Heat Tech Industries

Project # 23-144
Model: HTP Bay
Type: Pellet-Fired Room Heater
June 30, 2023

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

Contact: Mr. Tom Bassett
PO Box 727
Biggs, CA 95917
heattechstoves@gmail.com
530-846-1985

Prepared by: Aaron Kravitz, Testing Supervisor

11785 SE Highway 212 – Suite 305
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(503) 650-0088
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Revision History

June 30, 2023 – Original Issue

Contents

Affidavit

PFS-TECO was contracted by Heat Tech Industries (Heat Tech) to provide testing services for the HTP Bay 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 5/5/2023. 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 Standard 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 the HTP Bay 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 Bay***
- Serial Number: ***N/A – Prototype Unit; PFS Tracking #0145***
- Manufacturer*:* ***Heat Tech***
- Catalyst: ***No***
- Heat exchange blower: ***Integral***
- Type: ***Pellet Stove***
- Style: ***Free Standing***
- Date Received: ***Friday, March 31, 2023***
- Testing Period – Start: ***Friday, May 05, 2023*** Finish: ***Friday, May 05, 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 **1.7 g/hr** with a Higher Heating Value efficiency of **64%** and a CO emission rate of **0.71 g/min**. The calculated first hour particulate emission rate was **2.5 g/hr**. The Heat Tech Model HTP Bay 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	5/5/2023	OA	0.87	360	10393	2.5	1.7	0.71	0.71	64%	64%
		H	1.64	60	20846			0.20		68%	
		M	0.87	120	9815			0.83		61%	
		L	0.62	180	7181			0.78		62%	

Test Run Narrative

Run 1

Run 1 was performed on 5/5/2023 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 1.7 g/hr. The run had an overall HHV efficiency of 64%. 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	63	66	42.4	39.1	29.91	3.7	12.3	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 Bay

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 Bay Dimensions

Height	Width	Depth	Firebox Volume
31.5”	27.5”	21.5”	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, 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

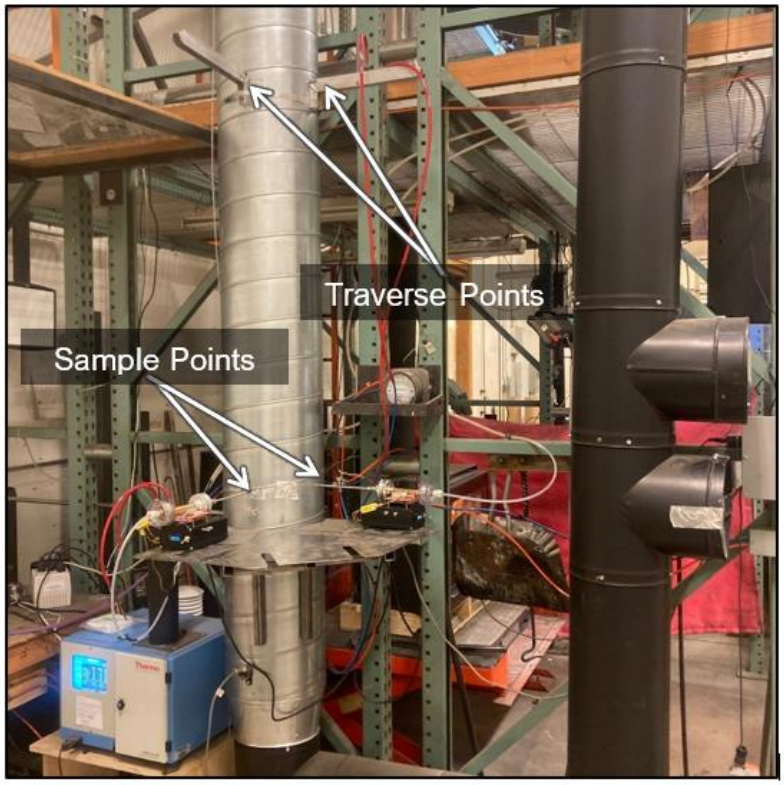
	METHOD	UNITS	MOISTURE FREE	AS RECEIVED
Moisture Total	ASTM E871	wt. %		5.98
Ash	ASTM D1102	wt. %	0.47	0.45
Volatile Matter	ASTM D3175	wt. %		
Fixed Carbon by Difference	ASTM D3172	wt. %		
Sulfur	ASTM D4239	wt. %	0.011	0.011
SO_2	Calculated	lb/mmbtu		0.027
Net Cal. Value at Const. Pressure	ISO 1928	GJ/tonne	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		

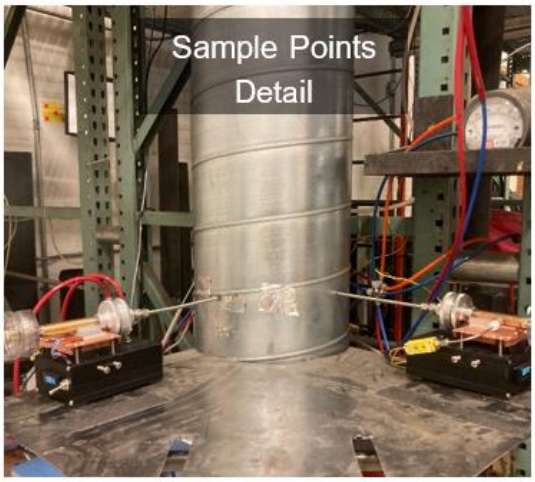
Comments:

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 # 23-144
MANUFACTURER Heat Tech
MODEL: HTP-BAY

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:	Bay
Job #:	23-144
Tracking #:	145
Test Date:	5/5/2023

Techician Signature

6/2/2023
Date

TEST RESULTS - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Bay
Run #: 1

Job #: 23-144
Tracking #: 145
Technician: AK
Date: 5/5/2023

Burn Rate Summary	
High Burn Rate (dry kg/hr)	1.64
Medium Burn Rate (dry kg/hr)	0.87
Low Burn Rate (dry kg/hr)	0.62
Overall Burn Rate (dry kg/hr)	0.87

Medium Burn Rate Target: < 1.13 dry kg/hr

	Ambient Sample	Sample Train A	Sample Train B	1st Hour Filter - Train C
Total Sample Volume (ft^3)	48.937	54.377	52.804	10.345
Average Gas Velocity in Dilution Tunnel (ft/sec)	6.7			
Average Gas Flow Rate in Dilution Tunnel (dscf/hr)	18033.3			
Average Gas Meter Temperature (°F)	63.4	90.2	88.7	73.8
Total Sample Volume (dscf)	50.508	52.944	51.083	10.101
Average Tunnel Temperature (°F)	81.1			
Total Time of Test (min)	360			
Total Particulate Catch (mg)	0.0	4.9	5.1	1.4
Particulate Concentration, dry-standard (g/dscf)	0.0000000	0.0000926	0.0000998	0.0001386
Total PM Emissions (g)	0.00	10.01	10.80	2.50
Particulate Emission Rate (g/hr)	0.00	1.67	1.80	2.50
Emissions Factor (g/kg)	-	1.91	2.06	1.53
Difference from Average Total Particulate Emissions (g)	-	0.39	0.39	-
Difference from Average Total Particulate Emissions (%)	-	3.8%	3.8%	-
Difference from Average Emissions Factor (g/kg)	-	0.08	0.08	-

Final Average Results	
Total Particulate Emissions (g)	10.41
Particulate Emission Rate (g/hr)	1.73
Emissions Factor (g/kg)	1.98
HHV Efficiency (%)	63.7%
LHV Efficiency (%)	70.4%
CO Emissions (g/min)	0.71

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	72.5	OK
Face Velocity	< 30 ft/min	8.6	OK
Leakage Rate	Less than 4% of average sample rate	0.002 cfm	OK
Ambient Temp	55-90 °F	62 / 66.3	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	0.87	OK

Overall Pellet Test Efficiency Results

Manufacturer: Heat Tech
Model: Bay
Date: 05/05/23
Run: 1
Control #: 23-144
Test Duration: 360
Output Category: Integrated

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	63.7%	70.4%
Combustion Efficiency	98.5%	98.5%
Heat Transfer Efficiency	64.7%	71.5%

Output Rate (kJ/h)	10,956	10,393	**(Btu/h)**
Burn Rate (kg/h)	0.87	1.93	**(lb/h)**
Input (kJ/h)	17,189	16,305	**(Btu/h)**

Test Load Weight (dry kg)	5.25	11.56	**dry lb**
MC wet (%)	5.98		
MC dry (%)	6.36		
Particulate (g)	10.41		
CO (g)	256		
Test Duration (h)	6.00		

Emissions	**Particulate**	**CO**
g/MJ Output	0.16	3.90
g/kg Dry Fuel	1.98	48.82
g/h	1.73	42.70
g/min	0.03	0.71
lb/MM Btu Output	0.37	9.06

Air/Fuel Ratio (A/F)	41.88

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

Max Burn Rate Segment Efficiency Results

Manufacturer: Heat Tech
Model: Bay
Date: 05/05/23
Run: 1
Control #: 23-144
Test Duration: 60
Output Category: Maximum

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	68.3%	75.4%
Combustion Efficiency	99.5%	99.5%
Heat Transfer Efficiency	68.6%	75.8%

Output Rate (kJ/h)	21,976	20,846	**(Btu/h)**
Burn Rate (kg/h)	1.64	3.61	**(lb/h)**
Input (kJ/h)	32,198	30,543	**(Btu/h)**

Test Load Weight (dry kg)	1.64	3.61	**dry lb**
MC wet (%)	5.98		
MC dry (%)	6.36		
Particulate (g)	N/A		
CO (g)	12		
Test Duration (h)	1.00		

Emissions	**Particulate**	**CO**
g/MJ Output	N/A	0.55
g/kg Dry Fuel	N/A	7.36
g/h	N/A	12.06
g/min	N/A	0.20
lb/MM Btu Output	N/A	1.28

Air/Fuel Ratio (A/F)	22.60

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

Medium Burn Rate Segment Efficiency Results

Manufacturer: Heat Tech
Model: Bay
Date: 05/05/23
Run: 1
Control #: 23-144
Test Duration: 120
Output Category: Medium

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	60.6%	67.0%
Combustion Efficiency	97.9%	97.9%
Heat Transfer Efficiency	62.0%	68.5%

Output Rate (kJ/h)	10,346	9,815	**(Btu/h)**
Burn Rate (kg/h)	0.87	1.91	**(lb/h)**
Input (kJ/h)	17,063	16,186	**(Btu/h)**

Test Load Weight (dry kg)	1.74	3.83	**dry lb**
MC wet (%)	5.98		
MC dry (%)	6.36		
Particulate (g)	N/A		
CO (g)	99		
Test Duration (h)	2.00		

Emissions	**Particulate**	**CO**
g/MJ Output	N/A	4.79
g/kg Dry Fuel	N/A	57.08
g/h	N/A	49.55
g/min	N/A	0.83
lb/MM Btu Output	N/A	11.13

Air/Fuel Ratio (A/F)	43.63

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

Minimum Burn Rate Segment Efficiency Results

Manufacturer: Heat Tech
Model: Bay
Date: 05/05/23
Run: 1
Control #: 23-144
Test Duration: 180
Output Category: Minimum

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	61.7%	68.2%
Combustion Efficiency	97.4%	97.4%
Heat Transfer Efficiency	63.3%	70.0%

Output Rate (kJ/h)	7,570	7,181	**(Btu/h)**
Burn Rate (kg/h)	0.62	1.38	**(lb/h)**
Input (kJ/h)	12,270	11,639	**(Btu/h)**

Test Load Weight (dry kg)	1.87	4.13	**dry lb**
MC wet (%)	5.98		
MC dry (%)	6.36		
Particulate (g)	N/A		
CO (g)	140		
Test Duration (h)	3.00		

Emissions	Particulate	CO
g/MJ Output	N/A	6.16
g/kg Dry Fuel	N/A	74.75
g/h	N/A	46.66
g/min	N/A	0.78
lb/MM Btu Output	N/A	14.33

Air/Fuel Ratio (A/F)	56.19

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

DILUTION TUNNEL & MISC. DATA - ASTM E2779 / E2515

Client:	Heat Tech	Job #:	23-144
Model:	Bay	Tracking #:	145
Run #:	1	Technician:	AK
Test Start Time:	9:10	Date:	5/5/2023

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)	29.89	29.92	29.91
Relative Humidity (%)	42.4	39.1	
Room Air Velocity (ft/min)	<50	<50	
Scale Audit (lbs)	10.0	10.0	

Ambient Sample Volume: 48.937 ft^3

Sample Train Post-Test Leak Checks

(A)	0.000	cfm @		in. Hg
(B)	0.000	cfm @	-10	in. Hg
(C)	0.000	cfm @	-5	in. Hg
(Ambient)	0.002	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

Static Pressure: -0.050 in. H_2O

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}:	6.252	ft/sec
V_{scent}:	7.079	ft/sec
F_p:	0.883	[ratio]
Initial Tunnel Flow:	279.5	scf/min

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 #: 23-144
Model: Bay
Tracking #: 145
Run #: 1
Technician: AK
Date: 5/5/2023

Recording Interval (min): 1
Run Time (min): 60

		Average:	-0.041	345	64
Elapsed Time (min)	Scale Reading (lbs)	Weight Change (lbs)	Flue Draft (in H_2O)	Flue (°F)	Ambient (°F)
0	28.6	-	-0.023	265	63
1	28.6	-0.03	-0.022	257	63
2	28.6	-0.04	-0.023	256	63
3	28.6	-0.01	-0.017	248	64
4	28.5	-0.06	-0.028	259	64
5	28.4	-0.06	-0.030	280	64
6	28.4	-0.07	-0.036	295	64
7	28.3	-0.06	-0.034	301	64
8	28.2	-0.07	-0.034	311	64
9	28.2	-0.06	-0.039	314	64
10	28.1	-0.04	-0.031	313	64
11	28.1	-0.06	-0.037	311	64
12	28.0	-0.08	-0.038	330	64
13	27.9	-0.06	-0.040	337	64
14	27.9	-0.07	-0.040	340	64
15	27.8	-0.06	-0.042	341	65
16	27.8	-0.05	-0.040	341	65
17	27.7	-0.05	-0.036	341	65
18	27.6	-0.07	-0.042	341	65
19	27.6	-0.07	-0.041	348	65
20	27.5	-0.06	-0.040	350	65
21	27.4	-0.07	-0.039	354	65
22	27.4	-0.05	-0.043	352	65
23	27.3	-0.05	-0.039	347	65
24	27.3	-0.06	-0.043	351	65
25	27.2	-0.07	-0.040	355	65
26	27.1	-0.06	-0.044	359	65
27	27.1	-0.07	-0.046	359	65
28	27.0	-0.07	-0.045	366	65
29	26.9	-0.06	-0.041	363	65
30	26.9	-0.05	-0.042	362	65
31	26.8	-0.06	-0.040	361	65
32	26.8	-0.07	-0.043	361	65
33	26.7	-0.06	-0.046	365	65
34	26.7	-0.05	-0.039	358	65
35	26.6	-0.08	-0.043	363	65
36	26.5	-0.05	-0.042	362	65
37	26.5	-0.06	-0.043	364	65
38	26.4	-0.07	-0.045	369	65
39	26.3	-0.06	-0.046	373	65
40	26.6	0.28	-0.041	370	65
41	26.2	-0.42	-0.040	362	65
42	26.1	-0.07	-0.043	356	65
43	26.1	-0.07	-0.044	367	65
44	26.0	-0.06	-0.047	362	65
45	25.9	-0.06	-0.045	365	65
46	25.9	-0.05	-0.044	362	65

PELLET STOVE PREBURN DATA - ASTM E2779

Client: Heat Tech
Job #: 23-144
Model: Bay
Tracking #: 145
Run #: 1
Technician: AK
Date: 5/5/2023

47	25.8	-0.07	-0.046	363	65
48	25.7	-0.08	-0.046	369	65
49	25.7	-0.05	-0.043	367	64
50	25.6	-0.06	-0.046	366	65
51	25.5	-0.08	-0.048	371	64
52	25.5	-0.06	-0.044	371	64
53	25.4	-0.06	-0.046	367	64
54	25.4	-0.07	-0.048	370	63
55	25.3	-0.05	-0.043	365	63
56	25.2	-0.07	-0.047	366	64
57	25.2	-0.08	-0.045	374	63
58	25.1	-0.06	-0.049	368	63
59	25.0	-0.09	-0.048	378	63
60	24.9	-0.06	-0.048	375	63

BOX A TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Bay
Run #: 1

Job #: 23-144
Tracking #: 145
Technician: AK
Date: 5/5/2023

	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		0.013	0.26	70.2	0.21		12.3		87	376	68	63
1	0.133	0.133	0.013	1.88	70	0.77	-	12.3	-0.1	87	372	69	63
2	0.271	0.138	0.012	1.91	70	0.72	-	12.2	-0.1	88	371	69	62.8
3	0.416	0.145	0.013	1.86	70	0.81	-	12.1	-0.1	87	374	69	62.9
4	0.557	0.141	0.012	1.88	69.9	0.81	-	12.1	-0.1	87	370	69	62.6
5	0.690	0.133	0.013	1.89	69.9	0.79	-	12.0	-0.1	87	372	69	62.8
6	0.832	0.142	0.013	1.91	70	0.79	-	11.9	-0.1	87	365	69	62.6
7	0.966	0.134	0.012	1.93	70.1	0.82	-	11.9	-0.1	87	371	70	62.7
8	1.105	0.139	0.013	1.94	70.1	0.82	-	11.8	-0.1	87	377	70	62.5
9	1.246	0.141	0.013	1.95	70.2	0.85	-	11.8	0.0	87	362	70	62.7
10	1.381	0.135	0.013	1.95	70.3	0.81	94	11.7	-0.1	87	368	70	62.4
11	1.525	0.144	0.013	1.97	70.4	0.82	-	11.6	-0.1	87	372	70	62.5
12	1.663	0.138	0.013	1.99	70.6	0.82	-	11.6	-0.1	87	372	70	62.9
13	1.803	0.140	0.013	1.99	70.9	0.83	-	11.5	-0.1	87	374	70	62.6
14	1.946	0.143	0.013	2.01	71.1	0.81	-	11.4	-0.1	87	364	70	62.4
15	2.084	0.138	0.013	2.01	71.3	0.83	-	11.3	-0.1	87	374	70	62.4
16	2.230	0.146	0.012	2.03	71.4	0.86	-	11.3	-0.1	87	373	70	62.4
17	2.369	0.139	0.012	2.04	71.7	0.86	-	11.2	-0.1	87	372	70	62.3
18	2.510	0.141	0.013	2.04	71.9	0.86	-	11.1	-0.1	87	376	71	62.1
19	2.655	0.145	0.013	2.05	72.2	0.83	-	11.1	-0.1	87	381	71	62.1
20	2.796	0.141	0.012	2.06	72.5	0.82	98	11.0	-0.1	87	379	71	62.5
21	2.941	0.145	0.012	2.06	72.8	0.84	-	10.9	-0.1	88	378	71	62.3
22	3.081	0.140	0.013	2.06	73	0.87	-	10.9	-0.1	87	378	71	62.6
23	3.229	0.148	0.013	2.09	73.3	0.84	-	10.8	-0.1	87	380	71	62.7
24	3.370	0.141	0.013	2.08	73.6	0.88	-	10.8	-0.1	87	374	71	62.6
25	3.513	0.143	0.012	2.08	73.9	0.87	-	10.7	-0.1	87	374	71	62.8
26	3.659	0.146	0.012	2.10	74.2	0.87	-	10.6	-0.1	87	377	71	62.3
27	3.802	0.143	0.012	2.10	74.5	0.86	-	10.6	-0.1	87	376	71	62.5
28	3.949	0.147	0.012	2.10	74.8	0.85	-	10.5	-0.1	87	372	71	62.4
29	4.091	0.142	0.012	2.11	75.1	0.85	-	10.5	-0.1	87	370	71	62.5
30	4.238	0.147	0.013	2.12	75.4	0.85	100	10.4	-0.1	87	375	71	62.1
31	4.380	0.142	0.013	2.11	75.8	0.87	-	10.3	-0.1	87	375	71	62.4
32	4.530	0.150	0.013	2.12	76	0.85	-	10.2	-0.1	87	376	71	62.3

BOX A TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Bay
Run #: 1

Job #: 23-144
Tracking #: 145
Technician: AK
Date: 5/5/2023

	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	4.673	0.143	0.013	2.13	76.4	0.87	-	10.2	-0.1	87	376	71	62.2
34	4.820	0.147	0.012	2.13	76.7	0.85	-	10.1	-0.1	88	375	71	62
35	4.964	0.144	0.012	2.14	76.9	0.86	-	10.1	-0.1	88	375	71	62.2
36	5.110	0.146	0.013	2.14	77.3	0.88	-	10.0	-0.1	87	374	71	62
37	5.257	0.147	0.012	2.14	77.6	0.89	-	9.9	-0.1	87	374	71	62.4
38	5.402	0.145	0.013	2.15	77.9	0.86	-	9.9	-0.1	87	371	71	62.5
39	5.552	0.150	0.013	2.15	78.2	0.86	-	9.8	-0.1	87	372	71	62.4
40	5.695	0.143	0.012	2.16	78.5	0.87	100	9.7	-0.1	87	372	71	62.3
41	5.845	0.150	0.012	2.16	78.8	0.88	-	9.7	-0.1	87	373	71	62
42	5.988	0.143	0.013	2.16	79.1	0.87	-	9.6	-0.1	87	376	71	62.3
43	6.138	0.150	0.012	2.15	79.4	0.88	-	9.5	-0.1	87	371	71	62.2
44	6.282	0.144	0.012	2.17	79.7	0.86	-	9.5	-0.1	87	370	71	62
45	6.432	0.150	0.013	2.17	80	0.89	-	9.4	-0.1	87	377	71	62.1
46	6.577	0.145	0.013	2.17	80.2	0.87	-	9.3	-0.1	87	376	72	62.1
47	6.728	0.151	0.012	2.17	80.5	0.87	-	9.3	-0.1	87	373	72	62.1
48	6.873	0.145	0.012	2.18	80.8	0.88	-	9.2	-0.1	87	369	72	62
49	7.023	0.150	0.012	2.18	81	0.89	-	9.2	-0.1	87	372	72	62
50	7.169	0.146	0.012	2.19	81.3	0.87	103	9.1	-0.1	87	367	71	62.1
51	7.318	0.149	0.013	2.19	81.5	0.87	-	9.1	-0.1	87	366	71	62.4
52	7.465	0.147	0.012	2.19	81.8	0.85	-	9.0	-0.1	87	367	71	62.3
53	7.613	0.148	0.013	2.19	82	0.86	-	8.9	-0.1	87	375	71	62
54	7.761	0.148	0.012	2.18	82.2	0.88	-	8.8	-0.1	87	372	71	62.3
55	7.909	0.148	0.013	2.19	82.5	0.89	-	8.8	-0.1	87	372	71	62.3
56	8.058	0.149	0.012	2.19	82.7	0.87	-	8.7	-0.1	87	374	72	62.3
57	8.203	0.145	0.012	2.20	82.9	0.89	-	8.7	0.0	87	367	72	62.2
58	8.353	0.150	0.013	2.19	83.2	0.9	-	8.6	-0.1	87	377	72	62.3
59	8.501	0.148	0.013	2.20	83.4	0.89	-	8.5	-0.1	87	371	72	62
60	8.652	0.151	0.013	2.21	83.6	0.88	101	8.5	-0.1	87	374	72	62.4
61	8.801	0.149	0.013	2.21	83.9	0.87	-	8.4	0.0	87	367	72	62.3
62	8.952	0.151	0.012	2.22	84.1	0.89	-	8.4	0.0	87	352	72	62.3
63	9.100	0.148	0.013	2.22	84.3	0.91	-	8.4	0.0	86	335	72	62.5
64	9.251	0.151	0.013	2.23	84.5	0.88	-	8.3	0.0	86	331	72	62.4
65	9.399	0.148	0.013	2.22	84.6	0.88	-	8.3	0.0	85	324	72	62.4

BOX A TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Bay
Run #: 1

Job #: 23-144
Tracking #: 145
Technician: AK
Date: 5/5/2023

	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	9.551	0.152	0.012	2.22	84.9	0.9	-	8.3	0.0	85	319	71	62.3
67	9.698	0.147	0.013	2.23	85.1	0.92	-	8.2	0.0	85	315	71	62.2
68	9.850	0.152	0.012	2.22	85.2	0.89	-	8.2	0.0	84	313	71	62.4
69	9.995	0.145	0.012	2.22	85.4	0.89	-	8.2	0.0	84	302	71	62.3
70	10.150	0.155	0.013	2.22	85.6	0.91	99	8.1	0.0	84	302	71	62.4
71	10.297	0.147	0.013	2.23	85.8	0.92	-	8.1	0.0	84	302	71	62.2
72	10.450	0.153	0.012	2.23	86	0.87	-	8.1	0.0	84	294	71	62.3
73	10.597	0.147	0.012	2.23	86.2	0.9	-	8.0	0.0	83	295	71	62.1
74	10.750	0.153	0.012	2.23	86.4	0.9	-	8.0	-0.1	83	294	71	62.5
75	10.898	0.148	0.013	2.24	86.6	0.88	-	7.9	0.0	83	298	71	62.2
76	11.050	0.152	0.013	2.23	86.7	0.87	-	7.9	-0.1	83	298	71	62.3
77	11.198	0.148	0.012	2.24	86.9	0.89	-	7.9	0.0	83	291	71	62.4
78	11.350	0.152	0.013	2.24	87	0.9	-	7.8	0.0	83	280	71	62.5
79	11.499	0.149	0.012	2.23	87.1	0.93	-	7.8	-0.1	83	294	71	62.3
80	11.651	0.152	0.013	2.24	87.3	0.89	99	7.8	0.0	83	286	71	62.2
81	11.798	0.147	0.013	2.24	87.5	0.89	-	7.7	-0.1	82	285	71	62.3
82	11.950	0.152	0.013	2.25	87.6	0.91	-	7.7	0.0	82	286	71	62.3
83	12.101	0.151	0.012	2.24	87.8	0.86	-	7.7	0.0	82	273	71	62.3
84	12.253	0.152	0.012	2.24	87.9	0.91	-	7.6	0.0	82	279	71	62.4
85	12.400	0.147	0.013	2.24	88	0.9	-	7.6	0.0	82	279	71	62.6
86	12.552	0.152	0.012	2.24	88.2	0.89	-	7.6	0.0	82	269	71	62.7
87	12.702	0.150	0.013	2.23	88.2	0.9	-	7.5	-0.1	82	279	71	62.6
88	12.854	0.152	0.013	2.24	88.4	0.89	-	7.5	0.0	82	270	71	62.2
89	13.004	0.150	0.013	2.24	88.5	0.91	-	7.4	-0.1	82	277	71	62.1
90	13.158	0.154	0.013	2.24	88.6	0.89	99	7.4	0.0	82	283	71	62.1
91	13.310	0.152	0.013	2.24	88.7	0.88	-	7.4	0.0	82	277	71	62
92	13.461	0.151	0.012	2.24	88.8	0.88	-	7.3	0.0	82	275	71	62.3
93	13.613	0.152	0.013	2.25	88.9	0.91	-	7.3	0.0	82	276	71	62.4
94	13.763	0.150	0.012	2.24	89.1	0.9	-	7.3	0.0	82	267	71	62.3
95	13.916	0.153	0.013	2.25	89.2	0.9	-	7.2	0.0	82	269	71	62.2
96	14.065	0.149	0.012	2.25	89.3	0.92	-	7.2	-0.1	82	284	71	62.3
97	14.219	0.154	0.013	2.25	89.3	0.9	-	7.2	0.0	82	268	71	62.4
98	14.368	0.149	0.013	2.25	89.4	0.89	-	7.1	0.0	81	257	71	62.4

BOX A TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Bay
Run #: 1

Job #: 23-144
Tracking #: 145
Technician: AK
Date: 5/5/2023

	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	14.522	0.154	0.013	2.26	89.6	0.89	-	7.1	0.0	81	261	71	62.3
100	14.669	0.147	0.013	2.26	89.7	0.92	99	7.1	0.0	81	269	71	62.4
101	14.824	0.155	0.013	2.24	89.7	0.9	-	7.0	0.0	81	271	71	62.3
102	14.972	0.148	0.013	2.25	89.9	0.89	-	7.0	0.0	81	268	71	62.2
103	15.127	0.155	0.012	2.26	90	0.9	-	7.0	0.0	81	264	71	62.3
104	15.275	0.148	0.013	2.26	90.1	0.93	-	6.9	0.0	81	269	71	62.3
105	15.430	0.155	0.013	2.26	90.2	0.92	-	6.9	0.0	81	257	71	62.1
106	15.578	0.148	0.012	2.25	90.2	0.91	-	6.9	0.0	81	250	70	62.2
107	15.733	0.155	0.012	2.25	90.3	0.93	-	6.9	0.0	81	260	70	62.3
108	15.882	0.149	0.013	2.25	90.4	0.91	-	6.8	0.0	81	265	70	62.3
109	16.038	0.156	0.013	2.27	90.5	0.94	-	6.8	0.0	81	268	70	62.5
110	16.187	0.149	0.013	2.26	90.5	0.86	99	6.8	0.0	81	261	70	62.5
111	16.341	0.154	0.012	2.25	90.6	0.89	-	6.7	-0.1	81	268	71	62.4
112	16.490	0.149	0.012	2.25	90.7	0.9	-	6.7	0.0	81	271	71	62.4
113	16.642	0.152	0.013	2.26	90.8	0.9	-	6.6	0.0	81	262	71	62.4
114	16.789	0.147	0.013	2.25	90.9	0.91	-	6.6	0.0	81	261	71	62.3
115	16.943	0.154	0.012	2.25	91	0.9	-	6.6	-0.1	81	272	71	62.3
116	17.097	0.154	0.013	2.26	91	0.9	-	6.5	0.0	81	259	71	62.5
117	17.250	0.153	0.013	2.26	91.1	0.9	-	6.5	0.0	81	264	71	62.5
118	17.401	0.151	0.012	2.25	91.1	0.89	-	6.5	0.0	81	264	71	62.4
119	17.549	0.148	0.013	2.26	91.2	0.9	-	6.4	0.0	81	263	71	62.6
120	17.702	0.153	0.013	2.25	91.3	0.91	99	6.4	0.0	81	258	71	62.5
121	17.854	0.152	0.013	2.25	91.3	0.9	-	6.4	0.0	81	254	71	62.5
122	18.007	0.153	0.013	2.26	91.4	0.89	-	6.3	-0.1	81	257	71	62.6
123	18.159	0.152	0.013	2.25	91.5	0.89	-	6.3	0.0	81	264	71	62.5
124	18.315	0.156	0.013	2.25	91.6	0.89	-	6.3	0.0	81	265	71	62.6
125	18.465	0.150	0.013	2.26	91.6	0.91	-	6.2	0.0	81	258	71	62.6
126	18.620	0.155	0.013	2.27	91.6	0.91	-	6.2	0.0	81	258	71	62.5
127	18.768	0.148	0.013	2.26	91.7	0.89	-	6.2	0.0	81	263	71	62.5
128	18.923	0.155	0.013	2.26	91.8	0.94	-	6.1	-0.1	81	266	71	62.6
129	19.072	0.149	0.013	2.26	91.9	0.94	-	6.1	0.0	81	257	71	62.3
130	19.225	0.153	0.013	2.27	91.9	0.91	99	6.1	0.0	81	235	71	62.6
131	19.374	0.149	0.012	2.25	92	0.9	-	6.1	0.0	80	230	71	62.6

BOX A TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Bay
Run #: 1

Job #: 23-144
Tracking #: 145
Technician: AK
Date: 5/5/2023

	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	19.529	0.155	0.013	2.25	92	0.94	-	6.1	0.0	80	242	71	62.6
133	19.681	0.152	0.013	2.25	92	0.91	-	6.0	-0.1	81	258	71	62.5
134	19.837	0.156	0.012	2.26	92.1	0.92	-	6.0	-0.1	81	268	71	62.5
135	19.986	0.149	0.013	2.25	92.2	0.91	-	5.9	0.0	81	277	71	62.3
136	20.142	0.156	0.013	2.27	92.2	0.91	-	5.9	0.0	81	268	71	62.4
137	20.289	0.147	0.012	2.26	92.2	0.91	-	5.9	0.0	81	268	71	62.5
138	20.443	0.154	0.012	2.27	92.3	0.92	-	5.8	0.0	81	265	71	62.5
139	20.595	0.152	0.012	2.26	92.4	0.93	-	5.8	0.0	81	268	71	62.5
140	20.749	0.154	0.012	2.26	92.4	0.89	101	5.8	0.0	81	259	71	62.7
141	20.897	0.148	0.013	2.25	92.4	0.9	-	5.7	0.0	81	247	71	63
142	21.050	0.153	0.013	2.26	92.5	0.91	-	5.7	0.0	81	256	71	62.7
143	21.206	0.156	0.012	2.26	92.5	0.92	-	5.7	0.0	81	258	71	62.5
144	21.355	0.149	0.012	2.26	92.5	0.93	-	5.6	-0.1	81	268	71	62.7
145	21.509	0.154	0.013	2.26	92.6	0.92	-	5.6	0.0	81	267	71	62.7
146	21.660	0.151	0.012	2.26	92.7	0.9	-	5.6	0.0	81	259	71	62.7
147	21.817	0.157	0.013	2.26	92.7	0.91	-	5.5	0.0	81	260	71	62.3
148	21.966	0.149	0.013	2.26	92.8	0.91	-	5.5	0.0	81	264	71	62.6
149	22.119	0.153	0.013	2.26	92.8	0.92	-	5.5	0.0	81	261	71	62.7
150	22.270	0.151	0.012	2.27	92.8	0.91	103	5.4	0.0	81	258	71	62.6
151	22.423	0.153	0.013	2.27	92.9	0.9	-	5.4	0.0	81	259	71	62.6
152	22.575	0.152	0.012	2.26	93	0.91	-	5.3	-0.1	81	268	71	62.7
153	22.728	0.153	0.013	2.26	93	0.93	-	5.3	0.0	82	270	71	62.6
154	22.875	0.147	0.012	2.26	93.1	0.91	-	5.3	0.0	82	265	71	62.7
155	23.031	0.156	0.013	2.26	93.1	0.88	-	5.2	0.0	81	260	71	62.7
156	23.184	0.153	0.012	2.26	93.1	0.91	-	5.2	0.0	82	267	71	62.7
157	23.341	0.157	0.013	2.28	93.1	0.92	-	5.2	0.0	81	263	71	62.8
158	23.489	0.148	0.013	2.26	93.2	0.9	-	5.2	0.0	81	248	71	63.1
159	23.645	0.156	0.013	2.27	93.2	0.9	-	5.1	0.0	81	251	71	63
160	23.794	0.149	0.012	2.27	93.2	0.91	103	5.1	0.0	81	265	71	63.1
161	23.942	0.148	0.013	2.26	93.2	0.91	-	5.0	0.0	82	271	71	63.1
162	24.099	0.157	0.012	2.26	93.3	0.89	-	5.0	0.0	81	265	71	62.9
163	24.249	0.150	0.012	2.26	93.4	0.9	-	5.0	0.0	82	267	71	63.1
164	24.409	0.160	0.013	2.26	93.3	0.93	-	4.9	0.0	81	260	71	63.2

BOX A TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Bay
Run #: 1

Job #: 23-144
Tracking #: 145
Technician: AK
Date: 5/5/2023

	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	24.560	0.151	0.013	2.27	93.4	0.92	-	4.9	0.0	81	254	71	63.2
166	24.715	0.155	0.013	2.27	93.5	0.94	-	4.9	0.0	81	259	71	63.1
167	24.864	0.149	0.013	2.26	93.5	0.9	-	4.8	0.0	81	266	71	63.2
168	25.017	0.153	0.013	2.27	93.4	0.91	-	4.8	0.0	81	270	71	63.2
169	25.168	0.151	0.013	2.27	93.4	0.91	-	4.8	0.0	81	261	71	63.3
170	25.324	0.156	0.013	2.28	93.5	0.91	101	4.7	0.0	81	260	71	63.3
171	25.470	0.146	0.013	2.26	93.5	0.94	-	4.7	0.0	81	264	71	63.3
172	25.627	0.157	0.013	2.27	93.6	0.91	-	4.7	0.0	81	263	71	63.3
173	25.780	0.153	0.013	2.27	93.6	0.91	-	4.6	0.0	81	261	71	63.5
174	25.935	0.155	0.014	2.26	93.6	0.89	-	4.6	0.0	81	269	71	63.3
175	26.082	0.147	0.013	2.27	93.7	0.94	-	4.6	0.0	81	262	71	63.4
176	26.238	0.156	0.013	2.27	93.7	0.9	-	4.5	0.0	81	255	71	63.4
177	26.385	0.147	0.013	2.27	93.7	0.93	-	4.5	0.0	81	264	71	63.2
178	26.544	0.159	0.013	2.26	93.7	0.94	-	4.5	0.0	81	259	71	63.2
179	26.690	0.146	0.013	2.26	93.8	0.92	-	4.4	0.0	81	264	71	63.2
180	26.844	0.154	0.013	2.27	93.8	0.9	99	4.4	0.0	81	263	71	63.2
181	27.002	0.158	0.013	2.27	93.8	0.94	-	4.4	0.0	80	263	71	63.7
182	27.151	0.149	0.013	2.26	93.9	0.9	-	4.4	0.0	80	247	71	63.8
183	27.302	0.151	0.013	2.26	93.9	0.89	-	4.3	0.0	80	249	71	63.7
184	27.456	0.154	0.013	2.26	93.9	0.92	-	4.3	0.0	80	249	71	63.7
185	27.612	0.156	0.012	2.27	93.9	0.91	-	4.3	0.0	80	248	71	63.4
186	27.763	0.151	0.013	2.27	93.9	0.93	-	4.3	0.0	79	236	71	63.3
187	27.916	0.153	0.012	2.27	94	0.91	-	4.2	0.0	79	227	71	63.3
188	28.066	0.150	0.013	2.27	94	0.87	-	4.2	0.0	79	231	71	63.5
189	28.224	0.158	0.013	2.25	93.9	0.93	-	4.2	0.0	79	237	71	63.4
190	28.370	0.146	0.013	2.26	93.9	0.93	99	4.2	0.0	79	230	71	63.5
191	28.524	0.154	0.012	2.26	94	0.93	-	4.1	0.0	79	230	71	63.4
192	28.680	0.156	0.013	2.26	94	0.94	-	4.1	0.0	79	219	71	63.3
193	28.833	0.153	0.013	2.26	94	0.95	-	4.1	0.0	78	216	71	63.5
194	28.980	0.147	0.013	2.27	94	0.92	-	4.1	0.0	79	227	71	63.6
195	29.139	0.159	0.013	2.26	94	0.95	-	4.0	0.0	78	222	71	63.3
196	29.291	0.152	0.012	2.27	94	0.92	-	4.0	0.0	78	218	71	63.4
197	29.444	0.153	0.013	2.26	94	0.93	-	4.0	0.0	78	220	70	63.5

BOX A TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Bay
Run #: 1

Job #: 23-144
Tracking #: 145
Technician: AK
Date: 5/5/2023

	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	29.597	0.153	0.012	2.26	94.1	0.92	-	4.0	0.0	78	212	70	63.3
199	29.749	0.152	0.012	2.26	94.1	0.92	-	3.9	0.0	78	220	70	63.2
200	29.904	0.155	0.013	2.26	94.2	0.94	99	3.9	0.0	78	222	71	63.4
201	30.055	0.151	0.013	2.27	94.2	0.92	-	3.9	0.0	78	228	71	63.4
202	30.207	0.152	0.013	2.26	94.2	0.95	-	3.9	0.0	78	225	70	63.4
203	30.358	0.151	0.013	2.27	94.2	0.95	-	3.8	0.0	78	221	70	63.4
204	30.512	0.154	0.012	2.28	94.2	0.92	-	3.8	0.0	78	220	70	63.5
205	30.662	0.150	0.013	2.27	94.2	0.89	-	3.8	0.0	78	224	70	63.5
206	30.815	0.153	0.013	2.27	94.3	0.92	-	3.8	0.0	78	222	70	63.3
207	30.966	0.151	0.012	2.26	94.2	0.91	-	3.7	0.0	78	218	70	63.4
208	31.123	0.157	0.013	2.27	94.2	0.93	-	3.7	0.0	78	213	70	63.4
209	31.273	0.150	0.013	2.27	94.3	0.91	-	3.7	0.0	78	214	70	63.3
210	31.429	0.156	0.012	2.26	94.3	0.93	101	3.7	0.0	78	202	70	63.4
211	31.579	0.150	0.013	2.26	94.2	0.93	-	3.7	0.0	77	199	70	63.2
212	31.734	0.155	0.013	2.27	94.3	0.92	-	3.6	0.0	78	212	70	63.2
213	31.884	0.150	0.013	2.27	94.3	0.9	-	3.6	0.0	78	222	70	63.5
214	32.038	0.154	0.013	2.27	94.3	0.9	-	3.6	0.0	78	226	70	63.6
215	32.189	0.151	0.012	2.27	94.3	0.9	-	3.6	0.0	78	215	70	63.6
216	32.342	0.153	0.013	2.25	94.3	0.93	-	3.5	0.0	78	210	70	63.3
217	32.495	0.153	0.013	2.27	94.3	0.94	-	3.5	0.0	78	203	70	63.4
218	32.648	0.153	0.013	2.27	94.3	0.9	-	3.5	0.0	78	205	70	63.4
219	32.805	0.157	0.012	2.27	94.3	0.9	-	3.4	0.0	78	215	70	63.4
220	32.953	0.148	0.013	2.27	94.3	0.93	101	3.4	0.0	78	223	70	63.4
221	33.111	0.158	0.012	2.27	94.4	0.92	-	3.4	0.0	78	222	70	63.4
222	33.260	0.149	0.013	2.26	94.4	0.96	-	3.4	0.0	78	219	70	63.4
223	33.413	0.153	0.013	2.27	94.4	0.91	-	3.4	0.0	78	213	70	63.1
224	33.563	0.150	0.013	2.27	94.4	0.92	-	3.3	0.0	78	213	70	63.1
225	33.722	0.159	0.013	2.26	94.4	0.93	-	3.3	0.0	78	210	70	63.4
226	33.869	0.147	0.013	2.26	94.4	0.92	-	3.3	0.0	78	205	70	63.6
227	34.022	0.153	0.013	2.25	94.4	0.92	-	3.3	0.0	77	201	70	63.4
228	34.178	0.156	0.013	2.27	94.4	0.92	-	3.2	0.0	78	213	70	63.4
229	34.331	0.153	0.013	2.26	94.4	0.92	-	3.2	0.0	78	217	70	63.6
230	34.481	0.150	0.013	2.27	94.5	0.92	99	3.2	0.0	78	214	70	63.4

BOX A TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Bay
Run #: 1

Job #: 23-144
Tracking #: 145
Technician: AK
Date: 5/5/2023

	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	34.637	0.156	0.013	2.27	94.4	0.94	-	3.2	0.0	78	220	70	63.5
232	34.786	0.149	0.013	2.27	94.5	0.95	-	3.1	0.0	78	220	70	63.6
233	34.940	0.154	0.012	2.26	94.4	0.94	-	3.1	0.0	78	206	70	63.7
234	35.092	0.152	0.012	2.27	94.5	0.93	-	3.1	0.0	78	201	70	63.6
235	35.246	0.154	0.013	2.25	94.4	0.92	-	3.1	0.0	78	203	70	63.6
236	35.397	0.151	0.012	2.26	94.4	0.92	-	3.1	0.0	78	206	70	63.7
237	35.551	0.154	0.013	2.26	94.4	0.9	-	3.0	0.0	78	219	70	63.8
238	35.706	0.155	0.013	2.27	94.4	0.92	-	3.0	0.0	78	219	70	63.7
239	35.854	0.148	0.013	2.26	94.5	0.91	-	3.0	0.0	78	208	70	63.8
240	36.011	0.157	0.013	2.26	94.6	0.91	99	3.0	0.0	78	216	70	64
241	36.161	0.150	0.012	2.26	94.5	0.93	-	2.9	0.0	78	229	70	64
242	36.314	0.153	0.013	2.27	94.6	0.94	-	2.9	0.0	78	214	70	63.9
243	36.467	0.153	0.012	2.26	94.6	0.9	-	2.9	0.0	78	217	70	63.8
244	36.625	0.158	0.013	2.27	94.6	0.9	-	2.8	0.0	78	224	70	63.7
245	36.773	0.148	0.012	2.26	94.6	0.93	-	2.8	0.0	78	224	70	63.9
246	36.931	0.158	0.013	2.27	94.5	0.91	-	2.8	0.0	78	219	70	63.9
247	37.079	0.148	0.013	2.27	94.5	0.92	-	2.8	0.0	78	207	70	63.9
248	37.231	0.152	0.013	2.27	94.6	0.93	-	2.8	0.0	78	201	70	63.8
249	37.384	0.153	0.013	2.27	94.6	0.92	-	2.7	0.0	78	211	70	63.8
250	37.536	0.152	0.012	2.27	94.6	0.93	101	2.7	0.0	78	217	70	63.9
251	37.690	0.154	0.013	2.26	94.6	0.94	-	2.7	-0.1	78	230	70	63.9
252	37.846	0.156	0.013	2.27	94.6	0.91	-	2.6	0.0	79	227	70	64
253	37.998	0.152	0.013	2.26	94.6	0.92	-	2.6	0.0	78	212	70	63.8
254	38.149	0.151	0.013	2.25	94.6	0.92	-	2.6	0.0	78	207	70	64
255	38.307	0.158	0.013	2.28	94.7	0.93	-	2.6	0.0	78	212	70	63.9
256	38.454	0.147	0.013	2.27	94.7	0.9	-	2.5	0.0	78	222	70	64.2
257	38.612	0.158	0.013	2.28	94.7	0.91	-	2.5	0.0	78	213	70	64.2
258	38.759	0.147	0.013	2.27	94.7	0.93	-	2.5	0.0	78	202	70	64.2
259	38.915	0.156	0.013	2.26	94.7	0.93	-	2.5	0.0	78	214	70	64.1
260	39.066	0.151	0.013	2.27	94.7	0.93	101	2.5	0.0	78	216	70	64.1
261	39.224	0.158	0.013	2.27	94.8	0.9	-	2.4	0.0	78	222	70	64.4
262	39.372	0.148	0.013	2.26	94.8	0.91	-	2.4	0.0	79	226	70	64.1
263	39.528	0.156	0.013	2.27	94.8	0.92	-	2.4	0.0	78	217	70	64

BOX A TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Bay
Run #: 1

Job #: 23-144
Tracking #: 145
Technician: AK
Date: 5/5/2023

	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	39.678	0.150	0.012	2.28	94.8	0.9	-	2.4	0.0	78	212	70	64.2
265	39.832	0.154	0.012	2.27	94.8	0.94	-	2.3	0.0	78	211	70	64.3
266	39.981	0.149	0.013	2.27	94.8	0.92	-	2.3	-0.1	78	222	70	64.2
267	40.137	0.156	0.013	2.26	94.8	0.93	-	2.3	0.0	79	226	70	63.9
268	40.291	0.154	0.013	2.26	94.9	0.92	-	2.3	0.0	79	215	71	63.9
269	40.444	0.153	0.012	2.27	94.9	0.92	-	2.2	0.0	78	207	71	64.2
270	40.601	0.157	0.013	2.27	94.9	0.91	99	2.2	0.0	78	216	71	64.1
271	40.750	0.149	0.013	2.26	94.9	0.9	-	2.2	0.0	78	218	70	64.1
272	40.907	0.157	0.013	2.26	94.8	0.93	-	2.2	0.0	78	218	70	64.1
273	41.054	0.147	0.013	2.26	94.9	0.93	-	2.1	0.0	78	218	70	64.3
274	41.210	0.156	0.013	2.27	94.9	0.9	-	2.1	0.0	79	223	70	64.3
275	41.360	0.150	0.013	2.27	94.8	0.92	-	2.1	0.0	78	216	70	64.1
276	41.517	0.157	0.013	2.27	94.9	0.93	-	2.1	0.0	78	208	71	64
277	41.668	0.151	0.012	2.27	95	0.9	-	2.1	0.0	78	203	71	64
278	41.823	0.155	0.013	2.27	94.9	0.96	-	2.0	0.0	78	210	71	64.1
279	41.974	0.151	0.012	2.27	94.9	0.93	-	2.0	-0.1	78	221	71	64.3
280	42.129	0.155	0.013	2.28	94.9	0.92	99	2.0	0.0	79	221	71	64.4
281	42.280	0.151	0.013	2.27	94.9	0.93	-	1.9	0.0	78	213	71	64.3
282	42.434	0.154	0.013	2.27	94.9	0.91	-	1.9	0.0	78	208	70	64.2
283	42.586	0.152	0.013	2.26	95	0.9	-	1.9	0.0	78	201	71	64.3
284	42.740	0.154	0.013	2.26	95	0.9	-	1.9	0.0	78	205	71	64.2
285	42.895	0.155	0.013	2.27	95	0.93	-	1.9	0.0	78	211	71	64.5
286	43.046	0.151	0.013	2.26	95	0.95	-	1.8	0.0	78	202	71	64.6
287	43.204	0.158	0.013	2.28	95	0.91	-	1.8	0.0	78	210	71	64.8
288	43.351	0.147	0.013	2.28	95	0.96	-	1.8	0.0	78	222	71	64.6
289	43.507	0.156	0.013	2.27	95	0.95	-	1.8	0.0	78	214	71	64.5
290	43.654	0.147	0.012	2.27	95	0.9	101	1.7	0.0	79	214	71	64.4
291	43.810	0.156	0.013	2.27	95.1	0.91	-	1.7	0.0	79	211	71	64.5
292	43.964	0.154	0.012	2.27	95.2	0.92	-	1.7	-0.1	79	215	71	64.3
293	44.117	0.153	0.013	2.27	95.1	0.9	-	1.6	0.0	79	224	71	64.4
294	44.271	0.154	0.013	2.27	95.1	0.95	-	1.6	0.0	79	229	71	64.6
295	44.424	0.153	0.013	2.27	95.1	0.91	-	1.6	0.0	79	217	71	64.7
296	44.576	0.152	0.013	2.26	95.1	0.92	-	1.6	0.0	79	217	71	64.6

BOX A TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Bay
Run #: 1

Job #: 23-144
Tracking #: 145
Technician: AK
Date: 5/5/2023

	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	44.728	0.152	0.013	2.27	95.1	0.96	-	1.5	0.0	79	220	71	64.6
298	44.880	0.152	0.012	2.27	95.1	0.9	-	1.5	0.0	79	220	71	64.5
299	45.039	0.159	0.013	2.26	95.2	0.94	-	1.5	0.0	79	219	71	64.4
300	45.188	0.149	0.012	2.26	95.2	0.91	103	1.5	0.0	79	221	71	64.1
301	45.343	0.155	0.013	2.27	95.2	0.93	-	1.4	0.0	79	226	71	64.6
302	45.495	0.152	0.012	2.26	95.2	0.94	-	1.4	0.0	79	223	71	64.7
303	45.649	0.154	0.013	2.27	95.2	0.94	-	1.4	0.0	79	216	71	64.8
304	45.806	0.157	0.013	2.27	95.3	0.94	-	1.4	0.0	79	216	71	64.5
305	45.954	0.148	0.013	2.27	95.3	0.92	-	1.3	0.0	79	220	71	64.7
306	46.109	0.155	0.013	2.27	95.3	0.93	-	1.3	0.0	79	228	71	64.5
307	46.260	0.151	0.013	2.27	95.3	0.94	-	1.3	0.0	79	222	71	64.6
308	46.417	0.157	0.013	2.27	95.3	0.93	-	1.3	0.0	79	206	71	64.5
309	46.570	0.153	0.013	2.27	95.3	0.98	-	1.3	0.0	78	188	71	64.7
310	46.723	0.153	0.013	2.27	95.3	0.93	101	1.3	0.0	78	181	71	64.8
311	46.873	0.150	0.013	2.28	95.3	0.94	-	1.3	0.0	77	179	71	64.6
312	47.027	0.154	0.013	2.27	95.3	0.91	-	1.2	0.0	77	195	71	65
313	47.179	0.152	0.013	2.27	95.3	0.91	-	1.2	-0.1	78	217	71	64.8
314	47.333	0.154	0.013	2.26	95.3	0.94	-	1.1	0.0	78	237	71	64.9
315	47.487	0.154	0.013	2.26	95.3	0.93	-	1.1	0.0	79	241	71	64.8
316	47.637	0.150	0.013	2.26	95.4	0.91	-	1.0	-0.1	79	250	71	64.9
317	47.792	0.155	0.013	2.27	95.3	0.94	-	1.0	0.0	79	246	71	64.8
318	47.946	0.154	0.013	2.27	95.4	0.94	-	1.0	0.0	79	233	71	65.2
319	48.101	0.155	0.013	2.28	95.4	0.92	-	1.0	0.0	79	230	71	64.7
320	48.251	0.150	0.013	2.28	95.4	0.93	99	1.0	0.0	79	222	71	64.8
321	48.407	0.156	0.012	2.26	95.4	0.9	-	0.9	0.0	79	220	71	64.5
322	48.557	0.150	0.013	2.27	95.4	0.94	-	0.9	0.0	79	222	71	64.6
323	48.714	0.157	0.013	2.27	95.4	0.94	-	0.9	0.0	79	231	71	64.6
324	48.864	0.150	0.013	2.27	95.4	0.93	-	0.8	0.0	79	227	71	64.8
325	49.020	0.156	0.013	2.27	95.5	0.98	-	0.8	0.0	79	215	71	64.6
326	49.171	0.151	0.013	2.27	95.5	0.94	-	0.8	0.0	79	209	71	64.5
327	49.328	0.157	0.013	2.27	95.5	0.9	-	0.8	0.0	79	210	71	64.4
328	49.474	0.146	0.013	2.27	95.4	0.93	-	0.8	0.0	79	215	71	64.6
329	49.630	0.156	0.013	2.27	95.5	0.94	-	0.7	0.0	79	230	71	64.6

BOX A TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Bay
Run #: 1

Job #: 23-144
Tracking #: 145
Technician: AK
Date: 5/5/2023

	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	49.785	0.155	0.013	2.27	95.5	0.93	99	0.7	0.0	79	229	71	64.8
331	49.937	0.152	0.013	2.27	95.5	0.94	-	0.7	0.0	79	220	71	64.9
332	50.089	0.152	0.013	2.26	95.5	0.92	-	0.7	0.0	79	226	71	65
333	50.243	0.154	0.012	2.27	95.6	0.94	-	0.6	0.0	80	221	71	65
334	50.398	0.155	0.012	2.27	95.6	0.96	-	0.6	0.0	79	209	71	64.9
335	50.547	0.149	0.012	2.26	95.6	0.92	-	0.6	0.0	79	203	71	65.1
336	50.706	0.159	0.013	2.26	95.6	0.96	-	0.6	0.0	79	215	71	65.1
337	50.853	0.147	0.013	2.26	95.6	0.9	-	0.5	0.0	80	229	71	65.2
338	51.007	0.154	0.013	2.27	95.6	0.93	-	0.5	0.0	80	234	71	65.1
339	51.160	0.153	0.012	2.27	95.7	0.94	-	0.5	0.0	80	234	72	65.2
340	51.314	0.154	0.013	2.27	95.7	0.93	99	0.5	0.0	80	215	72	65.3
341	51.467	0.153	0.012	2.27	95.8	0.96	-	0.5	0.0	80	201	72	65.3
342	51.622	0.155	0.013	2.27	95.7	0.93	-	0.5	0.0	80	200	72	65.3
343	51.773	0.151	0.012	2.27	95.7	0.91	-	0.4	0.0	80	208	72	65.4
344	51.927	0.154	0.013	2.27	95.8	0.93	-	0.4	0.0	80	220	72	65.5
345	52.079	0.152	0.012	2.27	95.8	0.91	-	0.4	0.0	80	219	72	65.5
346	52.233	0.154	0.012	2.26	95.8	0.96	-	0.3	0.0	80	225	72	65.6
347	52.388	0.155	0.012	2.27	95.9	0.94	-	0.3	0.0	81	237	72	65.7
348	52.539	0.151	0.012	2.26	96	0.95	-	0.3	0.0	81	233	72	65.7
349	52.695	0.156	0.012	2.27	96	0.94	-	0.3	0.0	81	225	72	65.8
350	52.844	0.149	0.012	2.27	96	0.91	101	0.2	0.0	81	220	72	65.8
351	52.998	0.154	0.012	2.27	96	0.91	-	0.2	0.0	80	222	72	65.8
352	53.150	0.152	0.012	2.27	96.1	0.93	-	0.2	0.0	81	223	72	65.8
353	53.306	0.156	0.012	2.27	96.1	0.95	-	0.2	0.0	81	221	72	65.8
354	53.454	0.148	0.012	2.27	96.1	0.93	-	0.1	0.0	80	218	72	65.8
355	53.614	0.160	0.012	2.26	96.1	0.95	-	0.1	0.0	80	217	72	66
356	53.764	0.150	0.012	2.26	96.1	0.96	-	0.1	0.0	80	223	72	66
357	53.918	0.154	0.012	2.27	96.2	0.95	-	0.0	0.0	81	226	72	66.1
358	54.068	0.150	0.012	2.27	96.2	0.95	-	0.0	0.0	80	217	72	66.1
359	54.227	0.159	0.012	2.27	96.3	0.92	-	0.0	0.0	80	214	72	66.2
360	54.377	0.150	0.013	2.26	96.3	0.93	101	0.0	0.0	80	206	72	66.3
Avg/Tot	54.377	0.151	0.013	2.23	90	0.90	100			81	262	71	63

BOX B TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Bay
Run #: 1

Job #: 23-144
Tracking #: 145
Technician: AK
Date: 5/5/2023

	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	69.5	0.6		68	-0.046	4.89	0.04
1	0.063	0.063	0.72	69.5	0.91	-	69	-0.047	4.81	0.03
2	0.193	0.130	3.92	69.3	2.09	-	69	-0.043	4.67	0.04
3	0.349	0.156	2.03	69.2	1.68	-	71	-0.047	3.81	0.07
4	0.490	0.141	2.05	69.2	1.83	-	70	-0.045	5.10	0.03
5	0.629	0.139	2.06	69.2	1.69	-	70	-0.047	4.89	0.03
6	0.771	0.142	2.05	69.3	1.94	-	70	-0.044	4.45	0.05
7	0.910	0.139	2.06	69.5	1.5	-	70	-0.049	5.08	0.03
8	1.052	0.142	2.07	69.6	1.7	-	71	-0.046	7.21	0.02
9	1.191	0.139	2.06	69.8	1.7	-	71	-0.045	3.47	0.11
10	1.334	0.143	2.08	70.1	1.91	94	71	-0.047	4.25	0.04
11	1.474	0.140	2.08	70.3	1.49	-	71	-0.046	6.57	0.02
12	1.614	0.140	2.08	70.5	1.83	-	71	-0.047	5.40	0.03
13	1.758	0.144	2.08	70.8	1.63	-	71	-0.047	5.29	0.02
14	1.897	0.139	2.09	71	1.47	-	71	-0.047	4.00	0.09
15	2.040	0.143	2.08	71.3	1.53	-	71	-0.046	6.55	0.03
16	2.180	0.140	2.08	71.6	1.5	-	71	-0.047	5.63	0.02
17	2.324	0.144	2.09	71.8	1.51	-	71	-0.045	5.97	0.02
18	2.465	0.141	2.09	72.1	1.54	-	71	-0.049	5.05	0.03
19	2.606	0.141	2.10	72.5	1.8	-	71	-0.046	7.02	0.02
20	2.751	0.145	2.10	72.8	1.73	101	71	-0.048	5.41	0.03
21	2.891	0.140	2.10	73.1	1.77	-	71	-0.047	5.08	0.03
22	3.036	0.145	2.10	73.5	1.83	-	71	-0.047	5.73	0.03
23	3.176	0.140	2.10	73.7	1.46	-	72	-0.047	5.86	0.02
24	3.321	0.145	2.11	74	1.63	-	72	-0.044	5.99	0.03
25	3.463	0.142	2.10	74.4	1.73	-	72	-0.045	4.60	0.04
26	3.606	0.143	2.11	74.6	1.55	-	72	-0.048	6.23	0.02
27	3.749	0.143	2.10	75	1.51	-	72	-0.048	5.86	0.03
28	3.891	0.142	2.10	75.3	1.92	-	72	-0.046	5.34	0.03
29	4.037	0.146	2.12	75.5	1.73	-	72	-0.044	6.33	0.03
30	4.178	0.141	2.11	75.8	1.53	101	72	-0.047	5.28	0.04
31	4.323	0.145	2.11	76.2	1.75	-	72	-0.046	5.43	0.03

BOX B TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Bay
Run #: 1

Job #: 23-144
Tracking #: 145
Technician: AK
Date: 5/5/2023

	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	4.465	0.142	2.11	76.5	1.94	-	72	-0.048	5.16	0.03
33	4.611	0.146	2.12	76.8	1.95	-	72	-0.048	6.17	0.02
34	4.754	0.143	2.12	77	1.54	-	72	-0.047	5.70	0.03
35	4.898	0.144	2.12	77.3	1.9	-	72	-0.044	5.37	0.04
36	5.041	0.143	2.13	77.6	1.95	-	72	-0.045	5.43	0.03
37	5.184	0.143	2.12	78	1.73	-	72	-0.048	5.15	0.03
38	5.330	0.146	2.12	78.3	1.72	-	72	-0.046	5.19	0.04
39	5.473	0.143	2.13	78.6	1.67	-	72	-0.045	5.03	0.04
40	5.620	0.147	2.13	78.9	1.97	102	72	-0.047	4.90	0.04
41	5.761	0.141	2.13	79.1	1.67	-	72	-0.047	5.09	0.04
42	5.908	0.147	2.13	79.4	1.74	-	72	-0.046	6.44	0.02
43	6.050	0.142	2.13	79.7	1.52	-	72	-0.046	4.37	0.06
44	6.197	0.147	2.13	79.9	1.55	-	72	-0.045	4.43	0.04
45	6.341	0.144	2.14	80.2	1.58	-	72	-0.047	6.84	0.02
46	6.487	0.146	2.13	80.5	1.63	-	72	-0.045	5.41	0.03
47	6.631	0.144	2.14	80.7	1.76	-	72	-0.046	5.28	0.04
48	6.775	0.144	2.14	81	1.52	-	72	-0.045	4.27	0.05
49	6.921	0.146	2.14	81.2	1.97	-	72	-0.047	5.31	0.03
50	7.065	0.144	2.15	81.4	1.47	103	72	-0.046	4.50	0.05
51	7.213	0.148	2.15	81.7	1.49	-	72	-0.046	5.00	0.04
52	7.357	0.144	2.15	81.9	1.76	-	72	-0.044	5.33	0.03
53	7.504	0.147	2.14	82.1	1.99	-	72	-0.046	6.35	0.02
54	7.647	0.143	2.15	82.3	1.89	-	72	-0.046	5.63	0.04
55	7.795	0.148	2.15	82.5	1.5	-	72	-0.046	5.68	0.03
56	7.938	0.143	2.14	82.8	1.79	-	72	-0.044	6.30	0.02
57	8.084	0.146	2.15	82.9	1.48	-	72	-0.043	5.01	0.04
58	8.228	0.144	2.15	83.1	1.75	-	72	-0.048	6.43	0.03
59	8.376	0.148	2.15	83.3	1.44	-	72	-0.047	5.35	0.03
60	8.521	0.145	2.16	83.6	1.77	102	72	-0.046	5.91	0.03
61	8.670	0.149	2.15	83.8	1.69	-	72	-0.044	5.78	0.03
62	8.815	0.145	2.16	84	1.44	-	72	-0.042	3.05	0.13
63	8.961	0.146	2.16	84.3	1.65	-	72	-0.037	1.87	0.17

BOX B TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Bay
Run #: 1

Job #: 23-144
Tracking #: 145
Technician: AK
Date: 5/5/2023

	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	9.107	0.146	2.16	84.4	1.95	-	72	-0.043	2.12	0.17
65	9.251	0.144	2.15	84.6	1.91	-	72	-0.040	3.17	0.06
66	9.399	0.148	2.16	84.8	1.98	-	71	-0.037	3.15	0.08
67	9.544	0.145	2.16	85	1.92	-	71	-0.039	2.82	0.11
68	9.692	0.148	2.16	85.1	1.98	-	71	-0.036	3.29	0.08
69	9.835	0.143	2.16	85.2	1.69	-	71	-0.032	2.58	0.13
70	9.986	0.151	2.16	85.4	1.51	100	71	-0.035	2.85	0.11
71	10.129	0.143	2.16	85.6	1.73	-	71	-0.033	2.60	0.13
72	10.278	0.149	2.16	85.7	1.43	-	71	-0.034	2.29	0.17
73	10.422	0.144	2.16	85.9	1.55	-	71	-0.037	2.91	0.12
74	10.571	0.149	2.16	86.1	1.98	-	71	-0.036	2.46	0.13
75	10.715	0.144	2.17	86.3	1.77	-	71	-0.038	3.52	0.07
76	10.863	0.148	2.16	86.5	1.65	-	71	-0.033	3.33	0.09
77	11.008	0.145	2.16	86.6	1.99	-	71	-0.030	3.37	0.06
78	11.157	0.149	2.16	86.8	1.43	-	71	-0.031	1.26	0.23
79	11.302	0.145	2.16	86.8	1.97	-	71	-0.036	3.92	0.05
80	11.451	0.149	2.17	86.9	1.67	99	71	-0.027	3.45	0.09
81	11.595	0.144	2.17	87	1.46	-	71	-0.033	1.72	0.24
82	11.742	0.147	2.16	87.3	1.75	-	71	-0.030	3.92	0.04
83	11.890	0.148	2.17	87.6	1.5	-	71	-0.032	1.41	0.22
84	12.038	0.148	2.16	87.7	1.91	-	71	-0.031	2.59	0.13
85	12.182	0.144	2.17	87.8	1.92	-	70	-0.028	3.08	0.12
86	12.329	0.147	2.17	87.8	1.52	-	70	-0.028	1.88	0.19
87	12.475	0.146	2.17	87.9	1.78	-	70	-0.033	3.21	0.08
88	12.621	0.146	2.16	87.9	1.85	-	70	-0.027	2.78	0.10
89	12.770	0.149	2.17	88	1.99	-	70	-0.034	2.43	0.14
90	12.918	0.148	2.16	88	1.97	99	70	-0.033	3.48	0.07
91	13.066	0.148	2.17	88.3	1.93	-	70	-0.028	2.27	0.18
92	13.212	0.146	2.17	88.4	1.41	-	70	-0.029	2.31	0.14
93	13.361	0.149	2.17	88.4	1.43	-	70	-0.028	3.16	0.09
94	13.506	0.145	2.17	88.5	1.42	-	70	-0.027	1.66	0.22
95	13.656	0.150	2.18	88.5	1.71	-	70	-0.029	2.44	0.15

BOX B TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Bay
Run #: 1

Job #: 23-144
Tracking #: 145
Technician: AK
Date: 5/5/2023

	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	13.801	0.145	2.18	88.6	1.91	-	70	-0.033	4.00	0.04
97	13.951	0.150	2.18	88.7	1.45	-	70	-0.025	2.28	0.17
98	14.096	0.145	2.17	88.8	1.65	-	70	-0.023	1.24	0.20
99	14.245	0.149	2.17	88.9	1.91	-	70	-0.029	2.22	0.13
100	14.388	0.143	2.17	88.9	1.81	99	70	-0.029	3.33	0.07
101	14.540	0.152	2.17	88.9	1.89	-	70	-0.030	2.95	0.09
102	14.684	0.144	2.17	89.2	1.94	-	70	-0.029	2.61	0.12
103	14.834	0.150	2.17	89.2	1.46	-	70	-0.029	2.31	0.13
104	14.979	0.145	2.17	89.3	1.75	-	70	-0.027	3.23	0.09
105	15.128	0.149	2.17	89.3	1.92	-	70	-0.022	2.06	0.17
106	15.273	0.145	2.16	89.5	1.8	-	70	-0.022	1.60	0.21
107	15.423	0.150	2.17	89.5	1.8	-	70	-0.028	2.09	0.15
108	15.568	0.145	2.17	89.5	1.91	-	70	-0.028	3.21	0.08
109	15.718	0.150	2.17	89.6	1.64	-	70	-0.029	3.01	0.11
110	15.864	0.146	2.18	89.6	1.8	99	70	-0.028	2.28	0.17
111	16.012	0.148	2.17	89.7	1.94	-	70	-0.030	2.52	0.14
112	16.159	0.147	2.17	89.7	1.9	-	70	-0.029	3.68	0.05
113	16.306	0.147	2.17	89.8	1.99	-	70	-0.025	2.13	0.17
114	16.449	0.143	2.17	89.7	1.68	-	70	-0.026	2.51	0.10
115	16.597	0.148	2.17	89.8	1.68	-	70	-0.030	3.32	0.07
116	16.749	0.152	2.17	89.9	1.95	-	70	-0.025	2.32	0.16
117	16.897	0.148	2.16	89.9	1.74	-	70	-0.031	2.31	0.16
118	17.044	0.147	2.17	89.9	1.88	-	70	-0.029	2.78	0.10
119	17.186	0.142	2.17	90	1.48	-	70	-0.025	2.93	0.09
120	17.336	0.150	2.17	90.1	1.55	99	70	-0.026	2.05	0.16
121	17.483	0.147	2.17	90.2	1.55	-	70	-0.024	1.92	0.17
122	17.631	0.148	2.17	90.3	1.56	-	70	-0.028	1.69	0.19
123	17.777	0.146	2.17	90.3	1.83	-	70	-0.030	3.30	0.08
124	17.928	0.151	2.17	90.4	1.83	-	70	-0.026	3.02	0.12
125	18.075	0.147	2.17	90.4	2	-	70	-0.026	2.29	0.16
126	18.223	0.148	2.17	90.4	1.83	-	70	-0.025	1.96	0.18
127	18.370	0.147	2.17	90.4	1.77	-	70	-0.028	2.99	0.10

BOX B TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Bay
Run #: 1

Job #: 23-144
Tracking #: 145
Technician: AK
Date: 5/5/2023

	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	18.519	0.149	2.17	90.5	1.67	-	70	-0.031	2.68	0.12
129	18.665	0.146	2.17	90.5	1.97	-	70	-0.022	2.75	0.12
130	18.812	0.147	2.17	90.5	1.88	99	70	-0.018	0.78	0.22
131	18.958	0.146	2.18	90.6	1.9	-	70	-0.019	0.98	0.16
132	19.108	0.150	2.17	90.5	1.74	-	70	-0.026	1.72	0.14
133	19.256	0.148	2.18	90.5	1.88	-	70	-0.029	3.62	0.06
134	19.406	0.150	2.17	90.5	1.51	-	70	-0.032	3.22	0.08
135	19.551	0.145	2.17	90.5	1.81	-	70	-0.032	4.41	0.04
136	19.701	0.150	2.18	90.6	1.46	-	70	-0.028	3.20	0.09
137	19.844	0.143	2.17	90.6	2.01	-	70	-0.025	2.82	0.14
138	19.994	0.150	2.17	90.6	1.52	-	70	-0.030	1.89	0.20
139	20.141	0.147	2.17	90.6	1.53	-	70	-0.029	3.09	0.07
140	20.291	0.150	2.18	90.7	1.94	101	70	-0.023	2.58	0.14
141	20.434	0.143	2.17	90.9	1.5	-	70	-0.026	1.11	0.19
142	20.584	0.150	2.17	90.8	1.91	-	70	-0.028	2.56	0.10
143	20.732	0.148	2.17	90.8	1.54	-	70	-0.026	3.02	0.08
144	20.879	0.147	2.17	90.8	1.72	-	70	-0.032	3.13	0.08
145	21.024	0.145	2.17	90.8	1.47	-	70	-0.028	2.79	0.11
146	21.174	0.150	2.17	90.9	1.47	-	70	-0.024	2.30	0.16
147	21.322	0.148	2.17	90.9	1.48	-	70	-0.026	2.10	0.16
148	21.472	0.150	2.17	90.9	1.96	-	70	-0.028	2.76	0.10
149	21.615	0.143	2.17	90.9	1.49	-	70	-0.026	2.81	0.12
150	21.767	0.152	2.17	90.9	1.69	103	70	-0.026	2.43	0.15
151	21.911	0.144	2.17	91	1.48	-	70	-0.029	2.23	0.14
152	22.063	0.152	2.17	91	1.44	-	70	-0.030	3.37	0.06
153	22.206	0.143	2.17	91	1.51	-	70	-0.031	2.79	0.12
154	22.354	0.148	2.17	91.1	1.48	-	70	-0.027	3.68	0.05
155	22.501	0.147	2.17	91.1	1.78	-	70	-0.026	2.33	0.15
156	22.652	0.151	2.17	91.1	1.97	-	70	-0.030	2.74	0.10
157	22.800	0.148	2.18	91.2	1.7	-	70	-0.024	2.71	0.11
158	22.947	0.147	2.18	91.3	1.64	-	70	-0.025	1.52	0.19
159	23.096	0.149	2.17	91.3	2	-	70	-0.030	1.79	0.16

BOX B TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Bay
Run #: 1

Job #: 23-144
Tracking #: 145
Technician: AK
Date: 5/5/2023

	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	23.242	0.146	2.17	91.4	1.85	103	70	-0.030	3.39	0.06
161	23.384	0.142	2.17	91.4	1.82	-	70	-0.028	4.42	0.04
162	23.537	0.153	2.17	91.4	1.78	-	70	-0.029	1.96	0.22
163	23.682	0.145	2.17	91.5	1.47	-	71	-0.027	3.56	0.07
164	23.835	0.153	2.17	91.5	1.43	-	70	-0.025	1.93	0.16
165	23.983	0.148	2.17	91.5	1.86	-	70	-0.024	2.06	0.15
166	24.131	0.148	2.17	91.6	1.43	-	71	-0.030	2.22	0.15
167	24.278	0.147	2.17	91.5	1.43	-	70	-0.026	3.51	0.05
168	24.422	0.144	2.18	91.6	1.75	-	71	-0.028	3.09	0.10
169	24.573	0.151	2.17	91.6	1.73	-	70	-0.028	2.13	0.17
170	24.721	0.148	2.17	91.6	1.65	101	71	-0.027	2.57	0.12
171	24.866	0.145	2.16	91.7	1.97	-	71	-0.031	2.43	0.12
172	25.013	0.147	2.17	91.7	1.51	-	71	-0.027	2.65	0.12
173	25.164	0.151	2.16	91.7	1.88	-	71	-0.029	2.29	0.17
174	25.310	0.146	2.17	91.7	1.85	-	71	-0.029	3.14	0.09
175	25.458	0.148	2.17	91.8	1.59	-	71	-0.025	2.43	0.12
176	25.603	0.145	2.17	91.7	2	-	71	-0.029	1.49	0.21
177	25.751	0.148	2.18	91.6	1.53	-	71	-0.028	3.36	0.08
178	25.902	0.151	2.17	91.9	1.42	-	71	-0.026	2.59	0.11
179	26.047	0.145	2.17	91.8	1.66	-	71	-0.029	2.42	0.16
180	26.193	0.146	2.17	91.8	1.51	99	71	-0.036	2.87	0.11
181	26.347	0.154	2.17	92	1.55	-	71	-0.034	3.29	0.08
182	26.491	0.144	2.17	92	1.7	-	71	-0.024	2.09	0.15
183	26.638	0.147	2.16	92.1	1.84	-	71	-0.031	1.50	0.21
184	26.786	0.148	2.17	92	1.8	-	71	-0.029	2.78	0.11
185	26.936	0.150	2.16	92	1.99	-	71	-0.028	2.78	0.08
186	27.084	0.148	2.17	92	1.77	-	70	-0.027	1.65	0.17
187	27.231	0.147	2.17	92	1.71	-	70	-0.025	1.04	0.16
188	27.376	0.145	2.17	91.9	1.45	-	70	-0.031	1.77	0.14
189	27.529	0.153	2.17	91.9	1.46	-	70	-0.029	2.91	0.08
190	27.672	0.143	2.17	91.8	1.99	99	70	-0.026	2.35	0.11
191	27.819	0.147	2.17	91.9	1.64	-	70	-0.026	1.95	0.14

BOX B TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Bay
Run #: 1

Job #: 23-144
Tracking #: 145
Technician: AK
Date: 5/5/2023

	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	27.970	0.151	2.16	91.9	1.6	-	70	-0.022	1.54	0.15
193	28.117	0.147	2.17	92	2.01	-	70	-0.026	1.29	0.17
194	28.260	0.143	2.16	92	1.98	-	70	-0.027	2.43	0.10
195	28.415	0.155	2.17	92	1.43	-	70	-0.025	2.17	0.10
196	28.560	0.145	2.17	92	1.93	-	70	-0.023	1.71	0.15
197	28.710	0.150	2.17	92	1.97	-	70	-0.024	1.87	0.16
198	28.855	0.145	2.16	92.1	1.65	-	70	-0.024	1.54	0.17
199	29.005	0.150	2.16	92	1.78	-	70	-0.025	2.26	0.11
200	29.151	0.146	2.16	92.1	1.88	99	70	-0.028	2.27	0.12
201	29.301	0.150	2.17	92.1	1.78	-	70	-0.029	2.88	0.07
202	29.444	0.143	2.16	92.1	1.44	-	70	-0.025	2.50	0.12
203	29.594	0.150	2.16	92.1	1.59	-	70	-0.026	1.55	0.16
204	29.740	0.146	2.17	92.2	1.53	-	70	-0.024	2.35	0.09
205	29.890	0.150	2.17	92.2	1.49	-	70	-0.023	2.34	0.12
206	30.034	0.144	2.17	92.2	1.86	-	70	-0.023	2.13	0.14
207	30.185	0.151	2.17	92.1	1.99	-	70	-0.026	1.72	0.15
208	30.332	0.147	2.17	92.2	1.53	-	70	-0.024	1.75	0.13
209	30.480	0.148	2.17	92.1	1.53	-	70	-0.020	2.14	0.11
210	30.627	0.147	2.16	92.2	1.53	100	70	-0.020	1.12	0.17
211	30.776	0.149	2.15	92.1	1.48	-	70	-0.023	0.91	0.19
212	30.923	0.147	2.17	92.2	1.97	-	70	-0.026	1.90	0.14
213	31.071	0.148	2.16	92.3	1.56	-	70	-0.029	3.28	0.06
214	31.218	0.147	2.17	92.2	1.99	-	70	-0.028	3.05	0.08
215	31.366	0.148	2.16	92.3	1.47	-	70	-0.023	1.72	0.18
216	31.514	0.148	2.16	92.2	1.56	-	70	-0.022	1.13	0.18
217	31.661	0.147	2.16	92.2	1.85	-	70	-0.019	1.70	0.12
218	31.809	0.148	2.17	92.2	1.72	-	70	-0.025	1.11	0.19
219	31.959	0.150	2.16	92.2	1.52	-	70	-0.028	2.48	0.10
220	32.104	0.145	2.16	92.2	1.84	100	70	-0.024	3.66	0.05
221	32.254	0.150	2.17	92.2	1.76	-	70	-0.026	1.88	0.20
222	32.402	0.148	2.17	92.2	1.92	-	70	-0.022	2.47	0.11
223	32.547	0.145	2.17	92.3	2	-	70	-0.021	1.14	0.22

BOX B TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Bay
Run #: 1

Job #: 23-144
Tracking #: 145
Technician: AK
Date: 5/5/2023

	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	32.696	0.149	2.16	92.3	1.68	-	70	-0.025	1.92	0.13
225	32.844	0.148	2.16	92.2	1.47	-	70	-0.023	1.69	0.14
226	32.992	0.148	2.17	92.3	1.82	-	70	-0.019	1.59	0.17
227	33.135	0.143	2.17	92.2	1.78	-	70	-0.021	1.24	0.16
228	33.290	0.155	2.17	92.2	1.5	-	70	-0.023	2.58	0.09
229	33.433	0.143	2.16	92.2	1.61	-	70	-0.023	2.55	0.12
230	33.583	0.150	2.17	92.2	1.9	99	70	-0.024	1.82	0.18
231	33.731	0.148	2.16	92.2	1.89	-	70	-0.027	2.00	0.16
232	33.879	0.148	2.16	92.2	2.01	-	70	-0.026	2.84	0.07
233	34.025	0.146	2.17	92.2	1.74	-	70	-0.019	1.25	0.20
234	34.175	0.150	2.17	92.2	1.86	-	70	-0.020	1.02	0.14
235	34.320	0.145	2.16	92.2	1.64	-	70	-0.025	1.54	0.12
236	34.468	0.148	2.16	92.2	1.8	-	70	-0.023	2.06	0.11
237	34.615	0.147	2.16	92.2	1.76	-	70	-0.025	3.18	0.06
238	34.766	0.151	2.17	92.2	1.44	-	70	-0.023	2.82	0.09
239	34.908	0.142	2.16	92.4	1.6	-	70	-0.023	1.25	0.18
240	35.061	0.153	2.17	92.4	1.57	99	70	-0.025	1.94	0.14
241	35.206	0.145	2.17	92.4	1.97	-	70	-0.025	3.60	0.04
242	35.354	0.148	2.17	92.4	1.92	-	70	-0.022	1.74	0.20
243	35.502	0.148	2.16	92.3	1.97	-	70	-0.026	1.73	0.18
244	35.655	0.153	2.17	92.3	1.97	-	70	-0.024	2.94	0.09
245	35.797	0.142	2.17	92.3	1.97	-	70	-0.025	2.43	0.15
246	35.950	0.153	2.17	92.3	1.91	-	70	-0.023	1.90	0.15
247	36.092	0.142	2.16	92.2	1.51	-	70	-0.021	1.05	0.17
248	36.240	0.148	2.16	92.2	1.49	-	70	-0.019	0.91	0.14
249	36.388	0.148	2.17	92.2	1.77	-	70	-0.021	2.10	0.11
250	36.536	0.148	2.17	92.3	1.84	100	70	-0.025	2.70	0.09
251	36.684	0.148	2.16	92.3	1.61	-	70	-0.029	3.57	0.05
252	36.836	0.152	2.17	92.3	1.73	-	70	-0.023	2.75	0.12
253	36.980	0.144	2.17	92.4	1.58	-	70	-0.021	1.04	0.20
254	37.129	0.149	2.16	92.4	1.64	-	70	-0.022	1.07	0.21
255	37.278	0.149	2.17	92.5	1.95	-	70	-0.026	1.70	0.12

BOX B TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Bay
Run #: 1

Job #: 23-144
Tracking #: 145
Technician: AK
Date: 5/5/2023

	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	37.425	0.147	2.17	92.5	1.73	-	70	-0.022	2.91	0.07
257	37.573	0.148	2.16	92.5	1.5	-	70	-0.021	2.02	0.13
258	37.721	0.148	2.17	92.5	1.78	-	70	-0.019	0.73	0.24
259	37.868	0.147	2.17	92.4	1.84	-	70	-0.027	1.87	0.11
260	38.017	0.149	2.17	92.6	1.97	101	70	-0.024	2.42	0.09
261	38.166	0.149	2.17	92.7	1.56	-	70	-0.026	2.15	0.13
262	38.312	0.146	2.17	92.6	1.56	-	70	-0.025	3.41	0.06
263	38.459	0.147	2.16	92.6	1.98	-	70	-0.023	1.76	0.20
264	38.607	0.148	2.16	92.5	1.55	-	70	-0.023	1.07	0.22
265	38.755	0.148	2.17	92.5	1.82	-	70	-0.021	1.80	0.12
266	38.900	0.145	2.16	92.5	1.47	-	70	-0.024	2.71	0.11
267	39.050	0.150	2.17	92.6	1.48	-	70	-0.023	3.08	0.07
268	39.198	0.148	2.16	92.5	1.54	-	70	-0.022	1.74	0.17
269	39.346	0.148	2.16	92.8	1.64	-	70	-0.021	1.14	0.17
270	39.496	0.150	2.17	92.7	1.43	99	70	-0.021	1.90	0.11
271	39.642	0.146	2.17	92.7	1.51	-	70	-0.026	2.32	0.12
272	39.791	0.149	2.17	92.6	1.92	-	70	-0.024	2.35	0.12
273	39.937	0.146	2.16	92.7	1.8	-	70	-0.022	2.55	0.10
274	40.083	0.146	2.16	92.6	1.53	-	70	-0.026	2.27	0.12
275	40.232	0.149	2.16	92.6	1.8	-	70	-0.021	2.24	0.12
276	40.379	0.147	2.16	92.7	1.55	-	70	-0.022	1.44	0.16
277	40.528	0.149	2.17	92.8	1.48	-	70	-0.022	1.22	0.13
278	40.675	0.147	2.17	92.7	1.72	-	70	-0.026	1.87	0.15
279	40.825	0.150	2.17	92.7	1.92	-	70	-0.025	2.86	0.07
280	40.971	0.146	2.18	92.7	1.49	98	70	-0.018	3.15	0.07
281	41.120	0.149	2.17	92.7	1.85	-	70	-0.021	1.33	0.21
282	41.266	0.146	2.17	92.7	1.94	-	70	-0.023	1.44	0.14
283	41.416	0.150	2.17	92.7	1.43	-	70	-0.022	1.07	0.18
284	41.562	0.146	2.17	92.6	1.9	-	70	-0.025	1.75	0.12
285	41.712	0.150	2.17	92.7	1.46	-	70	-0.026	2.73	0.06
286	41.859	0.147	2.18	92.7	1.86	-	70	-0.019	1.39	0.19
287	42.010	0.151	2.17	92.8	1.89	-	70	-0.024	1.79	0.15

BOX B TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Bay
Run #: 1

Job #: 23-144
Tracking #: 145
Technician: AK
Date: 5/5/2023

	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	42.155	0.145	2.17	92.8	1.99	-	70	-0.026	2.90	0.09
289	42.305	0.150	2.17	92.8	1.47	-	70	-0.023	2.26	0.15
290	42.447	0.142	2.16	92.8	1.73	100	71	-0.022	1.91	0.16
291	42.598	0.151	2.17	92.8	1.85	-	71	-0.023	1.62	0.15
292	42.746	0.148	2.16	92.8	1.86	-	71	-0.025	1.64	0.16
293	42.894	0.148	2.17	92.7	1.96	-	71	-0.027	2.51	0.11
294	43.041	0.147	2.17	92.8	1.95	-	71	-0.026	2.99	0.09
295	43.189	0.148	2.16	92.9	1.87	-	71	-0.022	1.55	0.19
296	43.337	0.148	2.16	92.8	1.82	-	71	-0.026	1.36	0.18
297	43.485	0.148	2.16	92.8	1.45	-	71	-0.025	2.68	0.07
298	43.630	0.145	2.17	92.8	1.93	-	71	-0.023	2.41	0.12
299	43.786	0.156	2.16	92.9	1.84	-	71	-0.026	1.58	0.20
300	43.925	0.139	2.16	92.8	1.76	103	71	-0.025	2.58	0.09
301	44.078	0.153	2.17	92.8	1.47	-	71	-0.022	2.65	0.08
302	44.221	0.143	2.16	92.8	1.5	-	71	-0.022	2.01	0.16
303	44.374	0.153	2.16	92.8	1.45	-	71	-0.023	1.44	0.15
304	44.522	0.148	2.17	92.9	1.44	-	71	-0.026	1.79	0.15
305	44.669	0.147	2.16	92.9	1.98	-	71	-0.023	2.79	0.09
306	44.815	0.146	2.16	93	1.78	-	71	-0.026	2.60	0.10
307	44.965	0.150	2.16	92.9	1.46	-	71	-0.026	2.02	0.17
308	45.111	0.146	2.16	93	1.53	-	71	-0.018	1.21	0.15
309	45.263	0.152	2.16	93.1	1.44	-	71	-0.014	0.37	0.15
310	45.407	0.144	2.16	93.1	1.49	101	71	-0.014	0.38	0.09
311	45.556	0.149	2.16	93.1	1.43	-	71	-0.017	0.67	0.09
312	45.703	0.147	2.16	93.1	1.99	-	71	-0.025	1.96	0.09
313	45.852	0.149	2.16	93.1	1.98	-	71	-0.028	2.93	0.06
314	45.999	0.147	2.17	93.2	1.84	-	71	-0.031	4.22	0.04
315	46.148	0.149	2.17	93.4	1.81	-	71	-0.030	3.63	0.10
316	46.293	0.145	2.17	93.4	1.73	-	71	-0.034	3.02	0.08
317	46.442	0.149	2.16	93.4	1.43	-	71	-0.026	3.86	0.06
318	46.591	0.149	2.17	93.5	1.45	-	71	-0.027	1.35	0.24
319	46.740	0.149	2.17	93.4	1.69	-	71	-0.024	2.23	0.11

BOX B TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Bay
Run #: 1

Job #: 23-144
Tracking #: 145
Technician: AK
Date: 5/5/2023

	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	46.887	0.147	2.17	93.3	1.91	99	71	-0.024	1.39	0.17
321	47.036	0.149	2.16	93.1	1.48	-	71	-0.024	1.80	0.15
322	47.183	0.147	2.16	93.1	1.95	-	71	-0.025	1.73	0.17
323	47.331	0.148	2.16	93.1	1.9	-	71	-0.026	3.21	0.05
324	47.479	0.148	2.17	93.1	1.48	-	71	-0.026	1.74	0.21
325	47.627	0.148	2.16	93.1	1.75	-	71	-0.022	1.60	0.13
326	47.775	0.148	2.17	93.1	2.01	-	71	-0.022	1.00	0.17
327	47.925	0.150	2.16	93.2	1.92	-	71	-0.024	1.80	0.12
328	48.068	0.143	2.17	93.1	2.01	-	71	-0.027	1.46	0.16
329	48.218	0.150	2.17	93.2	1.64	-	71	-0.027	3.34	0.05
330	48.367	0.149	2.17	93.2	1.98	99	71	-0.023	3.04	0.06
331	48.514	0.147	2.17	93.2	1.51	-	71	-0.024	1.64	0.19
332	48.659	0.145	2.16	93.2	1.88	-	71	-0.025	2.32	0.12
333	48.809	0.150	2.16	93.2	1.44	-	71	-0.022	1.99	0.15
334	48.957	0.148	2.16	93.2	1.96	-	71	-0.021	0.94	0.19
335	49.104	0.147	2.16	93.2	1.95	-	71	-0.020	1.02	0.12
336	49.256	0.152	2.16	93.2	1.78	-	71	-0.024	2.47	0.09
337	49.400	0.144	2.17	93.1	2	-	71	-0.030	2.91	0.09
338	49.547	0.147	2.17	93.1	1.56	-	72	-0.026	3.55	0.05
339	49.696	0.149	2.16	93.2	1.76	-	72	-0.029	2.53	0.14
340	49.843	0.147	2.16	93.1	1.42	98	72	-0.021	1.30	0.18
341	49.992	0.149	2.16	93.2	1.58	-	72	-0.021	0.48	0.17
342	50.141	0.149	2.16	93.2	1.79	-	72	-0.021	1.06	0.09
343	50.287	0.146	2.16	93.1	1.93	-	72	-0.022	1.96	0.09
344	50.437	0.150	2.16	93.1	1.49	-	72	-0.023	2.83	0.07
345	50.583	0.146	2.17	93.2	1.46	-	72	-0.022	2.08	0.14
346	50.734	0.151	2.16	93.2	1.85	-	72	-0.027	2.23	0.13
347	50.880	0.146	2.16	93.3	2.01	-	72	-0.027	3.67	0.04
348	51.030	0.150	2.16	93.4	1.77	-	72	-0.025	2.61	0.13
349	51.176	0.146	2.17	93.3	1.7	-	72	-0.020	1.77	0.15
350	51.325	0.149	2.17	93.4	1.94	101	72	-0.023	1.49	0.14
351	51.468	0.143	2.16	93.3	1.99	-	72	-0.022	1.66	0.14

BOX B TEST DATA - ASTM E2779 / ASTM E2515

Client: Heat Tech
Model: Bay
Run #: 1

Job #: 23-144
Tracking #: 145
Technician: AK
Date: 5/5/2023

	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	51.621	0.153	2.16	93.4	1.46	-	72	-0.024	2.23	0.15
353	51.766	0.145	2.16	93.4	1.85	-	72	-0.022	1.92	0.13
354	51.915	0.149	2.16	93.4	1.46	-	72	-0.024	1.58	0.17
355	52.062	0.147	2.16	93.5	1.43	-	72	-0.021	2.22	0.10
356	52.213	0.151	2.16	93.5	1.45	-	72	-0.026	2.05	0.12
357	52.356	0.143	2.16	93.5	1.56	-	72	-0.025	2.82	0.09
358	52.506	0.150	2.16	93.5	1.48	-	72	-0.021	1.69	0.17
359	52.657	0.151	2.16	93.7	1.5	-	72	-0.021	1.54	0.15
360	52.804	0.147	2.16	93.7	1.58	101	73	-0.022	1.19	0.13
Avg/Tot	52.804	0.147	2.15	89	1.71	100			2.81	0.11

LAB SAMPLE DATA - ASTM E2515

Client: Heat Tech
Model: Bay
Run #: 1

Job #: 23-144
Tracking #: 145
Technician: AK
Date: 5/5/2023

		Sample ID	Tare, mg	Final, mg	Catch, mg
Filters	**A**	G00538	243.9	248.6	4.7
	B	G00539	242.7	247.5	4.8
	C - 1st Hour	G00540	243.1	244.2	1.1
	Amb	G00541	241.9	241.9	0.0
Probes	**A**	2A	116056.8	116056.8	0.0
	B	2B	116173.6	116173.6	0.0
	C - 1st Hour	2C	116429.1	116429.2	0.1
O-rings	**A**	2A	3552.8	3553.0	0.2
	B	2B	3571.9	3572.2	0.3
	C - 1st Hour	2C	3389.8	3390.0	0.2

Placed in Dessicator on:	5/5/2023

Filters	**A**	248.6	5/8 10:24	248.6	5/9 8:30				
	B	247.5	5/8 10:24	247.5	5/9 8:30				
	C - 1st Hour	244.1	5/8 10:24	244.2	5/9 8:30				
	Amb	241.9	5/8 10:24	241.9	5/9 8:30				
Probes	**A**	116056.9	5/8 10:24	116056.6	5/9 8:30	116056.8	5/10 15:33		
	B	116173.9	5/8 10:24	116173.5	5/9 8:30	116173.6	5/10 15:33		
	C - 1st Hour	116429.4	5/8 10:24	116429.0	5/9 8:30	116429.2	5/10 15:33		
O-Rings	**A**	3553.2	5/8 10:24	3553.0	5/9 8:30				
	B	3572.3	5/8 10:24	3572.2	5/9 8:30				
	C - 1st Hour	3390.0	5/8 10:24	3390.0	5/9 8:30				

Train A Aggregate, mg:	**4.9**
Train B Aggregate, mg:	**5.1**
Train C Aggregate, mg:	**1.4**
Ambient Aggregate, mg:	**0.0**

ASTM E2779 Wood Heater Run Sheets

Client: Heat Tech Job Number: 23-144 Tracking #: 145
Model: Bay Run Number: 1 Test Date: 5/5/2023

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: 8:10

Time	Notes
8:10	Started recording preburn data, unit on high setting
9:10	PB End

Test Notes

Test Burn Start Time: 9:10

Time	Notes
9:10	Started sampling, unit at high setting
10:10	Switched to medium test setting
12:10	Switched to low test setting
15:10	End of test

Test Burn End Time: 15:10

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	8:59	9:00	9:01	15:11	15:12	15:13
CO_2	0.02	17.08	10.08	0.02	17.09	10.06
CO	0.000	4.254	2.527	-0.004	4.256	2.505

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 BAY 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.

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

Unit: HEAT TECH HTP 26 Bay
Date(s): 6/24, 25, 26, 29, 30, 2015
Technicians: ATM ESS
Page: 1 of 2

T/C#

HOUR #	2015 DATE	TIME	POUNDS BURNT	STACK TEMP	COMMENTS
1	6/24	950	2.5	324	Fire Started @ 8:50
2	|	1050	2.5	313	
3	|	1150	2.6	310	
4	|	1250	2.6	312	
5	|	1350	2.7	327	
6	|	1450	2.6	320	
7	|	1550	2.7	337	
8	|	1650	2.7	338	
9	|	1750	2.7	327	
10	|	1850	2.5	344	
11	|	1950	2.6	345	
12	|	2050	2.8	337	
13	|	2130	2.5	329	
14	|	2230	2.6	335	
15	↓	2330	2.6	332	
16	6/25	0030	2.5	342	
17	|	0130	2.6	337	
18	|	0230	2.4	327	
19	↓	0330	2.0	280	
20	6/25	0945	2.7	326	Fire Started @ 9:45
21	|	1045	2.9	323	
22	|	1145	2.6	326	
23	|	1245	1.0	327	
24	|	1345	2.5	343	
25	|	1445	3.0	356	
26	|	1545	2.6	347	
27	|	1645	2.9	345	Added fuel @ 1605
28	|	1745	3.0	343	
29	↓	1845	2.5	347	

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

Unit: HEAT TECH HTP 26 BAY
Date(s): 6/24, 25, 26, 29, 30, 2015
Technicians: ATM EDS
Page: 2 of 2

T/C# 1

HOUR #	2015 DATE	TIME	POUNDS BURNT	STACK TEMP	COMMENTS
30	6/25	1945	2.9	342	
31		2045	2.7	340	
32		2145	2.6	346	
33		2245	2.5	342	
34		2345	2.7	339	
35	6/26	0045	2.6	333	
36		0145	2.6	341	
37		0245	2.7	350	
38		0345	2.7	344	
39		0445	2.5	339	
40		0545	2.4	323	
41		0645	2.3	304	
42	6/29	1503	1.2	230	Fire Started @ 1403
43		1603	1.5	213	
44		1703	1.8	230	
45		1803	1.2	249	
46		1903	1.7	241	
47		2003	2.9	266	
48		2103	1.5	261	
49		2203	1.8	240	
50		2303	2.9	246	
51	6/30	0003	1.5	246	

Equations and Sample Calculations – ASTM E2779 & E2515

Client	Heat Tech
Model:	Bay
Tracking #:	145
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} = 12.3 lbs
M_{Ewb} = 0.0 lbs
0.4536 = Conversion factor from lbs to kg

M_{Bdb} = [(12.3 x 0.4536) - (0.0 x 0.4536)] (100/(100 + 6.36)

M_{Bdb} = **5.25** 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} = 8.5 lbs

M_{ESiwb} = 4.4 lbs

0.4536 = Conversion factor from lbs to kg

M_{BSidb} = [(8.5 x 0.4536) - (4.4 x 0.4536)] (100/(100 + 6)

M_{BSidb} = **1.74** 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} = 5.25 kg
θ = 360 min

$$BR = \frac{60 \times 5.25}{360}$$

BR = **0.87** 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} = 1.74 kg
θ = 120 min

$$BR = \frac{60 \times 1.74}{120}$$

BR = **0.87** 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:

$$Fp = \frac{6.25}{7.08} = 0.883$$

$$V_s = 0.883 \times 85.49 \times 0.99 \times 0.113 \times \left(\frac{81.1 + 460}{\left(29.91 + \frac{-0.05}{13.6}\right) \times 28.78} \right)^{1/2}$$

V_s = **6.67** 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:

$$Q_{sd} = 3600 \times (1 - 0.02) \times 6.67 \times 0.7854 \times \frac{528}{81.1 + 460} \times \frac{29.91 + \frac{-0.05}{13.6}}{29.92}$$

Q_{sd} = **18033.3** 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:

$$V_{m(std)} = 17.64 \times 54.377 \times 1.01 \times \frac{\left(29.91 + \frac{2.23}{13.6}\right)}{(90.2 + 460)}$$

$V_{m(std)}$ = **52.944** dscf

Using equation for Train B:

$$V_{m(std)} = 17.64 \times 52.804 \times 1.001 \times \frac{\left(29.91 + \frac{2.15}{13.6}\right)}{(88.7 + 460)}$$

$V_{m(std)}$ = **51.083** dscf

Using equation for ambient train:

$$V_{m(std)} = 17.64 \times 48.94 \times 1.024 \times \frac{\left(\underline{29.91} + \frac{0.00}{13.6}\right)}{(63.4 + 460)}$$

$V_{m(std)}$ = **50.508** 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 + 4.7 + 0.2

m_n = **4.9** mg

Using equation for Train B:

m_n = 0.0 + 4.8 + 0.3

m_n = **5.1** 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:

$$C_s = 0.001 \times \frac{4.9}{52.944}$$

C_s = **0.00009** g/dscf

For Train B:

$$C_s = 0.001 \times \frac{5.1}{51.083}$$

C_s = **0.00010** g/dscf

For Ambient Train

$$C_r = 0.001 \times \frac{0.0}{50.508}$$

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 = (0.000093 - 0.000000) x 18033.3 x 360 /60

E_T = **10.01** g

For Train B

E_T = (0.000100 - 0.000000) x 18033.3 x 360 /60

E_T = **10.80** g

Average

E = **10.41** g

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

7.5% of the average =	0.78
Train A difference (%) =	**3.8%**
Train B difference (%)=	**3.8%**

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):

$$PR = \left(\frac{360 \times 1.381 \times 6.67 \times (90.2 + 460) \times (86.8 + 460)}{10 \times 54.377 \times 6.79 \times (81.1 + 460) \times (70.3 + 460)} \right) \times 100$$

PR = **94** %

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) = 10.41 g

θ = 360 min

$$PM_R = 60 \times (10.41 / 360)$$

PM_R = **1.73** 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) = 10.41 g

M_{Bdb} = 5.25 kg

PM_F = 10.41 / 5.25)

PM_F = **1.98** 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: Bay
Date: 05/05/23
Run: 1
Control #: 23-144
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	63.74%	70.42%
Comb Eff	98.47%	98.47%
HT Eff	64.73%	71.52%
Output	10,956	kJ/h
Burn Rate	0.87	kg/h
Grams CO	256	g
Input	17,189	kJ/h
MC wet	5.98	

Ultimate CO_2
$CO_{2\text{-ult}}$ 18.12
F_0 1.142

Overall Heating Efficiency:	63.74%	Air Fuel Ratio (A/F)			
Combustion Efficiency:	98.47%	Dry Molecular Weight (M_d)	29.15		
Heat Transfer Efficiency:	64.73%	Dry Moles Exhaust Gas (N_j):	1453.85	%HC	
		Air Fuel Ratio (A/F)	41.88	0.8	

Heat Output:	10,393	Btu/h	10,956	kJ/h
Heat Input:	16,305	Btu/h	17,189	kJ/h
Burn Duration:	6.00	h		
Burn Rate:	1.93	lb/h	0.875	kg/h
Stack Temp:	261.8	Deg. F	127.7	Deg. C

Averages	0.11	2.81	6.67	20.49	17.62	127.84	17.43	97.8%	63.2%	#DIV/0!	47.48	2.26	59.58	2.17	58.67	103177	3.83

INPUT DATA				Oxygen Calculation			Input Data											
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)	Combust Eff %	Heat Transfer %	Net Eff %	Air Fuel Ratio	Wet Wt Now Wt	% Wet Consumed x	Dry Wt. Now Wt_{dn}	% Dry Comsumed y	Total Input	Carbon /12= [a]
0	5.58	0.04	4.89	267.8%	20.17	15.27	191.3	17.2	100.3%	67.4%	67.6%	22.9	5.58	0.00	5.25	0.00	0	3.83
1	5.56	0.03	4.81	273.9%	20.19	15.36	188.6	17.2	100.4%	67.4%	67.7%	23.2	5.56	0.41	5.23	0.41	671	3.83
2	5.53	0.04	4.67	284.3%	20.21	15.51	188.3	17.2	100.3%	66.9%	67.0%	23.9	5.53	0.89	5.20	0.89	503	3.83
3	5.50	0.07	3.81	366.9%	20.34	16.49	190.2	17.1	99.8%	61.9%	61.8%	29.0	5.50	1.38	5.17	1.38	587	3.83
4	5.47	0.03	5.10	253.4%	20.14	15.03	187.6	17.2	100.5%	68.7%	69.1%	22.0	5.47	2.03	5.14	2.03	587	3.83
5	5.44	0.03	4.89	268.3%	20.18	15.27	189.1	17.0	100.5%	67.7%	68.0%	22.9	5.44	2.52	5.11	2.52	461	3.83
6	5.42	0.05	4.45	302.4%	20.24	15.76	184.8	17.1	100.2%	66.3%	66.5%	25.0	5.42	2.93	5.09	2.93	503	3.83
7	5.39	0.03	5.08	254.5%	20.15	15.05	188.2	17.0	100.4%	68.5%	68.8%	22.0	5.39	3.50	5.06	3.50	629	3.83
8	5.35	0.02	7.21	150.8%	19.82	12.60	191.4	17.1	100.3%	73.9%	74.1%	15.6	5.35	4.15	5.03	4.15	461	3.83
9	5.34	0.11	3.47	406.3%	20.38	16.86	183.1	16.9	98.9%	60.6%	60.0%	31.3	5.34	4.39	5.02	4.39	461	3.83
10	5.30	0.04	4.25	322.5%	20.27	16.00	186.6	17.1	100.4%	65.0%	65.3%	26.3	5.30	5.04	4.98	5.04	587	3.83
11	5.27	0.02	6.57	175.1%	19.92	13.34	188.9	16.9	100.4%	72.8%	73.0%	17.1	5.27	5.53	4.96	5.53	545	3.83
12	5.24	0.03	5.40	234.3%	20.10	14.69	188.9	16.9	100.5%	69.5%	69.9%	20.8	5.24	6.10	4.93	6.10	587	3.83
13	5.21	0.02	5.29	241.1%	20.11	14.81	190.1	17.2	100.5%	69.1%	69.4%	21.2	5.21	6.67	4.90	6.67	503	3.83
14	5.19	0.09	4.00	343.6%	20.31	16.26	184.4	17.0	99.5%	64.0%	63.7%	27.5	5.19	7.07	4.88	7.07	587	3.83
15	5.15	0.03	6.55	175.5%	19.92	13.35	190.2	16.9	100.3%	72.6%	72.8%	17.2	5.15	7.80	4.84	7.80	587	3.83
16	5.12	0.02	5.63	220.7%	20.06	14.42	189.3	16.9	100.5%	70.2%	70.6%	20.0	5.12	8.21	4.82	8.21	461	3.83
17	5.10	0.02	5.97	202.8%	20.01	14.03	189.1	16.9	100.5%	71.2%	71.6%	18.9	5.10	8.70	4.79	8.70	629	3.83
18	5.05	0.03	5.05	256.7%	20.15	15.09	191.3	16.8	100.4%	68.0%	68.3%	22.2	5.05	9.43	4.75	9.43	713	3.83
19	5.02	0.02	7.02	157.4%	19.85	12.82	194.1	16.7	100.4%	73.2%	73.5%	16.0	5.02	10.08	4.72	10.08	545	3.83
20	5.00	0.03	5.41	233.2%	20.09	14.67	192.7	16.7	100.5%	69.1%	69.5%	20.7	5.00	10.49	4.70	10.49	503	3.83
21	4.96	0.03	5.08	254.1%	20.14	15.04	191.9	16.9	100.4%	68.1%	68.3%	22.0	4.96	11.06	4.67	11.06	545	3.83
22	4.94	0.03	5.73	214.7%	20.05	14.30	192.1	16.8	100.4%	70.2%	70.5%	19.6	4.94	11.54	4.64	11.54	545	3.83
23	4.90	0.02	5.86	208.0%	20.03	14.15	193.1	17.0	100.4%	70.5%	70.8%	19.2	4.90	12.11	4.61	12.11	503	3.83
24	4.88	0.03	5.99	201.0%	20.00	14.00	189.7	17.1	100.3%	71.3%	71.5%	18.7	4.88	12.52	4.59	12.52	461	3.83
25	4.85	0.04	4.60	290.4%	20.22	15.60	189.8	17.0	100.4%	66.3%	66.6%	24.3	4.85	13.01	4.56	13.01	545	3.83
26	4.82	0.02	6.23	189.7%	19.97	13.72	191.6	17.1	100.4%	71.7%	72.0%	18.0	4.82	13.58	4.53	13.58	587	3.83
27	4.79	0.03	5.86	207.8%	20.03	14.15	190.9	16.8	100.3%	70.7%	71.0%	19.2	4.79	14.15	4.50	14.15	545	3.83
28	4.76	0.03	5.34	237.3%	20.11	14.75	189.0	16.9	100.3%	69.3%	69.6%	21.0	4.76	14.63	4.48	14.63	461	3.83
29	4.74	0.03	6.33	185.3%	19.95	13.61	187.8	16.9	100.4%	72.3%	72.6%	17.8	4.74	15.04	4.46	15.04	545	3.83
30	4.71	0.04	5.28	241.3%	20.11	14.82	190.5	16.9	100.3%	68.9%	69.2%	21.2	4.71	15.69	4.42	15.69	587	3.83
31	4.68	0.03	5.43	232.1%	20.09	14.65	190.7	16.7	100.4%	69.4%	69.7%	20.7	4.68	16.18	4.40	16.18	545	3.83
32	4.65	0.03	5.16	248.8%	20.13	14.95	191.3	16.9	100.4%	68.4%	68.7%	21.7	4.65	16.75	4.37	16.75	545	3.83

Moisture Content M_{Cwb}: 5.98

Combustion Efficiency:	98.47%		Moisture of Wood (wet basis):	5.98	Dry kg : 5.25
Total Input (kJ):	103,133	97,817 (Btu)	Initial Dry Weight Wt_{do} (kg):	5.25	CA: 46
Total Output (kJ):	65,735	62,346 (Btu)	Moisture Content Dry	6.36	HY: 9
Efficiency:	63.74%				OX: 44.87
Total CO (g):	256.17				

Load Weight (kg):	**5.58**			
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	79.46	21.08	0.76	3.31	-0.01	0.08	36.58	299.70	2.14	-0.19	1301.33	43.84	3.53	400.99	4383.27	3305.10	3215.53	3179.57
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	79.81	21.17	1.28	5.58	-0.02	0.13	38.39	119.89	0.31	-0.17	626.72	43.79	3.53	464.48	7048.96	5254.47	5097.21	5043.31
8.65	2.80	19655.47	5.98	79.80	21.17	1.26	5.49	-0.02	0.13	38.44	122.62	0.26	-0.18	637.19	43.82	3.53	461.76	6931.98	5170.22	5016.21	4963.01
8.65	2.80	19655.47	5.98	79.77	21.16	1.22	5.34	-0.02	0.12	38.34	127.29	0.36	-0.17	654.55	43.80	3.53	461.43	6917.67	5159.91	5006.29	4953.18
8.65	2.80	19655.47	5.98	79.63	21.12	1.01	4.39	-0.02	0.10	37.99	164.42	0.72	-0.18	793.92	43.82	3.53	463.37	7005.41	5223.34	5067.34	5013.69
8.65	2.80	19655.47	5.98	79.84	21.18	1.33	5.81	-0.02	0.13	38.51	113.38	0.19	-0.18	602.45	43.81	3.53	460.76	6891.18	5140.92	4988.06	4935.11
8.65	2.80	19655.47	5.98	79.81	21.17	1.28	5.57	-0.02	0.13	38.47	120.09	0.24	-0.18	627.71	43.82	3.53	462.26	6961.89	5192.22	5037.48	4984.08
8.65	2.80	19655.47	5.98	79.73	21.15	1.17	5.10	-0.02	0.12	38.27	135.43	0.43	-0.18	685.11	43.81	3.53	457.93	6771.85	5054.96	4905.41	4853.18
8.65	2.80	19655.47	5.98	79.84	21.18	1.33	5.79	-0.02	0.13	38.43	113.88	0.26	-0.17	604.11	43.79	3.53	461.37	6923.73	5164.72	5011.03	4957.86
8.65	2.80	19655.47	5.98	80.17	21.27	1.88	8.17	-0.02	0.19	38.52	67.36	0.11	-0.11	428.57	43.66	3.53	464.54	7057.67	5261.09	5103.66	5049.69
8.65	2.80	19655.47	5.98	79.56	21.10	0.93	4.05	-0.01	0.09	37.46	182.05	1.20	-0.13	859.11	43.72	3.53	456.21	6704.47	5006.65	4859.02	4807.18
8.65	2.80	19655.47	5.98	79.71	21.14	1.11	4.86	-0.02	0.11	38.37	144.47	0.36	-0.21	719.55	43.86	3.53	459.76	6852.51	5113.26	4961.52	4908.79
8.65	2.80	19655.47	5.98	80.07	21.24	1.71	7.45	-0.02	0.17	38.53	78.26	0.12	-0.12	469.80	43.70	3.53	462.04	6956.56	5188.61	5034.06	4980.68
8.65	2.80	19655.47	5.98	79.89	21.19	1.41	6.14	-0.02	0.14	38.50	104.80	0.19	-0.16	569.99	43.78	3.53	462.04	6954.45	5186.98	5032.47	4979.10
8.65	2.80	19655.47	5.98	79.87	21.19	1.38	6.01	-0.02	0.14	38.53	107.85	0.17	-0.17	581.59	43.79	3.53	463.26	6998.52	5218.27	5062.43	5008.83
8.65	2.80	19655.47	5.98	79.65	21.13	1.06	4.62	-0.02	0.11	37.86	153.90	0.81	-0.15	753.83	43.75	3.53	457.54	6759.41	5046.21	4897.05	4844.88
8.65	2.80	19655.47	5.98	80.07	21.24	1.71	7.44	-0.02	0.17	38.50	78.44	0.15	-0.12	470.37	43.69	3.53	463.32	7011.45	5228.15	5072.08	5018.37
8.65	2.80	19655.47	5.98	79.93	21.20	1.47	6.39	-0.02	0.15	38.52	98.71	0.16	-0.16	547.05	43.76	3.53	462.48	6975.65	5202.36	5047.29	4993.79
8.65	2.80	19655.47	5.98	79.98	21.22	1.56	6.77	-0.02	0.15	38.55	90.65	0.12	-0.15	516.68	43.75	3.53	462.26	6966.10	5195.49	5040.68	4987.23
8.65	2.80	19655.47	5.98	79.83	21.18	1.32	5.75	-0.02	0.13	38.44	114.88	0.25	-0.17	607.93	43.79	3.53	464.48	7063.72	5265.90	5108.40	5054.37
8.65	2.80	19655.47	5.98	80.14	21.26	1.83	7.96	-0.02	0.18	38.54	70.33	0.10	-0.11	439.83	43.68	3.53	467.26	7187.52	5355.21	5194.30	5139.51
8.65	2.80	19655.47	5.98	79.89	21.19	1.41	6.16	-0.02	0.14	38.50	104.30	0.18	-0.16	568.11	43.78	3.53	465.82	7125.31	5310.46	5151.29	5096.87
8.65	2.80	19655.47	5.98	79.84	21.18	1.33	5.79	-0.02	0.13	38.43	113.72	0.26	-0.17	603.53	43.79	3.53	465.09	7085.79	5281.56	5123.39	5069.24
8.65	2.80	19655.47	5.98	79.94	21.20	1.50	6.52	-0.02	0.15	38.49	96.02	0.18	-0.15	536.77	43.75	3.53	465.21	7094.79	5288.27	5129.90	5075.68
8.65	2.80	19655.47	5.98	79.96	21.21	1.53	6.66	-0.02	0.15	38.52	93.01	0.15	-0.15	525.50	43.75	3.53	466.26	7133.90	5316.06	5156.52	5102.09
8.65	2.80	19655.47	5.98	79.98	21.22	1.56	6.81	-0.02	0.16	38.47	89.87	0.19	-0.13	513.50	43.72	3.53	462.87	6986.03	5209.50	5054.06	5000.52
8.65	2.80	19655.47	5.98	79.76	21.16	1.20	5.26	-0.02	0.12	38.39	130.05	0.32	-0.19	665.12	43.83	3.53	462.98	6992.91	5214.57	5058.97	5005.38
8.65	2.80	19655.47	5.98	80.02	21.23	1.63	7.08	-0.02	0.16	38.51	84.80	0.15	-0.13	494.42	43.72	3.53	464.71	7062.74	5264.62	5107.02	5053.03
8.65	2.80	19655.47	5.98	79.96	21.21	1.53	6.66	-0.02	0.15	38.46	92.92	0.20	-0.14	525.02	43.73	3.53	464.04	7044.61	5252.14	5095.17	5041.25
8.65	2.80	19655.47	5.98	79.88	21.19	1.40	6.08	-0.02	0.14	38.43	106.17	0.24	-0.15	574.99	43.76	3.53	462.15	6959.22	5190.42	5035.77	4982.38
8.65	2.80	19655.47	5.98	80.03	21.23	1.65	7.18	-0.02	0.16	38.50	82.83	0.15	-0.13	486.98	43.71	3.53	460.93	6908.87	5154.24	5001.01	4947.92
8.65	2.80	19655.47	5.98	79.87	21.18	1.38	6.01	-0.02	0.14	38.42	107.94	0.26	-0.15	581.63	43.76	3.53	463.65	7023.67	5236.84	5080.40	5026.62
8.65	2.80	19655.47	5.98	79.89	21.19	1.42	6.18	-0.02	0.14	38.47	103.81	0.21	-0.16	566.18	43.77	3.53	463.82	7039.27	5248.53	5091.76	5037.85
8.65	2.80	19655.47	5.98	79.85	21.18	1.35	5.88	-0.02	0.13	38.45	111.33	0.24	-0.16	594.54	43.78	3.53	464.48	7061.61	5264.27	5106.80	5052.79

			SUMS							AVERAGE	SUMS						
4205.60	3848.40	290.58	58365.08	316526.99	220839.24	1346101.09	-62657.17	756781.39	60996.52	7470.78	37555.86	1738.85	35817.0	65620.9	1581.3	256.2	-15.3
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
6896.01	6095.69	290.37	270.58	629.97	88.22	3160.74	-151.76	2192.46	176.91	6367.12	0.00	0	0.00	0	0	0.00	0.00
6775.13	5999.05	290.37	266.47	633.99	75.89	3162.37	-162.62	2189.44	176.56	6342.11	216.44	-3	219.40	454	-3	0.25	-0.10
6760.36	5987.22	290.37	265.19	656.81	103.98	3242.09	-155.75	2188.16	176.52	6477.00	165.78	-1	167.12	337	-1	0.26	-0.07
6850.48	6060.08	290.26	266.12	858.82	206.79	3980.45	-163.67	2192.23	176.78	7517.53	224.48	1	223.27	362	1	0.60	-0.09
6732.76	5965.48	290.32	265.39	582.87	54.32	2973.13	-158.56	2187.52	176.45	6081.12	181.59	-3	184.69	405	-3	0.16	-0.08
6805.02	6024.47	290.15	267.81	623.56	67.96	3128.54	-162.57	2190.55	176.65	6292.51	147.64	-2	149.86	314	-2	0.16	-0.07
6609.47	5866.88	290.26	259.16	684.57	123.69	3324.95	-158.89	2183.24	176.10	6592.82	168.75	-1	169.67	334	-1	0.31	-0.07
6765.61	5992.92	290.15	266.09	588.14	74.10	2995.11	-149.14	2187.67	176.54	6138.51	196.40	-2	198.80	432	-2	0.23	-0.09
6904.27	6103.41	290.21	271.83	354.41	32.34	2164.16	-94.20	2186.37	176.93	5091.86	119.47	-1	120.91	342	-1	0.07	-0.04
6539.36	5811.56	290.09	251.14	911.46	345.02	4129.91	-120.93	2176.60	175.90	7869.11	184.63	5	179.49	277	5	0.79	-0.05
6692.37	5933.83	290.21	262.91	738.72	103.98	3532.12	-184.02	2188.97	176.33	6819.01	203.62	-2	206.03	383	-2	0.30	-0.10
6799.02	6020.42	290.04	268.03	406.09	33.80	2339.94	-111.38	2184.67	176.64	5297.78	146.90	-2	149.04	398	-2	0.09	-0.06
6797.09	6018.50	290.09	267.74	543.58	53.43	2838.02	-144.90	2188.32	176.63	5922.82	176.86	-3	179.59	410	-3	0.16	-0.08
6843.62	6054.21	290.32	269.62	562.79	48.24	2913.08	-152.63	2190.74	176.76	6008.60	153.79	-3	156.46	349	-3	0.12	-0.07
6596.17	5856.92	290.15	255.88	776.63	234.31	3652.19	-131.98	2179.81	176.06	7142.92	213.30	3	210.33	374	3	0.68	-0.07
6855.73	6065.77	290.04	269.91	410.09	42.31	2360.47	-107.27	2186.19	176.80	5338.50	159.41	-2	161.35	428	-2	0.12	-0.06
6818.73	6036.19	290.04	268.70	513.54	45.34	2731.85	-139.08	2188.44	176.70	5785.51	135.74	-2	137.93	325	-2	0.10	-0.06
6808.87	6028.30	290.04	268.57	470.99	33.49	2576.81	-131.94	2187.30	176.67	5581.89	178.59	-3	181.72	450	-3	0.10	-0.08
6909.51	6109.11	289.98	271.53	604.95	72.40	3072.69	-151.71	2193.04	176.95	6239.86	226.26	-3	229.14	486	-3	0.26	-0.10
7037.15	6211.60	289.87	276.98	376.63	28.47	2260.53	-101.11	2191.87	177.32	5210.69	144.48	-2	146.49	401	-2	0.08	-0.05
6972.73	6160.29	289.87	274.31	553.89	53.27	2895.58	-144.21	2194.45	177.13	6004.42	153.68	-2	156.01	349	-2	0.13	-0.07
6932.85	6126.98	290.09	272.32	600.62	74.05	3059.42	-148.95	2193.52	177.02	6227.99	172.69	-2	174.77	372	-2	0.20	-0.07
6941.65	6134.76	289.98	273.06	507.75	52.23	2724.46	-131.09	2191.86	177.04	5795.32	160.69	-2	162.88	384	-2	0.14	-0.06
6982.90	6166.49	290.15	274.78	494.46	43.55	2681.14	-130.65	2193.20	177.16	5733.64	146.75	-2	148.98	356	-2	0.11	-0.06
6830.21	6044.24	290.21	268.76	468.18	53.63	2567.79	-120.23	2186.69	176.72	5601.55	131.43	-2	132.99	330	-2	0.12	-0.05
6837.07	6050.11	290.15	268.47	678.15	91.28	3329.19	-166.90	2192.16	176.75	6569.10	182.15	-2	184.26	363	-2	0.25	-0.08
6909.76	6107.41	290.26	271.95	446.42	42.72	2498.30	-117.53	2189.15	176.95	5507.97	164.47	-2	166.70	422	-2	0.12	-0.06
6889.75	6093.33	289.98	270.96	488.04	56.75	2646.74	-123.65	2189.22	176.90	5704.96	158.19	-2	160.04	387	-2	0.15	-0.06
6802.02	6022.44	290.09	267.46	551.07	70.49	2864.83	-138.33	2187.76	176.65	5979.93	140.30	-2	141.90	321	-2	0.16	-0.06
6749.78	5980.98	290.04	265.97	426.94	43.81	2409.53	-113.71	2183.20	176.50	5392.25	149.52	-2	151.45	395	-2	0.12	-0.06
6868.61	6075.69	290.09	269.82	565.26	75.52	2923.64	-138.65	2190.12	176.84	6062.55	181.03	-2	182.93	406	-2	0.22	-0.07
6883.73	6089.28	289.87	270.83	544.84	59.21	2852.34	-140.30	2190.90	176.88	5954.69	165.11	-2	167.36	380	-2	0.16	-0.07
6907.59	6107.19	290.04	271.51	586.08	68.64	3004.10	-147.81	2192.53	176.95	6152.00	170.58	-2	172.78	374	-2	0.18	-0.07

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.

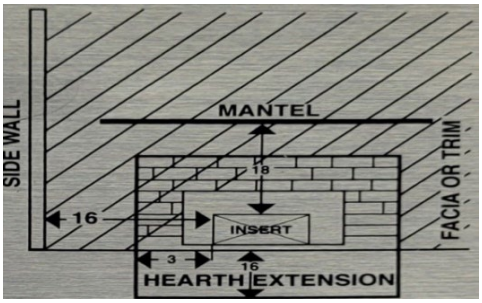
----------**Minimum Clearances to Combustible Materials (in inches)**- ----------

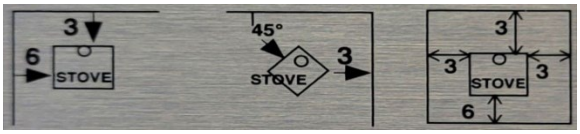
Compliant to EPA emission standards 2020." to "U.S. ENVIRONMENTAL PROTECTION AGENCY Certified to comply with 2020 particulate emission standards. Tested to ASTM E2779-10 & ASTM E2515-17 HTP STANDARD 1.2 G/HR, HTP BAY 1.7 G/HR. These pellet fire appliances have been tested & approved for use in manufactured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

Table of Contents

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.

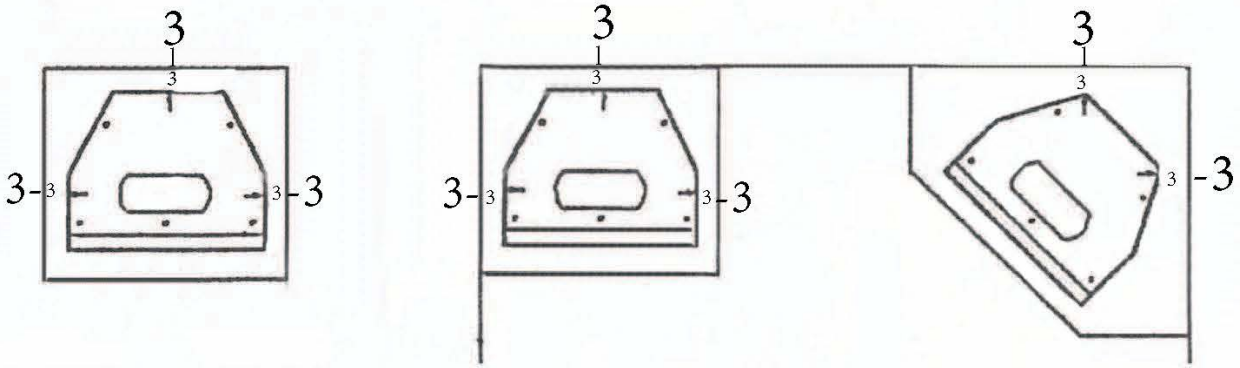
The purchaser must return the warranty card to validate the warranty.

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.



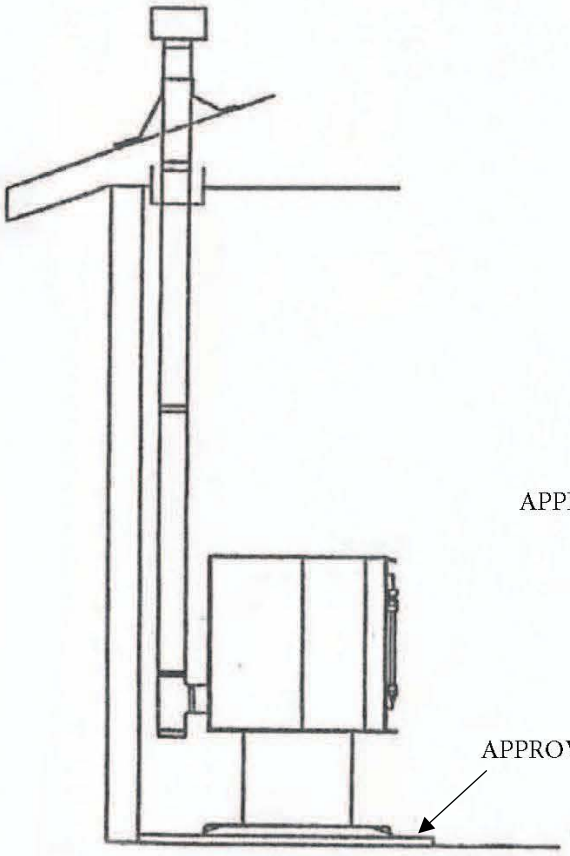


FIGURE 1: LONG EXHAUST SYSTEM

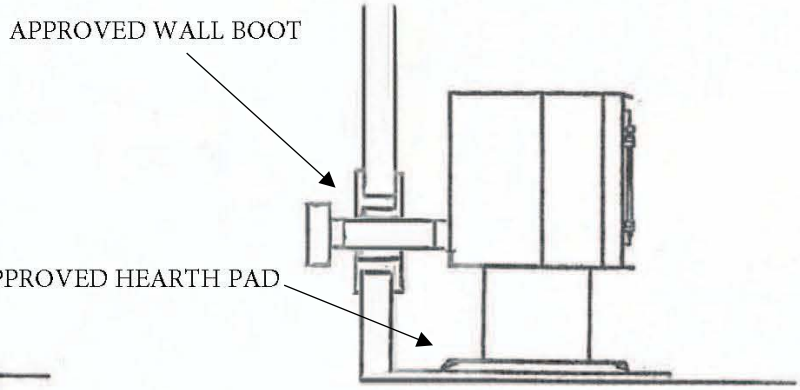


FIGURE 2: SHORT EXHAUST SYSTEM

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.

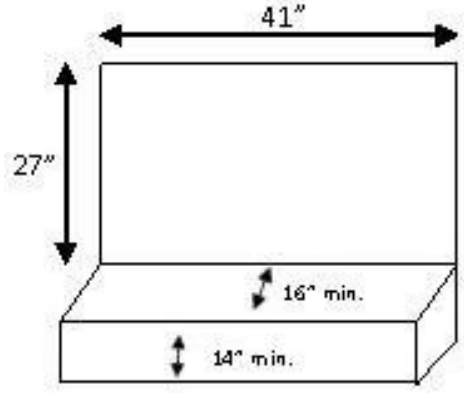
- Route power cord out the side nearest a 120V receptacle.
- Slide in insert.
- Measure and build chimney top. Cut out hole for vent pipe (and combustion air pipe if used). Install and seal with a non- hardening mastic to prevent water leakage.
- Install the vent cap.

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

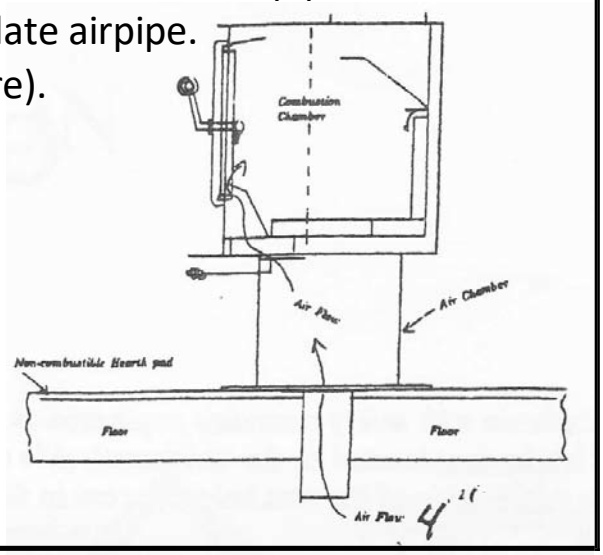
The combustion air supply for mobile home installations must be connected to an outside source of combustion air. A 1 ¾" inside diameter metallic pipe, either flexible or rigid, must be used when outside air is to be connected. It attaches to the combustion air outlet at the rear of the stove and is 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.

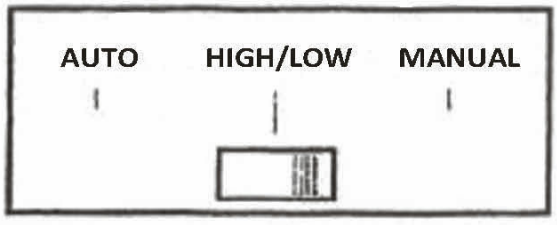
AUTO THERMOSTAT MODE

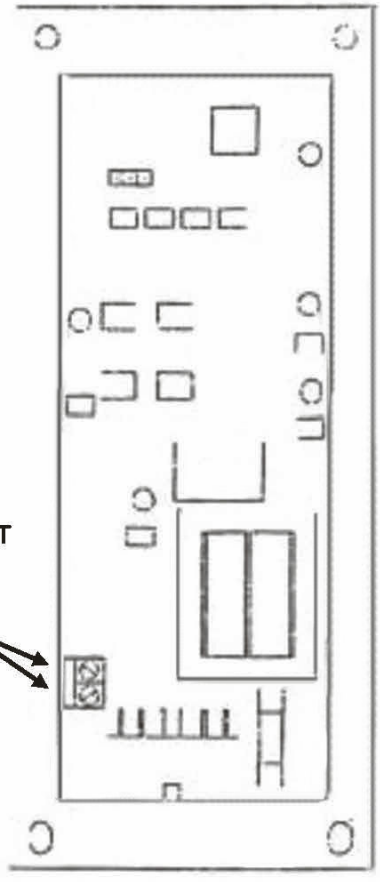
- When engaged in this mode the stove will automatically switch between two settings. When warm enough, it will switch to the #1 or low setting. The room air blower will also slow to its lowest speed.
- The Heat Level Advance setting on the bar graph will stay where it was initially set. When the house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

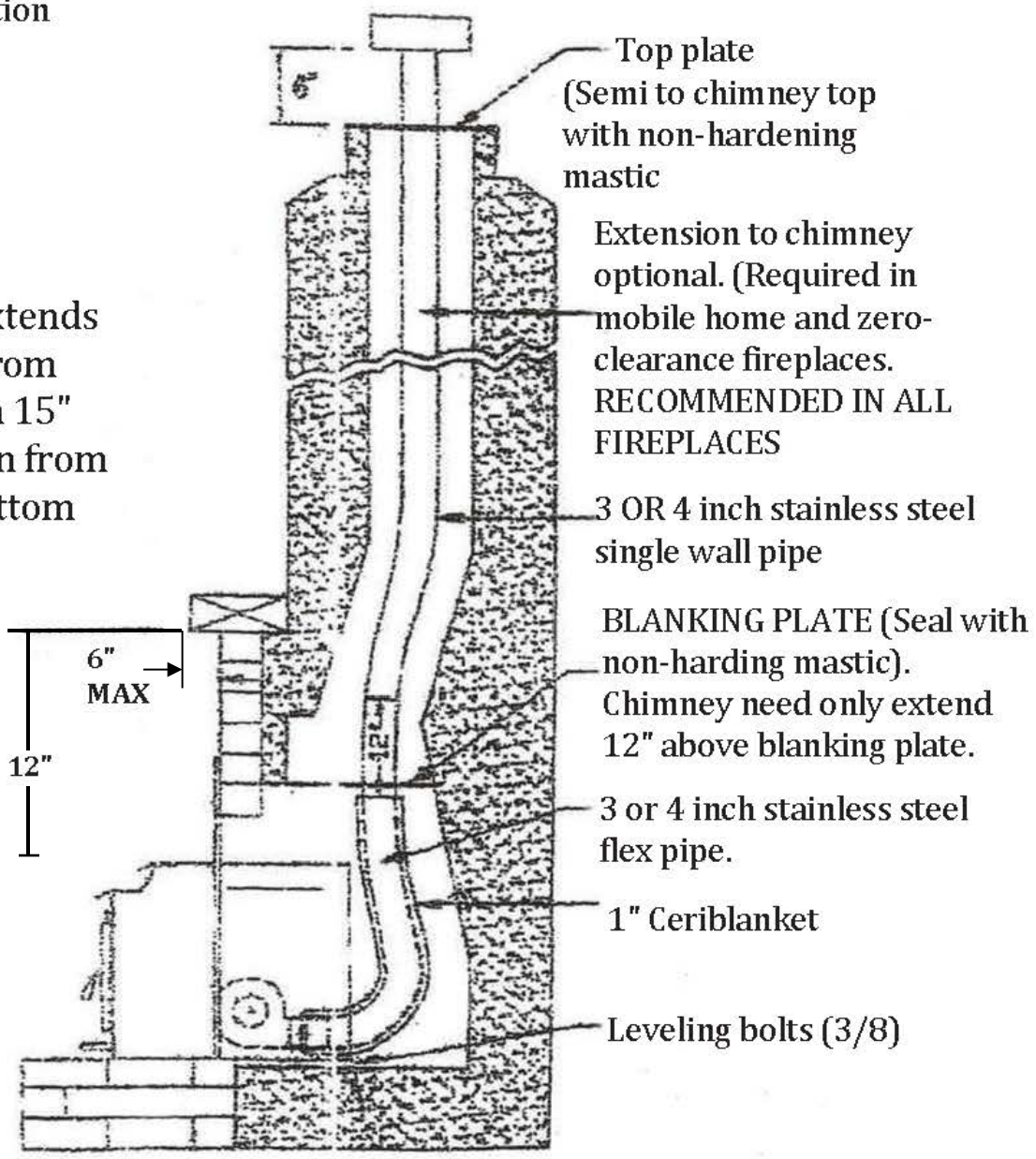
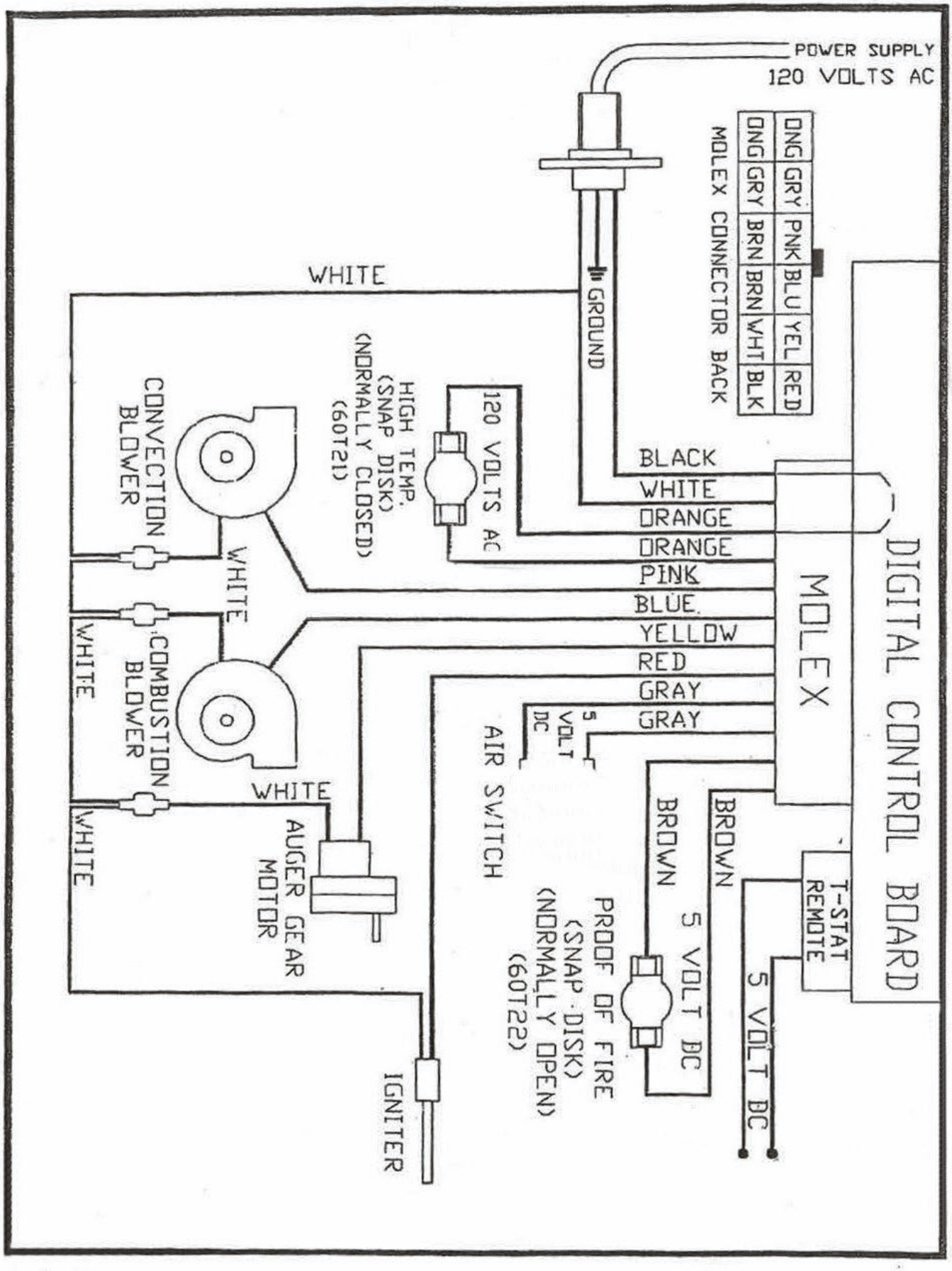


FIGURE 13


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

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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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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 #: 28140-203324-14

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Local 503-654-9620

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:

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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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: 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:

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 #:	28140-203325-14	**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.
Cleaning and preventative maintenance were performed as part of this service.

Cal-Cert is accredited by A2LA under Calibration Laboratory Code #4986.01.
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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

Report and Certificate of Calibration

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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:

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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

Report and Certificate of Calibration

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

Technical Manager: Marshall Doyle **Signature:** 

Report #: 28140-203320-14

Report and Certificate of Calibration

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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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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

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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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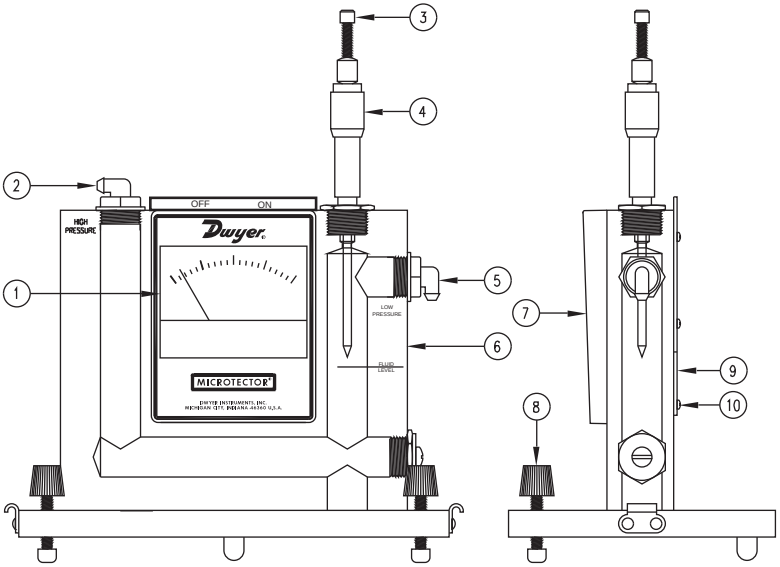
e-mail: info@dwyer-inst.com



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
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Fax: 219/872-9057 **e-mail: info@dwyer-inst.com**

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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

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CALIBRATION CERTIFICATION

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800-356-4662

Address
5777 SE International Way
Milwaukie, OR 97222

Local
503-654-9620

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

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:**	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