube and 36 inches upstream from the end of this section. (See Figure 1.)

Stack gas samples are collected from the steel chimney section 8 feet ± 6 inches above the scale platform. (See Figure 2.)

IV.A.(1) DILUTION TUNNEL

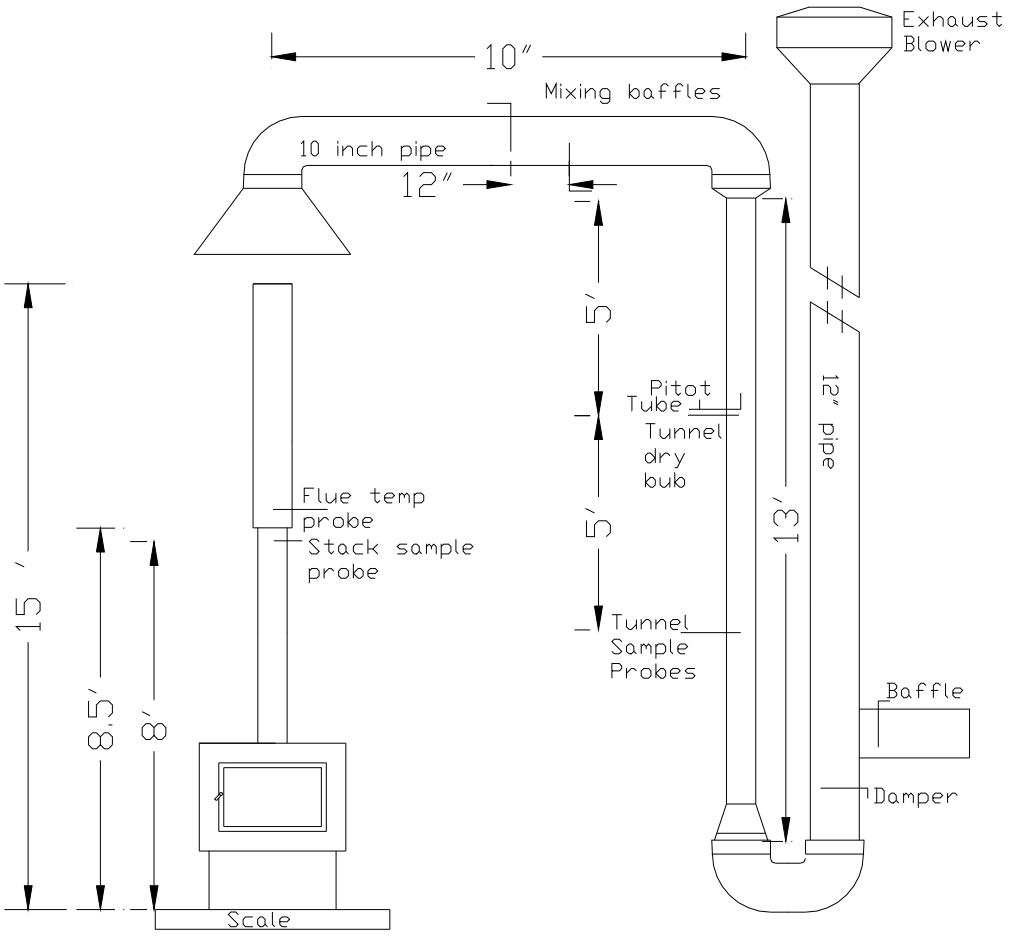
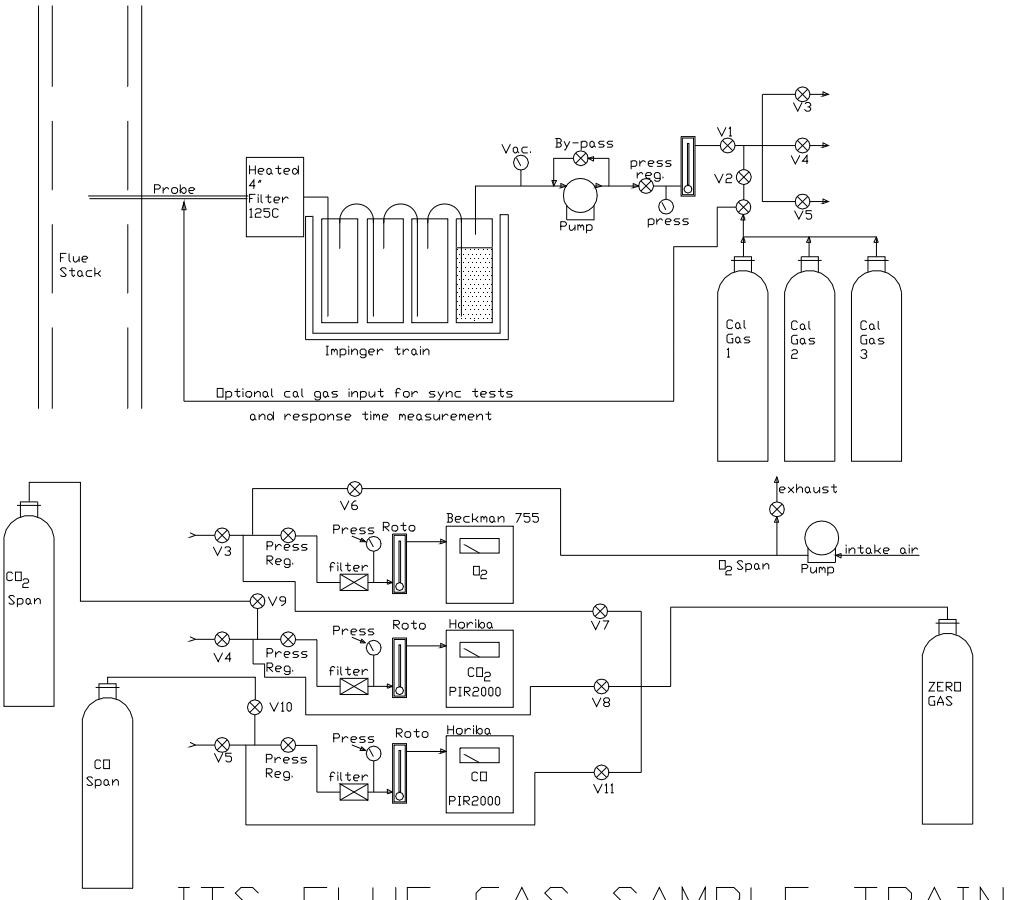


FIGURE 1

IV.B.OPERATIONAL DRAWINGS

IV.B.(1) STACK GAS SAMPLE TRAIN



ITS FLUE GAS SAMPLE TRAIN

FIGURE 2

IV.B.(2). DILUTION TUNNEL SAMPLE SYSTEMS

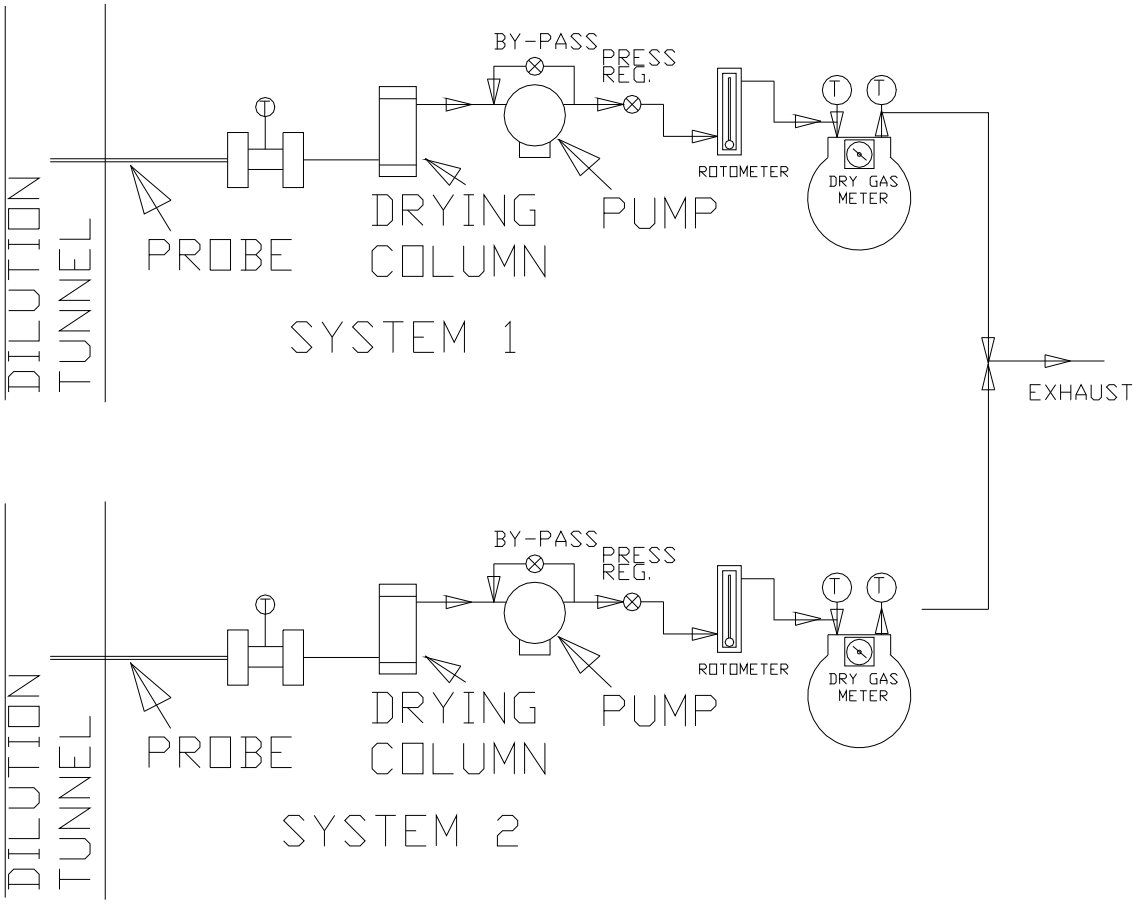


Figure 3

V. SAMPLING METHODS

V.A. PARTICULATE SAMPLING

Particulates were sampled in strict accordance with EPA Method 5G-3. This method uses two identical sampling systems with Gelman A/E 61631 binder free, 47-mm diameter filters. The dryers used in the sample systems are filled with “Drierite” before each test run.

VI. QUALITY ASSURANCE

VI.A. INSTRUMENT CALIBRATION

VI.A. (1). DRY GAS METERS

At the conclusion of each test program the dry gas meters are checked against our standard dry gas meter. Three runs are made on each dry gas meter used during the test program. The average calibration factors obtained are then compared with the six-month calibration factor and, if within 5%, the six-month factor is used to calculate standard volumes. Results of this calibration are contained in Appendix D.

An integral part of the post test calibration procedure is a leak check of the pressure side by plugging the system exhaust and pressurizing the system to 10” W.C. The system is judged to be leak free if it retains the pressure for at least 10 minutes.

The standard dry gas meter is calibrated every 6 months using a Spirometer designed by the EPA Emissions Measurement Branch. The process involves sampling the train operation for 1 cubic foot of volume. With readings made to .001 ft^3, the resolution is .1%, giving an accuracy higher than the ±2% required by the standard.

VI.A.(2). STACK SAMPLE ROTAMETER

The stack sample rotometer is checked by running three tests at each flow rate used during the test program. The flow rate is checked by running the rotometer in series with one of the dry gas meters for 10 minutes with the rotometer at a constant setting. The dry gas meter volume measured is then corrected to standard temperature and pressure conditions. The flow rate determined is then used to calculate actual sampled volumes.

VI.A.(3). GAS ANALYZERS

The continuous analyzers are zeroed and spanned before each test with appropriate gases. A mid-scale multi-component calibration gas is then analyzed (values are recorded). At the conclusion of a test, the instruments are checked again with zero, span and calibration gases (values are recorded only). The drift in each meter is then calculated and must not exceed 5% of the scale used for the test.

At the conclusion of each unit test program, a five-point calibration check is made. This calibration check must meet accuracy requirements of the applicable standards. Consistent deviations between analyzer readings and calibration gas concentrations are used to correct data before computer processing. Data is also corrected for interferences as prescribed by the instrument manufacturer's instructions.

VI.B. TEST METHOD PROCEDURES

VI.B.(1). LEAK CHECK PROCEDURES

Before and after each test, each sample train is tested for leaks. Leakage rates are measured and must not exceed 0.02 CFM or 4% of the sampling rate. Leak checks are performed checking the entire sampling train, not just the dry gas meters. Pre-test and post-test leak checks are conducted with a vacuum of 10 inches of mercury. Vacuum is monitored during each test and the highest vacuum reached is then used for the post test vacuum value. If leakage limits are not met, the test run is rejected. During, these tests the vacuum was typically less than 2 inches of mercury. Thus, leakage rates reported are expected to be much higher than actual leakage during the tests.

VI.B.(2). TUNNEL VELOCITY/FLOW MEASUREMENT

The tunnel velocity is calculated from a center point Pitot tube signal multiplied by an adjustment factor. This factor is determined by a traverse of the tunnel as prescribed in EPA Method 1. Final tunnel velocities and flow rates are calculated from EPA Method 2, Equation 6.9 and 6.10. (Tunnel cross sectional area is the average from both lines of traverse.)

Pitot tubes are cleaned before each test and leak checks are conducted after each test.

VI.B.(3). PM SAMPLING PROPORTIONALITY (5G-3)

Proportionality was calculated in accordance with EPA Method 5G-3. The data and results are included in Appendix C.

VII. CONCLUSION

These tests demonstrate that this unit is an affected facility under the definition given in the regulation. The weighted average emission rate of 1.972 g/hr meets the requirements for the State of Colorado, State of Washington, and State of Oregon.

VII.A RESULTS AND OBSERVATIONS

The Model P963 Pellet Fuel Room Heater has been found to be in compliance with the applicable performance and construction requirements of the following criteria: EPA Method 28 “Certification and auditing of wood heaters” and Method 5G Determination of particulate matter emissions from wood heaters.”

Models P963 C, P963 D, and P963 M are all similar models to the P963 with the only difference being the exterior cosmetic components. Intertek has deemed that these models would operate and have the same results as the model P963.

INTERTEK TESTING SERVICES NA

Evaluated by: Ken Slater

Ken Slater
Associate Engineer - Hearth

Reviewed by:

Brian Ziegler
Lead Engineer - Hearth