Heat Tech Industries

Project # 23-143
Model: HTP Standard
Type: Pellet-Fired Room Heater
6/30/2023

ASTM E2779 Standard Test Method for Determining Particulate Matter Emissions from Pellet Heaters (EPA ALT-146)

Contact: Mr. Tom Bassett
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Biggs, CA 95917
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Prepared by: Aaron Kravitz, Testing Supervisor

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Revision History

6/30/2023– Original Issue

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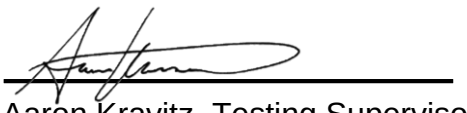
Affidavit

PFS-TECO was contracted by Heat Tech Industries (Heat Tech) to provide testing services for the Standard Pellet-Fired Room Heater per ASTM E2779, *Determining PM Emissions from Pellet Heaters*. All testing and associated procedures were conducted at PFS-TECO's Portland Laboratory on 5/3/2023. PFS-TECO's Portland Laboratory is located at 11785 SE Highway 212 – Suite 305, Clackamas, Oregon 97015. Testing procedures followed EPA ALT-146 / ASTM E2779. Particulate sampling was performed per ASTM E2515, *Standard Test Method for Determination of Particulate Matter Emissions Collected by a Dilution Tunnel.*

PFS-TECO is accredited by the U.S. Environmental Protection Agency for the certification and auditing of wood heaters pursuant to subpart AAA of 40 CFR Part 60, New Source Performance Standards for Residential Wood Heaters and subpart QQQQ of 40 CFR Part 60, Standards of Performance for New Hydronic Heaters and Forced Air Furnaces, Methods 28R, 28WHH, 28 WHH-PTS, and all methods listed in Sections 60.534 and 60.5476. PFS-TECO holds EPA Accreditation Certificate Numbers 4 and 4M (mobile). PFS-TECO is accredited by IAS to ISO 17020:2012 "Criteria for Bodies Performing Inspections", and ISO 17025:2005 "Requirements for Testing Laboratories." PFS-TECO is also accredited by Standards Council of Canada to ISO 17065:2012 "Requirements for Bodies Operating Product Certification Systems."

The following people were associated with the testing, analysis and report writing associated with this project.



Aaron Kravitz, Testing Supervisor

Introduction

Heat Tech of Biggs, CA contracted with PFS-TECO to perform EPA certification testing on HTP Standard Pellet-Fired Room Heater. All testing was performed at PFS-TECO's Portland Laboratory. Testing was performed by Mr. Aaron Kravitz.

Notes

- Prior to start of testing, 50 hours of conditioning was performed by the manufacturer at a medium heat setting, per ASTM E2779
- Prior to start of testing, the dilution tunnel was cleaned with a steel brush.
- A separate, independent sample train was utilized to determine 1st hour emissions.
- A single test was performed in accordance with EPA ALT-146 burn rate settings:
    - 1 Hour at Maximum Burn Setting
    - 2 Hours at Medium Burn Setting (less than the mid-point of the high and low rates)
    - 3 Hours at Minimum Burn Setting

Pellet Heater Identification and Testing

- Appliance Tested: ***HTP Standard***
- Serial Number: ***N/A – Prototype Unit; PFS Tracking #0144***
- Manufacturer*:* ***Heat Tech***
- Catalyst: ***No***
- Heat exchange blower: ***Integral***
- Type: ***Pellet Stove***
- Style: ***Free Standing***
- Date Received: ***Friday, March 31, 2023***
- Testing Period – Start: ***Wednesday, May 03, 2023*** Finish: ***Wednesday, May 03, 2023***
- Test Location: ***PFS-TECO Portland Laboratory, 11785 SE HWY 212 - Suite 305, Clackamas, OR 97015***
- Elevation: ***≈131 Feet above sea level***
- Test Technician(s): ***Aaron Kravitz***
- Observers: ***N/A***

Test Procedures and Equipment

All Sampling and analytical procedures were performed by Aaron Kravitz. All procedures used are directly from ASTM E2779 and ASTM E2515. See the list below for equipment used. See Appendix C submitted with this report for calibration data.

Equipment List:

Equipment ID#	Equipment Description
50	Digiweigh DWP12i Platform Scale
53	APEX XC-60-ED Digital Emissions Sampling Box A
54	APEX XC-60-ED Digital Emissions Sampling Box B
203	APEX XC-50-DIR Digital Emissions Sampling Box C
55	Apex Ambient Air Sample Box
57	California Analytical ZRE CO2/CO/O2 IR ANALYZER
95	Anemometer
97	10 lb audit weight
107	Sartorius Analytical Balance
109A/B	Troemner 100mg/200mg Audit Weights
111	Microtector
189	Mettler 3'x3' floor scale w/digital weight indicator
215	Temperature Logger
CC121798	Gas Analyzer Calibration Span Gas
CC139173	Gas Analyzer Calibration Mid Gas

Results

The integrated test run emission rate for test Run 1 was measured to be **1.2 g/hr** with a Higher Heating Value efficiency of **67%** and a CO emission rate of **0.35 g/min**. The calculated first hour particulate emission rate was **1.6 g/hr**. The Heat Tech Model HTP Standard Pellet-Fired Room Heater meets the 2020 PM emission standard of ≤ 2.0 g/hr per CFR 40 part 60, §60.532 (b).

Detailed individual run data can be found in Appendix A submitted with this report.

Summary Table

EPA Application Table											
Run Number	Date	Segments		Run Time (min)	Heat Output (BTU/hr)	1st Hr Emissions (g/hr)	Integrated Total (g/hr)	CO Emissions (g/min)	Overall CO Emissions (g/min)	Heating Efficiency (%HHV)	Overall Heating Efficiency (%HHV)
		Setting	BR								
1	5/3/2023	OA	0.90	360	11255	1.6	1.2	0.35	0.35	67%	67%
		H	1.55	60	19455			0.27		67%	
		M	0.95	120	11245			0.55		63%	
		L	0.64	180	8419			0.24		70%	

Test Run Narrative

Run 1

Run 1 was performed on 5/3/2023 as an attempted integrated test run per EPA ALT-146/ ASTM E2779. The overall test duration was 360 minutes. The particulate emissions rate for the integrated test run was 1.2 g/hr. The run had an overall HHV efficiency of 67%. A separate filter train C was run for the first hour of the run only. All test results were appropriate and valid and the burn rate requirement for the integrated test run were achieved. There were no anomalies and all criteria were met.

Test Conditions Summary

Testing conditions for all runs fell within allowable specifications of ASTM E2779 and ASTM E2515. A summary of facility conditions, fuel burned, and run times is listed below.

Runs	Ambient (°F)		Relative Humidity (%)		Average Barometric Pressure (In. Hg.)	Preburn Fuel Weight (lbs)	Test Fuel Weight (lbs)	Test Fuel Moisture (%DB)	Test Run Time (Min)
	Pre	Post	Pre	Post					
1	67	72	44.7	38.0	29.65	3.6	12.6	6.4%	360

Appliance Operation and Test Settings

The appliance was operated according to procedures as described in the Operations Manual, found in Appendix B submitted with this report. Detailed run information can be found in Appendix A submitted with this report.

Settings & Run Notes

	Pre-Burn	Test Run		
Run 1	Heat Level: 5	**Maximum Segment** Heat Level: 5	**Medium Segment** Heat Level: 2	**Minimum Segment** Heat Level: 1

Appliance Description

Model(s): HTP Standard

Appliance Type: Pellet-Fired Room Heater

Additional Models: None

Air Introduction System: A variable speed combustion fan forces air into the firebox through holes in the bottom of the firepot.

Combustion Control: A control panel on the side of the unit is used to select burn rates, which are varied by automatic modulation of the combustion fan and feed system. An automatically controlled distribution bower is also installed.

Fueling System: An inclined auger driven by a gear motor, meters pellets through a drop tube (over feed) to a fire pot in the firebox.

Baffles: N/A

Flue Outlet: Venting is through a 3" diameter steel pipe, which exits through the back of the unit.

Appliance Dimensions

HTP Standard Dimensions

Height	Width	Depth	Firebox Volume
31.5”	26.5”	21”	N/A – Pellet Stove

Appliance design drawings can be found in Appendix D submitted with the CBI copy of this report.

Appliance Front

Appliance Left

Appliance Right

Appliance Rear

Test Fuel Properties

Test fuel used was Energex Wood Pellet Fuel, a PFI Certified Premium Pellet Brand. A sample of pellets was sent to Twin Ports Testing for analysis, see report below.

Pellet Fuel Analysis

Twin Ports Testing

Twin Ports Testing, Inc.
1301 North 3rd Street
Superior, WI 54880
p: 715-392-7114
p: 800-373-2562
f: 715-392-7163
www.twinportstesting.com

Analytical Test Report

Report No: USR:W223-0247-01
Issue No: 1

Client: PFS-TECO
11785 SE Hwy 212 Ste 305
Clackamas, OR 97015
Attention: Sebastian Button

PO No:

Signed:
Amber Anderson
Chemist
Date of Issue: 5/11/2023

Sample Details

Sample Log No:	W223-0247-01	**Sample Date:**	
Sample Designation:	Biomass Pellets	**Sample Time:**	
Sample Recognized As:	Biomass Pellets	**Arrival Date:**	5/8/2023

Test Results

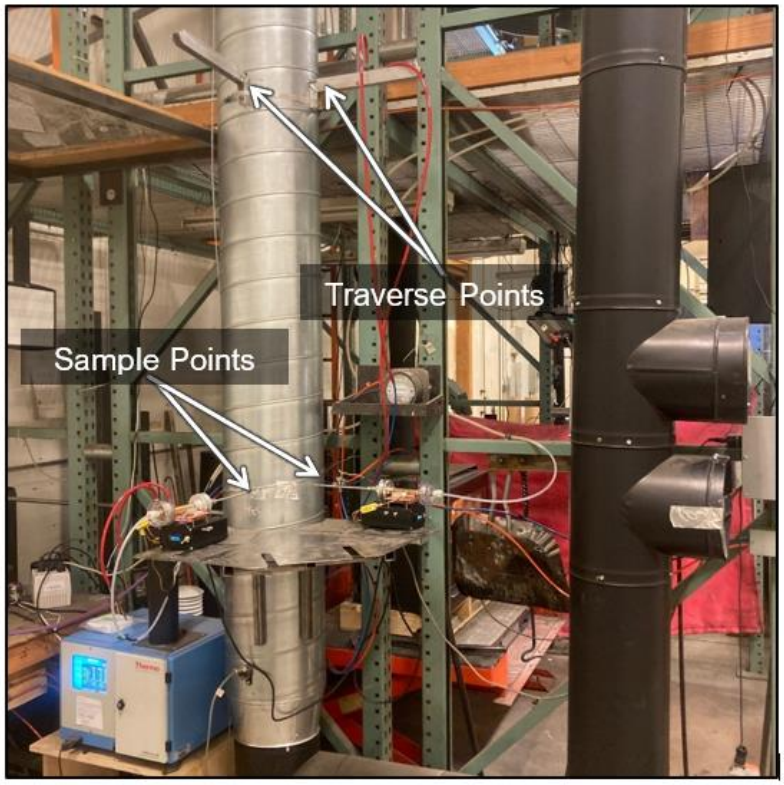
	METHOD	UNITS	MOISTURE FREE	AS RECEIVED
Moisture Total	ASTM E871	wt. %		5.98
Ash	ASTM D1102	wt. %	0.47	0.45
Volatile Matter	ASTM D3175	wt. %		
Fixed Carbon by Difference	ASTM D3172	wt. %		
Sulfur	ASTM D4239	wt. %	0.011	0.011
SO_2	Calculated	lb/mmbtu		0.027
Net Cal. Value at Const. Pressure	ISO 1928	GJ/tonne	17.80	16.59
Gross Cal. Value at Const. Vol.	ASTM E711	Btu/lb	8456	7950
Carbon	ASTM D5373	wt. %	46.01	43.26
Hydrogen*	ASTM D5373	wt. %	8.65	8.13
Nitrogen	ASTM D5373	wt. %	< 0.20	< 0.19
Oxygen*	ASTM D3176	wt. %	> 44.66	> 41.99
*Note: As received values do not include hydrogen and oxygen in the total moisture.				
Chlorine	ASTM D6721	mg/kg		
Fluorine	ASTM D3761	mg/kg		
Mercury	ASTM D6722	mg/kg		
Bulk Density	ASTM E873	lbs/ft^3		
Fines (Less than 1/8")	TPT CH-P-06	wt.%		
Durability Index	Kansas State	PDI		
Sample Above 1.50"	TPT CH-P-06	wt.%		
Maximum Length (Single Pellet)	TPT CH-P-06	inch		
Diameter, Range	TPT CH-P-05	inch		to
Diameter, Average	TPT CH-P-05	inch		
Stated Bag Weight	TPT CH-P-01	lbs		
Actual Bag Weight	TPT CH-P-01	lbs		

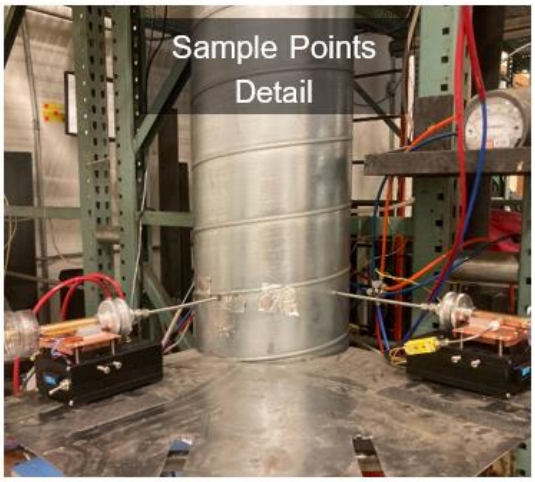
Comments:

ilac-MRA
PJLA Testing
Accreditation #80243

Sampling Locations and Descriptions

Sample ports are located 16.5 feet downstream from any disturbances and 2 feet upstream from any disturbances. Flow rate traverse data was collected 8 feet downstream from any disturbances and 4 feet upstream from any disturbances. (See below).





Sampling Methods

ASTM E2515 was used in collecting particulate samples. The dilution tunnel is 12 inches in diameter. All sampling conditions per ASTM E2515 were followed. No alternate procedures were used.

Analytical Methods Description

All sample recovery and analysis procedures followed ASTM E2515 procedures. At the end of each test run, filters, O-Rings and probes were removed from their housings, dessicated for a minimum of 24 hours, and then weighed at 6 hour intervals to a constant weight per ASTM E2515-11 Section 10.

Calibration, Quality Control and Assurances

Calibration procedures and results were conducted per EPA Method 28R, ASTM E2515-11 and ASTM E2780-10. Test method quality control procedures (leak checks, volume meter checks, stratification checks, proportionality results) followed the procedures outlined.

Appliance Sealing and Storage

Upon completion of testing, the appliance was secured with metal strapping and the seal below was applied, the appliance was then returned to the manufacturer's location at: 867 Hwy 99, Gridley, CA 95948 for archival.

Sealing Label

ATTENTION:

THIS SEAL IS NOT TO BE BROKEN WITHOUT PRIOR AUTHORIZATION FROM THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY.

THIS APPLIANCE HAS BEEN SEALED INACCORDANCE WITH REQUIREMNTS OF 40CFR PART 60 SUBPART AAA §60.535 (a)(2)(vii)

REPORT #_____ DATE SEALED_____

MANUFACTURER_____ MODEL #_____

Sealed Unit


ATTENTION
REPORT # 23-143
DATE SEALED: 3/8/23
MANUFACTURER: Host Tech
MODEL: HTP Standard

List of Appendices

The following appendices have been submitted electronically in conjunction with this report:

Appendix A – Test Run Data, Technician Notes, and Sample Analysis

Appendix B – Labels and Manuals

Appendix C –Equipment Calibration Records

Appendix D – Design Drawings (CBI Report Only)

Appendix E – Manufacturer QAP (CBI Report Only)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

Mr. John Steinert
Vice President
PFS TECO
11785 SE Hwy 212
Suite 305
Clackamas, OR 97015

02/04/2022

Dear Mr. Steinert,

I am writing you in response to your correspondence dated February 3, 2022, in which you request the use of an alternative testing procedure to demonstrate compliance with 40 CFR part 60, Subpart AAA – Standards of Performance for New Residential Wood Heaters (Subpart AAA). The Office of Air Quality Planning and Standards, as the delegated authority, must make the determination on any major alternatives to test methods and procedures required under 40 CFR parts 59, 60, 61, 63, and 65. Your proposed alternative test method and our approval decisions are discussed below.

According to the information provided, you seek an alternative test method for use when conducting testing on the United States Stove Company, Model KP5517 pellet heater. Currently, as required by section 60.534(a)(l)(i) of Subpart AAA, a manufacturer has the option to test their appliance in accordance with 40 CFR part 60, Appendix B, Method 28R for a crib fuel appliance or ASTM E2779-10 "Standard Test Method for Determining Particulate Matter Emissions from Pellet Heaters" (ASTM E2779-10) for a pellet fuel appliance. This request seeks an alternative to section 9.4.1.2 of ASTM E2779-10 which specifies test conditions for pellet heaters including the determination of the Medium Burn Rate Category and states that the medium burn rate must be ≤50% of the maximum burn rate.

In your request, you state that the specification for determining the medium burn rate found in ASTM E2779-10 is incorrect, and the Medium Burn Rate Category should be defined as less than 50% of the midpoint point (this is defined in the attached Memo as 50% of the span between the Maximum Burn Rate and the Low Burn Rate) between the high and low burn rates. Furthermore, your request includes a memorandum dated February 2, 2022, titled "Appropriate Calculation of Medium Burn Rate Category in ASTM E-2779 Testing" (attached) which was sent to the EPA's Office of Enforcement and Compliance Assurance. This memorandum states that an error had been uncovered in determining the appropriate Medium Burn Rate Category in ASTM E2779-10 for compliance pursuant to Subpart AAA. Specifically, section 9.4.1.2 of ASTM E2779-10 states that "the pellet heater shall be operated with the control or controls set in

the position(s) as needed to achieve a burn rate that is ≤ 50% of the maximum burn rate." Table 1 of ASTM E2779-10 also notes that the Medium Burn Rate Category test must be ≤ 50% of the maximum burn rate. The memorandum states that this is incorrect as it assumes that zero is the other bound for determining half of the maximum burn rate, and that the correct approach in determining the Medium Burn Rate Category should be at a level below 50% of the span between the Maximum Burn Rate and the Low Burn Rate (a non-zero value).

We have reviewed your request and agree that the Medium Burn Rate Category should be defined as less than 50% of the span between the high and low burn rates. Meaning that the Medium Burn Rate Category should be at a level below 50% of the span between the Maximum Burn Rate and the Low Burn Rate (a non-zero value).

Based on the information provided and with the caveats set forth below, we are approving your request for an alternative methodology used when calculating the Medium Burn Rate Category to conduct certification testing as required by Subpart AAA, section 60.534(a)(1)(i) on pellet heaters. This approval is based on the understanding that the Medium Burn Rate Category is defined as less than 50% of the span between the high and low burn rates. Additionally, this approval is based on the understanding that the lowest heat output (Btu/hr) setting available to the user, and corresponds to the lowest burn rate to be evaluated during certification testing; this is consistent with Subpart AAA, section 60.534(a)(1), which states: "The burn rate for the low burn category must be no greater than the rate that an operator can achieve in home use and no greater than is advertised by the manufacturer or retailer."

With this Alternate Test Method, the following changes to ASTM E2779-10 must be followed for certification testing:

1. Medium Burn Rate Category burn rate is defined as:

   Nomenclature:
   Max = Maximum burn rate (kg/h)
   Min = Minimum burn rate (kg/h)

$$\frac{Max+Min}{2} \qquad \text{Eq.1}$$

All other requirements of ASTM E-2779-10 must be followed during the testing, and all requirements of 40 CFR part 60, Subpart AAA must be satisfied as described in your test report. A copy of this letter must be included in each certification test report where this alternative test method is utilized.

Because this alternative method may be of use to others, we feel that it is reasonable that this approval be broadly applicable to all pellet heaters tested in accordance with ASTM E2779-10 "Standard Test Method for Determining Particulate Matter Emissions from Pellet Heaters" and subject to the requirements of §60.534(a)(1)(i) of Subpart AAA. For this reason, we will post this

letter as ALT-146 on our website at *https://www.epa.gov/emc/broadly-applicable-approved-alternative-test-methods* for use by other interested parties. This alternative method approval is valid until such time that Subpart AAA is revised or replaced to require a different pellet heater certification method, and at such time, this alternative will be reconsidered and possibly withdrawn.

If you have additional questions regarding this approval, please contact Angelina Brashear of my staff at 919-541-4746 or *brashear.angelina@epa.gov.*

Sincerely,

Steffan M Johnson

Steffan M. Johnson
Group Leader
Measurement Technology Group

cc: Angelina Brashear – EPA/OAQPS/AQAD
Chuck French – EPA/OAQPS/SPPD
Rafael Sanchez – EPA/OECA
Robert Scinta – EPA/OECA
Michael Toney – EPA/OAQPS/AQAD
Nathan Topham – EPA/OAQPS/SPPD
John Voorhees – United States Stove Company
Chet Wayland – EPA/OAQPS/AQAD

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

MEMORANDUM

02/02/2022

SUBJECT: Appropriate calculation of Medium Burn Rate Category in ASTM E-2779 Testing

FROM: Steffan Johnson
Group Leader
Measurement Technology Group
Air Quality Assessment Division

STEFFAN JOHNSON
Digitally signed by STEFFAN JOHNSON
Date: 2022.02.02 08:28:07 -05'00'

TO: Robert Scinta, P.E.
Chief, Air Branch
Monitoring, Assistance, and Media Programs Division
Office of Compliance, Office of Enforcement and Compliance Assurance

During a recent review of pellet heater compliance test reports, the Measurement Technology Group has uncovered an error in determining the appropriate Medium Burn Rate Category when using ASTM E-2779 for compliance pursuant to 40 CFR 60, subpart AAA. Specifically, the method requirements in section 9.4.1.2 and Table 1 of that test method incorrectly require that the Medium Burn Rate Category must fall below 50% of the maximum burn rate. This is not correct as this requirement assumes then that zero is the other bound for determining half of the maximum.

9.4.1.2 *Medium Burn Rate Category*—For burn rates in the medium segment, except as allowed in 9.4.1.4 or 9.4.1.5, the pellet heater shall be operated with the control or controls set in the position(s) as needed to achieve a burn rate that is ≤50 % of the maximum burn rate.

TABLE 1

Burn Rate Segment	Maximum	Medium	Minimum
Description	Maximum achievable	≤ 50% of Maximum	Minimum achievable
Time at Burn Rate	60 +5 / – 0 minutes	120 +5 / – 0 minutes	180 +5 / – 0 minutes

The correct application of this requirement would be to determine the Medium Burn Rate Category at a level below 50% of the span between the Maximum Burn Rate and the Low Burn Rate (a non-zero value). Ergo, the correct calculation for finding that midpoint of 50% is defined as $\frac{Max+M}{2}$.

For example, if the Maximum Burn rate of an appliance is 1.79 kg/hr and the minimum is 1.23 kg/hr, the method would currently place the 50% requirement at 0.895 kg/hr. This is unachievable on this appliance and presents an impossible compliance requirement. Applying the equation laid out above the value of 1.51 is derived and, therefore, presents an appropriate and likely attainable emissions test requirement for the Medium Burn Rate Category.

During your reviews of such emissions tests, as reported to OECA and intended for compliance certification purposes, MTG recommends applying the above procedure in order to ascertain if a Medium Burn Rate was appropriately established during a compliance test.

CC:
Sarah Ayres - OECA
Angelina Brashear – OAQPS
Alice Edwards – Alaska DEC
Chuck French – OAQPS
Robert Lischinsky - OECA
Theresa Lowe - OAQPS
Rafael Sanchez – OECA
Robert Scinta - OECA
Mike Toney – OAQPS
Nathan Topham - OAQPS
Chet Wayland – OAQPS

PELLET TEST DATA PACKET
ASTM E2779/E2515

Run 1 Data Summary

Client: Heat Tech
Model: Standard
Job #: 23-143
Tracking #: 144
Test Date: 5/3/2023

Techician Signature — Date: 6/2/2023

TEST RESULTS - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Standard
Run #: 1

Job #: 23-143
Tracking #: 144
Technician: AK
Date: 5/3/2023

Burn Rate Summary	
High Burn Rate (dry kg/hr)	1.55
Medium Burn Rate (dry kg/hr)	0.95
Low Burn Rate (dry kg/hr)	0.64
Overall Burn Rate (dry kg/hr)	0.90

Medium Burn Rate Target: < 1.1 dry kg/hr

	Ambient Sample	Sample Train A	Sample Train B	1st Hour Filter - Train C
Total Sample Volume (ft^3)	48.854	55.907	55.549	10.245
Average Gas Velocity in Dilution Tunnel (ft/sec)	6.7			
Average Gas Flow Rate in Dilution Tunnel (dscf/hr)	17795.5			
Average Gas Meter Temperature (°F)	70.1	95.1	94.0	76.5
Total Sample Volume (dscf)	49.358	53.514	52.805	9.869
Average Tunnel Temperature (°F)	87.0			
Total Time of Test (min)	360			
Total Particulate Catch (mg)	0.0	3.8	3.6	0.9
Particulate Concentration, dry-standard (g/dscf)	0.0000000	0.0000710	0.0000682	0.0000912
Total PM Emissions (g)	0.00	7.58	7.28	1.62
Particulate Emission Rate (g/hr)	0.00	1.26	1.21	1.62
Emissions Factor (g/kg)	-	1.41	1.35	1.05
Difference from Average Total Particulate Emissions (g)	-	0.15	0.15	-
Difference from Average Total Particulate Emissions (%)	-	2.0%	2.0%	-
Difference from Average Emissions Factor (g/kg)	-	0.03	0.03	-

Final Average Results	
Total Particulate Emissions (g)	7.43
Particulate Emission Rate (g/hr)	1.24
Emissions Factor (g/kg)	1.38
HHV Efficiency (%)	67.3%
LHV Efficiency (%)	74.4%
CO Emissions (g/min)	0.35

Quality Checks	Requirement	Observed	Result
Dual Train Precision	Each train within 7.5% of average emissions (in grams), or emission factors within 0.5 g/kg	See Above	OK
Filter Temps	<90 °F	77.6	OK
Face Velocity	< 30 ft/min	8.7	OK
Leakage Rate	Less than 4% of average sample rate	0.001 cfm	OK
Ambient Temp	55-90 °F	67.4 / 72.3	OK
Negative Probe Weight Evaluation	<5% of Total Catch	Probe Catch Not Negative	OK
Pro-Rate Variation	90% of readings between 90-110%; none greater than 120% or less than 80%	See Data Tabs	OK
Medium Burn Rate	< midpoint of the high and low burn rates	0.95	OK

Overall Pellet Test Efficiency Results

Manufacturer: Heat Tech
Model: Standard
Date: 05/03/23
Run: 1
Control #: 23-143
Test Duration: 360
Output Category: Integrated

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	67.3%	74.4%
Combustion Efficiency	99.5%	99.5%
Heat Transfer Efficiency	67.7%	74.8%

Output Rate (kJ/h)	11,865	11,255	**(Btu/h)**
Burn Rate (kg/h)	0.90	1.98	**(lb/h)**
Input (kJ/h)	17,622	16,716	**(Btu/h)**

Test Load Weight (dry kg)	5.38	11.86	**dry lb**
MC wet (%)	5.98		
MC dry (%)	6.36		
Particulate (g)	7.43		
CO (g)	127		
Test Duration (h)	6.00		

Emissions	**Particulate**	**CO**
g/MJ Output	0.10	1.78
g/kg Dry Fuel	1.38	23.56
g/h	1.24	21.13
g/min	0.02	0.35
lb/MM Btu Output	0.24	4.14

Air/Fuel Ratio (A/F)	34.73

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

Max Burn Rate Segment Efficiency Results

Manufacturer: Heat Tech
Model: Standard
Date: 05/03/23
Run: 1
Control #: 23-143
Test Duration: 60
Output Category: Maximum

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	67.4%	74.4%
Combustion Efficiency	99.5%	99.5%
Heat Transfer Efficiency	67.7%	74.8%

Output Rate (kJ/h)	20,509	19,455	**(Btu/h)**
Burn Rate (kg/h)	1.55	3.41	**(lb/h)**
Input (kJ/h)	30,437	28,873	**(Btu/h)**

Test Load Weight (dry kg)	1.55	3.41	**dry lb**
MC wet (%)	5.98		
MC dry (%)	6.36		
Particulate (g)	N/A		
CO (g)	16		
Test Duration (h)	1.00		

Emissions	**Particulate**	**CO**
g/MJ Output	N/A	0.78
g/kg Dry Fuel	N/A	10.32
g/h	N/A	15.98
g/min	N/A	0.27
lb/MM Btu Output	N/A	1.81

Air/Fuel Ratio (A/F)	22.72

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

Medium Burn Rate Segment Efficiency Results

Manufacturer: Heat Tech
Model: Standard
Date: 05/03/23
Run: 1
Control #: 23-143
Test Duration: 120
Output Category: Medium

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	63.4%	70.0%
Combustion Efficiency	99.0%	99.0%
Heat Transfer Efficiency	64.0%	70.7%

Output Rate (kJ/h)	11,854	11,245	**(Btu/h)**
Burn Rate (kg/h)	0.95	2.10	**(lb/h)**
Input (kJ/h)	18,698	17,737	**(Btu/h)**

Test Load Weight (dry kg)	1.90	4.19	**dry lb**
MC wet (%)	5.98		
MC dry (%)	6.36		
Particulate (g)	N/A		
CO (g)	67		
Test Duration (h)	2.00		

Emissions	**Particulate**	**CO**
g/MJ Output	N/A	2.81
g/kg Dry Fuel	N/A	34.99
g/h	N/A	33.28
g/min	N/A	0.55
lb/MM Btu Output	N/A	6.53

Air/Fuel Ratio (A/F)	36.99

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

Minimum Burn Rate Segment Efficiency Results

Manufacturer: Heat Tech
Model: Standard
Date: 05/03/23
Run: 1
Control #: 23-143
Test Duration: 180
Output Category: Minimum

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	70.2%	77.6%
Combustion Efficiency	99.5%	99.5%
Heat Transfer Efficiency	70.6%	78.0%

Output Rate (kJ/h)	8,875	8,419	**(Btu/h)**
Burn Rate (kg/h)	0.64	1.42	**(lb/h)**
Input (kJ/h)	12,633	11,984	**(Btu/h)**

Test Load Weight (dry kg)	1.93	4.25	**dry lb**
MC wet (%)	5.98		
MC dry (%)	6.36		
Particulate (g)	N/A		
CO (g)	43		
Test Duration (h)	3.00		

Emissions	**Particulate**	**CO**
g/MJ Output	N/A	1.63
g/kg Dry Fuel	N/A	22.49
g/h	N/A	14.45
g/min	N/A	0.24
lb/MM Btu Output	N/A	3.79

Air/Fuel Ratio (A/F)	40.07

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

DILUTION TUNNEL & MISC. DATA - ASTM E2779 / E2515

Client:	Heat Tech	Job #:	23-143
Model:	Standard	Tracking #:	144
Run #:	1	Technician:	AK
Test Start Time:	10:01	Date:	5/3/2023

High Burn End Time (min):	60
Medium Burn End Time (min):	180
Total Sampling Time (min):	360
Recording Interval (min):	1

Meter Box γ Factor:	1.010	(A)
Meter Box γ Factor:	1.001	(B)
Meter Box γ Factor:	0.985	(C)
Meter Box γ Factor:	1.024	(Ambient)
Induced Draft Check (in. H_2O):	0	
Smoke Capture Check (%):	100%	
Date Flue Pipe Last Cleaned:	5/1/2023	

	Pre-Test	Post Test	Avg.
Barometric Pressure (in. Hg)	29.69	29.61	29.65
Relative Humidity (%)	44.7	38.0	
Room Air Velocity (ft/min)	<50	<50	
Scale Audit (lbs)	10.0	10.0	

Ambient Sample Volume: 48.854 ft^3

Sample Train Post-Test Leak Checks

(A)	0.000 cfm @	-5	in. Hg
(B)	0.000 cfm @	-5	in. Hg
(C)	0.000 cfm @	-5	in. Hg
(Ambient)	0.001 cfm @	-12	in. Hg

DILUTION TUNNEL FLOW

Traverse Data

Point	dP (in H_2O)	Temp (°F)
1	0.006	84
2	0.010	84
3	0.010	84
4	0.012	85
5	0.010	85
6	0.004	85
7	0.006	85
8	0.010	85
9	0.012	85
10	0.012	85
11	0.008	86
12	0.006	86
Center	0.011	87

Dilution Tunnel H_2O:	2.00	percent
Tunnel Diameter:	12	inches
Pitot Tube Cp:	0.99	[unitless]
Dilution Tunnel MW(dry):	29.00	lb/lb-mole
Dilution Tunnel MW(wet):	28.78	lb/lb-mole
Tunnel Area:	0.7854	ft^2
V_{strav}:	6.273	ft/sec
V_{scent}:	7.103	ft/sec
F_p:	0.883	[ratio]
Initial Tunnel Flow:	278.3	scf/min

Static Pressure: -0.050 in. H_2O

TEST FUEL PROPERTIES

Default Fuel Values

Fuel Type:	D. Fir	Oak
HHV (kJ/kg)	19,810	19,887
%C	48.73	50
%H	6.87	6.6
%O	43.9	42.9
%Ash	0.5	0.5

Actual Fuel Used Properties

Pellet Brand:	Energex
Pellet Fuel Grade:	PFI Premium
HHV (BTU/lb)	8456
%C	46.01
%H	8.65
%O	44.87
%Ash	0.47
MC (%WB)	5.98

PELLET STOVE PREBURN DATA - ASTM E2779

Client: Heat Tech
Job #: 23-143
Model: Standard
Tracking #: 144
Run #: 1
Technician: AK
Date: 5/3/2023

Recording Interval (min): 1
Run Time (min): 67

		Average:	-0.036	333	67
Elapsed Time (min)	**Scale Reading (lbs)**	**Weight Change (lbs)**	**Flue Draft (in H_2O)**	**Flue (°F)**	**Ambient (°F)**
0	28.1	-	-0.028	202	66
1	28.0	-0.02	-0.027	207	66
2	28.0	-0.01	-0.026	202	66
3	28.0	-0.03	-0.028	206	66
4	28.0	-0.02	-0.027	209	66
5	27.9	-0.03	-0.027	208	66
6	27.9	-0.03	-0.027	210	66
7	27.9	-0.02	-0.026	206	66
8	27.9	-0.03	-0.009	218	66
9	27.8	-0.06	-0.021	243	66
10	27.8	-0.05	-0.025	265	66
11	27.7	-0.07	-0.029	293	66
12	27.6	-0.06	-0.026	300	66
13	27.6	-0.05	-0.030	302	67
14	27.5	-0.07	-0.033	315	67
15	27.5	-0.03	-0.028	311	67
16	27.4	-0.06	-0.035	310	66
17	27.4	-0.06	-0.033	329	67
18	27.3	-0.06	-0.033	331	67
19	27.2	-0.06	-0.037	338	67
20	27.2	-0.04	-0.032	329	67
21	27.2	-0.04	-0.034	328	67
22	27.1	-0.06	-0.035	336	67
23	27.1	-0.04	-0.033	324	67
24	27.0	-0.05	-0.035	333	67
25	26.9	-0.07	-0.036	341	67
26	26.9	-0.04	-0.034	339	67
27	26.8	-0.06	-0.037	339	67
28	26.8	-0.07	-0.037	344	67
29	26.7	-0.05	-0.038	353	67
30	26.7	-0.05	-0.037	347	67
31	26.6	-0.07	-0.041	354	67
32	26.5	-0.05	-0.037	357	67
33	26.5	-0.06	-0.038	358	67
34	26.4	-0.05	-0.039	359	67
35	26.4	-0.05	-0.038	358	67
36	26.3	-0.05	-0.035	352	67
37	26.3	-0.08	-0.039	359	67
38	26.2	-0.05	-0.041	364	67
39	26.1	-0.06	-0.043	367	67
40	26.1	-0.07	-0.041	370	67
41	26.0	-0.05	-0.038	364	67
42	26.0	-0.06	-0.042	368	67
43	25.9	-0.05	-0.041	372	67
44	25.8	-0.07	-0.044	375	67
45	25.8	-0.07	-0.043	380	67
46	25.7	-0.04	-0.036	369	67

PELLET STOVE PREBURN DATA - ASTM E2779

Client: Heat Tech
Job #: 23-143
Model: Standard
Tracking #: 144
Run #: 1
Technician: AK
Date: 5/3/2023

47	25.7	-0.05	-0.041	367	67
48	25.6	-0.08	-0.044	377	67
49	25.6	-0.05	-0.040	376	67
50	25.5	-0.07	-0.042	382	67
51	25.4	-0.05	-0.042	379	67
52	25.4	-0.07	-0.046	380	67
53	25.3	-0.06	-0.042	384	67
54	25.3	-0.05	-0.042	373	67
55	25.2	-0.05	-0.040	376	67
56	25.1	-0.07	-0.043	377	67
57	25.1	-0.06	-0.044	377	67
58	25.0	-0.05	-0.043	376	67
59	25.0	-0.05	-0.042	376	67
60	24.9	-0.07	-0.044	379	67
61	24.8	-0.07	-0.042	381	67
62	24.8	-0.06	-0.040	383	67
63	24.7	-0.06	-0.039	382	67
64	24.7	-0.05	-0.044	374	67
65	24.6	-0.05	-0.042	375	68
66	24.6	-0.06	-0.042	379	67
67	24.5	-0.07	-0.041	378	67

BOX A TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Standard
Run #: 1

Job #: 23-143
Tracking #: 144
Technician: AK
Date: 5/3/2023

	Particulate Sampling Data							Fuel Weight (lb)		Temperature Data (°F)			
Elapsed Time (min)	Gas Meter (ft^3)	Sample Rate (cfm)	Dilution Tunnel dP (in H_2O)	Orifice dH (in H_2O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Scale Reading	Weight Change	Dilution Tunnel	Flue	Filter	Ambient
0	0.000		0.012	1.33	72.1	0.66		12.6		91	382	70	67.4
1	0.135	0.135	0.012	1.89	72	0.77	-	12.6	-0.1	91	381	71	67.5
2	0.276	0.141	0.012	1.93	71.9	0.78	-	12.5	-0.1	91	383	71	67.4
3	0.411	0.135	0.012	1.96	72	0.81	-	12.4	-0.1	92	384	71	67.5
4	0.556	0.145	0.012	1.97	72	0.8	-	12.4	0.0	92	386	71	67.6
5	0.694	0.138	0.012	2.00	72	0.79	-	12.3	-0.1	92	383	71	67.5
6	0.834	0.140	0.012	2.00	72.1	0.8	-	12.3	-0.1	92	386	71	67.6
7	0.979	0.145	0.012	2.02	72.2	0.79	-	12.2	-0.1	92	381	71	67.6
8	1.117	0.138	0.012	2.04	72.3	0.83	-	12.1	-0.1	91	385	72	67.6
9	1.263	0.146	0.012	2.05	72.4	0.84	-	12.1	-0.1	91	386	72	67.6
10	1.405	0.142	0.012	2.07	72.6	0.83	97	12.0	-0.1	92	384	72	67.6
11	1.550	0.145	0.011	2.08	72.8	0.78	-	11.9	-0.1	92	394	72	67.7
12	1.692	0.142	0.011	2.10	72.8	0.85	-	11.9	-0.1	92	393	72	67.8
13	1.837	0.145	0.012	2.10	73.1	0.82	-	11.8	-0.1	92	384	72	67.6
14	1.983	0.146	0.012	2.12	73.3	0.87	-	11.8	0.0	92	380	72	67.8
15	2.127	0.144	0.012	2.14	73.5	0.85	-	11.7	-0.1	92	385	72	67.8
16	2.275	0.148	0.011	2.14	73.8	0.87	-	11.6	-0.1	92	386	72	67.9
17	2.417	0.142	0.012	2.14	74	0.85	-	11.6	-0.1	92	382	72	67.9
18	2.566	0.149	0.012	2.14	74.3	0.89	-	11.5	-0.1	92	388	73	67.8
19	2.709	0.143	0.012	2.16	74.5	0.81	-	11.5	-0.1	92	382	73	67.9
20	2.859	0.150	0.011	2.15	74.9	0.87	102	11.4	-0.1	92	397	73	68
21	3.004	0.145	0.012	2.17	75.2	0.86	-	11.3	-0.1	93	384	73	68
22	3.154	0.150	0.012	2.18	75.5	0.82	-	11.3	-0.1	93	394	73	68.2
23	3.299	0.145	0.012	2.18	75.8	0.82	-	11.2	0.0	93	387	73	68
24	3.448	0.149	0.012	2.19	76	0.83	-	11.2	-0.1	92	383	73	68.1
25	3.594	0.146	0.012	2.20	76.4	0.86	-	11.1	-0.1	93	385	73	68.1
26	3.743	0.149	0.011	2.20	76.8	0.87	-	11.0	-0.1	93	386	73	68.2
27	3.890	0.147	0.012	2.21	77	0.9	-	11.0	-0.1	93	386	73	68.2
28	4.039	0.149	0.012	2.20	77.4	0.9	-	10.9	-0.1	93	387	74	68.1
29	4.187	0.148	0.012	2.21	77.7	0.86	-	10.9	-0.1	92	390	74	68.1
30	4.336	0.149	0.012	2.22	78.1	0.9	103	10.8	-0.1	93	392	74	68.2
31	4.486	0.150	0.012	2.22	78.4	0.87	-	10.7	-0.1	93	396	74	68.3
32	4.634	0.148	0.012	2.23	78.8	0.9	-	10.7	0.0	93	384	74	68.4

BOX A TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Standard
Run #: 1

Job #: 23-143
Tracking #: 144
Technician: AK
Date: 5/3/2023

	Particulate Sampling Data							Fuel Weight (lb)		Temperature Data (°F)			
Elapsed Time (min)	Gas Meter (ft^3)	Sample Rate (cfm)	Dilution Tunnel dP (in H_2O)	Orifice dH (in H_2O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Scale Reading	Weight Change	Dilution Tunnel	Flue	Filter	Ambient
33	4.785	0.151	0.012	2.23	79	0.88	-	10.6	-0.1	93	389	74	68.3
34	4.933	0.148	0.011	2.23	79.4	0.86	-	10.6	-0.1	93	391	74	68.4
35	5.084	0.151	0.012	2.24	79.7	0.9	-	10.5	-0.1	93	388	74	68.2
36	5.233	0.149	0.012	2.24	80.1	0.85	-	10.4	0.0	93	387	74	68.4
37	5.384	0.151	0.012	2.24	80.3	0.91	-	10.4	-0.1	93	390	74	68.3
38	5.533	0.149	0.012	2.24	80.6	0.85	-	10.3	-0.1	93	390	74	68.3
39	5.685	0.152	0.011	2.26	81	0.9	-	10.3	-0.1	93	387	74	68.4
40	5.834	0.149	0.012	2.26	81.3	0.92	102	10.2	-0.1	92	387	74	68.5
41	5.985	0.151	0.012	2.25	81.7	0.89	-	10.1	-0.1	93	397	74	68.5
42	6.136	0.151	0.012	2.26	82	0.84	-	10.1	-0.1	93	395	75	68.6
43	6.287	0.151	0.012	2.26	82.3	0.87	-	10.0	-0.1	93	397	75	68.5
44	6.438	0.151	0.012	2.26	82.6	0.88	-	9.9	0.0	93	391	75	68.5
45	6.590	0.152	0.012	2.27	82.9	0.87	-	9.9	-0.1	93	387	75	68.5
46	6.742	0.152	0.012	2.27	83.2	0.88	-	9.8	-0.1	93	387	75	68.6
47	6.893	0.151	0.011	2.26	83.5	0.86	-	9.8	0.0	93	388	75	68.7
48	7.046	0.153	0.012	2.28	83.8	0.89	-	9.7	-0.1	93	392	75	68.5
49	7.196	0.150	0.012	2.28	84.1	0.9	-	9.6	-0.1	93	395	75	68.6
50	7.350	0.154	0.012	2.28	84.4	0.88	103	9.6	-0.1	93	384	75	68.7
51	7.499	0.149	0.012	2.28	84.6	0.89	-	9.5	-0.1	93	390	75	68.7
52	7.653	0.154	0.012	2.29	84.9	0.86	-	9.5	-0.1	94	392	75	68.7
53	7.802	0.149	0.012	2.28	85.2	0.89	-	9.4	-0.1	93	388	75	68.7
54	7.957	0.155	0.012	2.29	85.4	0.92	-	9.4	-0.1	93	387	75	68.8
55	8.106	0.149	0.012	2.28	85.7	0.91	-	9.3	-0.1	93	388	75	68.8
56	8.262	0.156	0.012	2.29	86	0.89	-	9.2	-0.1	93	390	75	68.9
57	8.411	0.149	0.012	2.29	86.2	0.9	-	9.2	-0.1	93	391	75	68.8
58	8.568	0.157	0.012	2.29	86.4	0.88	-	9.1	-0.1	93	387	75	68.7
59	8.718	0.150	0.012	2.31	86.8	0.92	-	9.0	-0.1	93	393	75	68.9
60	8.873	0.155	0.012	2.30	87	0.92	103	9.0	-0.1	93	393	75	68.9
61	9.024	0.151	0.012	2.31	87.2	0.93	-	8.9	-0.1	93	380	75	69
62	9.178	0.154	0.012	2.31	87.5	0.89	-	8.9	0.0	92	368	76	69.1
63	9.330	0.152	0.012	2.29	87.8	0.93	-	8.8	-0.1	92	366	76	69.1
64	9.484	0.154	0.012	2.31	87.9	0.88	-	8.8	0.0	92	358	76	68.9
65	9.637	0.153	0.012	2.31	88.1	0.93	-	8.8	-0.1	91	354	76	68.9

BOX A TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Standard
Run #: 1

Job #: 23-143
Tracking #: 144
Technician: AK
Date: 5/3/2023

	Particulate Sampling Data							Fuel Weight (lb)		Temperature Data (°F)			
Elapsed Time (min)	Gas Meter (ft^3)	Sample Rate (cfm)	Dilution Tunnel dP (in H_2O)	Orifice dH (in H_2O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Scale Reading	Weight Change	Dilution Tunnel	Flue	Filter	Ambient
66	9.791	0.154	0.012	2.31	88.3	0.9	-	8.7	0.0	91	348	76	68.9
67	9.946	0.155	0.012	2.31	88.6	0.92	-	8.7	0.0	91	349	76	68.9
68	10.098	0.152	0.012	2.32	88.8	0.88	-	8.6	0.0	91	348	76	68.9
69	10.253	0.155	0.012	2.32	89	0.93	-	8.6	0.0	91	337	76	69
70	10.404	0.151	0.012	2.32	89.2	0.88	103	8.6	0.0	91	339	76	69.1
71	10.561	0.157	0.012	2.32	89.4	0.92	-	8.5	0.0	90	333	76	69.1
72	10.712	0.151	0.012	2.33	89.7	0.9	-	8.5	0.0	90	331	76	69.1
73	10.870	0.158	0.012	2.33	89.8	0.89	-	8.5	0.0	90	325	76	69
74	11.022	0.152	0.012	2.33	90	0.92	-	8.4	0.0	90	325	76	69
75	11.177	0.155	0.012	2.33	90.2	0.91	-	8.4	-0.1	90	329	76	68.9
76	11.330	0.153	0.012	2.33	90.4	0.94	-	8.3	-0.1	90	331	76	68.9
77	11.484	0.154	0.012	2.33	90.6	0.87	-	8.3	0.0	90	338	76	69
78	11.641	0.157	0.012	2.34	90.7	0.93	-	8.2	-0.1	90	322	76	68.9
79	11.794	0.153	0.012	2.33	90.9	0.9	-	8.2	0.0	89	324	76	68.9
80	11.950	0.156	0.012	2.34	91.1	0.93	103	8.2	0.0	90	327	76	69
81	12.102	0.152	0.012	2.33	91.3	0.93	-	8.1	-0.1	90	327	76	69
82	12.259	0.157	0.012	2.33	91.4	0.93	-	8.1	0.0	90	329	76	69.1
83	12.411	0.152	0.012	2.33	91.6	0.92	-	8.0	0.0	90	321	76	69
84	12.569	0.158	0.012	2.33	91.7	0.9	-	8.0	0.0	90	322	76	69
85	12.722	0.153	0.012	2.34	91.9	0.9	-	7.9	-0.1	90	326	76	69
86	12.878	0.156	0.012	2.34	92.1	0.89	-	7.9	0.0	90	317	76	69.1
87	13.032	0.154	0.012	2.33	92.2	0.92	-	7.9	0.0	89	302	76	69.2
88	13.187	0.155	0.012	2.34	92.4	0.91	-	7.8	0.0	89	305	76	69.1
89	13.345	0.158	0.012	2.34	92.6	0.95	-	7.8	-0.1	89	314	76	69
90	13.497	0.152	0.012	2.35	92.7	0.9	103	7.7	-0.1	90	316	76	69.2
91	13.655	0.158	0.012	2.34	92.9	0.91	-	7.7	0.0	89	309	76	69.1
92	13.806	0.151	0.012	2.33	93	0.93	-	7.7	0.0	89	301	76	69.1
93	13.966	0.160	0.012	2.35	93.1	0.93	-	7.6	-0.1	89	300	76	69
94	14.119	0.153	0.012	2.35	93.2	0.95	-	7.6	0.0	89	303	76	69
95	14.275	0.156	0.012	2.34	93.4	0.91	-	7.6	0.0	89	310	76	69.1
96	14.429	0.154	0.012	2.34	93.5	0.92	-	7.5	0.0	89	297	76	69.2
97	14.585	0.156	0.012	2.34	93.6	0.89	-	7.5	-0.1	89	310	76	69.2
98	14.742	0.157	0.012	2.34	93.8	0.93	-	7.4	0.0	89	317	76	69.1

BOX A TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Standard
Run #: 1

Job #: 23-143
Tracking #: 144
Technician: AK
Date: 5/3/2023

	Particulate Sampling Data							Fuel Weight (lb)		Temperature Data (°F)			
Elapsed Time (min)	Gas Meter (ft^3)	Sample Rate (cfm)	Dilution Tunnel dP (in H_2O)	Orifice dH (in H_2O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Scale Reading	Weight Change	Dilution Tunnel	Flue	Filter	Ambient
99	14.896	0.154	0.012	2.35	93.9	0.93	-	7.4	-0.1	89	315	76	69.3
100	15.053	0.157	0.012	2.35	94	0.9	103	7.4	0.0	89	311	76	69.3
101	15.205	0.152	0.012	2.35	94.2	0.92	-	7.3	0.0	89	311	76	69.4
102	15.365	0.160	0.012	2.35	94.3	0.88	-	7.3	0.0	89	298	76	69.4
103	15.519	0.154	0.012	2.36	94.4	0.91	-	7.3	-0.1	89	306	76	69.3
104	15.675	0.156	0.012	2.35	94.6	0.91	-	7.2	0.0	89	307	76	69.3
105	15.830	0.155	0.012	2.35	94.7	0.94	-	7.2	0.0	89	296	76	69.3
106	15.986	0.156	0.012	2.35	94.7	0.88	-	7.2	0.0	89	300	76	69.4
107	16.144	0.158	0.012	2.35	94.9	0.9	-	7.1	0.0	89	302	76	69.4
108	16.296	0.152	0.012	2.35	95	0.92	-	7.1	0.0	89	306	76	69.3
109	16.455	0.159	0.012	2.35	95.1	0.92	-	7.0	0.0	89	299	76	69.4
110	16.608	0.153	0.012	2.35	95.2	0.88	103	7.0	0.0	89	296	76	69.3
111	16.768	0.160	0.012	2.35	95.3	0.93	-	7.0	-0.1	88	299	76	69.3
112	16.921	0.153	0.012	2.35	95.4	0.92	-	6.9	0.0	89	302	76	69.3
113	17.078	0.157	0.012	2.34	95.6	0.94	-	6.9	-0.1	89	297	76	69.4
114	17.234	0.156	0.012	2.34	95.6	0.94	-	6.8	0.0	89	301	76	69.4
115	17.390	0.156	0.012	2.35	95.8	0.9	-	6.8	0.0	89	299	76	69.3
116	17.548	0.158	0.012	2.35	95.8	0.94	-	6.8	0.0	89	297	76	69.4
117	17.700	0.152	0.012	2.35	95.9	0.93	-	6.7	0.0	89	297	76	69.4
118	17.860	0.160	0.012	2.35	95.9	0.92	-	6.7	0.0	89	303	76	69.3
119	18.014	0.154	0.012	2.35	96.1	0.93	-	6.7	0.0	89	298	76	69.4
120	18.172	0.158	0.012	2.35	96.1	0.94	103	6.6	0.0	88	285	76	69.4
121	18.326	0.154	0.012	2.35	96.2	0.94	-	6.6	0.0	88	280	76	69.5
122	18.484	0.158	0.012	2.35	96.3	0.94	-	6.6	-0.1	88	284	76	69.5
123	18.642	0.158	0.012	2.36	96.4	0.92	-	6.6	0.0	88	286	76	69.5
124	18.795	0.153	0.012	2.36	96.4	0.9	-	6.5	0.0	88	284	76	69.6
125	18.954	0.159	0.012	2.34	96.5	0.94	-	6.5	-0.1	88	293	76	69.5
126	19.109	0.155	0.012	2.37	96.6	0.88	-	6.4	0.0	88	290	76	69.4
127	19.268	0.159	0.012	2.36	96.7	0.92	-	6.4	0.0	88	279	76	69.4
128	19.421	0.153	0.013	2.36	96.8	0.95	-	6.4	-0.1	88	288	76	69.6
129	19.578	0.157	0.012	2.37	96.9	0.88	-	6.3	-0.1	88	301	76	69.7
130	19.737	0.159	0.012	2.37	97	0.93	103	6.3	0.0	88	295	76	69.8
131	19.892	0.155	0.012	2.36	97.1	0.94	-	6.3	0.0	88	281	76	70.1

BOX A TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Standard
Run #: 1

Job #: 23-143
Tracking #: 144
Technician: AK
Date: 5/3/2023

	Particulate Sampling Data							Fuel Weight (lb)		Temperature Data (°F)			
Elapsed Time (min)	Gas Meter (ft^3)	Sample Rate (cfm)	Dilution Tunnel dP (in H_2O)	Orifice dH (in H_2O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Scale Reading	Weight Change	Dilution Tunnel	Flue	Filter	Ambient
132	20.050	0.158	0.013	2.36	97.2	0.98	-	6.2	0.0	88	288	76	69.6
133	20.204	0.154	0.013	2.36	97.3	0.94	-	6.2	-0.1	88	304	76	69.7
134	20.364	0.160	0.013	2.37	97.3	0.97	-	6.1	0.0	88	304	76	69.9
135	20.518	0.154	0.013	2.36	97.4	0.96	-	6.1	0.0	88	295	76	70.1
136	20.676	0.158	0.013	2.36	97.5	0.93	-	6.1	0.0	88	292	76	70.3
137	20.834	0.158	0.013	2.35	97.5	0.96	-	6.0	0.0	88	289	76	70.1
138	20.990	0.156	0.013	2.37	97.5	0.92	-	6.0	0.0	88	298	76	69.9
139	21.148	0.158	0.013	2.37	97.6	0.9	-	5.9	0.0	88	299	76	70
140	21.301	0.153	0.013	2.36	97.6	0.89	101	5.9	0.0	88	292	76	70.1
141	21.462	0.161	0.013	2.36	97.7	0.89	-	5.9	0.0	88	285	76	69.4
142	21.616	0.154	0.013	2.37	97.7	0.94	-	5.9	0.0	87	280	76	69.7
143	21.774	0.158	0.013	2.37	97.7	0.9	-	5.8	-0.1	88	296	76	69.6
144	21.931	0.157	0.013	2.37	97.7	0.96	-	5.8	0.0	88	290	76	69.8
145	22.087	0.156	0.013	2.36	97.7	0.96	-	5.7	0.0	88	291	76	69.7
146	22.245	0.158	0.013	2.36	97.8	0.94	-	5.7	0.0	88	286	76	69.6
147	22.399	0.154	0.013	2.36	97.8	0.9	-	5.7	0.0	88	292	76	69.8
148	22.560	0.161	0.013	2.37	97.8	0.96	-	5.7	0.0	88	282	76	69.7
149	22.714	0.154	0.012	2.37	97.9	0.93	-	5.6	0.0	88	280	76	69.7
150	22.872	0.158	0.013	2.37	98	0.9	99	5.6	-0.1	88	295	76	69.6
151	23.029	0.157	0.013	2.36	98	0.89	-	5.5	0.0	88	283	76	69.5
152	23.185	0.156	0.013	2.37	98	0.89	-	5.5	0.0	88	285	76	69.6
153	23.343	0.158	0.013	2.37	97.9	0.94	-	5.4	0.0	88	291	76	69.6
154	23.497	0.154	0.013	2.37	98	0.93	-	5.4	0.0	87	279	76	69.8
155	23.657	0.160	0.013	2.36	98	0.91	-	5.4	-0.1	88	282	76	69.7
156	23.812	0.155	0.013	2.36	97.9	0.9	-	5.4	0.0	87	287	76	69.6
157	23.969	0.157	0.013	2.36	98	0.92	-	5.3	0.0	87	277	76	69.7
158	24.125	0.156	0.012	2.36	98.1	0.9	-	5.3	0.0	87	284	76	69.9
159	24.282	0.157	0.013	2.37	98.1	0.9	-	5.3	0.0	88	290	76	69.8
160	24.441	0.159	0.013	2.38	98.1	0.92	99	5.2	0.0	88	291	76	69.9
161	24.594	0.153	0.013	2.37	98.2	0.92	-	5.2	0.0	88	289	76	69.9
162	24.755	0.161	0.013	2.37	98.2	0.9	-	5.2	0.0	88	289	76	69.8
163	24.909	0.154	0.013	2.36	98.1	0.91	-	5.1	0.0	87	280	76	69.9
164	25.067	0.158	0.013	2.36	98.2	0.92	-	5.1	0.0	88	277	76	69.8

BOX A TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Standard
Run #: 1

Job #: 23-143
Tracking #: 144
Technician: AK
Date: 5/3/2023

	Particulate Sampling Data							Fuel Weight (lb)		Temperature Data (°F)			
Elapsed Time (min)	Gas Meter (ft^3)	Sample Rate (cfm)	Dilution Tunnel dP (in H_2O)	Orifice dH (in H_2O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Scale Reading	Weight Change	Dilution Tunnel	Flue	Filter	Ambient
165	25.223	0.156	0.013	2.35	98.3	0.91	-	5.1	0.0	87	281	76	70.3
166	25.380	0.157	0.013	2.36	98.3	0.94	-	5.0	0.0	88	290	76	70.5
167	25.539	0.159	0.013	2.37	98.4	0.92	-	5.0	0.0	88	283	76	70.1
168	25.693	0.154	0.012	2.37	98.3	0.96	-	5.0	0.0	87	273	76	70.1
169	25.852	0.159	0.013	2.37	98.4	0.93	-	4.9	-0.1	87	283	76	69.9
170	26.007	0.155	0.013	2.36	98.3	0.91	99	4.9	0.0	87	279	76	69.9
171	26.166	0.159	0.013	2.36	98.4	0.93	-	4.9	0.0	87	279	76	70
172	26.320	0.154	0.013	2.37	98.3	0.93	-	4.8	0.0	87	285	76	70
173	26.478	0.158	0.013	2.36	98.3	0.91	-	4.8	0.0	88	288	76	69.8
174	26.637	0.159	0.013	2.36	98.4	0.97	-	4.7	0.0	88	282	76	70
175	26.790	0.153	0.013	2.37	98.5	0.91	-	4.7	0.0	88	282	76	70.1
176	26.950	0.160	0.013	2.36	98.5	0.92	-	4.7	0.0	88	285	76	70.3
177	27.105	0.155	0.013	2.37	98.6	0.91	-	4.6	-0.1	88	287	76	70.2
178	27.264	0.159	0.013	2.37	98.6	0.97	-	4.6	0.0	88	289	76	70.3
179	27.419	0.155	0.013	2.36	98.7	0.92	-	4.6	0.0	88	293	76	70.5
180	27.576	0.157	0.012	2.36	98.7	0.92	101	4.5	0.0	88	293	76	70.8
181	27.735	0.159	0.013	2.37	98.7	0.97	-	4.5	0.0	88	287	76	70.6
182	27.888	0.153	0.013	2.36	98.7	0.94	-	4.5	0.0	86	270	76	70.8
183	28.048	0.160	0.013	2.35	98.7	0.94	-	4.5	0.0	85	259	76	70.7
184	28.203	0.155	0.013	2.36	98.7	0.91	-	4.4	0.0	85	263	76	70.4
185	28.363	0.160	0.013	2.36	98.7	0.93	-	4.4	0.0	85	260	76	70.5
186	28.517	0.154	0.013	2.36	98.7	0.92	-	4.4	0.0	84	257	76	70.4
187	28.675	0.158	0.013	2.36	98.8	0.9	-	4.3	0.0	84	252	76	70.1
188	28.833	0.158	0.013	2.35	98.8	0.94	-	4.3	0.0	84	241	76	70.3
189	28.987	0.154	0.013	2.36	98.8	0.92	-	4.3	0.0	84	242	76	70.3
190	29.146	0.159	0.013	2.36	98.8	0.86	101	4.3	0.0	84	245	76	70.4
191	29.301	0.155	0.013	2.36	98.8	0.92	-	4.2	0.0	84	248	76	70.4
192	29.461	0.160	0.013	2.37	98.8	0.96	-	4.2	0.0	84	248	76	70.3
193	29.616	0.155	0.013	2.36	98.8	0.94	-	4.2	0.0	84	246	76	70.1
194	29.773	0.157	0.013	2.37	98.8	0.92	-	4.2	0.0	84	243	76	70.2
195	29.932	0.159	0.013	2.36	98.9	0.94	-	4.1	0.0	83	241	76	70.2
196	30.086	0.154	0.013	2.37	98.8	0.89	-	4.1	0.0	84	243	76	70.2
197	30.246	0.160	0.013	2.37	98.9	0.92	-	4.1	0.0	84	236	76	70.3

BOX A TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Standard
Run #: 1

Job #: 23-143
Tracking #: 144
Technician: AK
Date: 5/3/2023

	Particulate Sampling Data							Fuel Weight (lb)		Temperature Data (°F)			
Elapsed Time (min)	Gas Meter (ft^3)	Sample Rate (cfm)	Dilution Tunnel dP (in H_2O)	Orifice dH (in H_2O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Scale Reading	Weight Change	Dilution Tunnel	Flue	Filter	Ambient
198	30.401	0.155	0.012	2.36	98.8	0.96	-	4.1	0.0	84	245	76	70.1
199	30.561	0.160	0.013	2.36	98.9	0.9	-	4.0	0.0	84	245	76	69.9
200	30.715	0.154	0.013	2.37	98.9	0.93	98	4.0	0.0	84	240	76	70
201	30.873	0.158	0.012	2.36	98.9	0.92	-	4.0	0.0	84	240	76	70.1
202	31.031	0.158	0.013	2.36	99	0.96	-	3.9	0.0	84	242	76	70.2
203	31.186	0.155	0.013	2.37	98.9	0.97	-	3.9	0.0	84	239	76	70.1
204	31.345	0.159	0.013	2.36	99.1	0.96	-	3.9	0.0	84	234	76	70.3
205	31.500	0.155	0.013	2.36	99.1	0.95	-	3.9	0.0	84	237	76	70.2
206	31.660	0.160	0.013	2.37	99.1	0.94	-	3.9	0.0	83	233	76	70.2
207	31.814	0.154	0.013	2.36	99.1	0.92	-	3.8	0.0	83	233	76	70.1
208	31.972	0.158	0.013	2.36	99.1	0.93	-	3.8	0.0	83	233	76	70.2
209	32.131	0.159	0.012	2.35	99.1	0.95	-	3.8	0.0	83	232	76	70.1
210	32.285	0.154	0.013	2.36	99.1	0.99	98	3.8	0.0	83	235	76	69.9
211	32.444	0.159	0.013	2.37	99.1	0.94	-	3.7	0.0	83	237	76	70
212	32.600	0.156	0.013	2.36	99.1	0.95	-	3.7	0.0	83	234	76	70.3
213	32.759	0.159	0.013	2.37	99.2	0.91	-	3.7	0.0	84	243	76	70.2
214	32.914	0.155	0.013	2.37	99.2	0.92	-	3.7	0.0	84	238	76	70.2
215	33.072	0.158	0.013	2.36	99.2	0.94	-	3.6	0.0	84	242	76	70.1
216	33.231	0.159	0.013	2.37	99.2	0.9	-	3.6	0.0	84	243	76	70.1
217	33.385	0.154	0.013	2.37	99.2	0.92	-	3.6	0.0	84	241	76	70.2
218	33.544	0.159	0.013	2.37	99.3	0.94	-	3.5	0.0	84	240	76	70.3
219	33.700	0.156	0.013	2.37	99.3	0.89	-	3.5	0.0	84	234	76	70.5
220	33.859	0.159	0.013	2.37	99.3	0.93	99	3.5	-0.1	84	247	76	70.4
221	34.014	0.155	0.013	2.37	99.4	0.93	-	3.5	0.0	84	239	76	70.5
222	34.172	0.158	0.013	2.37	99.4	0.91	-	3.5	0.0	84	236	76	70.4
223	34.331	0.159	0.013	2.36	99.5	0.96	-	3.4	0.0	83	230	76	70.4
224	34.485	0.154	0.013	2.36	99.5	0.95	-	3.4	0.0	84	236	76	70.4
225	34.645	0.160	0.013	2.36	99.5	0.95	-	3.4	0.0	84	235	76	70.4
226	34.800	0.155	0.012	2.36	99.5	0.94	-	3.3	0.0	84	237	76	70.4
227	34.959	0.159	0.013	2.36	99.5	0.9	-	3.3	0.0	84	232	76	70.5
228	35.114	0.155	0.013	2.36	99.6	0.91	-	3.3	0.0	84	229	76	70.6
229	35.272	0.158	0.013	2.36	99.6	0.94	-	3.3	0.0	83	226	76	70.4
230	35.432	0.160	0.013	2.37	99.7	0.92	99	3.3	0.0	83	221	76	70.6

BOX A TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Standard
Run #: 1

Job #: 23-143
Tracking #: 144
Technician: AK
Date: 5/3/2023

	Particulate Sampling Data							Fuel Weight (lb)		Temperature Data (°F)			
Elapsed Time (min)	Gas Meter (ft^3)	Sample Rate (cfm)	Dilution Tunnel dP (in H_2O)	Orifice dH (in H_2O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Scale Reading	Weight Change	Dilution Tunnel	Flue	Filter	Ambient
231	35.586	0.154	0.013	2.37	99.7	0.94	-	3.2	0.0	83	217	76	70.7
232	35.746	0.160	0.013	2.36	99.8	0.92	-	3.2	0.0	83	223	76	70.7
233	35.901	0.155	0.013	2.37	99.8	0.89	-	3.2	0.0	83	218	76	70.8
234	36.060	0.159	0.013	2.37	99.9	0.94	-	3.2	0.0	83	225	76	70.6
235	36.216	0.156	0.013	2.36	99.9	0.96	-	3.1	0.0	83	227	76	70.5
236	36.374	0.158	0.013	2.37	99.9	0.94	-	3.1	0.0	83	232	76	70.7
237	36.533	0.159	0.013	2.37	99.9	0.92	-	3.1	0.0	83	237	76	70.8
238	36.687	0.154	0.013	2.37	99.9	0.94	-	3.1	0.0	83	229	76	70.6
239	36.848	0.161	0.013	2.36	99.9	0.97	-	3.0	0.0	83	229	76	70.6
240	37.004	0.156	0.013	2.37	100	0.9	98	3.0	0.0	83	229	76	70.8
241	37.162	0.158	0.013	2.37	100	0.94	-	3.0	0.0	83	226	76	70.9
242	37.319	0.157	0.013	2.36	100.1	0.94	-	3.0	0.0	83	232	76	70.7
243	37.476	0.157	0.013	2.36	100.1	0.96	-	2.9	0.0	84	234	76	70.8
244	37.634	0.158	0.013	2.35	100.1	0.97	-	2.9	0.0	84	236	76	71
245	37.788	0.154	0.013	2.36	100.1	0.94	-	2.9	0.0	84	238	76	71
246	37.950	0.162	0.013	2.37	100.1	0.94	-	2.9	0.0	84	232	76	70.8
247	38.104	0.154	0.013	2.37	100.2	0.95	-	2.8	0.0	84	230	76	70.8
248	38.262	0.158	0.013	2.38	100.2	0.93	-	2.8	0.0	84	229	76	71
249	38.421	0.159	0.013	2.36	100.3	0.93	-	2.8	0.0	84	231	76	70.9
250	38.577	0.156	0.013	2.37	100.3	0.92	98	2.8	0.0	84	224	76	71
251	38.736	0.159	0.013	2.37	100.4	0.96	-	2.7	0.0	84	231	76	70.8
252	38.891	0.155	0.013	2.38	100.4	0.91	-	2.7	0.0	84	230	76	71
253	39.052	0.161	0.013	2.37	100.4	0.91	-	2.7	0.0	84	230	76	71
254	39.206	0.154	0.012	2.37	100.3	0.91	-	2.7	0.0	84	226	76	71
255	39.364	0.158	0.013	2.36	100.4	0.96	-	2.6	0.0	84	231	76	71
256	39.523	0.159	0.013	2.37	100.5	0.95	-	2.6	0.0	84	235	76	71.1
257	39.679	0.156	0.013	2.37	100.5	0.94	-	2.6	0.0	84	227	76	71.2
258	39.838	0.159	0.013	2.36	100.5	0.97	-	2.6	0.0	84	227	76	71.2
259	39.993	0.155	0.013	2.35	100.6	0.97	-	2.6	0.0	84	226	76	71.2
260	40.154	0.161	0.013	2.36	100.6	0.94	99	2.5	0.0	83	226	76	71.1
261	40.308	0.154	0.013	2.36	100.6	0.94	-	2.5	0.0	84	234	76	71.1
262	40.467	0.159	0.013	2.36	100.6	0.93	-	2.5	0.0	84	232	76	71.1
263	40.626	0.159	0.013	2.36	100.6	0.95	-	2.4	-0.1	84	233	76	71.1

BOX A TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Standard
Run #: 1

Job #: 23-143
Tracking #: 144
Technician: AK
Date: 5/3/2023

	Particulate Sampling Data							Fuel Weight (lb)		Temperature Data (°F)			
Elapsed Time (min)	Gas Meter (ft^3)	Sample Rate (cfm)	Dilution Tunnel dP (in H_2O)	Orifice dH (in H_2O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Scale Reading	Weight Change	Dilution Tunnel	Flue	Filter	Ambient
264	40.780	0.154	0.013	2.36	100.8	0.9	-	2.4	0.0	84	230	76	71.3
265	40.940	0.160	0.013	2.36	100.8	0.95	-	2.4	0.0	84	220	76	71.2
266	41.095	0.155	0.013	2.37	100.8	0.97	-	2.4	0.0	84	225	76	71.2
267	41.255	0.160	0.013	2.37	100.9	0.99	-	2.3	0.0	84	240	77	71.3
268	41.410	0.155	0.013	2.37	100.9	0.92	-	2.3	0.0	84	237	77	71.4
269	41.569	0.159	0.013	2.37	100.9	0.94	-	2.3	0.0	84	238	77	71.3
270	41.728	0.159	0.013	2.37	100.9	0.92	98	2.3	0.0	84	226	77	71.3
271	41.882	0.154	0.013	2.37	100.9	0.96	-	2.3	0.0	84	218	77	71.4
272	42.043	0.161	0.013	2.36	101	0.96	-	2.2	0.0	84	229	77	71.3
273	42.198	0.155	0.013	2.37	101	0.92	-	2.2	0.0	84	233	77	71.5
274	42.357	0.159	0.013	2.38	101	0.92	-	2.2	0.0	84	233	77	71.4
275	42.513	0.156	0.013	2.37	101	0.96	-	2.2	0.0	84	232	77	71.3
276	42.671	0.158	0.013	2.37	101.1	0.91	-	2.1	0.0	84	226	77	71.2
277	42.830	0.159	0.013	2.37	101.1	0.98	-	2.1	0.0	84	226	77	71.3
278	42.983	0.153	0.013	2.36	101.2	0.96	-	2.1	0.0	84	236	77	71.5
279	43.145	0.162	0.013	2.36	101.2	0.93	-	2.1	0.0	84	232	77	71.4
280	43.300	0.155	0.013	2.37	101.2	0.93	98	2.0	0.0	84	227	77	71.2
281	43.458	0.158	0.013	2.37	101.2	0.95	-	2.0	0.0	84	228	77	71.3
282	43.616	0.158	0.013	2.35	101.3	0.94	-	2.0	0.0	84	238	77	71.4
283	43.773	0.157	0.013	2.35	101.2	0.96	-	2.0	0.0	84	238	77	71.4
284	43.931	0.158	0.013	2.36	101.2	0.97	-	1.9	0.0	84	233	77	71.5
285	44.085	0.154	0.013	2.36	101.3	0.95	-	1.9	-0.1	84	239	77	71.5
286	44.247	0.162	0.013	2.36	101.3	0.93	-	1.9	0.0	84	236	77	71.6
287	44.401	0.154	0.013	2.37	101.3	0.95	-	1.9	0.0	84	230	77	71.5
288	44.559	0.158	0.013	2.35	101.3	1	-	1.8	0.0	84	233	77	71.5
289	44.719	0.160	0.013	2.36	101.3	0.94	-	1.8	0.0	84	232	77	71.3
290	44.874	0.155	0.013	2.36	101.3	0.94	98	1.8	0.0	84	237	77	71.2
291	45.033	0.159	0.013	2.35	101.4	0.99	-	1.8	0.0	85	236	77	71.3
292	45.188	0.155	0.013	2.34	101.4	0.94	-	1.7	0.0	84	225	77	71.3
293	45.349	0.161	0.013	2.34	101.4	0.95	-	1.7	0.0	84	228	77	71.3
294	45.504	0.155	0.013	2.35	101.4	0.98	-	1.7	0.0	84	232	77	71.3
295	45.662	0.158	0.013	2.35	101.4	0.98	-	1.7	0.0	84	225	77	71.3
296	45.821	0.159	0.013	2.34	101.4	0.97	-	1.6	0.0	84	231	77	71.2

BOX A TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Standard
Run #: 1

Job #: 23-143
Tracking #: 144
Technician: AK
Date: 5/3/2023

	Particulate Sampling Data							Fuel Weight (lb)		Temperature Data (°F)			
Elapsed Time (min)	Gas Meter (ft^3)	Sample Rate (cfm)	Dilution Tunnel dP (in H_2O)	Orifice dH (in H_2O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Scale Reading	Weight Change	Dilution Tunnel	Flue	Filter	Ambient
297	45.975	0.154	0.013	2.34	101.3	0.96	-	1.6	0.0	84	225	77	71.4
298	46.135	0.160	0.013	2.35	101.4	0.94	-	1.6	0.0	84	228	77	71.4
299	46.291	0.156	0.013	2.35	101.4	0.94	-	1.6	0.0	84	233	77	71.4
300	46.451	0.160	0.013	2.36	101.5	0.94	99	1.5	0.0	84	228	77	71.5
301	46.606	0.155	0.013	2.36	101.5	0.94	-	1.5	0.0	84	230	77	71.5
302	46.764	0.158	0.013	2.35	101.5	0.97	-	1.5	0.0	84	232	77	71.6
303	46.924	0.160	0.013	2.37	101.5	0.99	-	1.5	0.0	84	225	77	71.6
304	47.078	0.154	0.013	2.37	101.5	0.91	-	1.4	0.0	84	232	77	71.5
305	47.239	0.161	0.013	2.36	101.5	0.95	-	1.4	0.0	84	232	77	71.5
306	47.394	0.155	0.013	2.36	101.5	0.91	-	1.4	0.0	84	232	77	71.5
307	47.552	0.158	0.013	2.36	101.5	0.93	-	1.4	0.0	84	232	77	71.5
308	47.709	0.157	0.013	2.36	101.5	0.95	-	1.4	0.0	84	224	77	71.5
309	47.867	0.158	0.013	2.35	101.5	0.92	-	1.3	0.0	84	225	77	71.6
310	48.026	0.159	0.013	2.35	101.5	0.97	98	1.3	0.0	84	225	77	71.6
311	48.180	0.154	0.013	2.35	101.6	0.99	-	1.3	0.0	84	230	77	71.7
312	48.342	0.162	0.014	2.37	101.6	0.92	-	1.2	0.0	84	226	77	71.7
313	48.497	0.155	0.013	2.36	101.5	0.95	-	1.2	0.0	84	228	77	71.6
314	48.655	0.158	0.013	2.37	101.7	0.93	-	1.2	0.0	84	220	77	71.8
315	48.814	0.159	0.013	2.36	101.7	0.93	-	1.2	0.0	84	230	77	72
316	48.970	0.156	0.013	2.36	101.7	0.94	-	1.1	0.0	84	230	77	72
317	49.129	0.159	0.013	2.36	101.7	0.94	-	1.1	0.0	84	228	77	71.9
318	49.284	0.155	0.013	2.36	101.7	0.96	-	1.1	0.0	84	219	77	71.9
319	49.445	0.161	0.013	2.36	101.7	1	-	1.1	-0.1	84	226	77	71.8
320	49.599	0.154	0.013	2.36	101.8	0.94	98	1.0	0.0	84	234	77	71.9
321	49.758	0.159	0.013	2.36	101.9	0.97	-	1.0	0.0	84	233	77	71.9
322	49.918	0.160	0.013	2.35	101.9	0.99	-	1.0	0.0	84	220	77	72
323	50.072	0.154	0.013	2.36	101.9	0.91	-	1.0	0.0	84	220	77	72
324	50.232	0.160	0.013	2.35	101.9	0.98	-	0.9	0.0	84	224	77	71.9
325	50.388	0.156	0.013	2.35	101.9	0.98	-	0.9	0.0	84	228	77	71.8
326	50.548	0.160	0.013	2.36	101.9	0.91	-	0.9	0.0	84	228	77	71.9
327	50.703	0.155	0.013	2.34	102	0.92	-	0.9	0.0	84	223	77	72.1
328	50.862	0.159	0.013	2.34	102.1	0.99	-	0.8	0.0	84	234	77	72.1
329	51.022	0.160	0.013	2.35	102.1	0.91	-	0.8	0.0	85	236	77	72

BOX A TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Standard
Run #: 1

Job #: 23-143
Tracking #: 144
Technician: AK
Date: 5/3/2023

	Particulate Sampling Data							Fuel Weight (lb)		Temperature Data (°F)			
Elapsed Time (min)	Gas Meter (ft^3)	Sample Rate (cfm)	Dilution Tunnel dP (in H_2O)	Orifice dH (in H_2O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Scale Reading	Weight Change	Dilution Tunnel	Flue	Filter	Ambient
330	51.176	0.154	0.013	2.35	102.1	0.94	98	0.8	0.0	85	232	77	72.1
331	51.337	0.161	0.013	2.34	102.1	1.01	-	0.8	0.0	85	238	77	72
332	51.492	0.155	0.013	2.34	102.1	0.96	-	0.7	0.0	85	239	77	72
333	51.651	0.159	0.013	2.36	102.1	0.98	-	0.7	0.0	85	239	78	71.9
334	51.808	0.157	0.013	2.35	102.1	0.97	-	0.7	0.0	85	239	77	71.8
335	51.966	0.158	0.013	2.34	102.1	0.97	-	0.7	0.0	85	234	77	72
336	52.124	0.158	0.013	2.34	102.2	0.98	-	0.6	0.0	85	242	77	72
337	52.279	0.155	0.013	2.33	102.2	1	-	0.6	0.0	85	248	78	72.1
338	52.441	0.162	0.013	2.35	102.1	0.96	-	0.6	0.0	86	250	77	71.9
339	52.595	0.154	0.013	2.36	102.2	0.98	-	0.5	0.0	86	239	78	71.9
340	52.754	0.159	0.013	2.35	102.2	0.96	99	0.5	0.0	85	233	78	72.1
341	52.913	0.159	0.013	2.34	102.2	0.98	-	0.5	0.0	85	232	78	72.2
342	53.069	0.156	0.013	2.35	102.3	0.95	-	0.5	0.0	85	235	78	72.1
343	53.228	0.159	0.013	2.34	102.2	0.93	-	0.5	0.0	85	233	78	72.1
344	53.383	0.155	0.013	2.34	102.3	0.95	-	0.4	0.0	85	237	78	72
345	53.544	0.161	0.013	2.34	102.3	0.97	-	0.4	0.0	85	239	78	72.1
346	53.699	0.155	0.013	2.36	102.3	0.97	-	0.4	0.0	85	236	78	72.2
347	53.858	0.159	0.013	2.33	102.3	0.91	-	0.4	0.0	85	236	78	72.2
348	54.017	0.159	0.013	2.33	102.3	0.95	-	0.3	0.0	85	234	78	72.2
349	54.171	0.154	0.013	2.31	102.3	0.91	-	0.3	0.0	85	235	78	72.3
350	54.331	0.160	0.013	2.33	102.3	0.97	98	0.3	0.0	85	239	78	72.1
351	54.487	0.156	0.013	2.33	102.3	0.98	-	0.3	0.0	85	230	78	72.2
352	54.646	0.159	0.013	2.34	102.3	0.99	-	0.2	0.0	85	234	78	72.2
353	54.802	0.156	0.013	2.33	102.3	0.99	-	0.2	0.0	85	232	78	72.2
354	54.961	0.159	0.013	2.32	102.4	0.97	-	0.2	0.0	85	234	78	72.3
355	55.120	0.159	0.013	2.35	102.3	0.95	-	0.1	0.0	85	241	78	72
356	55.274	0.154	0.013	2.34	102.4	0.95	-	0.1	0.0	85	234	78	72.2
357	55.435	0.161	0.013	2.33	102.3	0.95	-	0.1	0.0	85	233	78	72.2
358	55.591	0.156	0.013	2.34	102.3	0.99	-	0.1	0.0	85	243	78	72.1
359	55.749	0.158	0.013	2.34	102.2	1	-	0.0	0.0	86	247	78	72.1
360	55.907	0.158	0.013	2.33	102.2	0.94	98	0.0	0.0	86	240	78	72.1
Avg/Tot	55.907	0.155	0.013	2.32	95	0.92	100			87	283	76	70

BOX B TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Standard
Run #: 1

Job #: 23-143
Tracking #: 144
Technician: AK
Date: 5/3/2023

	Particulate Sampling Data							Flue Gas Data		
Elapsed Time (min)	Gas Meter (ft^3)	Sample Rate (cfm)	Orifice dH (in H_2O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H_2O)	CO_2 (%)	CO (%)
0	0.000		0.01	71.1	0.62		71	-0.045	4.26	0.08
1	0.060	0.060	2.25	71	1.98	-	71	-0.043	6.70	0.02
2	0.209	0.149	2.26	71	1.85	-	71	-0.042	4.57	0.07
3	0.356	0.147	2.27	71	1.58	-	72	-0.042	5.66	0.04
4	0.504	0.148	2.27	71	1.92	-	72	-0.042	5.69	0.02
5	0.652	0.148	2.27	71.1	1.87	-	72	-0.043	5.09	0.05
6	0.800	0.148	2.27	71.2	2.03	-	72	-0.040	4.94	0.05
7	0.948	0.148	2.27	71.1	1.52	-	72	-0.045	3.77	0.09
8	1.096	0.148	2.27	71.3	1.58	-	72	-0.048	5.52	0.03
9	1.244	0.148	2.28	71.5	1.68	-	72	-0.042	6.30	0.03
10	1.393	0.149	2.29	71.7	2.02	97	72	-0.045	3.82	0.13
11	1.542	0.149	2.29	71.8	1.72	-	72	-0.045	6.73	0.03
12	1.690	0.148	2.29	71.9	1.62	-	72	-0.044	6.43	0.03
13	1.839	0.149	2.29	72.1	1.67	-	72	-0.042	4.25	0.05
14	1.988	0.149	2.29	72.4	1.61	-	72	-0.042	4.92	0.03
15	2.137	0.149	2.29	72.7	1.97	-	73	-0.045	5.22	0.04
16	2.287	0.150	2.30	73	1.72	-	73	-0.043	6.48	0.03
17	2.436	0.149	2.29	73.2	1.63	-	73	-0.042	5.20	0.04
18	2.586	0.150	2.30	73.5	1.75	-	73	-0.043	5.53	0.04
19	2.735	0.149	2.30	73.7	1.7	-	73	-0.045	4.59	0.08
20	2.885	0.150	2.30	74.1	1.59	106	73	-0.044	6.57	0.02
21	3.034	0.149	2.30	74.4	1.66	-	73	-0.040	5.40	0.07
22	3.184	0.150	2.30	74.7	1.91	-	73	-0.046	5.87	0.05
23	3.333	0.149	2.31	75.1	2.01	-	73	-0.042	4.29	0.08
24	3.485	0.152	2.31	75.3	1.9	-	73	-0.041	4.48	0.05
25	3.633	0.148	2.31	75.8	1.83	-	73	-0.044	5.19	0.04
26	3.784	0.151	2.32	76	1.79	-	73	-0.040	6.25	0.02
27	3.933	0.149	2.30	76.4	1.85	-	73	-0.039	5.23	0.05
28	4.085	0.152	2.31	76.7	2.03	-	74	-0.044	4.36	0.06
29	4.233	0.148	2.31	76.9	2.01	-	73	-0.045	5.68	0.04
30	4.386	0.153	2.31	77.3	1.5	106	74	-0.042	6.35	0.03
31	4.534	0.148	2.31	77.6	1.49	-	74	-0.044	6.39	0.03

BOX B TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Standard
Run #: 1

Job #: 23-143
Tracking #: 144
Technician: AK
Date: 5/3/2023

	Particulate Sampling Data							Flue Gas Data		
Elapsed Time (min)	Gas Meter (ft^3)	Sample Rate (cfm)	Orifice dH (in H_2O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H_2O)	CO_2 (%)	CO (%)
32	4.687	0.153	2.32	78	1.67	-	74	-0.042	4.52	0.07
33	4.836	0.149	2.32	78.4	1.79	-	74	-0.045	5.21	0.04
34	4.990	0.154	2.32	78.7	1.52	-	74	-0.043	4.59	0.06
35	5.138	0.148	2.33	79	1.55	-	74	-0.045	4.23	0.09
36	5.292	0.154	2.33	79.3	1.85	-	74	-0.041	6.39	0.02
37	5.441	0.149	2.33	79.6	1.96	-	74	-0.044	4.74	0.04
38	5.594	0.153	2.33	79.9	1.85	-	74	-0.041	6.36	0.03
39	5.743	0.149	2.33	80.3	1.5	-	74	-0.045	4.68	0.06
40	5.896	0.153	2.33	80.6	2.02	104	74	-0.044	4.78	0.06
41	6.046	0.150	2.32	81	1.87	-	74	-0.046	6.61	0.02
42	6.199	0.153	2.34	81.3	2	-	74	-0.045	5.03	0.05
43	6.351	0.152	2.33	81.6	1.55	-	74	-0.046	4.94	0.04
44	6.503	0.152	2.34	81.9	1.65	-	74	-0.044	6.22	0.03
45	6.656	0.153	2.34	82.2	1.91	-	74	-0.043	4.10	0.06
46	6.806	0.150	2.34	82.5	1.72	-	74	-0.044	4.74	0.04
47	6.959	0.153	2.33	82.8	1.75	-	74	-0.045	5.48	0.03
48	7.109	0.150	2.33	83	1.95	-	74	-0.047	5.74	0.02
49	7.263	0.154	2.33	83.3	1.89	-	74	-0.043	7.70	0.02
50	7.414	0.151	2.34	83.7	1.54	103	74	-0.042	3.47	0.15
51	7.569	0.155	2.35	84	1.51	-	74	-0.043	6.50	0.02
52	7.720	0.151	2.35	84.2	1.72	-	74	-0.045	4.61	0.04
53	7.874	0.154	2.35	84.5	1.64	-	74	-0.044	4.77	0.04
54	8.024	0.150	2.35	84.8	1.68	-	74	-0.043	5.04	0.03
55	8.178	0.154	2.34	85.1	2.01	-	74	-0.043	4.93	0.03
56	8.331	0.153	2.35	85.4	1.82	-	75	-0.042	6.66	0.02
57	8.484	0.153	2.35	85.6	1.52	-	75	-0.041	5.33	0.05
58	8.638	0.154	2.35	85.7	1.59	-	74	-0.045	3.50	0.12
59	8.790	0.152	2.36	86.1	1.64	-	75	-0.043	6.70	0.02
60	8.944	0.154	2.35	86.4	1.53	104	75	-0.041	6.58	0.01
61	9.095	0.151	2.34	86.7	2.03	-	75	-0.046	4.61	0.06
62	9.251	0.156	2.36	87	2.02	-	75	-0.044	4.41	0.06
63	9.402	0.151	2.35	87.1	1.65	-	75	-0.044	3.38	0.10

BOX B TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Standard
Run #: 1

Job #: 23-143
Tracking #: 144
Technician: AK
Date: 5/3/2023

	Particulate Sampling Data							Flue Gas Data		
Elapsed Time (min)	Gas Meter (ft^3)	Sample Rate (cfm)	Orifice dH (in H_2O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H_2O)	CO_2 (%)	CO (%)
64	9.558	0.156	2.36	87.3	2.01	-	75	-0.041	3.88	0.05
65	9.708	0.150	2.35	87.5	1.93	-	75	-0.041	2.95	0.11
66	9.863	0.155	2.35	87.7	1.95	-	75	-0.040	3.00	0.11
67	10.015	0.152	2.36	88	1.57	-	75	-0.042	4.41	0.04
68	10.170	0.155	2.36	88.1	1.97	-	75	-0.038	5.47	0.03
69	10.325	0.155	2.37	88.4	2.01	-	75	-0.038	2.96	0.11
70	10.476	0.151	2.36	88.7	1.85	103	75	-0.040	3.89	0.05
71	10.631	0.155	2.36	88.9	1.82	-	75	-0.037	3.70	0.05
72	10.783	0.152	2.36	89.1	1.6	-	75	-0.038	3.51	0.07
73	10.940	0.157	2.37	89.2	1.74	-	75	-0.033	3.78	0.06
74	11.091	0.151	2.36	89.4	1.97	-	75	-0.040	2.23	0.17
75	11.246	0.155	2.37	89.7	1.75	-	75	-0.038	4.15	0.04
76	11.398	0.152	2.36	89.8	1.84	-	75	-0.039	3.87	0.05
77	11.554	0.156	2.37	90	1.94	-	75	-0.034	5.96	0.01
78	11.708	0.154	2.36	90.2	1.48	-	75	-0.036	2.52	0.20
79	11.862	0.154	2.37	90.3	1.96	-	75	-0.037	2.92	0.12
80	12.017	0.155	2.37	90.5	1.9	103	75	-0.038	3.81	0.05
81	12.169	0.152	2.36	90.7	1.66	-	75	-0.039	3.33	0.07
82	12.326	0.157	2.37	90.9	1.93	-	75	-0.035	4.76	0.02
83	12.478	0.152	2.37	91	1.91	-	75	-0.037	2.17	0.21
84	12.634	0.156	2.37	91.1	1.95	-	75	-0.033	3.90	0.04
85	12.786	0.152	2.37	91.3	1.52	-	75	-0.034	4.02	0.04
86	12.942	0.156	2.37	91.5	1.49	-	75	-0.034	3.53	0.09
87	13.097	0.155	2.37	91.6	1.96	-	75	-0.029	1.53	0.21
88	13.250	0.153	2.38	91.7	1.51	-	75	-0.031	2.08	0.15
89	13.406	0.156	2.37	92	1.62	-	75	-0.038	4.14	0.04
90	13.559	0.153	2.37	92	2.03	103	75	-0.037	4.14	0.04
91	13.716	0.157	2.37	92.2	1.96	-	75	-0.030	3.21	0.10
92	13.869	0.153	2.38	92.3	1.6	-	75	-0.028	2.40	0.12
93	14.024	0.155	2.37	92.4	1.54	-	75	-0.030	2.51	0.12
94	14.177	0.153	2.37	92.6	1.73	-	75	-0.031	3.25	0.09
95	14.334	0.157	2.37	92.6	1.48	-	75	-0.038	3.57	0.06

BOX B TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Standard
Run #: 1

Job #: 23-143
Tracking #: 144
Technician: AK
Date: 5/3/2023

	Particulate Sampling Data							Flue Gas Data		
Elapsed Time (min)	Gas Meter (ft^3)	Sample Rate (cfm)	Orifice dH (in H_2O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H_2O)	CO_2 (%)	CO (%)
96	14.489	0.155	2.37	92.8	1.47	-	75	-0.031	3.47	0.09
97	14.642	0.153	2.37	92.9	1.92	-	75	-0.037	2.52	0.17
98	14.798	0.156	2.37	93	1.57	-	75	-0.035	4.97	0.03
99	14.952	0.154	2.37	93.2	1.97	-	75	-0.036	3.87	0.06
100	15.109	0.157	2.38	93.4	2.02	103	75	-0.034	3.46	0.08
101	15.261	0.152	2.38	93.4	1.9	-	75	-0.031	3.37	0.07
102	15.417	0.156	2.37	93.5	1.53	-	75	-0.030	2.95	0.09
103	15.572	0.155	2.37	93.7	1.57	-	75	-0.034	2.34	0.16
104	15.727	0.155	2.37	93.8	1.53	-	75	-0.030	4.20	0.04
105	15.882	0.155	2.38	93.9	1.63	-	75	-0.029	3.22	0.08
106	16.035	0.153	2.37	93.9	1.93	-	75	-0.031	2.20	0.16
107	16.193	0.158	2.37	94.1	1.97	-	75	-0.034	3.63	0.05
108	16.346	0.153	2.37	94.1	1.65	-	75	-0.035	3.11	0.10
109	16.502	0.156	2.38	94.2	1.92	-	75	-0.030	4.11	0.05
110	16.656	0.154	2.37	94.3	1.82	103	75	-0.031	2.47	0.17
111	16.812	0.156	2.37	94.5	1.76	-	75	-0.035	2.65	0.12
112	16.968	0.156	2.38	94.4	1.77	-	75	-0.031	3.20	0.10
113	17.121	0.153	2.37	94.6	1.61	-	75	-0.034	3.70	0.06
114	17.278	0.157	2.37	94.6	1.66	-	75	-0.033	2.90	0.12
115	17.431	0.153	2.37	94.8	1.59	-	75	-0.033	3.52	0.04
116	17.589	0.158	2.37	94.8	1.56	-	75	-0.031	3.19	0.10
117	17.741	0.152	2.37	94.9	1.56	-	75	-0.035	3.02	0.08
118	17.897	0.156	2.38	94.9	1.88	-	75	-0.032	2.70	0.09
119	18.053	0.156	2.37	95	1.93	-	75	-0.032	4.10	0.04
120	18.207	0.154	2.38	95.1	1.52	103	75	-0.028	3.62	0.07
121	18.364	0.157	2.37	95.2	1.64	-	75	-0.025	2.28	0.14
122	18.517	0.153	2.37	95.3	1.92	-	75	-0.029	2.25	0.12
123	18.675	0.158	2.37	95.3	1.98	-	75	-0.030	2.29	0.12
124	18.827	0.152	2.37	95.4	1.53	-	75	-0.032	3.01	0.07
125	18.984	0.157	2.37	95.5	1.59	-	75	-0.032	2.80	0.12
126	19.139	0.155	2.38	95.6	1.79	-	75	-0.029	3.10	0.09
127	19.295	0.156	2.38	95.6	1.98	-	75	-0.028	4.01	0.03

BOX B TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Standard
Run #: 1

Job #: 23-143
Tracking #: 144
Technician: AK
Date: 5/3/2023

	Particulate Sampling Data							Flue Gas Data		
Elapsed Time (min)	Gas Meter (ft^3)	Sample Rate (cfm)	Orifice dH (in H_2O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H_2O)	CO_2 (%)	CO (%)
128	19.450	0.155	2.37	95.7	1.79	-	75	-0.032	2.53	0.16
129	19.604	0.154	2.37	95.9	1.62	-	75	-0.033	2.16	0.16
130	19.762	0.158	2.38	96.1	1.68	103	75	-0.032	3.39	0.07
131	19.916	0.154	2.38	96.3	1.49	-	76	-0.031	4.60	0.03
132	20.072	0.156	2.38	96.3	1.99	-	76	-0.032	3.19	0.12
133	20.227	0.155	2.38	96.3	1.86	-	76	-0.037	2.07	0.17
134	20.383	0.156	2.37	96.5	1.92	-	76	-0.034	2.36	0.12
135	20.539	0.156	2.38	96.6	1.6	-	76	-0.034	4.49	0.02
136	20.692	0.153	2.37	96.8	1.69	-	76	-0.031	4.55	0.03
137	20.850	0.158	2.37	96.7	1.59	-	76	-0.031	3.04	0.11
138	21.004	0.154	2.38	96.6	2.03	-	75	-0.033	2.55	0.13
139	21.160	0.156	2.38	96.9	1.67	-	75	-0.033	2.92	0.08
140	21.314	0.154	2.37	96.8	1.63	101	75	-0.030	2.77	0.12
141	21.472	0.158	2.37	96.8	1.49	-	75	-0.032	3.52	0.06
142	21.628	0.156	2.38	96.7	2.02	-	75	-0.029	3.52	0.06
143	21.781	0.153	2.38	96.6	1.57	-	75	-0.037	3.19	0.08
144	21.939	0.158	2.38	96.7	1.78	-	75	-0.030	2.83	0.11
145	22.093	0.154	2.37	96.7	1.7	-	75	-0.035	2.47	0.14
146	22.250	0.157	2.38	96.7	1.7	-	75	-0.030	2.34	0.13
147	22.403	0.153	2.37	96.9	1.53	-	75	-0.035	2.69	0.11
148	22.561	0.158	2.38	96.9	1.63	-	75	-0.024	3.88	0.05
149	22.717	0.156	2.38	96.9	1.55	-	75	-0.031	3.38	0.12
150	22.871	0.154	2.38	96.9	1.48	99	75	-0.033	3.01	0.15
151	23.028	0.157	2.38	97	1.74	-	75	-0.028	2.90	0.12
152	23.182	0.154	2.37	97	2.01	-	75	-0.030	2.70	0.12
153	23.339	0.157	2.38	96.9	1.51	-	75	-0.035	2.84	0.09
154	23.492	0.153	2.37	97	2.02	-	75	-0.027	2.76	0.11
155	23.649	0.157	2.37	97	1.69	-	75	-0.030	2.60	0.11
156	23.806	0.157	2.37	97	1.52	-	75	-0.031	3.25	0.08
157	23.959	0.153	2.37	97.1	1.51	-	75	-0.028	2.95	0.11
158	24.116	0.157	2.37	97.2	1.49	-	76	-0.032	3.00	0.09
159	24.271	0.155	2.37	97.2	1.56	-	75	-0.032	3.07	0.08

BOX B TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Standard
Run #: 1

Job #: 23-143
Tracking #: 144
Technician: AK
Date: 5/3/2023

	Particulate Sampling Data							Flue Gas Data		
Elapsed Time (min)	Gas Meter (ft^3)	Sample Rate (cfm)	Orifice dH (in H_2O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H_2O)	CO_2 (%)	CO (%)
160	24.429	0.158	2.37	97.3	1.76	99	75	-0.031	2.72	0.11
161	24.581	0.152	2.37	97.2	1.9	-	76	-0.031	2.60	0.11
162	24.738	0.157	2.37	97.3	1.57	-	75	-0.031	2.86	0.09
163	24.894	0.156	2.36	97.2	1.62	-	75	-0.031	2.99	0.08
164	25.049	0.155	2.37	97.2	1.66	-	75	-0.027	2.86	0.08
165	25.205	0.156	2.37	97.6	1.59	-	76	-0.031	2.68	0.10
166	25.359	0.154	2.37	97.8	1.86	-	76	-0.032	2.75	0.10
167	25.518	0.159	2.38	97.7	2.01	-	76	-0.030	3.14	0.07
168	25.670	0.152	2.37	97.5	1.56	-	76	-0.025	3.05	0.08
169	25.827	0.157	2.37	97.5	1.84	-	76	-0.035	2.81	0.10
170	25.983	0.156	2.37	97.4	1.7	99	76	-0.028	2.60	0.11
171	26.138	0.155	2.37	97.4	1.86	-	76	-0.031	2.62	0.10
172	26.294	0.156	2.37	97.3	1.84	-	76	-0.027	2.89	0.09
173	26.448	0.154	2.36	97.4	1.99	-	76	-0.031	3.14	0.07
174	26.606	0.158	2.37	97.4	1.88	-	76	-0.032	3.15	0.08
175	26.759	0.153	2.37	97.5	2.04	-	76	-0.029	2.92	0.10
176	26.915	0.156	2.37	97.7	2.01	-	76	-0.028	2.66	0.12
177	27.071	0.156	2.37	97.7	2.03	-	76	-0.029	2.50	0.13
178	27.227	0.156	2.38	97.8	1.97	-	76	-0.030	2.68	0.11
179	27.383	0.156	2.37	97.9	1.52	-	76	-0.031	2.78	0.12
180	27.536	0.153	2.37	98	1.53	100	76	-0.031	2.78	0.11
181	27.695	0.159	2.37	98	1.55	-	76	-0.042	2.91	0.10
182	27.848	0.153	2.37	98.2	1.84	-	76	-0.038	3.00	0.09
183	28.004	0.156	2.37	98.1	1.53	-	76	-0.039	2.97	0.09
184	28.160	0.156	2.37	97.9	1.54	-	76	-0.040	2.92	0.09
185	28.315	0.155	2.37	97.9	1.6	-	76	-0.037	2.86	0.09
186	28.471	0.156	2.36	98	1.57	-	76	-0.038	2.84	0.09
187	28.625	0.154	2.36	98	1.98	-	76	-0.039	2.87	0.09
188	28.784	0.159	2.37	98.1	1.73	-	76	-0.033	2.90	0.09
189	28.937	0.153	2.37	98	1.5	-	76	-0.035	3.00	0.08
190	29.094	0.157	2.37	97.9	1.73	101	76	-0.038	3.12	0.07
191	29.248	0.154	2.37	97.9	1.93	-	76	-0.036	3.20	0.07

BOX B TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Standard
Run #: 1

Job #: 23-143
Tracking #: 144
Technician: AK
Date: 5/3/2023

	Particulate Sampling Data							Flue Gas Data		
Elapsed Time (min)	Gas Meter (ft^3)	Sample Rate (cfm)	Orifice dH (in H_2O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H_2O)	CO_2 (%)	CO (%)
192	29.404	0.156	2.36	98	1.56	-	76	-0.037	3.23	0.07
193	29.561	0.157	2.37	97.9	1.52	-	75	-0.038	3.17	0.08
194	29.714	0.153	2.36	97.9	2	-	76	-0.034	3.09	0.08
195	29.873	0.159	2.37	98	1.83	-	76	-0.036	3.00	0.08
196	30.026	0.153	2.37	97.9	1.8	-	76	-0.032	2.91	0.08
197	30.183	0.157	2.37	98	1.63	-	75	-0.036	2.98	0.07
198	30.337	0.154	2.37	98	2.02	-	75	-0.037	3.12	0.07
199	30.494	0.157	2.37	97.9	1.79	-	76	-0.036	3.14	0.06
200	30.650	0.156	2.37	97.8	1.9	98	75	-0.035	2.93	0.07
201	30.804	0.154	2.37	97.9	1.55	-	75	-0.037	2.79	0.07
202	30.962	0.158	2.37	97.9	1.59	-	75	-0.036	2.86	0.06
203	31.116	0.154	2.37	97.9	1.83	-	75	-0.034	2.97	0.06
204	31.272	0.156	2.37	98.2	1.64	-	76	-0.037	3.08	0.05
205	31.426	0.154	2.37	98.1	1.62	-	76	-0.035	3.13	0.05
206	31.584	0.158	2.37	98	1.55	-	76	-0.030	3.07	0.06
207	31.740	0.156	2.37	98	1.85	-	76	-0.036	3.04	0.06
208	31.894	0.154	2.37	98	2.01	-	76	-0.033	3.01	0.06
209	32.052	0.158	2.37	97.9	1.64	-	75	-0.037	2.97	0.06
210	32.205	0.153	2.36	98	1.97	98	76	-0.035	2.99	0.06
211	32.362	0.157	2.37	98	1.62	-	76	-0.035	3.04	0.06
212	32.516	0.154	2.36	98	1.98	-	76	-0.034	3.14	0.05
213	32.673	0.157	2.37	98.1	1.85	-	76	-0.037	3.17	0.05
214	32.830	0.157	2.37	98.1	1.55	-	76	-0.034	3.20	0.05
215	32.983	0.153	2.37	98	2	-	76	-0.035	3.19	0.05
216	33.141	0.158	2.38	98.1	1.71	-	76	-0.034	3.13	0.05
217	33.295	0.154	2.36	98.1	2.04	-	76	-0.037	3.07	0.05
218	33.452	0.157	2.37	98.1	2.02	-	76	-0.032	3.06	0.05
219	33.606	0.154	2.37	98.1	1.56	-	76	-0.032	3.01	0.05
220	33.763	0.157	2.37	98.1	1.5	98	76	-0.038	2.97	0.05
221	33.920	0.157	2.37	98.2	1.55	-	76	-0.032	2.92	0.06
222	34.073	0.153	2.38	98.2	1.54	-	76	-0.033	2.85	0.06
223	34.230	0.157	2.37	98.2	1.52	-	76	-0.034	2.84	0.06

BOX B TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Standard
Run #: 1

Job #: 23-143
Tracking #: 144
Technician: AK
Date: 5/3/2023

	Particulate Sampling Data							Flue Gas Data		
Elapsed Time (min)	Gas Meter (ft^3)	Sample Rate (cfm)	Orifice dH (in H_2O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H_2O)	CO_2 (%)	CO (%)
224	34.384	0.154	2.36	98.2	1.89	-	76	-0.035	2.80	0.06
225	34.542	0.158	2.37	98.3	1.61	-	76	-0.034	2.82	0.05
226	34.695	0.153	2.36	98.2	1.76	-	76	-0.034	2.83	0.05
227	34.852	0.157	2.37	98.3	2.01	-	76	-0.032	2.84	0.06
228	35.009	0.157	2.36	98.3	1.62	-	76	-0.034	2.89	0.06
229	35.162	0.153	2.36	98.3	1.51	-	76	-0.032	2.95	0.05
230	35.319	0.157	2.37	98.4	1.49	98	76	-0.031	3.01	0.05
231	35.474	0.155	2.36	98.5	1.86	-	76	-0.033	3.06	0.06
232	35.632	0.158	2.37	98.5	1.85	-	76	-0.036	3.07	0.05
233	35.785	0.153	2.37	98.5	1.53	-	76	-0.033	3.11	0.05
234	35.942	0.157	2.36	98.5	1.94	-	76	-0.033	3.10	0.05
235	36.098	0.156	2.36	98.6	1.55	-	76	-0.035	3.09	0.05
236	36.252	0.154	2.37	98.5	1.96	-	76	-0.037	3.07	0.05
237	36.409	0.157	2.36	98.5	1.5	-	76	-0.036	3.06	0.05
238	36.564	0.155	2.36	98.6	1.81	-	76	-0.029	3.03	0.06
239	36.722	0.158	2.37	98.6	1.86	-	76	-0.033	3.05	0.06
240	36.875	0.153	2.37	98.6	2.03	98	76	-0.034	3.03	0.05
241	37.032	0.157	2.36	98.6	1.56	-	76	-0.031	3.03	0.06
242	37.188	0.156	2.36	98.7	1.51	-	76	-0.035	3.02	0.06
243	37.342	0.154	2.36	98.7	1.76	-	76	-0.034	2.99	0.06
244	37.499	0.157	2.36	98.7	1.81	-	76	-0.037	2.97	0.07
245	37.653	0.154	2.37	98.7	1.48	-	76	-0.037	2.95	0.06
246	37.812	0.159	2.37	98.8	1.89	-	77	-0.033	3.03	0.06
247	37.964	0.152	2.37	98.8	2.01	-	76	-0.034	1.56	0.14
248	38.121	0.157	2.37	98.9	1.6	-	76	-0.033	3.71	0.02
249	38.277	0.156	2.36	98.9	2	-	77	-0.032	3.16	0.06
250	38.432	0.155	2.37	98.9	1.49	98	76	-0.032	1.87	0.12
251	38.589	0.157	2.36	98.9	2.04	-	77	-0.034	3.07	0.07
252	38.743	0.154	2.37	99	2	-	77	-0.034	3.56	0.04
253	38.902	0.159	2.37	99	1.79	-	77	-0.035	3.10	0.05
254	39.054	0.152	2.37	98.9	1.59	-	76	-0.036	2.33	0.06
255	39.211	0.157	2.37	99	1.6	-	76	-0.036	2.97	0.04

BOX B TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Standard
Run #: 1

Job #: 23-143
Tracking #: 144
Technician: AK
Date: 5/3/2023

	Particulate Sampling Data							Flue Gas Data		
Elapsed Time (min)	Gas Meter (ft^3)	Sample Rate (cfm)	Orifice dH (in H_2O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H_2O)	CO_2 (%)	CO (%)
256	39.367	0.156	2.36	99.1	1.51	-	77	-0.034	4.32	0.01
257	39.522	0.155	2.37	99.1	2.02	-	77	-0.034	3.17	0.05
258	39.679	0.157	2.36	99	2.02	-	76	-0.036	2.17	0.10
259	39.833	0.154	2.36	99.2	2.05	-	77	-0.035	2.63	0.04
260	39.991	0.158	2.36	99.2	1.92	98	77	-0.033	2.60	0.07
261	40.143	0.152	2.36	99.3	1.91	-	77	-0.038	3.93	0.03
262	40.300	0.157	2.36	99.2	2.04	-	77	-0.032	4.61	0.02
263	40.456	0.156	2.36	99.2	2.01	-	77	-0.035	1.85	0.13
264	40.612	0.156	2.37	99.2	1.52	-	77	-0.032	4.09	0.02
265	40.768	0.156	2.37	99.2	1.56	-	77	-0.031	1.58	0.14
266	40.922	0.154	2.36	99.3	1.54	-	77	-0.031	2.10	0.10
267	41.080	0.158	2.36	99.3	2.02	-	77	-0.037	3.48	0.02
268	41.233	0.153	2.36	99.4	1.94	-	77	-0.033	5.19	0.01
269	41.389	0.156	2.36	99.3	2	-	77	-0.037	2.57	0.12
270	41.545	0.156	2.37	99.3	1.93	98	77	-0.031	2.84	0.06
271	41.701	0.156	2.36	99.3	1.81	-	77	-0.033	0.90	0.12
272	41.857	0.156	2.37	99.4	2.02	-	77	-0.035	1.77	0.08
273	42.010	0.153	2.37	99.5	2.04	-	77	-0.030	4.11	0.01
274	42.169	0.159	2.36	99.5	1.56	-	77	-0.035	3.43	0.05
275	42.322	0.153	2.37	99.5	1.61	-	77	-0.034	3.18	0.05
276	42.479	0.157	2.36	99.6	1.53	-	77	-0.033	3.37	0.05
277	42.634	0.155	2.36	99.6	1.55	-	77	-0.036	1.90	0.12
278	42.790	0.156	2.36	99.6	1.64	-	77	-0.034	2.72	0.05
279	42.946	0.156	2.36	99.6	1.86	-	77	-0.035	3.16	0.06
280	43.099	0.153	2.35	99.6	2.03	98	77	-0.034	3.91	0.02
281	43.258	0.159	2.36	99.7	1.57	-	77	-0.034	2.50	0.08
282	43.411	0.153	2.36	99.7	1.95	-	77	-0.038	2.17	0.09
283	43.568	0.157	2.36	99.7	1.55	-	77	-0.036	2.75	0.05
284	43.723	0.155	2.36	99.6	1.83	-	77	-0.034	3.92	0.02
285	43.879	0.156	2.35	99.9	2	-	77	-0.039	4.42	0.02
286	44.035	0.156	2.36	99.9	1.59	-	77	-0.037	3.67	0.04
287	44.188	0.153	2.35	99.9	1.5	-	77	-0.031	2.51	0.12

BOX B TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Standard
Run #: 1

Job #: 23-143
Tracking #: 144
Technician: AK
Date: 5/3/2023

	Particulate Sampling Data							Flue Gas Data		
Elapsed Time (min)	Gas Meter (ft^3)	Sample Rate (cfm)	Orifice dH (in H_2O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H_2O)	CO_2 (%)	CO (%)
288	44.347	0.159	2.35	99.9	1.54	-	77	-0.034	2.43	0.10
289	44.501	0.154	2.36	99.8	1.93	-	77	-0.034	3.16	0.05
290	44.657	0.156	2.36	99.8	1.98	98	77	-0.032	3.68	0.03
291	44.811	0.154	2.35	99.8	1.56	-	77	-0.036	2.43	0.10
292	44.968	0.157	2.36	99.8	1.64	-	77	-0.033	2.82	0.06
293	45.124	0.156	2.36	99.8	1.59	-	77	-0.034	2.95	0.06
294	45.278	0.154	2.36	99.8	1.85	-	77	-0.037	3.47	0.04
295	45.436	0.158	2.36	99.8	1.59	-	77	-0.033	3.29	0.06
296	45.589	0.153	2.35	99.8	1.74	-	77	-0.033	2.15	0.11
297	45.746	0.157	2.36	99.8	1.95	-	77	-0.032	2.65	0.06
298	45.900	0.154	2.35	99.8	1.73	-	77	-0.034	3.15	0.03
299	46.057	0.157	2.36	99.9	1.88	-	77	-0.035	2.91	0.05
300	46.214	0.157	2.36	99.9	1.82	98	77	-0.035	2.68	0.06
301	46.367	0.153	2.36	100	1.69	-	77	-0.037	2.99	0.04
302	46.524	0.157	2.36	100	2	-	77	-0.033	2.59	0.09
303	46.678	0.154	2.35	100	2	-	77	-0.032	3.34	0.03
304	46.835	0.157	2.36	100	1.68	-	77	-0.034	2.86	0.05
305	46.989	0.154	2.35	100	2.02	-	77	-0.037	2.82	0.06
306	47.146	0.157	2.36	99.9	1.86	-	77	-0.034	3.25	0.03
307	47.302	0.156	2.36	100	1.72	-	77	-0.036	2.63	0.08
308	47.456	0.154	2.36	99.9	1.89	-	77	-0.033	3.13	0.05
309	47.613	0.157	2.35	100	1.98	-	77	-0.036	3.45	0.03
310	47.767	0.154	2.36	100	1.48	98	77	-0.034	3.29	0.03
311	47.925	0.158	2.36	99.9	2.04	-	77	-0.037	3.11	0.04
312	48.078	0.153	2.36	99.9	1.82	-	77	-0.032	3.08	0.04
313	48.235	0.157	2.35	99.9	2.06	-	77	-0.035	3.12	0.04
314	48.391	0.156	2.36	100.1	1.61	-	77	-0.033	2.80	0.05
315	48.545	0.154	2.35	100.1	2	-	77	-0.039	2.51	0.06
316	48.702	0.157	2.35	100.2	1.76	-	77	-0.038	2.67	0.04
317	48.857	0.155	2.36	100.1	1.51	-	77	-0.033	3.02	0.03
318	49.015	0.158	2.36	100.1	1.88	-	77	-0.029	3.04	0.04
319	49.168	0.153	2.35	100.1	1.95	-	77	-0.035	3.07	0.03

BOX B TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Standard
Run #: 1

Job #: 23-143
Tracking #: 144
Technician: AK
Date: 5/3/2023

	Particulate Sampling Data							Flue Gas Data		
Elapsed Time (min)	Gas Meter (ft^3)	Sample Rate (cfm)	Orifice dH (in H_2O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H_2O)	CO_2 (%)	CO (%)
320	49.324	0.156	2.36	100.1	2.03	98	77	-0.036	2.98	0.04
321	49.480	0.156	2.35	100.2	1.98	-	77	-0.033	2.75	0.07
322	49.635	0.155	2.36	100.2	1.7	-	77	-0.033	3.82	0.02
323	49.792	0.157	2.36	100.2	1.62	-	77	-0.033	3.15	0.05
324	49.945	0.153	2.35	100.2	1.5	-	77	-0.035	3.23	0.04
325	50.104	0.159	2.36	100.3	1.84	-	78	-0.035	3.75	0.02
326	50.256	0.152	2.36	100.3	1.78	-	78	-0.032	4.16	0.01
327	50.413	0.157	2.35	100.3	1.62	-	78	-0.034	3.57	0.03
328	50.569	0.156	2.35	100.5	1.49	-	78	-0.040	2.52	0.08
329	50.724	0.155	2.36	100.4	1.72	-	78	-0.032	1.90	0.10
330	50.881	0.157	2.36	100.4	1.96	98	78	-0.033	2.24	0.07
331	51.035	0.154	2.35	100.4	1.49	-	78	-0.035	2.95	0.03
332	51.193	0.158	2.36	100.4	1.76	-	78	-0.034	3.40	0.02
333	51.346	0.153	2.35	100.5	1.86	-	78	-0.035	3.23	0.04
334	51.502	0.156	2.35	100.4	1.97	-	78	-0.033	2.87	0.05
335	51.659	0.157	2.35	100.4	1.53	-	77	-0.032	3.32	0.03
336	51.814	0.155	2.35	100.5	1.6	-	78	-0.037	3.43	0.03
337	51.970	0.156	2.36	100.5	2.04	-	77	-0.036	3.22	0.04
338	52.124	0.154	2.36	100.5	1.94	-	77	-0.039	2.85	0.05
339	52.282	0.158	2.35	100.5	1.51	-	78	-0.032	2.96	0.04
340	52.435	0.153	2.36	100.5	1.76	98	77	-0.035	2.95	0.04
341	52.592	0.157	2.35	100.7	1.96	-	77	-0.035	2.91	0.04
342	52.747	0.155	2.35	100.7	1.6	-	77	-0.036	2.81	0.04
343	52.903	0.156	2.36	100.6	1.59	-	77	-0.034	2.74	0.05
344	53.059	0.156	2.35	100.7	1.95	-	77	-0.035	3.04	0.03
345	53.213	0.154	2.36	100.8	1.51	-	78	-0.033	3.30	0.02
346	53.371	0.158	2.35	100.8	1.6	-	77	-0.035	3.44	0.02
347	53.525	0.154	2.36	100.7	1.88	-	77	-0.034	3.36	0.03
348	53.681	0.156	2.35	100.7	2.04	-	77	-0.033	3.06	0.05
349	53.836	0.155	2.36	100.8	1.51	-	77	-0.033	2.63	0.06
350	53.992	0.156	2.35	100.8	1.87	98	78	-0.033	2.33	0.07
351	54.148	0.156	2.35	100.7	1.52	-	78	-0.033	2.32	0.05

BOX B TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Standard
Run #: 1

Job #: 23-143
Tracking #: 144
Technician: AK
Date: 5/3/2023

	Particulate Sampling Data							Flue Gas Data		
Elapsed Time (min)	Gas Meter (ft^3)	Sample Rate (cfm)	Orifice dH (in H_2O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H_2O)	CO_2 (%)	CO (%)
352	54.301	0.153	2.35	100.7	2.03	-	77	-0.034	2.42	0.05
353	54.460	0.159	2.35	100.8	1.52	-	77	-0.034	2.55	0.04
354	54.614	0.154	2.35	100.7	1.67	-	77	-0.035	2.73	0.05
355	54.770	0.156	2.36	100.7	1.61	-	78	-0.037	2.85	0.04
356	54.924	0.154	2.35	100.8	1.52	-	77	-0.033	2.83	0.05
357	55.081	0.157	2.34	100.8	1.56	-	77	-0.036	2.28	0.08
358	55.237	0.156	2.36	100.8	1.93	-	77	-0.033	3.20	0.02
359	55.391	0.154	2.35	100.8	1.86	-	77	-0.038	4.49	0.01
360	55.549	0.158	2.35	100.8	1.68	98	77	-0.035	3.81	0.03
Avg/Tot	55.549	0.154	2.35	94	1.75	100			3.46	0.07

LAB SAMPLE DATA - ASTM E2515

Client: Heat Tech
Model: Standard
Run #: 1

Job #: 23-143
Tracking #: 144
Technician: AK
Date: 5/3/2023

		Sample ID	Tare, mg	Final, mg	Catch, mg
Filters	**A**	G00534	242.2	245.4	3.2
	B	G00535	241.5	244.7	3.2
	C - 1st Hour	G00536	242.1	242.4	0.3
	Amb	G00537	244.1	244.1	0.0
Probes	**A**	1A	115627.0	115627.0	0.0
	B	1B	115901.9	115901.9	0.0
	C - 1st Hour	1C	116432.6	116432.7	0.1
O-rings	**A**	1A	3566.9	3567.5	0.6
	B	1B	3555.3	3555.7	0.4
	C - 1st Hour	1C	4167.0	4167.5	0.5

Placed in Dessicator on:	5/3/23

Filters	**A**	245.4	5/8 10:23	245.4	5/9 8:30				
	B	244.8	5/8 10:23	244.7	5/9 8:30				
	C - 1st Hour	242.4	5/8 10:23	242.4	5/9 8:30				
	Amb	244.1	5/8 10:23	244.1	5/9 8:30				
Probes	**A**	115627.0	5/8 10:23	115627.0	5/9 8:30				
	B	115902.1	5/8 10:23	115901.7	5/9 8:30	115901.9	5/10 15:31		
	C - 1st Hour	116432.9	5/8 10:23	116432.5	5/9 8:30	116432.7	5/10 15:31		
O-Rings	**A**	3567.8	5/8 10:23	3567.5	5/9 8:30	3567.5	5/10 15:31		
	B	3555.9	5/8 10:23	3555.6	5/9 8:30	3555.7	5/10 15:31		
	C - 1st Hour	4167.5	5/8 10:23	4167.5	5/9 8:30				

Train A Aggregate, mg:	**3.8**
Train B Aggregate, mg:	**3.6**
Train C Aggregate, mg:	**0.9**
Ambient Aggregate, mg:	**0.0**

ASTM E2779 Wood Heater Run Sheets

Client: Heat Tech Job Number: 23-143 Tracking #: 144
Model: Standard Run Number: 1 Test Date: 5/3/2023

Pellet Heater Control Settings

High Burn Rate Settings: Heat Level 5

Medium Burn Rate Settings: Heat Level 2

Low Burn Rate Settings: Heat Level 1

Preburn Notes

Preburn Start Time: 8:54

Time	Notes
8:54	Started recording preburn data, unit on high setting
10:01	PB End

Test Notes

Test Burn Start Time: 10:01

Time	Notes
10:01	Started sampling, unit at high setting
11:01	Switched to medium test setting
13:01	Switched to low test setting
16:01	End of test

Test Burn End Time: 16:01

Flue Gas Concentration Measurement

Calibration Gas Values: Span Gas CO_2 (%): 17.01 CO (%): 4.306

Mid Gas CO_2 (%): 10.11 CO (%): 2.530

Calibration Results:

	Pre Test			Post Test		
	Zero	Span	Mid	Zero	Span	Mid
Time	9:04	9:05	9:06	16:03	16:04	16:05
CO_2	0.00	17.03	10.15	-0.02	17.11	10.17
CO	0.00	4.300	2.529	-0.052	4.249	2.475

Flue Gas Probe Leak Check: Initial: No Leakage Final: No Leakage

Technician Signature: Date: 6/2/2023

ASTM E2515 - Glass Filters

Sample	Weight 1	Weight 2	Weigth 3	Weight 4	Initial	Project	Run
G00505	240.8	241.0	–	–	SB	23-141	#3
G00506	242.8	243.0	–	–	SB	↓	↓
G00507	243.0	242.9	–	–	SB	↓	↓
G00508	244.3	244.2	–	–	SB	23-141	#4
G00509	241.8	241.9	–	–	SB	↓	↓
G00510	243.9	244.0	–	–	SB	↓	↓
G00511	243.6	243.5	–	–	SB	↓	↓
G00512	242.7	242.7	–	–	SB	22-791	#6 Acrylic
G00513	241.6	241.6	–	–	SB	↓	↓
G00514	243.8	243.9	–	–	SB	23-141	#5
G00515	242.4	242.3	–	–	SB	↓	↓
G00516	243.4	243.5	–	–	SB	↓	↓
G00517	244.3	244.3	–	–	SB	↓	↓
G00518	243.8	243.8	–	–	SB	#5	Sample Blank
G00519	243.8	243.7	–	–	SB	#5	Room Blank
G00520	243.5	243.6	–	–	SB	5T5	#1
G00521	244.2	244.3	–	–	SB	↓	↓
G00522	243.7	243.7	–	–	SB	↓	↓

Weight 1 Date/Time:
4/13 - 15:00
Weight 2 Date/Time:
4/14 - 10:00
Weight 3 Date/Time:
Weight 4 Date/Time:

Sample	Weight 1	Weight 2	Weigth 3	Weight 4	Initial	Project	Run
G00523	242.5	242.5	–	–	SB	5T5	#2
G00524	241.7	241.8	–	–	SB	↓	↓
G00525	242.7	242.5	–	–	SB	↓	↓
G00526	242.1	242.1	–	–	SB	5T5	#3
G00527	243.9	243.8	–	–	SB	↓	↓
G00528	242.7	242.7	–	–	SB	↓	↓
G00529	240.3	240.3	–	–	SB	5T5	#4
G00530	241.9	241.9	–	–	SB	↓	↓
G00531	244.1	244.0	–	–	SB	↓	↓
G00532	244.0	244.0	–	–	SB	22-791	#7 Acrylic #2
G00533	242.3	242.2	–	–	SB	↓	↓
G00534	242.3	242.2	–	–	SB	23-143	#1
G00535	241.4	241.5	–	–	SB	↓	↓
G00536	242.1	242.1	–	–	SB	↓	↓
G00537	244.0	244.1	–	–	SB	↓	↓
G00538	244.1	243.9	–	–	SB	23-144	#1
G00539	242.6	242.7	–	–	SB	↓	↓
G00540	243.1	243.1	–	–	SB	↓	↓

Weight 1 Date/Time:
4/13 - 15:00
Weight 2 Date/Time:
4/14 - 10:00
Weight 3 Date/Time:
Weight 4 Date/Time:

ASTM E2515 - Glass Filters

Sample	Weight 1	Weight 2	Weigth 3	Weight 4	Initial	Project	Run
G00541	241.9	241.9	-	-	SB	23-144	#1
G00542	242.2	242.0	—	-	SB	23-114	#1
G00543	242.9	242.9	—	-	SB	↓	↓
G00544	243.4	243.5	—	-	SB		
G00545	241.7	241.5	—	-	SB		
G00546	241.6	241.6	—	-	SB		
G00547	243.0	242.8	—	-	SB		
G00548	243.2	243.2	—	-	SB		
G00549	243.0	242.9	—	—	SB		
G00550	243.6	243.7	—	-	SB		
G00551	243.8	243.9	—	-	SB		
G00552	241.6	241.7	—	-	SB		
G00553	241.9	241.8	—	-	SB		
G00554	244.4	244.2	—	-	SB		
G00555	243.5	243.6	—	-	SB		
G00556	242.6	242.5	-	-	SB		
G00557	242.8	242.7	-	-	SB		
G00558	243.5	243.4	—	-	SB		

Weight 1 Date/Time:
5/4 - 11:00
Weight 2 Date/Time:
5/5 . 8:00
Weight 3 Date/Time:
Weight 4 Date/Time:

Sample	Weight 1	Weight 2	Weigth 3	Weight 4	Initial	Project	Run
G00559							
G00560							
G00561							
G00562							
G00563							
G00564							
G00565							
G00566							
G00567							
G00568							
G00569							
G00570							
G00571							
G00572							
G00573							
G00574							
G00575							
G00576							

Weight 1 Date/Time:
Weight 2 Date/Time:
Weight 3 Date/Time:
Weight 4 Date/Time:

ASTM E2515 - ~~O-Ring~~ Probe Samples 1-10

Date:	5/1/23	5/2/23	5/3/23				
Time:	1730	1430	0900				
	Weight 1	**Weight 2**	**Weigth 3**	**Weight 4**	**Initial**	**Project**	**Run**
1A	115626.3	115626.8	115627.0	-	A	23-143	#1
1B	115901.7	115901.9	-	-	A		
1C	116432.7	116432.6	-	-	A		
2A	116056.6	116056.8	-	-	A	23-144	#1
2B	116173.3	116173.7	116173.6	-	A		
2C	116429.2	116429.1	-	-	A		
3A	115879.9	115880.0	-	-	A	23-109	#1
3B	116119.8	116120.0	-	-	A		
3C	116617.2	116617.3	-	-	A		
4A	116022.2	116022.6	116022.4	-	A		
4B	116181.5	116181.8	116181.8	-	A		
4C	116997.0	116997.1	-	-	A		
5A	116756.9	116757.0	-	-	A		
5B	116875.2	116875.4	-	-	A		
5C	115854.7	115855.0	115855.0	-	A		

Date:	5/31/23	6/1/23	6/2/23				
Time:	10:00	15:30	11:00				
	Weight 1	**Weight 2**	**Weigth 3**	**Weight 4**	**Initial**	**Project**	**Run**
6A	116381.9	116382.0	-	-	A		
6B	115953.3	115953.4	-	-	A		
6C	115127.9	115127.9	-	-	A		
7A	116557.4	116557.4	-	-	A		
7B	117128.0	117128.2	-	-	A		
7C	116550.7	116550.7	-	-	A		
8A	116632.8	116633.0	-	-	A		
8B	116664.8	116664.9	-	-	A		
8C	116662.7	116662.3	116662.7				
9A	116530.1	116530.0	-	-	A		
9B	117737.8	117737.7	-	-	A		
9C	116602.9	116603.0	-	-	A		
10A	116645.5	116645.5	-	-	A		
10B	117753.5	117753.6	-	-	A		
10C	116727.8	116727.8	-	-	A		

ASTM E2515 - ~~Probe~~ O-Ring Samples 1-10

Date:	5/1/23	5/2/23					
Time:	17:00	1400					
	Weight 1	**Weight 2**	**Weigth 3**	**Weight 4**	**Initial**	**Project**	**Run**
1A	3566.7	3566.9	-	-	A	23-143	#1
1B	3555.1	3555.83	-	-	A		
1C	4166.88	4167.0	-	-	A		
2A	3552.7	3552.8	-	-	A	23-144	#1
2B	3571.8	3571.9	-	-	A		
2C	3389.8	3389.8	-	-	A		
3A	3579.6	3579.4	-	-	A	23-114	#1
3B	3568.3	3568.3	-	-	A		
3C	3622.0	3621.9	-	-	A		
4A	3374.9	3374.9	-	-	A	23-161	#1
4B	3579.4	3579.3	-	-	A		
4C	3371.3	3371.4	-	-	A		
5A	3535.2	3535.4	-	-	A	23-161	#2
5B	3531.3	3531.4	-	-	A		
5C	3375.2	3375.4	-	-	A		

Date:	5/30/23	5/31/23					
Time:	16:00	8:00					
	Weight 1	**Weight 2**	**Weigth 3**	**Weight 4**	**Initial**	**Project**	**Run**
6A	3614.1	3614.2	—	—	JB	23-161	#3
6B	3396.5	3396.4	—	—	JB		
6C	3401.4	3401.2	—	—	JB		
7A	3572.1	3572.0	—	—	JB	23-161	#4
7B	3522.9	3523.1	—	—	JB		
7C	3406.8	3406.7	—	—	JB		
8A	3551.5	3551.3	—	—	JB		
8B	3357.2	3357.2	—	—	JB		
8C	3586.3	3586.2	—	—	JB		
9A	3580.6	3580.6	—	—	JB		
9B	3523.5	3523.5	—	—	JB		
9C	3430.5	3430.7	—	—	JB		
10A	3360.9	3360.7	—	—	JB		
10B	3570.7	3570.6	—	—	JB		
10C	3365.9	3366.0	—	—	JB		

Twin Ports Testing, Inc.
1301 North 3rd Street
Superior, WI 54880
p: 715-392-7114
p: 800-373-2562
f: 715-392-7163
www.twinportstesting.com

Analytical Test Report

Report No: USR:W223-0247-01
Issue No: 1

Client: PFS-TECO
11785 SE Hwy 212 Ste 305
Clackamas, OR 97015
Attention: Sebastian Button

PO No:

Signed:

Amber Anderson
Chemist
Date of Issue: 5/11/2023

Sample Details

Sample Log No:	W223-0247-01	**Sample Date:**	
Sample Designation:	Biomass Pellets	**Sample Time:**	
Sample Recognized As:	Biomass Pellets	**Arrival Date:**	5/8/2023

Test Results

	METHOD	UNITS	MOISTURE FREE	AS RECEIVED
Moisture Total	ASTM E871	wt. %		5.98
Ash	ASTM D1102	wt. %	0.47	0.45
Volatile Matter	ASTM D3175	wt. %		
Fixed Carbon by Difference	ASTM D3172	wt. %		
Sulfur	ASTM D4239	wt. %	0.011	0.011
SO_2	Calculated	lb/mmbtu		0.027
Net Cal. Value at Const. Pressure	ISO 1928	GJ/tonne	17.80	16.59
Gross Cal. Value at Const. Vol.	ASTM E711	Btu/lb	8456	7950
Carbon	ASTM D5373	wt. %	46.01	43.26
Hydrogen*	ASTM D5373	wt. %	8.65	8.13
Nitrogen	ASTM D5373	wt. %	< 0.20	< 0.19
Oxygen*	ASTM D3176	wt. %	> 44.66	> 41.99
*Note: As received values do not include hydrogen and oxygen in the total moisture.				
Chlorine	ASTM D6721	mg/kg		
Fluorine	ASTM D3761	mg/kg		
Mercury	ASTM D6722	mg/kg		
Bulk Density	ASTM E873	lbs/ft^3		
Fines (Less than 1/8")	TPT CH-P-06	wt.%		
Durability Index	Kansas State	PDI		
Sample Above 1.50"	TPT CH-P-06	wt.%		
Maximum Length (Single Pellet)	TPT CH-P-06	inch		
Diameter, Range	TPT CH-P-05	inch		to
Diameter, Average	TPT CH-P-05	inch		
Stated Bag Weight	TPT CH-P-01	lbs		
Actual Bag Weight	TPT CH-P-01	lbs		

Comments:

Accreditation #60243

AGING DATA

The Heat Tech HTP 26 Standard Pellet Stove was aged by Myren Consulting, Inc. The Aging installation configuration was the same as the installation used during certification testing. During Aging the stove was run on the Medium setting used during certification testing and the temperature and the (wet) burn rate data were collected using a Data Acquisition System (DAS). The Aging data was then transferred from the DAS spreadsheet to the Aging data pages in this section.

Unit: HEAT Tech HTP 26 STD
Date(s): 7/1 - 7/3/15
Technicians: ATM ESS
Page: 1 of 2

PELLET STOVE AGING DATA
Woodstove Test Data Sheet #25P
WST5-Form 3A, Rev 12/15

T/C# 1

HOUR #	2015 DATE	TIME	POUNDS BURNT	STACK TEMP	COMMENTS
1	7/1	1127	2.0	299	Fire Started @ 10:27
2		1227	2.1	320	
3		1327	2.2	318	
4		1427	2.3	339	
5		1527	2.4	343	Added fuel @ 1549
6		1627	1.7	344	
7		1727	2.4	343	
8		1827	2.4	352	
9		1927	2.3	346	
10		2027	2.3	344	
11		2127	2.2	340	
12		2227	2.2	328	
13	↓	2327	2.2	339	
14	7/2	0027	2.3	329	
15		0127	2.2	307	
16		0227	2.2	327	
17		0327	2.3	327	
18		0427	2.2	318	
19		0527	2.0	280	
20		0627	2.1	303	
21		0727	2.0	298	
22		0827	2.0	290	Added Fuel @ 911
23		0927	1.7	255	
24		1027	2.2	318	
25		1127	2.3	336	
26		1227	2.3	327	
27		1327	2.5	350	
28		1427	2.6	354	Added fuel @ 1507
29	↓	1527	2.6	357	

Unit: HEAT TECH HTP 26 STD

PELLET STOVE AGING DATA
Woodstove Test Data Sheet #25P
WST5-Form 3A, Rev 12/15

Date(s): 7/1 - 7/3/15
Technicians: AJM
Page: 2 of 2

T/C#

HOUR #	DATE	TIME	POUNDS BURNT	STACK TEMP	COMMENTS
30	7/2	1627	2.4	354	
31		1727	2.5	341	
32		1827	2.5	351	
33		1927	2.5	356	
34		2027	2.4	350	
35		2127	2.3	311	
36		2227	2.4	331	
37		2327	2.2	328	
38	7/3	0027	2.2	313	
39		0127	2.2	314	
40		0227	2.2	311	
41		0327	2.1	299	
42		0427	1.9	274	
43		0527	1.7	267	
44		0627	1.1	184	Hopper Ran Out of Fuel
45		0945	2.2	341	Fire Started @ 0845
46		1045	2.3	332	
47		1145	2.2	328	
48		1245	2.2	336	
49		1345	2.2	334	
50		1445	2.2	328	
51		1545	2.1	326	

Equations and Sample Calculations – ASTM E2779 & E2515

Client	Heat Tech
Model:	Standard
Tracking #:	144
Run:	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_{Bdb} – Weight of test fuel burned during test run, dry basis, kg

M_{BSidb} – Weight of test fuel burned during test run segment *i* , dry basis, kg

BR – Average dry burn rate over full integrated test run, kg/hr

BR_{Si} – Average dry burn rate over test run segment *i* , 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 STP, g/dscf

E_T – Total Particulate Emissions, g

PR - Proportional Rate Variation

PM_R – Average particulate emissions for full integrated test run, g/hr

PM_F – Average particulate emission factor for full integrated test run, g/dry kg of fuel burned

M_{Bdb} – Weight of test fuel burned during test run, dry basis, kg
ASTM E2779 equation (1)

$$M_{Bdb} = (M_{Swb} - M_{Ewb})(100/(100 + FM))$$

Where,

FM = average fuel moisture of test fuel, % dry basis
M_{Swb} = weight of test fuel in hopper at start of test run, wet basis, kg
M_{Ewb} = weight of test fuel in hopper at end of test run, wet basis, kg

Sample Calculation:

FM = 6.36 %
M_{Swb} = 12.6 lbs
M_{Ewb} = 0.0 lbs
0.4536 = Conversion factor from lbs to kg

M_{Bdb} = [(12.6 x 0.4536) - (0.0 x 0.4536)] (100/(100 + 6.36)

M_{Bdb} = **5.38** kg

M_{BSidb} – Weight of test fuel burned during test run segment *i* , dry basis, kg
ASTM E2779 equation (2)

$$M_{BSidb} = (MS_{Siwb} - M_{ESiwb})(100/(100 + FM))$$

Where,

M_{SSiwb} = weight of test fuel in hopper at start of test run segment *i* , wet basis, kg

M_{ESiwb} = weight of test fuel in hopper at end of test run segment *i* , wet basis, kg

Sample Calculation (from medium burn rate segment):

FM = 6.36 %

M_{SSiwb} = 9.0 lbs

M_{ESiwb} = 4.5 lbs

0.4536 = Conversion factor from lbs to kg

M_{BSidb} = [(9.0 x 0.4536) - (4.5 x 0.4536)] (100/(100 + 6)

M_{BSidb} = **1.9** kg

BR – Average dry burn rate over full integrated test run, kg/hr
ASTM E2779 equation (3)

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

Where,

θ = Total length of full integrated test run, min

Sample Calculation:

M_{Bdb} = 5.38 kg
θ = 360 min

$$BR = \frac{60 \times 5.38}{360}$$

BR = **0.90** kg/hr

BR_{Si} – Average dry burn rate over test run segment *i* , kg/hr
ASTM E2779 equation (4)

$$BR_{Si} = \frac{60\ M_{BSidb}}{\theta_{Si}}$$

Where,

θ_{Si} = Total length of test run segment *i* , min

Sample Calculation (from medium burn rate segment):

M_{BSidb} = 1.90 kg
θ = 120 min

$$BR = \frac{60 \times 1.9}{120}$$

BR = **0.95** kg/hr

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

$$V_s = F_p \times K_p \times C_P \times \left(\sqrt{\Delta P}\right)_{avg} \times \sqrt{\frac{T_s}{P_s \times M_s}}$$

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:

$$Fp = \frac{6.27}{7.10} = 0.883$$

$$V_s = 0.883 \times 85.49 \times 0.99 \times 0.112 \times \left(\frac{87.0 + 460}{\left(29.65 + \frac{-0.05}{13.6}\right) \times 28.78} \right)^{1/2}$$

V_s = **6.71** 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)

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

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	=	Absolute average gas temperature in the dilution tunnel, °R; (°R = °F + 460)
P_{std}	=	Standard absolute pressure, 29.92 in Hg

Sample calculation:

$$Q_{sd} = 3600 \times (1 - 0.02) \times 6.71 \times 0.7854 \times \frac{528}{87.0 + 460} \times \frac{29.65 + \frac{-0.05}{13.6}}{29.92}$$

Q_{sd} = **17795.5** dscf/hr

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

ASTM E2515 equation (6)

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

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 A:

$$V_{m(std)} = 17.64 \times 55.907 \times 1.01 \times \frac{\left(29.65 + \frac{2.32}{13.6}\right)}{(95.1 + 460)}$$

$V_{m(std)}$ = **53.514** dscf

Using equation for Train B:

$$V_{m(std)} = 17.64 \times 55.549 \times 1.001 \times \frac{\left(29.65 + \frac{2.35}{13.6}\right)}{(94.0 + 460)}$$

$V_{m(std)}$ = **52.805** dscf

Using equation for ambient train:

$$V_{m(std)} = 17.64 \times 48.85 \times 1.024 \times \frac{\left(29.65 + \frac{0.00}{13.6}\right)}{(70.1 + 460)}$$

$V_{m(std)}$ = **49.358** 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 A:

m_n = 0.0 + 3.2 + 0.6

m_n = **3.8** mg

Using equation for Train B:

m_n = 0.0 + 3.2 + 0.4

m_n = **3.6** mg

C_s - Concentration of particulate matter in tunnel gas, dry basis, 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 A:

$$C_s = 0.001 \times \frac{3.8}{53.514}$$

C_s = **0.00007** g/dscf

For Train B:

$$C_s = 0.001 \times \frac{3.6}{52.805}$$

C_s = **0.00007** g/dscf

For Ambient Train

$$C_r = 0.001 \times \frac{0.0}{49.358}$$

C_r = **0.000000** 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 A

E_T = (0.000071 - 0.000000) x 17795.5 x 360 /60

E_T = **7.58** g

For Train B

E_T = (0.000068 - 0.000000) x 17795.5 x 360 /60

E_T = **7.28** g

Average

E = **7.43** g

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

7.5% of the average =	0.56
Train A difference (%) =	**2.0%**
Train B difference (%)=	**2.0%**

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 10 minute interval of Train A):

$$PR = \left(\frac{360 \times 1.405 \times 6.71 \times (95.1 + 460) \times (91.8 + 460)}{10 \times 55.907 \times 6.59 \times (87.0 + 460) \times (72.6 + 460)} \right) \times 100$$

PR = **97** %

PM_R – Average particulate emissions for full integrated test run, g/hr
ASTM E2779 equation (5)

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

Where,

E_T = Total particulate emissions, grams

θ = Total length of full integrated test run, min

Sample Calculation:

E_T (Dual train average) = 7.43 g

θ = 360 min

$PM_R = 60 \times (7.43 / 360)$

PM_R = **1.24** g/hr

PM_F – Average particulate emission factor for full integrated test run, g/dry kg of fuel burned
ASTM E2779 equation (6)

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

Where,

E_T = Total particulate emissions, grams

M_{Bdb} = Weight of test fuel burned during test run, dry basis, kg

Sample Calculation:

E_T (Dual train average) = 7.43 g

M_{Bdb} = 5.38 kg

PM_F = 7.43 / 5.38)

PM_F = **1.38** g/kg

Stack Loss Efficiency and CO emissions calculations are done in accordance with CSA B415.1, using the password protected excel spreadsheet provided with the test standard. No alterations or alternative calculations are used for determining efficiency or CO emissions. The following pages are a sample of the calculations page from the B415.1 Spreadsheet (V2_4 - Dated April 15, 2010).

Manufacturer: Heat Tech
Model: Standard
Date: 05/03/23
Run: 1
Control #: 23-143
Test Duration: 360 min

Note: In the "Input data", "Calc. % O_2", "Fuel Properties", and "Mass Balance" columns, [e], [d], [g], [a]. [b], [c], [h], [u], [w], [j], and [k] refer to their respective variables in Clauses 13.7.3 to 13.7.5.

	HHV	LHV
Eff	67.33%	74.39%
Comb Eff	99.50%	99.50%
HT Eff	67.67%	74.76%
Output	11,865	kJ/h
Burn Rate	0.90	kg/h
Grams CO	127	g
Input	17,622	kJ/h
MC wet	5.98	

Ultimate CO_2
$CO_{2\text{-ult}}$ 18.12
F_0 1.144

Overall Heating Efficiency: 67.33%
Combustion Efficiency: 99.50%
Heat Transfer Efficiency: 67.67%

Air Fuel Ratio (A/F)	
Dry Molecular Weight (M_d)	29.23
Dry Moles Exhaust Gas (N_d):	1205.49
Air Fuel Ratio (A/F)	34.73

%HC 0.8

Heat Output: 11,255 Btu/h 11,865 kJ/h
Heat Input: 16,716 Btu/h 17,622 kJ/h
Burn Duration: 6.00 h
Burn Rate: 1.98 lb/h 0.897 kg/h
Stack Temp: 282.6 Deg. F 139.2 Deg. C

Averages	0.07	3.46	4.56	20.39	16.90	139.39	21.17	99.8%	68.3%	68.2%	34.50	2.34	59.07	2.25	58.16	105820	3.83
INPUT DATA			Oxygen Calculation			Input Data		Combust	Heat	Net	Air	Wet Wt	% Wet	Dry Wt.	% Dry		
Elapsed Time	Weight Remaining (kg)	% CO [e]	% CO_2 [d]	Excess Air EA	Total O_2	Calc. % O_2 [g]	Flue Gas (°C)	Room Temp (°C)	Eff %	Transfer %	Eff %	Fuel Ratio	Now Wt	Consumed x	Now Wt_{dn}	Comsumed y	Total Input	Carbon /12= [a]
0	5.72	0.08	4.26	317.5%	20.27	15.96	194.4	19.7	99.6%	64.3%	64.1%	25.9	5.72	0.00	5.38	0.00	0	3.83
1	5.70	0.02	6.70	169.9%	19.90	13.19	194.1	19.7	100.4%	72.8%	73.1%	16.8	5.70	0.40	5.36	0.40	713	3.83
2	5.67	0.07	4.57	290.6%	20.22	15.62	194.9	19.7	99.7%	65.8%	65.6%	24.2	5.67	0.95	5.33	0.95	587	3.83
3	5.64	0.04	5.66	218.4%	20.06	14.38	195.4	19.7	100.3%	69.9%	70.1%	19.8	5.64	1.51	5.30	1.51	503	3.83
4	5.61	0.02	5.69	217.4%	20.05	14.35	196.7	19.7	100.5%	69.9%	70.2%	19.8	5.61	1.90	5.28	1.90	461	3.83
5	5.59	0.05	5.09	252.2%	20.14	15.02	194.8	19.8	100.0%	68.1%	68.1%	21.9	5.59	2.38	5.25	2.38	503	3.83
6	5.56	0.05	4.94	263.6%	20.17	15.21	196.6	19.7	100.1%	67.2%	67.3%	22.6	5.56	2.85	5.23	2.85	461	3.83
7	5.54	0.09	3.77	370.7%	20.34	16.53	193.7	19.8	99.5%	61.4%	61.1%	29.2	5.54	3.25	5.20	3.25	503	3.83
8	5.50	0.03	5.52	226.9%	20.08	14.55	196.2	19.8	100.4%	69.4%	69.7%	20.3	5.50	3.81	5.17	3.81	545	3.83
9	5.48	0.03	6.30	186.5%	19.96	13.64	196.8	19.8	100.3%	71.6%	71.8%	17.8	5.48	4.28	5.15	4.28	503	3.83
10	5.45	0.13	3.82	359.1%	20.33	16.45	195.4	19.8	98.5%	61.5%	60.6%	28.4	5.45	4.76	5.12	4.76	587	3.83
11	5.41	0.03	6.73	168.4%	19.89	13.15	200.8	19.8	100.3%	72.2%	72.4%	16.7	5.41	5.39	5.09	5.39	545	3.83
12	5.39	0.03	6.43	180.8%	19.94	13.50	200.5	19.8	100.3%	71.5%	71.8%	17.5	5.39	5.79	5.07	5.79	503	3.83
13	5.36	0.05	4.25	321.5%	20.27	16.00	195.3	19.9	100.2%	64.2%	64.3%	26.2	5.36	6.34	5.04	6.34	419	3.83
14	5.34	0.03	4.92	266.0%	20.17	15.23	193.2	19.8	100.5%	67.6%	68.0%	22.8	5.34	6.58	5.03	6.58	419	3.83
15	5.31	0.04	5.22	244.8%	20.12	14.89	196.2	19.9	100.2%	68.4%	68.5%	21.4	5.31	7.14	5.00	7.14	587	3.83
16	5.28	0.03	6.48	178.2%	19.93	13.43	196.7	19.9	100.3%	72.1%	72.3%	17.3	5.28	7.69	4.97	7.69	503	3.83
17	5.26	0.04	5.20	245.9%	20.13	14.91	194.4	19.9	100.3%	68.5%	68.7%	21.5	5.26	8.09	4.94	8.09	503	3.83
18	5.23	0.04	5.53	225.8%	20.08	14.53	197.9	19.9	100.3%	69.3%	69.5%	20.3	5.23	8.64	4.91	8.64	503	3.83
19	5.20	0.08	4.59	288.1%	20.21	15.59	194.7	19.9	99.6%	66.0%	65.7%	24.1	5.20	9.04	4.89	9.04	545	3.83
20	5.17	0.02	6.57	174.8%	19.92	13.33	202.7	19.9	100.3%	71.7%	71.9%	17.1	5.17	9.67	4.86	9.67	545	3.83
21	5.15	0.07	5.40	231.1%	20.09	14.65	195.7	20.0	99.8%	69.1%	68.9%	20.6	5.15	10.07	4.84	10.07	545	3.83
22	5.11	0.05	5.87	206.6%	20.02	14.13	201.1	20.0	100.1%	70.0%	70.1%	19.1	5.11	10.71	4.80	10.71	545	3.83
23	5.09	0.08	4.29	314.4%	20.26	15.93	197.2	20.1	99.6%	64.2%	63.9%	25.7	5.09	11.10	4.78	11.10	419	3.83
24	5.06	0.05	4.48	300.1%	20.24	15.73	194.8	20.0	100.2%	65.5%	65.6%	24.9	5.06	11.50	4.76	11.50	503	3.83
25	5.03	0.04	5.19	246.9%	20.13	14.92	196.3	20.1	100.4%	68.3%	68.5%	21.6	5.03	12.05	4.73	12.05	503	3.83
26	5.01	0.02	6.25	189.0%	19.97	13.71	196.5	20.1	100.4%	71.5%	71.8%	18.0	5.01	12.45	4.71	12.45	461	3.83
27	4.98	0.05	5.23	243.1%	20.12	14.86	196.7	20.1	100.1%	68.4%	68.5%	21.3	4.98	12.93	4.68	12.93	545	3.83
28	4.95	0.06	4.36	309.9%	20.25	15.86	197.0	20.1	99.9%	64.5%	64.5%	25.5	4.95	13.48	4.65	13.48	545	3.83
29	4.92	0.04	5.68	217.0%	20.05	14.35	198.7	20.1	100.2%	69.7%	69.8%	19.7	4.92	13.96	4.63	13.96	503	3.83
30	4.90	0.03	6.35	184.2%	19.95	13.59	199.8	20.1	100.3%	71.4%	71.7%	17.7	4.90	14.43	4.60	14.43	545	3.83
31	4.86	0.03	6.39	182.4%	19.94	13.54	202.4	20.1	100.3%	71.3%	71.5%	17.6	4.86	14.99	4.57	14.99	461	3.83
32	4.85	0.07	4.52	295.4%	20.23	15.68	195.8	20.2	99.8%	65.5%	65.4%	24.5	4.85	15.31	4.56	15.31	419	3.83

Moisture Content M_{Cwb}: 5.98

Combustion Efficiency:	99.50%		Moisture of Wood (wet basis):	5.98	Dry kg :	5.38
Total Input (kJ):	105,732	100,282 (Btu)	Initial Dry Weight Wt_{do} (kg):	5.38	CA:	46
Total Output (kJ):	71,187	67,518 (Btu)	Moisture Content Dry	6.36	HY:	9
Efficiency:	67.33%				OX:	44.87
Total CO (g):	126.76					

Load Weight (kg):	**5.72**			
Fuel Heating	**HHV**	**LHV**		**HHV**	**LHV**
Value in kj/kg - CV:	**19,655**	**17,790**	Btu/lb	**8456.0**	**7653.6**

8.65	2.80	19655.47	5.98	79.57	21.11	0.91	3.99	-0.02	0.09	37.89	204.58	0.86	-0.23	945.43	43.92	3.53	412.54	4719.42	3547.19	3448.27	3410.29
Fuel Properties			**Mw**	**Mass Balance**					**kg Wood per**								**Stack**	**Heat Content Change - Ambient to Stack T**			
Hydrogen	**Oxygen**	**Calorific**	**Moisture**	**(moles/100 mole dry flue gas)**					**100 mole dfp**	**Moles per kg of Dry Wood**						**Moisture**	**Temp**	**Flue Gas Constituent**			
/1= [b]	**/16= [c]**	**Value**	**Fuel Burnt**	**[h]**	**[u]**	**[w]**	**[j]**	**[k]**	**Nk**	**CO_2**	**O_2**	**CO**	**HC**	**N_2**	**H_2O**	**Present**	**K**	**CO_2**	**O_2**	**CO**	**N_2**
8.65	2.80	19655.47	5.98	79.69	21.14	1.13	4.91	-0.02	0.11	37.94	142.19	0.72	-0.14	709.81	43.74	3.53	467.59	7090.03	5278.96	5119.44	5065.63
8.65	2.80	19655.47	5.98	80.09	21.25	1.75	7.59	-0.02	0.17	38.53	75.89	0.11	-0.12	460.86	43.70	3.53	467.26	7075.66	5268.63	5109.52	5055.79
8.65	2.80	19655.47	5.98	79.74	21.15	1.21	5.25	-0.02	0.12	38.05	130.11	0.61	-0.14	664.43	43.73	3.53	468.09	7109.47	5292.82	5132.73	5078.82
8.65	2.80	19655.47	5.98	79.93	21.20	1.48	6.44	-0.02	0.15	38.41	97.66	0.25	-0.14	542.76	43.73	3.53	468.54	7130.75	5308.23	5147.57	5093.52
8.65	2.80	19655.47	5.98	79.94	21.20	1.48	6.46	-0.02	0.15	38.54	97.22	0.14	-0.15	541.46	43.76	3.53	469.87	7186.16	5347.94	5185.69	5131.32
8.65	2.80	19655.47	5.98	79.83	21.18	1.34	5.82	-0.02	0.13	38.26	112.86	0.41	-0.14	599.79	43.73	3.53	467.93	7100.17	5286.02	5126.17	5072.31
8.65	2.80	19655.47	5.98	79.81	21.17	1.29	5.64	-0.02	0.13	38.30	118.00	0.38	-0.15	619.33	43.76	3.53	469.71	7178.97	5342.77	5180.72	5126.40
8.65	2.80	19655.47	5.98	79.62	21.12	1.00	4.36	-0.02	0.10	37.83	166.14	0.85	-0.16	800.00	43.78	3.53	466.87	7054.68	5253.31	5094.74	5041.15
8.65	2.80	19655.47	5.98	79.91	21.20	1.44	6.27	-0.02	0.14	38.49	101.49	0.19	-0.16	557.48	43.76	3.53	469.37	7162.47	5330.80	5169.19	5114.97
8.65	2.80	19655.47	5.98	80.03	21.23	1.64	7.15	-0.02	0.16	38.47	83.34	0.18	-0.12	488.83	43.70	3.53	469.98	7188.85	5349.75	5187.40	5133.02
8.65	2.80	19655.47	5.98	79.61	21.12	1.03	4.46	-0.01	0.10	37.30	160.79	1.30	-0.08	778.36	43.61	3.53	468.54	7126.52	5304.97	5144.37	5090.36
8.65	2.80	19655.47	5.98	80.10	21.25	1.76	7.63	-0.02	0.17	38.49	75.26	0.14	-0.11	458.34	43.68	3.53	473.98	7361.76	5473.87	5306.62	5251.23
8.65	2.80	19655.47	5.98	80.05	21.23	1.68	7.30	-0.02	0.17	38.48	80.79	0.17	-0.12	479.22	43.70	3.53	473.65	7345.22	5461.89	5295.08	5239.80
8.65	2.80	19655.47	5.98	79.70	21.14	1.12	4.87	-0.02	0.11	38.27	144.02	0.44	-0.19	717.59	43.84	3.53	468.48	7119.90	5299.97	5139.52	5085.56
8.65	2.80	19655.47	5.98	79.82	21.17	1.29	5.61	-0.02	0.13	38.49	119.06	0.22	-0.18	623.84	43.82	3.53	466.37	7033.15	5237.82	5079.85	5026.39
8.65	2.80	19655.47	5.98	79.86	21.18	1.37	5.95	-0.02	0.14	38.36	109.52	0.31	-0.15	587.45	43.75	3.53	469.32	7155.85	5325.81	5164.34	5110.17
8.65	2.80	19655.47	5.98	80.06	21.24	1.69	7.37	-0.02	0.17	38.46	79.66	0.18	-0.12	474.88	43.69	3.53	469.82	7177.43	5341.31	5179.23	5124.94
8.65	2.80	19655.47	5.98	79.85	21.18	1.36	5.93	-0.02	0.14	38.38	110.05	0.30	-0.15	589.50	43.76	3.53	467.54	7077.07	5269.07	5109.79	5056.09
8.65	2.80	19655.47	5.98	79.91	21.20	1.45	6.29	-0.02	0.14	38.42	101.00	0.24	-0.14	555.42	43.74	3.53	471.09	7230.49	5379.31	5215.71	5161.11
8.65	2.80	19655.47	5.98	79.74	21.15	1.21	5.28	-0.01	0.12	37.97	128.98	0.68	-0.12	659.93	43.70	3.53	467.82	7091.15	5279.31	5119.66	5065.87
8.65	2.80	19655.47	5.98	80.07	21.24	1.71	7.46	-0.02	0.17	38.50	78.10	0.14	-0.12	469.11	43.69	3.53	475.87	7437.23	5527.63	5358.15	5302.35
8.65	2.80	19655.47	5.98	79.88	21.19	1.42	6.19	-0.02	0.14	38.13	103.39	0.50	-0.11	563.67	43.67	3.53	468.87	7132.45	5308.76	5147.90	5093.88
8.65	2.80	19655.47	5.98	79.96	21.21	1.54	6.68	-0.02	0.15	38.35	92.40	0.29	-0.12	522.72	43.70	3.53	474.21	7362.92	5474.23	5306.85	5251.48
8.65	2.80	19655.47	5.98	79.70	21.14	1.14	4.95	-0.02	0.11	37.97	140.82	0.70	-0.14	704.69	43.74	3.53	470.37	7192.96	5352.01	5189.39	5135.03
8.65	2.80	19655.47	5.98	79.74	21.15	1.18	5.13	-0.02	0.12	38.28	134.39	0.42	-0.18	681.21	43.81	3.53	467.93	7091.72	5279.49	5119.77	5065.99
8.65	2.80	19655.47	5.98	79.85	21.18	1.36	5.91	-0.02	0.14	38.42	110.46	0.26	-0.16	591.19	43.77	3.53	469.43	7154.30	5324.35	5162.85	5108.71
8.65	2.80	19655.47	5.98	80.02	21.23	1.63	7.09	-0.02	0.16	38.51	84.48	0.14	-0.13	493.26	43.72	3.53	469.65	7163.89	5331.24	5169.47	5115.27
8.65	2.80	19655.47	5.98	79.86	21.18	1.37	5.98	-0.02	0.14	38.31	108.78	0.35	-0.14	584.55	43.74	3.53	469.87	7171.37	5336.50	5174.49	5120.26
8.65	2.80	19655.47	5.98	79.72	21.14	1.15	5.00	-0.02	0.11	38.13	138.81	0.55	-0.16	697.55	43.78	3.53	470.15	7183.36	5345.11	5182.77	5128.46
8.65	2.80	19655.47	5.98	79.93	21.20	1.49	6.47	-0.02	0.15	38.38	97.04	0.28	-0.13	540.33	43.72	3.53	471.82	7257.47	5398.45	5234.03	5179.29
8.65	2.80	19655.47	5.98	80.04	21.23	1.66	7.21	-0.02	0.17	38.47	82.32	0.18	-0.12	484.95	43.70	3.53	472.93	7305.52	5432.93	5267.15	5212.13
8.65	2.80	19655.47	5.98	80.04	21.23	1.67	7.26	-0.02	0.17	38.48	81.52	0.17	-0.12	481.96	43.70	3.53	475.59	7418.85	5514.10	5345.06	5289.39
8.65	2.80	19655.47	5.98	79.74	21.15	1.19	5.19	-0.02	0.12	38.10	132.26	0.57	-0.15	672.66	43.75	3.53	468.93	7128.50	5305.58	5144.75	5090.78

			SUMS							AVERAGE	SUMS						
4553.03	4126.06	294.32	64575.16	246611.16	89348.36	1108465.87	-74846.53	762465.31	61350.71	6254.76	34276.00	259.72	34016.3	71543.9	265.0	126.8	-18.4
emperature		Room Temp	Energy Losses (kJ/kg of Dry Fuel) Flue Gas Constituent							Total Loss	Total	Chemical	Sensible and	Total	Chem	Grams Produced	
CH_4	H_2O	K	CO_2	O_2	CO	N_2	CH_4	H_2O Comb	H_2O Fuel MC	Rate	Loss	Loss 1	Latent Loss	Output	Loss 2	CO	HC
6949.60	6121.80	292.82	269.01	750.64	207.82	3595.62	-126.55	2190.79	177.00	7064.33	0.00	0	0.00	0	0	0.00	0.00
6934.72	6109.96	292.82	272.66	399.86	31.50	2330.02	-108.69	2188.28	176.96	5290.58	191.84	-3	194.63	521	-3	0.11	-0.07
6970.00	6137.64	292.87	270.53	688.64	175.25	3374.52	-123.54	2191.15	177.05	6753.60	201.67	1	200.19	385	1	0.51	-0.07
6991.80	6155.35	292.82	273.88	518.39	72.40	2764.58	-123.36	2191.90	177.12	5874.92	150.37	-1	151.68	353	-1	0.18	-0.06
7049.53	6200.81	292.87	276.92	519.95	40.99	2778.42	-138.93	2195.63	177.28	5850.27	137.26	-2	139.55	324	-2	0.09	-0.06
6960.62	6129.80	292.93	271.63	596.57	116.89	3042.33	-125.34	2191.00	177.03	6270.10	160.49	0	160.73	343	0	0.29	-0.06
7042.07	6194.89	292.87	274.92	630.45	109.58	3174.93	-137.63	2195.22	177.26	6424.73	150.74	-1	151.42	310	-1	0.25	-0.06
6913.49	6092.31	292.93	266.89	872.79	246.06	4032.90	-146.18	2191.69	176.89	7641.04	195.57	2	193.10	308	2	0.61	-0.07
7025.21	6181.12	292.93	275.68	541.05	54.28	2851.48	-139.07	2194.78	177.21	5955.41	165.13	-2	167.48	380	-2	0.15	-0.07
7052.57	6202.84	292.93	276.55	445.86	51.05	2509.16	-110.85	2192.58	177.28	5541.62	141.84	-2	143.37	361	-2	0.13	-0.05
6987.93	6151.51	292.93	265.83	852.99	374.70	3962.12	-70.78	2185.86	177.10	7747.82	231.36	9	222.47	356	9	1.09	-0.04
7232.18	6345.04	292.93	283.38	411.94	41.24	2406.84	-102.64	2197.87	177.79	5416.43	150.19	-2	151.89	395	-2	0.11	-0.05
7215.24	6331.27	292.98	282.61	441.29	48.32	2511.00	-108.09	2197.88	177.74	5550.75	142.07	-2	143.60	361	-2	0.12	-0.05
6981.57	6145.70	293.04	272.50	763.29	127.11	3649.34	-171.38	2196.84	177.08	7014.78	149.62	-1	150.59	270	-1	0.26	-0.07
6891.19	6074.55	292.93	270.68	623.60	63.04	3135.66	-163.43	2192.84	176.83	6299.22	134.36	-2	136.50	285	-2	0.13	-0.06
7018.84	6175.31	293.04	274.52	583.26	89.03	3001.96	-134.28	2193.99	177.19	6185.67	184.71	-1	186.08	402	-1	0.26	-0.07
7041.23	6193.08	293.04	276.05	425.47	51.28	2433.72	-104.66	2191.46	177.25	5450.58	139.51	-1	140.88	364	-1	0.13	-0.05
6937.43	6110.23	293.09	271.62	579.84	85.07	2980.58	-137.19	2191.47	176.96	6148.36	157.37	-1	158.71	346	-1	0.21	-0.06
7096.56	6236.58	293.09	277.83	543.29	70.12	2866.59	-130.07	2196.20	177.40	6001.37	153.61	-2	155.15	349	-2	0.17	-0.06
6951.78	6122.02	293.04	269.24	680.91	195.51	3343.11	-111.17	2189.08	177.00	6743.68	186.99	2	184.72	358	2	0.53	-0.05
7311.49	6406.46	293.09	286.35	431.71	40.54	2487.37	-107.70	2201.12	178.00	5517.40	152.99	-2	154.85	392	-2	0.11	-0.05
6995.08	6155.68	293.15	271.95	548.87	144.37	2871.25	-95.53	2188.80	177.12	6106.83	169.33	1	168.03	376	1	0.39	-0.05
7234.43	6345.27	293.15	282.36	505.79	84.81	2745.03	-108.32	2198.51	177.79	5885.99	163.21	-1	163.88	382	-1	0.23	-0.05
7058.36	6205.15	293.26	273.09	753.69	201.30	3618.60	-127.73	2194.56	177.29	7090.81	151.24	2	149.73	268	2	0.42	-0.05
6952.87	6122.13	293.15	271.48	709.49	120.61	3451.03	-158.88	2194.41	177.00	6765.14	173.16	-1	174.16	330	-1	0.30	-0.07
7018.00	6173.51	293.21	274.89	588.14	74.67	3020.21	-143.28	2194.92	177.18	6186.73	158.35	-2	160.11	345	-2	0.19	-0.07
7027.95	6181.40	293.21	275.90	450.40	40.85	2523.15	-118.01	2192.44	177.21	5541.95	130.03	-2	131.83	331	-2	0.09	-0.05
7035.96	6187.38	293.26	274.75	580.52	101.25	2993.04	-126.76	2193.68	177.23	6193.72	171.74	-1	172.47	373	-1	0.27	-0.06
7048.41	6197.25	293.26	273.93	741.98	158.87	3577.35	-146.39	2196.31	177.27	6979.31	193.52	0	193.23	351	0	0.43	-0.07
7125.09	6258.41	293.21	278.52	523.84	79.89	2798.52	-118.49	2195.86	177.48	5935.62	151.92	-1	152.93	351	-1	0.20	-0.05
7175.00	6297.91	293.21	281.04	447.21	50.65	2527.60	-109.39	2196.57	177.62	5571.29	154.48	-2	156.11	391	-2	0.14	-0.05
7293.14	6390.83	293.26	285.45	449.51	48.61	2549.27	-109.15	2200.60	177.95	5602.24	131.44	-1	132.86	330	-1	0.11	-0.05
6991.75	6151.90	293.32	271.57	701.69	165.29	3424.38	-132.24	2192.74	177.10	6800.54	145.05	1	144.39	274	1	0.34	-0.05

CONTACT YOUR LOCAL BUILDING OR FIRE OFFICALS ABOUT
RESTRICTIONS AND INSTALLATION INSPECTIONS IN YOUR AREA

LISTED MASONRY OR ZERO CLEARANCE FIREPLACE INSERT
ALSO SUITABLE FOR MOBILE HOME INSTALLATION PURSUANT TO (UM) 84-HUD

Manufactured by:
Heat Tech Inc.
P.O. BOX 727 – BIGGS, CA 95917

MF DATE:

Serial No.

☐ HTP26 BAY
☐ HTP26 STD

☐ FREE STANDING
☐ FIREPLACE INSERT
☐ MOBILE HOME

TEST DATE: 5/2023

Install and use only accordance with manufacturer's installation and operating instructions and your local building codes. Do not connect this unit to a chimney flue serving another appliance.

WARNING: (MOBILE HOME) An outside air inlet must be provided for combustion and be unrestricted while unit is in use. Do not install appliance in a sleeping room. The structural integrity of a mobile home floor, walls and ceiling/roof must be maintained.

NOTE: Replace glass only with 5 mm ceramic.

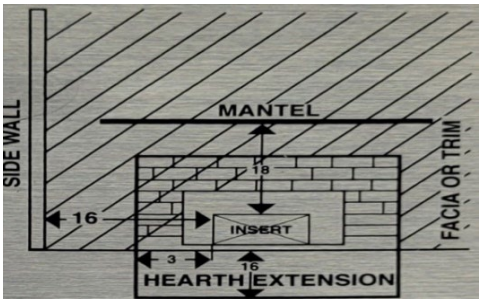
----------**Minimum Clearances to Combustible Materials (in inches)**- ----------

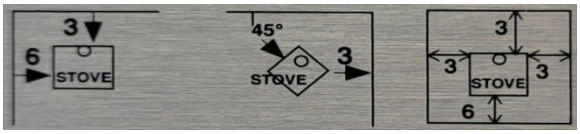
Compliant to EPA emission standards 2020." to "U.S. ENVIRONMENTAL PROTECTION AGENCY Certified to comply with 2020 particulate emission standards. Tested to ASTM E2779-10 & ASTM E2515-17 HTP STANDARD 1.2 G/HR, HTP BAY 1.7 G/HR. These pellet fire appliances have been tested & approved for use in manufactured homes.

For use with recommended pelletized fuel only: ¼: /5mm diameter densified wood pellets.

ELECTRICAL RATING: 115 VAC 5 Amps 60 Hz

Install insert with a minimum of 6" clearance to combustible sidewall, 3" to side and 2" to top trim. 16" from top of insert to mantel. Floor protector must be 3/8" minimum noncombustible material or equivalent, extending 6" in front and 3" to both sides. When used as an insert stove install in a masonry fireplace or any zero clearance Fireplace 30" wide and 20" high, built to UBC Chapter 37. Do not remove brick or mortar from masonry fireplace to accommodate insert, use flue outlet with a direct connector.





Floor protector must be 3/8" min. thickness non-combustible material or equivalent, extending beneath heater and in the front 6" and sides 3".

CHIMNEY & CONNECTOR: Use listed Pellet Vent Pipe only. Maintain 3 inch minimum.

CAUTION! DO NOT USE FLAMMABLE FLUIDS OR CHEMICALS TO START OR RESTART THE HEAT TECH STOVE. USE ONLY RECOMMENDED FIRE-STARTING MATERIALS. NEVER ALLOW STOVE TO RUN IF THE SMELL OF SMOKE IS PRESENT OR ANY PART OF THE STOVE GLOWS RED. IF EITHER OR BOTH THINGS HAPPEN, DISCONNECT POWER CORD FROM POWER RECEPTACLE.

STARTING INSTRUCTIONS: Your Heat Tech stove comes equipped with an automatic ignitor (self-start). Simply push the On/Off button. Your stove will begin feeding pellets and will light in 4-8 minutes. Note: for your stove to light properly you must keep burn pot clear of ash and burn pot must be pushed right against the back wall.

SHUT DOWN

Turning your Heat Tech pellet stove off, simply push the On/Off Button. The blowers will continue to run until the stove cools down.

At The End of Each Season, The Pellet Stove Should Be Inspected & Completely Serviced.

HEAT TECH

HTP BAY & HTP STANDARD PELLET STOVE OWNER'S MANUAL

Installation, Operating and
Maintenance Instructions for
Pellet Stoves

Congratulations on your purchase of a HEAT-TECH pellet stove.

We at HEAT-TECH take great pride in the quality of our products. We assure you that with proper management, your HEAT-TECH stove will provide you with many years of comfort and enjoyment. Please read this owner's manual and follow the guidelines thoroughly.

WARNING! READ MANUAL FULLY BEFORE INSTALLATION AND OPERATION.

COMPLIANCE STATUS

-This wood pellet heater needs periodic inspection and repair for proper operation. It is against federal regulations to operate this wood heater in a manner inconsistent with operating instructions in this manual.

-This wood pellet 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.

- Certified to comply with 2020 particulate emission standards.

- Heat output range: 7,200 – 20,800 BTU/hr for the Bay and 8,400 – 19,500 BTU/hr for the Standard.

- Efficiency: 68% for the Bay and 67% HHV for the Standard.

FOR SERVICE AND REPAIR

DEALER:_____

PHONE: ( )_____

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INTRODUCTION

This stove has been independently tested and approved in accordance with the specifications and procedures outlined by Underwriters Laboratories, Inc. standards for safety UL 1482, UL 907 solid fuels type room heater, April 1987, and HUD requirements for installation as a stove heater and insert for masonry or metal fireplaces, plus Oregon's rules for mobile homes (814-23-900 through 814-23-9090).

This appliance is designed specifically for use only with pelletized wood. It is approved for residential installation according to current national and local building codes when installed on a hearth of masonry or metal fireplace. It is also approved as a mobile home heater and is designed for connection with an outside air source.

This stove will NOT operate using a natural draft, or without an electrical power source for the blower and fuel system.

SPECIFICATIONS/FEATURES

SAFETY FEATURES

If there is a power outage longer than a few seconds, the auger will no longer operate once the power is restored. This prevents pellets from being fed to a non-burning burn pot. Pressing the start button will reactivate the auger feed mode. The blowers will come on when the power is restored to evacuate the combustion chamber gases.

GOVERNMENT LISTINGS

Emissions tested by PFS TECO-11785 SE Highway 212 Suite 305 - Clackamas, OR 97015 . EPA approved and listed with the Underwriters Laboratory standards.

INSTALLATION

WARNINGS AND PRECAUTIONS:

Installation should be done by your qualified dealer or approved stove installer to meet all federal, state, and local codes for pellet burning appliances. Improper installation or operation may result in a house fire. Care must be taken not to interfere with the structural integrity of the building.

All local building and fire codes MUST be strictly adhered to. A permit must be obtained by the homeowner, at the home owner's expense, prior to installation.

Check all equipment for damage, possibly caused by shipping. The stove should be burn-tested in a well-ventilated area for at least one hour according to operation instructions. This will cure the paint and season the stove's metal. (Your stove dealer may have already done this). NOTE: Minor smoking and steaming is normal during the curing process.

Use only listed and approved stovepipe designed for use with pellet stove. Follow pipe manufacturer's installation instructions. Do not use single wall pipe to vent exhaust from the stove. Approved metal tube is required between the air intake tube and the outside fitting on fresh air intakes.

Care must be taken to maintain minimum clearances to combustibles as per local building codes, fire codes and the safety listing tag on the back of the stove. Use non-combustible 3/8" minimum hearth pads.

The Heat Tech HTP 26 pellet insert has been tested and listed for installation into masonry fireplaces and factory-built "zero clearance" fireplaces.

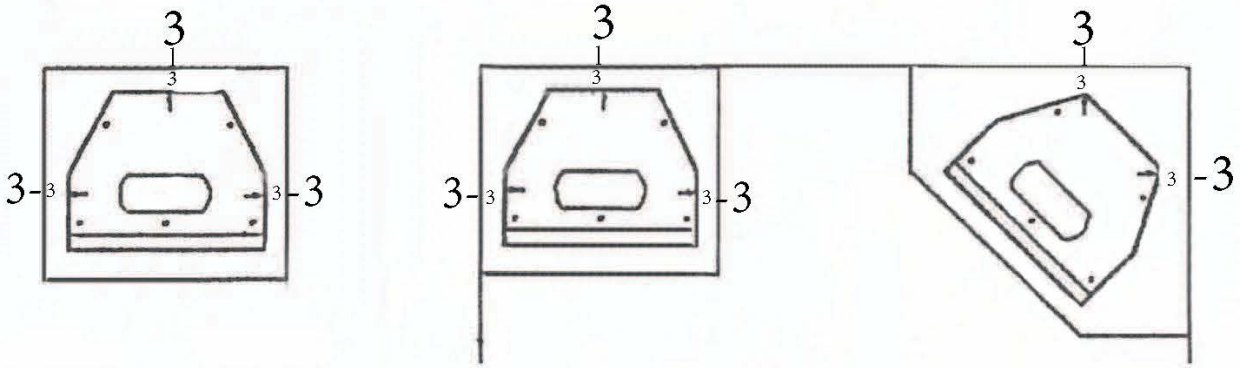
The purchaser must return the warranty card to validate the warranty.

When the stove is not used for long periods, for example summer months, the stove should be cleaned and free of ash.

CLEARANCES

Your Heat Tech freestanding stove has 3" clearances to combustibles on back and sides.

The hearth pad must extend out a minimum of 3" from the stove on each side and a minimum of 6" in front of the door.



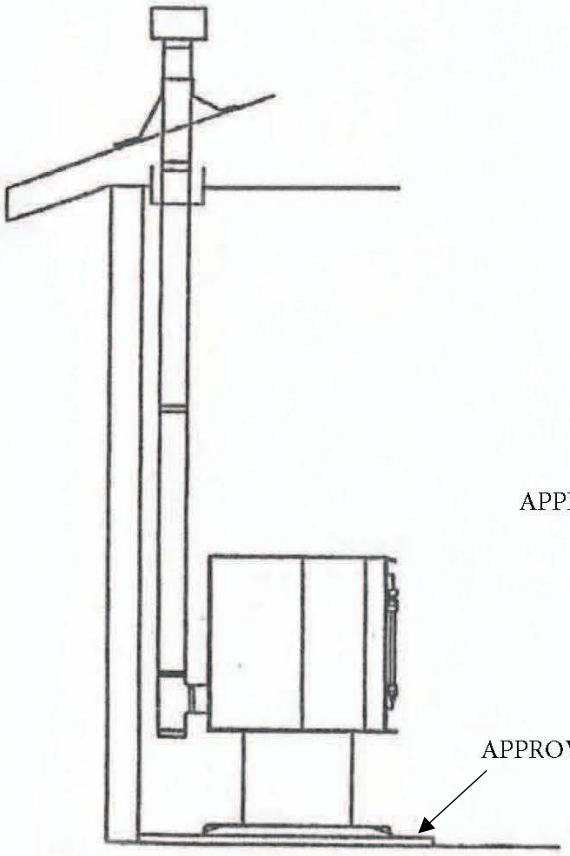


FIGURE 1: LONG EXHAUST SYSTEM

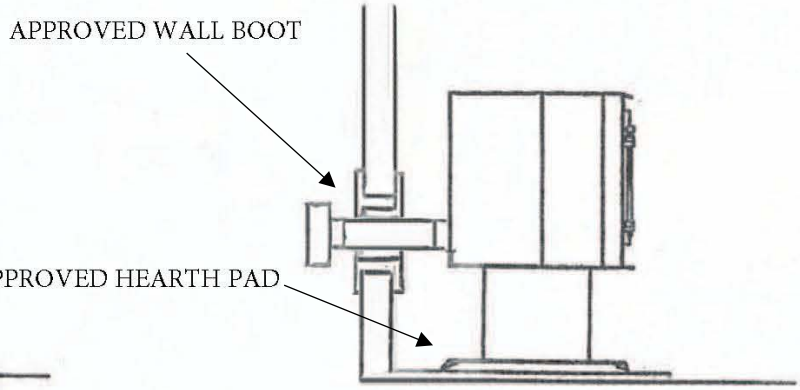


FIGURE 2: SHORT EXHAUST SYSTEM

EXHAUST HORIZONTALLY THROUGH AWALL

- Position the stove, adhering to clearances.
- Locate position of hole in wall, directly behind stove's exhaust vent.
- Cut an opening in the wall: 9 5/8" round for 3" vent or 10 5/8" for4" vent. This provides space for the wall thimble.
- After exiting exhaust pipe through the wall, you should install3' vertical rise to evacuate exhaust gases in case of power outage.
- Attach end cap and seal outside wall thimble with non-hardening waterproof mastic.

EXHAUST VERTICALLY THROUGH ACEILING

- Locate exhaust pipe location at the rear of the stove. Drop a plumb-bob to the center of the exhaust pipe at the rear of the stove with clean-out "T" installed. Mark center point on the ceiling. Cut a square hole in ceiling, to accommodate firestop support assembly: 8" square hole for 3" or 9" square hole for 4".
- Connect chimney section from stove upwards.
- When the pipe passes through the firestop at the ceiling, tighten bolts and clamp around pipe.
- Always maintain 3" clearances from combustible materials, when passing through additional floors or ceilings. Always install fire-stop spacers.
- After lining up the hole in the roof, always 3" larger than the pipe all the way around, install upper edge and sides of flashing under roof materials. Nail to roof on top edge under roof material. DO NOT NAIL ON LOWER EDGE.
- Seal nail heads with sealant or mastic.
- Apply a non-hardening, waterproof mastic where the storm collar will meet the vent pipe. Slide storm collar down until it sits on flashing. Put on a cap and twist to lock.

INSERT INSTALLATION

- Insert installations must be vented with 3” or 4” pipe. Pipe may be single wall steel flexible pipe. Vent should extend to the chimney top.
- The fireplace and chimney should be cleaned thoroughly before starting the installation. We suggest painting the interior of particularly old and dirty fireplaces to seal any odors. In zero-clearance fireplace installations, when the fireplace opening is above the floor or raised hearth, a “skirt” can be used to bridge the gap between the hearth and stove bottom.

WHEN VENT PIPE EXTENDS TO CHIMNEY TOP

- Refer to Figure 13
- You will need a pipe length equal to the chimney height (from hearth) plus 6”. If outside combustion air is to be used, you will need a pipe length equal to the chimney height plus 12”.
- Set the insert on the hearth.
- Adjust the leveler leg bolts located on the back of the stove. Slide the stove in far enough to attach the vent pipe (and combustion air pipe if used).

Attach flashing.

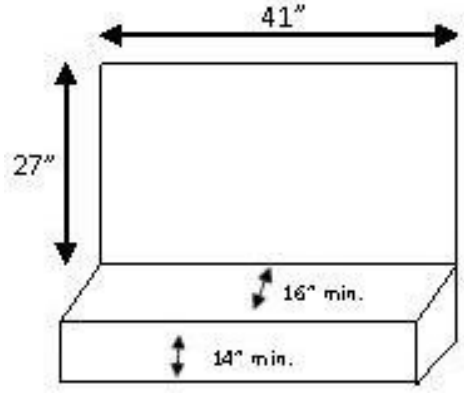
- Route power cord out the side nearest a 120V receptacle.
- Slide in insert.
- Measure and build chimney top. Cut out hole for vent pipe (and combustion air pipe if used). Install and seal with a non- hardening mastic to prevent water leakage.
- Install the vent cap.

USING YOUR PELLET INSERT AS A BULT-IN FIREPLACE

- Framing your fireplace opening, you must have 7” of clearance on both sides and the top of your Heat Tech Pellet Insert. This means that no combustible material can be closer than 7” to the insert sides and top. The depth of the opening must be no less than 22” deep. This will allow the required clearance for the pellet vent. Dura pellet vent is required as it has a 1” clearance to combustibles.
- Preparing the base or bottom of the fireplace opening using a 1” thick noncombustible material inside the fireplace and in front of the fireplace, extending far enough in front of the fireplace to allow at least 16” of noncombustible material to extend in front of the Heat Tech Pellet Insert. If you are building a raised hearth, you are allowed 1” for every 2” s of rise.
- Connecting the exhaust pipe 3” Dura Vent Double wall pellet vent. Pipe must be used and no less than 1” clearance **must** be maintained. If your chimney exhaust is more than 20’, you must increase the pellet vent to 4”.

INSTALLATION OF A MANTEL

- Any combustible material used for the mantel must be no less than 16” from the top of the Heat Tech Pellet Insert
- Fireplace opening must be 41” W and 27” H and 16” Hearth. The sides and top must have steel studs. The pellet stove must have a 1” noncombustible base.



MOBILE HOME INSTALLATION

SPECIAL MOBILE HOME REQUIREMENTS:

Mobile home installations made prior to the sale of the mobile home are governed by U.S. Department of Housing and Urban Development (HUD) standards. They include the following:

- Do not install in a sleeping room
- **Stove should be grounded with a #8 copper wire and terminated with a N.E.C. approved grounding device**
- Stove should be attached to mobile home during shipment

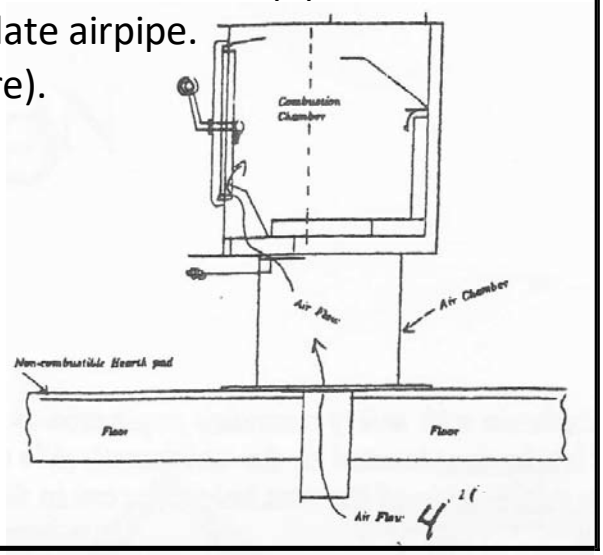
The combustion air supply for mobile home installations must be connected to an outside source of combustion air. A 1 ¾" inside diameter metallic pipe, either flexible or rigid, must be used when outside air is to be connected. It attaches to the combustion air outlet at the rear of the stove and is terminated outside to wind hood or turned down at 90 degrees to prevent back draft. Outside air can also be channeled through the floor under the stove and through the pedestal and into the firebox.

SOURCES OF OUTSIDE AIR FOR FIREPLACES:

- Ash cleans out through floor of fireplace to outside ash clean outdoor. Always plug excess opening in ash doors with fiberglass insulation or sheet metal to reduce draft to inside of fireplace that will chill air for convection air supply
- Hole can be drilled out through rear of fireplace wall when fireplace is located on an outside wall.
- Top of chimney alongside of exhaust. Remember that the length of the intake tube should remain as short as possible of size up the air intake pipe to 2" or 2½" pipe.

SOURCES OF OUTSIDE AIR FOR FREE STANDING STOVE:

- Hole in floor at rear of stove to accommodate outside air pipe.
- Hole in wall at rear of stove to accommodate airpipe.
- Hole in floor under the pedestal (see figure).



ELECTRICAL INSTALLATION

This stove is provided with an 8-foot grounded cord extending from the rear of the stove. This should be connected to a standard 110volt, 60hz electrical outlet. The approximate power requirements are 125 watts.

THERMOSTAT INSTALLATION

A thermostat may help you maintain a constant house temperature automatically. **A millivolt thermostat is required**. A fixed wall mount or Heat Tech handheld model can be used. The control panel can be set up two ways to operate your stove in thermostat mode.

A MILLIVOLT THERMOSTAT IS REQUIRED
Unplug stove from power unit
Remove control board from stove
The two thermostat wires connect to the terminal block on the lower left side of the back of the control board (See page 10)
Insert the wires in the terminal side and tighten the two screws.

MODES: To switch between any of the three modes the stove must be shut off, the new mode selected, and the stove restarted.

MANUAL MODE

- In this mode the stove will operate only from the control panel as detailed in the “OPERATION” section of this manual. If your stove is not equipped with a wall thermostat or a remote handheld thermostat, the Thermostat switch must remain in the manual position.

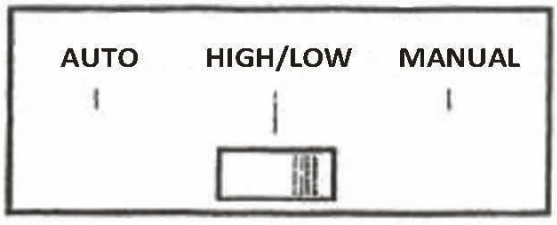
AUTO THERMOSTAT MODE

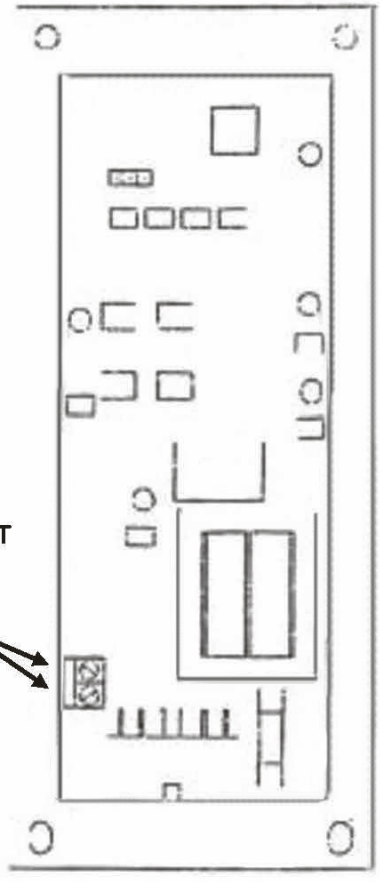
- When engaged in this mode the stove will automatically switch between two settings. When warm enough, it will switch to the #1 or low setting. The room air blower will also slow to its lowest speed.
- The Heat Level Advance setting on the bar graph will stay where it was initially set. When the house cools below the thermostat setting, the stove will switch to the feed rate of the heat level advance setting.

AUTO THERMOSTAT MODE

- In this mode when the home is warm enough the stove will shut off. The fans will continue to run until the stove cools.
- When the home cools below the thermostat setting, the stove will automatically restart and run at the last feed rate setting.

NOTE: When in "high/low" or "on/off" thermostat mode, do not operate the stove higher than the #3 setting.





OPERATION

OPERATION WARNINGS ANDPRECAUTIONS

CAUTION! DO NOT USE FLAMMABLE FLUIDS OR CHEMICALS TO START OR RESTART THE HEAT TECH STOVE. NEVER ALLOW STOVE TO RUN IF THE SMELL OF SMOKE IS PRESENT OR ANY PART OF THE STOVE GLOWS RED. IF EITHER OR BOTH THINGS HAPPEN, TURN STOVE OFF. FUEL WILL STOP FEEDING AND ALLOW THE UNIT TO COOL. IF FUEL CONTINUES TO FEED, DISCONNECT THE POWER CORD FROM THE POWER OUTLET.

Always check hopper for foreign matter before each filling.

Always check to be certain that the pellets to be put into the stove are dry, free of foreign matter, and are of correct size for the stove (use ONLY ¼" and not over 1" long wood pellets). Always use a premium quality pellet fuel. Premium fuel provides quality heat for the investment and makes for trouble free operation. Ask your dealer which fuels are the best for your stove. DO NOT BURN WALNUT BY PRODUCT PELLET OR ANY PELLET THAT HAS BINDERS OR ANY MATERIAL NOT CONSIDERED WOOD.

Pellets should be free from excessive fines (loose matter that looks like saw dust or sand). Pellets can be screened before being placed into hopper to remove most fines.

Ash content should not be greater than 1%.

Some pellets use binders – do not use pellets that contain binders, petroleum distillates or other materials to hold them together or bind them. These pellets can be very hard and can jam the auger causing damage to the auger. Heat Tech Industries cannot accept responsibility for damage due to poor quality pellets.

*DON'T BURN REFUSE IN STOVE
*BURN ANY MATERIAL OTHER THAN APPROVED PELLETS WILL VOID THE WARRANTY.

Gasket materials should be checked for normal wear or damage annually. Replace gasket material if damaged or worn. Contact your local dealer or Heat Tech for proper size and instructions.

Maintain proper ventilation. It is important that adequate oxygen be supplied to the fire for the combustion process. Modern houses are often so well insulated, it may be necessary to open a window or install an outside air vent to provide a sufficient combustion process.

Since heating with a solid fuel fire is potentially hazardous, even in a well-made and thoroughly tested stove, it would be wise to install strategically placed smoke & carbon monoxide detectors and have a fire extinguisher in a convenient location.

Do not permit operation by young children or those unfamiliar with the stove's operation.

Do not add more fuel to the burn pot than the automatic fuel system provides, as this could cause an over-firing condition.

Do not service this appliance without disconnecting power cord.

If during start-up or operation you notice a smoldering firepot and heavy smoke build up in the firebox with no visible fire or hot embers, turn off the unit and do not tamper with controls. Wait 15 minutes or until firebox clears, then open the door to clear the burn pot. Turn on stove and restart.

BASIC OPERATION

Before filling the hopper, check for foreign objects. Fill only with ¼" and not over 1" wood pellets. Close hopper lid. Fill hopper to top. Always allowing lid to close completely. DO NOT OVER FILL.

Your Heat Tech pellet stove comes equipped with an automatic igniter, simply turn on the power switch. Your stove will immediately begin feeding pellets and will light in 5-10 minutes. NOTE: For your automatic igniter to work properly, you must keep the burn pot clear of ash and the burn pot must be pushed tight against the back wall.

MANUAL MODE

To turn your pellet stove on, simply push the on/off button. Allow approximately 5-10 minutes for the pellets to ignite. For low heat, keep the heat level on low (indicated by the red light at the bottom of the 5 heat level lights). To increase the heat output, simply push the arrow up to the desired heat (indicated by the red light).

SHUT DOWN PROCEDURES

Turning the Heat Tech pellet stove off is simply a matter of turning the control panel switch to OFF. The blowers will continue to operate until the internal firebox temperatures have fallen to a preset level.

MAINTENANCE

Always make sure fire is out when servicing stove.

ASH REMOVAL

Empty ashes from burn pot after every 48 hours of burning.

Remove burn pot by grasping and twist, pulling straight out. NOTE: Inspect burn pot weekly to ensure that holes have not become plugged or that holes have not become burnt out.

Ashes should be placed in a metal container with an airtight fitting lid. The container should be placed on a non-combustible surface on the ground, well away from all combustible materials pending final disposal. If ashes are disposed of by soil burial or otherwise locally disbursed, they should be retained in the closed container until all cinders have thoroughly cooled.

CLEANING AND SERVICING

If you choose to clean and service your stove on your own, you should follow these steps:

- With the front door of your stove open, look inside. To the top you see the heat exchange tubes. These tubes should be brushed and cleaned weekly.
  - Between the heat exchange tubes there are 4 small openings approximately 1” in diameter – 2 on the left and 2 on the right side in between the heat exchange tubes. Clean DOWN these openings.
  - Insert the brush provided with your stove approximately 15” into these slots. This will force ash to the bottom of the stove. A simple way to do this is to remove the handle from the brush, insert the brush stem into a cordless drill and allow the brush to rotate as it enters and exits the 4 tubes. Insert brush into tube

and run drill in forward position until drill contact's tube. Note: Only run drill in forward position. DO NOT reverse drill to pull brush out of tubes.

- Next, close the front door of the stove. Notice under the door there is a plate the full width of the stove held on by 2 or 3 screws. Remove the plate and clear any ash behind it. This can be done by inserting a small vacuum hose into the slots. Use a flashlight to make sure bottom is completely vacuumed out.
- At the end of each burn season, the stove should be completely and cleaned and serviced. This is done by removing the back of the stove and oiling the motors that need servicing. At this time, the internal components should be thoroughly cleaned to prevent corrosion caused by moisture.
- SERVICING TIPS:
    - Always contact your dealer for information on the stove operation.
    - A clean stove and exhaust will always give more efficient and trouble-free operation.
    - Always unplug the stove before working on the electrical system and servicing the stove.

TROUBLE SHOOTING

When your stove is not functioning properly, use this guide to identify and correct common simple problems. Most problems can be solved by following the instructions indicated. If problems continue, or for problems not addressed in this guide, contact your dealer for assistance.

WARNING: UNPLUG STOVE FIRST WHEN POSSIBLE!

Stove shuts off and the #2 light flashes

COMMON CAUSES	INSTRUCTIONS TO CORRECT PROBLEM
Airflow switch hose or stove attachment pipes for hose is/are blocked	Unhook hose from the airflow switch and blow through it. If air flows freely, the hose and tube are fine. If air will not flow through the hose, use a wire coat hanger to clear the blockage.
Components are blocked with ash or foreign material	Follow cleaning instructions in the "Maintenance" section for cleaning air inlet, burn pot, blower, interior air chambers and exhaust pipe.
Firebox is not sealed properly	Check that the door is closed completely. Check that the door gasket is intact and installed properly. If your stove has an ash drawer, ensure that it is properly closed, and that the gasket is intact. If you stove has a small hole under the burn pot for ashes, check that the slider plate is in place to seal off the firebox floor.
Ventilation pipe is not installed properly	Check that the vent pipe is installed according to the instructions in the "Installation" section.
Bad wire connections to the airflow switch	Check that the connections of the grey wires to the airflow switch are intact and properly wired.
Bad wire connections at the Molex connector (on wiring harness)	Check that the connections of the grey wires to the Molex connector are intact and properly wired.
Combustion blower not functioning	If the combustion blower does not function when the stove is on, check for power to the combustion blower. If power is running to the combustion blower, the blower is malfunctioning. If power is not running to the combustion blower, see "combustion blower not receiving power" below.
Combustion blower not receiving power	Check that all wire connections are intact and properly wired. If they are, the control board is malfunctioning.
Air switch not receiving power	After the stove has been running for at least 30 seconds, check that a current is running to the air switch (approximately 5 volts). If current is running to the air switch, it may be malfunctioning – see "air switch not functioning" below.
Air switch not functioning (rare)	Follow these steps to test the air switch: 1) First check that airflow switch hose is not blocked (see "airflow switch hose or stove attachment pipes for hose is/are blocked" above) 2) Disconnect the air hose from the body of the stove **3)** With the other end still attached to the air switch, **very gently** suck on the loose end of the hose – **Caution: too much suction can damage the air switch!** If no click is heard, the air switch is malfunctioning.

Stove shuts off and the #3 light flashes

COMMON CAUSES	INSTRUCTIONS TO CORRECT PROBLEM
The hopper is empty	Refill the hopper with approved pellet fuel See "Maintenance" section for specifications of approved pellet fuel
The burn pot is not pushed completely to the rear of the firebox	Make sure that the air intake collar on the burn pot is touching the rear wall of the firebox.
The burn pot holes are blocked	Remove the burn pot and thoroughly clean it.
The air inlet, the interior chambers, or exhaust system has a partial blockage	Follow all cleaning procedures in the maintenance section of this manual.
The auger shaft is jammed	Empty the hopper and remove the auger pin to remove the auger motor. After removing the auger shaft inspection plate, you will be able to see the auger shaft. Lift the shaft straight up carefully to remove it from the bottom auger bushing. Remove the two nuts holding the top auger biscuit in then lift the shaft out of the stove by rotating the bottom end towards you while lifting the shaft. Inspect the auger shaft and auger tube for damage or burrs and remove any foreign material.
The auger motor has failed	Empty the hopper and remove the auger pin to remove the auger motor. Run the unit. If the motor turns, then the shaft is jammed. If the motor does not turn, then the motor is bad.
The Proof of Fire thermodisk has malfunctioned	Unplug the stove. Temporarily bypass the Proof of Fire thermodisk by disconnecting the two brown wires and connecting them with a short piece of wire. Plug the stove back in. If the stove works, the Proof of Fire thermodisk is bad and must be replaced. WARNING: DO NOT LEAVE THE PROOF OF FIRE THERMODISK BYPASSED! If it remains bypassed, the blowers will never shut off and the auger will continue to feed pellets until the hopper is empty even if the fire goes out.
The high limit thermodisk has tripped or is defective	Wait for the stove to cool for about 30 – 45 minutes. It should now function normally. If not use the owner's manual to locate the high limit thermodisk. To test if the thermodisk is bad, you can bypass it as described previously for the POF thermodisk.
The fuse on the control board has blown	Remove the control board. On the back there is one fuse. If it appears to be bad, replace it with a 5-amp 250 Volt fuse. Plug the stove back in and try to run the unit.
The control board is not sending power to the Proof of Fire thermodisk or other auger system components	There should be a 5-Volt (approximately) current going to the POF thermodisk after the stove has been on for 10 minutes.

Pellets do not ignite

COMMON CAUSES	INSTRUCTIONS TO CORRECT PROBLEM
Blockage in igniter tube or inlet for igniter tube	Find the igniter housing on the backside of the firewall. The air intake hole is a small hole located on bottom side of the housing. Make sure it is clear. Also look from the front of the stove to make sure there is not any debris around the igniter element inside of the igniter housing.
The burn pot is not pushed completely to the rear of the firebox.	Make sure that the air intake collar on the burn pot is touching the rear wall of the firebox.
Bad igniter element	Put power directly to the igniter element. Watch the tip

	of the igniter from the front of the stove. After about 2 minutes the tip should glow. If it does not, the element is bad.
The control board is not sending power to the igniter	Check the voltage going to the igniter during startup. It should be a full current. If the voltage is lower than full current, check the wiring. If the wiring checks out good, the board is bad.

Home smells of smoke

COMMON CAUSES	INSTRUCTIONS TO CORRECT PROBLEM
There is a leak in the vent pipe system	Inspect all vent pipe connections. Make sure they are sealed with RTV silicone that has a temperature rating of 500 degrees F or higher. Also, seal joints with UL-181-AP foil tape. Also, make sure the square to round adapter piece on the combustion blower has been properly sealed with the same RTV.
The gasket on the combustion blower has gone bad	Inspect both gaskets on the combustion blower to make sure they are in good shape.

Convection blower shuts off and on

COMMON CAUSES	INSTRUCTIONS TO CORRECT PROBLEM
The convection blower is overheating and tripping the internal temperature shutoff.	Clean any dust off the windings and fan blades. If cleaning the blower does not help, it may be bad.
Circuit board malfunction	Test the current going to the convection blower. If there is power being sent to the blower when it is shut off, then the control board is fine. If there is NOT power being sent to the blower when it shuts off during operation, then you have a bad control board.

Feed light on but pellets not feeding

COMMON CAUSES	INSTRUCTIONS TO CORRECT PROBLEM
Fuse on control board blew	Remove the control board. On the back there is one fuse. If it appears to be bad, replace it with a 5-amp 250 Volt fuse. Plug the stove back in and try to run the unit.
High limit switch has tripped or is defective	Wait for the stove to cool for about 30 – 45 minutes. It should now function normally. If not, use the owner's manual to locate the high limit thermodisk. To test if the thermodisk is bad, you can bypass it as described previously for the POF thermodisk.
Bad auger motor	Remove the auger motor from the auger shaft and try to run the unit. If the motor will turn, the shaft is jammed on something. If the motor will not turn, the motor is bad.
Auger jam	Always unplug stove first. Clean all the pellets out of the hopper. Then vacuum remaining pellets out of the auger at the bottom of the auger. With a pair of pliers, reach down and grab the auger blade and first see if you can wiggle it back and forth to unjam the auger. If auger is still jammed, from the back of the stove, remove the 1/4"bolts from each side of the auger housing located just above the auger motor. You can then remove the auger assembly by gently tapping and

	twisting downward on the auger motor. This will empty the auger housing, thus unjamming the auger. After you have removed the shaft, inspect it for bent flights, burrs, or broken welds. Remove any foreign material that might have caused the jam. Also, check the auger tube for signs of damage such as burrs, rough spots, or grooves cut into the metal that could have caused a jam. Reverse steps to reinstall auger assembly.
Loose wire or connector	Check all wires and connectors that connector to the auger motor, high limit switch, and the Molex connector.
Bad control board	If the fuse is good, the wires and connectors check out good, and the high limit switch did not trip, test for power going to the auger motor. If there is not a full current going to the auger motor when the fuel feed light is on, you have a bad control board.

Glass soots up quickly, flame is lazy/dark/has black tips, burn pot overfills

COMMON CAUSES	INSTRUCTIONS TO CORRECT PROBLEM
Stove or vent pipe is dirty, which restricts airflow through the burn pot	Follow all cleaning procedure in the maintenance section of the owner's manual.
Vent pipe installed improperly	Check to make sure the vent pipe has been installed according to the criteria in the owner's manual.
Burn potholes are blocked	Remove the burn pot and thoroughly clean it.
Circuit board malfunction	Time the fuel feed light at each setting (after the stove has completed the startup cycle). Make sure the times match the auger timing chart. If the auger motor runs constantly, the board is bad.
Combustion blower is not spinning fast enough	Test the RPM on the blower after the blades have been cleaned. The RPM should be approximately 3000 RPM.
Bad pellets (applies to "GLASS SOOTS UP QUICKLY" only)	The brand of pellets or the batch of pellets that are being used may be of poor quality. If possible, try a different brand of pellets. You might also want to try a brand that is made from a different type of wood (softwood vs hardwood). Different woods have different characteristics when being burned.
The trim setting on the low feed rate is too low (applies to "GLASS SOOTS UP QUICKLY" only)	Use the "Reset Trim" button to increase the low feed rate setting. If the 1 & 3 lights are on, the stove is currently on the lowest setting. If only the 1 light is on, the stove is in the default (medium) setting. If the 1 & 4 lights are on, the stove is in the high trim setting for the low feed rate. If the stove is being burned on one of the two lower settings, advance to the next trim setting and try burning the stove.

High limit switch keeps tripping

COMMON CAUSES	INSTRUCTIONS TO CORRECT PROBLEM
The convection blower is overheating and tripping the internal temperature shutoff	Clean any dust off the windings and fan blades. If cleaning the blower does not help, it may be bad.
The stove is being left on the highest setting for extended periods of time	The highest heat level setting is designed for use over short periods of time. Burning the stove on the highest setting for longer than 1 -2 hours could lead to potential overheating situations.
Fuel other than wood pellets is being burned in the stove	Heat Tech pellet stoves are designed and tested to use wood pellets. While it is possible to burn a corn mixture

	(Corn mixed in with wood pellets) in the stove, it is not recommended to burn above the number 3 heat level. Check for signs of fuel other than wood pellets. If there are signs of corn being used, find out what mix was being used and what setting. No other types of fuel have been approved for Heat Tech pellet stoves. If there are signs of other types of fuel being used, advise the consumer to stop using them immediately.
Power surge or brown out situation	A power surge, spike, or voltage drop could cause the high limit switch to trip. Check to see if a surge protector is being used on the stove. If not, recommend one to the consumer.
High limit switch is malfunctioning	If the other items check out ok, replace the high limit switch.

Smoke smell or soot buildup

Because it is a wood burning device, your Heat Tech stove may emit a faint wood burning odor. If this increases beyond normal, or if you notice an unusual soot build-up on walls or furniture, check your exhaust system carefully for leaks. All joints should be properly sealed. Also clean your stove, following instructions in “MAINTENANCE”. If problem persists, contact your dealer. It is recommended to have properly maintained smoke and carbon monoxide detectors installed.

DIAGRAMS

FIREPLACE INSERT
SIDE ELEVATION

NOTE:
Follow metal chimney installation instructions.

NOTE:
Then mantle extends more than 6" from fireplace face, a 15" min. exemption from stove top to bottom of the mantle.

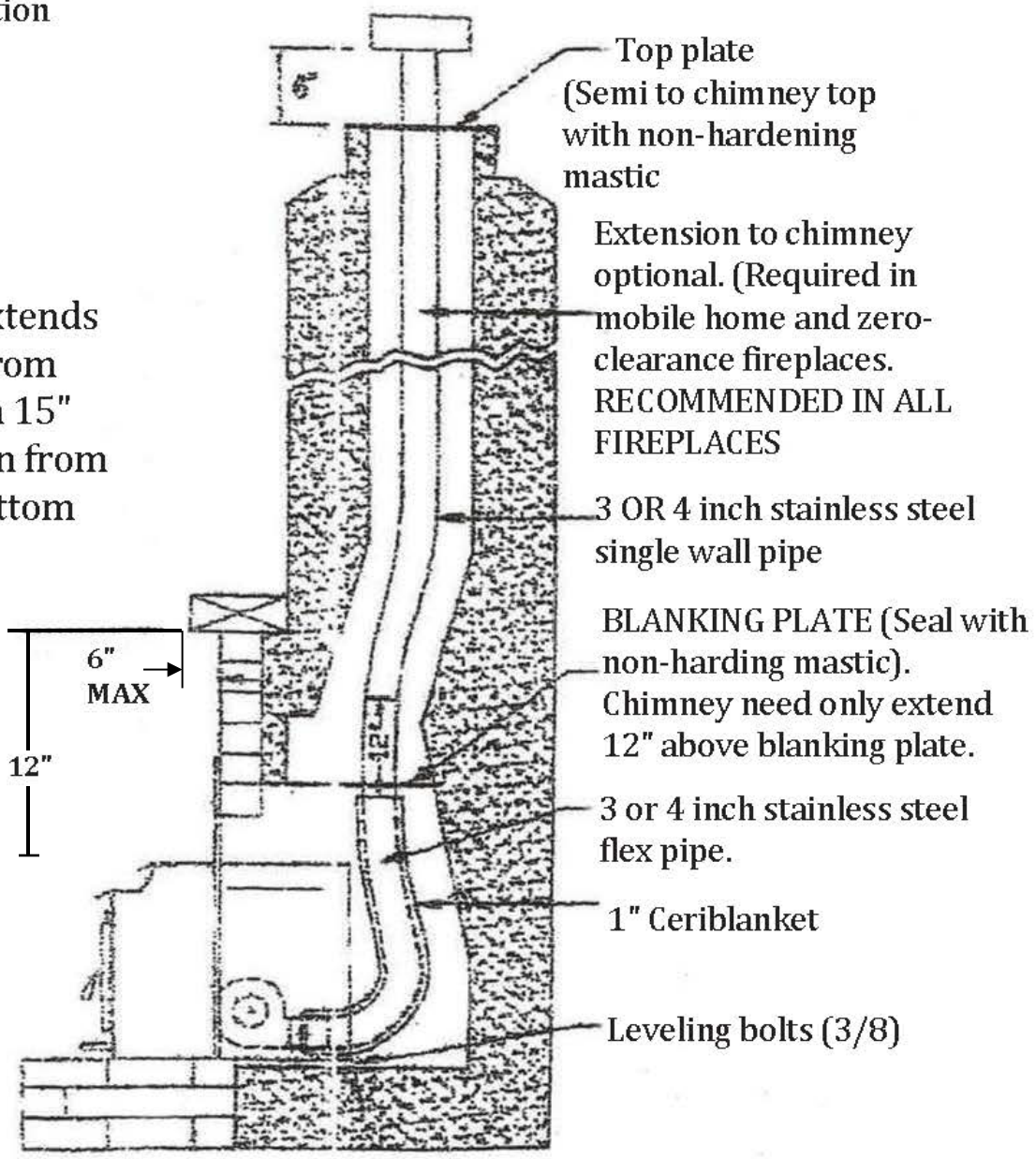
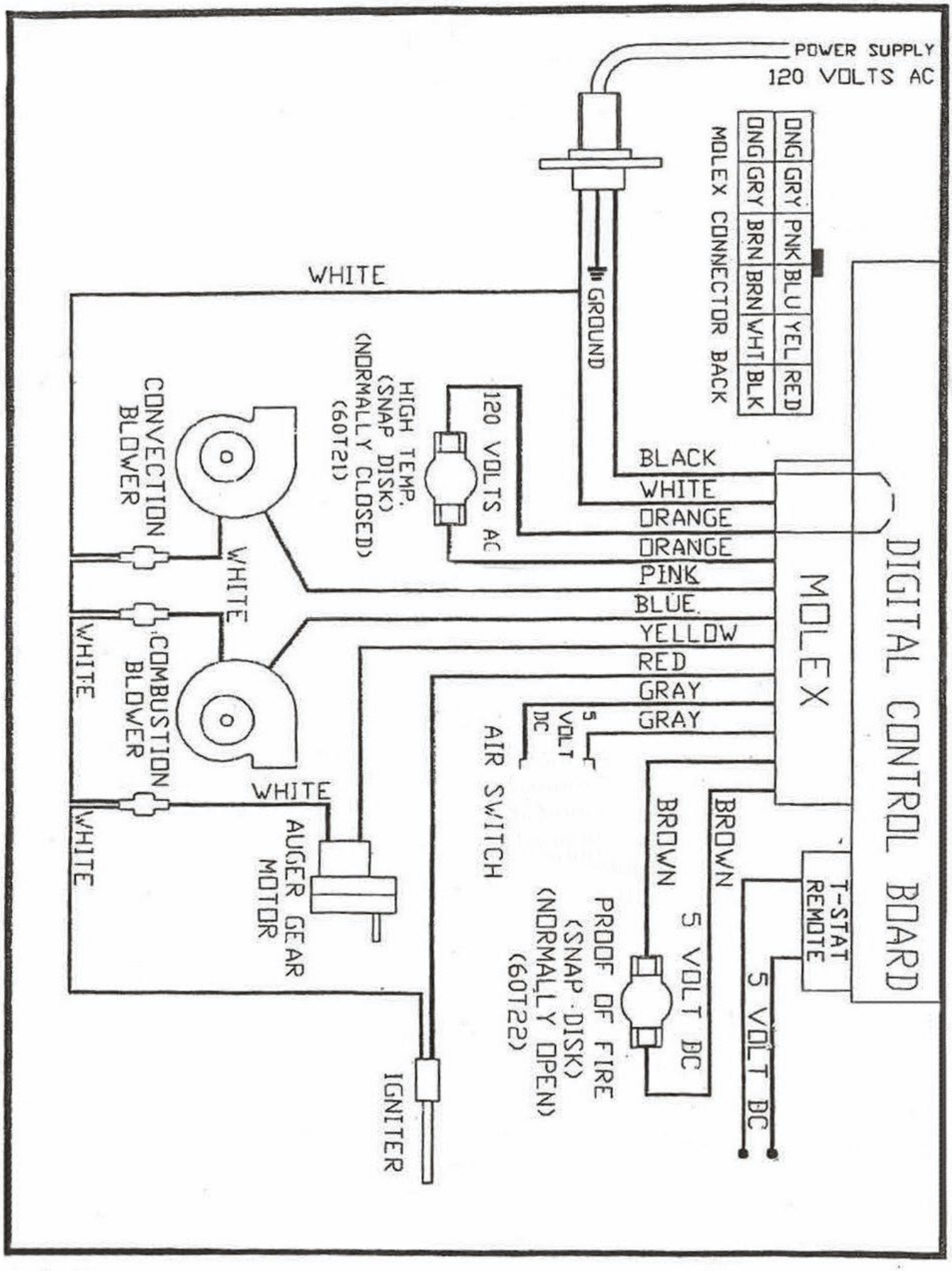


FIGURE 13


POWER SUPPLY
120 VOLTS AC
MOLEX CONNECTOR BACK
ORG GRY PNK BLU YEL RED
ORG GRY BRN BRN WHT BLK
GROUND
WHITE
BLACK
WHITE
ORANGE
ORANGE
PINK
BLUE
YELLOW
RED
GRAY
GRAY
MOLEX
DIGITAL CONTROL BOARD
T-STAT REMOTE
5 VOLT DC
5 VOLT DC
BROWN
BROWN
PROOF OF FIRE (SNAP DISK) (NORMALLY OPEN) (60T22)
AIR SWITCH
IGNITER
AUGER GEAR MOTOR
WHITE
WHITE
WHITE
COMBUSTION BLOWER
CONVECTION BLOWER
WHITE
HIGH TEMP. (SNAP DISK) (NORMALLY CLOSED) (60T21)
120 VOLTS AC

WARRANTY

Heat Tech Industries gives a five-year limited warranty on all steel manufactured parts. A one-year warranty is provided on electrical components including the solid-state circuit control board. The above limited warranties are extended to only the original purchaser.

There is NO warranty on the following parts:

- Glass window
- Fiberglass rope gasket
- Refractory material
- Burn pot
- Paint
- Enamel finish, gold, or brass

All claims must be forwarded to the dealer that the stove was purchased from and must reflect the model and serial number on the stove.

All warranty claims must be on the official warranty claim form and must reflect the specific nature of the problem.

The limited warranty covers defects in materials and workmanship if the product has been installed according to the manual's instructions. If the product is damaged or broken because of mishandling or misuse, the warranty does not apply. Removal and reinstallation cost are not covered in this warranty.

It is the manufacturer's option whether to repair or replace the appliance. The shipping to and from the factory is paid by the consumer. All warranties by the manufacturer are set forth herein and no claim shall be made against the manufacturer on any oral agreement.

WARRANTY REGISTRATION

Complete information below. Detach and return to dealer.

Customer Name:_____

Purchase Date:_____

Serial #/Invoice #:_____

HEAT TECH HTP BAY-HTP STANDARD PELLET STOVE

If your Heat Tech Stove fails to operate correctly due to defective material or workmanship, HEAT TECH IND. will replace or repair it at our option free of charge. You must return your stove or part directly to the factory.

This warranty is effective for 5 (five) years from the date of purchase to the original owner.

This warranty does not apply to the door gasket, ceramic window, paint or burn pot. These replaceable parts may be obtained from your dealer.

Warranty is void on any stove which has been altered, misused (i.e., over fired), neglected, tampered with, or damaged by any circumstances beyond the control of HEAT TECH IND.

Warranty Voided

1. Over filled.
2. Damp pellets or excess fined.
3. Oversized pellets.
4. Burning anything other than recommended pellets.
5. Other highly volatile substances are burned in the stove.

All charges for shipping of stove or part will be assumed by purchaser. No labor or expense is covered except that which is authorized by HEAT TECH INC.

No other warranty, express or implied is assumed by HEAT TECH INC.

Purchasers Name: _____

Address: _____

City, State & Zip: _____

Purchased from: _____

City & State: _____

Date Purchased: _____ Serial No. _____

Model: _____ T r i m : _____

Dry Gas Meter Calibration

DUT	
Manufacturer:	APEX
Model:	XC-60
Lab ID #:	53
Serial #:	1902130
Calibration Date:	1/26/2023
Calibration Expiration:	7/26/2023
Barometric Pressure:	30.51 in. Hg

Equipment Used:	Ref. Std. DGM	Thermometer	Barometer	Manometer
Manufacturer:	Apex	Fluke	Aquatech	Dwyer
Model:	SK25DA	52 II	DBX2	475
Lab ID#:	47	196	202	174
Calibration Expiration Date:	3/30/2023	11/29/2023	4/16/2023	3/29/2023
Calibration γ Factor:	0.9978			

Use in accordance with EPA Method 5, sections 10.3 and 16.1. Use only calibrated, NIST traceable reference standard DGM. Caibrate over expected operating flow range of DUT.

Calibration Data	Run 1	Run 2	Run 3
Standard DGM Initial Volume (L)	0.000	0.000	0.000
Standard DGM Final Volume (L)	149.049	145.786	156.580
Standard DGM Temperature (°F)	64.0	64.0	64.0
Standard DGM Pressure (in H_2O)	0.00	0.00	0.0
DGM Initial Volume (ft^3)	0.000	0.000	0.000
DGM Final Volume (ft^3)	5.425	5.311	5.765
DGM Temperature (°F)	89.0	92.0	94.0
DGM Pressure (in H_2O)	2.00	3.50	1.2
Net Volume for Standard DGM (ft^3)	5.264	5.148	5.530
Net Volume for DGM (ft^3)	5.425	5.311	5.765

Dry Gas Meter γ Factor	1.009	1.010	1.009
γ Factor Deviation From Average	1.009	1.010	1.009

Average Gas Meter γ Factor: 1.010

Measurement Uncertainty: Total measurement uncertainty +/- 0.748% RD, K=2

Calculations:

1. Deviation = |Average value for all runs - current run value|
2. $\gamma = [V_{std} \times (\gamma_{Std}) \times (P_{bar}+P_{std}/13.6) \times (T_{DGM} + 460)] / [V_{DGM} \times (T_{std} + 460) \times (P_{bar} + P_{DGM}/ 13.6)]$

Technician:

Report and Certificate of Calibration

CAL-CERT CALIBRATION CERTIFICATION

www.Cal-Cert.com

Toll Free 800-356-4662

Address 5777 SE International Way Milwaukie, OR 97222

Local 503-654-9620

A2LA ACCREDITED CERT #4986.01

Report #:	28140-203323-14	**Customer PO#:** 1090	
Customer Name:	PFS TECO		
Customer Address:	11785 SE Highway 212 Ste 305		
City:	Clackamas	**State:** OR	**Zip:** 97015
Contact:	Aaron Kravitz		
Service Address:	11785 SE Highway 212 Ste 305	Clackamas, OR 97015	

Calibration Standards

19-00269 | Thermo-Hygrometer | Comark | SN: 6237360167 | Cal: 09/14/2022 | Due: 08/31/2023 | Vendor: Cal-Cert | Range: 122 °F 95 %RH | Report #: 25699-30694-3486
LA-01776 | Pressure Transducer | Fluke | SN: 5956001 | Cal: 11/25/2022 | Due: 11/25/2023 | Range: 10 in H2O | Report #: EVL846346

Instrument Data

Calibration Date:	March 1, 2023	**Reference:**	ASME B40.100
Recommended Due Date:	March 1, 2024	**Cal-Cert Procedure:**	CP-003
Calibration Frequency:	12 Months	**Indicating System:**	Digital
Manufacturer:	Unknown	**Temperature:**	69 °F
Type:	Pressure Transducer	**Humidity:**	36% RH
Model Number:	Unknown	**Cal Factor:**	None
Serial #:	Unknown	**Asset #:**	53B
Capacity:	1 In H2O	**Service Location:**	Service Address
Tolerance:	± 1.00% of Span	**As Found:**	Pass
Gauge Class:	A	**As Left:**	Pass

Instrument Range: 1.00 **Range Resolution:** 0.01 **Mode Verified:** Pressure

UUT Reading In H2O	Standard As Found In H2O	Standard Verification Reading #1 In H2O	Error In H2O	Standard Verification Reading #2 In H2O	Error In H2O	Tolerance In H2O	Expanded Uncertainty ± In H2O
0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.005
0.10	0.10	0.10	0.00	0.10	0.00	0.01	0.005
0.25	0.25	0.25	0.00	0.25	0.00	0.01	0.005
0.50	0.50	0.50	0.00	0.50	0.00	0.01	0.005
0.75	0.75	0.75	0.00	0.75	0.00	0.01	0.005
1.00	1.00	1.00	0.00	1.00	0.00	0.01	0.005
0.75	0.75	0.75	0.00	0.75	0.00	0.01	0.005
0.50	0.50	0.50	0.00	0.50	0.00	0.01	0.005
0.25	0.25	0.25	0.00	0.25	0.00	0.01	0.005
0.10	0.10	0.10	0.00	0.10	0.00	0.01	0.005
0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.005

Manufacturer: Unknown **Type:** Pressure Transducer **Serial #:** Unknown

Remarks:

We sincerely thank you for your business. Please call us at 503-654-9620 for all your sales and calibration needs.
Cleaning and preventative maintenance were performed as part of this service.

Cal-Cert is accredited by A2LA under Calibration Laboratory Code #4986.01.
A2LA is recognized under the ILAC mutual recognition agreement (MRA).

This certificate is hereby issued that the above instrument was tested for accuracy with calibrated standards traceable to the National Institute of Standards and Technology (NIST). The information provided on this form complies with the data gathering and reporting requirements of ISO/IEC 17025 and ANSI/NCSL Z540.1, and meets the requirements of all applicable references and Cal-Cert procedures listed above.
Any stated measurement uncertainty includes the uncertainty of the Calibration standards used, combined with the uncertainty of the measurement process using the RSS method with a k=2 for an approximate 95% level of confidence. The calibration process meets or exceeds a ratio of 4:1 unless otherwise stated.
All tolerances were derived from the applicable standards and pass/fail determination is based on those tolerances. The customer determined any recommended due dates indicated on the certificate.

Service Engineer: Jon Rau **Date:** March 1, 2023

Technical Manager: Marshall Doyle **Signature:** 

Report #: 28140-203323-14

Report and Certificate of Calibration

CAL-CERT CALIBRATION CERTIFICATION

www.Cal-Cert.com

Toll Free 800-356-4662

Address 5777 SE International Way Milwaukie, OR 97222

Local 503-654-9620

A2LA ACCREDITED CERT #4986.01

Report #:	28140-203324-14	**Customer PO#:** 1090	
Customer Name:	PFS TECO		
Customer Address:	11785 SE Highway 212 Ste 305		
City:	Clackamas	**State:** OR	**Zip:** 97015
Contact:	Aaron Kravitz		
Service Address:	11785 SE Highway 212 Ste 305	Clackamas, OR 97015	

Calibration Standards

19-00269 | Thermo-Hygrometer | Comark | SN: 6237360167 | Cal: 09/14/2022 | Due: 08/31/2023 | Vendor: Cal-Cert | Range: 122 °F 95 %RH | Report #: 25699-30694-3486
LA-01776 | Pressure Transducer | Fluke | SN: 5956001 | Cal: 11/25/2022 | Due: 11/25/2023 | Range: 10 in H2O | Report #: EVL846346

Instrument Data

Calibration Date:	March 1, 2023	**Reference:**	ASME B40.100
Recommended Due Date:	March 1, 2024	**Cal-Cert Procedure:**	CP-003
Calibration Frequency:	12 Months	**Indicating System:**	Digital
Manufacturer:	Newport	**Temperature:**	73 °F
Type:	Pressure Transducer	**Humidity:**	30% RH
Model Number:	Unknown	**Cal Factor:**	None
Serial #:	Unknown	**Asset #:**	53C
Capacity:	5 In H2O	**Service Location:**	Service Address
Tolerance:	± 1.00% of Span	**As Found:**	Pass
Gauge Class:	A	**As Left:**	Pass

Instrument Range: 5.00 **Range Resolution:** 0.01 **Mode Verified:** Pressure

UUT Reading In H2O	Standard As Found In H2O	Standard Verification Reading #1 In H2O	Error In H2O	Standard Verification Reading #2 In H2O	Error In H2O	Tolerance In H2O	Expanded Uncertainty ± In H2O
0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.005
0.50	0.50	0.50	0.00	0.50	0.00	0.05	0.005
1.25	1.25	1.25	0.00	1.25	0.00	0.05	0.005
2.50	2.50	2.50	0.00	2.50	0.00	0.05	0.006
3.75	3.75	3.75	0.00	3.75	0.00	0.05	0.007
5.00	5.00	5.00	0.00	5.00	0.00	0.05	0.008
3.75	3.75	3.75	0.00	3.75	0.00	0.05	0.007
2.50	2.50	2.50	0.00	2.50	0.00	0.05	0.006
1.25	1.25	1.25	0.00	1.25	0.00	0.05	0.005
0.50	0.50	0.50	0.00	0.50	0.00	0.05	0.005
0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.005

Manufacturer: Newport **Type:** Pressure Transducer **Serial #:** Unknown

Remarks:

We sincerely thank you for your business. Please call us at 503-654-9620 for all your sales and calibration needs.
Cleaning and preventative maintenance were performed as part of this service.

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A2LA is recognized under the ILAC mutual recognition agreement (MRA).

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All tolerances were derived from the applicable standards and pass/fail determination is based on those tolerances. The customer determined any recommended due dates indicated on the certificate.

Service Engineer: Jon Rau **Date:** March 1, 2023

Technical Manager: Marshall Doyle **Signature:** 

Report #: 28140-203324-14

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A2LA ACCREDITED CERT #4986.01

Report #: 26398-201253-5 **Customer PO#:** 1079
Customer Name: PFS TECO
Customer Address: 11785 SE Highway 212
City: Clackamas **State:** OR **Zip:** 97015
Contact: Ethan Frederick
Service Address: 5777 SE International Way Milwaukie, OR 97222

Calibration Standards

LP-00397 | Gage Block Set | Mitutoyo | SN: 509020 | Cal: 11/25/2020 | Due: 11/30/2022 | Vendor: BHD Test and Measurement | Report #: 112520A
LP-01346 | Thermo-Hygrometer | Comark | SN: 06210350198 | Cal: 02/07/2022 | Due: 02/28/2023 | Vendor: Cal-Cert | Range: 122 °F 95 %RH | Report #: 22748-67215-3486

Instrument Data

Calibration Date:	October 21, 2022	**Reference:**	ASME B89.1.14 2018
Calibration Due Date:	October 21, 2023	**Cal-Cert Procedure:**	CP-008
Calibration Frequency:	12 Months	**Indicating System:**	Digital
Manufacturer:	Mitutoyo	**Temperature:**	69 °F
Type:	Digital Caliper	**Humidity:**	38% RH
Model Number:	CD-P6"S	**Asset #:**	208
Serial #:	B22159310	**Service Location:**	Cal-Cert Lab
Capacity:	6 Inches	**As Found:**	PASS
Resolution:	0.0005 Inches	**As Left:**	PASS

Instrument Range: 6.0000 Inches **Range Resolution:** 0.0005 Inches

Outside Jaws / Linearity

Calibration Standard Inches	As Found Inches	As Left Reading 1 Inches	As Left Reading 2 Inches	Tolerance ± Inches
0.0000	0.0000	0.0000	0.0000	0.0000
0.0500	0.0500	0.0500	0.0500	0.0010
0.3000	0.3000	0.3000	0.3000	0.0010
0.6000	0.6005	0.6005	0.6005	0.0010
1.2000	1.2000	1.2000	1.2000	0.0010
2.4000	2.4005	2.4005	2.4005	0.0010
3.5000	3.5000	3.5000	3.5000	0.0010
5.0000	5.0005	5.0005	5.0005	0.0010
6.0000	6.0005	6.0005	6.0005	0.0010

Expanded Uncertainty ± 0.00036 Inches

Verifications (for information only)

	Target	Measured	Tolerance ±
Resolution Check	0.1005	0.10050	N/A
Depth	1.000	1.00000	N/A
Step	1.000	1.00000	N/A
Inside Jaws	1.000	1.00000	N/A

Inspections

Jaws Parallel	Acceptable

Remarks:

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All tolerances were derived from the applicable standards and pass/fail determination is based on those tolerances. The customer determined any recommended due dates indicated on the certificate.

Service Engineer: Cameron Walling **Date:** October 21, 2022

Technical Manager: Marshall Doyle **Signature:** Marshall Doyle

Dry Gas Meter Calibration

DUT	
Manufacturer:	APEX
Model:	XC-60
Lab ID #:	54
Serial #:	1902133
Calibration Date:	1/26/2023
Calibration Expiration:	7/26/2023
Barometric Pressure:	30.49 in. Hg

Equipment Used:	Ref. Std. DGM	Thermometer	Barometer	Manometer
Manufacturer:	Apex	Fluke	Aquatech	Dwyer
Model:	SK25DA	52 II	DBX2	475
Lab ID#:	47	196	202	174
Calibration Expiration Date:	3/30/2023	11/29/2023	4/16/2023	3/29/2023
Calibration γ Factor:	0.9978			

Use in accordance with EPA Method 5, sections 10.3 and 16.1. Use only calibrated, NIST traceable reference standard DGM. Caibrate over expected operating flow range of DUT.

Calibration Data	Run 1	Run 2	Run 3
Standard DGM Initial Volume (L)	0.000	0.000	0.000
Standard DGM Final Volume (L)	160.750	154.658	151.064
Standard DGM Temperature (°F)	64.0	65.0	66.0
Standard DGM Pressure (in H_2O)	0.00	0.00	0.0
DGM Initial Volume (ft^3)	0.000	0.000	0.000
DGM Final Volume (ft^3)	5.962	5.736	5.621
DGM Temperature (°F)	97.0	96.0	97.0
DGM Pressure (in H_2O)	3.00	2.00	1.0
Net Volume for Standard DGM (ft^3)	5.677	5.462	5.335
Net Volume for DGM (ft^3)	5.962	5.736	5.621

Dry Gas Meter γ Factor	1.003	1.001	1.000
γ Factor Deviation From Average	1.003	1.001	1.000

Average Gas Meter γ Factor: 1.001

Measurement Uncertainty: Total measurement uncertainty +/- 0.748% RD, K=2

Calculations:

1. Deviation = |Average value for all runs - current run value|
2. $\gamma = [V_{std} \times (\gamma_{Std}) \times (P_{bar}+P_{std}/13.6) \times (T_{DGM} + 460)] / [V_{DGM} \times (T_{std} + 460) \times (P_{bar} + P_{DGM}/ 13.6)]$

Technician:

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Local 503-654-9620

A2LA ACCREDITED CERT #4986.01

Report #:	28140-203325-14	**Customer PO#:** 1090	
Customer Name:	PFS TECO		
Customer Address:	11785 SE Highway 212 Ste 305		
City:	Clackamas	**State:** OR	**Zip:** 97015
Contact:	Aaron Kravitz		
Service Address:	11785 SE Highway 212 Ste 305	Clackamas, OR 97015	

Calibration Standards

19-00269 | Thermo-Hygrometer | Comark | SN: 6237360167 | Cal: 09/14/2022 | Due: 08/31/2023 | Vendor: Cal-Cert | Range: 122 °F 95 %RH | Report #: 25699-30694-3486
LA-01776 | Pressure Transducer | Fluke | SN: 5956001 | Cal: 11/25/2022 | Due: 11/25/2023 | Range: 10 in H2O | Report #: EVL846346

Instrument Data

Calibration Date:	March 1, 2023	**Reference:**	ASME B40.100
Recommended Due Date:	March 1, 2024	**Cal-Cert Procedure:**	CP-003
Calibration Frequency:	12 Months	**Indicating System:**	Digital
Manufacturer:	Newport	**Temperature:**	68 °F
Type:	Pressure Transducer	**Humidity:**	37% RH
Model Number:	Unknown	**Cal Factor:**	None
Serial #:	Unknown	**Asset #:**	54B
Capacity:	1 In H2O	**Service Location:**	Service Address
Tolerance:	± 1.00% of Span	**As Found:**	Pass
Gauge Class:	A	**As Left:**	Pass

Instrument Range: 1.00 **Range Resolution:** 0.01 **Mode Verified:** Pressure

UUT Reading In H2O	Standard As Found In H2O	Standard Verification Reading #1 In H2O	Error In H2O	Standard Verification Reading #2 In H2O	Error In H2O	Tolerance In H2O	Expanded Uncertainty ± In H2O
0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.005
0.10	0.10	0.10	0.00	0.10	0.00	0.01	0.005
0.25	0.25	0.25	0.00	0.25	0.00	0.01	0.005
0.50	0.50	0.50	0.00	0.50	0.00	0.01	0.005
0.75	0.75	0.75	0.00	0.75	0.00	0.01	0.005
1.00	0.99	0.99	-0.01	0.99	-0.01	0.01	0.005
0.75	0.75	0.75	0.00	0.75	0.00	0.01	0.005
0.50	0.50	0.50	0.00	0.50	0.00	0.01	0.005
0.25	0.25	0.25	0.00	0.25	0.00	0.01	0.005
0.10	0.10	0.10	0.00	0.10	0.00	0.01	0.005
0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.005

Manufacturer: Newport **Type:** Pressure Transducer **Serial #:** Unknown

Remarks:

We sincerely thank you for your business. Please call us at 503-654-9620 for all your sales and calibration needs.
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All tolerances were derived from the applicable standards and pass/fail determination is based on those tolerances. The customer determined any recommended due dates indicated on the certificate.

Service Engineer: Jon Rau **Date:** March 1, 2023

Technical Manager: Marshall Doyle **Signature:** 

Report #: 28140-203325-14

Dry Gas Meter Calibration

DUT	
Manufacturer:	APEX
Model:	XC-50-DIR
Lab ID #:	203
Serial #:	A2204292
Calibration Date:	1/26/2023
Calibration Expiration:	7/26/2023
Barometric Pressure:	30.50 in. Hg

Equipment Used:	Ref. Std. DGM	Thermometer	Barometer	Manometer
Manufacturer:	Apex	Fluke	Aquatech	Dwyer
Model:	SK25DA	52 II	DBX2	475
Lab ID#:	47	196	202	174
Calibration Expiration Date:	3/30/2023	11/29/2023	4/16/2023	3/29/2023
Calibration γ Factor:	0.9978			

Use in accordance with EPA Method 5, sections 10.3 and 16.1. Use only calibrated, NIST traceable reference standard DGM. Caibrate over expected operating flow range of DUT.

Calibration Data	Run 1	Run 2	Run 3
Standard DGM Initial Volume (L)	0.000	0.000	0.000
Standard DGM Final Volume (L)	230.939	193.894	200.071
Standard DGM Temperature (°F)	66.0	66.0	66.0
Standard DGM Pressure (in H_2O)	0.00	0.00	0.0
DGM Initial Volume (ft^3)	0.000	0.000	0.000
DGM Final Volume (ft^3)	8.610	7.251	7.491
DGM Temperature (°F)	92.0	92.0	91.0
DGM Pressure (in H_2O)	2.56	1.30	0.8
Net Volume for Standard DGM (ft^3)	8.156	6.847	7.065
Net Volume for DGM (ft^3)	8.610	7.251	7.491

Dry Gas Meter γ Factor	0.986	0.986	0.984
γ Factor Deviation From Average	0.986	0.986	0.984

Average Gas Meter γ Factor: 0.985

Measurement Uncertainty: Total measurement uncertainty +/- 0.748% RD, K=2

Calculations:

1. Deviation = |Average value for all runs - current run value|
2. $\gamma = [V_{std} \times (\gamma_{Std}) \times (P_{bar}+P_{std}/13.6) \times (T_{DGM} + 460)] / [V_{DGM} \times (T_{std} + 460) \times (P_{bar} + P_{DGM}/ 13.6)]$

Technician

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Address 5777 SE International Way Milwaukie, OR 97222

Local 503-654-9620

A2LA ACCREDITED CERT #4986.01

Report #:	28140-203319-14	**Customer PO#:** 1090	
Customer Name:	PFS TECO		
Customer Address:	11785 SE Highway 212 Ste 305		
City:	Clackamas	**State:** OR	**Zip:** 97015
Contact:	Aaron Kravitz		
Service Address:	11785 SE Highway 212 Ste 305	Clackamas, OR 97015	

Calibration Standards

19-00269 | Thermo-Hygrometer | Comark | SN: 6237360167 | Cal: 09/14/2022 | Due: 08/31/2023 | Vendor: Cal-Cert | Range: 122 °F 95 %RH | Report #: 25699-30694-3486
LA-01776 | Pressure Transducer | Fluke | SN: 5956001 | Cal: 11/25/2022 | Due: 11/25/2023 | Range: 10 in H2O | Report #: EVL846346

Instrument Data

Calibration Date:	March 1, 2023	**Reference:**	ASME B40.100
Recommended Due Date:	March 1, 2024	**Cal-Cert Procedure:**	CP-003
Calibration Frequency:	12 Months	**Indicating System:**	Digital
Manufacturer:	Red Lion	**Temperature:**	69 °F
Type:	Pressure Transducer	**Humidity:**	35% RH
Model Number:	Unknown	**Cal Factor:**	None
Serial #:	Unknown	**Asset #:**	203B
Capacity:	1 In H2O	**Service Location:**	Service Address
Tolerance:	± 1.00% of Span	**As Found:**	Pass
Gauge Class:	A	**As Left:**	Pass

Instrument Range: 1.00 **Range Resolution:** 0.001 **Mode Verified:** Pressure

UUT Reading In H2O	Standard As Found In H2O	Standard Verification Reading #1 In H2O	Error In H2O	Standard Verification Reading #2 In H2O	Error In H2O	Tolerance In H2O	Expanded Uncertainty ± In H2O
0.000	0.000	0.000	0.00	0.000	0.00	0.01	0.0005
0.100	0.100	0.100	0.00	0.100	0.00	0.01	0.0005
0.250	0.250	0.250	0.00	0.250	0.00	0.01	0.0006
0.500	0.500	0.500	0.00	0.500	0.00	0.01	0.0008
0.750	0.750	0.750	0.00	0.750	0.00	0.01	0.001
1.000	1.000	1.000	0.00	1.000	0.00	0.01	0.0012
0.750	0.750	0.750	0.00	0.750	0.00	0.01	0.001
0.500	0.500	0.500	0.00	0.500	0.00	0.01	0.0008
0.250	0.250	0.250	0.00	0.250	0.00	0.01	0.0006
0.100	0.100	0.100	0.00	0.100	0.00	0.01	0.0005
0.000	0.000	0.000	0.00	0.000	0.00	0.01	0.0005

Manufacturer: Red Lion **Type:** Pressure Transducer **Serial #:** Unknown

Remarks:

We sincerely thank you for your business. Please call us at 503-654-9620 for all your sales and calibration needs.
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All tolerances were derived from the applicable standards and pass/fail determination is based on those tolerances. The customer determined any recommended due dates indicated on the certificate.

Service Engineer: Jon Rau **Date:** March 1, 2023

Technical Manager: Marshall Doyle **Signature:** 

Report #: 28140-203319-14

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Local 503-654-9620

A2LA ACCREDITED CERT #4986.01

Report #:	28140-203320-14	**Customer PO#:** 1090	
Customer Name:	PFS TECO		
Customer Address:	11785 SE Highway 212 Ste 305		
City:	Clackamas	**State:** OR	**Zip:** 97015
Contact:	Aaron Kravitz		
Service Address:	11785 SE Highway 212 Ste 305	Clackamas, OR 97015	

Calibration Standards

19-00269 | Thermo-Hygrometer | Comark | SN: 6237360167 | Cal: 09/14/2022 | Due: 08/31/2023 | Vendor: Cal-Cert | Range: 122 °F 95 %RH | Report #: 25699-30694-3486
LA-01776 | Pressure Transducer | Fluke | SN: 5956001 | Cal: 11/25/2022 | Due: 11/25/2023 | Range: 10 in H2O | Report #: EVL846346

Instrument Data

Calibration Date:	March 1, 2023	**Reference:**	ASME B40.100
Recommended Due Date:	March 1, 2024	**Cal-Cert Procedure:**	CP-003
Calibration Frequency:	12 Months	**Indicating System:**	Digital
Manufacturer:	Red Lion	**Temperature:**	73 °F
Type:	Pressure Transducer	**Humidity:**	30% RH
Model Number:	Unknown	**Cal Factor:**	None
Serial #:	Unknown	**Asset #:**	203C
Capacity:	5 In H2O	**Service Location:**	Service Address
Tolerance:	± 1.00% of Span	**As Found:**	Pass
Gauge Class:	A	**As Left:**	Pass

Instrument Range: 5.00 **Range Resolution:** 0.01 **Mode Verified:** Pressure

UUT Reading In H2O	Standard As Found In H2O	Standard Verification Reading #1 In H2O	Error In H2O	Standard Verification Reading #2 In H2O	Error In H2O	Tolerance In H2O	Expanded Uncertainty ± In H2O
0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.005
0.50	0.50	0.50	0.00	0.50	0.00	0.05	0.005
1.25	1.25	1.25	0.00	1.25	0.00	0.05	0.005
2.50	2.50	2.50	0.00	2.50	0.00	0.05	0.006
3.75	3.75	3.75	0.00	3.75	0.00	0.05	0.007
5.00	5.00	5.00	0.00	5.00	0.00	0.05	0.008
3.75	3.75	3.75	0.00	3.75	0.00	0.05	0.007
2.50	2.50	2.50	0.00	2.50	0.00	0.05	0.006
1.25	1.25	1.25	0.00	1.25	0.00	0.05	0.005
0.50	0.50	0.50	0.00	0.50	0.00	0.05	0.005
0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.005

Manufacturer: Red Lion **Type:** Pressure Transducer **Serial #:** Unknown

Remarks:

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All tolerances were derived from the applicable standards and pass/fail determination is based on those tolerances. The customer determined any recommended due dates indicated on the certificate.

Service Engineer: Jon Rau **Date:** March 1, 2023

Technical Manager: Marshall Doyle **Signature:** 

Report #: 28140-203320-14

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Local 503-654-9620

A2LA ACCREDITED CERT #4986.01

Report #:	28140-203326-14	**Customer PO#:** 1090	
Customer Name:	PFS TECO		
Customer Address:	11785 SE Highway 212 Ste 305		
City:	Clackamas	**State:** OR	**Zip:** 97015
Contact:	Aaron Kravitz		
Service Address:	11785 SE Highway 212 Ste 305	Clackamas, OR 97015	

Calibration Standards

19-00269 | Thermo-Hygrometer | Comark | SN: 6237360167 | Cal: 09/14/2022 | Due: 08/31/2023 | Vendor: Cal-Cert | Range: 122 °F 95 %RH | Report #: 25699-30694-3486
LA-01776 | Pressure Transducer | Fluke | SN: 5956001 | Cal: 11/25/2022 | Due: 11/25/2023 | Range: 10 in H2O | Report #: EVL846346

Instrument Data

Calibration Date:	March 1, 2023	**Reference:**	ASME B40.100
Recommended Due Date:	March 1, 2024	**Cal-Cert Procedure:**	CP-003
Calibration Frequency:	12 Months	**Indicating System:**	Digital
Manufacturer:	Newport	**Temperature:**	73 °F
Type:	Pressure Transducer	**Humidity:**	30% RH
Model Number:	Unknown	**Cal Factor:**	None
Serial #:	Unknown	**Asset #:**	54C
Capacity:	5 In H2O	**Service Location:**	Service Address
Tolerance:	± 1.00% of Span	**As Found:**	Pass
Gauge Class:	A	**As Left:**	Pass

Instrument Range: 5.00 **Range Resolution:** 0.01 **Mode Verified:** Pressure

UUT Reading In H2O	Standard As Found In H2O	Standard Verification Reading #1 In H2O	Error In H2O	Standard Verification Reading #2 In H2O	Error In H2O	Tolerance In H2O	Expanded Uncertainty ± In H2O
0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.005
0.50	0.50	0.50	0.00	0.50	0.00	0.05	0.005
1.25	1.25	1.25	0.00	1.25	0.00	0.05	0.005
2.50	2.50	2.50	0.00	2.50	0.00	0.05	0.006
3.75	3.75	3.75	0.00	3.75	0.00	0.05	0.007
5.00	5.00	5.00	0.00	5.00	0.00	0.05	0.008
3.75	3.75	3.75	0.00	3.75	0.00	0.05	0.007
2.50	2.50	2.50	0.00	2.50	0.00	0.05	0.006
1.25	1.25	1.25	0.00	1.25	0.00	0.05	0.005
0.50	0.50	0.50	0.00	0.50	0.00	0.05	0.005
0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.005

Manufacturer: Newport **Type:** Pressure Transducer **Serial #:** Unknown

Remarks:

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Cal-Cert is accredited by A2LA under Calibration Laboratory Code #4986.01.
A2LA is recognized under the ILAC mutual recognition agreement (MRA).

This certificate is hereby issued that the above instrument was tested for accuracy with calibrated standards traceable to the National Institute of Standards and Technology (NIST). The information provided on this form complies with the data gathering and reporting requirements of ISO/IEC 17025 and ANSI/NCSL Z540.1, and meets the requirements of all applicable references and Cal-Cert procedures listed above.
Any stated measurement uncertainty includes the uncertainty of the Calibration standards used, combined with the uncertainty of the measurement process using the RSS method with a k=2 for an approximate 95% level of confidence. The calibration process meets or exceeds a ratio of 4:1 unless otherwise stated.
All tolerances were derived from the applicable standards and pass/fail determination is based on those tolerances. The customer determined any recommended due dates indicated on the certificate.

Service Engineer: Jon Rau **Date:** March 1, 2023

Technical Manager: Marshall Doyle **Signature:** 

Report #: 28140-203326-14

Dry Gas Meter Calibration

DUT	
Manufacturer:	APEX
Model:	Apex-AK-600
Lab ID #:	55
Serial #:	810016
Calibration Date:	1/27/2023
Calibration Expiration:	7/27/2023
Barometric Pressure:	30.15 in. Hg

Equipment Used:	Ref. Std. DGM	Thermometer	Barometer	Manometer
Manufacturer:	Apex	Fluke	Aquatech	Dwyer
Model:	SK25DA	52 II	DBX2	475
Lab ID#:	47	196	202	174
Calibration Expiration Date:	3/30/2023	11/29/2023	4/16/2023	3/29/2023
Calibration γ Factor:	0.9978			

Use in accordance with EPA Method 5, sections 10.3 and 16.1. Use only calibrated, NIST traceable reference standard DGM. Caibrate over expected operating flow range of DUT.

Calibration Data	Run 1	Run 2	Run 3
Standard DGM Initial Volume (L)	0.000	0.000	0.000
Standard DGM Final Volume (L)	155.374	168.471	375.274
Standard DGM Temperature (°F)	65.0	66.0	67.0
Standard DGM Pressure (in H_2O)	0.00	0.00	0.0
DGM Initial Volume (ft^3)	0.000	0.000	0.000
DGM Final Volume (ft^3)	5.505	5.830	13.012
DGM Temperature (°F)	73.0	74.0	75.0
DGM Pressure (in H_2O)	0.50	0.50	0.5
Net Volume for Standard DGM (ft^3)	5.487	5.949	13.253
Net Volume for DGM (ft^3)	5.505	5.830	13.012

Dry Gas Meter γ Factor	1.008	1.032	1.030
γ Factor Deviation From Average	1.008	1.032	1.030

Average Gas Meter γ Factor: 1.024

Measurement Uncertainty: Total measurement uncertainty +/- 0.748% RD, K=2

Calculations:

1. Deviation = |Average value for all runs - current run value|
2. $\gamma = [V_{std} \times (\gamma_{Std}) \times (P_{bar}+P_{std}/13.6) \times (T_{DGM} + 460)] / [V_{DGM} \times (T_{std} + 460) \times (P_{bar} + P_{DGM}/ 13.6)]$

Technician

CERTIFICATE OF CALIBRATION

CUSTOMER:	**PFS-TECO :** CLACKAMAS, OR	**CALIBRATION DATE:**	05/03/2022
PO NUMBER:	1071	**CALIBRATION DUE:**	05/03/2023
INST. MANUFACTURER:	DWYER	**PROCEDURE:**	T.O.33K6-4-1769-1
INST. DESCRIPTION:	VELOMETER	**CALIBRATION FLUID:**	AIR @ 14.7 PSIA 70°F
MODEL NUMBER:	471	**RECEIVED CONDITION:**	WITHIN MFG. SPECS.
SERIAL NUMBER:	CP288559 ID# 095	**LEFT CONDITION:**	WITHIN MFG. SPECS.
RATED ACCURACY:	SEE NOTES BELOW.	**AMBIENT CONDITIONS:**	763mm HGA 51% RH 72°F
UNCERTAINTY GIVEN:	± 0.43% RD ; k=2	**CERTIFICATE FILE #:**	490265.2021

NOTES: ± 3% FS (0-500 / 0-1500) *** ± 4% F.S. (0-5000) ***± 5% F.S. (0-15000) *** ± 2 °F

Q.MANUAL IM 2.0 REV 2020.2 DATED 7-27-2020 ** DECISION RULE : NO PFA%**

UUT INDICATED FT/MIN	DM.STD. ACTUAL FT/MIN	UUT INDICATED DEG. F	DM STD. ACTUAL DEG. F
65	68	0 TO 200°F	0 TO 200°F
129	133	45.1	44.2
260	266	71.7	70.9
498	509	99.3	98.5
526	534		
1039	1058		
1484	1517		
523	534		
3076	3151		
4998	5127		
6752	6907		
14679	15068		

STANDARDS USED:		
A24: HART SCIENTIFIC TEMP. STANDARD | ± 0.024 F | TRACE# 1617259390	DUE	04/12/2023
A800: FLOW-DYNE SONIC NOZZLE SYSTEM | 0 – 1086 CFM ± 0.46% RD. | TRACE# 1329407628, 89576, 152043238	DUE	12/10/2022

All instruments used in the performance of the shown calibration have traceability to the National Institute of Standards and Technology (NIST). The uncertainty ratio between the calibration standards (DM.STD.) and the Unit Under Test (UUT) is a minimum of 4:1, unless otherwise noted. Calibration has been performed according to the shown procedure. The use of IAS/ILAC logo indicates calibrations are in accordance to ISO/IEC 17025:2017.

Dick Munns Company · 11133 Winners Circle, Los Alamitos, CA 90720
Phone: 714-827-1215 · www.dickmunns.com

Issuing Date: 05/03/2022 Approved By: Cal. Technician: D.C

Calibrated at: ✓ Lab
___ On-Site (Customer's)

Certificate of Calibration

Certificate Number: 743892

JJ Calibrations, Inc.
7724 SE Aspen Summit Drive
Portland, OR 97266-9217
Phone 503.786.3005
FAX 503.786.2994

PFS TECO
11785 SE Hwy 212
Suite 305
Clackamas, OR 97015

ACCREDITED
0723.01
Calibration

PO: 1033
Order Date: 03/08/2021
Authorized By: N/A

Property #: 097
User: N/A
Department: N/A
Make: Unknown
Model: 10 Lbs.
Serial #: 097
Description: Mass
Procedure: DCN 500901
Accuracy: Raw Data

Calibrated on: 03/18/2021
*Recommended Due: 03/18/2026
Environment: 19 °C 41 % RH
* As Received: Other - See Remarks
* As Returned: Other - See Remarks
Action Taken: Calibrated
Technician: 126

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.

Data is provided for your determination of acceptability. Received/returned without accessories.

Standards Used

Std ID	Manufacturer	Model	Nomenclature	Due Date	Trace ID
484A	Rice Lake	1kg-10kg (Class ASTM 1)	Mass Set,	05/28/2021	699197
503A	Rice Lake	1mg-200g (Class 0)	Mass Set,	09/11/2021	729241
550A	And (A&D) Co.	HP-30K	Balance 30 Kg	12/31/2021	739307
723A	Rice Lake	1mg-200g (Class 0)	Mass Set,	06/09/2021	723431

Measurement Data

Parameter / Measurement Description	Range	Unit	Reference	Min	Max	*Error	UUT	Uncertainty
Before/After								Accredited = ü
Mass								
Raw Data		g	4535.92370000	0.0000000	0.0000000	0.1785299	4536.1022299 g	3.5E-01 ü

This instrument has been calibrated in accordance with the JJ Calibrations Quality Assurance Manual and is traceable to either the SI or to National Institute of Standards and Technology (NIST). The quality system and this certificate are in compliance with ANSI/NCSL Z540-1-1994, ISO/IEC 17025-2017, 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 stated in the comments, certificates reflect the "Simple Acceptance Rule" as specified by JCGM 106:2012. 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 written approval of JJ Calibrations.

Reviewer

3 Issued 03/25/2021 Rev # 15

Inspector

Established 1974

QUALITY CONTROL SERVICES

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A2LA ACCREDITED
CERTIFICATE #1550.01

PFS Teco
11785 SE Hwy 212 STE#305
Clackamas, OR 97015

Report Number: DIRI0134307497221214

A2LA ACCREDITED
CERTIFICATE OF CALIBRATION WITH DATA

INSTRUMENT INFORMATION

Item	Make	Model	Serial Number	Customer ID	Location
Balance	Sartorius	ENTRIS224-1S	34307497	#107	Lab
Units	**Readability**	**SOP**	**Cal Date**	**Last Cal Date**	**Cal Due Date**
g	0.0001	QC012	12/14/22	6/9/22	12/2023

FUNCTIONAL CHECKS

ECCENTRICITY
Test Wt: 100 Tol: 0.0003
As-Found: Pass: ☑ Fail: ☐
As-Left: Pass: ☑ Fail: ☐

LINEARITY
Test Wt: 50 x 4 Tol: 0.0002
As-Found: Pass: ☑ Fail: ☐
As-Left: Pass: ☑ Fail: ☐

STANDARD DEVIATION
Test Wt: 100 Tol: 0.0001

1.	100.0002	5.	1000.0003	9.	1000.0003
2.	1000.0001	6.	1000.0002	10.	1000.0002
3.	1000.0002	7.	1000.0002	**Result**	
4.	1000.0002	8.	1000.0003	284.60499	

ENVIRONMENTAL CONDITIONS
☐ Good ☑ Fair ☐ Poor
Temperature: 20.6°C

A2LA ACCREDITED SECTION OF REPORT

Standard	As-Found	As-Left	Expanded Uncertainty
200	200.0009	200.0004	569.20999
100	100.0005	100.0002	569.20999
50	50.0004	50.0001	569.20999
20	20.0003	20.0000	569.20999
1	1.0001	1.0000	569.20999
0.1	0.1001	0.1000	569.20999

CALIBRATION STANDARDS

Item	Make	Model	Serial Number	Cal Date	Cal Due Date	NIST ID
Weight Set	Rice Lake	20 kg to 1mg	2831W	3/1/22	3/2023	20220382

Permanent Information Concerning this Equipment:
6 month calibration cycle
1/22 Extra checkpoint to encapsulate user range 0.05g.
AF= 0.0500g A/L= 0.0500

Comments/Info Concerning this Calibration:
12/22 RH= 45%. Adjusted span.

Report prepared/reviewed by: JC **Date:** 12/14/22 **Technician:** J. Colacchio

Signature:

The uncertainty is calculated according to the ISO Guide to the Expression of Uncertainty in Measurement and includes the uncertainty of standards used combined with the observed standard deviation and readability of the unit under test. The uncertainty is expanded with a k factor of 2 for an approximate 95% level of confidence. Instruments listed above were calibrated using standards traceable to the National Institute of Standards and Technology (NIST). Calibration data reflect results at the time and location of calibration. Calibration data should be reviewed to insure that the instrument is performing to its required accuracy. Calibrations comply with ISO/IEC 17025 and ANSI/Z540-1-1994 quality standards.

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ACCREDITED
CERTIFICATE #1550.01

Report of Calibration

Firm: PFS-TECO
Address: 11785 SE Hwy 212, Ste 305
City/State/Zip: Clackamas, OR 97015

Test Completed: 05/09/22
Purchase Order: 1067
Traceable Number: 20220682

Test Item: 200 mg and 100 mg Individual Weights
Serial No.: Listed in Table

Manufacturer: Troemner
Customer ID: Listed in Table

Material	Assumed Density	Range	Tolerance Class
Stainless Steel	7.95 g/cm^3	200 mg & 100 mg	ASTM Class 1

Method and Traceability
The procedure used for this calibration is NIST IR 6969 SOP 4 Double Substitution Weighing Design. Standards used for comparison are traceable to the National Institute of Standards and Technology (reports on file) and are part of a comprehensive measurement assurance program for ensuring continued accuracy and traceability within the level of uncertainty reported. The Traceable Number listed above is Traceable to National Standards through an unbroken chain of comparison each having stated uncertainties.

Standards Used:
100 g to 1 mg Working Standards Were Calibrated: 07/02/21 Due: 07/31/22 Standards ID: 723318
Mass Comparators Used: MET-05 **Tested by:** D. Thompson

Conventional Mass: "The conventional value of the result of weighing a body in air is equal to the mass of a standard, of conventionally chosen density, at a conventionally chosen temperature, which balances this body at this reference temperature in air of conventionally chosen density. International Recommendation 33 (OIML IR 33 1973, 1979). "Conventional Value of the Result of Weighing in Air" **(Previously known as "Apparent Mass vs. 8.0 g/cm^3).**

Uncertainty Statement: The uncertainty conforms to the ISO Guide to the Expressions of Uncertainty in Measurement. Uncertainty as reported is based on a coverage factor k=2 for an approximate 95 percent level of uncertainty. Uncertainty components include the standard deviation of the process, the uncertainty of the standard used, an uncertainty component associated with the potential drift of the standard used, and the estimated uncertainty related to measuring and determining the air buoyancy effect.

Conventional Mass Values are listed on page 2 of this report.

Quality Control Services, Inc.
Metrology Laboratory Manager
E-mail dthompson@qc-services.com

Date: 05/09/22

Signature David S. Thompson

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ACCREDITED
CERTIFICATE #1550.01

Report of Calibration

Firm: PFS-TECO
Address: 11785 SE Hwy 212, Ste 305
City/State/Zip: Clackamas, OR 97015

Test Completed: 05/09/22
Purchase Order: 1067
Traceable Number: 20220682

Test Item: 200 mg and 100 mg Individual Weights
Serial No.: Listed in Table

Manufacturer: Troemner
Customer ID: Listed in Table

Laboratory Environment at time of test

Temperature °C	Pressure mmHg	Humidity %RH
21.93 to 21.94	760.7 to 760.8	47.8 to 47.9

Conventional Mass Value

Nominal Value	As Found Value (g)	As Found Correction* (mg)	As Left Value (g)	As Left Correction* (mg)	Uncertainty (mg)	Tolerance (mg)
200 mg, 1000101395, #109-B	0.2000082	0.0082	0.2000082	0.0082	0.0014	0.010
100 mg, 1000126267, #109-A	0.1000065	0.0065	0.1000065	0.0065	0.0014	0.010

*Correction is the difference between the conventional mass value of a weight and its nominal value.

Comments: These weights were received in good condition and were within ASTM Class 1 tolerances As Found.

Recalibration Due: The customer has requested a 5-year calibration cycle. The calibration due date for these weights is 05/09/27. The values listed above were found at the time of calibration. Any number of factors may cause these items to drift out of calibration before the calibration interval has expired.

Accredited by the American Association for Laboratory Accreditation (A2LA) under Calibration Laboratory Code 115953 and Certificate Number 1550.01. This laboratory meets the requirements of ISO/IEC 17025:2017 *General Requirements for the Competence of Testing and Calibration Laboratories.* This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994 and any additional program requirements in the field of calibration.

Quality Control Services, Inc.
Metrology Laboratory Manager
E-mail dthompson@qc-services.com

Date: 05/09/22

Signature David S. Thompson

Model 1430 Microtector® Electronic Point Gage

Installation and Operating Instructions

Model 1430 Microtector® Portable Electronic Point Gage combines modern, solid-state integrated circuit electronics with a time-proven point gage manometer to provide fast, accurate pressure measurements.

SPECIFICATIONS AND FEATURES

- Accurate and repeatable to ± .00025 inches water column
- Pressure range: 0 - 2″ w.c., positive, negative, or differential pressures
- Non-toxic and inexpensive gage fluid consists of distilled water mixed with a small amount of fluorescein green color concentrate
- Convenient, portable, lightweight and self-contained, the unit requires no external power connections and is operated by a 1.5 volt penlight cell
- A.C. detector current eliminates point plating, fouling and erosion
- Micrometers are manufactured in accordance with ASME B89.1.13-2001, and are traceable to a standard at the National Institute of Standards and Technology
- Three-point mounting, dual leveling adjustment, and circular level vial assure rapid setup
- Durablock® precision-machined acrylic plastic gage body
- Sensitive 0 - 50 microamp D.C. meter acts as a detector and also indicates battery and probe condition
- Heavy 2″ thick steel base plate provides steady mounting
- Top-quality glass epoxy circuit board and solid-state, integrated circuit electronics
- Electronic enclosure of tough, molded styrene acrylonitrile provides maximum protection to components yet allows easy access to battery compartment
- Rugged sheet steel cover and carrying case protects the entire unit when not in use
- Accessories included are (2) 3-foot lengths Tygon® tubing, (2) 1/8″ pipe thread adapters and 3/4 oz. bottle of fluorescein green color concentrate with wetting agent

Maximum pressure: 100 psig with optional pipe thread connections.

Tygon® is a registered trademark of Saint-Gobain Corporation

DWYER INSTRUMENTS, INC.
P.O. BOX 373
MICHIGAN CITY, INDIANA 46361,U.S.A
Phone: 219/879-8000
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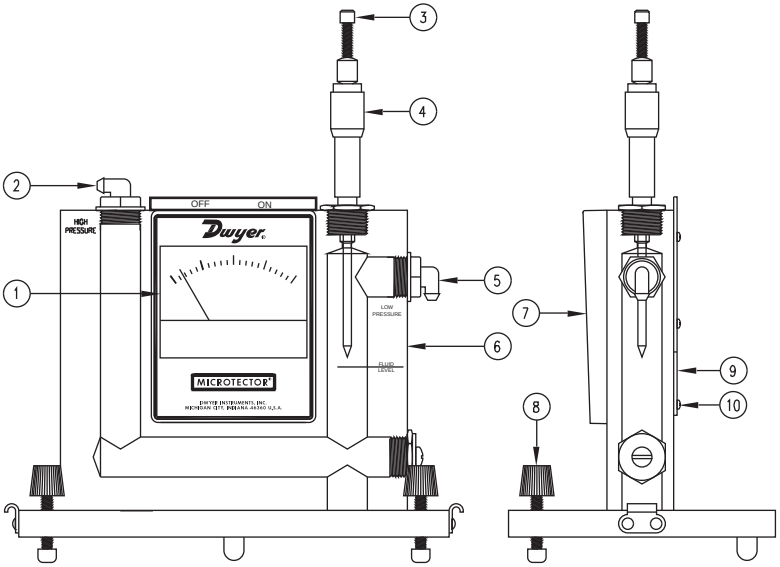

Microtector® Gage

Precision Pressure Measurement

The Microtector® Gage combines the time-proven principles of the Hook Gage type manometer and modern solid-state integrated circuit electronics. It provides an inexpensive means of achieving accuracy and repeatability within ± .00025 inches water column throughout its 0 to 2 inches w.c. range. It is truly a new standard in precision measuring devices.

Principles of Operation

A pressure to be measured is applied to the manometer fluid which is displaced in each leg of the manometer by an amount equal to 1/2 the applied pressure. A micrometer mounted point is then lowered until it contacts the manometer gage fluid. The instant of contact is detected by completion of a low-power A.C. circuit. Current for this circuit is supplied by a 1.5 volt penlight cell feeding two semiconductor amplifiers which act as a free-running multivibrator operating at a frequency of approximately two kilohertz. Completion of the A.C. circuit activates a bridge rectifier which provides the signal for indication on a sensitive (0 to 50 microamps) D.C. microammeter.

On indication of contact, the operator stops lowering the point and reads the micrometer which indicates one half the applied pressure. By interpolating eight divisions (each being .000125″ w.c.) between .001 micrometer graduations, a total accuracy of .00025 can easily be achieved. The micrometer complies with Federal Specification GGG-C-105A and is traceable to a master at the NIST.

Locating and Opening

Stand the Microtector® Gage and case on a firm flat level surface. Remove cover by releasing the latches and lifting it straight up. If it is necessary to move the gage without case, handle only the base plate or clear acrylic block. (**CAUTION:** Do not handle gage by grasping meter-electronic package housing Item 7 on drawing.)

Fluid Level

Level the gage by adjusting the two front leveling screws (Item 8 on drawing) until the bubble in the spirit level is centered in the small circle. After leveling the gage, open both rapid shut-off valve tube connectors (Items 2 and 5). Back off the micrometer (Item 4), if necessary, to make sure that the point is not immersed in the gage fluid. The fluid level in the gage should now coincide with the mark on the right hand bore (Item 6) plus or minus approximately 1/32 inch. If the level of fluid is too high, fluid can be removed with an eye dropper pipette or carefully poured out of the right connection (Item 5).

If the level is too low, remove the top left rapid shut-off valve tube connector (Item 2) and add distilled water pre-mixed with the proper amount of green concentrate. (See maintenance instructions for proportions. After correcting the fluid level, re-install the rapid shut-off connectors and, with these in the open position, re-level the Microtector® Gage. The gage is now ready to be zeroed.

Zeroing

Turn the Micrometer barrel (Item 4) until its lower end just coincides with the zero mark on the scale and the zero on the barrel scale coincides with the vertical line on the internal scale. Note that the internal scale is graduated every .025″ from 0 to 1.00 inch and the barrel scale is graduated in one thousandths from 0 to .025″. Turn the meter circuit switch at the top of gage to the “on” position. While holding the barrel at the zero position (and with gage level), raise or lower the point by turning the knurled knob (Item 3) until the point is above, but near, the fluid.

Check to be sure that the meter registers zero. Watch the meter, hold the barrel, and lower the point slowly by turning the top knurled knob. As the knob is turned, the point will contact the fluid and the meter pointer will move from zero to some upscale position.

After making contact, turn the point out of the fluid by turning the micrometer barrel counterclockwise to a reading of .010 or more. Again, watch the meter and, this time, lower the point by turning the micrometer barrel. The point position where the meter pointer begins to move up scale is the zero position. This position should correspond to the zero reading on the micrometer. Adjust the point in relation to the micrometer barrel by turning the top knob while holding the barrel steady. Repeat lowering the point, watching the meter for contact, and adjusting the point until the zero position and zero reading exactly coincide. The gage is now zeroed and should not be moved.

An alternative method of zeroing and reading can be used wherein, instead of zeroing the gage completely, a zero correction reading is taken and recorded, then subtracted from the final reading. Comparable results can be obtained with either method.

Positive Pressure Measurement

With the fluid at its proper level, a pressure of 2.0″ water column maximum can be measured. Positive pressure should be applied to the top left connection (Item 2) with the micrometer zeroed as described above. This will permit a simple direct reading to be taken.

After an unknown pressure has been applied at the top left connection, the fluid level will drop in the left bore and rise over the point in the right bore. Note that the indicating meter point has moved upscale because the point is immersed in the fluid. Turn the micrometer counter-clockwise until the point leaves the fluid as indicated by the meter pointer dropping to zero on its scale. Then slowly turn the micrometer down until its point just touches the fluid surface, causing movement of the meter pointer. Withdraw the point and repeat several times, noting each time the micrometer reading where the meter pointer begins. The average of these readings multiplied by two is the pressure applied to the gage. (Avg. reading x 2 = pressure applied in inches w.c. The degree of uncertainty for the operator is indicated by the difference in these readings.

When the readings are complete, the pressure should be removed and the zero setting of Microtector® Gage rechecked. Any change in the zero position will indicate inaccurate readings. Should this happen, the zero-set and pressure measurement procedure should be repeated.

Negative Pressure or Vacuum Measurement

Zero the gage. Connect the source of vacuum or negative pressure to the right-side gage connection (Item 5) and proceed as described under Positive Pressure Measurement section. Remember that the pressure measured in this way is negative.

Differential Pressure Measurement

Differential pressures may be measured by connecting the higher (more positive) pressure to the left connection (Item 2) and the lower pressure to the right connection (Item 5).

Storage

Turn meter circuit switch to "off" position and withdraw the point well clear of fluid (by turning micrometer clockwise) when gage is not in use. This will conserve the batteries and minimize build-up of oxides, etc., on the point. Keep the unit covered and in an area free of strong solvent fumes.

Maintenance

When the meter reading becomes reduced or the pointer movement gets sluggish (with the circuit on and the point in fluid), the following should be done:

(1) Remove the point (by unscrewing) and clean the tip lightly using fine crocus cloth. Wipe off all grit and dirt with a clean rag; reassemble and recheck meter operation.

(2) If the meter operation continues to be sluggish, replace the size AA, 1.5 volt battery. (Replace the battery at least once a year to avoid deterioration of battery and damage to gage. Leakproof alkaline battery is recommended.)

To replace the battery, remove center screw (Item 10) located in the back of the electronic enclosure. Cover (Item 9) will come off, exposing the battery. Pull the old battery out and push a new battery into the battery holder with the positive (center) terminal to the right (to the end marked with + on the holder).

If the fluid becomes contaminated and requires replacement: empty old fluid from gage; flush out with clear water and replace with distilled water and A-126 fluorescein green color concentrate mixed with 3/4 oz. concentrate to each quart of water.

CAUTION:

1. Do not substitute other gage fluids, as proper gage operation depends on use of the specified gage fluid to provide proper surface tension, wetting ability and electrolyte capability with unity specific gravity.

If the gage bore is very dirty, a mild soap solution may be used to aid in cleaning prior to flushing with clear water.

2. Do not clean with liquid soaps, special solvent, de-greasers, aromatic hydrocarbons, etc. Such cleaners and solvents may contain chlorine, fluorine, acetone and related compounds that will permanently damage the gage and prevent proper operation.

Printed in U.S.A. 7/09 FR# 38-440190-00 Rev. 8

DWYER INSTRUMENTS, INC.
P.O. BOX 373
MICHIGAN CITY, INDIANA 46361,U.S.A
Phone: 219/879-8000 **www.dwyer-inst.com**
Fax: 219/872-9057 **e-mail: info@dwyer-inst.com**

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Clackamas, OR 97015

Report Number: DIRI01C101887027221214

A2LA ACCREDITED
CERTIFICATE OF CALIBRATION WITH DATA

INSTRUMENT INFORMATION

Item	Make	Model	Serial Number	Customer ID	Location
Scale	Mettler	IND570 - 1000lbx0	C101887027	#189	Lab
Units	**Readability**	**SOP**	**Cal Date**	**Last Cal Date**	**Cal Due Date**
lbs	0.02	QC033	12/14/22	1/27/22	12/2023

FUNCTIONAL CHECKS

SHIFT TEST	LINEARITY	REPEATABILITY	ENVIRONMENTAL CONDITIONS
Test Wt: 400 Tol: 0.10	Test Wt: HB44 Tol: HB44	Test Wt: 200 Tol: 0.04	☐ Good ☑ Fair ☐ Poor
As-Found: Pass:☑ Fail:☐	As-Found: Pass:☑ Fail:☐	As-Found: Pass:☑ Fail:☐	Temperature: 16.7°C
As-Left: Pass:☑ Fail:☐	As-Left: Pass:☑ Fail:☐	As-Left: Pass:☑ Fail:☐	

CALIBRATION DATA

Standard	As-Found	As-Left	Expanded Uncertainty
1000	1000.84	1000.02	0.012
600	600.32	600.00	0.011
400	400.10	400.00	0.011
200	200.00	199.98	0.011
100	100.00	99.98	0.011
50	50.00	50.00	0.011

CALIBRATION STANDARDS

Item	Make	Model	Serial Number	Cal Date	Cal Due Date	NIST ID
Avoirdupois Cast W	Rice Lake	25 and 50lb	PWO990-CA	7/18/22	7/2024	20221688

Permanent Information Concerning this Equipment:

Comments/Information Concerning this Calibration

12/14 As-Found Failed Linearity. Performed 3 point Linearity adjustment. As-Left Passed Linearity. Adjusted span.

Report prepared/reviewed by: JC **Date:** 12/14/22 **Technician:** J. Colacchio **Signature:**

The uncertainty is calculated according to the ISO Guide to the Expression of Uncertainty in Measurement and includes the uncertainty of standards used combined with the observed standard deviation of the unit under test. The uncertainty is expanded with a k factor of 2 for an approximate 95% level of confidence. Instruments listed above were calibrated using standards traceable to the National Institute of Standards and Technology (NIST). Calibration data reflect results at the time and location of calibration. Calibration data should be reviewed to insure that the instrument is performing to its required accuracy.

Report and Certificate of Calibration

CAL-CERT CALIBRATION CERTIFICATION

www.Cal-Cert.com

Toll Free 800-356-4662

Address 5777 SE International Way Milwaukie, OR 97222

Local 503-654-9620

A2LA ACCREDITED CERT #4986.01

Report #: 28134-206391-14 **Customer PO#:** 1090
Customer Name: PFS TECO
Customer Address: 11785 SE Highway 212 Ste 305
City: Clackamas **State:** OR **Zip:** 97015
Contact: Aaron Kravitz
Service Address: 11785 SE Highway 212 Ste 305 Clackamas, OR 97015

Calibration Standards

19-00269 | Thermo-Hygrometer | Comark | SN: 6237360167 | Cal: 09/14/2022 | Due: 08/31/2023 | Vendor: Cal-Cert | Range: 122 °F 95 %RH | Report #: 25699-30694-3486
19-01135 | Thermocouple Meter | Tegam | SN: T-312250 | Cal: 08/01/2022 | Due: 08/31/2023 | Vendor: Cal-Cert | Range: 2,450 °F | Report #: 25315-30977-3646

Instrument Data

Calibration Date:	February 28, 2023	**Reference:**	NAVAIR 17-20.ST-95
Recommended Due Date:	February 28, 2024	**Cal-Cert Procedure:**	CP-013
Calibration Frequency:	12 Months	**Indicating System:**	Digital
Manufacturer:	National Instruments	**Temperature:**	70 °F
Type:	Data Logger	**Humidity:**	31% RH
Model Number:	NI 9213	**Asset #:**	215 Booth 1
Serial #:	1B182FB	**Service Location:**	Service Address
Resolution:	0.1 °F	**As Found:**	Pass
Capacity:	2500 °F	**As Left:**	Pass
Tolerance:	± 3.0 °F		
Additional Error	± - °F		

Type K Thermocouple
METER FUNCTION

Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Tunnel	0.00	0.20	0.20	0.20	0.20	0.346
	500.00	500.30	500.30	500.30	0.30	
	1000.00	1000.40	1000.40	1000.40	0.40	
	1500.00	1500.40	1500.40	1500.40	0.40	
	2000.00	2000.50	2000.50	2000.50	0.50	
	2400.00	2400.70	2400.70	2400.70	0.70	

Type K Thermocouple
METER FUNCTION

Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Flue	0.00	0.10	0.10	0.10	0.10	0.346
	500.00	500.30	500.30	500.30	0.30	
	1000.00	1000.30	1000.30	1000.30	0.30	
	1500.00	1500.30	1500.30	1500.30	0.30	
	2000.00	2000.50	2000.50	2000.50	0.50	
	2400.00	2400.60	2400.60	2400.60	0.60	

Manufacturer: National Instruments **Type:** Data Logger **Serial #:** 1B182FB

	Type K Thermocouple METER FUNCTION					
Channel	**Calibration Standard**	**UUT As Found**	**UUT As Left Reading 1**	**UUT As Left Reading 2**	**As Left Error**	**Expanded Uncertainty±**
Filter A	0.00	0.10	0.10	0.10	0.10	0.346
	500.00	500.10	500.10	500.10	0.10	
	1000.00	1000.20	1000.20	1000.20	0.20	
	1500.00	1500.30	1500.30	1500.30	0.30	
	2000.00	2000.30	2000.30	2000.30	0.30	
	2400.00	2400.40	2400.40	2400.40	0.40	

	Type K Thermocouple METER FUNCTION					
Channel	**Calibration Standard**	**UUT As Found**	**UUT As Left Reading 1**	**UUT As Left Reading 2**	**As Left Error**	**Expanded Uncertainty±**
Back	0.00	0.10	0.10	0.10	0.10	0.346
	500.00	500.00	500.00	500.00	0.00	
	1000.00	1000.20	1000.20	1000.20	0.20	
	1500.00	1500.50	1500.50	1500.50	0.50	
	2000.00	2000.60	2000.60	2000.60	0.60	
	2400.00	2400.70	2400.70	2400.70	0.70	

	Type K Thermocouple METER FUNCTION					
Channel	**Calibration Standard**	**UUT As Found**	**UUT As Left Reading 1**	**UUT As Left Reading 2**	**As Left Error**	**Expanded Uncertainty±**
Catgalyst	0.00	-0.30	-0.30	-0.30	-0.30	0.346
	500.00	499.90	499.90	499.90	-0.10	
	1000.00	1000.10	1000.10	1000.10	0.10	
	1500.00	1500.10	1500.10	1500.10	0.10	
	2000.00	2000.10	2000.10	2000.10	0.10	
	2400.00	2400.20	2400.20	2400.20	0.20	

	Type K Thermocouple METER FUNCTION					
Channel	**Calibration Standard**	**UUT As Found**	**UUT As Left Reading 1**	**UUT As Left Reading 2**	**As Left Error**	**Expanded Uncertainty±**
Meter A	0.00	-0.50	-0.50	-0.50	-0.50	0.346
	500.00	499.70	499.70	499.70	-0.30	
	1000.00	999.90	999.90	999.90	-0.10	
	1500.00	1500.00	1500.00	1500.00	0.00	
	2000.00	2000.00	2000.00	2000.00	0.00	
	2400.00	2400.00	2400.00	2400.00	0.00	

	Type K Thermocouple METER FUNCTION					
Channel	**Calibration Standard**	**UUT As Found**	**UUT As Left Reading 1**	**UUT As Left Reading 2**	**As Left Error**	**Expanded Uncertainty±**
Left	0.00	-0.50	-0.50	-0.50	-0.50	0.346
	500.00	499.70	499.70	499.70	-0.30	
	1000.00	999.70	999.70	999.70	-0.30	
	1500.00	1500.00	1500.00	1500.00	0.00	
	2000.00	2000.10	2000.10	2000.10	0.10	
	2400.00	2400.20	2400.20	2400.20	0.20	

	Type K Thermocouple METER FUNCTION					
Channel	**Calibration Standard**	**UUT As Found**	**UUT As Left Reading 1**	**UUT As Left Reading 2**	**As Left Error**	**Expanded Uncertainty±**
Right	0.00	-0.60	-0.60	-0.60	-0.60	0.346
	500.00	499.70	499.70	499.70	-0.30	
	1000.00	999.80	999.80	999.80	-0.20	
	1500.00	1499.80	1499.80	1499.80	-0.20	
	2000.00	1999.90	1999.90	1999.90	-0.10	
	2400.00	2400.00	2400.00	2400.00	0.00	

	Type K Thermocouple METER FUNCTION					
Channel	**Calibration Standard**	**UUT As Found**	**UUT As Left Reading 1**	**UUT As Left Reading 2**	**As Left Error**	**Expanded Uncertainty±**
Filter B	0.00	0.00	0.00	0.00	0.00	0.346
	500.00	500.80	500.80	500.80	0.80	
	1000.00	1000.60	1000.60	1000.60	0.60	
	1500.00	1500.20	1500.20	1500.20	0.20	
	2000.00	2000.00	2000.00	2000.00	0.00	
	2400.00	2399.70	2399.70	2399.70	-0.30	

	Type K Thermocouple METER FUNCTION					
Channel	**Calibration Standard**	**UUT As Found**	**UUT As Left Reading 1**	**UUT As Left Reading 2**	**As Left Error**	**Expanded Uncertainty±**
Top	0.00	-0.80	-0.80	-0.80	-0.80	0.346
	500.00	499.30	499.30	499.30	-0.70	
	1000.00	999.50	999.50	999.50	-0.50	
	1500.00	1499.60	1499.60	1499.60	-0.40	
	2000.00	1999.60	1999.60	1999.60	-0.40	
	2400.00	2399.70	2399.70	2399.70	-0.30	

	Type K Thermocouple METER FUNCTION					
Channel	**Calibration Standard**	**UUT As Found**	**UUT As Left Reading 1**	**UUT As Left Reading 2**	**As Left Error**	**Expanded Uncertainty±**
Bottom	0.00	-1.00	-1.00	-1.00	-1.00	0.346
	500.00	499.20	499.20	499.20	-0.80	
	1000.00	999.50	999.50	999.50	-0.50	
	1500.00	1499.50	1499.50	1499.50	-0.50	
	2000.00	1999.60	1999.60	1999.60	-0.40	
	2400.00	2399.60	2399.60	2399.60	-0.40	

	Type K Thermocouple METER FUNCTION					
Channel	**Calibration Standard**	**UUT As Found**	**UUT As Left Reading 1**	**UUT As Left Reading 2**	**As Left Error**	**Expanded Uncertainty±**
Meter B	0.00	-0.80	-0.80	-0.80	-0.80	0.346
	500.00	499.30	499.30	499.30	-0.70	
	1000.00	999.50	999.50	999.50	-0.50	
	1500.00	1499.50	1499.50	1499.50	-0.50	
	2000.00	1999.60	1999.60	1999.60	-0.40	
	2400.00	2399.50	2399.50	2399.50	-0.50	

	Type K Thermocouple METER FUNCTION					
Channel	**Calibration Standard**	**UUT As Found**	**UUT As Left Reading 1**	**UUT As Left Reading 2**	**As Left Error**	**Expanded Uncertainty±**
Meter C	0.00	-1.20	-1.20	-1.20	-1.20	0.346
	500.00	499.00	499.00	499.00	-1.00	
	1000.00	999.20	999.20	999.20	-0.80	
	1500.00	1499.30	1499.30	1499.30	-0.70	
	2000.00	1999.30	1999.30	1999.30	-0.70	
	2400.00	2399.30	2399.30	2399.30	-0.70	

	Type K Thermocouple METER FUNCTION					
Channel	**Calibration Standard**	**UUT As Found**	**UUT As Left Reading 1**	**UUT As Left Reading 2**	**As Left Error**	**Expanded Uncertainty±**
Filter C	0.00	-1.00	-1.00	-1.00	-1.00	0.346
	500.00	499.20	499.20	499.20	-0.80	
	1000.00	999.40	999.40	999.40	-0.60	
	1500.00	1499.50	1499.50	1499.50	-0.50	
	2000.00	1999.50	1999.50	1999.50	-0.50	
	2400.00	2399.50	2399.50	2399.50	-0.50	

Manufacturer: National Instruments **Type:** Data Logger **Serial #:** 1B182FB

	Type T Thermocouple METER FUNCTION					
Channel	**Calibration Standard**	**UUT As Found**	**UUT As Left Reading 1**	**UUT As Left Reading 2**	**As Left Error**	**Expanded Uncertainty±**
Ambient	0.00	0.00	0.00	0.00	0.00	0.346
	20.00	17.70	17.70	17.70	-2.30	
	40.00	37.80	37.80	37.80	-2.20	
	60.00	57.70	57.70	57.70	-2.30	
	80.00	77.90	77.90	77.90	-2.10	
	100.00	97.90	97.90	97.90	-2.10	

Remarks:

15 Channels tested. Ambient is Type T, tested from 0 to 100 °F per customer request.

We sincerely thank you for your business. Please call us at 503-654-9620 for all your sales and calibration needs.
Cleaning and preventative maintenance were performed as part of this service.

Cal-Cert is accredited by A2LA under Calibration Laboratory Code #4986.01.
A2LA is recognized under the ILAC mutual recognition agreement (MRA).

This certificate is hereby issued that the above instrument was tested for accuracy with calibrated standards traceable to the National Institute of Standards and Technology (NIST). The information provided on this form complies with the data gathering and reporting requirements of ISO/IEC 17025 and ANSI/NCSL Z540.1, and meets the requirements of all applicable references and Cal-Cert procedures listed above.
Any stated measurement uncertainty includes the uncertainty of the Calibration standards used, combined with the uncertainty of the measurement process using the RSS method with a k=2 for an approximate 95% level of confidence. The calibration process meets or exceeds a ratio of 4:1 unless otherwise stated. All tolerances were derived from the applicable standards and pass/fail determination is based on those tolerances. The customer determined any recommended due dates indicated on the certificate.

Service Engineer: Jon Rau **Date:** February 28, 2023

Technical Manager Marshall Doyle **Signature:** 

Report #: 28134-206391-14

Report and Certificate of Calibration

CAL-CERT CALIBRATION CERTIFICATION

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Address 5777 SE International Way Milwaukie, OR 97222

Local 503-654-9620

A2LA ACCREDITED CERT #4986.01

Report #: 28134-206391-14 **Customer PO#:** 1090
Customer Name: PFS TECO
Customer Address: 11785 SE Highway 212 Ste 305
City: Clackamas **State:** OR **Zip:** 97015
Contact: Aaron Kravitz
Service Address: 11785 SE Highway 212 Ste 305 Clackamas, OR 97015

Calibration Standards

19-00269 | Thermo-Hygrometer | Comark | SN: 6237360167 | Cal: 09/14/2022 | Due: 08/31/2023 | Vendor: Cal-Cert | Range: 122 °F 95 %RH | Report #: 25699-30694-3486
19-01135 | Thermocouple Meter | Tegam | SN: T-312250 | Cal: 08/01/2022 | Due: 08/31/2023 | Vendor: Cal-Cert | Range: 2,450 °F | Report #: 25315-30977-3646

Instrument Data

Calibration Date:	February 28, 2023	**Reference:**	NAVAIR 17-20.ST-95
Recommended Due Date:	February 28, 2024	**Cal-Cert Procedure:**	CP-013
Calibration Frequency:	12 Months	**Indicating System:**	Digital
Manufacturer:	National Instruments	**Temperature:**	72 °F
Type:	Data Logger	**Humidity:**	30% RH
Model Number:	NI 9213	**Asset #:**	215 Booth 1
Serial #:	1B182FB	**Service Location:**	Service Address
Resolution:	0.1 °F	**As Found:**	Pass
Capacity:	2500 °F	**As Left:**	Pass
Tolerance:	± 2.0 °F		
Additional Error	± - °F		

Type K Thermocouple
METER FUNCTION

Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Tunnel	0.00	-0.20	-0.20	-0.20	-0.20	0.346
	500.00	499.80	499.80	499.80	-0.20	
	1000.00	1000.00	1000.00	1000.00	0.00	
	1500.00	1500.10	1500.10	1500.10	0.10	
	2000.00	2000.10	2000.10	2000.10	0.10	
	2400.00	2400.10	2400.10	2400.10	0.10	

Type K Thermocouple
METER FUNCTION

Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Flue	0.00	-0.40	-0.40	-0.40	-0.40	0.346
	500.00	499.60	499.60	499.60	-0.40	
	1000.00	999.70	999.70	999.70	-0.30	
	1500.00	1499.90	1499.90	1499.90	-0.10	
	2000.00	1999.80	1999.80	1999.80	-0.20	
	2400.00	2400.00	2400.00	2400.00	0.00	

	Type K Thermocouple METER FUNCTION					
Channel	**Calibration Standard**	**UUT As Found**	**UUT As Left Reading 1**	**UUT As Left Reading 2**	**As Left Error**	**Expanded Uncertainty±**
Filter A	0.00	-0.60	-0.60	-0.60	-0.60	0.346
	500.00	499.50	499.50	499.50	-0.50	
	1000.00	999.60	999.60	999.60	-0.40	
	1500.00	1499.70	1499.70	1499.70	-0.30	
	2000.00	1999.80	1999.80	1999.80	-0.20	
	2400.00	2399.80	2399.80	2399.80	-0.20	

	Type K Thermocouple METER FUNCTION					
Channel	**Calibration Standard**	**UUT As Found**	**UUT As Left Reading 1**	**UUT As Left Reading 2**	**As Left Error**	**Expanded Uncertainty±**
Back	0.00	-0.70	-0.70	-0.70	-0.70	0.346
	500.00	499.50	499.50	499.50	-0.50	
	1000.00	999.50	999.50	999.50	-0.50	
	1500.00	1499.60	1499.60	1499.60	-0.40	
	2000.00	1999.70	1999.70	1999.70	-0.30	
	2400.00	2399.60	2399.60	2399.60	-0.40	

	Type K Thermocouple METER FUNCTION					
Channel	**Calibration Standard**	**UUT As Found**	**UUT As Left Reading 1**	**UUT As Left Reading 2**	**As Left Error**	**Expanded Uncertainty±**
Catgalyst	0.00	-0.70	-0.70	-0.70	-0.70	0.346
	500.00	499.40	499.40	499.40	-0.60	
	1000.00	999.60	999.60	999.60	-0.40	
	1500.00	1499.60	1499.60	1499.60	-0.40	
	2000.00	1999.70	1999.70	1999.70	-0.30	
	2400.00	2399.70	2399.70	2399.70	-0.30	

	Type K Thermocouple METER FUNCTION					
Channel	**Calibration Standard**	**UUT As Found**	**UUT As Left Reading 1**	**UUT As Left Reading 2**	**As Left Error**	**Expanded Uncertainty±**
Meter A	0.00	-1.30	-1.30	-1.30	-1.30	0.346
	500.00	498.80	498.80	498.80	-1.20	
	1000.00	999.10	999.10	999.10	-0.90	
	1500.00	1499.10	1499.10	1499.10	-0.90	
	2000.00	1999.10	1999.10	1999.10	-0.90	
	2400.00	2399.10	2399.10	2399.10	-0.90	

	Type K Thermocouple METER FUNCTION					
Channel	**Calibration Standard**	**UUT As Found**	**UUT As Left Reading 1**	**UUT As Left Reading 2**	**As Left Error**	**Expanded Uncertainty±**
Left	0.00	-1.30	-1.30	-1.30	-1.30	0.346
	500.00	498.90	498.90	498.90	-1.10	
	1000.00	999.00	999.00	999.00	-1.00	
	1500.00	1499.20	1499.20	1499.20	-0.80	
	2000.00	1999.20	1999.20	1999.20	-0.80	
	2400.00	2399.20	2399.20	2399.20	-0.80	

	Type K Thermocouple METER FUNCTION					
Channel	**Calibration Standard**	**UUT As Found**	**UUT As Left Reading 1**	**UUT As Left Reading 2**	**As Left Error**	**Expanded Uncertainty±**
Right	0.00	-1.40	-1.40	-1.40	-1.40	0.346
	500.00	498.90	498.90	498.90	-1.10	
	1000.00	999.00	999.00	999.00	-1.00	
	1500.00	1499.00	1499.00	1499.00	-1.00	
	2000.00	1999.00	1999.00	1999.00	-1.00	
	2400.00	2399.10	2399.10	2399.10	-0.90	

	Type K Thermocouple METER FUNCTION					
Channel	**Calibration Standard**	**UUT As Found**	**UUT As Left Reading 1**	**UUT As Left Reading 2**	**As Left Error**	**Expanded Uncertainty±**
Filter B	0.00	0.00	0.00	0.00	0.00	0.346
	500.00	500.60	500.60	500.60	0.60	
	1000.00	1000.30	1000.30	1000.30	0.30	
	1500.00	1500.10	1500.10	1500.10	0.10	
	2000.00	1999.80	1999.80	1999.80	-0.20	
	2400.00	2399.50	2399.50	2399.50	-0.50	

	Type K Thermocouple METER FUNCTION					
Channel	**Calibration Standard**	**UUT As Found**	**UUT As Left Reading 1**	**UUT As Left Reading 2**	**As Left Error**	**Expanded Uncertainty±**
Top	0.00	-1.40	-1.40	-1.40	-1.40	0.346
	500.00	498.90	498.90	498.90	-1.10	
	1000.00	999.00	999.00	999.00	-1.00	
	1500.00	1499.10	1499.10	1499.10	-0.90	
	2000.00	1999.00	1999.00	1999.00	-1.00	
	2400.00	2399.00	2399.00	2399.00	-1.00	

	Type K Thermocouple METER FUNCTION					
Channel	**Calibration Standard**	**UUT As Found**	**UUT As Left Reading 1**	**UUT As Left Reading 2**	**As Left Error**	**Expanded Uncertainty±**
Bottom	0.00	-1.50	-1.50	-1.50	-1.50	0.346
	500.00	498.80	498.80	498.80	-1.20	
	1000.00	999.00	999.00	999.00	-1.00	
	1500.00	1499.00	1499.00	1499.00	-1.00	
	2000.00	1999.00	1999.00	1999.00	-1.00	
	2400.00	2399.00	2399.00	2399.00	-1.00	

	Type K Thermocouple METER FUNCTION					
Channel	**Calibration Standard**	**UUT As Found**	**UUT As Left Reading 1**	**UUT As Left Reading 2**	**As Left Error**	**Expanded Uncertainty±**
Meter B	0.00	-1.30	-1.30	-1.30	-1.30	0.346
	500.00	499.00	499.00	499.00	-1.00	
	1000.00	999.00	999.00	999.00	-1.00	
	1500.00	1499.20	1499.20	1499.20	-0.80	
	2000.00	1999.20	1999.20	1999.20	-0.80	
	2400.00	2399.10	2399.10	2399.10	-0.90	

	Type K Thermocouple METER FUNCTION					
Channel	**Calibration Standard**	**UUT As Found**	**UUT As Left Reading 1**	**UUT As Left Reading 2**	**As Left Error**	**Expanded Uncertainty±**
Meter C	0.00	-1.20	-1.20	-1.20	-1.20	0.346
	500.00	498.90	498.90	498.90	-1.10	
	1000.00	999.10	999.10	999.10	-0.90	
	1500.00	1499.20	1499.20	1499.20	-0.80	
	2000.00	1999.20	1999.20	1999.20	-0.80	
	2400.00	2399.20	2399.20	2399.20	-0.80	

	Type K Thermocouple METER FUNCTION					
Channel	**Calibration Standard**	**UUT As Found**	**UUT As Left Reading 1**	**UUT As Left Reading 2**	**As Left Error**	**Expanded Uncertainty±**
Filter C	0.00	-1.20	-1.20	-1.20	-1.20	0.346
	500.00	499.10	499.10	499.10	-0.90	
	1000.00	999.20	999.20	999.20	-0.80	
	1500.00	1499.30	1499.30	1499.30	-0.70	
	2000.00	1999.30	1999.30	1999.30	-0.70	
	2400.00	2399.20	2399.20	2399.20	-0.80	

Manufacturer: National Instruments **Type:** Data Logger **Serial #:** 1B182FB

	Type T Thermocouple METER FUNCTION					
Channel	**Calibration Standard**	**UUT As Found**	**UUT As Left Reading 1**	**UUT As Left Reading 2**	**As Left Error**	**Expanded Uncertainty±**
Ambient	0.00	-1.40	-1.40	-1.40	-1.40	0.346
	20.00	18.80	18.80	18.80	-1.20	
	40.00	38.80	38.80	38.80	-1.20	
	60.00	58.70	58.70	58.70	-1.30	
	80.00	78.80	78.80	78.80	-1.20	
	100.00	98.70	98.70	98.70	-1.30	

Remarks:

15 Channels tested. Ambient is Type T, tested from 0 to 100 °F per customer request.

We sincerely thank you for your business. Please call us at 503-654-9620 for all your sales and calibration needs.
Cleaning and preventative maintenance were performed as part of this service.

Cal-Cert is accredited by A2LA under Calibration Laboratory Code #4986.01.
A2LA is recognized under the ILAC mutual recognition agreement (MRA).

This certificate is hereby issued that the above instrument was tested for accuracy with calibrated standards traceable to the National Institute of Standards and Technology (NIST). The information provided on this form complies with the data gathering and reporting requirements of ISO/IEC 17025 and ANSI/NCSL Z540.1, and meets the requirements of all applicable references and Cal-Cert procedures listed above.
Any stated measurement uncertainty includes the uncertainty of the Calibration standards used, combined with the uncertainty of the measurement process using the RSS method with a k=2 for an approximate 95% level of confidence. The calibration process meets or exceeds a ratio of 4:1 unless otherwise stated. All tolerances were derived from the applicable standards and pass/fail determination is based on those tolerances. The customer determined any recommended due dates indicated on the certificate.

Service Engineer: Jon Rau **Date:** February 28, 2023

Technical Manager Marshall Doyle **Signature:** 

Report #: 28134-206391-14

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA LLC
11711 S. Alameda Street
Los Angeles, CA 90059
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Part Number:	E04NI61E15A0574	Reference Number:	48-402546580-1
Cylinder Number:	CC121798	Cylinder Volume:	143.7 CF
Laboratory:	124 - Los Angeles (SAP) - CA	Cylinder Pressure:	2016 PSIG
PGVP Number:	B32022	Valve Outlet:	590
Gas Code:	CO,CO2,O2,BALN	Certification Date:	Sep 23, 2022

Expiration Date: Sep 23, 2030

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON MONOXIDE	4.250 %	4.306 %	G1	+/- 0.6% NIST Traceable	09/23/2022
CARBON DIOXIDE	17.00 %	17.01 %	G1	+/- 0.6% NIST Traceable	09/23/2022
OXYGEN	17.00 %	17.11 %	G1	+/- 0.7% NIST Traceable	09/23/2022
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	12061520	CC354777	19.87 % CARBON DIOXIDE/NITROGEN	+/- 0.6%	Jan 11, 2024
NTRM	98051002	SG9150866BAL	12.05 % OXYGEN/NITROGEN	+/- 0.7%	Dec 14, 2023
NTRM	08061402	CC267714	1.959 %W CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jul 02, 2024

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS 6E CO2	NDIR	Sep 16, 2022
SIEMENS 6E CO HIGH	NDIR	Sep 06, 2022
SIEMENS OXYMAT 6	PARAMAGNETIC	Sep 12, 2022

Triad Data Available Upon Request

Approved for Release

PRAXAIR
Making our planet more productive

DocNumber: 271687

Praxair Distribution, Inc.
5700 S. Alameda Street
Los Angeles CA 90058
Tel: 323-585-2154
Fax: 714-542-6689
PGVP ID: F22019

CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

Customer & Order Information

PXPKG TUALATIN OR H
10450 SW TUALATIN SHERWOOD ROAD
TUALATIN OR 97062-9547

Certificate Issuance Date: 10/16/2019
Praxair Order Number: 71120745
Part Number: NI CD10CO33E-AS
Customer PO Number: 79106732

Fill Date: 10/08/2019
Lot Number: 70086928102
Cylinder Style & Outlet: AS CGA 590
Cylinder Pressure and Volume: 2000 psig 140 ft3

Certified Concentration

ProSpec EZ Cert

Expiration Date: 10/16/2027		NIST Traceable
Cylinder Number: CC139173		Expanded Uncertainty
10.09 %	Carbon dioxide	± 0.4 %
2.53 %	Carbon monoxide	± 0.6 %
10.48 %	Oxygen	± 0.4 %
Balance	Nitrogen	

Certification Information:

Certification Date: 10/16/2019 *Term:* 96 Months *Expiration Date:* 10/16/2027

This cylinder was certified according to the 2012 EPA Traceability Protocol, Document #EPA-600/R-12/531, using Procedure G1.
Do Not Use this Standard if Pressure is less than 100 PSIG.
CO2 responses have been corrected for Oxygen IR Broadening effect. O2 responses have been corrected for CO2 interference.

Analytical Data:

(R=Reference Standard, Z=Zero Gas, C=Gas Candidate)

1. ***Component:*** **Carbon dioxide**

Requested Concentration: 10 %
Certified Concentration: 10.09 %
Instrument Used: Horiba VIA-510 S/N 20C194WK
Analytical Method: NDIR
Last Multipoint Calibration: 09/18/2019

First Analysis Data:						Date	10/16/2019
Z:	0	R:	14	C:	10.09	Conc:	10.09
R:	14	Z:	0	C:	10.1	Conc:	10.1
Z:	0	C:	10.1	R:	14.01	Conc:	10.1
UOM:	%				Mean Test Assay:		10.09 %

Reference Standard: Type / Cylinder #: GMIS / CC164230
Concentration / Uncertainty: 14.00 % ±0.265%
Expiration Date: 04/16/2027
Traceable to: SRM # / Sample # / Cylinder #: SRM 1675b / 6-F-51 / CAL014538
SRM Concentration / Uncertainty: 13.963% / ±0.034%
SRM Expiration Date: 05/16/2022

Second Analysis Data:						Date	
Z:	0	R:	0	C:	0	Conc:	0
R:	0	Z:	0	C:	0	Conc:	0
Z:	0	C:	0	R:	0	Conc:	0
UOM:	%				Mean Test Assay:		%

2. ***Component:*** **Carbon monoxide**

Requested Concentration: 2.5 %
Certified Concentration: 2.53 %
Instrument Used: Horiba VIA-510 S/N UB9UCSYX
Analytical Method: NDIR
Last Multipoint Calibration: 09/19/2019

First Analysis Data:						Date	10/16/2019
Z:	0	R:	5	C:	2.53	Conc:	2.53
R:	5	Z:	0	C:	2.53	Conc:	2.53
Z:	0	C:	2.54	R:	5.01	Conc:	2.54
UOM:	%				Mean Test Assay:		2.53 %

Reference Standard: Type / Cylinder #: GMIS / CC242633
Concentration / Uncertainty: 5.00 % ±0.543%
Expiration Date: 04/03/2025
Traceable to: SRM # / Sample # / Cylinder #: SRM 2642a / 51-D-23 / FF23106
SRM Concentration / Uncertainty: 7.859% / ±0.039%
SRM Expiration Date: 07/15/2019

Second Analysis Data:						Date	
Z:	0	R:	0	C:	0	Conc:	0
R:	0	Z:	0	C:	0	Conc:	0
Z:	0	C:	0	R:	0	Conc:	0
UOM:	%				Mean Test Assay:		%

3. ***Component:*** **Oxygen**

Requested Concentration: 10.5 %
Certified Concentration: 10.48 %
Instrument Used: OXYMAT 5E
Analytical Method: Paramagnetic
Last Multipoint Calibration: 09/18/2019

First Analysis Data:						Date	10/16/2019
Z:	0	R:	9.88	C:	10.49	Conc:	10.48
R:	9.88	Z:	0	C:	10.49	Conc:	10.48
Z:	0	C:	10.5	R:	9.89	Conc:	10.49
UOM:	%				Mean Test Assay:		10.48 %

Reference Standard: Type / Cylinder #: NTRM / DT0010384
Concentration / Uncertainty: 9.875 % ±0.4%
Expiration Date: 11/18/2022
Traceable to: SRM # / Sample # / Cylinder #: NTRM / 170701 / NTRM DT0010384
SRM Concentration / Uncertainty: 9.875% / ±0.040%
SRM Expiration Date: 11/18/2022

Second Analysis Data:						Date	
Z:	0	R:	0	C:	0	Conc:	0
R:	0	Z:	0	C:	0	Conc:	0
Z:	0	C:	0	R:	0	Conc:	0
UOM:	%				Mean Test Assay:		%

Analyzed By: Jose Vasquez

Certified By: Jenna Lockman