TEST REPORT

REPORT NUMBER: 101798475MID-006
REPORT DATE: May 20, 2016

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

RENDERED TO
PINEY MANUFACTURING, LTD.
PO BOX 130
PINEY, MB R0A 1K0
CANADA

PRODUCT EVALUATED:

MODEL EGR250 WOOD HYDRONIC HEATER

Report of Testing Model EGR250 Wood Hydronic Heater for compliance as an "Affected Wood Heater" with the applicable requirements of the following criteria: EPA 40 CFR Part 60 "Standards of Performance for New Residential Wood Heaters, New Residential Hydronic Heaters and Forced-Air Furnaces", March 16, 2015.

Contents

REVISION SUMMARY

DATE	SUMMARY

I. INTRODUCTION

Intertek Testing Services NA (Intertek) has conducted testing for Piney Manufacturing, Ltd., on model EGR250 Wood Hydronic Heater to evaluate all applicable performance requirements included in “Determination of particulate matter emissions from wood hydronic heaters.”

I.A PURPOSE OF TEST

The test was conducted to determine if the unit is in accordance with U.S EPA requirements under EPA 40 CFR Part 60 “Standards of Performance for New Residential Wood Heaters, New Residential Hydronic Heaters and Forced-Air Furnaces”. This evaluation was started on May 2, 2016 and completed on May 5, 2016. The following test methods were applicable:

ASTM E2515-11- Standard Test Method for Determination of Particulate Matter Emissions Collected by a Dilution Tunnel

ASTM E2618-13 - Standard Test Method for Measurement of Particulate Emissions and Heating Efficiency of Solid Fuel-Fired Hydronic Heating Appliances

EPA Test Method 28 WHH-15 – Measurement of Particulate Emissions and Heating Efficiency of Solid Fuel-Fired Hydronic Heating Appliances

CSA B415.1-10 - Performance Testing of Solid-Fuel-Burning Heating Appliances

I.B LABORATORY

The tests on the model EGR250 Wood Hydronic Heater were conducted at the Intertek testing Services Laboratory located at 8431 Murphy Drive, Middleton, WI, 53562. The laboratory is accredited by the U.S. EPA, Certificate Number 3. The test was conducted by Brian Ziegler and Ken Slater.

I.C DESCRIPTION OF UNIT

The model EGR250 Wood Hydronic Heater is constructed of sheet steel. The outer dimensions are 41-in wide, 80-in deep, 74-in high. The unit has a door located on the front.

(See product drawings.)

Proprietary drawings and manufacturing methods are on file at Intertek in (Intertek location)

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. SUMMARY

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, WI on April 29, 2016 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. Prior to beginning the emissions tests, the unit was operated for a minimum of 10 hours at high-to-medium burn rate to break in the heater. This break-in period was performed Intertek and data is included in the final report. The unit was found to be operating satisfactory during this break-in. The 10 plus hours of pre-burning were conducted May 2, 2016. The fuel used for the break-in process was cordwood.

Following the pre-burn break-in process the unit was allowed to cool and ash and residue was removed from the firebox. The unit's chimney system and laboratory dilution tunnels were cleaned using standard wire brush chimney cleaning equipment. On May 3, 2016 the unit was set-up for testing.

II.B INFORMATION LOG

II.B(1) TEST STANDARD

From May 3, 2016 to May 5, 2016, the unit was tested for EPA emissions. For Wood Hydronic Heaters, the test was conducted in accordance with ASTM E2618-13. The fuel used for the test run was Oak 4" x 4" lumber.

The applicable EPA regulatory limits are:

Step 1 – 2015 – 0.32 lbs/MMBtu Output, with an 18 g/hr limit per test

Step 2 – 2020 – 0.15 lbs/MMBtu Output (Cordwood) or 0.10 lbs/MMBtu Output (Cribs)

II.B(2) Deviation from Standard Method

No deviations from the standards were performed, however, only the applicable sections from each standard were used during all testing.

II.C SUMMARY OF TEST RESULTS

The appliance tests resulted in the following performance:

Particulate Emissions: 0.271 lbs/MMBtu Output

Carbon Monoxide Emissions: 6.012 g/min

Heating Efficiency: 74.9% (Higher Heating Value Basis)

II.D DESCRIPTION OF TEST RUNS

RUN #1 (May 3, 2016). The cooling water for the heat exchanger was set to draw a category 4 burn rate. Minor adjustments were made to maintain the heat exchange rate. The Test Load weighed 128.21 lbs. and utilized a 25 lb. coal bed. The average Btu/hr output was 210,486. Burn time was 3.65 hours. The kg/hr burn rate was 12.96.

RUN #2 (May 4, 2016). The cooling water for the heat exchanger was set to draw a category 1 burn rate. Minor adjustments were made to maintain the heat exchange rate. The Test Load weighed 128.54 lbs. and utilized a 25 lb. coal bed. The average Btu/hr output was 33,017. Burn time was 19.63 hours. The kg/hr burn rate was 2.43.

RUN #3 (May 5, 2016). The cooling water for the heat exchanger was set to draw a category 2 burn rate. Minor adjustments were made to maintain the heat exchange rate. The Test Load weighed 124.52 lbs. and utilized a 24 lb. coal bed. The average Btu/hr output was 52,182. Burn time was 12.57 hours. The kg/hr burn rate was 3.67.

RUN #4 (May 5, 2016). The cooling water for the heat exchanger was set to draw a category 3 burn rate. Minor adjustments were made to maintain the heat exchange rate. The Test Load weighed 126.70 lbs. and utilized a 25 lb. coal bed. The average Btu/hr output was 103,399. Burn time was 6.80 hours. The kg/hr burn rate was 6.98.

II.D SUMMARY OF OTHER DATA

TABLE 1. – DATA SUMMARY PART A

						Θ	W_{fuel}	MC_{ave}	Q_{in}	Q_{out}
Category	**Run No.**	**Load % Capacity**	**Target Load**	**Actual Load**	**Actual Load**	**Test Duration**	**Wood Weight as-fired**	**Wood Moisture**	**Heat Input**	**Heat Output**
			Btu/hr	Btu/hr	% of Max	hrs	lb	% DB	Btu	Btu
I	2	<15% of Max	34,500	33,017	14.4%	19.63	128.54	22.07	905,585	648,226
II	3	16-24% of Max	55,200	52,182	22.7%	12.57	124.52	22.39	874,942	655,758
III	4	25-50% of max	115,000	103,399	45.0%	6.80	126.70	21.04	900,207	703,113
IV	1	Max capacity	230,000	210,486	91.5%	3.65	128.21	22.97	896,625	768,273

TABLE 2. – DATA SUMMARY PART B

			T2 Min	E_T	E	E	$E_{g/hr}$	$E_{g/kg}$	η_{del}	η_{SLM}
Category	**Run No.**	**Load % Capacity**	**Min Return Water Temp.**	**Total PM Emissions**	**PM Output Based**	**PM Output Based**	**PM Rate**	**PM Factor**	**Delivered Efficiency**	**Stack Loss Efficiency**
			ºF	g	lb/mmBtu Out	g/MJ	g/hr	g/kg	%	%
I	2	<15% of Max	155.61	110.35	0.375	0.161	5.62	2.31	71.6%	72.8%
II	3	16-24% of Max	155.5	79.50	0.267	0.115	6.33	1.72	74.9%	69.0%
III	4	25-50% of max	154.4	46.14	0.145	0.062	6.78	0.97	78.1%	83.4%
IV	1	Max capacity	138.9	25.18	0.072	0.031	6.90	0.53	85.7%	81.9%

TABLE 3. – HANG TAG INFORMATION

MANUFACTURER:	**Piney Mfg.**		
MODEL NUMBER:	**EGR250**		
8-HOUR OUTPUT RATING:	$Q_{out\text{-}8hr}$	92,747	Btu/hr
8-HOUR AVERAGE EFFICIENCY:	$\eta_{avg\text{-}8hr}$	77.4%	(Using higher heating value)
		83.4%	(using lower heating value)
ANNUAL EFFICIENCY RATING:	η_{avg}	74.9%	(Using higher heating value)
		80.6%	(using lower heating value)
PARTICULATE EMISSIONS:	E_{avg}	6.17	GRAMS/HR (average)
		0.271	LBS/MILLION Btu OUTPUT
CARBON MONOXIDE:	CO (g/min)	6.012	GRAMS/MINUTE

TABLE 4. – YEAR ROUND USE WEIGHTING

Category	Run No.	Weighting Factor	$\eta_{del,i}$ x F_i-HHV	$\eta_{del,i}$ x F_i-LHV	$E_{g/MJ,i}$ x F_i	$E_{g/kg,i}$ x F_i	$E_{lb/mmbtu,i}$ x F_i	$E_{g/hr,i}$ x F_i	$CO_{g/min,i}$ x F_i
I	2	0.437	0.313	0.337	0.071	1.009	0.164	2.456	2.243
II	3	0.238	0.178	0.192	0.027	0.410	0.064	1.506	1.294
III	4	0.275	0.215	0.231	0.017	0.267	0.040	1.866	2.243
IV	1	0.050	0.043	0.046	0.002	0.027	0.004	0.345	0.232
Totals		1.000	74.9%	80.6%	0.117	1.713	0.271	6.173	6.012

TABLE 5. - GENERAL SUMMARY OF RESULTS

Run No.	Burn Rate (kg/hr)(Dry)	1st Hour Emissions (g/hr)	Run Time (min)
2	2.43	5.05	19.63
3	3.67	10.02	12.57
4	6.98	4.50	6.80
1	12.96	4.26	3.65

TABLE 6. – CSA B415.1 RESULTS

Run No.	CO Emissions (g/min)	Heating Efficiency (% HHV)	Heat Output (Btu/hr)
2	5.13	72.8	33,427
3	5.44	69.0	47,842
4	8.16	83.4	109,857
1	4.64	81.9	200,310

III. PROCESS DESCRIPTION

III.A TEST SET-UP DESCRIPTON

A standard 6" diameter vertical single wall pipe and insulated chimney system was installed to 15' above floor level. The singe wall pipe extended to 8 feet above the floor and insulated chimney extended the remaining height.

III.B AIR SUPPLY SYSTEM

Combustion air enters an inlet plenum located on the back of the heater, which is directed to the firebox. All gases exit through the 6" flue also located at the back/top of the heater. The exhaust gases are assisted by a combustion blower.

III.C TEST FUEL PROPERTIES

Wood used for the testing is 4" x 4" dimensional Oak lumber. Oak has a default heating value of 8600 Btu/lb (19887 kJ/kg) and a moisture content between 19% and 25% on a 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

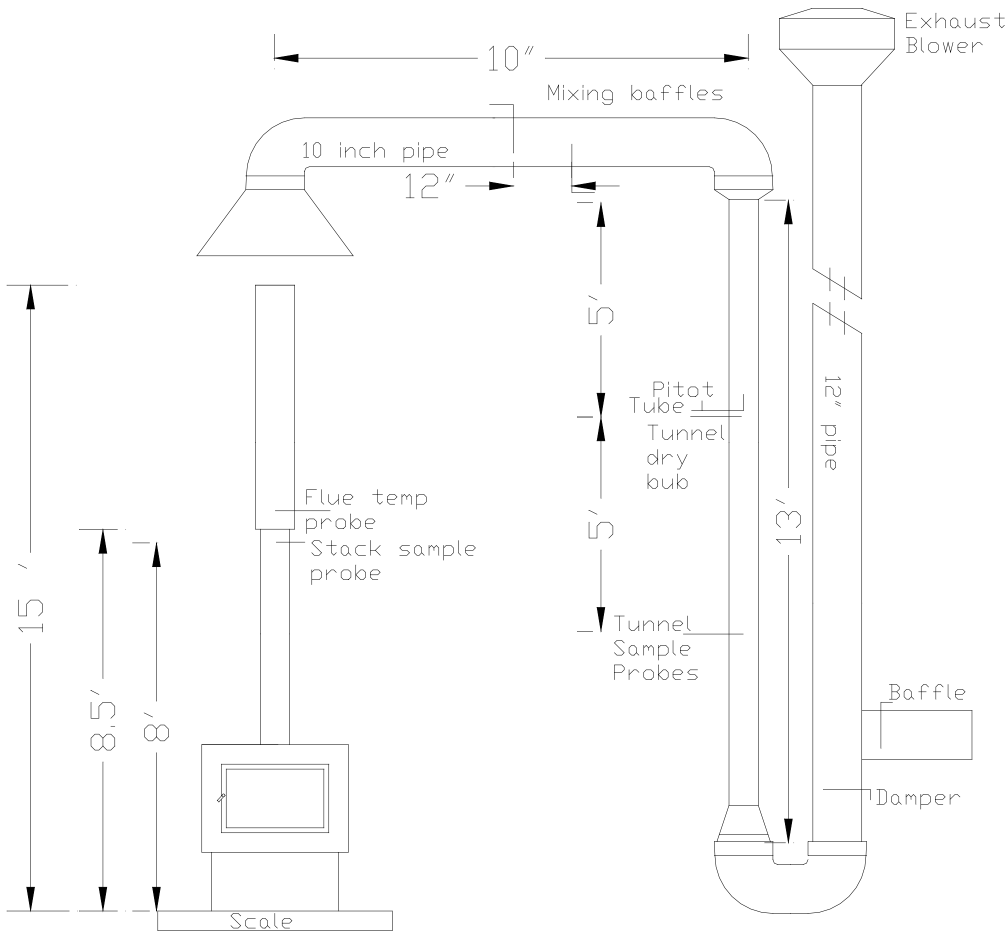
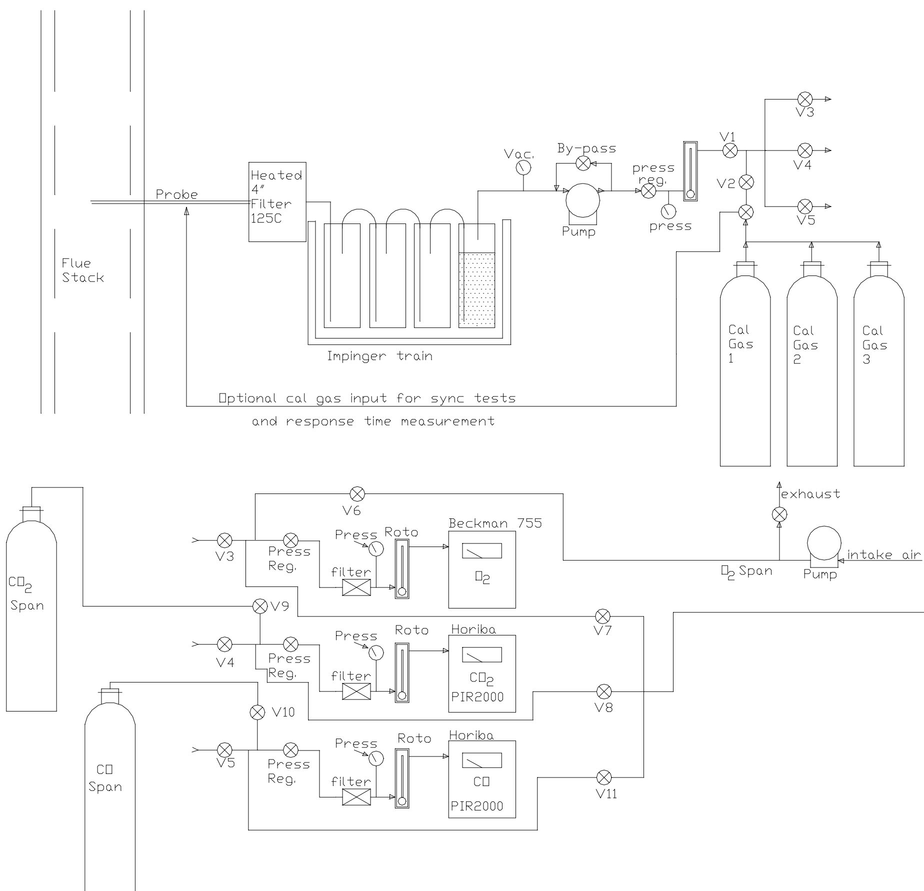


FIGURE 1

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

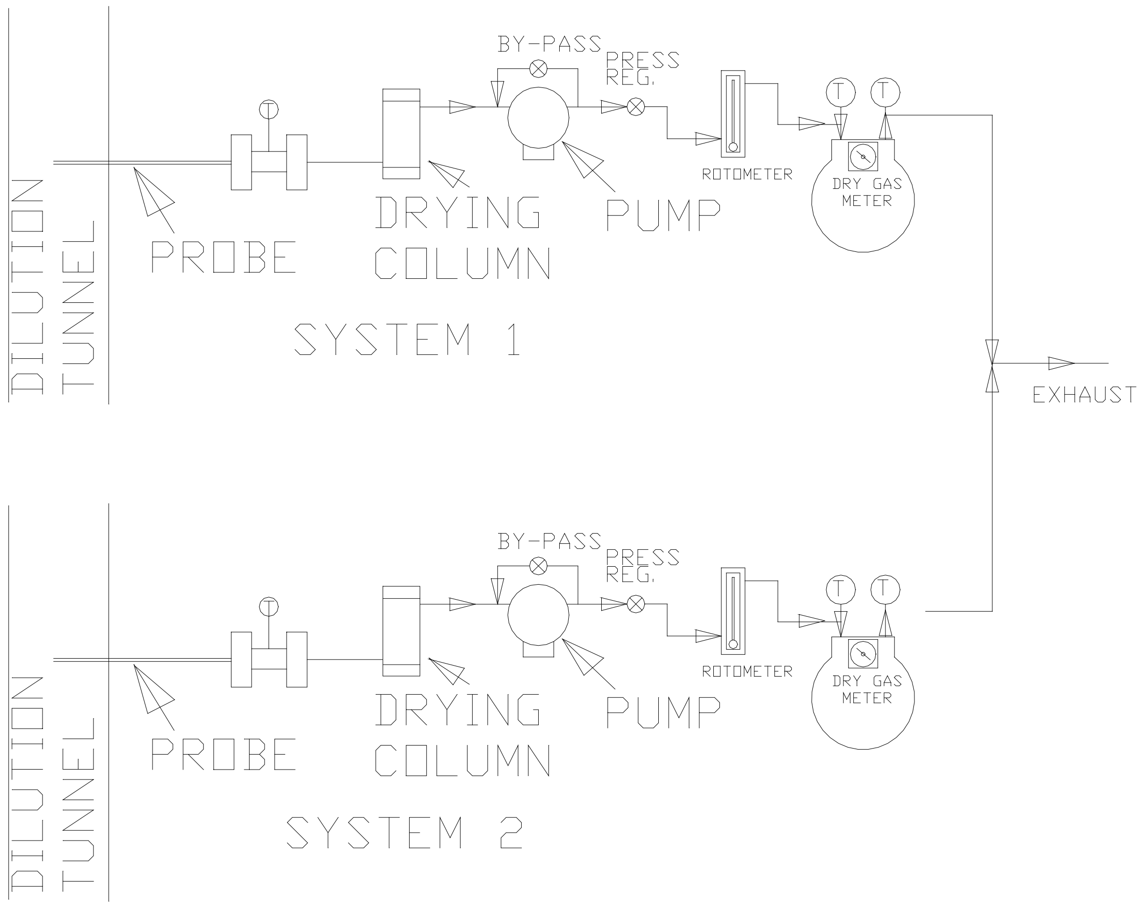


Figure 3

V. SAMPLING METHODS

V.A. PARTICULATE SAMPLING

Particulates were sampled in strict accordance with ASTM E2515-2011. 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. In order to measure first-hour emissions rates the a third filter set is prepared at one hour into the test run, the filter sets are changed in one of the two sample trains. The two filter sets used for this train are analyzed individually to determine the first hour and total emissions rate.

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 three-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

Proportionality was calculated in accordance with ASTM E2515-11. The data and results are included in Appendix C.

VII. CONCLUSION

This test demonstrates that this unit is an affected facility under the definition given in the regulation. The emission rate of 0.271 g/hr meets the EPA requirements for the Step 1 limits.

INTERTEK TESTING SERVICES NA

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