

**Certification Test Report**  
**Non-Confidential Business Information**  
**(Non-CBI)**

Central Boiler, Inc. and WoodMaster Inc.  
(an affiliate of Central Boiler, Inc.)  
**Pellet-Fired Hydronic Heater**  
**Model: Maxim M255 PE**

**Prepared for:** Central Boiler, Inc.  
WoodMaster, Inc  
20502 160th Street  
Greenbush, MN 56726

**Prepared by:** OMNI-Test Laboratories, Inc.  
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**Test Period:** 8/17/2020 – 8/19/2020

**Original Report Date:** October 7, 2020  
**Report Revision Date:** December 23, 2021  
**Report Number:** 0117PS024E

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*Model: Maxim M255 PE  
Central Boiler, Inc. WoodMaster, Inc.  
20502 160th Street  
Greenbush, MN 56726*

## **AUTHORIZED SIGNATORIES**

This report has been reviewed and approved by the following authorized signatories:

### **Evaluator:**

A handwritten signature in black ink, appearing to read "Bruce Davis", written over a horizontal line.

Bruce Davis, Testing Manager  
OMNI-Test Laboratories, Inc.



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# **Section 1**

## **Introduction/Appliance Description/Photographs/Drawings**

## INTRODUCTION

Central Boiler, Inc., and WoodMaster, Inc. are commonly owned and operated under Central Boiler Companies. Any use of the Central Boiler, Inc name in this report will also cover products manufactured under WoodMaster, Inc. Central Boiler, Inc. retained OMNI-Test Laboratories, Inc. (*OMNI*) to perform certification emissions testing on the Maxim M255 PE boiler in accordance with U.S. EPA 40 CFR Part 60, Subpart QQQQ – Standards of Performance for New Residential Hydronic Heaters and Forced-Air Furnaces. The Maxim M255 PE furnace when tested with pellet fuel meets the 2020 particulate matter emission limit of 0.10 lbs/mmBtu heat output for each individual category.

Test Number	Output BTU/Hr.	Particulate Emissions lb/mmBtu Output	Delivered Efficiency (% HHV)
Run 2 / CAT I	27846	0.02	89.6
Run 2 / CAT I	42670	0.03	89.9
Run 3 / CAT II	70570	0.05	89.3
Run 1 / CAT IV	182504	0.05	82.8

The testing was performed at *OMNI*'s testing facility in Portland, Oregon. The unit was received in good condition and logged in on August 13, 2020 then assigned and labeled with *OMNI* ID #2423. *OMNI* representatives Bruce Davis conducted the certification testing and completed all testing by August 19, 2020.

The unit was conditioned for 48 hours prior to testing by operating it at a Category II and III heat output rate.

The testing method used is composed of four distinct aspects:

- **Particulate Matter Emissions:** Particulate matter sampling using a dilution tunnel via ASTM E2618-13, and ASTM E2515-11
- **Delivered Efficiency:** Using entering and exiting water temperature differences along with measured flow rate to determine useful heat output.
- **Thermal Efficiency and CO Emissions:** Measured using sections 13.7 through 13.10 of CSA B415-10.
- **Operation:** As dictated by ASTM E2618, the appliance is brought to operating temperature before starting particulate sampling, providing for a hot-to-hot test cycle with measurements taken under constant heat draw conditions within pre-determined ranges. There is no attempt to modulate heat demand to simulate an indoor thermostat cycling on and off in response to changes in the indoor environment.

Four test categories are used within the "Operation" scope:

- **Category I:** Heat Output less than 15% of Manufacturer's Rated Heat Output Capacity
- **Category II:** Heat Output 16 To 24% of Manufacturer's Rated Heat Output Capacity
- **Category III:** Heat Output 25 To 50% of Manufacturer's Rated Heat Output Capacity
- **Category IV:** Manufacturer's Rated Heat Output Capacity

This test report shall not be reproduced, except in full, without written approval from *OMNI*. The test results presented herein apply only to the specific appliance tested.

In a letter dated September 1, 2021, generated by the EPA (see appendix B), deficiencies were published concerning first hour sampling procedures and conditioning documentation. In edition 002 of this report, dated March 22, 2021, deficiencies from an EPA review conducted in December of 2020 concerning conditioning data and first hour emissions data were addressed. In this most current deficiency letter, EPA added a concern regarding leak check procedures in collecting first hour emissions data. To date, there has been no written procedure in any certification standard on how to handle a first hour filter change. The requirement only states that the testing laboratory must also measure the first hour emissions for each test using a separate filter in one of the two parallel trains. A leak check requirement is established in the test standard but has no procedure on how to handle volume loss during the required 1-minute leak check procedure. This loss of volume when sampling at 1-minute intervals will produce proportional rates outside of acceptable limits. To avoid possible rejection of data based on proportional rate requirements, OMNI has used the following procedure:

A pre-test leak check was performed on all filter trains at a vacuum considerably higher than what is present during normal sampling operation. This validates no leaks are present in all sampling systems at the start of the test. As required at one hour, the front filter in train A was replaced using a separate filter. At the conclusion of testing, a post-test leak check is conducted as required by the standard. This procedure assures that the sampling system was leak tight throughout the sampling period.

Similar to sampling system A, sampling system B is leak checked prior to testing and then again at the conclusion of the sampling period, however this train is not opened during testing. Comparing particulate concentrations of trains, A, and train B for test number two, it shows a concentration of 0.000011 grams/dscf. for train A, and 0.000010 grams/dscf. for train B. As shown in section 4, emissions results for each train are in acceptable agreeance with each other as specified by clause 11.7.

Clause 9.6.5.1 of ASTM E2515 states that if a leak rate of 0.01 cfm or 4% of the average sample rate can not be achieved the test shall be considered void, unless the total emissions measured by the dual sampling trains agree within the allowable limit as shown in clause 11.7, and one of the trains is within the specified maximum posttest leakage rate. Based on this, train A total emissions including both first hour and remainder emissions are within specifications of clause 11.7 and therefor valid for inclusion into the average emissions results.

The appliance under test utilizes an automatic fuel/combustion system that cycles on and off to maintain a preset internal water temperature, the frequency of the cycle is dependent on the amount of demand for heated water. Due to the nearly steady state combustion characteristics of this mechanized pellet fueled appliance, it is reasonable that the first hour emissions are proportional to the total hours of the respective test run.

In an email dated December 15, 2021, EPA raised additional concerns regarding negative filter weights in the first hour emissions results. At the conclusion of run two, first hour front filter was found to be negative by 0.3 milligrams. The O-ring used in the first hour train did not show the 0.3 milligrams of weight transfer from the first hour filter. Since the remainder filter used in run two shares the same O-ring gasket, it is possible that filter material transferred from the first hour filter to the O-ring, was again transferred to the remainder filter which did pick up more weight than all other filters. It should be noted that the test standard considers filters to have reached a constant weight when a difference of no more than 0.2 milligrams is observed in weighing no less than 6 hours apart. Any variance of 0.2 milligrams or less in filter weights, be it negative or positive is built into the standard and should be expected.

Because there was no definitive evidence of where the 0.3 milligrams of filter weight in question ended up, EPA took exception to adding the negative filter weight into the total catch calculation. Negative filter values are typically added back into the calculation to prevent transfer weight from being counted as emissions on the remainder filter train.

To eliminate the concern, any negative filter weights found on any train used during the four-run series were counted as zero weight. This would allow any transfer filter weight to be wrongly counted as emissions. The following table provides emissions results that can be used as reference data showing the affects of negative filter weights. Average lb/MMBtu increased from 0.03 to 0.04, first hour emissions for tests 1 and 2 remain less than detectable by the test standard. See appendix C to view modified data.

**Modified results with all negative filter weights counted as zero weight.  
 (Reference Values)**

	E <sub>T</sub>	E	E	E <sub>g/hr.</sub>	E <sub>g/kg</sub>	
Run Number	Total PM Emissions (Grams)	PM output Based (lb/MMBtu Out)	PM output Based (g/MJ)	PM Rate (g/hr)	PM Rate (g/hr)	Train Precision (g/kg)
<b>2</b>	<b>1.5</b>	<b>0.03</b>	<b>0.01</b>	<b>0.4</b>	<b>0.2</b>	<b>0.19</b>
<b>3</b>	<b>2.7</b>	<b>0.03</b>	<b>0.01</b>	<b>0.7</b>	<b>0.3</b>	<b>0.07</b>
<b>4</b>	<b>6.3</b>	<b>0.05</b>	<b>0.02</b>	<b>1.6</b>	<b>0.4</b>	<b>0.04</b>
<b>1</b>	<b>20.7</b>	<b>0.06</b>	<b>0.03</b>	<b>5.2</b>	<b>0.4</b>	<b>0.01</b>

**Results with all negative filter weights subtracted from emissions calculations.  
 (Certification Values)**

	E <sub>T</sub>	E	E	E <sub>g/hr.</sub>	E <sub>g/kg</sub>	
Run Number	Total PM Emissions (Grams)	PM output Based (lb/MMBtu Out)	PM output Based (g/MJ)	PM Rate (g/hr)	PM Rate (g/hr)	Train Precision (g/kg)
<b>2</b>	<b>0.9</b>	<b>0.02</b>	<b>0.01</b>	<b>0.2</b>	<b>0.1</b>	<b>0.01</b>
<b>3</b>	<b>2.3</b>	<b>0.03</b>	<b>0.01</b>	<b>0.6</b>	<b>0.2</b>	<b>0.01</b>
<b>4</b>	<b>6.1</b>	<b>0.05</b>	<b>0.02</b>	<b>1.5</b>	<b>0.4</b>	<b>0.01</b>
<b>1</b>	<b>16.7</b>	<b>0.05</b>	<b>0.02</b>	<b>4.2</b>	<b>0.4</b>	<b>0.01</b>

## INDIVIDUAL RUN SUMMARIES – Certification Testing

- Run 1 -** Test procedures followed to produce a Category IV burn; heat draw was adjusted to approximately 190,000 BTU's. Observed burn rate was calculated at 11.91 kg/h. Emissions results were calculated using particulate sampling from pellet fuel, on a hot to hot cycle. Heat demand water temperature set to call for heat at 165 degrees Fahrenheit and to go off demand mode at 190 degrees Fahrenheit. No sampling anomalies occurred, this test run was determined to be valid and appropriate for inclusion in the weighted average.
- Run 2 -** Test procedures followed to produce a Category I burn; heat draw was adjusted to approximately 28,000 BTU's. Heat demand water temperature set to call for heat at 165 degrees Fahrenheit and to go off demand mode at 190 degrees Fahrenheit. Observed burn rate was calculated at 1.68 kg/h. Emissions results were calculated using particulate sampling from pellet fuel, on a hot to hot cycle. First hour emissions were found to be less than detectable by the test method, measurable catch and train precision were acceptable for entire test (See Note Below). No additional sampling anomalies occurred, this test run was determined to be valid and appropriate for inclusion in the weighted average.
- Run 3 -** Test procedures followed to produce a Category II burn; heat draw was adjusted to approximately 43,000 BTU's. Heat demand water temperature set to call for heat at 165 degrees Fahrenheit and to go off demand mode at 190 degrees Fahrenheit. Observed burn rate was calculated at 2.57 kg/h. Emissions results were calculated using particulate sampling from pellet fuel, on a hot to hot cycle. First hour (see note) emissions were found to be less than detectable by the test method, measurable catch and train precision were acceptable for entire test (See Note Below). No additional anomalies occurred, this test run was determined to be valid and appropriate for inclusion in the weighted average.
- Run 4 -** Test procedures followed to produce a Category III burn; heat draw was adjusted to approximately 70,000 BTU's. Heat demand water temperature set to call for heat at 165 degrees Fahrenheit and to go off demand mode at 190 degrees Fahrenheit. Observed burn rate was calculated at 4.27 kg/h. Emissions results were calculated using particulate sampling from pellet fuel, on a hot to hot cycle. No sampling anomalies occurred, this test run was determined to be valid and appropriate for inclusion in the weighted average.

**Note:** For tests 2 and 3, negative first hour filter weights were found. In a procedure for the first hour filter pull, only the front filter for train A is replaced; the gasket set, probe, and rear filter are left in place for the remainder of the test. Due to the common probe and gasket, the first hour filter weight (be it positive or negative) needs to be added to the remainder to ensure that all residual weight from the first hour filter is accounted for. If the negative weight is not added into the remainder catch, the residual weight from the filter would be counted as emissions in the remainder of the test.

In both cases, negative values are at or near tare weight tolerances. During the use of this standard, probe assembly parts are determined to be at a constant weight when two weights at a minimum of 6 hours apart agree within  $\pm 0.2$  milligrams. Since a  $\pm 0.2$  milligram tolerance is built into the standard, this value was deemed acceptable.

## **APPLIANCE DESCRIPTION**

The Maxim M255 PE is a pellet fired outdoor hydronic heater. It is designed to heat and circulate water in a closed loop, supplying energy to an existing system. Its heavy gauge steel structure consists of a large, roughly rectangular firebox constructed of carbon steel or Stainless Steel and is surrounded by a water jacket with an integrated heat exchanger. The unit is well insulated and protected by an outer sheet metal skin designed for outdoor installation.

Combustion air is regulated by a blower which supplies air to various parts of the firebox. Combustion air is introduced through the burn chamber walls and floor, it also is introduced through an aerator that is attached to the end of the auger shaft.

The Maxim M255 PE responds to heat demand by cycling the combustion blower and fuel feed system on and off depending on water temperature. The water temperature set point is user adjustable.

Other features of the Maxim M255 PE include:

- Overtemperature protection
- Fuel Burn-back protection
- Atmospheric pressure vent for water circuit
- Network-enabled temperature logging

Water capacity of the Maxim M255 PE is approximately 80 gallons. The dry weight of the unit is approximately 1297 lbs.

Model: Maxim M255 PE  
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## Central Boiler, Inc. Maxim M255 PE

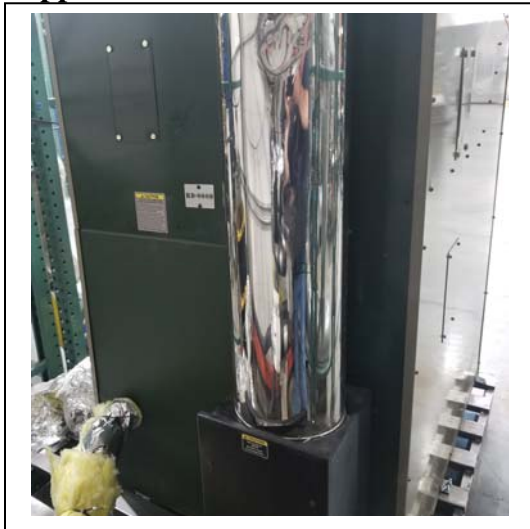
**Appliance Front**



**Appliance Left**



**Appliance Back**





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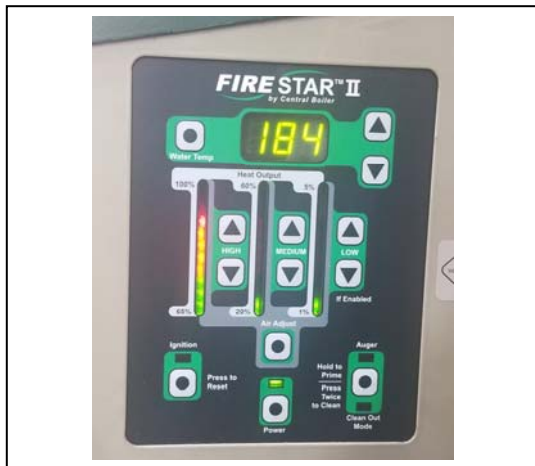
### Category IV Burn Setting



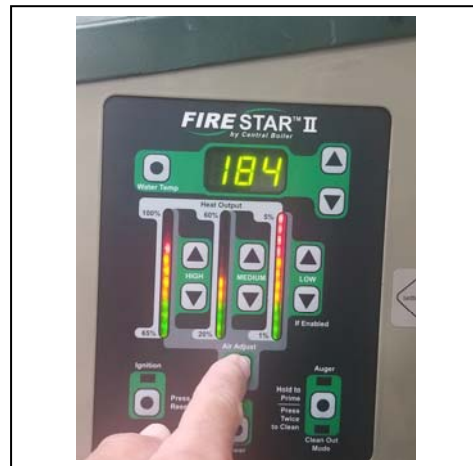
### Category IV Air Setting



### Category I Burn Setting



### Category I Air Setting

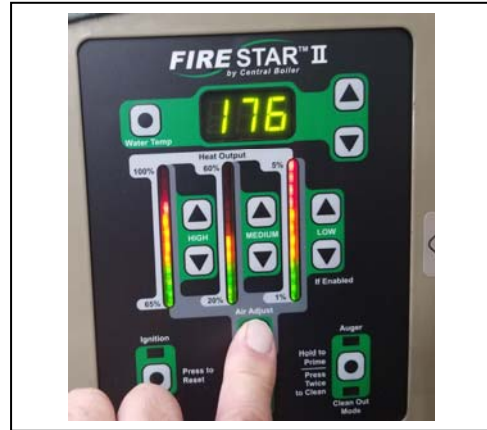


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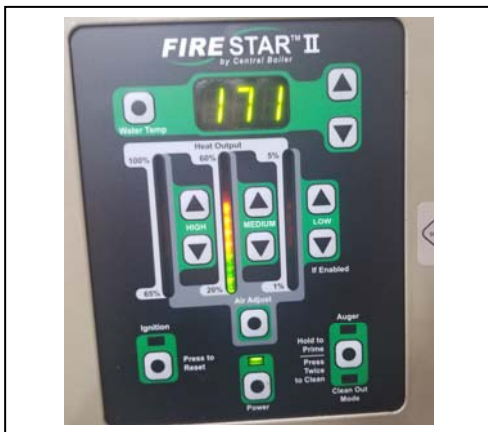
### Category II Burn Setting



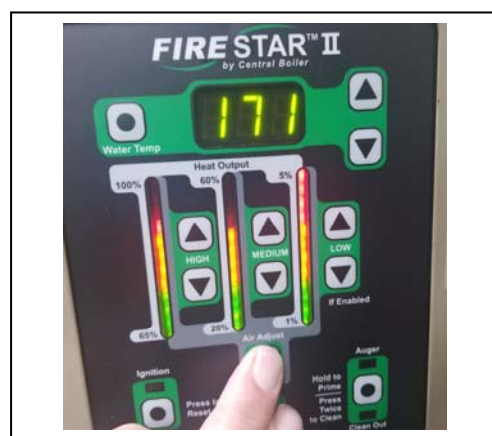
### Category II Air Setting



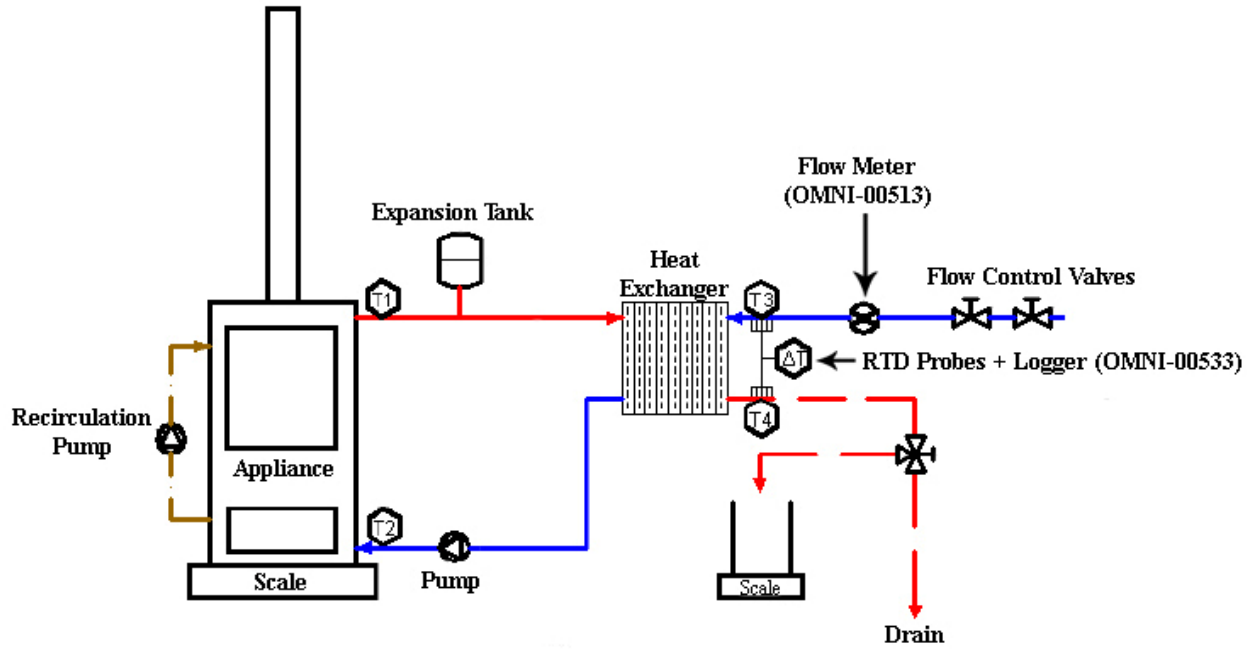
### Category III Burn Setting



### Category III Air Setting



## Test Equipment Schematic



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# **Section 2**

## **Quality Assurance/Quality Control**

## QUALITY ASSURANCE/QUALITY CONTROL

OMNI follows the guidelines of ISO/IEC 17025, “General Requirements for the Competence of Testing and Calibration Laboratories,” and the quality assurance/quality control (QA/QC) procedures found in OMNI’s Quality Assurance Manual.

OMNI’s scope of accreditation includes, but is not limited to, the following:

- ANSI (American National Standards Institute) for certification of product to safety standards.
- To perform product safety testing by the International Accreditation Service, Inc. (formerly ICBO ES) under accreditation as a testing laboratory designated TL-130.
- To perform product safety testing as a “Certification Organization” by the Standards Council of Canada (SCC).
- Serving as a testing laboratory for the certification of wood heaters by the U.S. Environmental Protection Agency.

This report is issued within the scope of OMNI’s accreditation. Accreditation certificates are available upon request.

The manufacturing facilities and quality control system for the production of the Maxim M255 PE at Central Boiler’s and WoodMaster’s manufacturing facility were evaluated to determine if sufficient to maintain conformance with OMNI’s requirements for product certification. OMNI has concluded that the manufacturing facilities, processes, and quality control system are adequate to produce the appliance congruous with the standards and model codes to which it was evaluated.

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# **Sample Analysis**

Analysis Worksheets  
Tared Filter, Probe, & O-Ring Data

### ASTM E2618 Wood Heater Run Sheets

Client: Central Boiler Project Number: 0117PS024E Run Number: 1  
 Model: Maxim M255 PE Tracking Number: 2423 Date: 8/17/20  
 Test Crew: BD TT  
 OMNI Equipment ID numbers: 637, 592, 213A

#### ASTM E2515 Lab Sheet

Assembled By:

BD Daus

Date/Time in Dessicator:

8/17/20

Weighing #1	Weighing #2	Weighing #3	Weighing #4	Weighing #5
Date/Time: <u>8/19/20</u>	Date/Time: <u>8/20/20 0715</u>	Date/Time: <u>8/21/20 0715</u>	Date/Time: <u>8/25/20 0810</u>	Date/Time:
R/H %: <u>20.1</u>	R/H %: <u>23.4</u>	R/H %: <u>19.1</u>	R/H %: <u>20.6</u>	R/H %:
Temp: <u>75.2</u>	Temp: <u>74.4</u>	Temp: <u>78.0</u>	Temp: <u>75.9</u>	Temp:
200 mg Audit: <u>200.2</u>	200 mg Audit: <u>200.2</u>	200 mg Audit: <u>200.2</u>	200 mg Audit: <u>200.2</u>	200 mg Audit:
2 g Audit: <u>2000.2</u>	2 g Audit: <u>2000.2</u>	2 g Audit: <u>2000.2</u>	2 g Audit: <u>2000.2</u>	2 g Audit:
100 g Audit: <u>9999.0</u>	100 g Audit: <u>9999.0</u>	100 g Audit: <u>9999.0</u>	100 g Audit: <u>9999.0</u>	100 g Audit:
Initials: <u>DL</u>	Initials: <u>DL</u>	Initials: <u>DL</u>	Initials: <u>DL</u>	Initials:

Train	Element	ID #	Tare (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)
A (First Hour)	Front Filter	<u>E001</u>	<u>121.3</u>	<u>123.2</u>	<u>123.0</u>	✓		
	Rear Filter							
	Probe							
	O-Ring Set							
A (Remainder)	Front Filter	<u>E002</u>	<u>120.3</u>	<u>126.3</u>	<u>126.2</u>	✓		
	Rear Filter	<u>E003</u>	<u>121.1</u>	<u>121.1</u>	<u>121.2</u>	✓		
	Probe	<u>OES4</u>	<u>114148.4</u>	<u>114149.9</u>	<u>114149.3</u>	<u>114148.7</u>	<u>114148.7</u>	✓
	O-Ring Set	<u>S0007</u>	<u>3302.1</u>	<u>3304.9</u>	<u>3302.5</u>	<u>3302.3</u>	✓	
B	Front Filter	<u>E004</u>	<u>118.9</u>	<u>127.4</u>	<u>127.2</u>	✓		
	Rear Filter	<u>E005</u>	<u>120.9</u>	<u>120.7</u>	<u>120.7</u>	✓		
	Probe	<u>OES5</u>	<u>113571.4</u>	<u>113616.0</u>	<u>113571.5</u>	<u>113572.0</u>	<u>113572.0</u>	✓
	O-Ring Set	<u>S0008</u>	<u>3334.1</u>	<u>3337.5</u>	<u>3335.1</u>	<u>3334.6</u>	<u>3334.4</u>	✓
BG	Filter	<u>E006</u>	<u>120.1</u>	<u>119.9</u>	<u>120.1</u>	✓		

Technician Signature: BD

Date: 8/25/20

### ASTM E2618 Wood Heater Run Sheets

Client: Central Boiler

Project Number: 0117PS024E

Run Number: 2

Model: Maxim M255 PE

Tracking Number: 2423

Date: 8/10/20

Test Crew: BD TT

OMNI Equipment ID numbers: 637, 592, 2P3A

#### ASTM E2515 Lab Sheet

Assembled By:

B Davis

Date/Time in Dessicator:

8/12/20

Weighing #1	Weighing #2	Weighing #3	Weighing #4	Weighing #5
Date/Time: <u>8/20/20<sup>07:45</sup></u>	Date/Time: <u>8/24/20<sup>07:15</sup></u>	Date/Time: <u>8/25/20<sup>07:10</sup></u>		
R/H %: <u>23.4</u>	R/H %: <u>19.1</u>	R/H %: <u>20.6</u>		
Temp: <u>74.4</u>	Temp: <u>75.0</u>	Temp: <u>75.9</u>		
200 mg Audit: <u>200.2</u>	200 mg Audit: <u>200.2</u>	200 mg Audit: <u>200.2</u>		
2 g Audit: <u>2000.2</u>	2 g Audit: <u>2000.2</u>	2 g Audit: <u>2000.2</u>		
100 g Audit: <u>99997.9</u>	100 g Audit: <u>99998.0</u>	100 g Audit: <u>99998.0</u>		
Initials: <u>BD</u>	Initials: <u>BD</u>	Initials: <u>BD</u>		

Train	Element	ID #	Tare (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)
A (First Hour)	Front Filter	<u>E007</u>	<u>120.4</u>	<u>119.9</u>	<u>120.1</u>			
	Rear Filter							
	Probe							
	O-Ring Set							
A (Remainder)	Front Filter	<u>E008</u>	<u>120.0</u>	<u>120.6</u>	<u>120.6</u>			
	Rear Filter	<u>E009</u>	<u>119.7</u>	<u>119.4</u>	<u>119.5</u>			
	Probe	<u>23</u>	<u>114077.0</u>	<u>114077.9</u>	<u>114077.9</u>			
	O-Ring Set	<u>S0010</u>	<u>3366.3</u>	<u>3366.5</u>	<u>3366.3</u>	<u>3366.3</u>		
B	Front Filter	<u>E010</u>	<u>119.8</u>	<u>119.8</u>	<u>119.8</u>			
	Rear Filter	<u>E013</u>	<u>119.4</u>	<u>119.1</u>	<u>119.4</u>	<u>119.4</u>		
	Probe	<u>24</u>	<u>114128.1</u>	<u>114128.4</u>	<u>114128.2</u>			
	O-Ring Set	<u>S0011</u>	<u>4149.2</u>	<u>4149.8</u>	<u>4149.4</u>	<u>4149.5</u>		
BG	Filter	<u>E012</u>	<u>120.2</u>	<u>120.3</u>	<u>120.3</u>	<u>120.2</u>		

Technician Signature: B Davis

Date: 8/25/20



### ASTM E2618 Wood Heater Run Sheets

Client: Central Boiler Project Number: 0117PS024E Run Number: 3  
 Model: Maxim M255 PE Tracking Number: 2423 Date: 8/10/20  
 Test Crew: AD TT  
 OMNI Equipment ID numbers: 637, 593, 2+3A

#### ASTM E2515 Lab Sheet

Assembled By: AD

Date/Time in Dessicator: 8/10/20

Weighing #1	Weighing #2	Weighing #3	Weighing #4	Weighing #5
Date/Time: <u>8/20/20 07:09</u>	Date/Time: <u>8/24/20 09:05</u>	Date/Time: <u>08/25/20 09:00</u>	Date/Time:	Date/Time:
R/H %: <u>23.4</u>	R/H %: <u>19.1</u>	R/H %: <u>20.6</u>	R/H %:	R/H %:
Temp: <u>74.4</u>	Temp: <u>72.0</u>	Temp: <u>75.9</u>	Temp:	Temp:
200 mg Audit: <u>200.2</u>	200 mg Audit: <u>200.2</u>	200 mg Audit: <u>200.2</u>	200 mg Audit:	200 mg Audit:
2 g Audit: <u>2000.2</u>	2 g Audit: <u>2000.2</u>	2 g Audit: <u>2000.2</u>	2 g Audit:	2 g Audit:
100 g Audit: <u>99992.9</u>	100 g Audit: <u>99998.0</u>	100 g Audit: <u>99998.0</u>	100 g Audit:	100 g Audit:
Initials: <u>BC</u>	Initials: <u>DL</u>	Initials: <u>AL</u>	Initials:	Initials:

Train	Element	ID #	Tare (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)
A (First Hour)	Front Filter	E014	120.2	119.9	120.0	-		
	Rear Filter							
	Probe							
	O-Ring Set							
A (Remainder)	Front Filter	E015	120.4	121.3	121.2	-		
	Rear Filter	E016	119.4	119.2	119.3	-		
	Probe	28	11475.1	11475.14	11475.3	-		
	O-Ring Set	S0012	4179.9	4180.4	4180.2	-		
B	Front Filter	E017	120.9	121.6	121.7	-		
	Rear Filter	E018	120.3	120.1	120.3	-		
	Probe	29	11427.0	11427.5	11427.2	11427.3	-	
	O-Ring Set	S0013	3301.3	3301.4	3301.3	-		
BG	Filter	E019	120.6	120.6	120.7	-		

Technician Signature: AD

Date: 8/25/20

**ASTM E2618 Wood Heater Run Sheets**

Client: Central Boiler Project Number: 0117PS024E Run Number: 4  
 Model: Maxim M255 PE Tracking Number: 2423 Date: 8/19/20  
 Test Crew: BD TT  
 OMNI Equipment ID numbers: 637, 592, 243A

**ASTM E2515 Lab Sheet**

Assembled By:

B Davis

Date/Time in Dessicator:

8/20/20

Weighing #1	Weighing #2	Weighing #3	Weighing #4	Weighing #5
Date/Time: <u>8/24/20 0915</u>	Date/Time: <u>8/25/20 0910</u>	Date/Time: <u>8/26/20 0915</u>		
R/H %: <u>19.1</u>	R/H %: <u>20.6</u>	R/H %: <u>21.4</u>		
Temp: <u>78.0</u>	Temp: <u>75.9</u>	Temp: <u>75.3</u>		
200 mg Audit: <u>200.2</u>	200 mg Audit: <u>200.2</u>	200 mg Audit: <u>200.2</u>		
2 g Audit: <u>2000.2</u>	2 g Audit: <u>2000.2</u>	2 g Audit: <u>2000.2</u>		
100 g Audit: <u>9997.0</u>	100 g Audit: <u>9997.0</u>	100 g Audit: <u>9997.9</u>		
Initials: <u>BD</u>	Initials: <u>TT</u>	Initials: <u>SC</u>		

Train	Element	ID #	Tare (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)
<b>A</b> (First Hour)	Front Filter	<u>E020</u>	<u>119.3</u>	<u>119.7</u>	<u>119.4</u>	<u>119.5</u>		
	Rear Filter							
	Probe							
	O-Ring Set							
<b>A</b> (Remainder)	Front Filter	<u>E021</u>	<u>120.5</u>	<u>122.5</u>	<u>122.3</u>			
	Rear Filter	<u>E022</u>	<u>119.2</u>	<u>119.8</u>	<u>119.1</u>	<u>119.1</u>		
	Probe	<u>53</u>	<u>118272.8</u>	<u>118273.4</u>	<u>118273.0</u>	<u>118273.0</u>		
	O-Ring Set	<u>S0014</u>	<u>3382.2</u>	<u>3382.2</u>	<u>3382.4</u>	<u>3382.4</u>		
<b>B</b>	Front Filter	<u>E023</u>	<u>120.1</u>	<u>122.4</u>	<u>122.1</u>	<u>122.1</u>		
	Rear Filter	<u>E024</u>	<u>119.2</u>	<u>119.1</u>	<u>119.1</u>			
	Probe	<u>56</u>	<u>118613.5</u>	<u>118614.6</u>	<u>118614.0</u>	<u>118614.0</u>		
	O-Ring Set	<u>S0015</u>	<u>3284.6</u>	<u>3284.9</u>	<u>3284.7</u>			
<b>BG</b>	Filter	<u>E025</u>	<u>120.6</u>	<u>120.5</u>	<u>120.5</u>			

Technician Signature: BD

Date: 8/26/20

Tare Sheet: (check one)

Probes \_\_\_\_\_

47mm Filters

100mm Filters \_\_\_\_\_

O-Ring Pair \_\_\_\_\_

Prepared By: Tony Tong

Balance ID #: OMNI-20637

Thermohygrometer ID #: 00592

Audit Weight ID #/Mass: OMNI-202834200 mg

Placed in Dessicator: Date: <u>06/11/2020</u> Time: <u>10:00</u>	Date: <u>06/15/2020</u> Time: <u>7:50</u> RH %: <u>15.0</u> T (°F): <u>72.3</u> Audit: <u>200.1</u>	Date: <u>06/16/2020</u> Time: <u>12:10</u> RH %: <u>17.0</u> T (°F): <u>72.1</u> Audit: <u>200.2</u>	Date: _____ Time: _____ RH %: _____ T (°F): _____ Audit: _____	Date: _____ Time: _____ RH %: _____ T (°F): _____ Audit: _____	Date Used	Project Number	Run No.
	ID #						
E001	121.4	121.3 ✓			8-17-20	0117PS024E	1
E002	120.2	120.3 ✓					
E003	120.9	121.1 ✓					
E004	119.0	118.9 ✓					
E005	121.0	120.9 ✓					
E006	120.2	120.1 ✓					
E007	120.3	120.4 ✓			8-18-20		2
E008	120.2	120.0 ✓					
E009	119.7	119.7 ✓			NOT Used		
E010	119.8	119.8 ✓					
E011	120.2	120.3 ✓					
E012	120.1	120.2 ✓					
E013	119.4	119.4 ✓					
E014	120.3	120.2 ✓					
E015	120.6	120.4 ✓					
E016	119.5	119.4 ✓					
E017	121.1	120.9 ✓					
E018	120.3	120.3 ✓					
E019	120.8	120.6 ✓			8-19-20		3
E020	119.3	119.3 ✓					
Initials: <u>TT</u>	Initials: <u>TT</u>	Initials: _____	Initials: _____				4

Final Technician Signature: Tony Tong  
Control No. P-SFDP-0002.xls, Effective date: 2/1/2017

Date: 06/16/2020  
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Evaluator signature: B D

Tare Sheet: (check one)

Probes \_\_\_\_\_

47mm Filters

100mm Filters \_\_\_\_\_

O-Ring Pair \_\_\_\_\_

Prepared By: Tony Tony

Balance ID #: omni-00637

Thermohygrometer ID #: omni-00592

Audit Weight ID #/Mass: omni-00283A 200 mg

Placed in Dessicator: Date: <u>08/04/2020</u> Time: <u>8:00</u>	Date: <u>08/05/2020</u> Time: <u>9:00</u> RH %: <u>12.9</u> T (°F): <u>77.9</u> Audit: <u>200.1</u>	Date: <u>08/06/2020</u> Time: <u>9:00</u> RH %: <u>16.5</u> T (°F): <u>78.2</u> Audit: <u>199.9</u>	Date: <u>08/24/2020</u> Time: <u>8:45</u> RH %: <u>21.0</u> T (°F): <u>75.3</u> Audit: <u>200.1</u>	Date: _____ Time: _____ RH %: _____ T (°F): _____ Audit: _____	Date Used	Project Number	Run No.
	ID #						
E021	120.3	120.5 ✓			8-19-20	0117PS024E	4
E022	119.2	119.2 ✓			↓	↓	↓
E023	120.0	120.1 ✓					
E024	119.4	119.2 ✓					
E025	120.6	120.6 ✓			↓	↓	↓
E026	120.3	120.1 ✓					
E027	120.2	120.0 ✓					
E028	121.3	121.0 ✓	120.9 ✓				
E029	120.4	120.4 ✓					
E030	119.4	119.5 ✓					
E031	120.5	120.6 ✓					
E032	119.9	119.7 ✓					
E033	119.9	119.9 ✓					
E034	120.1	120.1 ✓					
E035	120.8	121.1 ✓	120.9 ✓				
E036	121.0	120.8 ✓					
E037	120.6	120.5 ✓					
E038	120.7	120.7 ✓					
E039	120.8	120.6 ✓					
E040	120.6	120.6 ✓					
Initials: <u>TT</u>	Initials: <u>TT</u>	Initials: <u>TT</u>	Initials: _____				

Final Technician Signature: Tony Tony  
Control No. P-SFDP-0002.xls, Effective Date: 2/1/2017

Date: 08/24/2020  
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Evaluator signature: [Signature]



Tare Sheet: (check one)

Probes

47mm Filters \_\_\_\_\_

100mm Filters \_\_\_\_\_

O-Ring Pair \_\_\_\_\_

Prepared By: Terry Tong

Balance ID #: OMNI-00637

Thermohygrometer ID #: OMNI-00592

Audit Weight ID #/Mass: OMNI-00283A/100g

Placed in Dessicator:		Date: <u>06/09/2020</u> Time: <u>8:20</u> RH %: <u>6.9</u> T (°F): <u>70.3</u> Audit: <u>99998.1</u>	Date: <u>06/10/2020</u> Time: <u>11:20</u> RH %: <u>9.4</u> T (°F): <u>72.1</u> Audit: <u>99998.2</u>	Date: <u>06/11/2020</u> Time: <u>9:00</u> RH %: <u>11.4</u> T (°F): <u>73.5</u> Audit: <u>99998.2</u>	Date: <u>06/11/2020</u> Time: <u>16:00</u> RH %: <u>8.0</u> T (°F): <u>75.2</u> Audit: <u>99998.0</u>	Date Used	Project Number	Run No.
ID #								
7	114981.8	114982.7	114981.9					
8	115598.2	115598.7	115598.3	115598.4				
9	115696.1	115696.4	115696.1	115696.0				
11	114188.4	114188.8	114188.6					
16	114266.8	114267.1	114266.9					
17	114562.0	114562.3	114562.2					
23	114077.3	114077.7	114077.6		8-18-20	0117PS024E		2
24	114128.0	114128.5	114128.2	114128.1	↓	↓		↓
25	114299.8	114299.9						
27	114274.8	114275.3	114275.2					
28	114751.3	114751.6	114751.3	114751.1	8-18-20	0117PS024E		3
29	114276.8	114277.3	114276.9	114277.0	↓	↓		↓
Initials:	TT	Initials:	TT	Initials:	TT	Initials:	TT	

Final Technician Signature: Terry Tong  
Control No. P-SFDP-0002.xls, Effective date: 2/1/2017

Date: 06/11/2020  
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Evaluator signature: [Signature] 7/15/20

Tare Sheet: (check one)

Probes

47mm Filters

100mm Filters

O-Ring Pair

Prepared By:

Balance ID #: 0MN1-00637

Thermohygrometer ID #: 0MN1-00592

Audit Weight ID #/Mass: 0MN1-002834 100g

Placed in Dessicator: Date: <u>06/11/2020</u> Time: <u>9:30</u>	Date: <u>06/15/2020</u>	Date: <u>06/16/2020</u>	Date: <u>06/18/2020</u>	Date: _____	Date Used	Project Number	Run No.
	Time: <u>7:30</u>	Time: <u>12:30</u>	Time: <u>12:00</u>	Time: _____			
	RH %: <u>11.9</u>	RH %: <u>17.0</u>	RH %: <u>15.6</u>	RH %: _____			
	T (°F): <u>71.7</u>	T (°F): <u>72.1</u>	T (°F): <u>73.2</u>	T (°F): _____			
ID #	Audit: <u>99998.0</u>	Audit: <u>99998.2</u>	Audit: <u>99998.1</u>	Audit: _____			
<u>30</u>	<u>114328.0</u>	<u>114328.1</u> ✓					
<u>31</u>	<u>114364.6</u>	<u>114364.7</u> ✓					
<u>32</u>	<u>114742.2</u>	<u>114742.4</u> ✓					
<u>33</u>	<u>113943.3</u>	<u>113943.4</u> ✓					
<u>34</u>	<u>115868.4</u>	<u>115868.4</u> ✓					
<u>38</u>	<u>114151.3</u>	<u>114151.6</u>	<u>114151.4</u> ✓				
<u>53</u>	<u>118272.7</u>	<u>118272.8</u> ✓			<u>8-19-20</u>	<u>0117PS024E</u>	<u>4</u>
<u>56</u>	<u>118613.5</u>	<u>118613.5</u> ✓			↓	↓	↓
<u>58</u>	<u>117066.1</u>	<u>117066.2</u> ✓					
<u>59</u>	<u>117786.5</u>	<u>117786.8</u>	<u>117786.7</u> ✓				
Initials: <u>TT</u>	Initials: <u>TT</u>	Initials: <u>TT</u>	Initials: _____				

Final Technician Signature: Tony Tony  
Control No. P-SFDP-0002.xls, Effective date: 2/1/2017

Date: 06/18/2020  
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Evaluator signature: B D E



Tare Sheet: (check one)

Probes \_\_\_\_\_

47mm Filters \_\_\_\_\_

100mm Filters \_\_\_\_\_

O-Ring Pair

Prepared By: Tony Tong

Balance ID #: OMNI-00637

Thermohyrometer ID #: OMNI-00592

Audit Weight ID #/Mass: OMNI-0028345g

Placed in Dessicator:	Date: <u>07/07/2020</u>	Date: <u>07/08/2020</u>	Date: <u>07/09/2020</u>	Date: _____	Date Used	Project Number	Run No.
Date: <u>06/29/2020</u>	Time: <u>15:30</u>	Time: <u>8:15</u>	Time: <u>8:30</u>	Time: _____			
Time: <u>14:00</u>	RH %: <u>5.3</u>	RH %: <u>5.6</u>	RH %: <u>8.5</u>	RH %: _____			
ID #	T (°F): <u>75</u>	T (°F): <u>73.4</u>	T (°F): <u>74.8</u>	T (°F): _____			
Audit: <u>5000.0</u>	Audit: <u>5000.0</u>	Audit: <u>4999.9</u>	Audit: _____	Audit: _____			
S0001	3344.9	3345.1 ✓					
S0002	3328.5	3328.9 ✓	3328.8 ✓				
S0003	4126.1	4126.7 ✓	4126.6 ✓				
S0004	4099.6	4100.2 ✓	4100.1 ✓				
S0005	3429.7	3430.4 ✓	3430.2 ✓				
S0006	3286.4	3286.6 ✓					
S0007	3302.0	3302.1 ✓			8-17-20	0117PS024E	1
S0008	3333.7	3334.2 ✓	3334.1 ✓		↓	↓	↓
S0009	4113.0	4113.5 ✓	4113.3 ✓		Not Used		
S0010	3365.9	3366.5 ✓	3366.3 ✓		8-18-20	0117PS024E	2
S0011	4148.8	4149.3 ✓	4149.2 ✓		↓	↓	↓
S0012	4179.5	4180.1 ✓	4179.9 ✓		↓	↓	3
S0013	3300.9	3301.3 ✓	3301.3 ✓		↓	↓	↓
S0014	3382.1	3382.2 ✓			8-19-20		4
S0015	3284.3	3284.8 ✓	3284.6 ✓		↓	↓	↓
<del>S0016</del>							
S0016	3276.5	3276.7 ✓			Not Used		
Initials: <u>TT</u>	Initials: <u>TT</u>	Initials: <u>TT</u>	Initials: _____				

Final Technician Signature: Tony Tong  
 Control No. P-SFDP-0002.xls, Effective date: 2/1/2017

Date: 07/09/2020  
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Evaluator signature: [Signature]



# Calibrations

<b>ID #</b>	<b>Equipment Name/Description</b>	<b>Attachment Type</b>
637	Balance, Analytical - Mettler Instrument	Calibration Certificate
283A	Weight Standard set	Calibration Certificate
132	Weight Standard, 10 lb. - WeightMaker	Calibration Log
650	Barometer	Calibration Certificate
592	Hygrometer/Thermometer, Digital - Omega	Calibration Certificate
356	Scale, Pro-Dec (5000 lbs.) - Avery Weigh-Tronix	Calibration Certificate
410	Microtector	Calibration Certificate
594	Infrared gas analyzer	Manual Cover
371	Sampling Box, Automated Emissions - Apex XC-60	Calibration Log
372	Sampling Box, Automated Emissions - Apex XC-60	Calibration Log
513	Omega Low Flow Magmeter	Calibration Log
559	Dwyer Vaneometer	Manual
677	Dwyer Anemometer	Calibration Certificate

# Certificate of Calibration

Certificate Number: **728321**



**JJ Calibrations, Inc.**

7724 SE Aspen Summit Drive  
Portland, OR 97266-9217  
Phone 503.786.3005  
FAX 503.786.2994

**Omni-Test Laboratories**  
13327 NE Airport Way  
Portland, OR 97230

OnSite

PO: **200302**

Order Date: **07/09/2020**

Authorized By: **N/A**



Calibrated on: **07/09/2020**

\*Recommended Due: **01/09/2021**

Environment: **20 °C 42 % RH**

\* As Received: **Within Tolerance**

\* As Returned: **Within Tolerance**

Action Taken: **Calibrated**

Technician: **111**

Property #: **OMNI-00637**

User: **N/A**

Department: **N/A**

Make: **Mettler Toledo**

Model: **MS104TS/00**

Serial #: **B729400181**

Description: **Analytical Scale, 120g**

Procedure: **DCN 500887**

Accuracy: **±0.0005g**

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.

## Standards Used

Std ID	Manufacturer	Model	Nomenclature	Due Date	Trace ID
503A	Rice Lake	1mg-200g (Class 0)	Mass Set,	08/08/2020	702709

## Measurement Data

Parameter	Measurement Description	Range	Unit	Reference	Min	Max	*Error	UUT	Uncertainty
Before/After Force									Accredited = $\bar{U}$
			g	10.00000	9.9995	10.0005	0.0001	9.9999 g	9.7E-05 $\bar{U}$
			g	30.00000	29.9995	30.0005	0.0000	30.0000 g	1.3E-04 $\bar{U}$
			g	60.00000	59.9995	60.0005	0.0000	60.0000 g	2E-04 $\bar{U}$
			g	90.00000	89.9995	90.0005	0.0002	90.0002 g	2.4E-04 $\bar{U}$
			g	120.00000	119.9995	120.0005	0.0001	120.0001 g	3E-04 $\bar{U}$

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/NC SL 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

Reviewer

3 Issued 07/15/2020 Rev # 15

Inspector

# Certificate of Calibration

Certificate Number: **685888**



**JJ Calibrations, Inc.**

7007 SE Lake Rd  
Portland, OR 97267-2105  
Phone 503.786.3005  
FAX 503.786.2994

**Omni-Test Laboratories**  
13327 NE Airport Way  
Portland, OR 97230

PO: **180188**  
Order Date: **10/09/2018**  
Authorized By: **N/A**



Calibrated on: **10/26/2018**  
\*Recommended Due: **10/26/2023**  
Environment: **20 °C 57 % RH**  
\* As Received: **Within Tolerance**  
\* As Returned: **Within Tolerance**  
Action Taken: **Calibrated**  
Technician: **139**

Property #: **OMNI-00283A**  
User: **N/A**  
Department: **N/A**  
Make: **Troemner Inc**  
Model: **1mg-100g (Class F)**  
Serial #: **47883**  
Description: **Mass Set, 21pc**  
Procedure: **DCN 500901**  
Accuracy: **Class F**

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.

**This set meets Class F specifications.**  
**Received and returned eight (8) masses in a black case secured by a rubber band.**

### Standards Used

Std ID	Manufacturer	Model	Nomenclature	Due Date	Trace ID
723A	Rice Lake	1mg-200g (Class 0)	Mass Set,	03/23/2019	668240
800A	Sartorius	MSA225W100DI	Analytical Balance	12/11/2018	663857

### Measurement Data

Parameter	Measurement Description	Range Unit	Reference	Min	Max	*Error	UUT	Uncertainty
<b>Before/After</b>								Accredited = ✓
<b>Mass</b>								
Dot	200 mg		200.00030	199.4603	200.5403	0.0500	200.0503 mg	6.2E-01 ✓
	1 g		1.00000880	0.9991088	1.0009088	0.0000000	1.0000088 g	1E-03 ✓
	2 g		2.00001470	1.9989147	2.0011147	0.0003250	2.0003397 g	1.3E-03 ✓
	5 g		5.00000840	4.9985084	5.0015084	0.0000400	4.9999684 g	1.7E-03 ✓
	10 g		10.0000100	9.998010	10.002010	0.000245	9.999765 g	2.3E-03 ✓
Dot	20 g		20.0000140	19.996014	20.004014	0.000990	20.001004 g	4.6E-03 ✓
	50 g		49.9999660	49.989966	50.009966	0.000595	49.999371 g	1.1E-02 ✓
	100 g		100.000000	99.98000	100.02000	0.00194	99.99806 g	2.3E-02 ✓

JJ Calibrations, Inc. certifies that this instrument has been calibrated in accordance with the JJ Calibrations Quality Assurance Manual with the stated procedure using standards that are traceable to the National Institute of Standards and Technology (NIST), or other National Measurement Institutes (NMI's), or by using natural physical constants, intrinsic standards or ratio calibration techniques. The quality system and this certificate are in compliance with ANSI/NCCL Z540-1-1994, ISO/IEC 17025-2005, 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 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 prior written consent of JJ Calibrations, Inc.  
JJ Calibrations, Inc. quality system has been assessed and accredited to ISO/IEC 17025:2005.

  
Reviewer

3 Issued 10/29/2018 Rev # 15

  
Inspector

## SCALE WEIGHT CALIBRATION DATA SHEET

Weight to be calibrated: 10 pounds

ID Number: OMNI-00132

Standard Calibration Weight: 10 pounds

ID Number: OMNI-00255

Scale Used: MTW-150K

ID Number: OMNI-00353

Date: 2/23/2018

By: B. Davis

Standard Weight (A) (Lb.)	Weight Verified (B) (Lb.)	Difference (A - B)	% Error
10.0	10.0	0.0	0

\*Acceptable tolerance is 1%.

*This calibration is traceable to NIST using calibrated standard weights.*

Technician signature:  Date: 2/23/18

# Certificate of Calibration

Certificate Number: **725761**



**JJ Calibrations, Inc.**

7724 SE Aspen Summit Drive  
Portland, OR 97266-9217  
Phone 503.786.3005  
FAX 503.786.2994

**Omni-Test Laboratories**  
13327 NE Airport Way  
Portland, OR 97230

PO: **200299**  
Order Date: **05/28/2020**  
Authorized By: **N/A**



Property #: **OMNI-00650**  
User: **N/A**  
Department: **N/A**  
Make: **Control Company**  
Model: **6530**  
Serial #: **181062211**  
Description: **Thermohygrometer / Barometer**  
Procedure: **403406**  
Accuracy: **±3%RH, ±.4°C(0.8°F), ±4mbar(0.12inHg)**

Calibrated on: **06/01/2020**  
\*Recommended Due: **06/01/2021**  
Environment: **23 °C 41 % RH**  
\* As Received: **Within Tolerance**  
\* As Returned: **Within Tolerance**  
Action Taken: **Calibrated**  
Technician: **146**

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.

## Standards Used

Std ID	Manufacturer	Model	Nomenclature	Due Date	Trace ID
644A	Thunder Scientific	1200	Two Pressure Humidity Generator	10/14/2020	710583

Parameter Measurement Description	Range Unit	Measurement Data				UUT	Uncertainty Accredited = ✓
		Reference	Min	Max	Error		
<b>Before/After Humidity</b>	%	25.0	22	28	1	26 %	8.1E-01 ✓
	%	50.0	47	53	3	47 %	8.1E-01 ✓
	%	75.0	72	78	3	72 %	8.1E-01 ✓
<b>Temperature</b>	°F	68.00	67.2	68.8	0.2	68.2 °F	1.2E-01 ✓
	°F	86.00	85.2	86.8	0.2	85.8 °F	1.2E-01 ✓
	°F	104.00	103.2	104.8	0.3	104.3 °F	1.2E-01 ✓

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/NCCL 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 06/04/2020 Rev # 15

Inspector

## VWR Temperature Hygrometer Calibration Procedure and Data Sheet

Frequency: Every Two Years

Step 1: Locate NIST traceable standard.

Step 2: Place unit to be calibrated, tracking No. OMNI-00592, inside OMNI desiccate box on the same shelf with the NIST traceable standard.

Step 3: After a period of not less than four hours record the temperature and humidity of both units in the spaces provide below.

Step 4: If the unit to be calibrated matches the NIST standard within  $\pm 4\%$ , it is acceptable. If not, the unit needs to be sent to a repair company or replaced.

### Verification Data:

Date: 1/29/19  
1/29/19 Technician: B. Davis

Time in desiccate: 0840 Recording time: 1415

NIST Standard Temperature: 70.2 °F NIST Standard Humidity: 14.6

Test Unit Temperature Reading: 69.9 °F Test Unit Humidity Reading: 12.1

Test unit OMNI-00592 is  or was not  within acceptable limits.

Technician Signature: [Signature]

Comments: A difference of 2.5% was found, with a full scale of 90%  
on the instrument this gives a 2.77% deviation.



# QUALITY CONTROL SERVICES

LABORATORY EQUIPMENT • SALES • SERVICE • CALIBRATION • REPAIRS  
 2340 SE 11<sup>TH</sup> Ave. Portland, Oregon 97214 • Box 14831 Portland, Oregon 97293  
 (503) 236-2712 • FAX (503) 235-2535 • www.qc-services.com



OMNI-Test Laboratories, Inc.  
 13327 NE Airport Way  
 Portland, OR 97230

Report Number: OMNE03069076191031

## A2LA ACCREDITED CERTIFICATE OF CALIBRATION WITH DATA

### INSTRUMENT INFORMATION

Item	Make	Model	Serial Number	Customer ID	Location
Scale	Weigh-Tronix	WI-125x5000x0.5lt	069076	356	Lab
Units	Readability	SOP	Cal Date	Last Cal Date	Cal Due Date
lbs	0.5	QC033	10/31/19	10/2/18	10/2020

### FUNCTIONAL CHECKS

SHIFT TEST	LINEARITY	REPEATABILITY	ENVIRONMENTAL CONDITIONS
Test Wt: Tol: 1000 2.5	Test Wt: Tol: HB44 HB44	Test Wt: Tol: 1000 2.5	<input type="checkbox"/> Good <input checked="" type="checkbox"/> Fair <input type="checkbox"/> Poor  Temperature: 19.3°C
As-Found: Pass: <input checked="" type="checkbox"/> Fail: <input type="checkbox"/>	As-Found: Pass: <input checked="" type="checkbox"/> Fail: <input type="checkbox"/>	As-Found: Pass: <input checked="" type="checkbox"/> Fail: <input type="checkbox"/>	
As-Left: Pass: <input checked="" type="checkbox"/> Fail: <input type="checkbox"/>	As-Left: Pass: <input checked="" type="checkbox"/> Fail: <input type="checkbox"/>	As-Left: Pass: <input checked="" type="checkbox"/> Fail: <input type="checkbox"/>	

### CALIBRATION DATA

Standard	As-Found	As-Left	Expanded Uncertainty
1000	999.5	999.5	0.31
700	699.5	699.5	0.31
500	500.0	500.0	0.29
200	200.0	200.0	0.29
100	100.0	100.0	0.29
50	50.0	50.0	0.29

### CALIBRATION STANDARDS

Item	Make	Model	Serial Number	Cal Date	Cal Due Date	NIST ID
Avoirdupois Cast W	Rice Lake	25 and 50lb	PWO990-CA	11/24/17	11/2019	20172265

#### Permanent Information Concerning this Equipment:

10/19 Old s/n 53719

#### Comments/Information Concerning this Calibration

10/19 RH= 27%. Used 4052 lbs of dead load to be able to walk scale up close to capacity. Accurate to 5052 lbs.

Report prepared/reviewed by: R.B. Date: 10-31-19

Technician: J. Colacchio

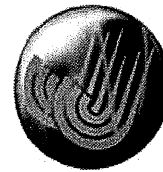
Signature: \_\_\_\_\_

THIS CERTIFICATE SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE APPROVAL OF QUALITY CONTROL SERVICES, INC.

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.

# Certificate of Calibration

Certificate Number: **712014**



**JJ Calibrations, Inc.**

7724 SE Aspen Summit Drive  
 Portland, OR 97266-9217  
 Phone 503.786.3005  
 FAX 503.786.2994

**Omni-Test Laboratories**  
 13327 NE Airport Way  
 Portland, OR 97230



PO: **190268**  
 Order Date: **10/29/2019**  
 Authorized By: **N/A**  
 Calibrated on: **11/07/2019**  
 \*Recommended Due: **11/07/2020**  
 Environment: **19 °C 38 % RH**  
 \* As Received: **Limited**  
 \* As Returned: **Limited**  
 Action Taken: **Calibrated**  
 Technician: **53**

Property #: **OMNI-00410**  
 User: **N/A**  
 Department: **N/A**  
 Make: **Dwyer**  
 Model: **1430**  
 Serial #: **OMNI-00410**  
 Description: **Microtector**  
 Procedure: **500364**  
 Accuracy: **±0.00025" WC**

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.

Previous limitation continued: **Calibrated micrometer head only.**

### Standards Used

Std ID	Manufacturer	Model	Nomenclature	Due Date	Trace ID
541A	Select	E8FED2	Gage Block Set, 8pc	12/30/2019	689507

Parameter

### Measurement Data

Measurement Description	Range	Unit	Reference	Min	Max	±Error	UUT	Uncertainty
<b>Before/After Length</b>								Accredited = ✓
	Inch		0.1300	0.129	0.131	0.000	0.130 Inch	8.1E-03 ✓
	Inch		0.3850	0.384	0.386	0.000	0.385 Inch	8.1E-03 ✓
	Inch		0.6150	0.614	0.616	0.000	0.615 Inch	8.1E-03 ✓
	Inch		0.8700	0.869	0.871	0.000	0.870 Inch	8.1E-03 ✓
	Inch		1.0000	0.999	1.001	0.000	1.000 Inch	8.1E-03 ✓

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/NC SL 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 ration (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 11/08/2019 Rev # 15

  
 Inspector




# Thermal Metering System Calibration Y Factor

Manufacturer: Apex  
 Model: XC-60-EP  
 Serial Number: 702003  
 OMNI Tracking No.: OMNI-00371  
 Calibrated Orifice:  Yes

<b>Average Gas Meter y Factor</b>
<b>0.994</b>

<b>Orifice Meter dH@</b>
<b>N/A</b>

Calibration Date: 06/15/20  
 Calibrated by: Tony Tong  
 Calibration Frequency: Six Month  
 Next Calibration Due: 12/15/2020  
 Instrument Range: 1.000 cfm  
 Standard Temp.: 68 oF  
 Standard Press.: 29.92 "Hg  
 Barometric Press., Pb: 29.99 "Hg  
 Signature/Date:  6/29/2020

### Previous Calibration Comparison

Date	<u>1/3/2020</u>	Acceptable Deviation (5%)	Deviation
y Factor	<u>0.988</u>	0.0494	0.006
Acceptance	<b>Acceptable</b>		

### Current Calibration

Acceptable y Deviation	0.020
Maximum y Deviation	0.006
Acceptable dH@ Deviation	N/A
Maximum dH@ Deviation	N/A
Acceptance	<b>Acceptable</b>

Reference Standard *		
Standard	Model	Standard Test Meter
Calibrator	S/N	<u>OMNI-00001</u>
	Calib. Date	<u>25-Nov-19</u>
	Calib. Value	<u>0.9981</u> y factor (ref)

Calibration Parameters	Run 1	Run 2	Run 3
Reference Meter Pressure ("H2O), Pr	<u>0.00</u>	<u>0.00</u>	<u>0.00</u>
DGM Pressure ("H2O), Pd	<u>3.00</u>	<u>1.70</u>	<u>0.90</u>
Initial Reference Meter	<u>145.242</u>	<u>151.1</u>	<u>157.68</u>
Final Reference Meter	<u>150.859</u>	<u>156.2</u>	<u>163.08</u>
Initial DGM	<u>0</u>	<u>0</u>	<u>0</u>
Final DGM	<u>5.578</u>	<u>5.107</u>	<u>5.448</u>
Temp. Ref. Meter (°F), Tr	<u>70.7</u>	<u>71.0</u>	<u>68.0</u>
Temperature DGM (°F), Td	<u>72.0</u>	<u>71.0</u>	<u>69.0</u>
Time (min)	<u>30.0</u>	<u>36.0</u>	<u>54.0</u>
Net Volume Ref. Meter, Vr	5.617	5.100	5.400
Net Volume DGM, Vd	5.578	5.107	5.448
<b>Gas Meter y Factor =</b>	<b>1.000</b>	<b>0.993</b>	<b>0.989</b>
<b>Gas Meter y Factor Deviation (from avg.)</b>	0.006	0.001	0.005
<b>Orifice dH@</b>	N/A	N/A	N/A
<b>Orifice dH@ Deviation (from avg.)</b>	N/A	N/A	N/A

where:

1. Deviation = |Average value for all runs - current run value|
- \*\* 2.  $y = [Vr \times (y \text{ factor (ref)}) \times (Pb + (Pr / 13.6)) \times (Td + 460)] / [Vd \times (Pb + (Pd / 13.6)) \times (Tr + 460)]$
- \*\* 3.  $dH@ = 0.0317 \times Pd / (Pb (Td + 460)) \times [(Tr + 460) \times \text{time}] / Vr]^2$

\* Reference calibration is traceable to NIST through NIST Test # 40674, Kimble ASTM E1272, or NIST traceable laboratory

\*\* Equations come from EPA Method 5

The uncertainty of measurement is  $\pm 0.14 \text{ ft}^3/\text{min}$ . This is based on the reference standard having a TAR (Test Accuracy Ratio) of at least 4:1.

## DIFFERENTIAL PRESSURE GAUGE CALIBRATION DATA SHEET

Instrument to be calibrated: Pressure Transducer

Maximum Range: 0 – 2" H<sub>2</sub>O

ID Number: OMNI-00371

Calibration Instrument: Digital Manometer

ID Number: OMNI-00395

Date: 06/16/2020

By: Tony Tong

**This form is to be used only in conjunction with Standard Procedure C-SPC.**

Range of Calibration Point ("WC)	Digital Manometer Input ("WC)	Pressure Gauge Response ("WC)	Difference (Input - Response)	% Error of Full Span*
0-20% Max. Range 0.0 – 0.4	0.37	0.34	0.03	1.5
20-40% Max. Range 0.4 – 0.8	0.46	0.44	0.02	1.0
40-60% Max. Range 0.8 – 1.2	0.84	0.82	0.02	1.0
60-80% Max. Range 1.2 – 1.6	1.25	1.23	0.02	1.0
80-100% Max. Range 1.6 – 2.0	1.87	1.85	0.02	1.0

\*Acceptable tolerance is 4%.

The uncertainty of measurement is  $\pm 0.4$ " WC. This is based on the reference standard having a TAR (Test Accuracy Ratio) of at least 4:1.

Technician signature: Tony Tong

Date: 06/16/2020

Reviewed by: 

Date: 6/29/2020

**Temperature Calibration  
EPA Method 28R, ASTM 2515**

<b>BOOTH:</b>		<b>TEMPERATURE MONITOR TYPE:</b>				<b>EQUIPMENT NUMBER:</b>	
Mobile		National Instruments Logger				00371, 00372	
<b>REFERENCE METER EQUIPMENT NUMBER: 00373</b>				<b>Calibration Due Date: 09/11/2020</b>			
<b>CALIBRATION PERFORMED BY:</b>			<b>DATE:</b>		<b>AMBIENT TEMPERATURE:</b>		<b>BAROMETRIC PRESSURE:</b>
Tony Tong			06/16/2020		71		29.95
Input Temperature (F)	Ambient	Meter A					FB Interior
			Meter B	Filter A	Filter B	Tunnel	
0	-1	-1	-1	-1	-1	0	0
100	99	99	99	99	99	100	100
300	299	299	299	299	299	300	300
500	499	499	499	499	499	500	500
700	699	699	699	699	699	700	700
1000	999	999	1000	999	999	1000	1000

Input (F)	FB Top	FB Bottom	FB Back	FB Left	FB Right	Imp A	Imp B	Cat	Stack
0	0	0	0	0	0	-1	-1	-1	-1
100	100	100	100	100	100	100	99	99	99
300	300	300	300	300	300	299	299	299	299
500	500	500	500	500	500	499	499	499	499
700	700	700	700	700	700	699	699	699	699
1000	1000	1000	1000	1000	1000	999	999	999	1000
1500								1499	
2000								1999	

Technician signature:     Tony Tong     Date:     06/16/2020    


Reviewed By:     *B. K. [Signature]*     Date:     6/29/2020

# Thermal Metering System Calibration Y Factor

Manufacturer: Apex  
 Model: XC-60-EP  
 Serial Number: 702004  
 OMNI Tracking No.: OMNI-00372  
 Calibrated Orifice:  Yes

<b>Average Gas Meter y Factor</b>
<b>0.998</b>

<b>Orifice Meter dH@</b>
<b>N/A</b>

Calibration Date: 06/16/20  
 Calibrated by: Tony Tong  
 Calibration Frequency: Six Months  
 Next Calibration Due: 12/16/2020  
 Instrument Range: 1.000 cfm  
 Standard Temp.: 68 oF  
 Standard Press.: 29.92 "Hg  
 Barometric Press., Pb: 29.94 "Hg  
 Signature/Date:  6/29/2020

### Previous Calibration Comparison

Date	<u>1/6/2020</u>	Acceptable Deviation (5%)	Deviation
y Factor	<u>0.985</u>	0.04925	0.013
Acceptance	<b>Acceptable</b>		

### Current Calibration

Acceptable y Deviation	0.020
Maximum y Deviation	0.005
Acceptable dH@ Deviation	N/A
Maximum dH@ Deviation	N/A
Acceptance	<b>Acceptable</b>

Reference Standard *		
Standard	Model	Standard Test Meter
Calibrator	S/N	<u>OMNI-00001</u>
	Calib. Date	<u>25-Nov-19</u>
	Calib. Value	<u>0.9981</u> y factor (ref)

Calibration Parameters	Run 1	Run 2	Run 3
Reference Meter Pressure ("H2O), Pr	0.00	0.00	0.00
DGM Pressure ("H2O), Pd	2.00	1.00	0.80
Initial Reference Meter	163.775	170.2	176.412
Final Reference Meter	169.978	175.987	183.35
Initial DGM	0	0	0
Final DGM	6.155	5.782	6.977
Temp. Ref. Meter (°F), Tr	68.0	68.0	69.0
Temperature DGM (°F), Td	69.0	69.0	70.0
Time (min)	34.9	47.2	62.2
Net Volume Ref. Meter, Vr	6.203	5.787	6.938
Net Volume DGM, Vd	6.155	5.782	6.977
<b>Gas Meter y Factor =</b>	<b>1.003</b>	<b>0.998</b>	<b>0.992</b>
<b>Gas Meter y Factor Deviation (from avg.)</b>	0.005	0.000	0.005
<b>Orifice dH@</b>	N/A	N/A	N/A
<b>Orifice dH@ Deviation (from avg.)</b>	N/A	N/A	N/A

where:

1. Deviation = |Average value for all runs - current run value|
- \*\* 2.  $y = [Vr \times (y \text{ factor (ref)}) \times (Pb + (Pr / 13.6)) \times (Td + 460)] / [Vd \times (Pb + (Pd / 13.6)) \times (Tr + 460)]$
- \*\* 3.  $dH@ = 0.0317 \times Pd / (Pb (Td + 460)) \times [(Tr + 460) \times \text{time}] / Vr]^2$

\* Reference calibration is traceable to NIST through NIST Test # 40674, Kimble ASTM E1272, or NIST traceable laboratory

\*\* Equations come from EPA Method 5

The uncertainty of measurement is  $\pm 0.14 \text{ ft}^3/\text{min}$ . This is based on the reference standard having a TAR (Test Accuracy Ratio) of at least 4:1.

## DIFFERENTIAL PRESSURE GAUGE CALIBRATION DATA SHEET

Instrument to be calibrated: Pressure Transducer

Maximum Range: 0 – 2" H<sub>2</sub>O

ID Number: OMNI-00372

Calibration Instrument: Digital Manometer

ID Number: OMNI-00395

Date: 06/16/2020

By: Tony Tong

**This form is to be used only in conjunction with Standard Procedure C-SPC.**

Range of Calibration Point ("WC)	Digital Manometer Input ("WC)	Pressure Gauge Response ("WC)	Difference (Input - Response)	% Error of Full Span*
0-20% Max. Range 0.0 – 0.4	0.25	0.22	0.03	1.5
20-40% Max. Range 0.4 – 0.8	0.48	0.47	0.01	0.5
40-60% Max. Range 0.8 – 1.2	1.01	0.98	0.03	1.5
60-80% Max. Range 1.2 – 1.6	1.44	1.43	0.01	0.5
80-100% Max. Range 1.6 – 2.0	1.78	1.77	0.01	0.5

\*Acceptable tolerance is 4%.

The uncertainty of measurement is  $\pm 0.4$ " WC. This is based on the reference standard having a TAR (Test Accuracy Ratio) of at least 4:1.

Technician signature: Tony Tong

Date: 06/16/2020

Reviewed by: 

Date: 6/29/2020

**Temperature Calibration  
EPA Method 28R, ASTM 2515**

<b>BOOTH:</b>		<b>TEMPERATURE MONITOR TYPE:</b>				<b>EQUIPMENT NUMBER:</b>	
Mobile		National Instruments Logger				00371, 00372	
<b>REFERENCE METER EQUIPMENT NUMBER: 00373</b>				<b>Calibration Due Date: 09/11/2020</b>			
<b>CALIBRATION PERFORMED BY:</b>			<b>DATE:</b>		<b>AMBIENT TEMPERATURE:</b>		<b>BAROMETRIC PRESSURE:</b>
Tony Tong			06/16/2020		71		29.95
Input Temperature (F)	Ambient	Meter A					FB Interior
			Meter B	Filter A	Filter B	Tunnel	
0	-1	-1	-1	-1	-1	0	0
100	99	99	99	99	99	100	100
300	299	299	299	299	299	300	300
500	499	499	499	499	499	500	500
700	699	699	699	699	699	700	700
1000	999	999	1000	999	999	1000	1000

Input (F)	FB Top	FB Bottom	FB Back	FB Left	FB Right	Imp A	Imp B	Cat	Stack
0	0	0	0	0	0	-1	-1	-1	-1
100	100	100	100	100	100	100	99	99	99
300	300	300	300	300	300	299	299	299	299
500	500	500	500	500	500	499	499	499	499
700	700	700	700	700	700	699	699	699	699
1000	1000	1000	1000	1000	1000	999	999	999	1000
1500								1499	
2000								1999	

Technician signature:     Tony Tong     Date:     06/16/2020    

Reviewed By:     *B...*     Date:     6/29/2020

# Calibration Record

Vaneometer Air Velocity Meter OMNI-00559

## Calibration Service Record

Date	By	Results	Date of next Calibration
11/17/17	BD	Installed New Vane From Manufacturer	5/17/18
7/12/18	BD	Installed New Vane From Manufacturer	1/12/19
1/15/19	BD	Installed New Vane From Manufacturer	6/15/19
6/13/19	BD	Installed New Vane From Manufacturer	12/13/19
05/21/2020	TT	Installed new vane from manufacturer	11/21/2020



# Certificate of Calibration



14956685

Certificate Page 1 of 2

## Instrument Identification

Company ID: 74857  
OMNI-TEST  
MICHAEL CASTILLO  
13327 NE ARIPOINT WAY  
PORTLAND, OR 97230

PO Number: 190251

Instrument ID: **OMNI-00677**  
Manufacturer: DWYER INSTRUMENTS  
Description: ANEMOMETER VANE

Model Number: VT-200  
Serial Number: 18200149

---

## Certificate Information

Reason For Service: CALIBRATION

Type of Cal: NORMAL

As Found Condition: IN TOLERANCE

As Left Condition: IN TOLERANCE

Procedure: 33K6-4-1769-1 VELOCITY, TEMP, AND FLOW REV:  
9/30/15

Remarks:

Technician: RYAN EDWARDS

Cal Date 04Sep2019

Cal Due Date: 04Sep2020

Interval: 12 MONTHS

Temperature: 23.0 C

Humidity: 61.0 %

---

Tektronix certifies the performance of the above instrument has been verified using test equipment of known accuracy, which is traceable to the International System of Units (SI), National Metrology Institutes (NIST, NPL, PTB), derived from ratio type measurements, compared to reference materials or recognized consensus standards. The policies and procedures comply with ANSI/NCSL Z540.1-1994. The quality system complies with ISO9001.

This certificate shall not be reproduced, except in full, without the written consent of Tektronix.

Approved By: RYAN EDWARDS

Service Representative

Issue Date: 9/4/2019

---

## Calibration Standards

<u>NIST Traceable#</u>	<u>Inst. ID#</u>	<u>Description</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Cal Date</u>	<u>Date Due</u>
14717431	17021560	TEMP/HUM RECORDER	OMEGA	ITHX-SD	08Jun2019	08Jul2020
14942663	38-1005980	PITOT TUBE AIRFLOW SYSTEM	SYPRIS	AF12319/PX653	16Aug2019	16Feb2021
14468373	38-1007264	PLATINUM RESISTANCE THERMOMETER	HART SCIENTIFIC	1502A/5612	15Mar2019	15Mar2020





# Certificate of Calibration



14956685

Certificate Page 2 of 2

## Calibration Standards

<u>NIST Traceable#</u>	<u>Inst. ID#</u>	<u>Description</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Cal Date</u>	<u>Date Due</u>
14330222	38-1018828	TEMP/HUMIDITY PROBE	VAISALA	HMP45A	30Jan2019	30Jan2020
14333248	38-1037024	BAROMETRIC TRANSDUCER	OMEGADYNE	PX02K1-28A5T	31Jan2019	31Jan2020
14302838	B0023974	DATA ACQUISITION/SWITCH UNIT	AGILENT	34970A	22Jan2019	22Feb2020
14550342	H058567	DIGITAL PRESSURE GAGE	MENSOR	2101	09Apr2019	09Jun2020

*Model: Maxim M255 PE  
Central Boiler, Inc. WoodMaster, Inc.  
20502 160th Street  
Greenbush, MN 56726*

# **Section 3**

## **Owner's Manual**

Tested &  
Listed By



Portland  
Oregon USA

OMNI-Test Laboratories, Inc.

Report # 0117PS024S, # 0117PS024E



**Central Boiler**  
**20502 160th Street**  
**Greenbush, MN 56726**

Serial No.

Month/Year Manufactured

## Model: Maxim® M255 PE Wood Pellet Hydronic Heater

Dry Weight: 1,297 lbs.

Water Capacity: 90 gallons

Listed by OMNI-Test Laboratories to the applicable portions of the following standards: UL 2523-2018 Solid Fuel-Fired Hydronic Heating Appliances, Water Heaters and Boilers, CAN/CSA B415.1-10 (R2015) Performance Testing of Solid-Fuel-Burning Heating Appliances, CSA-B366.1-11 (R2015) Solid-Fuel-Fired Central Heating Appliance, ASTM E2618-13 Standard Test Method for Measurement of Particulate Emissions and Heating Efficiency of Solid Fuel-Fired Hydronic Heating Appliances, ASTM E2515-11 Standard Test Method for Determination of Particulate Matter Emissions Collected by a Dilution Tunnel.

Certified for addition to existing heating systems.

For outdoor and non-habitable structure installations only; Category I Boiler. This unit is not intended to be installed in a building which can be damaged by smoke, soot or spills of water.

May be connected to existing boiler system by a qualified installer only.

Must be installed according to all applicable codes and regulations.

Install and use only in accordance with Central Boiler's installation and operating instructions. Refer to Owner's Manual for further instruction.

Never operate appliance with water level below the full mark.

Load fuel carefully or damage may result.

Do not attempt to light a fire when there is gas vapor present. For safety, keep firebox door latched. Leaving the firebox door open may lead to a runaway fire.

The appliance, chimney and ignitor must be kept in good condition and cleaned when necessary.

The appliance and chimney must be cleaned regularly to remove accumulated creosote and ash especially at the end of the heating season to minimize corrosion during the non-heating season.

A power generator may be used in event of power failure to prevent lines from freezing.

## DO NOT CONNECT THIS APPLIANCE TO CHIMNEY FLUE SERVING ANOTHER APPLIANCE.

### Installation and Clearance to Combustibles

Clearance to combustibles: 8 inches from the back, 48 inches from the front, 27 inches from the top, 6 inches from the sides.

Base: Non-combustible, level, stable ground; concrete preferred.

Chimney: 6 inch ASHT UL 103 (two 4-foot sections are supplied). Adjust flue draft between -0.010 and -0.090 in. WC (-2.490 and -22.418 Pa). Do not operate with flue draft exceeding -0.100 in. WC (-24.908 Pa).

Electrical Input: 120 Volts, 60 Hz, 20 Amps.

### Firebox Burner Fuel

**Fuel** Wood pellets. Premium grade wood pellets preferred. Load with caution to prevent damage to appliance. Do not use chemicals or fluids to start fire. Do not burn garbage, gasoline, naphtha, engine oil or other inappropriate materials. Refer to Owner's Manual regarding the burning of other types of biomass not listed above.

Manufacturer's Rated Heat Output Capacity: 190,000 Btu/hr

45 of 249

p/n 7000953

Central Boiler, Inc.  
20502 160th Street  
Greenbush, MN 56726

Serial No:                      Date Manufactured:

Model: Maxim M255 PE

U.S. ENVIRONMENTAL PROTECTION AGENCY Certified to  
comply with the 2020 particulate emission standards using  
wood pellets.

Tested to:     ASTM E2618-13, ASTM E2515-11,  
                  CAN/CSA-B415.1-10 (R2015)

Meets:         EPA Step 2 Emission Level

Total Particulate Matter: 0.9 g/hr annual weighted average  
                                  0.03 lbs/Million Btu heat output

Thermal Output Rating: 0 - 182,504 Btu/hr

Appliance needs periodic inspection and repair for proper  
operation. Consult owner's manual for further information. It is  
against federal regulations to operate this appliance in a  
manner inconsistent with operating instructions in the owner's  
manual.

p/n: 7000955

Tested &  
Listed By



Portland  
Oregon USA

OMNI-Test Laboratories, Inc.

Report # 0117PS024S, # 0117PS024E

WOODMASTER

WoodMaster, Inc.  
20502 160th Street  
Greenbush, MN 56726

Serial No.

Month/Year Manufactured

## Model: Maxim® M255 PE Wood Pellet Hydronic Heater

Dry Weight: 1,297 lbs.

Water Capacity: 90 gallons

Listed by OMNI-Test Laboratories to the applicable portions of the following standards: UL 2523-2018 Solid Fuel-Fired Hydronic Heating Appliances, Water Heaters and Boilers, CAN/CSA B415.1-10 (R2015) Performance Testing of Solid-Fuel-Burning Heating Appliances, CSA-B366.1-11 (R2015) Solid-Fuel-Fired Central Heating Appliance, ASTM E2618-13 Standard Test Method for Measurement of Particulate Emissions and Heating Efficiency of Solid Fuel-Fired Hydronic Heating Appliances, ASTM E2515-11 Standard Test Method for Determination of Particulate Matter Emissions Collected by a Dilution Tunnel.

Certified for addition to existing heating systems.

For outdoor and non-habitable structure installations only; Category I Boiler. This unit is not intended to be installed in a building which can be damaged by smoke, soot or spills of water.

May be connected to existing boiler system by a qualified installer only.

Must be installed according to all applicable codes and regulations.

Install and use only in accordance with WoodMaster's installation and operating instructions. Refer to Owner's Manual for further instruction.

Never operate appliance with water level below the full mark.

Load fuel carefully or damage may result.

Do not attempt to light a fire when there is gas vapor present. For safety, keep firebox door latched. Leaving the firebox door open may lead to a runaway fire.

The appliance, chimney and ignitor must be kept in good condition and cleaned when necessary.

The appliance and chimney must be cleaned regularly to remove accumulated creosote and ash especially at the end of the heating season to minimize corrosion during the non-heating season.

A power generator may be used in event of power failure to prevent lines from freezing.

## DO NOT CONNECT THIS APPLIANCE TO CHIMNEY FLUE SERVING ANOTHER APPLIANCE.

### Installation and Clearance to Combustibles

Clearance to combustibles: 8 inches from the back, 48 inches from the front, 27 inches from the top, 6 inches from the sides.

Base: Non-combustible, level, stable ground; concrete preferred.

Chimney: 6 inch ASHT UL 103 (two 4-foot sections are supplied). Adjust flue draft between -0.010 and -0.090 in. WC (-2.490 and -22.418 Pa). Do not operate with flue draft exceeding -0.100 in. WC (-24.908 Pa).

Electrical Input: 120 Volts, 60 Hz, 20 Amps.

### Firebox Burner Fuel

Fuel Wood pellets. Premium grade wood pellets preferred. Load with caution to prevent damage to appliance. Do not use chemicals or fluids to start fire. Do not burn garbage, gasoline, naphtha, engine oil or other inappropriate materials. Refer to Owner's Manual regarding the burning of other types of biomass not listed above.

Manufacturer's Rated Heat Output Capacity: 190,000 Btu/hr

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p/n 7000927

WoodMaster, Inc.  
20502 160th Street  
Greenbush, MN 56726

Serial No:

Date Manufactured:

Model: Maxim M255 PE

U.S. ENVIRONMENTAL PROTECTION AGENCY Certified to  
comply with the 2020 particulate emission standards using  
wood pellets.

Tested to: ASTM E2618-13, ASTM E2515-11,  
CAN/CSA-B415.1-10 (R2015)

Meets: EPA Step 2 Emission Level

Total Particulate Matter: 0.9 g/hr annual weighted average  
0.03 lbs/Million Btu heat output

Thermal Output Rating: 0 - 182,504 Btu/hr

Appliance needs periodic inspection and repair for proper  
operation. Consult owner's manual for further information. It is  
against federal regulations to operate this appliance in a  
manner inconsistent with operating instructions in the owner's  
manual.

p/n: 7000930



# MAXIM<sup>®</sup>

WOOD PELLET FURNACE  
OWNER'S MANUAL

## M255 PE



Tested &  
Listed By  Portland  
Oregon USA  
OMNI-Test Laboratories, Inc.  
0117PS024S  
0117PS024E

Save This Manual  
For Future Reference

# MAXIM<sup>®</sup>

20502 160th Street • Greenbush, MN 56726  
CentralBoiler.com

The Maxim Wood Pellet Furnace is listed by OMNI-Test Laboratories to the applicable portions of the following standards: UL 2523-2018 Solid Fuel-Fired Hydronic Heating Appliances, Water Heaters and Boilers, CAN/CSA B415.1-10 (R2015) Performance Testing of Solid-Fuel-Burning Heating Appliances, CSA-B366.1-11 (R2015) Solid-Fuel-Fired Central Heating Appliance, ASTM E2618-13 Standard Test Method for Measurement of Particulate Emissions and Heating Efficiency of Solid Fuel-Fired Hydronic Heating Appliances, ASTM E2515-11 Standard Test Method for Determination of Particulate Matter Emissions Collected by a Dilution Tunnel.

French Owner's Manual and decal set available upon request from your dealer.  
(Manuel d'installation en français et décalcomanies disponible sur demande auprès de votre revendeur)

The Maxim Wood Pellet Furnace includes two 4-foot chimney sections (6" ASHT) listed to UL 103.

M255 PE - Water Capacity: 90 gal. - Weight: 1,297 lbs

Maxim M255 PE thermal output rating: 182,504 Btu/hr (53.5 kW) - maximum  
Thermal Output Rating\*: Manufacturer's Rated Heat Output Capacity: 190,000 Btu/hr  
Annual Efficiency Rating\*: 96.2% (lower heating value), 89.2% (higher heating value)

\*Performance is a product of the combustion rate, combustion efficiency and heat exchange efficiency with a single fuel load without refueling. Results vary based on wood species, wood quality, wood quantity and moisture content. Efficiencies are determined under the same test conditions using higher heating value, lower heating value and annual fuel utilization efficiency (AFUE).

- This heater meets the 2020 U.S. Environmental Protection Agency's particulate emission standards for wood heaters sold after May 15, 2020. Under specific test conditions this heater has been shown to deliver heat at rates ranging from 0 to 182,504 Btu/hr.
- This wood heater has a manufacturer-set minimum low burn rate that must not be altered. This wood 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.
- DO NOT OVERFIRE THIS HEATER. Attempts to achieve heat output rates that exceed heater design specifications can result in permanent damage to the heater.
- Any person(s) operating a hydronic heater must comply with all applicable laws, including but not limited to local ordinances.
- Improper use or failure to maintain the hydronic heater may cause nuisance conditions. The person(s) operating a hydronic heater is/are responsible for operation in a manner that does not create a nuisance condition. Meeting the setback distance and stack height recommendations from the manufacturer and requirements in applicable State and local regulations may not always be adequate to prevent nuisance conditions in some areas due to terrain or other factors.
- Operating an outdoor furnace may not be suitable to some individuals' abilities or lifestyles. Be sure to review the Owner's Manual for the appliance with your dealer.

#### INSTALLATIONS IN MASSACHUSETTS:

1. All installation components must be products approved in the Commonwealth of Massachusetts by the Gas and Plumbing Board.
2. The minimum run of tubing from the water heater to a fan coil is 50 linear feet.
3. Persons operating this hydronic heater are responsible for operation of the hydronic heater so as not to cause a condition of air pollution as defined in 310 CMR 7.01(1).

For parts and accessories, service or repairs, call your authorized Central Boiler dealer or heating contractor. Record the information below for future reference.

Model	Serial Number	Installation Date
Dealership Name		Phone Number
Owner Name		



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# INTRODUCTION

## Labeling and Terminology

The outdoor furnace and this owner's manual use the following terms and symbols to bring attention to the presence of hazards of various risk levels and important information concerning the use and maintenance of the furnace.

**DANGER:** Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

**WARNING:** Indicates presence of a hazard which can cause severe personal injury, death, or substantial property damage if ignored.

**CAUTION:** Indicates presence of a hazard which will or can cause minor personal injury or property damage if ignored.

**NOTE:** Indicates supplementary information worthy of particular attention relating to installation, operation, or maintenance of the furnace but is not related to a hazardous condition.

Be sure to follow all instructions and related precautions as they are meant for your safety and protection. Store this manual in a readily accessible location for future reference.

## Foreword

This manual is to be used as a guideline for the installation, operation and maintenance of the Maxim Wood Pellet Furnace. This manual is organized into thirteen sections for easy reference.

- Section 1 – General Information;
- Section 2 – Location and Foundation;
- Section 3 – Electrical;
- Section 4 – Ignitor Operation;
- Section 5 – Chimney;
- Section 6 – System Installation;
- Section 7 – Filling System with Water and Purging Air;
- Section 8 – Operating Instructions;
- Section 9 – Routine Maintenance;
- Section 10 – Troubleshooting;
- Section 11 – Decals;
- Section 12 – Wiring Diagram

Anyone owning or operating this outdoor furnace must read, fully understand, and follow all of the information in this manual.

**NOTE:** In higher populated areas, extend the chimney to a height above the roofs of surrounding buildings (see Chimney Height in the Chimney section).

**NOTE:** The outdoor furnace may be connected to an existing boiler system or hot water heating system by a qualified installer only. However, the outdoor furnace must not be pressurized.

# IMPORTANT PRECAUTIONARY INFORMATION

The information contained on this page appears throughout this manual. Be sure to read carefully and understand these precautions before, during and after the installation, operation and maintenance of the furnace.

## WARNING

This outdoor furnace is not intended to be the only source of heat. In the event of a prolonged power failure, a generator may be used to prevent lines from freezing. Should the system be left unattended, run out of fuel or require service, an alternate heating source in the building being heated should be in place to prevent damage caused by freezing.

## WARNING

This outdoor furnace is not intended or certified to be installed inside habitable space. Do not install the outdoor furnace inside your home.

## CAUTION

This outdoor furnace should not be installed in a building that could be damaged or where a financial loss could occur from smoke, soot or water.

## WARNING

This outdoor furnace and/or chimney must not be installed inside or under any configuration or construction that contains combustible materials as part of the structure or configuration. The chimney is not intended or safety tested to be used or installed other than on the furnace located outside of any structure or enclosure.

## WARNING

Installation of the outdoor furnace is to be performed by a qualified installer.

## WARNING

When installing a heat exchanger on an existing hot water boiler, be sure none of the existing system safety controls are disabled.

## WARNING

Maintain the following clearances from combustibles for the outdoor furnace installation:

- 8" (20 cm) from the transition box
- 6" (15 cm) from the sides
- 48" (122 cm) from the front
- 8" (20 cm) from the chimney
- 27" (68.5 cm) from the top
- The foundation must be noncombustible

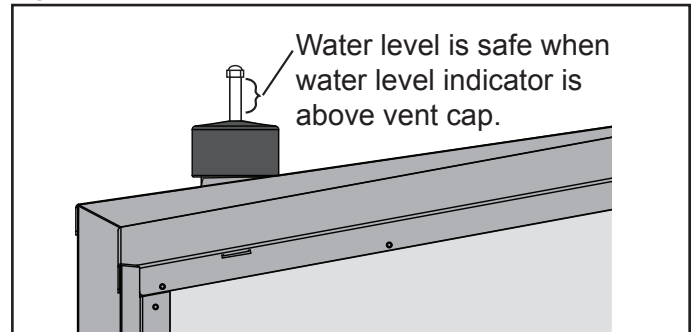
## WARNING

Use only chimneys listed to UL 103 HT for installation. The chimney and flue pipe must be clean and in good condition.

## WARNING

Be sure the outdoor furnace is filled with water before firing. Water level is safe when the water level indicator rod is above the vent cap (Fig. 1). MolyArmor 350 must be added before the initial fill (see Water Quality and Maintenance).

Fig. 1



## WARNING

Do not allow combustible materials (straw, hay or wood) near the outdoor furnace. Keep the perimeter of the outdoor furnace clear and clean.

## WARNING

Never leave the firebox door or hopper lid open or ajar when unattended.

## WARNING

Use only those listed fuels recommended by the manufacturer of your unit. Never use the following: trash, plastics, gasoline, rubber, naphtha, household garbage, material treated with petroleum products (particle board, railroad ties and pressure treated wood), leaves, paper products, and cardboard.

## CAUTION

Never use gasoline, gasoline-type lantern fuel, kerosene, charcoal lighter fluid, or similar liquids to start or 'freshen up' a fire in this outdoor furnace. Keep all such liquids well away from the outdoor furnace while it is in use.

# IMPORTANT PRECAUTIONARY INFORMATION

The information contained on this page appears throughout this manual. Be sure to read carefully and understand these precautions before, during and after the installation, operation and maintenance of the furnace.

## WARNING

Burn premium quality wood pellets only.

## WARNING

This heater is designed to burn premium quality wood pellets only.\* Higher efficiencies and lower emissions generally result when burning premium quality wood pellets, as compared to standard pellets. **DO NOT BURN:** unseasoned wood, garbage, tires, lawn clippings, leaves, brush trimmings or general yard waste, materials containing asbestos, materials containing lead, mercury or other heavy toxic metals, materials containing plastic, materials containing rubber, waste petroleum products, paints and paint thinners, asphalt products, chemicals, coal, glossy or colored paper, construction and demolition debris, plywood, particleboard, salt water driftwood and other previously salt water saturated materials, manure, animal carcasses and asphalt products. Burning these materials may result in release of toxic fumes or render the heater ineffective and cause smoke.

## WARNING

The outdoor furnace vent cap must fit loosely on the vent opening. Do not force the cap down or try to seal it tightly onto the vent pipe. Do not extend or restrict the vent pipe or opening. **DO NOT ALLOW THE OUTDOOR FURNACE TO PRESSURIZE.**

## WARNING

Disconnect the electrical power to the furnace and remove all ash from the firebox before performing maintenance that requires draining the water or replacing an electrical component.

## WARNING

Allow the outdoor furnace to thoroughly cool before draining water from the outdoor furnace. Never drain water from the outdoor furnace with live ash or fire in the firebox. If the water in the outdoor furnace ever boils, be sure to check the water level and restore to full. If water is added, the proper level of MolyArmor 350 (p/n 2900361) must be maintained.

## WARNING

When cleaning the outdoor furnace, be careful not to spill any hot ash.

## CAUTION

Always wear the appropriate personal protective gear when cleaning ash from the firebox.

**NOTE:** All installations and operations must be in accordance with local and state codes which may differ from the information in this manual.

**NOTE:** Check with your insurance company to see if they have any location requirements.

**NOTE:** Any changes to an existing boiler should be done by a qualified installer in accordance with applicable codes.

**NOTE:** Do not connect this outdoor furnace to a chimney flue serving another appliance.

**NOTE:** Chloride or sulfurous gases can be generated if plastic or rubber is burned and will mix with the moisture from the wood pellets and form hydrochloric or sulfuric acids in the firebox, creating corrosion.

**NOTE:** If installed in a non-habitable building, adequate combustion air and ventilation must be provided.

## CAUTION

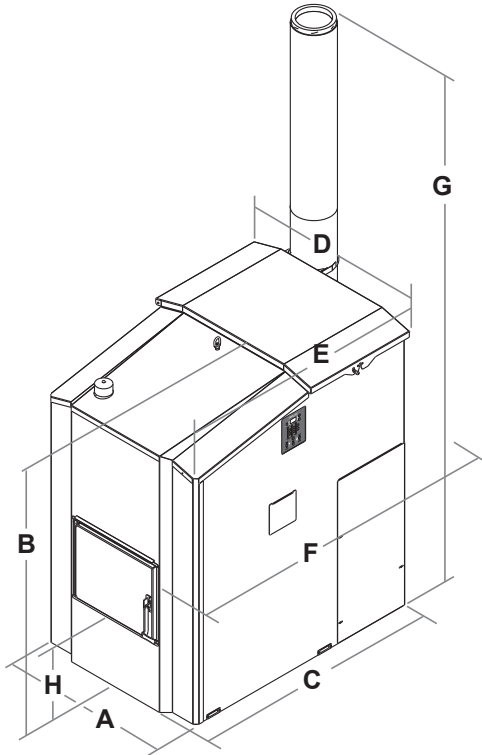
Failure to maintain and clean heat exchangers properly can result in the thermal valve activating.

# SECTION 1 – GENERAL INFORMATION

Anyone owning or operating this outdoor furnace must read, fully understand, and follow all of the information in this manual.

## Specifications and Dimensions

Fig. 2



Maxim M255 PE Measurements								
	A	B	C	D	E	F	G	H
in.	34	57	49.5	36	48	59.5*	117.5**	14.5
cm	86	145	126	91.5	122	151*	298.5**	37

\* Measurement (F) is from firebox door to chimney inspection cover.  
 \*\* Measurement (G) with two 4-foot chimney sections.

**NOTE:** See Section 5 for chimney installation guidelines.

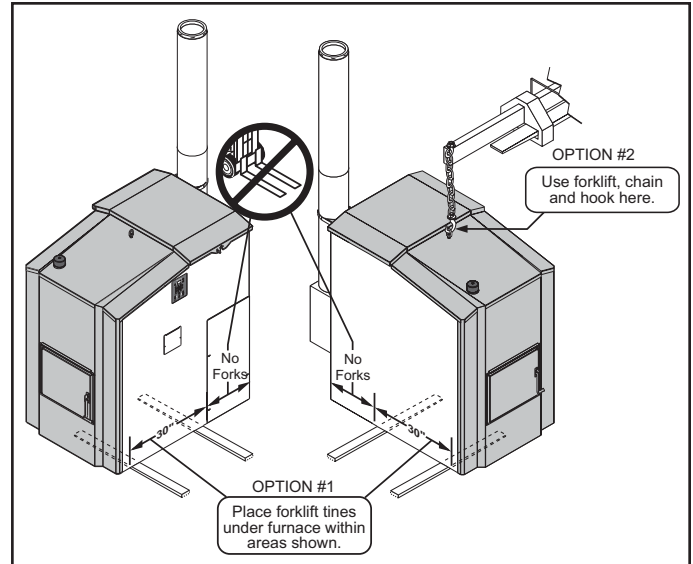
**NOTE:** The Maxim Furnace includes two 4-foot (1.2-meter) ASHT 6" in diameter chimney sections listed to UL103HT. For chimney sections or chimney replacement, use only genuine Central Boiler chimney components. Parts are available from an authorized Central Boiler dealer.

## Removing from Pallet

The outdoor furnace is secured to the shipping pallet with four brackets. To remove these brackets, loosen (but do not remove) the two screws securing each shipping slot cover and slide the cover up. Remove the bolts securing the bracket to the pallet and remove the bracket.

**NOTE:** Lift the outdoor furnace only where specified by Fig. 3.

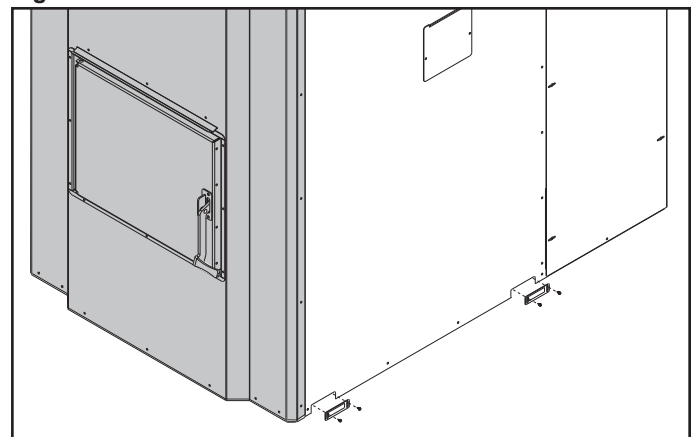
Fig. 3



## Shipping Slot Covers

Position each shipping slot cover so it is flush with the bottom of the outdoor furnace; then secure the cover by tightening the two screws. Make sure all four covers are properly positioned and secured (Fig. 4).

Fig. 4





## Options for Increasing Fuel Storage

An optional 48-Bushel Hopper is available (p/n 9660 or 9760) for increasing fuel storage. This hopper can be positioned to the side of the furnace using a 5-1/2' Auxiliary Auger Kit (p/n 9440).

A 6' Auxiliary Auger Kit (p/n 6453) and an 8' Auxiliary Auger Kit (p/n 9454) are also available for other applications. The auxiliary augers can also be used with larger external bins.

An optional Auxiliary Auger Vibrator with Timer Kit (p/n 9458) can be installed on the auxiliary auger connected to an external hopper. Vibration occurs based on a timer setting.

## Potable Water

If the outdoor furnace is to heat potable water associated with commercial food preparation or for heating milk-house hot water, it is recommended to install a double-wall heat exchanger. Also, when filling the system with water, a backflow preventer must be installed in the line used for filling.

## Adding Antifreeze to Outdoor Furnace System

Most outdoor furnaces are installed without antifreeze when an existing heating system is in place and there is no anticipation of leaving the outdoor furnace unattended for extended periods of time (10 days or more). If the building being heated has an alternate heat source, system water may be kept from freezing by running the circulating pump(s) and drawing heat from the existing furnace or boiler in the home or building.

To prevent freezing if the outdoor furnace is not fired for extended time periods or if lengthy power outages are anticipated during cold weather, a nontoxic propylene glycol may be used in the system. Some types of antifreeze that contain various inhibitors have been known to create problems like coagulation and jelling. To prevent potential problems, **do not use propylene glycol that is premixed with inhibitors.** MolyArmor 350 is compatible with (raw) propylene glycol. It is important to use MolyArmor 350 with straight propylene glycol for corrosion protection. If adding antifreeze to the system, it is imperative that the entire system contain **at least 30% antifreeze concentration mixed with softened, reverse osmosis or deionized water** to prevent bacterial growth and minimize minerals in the system. Bacterial growth is likely to occur with low antifreeze concentrations and can cause corrosion in the furnace water jacket and/or clogging of heat exchangers. To confirm the antifreeze solution is adequate and to kill bacteria, immediately heat the system up to 185° F, allow the pumps to circulate for at least 24 hours and then obtain a sample of the system water. Using an antifreeze tester, the solution must be protected to 10°F (-12°C) or below.

**NOTE: If using antifreeze, test the pH and Moly levels once each month. If the bacterial issues occur, the pH will decrease.**

**NOTE: Be sure to adhere to all warnings and precautions on the antifreeze label.**

**NOTE: Do not use automotive or RV types of antifreeze.**

**NOTE: If using antifreeze, see Water Quality and Maintenance in your Owner's Manual.**

## MolyArmor 350

MolyArmor 350 Corrosion Inhibitor gives optimum protection for the furnace water jacket and system parts when it is used to initially treat the water and is maintained at a minimum of 350 ppm of moly and pH level between 8.0 and 9.5.

MolyArmor 350 is composed of common materials. Molybdenum compounds are characterized as nontoxic in US Public Health Bulletin 293, by the Federal Hazardous Substances Labeling Act, and by the Occupational Safety and Health Act. However, in keeping with good safety and environmental practices, dispose furnace water in accordance with federal, state and local regulations.

- Unless regulation prohibits, you may drain the outdoor furnace to a home septic system. If doing so, however, be careful not to overflow the septic system.
- Do not drain the outdoor furnace in such a manner that the drain water could in any way contact surface water, stream, river, estuary (where a river meets a sea), lake, pond, ocean or other types of waters.
- Do not drain to any location within 50 feet (15 meters) of any water well.

## Shut-Off Valves

**Shut-off valves must be installed on each hot supply and return water line** so each line can be shut off individually for purging air from the system. Be sure all valves and fittings are metal. **Do not use plastic valves or fittings.**

## SECTION 2 – LOCATION AND FOUNDATION

### Selecting a Location

To ensure the Maxim Furnace functions as designed, careful planning and proper installation are imperative.

Be sure to read carefully and observe all of the information in the entire owner's manual.

If any installation questions arise that cannot be answered by the information in this manual, be sure to contact your dealer.

- This outdoor furnace is not intended or certified to be installed inside habitable space. Do not install the outdoor furnace inside your home.
- This outdoor furnace may be installed outdoors or in non-habitable structures and must be installed in accordance with all applicable codes and regulations.
- Check with your insurance company to see if they have any location requirements.
- This outdoor furnace should not be installed in a building that could be damaged or where a financial loss could occur from smoke, soot or water.

When selecting a suitable location, carefully consider each of the following:

- Must be installed in accordance with all applicable codes and regulations.
- A qualified installer must perform the installation of this supplementary outdoor furnace and must determine how to install it to be compatible with the existing heating source.
- Consider prevailing winds and the direction exhaust from the chimney will travel.
- The shorter the distance between the outdoor furnace and building(s) being heated, the lower the cost will be for the installation of the hot supply and return water lines and insulation.
- Be sure to maintain the required clearances to combustibles and recommended maintenance clearances.
- ThermoPEX pre-insulated piping is recommended for all underground installations. Other types of piping should not be buried in low-lying areas with standing water or with a very high water table, or under an area of heavy vehicle traffic unless protected from excessive compression.

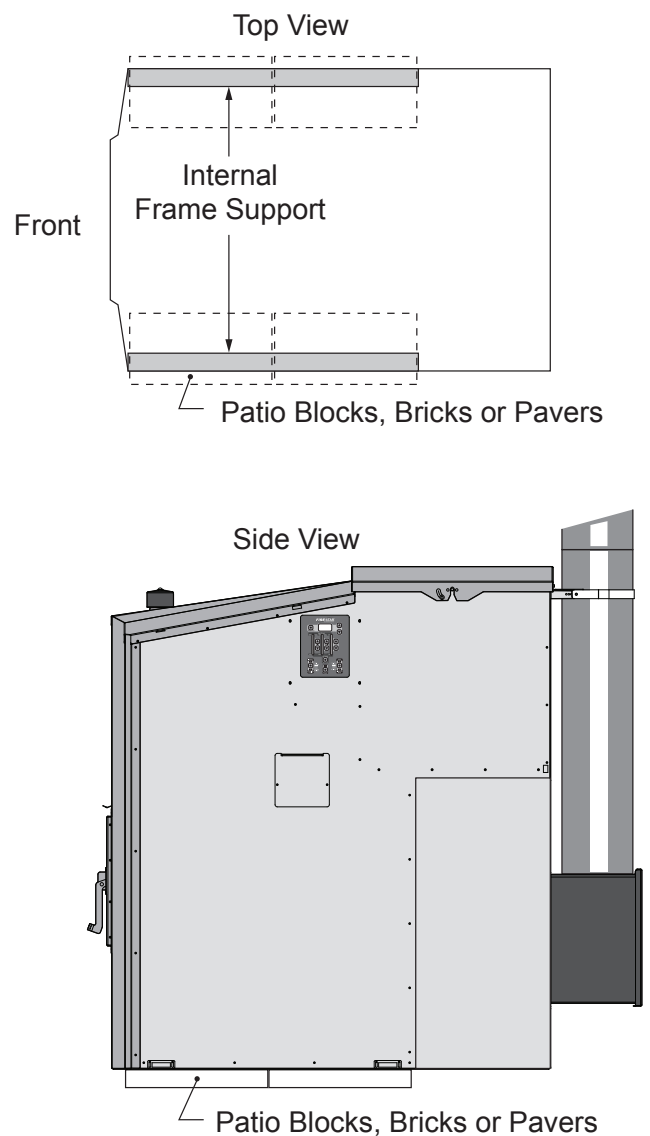
- If the ground at the location is unstable or subject to frost heaving, consider installing 2" closed-cell insulation under the front portion of the concrete slab the outdoor furnace will be installed on, and under the area around the slab used for walking (see Fig. 6).

### Foundation

The outdoor furnace may be installed directly on **stable, level ground** without the necessity of a foundation.

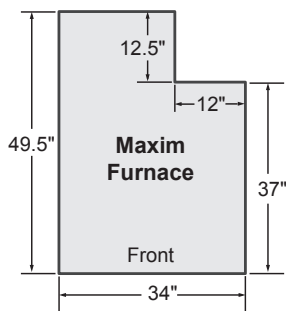
If the ground is unstable, one option is to use patio blocks, bricks or pavers under the base as indicated in Fig. 5. Another option is to pour a concrete foundation.

Fig. 5

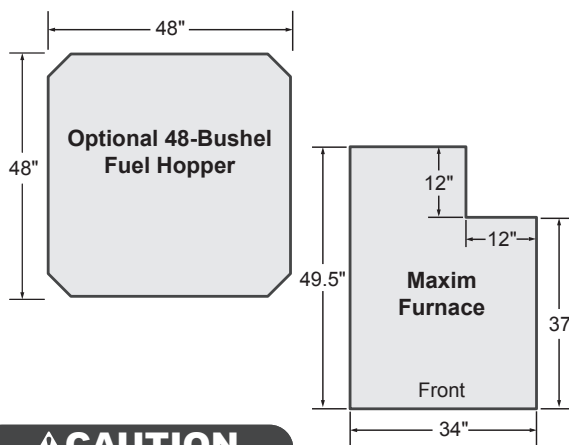


## Maxim Furnace Base Dimensions

*Furnace Base Dimensions*



*Optional 48-Bushel Hopper with Furnace Base Dimensions*



**NOTE**

Furnace must be installed on a noncombustible surface or foundation that incorporates an enclosure that will prevent supply and return lines from possible exposure to sunlight, fire, or physical damage that may be caused by an occurrence outside the furnace enclosure.

**CAUTION**

Do not use any combustible materials for the foundation.

To install the outdoor furnace on a concrete foundation, refer to Fig. 6 for dimensions and for the location of the hollowed-out area. A 4" to 6" (10 cm to 15 cm) thick concrete slab works well; however, a thicker slab may be used to obtain the desired firebox door opening height.

If installing on an existing slab, it may be necessary to use patio blocks, bricks or pavers (Fig. 5) to allow access to the water lines.

**NOTE: In all installations, the outdoor furnace must not be operated with the back panels removed. Make necessary allowances for access to the back of the outdoor furnace.**

If the area for the concrete slab is unstable or subject to frost heaving, consider installing 2" closed-cell insulation under the front portion of the concrete slab the outdoor furnace will be installed on, and under the area around the slab used for walking.

**NOTE: The installation surface or foundation must be noncombustible. The hot supply and return lines must also be protected from possible exposure to sunlight, fire or physical damage. Foundations may consist of concrete, crushed rock or patio blocks.**

### Leveling the Outdoor Furnace

**CAUTION**

**The back of the outdoor furnace must not be lower than the front of the outdoor furnace.**

The Maxim should be leveled so that the back of the transition box (i.e., the burner auger motor end) is slightly higher than the front. Smoke can condense into creosote inside the burner auger tube. If the burner auger is not sloped down toward the front of the furnace, condensation can form in the burner auger tube and drip into the transition box.

**WARNING**

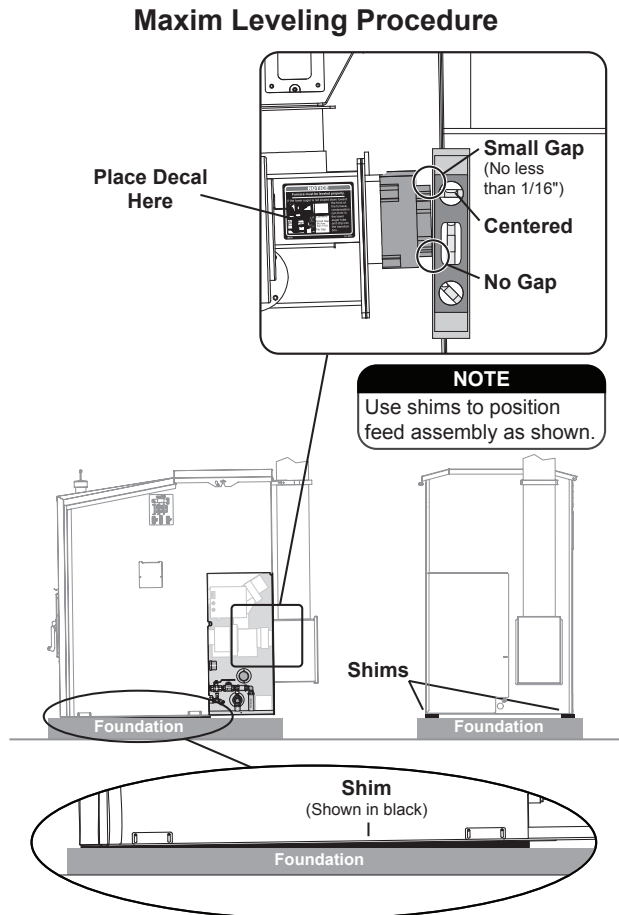
**Disconnect the electrical power at the main power source.**

1. Disconnect the electrical power at the main power source.
2. Remove the access panels from the back corner of the furnace and set aside.



- Place a level on the back of the burner auger motor as shown in Fig. 7. The back of the transition box should be slightly higher than the front, indicated when the level is vertical and there is a small gap (from 1/16" to 3/32", or 1.6 mm to 2.4 mm) between the level and the top of the burner auger motor and no gap between the level and the bottom of the burner auger motor.

Fig. 7



- Use shims as necessary under the outdoor furnace in the locations shown until the procedure in Step 3 indicates that the back of the transition box is slightly higher than the front.

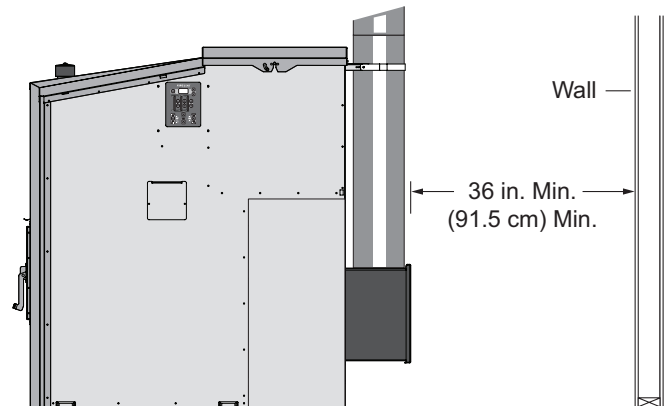
**NOTE: Periodically check that the outdoor furnace is leveled as described in these instructions because frost can cause the foundation to move.**

- Install the access panels on the back corner of the furnace.
- Connect the electrical power at the main power source.

## Clearances

**NOTE: Clearance to combustibles from the chimney transition box is 8" (20 cm); HOWEVER, if installing with the back of the outdoor furnace facing an immovable wall, object, etc., you must maintain 36" (91.5 cm) of clearance to the wall, object, etc. in order to perform periodic maintenance (see Fig. 8).**

Fig. 8



## WARNING

Maintain the following clearances from combustibles for the outdoor furnace installation:

- 8" (20 cm) from the transition box
- 6" (15 cm) from the sides
- 48" (122 cm) from the front
- 8" (20 cm) from the chimney
- 27" (68.5 cm) from the top
- The foundation must be noncombustible

## SECTION 3 – ELECTRICAL

**NOTE: Any electrical installation should be done by a qualified installer in accordance with applicable codes.**

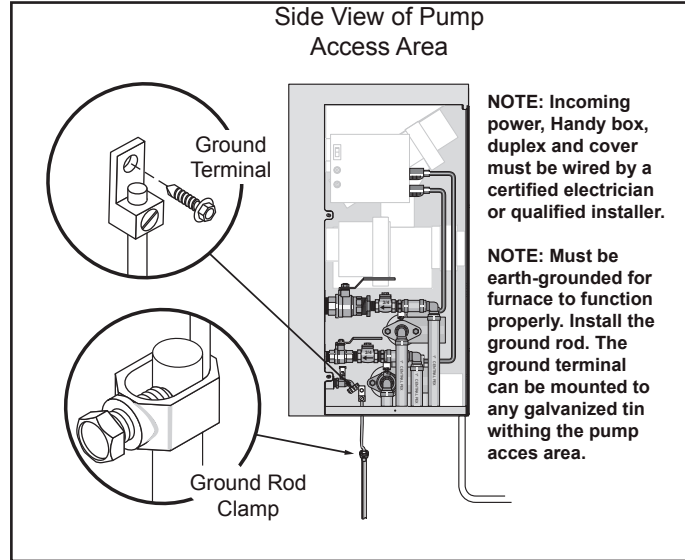
### Ground Rod

The outdoor furnace must be electrically bonded to ground in accordance with the requirements of the authority having jurisdiction or, in absence of such requirements, with the National Electrical Code, ANSI/NFPA 70 and/or the Canadian Electrical Code Part 1, CSA C22.1 Electrical Code.

Install the ground rod and connect it to the outdoor furnace.

1. In the water line trench near the outdoor furnace, drive the ground rod into the ground until the top of the ground rod is below the ground surface.
2. Remove the side and back panels; then route the ground wire from the ground rod under the outdoor furnace base and over to the bottom left corner at the back of the outdoor furnace.
3. Secure the ground terminal with the self-drilling screw provided. Secure the ground wire to the terminal; then secure the ground wire to the ground rod with the clamp. Tighten all hardware securely.

Fig. 9



# SECTION 4 – IGNITOR OPERATION

## Ignition Sequence

The ignition sequence follows a control logic to ensure safe and effective ignition. The ignition sequence is as follow:

1. The water temperature must be low enough for the furnace to shift into demand mode.
2. The fan will start and operate at the ignition fan speed and the Firestar control will send voltage to the igniter relay.
3. The air proving switch will close, completing the ignition relay control circuit.
4. The electric ignitor will warm up and heat the air blowing across it into the burn chamber.
5. The auger will cycle periodically to feed the required amount of fuel into the burn chamber, and to agitate any pellets already present in the burn chamber.
6. The ignitor will operate until the burn chamber reaches a temperature that is high enough to sustain itself, or for ten minutes, at which time the ignitor will turn off.

# SECTION 5 – CHIMNEY

## Chimney Height

The minimum recommended chimney length is eight feet (2.4 m). Two 4-foot (1.2 m) sections are standard. Additional sections may be needed (see Chimney Draft section).

**In higher populated areas, extend the chimney to a height above the roofs of surrounding buildings.** Use Central Boiler Chimney Extensions when extending the chimney. When only the standard eight feet (2.4 m) of chimney are used, the sections must be secured at the connection joint with four screws to stabilize the extension.

Be considerate of neighbors when operating your outdoor furnace. If you use your outdoor furnace in the summer months, be certain your chimney exhaust is not adversely affecting neighbors with open windows.

If located within 300 feet (91 m) of any residence not served by the outdoor furnace, it is recommended that the chimney be at least 2 feet (0.6 m) higher than the peak of the residence served.

Fig. 14

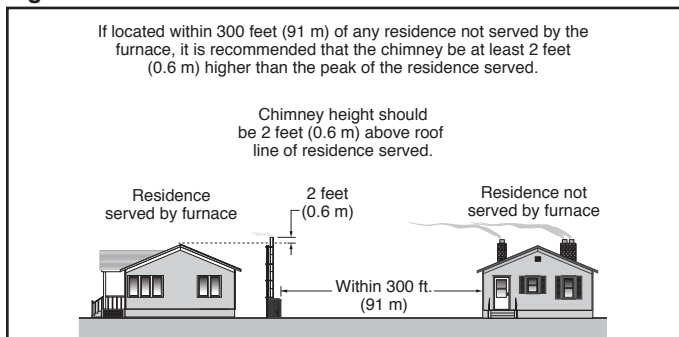
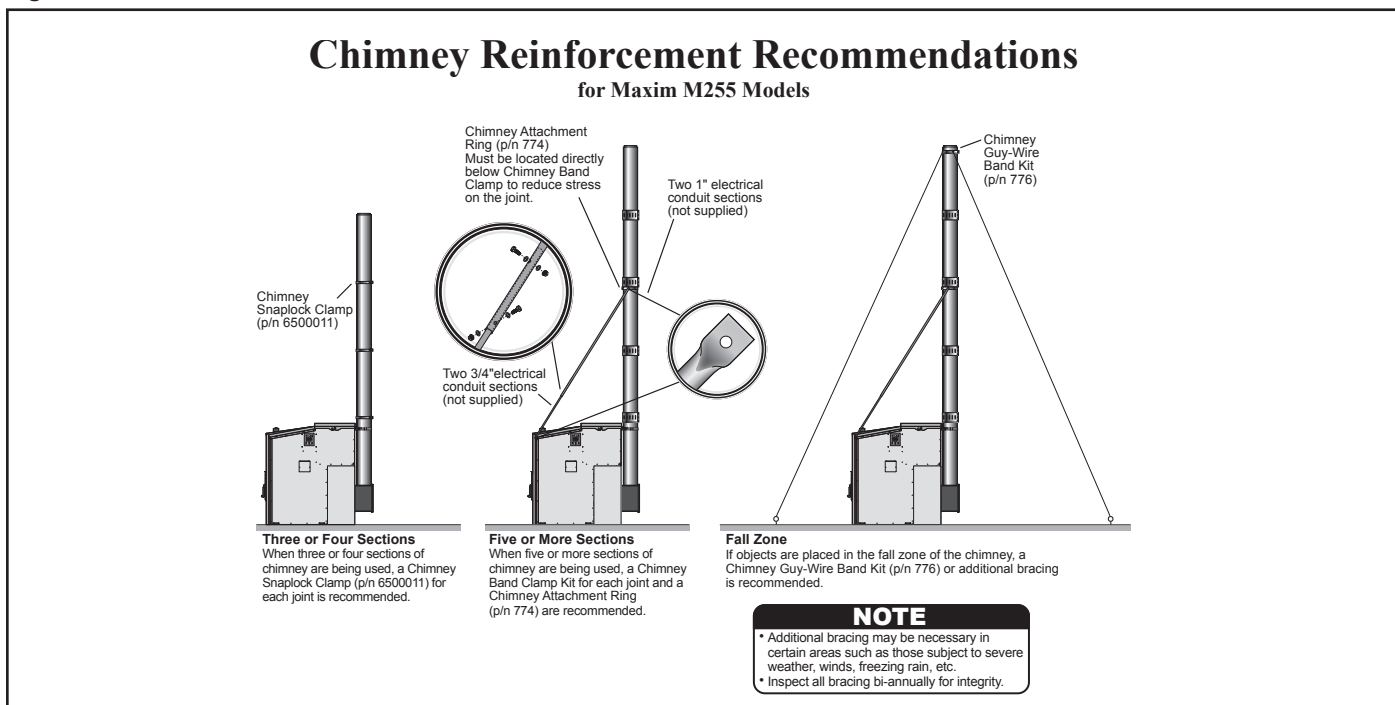


Fig. 15



**NOTE: If more than three 4-foot (1.2 m) sections of chimney are used, a support (e.g., a pole, pipe or other structural support) may be installed from the ground that can withstand wind. Other reinforcement recommendations are shown in Fig. 15.**

If extensions are added to the standard eight feet (2.4 m) of chimney, the chimney should be reinforced appropriately. Fig. 15 shows chimney support recommendations when three or more sections are used. When adding sections of chimney, make sure that there is nothing within the fall zone of the chimney that could be damaged. If something is located within the fall zone and cannot be removed, guy wires or braces may need to be installed to prevent a falling chimney from causing damage (see Fig. 15).

**NOTE: For chimney extensions or chimney replacement, use only genuine Central Boiler chimney components. Parts are available from an authorized Central Boiler dealer.**

The installation of a spark arrester is recommended, particularly where there are dry conditions or where there is combustible material near the unit, unless the installation of a spark arrester is prohibited by local requirements. Use common sense to avoid potential fires, including exercising caution when disposing of ash, cleaning and refueling. Keep all highly combustible materials (e.g., gasoline, propane, leaves, pine needles, etc.) away from an operating unit at all times. Take special precautions in windy conditions.

## Chimney Draft

Proper draft is necessary for the Maxim to operate optimally. Draft occurs when the temperature in the chimney is high enough and/or the chimney is high enough to cause a negative pressure that "pulls" the exhaust up and out the chimney. The higher the burn rate and fan settings, the more sections of chimney that will be required to provide proper draft.

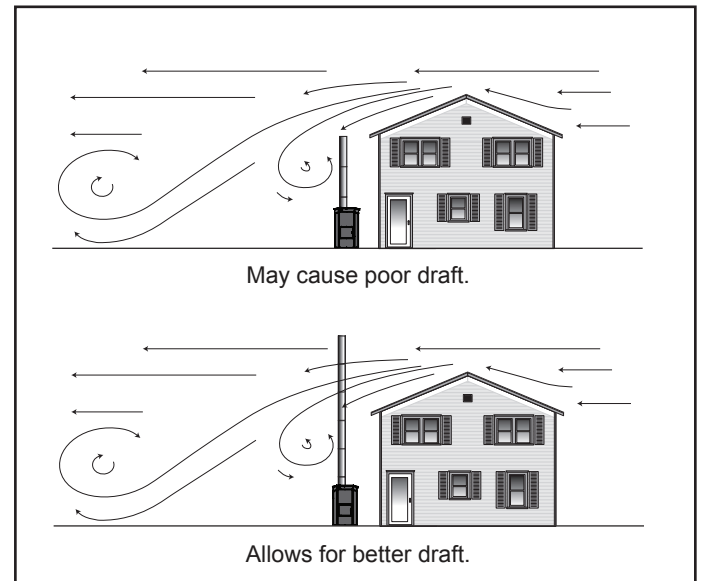
**NOTE: Adding more chimney sections increases the amount of negative pressure in the chimney.**

**NOTE: A qualified installer may perform the following test to check for proper draft.**

1. Drill a hole in the chimney inspection cover; then with the outdoor furnace and chimney at normal operating temperature, use a manometer to check draft. Flue draft should be between  $-0.02$  in. WC ( $-5$  Pa) and  $-0.05$  in. WC ( $-12.45$  Pa). If the flue draft is lower, add more chimney sections.
2. After the test, fill the hole in the chimney inspection cover with high-temp silicone.
3. If a spark arrestor is being used, make sure it is clean and unobstructed.

4. Objects like buildings and trees in close proximity or nearby terrain (e.g., hills, valleys, etc.) can adversely affect air flow in the chimney (see Fig. 16). Adding chimney sections may overcome these factors.

Fig. 16



## SECTION 6 – SYSTEM INSTALLATION

### SUPPLY AND RETURN LINES

Determine the configuration of the supply and return lines from the outdoor furnace to where the supply and return lines will connect to the existing heating system. Central Boiler recommends using the ThermoPEX® piping system.

**ThermoPEX** is a fully assembled, pre-insulated piping system consisting of two 1" Central PEX lines or two 1-1/4" PEX lines. The two lines (one a supply and one a return line) are insulated with high-density urethane insulation and a thick, durable, waterproof, polyethylene outer jacket. One of the lines is marked with a black stripe for identification.

**NOTE:** To prevent ground water from entering the house, do not use drain tile, PVC pipe with bubble wrap, or any other inferior material for insulating the water lines.

**NOTE:** If the outdoor furnace supply and return lines are not insulated properly, or if other brands of insulated piping are used, there can be excessive heat loss. This heat loss can greatly increase the fuel consumption.

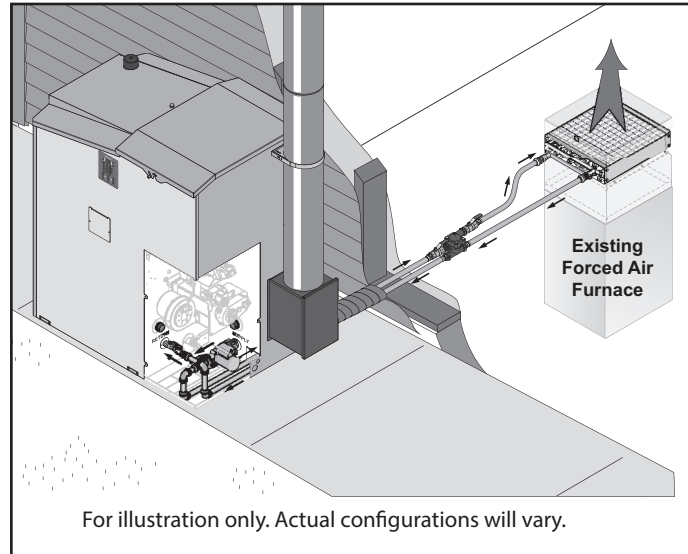
**NOTE:** If it is unavoidable that the supply and return lines will run through an area of ponding water, use ThermoPEX instead of other materials. ThermoPEX should also be used for above-ground or winter installations, and if the area is likely to be affected by compaction.

#### Above Ground or Winter Installations

For above ground or winter installations in which the supply and return lines can not immediately be buried underground, Central Boiler recommends using ThermoPEX. Be sure that both the insulation and the supply and return lines will not be exposed to ultraviolet rays. The ThermoPEX black exterior jacket has UV protection but the insulation and water lines inside do not. Use a ThermoPEX termination cap at each end of the installation to protect and seal the insulation from water.

If installed next to the building being heated, the supply and return lines can be installed above ground provided they are properly insulated and not exposed to ultraviolet rays (see Fig. 17 as an example).

Fig. 17



**NOTE:** If an above ground installation is temporary, bury the ThermoPEX as soon as conditions permit (e.g., once the ground has thawed).

**NOTE:** If ThermoPEX is installed temporarily above ground, provisions should be made (i.e., a firestop) to prevent possible risk of fire coming into contact with the ThermoPEX. ThermoPEX is constructed of materials that can burn and transfer a fire.

### CAUTION

If ThermoPEX is installed temporarily above ground, do not cover with combustible materials (e.g., stray, hay, leaves, etc.).

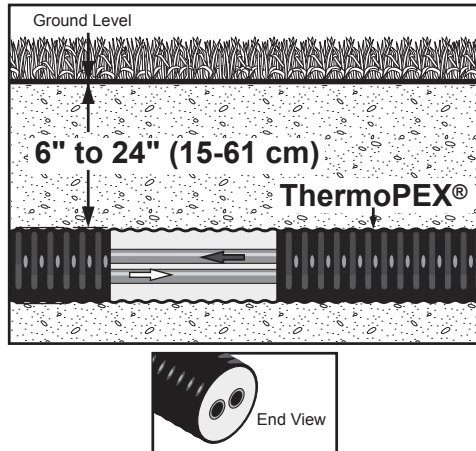
## Digging the Trench

### WARNING

Before digging, be sure to call for utility locator service.

The trench depth for ThermoPEX should be between 10" and 28" (25 and 71 cm).

Fig. 18



## Underground Electric Wire

A 12-2 (two wires plus ground) underground rated wire should supply the outdoor furnace with electricity. A heavier gauge wire may be needed if the run is over 200 feet (61 meters). Check local codes and requirements. A 20-amp circuit is recommended.

## Connecting to Existing Heating System

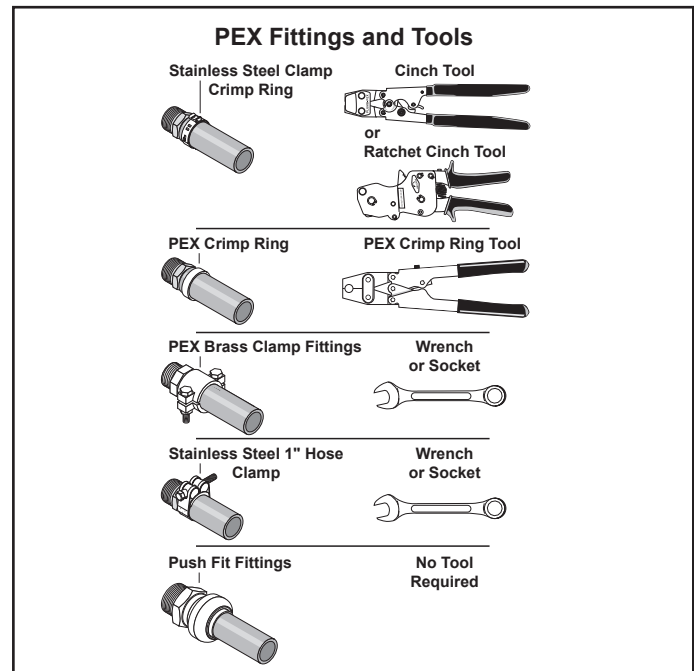
1. Make an entrance into the building(s) where the supply and return lines are to enter.
2. Lay the ThermoPEX assembly in the trench and feed one end into the building. Apply sealant around the supply and return lines where they enter the building.
3. Purge the supply and return lines before connecting any fittings to ensure there is no debris or foreign matter present.

**NOTE: All holes made in basement or building walls must be sealed completely to prevent water from entering the building.**

4. Close all valves on the outdoor furnace.
5. Install fittings to allow pressure-testing of both supply and return lines. Pressurize with 50 psi (3.5 kg/cm<sup>2</sup>) of air; then check after 30 minutes to see if pressure has dropped. A drop in pressure indicates a leak; repair as necessary.
6. Connect the supply and return lines to the outdoor furnace and the existing heat emitter(s). Fig. 19 shows some of the PEX fittings and tools used in making connections.

**NOTE: The base on the back of the outdoor furnace is removable if necessary for connecting the supply and return lines to the outdoor furnace.**

Fig. 19



### CAUTION

**Allow for expansion and contraction of the supply and return lines at each end. Without an allowance for expansion and contraction, the lines may kink or the fittings may be pulled apart, causing an immediate water loss from the outdoor furnace. Central PEX water lines can have an expansion and contraction rate up to .095" per each 100 ft and each 10°F (2.4 mm/30 m/5.5°C).**

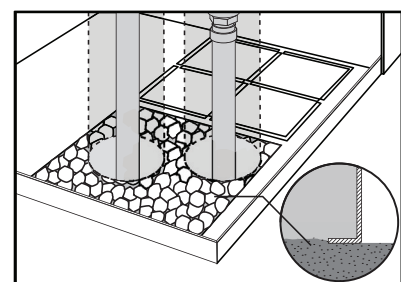
7. Make sure there are no leaks in the supply and return lines; then backfill the trench.

**NOTE: Do not backfill the trench until the supply and return lines have been tested to ensure there are no leaks.**

## Backfilling Water Line Enclosure

Using gravel or small rock, backfill the perimeter of the water line enclosure to the top, inner edge of the base (Fig. 20) to keep out rodents. Install the back and side panels.

Fig. 20





## CIRCULATION PUMPS

**NOTE:** The direction of water flow is very important for the proper operation of the outdoor furnace. Installing a swing check valve in the return line can prevent possible reverse flow.

### Water Flow

For a single building using a water-to-air heat exchanger system with a domestic water heater, the direction of water flow must go from the hot outlet on the outdoor furnace to the lower side fitting of the domestic water heater exchanger, to the lower fitting of the heat exchanger on the existing furnace, and then to the return port of the outdoor furnace.

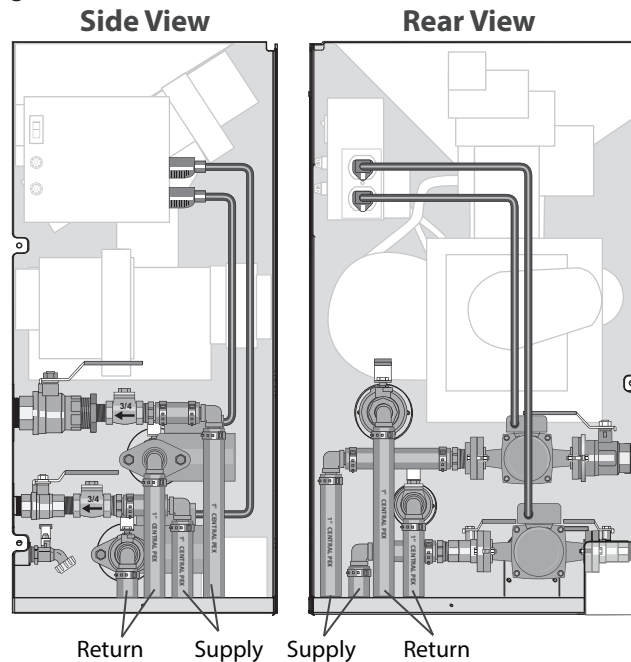
**NOTE:** if there is a high heat draw with a single set of lines, a wraparound pump (as shown in Fig. 21) may be needed in order to keep the supply water temperature the same temperature indicated by the FireStar controller.

**NOTE:** Some systems may have different flow patterns.

### Access to Ports on Furnace

Access to the hot supply and return ports is gained by removing the access panels on the lower right-hand side and back of the furnace. There are two hot supply and two return ports on the furnace. This configuration allows for mounting the circulation pumps on the furnace (Fig. 22).

Fig. 22



There are eight knock-out tabs on the floor panel of the furnace to accommodate the water lines. These align with the hollowed-out area in the foundation specifications (Fig. 6). The pump access area in the back right corner must align with the blocked out area of the foundation.

### Installing Circulation Pumps

The Taco 009 is a medium flow, high head pressure pump that requires an adequate amount of pressure on the outlet side to prevent the motor from overloading.

Fig. 21

## Maxim with Wrap-around-pump Installed

**Side View**

**Rear View**

**Area of Focus**

**Side      Rear**

Parts List		
Qty	p/n	Description
2	118	Close Nipple, 3/4"
1	119	Pump Flange Kit, 3/4"
1	198	Ball Valve, 3/4"
1	224	Isolation Flange, 3/4"
1	225	Isolation Flange, 1-1/4"
2	296	Swing Check Valve, 3/4"
1	388	Hex Bushing, 1-1/4" x 3/4"
1	410	Ball Valve, 1-1/4"
2	556	Power Supply Cord, 32"
4	1330	PEX Adapter, 1" x 3/4"
4	1334	PEX 90° Elbow, 1"
12	5926	Stainless Steel Clamp, 1"
2	5800004	Taco 007 Pump

Parts and accessories sold separately.  
Pump size may vary.



The Taco 014 is a high flow, high head pressure pump that requires an adequate amount of head pressure on the inlet side to prevent cavitation. Therefore, a Taco 014 may need to be mounted lower near the base of the furnace, and on the 1-1/4" bung.

The Taco 007 is a medium to high flow, low head pressure pump. In a very low-resistance system (e.g., short length of supply and return lines, only a flat plate heat exchanger, etc.), the 007 pump may need to be mounted lower near the base of the furnace or on the 1-1/4" bung to prevent cavitation at high water temperatures.

**NOTE: See the Hydronic Component Selection Guide for more detailed information.**

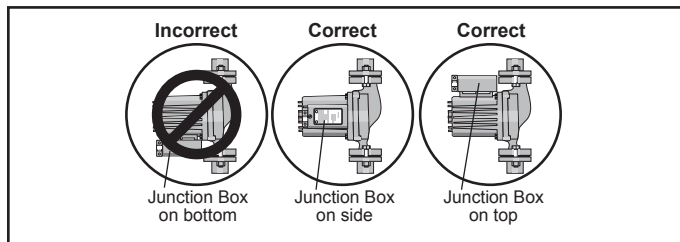
The following guidelines must be adhered to when installing the circulation pump(s).

**WARNING**

**Maximum load of the outlet on the outdoor furnace is 5A, 120VAC, and 60Hz.**

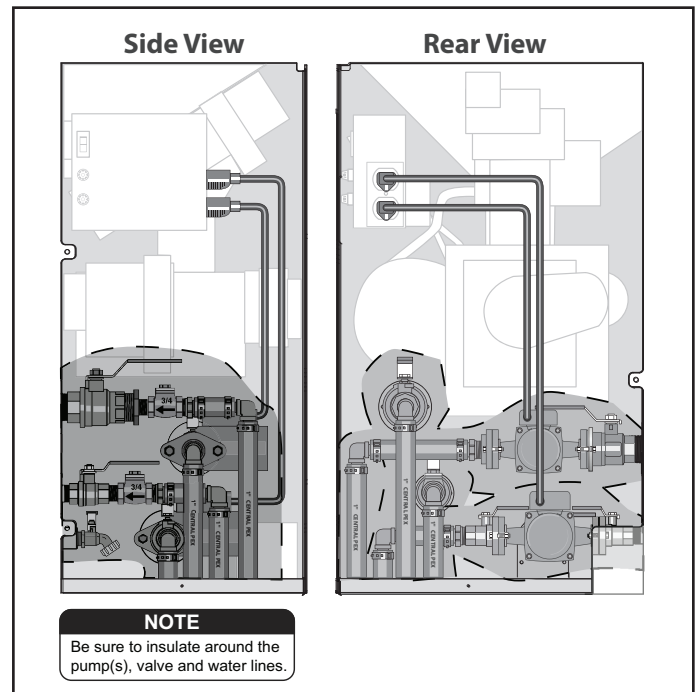
- A. The pump motor must be installed in a horizontal position.
- B. The junction box must not be located below the pump motor (see Fig. 23). If necessary, remove the four screws and rotate the pump body.

Fig. 23



- C. Do not operate the circulation pump until the entire system has been filled with water and checked for leaks or the pump may be damaged.
- D. Insulate the areas around the supply and return lines (Fig. 24) and pump(s) being careful not to block the area around the louvers; then install and secure the side and back panels.

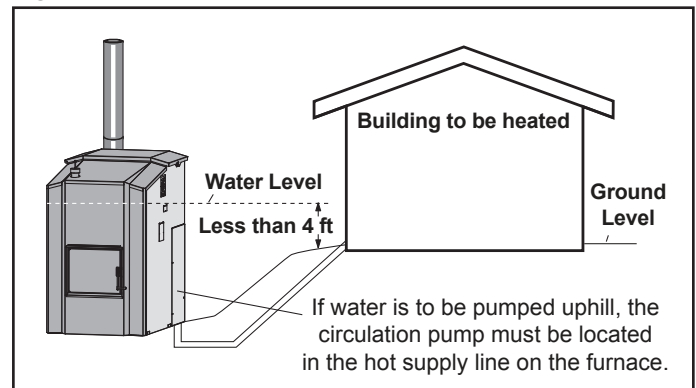
Fig. 24



**NOTE: At least one circulation pump must run continuously to ensure proper operation of the outdoor furnace.**

The circulation pump(s) **must be installed in the supply line(s)** with the arrow on each pump pointed away from the outdoor furnace. In order to avoid circulation problems, do not install the pump(s) in the return line(s).

Fig. 25

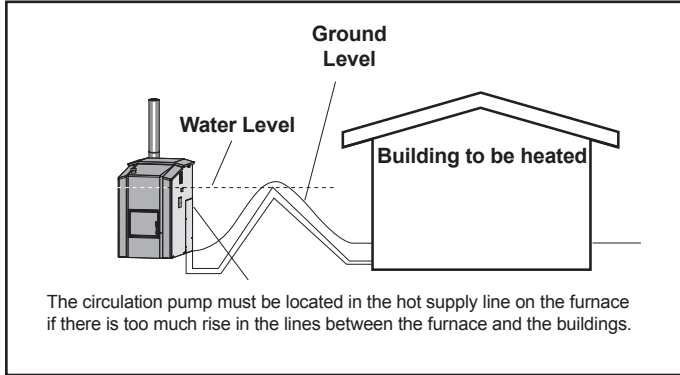


The pump(s) must be located near the base of the outdoor furnace if the system has a high-flow pump or very low resistance on the outlet side of the pump. For example, if the outdoor furnace is 20 feet (6 meters) from the building and pumping water through one-inch pipes, a heat exchanger, and back to the outdoor furnace, the pump needs to be mounted with four feet of water above the pump.

**NOTE: See the Hydronic Component Selection Guide for more detailed information.**

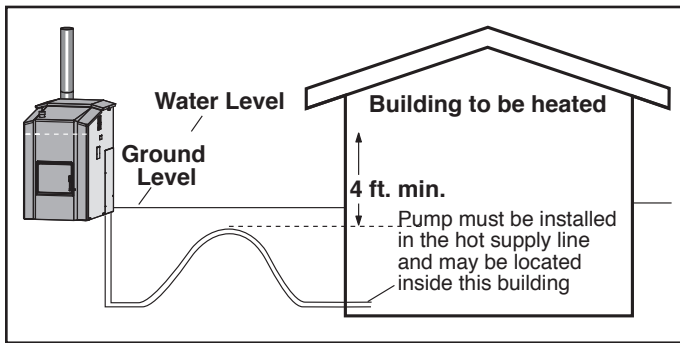
Installing the circulation pump(s) at the outdoor furnace is recommended, but required if the building being heated is higher than the outdoor furnace or if there is a large rise in the water lines between the outdoor furnace and building (see Fig. 26 and 27). Hot water boils at a lower temperature when pulled uphill (because it is at a lower pressure); therefore, hot water must be **pushed** uphill to ensure proper circulation.

Fig. 26



If not mounted on the outdoor furnace, the circulation pump(s) must be mounted 4 to 5 feet (1.2 to 1.5 m) lower than the top water level in the outdoor furnace (see Fig. 27).

Fig. 27



### Shut-Off Valves

Shut-off valves should be installed on both sides of each pump so if it becomes necessary to repair or replace the pump, the pump can be isolated.

### Filters

A Y-strainer or filter may be installed at the outlet side of the pump to remove foreign particles which may be present in the water. Always install Y-strainers with the cleanout in the lowest position.

### Optional Thermostatic Valve

**NOTE:** The thermostatic valves illustrated throughout the manual may vary from your installation. See the installation instructions provided with the thermostatic valve.

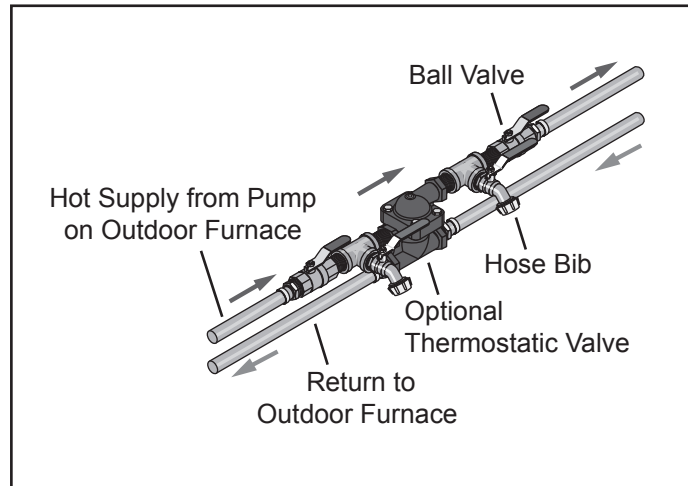
### CAUTION

**DO NOT** operate the outdoor furnace with the water temperature less than 150°F (65°C).

An optional thermostatic valve can be installed on each set of supply and return lines in the system to maintain the outdoor furnace water temperature above 150°F (65°C). Operating the outdoor furnace with the water temperature less than 150°F (65°C) may result in more condensation in the firebox that can lead to corrosion.

It is recommended that the water temperature setpoint of the furnace be set to 185°F (85°C) to decrease the likelihood of the water temperature falling to 150°F (65°C). As a result, the outdoor furnace will operate with a greater efficiency and require less maintenance. Failure to follow proper operating instructions may result in furnace damage.

Fig. 28



For thermostatic valves, contact your authorized Central Boiler dealer.

# OPTIONAL THERMOSTATIC VALVE - HOW IT WORKS

**NOTE:** With higher heat loads, it may be necessary to change the water temperature setpoint on the FireStar controller to be no less than 185°F.

**NOTE:** When the thermostatic valve allows a trace flow, enough water will pass through for the backup indoor heating system to backfeed heat to the outdoor furnace and water lines, protecting against freezing.

## Optional Thermostatic Valve - How It Works

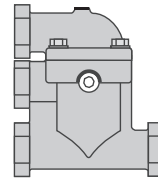
(arrow indicates water flow)

### NOTE

Install a Thermostatic Valve on each set of supply and return lines in the system. Each Thermostatic Valve must be installed inside the building to be heated.

### NOTE

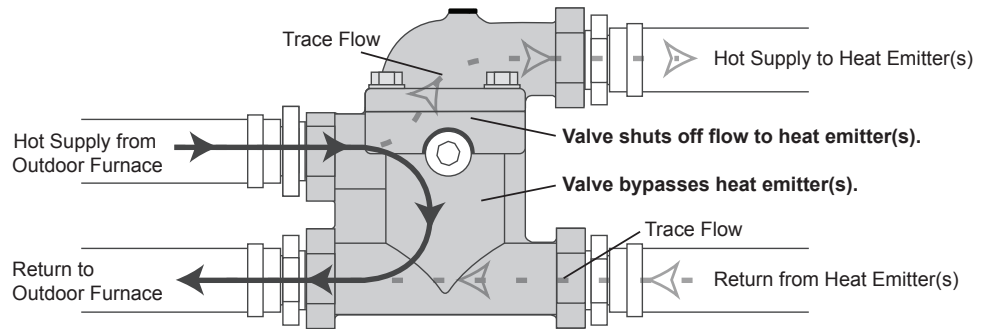
The proper level of Corrosion Inhibitor Plus™ (p/n 1650) must be maintained (see Owner's Manual for more information).



Note: Top of valve can be installed to face either direction. As shown here or as shown below.

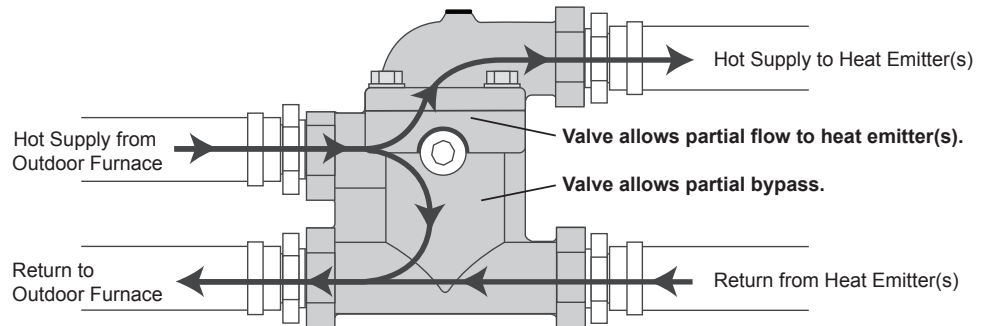
### Water Below 150°F at Thermostatic Valve

(water returns to furnace to be reheated)



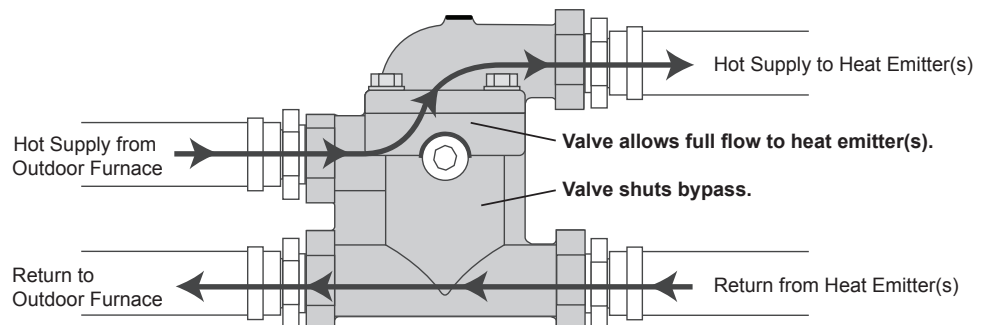
### Water at 150°F up to 170°F at Thermostatic Valve

(water is partially released to heat emitter(s) and partially bypassed)



### Water Above 170°F at Thermostatic Valve

(water is released to heat emitter(s))



## Purging Air from the System - Manual Air Bleeders

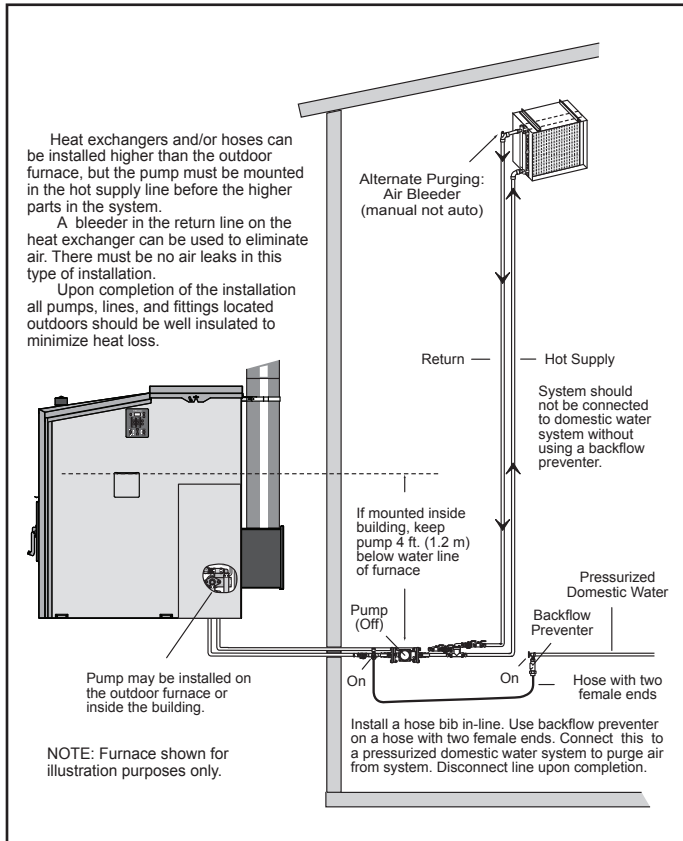
Manual air bleeders may be installed in the high points of the water lines where air may get trapped and cause circulation problems. Water can be pumped to levels higher than the outdoor furnace as long as the pump is **pushing** the water to the higher level and there are no air leaks in the system. Additionally, air should be purged from the system using pressurized domestic water and a hose with two female ends (see Fig. 29).

### WARNING

**The outdoor furnace vent cap must fit loosely on the vent opening. Do not force the cap down or try to seal it tightly onto the vent pipe. Do not extend or restrict the vent pipe or opening. DO NOT ALLOW THE OUTDOOR FURNACE TO BE PRESSURIZED.**

If any auto float vents are present in the system, they must be capped off tightly to prevent air from entering the system.

Fig. 29



**NOTE: See the Hydronic Component Selection Guide for more detailed information.**

## WATER HEATER INSTALLATION

### WARNING

**DO NOT disable or remove any safety reliefs or controls. Turn off the power to the water heater before installation.**

When installing a domestic hot water heat exchanger, the hot supply line from the outdoor furnace should be plumbed first to the water heater heat exchanger and then to the balance of the heating system.

A manual 3-way valve may be installed so that during the non-heating season, the water heater may be operated without operating the entire heating system (see Fig. 30). A tempering valve (or thermostatic mixing valve) is to be installed in the hot water outlet from the water heater. Install a tee in a fitting on the top of the water heater (see Fig. 32) for the hot water heat exchanger.

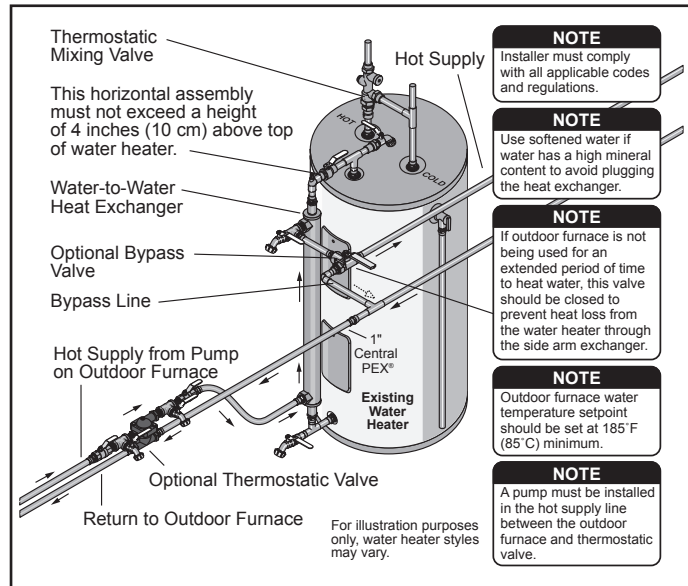
**NOTE: If the water heater has been in service, flush the water heater prior to installing the hot water heat exchanger. Anode rod residue or other sediments in the water heater may plug the heat exchanger.**

**NOTE: Some gas water heaters are equipped with a high water temperature probe that is connected to the gas valve. When the water temperature exceeds the high limit, the gas valve enters a non-resettable lock out condition. This requires replacement of the entire valve. The installer must determine if this type of valve is present before installation of a water-to-water heat exchanger.**

### CAUTION

**Costly maintenance may be incurred if steps are not taken during installation to reduce or eliminate the possibility of the water temperature in the water heater exceeding the high limit.**

Fig. 30



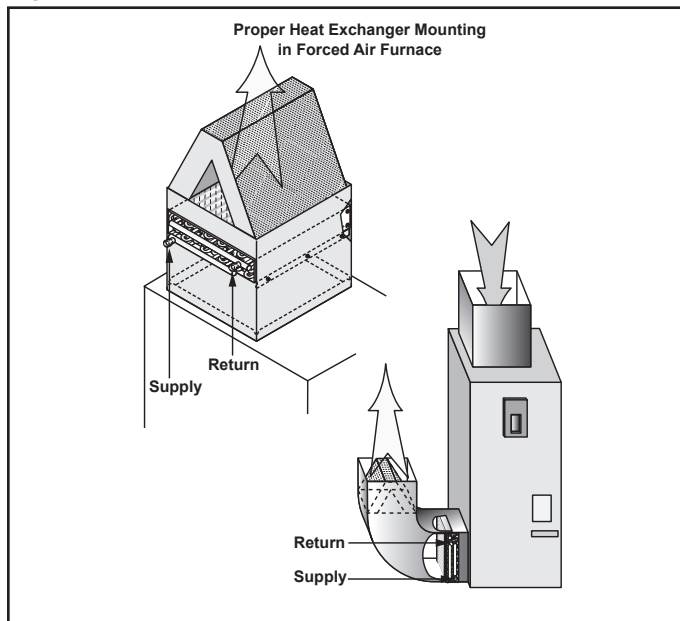
## EXISTING FORCED AIR INSTALLATION

When the Maxim is installed in conjunction with an existing forced air system, a water-to-air heat exchanger is mounted in the plenum or duct work of the existing furnace. Heated water from the outdoor furnace either continuously flows through the water-to-air heat exchanger or is diverted through a 3-way zone valve. When the thermostat senses the need for heat, the fan on the existing furnace forces air through the heat exchanger, transferring heat throughout the existing ductwork.

Following are several important items for this type of installation.

- Plenums installed to the furnace must be constructed of metal in accordance with NFPA 90B, 2-1.3.
- If an air conditioning coil is located in the plenum, the heat exchanger should be mounted between the fan and the air conditioning coil so the heat exchanger will not freeze when the air conditioner is being used.
- The heat exchanger should **not** be installed in the cold-air return of the existing forced air furnace because components of the existing furnace could overheat.
- The heat exchanger may be mounted either horizontally or vertically with the outlets on the side (see Fig. 31).

Fig. 31



- In all applications, the heat exchanger must be mounted level from front to back, with the outlets on the side. If the outlets are positioned upward or if the exchanger is not level, an air lock can restrict the water circulation and reduce the amount of heat transfer.

- The **lower fitting is the inlet/hot supply** from the outdoor furnace and the **top fitting is the outlet/return** back to the outdoor furnace.
- It is best to install a heat exchanger that fits the plenum.
- If the plenum is larger than the heat exchanger, it should be mounted in the center **without** gaps on the sides that would allow air to flow around the heat exchanger. All air must be directed through the face of the exchanger. Air flow deflectors need to be installed in the plenum on the outlet side of the heat exchanger if air flow is funneled into the heat exchanger.
- Be sure to consider the airflow through the ductwork so air circulation is not blocked off to parts of the building.
- Adding a heat exchanger coil in the hot air plenum or ductwork of the existing furnace may decrease the air flow in the system. The existing heat emitter(s) (gas or electric) should be operated before adding the heat exchanger.
- The air temperature rise should be measured with the heat emitter(s) running for an adequate amount of time to get a stabilized temperature reading. The heat exchanger can then be installed in the system. The existing heat emitter(s) should be operated again and the air flow should be adjusted to maintain the same temperature reading. The air flow may have to be increased to accomplish this.
- On a belt-drive system, the blower pulley and/or motor pulley may be changed; however, the electrical current flowing through the motor must not be changed to exceed the nameplate rating. A larger blower motor may be used. On a direct-drive system, in most cases the blower motor will not need to be replaced; however, the speed of the blower motor may have to be increased.

### CAUTION

When installing the heat exchanger, be sure none of the existing system safety controls are disabled.

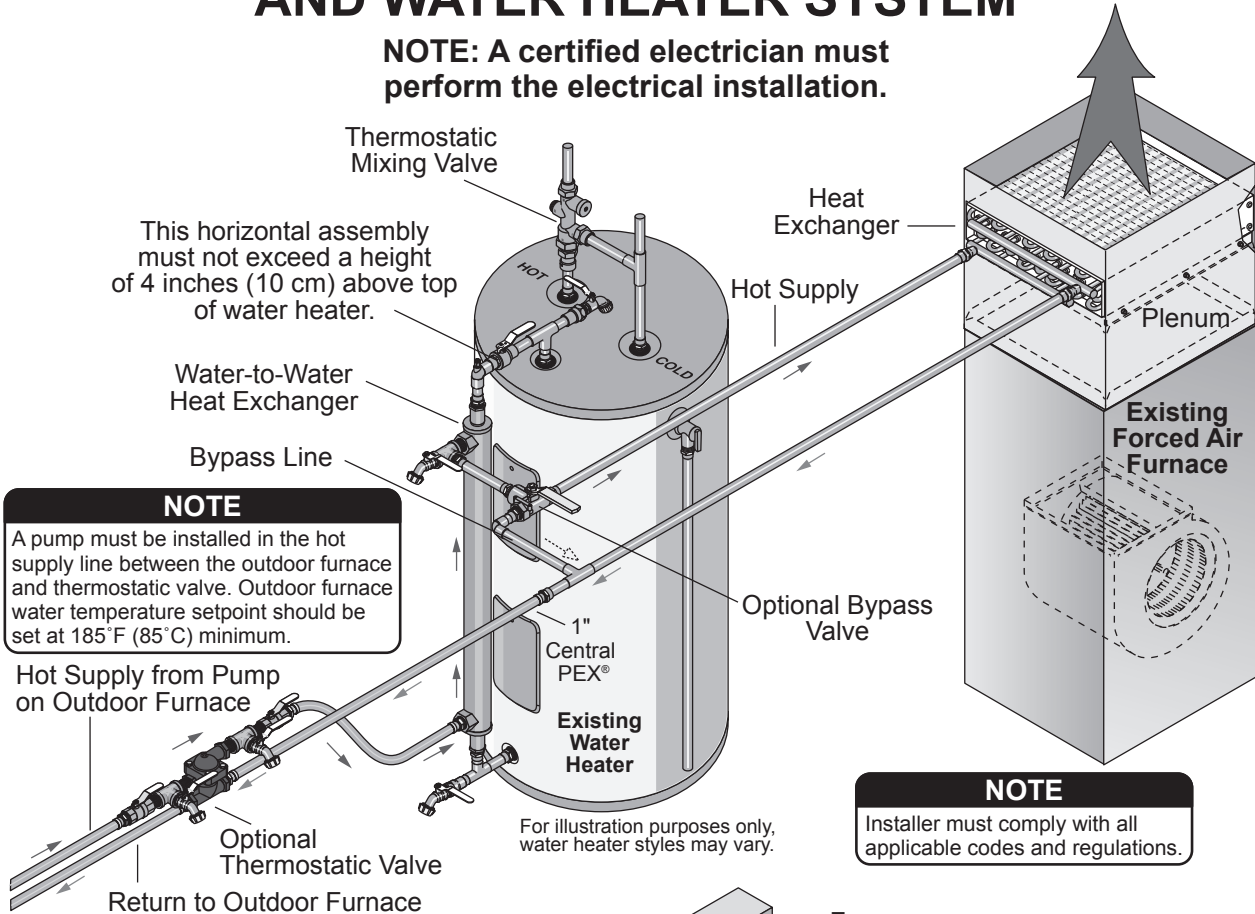
**NOTE:** Any electrical installation should be done by a certified electrician in accordance with all applicable codes.

- Due to the internal circuitry of some thermostats, a snap disc temperature control may have to be installed on the heat exchanger manifold to provide an interlock for the air conditioner. This prevents the air conditioner from operating when the water temperature is higher than 140°F (60°C).



# WATER-TO-AIR HEAT EXCHANGER AND WATER HEATER SYSTEM

**NOTE: A certified electrician must perform the electrical installation.**

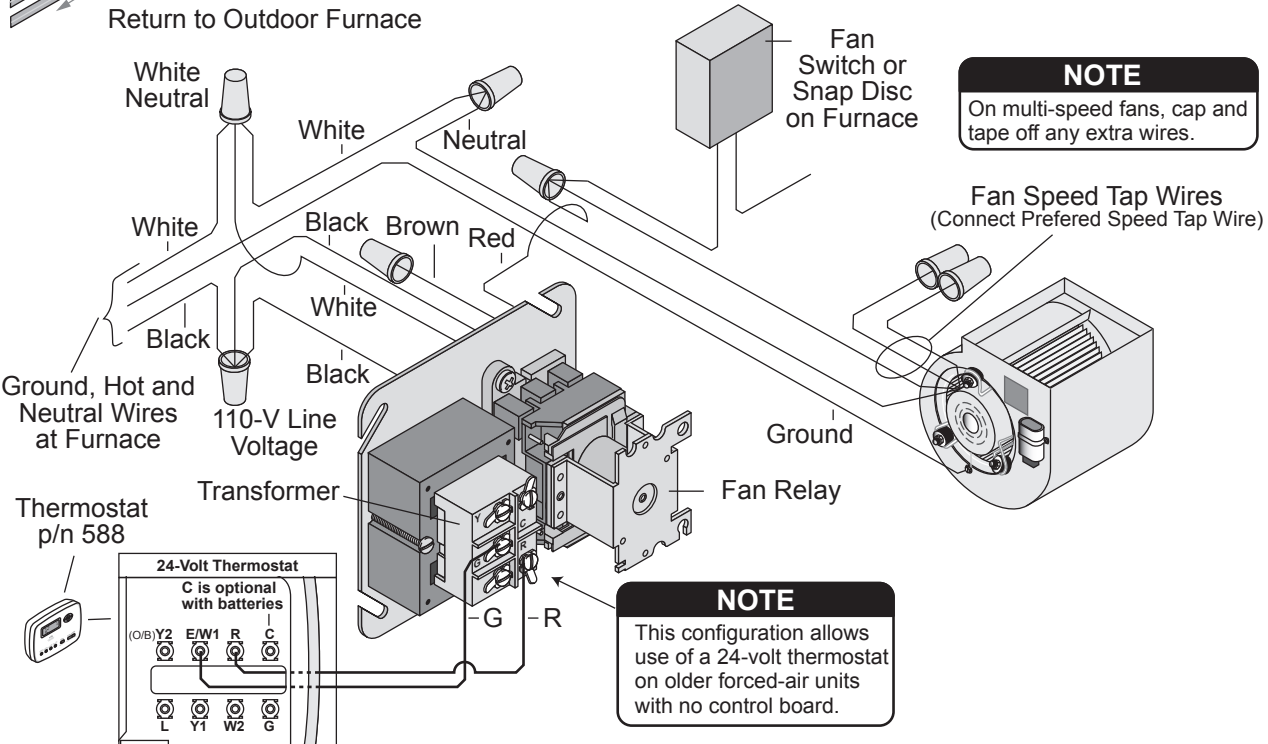


**NOTE**  
A pump must be installed in the hot supply line between the outdoor furnace and thermostatic valve. Outdoor furnace water temperature setpoint should be set at 185°F (85°C) minimum.

Hot Supply from Pump on Outdoor Furnace

For illustration purposes only, water heater styles may vary.

**NOTE**  
Installer must comply with all applicable codes and regulations.



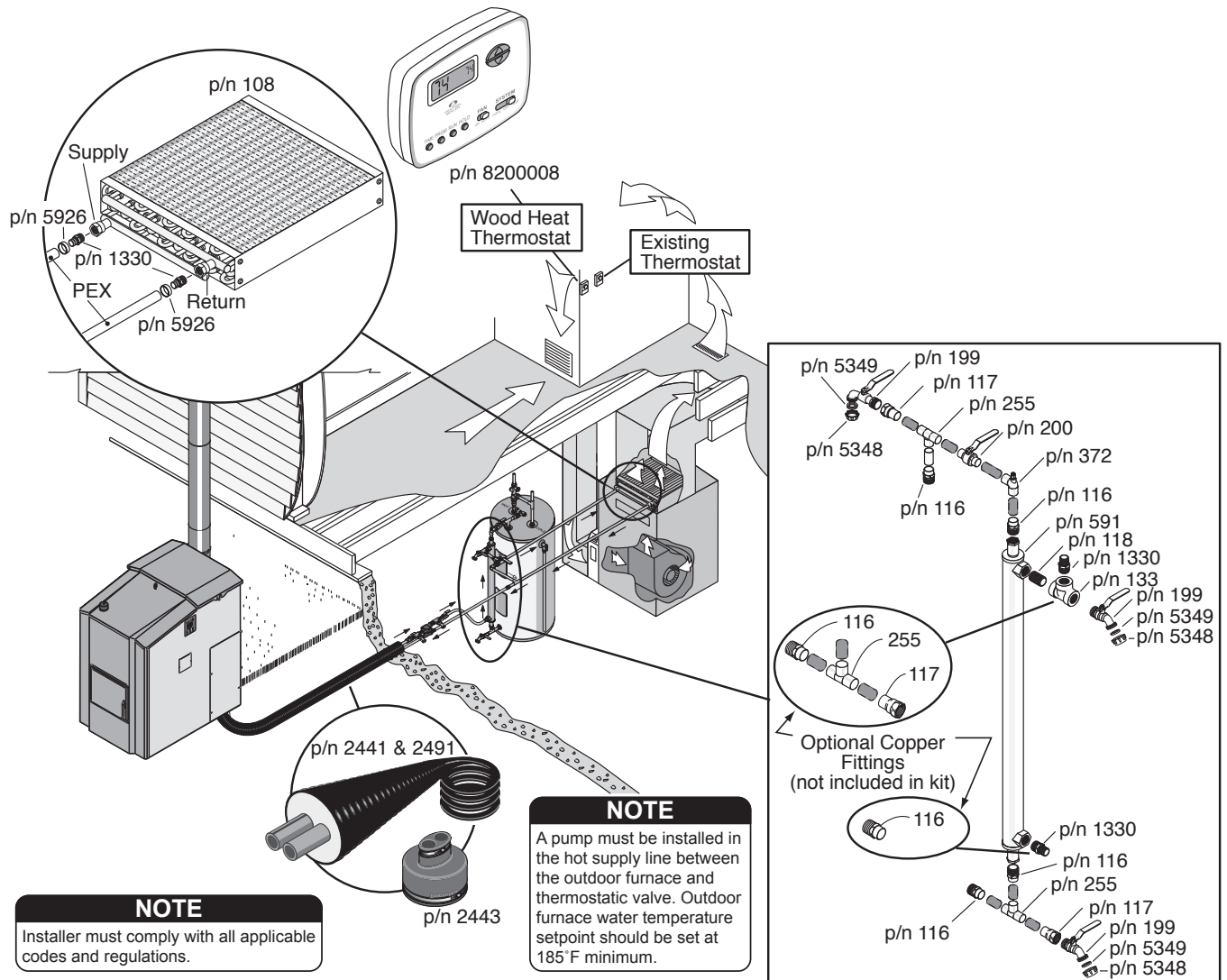
**NOTE**  
On multi-speed fans, cap and tape off any extra wires.

**NOTE**  
This configuration allows use of a 24-volt thermostat on older forced-air units with no control board.

For illustration purposes only.

Fig. 33

## Forced Air Heating and Water Heater System



## Thermostatic Controls

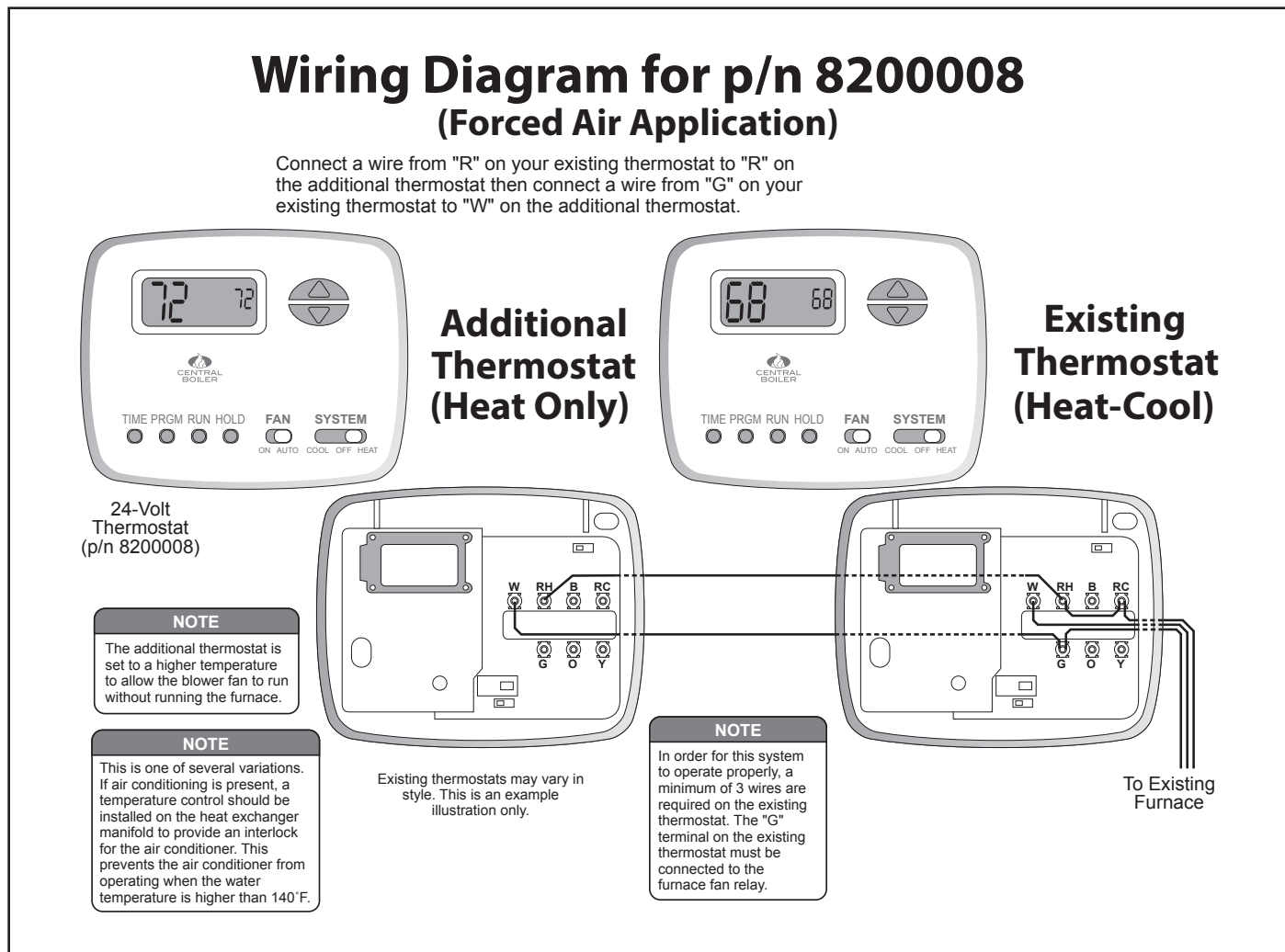
There are several methods for installing thermostatic controls for this type of installation.

1. If the forced air furnace has connections for control of the blower from a thermostat or switch, the simplest method is to add a second 24-volt thermostat. Wire the thermostat to the forced air furnace so that upon a call for heat, the thermostat closes the connection between power (usually 'R' or red) and the fan terminal (usually 'G' or green). By setting the new thermostat to the desired room temperature, it will control when the blower operates, drawing heat from the outdoor furnace. The existing thermostat should be set a few degrees below the new thermostat. This setting will be the temperature at which the existing forced air heating system will operate if the outdoor furnace is out of fuel. Refer to Fig. 34 for one possible arrangement.

2. An alternative method is to install a line voltage thermostat to control the blower on the forced air furnace. In this installation, a 120-volt wire is run from the thermostat to the forced air furnace. One wire is connected to the hot (line feed) and the other wire is connected to the forced air furnace blower wire. A low water temperature switch may be installed to shut off the blower if the temperature of the water is too low. The switch is connected in series to the wire coming from the line voltage thermostat and must be installed so that it does not affect the forced air system thermostat.

**NOTE: If the low water temperature switch is not installed, the fan will run continuously even when the outdoor furnace is out of fuel. This will keep the water in the outdoor furnace approximately the same temperature as the air in the house (to prevent the water in the outdoor furnace from freezing). This will also work with the thermostatic valve installed.**

Fig. 34





## HEATING MULTIPLE ZONES OR BUILDINGS

A single pump and manifold may be used to heat more than one zone as long as the return water can be maintained above 150°F (66°C). If the return water temperature can not be maintained above 150°F (66°C), then a separate pump should be used for each zone. A thermostatic bypass valve must be installed to ensure that the water temperature in the outdoor furnace is maintained above 150°F (66°C).

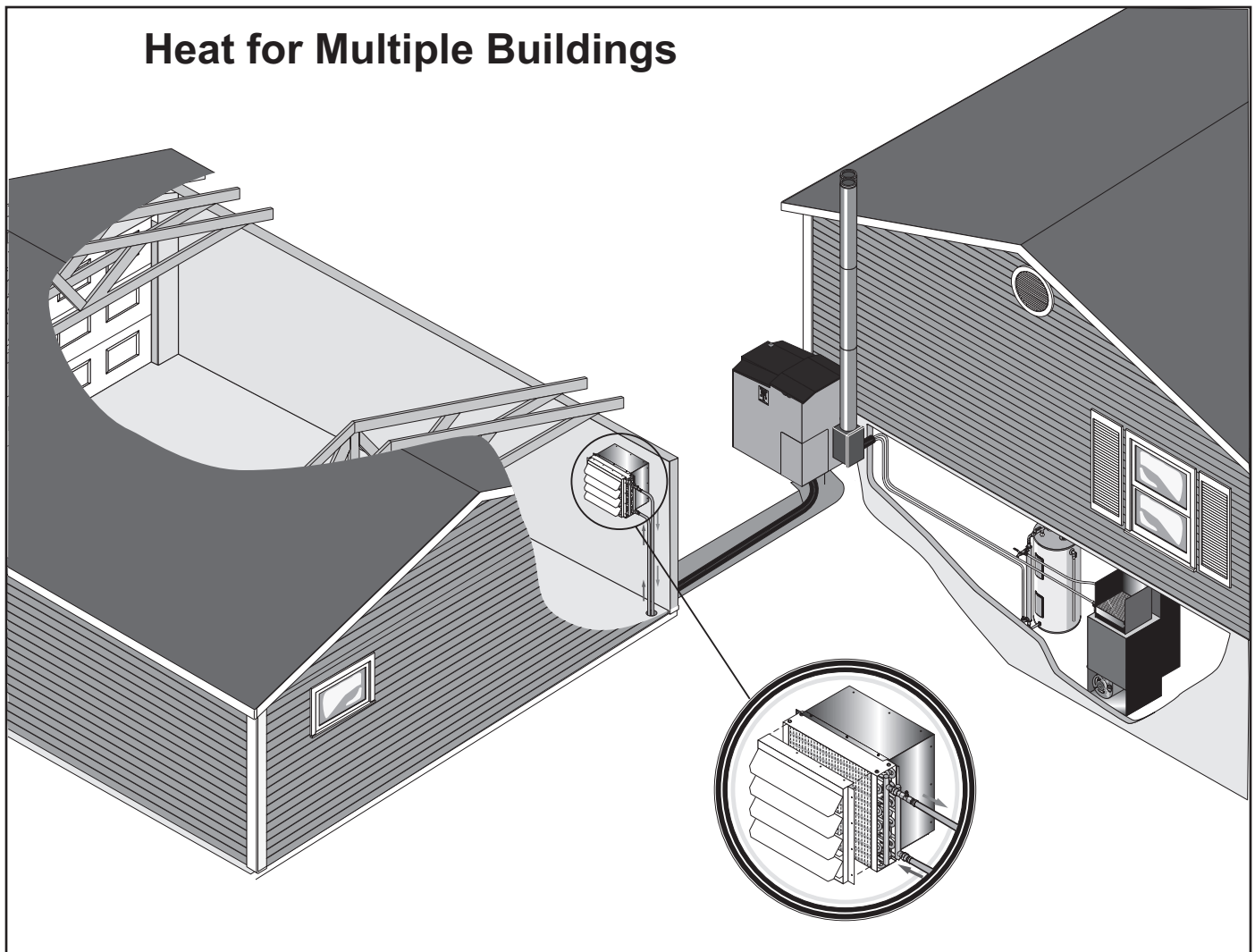
If a manifold is used, a swing check valve (p/n 296) should be installed in the line at the outlet of the pump. The swing check valve must be installed in a vertical position with the direction of flow as designated by the arrow on the swing check valve. This will prevent reverse circulation and loss of heat on multiple zones if one pump fails. Hose bibs (p/n 199) should be installed on each supply and return manifold to allow for purging air from the zones.

The Maxim offers two sets of outlets (for up to two zones or buildings without the need for manifolds) for mounting up to two pumps. Fig. 35 illustrates one possible configuration.

**NOTE:** If the outdoor furnace is unable to maintain a water temperature of 150°F (66°C) or higher, inspect the thermostatic valve and replace if necessary.

**NOTE:** A properly-sized backup furnace or boiler should be configured to provide heat if the outdoor furnace is out of fuel or the heat load exceeds the capacity of the outdoor furnace.

Fig. 35



## HYDRONIC INSTALLATIONS

**NOTE:** It is recommended that the circulation pump in all hydronic systems be located in the hot supply line, not in the return line (see Fig. 36 and 37).

Evaluate the existing hot water heating system before starting the installation. If the existing hot water heating system has been unable to maintain the temperatures in the home at any time during cold weather before installing the outdoor furnace, then the hot water heating system is not adequate. More baseboard or other type of heat exchanger must be added.

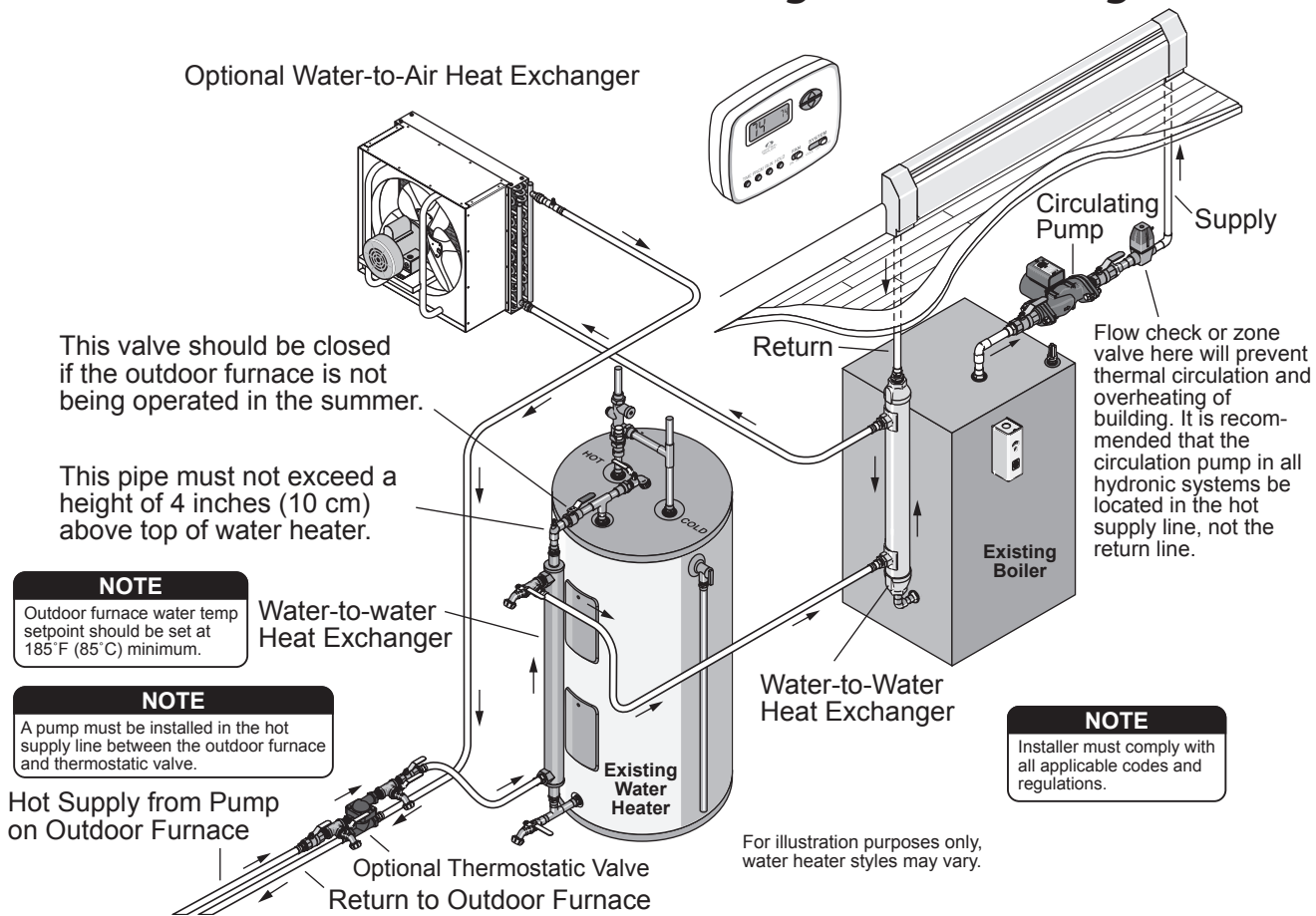
If a water-to-water heat exchanger is to be used with an existing heating system, the existing heating system must be able to adequately heat the building with a water temperature of approximately 165°F (74°C). Some existing finned tube baseboard hot water heating systems are designed to operate with water temperatures up to 220°F (104°C) or higher.

If the existing heating system is marginal or designed to operate with water temperatures above 165°F (74°C), there are alternative installation procedures that will make the existing system work very well with the outdoor furnace. These include:

1. Add more finned tube water baseboard heaters or panel radiators.
2. A water-to-air heat exchanger with a thermostatically controlled fan can be installed in the lower part of the building being heated (Fig. 36). This can increase the amount of heat added to the building, helping to maintain a constant temperature. This heat exchanger can be added in the return line of the system after the water-to-water heat exchanger.
3. An additional radiant heating circuit can be added to heat areas that require additional heat.

Fig. 36

## Water-to-Water Shell & Tube Exchanger with Existing Boiler



## Pressurized Water System Installations Water-to-Water Heat Transfer System

To keep the existing system pressurized, a plate exchanger or tube & shell water-to-water heat exchanger installed in the return line of the existing system may be used (see Fig. 37 and 38). The water from the existing system passes through the heat exchanger when the thermostat calls for heat. The water from the outdoor furnace circulates through the other side of the heat exchanger continuously.

It may be necessary to lower the water temperature at which the burner in the existing boiler starts to a setting that prevents the burner in the existing boiler from cycling on when the outdoor furnace is heating the home. Another option is to install a thermostatically controlled interlock switch that prevents the burner in the existing boiler from operating when the water temperature in the outdoor furnace is above 150°F (66°C).

Water-to-water heat exchangers will produce transfer temperatures approximately 20°F (11°C) less than the outdoor furnace water temperature; therefore if the outdoor furnace water temperature is 185°F (85°C), it will produce approximately 165°F (74°C) of water temperature transfer. The temperature controller on the outdoor furnace may be adjusted to allow the outdoor furnace to reach water temperatures up to 195°F (91°C). Each system will vary in water temperature transfer depending upon the heat load of the existing heating system.

Fig. 37

The addition of a wraparound pump with a water-to-water heat exchanger (see Fig. 37) may increase heat transfer by allowing circulation continuously through the existing boiler and heat exchanger. This will maintain the maximum temperature in the heat exchanger for heat transfer to the existing boiler. Note the water flows in opposite directions through the heat exchanger.

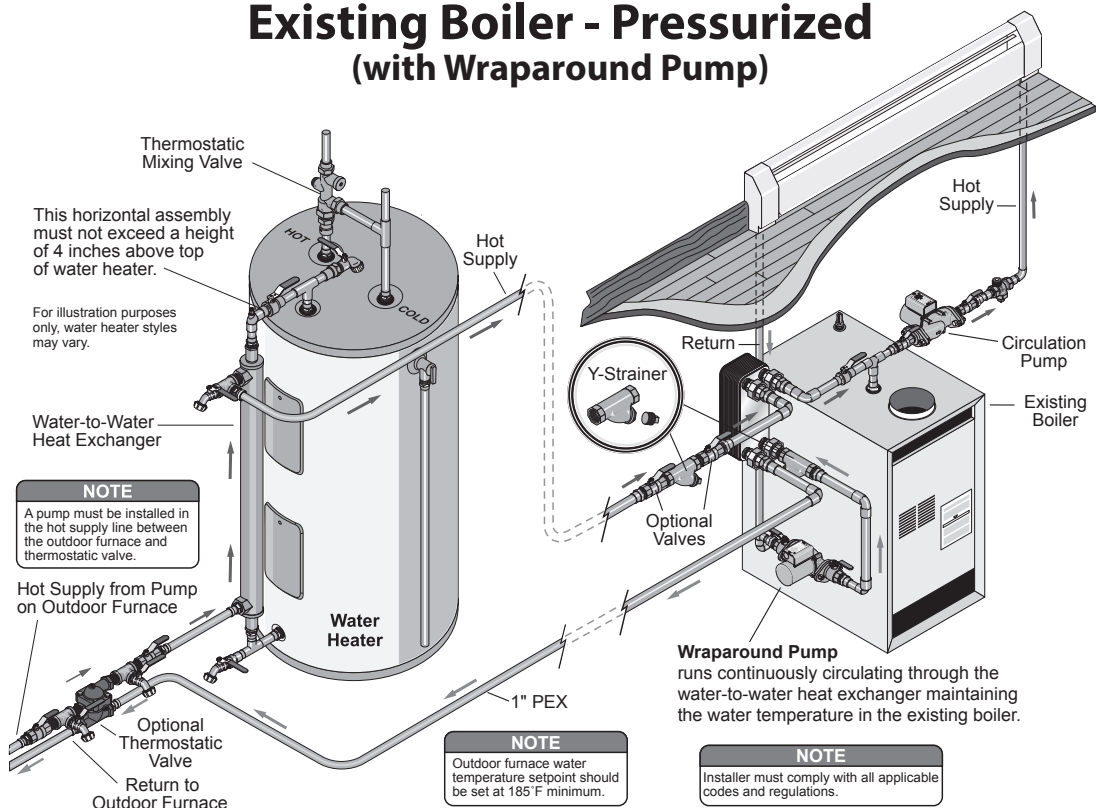
With this type of installation, the exchange temperature may be more than 165°F (74°C) and may eliminate the need for additional baseboard heaters, panel radiators or heat exchangers.

When installing water-to-water heat exchangers, be sure to flush any rust particles or sediments out of the existing boiler and install a Y-strainer as illustrated in Fig. 37. Also be sure to add MolyArmor 350 (p/n 2900630).

A Taco 007 or 014 pump can be used as a wraparound pump when a plate exchanger is installed. A Taco 009 or 014 pump should be used when a shell and tube heat exchanger (i.e., p/n 148, 151 or 177) is installed.

**NOTE: See the Hydronic Component Selection Guide for more detailed information.**

### Existing Boiler - Pressurized (with Wraparound Pump)



## Vented System Installation

The Maxim may be connected directly into an existing hot water system, changing it to an atmospheric vented system.

**NOTE: Any changes in the existing boiler and/or system should be done by a certified installer in accordance with applicable codes. Be sure the system water is properly maintained with MolyArmor 350 (see Water Quality and Maintenance section).**

The hot supply line from the outdoor furnace can be connected into the top of the existing boiler and returned to the outdoor furnace from the bottom of the boiler (see Fig. 38). Use one pump to continuously circulate the water from the outdoor furnace through the existing boiler and back to the outdoor furnace.

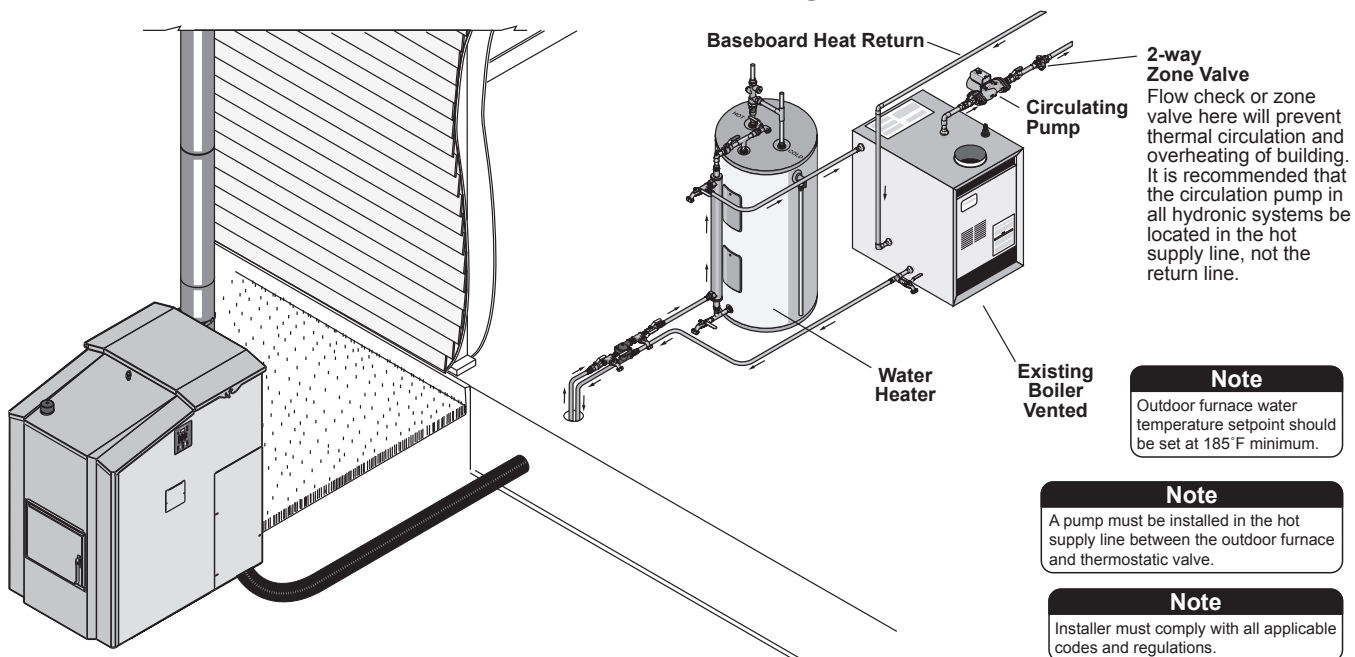
### CAUTION

**The outdoor furnace must NEVER be pressurized. The vent cap must always be loose. Do not extend the vent pipe. The outdoor furnace will be damaged if it is pressurized.**

When the existing system is connected to the outdoor furnace as illustrated in Fig. 38, the circulating pump(s) in the existing system must be located in the hot supply line(s), **not** in the return line(s). A flow check or zone valve will prevent thermal circulation and overheating of building.

Fig. 38

### Direct Connection to Existing Boiler



It is very important to eliminate all air and water leaks (valve packings, bleeders, etc.) and purge all air from the existing system.

1. **After filling the outdoor furnace** (see Initial Start-Up Procedures section) and existing system with water, purge the air from the indoor system by **closing the valves on the outdoor furnace**; then pressurize the indoor system with water from the domestic water line.

### CAUTION

**Do not apply more pressure to the indoor system than the pressure relief valve on the existing boiler is rated for.**

2. Bleed air from the pressurized indoor system; then operate the circulating pump(s) on the indoor system. Perform this procedure twice. If any auto float vents are used in the existing system, they must be capped off tightly after the air bleeding is completed. This eliminates the possibility of allowing air to enter after the system is depressurized.
3. When the indoor system is completely purged of air, close the valve on the water line used to pressurize the indoor system. If any air is trapped in the system, it can reduce water flow. This will prevent the system from heating properly.
4. Open valves on the outdoor furnace, turn on the pump and proceed to start the fire in the outdoor furnace.



## Direct Circulation Baseboard Installation

Baseboard heaters, as either the main source of heat or as supplements to forced-air or boiler applications are easily plumbed into the water lines from the outdoor furnace.

Refer to Fig. 39 and 40 for proper plumbing methods.

Fig. 39

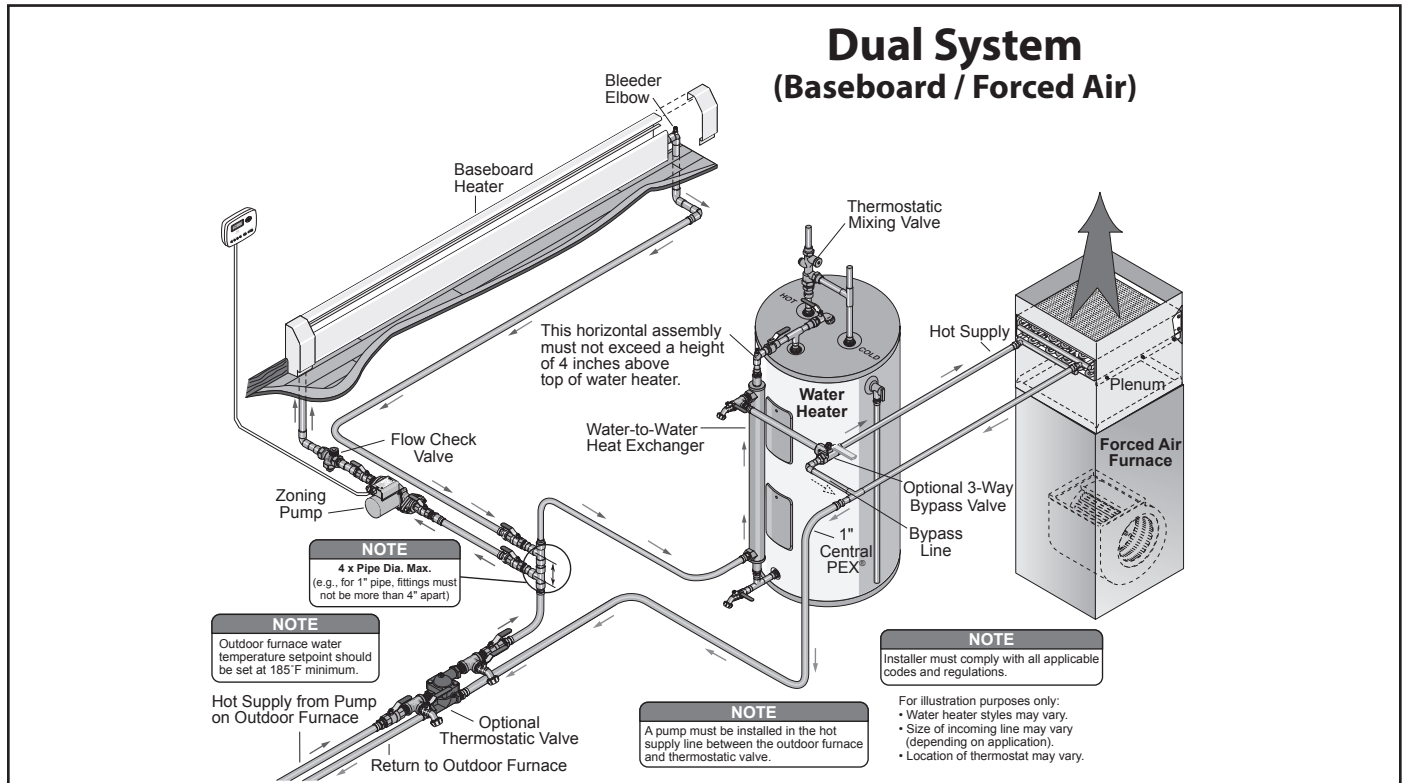
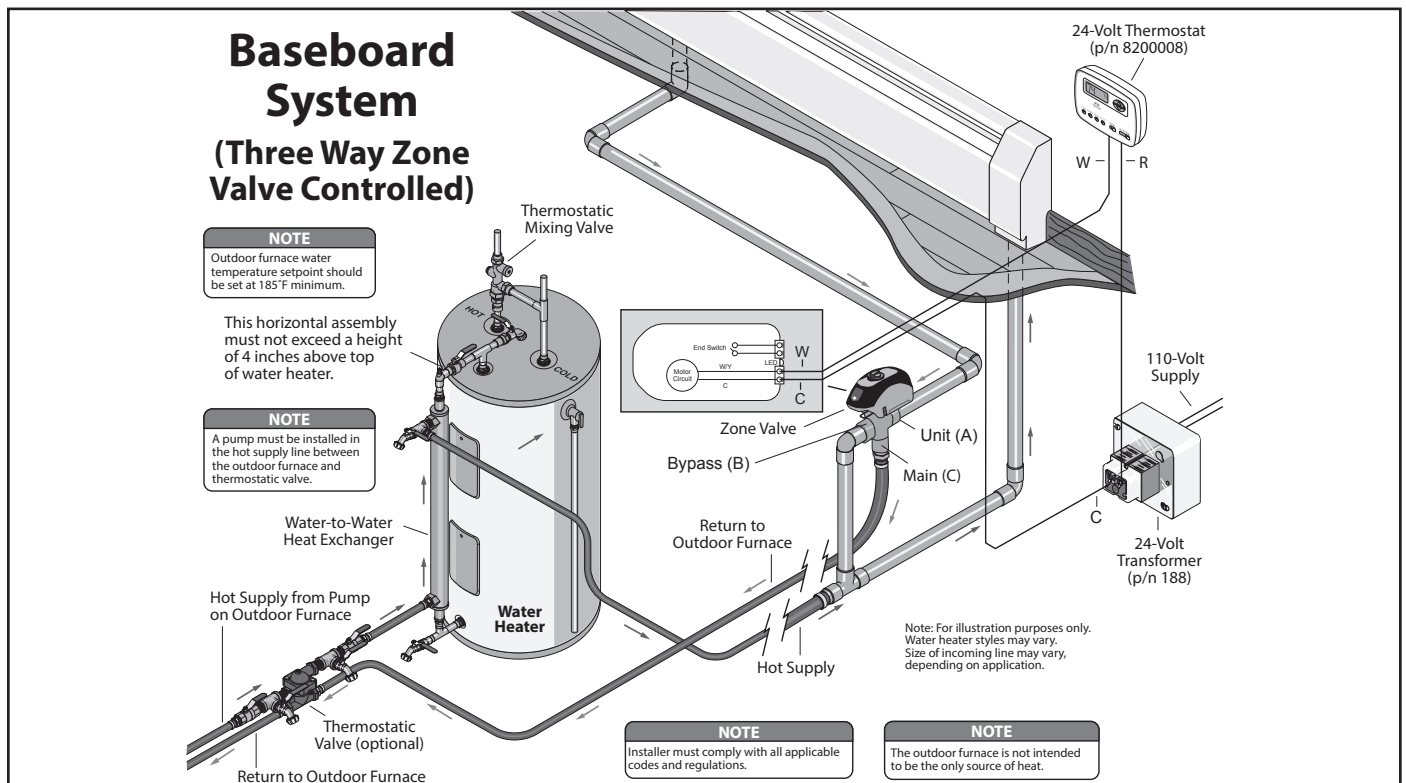


Fig. 40



## Radiant Floor System Installations

Radiant heat can be a great option for new construction or for adding to an existing home if the floor joists are exposed (as in an unfinished basement). Piping may be installed in a wide variety of configurations and locations including, but not limited to, the following:

- In a concrete slab
- Within the subfloor system (e.g., Gyp-Crete®)
- Within the floor joist system
- Within the walls or ceilings

Carefully consider each of the following before beginning construction and installation:

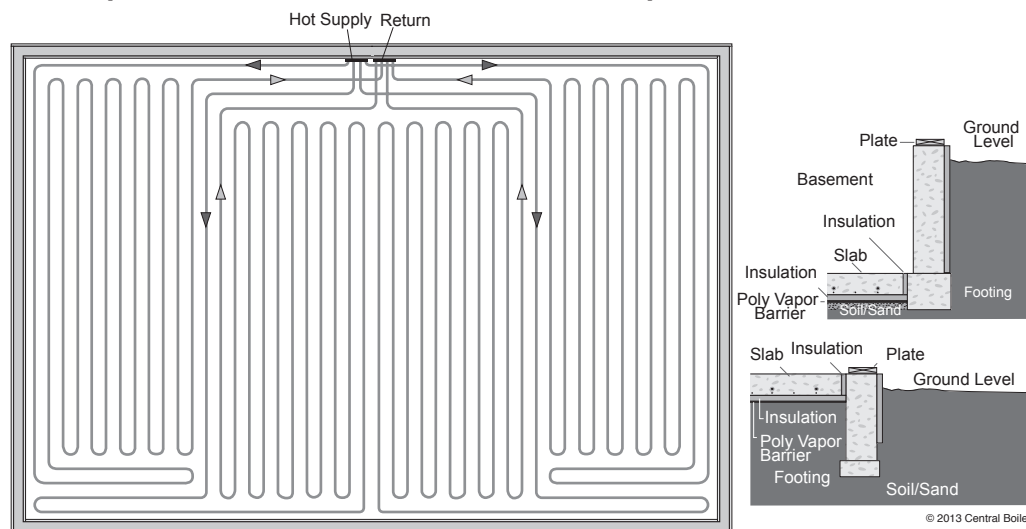
1. When installing piping between floor joists (16" or 41 cm on center) run two 1/2" pipes between each joist. Insulate below the piping to prevent excessive heat in the lower level.
2. Proper insulation is key to effective radiant heating and controlling large heat demands. Heat from this type of system radiates equally in all directions. As an example, if piping is installed in a slab, the ground below the slab must be dry and well-insulated. If not properly insulated, nearly 50% of the heat will be wasted warming the ground below the slab. Two inches (5 cm) of blueboard insulation is recommended. Two 1" (2.5 cm) layers of blueboard can be used. This allows lapping of the joints in the 4' x 8' (122 x 244 cm) sheets.

**NOTE: Do not use beadboard (expanded polystyrene), bubble foil or roll-out foam insulation.**

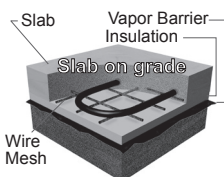
**NOTE: A minimum of one inch (2.5 cm) of insulation should be used. Two inches (5 cm) of insulation with vapor barrier below the insulation is recommended.**

Fig. 41

## Radiant Floor Heat (For Slab on Grade or Basement)



**NOTE: If the temperature of the concrete slab is below freezing (32°F), there must be adequate antifreeze in the system, or the slab must be pre-heated, before water is circulated through the radiant slab system.**



2" Blueboard Styrofoam® is recommended (minimum of 1" Blueboard Styrofoam®).

3. Areas with high water tables need to be prepared properly to prevent contact between the ground water and insulation.

**NOTE: For examples of radiant heating systems using 1/2" piping in the loops, refer to Fig. 42 through Fig. 45.**

4. The spacing of each circuit is 12" (30.5 cm) between pipes. The water circulates in opposite directions to provide an even distribution of heat. The mixing valve regulates the temperature of the water circulating through the loops by mixing return water with the hot supply water. In applications where high heat loss is expected, loop spacing may be reduced to 10" (25 cm) or less. If additional information is desired, contact your dealer.

**NOTE: The longer the loop length, the lower the flow rate and the lower the heating capacity. Loop lengths greater than 350 feet (107 m) are not recommended.**

**NOTE: The temperature of the water used in radiant heating should be determined by the installer in accordance with the application.**

5. It is not uncommon that it can be very difficult to get a concrete slab up to temperature in late fall or early winter in a new building that is not completely sealed and not well insulated. Once the building is completely sealed and well insulated, bringing the slab up to temperature can still take a considerable amount of time and fuel; however, once warm, fuel consumption will be reduced if the concrete slab and building are insulated properly.

**NOTE: For zone installations, refer to Fig. 42 (multi-zone) or Fig. 44 (single zone).**

Fig. 42

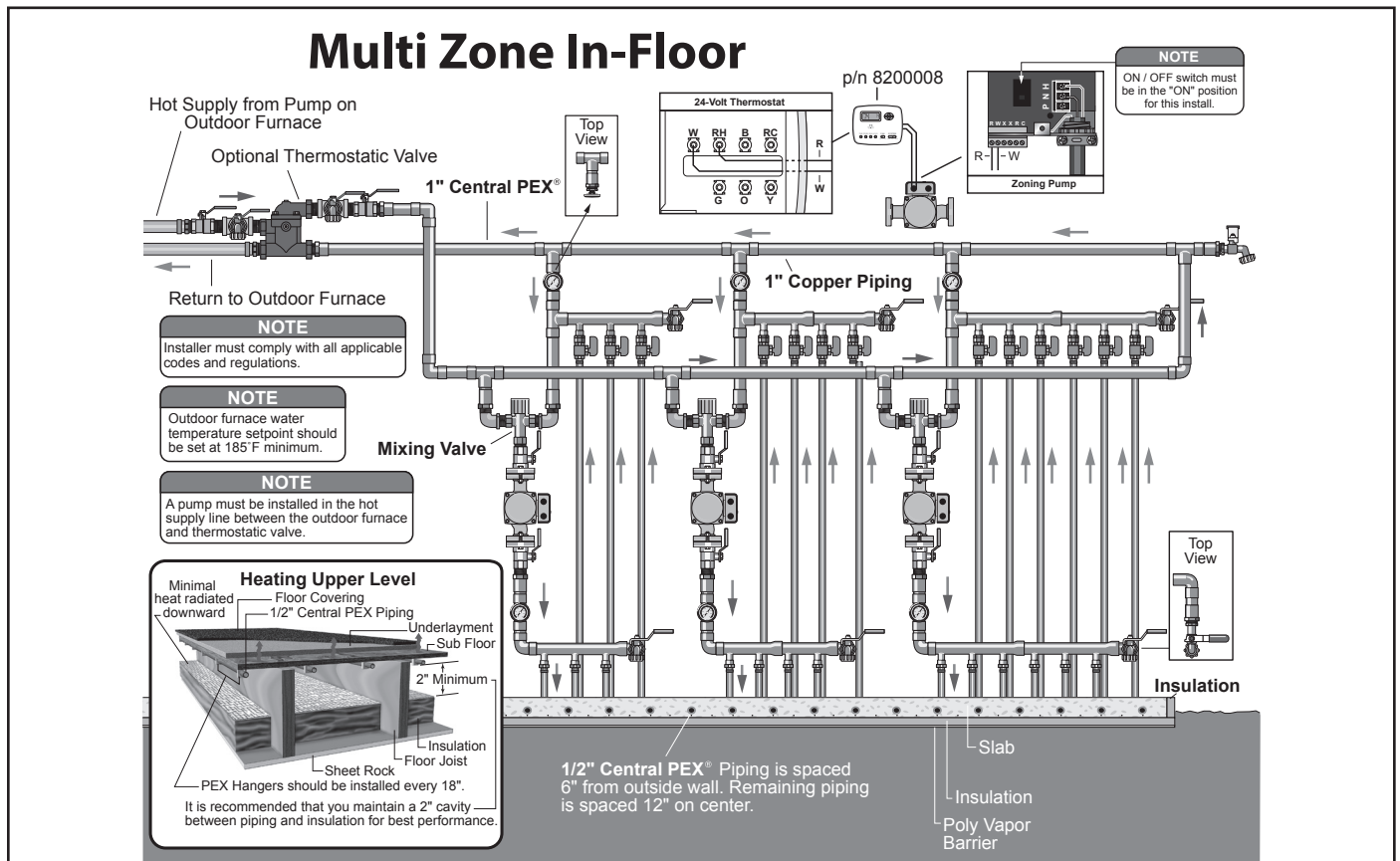


Fig. 43

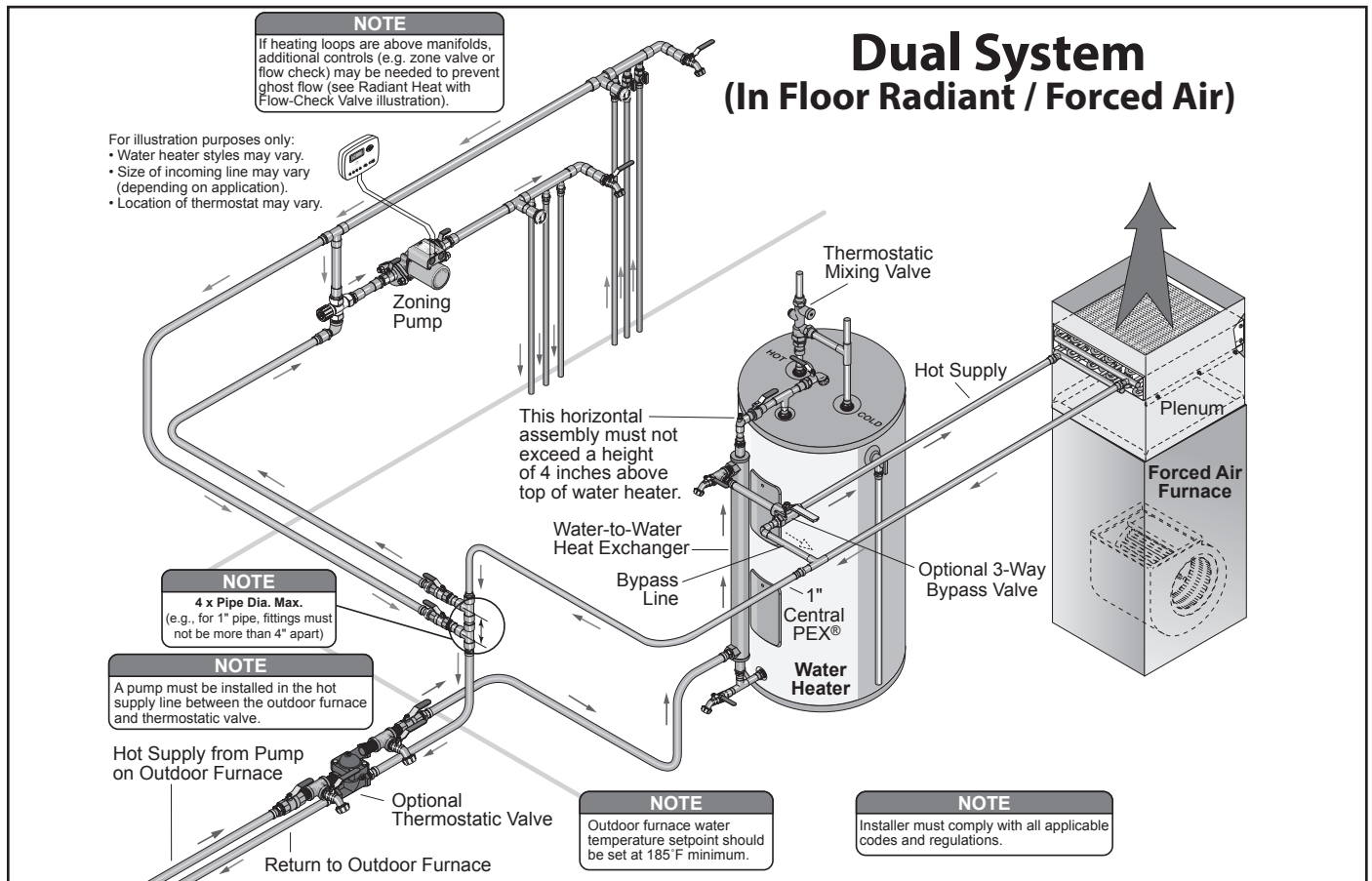


Fig. 44

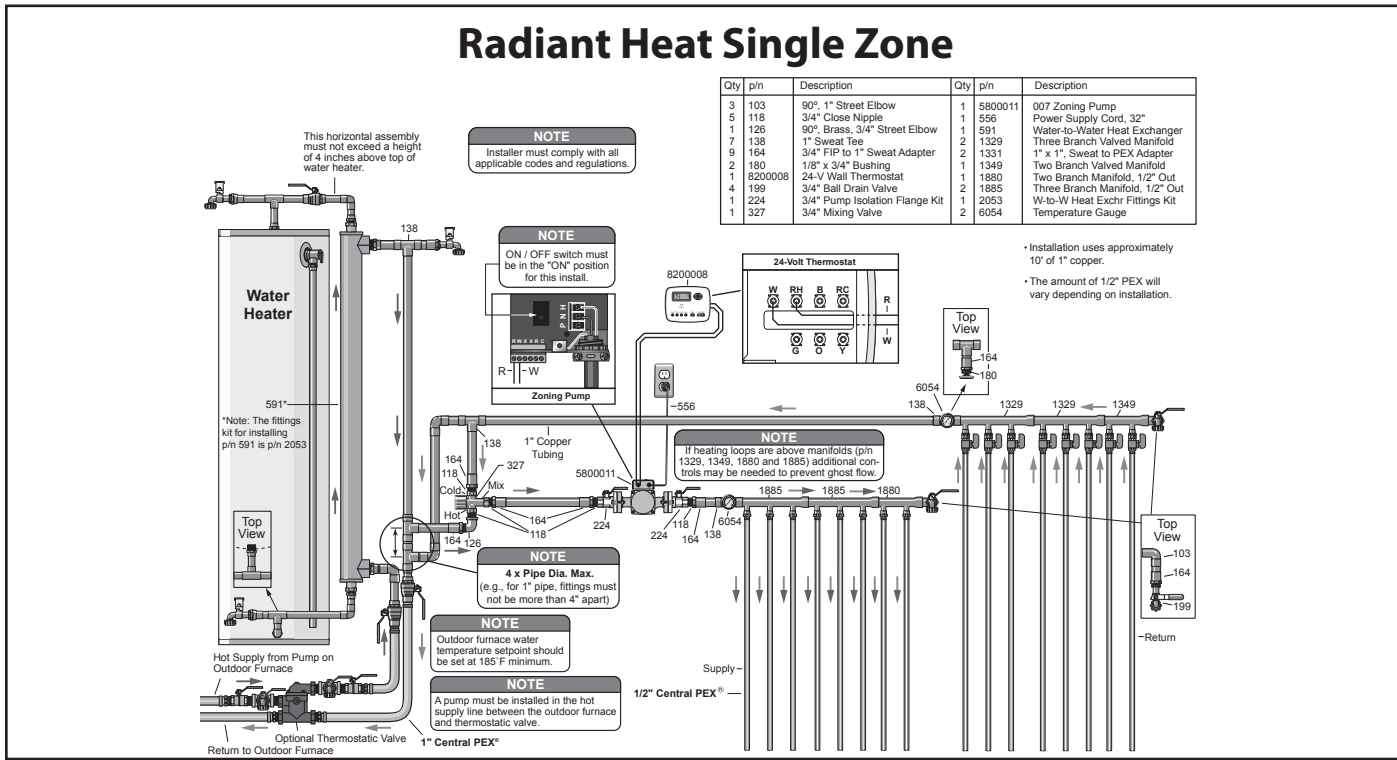
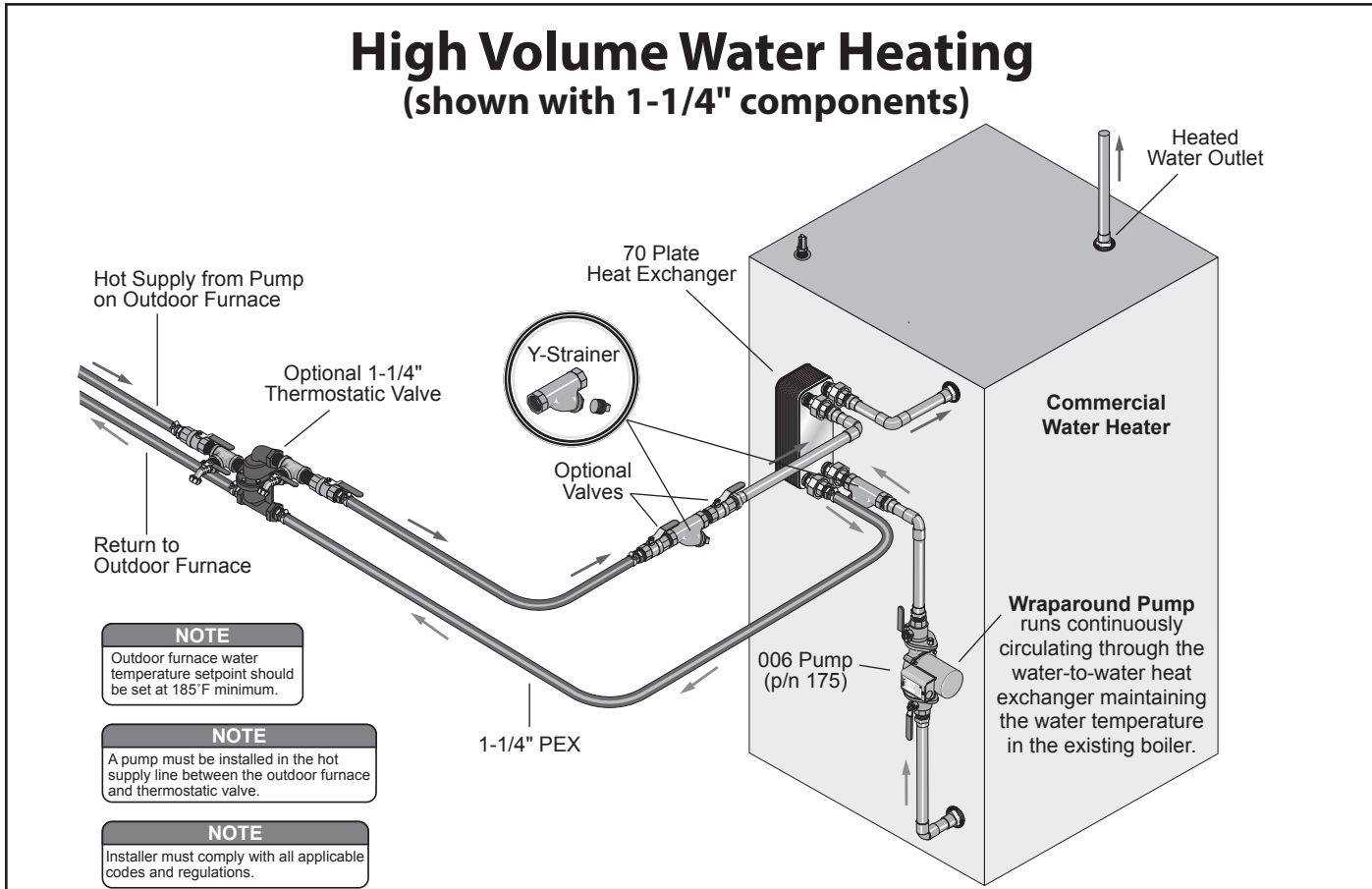


Fig. 45





## Pool and/or Hot Tub Heating

Valves should be installed so the heat exchanger can be isolated and bypassed when shock-treating or adding chemicals to a pool or hot tub (Fig. 46). Incorrect chemical concentrations can cause rapid corrosion to the heat exchanger. Bypassing the heat exchanger is recommended until the pH has stabilized between 7.2 and 7.8.

If the swimming pool or hot tub is salt water treated, the heat exchanger should be a shell and tube type (p/n 148, 151 or 177). See the Hydronic Component Selection Guide for more detailed information.

### CAUTION

Do not install a swimming pool heat exchanger inside a home or building below the level of the pool as a damaged heat exchanger may result in extensive flooding and draining of the pool.

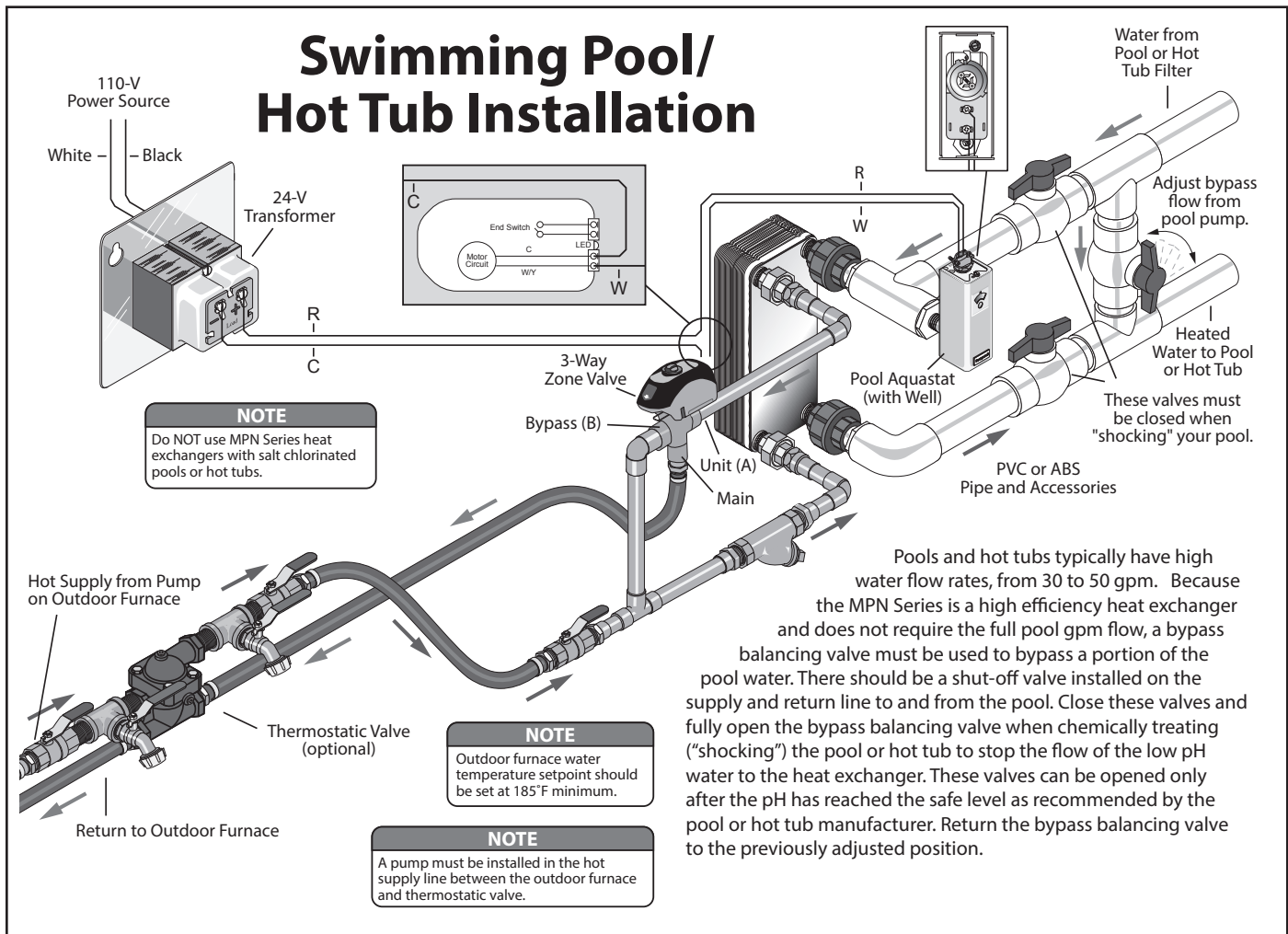
### WARNING

Do not use automotive or ethylene glycol antifreeze in an outdoor furnace connected to a swimming pool heat exchanger as a damaged heat exchanger may cause severe personal injury, death, or substantial property damage.

### CAUTION


Do not operate the outdoor furnace frequently or for extended periods of time with the water temperature below 150°F (65°C) as this will result in more condensation in the firebox that can lead to corrosion.

Fig. 46



# SECTION 7 – FILLING SYSTEM WITH WATER AND PURGING AIR

Before firing the outdoor furnace for the first time, perform the following important steps:

1. **Check for leaks.** Close the valves on the outdoor furnace before checking for leaks. Do not pressurize the outdoor furnace. Pressure-test the entire plumbing system. Apply 50 psi (3.5 kg/cm<sup>2</sup>) of air pressure for thirty minutes and closely monitor for any pressure loss. Inspect all fittings and hose ends for any signs of leakage using leak detection solution (leak soap); repair as necessary.
2. **Cover Supply and Return Lines.** Backfill the trench for the supply and return lines. Enclose the area where the supply and return lines enter the outdoor furnace. Do not leave the PEX hot supply and return lines exposed to sunlight as exposure to UV rays will damage them.
3. **Add MolyArmor 350.** Add the recommended amount (1/2 unit or 1/2 gallon) of MolyArmor 350 through the vent pipe on the outdoor furnace before filling with water to immediately begin to protect the steel. Refer to Water Quality and Maintenance.
4. **Turn the FireStar controller on** by pressing the **Power**  button. The LED display should flash **LD** to indicate that the water level is below the sensor.
5. **Fill with water, purge air from system and verify flow direction of the water.** See Water Quality and Maintenance and Testing Supply Water.
6. Install the vent cap. The vent cap must fit loosely over the outdoor furnace vent.

## FILLING OUTDOOR FURNACE WITH WATER AND PURGING AIR

**NOTE:** The items referred to in this procedure correspond to the items in Fig. 47. Refer to Fig. 47 when performing these steps.

All air must be purged from the water lines when filling the system. Also, the circulation pump(s) must be installed in the hot supply line(s).

**NOTE:** If using the valve on the water heater to fill the outdoor furnace, flush the water heater to remove all sediment before filling the outdoor furnace.

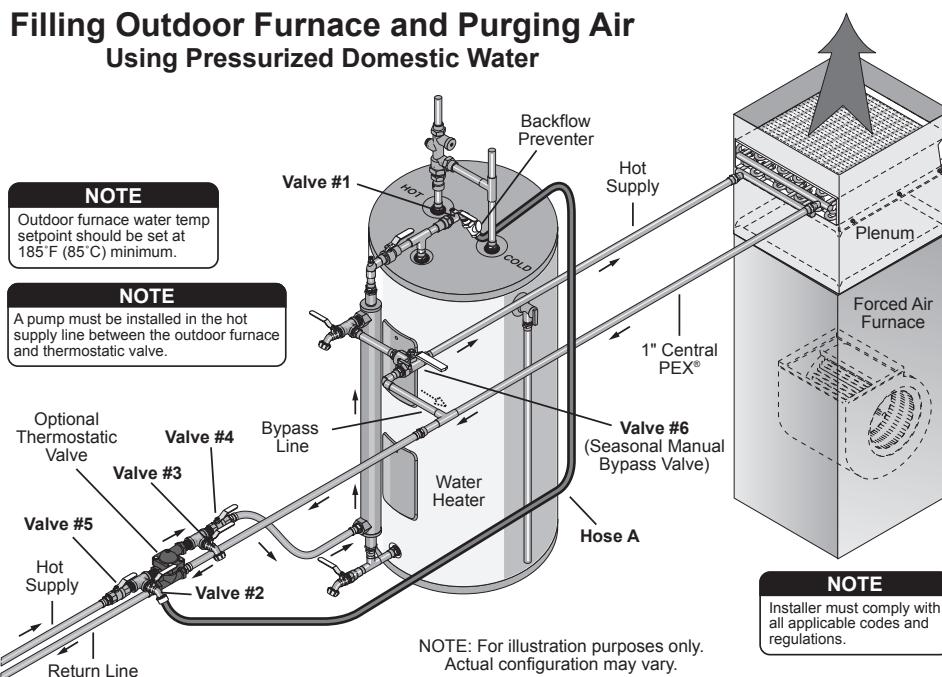
**NOTE:** If the outdoor furnace is being filled with water when the temperature is below freezing, circulate the water immediately after filling to prevent freezing the water lines.

**NOTE:** Be sure to fill the outdoor furnace with water of good quality (softened water, if possible). See Water Quality and Maintenance section.

Use the procedure in this section to fill the outdoor furnace with water and purge the air from the system. All valves in the outdoor furnace system that allow circulation through each circuit should be open before starting. Perform this procedure on each pump circuit from the outdoor furnace.

**NOTE:** Add MolyArmor 350 (p/n 2900630) through the 2-inch vent pipe on the outdoor furnace before filling with water to immediately begin to protect the steel.

Fig. 47



1. Connect the male end of garden hose A to valve #1 using the backflow preventer and two 3/4" female hose x 3/4" male pipe adapters (p/n 4928). Connect the female end of the garden hose to valve #2.
2. Close the valves on the hot supply and return lines of the outdoor furnace.
3. Close valve #4 and valve #5.
4. Open valve #1 and valve #2. This step begins filling the system with domestic water and purging the hot supply line and thermostatic valve.
5. Remove cap from valve #3 and open valve #3 slightly to purge air from valve body. Close valve #3 when air is purged.
6. Open valve #5.
7. Open the valve on the hot supply line of the outdoor furnace for 5 minutes; then close the valve. Water will purge air from the hot supply line. The valve and attached fittings on the outdoor furnace will become cold as water starts filling into outdoor furnace.
8. Close valve #5, #1 and #2.
9. Move hose A from valve #2 to valve #3.
10. Open valves #1, #3 and #4.

**NOTE: Skip to Step 12 if your system does not have a seasonal manual bypass valve (valve #6 shown in Fig. 35).**

11. Valve #6 (seasonal manual bypass valve) should be positioned to direct water through the heat exchanger first.
12. Open the valve on the return line of the outdoor furnace.

**NOTE: Skip to Step 14 if your system does not have a seasonal manual bypass valve (valve #6 shown in Fig. 35).**

13. As soon as the valve on the return line of the outdoor furnace is opened, turn valve #6 to the bypass direction for 30 seconds; then turn valve #6 back to previous position.

**NOTE: The heat exchanger manifold (lower manifold first) and fittings will become cold as water flows through the heat exchanger to the outdoor furnace.**

14. Allow outdoor furnace to fill until the controller no longer indicates **LD**.
15. Close valves #1 and #3. Disconnect hose A and replace caps on valves #1, #2 and #3.
16. Open the valve on the hot supply line of the outdoor furnace and valve #5.

**NOTE: The valves on the hot supply and return lines of the outdoor furnace, and valves #4 and #5 should all be open, allowing the pump to circulate heated water in the system. Start pump.**

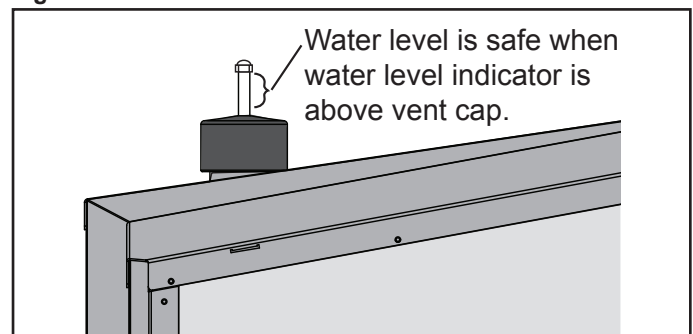
**NOTE: If there are multiple circuits connected to the outdoor furnace, repeat the process for each circuit.**

17. Refer to Firing the Outdoor Furnace to fire up the outdoor furnace.

## CAUTION

**Be sure the outdoor furnace is filled with water before firing. Water level is safe when the water level indicator rod is above the vent cap (Fig. 48). MolyArmor 350 must be added before the initial fill (see Water Quality and Maintenance).**

**Fig. 48**



18. **Check the system for leaks again.** Inspect all fittings and hose ends for any signs of leakage; repair as necessary. It may be possible to stop a very slow leak at a hose clamp by tightening the clamp after the system has warmed up and the poly becomes more pliable. It might also be necessary to install a second hose clamp with the screw positioned on the opposite side. Release the pressure upon completion of the test.

**NOTE: It should not be necessary to add water to the outdoor furnace more frequently than once every twelve months. If it is more frequent, either there is a leak in the system or the outdoor furnace is boiling because of improper operation or maintenance (see Troubleshooting Section). Be sure to locate and repair the problem immediately. Frequently adding water can cause deterioration in the water jacket. Each time water is added, refer to Water Quality and Maintenance for water testing procedures. If indicated by test results, add MolyArmor 350 as required. Deterioration due to improper operation and/or maintenance is not covered by warranty.**

# SECTION 8 – OPERATING INSTRUCTIONS

## Fuel Selection

Use only premium quality wood pellets.

**Feed rates and safe operation are not warranted with alternative fuels.**

### CAUTION

Do not use materials that will clog or jam the auger delivery system or damage the furnace. The heat exchanger must be cleaned regularly to maintain proper combustion air flow.

## Fuel Quality and Storage

Fuel must be stored in a container or building that prevents rain or other moisture from contact with the fuel.

### WARNING

Do not store fuel within the outdoor furnace installation clearances or within the spaces required for fueling, ash removal and other routine maintenance operations.

### CAUTION

If fans are used in the fuel storage area, they should be installed so as not to create negative pressures in the non-habitable building where the outdoor furnace is located.

## Other Important Information About Fuels

### CAUTION

Do not burn plastic, garbage, treated wood or fuels not listed for this outdoor furnace.

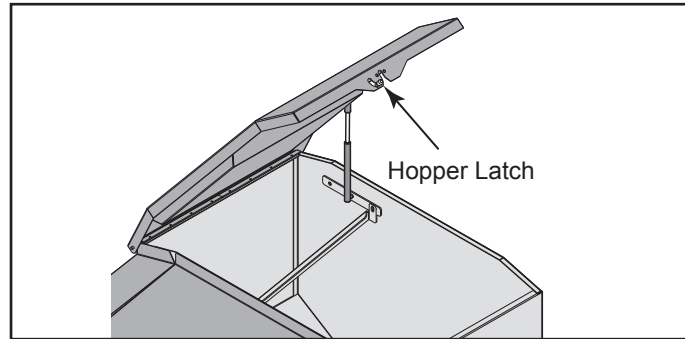
**NOTE:** Chloride or sulfurous gases will generate if plastic or rubber is burned and will mix with the moisture from the wood pellets to form hydrochloric or sulfuric acids in the firebox, creating corrosion.

**NOTE:** Wood pellets with a high sawdust content may cause a feed rate interruption. An interruption in fuel flow may result in an empty burn chamber, or if the blockage frees itself after the fire has gone out, a burn chamber full of unburned fuel.

## Filling the Hopper

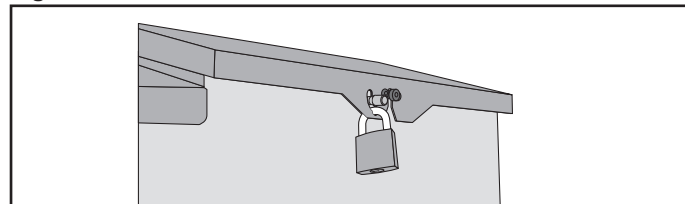
Open the hopper lid (Fig. 50) and add fuel. After filling, make sure the hopper lid is securely closed to prevent moisture from entering the hopper. Do not over-fill the hopper.

Fig. 50



**NOTE:** The hopper lid may be locked to prevent unauthorized access (Fig. 51).

Fig. 51



## Power Up

Press the Power button to turn the FireStar controller on.

## Basic Operation

The FireStar automatically controls combustion to allow the furnace to operate properly in most installations without adjustment.

## Lighting Instructions

Ignition is automatic. The fan will start and the ignitor will operate until the fuel in the burn chamber is lit.

## Auger Prime

If the hopper and auger are empty and fuel has been added, to expedite delivery of fuel to the burn chamber, start a prime cycle by pressing the Auger button. The prime cycle timer will count down. When starting from an empty auger, it may take two prime cycles. During the timer count down, prime can be stopped by pressing the Auger button again.

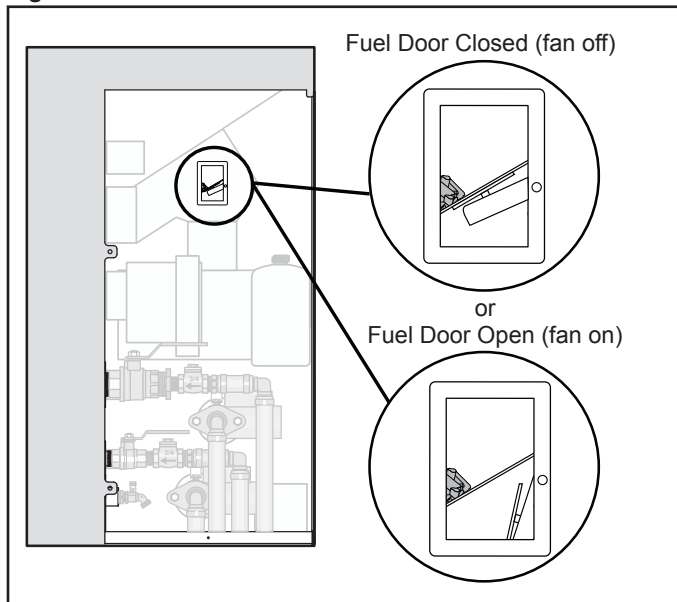
## Relighting after a Fire Out

If the hopper runs out of fuel (causing a Fire Out alarm on the controller), press and hold the Reset button to restart the ignition sequence (after filling the hopper with fuel).



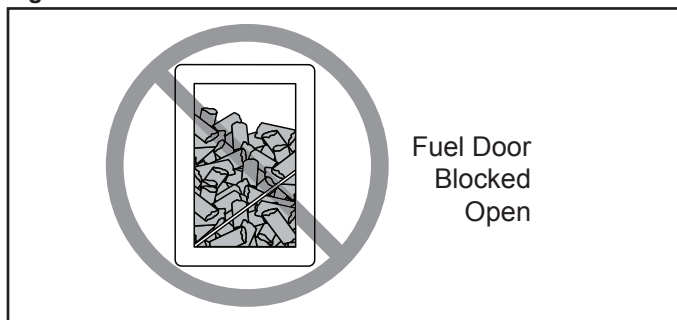
**NOTE:** Fuel must be flowing from the transfer auger to the burner auger when the burner auger is turning (see Fig. 52).

Fig. 52



**NOTE:** Fuel must not build up so that it prevents the fuel door from closing as shown in Fig. 53. This is an indication the burner auger is obstructed or has quit turning. If this condition exists, inspect the burner auger and clean or replace as necessary. If condition persists contact your Central Boiler dealer for more information.

Fig. 53



### FireStar Controller

Settings on the combustion controller can be adjusted to optimize the performance of the Maxim for a variety of different conditions. See the FireStar Operation Manual for instructions on changing the controller and for more information.

### Operating Precautions

**NOTE:** If the controller is flashing **LH** the system senses a low water condition. This outdoor furnace is equipped with an automatic shut down system if the water level falls to an unsafe level. The water level in the outdoor furnace is safe when the water level indicator rod is above the vent cap (see Fig. 56).

1. Do not burn garbage, gasoline, rubber, engine oil, naphtha, plastics, treated wood, cord wood or combustibles other than the fuel specified.
2. Do not store combustibles within the installation clearances listed on the Important Precautionary Information page. Be sure to leave a safe amount of room for cleaning out ash without causing a fire hazard. **Keep the area around the outdoor furnace clear of combustible materials. Combustible debris may be easily ignited if embers spill out of the firebox.**
3. The outdoor furnace water jacket must not be allowed to pressurize. Inspect the vent cap periodically for any obstructions or restrictions. The vent cap must fit loosely over the vent (Fig. 54). Do not extend or connect anything to the vent pipe.

Fig. 54



4. All cover plates, enclosures and guards must be secured at all times except during maintenance, inspection, and servicing.
5. In case of a power outage, a small generator can provide enough electricity to operate the system.
6. If any questions should arise that cannot be answered by the information in this manual, be sure to contact either your dealer or qualified installer.

## Smoke in Hopper

How air flows through the furnace is an important part of optimal operation. Smoke in the hopper is an indication that the air flow through the furnace is restricted, obstructed or different than it should be.

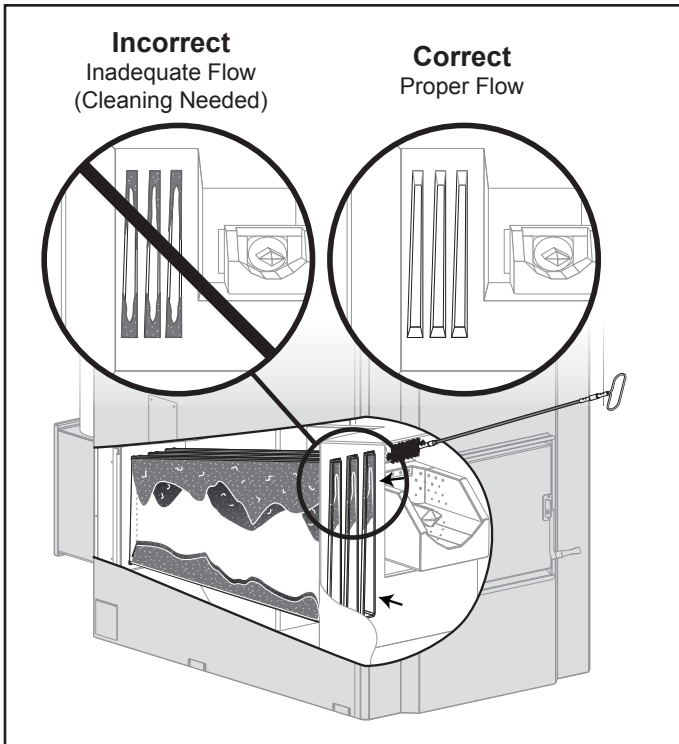
### CAUTION

**Operating for extended periods of time with air flow through the furnace restricted (i.e., smoke in the hopper) can damage components in the furnace.**

If smoke in the hopper occurs, check the following:

- **Heat exchanger obstructed** - clean the heat exchanger (see Fig. 55).
- **Aerator covered by ash** - do not allow ash in the burn chamber to accumulate over the aerator. Use the cleaning rod to pull ash forward to ash collection area.
- **Carbon buildup** - inspect the burner auger where it enters the firebox for carbon buildup and clean if necessary.
- **Chimney is obstructed** - inspect the chimney and chimney connector and clean if dirty or obstructed. If a spark arrestor is installed, ensure it is not dirty or obstructed.
- **Chimney too short** - may need to increase the height of the chimney.

Fig. 55



# SECTION 9 – ROUTINE MAINTENANCE

## PREVENTIVE MAINTENANCE SCHEDULE

Regular maintenance and inspections can help extend the life of your outdoor furnace and prevent high-cost repairs. This table is meant to serve as a general guideline until you become acquainted with how the outdoor furnace operates with your specific application.

OPERATION	SERVICE INTERVAL						SEE SECTION
	Before first operation of season	Daily	Weekly	Monthly	Semi-Annually	Post Season	
Check water level.	●	●					9.1
Remove ash.			G	C		●	9.2
Inspect firebox and firebox ash area.	●			B		●	9.3
Inspect gaskets.	●				●		9.4
Inspect and clean heat exchanger, chimney transition.			C			●	9.5
Inspect and clean aerator and burn chamber.		A					9.6
Lubricate door and hopper lid hinge points.						●	9.7
Check thermal valve.				B			9.9
Test thermal valve.	●					●	9.10
Check pH and moly levels of water.	●				D	●	E
Check that the outdoor furnace is level.					●		F
Check fuel door operation.			●				9.8

- A When the outdoor furnace is new, daily for the first week.
- B When new, after one month, then midway through the heating season, and in the spring.
- C Weekly until interval for your application can be determined.
- D When new, after three months, then every six months thereafter.
- E Refer to **Testing Treated Water in the Outdoor Furnace**.
- F Refer to **Leveling the Outdoor Furnace**.
- G During the first few weeks of operation, or when switching to a new brand of wood pellets, check ash level daily to determine rate of accumulation.

## CAUTION

Use only genuine Central Boiler Parts and Accessories if it ever becomes necessary to replace any component of the outdoor furnace.

## ROUTINE MAINTENANCE

Routine inspections and maintenance are essential to the proper operation and longevity of the outdoor furnace. The items indicated in the preventive maintenance schedule are intended to serve as a guideline. Actual intervals between inspections and maintenance may vary depending on a number of factors, including your heat load requirements, type and quality of fuel used, and outdoor temperatures.

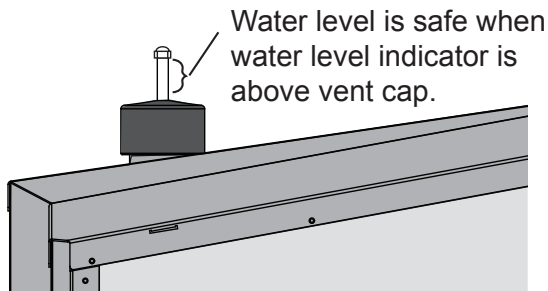
## CAUTION

Turn off the FireStar controller before performing any maintenance.

### 9.1 Water Level

The water level in the outdoor furnace is safe when the water level indicator rod is above the vent cap (see Fig. 56). If adding water is necessary, refer to the Water Quality and Maintenance section.

Fig. 56



### 9.2 Ash Removal

An ash scoop is included with your outdoor furnace. For your protection, always wear the appropriate personal protective gear when cleaning ash from the firebox.

## CAUTION

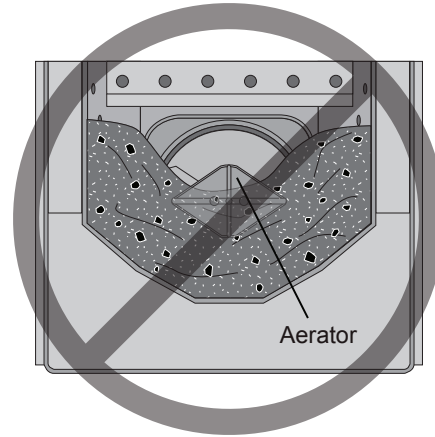
Always wear the appropriate personal protective gear when cleaning ash from the firebox.

## CAUTION

When cleaning the outdoor furnace, be careful not to spill any hot ash outside of the noncombustible container.

1. Do not allow ash in the burn chamber to accumulate over the aerator as shown in Fig. 57. Use the cleaning rod provided to pull the ash forward to the ash collection area.

Fig. 57



2. It is important to remove the ash in the firebox before it solidifies to prevent sealing in moisture on the bottom and along the edges. It is especially important to scrape all of the firebox where build up and ash are collected. Any heavy or solidified ash should be removed.

**NOTE: If these maintenance operations are not performed as directed, deterioration can result from the moisture trapped between the ash and the steel.**

3. If burning wood pellets with a high ash content, a hard deposit may form in the burn chamber. Remove the deposit by scraping the burn chamber with the cleaning rod provided.
4. **Disposal of ash** - Place ash in a metal container with a tight-fitting lid. Store the closed container of ash on a noncombustible surface, well away from all combustible materials until ready for final disposal. Do not dispose (either by burying or other means) until all cinders have thoroughly cooled.
5. Each time the ash are cleaned out, inspect the outdoor furnace door rope gasket to make sure it is sealing properly (see Fig. 59).

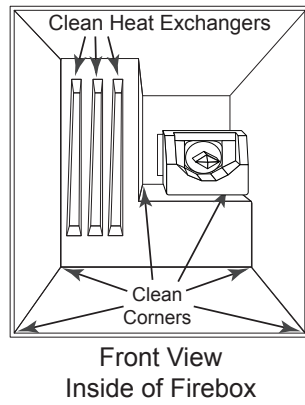
### 9.3 Firebox

**NOTE: Proper firebox maintenance is essential to the longevity of the outdoor furnace.**

Remove ash as described in Ash Removal section. Scrape all surfaces in the firebox, paying close attention to the corners (see Fig. 58). If needed, the aerator and burn chamber can be removed for a more thorough cleaning (see Aerator and Burn Chamber).

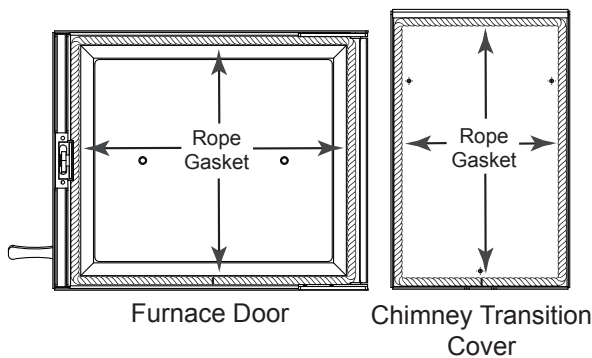


Fig. 58



### 9.4 Gaskets

Fig. 59

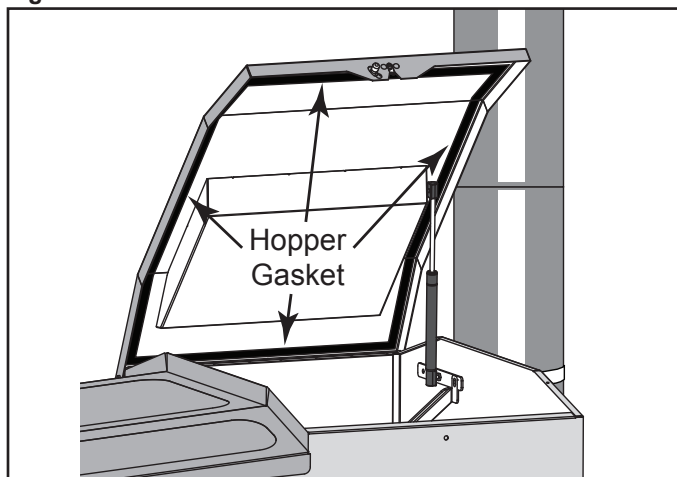


Inspect the rope gasket on the furnace door and on the chimney transition cover at the back of the furnace. A uniform indentation in the rope indicates the rope gasket is sealing properly. If it is not sealing properly, or if the rope gasket is damaged, replace the rope gasket.

Using Fig. 60 as a reference, inspect the hopper lid gasket and replace if necessary.

**NOTE: Replacement gaskets for the furnace door, chimney transition cover and hopper are available from authorized Central Boiler dealers.**

Fig. 60

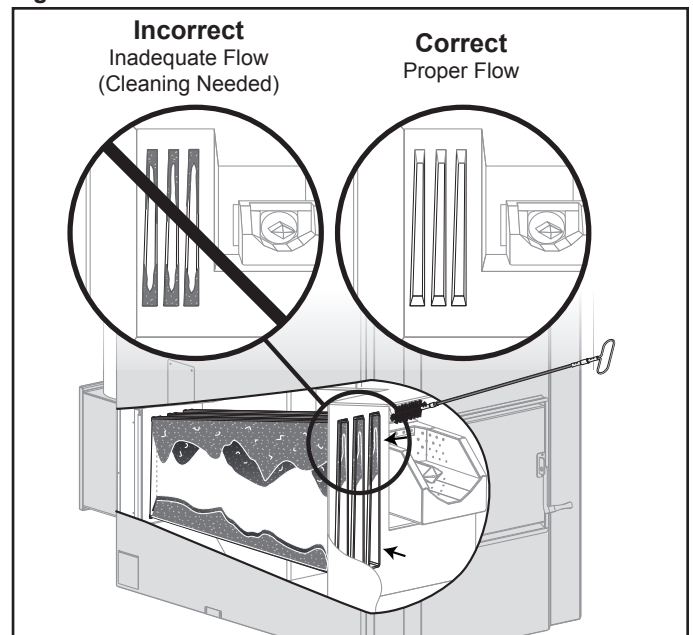


### 9.5 Heat Exchangers and Chimney Transition

The heat exchangers should be cleaned every time ash is removed, or if air flow through the heat exchangers becomes restricted (see Fig. 61).

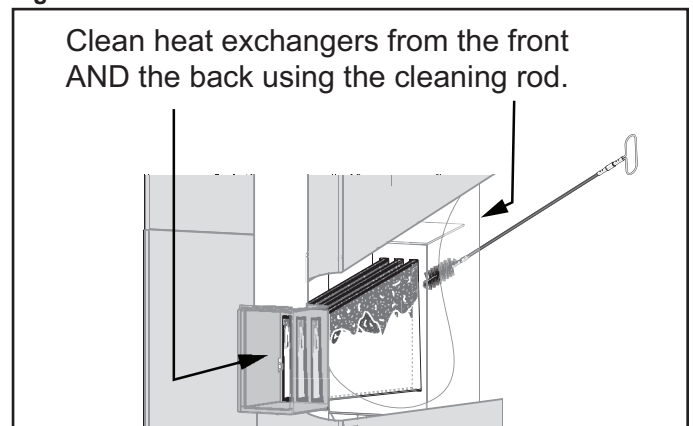
To inspect the heat exchangers, remove the chimney transition cover on the back of the furnace and open the firebox door. It will probably be necessary to kneel down at the back of the furnace to look through each heat exchanger passageway. The heat exchangers taper up from the back of the furnace to the front. Pay particular attention to the top of each passageway as this is where ash tends to accumulate. The top of each heat exchanger passageway is where most air flow and heat transfer occur, so it is especially important to keep the top free of any buildup.

Fig. 61



Remove deposits by scraping with the cleaning rod provided with your outdoor furnace. Use the cleaning rod from both the front and the back of the furnace, working from top to bottom of each passageway in the heat exchanger.

Fig. 62

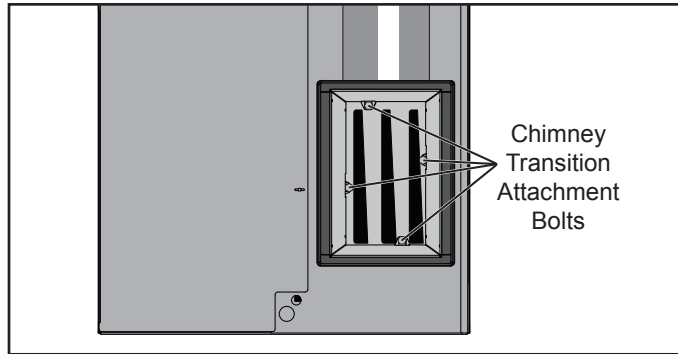


Inspect the chimney transition and clean if an excessive amount of buildup is present.

**NOTE: Twice a month during the heating season, inspect the chimney transition for excessive buildup. If present, the buildup should be removed for proper operation and fire safety. In case of a chimney fire, close the firebox door.**

Check the integrity of the chimney transition attachment bolts (Fig. 63) as they support the weight of the chimney.

Fig. 63

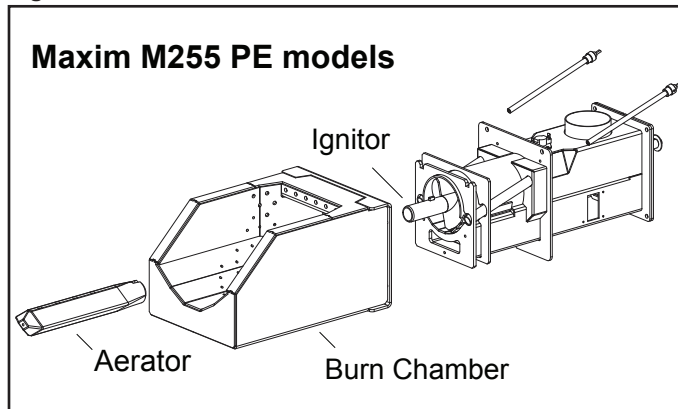


### 9.6 Aerator and Burn Chamber

As the quality of wood pellets varies from region to region, so will the requirements for component maintenance. The aerator and burn chamber should be inspected on a regular basis to ensure mineral deposits do not hinder burner performance. Regular inspection and removal of any deposits will ensure best furnace operation.

**NOTE: Make it a habit to visually inspect the burner on a weekly basis during the heating season.**

Fig. 64



### CAUTION

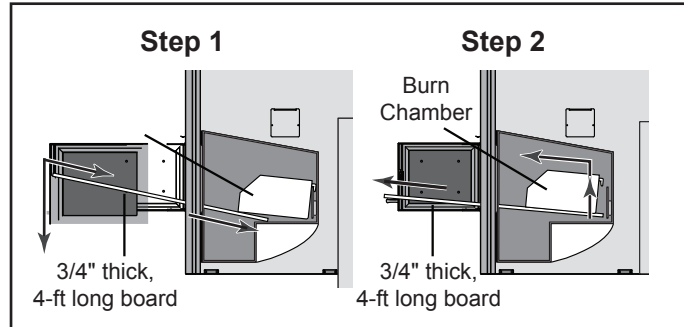
Before performing any maintenance on the burn chamber or aerator, shut off the burner, allow the outdoor furnace to cool and clean the firebox.

### Disassembly

1. Turn the aerator 1/4 turn counterclockwise and pull straight forward to remove.

2. Remove the side access panel from the furnace. Roll back the insulating tape securing the thermocouple and remove the thermocouple.
3. Open the firebox door. Using Fig. 65 as a reference, place a 3/4" thick, 4-ft long board under the front of the burn chamber; then push the board in until it reaches the back of the firebox. Pry up the entire burn chamber to disengage the hooks on the back of the burn chamber. Remove the board with burn chamber through the door.

Fig. 65



**NOTE: It will be necessary to angle the burn chamber when removing it through the firebox opening.**

### Inspecting and Cleaning

1. Inspect the aerator and burn chamber for any build-up of mineral deposits, especially in and around the combustion air holes.
2. To clean combustion air holes, use a suitably sized drill bit, round wire brush or other suitable tool to remove any deposits. Be careful not to damage, deform or increase the size of the combustion air holes. Clean ash from inside the burn chamber.
3. Scrape carbon deposits from the auger, the surfaces of the aerator and the burn chamber.

### CAUTION

Do not strike the aerator or burn chamber with a hammer or other hard item to remove deposits. Doing so could damage the parts and prevent proper operation of the burner.

### CAUTION

Before placing the aerator in water, allow it to cool thoroughly. Do not put the aerator in snow to cool faster as the aerator can be damaged.

### Assembly

1. Inspect the burn chamber gasket for damage and replace if necessary. Place the 3/4" thick, 4-ft long board used to remove the burn chamber in the firebox opening; then place the burn chamber on top of the board.

**NOTE: It will be necessary to angle the burn chamber to install it through the firebox opening.**

2. Push the board and burn chamber to the back of the firebox; then use the board to lift the burn chamber up so the hooks on the back of the burn chamber can engage. Remove the board.
3. Place the aerator on the end of the auger tube; then rotate it 1/4 turn clockwise to lock it in position.
4. Install the thermocouple and replace the insulating tape. Install the side access panel on the back of the outdoor furnace.

### 9.7 Door and Hopper

Lubricate the door pivot points and hopper lid latch with a light petroleum distillate (WD-40 or equivalent).

### 9.8 Check Fuel Door Operation

Make sure the fuel door is open when the combustion fan is running and closed when the fan is stopped. It is important to check the fuel door monthly to make sure it is operating properly. When operating properly, the fuel door will be closed when the combustion fan is not operating.

### 9.9 Thermal Valve

The thermal valve does not require electricity to operate. If during a power outage, a high temperature condition is detected in the burner auger area, the thermal valve is designed to release a small amount of water into the burner auger area to cool the area.

Twice each heating season, check to see if the thermal valve has activated:

1. Disconnect the electrical power at the main power source.
2. Remove the access panels from the back corner of the furnace and set aside.
3. Remove the 1/2" silicone tubing from the thermal valve, leaving it attached to the discharge tube. Blow air through the tubing to clean. Connect the silicone tubing to the thermal valve making sure not to kink the silicone tubing.

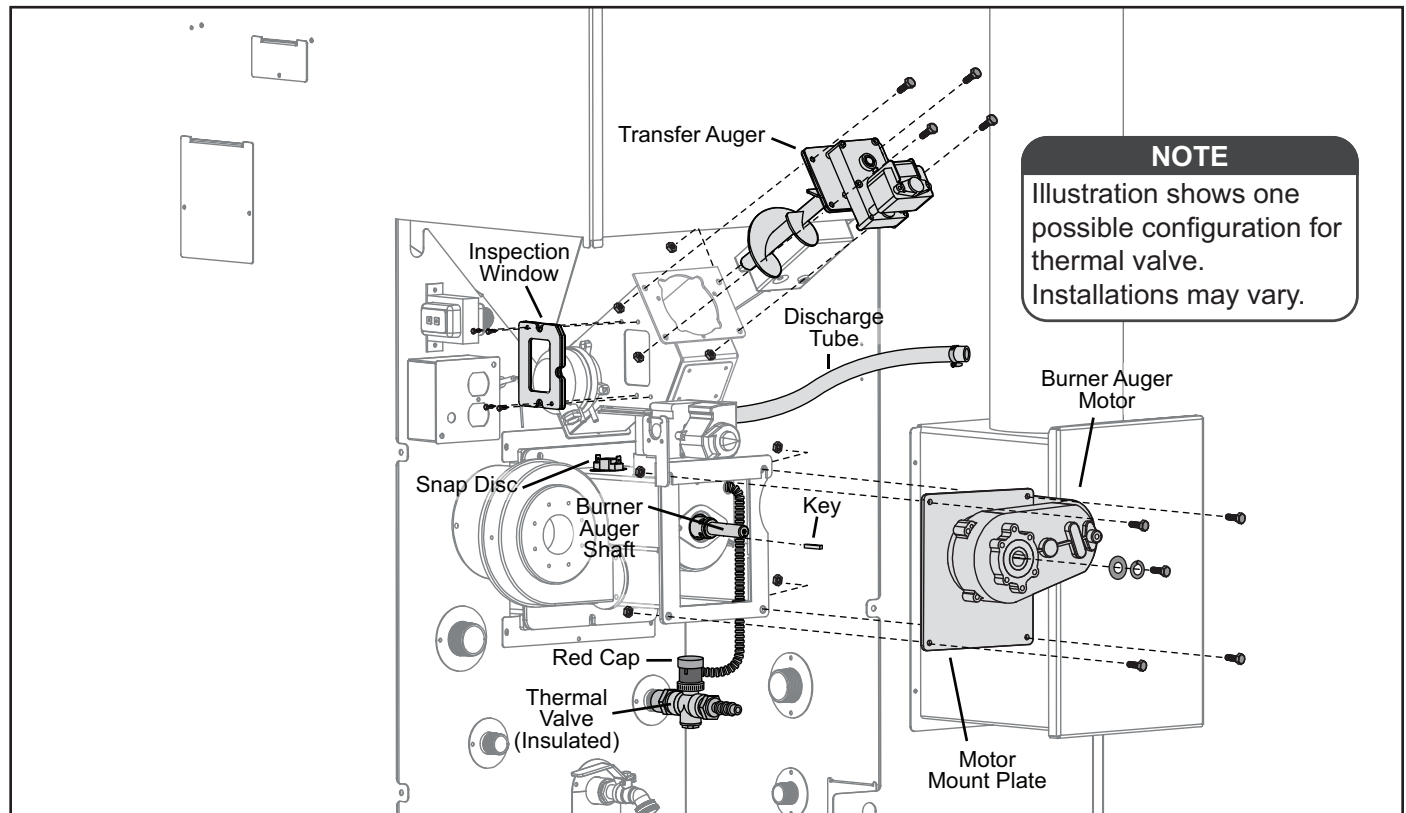
**NOTE: Fig. 66 shows one possible configuration for a thermal valve. Installations may vary slightly.**

4. Install the access panels.
5. Connect the electrical power at the main power source.

## CAUTION

**Do NOT operate this appliance with any panels removed.**

Fig. 66



## IF THE THERMAL VALVE ACTIVATES

If the thermal valve activates, it will be necessary to clean out the areas in which water from the thermal valve may have come in contact with the wood pellets. Do not use the furnace until these areas have been thoroughly cleaned. Read and understand these instructions before beginning the procedure.

**NOTE: Fig. 66 illustrates the disassembly required to clean the furnace if the thermal valve activates.**

1. Disconnect the electrical power at the main power source.
2. Remove the access panels from the back corner of the furnace and set aside.
3. Open the hopper lid and empty the hopper. One option for emptying the hopper is to use a wet-dry shop vacuum to remove the unused wood pellets. Wood pellets at the bottom of the hopper may have been saturated with water causing them to expand and fill the opening. If it is necessary to use a tool to break up the expanded wood pellets, use extreme caution not to damage any components of the furnace.

## Remove Transfer Auger

1. Disconnect the wires from the transfer auger motor.
2. Remove the bolts securing the transfer auger motor mount plate to transfer auger housing; then remove the transfer auger assembly.

**NOTE: Do not pull straight out or force the transfer auger assembly while removing. Turn the assembly counterclockwise.**

3. Remove the screws securing the inspection window to the side of the hopper; then remove the inspection window.
4. Remove the 1/2" silicone tubing from the thermal valve, leaving it attached to the discharge tube. Blow air through the tubing to clean.

## Remove Aerator, Burner Auger and Burner Auger Motor

1. Inside the firebox, turn the aerator 1/4 turn counterclockwise and pull straight forward to remove.
2. Disconnect the burner auger motor wiring connector.
3. Remove the bolt and washer securing the burner auger to the burner motor. Set the bolt and washer aside for assembly.
4. Remove the four bolts securing the motor mount plate to the transition box; then remove the burner auger motor and motor mount plate.
5. Remove the key from the keyway slot on the auger shaft and set aside for assembly.

6. Using a wooden block, tap the burner auger into the firebox. Do not hit the bushing.

7. Remove the burner auger from inside the firebox.

## Clean the Affected Areas

1. Inspect the bottom of the hopper and remove any wet fuel from the opening at the bottom.
2. Using a wet-dry shop vacuum, clean the transfer auger tube and the drop tube of any unused fuel or wet fuel; then clean the transition box that houses the burner assembly.

**NOTE: Make sure that no fuel gets pushed back toward the combustion fan area or the combustion fan could be damaged.**

3. Make sure the flightings on the augers are clean and dry.

## Replace Snap Disc

1. Disconnect the two wires from the snap disc located on top of the transition box.
2. Remove the two screws securing the snap disc to the transition box; then remove the snap disc.
3. Place a new snap disc into place and secure with screws; then connect the two wires.

## Install Burner Auger, Burner Auger Motor and Aerator

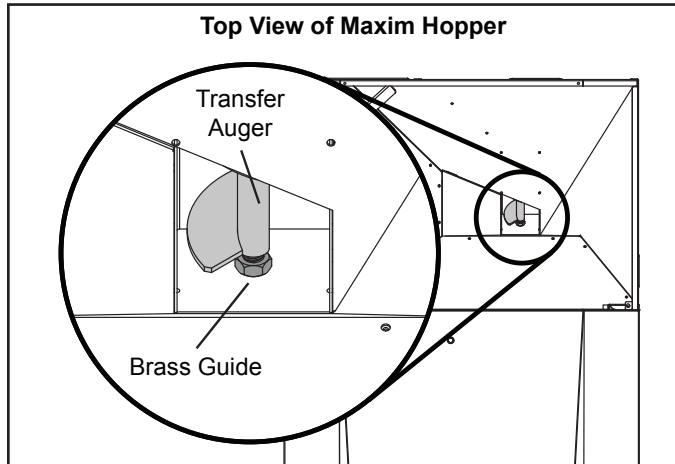
1. Apply grease to the portion of the burner auger shaft that will be seated in the bushing; then, from inside the firebox, install the burner auger into the burner assembly making sure it is properly aligned and seated in the bushing.
2. Install the motor mount plate on the transition box. Tighten the screws hand-tight only.
3. Align the keyway slot on the auger shaft with the keyway slot in the burner motor; then tap the key into the slot. Secure the burner auger with the bolt and washer removed earlier. Tighten securely.
4. Using a flashlight inside the firebox, check that the auger flightings are centered in the burner tube. If necessary, loosen the motor mount plate bolts and move the motor mount plate to center the auger flightings in the burner tube. Tighten the motor mount plate bolts securely.

## Install Transfer Auger

1. Install the transfer auger assembly in the transfer auger housing (see Fig. 66). Make sure the end of the transfer auger tube fits over the brass guide in the transfer auger housing. Verify by visually checking from the top of the hopper (see Fig. 67). Secure with the bolts.



Fig. 67



2. Connect the wires to the transfer auger motor.

### Finish Installation

1. Install the inspection window and secure with the screws.
2. Attach the 1/2" silicone tubing to the thermal valve and secure with hose clamp.
3. Install the access panels.
4. Connect the electrical power at the main power source.
5. Before adding fuel to the hopper, start the furnace and verify that both augers are turning freely without binding. The transfer auger can be viewed from the hopper and the burner auger can be viewed using a flashlight from inside the firebox.
6. Once it has been determined the augers are turning freely, add fuel to the hopper and start the furnace following the procedure in Initial Start-up.

### 9.10 Test Thermal Valve

Twice each heating season (at the beginning and the end), check to make sure the thermal valve operates properly.

## WARNING

**Allow the outdoor furnace to thoroughly cool down before performing maintenance.**

1. Disconnect the electrical power at the main power source.
2. Remove the access panels from the back corner of the furnace and set aside.
3. Remove the 1/2" silicone tubing from the thermal valve; then place a small cup under the outlet on the valve.
4. Push down on the red cap of the thermal valve and run a small amount of water through the valve to make sure it is operating properly.

5. Connect the silicone tubing to the thermal valve making sure not to kink the silicone tubing.
6. Install the access panels.
7. Connect the electrical power to the main power source.

## WATER QUALITY AND MAINTENANCE

### Test Supply Water

Test a sample of the supply water (makeup water) that will be used to fill the outdoor furnace (softened water is recommended). Test strips for testing pH are included in the water test kit which is provided with the outdoor furnace.

1. Collect a small sample of the water to be used to fill the outdoor furnace in a clean container.
2. Dip the pH test strip from the provided test kit in the water sample. Shake excess water off the test strip. Compare the color of the test strip to the chart provided to determine pH level.
3. If the pH level is between 6.5 and 8.0 and there are no other known water quality problems, then the outdoor furnace may be filled with this water.
4. Water that has a pH level of less than 6.5 or greater than 8.0, or that has other known water quality problems, should not be used to fill the furnace. Instead, water should be supplied from a different source.

### Adding Initial Water Treatment

## CAUTION

**Avoid damaging your furnace and voiding your warranty. Add water treatment BEFORE adding water to the system. Water treatment in your outdoor furnace is just as important as the oil in a car's engine.**

MolyArmor 350 Corrosion Inhibitor (p/n 2900630) gives optimum protection for the furnace water jacket and system parts when it is used to initially treat the water and is maintained at a minimum of 350 ppm of moly and pH level between 8.0 and 9.5. The recommended initial treatment rate for the outdoor furnace is specified by units. One unit of MolyArmor 350 is a 1-gallon (3.78-liter) container. **The recommended initial amount of MolyArmor for the Maxim M255 PE is 1/2 unit (1/2 gallon).**

1. Add the recommended amount of MolyArmor 350 to the outdoor furnace.

### Testing Treated Water in the Outdoor Furnace

After circulating the water in the system for 24 hours, test the treated system water for the recommended moly (at least 350 ppm) and pH level (between 8.0 and 9.5).

1. Collect a small sample of the water to be used to fill the outdoor furnace in a clean container.
2. Dip a pH test strip from the test kit in the water sample. Shake excess water off the test strip. Compare the color of the test strip to the chart provided to determine pH level. The pH of the treated water should be between 8.0 and 9.5.
3. Follow the instructions provided in the water test kit to test the moly level of the treated system water.

### Obtaining Treated Water Sample

A treated water sample from the outdoor furnace can be obtained either from the valve on the hot water heater (Fig. 68) or from the furnace drain valve (Fig. 69).

Fig. 68

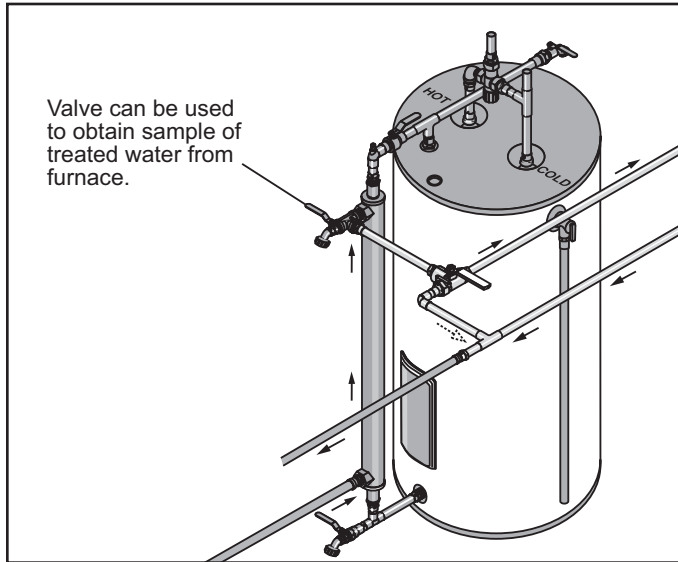
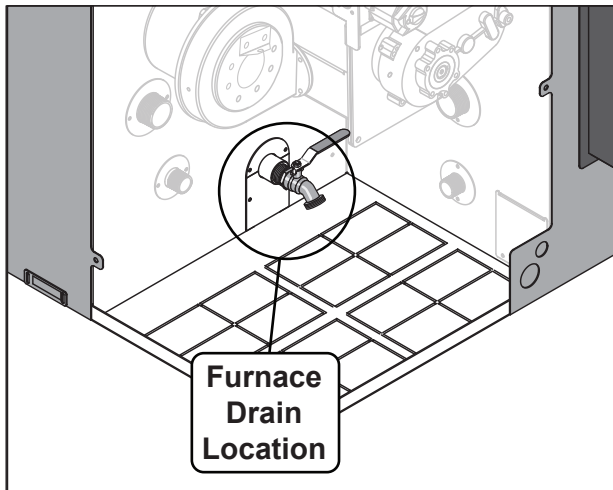


Fig. 69



Before collecting the sample, drain about a quart (liter) of water; then carefully fill the sample container without contaminating the sample. **Be sure to properly close the valve when finished.**

## Water Test Kits and Test Results

An important part of outdoor furnace maintenance is controlling the quality of the water in the furnace.

DATE	pH LEVEL	MOLY LEVEL

Record the results of pH and Moly level tests in the table above. If additional space is needed, record on a separate sheet of paper.

It is very important to keep record of water test results (including the date, pH and Moly level). The pH and Moly test strips and indicator have a shelf life of approximately two years that can affect their accuracy. Test kits should be stored in a dry area at room temperature to obtain maximum accuracy over a longer period of time.

Biological contamination can occur if the furnace is not heated up to 185°F immediately after filling it with inhibitor and water as directed.

**NOTE: ANY time water is added to the system, it is extremely important to bring the water temperature up to operating temperature (185°F) as soon as possible, even if it is during the off-season. Failure to bring the water in the system up to operating temperature immediately after filling the system can allow bacteria present in the water to multiply and may increase the potential for corrosion in the sytem.**

If the test indicates a significantly lower-than-recommended pH level, add MolyArmor to increase the pH level.

### Maintenance Levels

Test the pH and moly levels after the first three months and every six months thereafter, or after adding water to furnace.

The pH of the water should be between 8.0 and 9.5. If any other water quality issues are known, the water should be conditioned or water should be supplied from a different source.

## POST HEATING SEASON MAINTENANCE

**NOTE: The water should be left in the outdoor furnace during the non-heating season.**

1. At the end of the heating season, clean all of the fuel from the hopper. Clean the fuel from the augers by pressing the Auger button until no fuel enters the burn chamber.
2. Remove the aerator and burn chamber; inspect and clean as explained in section 9.7 Aerator and Burn Chamber.
3. Clean all the ash out of the outdoor furnace. Scrape the walls and floor of the firebox.
4. Check the chimney box and flues. Clean out any excessive buildup. Any large or dry crusty deposits on the walls or heat exchanger area should be removed. When cleaning the firebox, be sure to wear the appropriate personal protective gear.

### CAUTION

**To minimize corrosion caused by accumulated ash, it is especially important to clean the chimney, chimney box and flues at the end of the heating season.**

5. When the outdoor furnace is clean, carefully inspect the firebox for any signs of excessive corrosion or deterioration. If any corrosion or deterioration is found, call your dealer. It is always better to do maintenance during the non-heating season.
6. After the inspection is completed, apply a thin coat of new motor oil to the firebox and heat exchanger being sure to work oil into all corners.
7. Inspect the thermal valve as explained in section 9.9 Thermal Valve.
8. Place a cover over the chimney to keep rain from entering the outdoor furnace.

## SECTION 10 – TROUBLESHOOTING

### A. FURNACE DOES NOT HEAT (BUILDING IS LOSING TEMPERATURE)

1. **Out of fuel** - Check firebox to see if fire is out. Add fuel as necessary.
2. **Fire out** - If the controller is flashing **FD** refer to FireStar Controller for Maxim Operating Instructions.
3. **Thermal valve opened** - If during a power outage, a high temperature situation is detected in the burner auger area, the thermal valve will open to release a small amount of water into the burner auger area to cool the area. To determine if this has happened, first look in the firebox for the presence of water. Also check the glass inspection port just above the burner auger. If the fuel appears to have expanded from absorbing water, the thermal valve has opened. Contact your Central Boiler dealer for assistance.
4. **Circulation valve(s) closed** - Be sure all valves in the system are open.
5. **Circuit breaker off** - Reset the circuit breaker that supplies power to the outdoor furnace.
6. **Circulation pump(s) not operating** - Disconnect power to the pump. Close valves at the pump. Disassemble the pump and try to turn the pump shaft. If the shaft is stuck, replace the pump cartridge. Replace only the cartridge whenever possible. If necessary, replace the pump. Follow instructions supplied with the pump.
7. **Air in system** - Check for air in the supply and return lines or heat exchangers. If you hear a gurgling sound in a heat exchanger, air is present in the system. Shut off the pump, wait 15 seconds and start the pump. If it is necessary to force air from lines, refer to Section 7.
8. **Outdoor furnace exhaust obstructed** - Check outdoor furnace exhaust for obstructions by removing the chimney transition cover to expose the heat exchanger. The heat exchanger can also be observed from the front of the furnace through the front door opening.
9. **Combustion fan blocked or obstructed** - Check the combustion fan for obstructions.
10. **Building(s) poorly insulated or uninsulated** - Poorly insulated or uninsulated buildings and/or buildings with uninsulated or poorly insulated ceilings can cause excessive fuel consumption and or heating problems.

11. **Supply and return lines installed incorrectly** - Make sure the hot supply water line is connected to the correct fitting on the outdoor furnace and heat exchanger.
12. **Circulation pump(s) installed incorrectly** - Circulation pump(s) must be installed in the supply line(s) with the arrow on each pump pointed away from the outdoor furnace. Remove the pump and install correctly. Refer to the System Installation section for installation guidelines.
13. **Underground supply and return lines insulated poorly** - Heat loss from poorly insulated underground supply and return lines is often indicated by an unusually high amount of snow melting above the lines when the ground temperature is 10°F (-12°C) or colder.
14. **Supply and return lines uninsulated** - Uninsulated supply and return lines in areas that are not intended to be heated (unheated crawl spaces, under mobile homes, etc.) may cause excessive heat loss. Insulate the supply and return lines.
15. **Low water** - If the controller is flashing **LD** the system senses a low water condition. Check water level and if necessary add water according to the Water Quality and Maintenance section. If adding water does not correct the problem, contact your Central Boiler dealer.
16. **Poor water quality** - Water with high amounts of solids, sand or dirt can create deposits inside the wall of heat exchanger components, reducing the amount of heat output. If this condition is suspected, contact your Central Boiler dealer.

### B. FURNACE IS OVERHEATING (FIRESTAR LED DISPLAYS **HI**)

1. **FireStar controller set incorrectly** - Lower the water temperature setpoint and/or adjust the heat output settings in one or all of the three modes (see Setting the FireStar Controller for Heat Load and Efficiency).
2. **High limit switch tripped** - Lower the water temperature setpoint and/or adjust the heat output settings in one or all of the three modes (see Setting the FireStar Controller for Heat Load and Efficiency).
3. **Water is not circulating** - The pump should run and water should circulate continuously through the supply and return lines to keep water temperature uniform in the outdoor furnace.
4. **Circulation valve(s) closed** - Be sure the proper valves in the system are open to allow circulation.



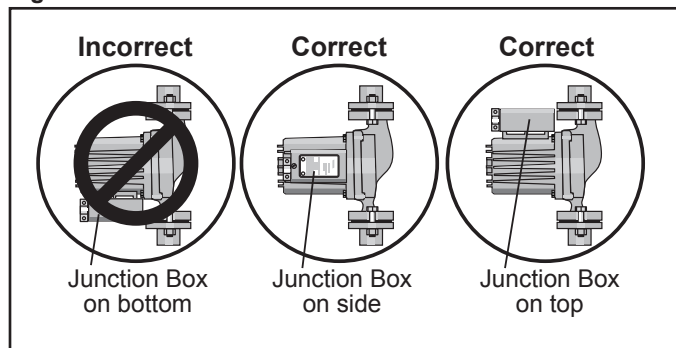
### C. BACK BURN (FIRESTAR DISPLAYS **b b** )

1. **High temperature in burner auger area** - Everything but the burner auger will be disabled. The burner auger will run for two minutes, pause for 10 minutes, and continue as required. The Back Burn alarm will not stop until the controller detects that the temperature in the burner auger area has dropped.

### D. FREQUENT PUMP TROUBLE OR POOR WATER CIRCULATION

1. **Pump mounted incorrectly** - The pump must be mounted with the pump motor horizontal and the junction box either on the side or on top (see Fig. 70).

Fig. 70



2. **Deposits in water lines/heat exchanger walls** - If water high in silica or other mineral content has been used to fill the outdoor furnace, material deposits may build up on the insides of the supply and return lines and on the heat exchanger walls. If this occurs, the system will need to be drained and then cleaned using Sludge Conditioner (p/n 166). The system must then be refilled with the proper amount of MolyArmor 350 and good quality water (softened water, if possible).
3. **Water will not circulate** - If the system has been drained and refilled, or if the system has been opened for any reason (e.g., replacement of pump, adding heat exchangers, repairing a leak), air must be purged from the system (see Filling System with Water and Purging Air section).
4. **Poor water quality** - Water with high amounts of solids, sand or dirt can cause frequent pump failure. Use softened and/or filtered water.

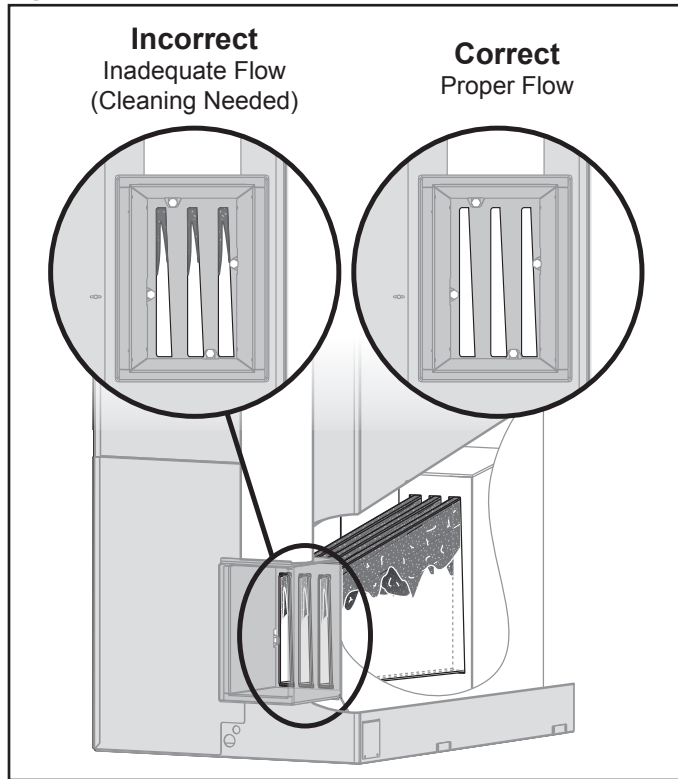
### E. BURNING AN EXCESSIVE AMOUNT OF FUEL.

1. **High volume water heating** - High volume water heating (e.g., car wash, swimming pool, etc.) will require high fuel consumption.
2. **Excessive heat loss** - See items 8-12 of Furnace Does Not Heat.
3. **Supply and return line heat loss** - If not using ThermoPEX, supply and return lines buried in a wet, low-lying area may cause a large heat loss that will greatly increase the fuel consumption.
4. **High heat demand** - Concrete slabs (with radiant heat) that are poorly insulated or are exposed to water or cold outside temperatures will require increased fuel consumption. Bringing a concrete slab up to temperature the first time will take a considerable amount of time and fuel; once warm, fuel consumption will be reduced if the concrete slab and building are insulated properly. The following items will cause a high heat demand: poor insulation, large amounts of glass windows/doors (e.g., greenhouses), overhead doors, uninsulated crawl spaces, outdoor air infiltration and air leaking through foundation.

### F. FUEL NOT BURNING PROPERLY

1. **Poor fuel or out of fuel** - See Fuel Quality and Storage section for recommendations about fuel types. Check firebox to see if fire is out. Add fuel as necessary.
2. **Combustion fan blocked or obstructed** - Check the combustion fan and air flow path for obstructions.
3. **Outdoor furnace exhaust obstructed** - Check outdoor furnace exhaust for obstructions. To inspect the heat exchangers, remove the chimney transition cover on the back of the furnace and open the firebox door. It will probably be necessary to kneel down at the back of the furnace to look through each heat exchanger passageway.

Fig. 71



4. **Heat output set too high or too low** - For best results, determine the lowest water temperature setpoint the outdoor furnace can be set to that will supply enough heat to the heat emitters. See FireStar Controller Manual for more information.
5. **Air setting too high or too low** - See Setting the FireStar Controller for Heat Load and Efficiency.

#### G. BURNER AUGER MOTOR NOT TURNING

1. **Fuel wet or swollen** - Check to see if the fuel has absorbed moisture and is swollen in the burner auger area. If the thermal valve has activated, it will be necessary to remove all of the fuel from the hopper; then remove the transfer auger, aerator, burner auger and burner auger motor and clean the entire area.
2. **Burn chamber obstructed** - Clean the burn chamber especially at the end of the auger.
3. **Motor overheated** - Clean the burner auger and allow the burner auger motor to cool.

#### H. IF CORROSION IS PRESENT

Corrosion in the firebox can occur when the outdoor furnace is being operated improperly. To maximize the life of your investment, it is important to identify signs of corrosion early (you can do this by performing the items in the Preventive Maintenance Schedule) and take measures to correct it as soon as possible. Some, but not all, causes of corrosion are listed below with possible solutions. If you are unsure how to proceed, contact your Central Boiler dealer.

1. **Water temperature is too low** - If the heat load in the system is too large, the water in the system will not reach high enough temperatures and corrosion can occur. Re-evaluate the system and match heat load to the outdoor furnace.

**NOTE: To reduce condensation in the firebox, set the temperature to 185°F or higher.**

2. **Heat load is too high** - Reduce heat load.
3. **Thermostatic valve is not installed** - A thermostatic valve must be installed on each set of supply and return lines in the system to maintain the outdoor furnace water temperature above 150°F (65°C).
4. **Firebox wasn't cleaned out at the end of the heating season** - Be sure to follow the post-heating season maintenance schedule which includes scraping out firebox and removing all ash.

#### J. WATER TEMPERATURE AT SUPPLY PORT LOWER THAN THE FIRESTAR INDICATES

1. **Water flow too low** - Add wraparound pump if using one set of lines. Install higher pressure-volume pumps if using two sets of lines.

#### K. LOW WATER (FIRESTAR LED DISPLAYS )

**System leak** - Try to identify the leak by inspecting all lines, fittings, heat exchangers, etc. in the system and repair as needed. If the leak cannot be found and **if there is no chance of the system or furnace freezing**, the following procedures can help determine whether the leak is in the furnace or somewhere else in the system:

- a. Turn off the FireStar controller; then completely empty the firebox of all coals, embers and ash.
- b. Allow the furnace to cool below 100°F (38°C).
- c. Refill the outdoor furnace with water until the water level indicator rod is above the vent cap. Add MolyArmor 350 if needed.
- d. Record the water level by measuring how far the water level indicator rod is above the vent cap.
- e. Close all shut-off valves on the hot supply and return lines at the outdoor furnace.

- f. Check the water level periodically during the next 48 hours (the water level may drop slightly as the water cools).
- g. Inspect the firebox and under and around the outside of the outdoor furnace for evidence of a leak each time the water level is checked.

During the 48-hour inspection period, the water lines should also be checked for leaks using a pressure gauge and the following procedure:

- a. Isolate the furnace by closing all shut-off valves on the hot supply and return lines at the furnace.

### WARNING

**Be sure to close all shut-off valves on the hot supply and return lines at the furnace. DO NOT ALLOW THE FURNACE TO PRESSURIZE.**

- b. Isolate each zone in the system using shut-off valves.
- c. Pressurize each zone with domestic water or air; then check the pressure gauge after 12 hours. A drop in pressure indicates that a leak is present in the zone. Before resuming furnace operation, it will be necessary to repair the leak.

### L. SMOKE IN THE HOPPER

How air flows through the furnace is an important part of optimal operation. Smoke in the hopper is an indication that the air flow through the furnace is restricted, obstructed or different than it should be.

### CAUTION

**Operating for extended periods of time with air flow through the furnace restricted (i.e., smoke in the hopper) can damage components in the furnace.**

1. **Heat exchanger dirty or obstructed** - Because the gases moving through the heat exchanger are hot, most of the heat transfer occurs at the top of the heat exchangers. It is therefore important to ensure that the top of each heat exchanger passageway is clean and not obstructed or blocked from ash. Use the procedure from 9.5 Heat Exchanger in the Routine Maintenance section to inspect the heat exchanger for obstructions or restrictions and clean if necessary.
2. **Aerator covered by ash** - do not allow ash in the burn chamber to accumulate over the aerator. Use the cleaning rod to pull ash forward to ash collection area.
3. **Carbon buildup** - inspect the burner auger where it enters the firebox for carbon buildup and clean if necessary.
4. **Fan setting for HIGH mode set too high** - Decrease the fan setting for HIGH mode (see Setting the FireStar Controller for Heat Load and Efficiency).

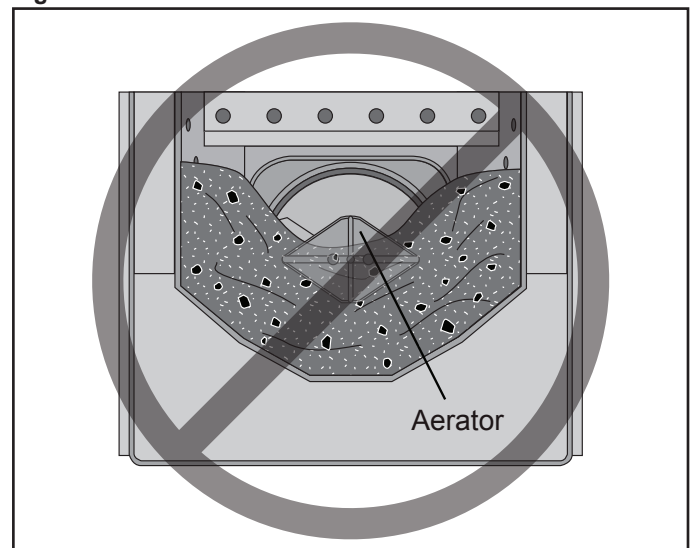
5. **Chimney dirty or obstructed** - Inspect the chimney transition and chimney for obstructions or restrictions and clean if necessary.
6. **Spark arrestor (if present) dirty or obstructed** - Inspect the spark arrestor screen for obstructions and remove. Clean the spark arrestor if it is restricting air flow.
7. **Chimney not drafting properly** - Proper draft is necessary for the Maxim to operate optimally. Draft occurs when the temperature in the chimney is high enough to cause a negative pressure that "pulls" the exhaust up through the heat exchanger and out the chimney.

If poor draft is suspected, check that the chimney transition cover is properly sealing. Adding chimney sections may be required. However, due to a number of variables (e.g., objects like buildings and trees in close proximity, nearby terrain such as hills, valleys, etc.), poor draft can be an intermittent problem.

### M. CREOSOTE ON COMBUSTION FAN

1. **Outdoor furnace not level** - The furnace should be leveled so that the back of the transition box (i.e., the burner auger motor end) is slightly higher than the front. If the burner auger is not sloped down toward the front of the furnace, condensation can form in the burner auger tube and drip into the transition box. See Leveling the Outdoor Furnace section.
2. **Ash covering aerator** - Do not allow ash in the burn chamber to accumulate over the aerator.

Fig. 72



# SECTION 11 – DECALS

## DANGER

- Risk of fire or explosion - DO NOT burn garbage, gasoline, drain oil or other flammable liquids.
- If you smell gas: DO NOT light this appliance. Extinguish any open flames. DO NOT touch any electrical switch; DO NOT use a phone located in the building where the appliance is installed. Call your fuel supplier and follow their instructions.
- Risk of electrical shock - disconnect power before servicing unit.

## MAINTENANCE SCHEDULE

### DAILY

Check water level, inspect firebox and remove ash as needed.

### WEEKLY

Inspect flues, aerator and burn chamber and clean as needed.

### SEMI-MONTHLY

Twice a month during the heating season, inspect chimney and chimney transition and clean as needed.

### MONTHLY

Inspect rope gaskets on the furnace door and chimney transition cover. Inspect chimney transition and clean as needed.

### SEMI-ANNUALLY

Shut down and completely clean and inspect firebox, flues, chimney and burner assembly. Remove the tubing from the thermal valve; then clean the tubing and discharge tube by blowing air through it. Check the pH and nitrite levels of the water semiannually or if water is added, and add water treatment as necessary. READ OWNER'S MANUAL FOR COMPLETE INSTRUCTIONS.

## WARNING

- Risk of fire - DO NOT store fuel or other combustible material within marked installation clearances.
- DO NOT install or operate this appliance before first reading and understanding the Owner's Manual.
- DO NOT allow others to install or operate this appliance without first reading and understanding the Owner's Manual.
- DO NOT leave this appliance unattended with firebox door unlatched.
- Avoid breathing smoke. Wear appropriate personal protective gear when servicing firebox or flues.
- DO NOT operate with flue draft exceeding -0.05 inches of water column.

## CAUTION

- Hot surfaces.
- Keep face away from door area.
- DO NOT start fire until water level is full.
- Comply with all applicable state or local codes and regulations.
- Store ash in a covered non-combustible container.
- Take care when opening the door to prevent hot ash from spilling out.
- Keep children away from this appliance.
- Maximum draft marked on nameplate.

### APPLIANCE LOCATION:

- When installing this appliance, consider the direction that smoke will travel with prevailing winds and chimney height.

## NOTICE

Fuel door must operate properly.

It is important to check the fuel door (located behind this panel) monthly, to make sure it is operating properly.

p/n 7000299

## NOTICE

After appliance has been installed, seal these holes with silicone to prevent rodents from entering.

p/n 4122

## NOTICE

DO NOT operate this appliance with this panel removed.

p/n 4125

## CAUTION

HOT GASES - Keep face away when viewing fire and from door area.

p/n 4120

## CAUTION

Do not plug, block or seal vent opening. Sealing can result in a dangerous buildup of pressure.

## ATTENTION

Ne pas bloquer, obturer ou sceller l'ouverture du conduit d'évacuation. Sceller l'ouverture pourrait entraîner une augmentation dangereuse de la pression.

p/n 7000535

## CAUTION

ANY TIME WATER IS ADDED, the furnace MUST BE immediately heated to 185°F, circulated, and the inhibitor level tested. FAILURE TO DO SO WILL RESULT IN DAMAGE to your furnace's water jacket!

Carefully follow the steps in your Owner's Manual for adding water and testing inhibitor levels.



The Online Support Center at CentralBoiler.com allows you to access the Owner's Manual and view videos and other resources specific to your furnace.

CentralBoiler.com Support

p/n 700056 Rev. 5

## NOTICE

DO NOT alter this equipment in any way.

p/n 5073

## CAUTION

HOT Surfaces  
DO NOT Touch During Operation

p/n 6079

## CAUTION

Failure to perform proper care and maintenance will reduce the life and performance of your furnace. For best results, always follow these guidelines:

1. Add water treatment before filling with water.
2. Do not burn anything other than the recommended fuels.
3. Clean and inspect the furnace regularly.
4. Do not operate with the water temperature below 150°F (66°C).
5. Maintain the recommended water treatment levels at all times.
6. Clean the firebox thoroughly and keep it dry when not in use.
7. See Owner's Manual for more information about regularly scheduled maintenance.

p/n 9419

## CAUTION

CLEAN OUT THE LOWER AUGER BEFORE DISCONNECTING POWER.

To prevent the thermal valve from activating, turn off the Auto Re-light function and clean out the lower (burner) auger using the Clean Out Mode before disconnecting power.

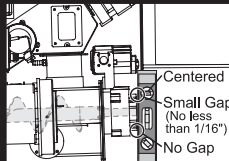
To start Clean Out Mode, press the Auger button two times within one second. The Clean Out Mode light will turn on and only the lower (burner) auger will operate to empty all of the fuel from the lower (burner) auger. To empty the fuel faster, press and hold the Auger button while in Clean Out Mode until the lower (burner) auger is empty. After the lower (burner) auger is empty, clean the burn chamber.

p/n 9431

## NOTICE

Furnace must be leveled properly.

If the lower auger is not sloped down toward the front of the furnace, condensation can form in the lower auger tube and drip into the transition box.



M250

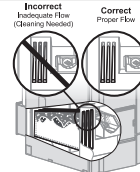
p/n 9433

## CAUTION

Smoke in the hopper is an indication that air flow through the furnace is restricted and may prevent proper furnace operation. If restricted air flow is suspected, inspect the following for obstructions or restrictions and clean if necessary:

1. Heat exchanger passageways.
2. Aerator - do not allow ashes in the burn chamber to accumulate over the aerator.
3. Chimney transition box/chimney.
4. Spark arrestor (if present).

Refer to the Owner's Manual for more information.

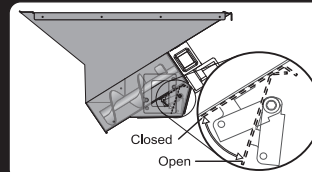


p/n 9761

## NOTICE

Fuel door must operate properly.

It is important to check the fuel door regularly to make sure it is operating properly. When operating properly, the fuel door will be closed when the combustion fan is not operating.



p/n 7000113

## NOTICE

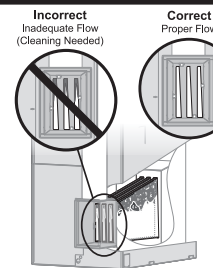
To lock and unlock the FireStar controller, press the 'Water Temp' button, located on the controller, four times rapidly. When locked, the display on the controller will indicate 'LOC' for five seconds and any time a button on the controller is pressed.



p/n 9631

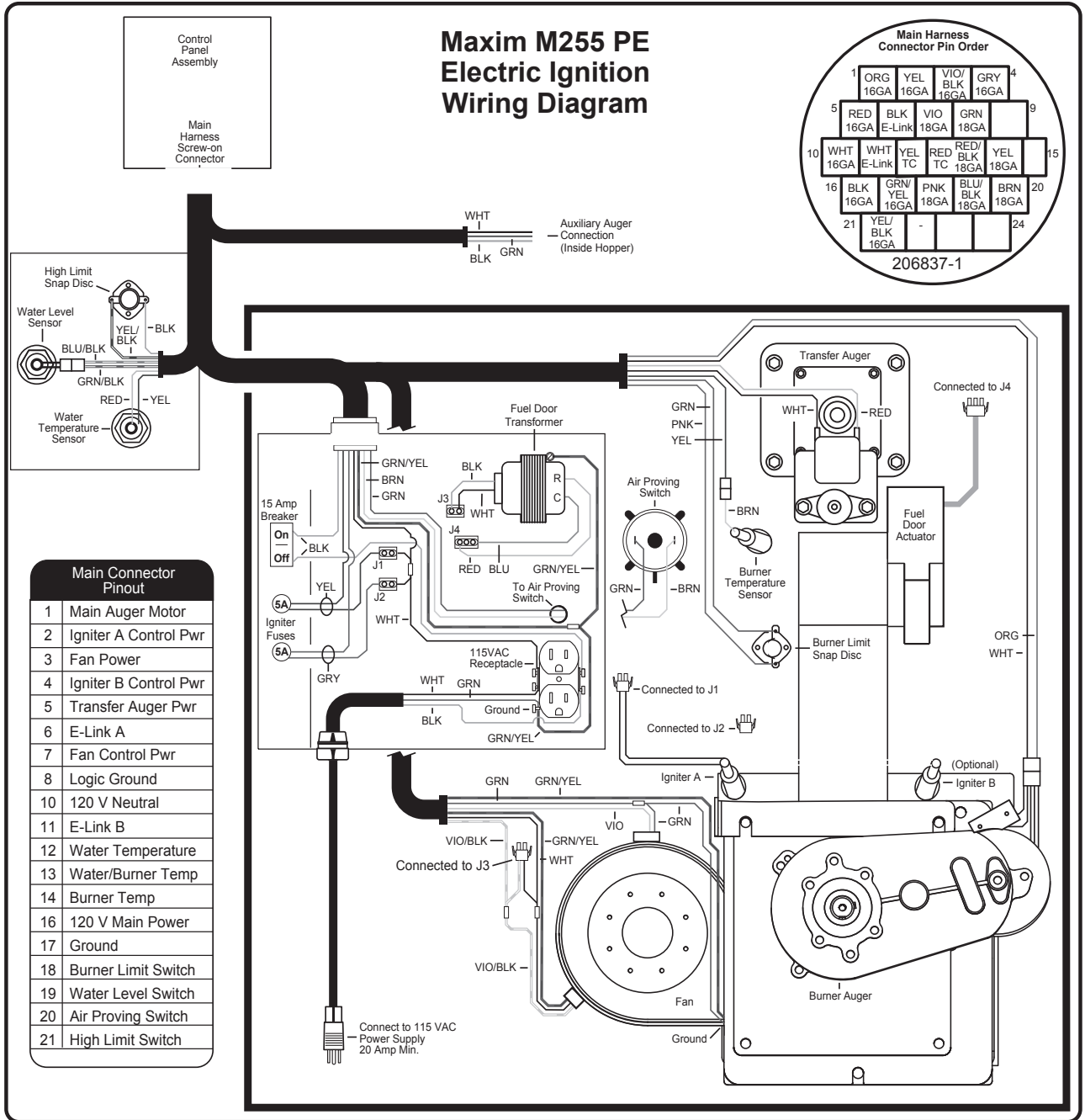
## CAUTION

For the furnace to operate optimally, air flow through the heat exchanger must be unrestricted. Failure to regularly care for and maintain the heat exchanger will reduce the life and performance of your furnace. Refer to the Owner's Manual for maintenance procedures and frequency.



p/n 9762

# SECTION 12 – WIRING DIAGRAMS





## 1-YEAR LIMITED WARRANTY

Central Boiler, Inc. ("Central Boiler") warrants to the original owner, except (a) parts manufactured by others and excluded from warranty coverage below; and (b) parts or items specified below as covered by a limited one year warranty, Central Boiler Maxim furnaces against defects in workmanship for a period of ONE (1) YEAR from the date of original retail purchase.

### **An optional 5-Year Warranty is available if a Limited Warranty Registration Form is completed and sent to Central Boiler within ten (10) days of the original owner taking possession of the furnace.**

If a defect exists, at its option Central Boiler will (1) repair the defective part at no charge, using new or refurbished replacement parts, (2) exchange the furnace with a comparable model furnace that is new or which has been manufactured from new or serviceable used parts and is at least functionally equivalent to the original furnace, or (3) refund the purchase price of the furnace based on the pro-ration scale. A replacement furnace/part assumes the remaining warranty of the original furnace/part or ninety (90) days from the date of replacement or repair, whichever provides longer coverage for you. If a furnace or part is qualified for replacement under the provisions of this limited warranty, at Central Boiler's discretion, the furnace or part may be required to be returned to Central Boiler for inspection and recycling or disposal.

**Parts Manufactured By Others.** Parts that are factory-installed by Central Boiler, but are manufactured by others, may be covered by their own manufacturer's warranty and are not covered by this limited warranty, except the FireStar™ controller is warranted against defects in workmanship for a period of two (2) years from the date of original retail purchase, provided that the Limited Warranty Registration Form is completed and sent to Central Boiler within ten (10) days of the original owner taking possession of the furnace; otherwise this limited warranty shall be good for a period of ONE (1) YEAR from the date of original retail purchase. This limited warranty covers the controller part only; service calls, mileage, and labor to diagnose the problem and install a new part are not covered.

**Parts Covered by a Limited One Year Warranty.** The following parts are covered by a limited warranty for workmanship defects for one year: aerator, burn chamber, thermocouple, hopper lid shock, chimney transition, firebox door parts, chimney box parts, paint, burner assembly, auger, auger motor and fan.

This Limited Warranty applies only to Central Boiler Maxim outdoor furnaces. This limited warranty covers only those defects that arise as a result of normal use of the outdoor furnace and does not cover any other defects or problems, including those that arise as a result of: (a) improper maintenance (b) operation outside the furnace's specifications (see owner's manual), accident, abuse, misuse, misapplication, or parts that are not factory-installed; (c) service performed by anyone other than Central Boiler unless authorized by Central Boiler in writing; (d) modifications undertaken without the written permission of Central Boiler; or (e) if any Central Boiler serial number has been removed or defaced. This warranty is void if the owner (fails to maintain the proper amount of corrosion inhibitor in the systems or) burns materials in the firebox other than premium grade wood pellets.\* This warranty excludes the cost of shipping, labor to remove or reinstall the furnace, plumbing labor and/or parts and the cost of alternative heat if the furnace is out of service for repairs. Warranty excludes replacement of water, inhibitors or other additives, and parts used in the system whether or not mounted on the furnace, such as pumps, valves, and piping.

Central Boiler is not liable for damage or repairs required as a consequence of faulty installations or applications by others or any event of force majeure. Central Boiler is not liable for incidents or accidents which can be prevented by the owner or that occur from the operation of the outdoor furnace. A backup heating system must be in place to prevent damage in case of failure to refuel the outdoor furnace or mechanical failure of the outdoor furnace or system occurs. Heat replacement representations found in Central Boiler promotional information should be used only as a guideline. Heat loss for all applications with all weather extremes and other heat variables must be considered when sizing an outdoor furnace for different applications.

THIS WARRANTY AND REMEDIES SET FORTH ABOVE ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, REMEDIES AND CONDITIONS, WHETHER ORAL OR WRITTEN, EXPRESS OR IMPLIED. CENTRAL BOILER SPECIFICALLY DISCLAIMS ANY AND ALL IMPLIED WARRANTIES, INCLUDING, WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IF CENTRAL BOILER CANNOT LAWFULLY DISCLAIM IMPLIED WARRANTIES UNDER THIS LIMITED WARRANTY, ALL SUCH WARRANTIES, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE LIMITED IN DURATION TO THE DURATION OF THIS WARRANTY. No Central Boiler dealer or employee is authorized to make any modification, extension, or addition to this warranty. CENTRAL BOILER IS NOT RESPONSIBLE FOR DIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM ANY BREACH OF WARRANTY OR CONDITION, OR UNDER ANY OTHER LEGAL THEORY. Some states and provinces do not allow the exclusion or limitation of incidental or consequential damages or exclusions or limitations on the duration of implied warranties or conditions, so the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights, and you may also have other rights that vary by state or province.

\*This voiding of warranty is required under the federal New Source Performance Standards for New Residential Hydronic Heaters and Forced Air Furnaces (40 CFR Part 60, Subpart QQQQ) and applies only if burning wood pellets mixed with other fuels for residential applications. Warranty disclaimer does not apply to devices using fuels other than wood pellets or units used solely for non-residential purposes (e.g., commercial or industrial purposes) that otherwise are operated in accordance with the Owner's Manual.

To obtain warranty service, contact the Central Boiler dealer from whom you purchased your furnace or contact Central Boiler by telephone (800-248-4681) or mail (20502 160th Street, Greenbush, MN 56726). Please provide the dealer's name, original date of sale, model number and serial number in all communications. Central Boiler reserves the right to require the warranty service to be performed at Central Boiler facility when deemed necessary by Central Boiler.



# MAXIM<sup>®</sup>

## WOOD PELLET FURNACE OWNER'S MANUAL

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### M255 PE



Tested &  
Listed By  Portland  
Oregon USA  
OMNI-Test Laboratories, Inc.  
0117PS024S  
0117PS024E

**Save This Manual  
For Future Reference**

# MAXIM<sup>®</sup>

20502 160th Street • Greenbush, MN 56726  
WoodMaster.com

The Maxim Wood Pellet Furnace is listed by OMNI-Test Laboratories to the applicable portions of the following standards: UL 2523-2018 Solid Fuel-Fired Hydronic Heating Appliances, Water Heaters and Boilers, CAN/CSA B415.1-10 (R2015) Performance Testing of Solid-Fuel-Burning Heating Appliances, CSA-B366.1-11 (R2015) Solid-Fuel-Fired Central Heating Appliance, ASTM E2618-13 Standard Test Method for Measurement of Particulate Emissions and Heating Efficiency of Solid Fuel-Fired Hydronic Heating Appliances, ASTM E2515-11 Standard Test Method for Determination of Particulate Matter Emissions Collected by a Dilution Tunnel.

French Owner's Manual and decal set available upon request from your dealer.  
(Manuel d'installation en français et décalcomanies disponible sur demande auprès de votre revendeur)

The Maxim Wood Pellet Furnace includes two 4-foot chimney sections (6" ASHT) listed to UL 103.

M255 PE - Water Capacity: 90 gal. - Weight: 1,297 lbs

Maxim M255 PE thermal output rating: 182,504 Btu/hr (53.5 kW) - maximum  
Thermal Output Rating\*: Manufacturer's Rated Heat Output Capacity: 190,000 Btu/hr  
Annual Efficiency Rating\*: 96.2% (lower heating value), 89.2% (higher heating value)

\*Performance is a product of the combustion rate, combustion efficiency and heat exchange efficiency with a single fuel load without refueling. Results vary based on wood species, wood quality, wood quantity and moisture content. Efficiencies are determined under the same test conditions using higher heating value, lower heating value and annual fuel utilization efficiency (AFUE).

- This heater meets the 2020 U.S. Environmental Protection Agency's particulate emission standards for wood heaters sold after May 15, 2020. Under specific test conditions this heater has been shown to deliver heat at rates ranging from 0 to 182,504 Btu/hr.
- This wood heater has a manufacturer-set minimum low burn rate that must not be altered. This wood 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.
- DO NOT OVERFIRE THIS HEATER. Attempts to achieve heat output rates that exceed heater design specifications can result in permanent damage to the heater.
- Any person(s) operating a hydronic heater must comply with all applicable laws, including but not limited to local ordinances.
- Improper use or failure to maintain the hydronic heater may cause nuisance conditions. The person(s) operating a hydronic heater is/are responsible for operation in a manner that does not create a nuisance condition. Meeting the setback distance and stack height recommendations from the manufacturer and requirements in applicable State and local regulations may not always be adequate to prevent nuisance conditions in some areas due to terrain or other factors.
- Operating an outdoor furnace may not be suitable to some individuals' abilities or lifestyles. Be sure to review the Owner's Manual for the appliance with your dealer.

#### INSTALLATIONS IN MASSACHUSETTS:

1. All installation components must be products approved in the Commonwealth of Massachusetts by the Gas and Plumbing Board.
2. The minimum run of tubing from the water heater to a fan coil is 50 linear feet.
3. Persons operating this hydronic heater are responsible for operation of the hydronic heater so as not to cause a condition of air pollution as defined in 310 CMR 7.01(1).

For parts and accessories, service or repairs, call your authorized WoodMaster dealer or heating contractor. Record the information below for future reference.

Model	Serial Number	Installation Date
Dealership Name		Phone Number
Owner Name		



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# INTRODUCTION

## Labeling and Terminology

The outdoor furnace and this owner's manual use the following terms and symbols to bring attention to the presence of hazards of various risk levels and important information concerning the use and maintenance of the furnace.

**DANGER:** Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

**WARNING:** Indicates presence of a hazard which can cause severe personal injury, death, or substantial property damage if ignored.

**CAUTION:** Indicates presence of a hazard which will or can cause minor personal injury or property damage if ignored.

**NOTE:** Indicates supplementary information worthy of particular attention relating to installation, operation, or maintenance of the furnace but is not related to a hazardous condition.

Be sure to follow all instructions and related precautions as they are meant for your safety and protection. Store this manual in a readily accessible location for future reference.

## Foreword

This manual is to be used as a guideline for the installation, operation and maintenance of the Maxim Wood Pellet Furnace. This manual is organized into thirteen sections for easy reference.

- Section 1 – General Information;
- Section 2 – Location and Foundation;
- Section 3 – Electrical;
- Section 4 – Ignitor Operation;
- Section 5 – Chimney;
- Section 6 – System Installation;
- Section 7 – Filling System with Water and Purging Air;
- Section 8 – Operating Instructions;
- Section 9 – Routine Maintenance;
- Section 10 – Troubleshooting;
- Section 11 – Decals;
- Section 12 – Wiring Diagram

Anyone owning or operating this outdoor furnace must read, fully understand, and follow all of the information in this manual.

**NOTE:** In higher populated areas, extend the chimney to a height above the roofs of surrounding buildings (see Chimney Height in the Chimney section).

**NOTE:** The outdoor furnace may be connected to an existing boiler system or hot water heating system by a qualified installer only. However, the outdoor furnace must not be pressurized.

# IMPORTANT PRECAUTIONARY INFORMATION

The information contained on this page appears throughout this manual. Be sure to read carefully and understand these precautions before, during and after the installation, operation and maintenance of the furnace.

## WARNING

This outdoor furnace is not intended to be the only source of heat. In the event of a prolonged power failure, a generator may be used to prevent lines from freezing. Should the system be left unattended, run out of fuel or require service, an alternate heating source in the building being heated should be in place to prevent damage caused by freezing.

## WARNING

This outdoor furnace is not intended or certified to be installed inside habitable space. Do not install the outdoor furnace inside your home.

## CAUTION

This outdoor furnace should not be installed in a building that could be damaged or where a financial loss could occur from smoke, soot or water.

## WARNING

This outdoor furnace and/or chimney must not be installed inside or under any configuration or construction that contains combustible materials as part of the structure or configuration. The chimney is not intended or safety tested to be used or installed other than on the furnace located outside of any structure or enclosure.

## WARNING

Installation of the outdoor furnace is to be performed by a qualified installer.

## WARNING

When installing a heat exchanger on an existing hot water boiler, be sure none of the existing system safety controls are disabled.

## WARNING

Maintain the following clearances from combustibles for the outdoor furnace installation:

- 8" (20 cm) from the transition box
- 6" (15 cm) from the sides
- 48" (122 cm) from the front
- 8" (20 cm) from the chimney
- 27" (68.5 cm) from the top
- The foundation must be noncombustible

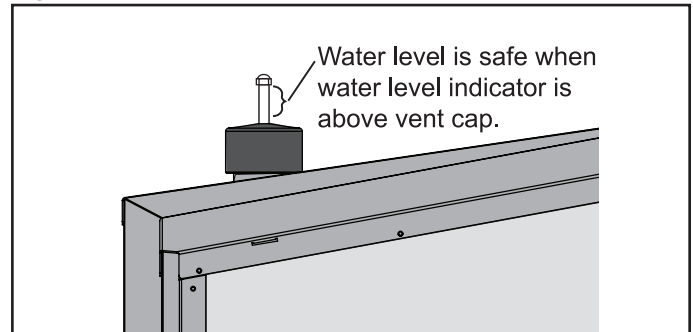
## WARNING

Use only chimneys listed to UL 103 HT for installation. The chimney and flue pipe must be clean and in good condition.

## WARNING

Be sure the outdoor furnace is filled with water before firing. Water level is safe when the water level indicator rod is above the vent cap (Fig. 1). MolyArmor 350 must be added before the initial fill (see Water Quality and Maintenance).

Fig. 1



## WARNING

Do not allow combustible materials (straw, hay or wood) near the outdoor furnace. Keep the perimeter of the outdoor furnace clear and clean.

## WARNING

Never leave the firebox door or hopper lid open or ajar when unattended.

## WARNING

Use only those listed fuels recommended by the manufacturer of your unit. Never use the following: trash, plastics, gasoline, rubber, naphtha, household garbage, material treated with petroleum products (particle board, railroad ties and pressure treated wood), leaves, paper products, and cardboard.

## CAUTION

Never use gasoline, gasoline-type lantern fuel, kerosene, charcoal lighter fluid, or similar liquids to start or 'freshen up' a fire in this outdoor furnace. Keep all such liquids well away from the outdoor furnace while it is in use.

# IMPORTANT PRECAUTIONARY INFORMATION

The information contained on this page appears throughout this manual. Be sure to read carefully and understand these precautions before, during and after the installation, operation and maintenance of the furnace.

## WARNING

Burn premium quality wood pellets.

## WARNING

This heater is designed to burn premium quality wood pellets only.\* Higher efficiencies and lower emissions generally result when burning premium quality wood pellets, as compared to standard pellets. **DO NOT BURN:** unseasoned wood, garbage, tires, lawn clippings, leaves, brush trimmings or general yard waste, materials containing asbestos, materials containing lead, mercury or other heavy toxic metals, materials containing plastic, materials containing rubber, waste petroleum products, paints and paint thinners, asphalt products, chemicals, coal, glossy or colored paper, construction and demolition debris, plywood, particleboard, salt water driftwood and other previously salt water saturated materials, manure, animal carcasses and asphalt products. Burning these materials may result in release of toxic fumes or render the heater ineffective and cause smoke.

## WARNING

The outdoor furnace vent cap must fit loosely on the vent opening. Do not force the cap down or try to seal it tightly onto the vent pipe. Do not extend or restrict the vent pipe or opening. **DO NOT ALLOW THE OUTDOOR FURNACE TO PRESSURIZE.**

## WARNING

Disconnect the electrical power to the furnace and remove all ash from the firebox before performing maintenance that requires draining the water or replacing an electrical component.

## WARNING

Allow the outdoor furnace to thoroughly cool before draining water from the outdoor furnace. Never drain water from the outdoor furnace with live ash or fire in the firebox. If the water in the outdoor furnace ever boils, be sure to check the water level and restore to full. If water is added, the proper level of MolyArmor 350 (p/n 2900361) must be maintained.

## WARNING

When cleaning the outdoor furnace, be careful not to spill any hot ash.

## CAUTION

Always wear the appropriate personal protective gear when cleaning ash from the firebox.

## WARNING

Sulfuric acid in the test kit is a corrosive acid. Handle carefully. Carefully read and follow precautions on test chemical labels. Keep test chemicals away from children. Safely dispose of tested samples.

**NOTE:** All installations and operations must be in accordance with local and state codes which may differ from the information in this manual.

**NOTE:** Check with your insurance company to see if they have any location requirements.

**NOTE:** Any changes to an existing boiler should be done by a qualified installer in accordance with applicable codes.

**NOTE:** Do not connect this outdoor furnace to a chimney flue serving another appliance.

**NOTE:** Chloride or sulfurous gases can be generated if plastic or rubber is burned and will mix with the moisture from the wood pellets and form hydrochloric or sulfuric acids in the firebox, creating corrosion.

**NOTE:** If installed in a non-habitable building, adequate combustion air and ventilation must be provided.

## CAUTION

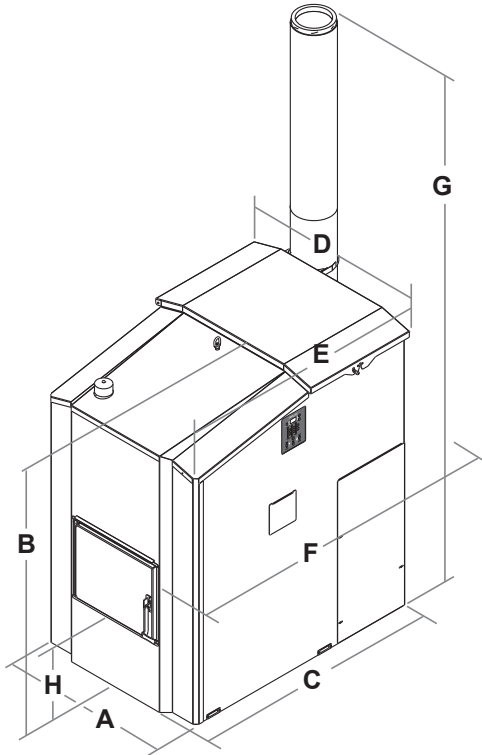
Failure to maintain and clean heat exchangers properly can result in the thermal valve activating.

# SECTION 1 – GENERAL INFORMATION

Anyone owning or operating this outdoor furnace must read, fully understand, and follow all of the information in this manual.

## Specifications and Dimensions

Fig. 2



Maxim M255 PE Measurements								
	A	B	C	D	E	F	G	H
in.	34	57	49.5	36	48	59.5*	117.5**	14.5
cm	86	145	126	91.5	122	151*	298.5**	37
* Measurement (F) is from firebox door to chimney inspection cover.								
** Measurement (G) with two 4-foot chimney sections.								

**NOTE:** See Section 5 for chimney installation guidelines.

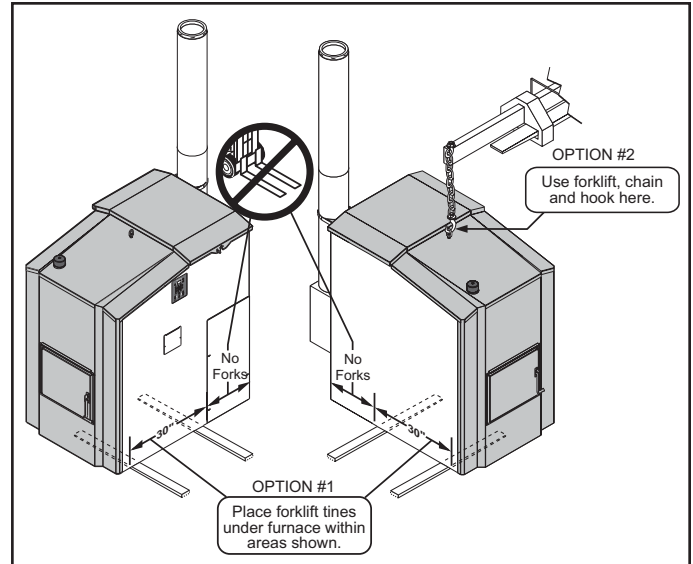
**NOTE:** The Maxim Furnace includes two 4-foot (1.2-meter) ASHT 6" in diameter chimney sections listed to UL103HT. For chimney sections or chimney replacement, use only genuine WoodMaster chimney components. Parts are available from an authorized WoodMaster dealer.

## Removing from Pallet

The outdoor furnace is secured to the shipping pallet with four brackets. To remove these brackets, loosen (but do not remove) the two screws securing each shipping slot cover and slide the cover up. Remove the bolts securing the bracket to the pallet and remove the bracket.

**NOTE:** Lift the outdoor furnace only where specified by Fig. 3.

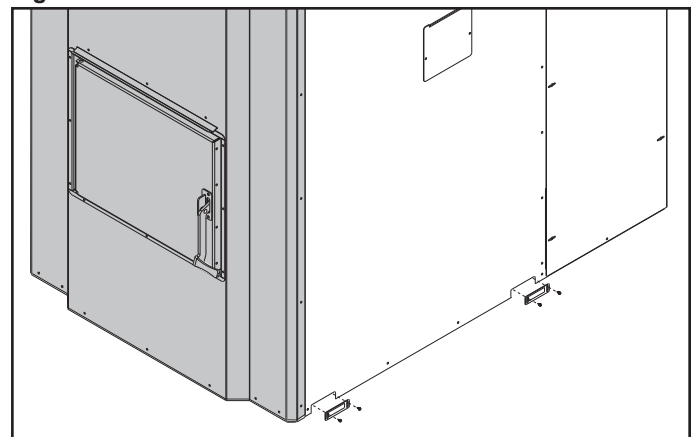
Fig. 3



## Shipping Slot Covers

Position each shipping slot cover so it is flush with the bottom of the outdoor furnace; then secure the cover by tightening the two screws. Make sure all four covers are properly positioned and secured (Fig. 4).

Fig. 4





## Options for Increasing Fuel Storage

An optional 48-Bushel Hopper is available (p/n 9660 or 9760) for increasing fuel storage. This hopper can be positioned to the side of the furnace using a 5-1/2' Auxiliary Auger Kit (p/n 9440).

A 6' Auxiliary Auger Kit (p/n 6453) and an 8' Auxiliary Auger Kit (p/n 9454) are also available for other applications. The auxiliary augers can also be used with larger external bins.

An optional Auxiliary Auger Vibrator with Timer Kit (p/n 9458) can be installed on the auxiliary auger connected to an external hopper. Vibration occurs based on a timer setting.

## Potable Water

If the outdoor furnace is to heat potable water associated with commercial food preparation or for heating milk-house hot water, it is recommended to install a double-wall heat exchanger. Also, when filling the system with water, a backflow preventer must be installed in the line used for filling.

## Adding Antifreeze to Outdoor Furnace System

Most outdoor furnaces are installed without antifreeze when an existing heating system is in place and there is no anticipation of leaving the outdoor furnace unattended for extended periods of time (10 days or more). If the building being heated has an alternate heat source, system water may be kept from freezing by running the circulating pump(s) and drawing heat from the existing furnace or boiler in the home or building.

To prevent freezing if the outdoor furnace is not fired for extended time periods or if lengthy power outages are anticipated during cold weather, a nontoxic propylene glycol may be used in the system. Some types of antifreeze that contain various inhibitors have been known to create problems like coagulation and jelling. To prevent potential problems, **do not use propylene glycol that is premixed with inhibitors**. MolyArmor 350 is compatible with (raw) propylene glycol. It is important to use MolyArmor 350 with straight propylene glycol for corrosion protection. If adding antifreeze to the system, it is imperative that the entire system contain **at least 30% antifreeze concentration mixed with softened, reverse osmosis or deionized water** to prevent bacterial growth and minimize minerals in the system. Bacterial growth is likely to occur with low antifreeze concentrations and can cause corrosion in the furnace water jacket and/or clogging of heat exchangers. To confirm the antifreeze solution is adequate and to kill bacteria, immediately heat the system up to 185° F, allow the pumps to circulate for at least 24 hours and then obtain a sample of the system water. Using an antifreeze tester, the solution must be protected to 10°F (-12°C) or below.

**NOTE: If using antifreeze, test the pH and Moly levels once each month. If the bacterial issues occur, the pH will decrease.**

**NOTE: Be sure to adhere to all warnings and precautions on the antifreeze label.**

**NOTE: Do not use automotive or RV types of antifreeze.**

**NOTE: If using antifreeze, see Water Quality and Maintenance in your Owner's Manual.**

## MolyArmor 350

To aid in protecting the system from corrosion, it is imperative to add MolyArmor 350 to the outdoor furnace immediately before it is filled with water. One of the ways the MolyArmor 350 water treatment works is to coat the metal with a layer of protectant. Not adding MolyArmor 350 before water is added (even within a matter of minutes) can allow corrosion to start that the MolyArmor 350 may be unable to stop.

MolyArmor 350 is composed of common materials. Molybdenum compounds are characterized as nontoxic in US Public Health Bulletin 293, by the Federal Hazardous Substances Labeling Act, and by the Occupational Safety and Health Act. However, in keeping with good safety and environmental practices, dispose furnace water in accordance with federal, state and local regulations.

- Unless regulation prohibits, you may drain the outdoor furnace to a home septic system. If doing so, however, be careful not to overflow the septic system.
- Do not drain the outdoor furnace in such a manner that the drain water could in any way contact surface water, stream, river, estuary (where a river meets a sea), lake, pond, ocean or other types of waters.
- Do not drain to any location within 50 feet (15 meters) of any water well.

## Shut-Off Valves

**Shut-off valves must be installed on each hot supply and return water line** so each line can be shut off individually for purging air from the system. Be sure all valves and fittings are metal. **Do not use plastic valves or fittings.**

## SECTION 2 – LOCATION AND FOUNDATION

### Selecting a Location

To ensure the Maxim Furnace functions as designed, careful planning and proper installation are imperative.

Be sure to read carefully and observe all of the information in the entire owner's manual.

If any installation questions arise that cannot be answered by the information in this manual, be sure to contact your dealer.

- This outdoor furnace is not intended or certified to be installed inside habitable space. Do not install the outdoor furnace inside your home.
- This outdoor furnace may be installed outdoors or in non-habitable structures and must be installed in accordance with all applicable codes and regulations.
- Check with your insurance company to see if they have any location requirements.
- This outdoor furnace should not be installed in a building that could be damaged or where a financial loss could occur from smoke, soot or water.

When selecting a suitable location, carefully consider each of the following:

- Must be installed in accordance with all applicable codes and regulations.
- A qualified installer must perform the installation of this supplementary outdoor furnace and must determine how to install it to be compatible with the existing heating source.
- Consider prevailing winds and the direction exhaust from the chimney will travel.
- The shorter the distance between the outdoor furnace and building(s) being heated, the lower the cost will be for the installation of the hot supply and return water lines and insulation.
- Be sure to maintain the required clearances to combustibles and recommended maintenance clearances.
- ThermoPEX pre-insulated piping is recommended for all underground installations. Other types of piping should not be buried in low-lying areas with standing water or with a very high water table, or under an area of heavy vehicle traffic unless protected from excessive compression.

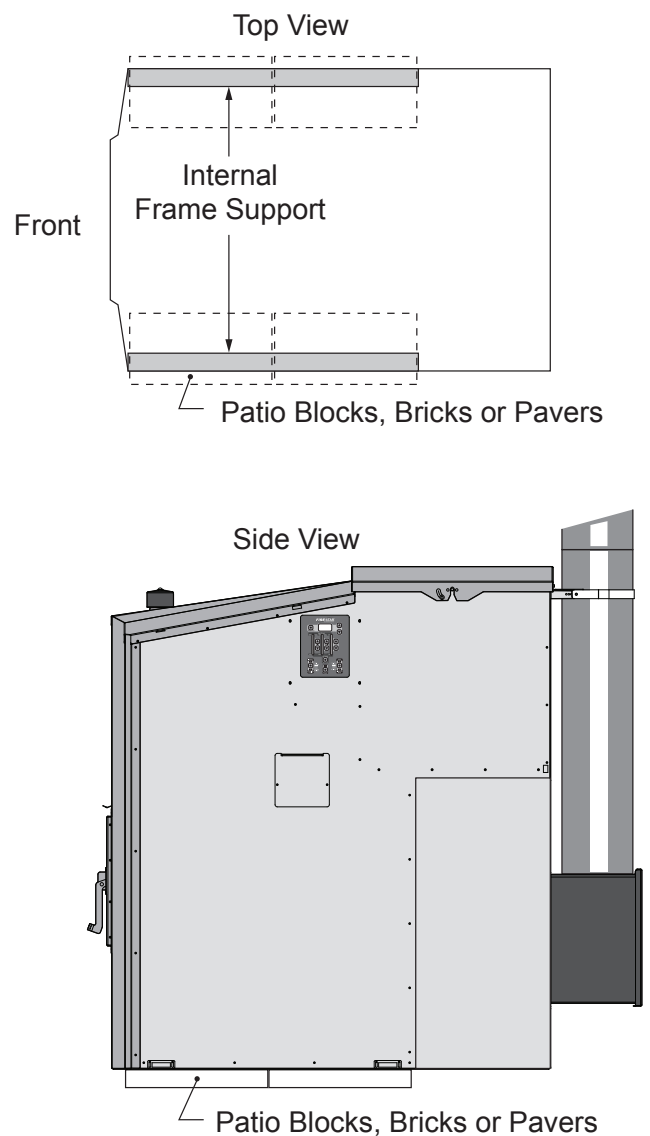
- If the ground at the location is unstable or subject to frost heaving, consider installing 2" closed-cell insulation under the front portion of the concrete slab the outdoor furnace will be installed on, and under the area around the slab used for walking (see Fig. 6).

### Foundation

The outdoor furnace may be installed directly on **stable, level ground** without the necessity of a foundation.

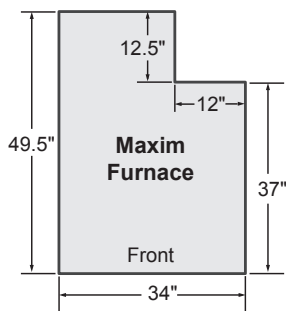
If the ground is unstable, one option is to use patio blocks, bricks or pavers under the base as indicated in Fig. 5. Another option is to pour a concrete foundation.

Fig. 5

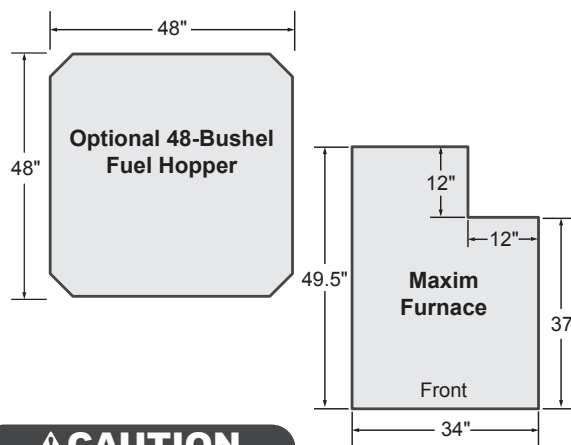


## Maxim Furnace Base Dimensions

*Furnace Base Dimensions*



*Optional 48-Bushel Hopper with Furnace Base Dimensions*



**NOTE**

Furnace must be installed on a noncombustible surface or foundation that incorporates an enclosure that will prevent supply and return lines from possible exposure to sunlight, fire, or physical damage that may be caused by an occurrence outside the furnace enclosure.

**CAUTION**

Do not use any combustible materials for the foundation.

To install the outdoor furnace on a concrete foundation, refer to Fig. 6 for dimensions and for the location of the hollowed-out area. A 4" to 6" (10 cm to 15 cm) thick concrete slab works well; however, a thicker slab may be used to obtain the desired firebox door opening height.

If installing on an existing slab, it may be necessary to use patio blocks, bricks or pavers (Fig. 5) to allow access to the water lines.

**NOTE: In all installations, the outdoor furnace must not be operated with the back panels removed. Make necessary allowances for access to the back of the outdoor furnace.**

If the area for the concrete slab is unstable or subject to frost heaving, consider installing 2" closed-cell insulation under the front portion of the concrete slab the outdoor furnace will be installed on, and under the area around the slab used for walking.

**NOTE: The installation surface or foundation must be noncombustible. The hot supply and return lines must also be protected from possible exposure to sunlight, fire or physical damage. Foundations may consist of concrete, crushed rock or patio blocks.**

### Leveling the Outdoor Furnace

**CAUTION**

**The back of the outdoor furnace must not be lower than the front of the outdoor furnace.**

The Maxim should be leveled so that the back of the transition box (i.e., the burner auger motor end) is slightly higher than the front. Smoke can condense into creosote inside the burner auger tube. If the burner auger is not sloped down toward the front of the furnace, condensation can form in the burner auger tube and drip into the transition box.

**WARNING**

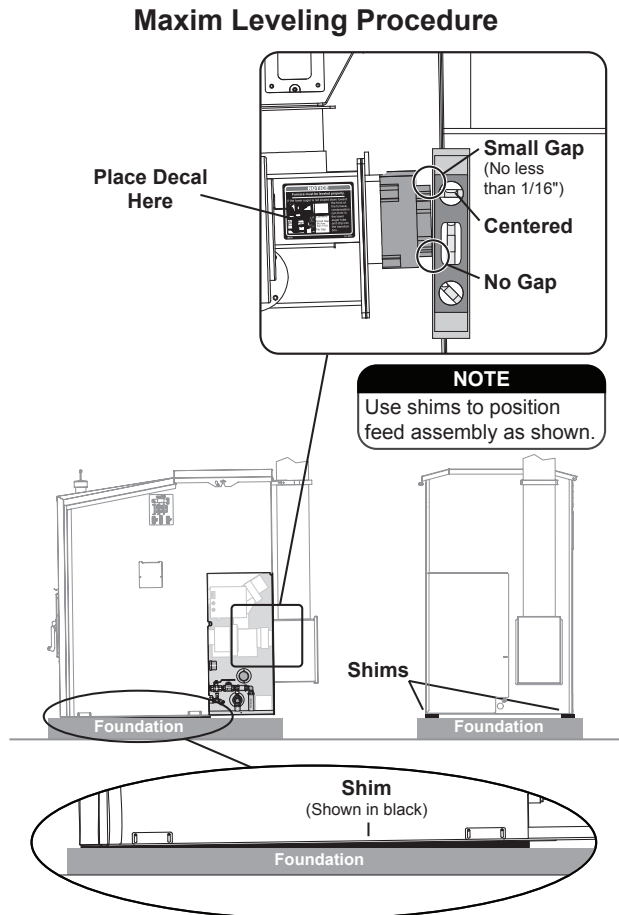
**Disconnect the electrical power at the main power source.**

1. Disconnect the electrical power at the main power source.
2. Remove the access panels from the back corner of the furnace and set aside.



- Place a level on the back of the burner auger motor as shown in Fig. 7. The back of the transition box should be slightly higher than the front, indicated when the level is vertical and there is a small gap (from 1/16" to 3/32", or 1.6 mm to 2.4 mm) between the level and the top of the burner auger motor and no gap between the level and the bottom of the burner auger motor.

Fig. 7



- Use shims as necessary under the outdoor furnace in the locations shown until the procedure in Step 3 indicates that the back of the transition box is slightly higher than the front.

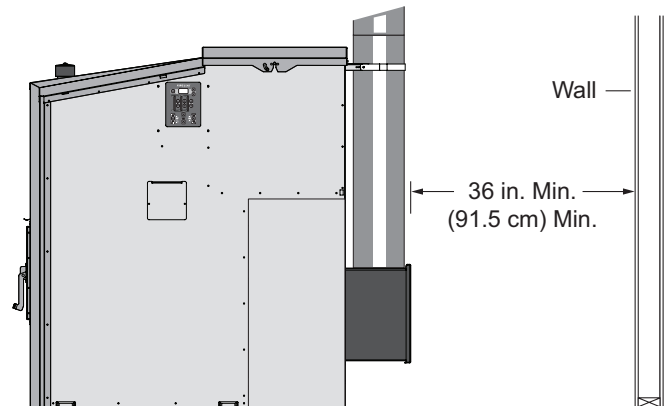
**NOTE: Periodically check that the outdoor furnace is leveled as described in these instructions because frost can cause the foundation to move.**

- Install the access panels on the back corner of the furnace.
- Connect the electrical power at the main power source.

## Clearances

**NOTE: Clearance to combustibles from the chimney transition box is 8" (20 cm); HOWEVER, if installing with the back of the outdoor furnace facing an immovable wall, object, etc., you must maintain 36" (91.5 cm) of clearance to the wall, object, etc. in order to perform periodic maintenance (see Fig. 8).**

Fig. 8



## WARNING

**Maintain the following clearances from combustibles for the outdoor furnace installation:**

- 8" (20 cm) from the transition box
- 6" (15 cm) from the sides
- 48" (122 cm) from the front
- 8" (20 cm) from the chimney
- 27" (68.5 cm) from the top
- The foundation must be noncombustible

## SECTION 3 – ELECTRICAL

**NOTE: Any electrical installation should be done by a qualified installer in accordance with applicable codes.**

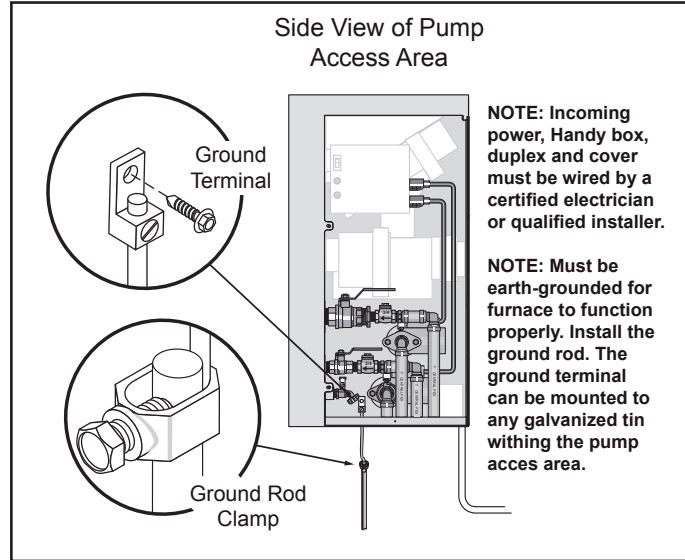
### Ground Rod

The outdoor furnace must be electrically bonded to ground in accordance with the requirements of the authority having jurisdiction or, in absence of such requirements, with the National Electrical Code, ANSI/NFPA 70 and/or the Canadian Electrical Code Part 1, CSA C22.1 Electrical Code.

Install the ground rod and connect it to the outdoor furnace.

1. In the water line trench near the outdoor furnace, drive the ground rod into the ground until the top of the ground rod is below the ground surface.
2. Remove the side and back panels; then route the ground wire from the ground rod under the outdoor furnace base and over to the bottom left corner at the back of the outdoor furnace.
3. Secure the ground terminal with the self-drilling screw provided. Secure the ground wire to the terminal; then secure the ground wire to the ground rod with the clamp. Tighten all hardware securely.

Fig. 9



## SECTION 4 – IGNITOR OPERATION

### Ignition Sequence

The ignition sequence follows a control logic to ensure safe and effective ignition. The ignition sequence is as follow:

1. The water temperature must be low enough for the furnace to shift into demand mode.
2. The fan will start and operate at the ignition fan speed and the Firestar control will send voltage to the igniter relay.
3. The air proving switch will close, completing the ignition relay control circuit.
4. The electric ignitor will warm up and heat the air blowing across it into the burn chamber.
5. The auger will cycle periodically to feed the required amount of fuel into the burn chamber, and to agitate any pellets already present in the burn chamber.
6. The ignitor will operate until the burn chamber reaches a temperature that is high enough to sustain itself, or for ten minutes, at which time the ignitor will turn off.

# SECTION 5 – CHIMNEY

## Chimney Height

The minimum recommended chimney length is eight feet (2.4 m). Two 4-foot (1.2 m) sections are standard. Additional sections may be needed (see Chimney Draft section).

**In higher populated areas, extend the chimney to a height above the roofs of surrounding buildings.** Use WoodMaster Chimney Extensions when extending the chimney. When only the standard eight feet (2.4 m) of chimney are used, the sections must be secured at the connection joint with four screws to stabilize the extension.

Be considerate of neighbors when operating your outdoor furnace. If you use your outdoor furnace in the summer months, be certain your chimney exhaust is not adversely affecting neighbors with open windows.

If located within 300 feet (91 m) of any residence not served by the outdoor furnace, it is recommended that the chimney be at least 2 feet (0.6 m) higher than the peak of the residence served.

Fig. 14

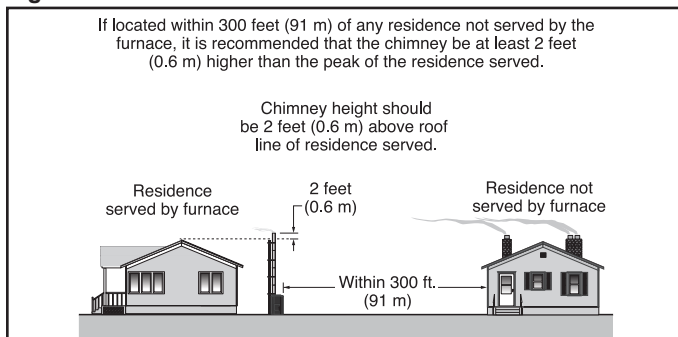
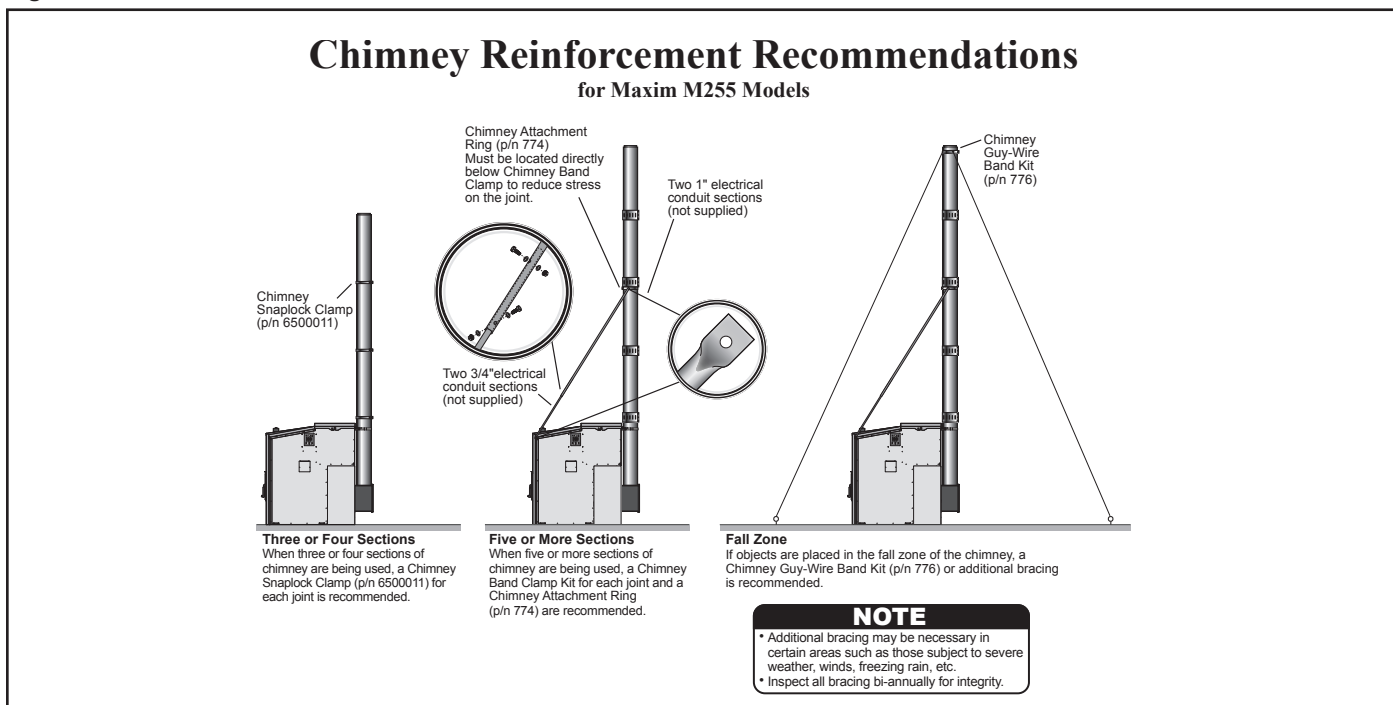


Fig. 15



**NOTE: If more than three 4-foot (1.2 m) sections of chimney are used, a support (e.g., a pole, pipe or other structural support) may be installed from the ground that can withstand wind. Other reinforcement recommendations are shown in Fig. 15.**

If extensions are added to the standard eight feet (2.4 m) of chimney, the chimney should be reinforced appropriately. Fig. 15 shows chimney support recommendations when three or more sections are used. When adding sections of chimney, make sure that there is nothing within the fall zone of the chimney that could be damaged. If something is located within the fall zone and cannot be removed, guy wires or braces may need to be installed to prevent a falling chimney from causing damage (see Fig. 15).

**NOTE: For chimney extensions or chimney replacement, use only genuine WoodMaster chimney components. Parts are available from an authorized WoodMaster dealer.**

The installation of a spark arrester is recommended, particularly where there are dry conditions or where there is combustible material near the unit, unless the installation of a spark arrester is prohibited by local requirements. Use common sense to avoid potential fires, including exercising caution when disposing of ash, cleaning and refueling. Keep all highly combustible materials (e.g., gasoline, propane, leaves, pine needles, etc.) away from an operating unit at all times. Take special precautions in windy conditions.

## Chimney Draft

Proper draft is necessary for the Maxim to operate optimally. Draft occurs when the temperature in the chimney is high enough and/or the chimney is high enough to cause a negative pressure that "pulls" the exhaust up and out the chimney. The higher the burn rate and fan settings, the more sections of chimney that will be required to provide proper draft.

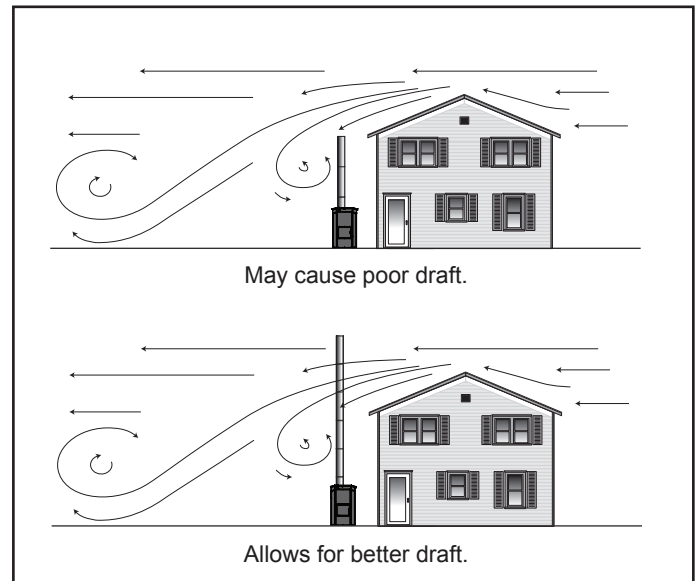
**NOTE: Adding more chimney sections increases the amount of negative pressure in the chimney.**

**NOTE: A qualified installer may perform the following test to check for proper draft.**

1. Drill a hole in the chimney inspection cover; then with the outdoor furnace and chimney at normal operating temperature, use a manometer to check draft. Flue draft should be between  $-0.02$  in. WC ( $-5$  Pa) and  $-0.05$  in. WC ( $-12.45$  Pa). If the flue draft is lower, add more chimney sections.
2. After the test, fill the hole in the chimney inspection cover with high-temp silicone.
3. If a spark arrestor is being used, make sure it is clean and unobstructed.

4. Objects like buildings and trees in close proximity or nearby terrain (e.g., hills, valleys, etc.) can adversely affect air flow in the chimney (see Fig. 16). Adding chimney sections may overcome these factors.

Fig. 16



## SECTION 6 – SYSTEM INSTALLATION

### SUPPLY AND RETURN LINES

Determine the configuration of the supply and return lines from the outdoor furnace to where the supply and return lines will connect to the existing heating system. WoodMaster recommends using the ThermoPEX® piping system.

**ThermoPEX** is a fully assembled, pre-insulated piping system consisting of two 1" Central PEX lines or two 1-1/4" PEX lines. The two lines (one a supply and one a return line) are insulated with high-density urethane insulation and a thick, durable, waterproof, polyethylene outer jacket. One of the lines is marked with a black stripe for identification.

**NOTE:** To prevent ground water from entering the house, do not use drain tile, PVC pipe with bubble wrap, or any other inferior material for insulating the water lines.

**NOTE:** If the outdoor furnace supply and return lines are not insulated properly, or if other brands of insulated piping are used, there can be excessive heat loss. This heat loss can greatly increase the fuel consumption.

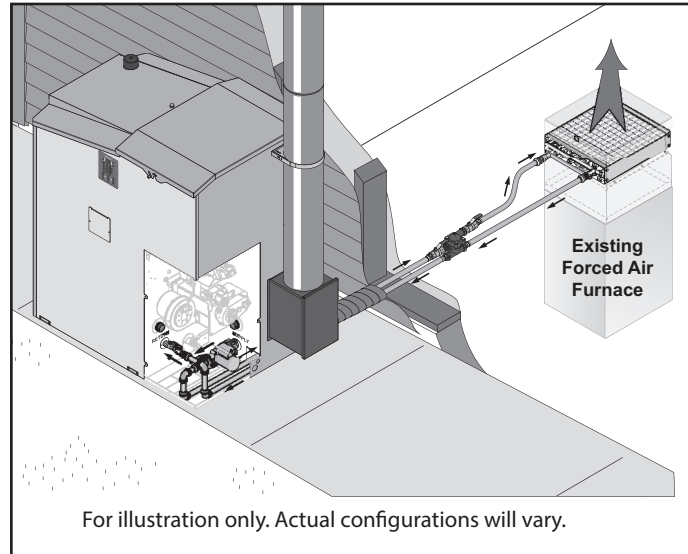
**NOTE:** If it is unavoidable that the supply and return lines will run through an area of ponding water, use ThermoPEX instead of other materials. ThermoPEX should also be used for above-ground or winter installations, and if the area is likely to be affected by compaction.

#### Above Ground or Winter Installations

For above ground or winter installations in which the supply and return lines can not immediately be buried underground, WoodMaster recommends using ThermoPEX. Be sure that both the insulation and the supply and return lines will not be exposed to ultraviolet rays. The ThermoPEX black exterior jacket has UV protection but the insulation and water lines inside do not. Use a ThermoPEX termination cap at each end of the installation to protect and seal the insulation from water.

If installed next to the building being heated, the supply and return lines can be installed above ground provided they are properly insulated and not exposed to ultraviolet rays (see Fig. 17 as an example).

Fig. 17



**NOTE:** If an above ground installation is temporary, bury the ThermoPEX as soon as conditions permit (e.g., once the ground has thawed).

**NOTE:** If ThermoPEX is installed temporarily above ground, provisions should be made (i.e., a firestop) to prevent possible risk of fire coming into contact with the ThermoPEX. ThermoPEX is constructed of materials that can burn and transfer a fire.

### CAUTION

If ThermoPEX is installed temporarily above ground, do not cover with combustible materials (e.g., stray, hay, leaves, etc.).

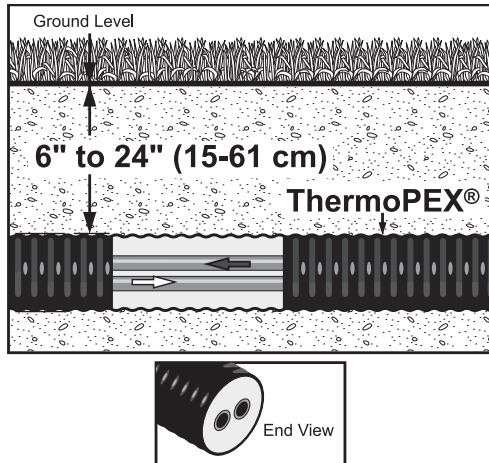
## Digging the Trench

### WARNING

Before digging, be sure to call for utility locator service.

The trench depth for ThermoPEX should be between 10" and 28" (25 and 71 cm).

Fig. 18



## Underground Electric Wire

A 12-2 (two wires plus ground) underground rated wire should supply the outdoor furnace with electricity. A heavier gauge wire may be needed if the run is over 200 feet (61 meters). Check local codes and requirements. A 20-amp circuit is recommended.

## Connecting to Existing Heating System

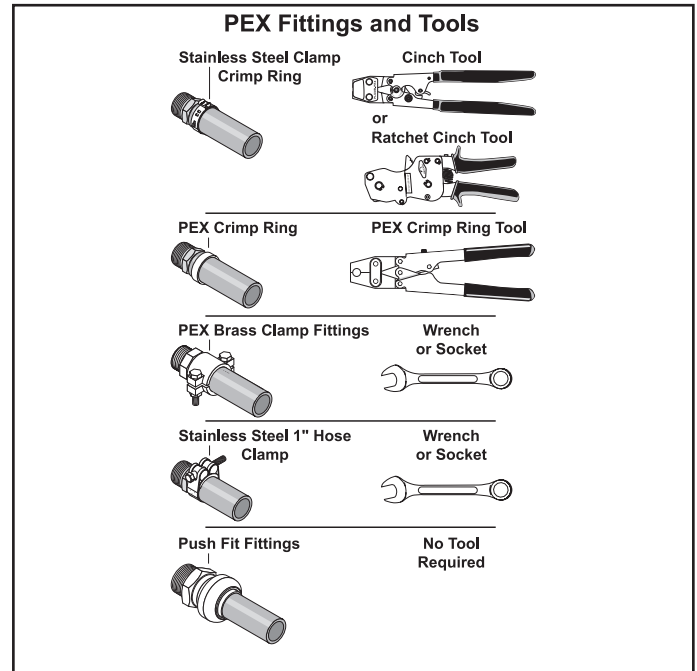
1. Make an entrance into the building(s) where the supply and return lines are to enter.
2. Lay the ThermoPEX assembly in the trench and feed one end into the building. Apply sealant around the supply and return lines where they enter the building.
3. Purge the supply and return lines before connecting any fittings to ensure there is no debris or foreign matter present.

**NOTE: All holes made in basement or building walls must be sealed completely to prevent water from entering the building.**

4. Close all valves on the outdoor furnace.
5. Install fittings to allow pressure-testing of both supply and return lines. Pressurize with 50 psi (3.5 kg/cm<sup>2</sup>) of air; then check after 30 minutes to see if pressure has dropped. A drop in pressure indicates a leak; repair as necessary.
6. Connect the supply and return lines to the outdoor furnace and the existing heat emitter(s). Fig. 19 shows some of the PEX fittings and tools used in making connections.

**NOTE: The base on the back of the outdoor furnace is removable if necessary for connecting the supply and return lines to the outdoor furnace.**

Fig. 19



### CAUTION

**Allow for expansion and contraction of the supply and return lines at each end. Without an allowance for expansion and contraction, the lines may kink or the fittings may be pulled apart, causing an immediate water loss from the outdoor furnace. Central PEX water lines can have an expansion and contraction rate up to .095" per each 100 ft and each 10°F (2.4 mm/30 m/5.5°C).**

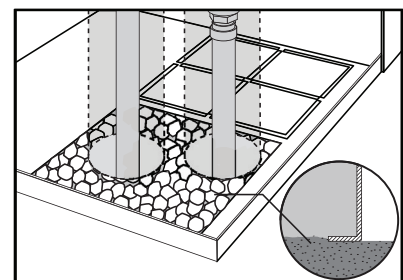
7. Make sure there are no leaks in the supply and return lines; then backfill the trench.

**NOTE: Do not backfill the trench until the supply and return lines have been tested to ensure there are no leaks.**

## Backfilling Water Line Enclosure

Using gravel or small rock, backfill the perimeter of the water line enclosure to the top, inner edge of the base (Fig. 20) to keep out rodents. Install the back and side panels.

Fig. 20





## CIRCULATION PUMPS

**NOTE:** The direction of water flow is very important for the proper operation of the outdoor furnace. Installing a swing check valve in the return line can prevent possible reverse flow.

### Water Flow

For a single building using a water-to-air heat exchanger system with a domestic water heater, the direction of water flow must go from the hot outlet on the outdoor furnace to the lower side fitting of the domestic water heater exchanger, to the lower fitting of the heat exchanger on the existing furnace, and then to the return port of the outdoor furnace.

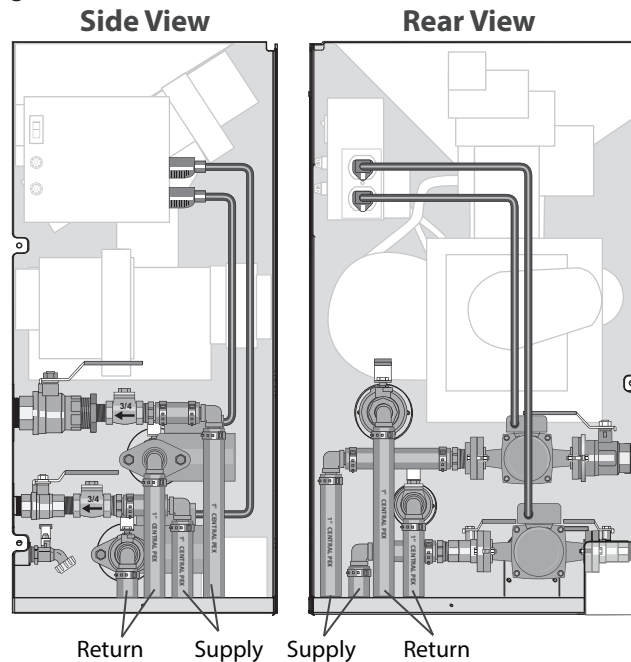
**NOTE:** if there is a high heat draw with a single set of lines, a wraparound pump (as shown in Fig. 21) may be needed in order to keep the supply water temperature the same temperature indicated by the FireStar controller.

**NOTE:** Some systems may have different flow patterns.

### Access to Ports on Furnace

Access to the hot supply and return ports is gained by removing the access panels on the lower right-hand side and back of the furnace. There are two hot supply and two return ports on the furnace. This configuration allows for mounting the circulation pumps on the furnace (Fig. 22).

Fig. 22



There are eight knock-out tabs on the floor panel of the furnace to accommodate the water lines. These align with the hollowed-out area in the foundation specifications (Fig. 6). The pump access area in the back right corner must align with the blocked out area of the foundation.

### Installing Circulation Pumps

The Taco 009 is a medium flow, high head pressure pump that requires an adequate amount of pressure on the outlet side to prevent the motor from overloading.

Fig. 21

## Maxim with Wrap-around-pump Installed

**Side View**

**Rear View**

**Area of Focus**

**Side      Rear**

Parts List		
Qty	p/n	Description
2	118	Close Nipple, 3/4"
1	119	Pump Flange Kit, 3/4"
1	198	Ball Valve, 3/4"
1	224	Isolation Flange, 3/4"
1	225	Isolation Flange, 1-1/4"
2	296	Swing Check Valve, 3/4"
1	388	Hex Bushing, 1-1/4" x 3/4"
1	410	Ball Valve, 1-1/4"
2	556	Power Supply Cord, 32"
4	1330	PEX Adapter, 1" x 3/4"
4	1334	PEX 90° Elbow, 1"
12	5926	Stainless Steel Clamp, 1"
2	5800004	Taco 007 Pump

Parts and accessories sold separately.  
Pump size may vary.



The Taco 014 is a high flow, high head pressure pump that requires an adequate amount of head pressure on the inlet side to prevent cavitation. Therefore, a Taco 014 may need to be mounted lower near the base of the furnace, and on the 1-1/4" bung.

The Taco 007 is a medium to high flow, low head pressure pump. In a very low-resistance system (e.g., short length of supply and return lines, only a flat plate heat exchanger, etc.), the 007 pump may need to be mounted lower near the base of the furnace or on the 1-1/4" bung to prevent cavitation at high water temperatures.

**NOTE: See the Hydronic Component Selection Guide for more detailed information.**

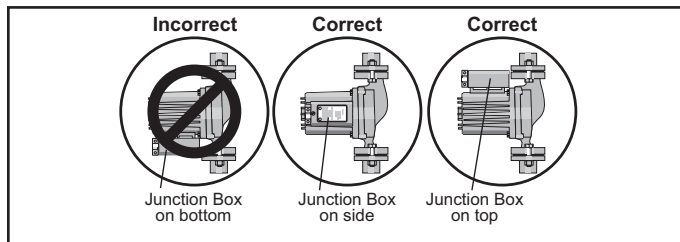
The following guidelines must be adhered to when installing the circulation pump(s).

### WARNING

**Maximum load of the outlet on the outdoor furnace is 5A, 120VAC, and 60Hz.**

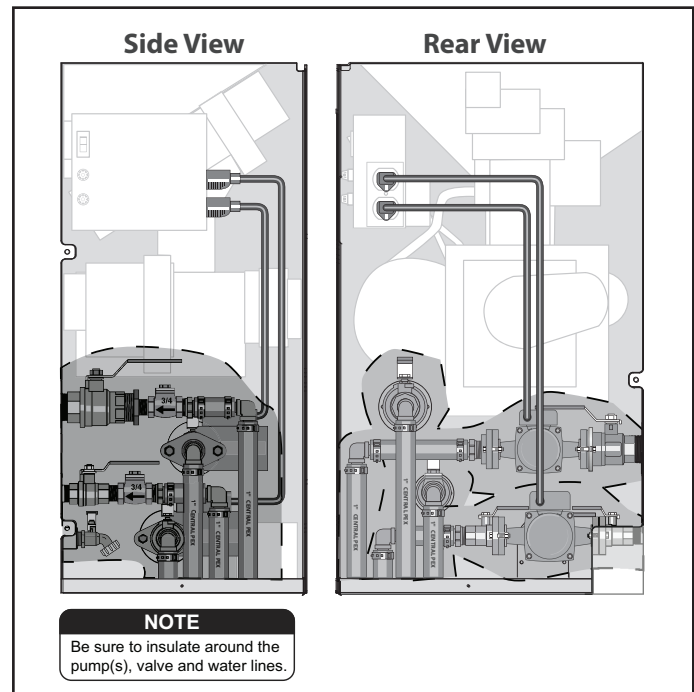
- A. The pump motor must be installed in a horizontal position.
- B. The junction box must not be located below the pump motor (see Fig. 23). If necessary, remove the four screws and rotate the pump body.

Fig. 23



- C. Do not operate the circulation pump until the entire system has been filled with water and checked for leaks or the pump may be damaged.
- D. Insulate the areas around the supply and return lines (Fig. 24) and pump(s) being careful not to block the area around the louvers; then install and secure the side and back panels.

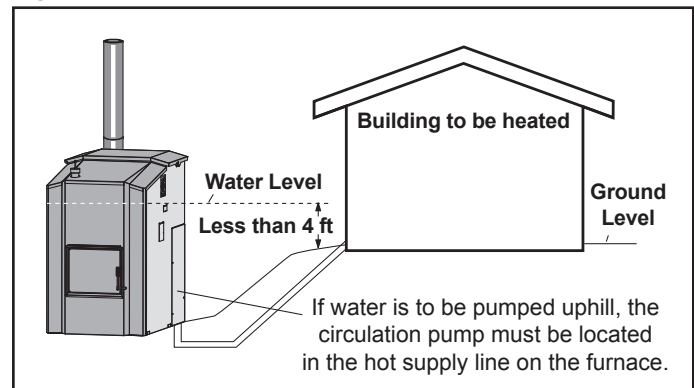
Fig. 24



**NOTE: At least one circulation pump must run continuously to ensure proper operation of the outdoor furnace.**

The circulation pump(s) **must be installed in the supply line(s)** with the arrow on each pump pointed away from the outdoor furnace. In order to avoid circulation problems, do not install the pump(s) in the return line(s).

Fig. 25

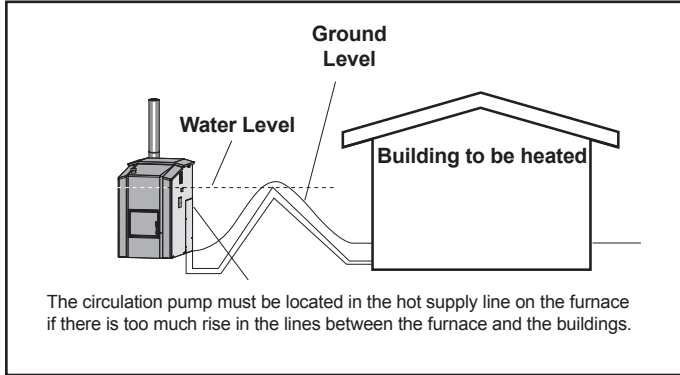


The pump(s) must be located near the base of the outdoor furnace if the system has a high-flow pump or very low resistance on the outlet side of the pump. For example, if the outdoor furnace is 20 feet (6 meters) from the building and pumping water through one-inch pipes, a heat exchanger, and back to the outdoor furnace, the pump needs to be mounted with four feet of water above the pump.

**NOTE: See the Hydronic Component Selection Guide for more detailed information.**

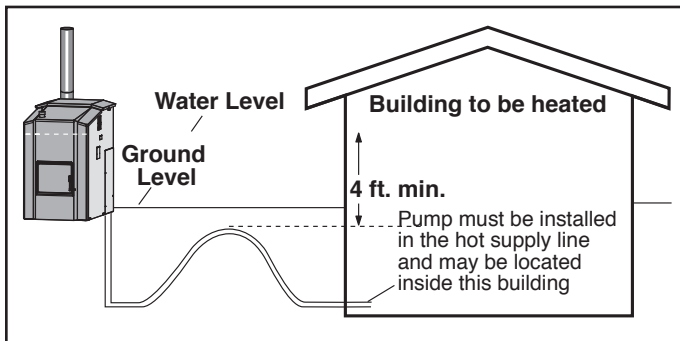
Installing the circulation pump(s) at the outdoor furnace is recommended, but required if the building being heated is higher than the outdoor furnace or if there is a large rise in the water lines between the outdoor furnace and building (see Fig. 26 and 27). Hot water boils at a lower temperature when pulled uphill (because it is at a lower pressure); therefore, hot water must be **pushed** uphill to ensure proper circulation.

Fig. 26



If not mounted on the outdoor furnace, the circulation pump(s) must be mounted 4 to 5 feet (1.2 to 1.5 m) lower than the top water level in the outdoor furnace (see Fig. 27).

Fig. 27



### Shut-Off Valves

Shut-off valves should be installed on both sides of each pump so if it becomes necessary to repair or replace the pump, the pump can be isolated.

### Filters

A Y-strainer or filter may be installed at the outlet side of the pump to remove foreign particles which may be present in the water. Always install Y-strainers with the cleanout in the lowest position.

### Optional Thermostatic Valve

**NOTE:** The thermostatic valves illustrated throughout the manual may vary from your installation. See the installation instructions provided with the thermostatic valve.

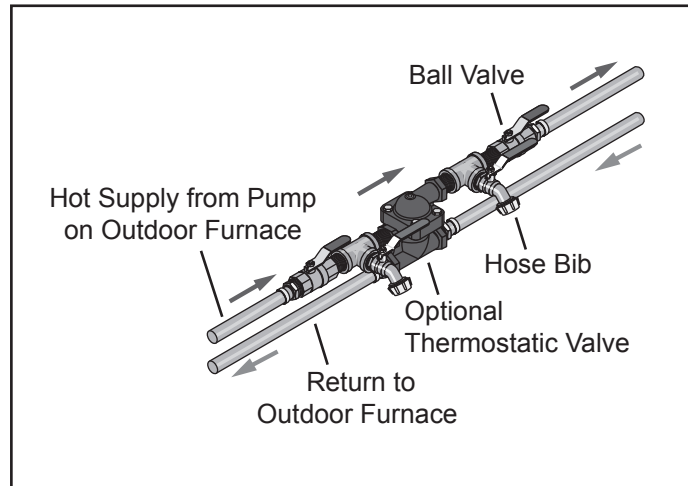
### CAUTION

**DO NOT** operate the outdoor furnace with the water temperature less than 150°F (65°C).

An optional thermostatic valve can be installed on each set of supply and return lines in the system to maintain the outdoor furnace water temperature above 150°F (65°C). Operating the outdoor furnace with the water temperature less than 150°F (65°C) may result in more condensation in the firebox that can lead to corrosion.

It is recommended that the water temperature setpoint of the furnace be set to 185°F (85°C) to decrease the likelihood of the water temperature falling to 150°F (65°C). As a result, the outdoor furnace will operate with a greater efficiency and require less maintenance. Failure to follow proper operating instructions may result in furnace damage.

Fig. 28



For thermostatic valves, contact your authorized WoodMaster dealer.

# OPTIONAL THERMOSTATIC VALVE - HOW IT WORKS

**NOTE:** With higher heat loads, it may be necessary to change the water temperature setpoint on the FireStar controller to be no less than 185°F.

**NOTE:** When the thermostatic valve allows a trace flow, enough water will pass through for the backup indoor heating system to backfeed heat to the outdoor furnace and water lines, protecting against freezing.

## Optional Thermostatic Valve - How It Works

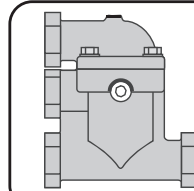
(arrow indicates water flow)

### NOTE

Install a Thermostatic Valve on each set of supply and return lines in the system. Each Thermostatic Valve must be installed inside the building to be heated.

### NOTE

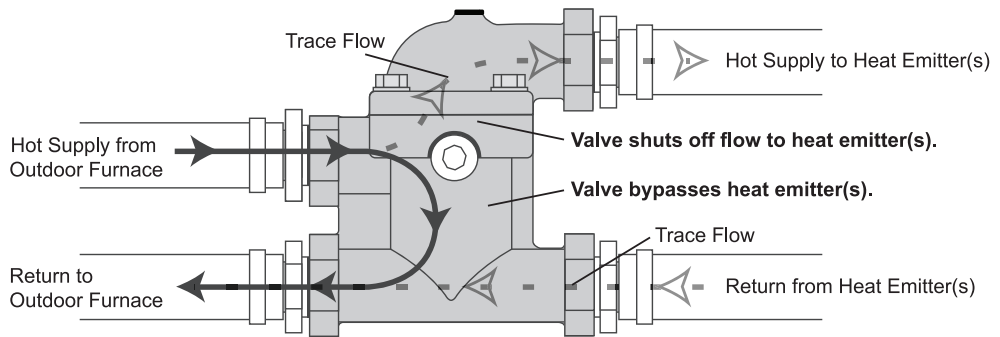
The proper level of Corrosion Inhibitor Plus™ (p/n 1650) must be maintained (see Owner's Manual for more information).



Note: Top of valve can be installed to face either direction. As shown here or as shown below.

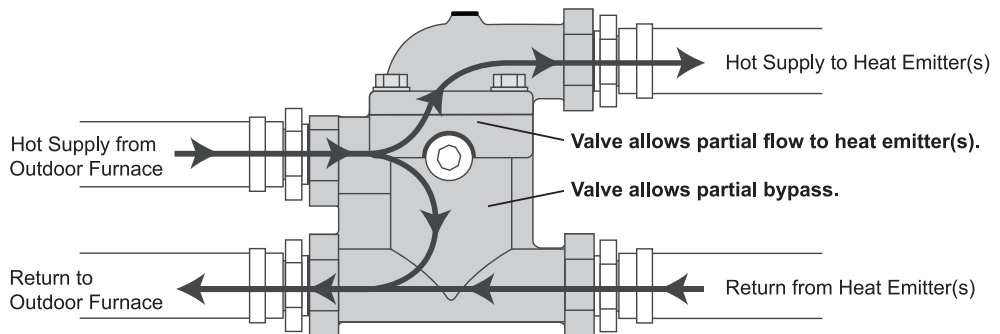
### Water Below 150°F at Thermostatic Valve

(water returns to furnace to be reheated)



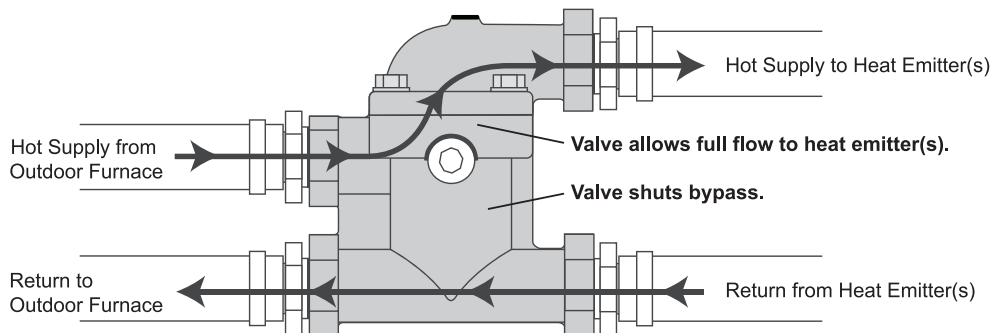
### Water at 150°F up to 170°F at Thermostatic Valve

(water is partially released to heat emitter(s) and partially bypassed)



### Water Above 170°F at Thermostatic Valve

(water is released to heat emitter(s))



## Purging Air from the System - Manual Air Bleeders

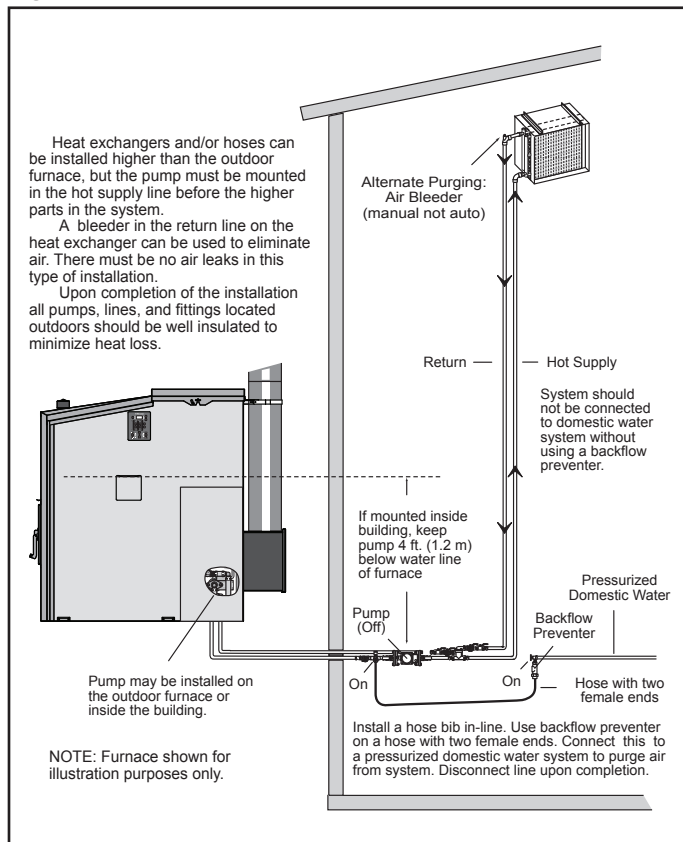
Manual air bleeders may be installed in the high points of the water lines where air may get trapped and cause circulation problems. Water can be pumped to levels higher than the outdoor furnace as long as the pump is **pushing** the water to the higher level and there are no air leaks in the system. Additionally, air should be purged from the system using pressurized domestic water and a hose with two female ends (see Fig. 29).

### WARNING

**The outdoor furnace vent cap must fit loosely on the vent opening. Do not force the cap down or try to seal it tightly onto the vent pipe. Do not extend or restrict the vent pipe or opening. DO NOT ALLOW THE OUTDOOR FURNACE TO BE PRESSURIZED.**

If any auto float vents are present in the system, they must be capped off tightly to prevent air from entering the system.

Fig. 29



**NOTE: See the Hydronic Component Selection Guide for more detailed information.**

## WATER HEATER INSTALLATION

### WARNING

**DO NOT disable or remove any safety reliefs or controls. Turn off the power to the water heater before installation.**

When installing a domestic hot water heat exchanger, the hot supply line from the outdoor furnace should be plumbed first to the water heater heat exchanger and then to the balance of the heating system.

A manual 3-way valve may be installed so that during the non-heating season, the water heater may be operated without operating the entire heating system (see Fig. 30). A tempering valve (or thermostatic mixing valve) is to be installed in the hot water outlet from the water heater. Install a tee in a fitting on the top of the water heater (see Fig. 32) for the hot water heat exchanger.

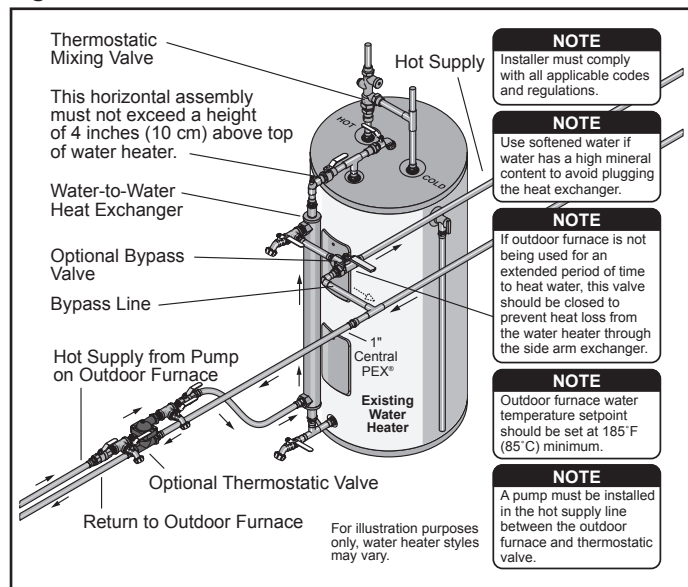
**NOTE: If the water heater has been in service, flush the water heater prior to installing the hot water heat exchanger. Anode rod residue or other sediments in the water heater may plug the heat exchanger.**

**NOTE: Some gas water heaters are equipped with a high water temperature probe that is connected to the gas valve. When the water temperature exceeds the high limit, the gas valve enters a non-resettable lock out condition. This requires replacement of the entire valve. The installer must determine if this type of valve is present before installation of a water-to-water heat exchanger.**

### CAUTION

**Costly maintenance may be incurred if steps are not taken during installation to reduce or eliminate the possibility of the water temperature in the water heater exceeding the high limit.**

Fig. 30



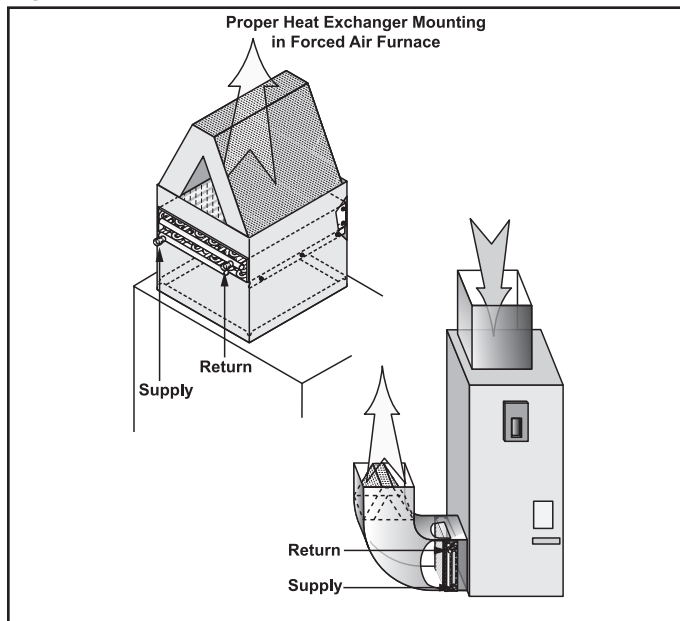
## EXISTING FORCED AIR INSTALLATION

When the Maxim is installed in conjunction with an existing forced air system, a water-to-air heat exchanger is mounted in the plenum or duct work of the existing furnace. Heated water from the outdoor furnace either continuously flows through the water-to-air heat exchanger or is diverted through a 3-way zone valve. When the thermostat senses the need for heat, the fan on the existing furnace forces air through the heat exchanger, transferring heat throughout the existing ductwork.

Following are several important items for this type of installation.

- Plenums installed to the furnace must be constructed of metal in accordance with NFPA 90B, 2-1.3.
- If an air conditioning coil is located in the plenum, the heat exchanger should be mounted between the fan and the air conditioning coil so the heat exchanger will not freeze when the air conditioner is being used.
- The heat exchanger should **not** be installed in the cold-air return of the existing forced air furnace because components of the existing furnace could overheat.
- The heat exchanger may be mounted either horizontally or vertically with the outlets on the side (see Fig. 31).

Fig. 31



- In all applications, the heat exchanger must be mounted level from front to back, with the outlets on the side. If the outlets are positioned upward or if the exchanger is not level, an air lock can restrict the water circulation and reduce the amount of heat transfer.

- The **lower fitting is the inlet/hot supply** from the outdoor furnace and the **top fitting is the outlet/return** back to the outdoor furnace.
- It is best to install a heat exchanger that fits the plenum.
- If the plenum is larger than the heat exchanger, it should be mounted in the center **without** gaps on the sides that would allow air to flow around the heat exchanger. All air must be directed through the face of the exchanger. Air flow deflectors need to be installed in the plenum on the outlet side of the heat exchanger if air flow is funneled into the heat exchanger.
- Be sure to consider the airflow through the ductwork so air circulation is not blocked off to parts of the building.
- Adding a heat exchanger coil in the hot air plenum or ductwork of the existing furnace may decrease the air flow in the system. The existing heat emitter(s) (gas or electric) should be operated before adding the heat exchanger.
- The air temperature rise should be measured with the heat emitter(s) running for an adequate amount of time to get a stabilized temperature reading. The heat exchanger can then be installed in the system. The existing heat emitter(s) should be operated again and the air flow should be adjusted to maintain the same temperature reading. The air flow may have to be increased to accomplish this.
- On a belt-drive system, the blower pulley and/or motor pulley may be changed; however, the electrical current flowing through the motor must not be changed to exceed the nameplate rating. A larger blower motor may be used. On a direct-drive system, in most cases the blower motor will not need to be replaced; however, the speed of the blower motor may have to be increased.

### CAUTION

When installing the heat exchanger, be sure none of the existing system safety controls are disabled.

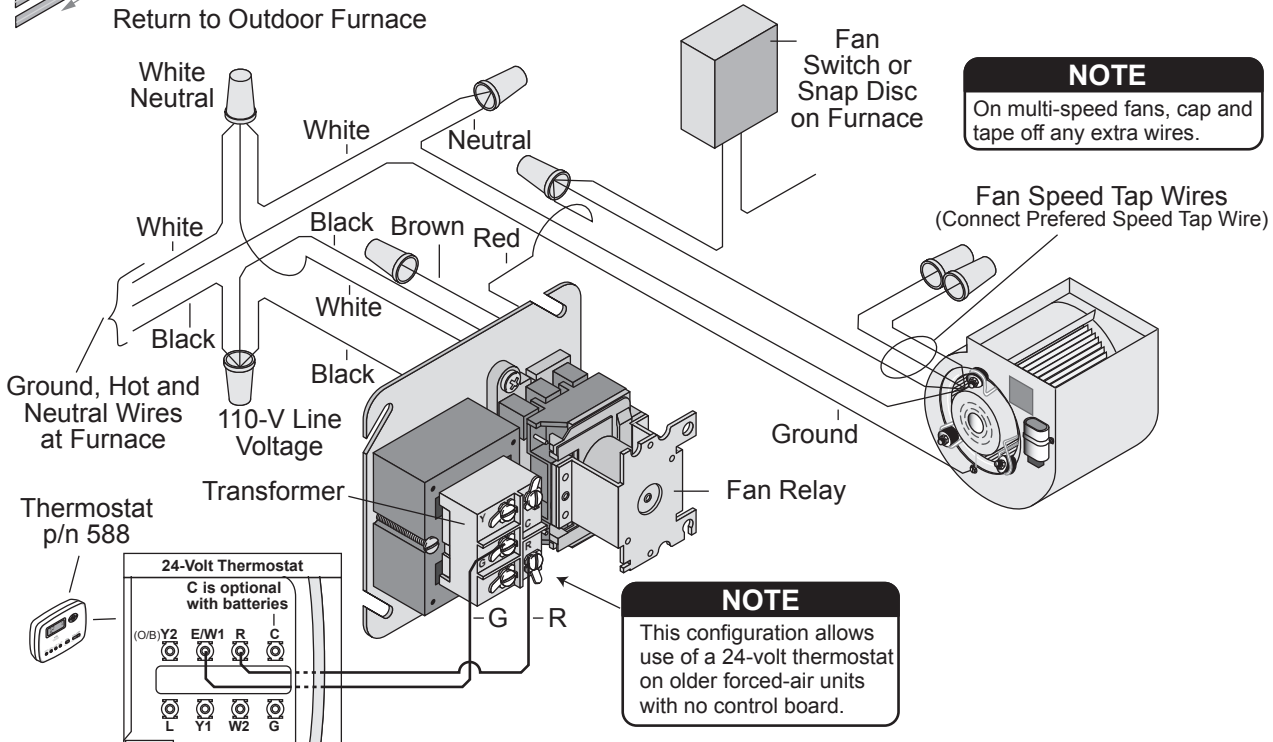
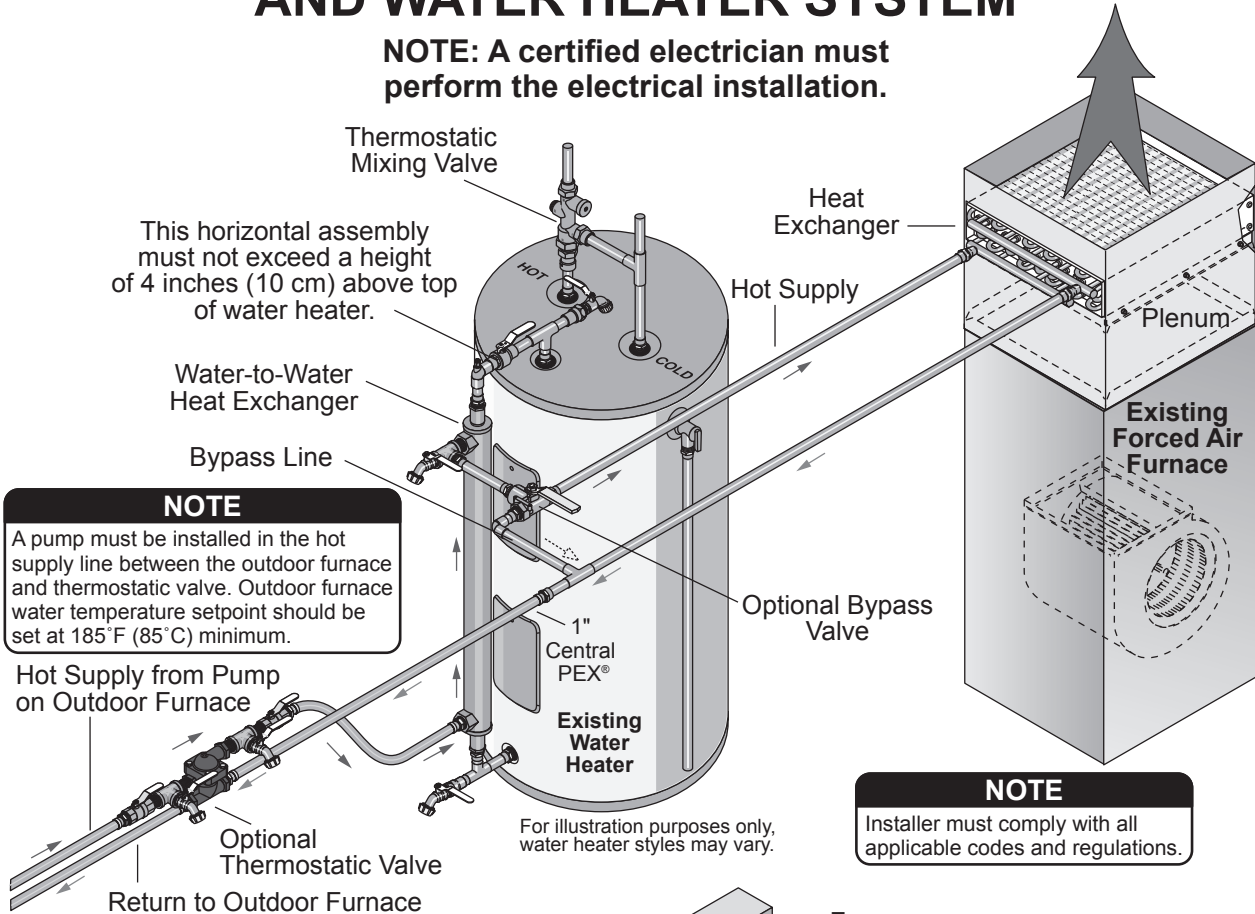
**NOTE:** Any electrical installation should be done by a certified electrician in accordance with all applicable codes.

- Due to the internal circuitry of some thermostats, a snap disc temperature control may have to be installed on the heat exchanger manifold to provide an interlock for the air conditioner. This prevents the air conditioner from operating when the water temperature is higher than 140°F (60°C).



# WATER-TO-AIR HEAT EXCHANGER AND WATER HEATER SYSTEM

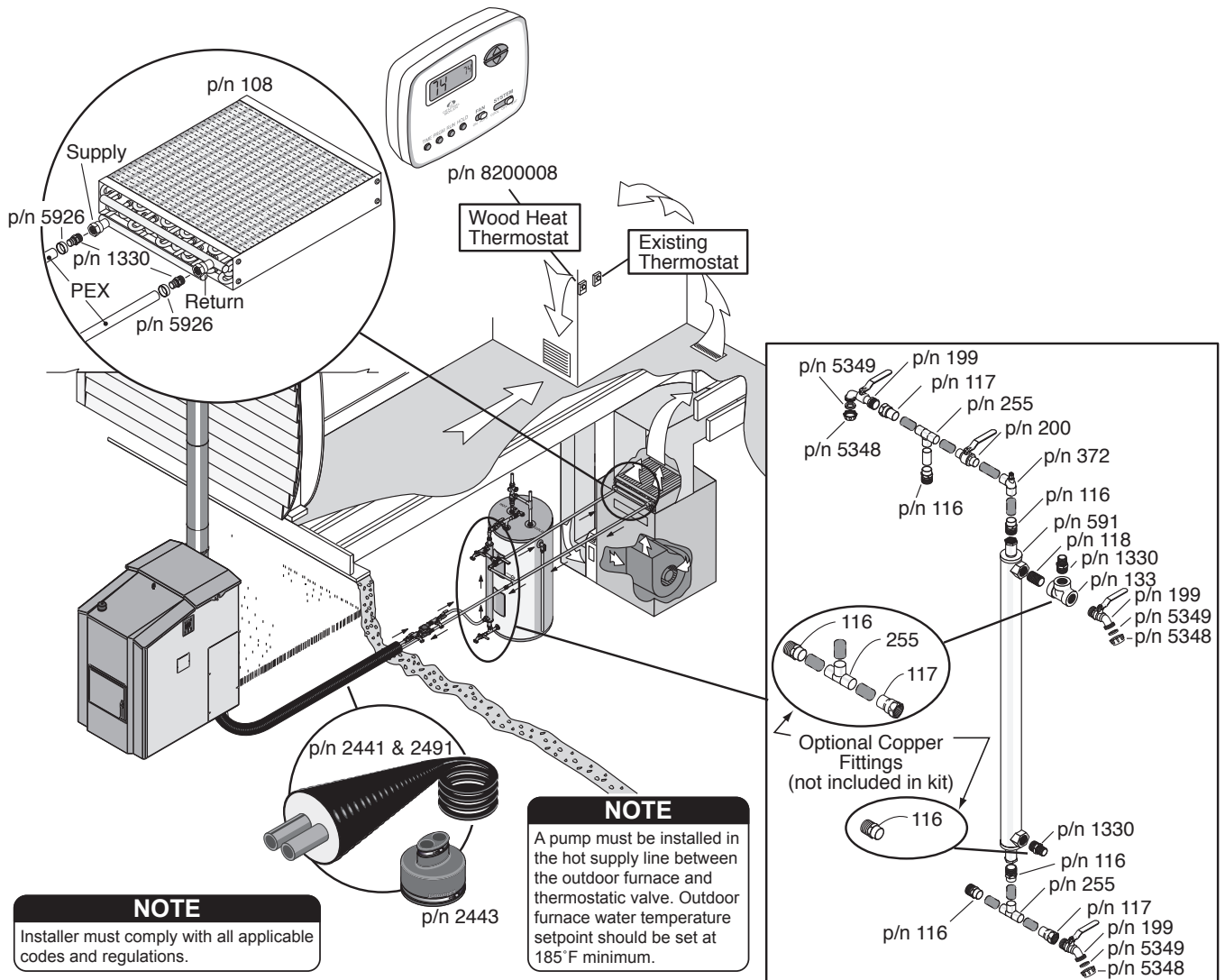
**NOTE: A certified electrician must perform the electrical installation.**



For illustration purposes only.

Fig. 33

## Forced Air Heating and Water Heater System





## Thermostatic Controls

There are several methods for installing thermostatic controls for this type of installation.

1. If the forced air furnace has connections for control of the blower from a thermostat or switch, the simplest method is to add a second 24-volt thermostat. Wire the thermostat to the forced air furnace so that upon a call for heat, the thermostat closes the connection between power (usually 'R' or red) and the fan terminal (usually 'G' or green). By setting the new thermostat to the desired room temperature, it will control when the blower operates, drawing heat from the outdoor furnace. The existing thermostat should be set a few degrees below the new thermostat. This setting will be the temperature at which the existing forced air heating system will operate if the outdoor furnace is out of fuel. Refer to Fig. 34 for one possible arrangement.

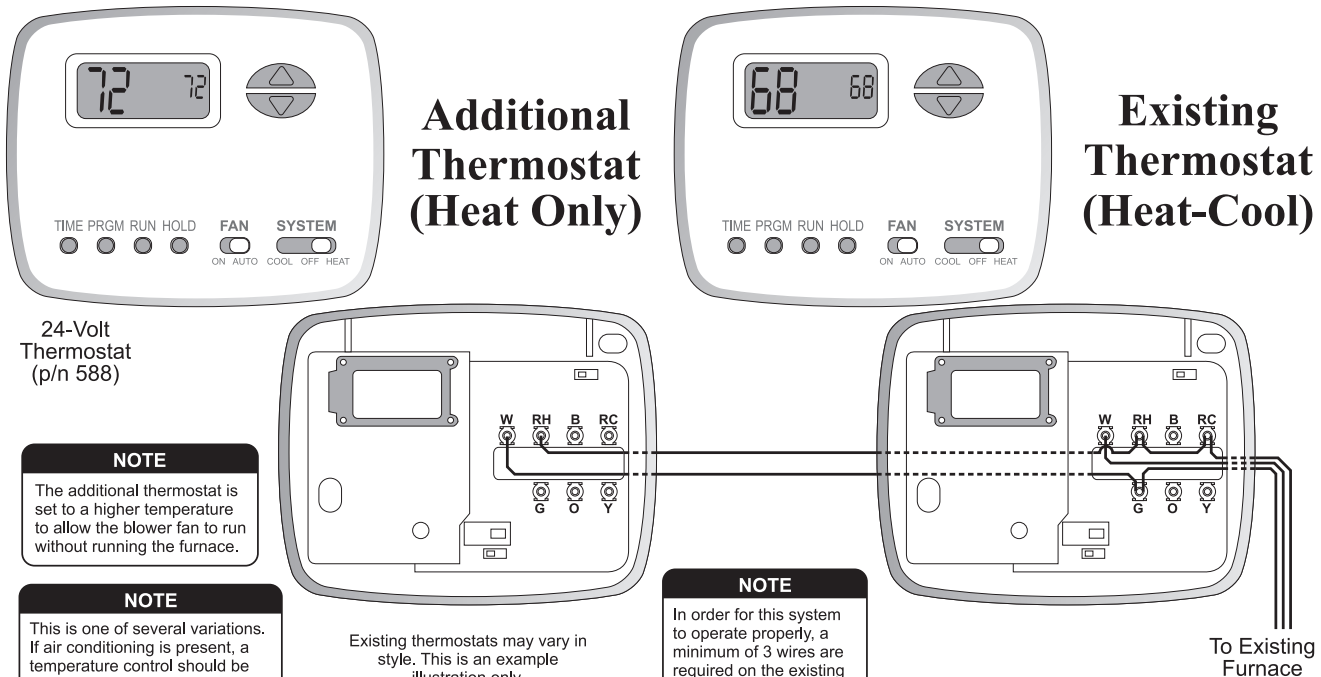
2. An alternative method is to install a line voltage thermostat to control the blower on the forced air furnace. In this installation, a 120-volt wire is run from the thermostat to the forced air furnace. One wire is connected to the hot (line feed) and the other wire is connected to the forced air furnace blower wire. A low water temperature switch may be installed to shut off the blower if the temperature of the water is too low. The switch is connected in series to the wire coming from the line voltage thermostat and must be installed so that it does not affect the forced air system thermostat.

**NOTE: If the low water temperature switch is not installed, the fan will run continuously even when the outdoor furnace is out of fuel. This will keep the water in the outdoor furnace approximately the same temperature as the air in the house (to prevent the water in the outdoor furnace from freezing). This will also work with the thermostatic valve installed.**

Fig. 34

## Wiring Diagram for p/n 588 (Forced Air Application)

Connect a wire from "R" on your existing thermostat to "R" on the additional thermostat then connect a wire from "G" on your existing thermostat to "W" on the additional thermostat.



## HEATING MULTIPLE ZONES OR BUILDINGS

A single pump and manifold may be used to heat more than one zone as long as the return water can be maintained above 150°F (66°C). If the return water temperature can not be maintained above 150°F (66°C), then a separate pump should be used for each zone. A thermostatic bypass valve must be installed to ensure that the water temperature in the outdoor furnace is maintained above 150°F (66°C).

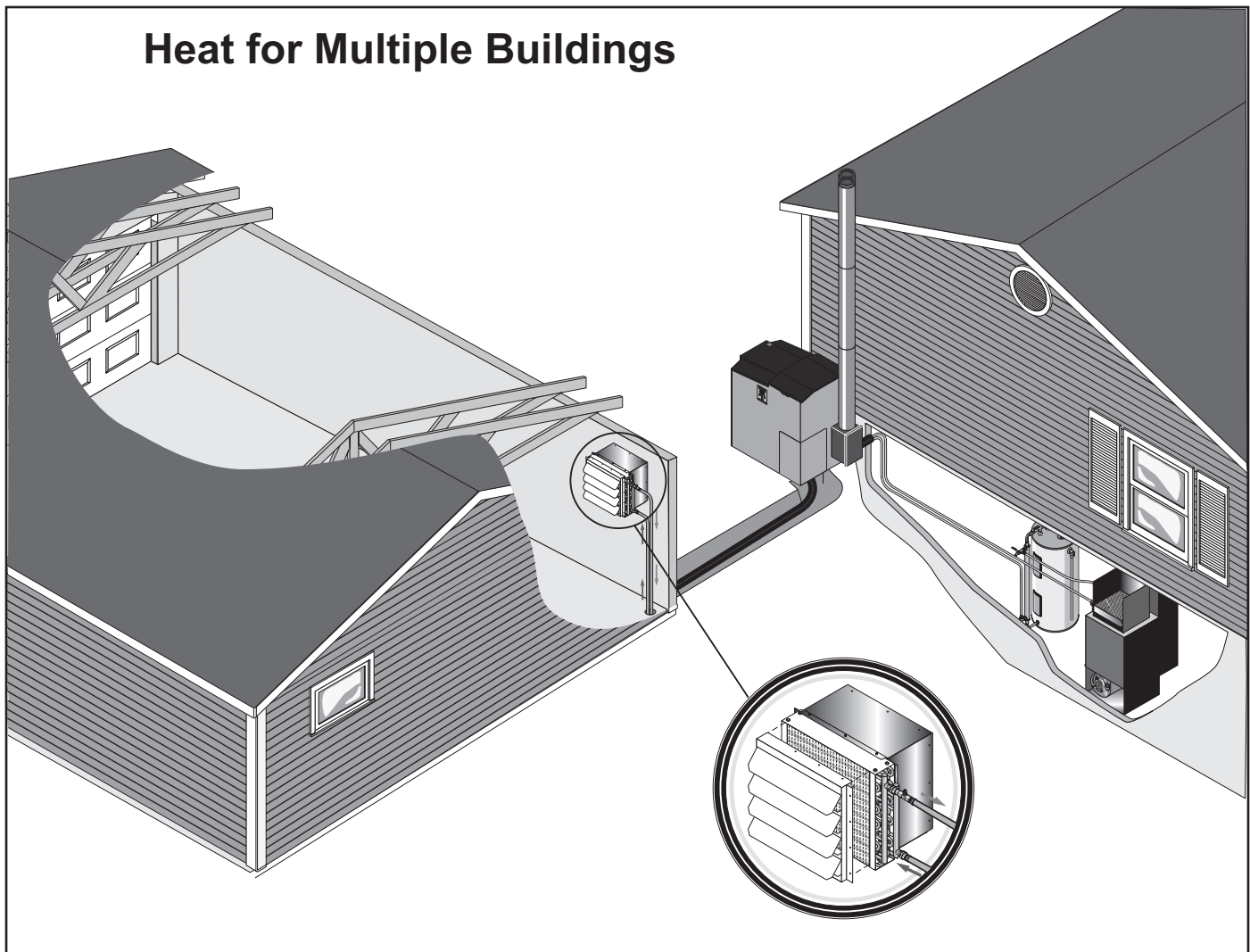
If a manifold is used, a swing check valve (p/n 296) should be installed in the line at the outlet of the pump. The swing check valve must be installed in a vertical position with the direction of flow as designated by the arrow on the swing check valve. This will prevent reverse circulation and loss of heat on multiple zones if one pump fails. Hose bibs (p/n 199) should be installed on each supply and return manifold to allow for purging air from the zones.

The Maxim offers two sets of outlets (for up to two zones or buildings without the need for manifolds) for mounting up to two pumps. Fig. 35 illustrates one possible configuration.

**NOTE:** If the outdoor furnace is unable to maintain a water temperature of 150°F (66°C) or higher, inspect the thermostatic valve and replace if necessary.

**NOTE:** A properly-sized backup furnace or boiler should be configured to provide heat if the outdoor furnace is out of fuel or the heat load exceeds the capacity of the outdoor furnace.

Fig. 35



## HYDRONIC INSTALLATIONS

**NOTE:** It is recommended that the circulation pump in all hydronic systems be located in the hot supply line, not in the return line (see Fig. 36 and 37).

Evaluate the existing hot water heating system before starting the installation. If the existing hot water heating system has been unable to maintain the temperatures in the home at any time during cold weather before installing the outdoor furnace, then the hot water heating system is not adequate. More baseboard or other type of heat exchanger must be added.

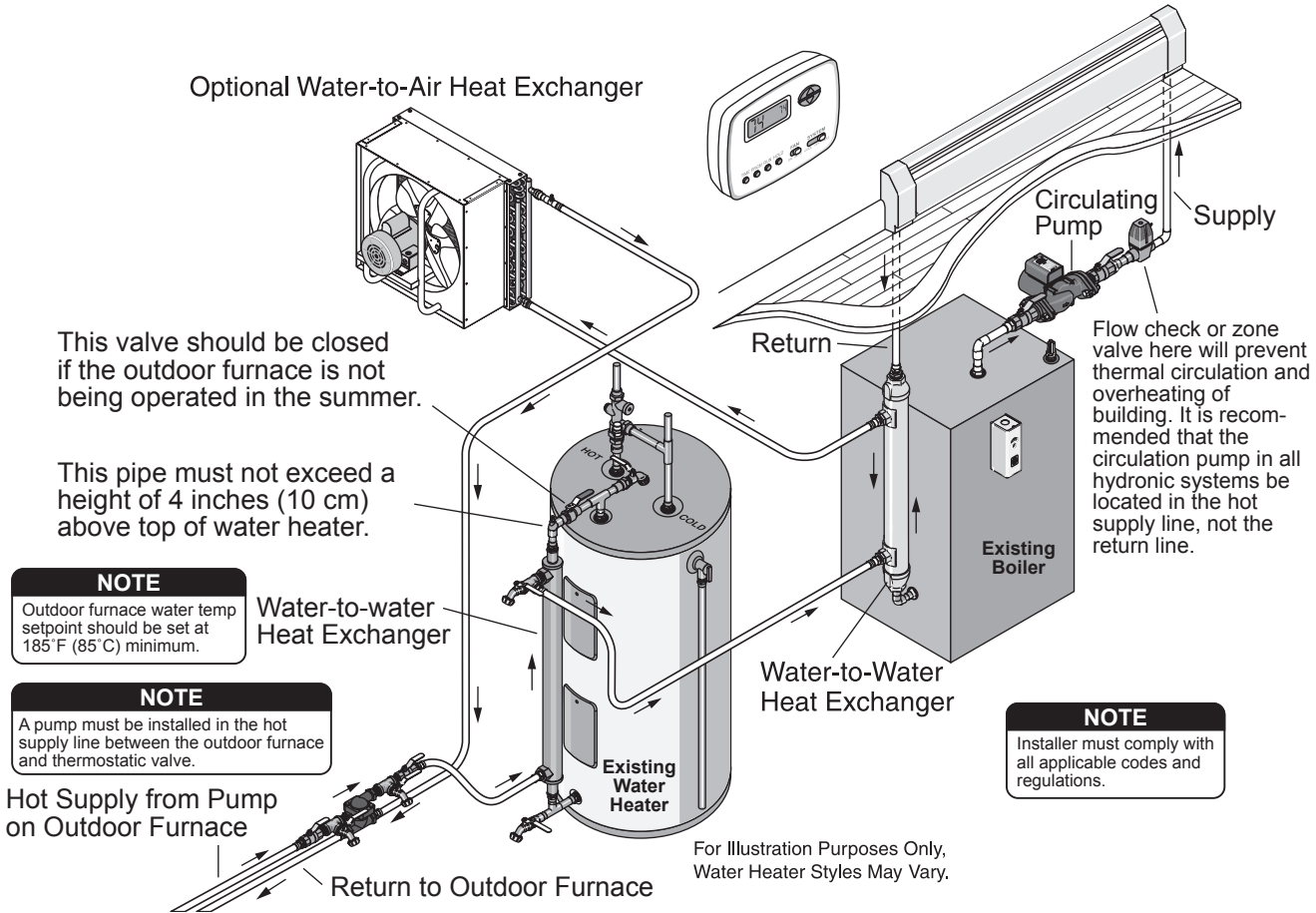
If a water-to-water heat exchanger is to be used with an existing heating system, the existing heating system must be able to adequately heat the building with a water temperature of approximately 165°F (74°C). Some existing finned tube baseboard hot water heating systems are designed to operate with water temperatures up to 220°F (104°C) or higher.

If the existing heating system is marginal or designed to operate with water temperatures above 165°F (74°C), there are alternative installation procedures that will make the existing system work very well with the outdoor furnace. These include:

1. Add more finned tube water baseboard heaters or panel radiators.
2. A water-to-air heat exchanger with a thermostatically controlled fan can be installed in the lower part of the building being heated (Fig. 36). This can increase the amount of heat added to the building, helping to maintain a constant temperature. This heat exchanger can be added in the return line of the system after the water-to-water heat exchanger.
3. An additional radiant heating circuit can be added to heat areas that require additional heat.

Fig. 36

### Water-to-Water Shell & Tube Exchanger with Existing Boiler



## Pressurized Water System Installations Water-to-Water Heat Transfer System

To keep the existing system pressurized, a plate exchanger or tube & shell water-to-water heat exchanger installed in the return line of the existing system may be used (see Fig. 37 and 38). The water from the existing system passes through the heat exchanger when the thermostat calls for heat. The water from the outdoor furnace circulates through the other side of the heat exchanger continuously.

It may be necessary to lower the water temperature at which the burner in the existing boiler starts to a setting that prevents the burner in the existing boiler from cycling on when the outdoor furnace is heating the home. Another option is to install a thermostatically controlled interlock switch that prevents the burner in the existing boiler from operating when the water temperature in the outdoor furnace is above 150°F (66°C).

Water-to-water heat exchangers will produce transfer temperatures approximately 20°F (11°C) less than the outdoor furnace water temperature; therefore if the outdoor furnace water temperature is 185°F (85°C), it will produce approximately 165°F (74°C) of water temperature transfer. The temperature controller on the outdoor furnace may be adjusted to allow the outdoor furnace to reach water temperatures up to 195°F (91°C). Each system will vary in water temperature transfer depending upon the heat load of the existing heating system.

The addition of a wraparound pump with a water-to-water heat exchanger (see Fig. 37) may increase heat transfer by allowing circulation continuously through the existing boiler and heat exchanger. This will maintain the maximum temperature in the heat exchanger for heat transfer to the existing boiler. Note the water flows in opposite directions through the heat exchanger.

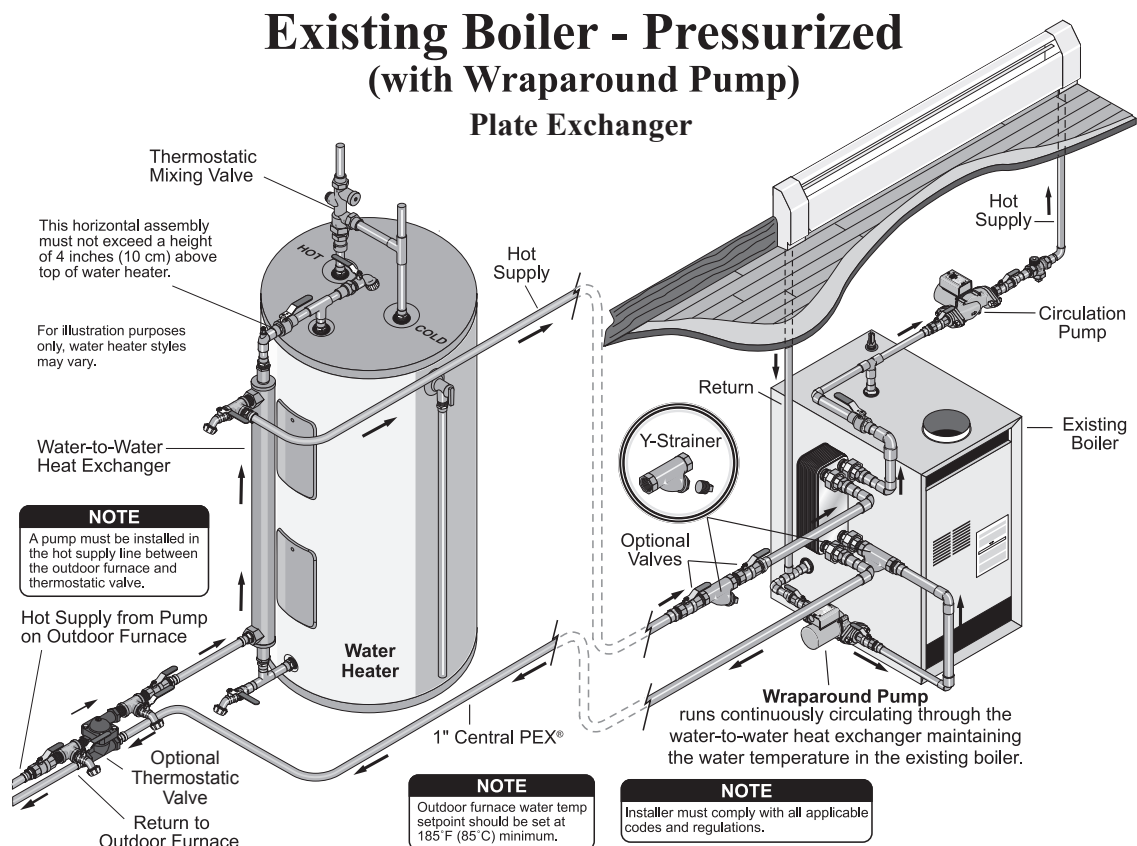
With this type of installation, the exchange temperature may be more than 165°F (74°C) and may eliminate the need for additional baseboard heaters, panel radiators or heat exchangers.

When installing water-to-water heat exchangers, be sure to flush any rust particles or sediments out of the existing boiler and install a Y-strainer as illustrated in Fig. 37. Also be sure to add MolyArmor 350 (p/n 2900631).

A Taco 007 or 014 pump can be used as a wraparound pump when a plate exchanger is installed. A Taco 009 or 014 pump should be used when a shell and tube heat exchanger (i.e., p/n 148, 151 or 177) is installed.

**NOTE: See the Hydronic Component Selection Guide for more detailed information.**

Fig. 37





## Vented System Installation

The Maxim may be connected directly into an existing hot water system, changing it to an atmospheric vented system.

**NOTE: Any changes in the existing boiler and/or system should be done by a certified installer in accordance with applicable codes. Be sure the system water is properly maintained with MolyArmor 350 (see Water Quality and Maintenance section).**

The hot supply line from the outdoor furnace can be connected into the top of the existing boiler and returned to the outdoor furnace from the bottom of the boiler (see Fig. 38). Use one pump to continuously circulate the water from the outdoor furnace through the existing boiler and back to the outdoor furnace.

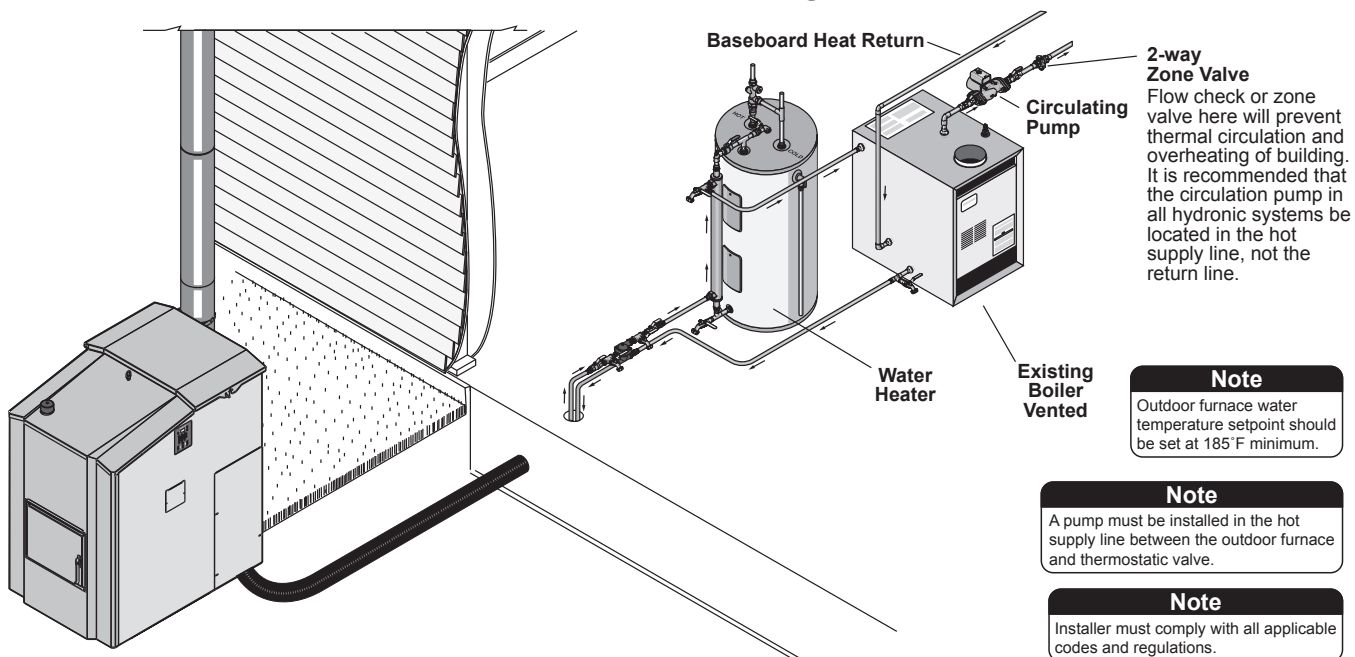
### CAUTION

**The outdoor furnace must NEVER be pressurized. The vent cap must always be loose. Do not extend the vent pipe. The outdoor furnace will be damaged if it is pressurized.**

When the existing system is connected to the outdoor furnace as illustrated in Fig. 38, the circulating pump(s) in the existing system must be located in the hot supply line(s), **not** in the return line(s). A flow check or zone valve will prevent thermal circulation and overheating of building.

Fig. 38

### Direct Connection to Existing Boiler



It is very important to eliminate all air and water leaks (valve packings, bleeders, etc.) and purge all air from the existing system.

1. **After filling the outdoor furnace** (see Initial Start-Up Procedures section) and existing system with water, purge the air from the indoor system by **closing the valves on the outdoor furnace**; then pressurize the indoor system with water from the domestic water line.

### CAUTION

**Do not apply more pressure to the indoor system than the pressure relief valve on the existing boiler is rated for.**

2. Bleed air from the pressurized indoor system; then operate the circulating pump(s) on the indoor system. Perform this procedure twice. If any auto float vents are used in the existing system, they must be capped off tightly after the air bleeding is completed. This eliminates the possibility of allowing air to enter after the system is depressurized.
3. When the indoor system is completely purged of air, close the valve on the water line used to pressurize the indoor system. If any air is trapped in the system, it can reduce water flow. This will prevent the system from heating properly.
4. Open valves on the outdoor furnace, turn on the pump and proceed to start the fire in the outdoor furnace.

## Direct Circulation Baseboard Installation

Baseboard heaters, as either the main source of heat or as supplements to forced-air or boiler applications are easily plumbed into the water lines from the outdoor furnace.

Refer to Fig. 39 and 40 for proper plumbing methods.

Fig. 39

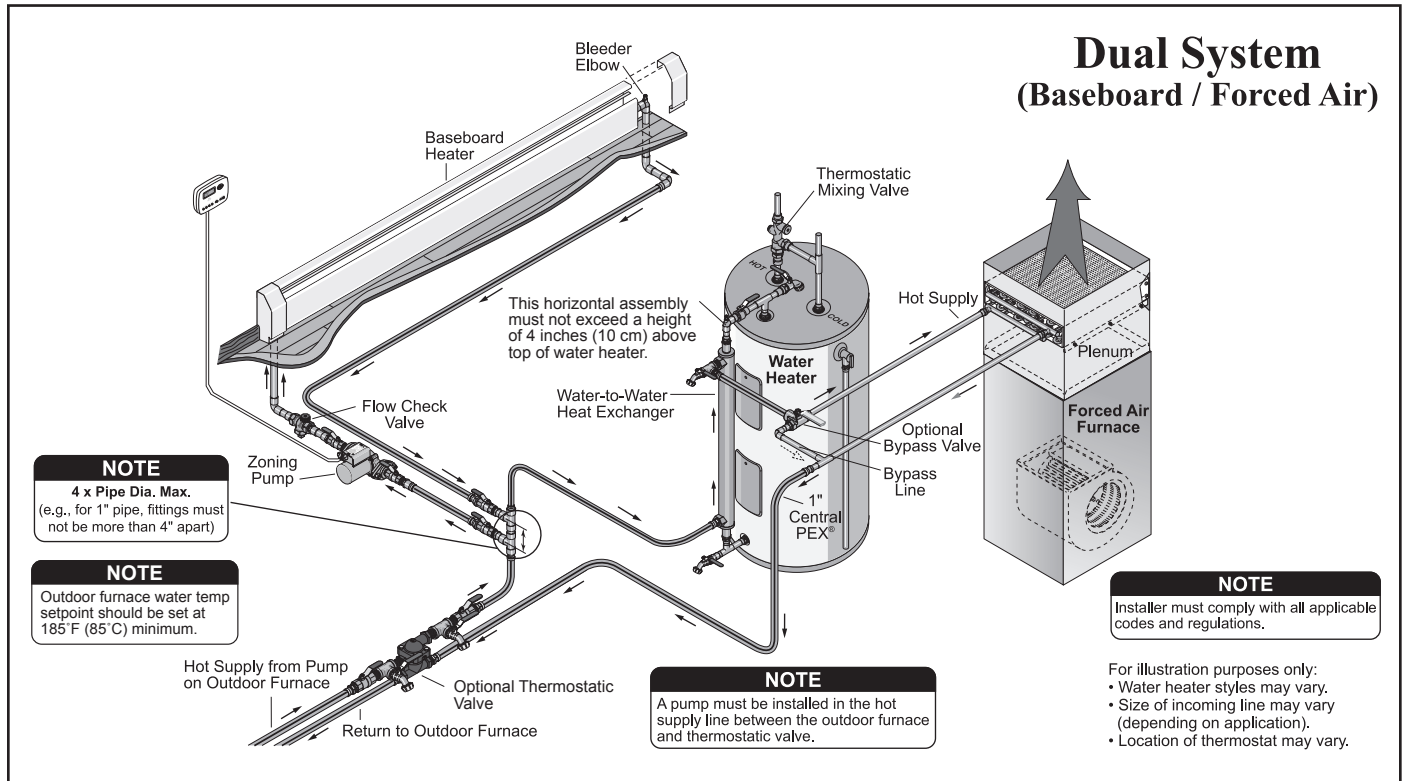
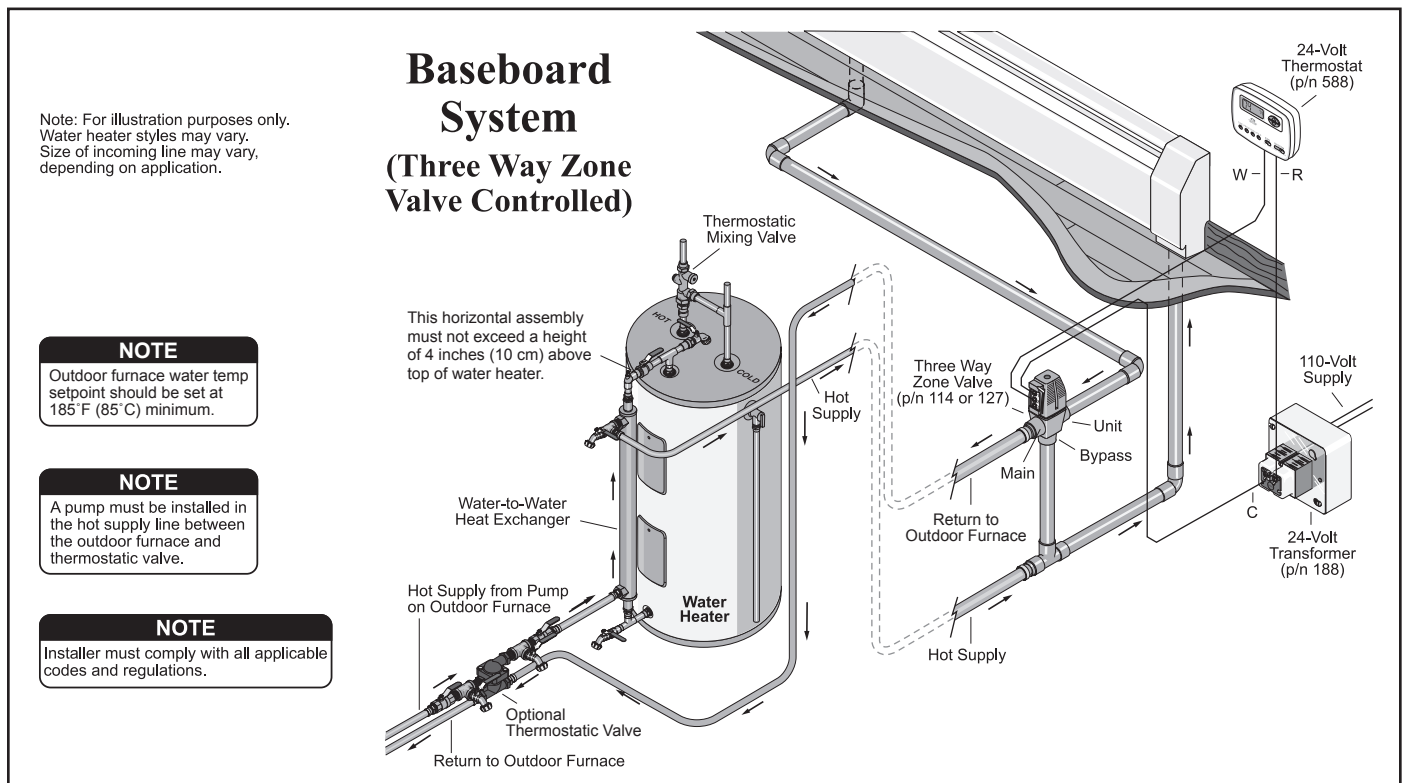


Fig. 40



## Radiant Floor System Installations

Radiant heat can be a great option for new construction or for adding to an existing home if the floor joists are exposed (as in an unfinished basement). Piping may be installed in a wide variety of configurations and locations including, but not limited to, the following:

- In a concrete slab
- Within the subfloor system (e.g., Gyp-Crete®)
- Within the floor joist system
- Within the walls or ceilings

Carefully consider each of the following before beginning construction and installation:

1. When installing piping between floor joists (16" or 41 cm on center) run two 1/2" pipes between each joist. Insulate below the piping to prevent excessive heat in the lower level.
2. Proper insulation is key to effective radiant heating and controlling large heat demands. Heat from this type of system radiates equally in all directions. As an example, if piping is installed in a slab, the ground below the slab must be dry and well-insulated. If not properly insulated, nearly 50% of the heat will be wasted warming the ground below the slab. Two inches (5 cm) of blueboard insulation is recommended. Two 1" (2.5 cm) layers of blueboard can be used. This allows lapping of the joints in the 4' x 8' (122 x 244 cm) sheets.

**NOTE: Do not use beadboard (expanded polystyrene), bubble foil or roll-out foam insulation.**

**NOTE: A minimum of one inch (2.5 cm) of insulation should be used. Two inches (5 cm) of insulation with vapor barrier below the insulation is recommended.**

3. Areas with high water tables need to be prepared properly to prevent contact between the ground water and insulation.

**NOTE: For examples of radiant heating systems using 1/2" piping in the loops, refer to Fig. 42 through Fig. 45.**

4. The spacing of each circuit is 12" (30.5 cm) between pipes. The water circulates in opposite directions to provide an even distribution of heat. The mixing valve regulates the temperature of the water circulating through the loops by mixing return water with the hot supply water. In applications where high heat loss is expected, loop spacing may be reduced to 10" (25 cm) or less. If additional information is desired, contact your dealer.

**NOTE: The longer the loop length, the lower the flow rate and the lower the heating capacity. Loop lengths greater than 350 feet (107 m) are not recommended.**

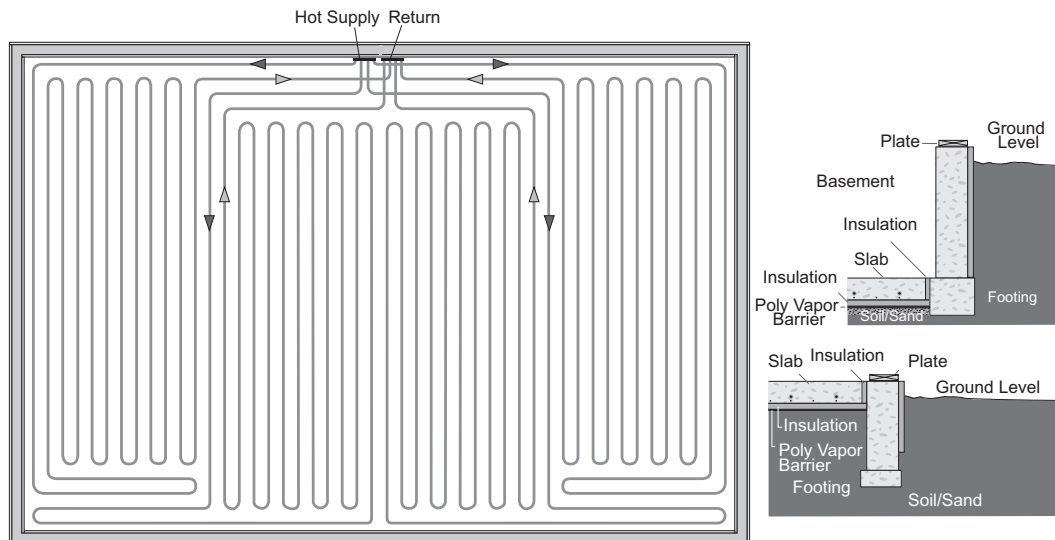
**NOTE: The temperature of the water used in radiant heating should be determined by the installer in accordance with the application.**

5. It is not uncommon that it can be very difficult to get a concrete slab up to temperature in late fall or early winter in a new building that is not completely sealed and not well insulated. Once the building is completely sealed and well insulated, bringing the slab up to temperature can still take a considerable amount of time and fuel; however, once warm, fuel consumption will be reduced if the concrete slab and building are insulated properly.

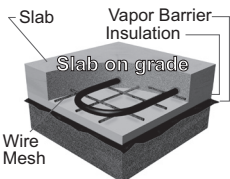
**NOTE: For zone installations, refer to Fig. 42 (multi-zone) or Fig. 44 (single zone).**

Fig. 41

## Radiant Floor Heat (For Slab on Grade or Basement)



**NOTE: If the temperature of the concrete slab is below freezing (32°F), there must be adequate antifreeze in the system, or the slab must be pre-heated, before water is circulated through the radiant slab system.**



2" Blueboard Styrofoam® is recommended (minimum of 1" Blueboard Styrofoam®).



Fig. 42

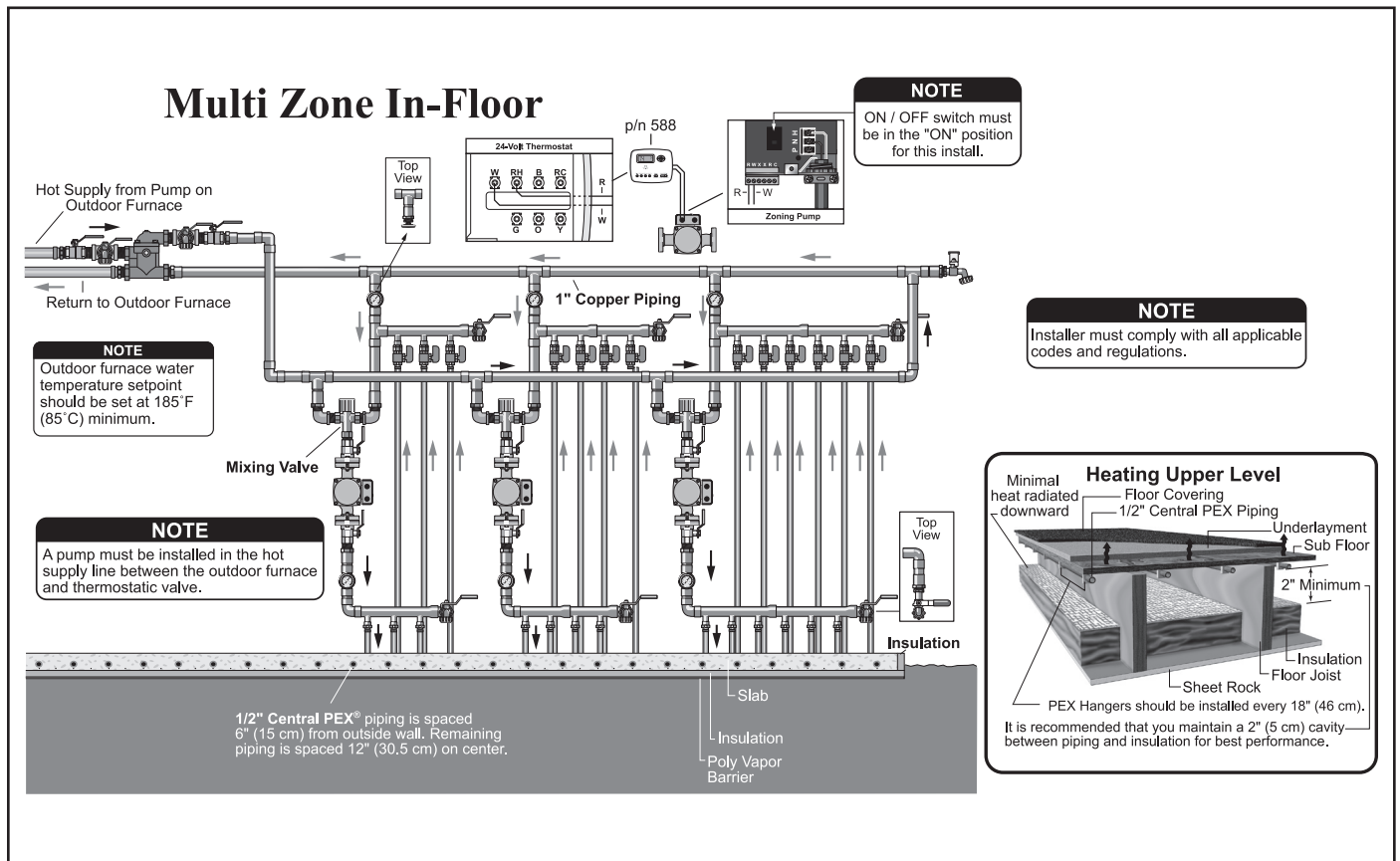


Fig. 43

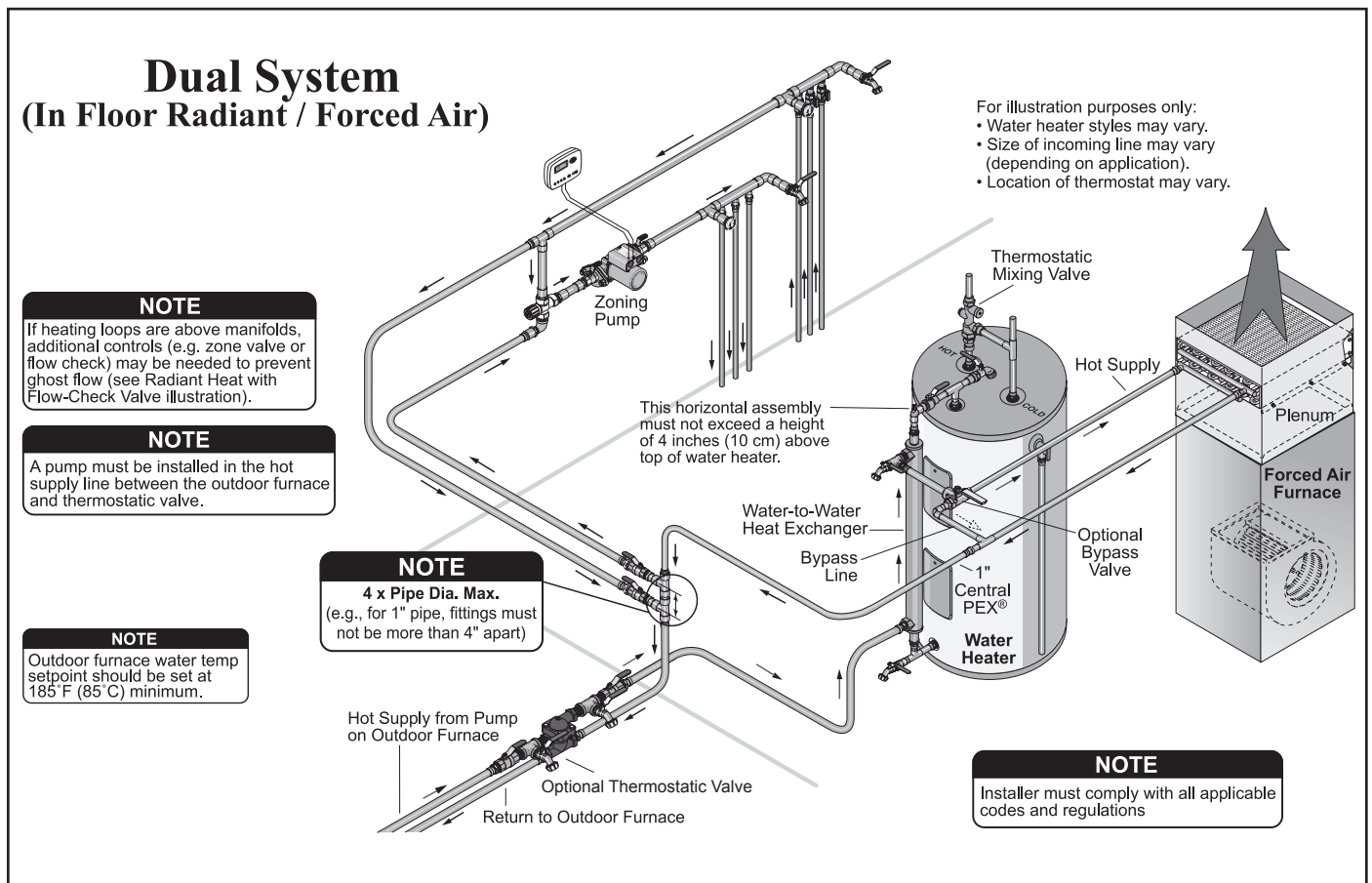


Fig. 44

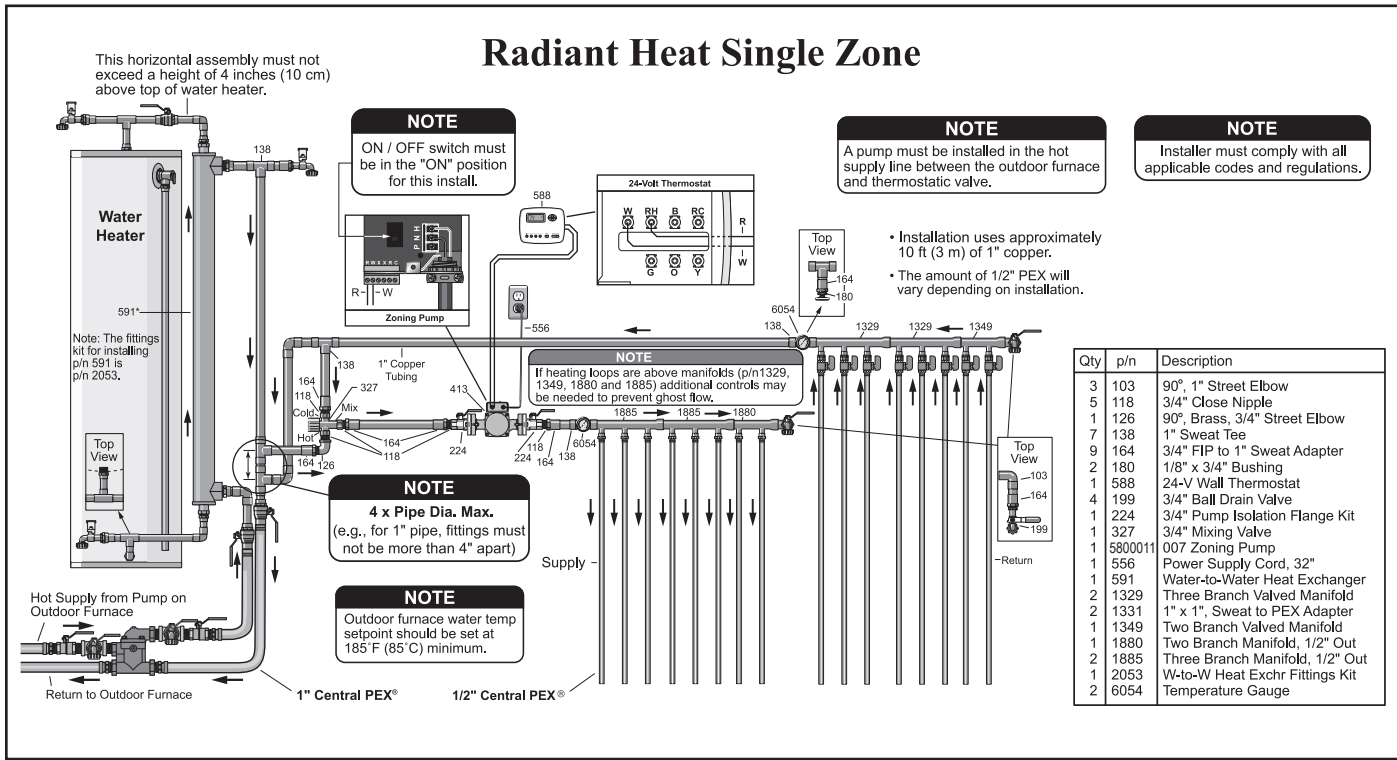
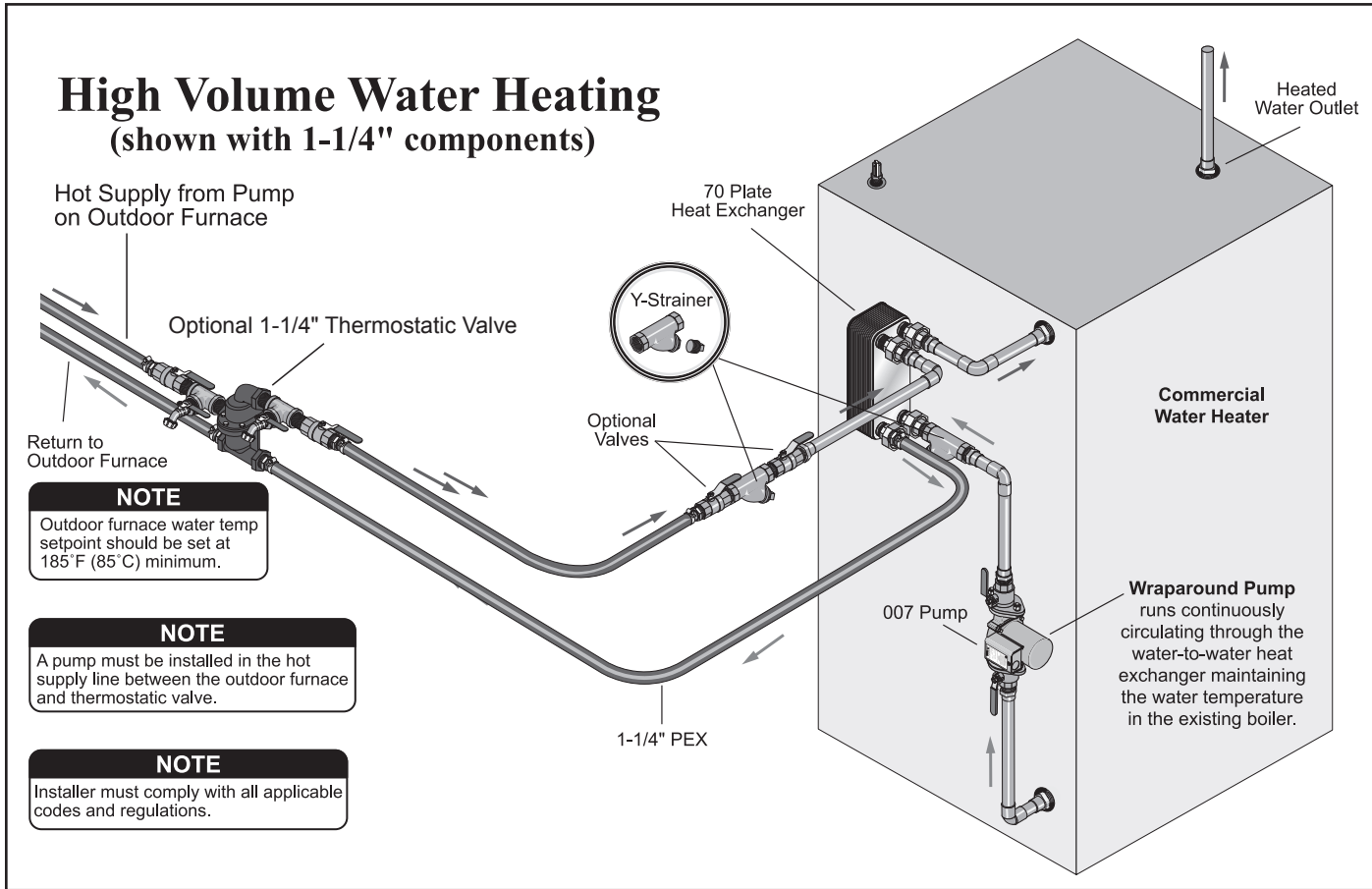


Fig. 45



## Pool and/or Hot Tub Heating

Valves should be installed so the heat exchanger can be isolated and bypassed when shock-treating or adding chemicals to a pool or hot tub (Fig. 46). Incorrect chemical concentrations can cause rapid corrosion to the heat exchanger. Bypassing the heat exchanger is recommended until the pH has stabilized between 7.2 and 7.8.

If the swimming pool or hot tub is salt water treated, the heat exchanger should be a shell and tube type (p/n 148, 151 or 177). See the Hydronic Component Selection Guide for more detailed information.

### CAUTION

Do not install a swimming pool heat exchanger inside a home or building below the level of the pool as a damaged heat exchanger may result in extensive flooding and draining of the pool.

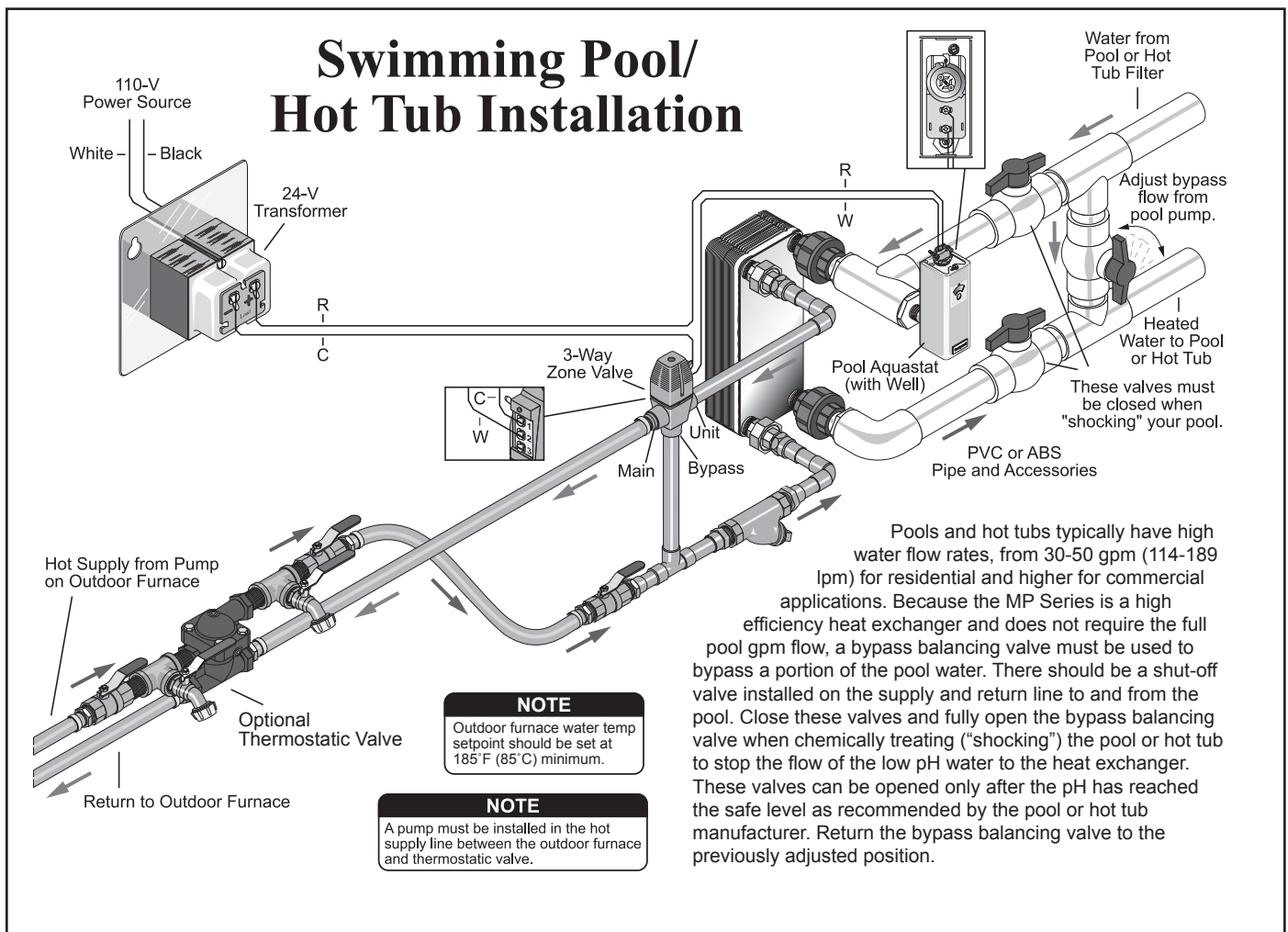
### WARNING

Do not use automotive or ethylene glycol antifreeze in an outdoor furnace connected to a swimming pool heat exchanger as a damaged heat exchanger may cause severe personal injury, death, or substantial property damage.

### CAUTION


Do not operate the outdoor furnace frequently or for extended periods of time with the water temperature below 150°F (65°C) as this will result in more condensation in the firebox that can lead to corrosion.

Fig. 46



## SECTION 7 – FILLING SYSTEM WITH WATER AND PURGING AIR

Before firing the outdoor furnace for the first time, perform the following important steps:

1. **Check for leaks.** Close the valves on the outdoor furnace before checking for leaks. Do not pressurize the outdoor furnace. Pressure-test the entire plumbing system. Apply 50 psi (3.5 kg/cm<sup>2</sup>) of air pressure for thirty minutes and closely monitor for any pressure loss. Inspect all fittings and hose ends for any signs of leakage using leak detection solution (leak soap); repair as necessary.
2. **Cover Supply and Return Lines.** Backfill the trench for the supply and return lines. Enclose the area where the supply and return lines enter the outdoor furnace. Do not leave the PEX hot supply and return lines exposed to sunlight as exposure to UV rays will damage them.
3. **Add MolyArmor 350.** Add the recommended amount of MolyArmor 350 through the vent pipe on the outdoor furnace before filling with water to immediately begin to protect the steel. Refer to Water Quality and Maintenance.
4. **Turn the FireStar controller on** by pressing the **Power**  button. The LED display should flash **LD** to indicate that the water level is below the sensor.
5. **Fill with water, purge air from system and verify flow direction of the water.** See Filling Outdoor Furnace with Water and Purging Air for details.
6. Install the vent cap. The vent cap must fit loosely over the outdoor furnace vent.

### FILLING OUTDOOR FURNACE WITH WATER AND PURGING AIR

**NOTE:** The items referred to in this procedure correspond to the items in Fig. 47. Refer to Fig. 47 when performing these steps.

All air must be purged from the water lines when filling the system. Also, the circulation pump(s) must be installed in the hot supply line(s).

**NOTE:** If using the valve on the water heater to fill the outdoor furnace, flush the water heater to remove all sediment before filling the outdoor furnace.

**NOTE:** If the outdoor furnace is being filled with water when the temperature is below freezing, circulate the water immediately after filling to prevent freezing the water lines.

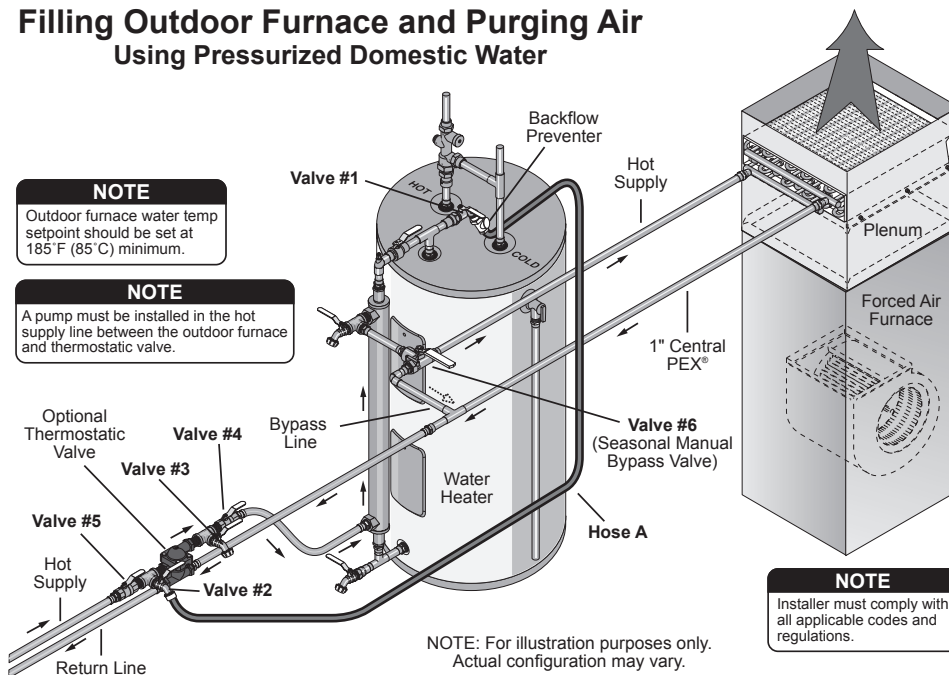
**NOTE:** Be sure to fill the outdoor furnace with water of good quality (softened water, if possible). See Water Quality and Maintenance section.

Use the procedure in this section to fill the outdoor furnace with water and purge the air from the system. All valves in the outdoor furnace system that allow circulation through each circuit should be open before starting. Perform this procedure on each pump circuit from the outdoor furnace.

**NOTE:** Add MolyArmor 350 (p/n 2900631) through the 2-inch vent pipe on the outdoor furnace before filling with water to immediately begin to protect the steel.

Fig. 47

### Filling Outdoor Furnace and Purging Air Using Pressurized Domestic Water





1. Connect the male end of garden hose A to valve #1 using the backflow preventer and two 3/4" female hose x 3/4" male pipe adapters (p/n 4928). Connect the female end of the garden hose to valve #2.
2. Close the valves on the hot supply and return lines of the outdoor furnace.
3. Close valve #4 and valve #5.
4. Open valve #1 and valve #2. This step begins filling the system with domestic water and purging the hot supply line and thermostatic valve.
5. Remove cap from valve #3 and open valve #3 slightly to purge air from valve body. Close valve #3 when air is purged.
6. Open valve #5.
7. Open the valve on the hot supply line of the outdoor furnace for 5 minutes; then close the valve. Water will purge air from the hot supply line. The valve and attached fittings on the outdoor furnace will become cold as water starts filling into outdoor furnace.
8. Close valve #5, #1 and #2.
9. Move hose A from valve #2 to valve #3.
10. Open valves #1, #3 and #4.

**NOTE: Skip to Step 12 if your system does not have a seasonal manual bypass valve (valve #6 shown in Fig. 35).**

11. Valve #6 (seasonal manual bypass valve) should be positioned to direct water through the heat exchanger first.
12. Open the valve on the return line of the outdoor furnace.

**NOTE: Skip to Step 14 if your system does not have a seasonal manual bypass valve (valve #6 shown in Fig. 35).**

13. As soon as the valve on the return line of the outdoor furnace is opened, turn valve #6 to the bypass direction for 30 seconds; then turn valve #6 back to previous position.

**NOTE: The heat exchanger manifold (lower manifold first) and fittings will become cold as water flows through the heat exchanger to the outdoor furnace.**

14. Allow outdoor furnace to fill until the controller no longer indicates **LD**.
15. Close valves #1 and #3. Disconnect hose A and replace caps on valves #1, #2 and #3.
16. Open the valve on the hot supply line of the outdoor furnace and valve #5.

**NOTE: The valves on the hot supply and return lines of the outdoor furnace, and valves #4 and #5 should all be open, allowing the pump to circulate heated water in the system. Start pump.**

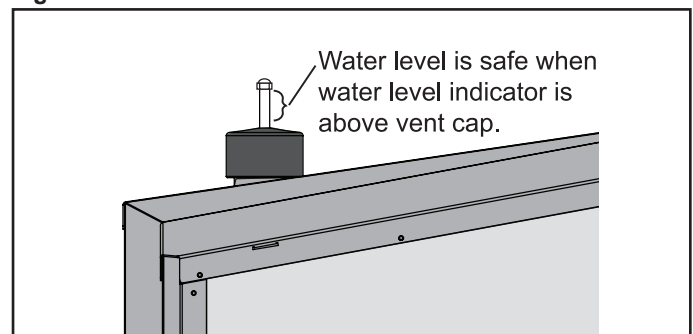
**NOTE: If there are multiple circuits connected to the outdoor furnace, repeat the process for each circuit.**

17. Refer to Firing the Outdoor Furnace to fire up the outdoor furnace.

## CAUTION

**Be sure the outdoor furnace is filled with water before firing. Water level is safe when the water level indicator rod is above the vent cap (Fig. 48). MolyArmor 350 must be added before the initial fill (see Water Quality and Maintenance).**

**Fig. 48**



18. Check the system for leaks again. Inspect all fittings and hose ends for any signs of leakage; repair as necessary. It may be possible to stop a very slow leak at a hose clamp by tightening the clamp after the system has warmed up and the poly becomes more pliable. It might also be necessary to install a second hose clamp with the screw positioned on the opposite side. Release the pressure upon completion of the test.

**NOTE: It should not be necessary to add water to the outdoor furnace more frequently than once every twelve months. If it is more frequent, either there is a leak in the system or the outdoor furnace is boiling because of improper operation or maintenance (see Troubleshooting Section). Be sure to locate and repair the problem immediately. Frequently adding water can cause deterioration in the water jacket. Each time water is added, refer to Water Quality and Maintenance for water testing procedures. If indicated by test results, add MolyArmor 350 as required. Deterioration due to improper operation and/or maintenance is not covered by warranty.**

# SECTION 8 – OPERATING INSTRUCTIONS

## Fuel Selection

Use only premium quality wood pellets.

**Feed rates and safe operation are not warranted with alternative fuels.**

### CAUTION

Do not use materials that will clog or jam the auger delivery system or damage the furnace. The heat exchanger must be cleaned regularly to maintain proper combustion air flow.

## Fuel Quality and Storage

Fuel must be stored in a container or building that prevents rain or other moisture from contact with the fuel.

### WARNING

Do not store fuel within the outdoor furnace installation clearances or within the spaces required for fueling, ash removal and other routine maintenance operations.

### CAUTION

If fans are used in the fuel storage area, they should be installed so as not to create negative pressures in the non-habitable building where the outdoor furnace is located.

## Other Important Information About Fuels

### CAUTION

Do not burn plastic, garbage, treated wood or fuels not listed for this outdoor furnace.

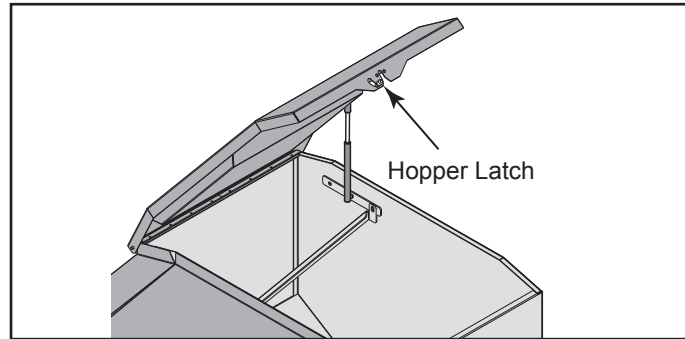
**NOTE:** Chloride or sulfurous gases will generate if plastic or rubber is burned and will mix with the moisture from the wood pellets to form hydrochloric or sulfuric acids in the firebox, creating corrosion.

**NOTE:** Wood pellets with a high sawdust content may cause a feed rate interruption. An interruption in fuel flow may result in an empty burn chamber, or if the blockage frees itself after the fire has gone out, a burn chamber full of unburned fuel.

## Filling the Hopper

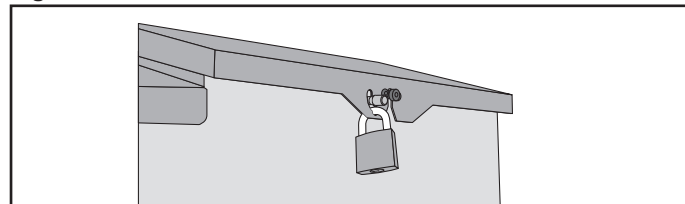
Open the hopper lid (Fig. 50) and add fuel. After filling, make sure the hopper lid is securely closed to prevent moisture from entering the hopper. Do not over-fill the hopper.

Fig. 50



**NOTE:** The hopper lid may be locked to prevent unauthorized access (Fig. 51).

Fig. 51



## Power Up

Press the Power button to turn the FireStar controller on.

## Basic Operation

The FireStar automatically controls combustion to allow the furnace to operate properly in most installations without adjustment.

## Lighting Instructions

Ignition is automatic. The fan will start and the ignitor will operate until the fuel in the burn chamber is lit.

## Auger Prime

If the hopper and auger are empty and fuel has been added, to expedite delivery of fuel to the burn chamber, start a prime cycle by pressing the Auger button. The prime cycle timer will count down. When starting from an empty auger, it may take two prime cycles. During the timer count down, prime can be stopped by pressing the Auger button again.

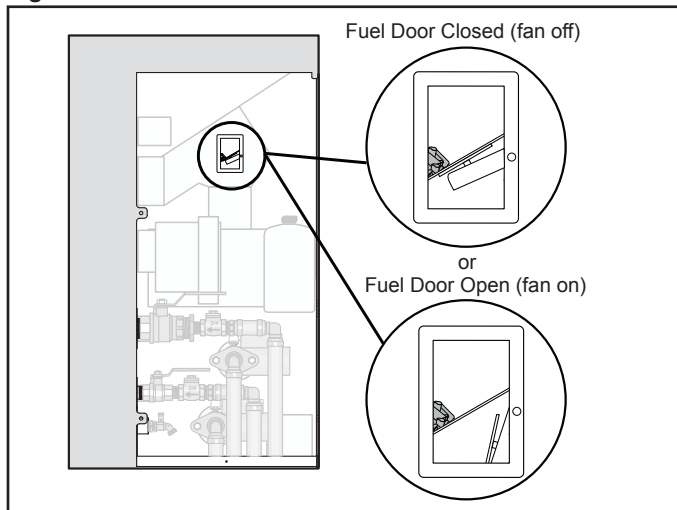
## Relighting after a Fire Out

If the hopper runs out of fuel (causing a Fire Out alarm on the controller), press and hold the Reset button to restart the ignition sequence (after filling the hopper with fuel).



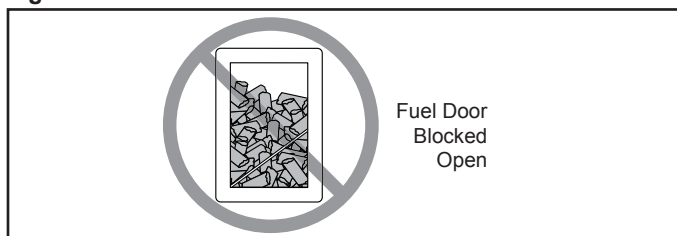
**NOTE:** Fuel must be flowing from the transfer auger to the burner auger when the burner auger is turning (see Fig. 52).

Fig. 52



**NOTE:** Fuel must not build up so that it prevents the fuel door from closing as shown in Fig. 53. This is an indication the burner auger is obstructed or has quit turning. If this condition exists, inspect the burner auger and clean or replace as necessary. If condition persists contact your Central Boiler dealer for more information.

Fig. 53



### FireStar Controller

Settings on the combustion controller can be adjusted to optimize the performance of the Maxim for a variety of different conditions. See the FireStar Operation Manual for instructions on changing the controller and for more information.

### Operating Precautions

**NOTE:** If the controller is flashing **LH** the system senses a low water condition. This outdoor furnace is equipped with an automatic shut down system if the water level falls to an unsafe level. The water level in the outdoor furnace is safe when the water level indicator rod is above the vent cap (see Fig. 56).

1. Do not burn garbage, gasoline, rubber, engine oil, naphtha, plastics, treated wood, cord wood or combustibles other than the fuel specified.
2. Do not store combustibles within the installation clearances listed on the Important Precautionary Information page. Be sure to leave a safe amount of room for cleaning out ash without causing a fire hazard. **Keep the area around the outdoor furnace clear of combustible materials. Combustible debris may be easily ignited if embers spill out of the firebox.**
3. The outdoor furnace water jacket must not be allowed to pressurize. Inspect the vent cap periodically for any obstructions or restrictions. The vent cap must fit loosely over the vent (Fig. 54). Do not extend or connect anything to the vent pipe.

Fig. 54



4. All cover plates, enclosures and guards must be secured at all times except during maintenance, inspection, and servicing.
5. In case of a power outage, a small generator can provide enough electricity to operate the system.
6. If any questions should arise that cannot be answered by the information in this manual, be sure to contact either your dealer or qualified installer.

## Smoke in Hopper

How air flows through the furnace is an important part of optimal operation. Smoke in the hopper is an indication that the air flow through the furnace is restricted, obstructed or different than it should be.

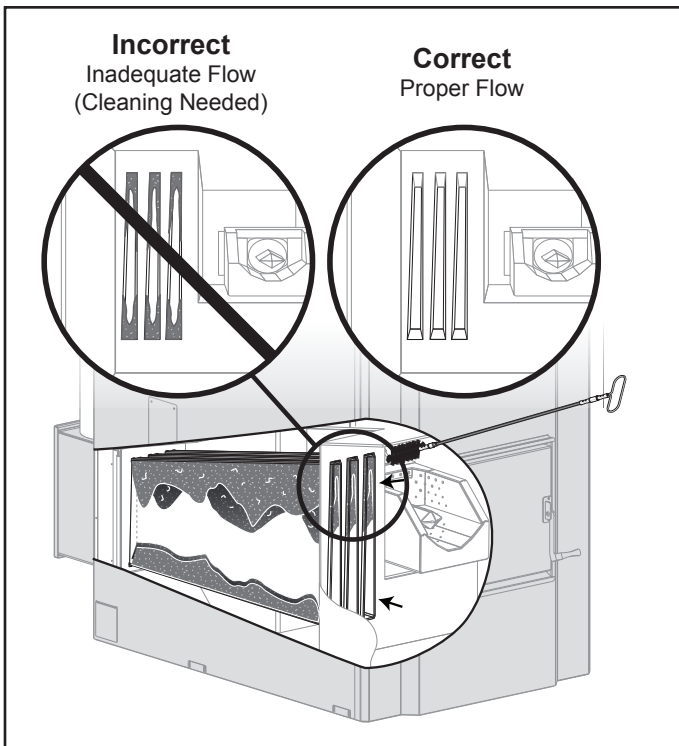
### CAUTION

**Operating for extended periods of time with air flow through the furnace restricted (i.e., smoke in the hopper) can damage components in the furnace.**

If smoke in the hopper occurs, check the following:

- **Heat exchanger obstructed** - clean the heat exchanger (see Fig. 55).
- **Aerator covered by ash** - do not allow ash in the burn chamber to accumulate over the aerator. Use the cleaning rod to pull ash forward to ash collection area.
- **Carbon buildup** - inspect the burner auger where it enters the firebox for carbon buildup and clean if necessary.
- **Chimney is obstructed** - inspect the chimney and chimney connector and clean if dirty or obstructed. If a spark arrestor is installed, ensure it is not dirty or obstructed.
- **Chimney too short** - may need to increase the height of the chimney.

Fig. 55



# SECTION 9 – ROUTINE MAINTENANCE

## PREVENTIVE MAINTENANCE SCHEDULE

Regular maintenance and inspections can help extend the life of your outdoor furnace and prevent high-cost repairs. This table is meant to serve as a general guideline until you become acquainted with how the outdoor furnace operates with your specific application.

OPERATION	SERVICE INTERVAL						SEE SECTION
	Before first operation of season	Daily	Weekly	Monthly	Semi-Annually	Post Season	
Check water level.	●	●					9.1
Remove ash.			G	C			9.2
Inspect firebox and firebox ash area.	●				B		9.3
Inspect gaskets.	●					●	9.4
Inspect and clean heat exchanger, chimney transition.				C			9.5
Inspect and clean aerator and burn chamber.			A				9.6
Lubricate door and hopper lid hinge points.							9.7
Check thermal valve.					B		9.9
Test thermal valve.	●						9.10
Check pH and moly levels of water.	●					D	E
Check that the outdoor furnace is level.						●	F
Check fuel door operation.				●			9.8

- A When the outdoor furnace is new, daily for the first week.
- B When new, after one month, then midway through the heating season, and in the spring.
- C Weekly until interval for your application can be determined.
- D When new, after three months, then every six months thereafter.
- E Refer to **Testing Treated Water in the Outdoor Furnace**.
- F Refer to **Leveling the Outdoor Furnace**.
- G During the first few weeks of operation, or when switching to a new brand of wood pellets, check ash level daily to determine rate of accumulation.

## CAUTION

Use only genuine WoodMaster Parts and Accessories if it ever becomes necessary to replace any component of the outdoor furnace.

## ROUTINE MAINTENANCE

Routine inspections and maintenance are essential to the proper operation and longevity of the outdoor furnace. The items indicated in the preventive maintenance schedule are intended to serve as a guideline. Actual intervals between inspections and maintenance may vary depending on a number of factors, including your heat load requirements, type and quality of fuel used, and outdoor temperatures.

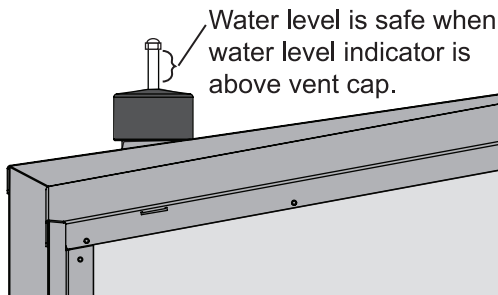
## CAUTION

Turn off the FireStar controller before performing any maintenance.

### 9.1 Water Level

The water level in the outdoor furnace is safe when the water level indicator rod is above the vent cap (see Fig. 56). If adding water is necessary, refer to the Water Quality and Maintenance section.

Fig. 56



### 9.2 Ash Removal

An ash scoop is included with your outdoor furnace. For your protection, always wear the appropriate personal protective gear when cleaning ash from the firebox.

## CAUTION

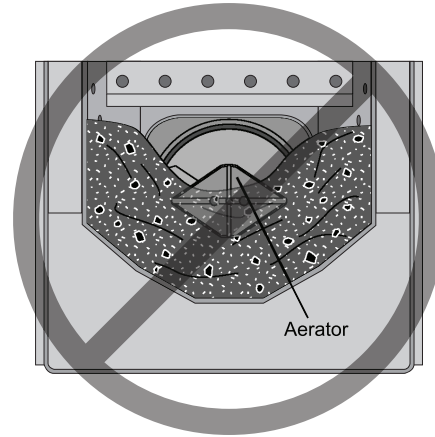
Always wear the appropriate personal protective gear when cleaning ash from the firebox.

## CAUTION

When cleaning the outdoor furnace, be careful not to spill any hot ash outside of the noncombustible container.

1. Do not allow ash in the burn chamber to accumulate over the aerator as shown in Fig. 57. Use the cleaning rod provided to pull the ash forward to the ash collection area.

Fig. 57



2. It is important to remove the ash in the firebox before it solidifies to prevent sealing in moisture on the bottom and along the edges. It is especially important to scrape all of the firebox where build up and ash are collected. Any heavy or solidified ash should be removed.

**NOTE: If these maintenance operations are not performed as directed, deterioration can result from the moisture trapped between the ash and the steel.**

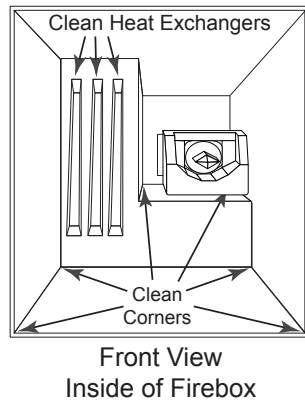
3. If burning wood pellets with a high ash content, a hard deposit may form in the burn chamber. Remove the deposit by scraping the burn chamber with the cleaning rod provided.
4. **Disposal of ash** - Place ash in a metal container with a tight-fitting lid. Store the closed container of ash on a noncombustible surface, well away from all combustible materials until ready for final disposal. Do not dispose (either by burying or other means) until all cinders have thoroughly cooled.
5. Each time the ash are cleaned out, inspect the outdoor furnace door rope gasket to make sure it is sealing properly (see Fig. 59).

### 9.3 Firebox

**NOTE: Proper firebox maintenance is essential to the longevity of the outdoor furnace.**

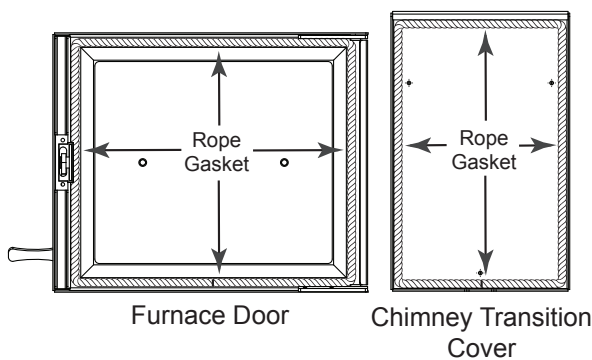
Remove ash as described in Ash Removal section. Scrape all surfaces in the firebox, paying close attention to the corners (see Fig. 58). If needed, the aerator and burn chamber can be removed for a more thorough cleaning (see Aerator and Burn Chamber).

Fig. 58



### 9.4 Gaskets

Fig. 59

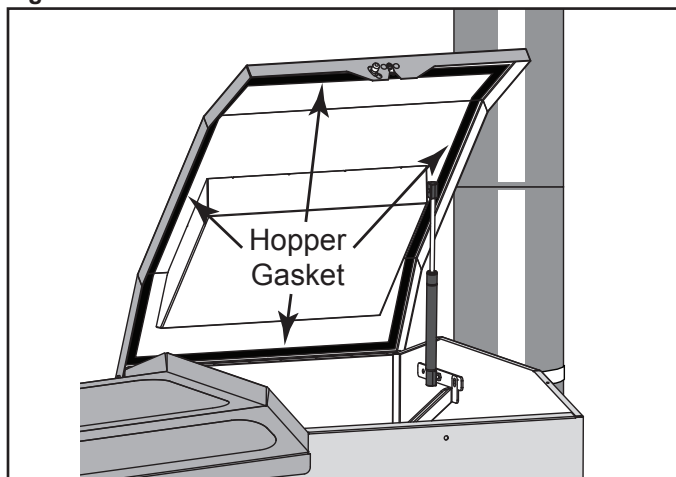


Inspect the rope gasket on the furnace door and on the chimney transition cover at the back of the furnace. A uniform indentation in the rope indicates the rope gasket is sealing properly. If it is not sealing properly, or if the rope gasket is damaged, replace the rope gasket.

Using Fig. 60 as a reference, inspect the hopper lid gasket and replace if necessary.

**NOTE: Replacement gaskets for the furnace door, chimney transition cover and hopper are available from authorized WoodMaster dealers.**

Fig. 60

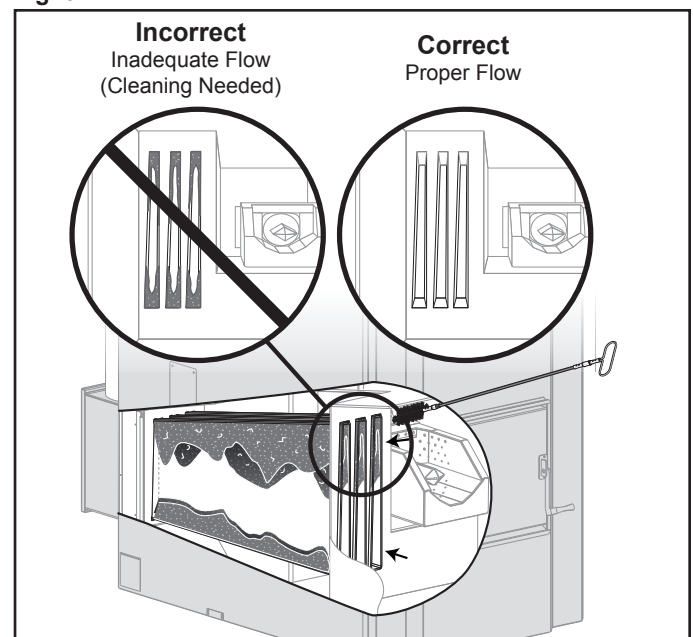


### 9.5 Heat Exchangers and Chimney Transition

The heat exchangers should be cleaned every time ash is removed, or if air flow through the heat exchangers becomes restricted (see Fig. 61).

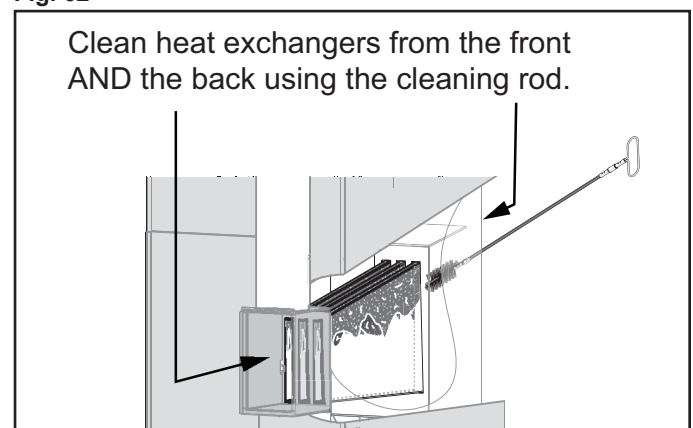
To inspect the heat exchangers, remove the chimney transition cover on the back of the furnace and open the firebox door. It will probably be necessary to kneel down at the back of the furnace to look through each heat exchanger passageway. The heat exchangers taper up from the back of the furnace to the front. Pay particular attention to the top of each passageway as this is where ash tends to accumulate. The top of each heat exchanger passageway is where most air flow and heat transfer occur, so it is especially important to keep the top free of any buildup.

Fig. 61



Remove deposits by scraping with the cleaning rod provided with your outdoor furnace. Use the cleaning rod from both the front and the back of the furnace, working from top to bottom of each passageway in the heat exchanger.

Fig. 62

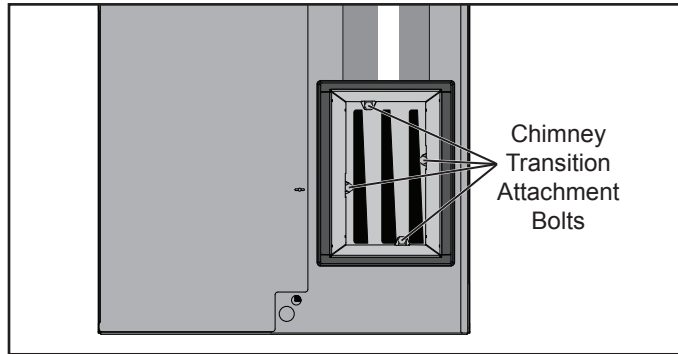


Inspect the chimney transition and clean if an excessive amount of buildup is present.

**NOTE: Twice a month during the heating season, inspect the chimney transition for excessive buildup. If present, the buildup should be removed for proper operation and fire safety. In case of a chimney fire, close the firebox door.**

Check the integrity of the chimney transition attachment bolts (Fig. 63) as they support the weight of the chimney.

Fig. 63

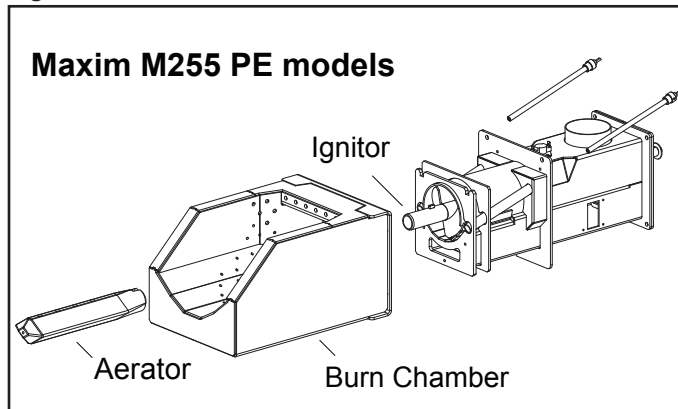


### 9.6 Aerator and Burn Chamber

As the quality of wood pellets varies from region to region, so will the requirements for component maintenance. The aerator and burn chamber should be inspected on a regular basis to ensure mineral deposits do not hinder burner performance. Regular inspection and removal of any deposits will ensure best furnace operation.

**NOTE: Make it a habit to visually inspect the burner on a weekly basis during the heating season.**

Fig. 64



### CAUTION

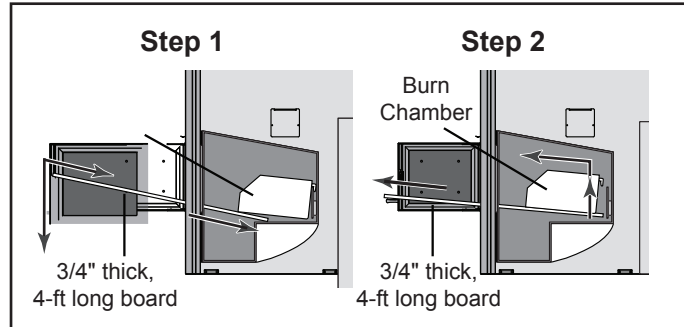
**Before performing any maintenance on the burn chamber or aerator, shut off the burner, allow the outdoor furnace to cool and clean the firebox.**

#### Disassembly

1. Turn the aerator 1/4 turn counterclockwise and pull straight forward to remove.

2. Remove the side access panel from the furnace. Roll back the insulating tape securing the thermocouple and remove the thermocouple.
3. Open the firebox door. Using Fig. 65 as a reference, place a 3/4" thick, 4-ft long board under the front of the burn chamber; then push the board in until it reaches the back of the firebox. Pry up the entire burn chamber to disengage the hooks on the back of the burn chamber. Remove the board with burn chamber through the door.

Fig. 65



**NOTE: It will be necessary to angle the burn chamber when removing it through the firebox opening.**

#### Inspecting and Cleaning

1. Inspect the aerator and burn chamber for any build-up of mineral deposits, especially in and around the combustion air holes.
2. To clean combustion air holes, use a suitably sized drill bit, round wire brush or other suitable tool to remove any deposits. Be careful not to damage, deform or increase the size of the combustion air holes. Clean ash from inside the burn chamber.
3. Scrape carbon deposits from the auger, the surfaces of the aerator and the burn chamber.

### CAUTION

**Do not strike the aerator or burn chamber with a hammer or other hard item to remove deposits. Doing so could damage the parts and prevent proper operation of the burner.**

### CAUTION

**Before placing the aerator in water, allow it to cool thoroughly. Do not put the aerator in snow to cool faster as the aerator can be damaged.**

#### Assembly

1. Inspect the burn chamber gasket for damage and replace if necessary. Place the 3/4" thick, 4-ft long board used to remove the burn chamber in the firebox opening; then place the burn chamber on top of the board.



**NOTE: It will be necessary to angle the burn chamber to install it through the firebox opening.**

2. Push the board and burn chamber to the back of the firebox; then use the board to lift the burn chamber up so the hooks on the back of the burn chamber can engage. Remove the board.
3. Place the aerator on the end of the auger tube; then rotate it 1/4 turn clockwise to lock it in position.
4. Install the thermocouple and replace the insulating tape. Install the side access panel on the back of the outdoor furnace.

### 9.7 Door and Hopper

Lubricate the door pivot points and hopper lid latch with a light petroleum distillate (WD-40 or equivalent).

### 9.8 Check Fuel Door Operation

Make sure the fuel door is open when the combustion fan is running and closed when the fan is stopped. It is important to check the fuel door monthly to make sure it is operating properly. When operating properly, the fuel door will be closed when the combustion fan is not operating.

### 9.9 Thermal Valve

The thermal valve does not require electricity to operate. If during a power outage, a high temperature condition is detected in the burner auger area, the thermal valve is designed to release a small amount of water into the burner auger area to cool the area.

Twice each heating season, check to see if the thermal valve has activated:

1. Disconnect the electrical power at the main power source.
2. Remove the access panels from the back corner of the furnace and set aside.
3. Remove the 1/2" silicone tubing from the thermal valve, leaving it attached to the discharge tube. Blow air through the tubing to clean. Connect the silicone tubing to the thermal valve making sure not to kink the silicone tubing.

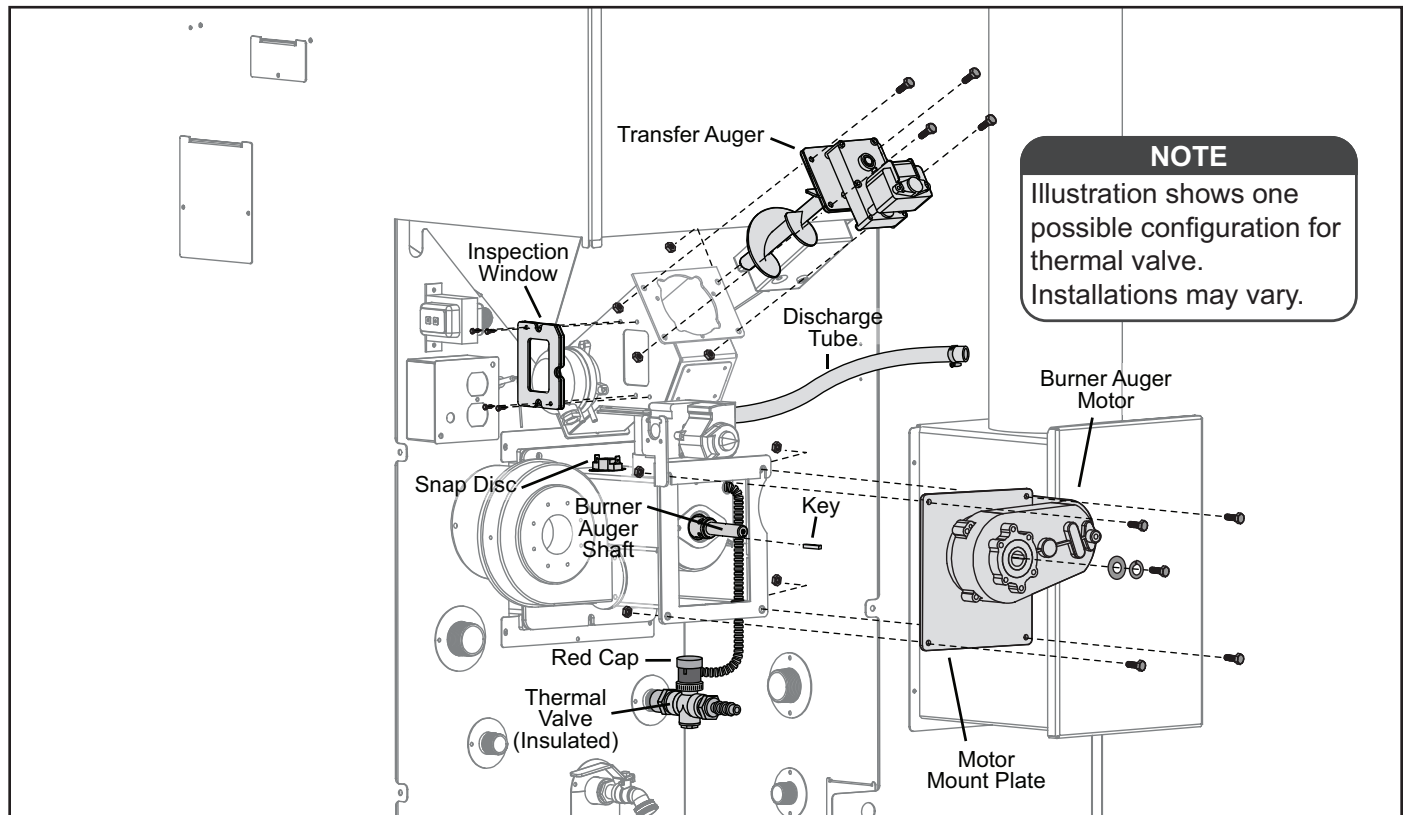
**NOTE: Fig. 66 shows one possible configuration for a thermal valve. Installations may vary slightly.**

4. Install the access panels.
5. Connect the electrical power at the main power source.

## CAUTION

**Do NOT operate this appliance with any panels removed.**

Fig. 66



## IF THE THERMAL VALVE ACTIVATES

If the thermal valve activates, it will be necessary to clean out the areas in which water from the thermal valve may have come in contact with the wood pellets. Do not use the furnace until these areas have been thoroughly cleaned. Read and understand these instructions before beginning the procedure.

**NOTE: Fig. 66 illustrates the disassembly required to clean the furnace if the thermal valve activates.**

1. Disconnect the electrical power at the main power source.
2. Remove the access panels from the back corner of the furnace and set aside.
3. Open the hopper lid and empty the hopper. One option for emptying the hopper is to use a wet-dry shop vacuum to remove the unused wood pellets. Wood pellets at the bottom of the hopper may have been saturated with water causing them to expand and fill the opening. If it is necessary to use a tool to break up the expanded wood pellets, use extreme caution not to damage any components of the furnace.

## Remove Transfer Auger

1. Disconnect the wires from the transfer auger motor.
2. Remove the bolts securing the transfer auger motor mount plate to transfer auger housing; then remove the transfer auger assembly.

**NOTE: Do not pull straight out or force the transfer auger assembly while removing. Turn the assembly counterclockwise.**

3. Remove the screws securing the inspection window to the side of the hopper; then remove the inspection window.
4. Remove the 1/2" silicone tubing from the thermal valve, leaving it attached to the discharge tube. Blow air through the tubing to clean.

## Remove Aerator, Burner Auger and Burner Auger Motor

1. Inside the firebox, turn the aerator 1/4 turn counterclockwise and pull straight forward to remove.
2. Disconnect the burner auger motor wiring connector.
3. Remove the bolt and washer securing the burner auger to the burner motor. Set the bolt and washer aside for assembly.
4. Remove the four bolts securing the motor mount plate to the transition box; then remove the burner auger motor and motor mount plate.
5. Remove the key from the keyway slot on the auger shaft and set aside for assembly.

6. Using a wooden block, tap the burner auger into the firebox. Do not hit the bushing.

7. Remove the burner auger from inside the firebox.

## Clean the Affected Areas

1. Inspect the bottom of the hopper and remove any wet fuel from the opening at the bottom.
2. Using a wet-dry shop vacuum, clean the transfer auger tube and the drop tube of any unused fuel or wet fuel; then clean the transition box that houses the burner assembly.

**NOTE: Make sure that no fuel gets pushed back toward the combustion fan area or the combustion fan could be damaged.**

3. Make sure the flightings on the augers are clean and dry.

## Replace Snap Disc

1. Disconnect the two wires from the snap disc located on top of the transition box.
2. Remove the two screws securing the snap disc to the transition box; then remove the snap disc.
3. Place a new snap disc into place and secure with screws; then connect the two wires.

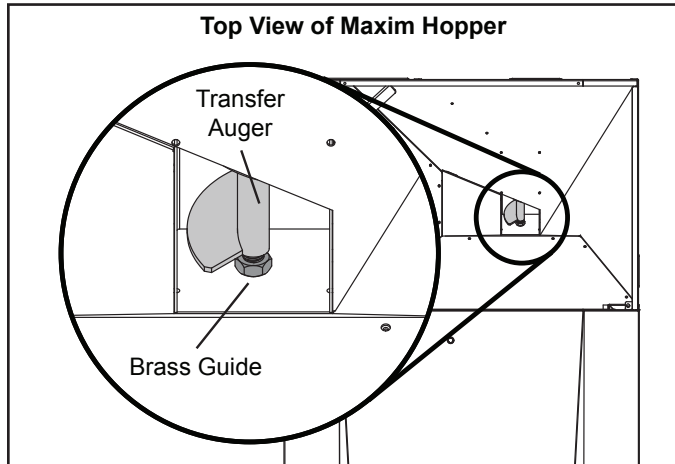
## Install Burner Auger, Burner Auger Motor and Aerator

1. Apply grease to the portion of the burner auger shaft that will be seated in the bushing; then, from inside the firebox, install the burner auger into the burner assembly making sure it is properly aligned and seated in the bushing.
2. Install the motor mount plate on the transition box. Tighten the screws hand-tight only.
3. Align the keyway slot on the auger shaft with the keyway slot in the burner motor; then tap the key into the slot. Secure the burner auger with the bolt and washer removed earlier. Tighten securely.
4. Using a flashlight inside the firebox, check that the auger flightings are centered in the burner tube. If necessary, loosen the motor mount plate bolts and move the motor mount plate to center the auger flightings in the burner tube. Tighten the motor mount plate bolts securely.

## Install Transfer Auger

1. Install the transfer auger assembly in the transfer auger housing (see Fig. 66). Make sure the end of the transfer auger tube fits over the brass guide in the transfer auger housing. Verify by visually checking from the top of the hopper (see Fig. 67). Secure with the bolts.

Fig. 67



2. Connect the wires to the transfer auger motor.

### Finish Installation

1. Install the inspection window and secure with the screws.
2. Attach the 1/2" silicone tubing to the thermal valve and secure with hose clamp.
3. Install the access panels.
4. Connect the electrical power at the main power source.
5. Before adding fuel to the hopper, start the furnace and verify that both augers are turning freely without binding. The transfer auger can be viewed from the hopper and the burner auger can be viewed using a flashlight from inside the firebox.
6. Once it has been determined the augers are turning freely, add fuel to the hopper and start the furnace following the procedure in Initial Start-up.

### 9.10 Test Thermal Valve

Twice each heating season (at the beginning and the end), check to make sure the thermal valve operates properly.

## WARNING

**Allow the outdoor furnace to thoroughly cool down before performing maintenance.**

1. Disconnect the electrical power at the main power source.
2. Remove the access panels from the back corner of the furnace and set aside.
3. Remove the 1/2" silicone tubing from the thermal valve; then place a small cup under the outlet on the valve.
4. Push down on the red cap of the thermal valve and run a small amount of water through the valve to make sure it is operating properly.

5. Connect the silicone tubing to the thermal valve making sure not to kink the silicone tubing.
6. Install the access panels.
7. Connect the electrical power to the main power source.

## WATER QUALITY AND MAINTENANCE

### Test Supply Water

Test a sample of the supply water (makeup water) that will be used to fill the outdoor furnace (softened water is recommended). Test strips for testing pH are included in the water test kit which is provided with the outdoor furnace.

1. Collect a small sample of the water to be used to fill the outdoor furnace in a clean container.
2. Dip the pH test strip from the provided test kit in the water sample. Shake excess water off the test strip. Compare the color of the test strip to the chart provided to determine pH level.
3. If the pH level is between 6.5 and 8.0 and there are no other known water quality problems, then the outdoor furnace may be filled with this water.
4. Water that has a pH level of less than 6.5 or greater than 8.0, or that has other known water quality problems, should not be used to fill the furnace. Instead, water should be supplied from a different source.

### Adding Initial Water Treatment

## CAUTION

**Avoid damaging your furnace and voiding your warranty. Add water treatment BEFORE adding water to the system. Water treatment in your outdoor furnace is just as important as the oil in a car's engine.**

MolyArmor 350 Corrosion Inhibitor (p/n 2900630) gives optimum protection for the furnace water jacket and system parts when it is used to initially treat the water and is maintained at a minimum of 350 ppm of moly and pH level between 8.0 and 9.5. The recommended initial treatment rate for the outdoor furnace is specified by units. One unit of MolyArmor 350 is a 1-gallon (3.78-liter) container. **The recommended initial amount of MolyArmor for the Maxim M255 PE is 1/2 unit (1/2 gallon).**

1. Add the recommended amount of MolyArmor 350 to the outdoor furnace.

### Testing Treated Water in the Outdoor Furnace

After circulating the water in the system for 24 hours, test the treated system water for the recommended moly (at least 350 ppm) and pH level (between 8.0 and 9.5).

1. Collect a small sample of the water to be used to fill the outdoor furnace in a clean container.
2. Dip a pH test strip from the test kit in the water sample. Shake excess water off the test strip. Compare the color of the test strip to the chart provided to determine pH level. The pH of the treated water should be between 8.0 and 9.5.
3. Follow the instructions provided in the water test kit to test the moly level of the treated system water.

### Obtaining Treated Water Sample

A treated water sample from the outdoor furnace can be obtained either from the valve on the hot water heater (Fig. 68) or from the furnace drain valve (Fig. 69).

Fig. 68

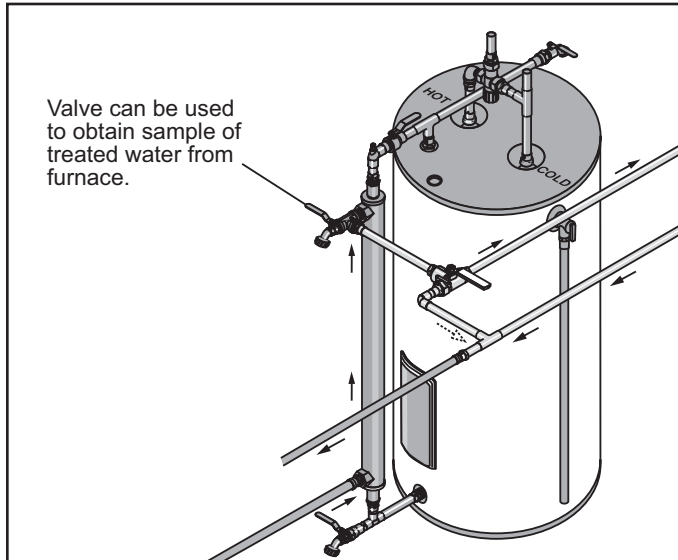
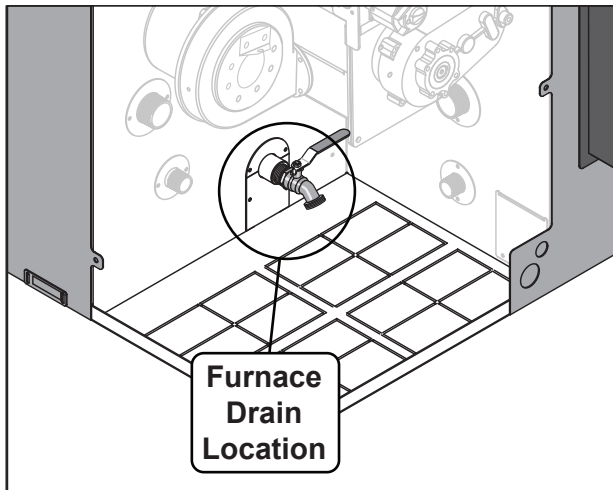


Fig. 69



Before collecting the sample, drain about a quart (liter) of water; then carefully fill the sample container without contaminating the sample. **Be sure to properly close the valve when finished.**

## Water Test Kits and Test Results

An important part of outdoor furnace maintenance is controlling the quality of the water in the furnace.

DATE	pH LEVEL	MOLY LEVEL

Record the results of pH and Moly level tests in the table above. If additional space is needed, record on a separate sheet of paper.

It is very important to keep record of water test results (including the date, pH and Moly level). The pH and Moly test strips and indicator have a shelf life of approximately two years that can affect their accuracy. Test kits should be stored in a dry area at room temperature to obtain maximum accuracy over a longer period of time.

Biological contamination can occur if the furnace is not heated up to 185°F immediately after filling it with inhibitor and water as directed.

**NOTE: ANY time water is added to the system, it is extremely important to bring the water temperature up to operating temperature (185°F) as soon as possible, even if it is during the off-season. Failure to bring the water in the system up to operating temperature immediately after filling the system can allow bacteria present in the water to multiply and may increase the potential for corrosion in the sytem.**

If the test indicates a significantly lower-than-recommended pH level, add MolyArmor to increase the pH level.

### Maintenance Levels

Test the pH and moly levels after the first three months and every six months thereafter, or after adding water to furnace.

The pH of the water should be between 8.0 and 9.5. If any other water quality issues are known, the water should be conditioned or water should be supplied from a different source.

## POST HEATING SEASON MAINTENANCE

The water should be left in the outdoor furnace during the non-heating season.

1. At the end of the heating season, clean all of the fuel from the hopper. Clean the fuel from the augers by pressing the Auger button until no fuel enters the burn chamber.
2. Remove the aerator and burn chamber; inspect and clean as explained in section 9.7 Aerator and Burn Chamber.
3. Clean all the ash out of the outdoor furnace. Scrape the walls and floor of the firebox.
4. Check the chimney box and flues. Clean out any excessive buildup. Any large or dry crusty deposits on the walls or heat exchanger area should be removed. When cleaning the firebox, be sure to wear the appropriate personal protective gear.

### CAUTION

**To minimize corrosion caused by accumulated ash, it is especially important to clean the chimney, chimney box and flues at the end of the heating season.**

5. When the outdoor furnace is clean, carefully inspect the firebox for any signs of excessive corrosion or deterioration. If any corrosion or deterioration is found, call your dealer. It is always better to do maintenance during the non-heating season.
6. After the inspection is completed, apply a thin coat of new motor oil to the firebox and heat exchanger being sure to work oil into all corners.
7. Inspect the thermal valve as explained in section 9.9 Thermal Valve.
8. Place a cover over the chimney to keep rain from entering the outdoor furnace.



## SECTION 10 – TROUBLESHOOTING

### A. FURNACE DOES NOT HEAT (BUILDING IS LOSING TEMPERATURE)

1. **Out of fuel** - Check firebox to see if fire is out. Add fuel as necessary.
2. **Fire out** - If the controller is flashing **FD** refer to FireStar Controller for Maxim Operating Instructions.
3. **Thermal valve opened** - If during a power outage, a high temperature situation is detected in the burner auger area, the thermal valve will open to release a small amount of water into the burner auger area to cool the area. To determine if this has happened, first look in the firebox for the presence of water. Also check the glass inspection port just above the burner auger. If the fuel appears to have expanded from absorbing water, the thermal valve has opened. Contact your WoodMaster dealer for assistance.
4. **Circulation valve(s) closed** - Be sure all valves in the system are open.
5. **Circuit breaker off** - Reset the circuit breaker that supplies power to the outdoor furnace.
6. **Circulation pump(s) not operating** - Disconnect power to the pump. Close valves at the pump. Disassemble the pump and try to turn the pump shaft. If the shaft is stuck, replace the pump cartridge. Replace only the cartridge whenever possible. If necessary, replace the pump. Follow instructions supplied with the pump.
7. **Air in system** - Check for air in the supply and return lines or heat exchangers. If you hear a gurgling sound in a heat exchanger, air is present in the system. Shut off the pump, wait 15 seconds and start the pump. If it is necessary to force air from lines, refer to Section 7.
8. **Outdoor furnace exhaust obstructed** - Check outdoor furnace exhaust for obstructions by removing the chimney transition cover to expose the heat exchanger. The heat exchanger can also be observed from the front of the furnace through the front door opening.
9. **Combustion fan blocked or obstructed** - Check the combustion fan for obstructions.
10. **Building(s) poorly insulated or uninsulated** - Poorly insulated or uninsulated buildings and/or buildings with uninsulated or poorly insulated ceilings can cause excessive fuel consumption and or heating problems.

11. **Supply and return lines installed incorrectly** - Make sure the hot supply water line is connected to the correct fitting on the outdoor furnace and heat exchanger.
12. **Circulation pump(s) installed incorrectly** - Circulation pump(s) must be installed in the supply line(s) with the arrow on each pump pointed away from the outdoor furnace. Remove the pump and install correctly. Refer to the System Installation section for installation guidelines.
13. **Underground supply and return lines insulated poorly** - Heat loss from poorly insulated underground supply and return lines is often indicated by an unusually high amount of snow melting above the lines when the ground temperature is 10°F (-12°C) or colder.
14. **Supply and return lines uninsulated** - Uninsulated supply and return lines in areas that are not intended to be heated (unheated crawl spaces, under mobile homes, etc.) may cause excessive heat loss. Insulate the supply and return lines.
15. **Low water** - If the controller is flashing **LD** the system senses a low water condition. Check water level and if necessary add water according to the Water Quality and Maintenance section. If adding water does not correct the problem, contact your WoodMaster dealer.
16. **Poor water quality** - Water with high amounts of solids, sand or dirt can create deposits inside the wall of heat exchanger components, reducing the amount of heat output. If this condition is suspected, contact your WoodMaster dealer.

### B. FURNACE IS OVERHEATING (FIRESTAR LED DISPLAYS **HI**)

1. **FireStar controller set incorrectly** - Lower the water temperature setpoint and/or adjust the heat output settings in one or all of the three modes (see Setting the FireStar Controller for Heat Load and Efficiency).
2. **High limit switch tripped** - Lower the water temperature setpoint and/or adjust the heat output settings in one or all of the three modes (see Setting the FireStar Controller for Heat Load and Efficiency).
3. **Water is not circulating** - The pump should run and water should circulate continuously through the supply and return lines to keep water temperature uniform in the outdoor furnace.
4. **Circulation valve(s) closed** - Be sure the proper valves in the system are open to allow circulation.



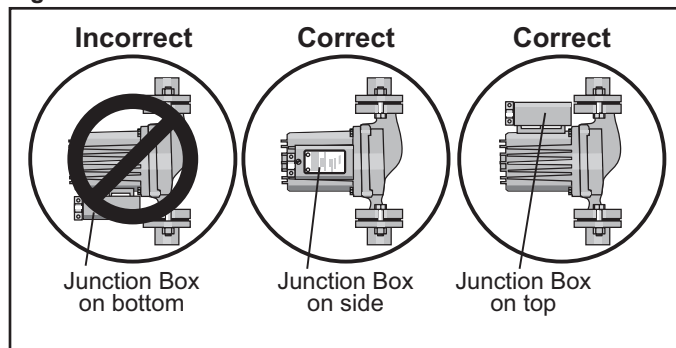
### C. BACK BURN (FIRESTAR DISPLAYS **b b** )

1. **High temperature in burner auger area** - Everything but the burner auger will be disabled. The burner auger will run for two minutes, pause for 10 minutes, and continue as required. The Back Burn alarm will not stop until the controller detects that the temperature in the burner auger area has dropped.

### D. FREQUENT PUMP TROUBLE OR POOR WATER CIRCULATION

1. **Pump mounted incorrectly** - The pump must be mounted with the pump motor horizontal and the junction box either on the side or on top (see Fig. 70).

Fig. 70



2. **Deposits in water lines/heat exchanger walls** - If water high in silica or other mineral content has been used to fill the outdoor furnace, material deposits may build up on the insides of the supply and return lines and on the heat exchanger walls. If this occurs, the system will need to be drained and then cleaned using Sludge Conditioner (p/n 166). The system must then be refilled with the proper amount of MolyArmor 350 and good quality water (softened water, if possible).
3. **Water will not circulate** - If the system has been drained and refilled, or if the system has been opened for any reason (e.g., replacement of pump, adding heat exchangers, repairing a leak), air must be purged from the system (see Filling System with Water and Purging Air section).
4. **Poor water quality** - Water with high amounts of solids, sand or dirt can cause frequent pump failure. Use softened and/or filtered water.

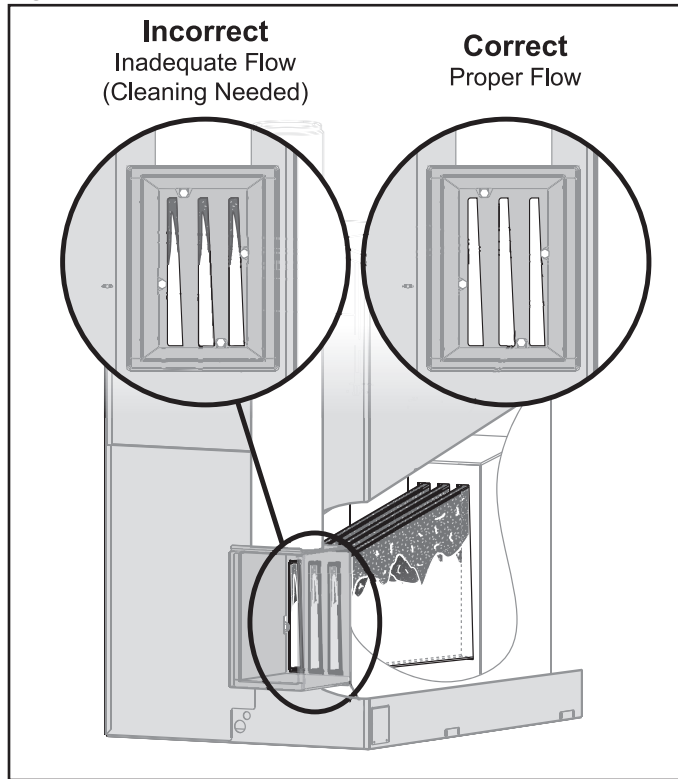
### E. BURNING AN EXCESSIVE AMOUNT OF FUEL.

1. **High volume water heating** - High volume water heating (e.g., car wash, swimming pool, etc.) will require high fuel consumption.
2. **Excessive heat loss** - See items 8-12 of Furnace Does Not Heat.
3. **Supply and return line heat loss** - If not using ThermoPEX, supply and return lines buried in a wet, low-lying area may cause a large heat loss that will greatly increase the fuel consumption.
4. **High heat demand** - Concrete slabs (with radiant heat) that are poorly insulated or are exposed to water or cold outside temperatures will require increased fuel consumption. Bringing a concrete slab up to temperature the first time will take a considerable amount of time and fuel; once warm, fuel consumption will be reduced if the concrete slab and building are insulated properly. The following items will cause a high heat demand: poor insulation, large amounts of glass windows/doors (e.g., greenhouses), overhead doors, uninsulated crawl spaces, outdoor air infiltration and air leaking through foundation.

### F. FUEL NOT BURNING PROPERLY

1. **Poor fuel or out of fuel** - See Fuel Quality and Storage section for recommendations about fuel types. Check firebox to see if fire is out. Add fuel as necessary.
2. **Combustion fan blocked or obstructed** - Check the combustion fan and air flow path for obstructions.
3. **Outdoor furnace exhaust obstructed** - Check outdoor furnace exhaust for obstructions. To inspect the heat exchangers, remove the chimney transition cover on the back of the furnace and open the firebox door. It will probably be necessary to kneel down at the back of the furnace to look through each heat exchanger passageway.

Fig. 71



4. **Heat output set too high or too low** - For best results, determine the lowest water temperature setpoint the outdoor furnace can be set to that will supply enough heat to the heat emitters. See FireStar Controller Manual for more information.
5. **Air setting too high or too low** - See Setting the FireStar Controller for Heat Load and Efficiency.

#### G. BURNER AUGER MOTOR NOT TURNING

1. **Fuel wet or swollen** - Check to see if the fuel has absorbed moisture and is swollen in the burner auger area. If the thermal valve has activated, it will be necessary to remove all of the fuel from the hopper; then remove the transfer auger, aerator, burner auger and burner auger motor and clean the entire area.
2. **Burn chamber obstructed** - Clean the burn chamber especially at the end of the auger.
3. **Motor overheated** - Clean the burner auger and allow the burner auger motor to cool.

#### H. IF CORROSION IS PRESENT

Corrosion in the firebox can occur when the outdoor furnace is being operated improperly. To maximize the life of your investment, it is important to identify signs of corrosion early (you can do this by performing the items in the Preventive Maintenance Schedule) and take measures to correct it as soon as possible. Some, but not all, causes of corrosion are listed below with possible solutions. If you are unsure how to proceed, contact your WoodMaster dealer.

1. **Water temperature is too low** - If the heat load in the system is too large, the water in the system will not reach high enough temperatures and corrosion can occur. Re-evaluate the system and match heat load to the outdoor furnace.

**NOTE: To reduce condensation in the firebox, set the temperature to 185°F or higher.**

2. **Heat load is too high** - Reduce heat load.
3. **Thermostatic valve is not installed** - A thermostatic valve must be installed on each set of supply and return lines in the system to maintain the outdoor furnace water temperature above 150°F (65°C).
4. **Firebox wasn't cleaned out at the end of the heating season** - Be sure to follow the post-heating season maintenance schedule which includes scraping out firebox and removing all ash.

#### J. WATER TEMPERATURE AT SUPPLY PORT LOWER THAN THE FIRESTAR INDICATES

1. **Water flow too low** - Add wraparound pump if using one set of lines. Install higher pressure-volume pumps if using two sets of lines.

#### K. LOW WATER (FIRESTAR LED DISPLAYS )

**System leak** - Try to identify the leak by inspecting all lines, fittings, heat exchangers, etc. in the system and repair as needed. If the leak cannot be found and **if there is no chance of the system or furnace freezing**, the following procedures can help determine whether the leak is in the furnace or somewhere else in the system:

- a. Turn off the FireStar controller; then completely empty the firebox of all coals, embers and ash.
- b. Allow the furnace to cool below 100°F (38°C).
- c. Refill the outdoor furnace with water until the water level indicator rod is above the vent cap. Add MolyArmor 350 if needed.
- d. Record the water level by measuring how far the water level indicator rod is above the vent cap.
- e. Close all shut-off valves on the hot supply and return lines at the outdoor furnace.

- f. Check the water level periodically during the next 48 hours (the water level may drop slightly as the water cools).
- g. Inspect the firebox and under and around the outside of the outdoor furnace for evidence of a leak each time the water level is checked.

During the 48-hour inspection period, the water lines should also be checked for leaks using a pressure gauge and the following procedure:

- a. Isolate the furnace by closing all shut-off valves on the hot supply and return lines at the furnace.

### WARNING

**Be sure to close all shut-off valves on the hot supply and return lines at the furnace. DO NOT ALLOW THE FURNACE TO PRESSURIZE.**

- b. Isolate each zone in the system using shut-off valves.
- c. Pressurize each zone with domestic water or air; then check the pressure gauge after 12 hours. A drop in pressure indicates that a leak is present in the zone. Before resuming furnace operation, it will be necessary to repair the leak.

### L. SMOKE IN THE HOPPER

How air flows through the furnace is an important part of optimal operation. Smoke in the hopper is an indication that the air flow through the furnace is restricted, obstructed or different than it should be.

### CAUTION

**Operating for extended periods of time with air flow through the furnace restricted (i.e., smoke in the hopper) can damage components in the furnace.**

1. **Heat exchanger dirty or obstructed** - Because the gases moving through the heat exchanger are hot, most of the heat transfer occurs at the top of the heat exchangers. It is therefore important to ensure that the top of each heat exchanger passageway is clean and not obstructed or blocked from ash. Use the procedure from 9.5 Heat Exchanger in the Routine Maintenance section to inspect the heat exchanger for obstructions or restrictions and clean if necessary.
2. **Aerator covered by ash** - do not allow ash in the burn chamber to accumulate over the aerator. Use the cleaning rod to pull ash forward to ash collection area.
3. **Carbon buildup** - inspect the burner auger where it enters the firebox for carbon buildup and clean if necessary.
4. **Fan setting for HIGH mode set too high** - Decrease the fan setting for HIGH mode (see Setting the FireStar Controller for Heat Load and Efficiency).

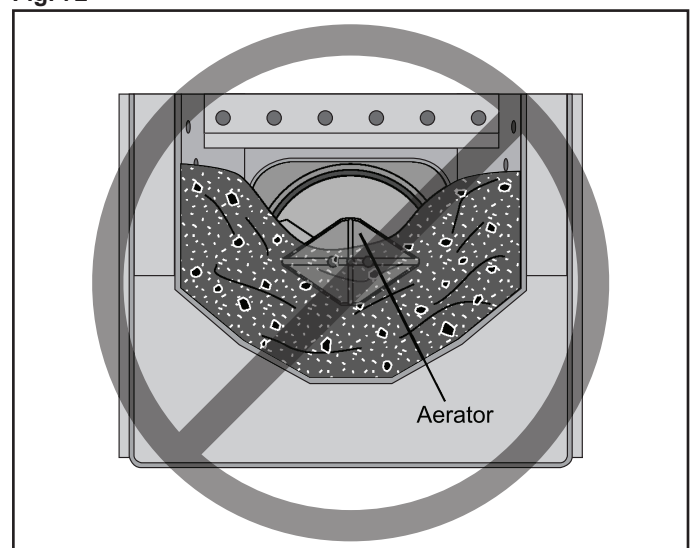
5. **Chimney dirty or obstructed** - Inspect the chimney transition and chimney for obstructions or restrictions and clean if necessary.
6. **Spark arrestor (if present) dirty or obstructed** - Inspect the spark arrestor screen for obstructions and remove. Clean the spark arrestor if it is restricting air flow.
7. **Chimney not drafting properly** - Proper draft is necessary for the Maxim to operate optimally. Draft occurs when the temperature in the chimney is high enough to cause a negative pressure that "pulls" the exhaust up through the heat exchanger and out the chimney.

If poor draft is suspected, check that the chimney transition cover is properly sealing. Adding chimney sections may be required. However, due to a number of variables (e.g., objects like buildings and trees in close proximity, nearby terrain such as hills, valleys, etc.), poor draft can be an intermittent problem.

### M. CREOSOTE ON COMBUSTION FAN

1. **Outdoor furnace not level** - The furnace should be leveled so that the back of the transition box (i.e., the burner auger motor end) is slightly higher than the front. If the burner auger is not sloped down toward the front of the furnace, condensation can form in the burner auger tube and drip into the transition box. See Leveling the Outdoor Furnace section.
2. **Ash covering aerator** - Do not allow ash in the burn chamber to accumulate over the aerator.

Fig. 72



# SECTION 11 – DECALS

## DANGER

- Risk of fire or explosion - DO NOT burn garbage, gasoline, drain oil or other flammable liquids.
- If you smell gas: DO NOT light this appliance. Extinguish any open flames. DO NOT touch any electrical switch; DO NOT use a phone located in the building where the appliance is installed. Call your fuel supplier and follow their instructions.
- Risk of electrical shock - disconnect power before servicing unit.

## MAINTENANCE SCHEDULE

### DAILY

Check water level, inspect firebox and remove ash as needed.

### WEEKLY

Inspect flues, aerator and burn chamber and clean as needed.

### SEMI-MONTHLY

Twice a month during the heating season, inspect chimney and chimney transition and clean as needed.

### MONTHLY

Inspect rope gaskets on the furnace door and chimney transition cover. Inspect chimney transition and clean as needed.

### SEMI-ANNUALLY

Shut down and completely clean and inspect firebox, flues, chimney and burner assembly. Remove the tubing from the thermal valve; then clean the tubing and discharge tube by blowing air through it. Check the pH and nitrite levels of the water semiannually or if water is added, and add water treatment as necessary. READ OWNER'S MANUAL FOR COMPLETE INSTRUCTIONS.

## WARNING

- Risk of fire - DO NOT store fuel or other combustible material within marked installation clearances.
- DO NOT install or operate this appliance before first reading and understanding the Owner's Manual.
- DO NOT allow others to install or operate this appliance without first reading and understanding the Owner's Manual.
- DO NOT leave this appliance unattended with firebox door unlatched.
- Avoid breathing smoke. Wear appropriate personal protective gear when servicing firebox or flues.
- DO NOT operate with flue draft exceeding -0.05 inches of water column.

## CAUTION

- Hot surfaces.
- Keep face away from door area.
- DO NOT start fire until water level is full.
- Comply with all applicable state or local codes and regulations.
- Store ash in a covered non-combustible container.
- Take care when opening the door to prevent hot ash from spilling out.
- Keep children away from this appliance.
- Maximum draft marked on nameplate.

### APPLIANCE LOCATION:

- When installing this appliance, consider the direction that smoke will travel with prevailing winds and chimney height.

## NOTICE

Fuel door must operate properly.

It is important to check the fuel door (located behind this panel) monthly, to make sure it is operating properly.

p/n 7000299

## NOTICE

After appliance has been installed, seal these holes with silicone to prevent rodents from entering.

p/n 41222

## NOTICE

DO NOT operate this appliance with this panel removed.

p/n 41225

## CAUTION

HOT GASES - Keep face away when viewing fire and from door area.

p/n 41220

## CAUTION

Do not plug, block or seal vent opening. Sealing can result in a dangerous buildup of pressure.

## ATTENTION

Ne pas bloquer, obturer ou sceller l'ouverture du conduit d'évacuation. Sceller l'ouverture pourrait entraîner une augmentation dangereuse de la pression.

p/n 7000535

## CAUTION

ANY TIME WATER IS ADDED, the furnace MUST BE immediately heated to 185°F, circulated, and the inhibitor level tested. FAILURE TO DO SO WILL RESULT IN DAMAGE to your furnace's water jacket!

Carefully follow the steps in your Owner's Manual for adding water and testing inhibitor levels.



The Online Support Center at CentralBoiler.com allows you to access the Owner's Manual and view videos and other resources specific to your furnace.

CentralBoiler.com Support

p/n 7000564 Rev. 5

## NOTICE

DO NOT alter this equipment in any way.

p/n 5073

## CAUTION

HOT Surfaces  
DO NOT Touch During Operation

p/n 6079

## CAUTION

Failure to perform proper care and maintenance will reduce the life and performance of your furnace. For best results, always follow these guidelines:

1. Add water treatment before filling with water.
2. Do not burn anything other than the recommended fuels.
3. Clean and inspect the furnace regularly.
4. Do not operate with the water temperature below 150°F (66°C).
5. Maintain the recommended water treatment levels at all times.
6. Clean the firebox thoroughly and keep it dry when not in use.
7. See Owner's Manual for more information about regularly scheduled maintenance.

p/n 9419

## CAUTION

CLEAN OUT THE LOWER AUGER BEFORE DISCONNECTING POWER.

To prevent the thermal valve from activating, turn off the Auto Re-light function and clean out the lower (burner) auger using the Clean Out Mode before disconnecting power.

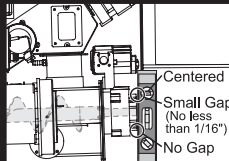
To start Clean Out Mode, press the Auger button two times within one second. The Clean Out Mode light will turn on and only the lower (burner) auger will operate to empty all of the fuel from the lower (burner) auger. To empty the fuel faster, press and hold the Auger button while in Clean Out Mode until the lower (burner) auger is empty. After the lower (burner) auger is empty, clean the burn chamber.

p/n 9431

## NOTICE

Furnace must be leveled properly.

If the lower auger is not sloped down toward the front of the furnace, condensation can form in the lower auger tube and drip into the transition box.



M250

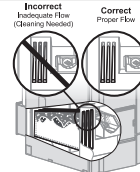
p/n 9433

## CAUTION

Smoke in the hopper is an indication that air flow through the furnace is restricted and may prevent proper furnace operation. If restricted air flow is suspected, inspect the following for obstructions or restrictions and clean if necessary:

1. Heat exchanger passageways.
2. Aerator - do not allow ashes in the burn chamber to accumulate over the aerator.
3. Chimney transition box/chimney.
4. Spark arrestor (if present).

Refer to the Owner's Manual for more information.

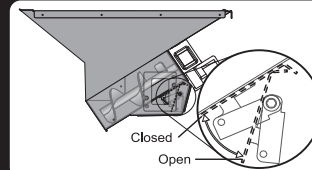


p/n 9761

## NOTICE

Fuel door must operate properly.

It is important to check the fuel door regularly to make sure it is operating properly. When operating properly, the fuel door will be closed when the combustion fan is not operating.



p/n 7000113

## NOTICE

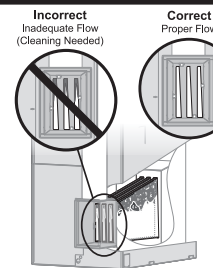
To lock and unlock the FireStar controller, press the 'Water Temp' button, located on the controller, four times rapidly. When locked, the display on the controller will indicate 'LOC' for five seconds and any time a button on the controller is pressed.



p/n 9631

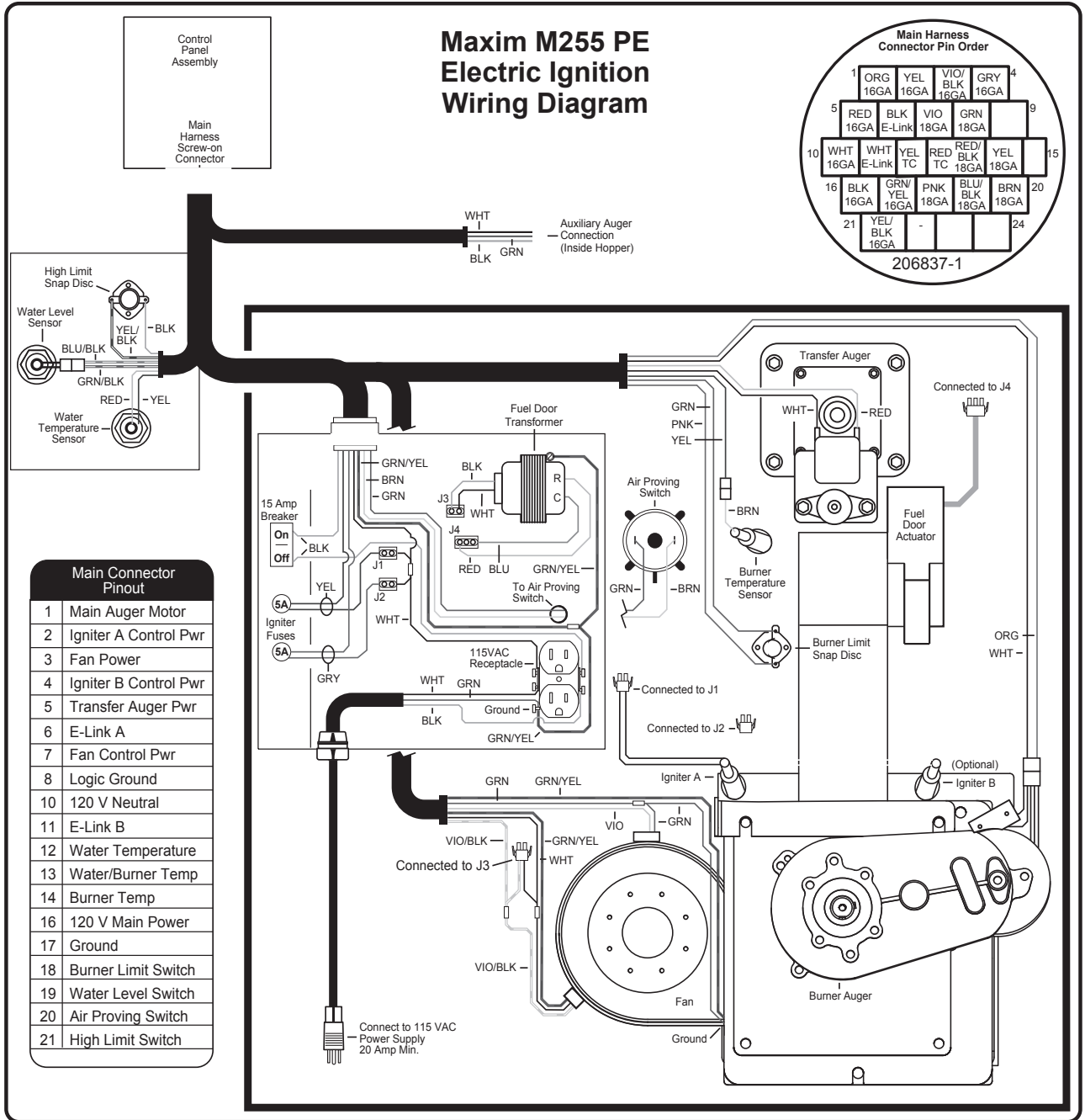
## CAUTION

For the furnace to operate optimally, air flow through the heat exchanger must be unrestricted. Failure to regularly care for and maintain the heat exchanger will reduce the life and performance of your furnace. Refer to the Owner's Manual for maintenance procedures and frequency.



p/n 9762

# SECTION 12 – WIRING DIAGRAMS





## 1-YEAR LIMITED WARRANTY

WoodMaster, Inc. ("WoodMaster") warrants to the original owner, except (a) parts manufactured by others and excluded from warranty coverage below; and (b) parts or items specified below as covered by a limited one year warranty, WoodMaster Maxim furnaces against defects in workmanship for a period of ONE (1) YEAR from the date of original retail purchase.

### **An optional 5-Year Warranty is available if a Limited Warranty Registration Form is completed and sent to WoodMaster within ten (10) days of the original owner taking possession of the furnace.**

If a defect exists, at its option WoodMaster will (1) repair the defective part at no charge, using new or refurbished replacement parts, (2) exchange the furnace with a comparable model furnace that is new or which has been manufactured from new or serviceable used parts and is at least functionally equivalent to the original furnace, or (3) refund the purchase price of the furnace based on the pro-ration scale. A replacement furnace/part assumes the remaining warranty of the original furnace/part or ninety (90) days from the date of replacement or repair, whichever provides longer coverage for you. If a furnace or part is qualified for replacement under the provisions of this limited warranty, at WoodMaster's discretion, the furnace or part may be required to be returned to WoodMaster for inspection and recycling or disposal.

**Parts Manufactured By Others.** Parts that are factory-installed by WoodMaster, but are manufactured by others, may be covered by their own manufacturer's warranty and are not covered by this limited warranty, except the FireStar™ controller is warranted against defects in workmanship for a period of two (2) years from the date of original retail purchase, provided that the Limited Warranty Registration Form is completed and sent to the WoodMaster within ten (10) days of the original owner taking possession of the furnace; otherwise this limited warranty shall be good for a period of ONE (1) YEAR from the date of original retail purchase. This limited warranty covers the controller part only; service calls, mileage, and labor to diagnose the problem and install a new part are not covered.

**Parts Covered by a Limited One Year Warranty.** The following parts are covered by a limited warranty for workmanship defects for one year: aerator, burn chamber, thermocouple, hopper lid shock, chimney transition, firebox door parts, chimney box parts, paint, burner assembly, auger, auger motor and fan.

This Limited Warranty applies only to WoodMaster Maxim outdoor furnaces. This limited warranty covers only those defects that arise as a result of normal use of the outdoor furnace and does not cover any other defects or problems, including those that arise as a result of: (a) improper maintenance (b) operation outside the furnace's specifications (see owner's manual), accident, abuse, misuse, misapplication, or parts that are not factory-installed; (c) service performed by anyone other than WoodMaster unless authorized by WoodMaster in writing; (d) modifications undertaken without the written permission of WoodMaster; or (e) if any WoodMaster serial number has been removed or defaced. This warranty is void if the owner (fails to maintain the proper amount of corrosion inhibitor in the systems or) burns materials in the firebox other than premium grade wood pellets.\* This warranty excludes the cost of shipping, labor to remove or reinstall the furnace, plumbing labor and/or parts and the cost of alternative heat if the furnace is out of service for repairs. Warranty excludes replacement of water, inhibitors or other additives, and parts used in the system whether or not mounted on the furnace, such as pumps, valves, and piping.

WoodMaster is not liable for damage or repairs required as a consequence of faulty installations or applications by others or any event of force majeure. WoodMaster is not liable for incidents or accidents which can be prevented by the owner or that occur from the operation of the outdoor furnace. A backup heating system must be in place to prevent damage in case of failure to refuel the outdoor furnace or mechanical failure of the outdoor furnace or system occurs. Heat replacement representations found in WoodMaster promotional information should be used only as a guideline. Heat loss for all applications with all weather extremes and other heat variables must be considered when sizing an outdoor furnace for different applications.

THIS WARRANTY AND REMEDIES SET FORTH ABOVE ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, REMEDIES AND CONDITIONS, WHETHER ORAL OR WRITTEN, EXPRESS OR IMPLIED. WOODMASTER SPECIFICALLY DISCLAIMS ANY AND ALL IMPLIED WARRANTIES, INCLUDING, WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IF WOODMASTER CANNOT LAWFULLY DISCLAIM IMPLIED WARRANTIES UNDER THIS LIMITED WARRANTY, ALL SUCH WARRANTIES, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE LIMITED IN DURATION TO THE DURATION OF THIS WARRANTY. No WoodMaster dealer or employee is authorized to make any modification, extension, or addition to this warranty. WOODMASTER IS NOT RESPONSIBLE FOR DIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM ANY BREACH OF WARRANTY OR CONDITION, OR UNDER ANY OTHER LEGAL THEORY. Some states and provinces do not allow the exclusion or limitation of incidental or consequential damages or exclusions or limitations on the duration of implied warranties or conditions, so the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights, and you may also have other rights that vary by state or province.

\*This voiding of warranty is required under the federal New Source Performance Standards for New Residential Hydronic Heaters and Forced Air Furnaces (40 CFR Part 60, Subpart QQQQ) and applies only if burning wood pellets mixed with other fuels for residential applications. Warranty disclaimer does not apply to devices using fuels other than wood pellets or units used solely for non-residential purposes (e.g., commercial or industrial purposes) that otherwise are operated in accordance with the Owner's Manual.

To obtain warranty service, contact the WoodMaster dealer from whom you purchased your furnace or contact WoodMaster by telephone (800-932-3629) or mail (600 Polk Ave. SW, Red Lake Falls, MN 56750). Please provide the dealer's name, original date of sale, model number and serial number in all communications. WoodMaster reserves the right to require the warranty service to be performed at WoodMaster facility when deemed necessary by WoodMaster.



*Model: Maxim M255 PE  
Central Boiler, Inc. WoodMaster, Inc.  
20502 160th Street  
Greenbush, MN 56726*

# **Section 4**

## **Test Data by Run**

MVTL

MINNESOTA VALLEY TESTING LABORATORIES, INC.

1126 N. Front St. ~ New Ulm, MN 56073 ~ 800-782-3557 ~ Fax 507-359-2890
2616 E. Broadway Ave. ~ Bismarck, ND 58501 ~ 800-279-6885 ~ Fax 701-258-9724
1201 Lincoln Highway ~ Nevada, IA 50201 ~ 800-362-0855 ~ Fax 515-382-3885
www.mvttl.com

MEMBER ACIL

Page: 1 of 1

Net Calorific Value added 26 Aug 20

Sample Number: 20-F69

Report Date: 8/26/20

Mark Reese
Central Boiler, Inc.
20502 160th St
Greenbush MN 56726

Work Order #: 81-0578
P.O. #: PO118791
Date Collected: 7/13/20
Date Received: 7/20/20

Sample Description: Black Hills Gold Pellets

Table with 4 main sections: \* PROXIMATE \*, \* ULTIMATE \*, \* SULFUR FORMS \*, and \* MISCELLANEOUS \*. Each section lists analytes and their values on AS RECEIVED and DRY BASIS.

Approved by: [Signature]

MVTL guarantees the accuracy of the analysis done on the sample submitted for testing. It is not possible for MVTL to guarantee that a test result obtained on a particular sample will be the same on any other sample unless all conditions affecting the sample are the same, including sampling by MVTL. As a mutual protection of clients, the public and ourselves, all reports are submitted as the confidential property of clients, and authorization for publication of statements, conclusions or extracts from or regarding our reports is reserved pending our written approval.

## Hydronic Heating Appliances - Test Method ASTM 2618 Conditioning

Manufacturer: Central Boiler  
 Model: Maxim M255 PE  
 Tracking No.: 2423  
 Project No.: 0117PS024E  
 Test Date: July 2020  
 Technician: Central Boiler  
 Operation Category: CAT II - CAT III

Stove Weight (lb): 1297  
 Water Weight (lb): 631.5

Elapsed Time (hr)	Flue Gas Temp (degrees F)
0	238.0
1	236.0
2	236.0
3	236.0
4	238.0
5	238.0
6	233.0
7	237.0
8	236.0
9	235.0
10	207.0
11	218.0
12	224.0
13	226.0
14	224.0
15	274.0
16	271.0
17	273.0
18	274.0
19	273.0
20	271.0
21	275.0
22	274.0
23	268.0
24	270.0
25	268.0
26	269.0
27	273.0
28	279.0
29	277.0
30	277.0
31	231.0
32	234.0
33	230.0
34	230.0
35	226.0
36	227.0
37	231.0
38	232.0
39	256.0
40	279.0
41	279.0
42	276.0
43	272.0
44	285.0
45	267.0
46	265.0
47	265.0
48	262.0
49	272.0
50	265.0

40 pound bags of the same pelet fuel used for certificaion were added as needed to maintain an approximat average fuel consumption of 8 pounds per hour. A total of 400 pounds of fuel were consumed.

Operated for 50 hours at a medium heat draw.

# ASTM 2618 Test Standard

Manufacturer: Central Boiler  
 Model: Maxim M255 PE  
 Tracking No.: 2423  
 Project No.: 0117PS024E  
 Technician: Central Boiler  
 Comments: Calorific value obtained from MVTL report dated 8/26/20, sample number 20-F69 for Black Hills Gold Pellets

Adjustable Parameters:	Category I	Category II	Category III	Category IV
Run Number:	2	3	4	1
Test Date:	8/18/20	8/18/20	8/19/20	8/17/20
Total Fuel Weight (lb):	15.5	23.7	39.4	109.8
Average Moisture of Fuel (% dry):	4.8	4.8	4.8	4.8
Average Temperature of Appliance Water at Start of Test:	173.6	163.6	161.0	162.8
Average Temperature of Appliance Water at End of Test:	177.5	163.9	161.2	165.6
Average Thermopile Reading:	99.3	90.6	93.0	107.0
Average Load Side Liquid Flow Rate (gal/min):	0.5	0.9	1.5	3.4
Time Interval (min):	240	240	240	240
Burn Rate (kg/hr):	1.68	2.56	4.26	11.89
Emissions (g):	0.9	2.3	6.1	16.7

Constant Parameters:

Fuel Heating Value:	8408	Btu/lb	Higher Heating Value
Heating Season Weighting			
Category I Weighting Factor:	0.175		
Category II Weighting Factor:	0.275		
Category III Weighting Factor:	0.450		
Category IV Weighting Factor:	0.100		
Year Round Use Weighting			
Category I Weighting Factor:	0.437		
Category II Weighting Factor:	0.238		
Category III Weighting Factor:	0.275		
Category IV Weighting Factor:	0.050		

Calculations:

	Category I	Category II	Category III	Category IV	Totals
Heat Input (Btu):	124267	189843	316205	881467	
Heat Input Rate (Btu/hr):	31067	47461	79051	220367	
Appliance Water Specific Heat (Btu/lb °F):	1.001	1.001	1.001	1.001	
Heat Output (Btu):	111356	170677	282278	730018	
Heat Output Rate (Btu/hr):	27839	42669	70569	182504	
Total Particulate Emissions (g):	0.9	2.3	6.1	16.7	
Time Interval (hr):	4.0	4.0	4.0	4.0	

Emissions (g/kg):	0.1	0.2	0.4	0.4	
Heating Season Weighting:	0.025	0.061	0.160	0.035	0.3
Year Round Use Weighting:	0.061	0.053	0.098	0.018	0.2
Total Particulate Emissions Rate (g/MJ):	0.01	0.01	0.02	0.02	
Heating Season Weighting:	0.001	0.003	0.009	0.002	0.02
Year Round Use Weighting:	0.003	0.003	0.006	0.001	0.01
Total Particulate Emissions Rate (lbs/mmbtu input):	0.02	0.03	0.04	0.04	
Heating Season Weighting:	0.003	0.007	0.019	0.004	0.03
Year Round Use Weighting:	0.007	0.006	0.012	0.002	0.03
Total Particulate Emissions Rate (lbs/mmbtu output):	0.019	0.029	0.047	0.051	
Heating Season Weighting:	0.003	0.008	0.021	0.005	0.04
Year Round Use Weighting:	0.008	0.007	0.013	0.003	0.03
Total Particulate Emissions Rate (g/hr 10,000BTU):	0.02	0.03	0.05	0.06	
Heating Season Weighting:	0.004	0.009	0.024	0.006	0.04
Year Round Use Weighting:	0.009	0.008	0.015	0.003	0.03
Emissions (g/hr):	0.2	0.6	1.5	4.2	
Heating Season Weighting:	0.04	0.16	0.68	0.42	1.3
Year Round Use Weighting:	0.10	0.14	0.42	0.21	0.9
Efficiency (%):	89.6	89.9	89.3	82.8	
Heating Season Weighting:	15.7	24.7	40.2	8.3	88.9
Year Round Use Weighting:	39.2	21.4	24.5	4.1	89.2
First Hour Emissions (g/hr):	0.0	0.0	0.5	3.4	
Target Load High:	27376	43801	91252	182504	
Target Load Low:	NA	29201	45626	NA	

**Weighted Emissions**

Heating Season Use: 0.03 lbs/mmbtu input  
 Year Round Use: 0.03 lbs/mmbtu input

Heating Season Use: 0.04 lbs/mmbtu output  
 Year Round Use: 0.03 lbs/mmbtu output

**Weighted Efficiency**

Heating Season Use: 88.9 %  
 Year Round Use: 89.2 %

*Model: Maxim M255 PE  
Central Boiler, Inc.  
20502 160th Street  
Greenbush, MN 56726*

# **Run 1**

## **Category IV**

## Hydronic Heating Appliances - Test Method ASTM 2618 Results

Manufacturer: Central Boiler  
 Model: Maxim M255 PE  
 Tracking No.: 2423  
 Project No.: 0117PS024E  
 Run: 1  
 Test Date: August 17, 2020

Burn Rate	<b>11.89 kg/hr dry</b>
Average Tunnel Temperature	174 degrees F
Average Gas Velocity in Dilution Tunnel - vs	8.1 feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	18792 dscf/hour
Average Delta p	0.016 inches H2O
Average Delta H	2.17 inches H2O
Total Time of Test	240 minutes

### PARTICULATE EMISSIONS RESULTS

First Hour:	<b>3.41 g/hr</b> <b>0.29 g/kg</b> <b>0.04 lb/mmBTU output</b>
Complete Run:	<b>4.19 g/hr</b> <b>0.35 g/kg</b> <b>0.05 lb/mmBTU output</b>

	SAMPLE TRAIN 1	SAMPLE TRAIN 2	AMBIENT SAMPLE TRAIN
Total Sample Volume - Vm	38.45 cubic feet	40.84 cubic feet	23.64 cubic feet
Average Gas Meter Temperature	86 degrees F	86 degrees F	82 degrees F
Total Sample Volume (Standard Conditions) - Vmstd	37.3 dscf	39.8 dscf	22.6 dscf
Total Particulates - mn	8.2 mg	9 mg	0 mg
Particulate Concentration (dry-standard)	0.00022 grams/dscf	0.00023 grams/dscf	0.000000 grams/dscf
Particulate Emissions	16.51 grams	16.98 grams	
Difference from Average	0.24 grams	0.24 grams	
<b>Results Are Acceptable</b>			

AVERAGE	
Total Sample Volume - Vm	39.64 cubic feet
Average Gas Meter Temperature	86 degrees F
Total Sample Volume (Standard Conditions) - Vmstd	38.6 dscf
Particulate Concentration (dry-standard)	0.00022 grams/dscf
Particulate Emissions	16.74 grams
7.5% of the average particulate emissions	1.26 grams

### ADDITIONAL ACCEPTANCE CRITERIA

Boiler Water Return Temperature >120 °F	<b>Acceptable</b>
Proportional Rate Variation >80%	<b>Acceptable</b>
90% of PR Values between 90-110%	<b>Acceptable</b>

SAMPLE TRAIN 1 - FIRST HOUR	
Total Sample Volume - Vm	9.59 cubic feet
Average Gas Meter Temperature	84 degrees F
Total Sample Volume (Standard Conditions) - Vmstd	9.37 dscf
Total Particulates - mn	1.7 mg
Particulate Concentration (dry-standard)	0.00018 grams/dscf
Particulate Emissions	3.41 grams
Burn Rate	11.79 (dry kg/hr)
Heat Output Rate	182522 BTU/hr











Elapsed Time	Particulate Sampling Data														Fuel Weight, lb		Flow, gpm		Temperature Data, °F										Specific Heat of Inlet Water (BTU/lb-°F)	Mass Flow Rate of Inlet Water (lb/min)	Heat Output, Btu					
	Gas Meter Cubic Feet (1)	Gas Meter Cubic Feet (2)	Gas Meter Cubic Feet (amb)	Sample Rate, cfm (1)	Sample Rate, cfm (2)	Orifice dH (1)	Orifice dH (2)	Orifice dH (amb)	Meter of (1)	Meter of (2)	Meter of (amb)	Meter Vac. In. Hg. (1)	Meter Vac. In. Hg. (2)	Dilution Tunnel Temp.	Dilution Tunnel dP	Pro. Rate (%) (1)	Pro. Rate (%) (2)	Scale Reading	Weight Change	Load Side Liquid Flow Rate	Boiler Side Liquid Flow Rate (optional)	Thermopile ΔT	Boiler to Heat Exch. Temp.	Heat Exch to Boiler Temp.	Inlet Load Temp.	Outlet Load Temp.	Stack	Filter (1)				Filter (2)	Ambient			
233	37.318	39.638		0.16	0.17	2.12	1.79	0.26	90	89	85	-0.76	-1.70	179	0.016	99	101	3.4	0.35	3.43	15.1	107.5	177.3	154.1	67.9	175.4	572	87	87	85		1.001	28.567	3075		
234	37.476	39.810		0.16	0.17	2.13	1.79	0.26	90	89	85	-1.05	-1.90	178	0.016	98	101	2.9	0.45	3.45	15.0	107.4	177.2	154.0	67.9	175.3	569	87	85	85		1.001	28.723	3088		
235	37.637	39.981		0.16	0.17	2.22	1.79	0.26	90	89	85	-0.86	-1.60	179	0.016	100	100	2.4	0.59	3.37	15.0	107.3	177.1	154.0	68.0	175.3	577	87	84	85		1.001	28.076	3016		
236	37.798	40.152		0.16	0.17	2.22	1.79	0.26	90	89	85	-0.76	-1.70	179	0.016	100	100	2.0	0.36	3.33	15.0	107.2	177.0	153.9	68.0	175.2	576	87	83	85		1.001	27.755	2979		
237	37.961	40.323		0.16	0.17	2.21	1.78	0.26	90	89	85	-1.01	-1.80	178	0.016	101	100	1.4	0.58	3.34	14.9	107.4	177.2	154.1	68.0	175.3	573	87	83	85		1.001	27.764	2985		
238	38.123	40.494		0.16	0.17	2.20	1.77	0.26	90	89	85	-0.88	-1.80	179	0.016	101	100	1.1	0.33	3.37	15.0	107.5	177.3	154.2	68.0	175.4	577	88	83	85		1.001	28.068	3021		
239	38.285	40.665		0.16	0.17	2.22	1.77	0.26	90	89	85	-1.17	-1.90	178	0.016	101	100	0.5	0.55	3.41	15.0	107.5	177.4	154.2	67.9	175.5	574	88	83	85		1.001	28.362	3053		
240	38.447	40.835	23.639	0.16	0.17	2.19	1.76	0.26	90	89	85	-0.80	-1.80	179	0.016	101	100	0.0	0.54	3.38	15.0	107.4	177.1	154.1	67.9	175.3	572	88	83	85		1.001	28.096	3020		
	38.447	40.835	23.639			2.17	1.77	0.26	86	86	82			174	0.016					3.40	15.01	107.0	176.2	153.3	67.5	174.5		86.17	87.82	#DIV/0!			3033			
																	TOTAL:																			727867

TF<sub>avg</sub> 165.611  
 T<sub>avg</sub> 162.788

## Hydronic Heating Appliances - Test Method ASTM 2618 Results

Manufacturer: Central Boiler  
 Model: Maxim M255 PE  
 Tracking No.: 2423  
 Project No.: 0117PS024E  
 Run #: 1  
 Date: 8/17/20

Equipment Numbers: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

### TRAIN 1 (First Hour emissions)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	E001	123.0	121.3	1.7
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe				0.0
E. Filter seals catch*	Seals				0.0

**Sub-Total**    Total Particulate, mg:    1.7

### TRAIN 1

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch (remainder)	Filter	E002	126.2	120.3	5.9
B. Rear filter catch	Filter	E003	121.2	121.1	0.1
C. Probe catch*	Probe	OES4	114148.7	114148.4	0.3
D. Filter seals catch*	Seals	S0007	3302.3	3302.1	0.2

**Sub-Total**    Total Particulate, mg:    6.5

Total Particulate, mg:    8.2

### TRAIN 2

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	E004	127.2	118.9	8.3
B. Rear filter catch	Filter	E005	120.7	120.9	-0.2
C. Probe catch*	Probe	OES5	113572.0	113571.4	0.6
D. Filter seals catch*	Seals	S0008	3334.4	3334.1	0.3

Total Particulate, mg:    9.0

### AMBIENT

Sample Component	Reagent	Filter # or Probe #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch*	Filter	E006	120.1	120.1	0.0

Total Particulate, mg:    0.0

\*Any particulate catch that results in a negative number, is assumed to be zero

Component	Equations:
A. Front filter catch	Final (mg) - Tare (mg) = Particulate, mg
B. Rear filter catch	Final (mg) - Tare (mg) = Particulate, mg
C. Probe catch	Final (mg) - Tare (mg) = Particulate, mg







## Hydronic Heating Appliances - Test Method ASTM 2618 Fuel Moisture

Manufacturer: Central Boiler  
 Model: Maxim M255 PE  
 Tracking No.: 2423  
 Project No.: 0117PS024E  
 Technician: Central Boiler  
 Run #: 1  
 Test Date: August 17, 2020

Wet Weight (lb)	% Moisture				
109.85	4.78	4.78	4.78	4.78	4.78

Total Weight of Load (lb):

Total Moisture of Load (%):

Equipment Numbers:  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

### ASTM E2618 Wood Heater Run Sheets

Client: Central Boiler Project Number: 0117PS024E Run Number: 1  
 Model: Maxim M255 PE Tracking Number: 2423 Date: 08/17/2020  
 Test Crew: DP TT  
 OMNI Equipment ID numbers: 00371, 00372

#### Wood Heater Supplemental Data

Start Time: 11:02 Booth #: \_\_\_\_\_

Stop Time: 15:02

**Stack Gas Leak Check:**

Initial: good Final: good

**Sample Train Leak Check:**

A: 0.0 @ -5.1"Hg  
 B: 0.0 @ -5.6"Hg

Calibrations: Span Gas CO<sub>2</sub>: 16.94 CO: 4.32

	Pre Test		Post Test	
	Zero	Span	Zero	Span
Time	<u>10:00</u>	<u>10:10</u>	<u>15:10</u>	<u>15:20</u>
CO <sub>2</sub>	<u>0.00</u>	<u>17.03</u>	<u>0.00</u>	<u>16.46</u>
CO	<u>0.00</u>	<u>4.30</u>	<u>0.00</u>	<u>4.132</u>

Air Velocity (ft/min): Initial: < 50 Final: = 50  
 Scale Audit (lbs): Initial: 10 Final: 10  
 Pitot Tube Leak Test: Initial: good Final: good  
 Stack Diameter (in): 6"  
 Induced Draft: 0.00  
 % Smoke Capture: 100  
 Flue Pipe Cleaned Prior to First Test in Series:  
 Date: 08/17/2020 Initials: DC

Tunnel Traverse		
Microtector Reading	dP (in H <sub>2</sub> O)	T(°F)
1	<u>.012</u>	<u>169</u>
2	<u>.014</u>	<u>169</u>
3	<u>.014</u>	<u>169</u>
4	<u>.016</u>	<u>168</u>
5	<u>.014</u>	<u>168</u>
6	<u>.010</u>	<u>167</u>
1	<u>.010</u>	<u>167</u>
2	<u>.014</u>	<u>167</u>
3	<u>.016</u>	<u>169</u>
4	<u>.014</u>	<u>169</u>
5	<u>.010</u>	<u>169</u>
6	<u>.008</u>	<u>170</u>
Center		
	<u>0.016</u>	<u>170</u>

	Initial	Middle	Ending
P <sub>b</sub> (in/Hg)	<u>30.13</u>		<u>30.08</u>
RH (%)			
Ambient (°F)	<u>77</u>		<u>86</u>

Tunnel Static Pressure (in H <sub>2</sub> O):	
Beginning of Test	End of Test
<u>-.150</u>	<u>-.150</u>

Background Filter Volume: 23.639

Technician Signature: [Signature]

Date: 9/21/20

*Model: Maxim M255 PE  
Central Boiler, Inc.  
20502 160th Street  
Greenbush, MN 56726*

## **Run 2**

### **Category I**

## Hydronic Heating Appliances - Test Method ASTM 2618 Results

Manufacturer: Central Boiler  
 Model: Maxim M255 PE  
 Tracking No.: 2423  
 Project No.: 0117PS024E  
 Run: 2  
 Test Date: August 18, 2020

Burn Rate	<b>1.68 kg/hr dry</b>
Average Tunnel Temperature	90 degrees F
Average Gas Velocity in Dilution Tunnel - vs	8.6 feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	22950 dscf/hour
Average Delta p	0.020 inches H2O
Average Delta H	2.18 inches H2O
Total Time of Test	240 minutes

### PARTICULATE EMISSIONS RESULTS

First Hour:	<b>0.00 g/hr</b> <b>0.00 g/kg</b> <b>0.00 lb/mmBTU output</b>
Complete Run:	<b>0.24 g/hr</b> <b>0.14 g/kg</b> <b>0.02 lb/mmBTU output</b>

	SAMPLE TRAIN 1	SAMPLE TRAIN 2	AMBIENT SAMPLE TRAIN
Total Sample Volume - Vm	38.46 cubic feet	41.06 cubic feet	22.82 cubic feet
Average Gas Meter Temperature	82 degrees F	82 degrees F	79 degrees F
Total Sample Volume (Standard Conditions) - Vmstd	37.7 dscf	40.4 dscf	22.0 dscf
Total Particulates - mn	0.4 mg	0.4 mg	0 mg
Particulate Concentration (dry-standard)	0.000011 grams/dscf	0.000010 grams/dscf	0.000000 grams/dscf
Particulate Emissions	0.97 grams	0.91 grams	
Difference from Average	0.03 grams	0.03 grams	
<b>Results Are Acceptable</b>			

	AVERAGE
Total Sample Volume - Vm	39.76 cubic feet
Average Gas Meter Temperature	82 degrees F
Total Sample Volume (Standard Conditions) - Vmstd	39.1 dscf
Particulate Concentration (dry-standard)	0.00001 grams/dscf
Particulate Emissions	0.94 grams
7.5% of the average particulate emissions	0.07 grams

### ADDITIONAL ACCEPTANCE CRITERIA

Boiler Water Return Temperature >120 °F	<b>Acceptable</b>
Proportional Rate Variation >80%	<b>Acceptable</b>
90% of PR Values between 90-110%	<b>Acceptable</b>

### SAMPLE TRAIN 1 - FIRST HOUR

Total Sample Volume - Vm	9.56 cubic feet
Average Gas Meter Temperature	80 degrees F
Total Sample Volume (Standard Conditions) - Vmstd	9.42 dscf
Total Particulates - mn	0 mg
Particulate Concentration (dry-standard)	0.00000 grams/dscf
Particulate Emissions	0.00 grams
Burn Rate	1.53 (dry kg/hr)
Heat Output Rate	27820 BTU/hr



### Hydronic Heating Appliances - Test Method ASTM 2618 Results

Manufacturer: Central Boiler                      Equipment Numbers: \_\_\_\_\_  
 Model: Maxim M255 PE                              \_\_\_\_\_  
 Tracking No.: 2423                                      \_\_\_\_\_  
 Project No.: 0117PS024E                              \_\_\_\_\_  
 Run #: 2    \_\_\_\_\_  
 Date: 8/18/20    \_\_\_\_\_

**TRAIN 1 (First Hour emissions)**

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	E007	120.1	120.4	-0.3
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe				0.0
E. Filter seals catch*	Seals				0.0

**Sub-Total**      Total Particulate, mg:      -0.3

**TRAIN 1 (Post First Hour Change-out)**

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	E008	120.6	120.0	0.6
C. Rear filter catch	Filter	E009	119.5	119.7	-0.2
D. Probe catch*	Probe	23	114077.9	114077.6	0.3
E. Filter seals catch*	Seals	S0010	3366.3	3366.3	0.0

**Sub-Total**      Total Particulate, mg:      0.7

**Train 1 Aggregate**      Total Particulate, mg:      **0.4**

**TRAIN 2**

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	E010	119.8	119.8	0.0
B. Rear filter catch	Filter	E013	119.4	119.4	0.0
C. Probe catch*	Probe	24	114128.2	114128.1	0.1
D. Filter seals catch*	Seals	S0011	4149.5	4149.2	0.3

Total Particulate, mg:      0.4

**AMBIENT**

Sample Component	Reagent	Filter # or Probe #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch*	Filter	E012	120.2	120.2	0.0

Total Particulate, mg:      0.0

\*Particulate catch that results in a negative number, is assumed to be zero for probes and seals, negative numbers for filters are assumed to be part of the seal weight.

Component	Equations:
A. Front filter catch	Final (mg) - Tare (mg) = Particulate, mg
B. Rear filter catch	Final (mg) - Tare (mg) = Particulate, mg
C. Probe catch	Final (mg) - Tare (mg) = Particulate, mg









Elapsed Time	Particulate Sampling Data																Fuel Weight, lb		Flow, gpm		Temperature Data, oF											Specific Heat of Inlet Water (BTU/lb-F)	Mass Flow Rate of Inlet Water (lb/min)	Heat Output, Btu
	Gas Meter Cubic Feet (1)	Gas Meter Cubic Feet (2)	Gas Meter Cubic Feet (amb)	Sample Rate, cfm (1)	Sample Rate, cfm (2)	Orifice dH (1)	Orifice dH (2)	Orifice dH (amb)	Meter oF (1)	Meter oF (2)	Meter oF (amb)	Meter Vac. In. Hg. (1)	Meter Vac. In. Hg. (2)	Dilution Tunnel Temp.	Dilution Tunnel dP	Pro. Rate (%) (1)	Pro. Rate (%) (2)	Scale Reading	Weight Change	Load Side Liquid Flow Rate	Boiler Side Liquid Flow Rate (optional)	Thermopile ΔT	Boiler to Heat Exch. Temp.	Heat Exch to Boiler Temp.	Inlet Load Temp.	Outlet Load Temp.	Stack	Filter (1)	Filter (2)	Ambient				
239	38.301	40.889		0.16	0.17	2.19	1.80	0.26	85	84	81	0.00	-0.50	92	0.020	100	100	0.3	0.24	0.48	15.1	101.0	178.6	176.2	77.3	178.3	234	83	83	81		1.001	3.956	400
240	38.461	41.062	22.823	0.16	0.17	2.19	1.79	0.26	85	84	81	-0.50	-0.70	92	0.020	100	101	0.0	0.32	0.48	15.1	100.9	178.6	176.4	77.4	178.3	234	83	83	81		1.001	3.956	400
	38.461	41.062	22.823			2.18	1.79	0.26	82	82	79			90	0.020					0.55	15.05	99.3	176.9	174.3	77.4	176.7		81.10	81.10		#DIV/0!			451
																															TOTAL:			108357

Manufacturer: Central Boiler  
 Model: Maxim M255 PE  
 Tracking No.: 2423  
 Project No.: 0117PS024E  
 Run: 2  
 Test Date: 8/18/2020

### Preburn Data

Appliance Side										Load Side										Fuel Wt. Loss	Average BTU output
Time Elapsed, Min	Appliance IN, °F	Appliance OUT, °F	ΔT	T <sub>avg</sub>	Water Flow, GPM	Water Density, kg/m <sup>3</sup>	Water Density, lb/gal	Flue Temperature, °F	Btu/Hr	Load IN, °F	Load Out, °F	Water Flow, GPM	C <sub>pi</sub>	ΔT	Mass Flow Rate, lb/min	Btu/Mi n	Btu/Hr	Fuel Weight, LB			
37.00	162.94	166.51	3.57	164.72	15.03	974.97	8.14	251.00	26200.10	79.97	166.27	0.79	1.00	86.30	6.56	566.92	34015.09	225.63			
38.00	163.00	166.41	3.41	164.71	15.08	975.00	8.14	251.00	25098.21	79.91	166.26	0.79	1.00	86.35	6.56	567.15	34028.89	225.48	0.15		
39.00	163.77	166.55	2.78	165.16	15.17	974.96	8.14	249.00	20580.56	79.94	166.29	0.60	1.00	86.35	4.95	427.66	25659.74	225.21	0.27		
40.00	163.78	166.54	2.76	165.16	15.07	974.96	8.14	247.00	20294.39	80.20	166.33	0.60	1.00	86.14	4.95	426.67	25600.28	225.44	-0.23		
41.00	163.99	166.77	2.78	165.38	15.15	974.88	8.14	245.00	20574.34	80.53	166.52	0.69	1.00	85.98	5.75	494.99	29699.52	225.30	0.13		
42.00	164.83	166.81	1.98	165.82	15.10	974.87	8.14	244.00	14627.39	80.73	166.58	0.46	1.00	85.85	3.82	328.42	19704.96	225.11	0.19		
43.00	163.83	167.03	3.20	165.43	15.12	974.79	8.14	243.00	23590.16	81.14	166.76	0.65	1.00	85.62	5.43	465.49	27929.29	225.17	-0.06		
44.00	163.78	166.91	3.13	165.35	15.04	974.83	8.14	241.00	22943.92	81.36	166.79	0.69	1.00	85.43	5.75	491.89	29513.28	224.88	0.29		
45.00	163.92	166.95	3.03	165.44	15.03	974.82	8.14	244.00	22239.38	81.68	166.77	0.65	1.00	85.09	5.43	462.78	27767.03	225.08	-0.21		
46.00	164.09	167.18	3.09	165.63	14.99	974.74	8.13	242.00	22642.36	81.78	166.95	0.73	1.00	85.17	6.07	517.68	31060.72	224.96	0.13		
47.00	164.33	167.36	3.04	165.85	15.11	974.68	8.13	239.00	22391.64	81.79	167.14	0.69	1.00	85.34	5.75	491.62	29497.17	224.70	0.25		
48.00	164.35	167.33	2.98	165.84	15.09	974.69	8.13	237.00	21945.14	81.65	167.14	0.67	1.00	85.49	5.59	478.45	28707.27	224.60	0.10		
49.00	164.39	167.27	2.88	165.83	15.09	974.71	8.13	234.00	21229.03	81.30	167.11	0.67	1.00	85.82	5.59	479.90	28793.95	224.68	-0.08		
50.00	165.08	167.25	2.17	166.16	15.11	974.72	8.13	238.00	16033.90	80.89	167.05	0.52	1.00	86.16	4.29	370.02	22201.38	224.41	0.27		
51.00	165.39	167.47	2.08	166.43	15.10	974.65	8.13	236.00	15297.45	80.31	167.17	0.52	1.00	86.86	4.30	373.95	22436.86	224.65	-0.24		
52.00	165.64	167.62	1.98	166.63	15.05	974.60	8.13	234.00	14526.71	79.77	167.40	0.56	1.00	87.63	4.63	405.79	24347.68	224.34	0.31		
53.00	165.48	167.76	2.28	166.62	15.10	974.55	8.13	232.00	16774.15	79.17	167.56	0.56	1.00	88.38	4.62	409.17	24550.32	224.20	0.15		
54.00	165.58	167.76	2.18	166.67	15.21	974.55	8.13	228.00	16187.76	78.53	167.60	0.50	1.00	89.07	4.14	369.25	22155.09	224.24	-0.04		
55.00	165.61	167.80	2.18	166.70	15.07	974.54	8.13	229.00	16053.40	77.91	167.57	0.52	1.00	89.66	4.29	384.83	23089.93	224.16	0.08		
56.00	165.66	167.82	2.17	166.74	15.08	974.53	8.13	229.00	15943.05	77.29	167.60	0.48	1.00	90.31	4.00	361.78	21706.69	224.19	-0.03		
57.00	165.56	167.88	2.32	166.72	15.10	974.51	8.13	228.00	17086.39	76.73	167.67	0.50	1.00	90.95	4.15	377.41	22644.57	224.06	0.13		
58.00	165.53	167.86	2.33	166.69	15.07	974.52	8.13	226.00	17121.60	76.21	167.71	0.56	1.00	91.50	4.63	424.04	25442.23	224.24	-0.18		
59.00	165.65	167.97	2.32	166.81	15.09	974.48	8.13	223.00	17055.73	75.79	167.78	0.56	1.00	91.98	4.63	426.07	25564.30	224.19	0.05		
60.00	165.72	167.98	2.26	166.85	15.06	974.47	8.13	228.00	16641.78	75.45	167.75	0.58	1.00	92.30	4.79	442.65	26559.23	223.89	0.30		
61.00	165.73	168.13	2.40	166.93	15.03	974.42	8.13	227.00	17627.34	75.18	167.86	0.58	1.00	92.68	4.79	444.54	26672.47	223.84	0.05		
62.00	165.86	168.22	2.36	167.04	15.10	974.39	8.13	227.00	17352.92	74.97	167.98	0.50	1.00	93.01	4.15	386.07	23163.97	223.82	0.02		
63.00	165.89	168.24	2.35	167.07	15.02	974.39	8.13	225.00	17222.98	74.85	168.01	0.48	1.00	93.16	3.98	371.50	22290.17	223.70	0.12		
64.00	165.95	168.31	2.36	167.13	15.07	974.36	8.13	223.00	17385.82	74.78	168.10	0.54	1.00	93.32	4.47	417.20	25032.02	223.65	0.06		
65.00	165.98	168.33	2.35	167.15	15.05	974.36	8.13	224.00	17263.45	74.77	168.16	0.52	1.00	93.39	4.30	402.40	24143.89	223.63	0.01		
66.00	166.01	168.29	2.28	167.15	15.17	974.37	8.13	223.00	16897.47	74.80	168.14	0.54	1.00	93.34	4.47	417.63	25057.84	223.63	0.00		
67.00	166.12	168.44	2.32	167.28	15.11	974.32	8.13	223.00	17085.05	74.89	168.25	0.54	1.00	93.36	4.46	417.22	25033.41	223.42	0.21		
68.00	165.97	168.28	2.31	167.12	15.10	974.37	8.13	224.00	17018.33	75.02	168.11	0.54	1.00	93.09	4.47	416.20	24971.90	223.60	-0.18		
69.00	166.11	168.38	2.27	167.25	14.98	974.34	8.13	220.00	16587.34	75.18	168.17	0.60	1.00	92.99	4.95	460.69	27641.39	223.29	0.31		
70.00	166.03	168.37	2.34	167.20	15.07	974.34	8.13	223.00	17170.99	75.36	168.20	0.56	1.00	92.84	4.63	430.05	25802.86	223.39	-0.10		
71.00	166.01	168.31	2.31	167.16	15.10	974.36	8.13	222.00	16986.48	75.58	168.10	0.52	1.00	92.52	4.31	398.81	23928.58	223.32	0.07		
72.00	166.23	168.47	2.24	167.35	15.07	974.31	8.13	223.00	16443.24	75.81	168.25	0.54	1.00	92.43	4.46	413.05	24782.90	223.33	-0.01		
73.00	166.17	168.49	2.32	167.33	15.09	974.30	8.13	222.00	17111.27	76.06	168.27	0.54	1.00	92.21	4.46	411.88	24712.99	223.00	0.33		
74.00	166.08	168.36	2.28	167.22	15.13	974.35	8.13	221.00	16855.03	76.32	168.20	0.56	1.00	91.87	4.63	425.51	25530.80	223.10	-0.10		
75.00	166.17	168.45	2.28	167.31	15.08	974.32	8.13	223.00	16807.19	76.56	168.29	0.56	1.00	91.73	4.63	424.78	25486.51	222.81	0.29		
76.00	166.31	168.57	2.26	167.44	15.10	974.28	8.13	221.00	16639.56	76.77	168.34	0.54	1.00	91.57	4.46	408.77	24526.02	222.99	-0.19		
77.00	166.36	168.53	2.18	167.44	15.05	974.29	8.13	222.00	15988.78	76.95	168.30	0.52	1.00	91.35	4.30	393.11	23586.31	222.75	0.24		
78.00	166.27	168.55	2.29	167.41	15.04	974.28	8.13	224.00	16794.31	77.11	168.30	0.54	1.00	91.19	4.46	407.51	24450.79	222.97	-0.21		
79.00	166.40	168.67	2.27	167.54	15.10	974.24	8.13	222.00	16713.17	77.25	168.48	0.54	1.00	91.23	4.46	407.53	24452.03	222.89	0.08		





137.00	171.21	173.42	2.21	172.31	15.07	972.62	8.12	230.00	16238.51	77.29	173.13	0.50	1.00	95.84	4.14	397.11	23826.31	218.98	0.14
138.00	171.04	173.42	2.39	172.23	15.10	972.62	8.12	231.00	17541.56	77.24	173.21	0.52	1.00	95.98	4.30	413.04	24782.65	219.03	-0.06
139.00	171.41	173.70	2.29	172.55	15.05	972.52	8.12	227.00	16747.08	77.18	173.38	0.48	1.00	96.19	3.97	382.78	22966.74	218.87	0.17
140.00	171.30	173.74	2.44	172.52	15.16	972.51	8.12	229.00	17999.72	77.13	173.48	0.56	1.00	96.35	4.62	445.76	26745.72	218.85	0.01
141.00	171.32	173.68	2.36	172.50	15.04	972.53	8.12	227.00	17296.45	77.07	173.46	0.56	1.00	96.39	4.62	445.96	26757.89	218.48	0.37
142.00	171.27	173.64	2.37	172.45	15.04	972.54	8.12	229.00	17386.20	77.04	173.43	0.52	1.00	96.39	4.28	413.22	24792.93	218.40	0.08
143.00	171.28	173.59	2.31	172.44	15.11	972.56	8.12	230.00	16997.81	77.01	173.40	0.55	1.00	96.39	4.59	443.28	26596.73	218.54	-0.14
144.00	171.47	173.91	2.44	172.69	15.08	972.45	8.12	227.00	17906.31	76.98	173.61	0.48	1.00	96.63	3.98	384.78	23087.09	218.27	0.27
145.00	171.57	173.98	2.41	172.78	15.06	972.42	8.12	228.00	17676.13	76.96	173.76	0.54	1.00	96.80	4.46	432.50	25950.21	218.18	0.09
146.00	171.62	174.00	2.37	172.81	15.17	972.42	8.12	228.00	17538.12	76.93	173.78	0.50	1.00	96.84	4.16	403.31	24198.80	218.53	-0.35
147.00	171.59	174.00	2.41	172.80	15.11	972.42	8.12	228.00	17716.87	76.92	173.79	0.54	1.00	96.87	4.46	432.92	25975.09	218.21	0.32
148.00	171.63	174.01	2.37	172.82	15.04	972.42	8.12	228.00	17371.79	76.91	173.83	0.56	1.00	96.92	4.62	448.40	26903.82	218.12	0.08
149.00	171.70	174.08	2.38	172.89	15.08	972.39	8.11	227.00	17466.66	76.91	173.86	0.56	1.00	96.95	4.62	448.44	26906.10	217.91	0.21
150.00	171.70	174.10	2.40	172.90	15.01	972.38	8.11	229.00	17552.32	76.93	173.94	0.57	1.00	97.01	4.78	464.18	27850.98	218.11	-0.19
151.00	171.69	174.10	2.41	172.89	15.13	972.38	8.11	231.00	17760.96	76.95	173.90	0.52	1.00	96.96	4.30	417.09	25025.17	218.02	0.09
152.00	171.90	174.34	2.45	173.12	15.05	972.30	8.11	231.00	17932.99	76.96	174.08	0.52	1.00	97.12	4.30	417.96	25077.73	218.03	-0.01
153.00	171.98	174.42	2.44	173.20	15.12	972.27	8.11	233.00	17982.36	76.97	174.15	0.56	1.00	97.18	4.62	449.65	26979.16	217.85	0.18
154.00	172.11	174.51	2.41	173.31	15.09	972.24	8.11	230.00	17668.58	76.98	174.22	0.59	1.00	97.24	4.94	481.03	28861.52	217.71	0.14
155.00	172.17	174.56	2.38	173.37	15.11	972.23	8.11	230.00	17524.80	76.99	174.39	0.54	1.00	97.40	4.46	434.94	26096.39	217.82	-0.12
156.00	172.10	174.57	2.47	173.33	15.04	972.22	8.11	229.00	18070.92	76.99	174.31	0.52	1.00	97.32	4.30	418.83	25129.62	217.75	0.07
157.00	172.18	174.62	2.44	173.40	15.09	972.20	8.11	229.00	17904.29	76.99	174.37	0.54	1.00	97.38	4.46	434.77	26086.26	217.44	0.31
158.00	172.16	174.57	2.41	173.37	15.18	972.22	8.11	231.00	17828.65	76.97	174.36	0.52	1.00	97.39	4.30	418.88	25133.04	217.57	-0.13
159.00	172.32	174.63	2.31	173.47	15.11	972.20	8.11	230.00	17001.16	76.95	174.43	0.52	1.00	97.48	4.30	419.38	25162.62	217.59	-0.02

### Hydronic Heating Appliances - Test Method ASTM 2618 Fuel Moisture

Manufacturer: Central Boiler  
Model: Maxim M255 PE  
Tracking No.: 2423  
Project No.: 0117PS024E  
Technician: Central Boiler  
Run #: 2  
Test Date: August 18, 2020

Wet Weight (lb)	% Moisture				
15.49	4.78	4.78	4.78	4.78	4.78

Total Weight of Load (lb):

Total Moisture of Load (%):

Equipment Numbers:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

### ASTM E2618 Wood Heater Run Sheets

Client: Central Boiler Project Number: 0117PS024E Run Number: 2  
 Model: Maxim M255 PE Tracking Number: 2423 Date: 08/18/2020  
 Test Crew: BD TV  
 OMNI Equipment ID numbers: \_\_\_\_\_

#### Wood Heater Supplemental Data

Start Time: 10:14 Booth #: E3

Stop Time: 14:14

#### Stack Gas Leak Check:

Initial: good Final: \_\_\_\_\_

#### Sample Train Leak Check:

A: 0.0 @ -6.9"Hg  
 B: 0.0 @ -4.8"Hg

#### Calibrations: Span Gas

CO<sub>2</sub>: 16.94 CO: 4.32

	Pre Test		Post Test	
	Zero	Span	Zero	Span
Time	<u>8:40</u>	<u>8:40</u>	<u>1429</u>	<u>1429</u>
CO <sub>2</sub>	<u>0.00</u>	<u>16.92</u>	<u>0.00</u>	<u>16.80</u>
CO	<u>0.00</u>	<u>4.29</u>	<u>0.03</u>	<u>4.31</u>

Air Velocity (ft/min): Initial: <50 Final: <50

Scale Audit (lbs): Initial: 10 Final: 100

Pitot Tube Leak Test: Initial: good Final: good

Stack Diameter (in): 6"

Induced Draft: 0.0

% Smoke Capture: 100

Flue Pipe Cleaned Prior to First Test in Series:

Date: 8/12/20 Initials: AC

	Initial	Middle	Ending
P <sub>b</sub> (in/Hg)	<u>30.21</u>		<u>30.15</u>
RH (%)			
Ambient (°F)	<u>77</u>		<u>81</u>

Tunnel Traverse		
Microtector Reading	dP (in H <sub>2</sub> O)	T(°F)
1	<u>0.014</u>	<u>88</u>
2	<u>0.014</u>	<u>88</u>
3	<u>0.018</u>	<u>88</u>
4	<u>0.016</u>	<u>88</u>
5	<u>0.012</u>	<u>88</u>
6	<u>0.012</u>	<u>88</u>
1	<u>0.018</u>	<u>88</u>
2	<u>0.018</u>	<u>88</u>
3	<u>0.018</u>	<u>88</u>
4	<u>0.018</u>	<u>88</u>
5	<u>0.020</u>	<u>88</u>
6	<u>0.016</u>	<u>88</u>
Center:		
	<u>0.019</u>	<u>88</u>

Tunnel Static Pressure (in H <sub>2</sub> O):	
Beginning of Test	End of Test
<u>-0.158</u>	<u>-0.158</u>

Background Filter Volume: 22823

Technician Signature: [Signature]

Date: 9/21/20

*Model: Maxim M255 PE  
Central Boiler, Inc.  
20502 160th Street  
Greenbush, MN 56726*

# **Run 3**

## **Category II**

## Hydronic Heating Appliances - Test Method ASTM 2618 Results

Manufacturer: Central Boiler  
 Model: Maxim M255 PE  
 Tracking No.: 2423  
 Project No.: 0117PS024E  
 Run: 3  
 Test Date: August 18, 2020

Burn Rate	<b>2.56 kg/hr dry</b>
Average Tunnel Temperature	97 degrees F
Average Gas Velocity in Dilution Tunnel - vs	9.5 feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	25012 dscf/hour
Average Delta p	0.020 inches H2O
Average Delta H	2.19 inches H2O
Total Time of Test	240 minutes

### PARTICULATE EMISSIONS RESULTS

First Hour:	<b>0.00 g/hr</b> <b>0.00 g/kg</b> <b>0.00 lb/mmBTU output</b>
Complete Run:	<b>0.57 g/hr</b> <b>0.22 g/kg</b> <b>0.03 lb/mmBTU output</b>

	SAMPLE TRAIN 1	SAMPLE TRAIN 2	AMBIENT SAMPLE TRAIN
Total Sample Volume - Vm	38.79 cubic feet	41.35 cubic feet	24.38 cubic feet
Average Gas Meter Temperature	88 degrees F	88 degrees F	85 degrees F
Total Sample Volume (Standard Conditions) - Vmstd	37.5 dscf	40.2 dscf	23.2 dscf
Total Particulates - mn	1 mg	1.1 mg	0.1 mg
Particulate Concentration (dry-standard)	0.00003 grams/dscf	0.00003 grams/dscf	0.000004 grams/dscf
Particulate Emissions	2.23 grams	2.31 grams	
Difference from Average	0.04 grams	0.04 grams	
<b>Results Are Acceptable</b>			

AVERAGE	
Total Sample Volume - Vm	40.07 cubic feet
Average Gas Meter Temperature	88 degrees F
Total Sample Volume (Standard Conditions) - Vmstd	38.9 dscf
Particulate Concentration (dry-standard)	0.00002 grams/dscf
Particulate Emissions	2.27 grams
7.5% of the average particulate emissions	0.17 grams

### ADDITIONAL ACCEPTANCE CRITERIA

Boiler Water Return Temperature >120 °F	<b>Acceptable</b>
Proportional Rate Variation >80%	<b>Acceptable</b>
90% of PR Values between 90-110%	<b>Acceptable</b>

SAMPLE TRAIN 1 - FIRST HOUR	
Total Sample Volume - Vm	9.65 cubic feet
Average Gas Meter Temperature	86 degrees F
Total Sample Volume (Standard Conditions) - Vmstd	9.37 dscf
Total Particulates - mn	0 mg
Particulate Concentration (dry-standard)	0.00000 grams/dscf
Particulate Emissions	0.00 grams
Burn Rate	2.54 (dry kg/hr)
Heat Output Rate	42656 BTU/hr

## Hydronic Heating Appliances - Test Method ASTM 2618 Results

Manufacturer: <u>Central Boiler</u>	Equipment Numbers: _____
Model: <u>Maxim M255 PE</u>	_____
Tracking No.: <u>2423</u>	_____
Project No.: <u>0117PS024E</u>	_____
Run #: <u>3</u>	_____
Date: <u>8/18/20</u>	_____

**TRAIN 1 (First Hour emissions)**

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	E014	120.0	120.2	-0.2
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe				0.0
E. Filter seals catch*	Seals				0.0

<b>Sub-Total</b>	Total Particulate, mg:	-0.2
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**TRAIN 1 (Post First Hour Change-out)**

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	E015	121.2	120.4	0.8
C. Rear filter catch	Filter	E016	119.3	119.4	-0.1
D. Probe catch*	Probe	28	114751.3	114751.1	0.2
E. Filter seals catch*	Seals	S0012	4180.2	4179.9	0.3

<b>Sub-Total</b>	Total Particulate, mg:	1.2
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<b>Train 1 Aggregate</b>	Total Particulate, mg:	1.0
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**TRAIN 2**

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	E017	121.7	120.9	0.8
B. Rear filter catch	Filter	E018	120.3	120.3	0.0
C. Probe catch*	Probe	29	114277.3	114277.0	0.3
D. Filter seals catch*	Seals	S0013	3301.3	3301.3	0.0

Total Particulate, mg:	1.1
------------------------	-----

**AMBIENT**

Sample Component	Reagent	Filter # or Probe #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch*	Filter	E019	120.7	120.6	0.1

Total Particulate, mg:	0.1
------------------------	-----

\*Particulate catch that results in a negative number, is assumed to be zero for probes and seals, negative numbers for filters are assumed to be part of the seal weight.

Component	Equations:
A. Front filter catch	Final (mg) - Tare (mg) = Particulate, mg
B. Rear filter catch	Final (mg) - Tare (mg) = Particulate, mg
C. Probe catch	Final (mg) - Tare (mg) = Particulate, mg



**Hydronic Heating Appliances - Test Method ASTM 2618**  
**Test Data**

Run: 3

Manufacturer: Central Boiler  
 Model: Maxim M255 PE  
 Tracking No.: 2423  
 Project No.: 0117PS024E  
 Test Date: August 18, 2020  
 Technician: Central Boiler  
 Beginning Clock Time: 16:26  
 Recording Interval: 1 min.  
 Total Sampling Time: 240 min.

Velocity Traverse Data													
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Pt.9	Pt.10	Pt.11	Pt.12	Center
Initial dP	0.016	0.020	0.020	0.020	0.016	0.010	0.018	0.020	0.018	0.020	0.018	0.016	0.018
Initial Temp.	96	96	96	96	96	96	96	96	96	96	96	96	96

Air Velocity: Initial: <50 Final: <50 V<sub>strav</sub> 8.98 ft/sec  
 Scale Audit: Pre: 10.0 Post: 10.0 Induced Draft: 0 V<sub>scant</sub> 9.10 ft/sec  
 Pilot Tube Leak Test: Pre: 0 Post: 0 % Smoke Capture: 100 F<sub>p</sub> 0.987  
 Flue Pipe Cleaned Prior to First Test in Series: Date:

PM Control Module: 371, 372  
 Dilution Tunnel MW(dry): 29.00 lb/lb-mole  
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole  
 Dilution Tunnel H<sub>2</sub>O: 2.00 percent  
 Dilution Tunnel Static: -0.156 H<sub>2</sub>O  
 Pitot Tube Cp: 0.99  
 Tunnel Velocity: 9.48 ft/sec  
 Initial Tunnel Flow: 395.8 scfm  
 Average Tunnel Flow: 416.9 scfm  
 Tunnel Area: 0.785 ft<sup>2</sup>  
 Post-Test Leak Check (1): 0.000 cfm @ 3 in. Hg  
 Post-Test Leak Check (2): 0.000 cfm @ 5 in. Hg  
 Fuel Moisture (dry basis %): 4.8  
 Meter Box Y Factor: 0.994 0.998 0.976  
 Barometric Pressure: Begin Middle End Average  
 30.11 30.08 30.10 \*Hg  
 Total Particulate (1): 1.0  
 Total Particulate (2): 1.1

Elapsed Time	Particulate Sampling Data																			Fuel Weight, lb		Flow, gpm		Temperature Data, °F										Stack			
	Gas Meter Cubic Feet (1)	Gas Meter Cubic Feet (2)	Gas Meter Cubic Feet (amb)	Sample Rate, cfm (1)	Sample Rate, cfm (2)	Orifice dH (1)	Orifice dH (2)	Orifice dH (amb)	Meter of (1)	Meter of (2)	Meter of (amb)	Meter Vac. In. Hg (1)	Meter Vac. In. Hg (2)	Dilution Tunnel Temp.	Dilution Tunnel dP	Pro. Rate (%) (1)	Pro. Rate (%) (2)	Scale Reading	Weight Change	Load Side Liquid Flow Rate	Boiler Side Liquid Flow Rate (optional)	Thermopile ΔT	Boiler to Heat Exch. Temp.	Heat Exch to Boiler Temp.	Inlet Load Temp.	Outlet Load Temp.	Stack	Filter (1)	Filter (2)	Ambient	Specific Heat of Inlet Water (BTU/lb-F)	Mass Flow Rate of Inlet Water (lb/min)	Heat Output, Btu				
	0	0.000	0.000	0			2.33	1.87	0.26	85	85	84	-0.1	-0.4	96	0.020			23.7		1.02	15.08	90.44	166.08	161.19	75.47	165.91	258	84	84	84						



Table with 42 columns and 173 rows. Columns include: Elapsed Time, Gas Meter Cubic Feet (1), Gas Meter Cubic Feet (2), Gas Meter Cubic Feet (amb), Sample Rate, cfm (1), Sample Rate, cfm (2), Orifice dH (1), Orifice dH (2), Orifice dH (amb), Meter of (1), Meter of (2), Meter of (amb), Meter Vac. In. Hg. (1), Meter Vac. In. Hg. (2), Dilution Tunnel Temp., Dilution Tunnel dP, Pro. Rate (%)(1), Pro. Rate (%)(2), Fuel Weight, lb (Scale Reading, Weight Change), Flow, gpm (Load Side Liquid Flow Rate, Boiler Side Liquid Flow Rate (optional)), Temperature Data, oF (Thermopile ΔT, Boiler to Heat Exch. Temp., Heat Exch to Boiler Temp., Inlet Load Temp., Outlet Load Temp., Stack, Filter (1), Filter (2), Ambient), Stack, Specific Heat of Inlet Water (BTU/lb-°F), Mass Flow Rate of Inlet Water (lb/min), Heat Output, Btu.



Elapsed Time	Particulate Sampling Data														Fuel Weight, lb		Flow, gpm		Temperature Data, oF										Stack					
	Gas Meter Cubic Feet (1)	Gas Meter Cubic Feet (2)	Gas Meter Cubic Feet (amb)	Sample Rate, cfm (1)	Sample Rate, cfm (2)	Orifice dH (1)	Orifice dH (2)	Orifice dH (amb)	Meter oF (1)	Meter oF (2)	Meter oF (amb)	Meter Vac. In. Hg. (1)	Meter Vac. In. Hg. (2)	Dilution Tunnel Temp.	Dilution Tunnel dP	Pro. Rate (%) (1)	Pro. Rate (%) (2)	Scale Reading	Weight Change	Load Side Liquid Flow Rate	Boiler Side Liquid Flow Rate (optional)	Thermopile ΔT	Boiler to Heat Exch. Temp.	Heat Exch to Boiler Temp.	Inlet Load Temp.	Outlet Load Temp.	Stack	Filter (1)	Filter (2)	Ambient		Specific Heat of Inlet Water (BTU/lb-F)	Mass Flow Rate of Inlet Water (lb/min)	Heat Output, Btu
236	38.145	40.667		0.16	0.17	2.18	1.78	0.26	90	89	85	-0.05	-0.5	96	0.020	99	99	0.4	-0.06	0.94	15.11	90.14	166.21	161.20	75.88	166.02	258	87	87	85		1.001	7.796	703
237	38.307	40.838		0.16	0.17	2.17	1.77	0.26	90	89	85	-0.27	-0.6	96	0.020	100	99	0.3	0.04	0.96	15.11	90.23	166.25	161.27	75.85	166.08	258	87	87	85		1.001	7.957	719
238	38.468	41.010		0.16	0.17	2.17	1.77	0.26	90	89	85	-0.06	-0.8	96	0.020	99	99	0.3	0.05	1.00	15.02	90.29	166.35	161.35	75.89	166.19	259	87	87	85		1.001	8.277	748
239	38.629	41.182		0.16	0.17	2.18	1.77	0.26	90	89	85	-0.54	-0.7	96	0.020	99	99	0.1	0.23	0.96	15.07	90.33	166.37	161.40	75.89	166.22	260	87	87	85		1.001	7.959	720
240	38.791	41.354	24.375	0.16	0.17	2.16	1.77	0.26	90	89	85	-0.08	-0.4	96	0.020	100	99	0.0	0.07	0.96	15.05	90.33	166.39	161.37	75.89	166.22	260	87	87	85		1.001	7.952	719
	38.791	41.354	24.375			2.19	1.79	0.26	88	88	85			97	0.020					0.94	15.08	90.6	166.4	161.4	75.6	166.2		86.71	86.70		#DIV/0!			710
																													TOTAL:			170494		

TF <sub>avg</sub>	163.876
T <sub>avg</sub>	163.636

### Hydronic Heating Appliances - Test Method ASTM 2618 Fuel Moisture

Manufacturer: Central Boiler  
Model: Maxim M255 PE  
Tracking No.: 2423  
Project No.: 0117PS024E  
Technician: Central Boiler  
Run #: 3  
Test Date: August 18, 2020

Wet Weight (lb)	% Moisture				
23.7	4.78	4.78	4.78	4.78	4.78

Total Weight of Load (lb):

Total Moisture of Load (%):

Equipment Numbers:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Manufacturer: Central Boiler  
Model: Maxim M255 PE  
Tracking No.: 2423  
Project No.: 0117PS024E  
Run: 3  
Test Date: 8/18/2020

Preburn Data

Appliance Side										Load Side										Average BTU output
Time Elapsed, Min	Appliance IN, °F	Appliance OUT, °F	ΔT	T <sub>avg</sub>	Water Flow, GPM	Water Density, kg/m <sup>3</sup>	Water Density, lb/gal	Flue Temperature °F	Btu/Hr	Load IN, °F	Load Out, °F	Water Flow, GPM	C <sub>pi</sub>	ΔT	Mass Flow Rate, lb/min	Btu/Min	Btu/Hr	Fuel Weight, LB	Fuel Wt. loss	
0.00	172.14	177.45	5.31	174.79	15.09	971.21	8.11	249.00	38967.63	77.61	177.31	0.92	1.00	99.70	7.66	764.92	45894.98	201.18		43116.78
1.00	171.86	177.13	5.27	174.50	15.06	971.33	8.11	250.00	38567.07	77.51	176.98	0.96	1.00	99.47	7.98	795.06	47703.82	201.23	-0.05	
2.00	171.72	176.99	5.27	174.35	15.06	971.38	8.11	251.00	38576.39	77.35	176.85	0.96	1.00	99.50	7.99	795.75	47745.01	201.01	0.22	
3.00	171.56	176.83	5.26	174.20	15.05	971.43	8.11	252.00	38524.80	77.15	176.70	0.94	1.00	99.55	7.83	779.85	46791.03	200.75	0.25	
4.00	171.44	176.68	5.25	174.06	15.08	971.48	8.11	253.00	38474.93	77.06	176.52	0.92	1.00	99.46	7.66	763.23	45793.70	200.47	0.28	
5.00	171.65	176.70	5.06	174.17	15.13	971.48	8.11	254.00	37215.46	76.86	176.51	0.98	1.00	99.65	8.15	812.69	48761.46	200.43	0.04	
6.00	171.25	176.52	5.27	173.89	15.13	971.54	8.11	255.00	38785.13	76.81	176.37	0.96	1.00	99.56	7.98	795.81	47748.82	200.54	-0.11	
7.00	171.16	176.45	5.28	173.80	15.12	971.57	8.11	255.00	38861.53	76.66	176.28	0.98	1.00	99.61	8.15	812.67	48759.95	200.43	0.11	
8.00	171.07	176.30	5.22	173.69	15.08	971.62	8.11	253.00	38319.35	76.60	176.13	0.90	1.00	99.53	7.50	747.64	44858.62	200.30	0.13	
9.00	170.88	176.10	5.22	173.49	15.05	971.69	8.11	255.00	38222.13	76.59	175.95	0.96	1.00	99.36	7.99	794.64	47678.38	200.31	0.00	
10.00	170.71	175.92	5.21	173.32	15.08	971.75	8.11	256.00	38242.89	76.50	175.75	0.96	1.00	99.26	7.99	793.63	47617.92	200.11	0.20	
11.00	170.63	175.83	5.21	173.23	15.01	971.78	8.11	256.00	38023.74	76.46	175.69	0.92	1.00	99.24	7.66	761.13	45667.98	199.85	0.26	
12.00	170.53	175.76	5.23	173.15	15.08	971.81	8.11	259.00	38418.46	76.43	175.58	0.92	1.00	99.16	7.67	761.14	45668.20	199.79	0.06	
13.00	170.72	175.89	5.17	173.31	15.06	971.76	8.11	258.00	37921.49	76.40	175.72	0.94	1.00	99.31	7.83	778.52	46711.21	199.92	-0.13	
14.00	170.56	175.82	5.26	173.19	15.04	971.79	8.11	260.00	38500.87	76.32	175.68	0.96	1.00	99.36	7.99	794.41	47664.78	199.96	-0.04	
15.00	170.57	175.71	5.14	173.14	15.03	971.82	8.11	260.00	37611.84	76.30	175.57	0.92	1.00	99.27	7.67	762.31	45738.85	199.62	0.34	
16.00	170.37	175.55	5.18	172.96	15.09	971.88	8.11	258.00	38051.66	76.32	175.41	0.96	1.00	99.10	8.00	793.35	47601.23	199.44	0.18	
17.00	170.19	175.39	5.20	172.79	15.06	971.93	8.11	258.00	38138.74	76.26	175.24	0.96	1.00	98.99	7.98	790.78	47446.96	199.21	0.23	
18.00	170.04	175.22	5.18	172.63	15.06	972.00	8.11	257.00	37928.30	76.24	175.10	0.94	1.00	98.86	7.82	773.57	46413.94	199.16	0.05	
19.00	170.02	175.22	5.19	172.62	14.96	972.00	8.11	259.00	37817.98	76.27	175.01	0.98	1.00	98.75	8.13	803.30	48198.19	199.14	0.02	
20.00	169.94	175.18	5.25	172.56	15.01	972.01	8.11	260.00	38355.53	76.29	175.01	0.96	1.00	98.72	7.99	789.25	47354.89	198.92	0.21	
21.00	170.22	175.06	4.84	172.64	15.08	972.05	8.11	258.00	35536.46	76.32	174.93	0.86	1.00	98.61	7.12	702.92	42175.02	199.11	-0.19	
22.00	169.67	174.83	5.17	172.25	14.99	972.13	8.11	257.00	37697.93	76.38	174.74	0.98	1.00	98.36	8.12	799.89	47993.25	199.13	-0.03	
23.00	169.60	174.81	5.21	172.20	15.13	972.14	8.11	257.00	38346.52	76.43	174.55	0.94	1.00	98.13	7.83	768.97	46138.20	198.74	0.39	
24.00	169.62	174.73	5.11	172.17	15.07	972.17	8.11	258.00	37481.83	76.46	174.57	0.90	1.00	98.11	7.51	737.45	44247.13	198.61	0.13	
25.00	169.54	174.67	5.13	172.10	15.08	972.19	8.11	258.00	37667.27	76.42	174.50	0.94	1.00	98.08	7.83	768.40	46104.04	198.60	0.02	
26.00	169.46	174.71	5.25	172.09	15.04	972.17	8.11	259.00	38431.89	76.44	174.54	0.96	1.00	98.10	7.99	784.63	47077.95	198.64	-0.04	
27.00	169.49	174.74	5.25	172.12	14.95	972.16	8.11	261.00	38239.64	76.43	174.57	0.92	1.00	98.14	7.66	752.67	45159.98	198.17	0.47	
28.00	169.64	174.61	4.98	172.13	15.12	972.21	8.11	259.00	36620.57	76.39	174.43	0.92	1.00	98.04	7.66	752.05	45122.73	198.05	0.13	
29.00	169.67	174.58	4.91	172.13	15.12	972.22	8.11	259.00	36128.08	76.41	174.44	0.90	1.00	98.04	7.50	736.13	44167.72	198.29	-0.24	
30.00	169.57	174.50	4.93	172.03	15.00	972.25	8.11	257.00	36008.24	76.41	174.34	0.92	1.00	97.93	7.66	751.26	45075.76	197.99	0.30	
31.00	169.51	174.36	4.85	171.93	15.09	972.30	8.11	258.00	35626.18	76.42	174.17	0.88	1.00	97.75	7.34	718.32	43099.25	198.12	-0.12	
32.00	169.61	174.26	4.65	171.93	15.05	972.33	8.11	256.00	34084.45	76.43	174.11	0.88	1.00	97.69	7.34	717.90	43074.04	197.90	0.22	
33.00	169.46	174.18	4.72	171.82	15.06	972.36	8.11	256.00	34587.53	76.38	173.99	0.94	1.00	97.61	7.82	764.42	45865.48	197.93	-0.04	
34.00	169.34	174.08	4.74	171.71	15.13	972.39	8.11	257.00	34949.96	76.32	173.89	0.90	1.00	97.57	7.50	732.67	43960.29	197.69	0.24	
35.00	169.39	174.10	4.71	171.75	15.16	972.38	8.11	257.00	34783.87	76.24	173.93	0.88	1.00	97.70	7.34	717.92	43075.41	197.72	-0.02	
36.00	169.34	174.04	4.70	171.69	15.02	972.41	8.12	257.00	34391.39	76.17	173.88	0.88	1.00	97.71	7.34	717.90	43073.82	197.28	0.44	
37.00	169.12	173.83	4.70	171.47	15.01	972.48	8.12	257.00	34383.48	76.12	173.70	0.88	1.00	97.58	7.34	717.03	43021.65	197.64	-0.35	
38.00	169.13	173.86	4.73	171.50	15.05	972.47	8.12	255.00	34684.07	76.09	173.68	0.88	1.00	97.58	7.34	716.89	43013.22	197.16	0.47	
39.00	169.11	173.82	4.71	171.47	15.03	972.48	8.12	258.00	34465.22	76.08	173.63	0.90	1.00	97.56	7.50	732.55	43952.70	197.11	0.05	
40.00	169.20	173.90	4.70	171.55	15.09	972.45	8.12	259.00	34508.00	76.07	173.71	0.88	1.00	97.64	7.34	717.55	43052.74	197.17	-0.06	
41.00	169.19	173.96	4.77	171.57	14.99	972.43	8.12	260.00	34790.41	76.07	173.74	0.90	1.00	97.67	7.50	733.22	43992.94	197.31	-0.15	
42.00	171.46	174.04	2.59	172.75	15.08	972.40	8.12	257.00	18995.77	76.08	173.84	0.49	1.00	97.76	4.11	402.70	24162.00	197.17	0.15	





100.00	160.98	165.84	4.87	163.41	15.03	975.19	8.14	257.00	35700.58	75.51	165.67	0.98	1.00	90.16	8.14	734.34	44060.51	191.05	0.30
101.00	161.10	165.78	4.68	163.44	15.06	975.21	8.14	258.00	34427.61	75.58	165.61	0.94	1.00	90.02	7.81	704.04	42242.69	190.75	0.30
102.00	161.38	166.01	4.63	163.70	15.16	975.14	8.14	258.00	34229.31	75.60	165.78	0.90	1.00	90.18	7.49	676.37	40582.39	190.70	0.05
103.00	161.24	166.13	4.89	163.68	15.01	975.09	8.14	260.00	35870.08	75.51	165.93	0.94	1.00	90.42	7.82	707.52	42451.30	190.72	-0.01
104.00	161.30	166.16	4.86	163.73	15.14	975.09	8.14	259.00	35921.96	75.56	166.02	0.92	1.00	90.46	7.66	693.48	41608.85	190.74	-0.02
105.00	161.38	166.25	4.87	163.81	15.07	975.06	8.14	257.00	35801.63	75.60	166.06	0.98	1.00	90.46	8.14	737.56	44253.75	190.87	-0.13
106.00	161.39	166.23	4.84	163.81	15.08	975.06	8.14	257.00	35666.45	75.55	166.09	1.00	1.00	90.55	8.29	751.37	45082.00	190.52	0.35
107.00	161.25	166.11	4.86	163.68	15.13	975.10	8.14	256.00	35879.09	75.51	165.99	0.94	1.00	90.48	7.82	708.62	42517.00	190.49	0.04
108.00	161.45	166.04	4.59	163.75	15.08	975.12	8.14	257.00	33801.40	75.53	165.89	0.86	1.00	90.36	7.17	648.51	38910.80	190.14	0.35
109.00	161.24	166.13	4.89	163.69	15.11	975.09	8.14	258.00	36058.09	75.54	165.96	1.00	1.00	90.42	8.28	749.35	44960.84	189.97	0.17
110.00	161.30	166.23	4.93	163.76	15.11	975.06	8.14	258.00	36344.00	75.60	166.02	0.97	1.00	90.42	8.11	733.96	44037.42	190.14	-0.17
111.00	161.37	166.22	4.86	163.80	15.02	975.06	8.14	257.00	35614.30	75.59	166.08	0.99	1.00	90.48	8.27	748.85	44930.73	190.12	0.02
112.00	161.31	166.14	4.83	163.72	15.11	975.09	8.14	255.00	35652.93	75.54	166.03	0.97	1.00	90.49	8.03	727.81	43668.85	189.71	0.41
113.00	161.07	165.93	4.86	163.50	15.10	975.16	8.14	254.00	35808.45	75.45	165.82	0.95	1.00	90.38	7.87	712.47	42748.36	189.99	-0.28
114.00	161.27	165.97	4.70	163.62	15.00	975.15	8.14	257.00	34435.29	75.39	165.81	0.88	1.00	90.42	7.33	663.98	39838.67	189.56	0.44
115.00	161.14	165.99	4.85	163.57	15.05	975.14	8.14	256.00	35616.64	75.41	165.86	0.96	1.00	90.45	7.98	722.29	43337.54	189.58	-0.03
116.00	161.07	165.99	4.92	163.53	15.05	975.14	8.14	257.00	36153.79	75.39	165.81	1.00	1.00	90.42	8.30	751.35	45081.19	189.36	0.22
117.00	161.17	166.11	4.94	163.64	15.18	975.10	8.14	260.00	36601.60	75.41	165.90	1.00	1.00	90.49	8.30	751.76	45105.88	189.33	0.02
118.00	161.31	166.20	4.89	163.76	15.12	975.07	8.14	259.00	36103.64	75.40	166.05	0.98	1.00	90.65	8.14	738.42	44305.24	189.44	-0.10
119.00	161.23	166.13	4.90	163.68	15.07	975.10	8.14	258.00	36045.28	75.42	165.98	0.90	1.00	90.55	7.49	678.99	40739.57	189.38	0.06
120.00	161.17	166.07	4.90	163.62	15.18	975.11	8.14	259.00	36344.87	75.41	165.94	0.96	1.00	90.53	7.99	723.77	43426.05	189.08	0.30

**ASTM E2618 Wood Heater Run Sheets**

Client: Central Boiler Project Number: 0117PS024E Run Number: 3  
 Model: Maxim M255 PE Tracking Number: 2423 Date: 08/18/2020  
 Test Crew: DD TT  
 OMNI Equipment ID numbers: \_\_\_\_\_

**Wood Heater Supplemental Data**

Start Time: 16:26 Booth #: \_\_\_\_\_

Stop Time: 20:26

**Stack Gas Leak Check:**

Initial: good Final: good

**Sample Train Leak Check:**

A: 0.0 @ -30"Hg  
 B: 0.0 @ -45"Hg

Calibrations: Span Gas CO<sub>2</sub>: 16.94% CO: 4.32%

	Pre Test		Post Test	
	Zero	Span	Zero	Span
Time	<u>1600</u>	<u>1600</u>	<u>2031</u>	<u>2031</u>
CO <sub>2</sub>	<u>0.00</u>	<u>16.93</u>	<u>0.00</u>	<u>16.90</u>
CO	<u>0.00</u>	<u>4.29</u>	<u>0.00</u>	<u>4.29</u>

Air Velocity (ft/min): Initial: 250 Final: 250  
 Scale Audit (lbs): Initial: 10.0 Final: 10.0  
 Pitot Tube Leak Test: Initial: good Final: good  
 Stack Diameter (in): 6"  
 Induced Draft: 0.0  
 % Smoke Capture: 100  
 Flue Pipe Cleaned Prior to First Test in Series:  
 Date: 8/17/20 Initials: BC

	Initial	Middle	Ending
P <sub>b</sub> (in/Hg)	<u>30.11</u>		<u>30.08</u>
RH (%)			
Ambient (°F)	<u>84</u>		<u>85</u>

Tunnel Traverse		
Microtector Reading	dP (in H <sub>2</sub> O)	T(°F)
1	<u>0.016</u>	<u>96</u>
2	<u>0.020</u>	<u>96</u>
3	<u>0.020</u>	<u>96</u>
4	<u>0.020</u>	<u>96</u>
5	<u>0.016</u>	<u>96</u>
	<del><u>0.010</u></del>	<del><u>90</u></del>
6	<u>0.010</u>	<u>96</u>
1	<u>0.018</u>	<u>96</u>
2	<u>0.020</u>	<u>96</u>
3	<u>0.018</u>	<u>96</u>
4	<u>0.020</u>	<u>96</u>
5	<u>0.018</u>	<u>96</u>
6	<u>0.016</u>	<u>96</u>
Center:		
	<u>0.018</u>	<u>96</u>

Background Filter Volume: 24.375

Tunnel Static Pressure (in H <sub>2</sub> O):	
Beginning of Test	End of Test
<u>-0.156</u>	<u>-0.156</u>

Technician Signature: [Signature] Date: 9/21/20

*Model: Maxim M255 PE  
Central Boiler, Inc.  
20502 160th Street  
Greenbush, MN 56726*

## **Run 4**

### **Category III**

## Hydronic Heating Appliances - Test Method ASTM 2618 Results

Manufacturer: Central Boiler  
 Model: Maxim M255 PE  
 Tracking No.: 2423  
 Project No.: 0117PS024E  
 Run: 4  
 Test Date: August 19, 2020

Burn Rate	<b>4.26 kg/hr dry</b>
Average Tunnel Temperature	96 degrees F
Average Gas Velocity in Dilution Tunnel - vs	9.3 feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	24561 dscf/hour
Average Delta p	0.020 inches H2O
Average Delta H	2.18 inches H2O
Total Time of Test	240 minutes

### PARTICULATE EMISSIONS RESULTS

First Hour:	<b>0.52 g/hr</b> <b>0.12 g/kg</b> <b>0.02 lb/mmBTU output</b>
Complete Run:	<b>1.52 g/hr</b> <b>0.36 g/kg</b> <b>0.05 lb/mmBTU output</b>

	SAMPLE TRAIN 1	SAMPLE TRAIN 2	AMBIENT SAMPLE TRAIN
Total Sample Volume - Vm	38.55 cubic feet	40.89 cubic feet	23.51 cubic feet
Average Gas Meter Temperature	83 degrees F	82 degrees F	80 degrees F
Total Sample Volume (Standard Conditions) - Vmstd	37.6 dscf	40.0 dscf	22.5 dscf
Total Particulates - mn	2.3 mg	2.5 mg	0 mg
Particulate Concentration (dry-standard)	0.00006 grams/dscf	0.00006 grams/dscf	0.000000 grams/dscf
Particulate Emissions	6.01 grams	6.13 grams	
Difference from Average	0.06 grams	0.06 grams	
<b>Results Are Acceptable</b>			

AVERAGE	
Total Sample Volume - Vm	39.72 cubic feet
Average Gas Meter Temperature	83 degrees F
Total Sample Volume (Standard Conditions) - Vmstd	38.8 dscf
Particulate Concentration (dry-standard)	0.00006 grams/dscf
Particulate Emissions	6.07 grams
7.5% of the average particulate emissions	0.46 grams

### ADDITIONAL ACCEPTANCE CRITERIA

Boiler Water Return Temperature >120 °F	<b>Acceptable</b>
Proportional Rate Variation >80%	<b>Acceptable</b>
90% of PR Values between 90-110%	<b>Acceptable</b>

SAMPLE TRAIN 1 - FIRST HOUR	
Total Sample Volume - Vm	9.59 cubic feet
Average Gas Meter Temperature	81 degrees F
Total Sample Volume (Standard Conditions) - Vmstd	9.39 dscf
Total Particulates - mn	0.2 mg
Particulate Concentration (dry-standard)	0.00002 grams/dscf
Particulate Emissions	0.52 grams
Burn Rate	4.23 (dry kg/hr)
Heat Output Rate	70624 BTU/hr

## Hydronic Heating Appliances - Test Method ASTM 2618 Results

Manufacturer: Central Boiler  
 Model: Maxim M255 PE  
 Tracking No.: 2423  
 Project No.: 0117PS024E  
 Run #: 4  
 Date: 8/19/20

Equipment Numbers: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

### TRAIN 1 (First Hour emissions)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	E020	119.5	119.3	0.2
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe				0.0
E. Filter seals catch*	Seals				0.0

**Sub-Total**      Total Particulate, mg:      0.2

### TRAIN 1 (Post First Hour Change-out)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch (remainder)	Filter	E021	122.3	120.5	1.8
C. Rear filter catch	Filter	E022	119.1	119.2	-0.1
D. Probe catch*	Probe	53	118273.0	118272.8	0.2
E. Filter seals catch*	Seals	S0014	3382.4	3382.2	0.2

**Sub-Total**      Total Particulate, mg:      2.1

**Train 1 Aggregate**      Total Particulate, mg:      2.3

### TRAIN 2

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	E023	122.1	120.1	2.0
B. Rear filter catch	Filter	E024	119.1	119.2	-0.1
C. Probe catch*	Probe	56	118614.0	118613.5	0.5
D. Filter seals catch*	Seals	S0015	3284.7	3284.6	0.1

Total Particulate, mg:      2.5

### AMBIENT

Sample Component	Reagent	Filter # or Probe #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch*	Filter	E025	120.5	120.6	0.0

Total Particulate, mg:      0.0

\*Particulate catch that results in a negative number, is assumed to be zero for probes and seals, negative numbers for filters are assumed to be part of the seal weight.

Component	Equations:
A. Front filter catch	Final (mg) - Tare (mg) = Particulate, mg
B. Rear filter catch	Final (mg) - Tare (mg) = Particulate, mg
C. Probe catch	Final (mg) - Tare (mg) = Particulate, mg











Elapsed Time	Particulate Sampling Data														Fuel Weight, lb		Flow, gpm		Temperature Data, °F										Specific Heat of Inlet Water (BTU/lb-°F)	Mass Flow Rate of Inlet Water (lb/min)	Heat Output, Btu			
	Gas Meter Cubic Feet (1)	Gas Meter Cubic Feet (2)	Gas Meter Cubic Feet (amb)	Sample Rate, cfm (1)	Sample Rate, cfm (2)	Orifice dH (1)	Orifice dH (2)	Orifice dH (amb)	Meter oF (1)	Meter oF (2)	Meter oF (amb)	Meter Vac. In. Hg. (1)	Meter Vac. In. Hg. (2)	Dilution Tunnel Temp.	Dilution Tunnel dP	Pro. Rate (%) (1)	Pro. Rate (%) (2)	Scale Reading	Weight Change	Load Side Liquid Flow Rate	Boiler Side Liquid Flow Rate (optional)	Thermopile ΔT	Boiler to Heat Exch. Temp.	Heat Exch to Boiler Temp.	Inlet Load Temp.	Outlet Load Temp.	Stack	Filter (1)				Filter (2)	Ambient	
236	37.899	40.202		0.16	0.17	2.24	1.79	0.26	86	85	83	-0.10	-0.90	100	0.020	101	101	0.4	0.33	1.50	15.0815287	93.0	165.4	156.8	72.2	165.1	315	85	85	83		1.001	12.489	1162
237	38.063	40.375		0.16	0.17	2.24	1.79	0.26	86	85	83	-0.47	-0.70	100	0.020	102	101	0.4	0.09	1.48	15.022357	93.0	165.4	156.8	72.2	165.2	315	85	85	83		1.001	12.328	1148
238	38.226	40.547		0.16	0.17	2.23	1.80	0.26	86	85	83	-0.51	-0.60	100	0.020	101	101	0.4	-0.06	1.56	15.0030241	92.8	165.2	156.7	72.2	165.1	315	85	85	83		1.001	12.969	1205
239	38.389	40.719		0.16	0.17	2.24	1.79	0.26	86	85	83	-0.14	-0.90	100	0.020	101	101	0.2	0.23	1.48	15.0315647	92.9	165.4	156.9	72.3	165.2	316	85	85	83		1.001	12.329	1147
240	38.553	40.891	23.513	0.16	0.17	2.24	1.79	0.26	86	85	83	-0.26	-0.90	100	0.020	102	101	0.0	0.18	1.48	15.1012983	93.0	165.5	156.9	72.2	165.2	317	85	85	83		1.001	12.329	1148
	38.553	40.891	23.513			2.18	1.76	0.26	83	82	80			96	0.020					1.52	15.05	93.0	165.2	156.8	72.0	165.1		82.20	82.07	#DIV/0!			1176	
																													TOTAL:		282125			

TF<sub>avg</sub> 161.178  
 Tl<sub>avg</sub> 160.979

Manufacture Central Boiler  
 Model: Maxim M255 PE  
 Tracking No. 2423  
 Project No. 0117PS024E  
 Run: 4  
 Test Date: 8/19/2020

Appliance Data										LOAD DATA											
Time Elapsed, Min	Appliance IN, °F	Appliance OUT, °F	ΔT	T <sub>avg</sub>	Water Flow, GPM	Water Density, kg/m <sup>3</sup>	Water Density, lb/gal	Flue Temperature, °F	Btu/Hr	Load IN, °F	Load Out, °F	Water Flow, GPM	C <sub>pi</sub>	ΔT	Mass Flow Rate, lb/min	Btu/Mi n	Btu/Hr	Fuel Weight, LB	Fuel Wt. Loss	Average BTU output	
10.00	145.43	152.23	6.80	148.83	15.05	979.56	8.17	300	50197.60	81.19	152.01	1.68	1.00	70.82	13.95	989.43	59365.89	159.52		<b>66898.16</b>	
11.00	145.42	152.72	7.30	149.07	15.02	979.41	8.17	299	53793.21	81.15	152.53	1.66	1.00	71.38	13.79	985.59	59135.54	159.36	0.16		
12.00	144.71	152.83	8.11	148.77	15.06	979.38	8.17	299	59915.00	81.14	152.56	1.66	1.00	71.42	13.79	986.10	59166.09	159.18	0.19		
13.00	146.37	153.23	6.87	149.80	15.04	979.25	8.17	302	50639.40	80.01	153.03	1.54	1.00	73.01	12.84	938.29	56297.49	159.03	0.14		
14.00	146.38	153.53	7.15	149.96	15.05	979.16	8.17	302	52743.43	76.84	153.35	1.54	1.00	76.51	12.84	983.50	59010.16	158.92	0.12		
15.00	146.69	153.98	7.29	150.34	15.05	979.02	8.17	302	53771.43	73.92	153.75	1.51	1.00	79.83	12.53	1001.17	60070.16	158.72	0.20		
16.00	147.55	153.99	6.44	150.77	15.06	979.02	8.17	304	47558.98	72.92	153.81	1.31	1.00	80.89	10.92	884.25	53054.75	158.64	0.08		
17.00	148.15	154.33	6.17	151.24	14.98	978.91	8.17	305	45329.37	73.46	154.15	1.27	1.00	80.69	10.60	856.00	51360.10	158.41	0.23		
18.00	148.58	154.73	6.15	151.66	15.07	978.78	8.17	306	45380.24	74.45	154.54	1.29	1.00	80.08	10.75	862.13	51727.63	158.34	0.07		
19.00	149.08	155.24	6.16	152.16	15.09	978.62	8.17	307	45565.03	75.51	155.04	1.25	1.00	79.52	10.43	830.67	49840.04	158.19	0.16		
20.00	149.48	155.53	6.05	152.50	15.07	978.53	8.17	309	44654.99	76.75	155.32	1.29	1.00	78.57	10.74	845.15	50709.20	157.96	0.23		
21.00	150.14	156.06	5.92	153.10	15.09	978.37	8.16	307	43750.60	77.93	155.88	0.89	1.00	77.95	7.36	574.21	34452.51	157.83	0.13		
22.00	151.29	156.75	5.46	154.02	15.11	978.15	8.16	305	40423.15	78.69	156.49	1.10	1.00	77.79	9.13	711.13	42667.68	157.62	0.21		
23.00	151.46	156.99	5.53	154.23	15.11	978.07	8.16	305	40932.62	79.24	156.87	1.24	1.00	77.63	10.27	798.42	47905.44	157.48	0.14		
24.00	151.67	157.33	5.66	154.50	15.13	977.96	8.16	304	41903.27	79.49	157.12	1.21	1.00	77.64	10.09	784.43	47065.98	157.23	0.25		
25.00	152.26	157.86	5.60	155.06	15.11	977.79	8.16	305	41403.10	79.47	157.64	1.20	1.00	78.17	9.94	777.66	46659.53	156.63	0.60		
26.00	152.89	158.53	5.64	155.71	15.13	977.58	8.16	303	41783.80	79.35	158.31	1.21	1.00	78.96	10.10	798.00	47880.27	156.71	-0.08		
27.00	153.21	158.97	5.76	156.09	15.18	977.44	8.16	301	42790.15	79.17	158.68	1.18	1.00	79.52	9.78	778.40	46704.20	156.29	0.41		
28.00	154.03	159.37	5.34	156.70	15.00	977.31	8.16	303	39154.46	78.92	159.21	1.18	1.00	80.29	9.78	786.42	47185.15	156.08	0.22		
29.00	153.91	159.74	5.82	156.83	15.08	977.19	8.16	306	42977.57	78.67	159.53	1.25	1.00	80.86	10.43	844.17	50650.09	155.94	0.14		
30.00	154.54	160.43	5.89	157.48	15.09	976.97	8.15	306	43473.86	78.39	160.22	1.27	1.00	81.84	10.59	867.65	52058.91	155.90	0.04		
31.00	154.99	160.93	5.94	157.96	15.05	976.81	8.15	305	43714.94	78.05	160.68	1.20	1.00	82.63	9.94	822.62	49357.29	155.67	0.22		
32.00	155.32	161.29	5.97	158.31	15.19	976.69	8.15	308	44346.24	77.76	161.09	1.22	1.00	83.33	10.10	842.75	50564.75	156.00	-0.33		
33.00	155.84	161.90	6.06	158.87	15.02	976.49	8.15	309	44536.36	77.56	161.65	1.20	1.00	84.09	9.94	837.13	50227.83	155.90	0.10		
34.00	156.43	162.40	5.97	159.42	15.07	976.33	8.15	308	44010.87	77.44	162.19	1.16	1.00	84.75	9.62	816.14	48968.49	155.66	0.25		
35.00	156.88	162.81	5.92	159.85	14.99	976.19	8.15	309	43418.29	77.39	162.59	1.22	1.00	85.20	10.11	862.17	51730.20	155.40	0.26		
36.00	157.13	163.29	6.16	160.21	15.09	976.03	8.15	309	45414.28	77.39	163.08	1.22	1.00	85.68	10.11	866.92	52015.38	155.13	0.27		
37.00	157.48	163.64	6.16	160.56	15.06	975.92	8.14	310	45301.85	77.43	163.40	1.24	1.00	85.97	10.27	883.82	53029.11	154.98	0.15		
38.00	157.87	163.94	6.07	160.91	15.03	975.82	8.14	311	44620.88	77.49	163.81	1.18	1.00	86.32	9.79	845.62	50736.95	154.97	0.00		
39.00	158.39	164.55	6.16	161.47	15.14	975.62	8.14	308	45519.56	77.53	164.28	1.22	1.00	86.75	10.11	877.65	52658.91	154.97	0.00		
40.00	158.74	164.79	6.05	161.76	15.05	975.54	8.14	310	44497.47	77.56	164.60	1.18	1.00	87.04	9.79	852.71	51162.42	154.69	0.28		
41.00	158.96	165.07	6.11	162.01	15.02	975.45	8.14	311	44864.97	77.57	164.88	1.14	1.00	87.31	9.47	827.40	49644.06	154.54	0.16		
42.00	159.43	165.57	6.14	162.50	15.10	975.28	8.14	313	45300.63	77.56	165.33	1.53	1.00	87.77	12.68	1114.54	66872.36	154.42	0.11		
43.00	156.92	166.11	9.19	161.51	14.97	975.10	8.14	312	67206.85	77.46	165.86	1.66	1.00	88.39	13.80	1221.61	73296.38	154.09	0.33		
44.00	156.98	166.23	9.25	161.60	15.08	975.06	8.14	311	68099.29	77.23	165.99	1.68	1.00	88.77	13.97	1241.75	74505.25	153.91	0.18		
45.00	156.94	166.19	9.25	161.56	15.01	975.08	8.14	312	67803.08	76.96	165.94	1.68	1.00	88.98	13.96	1243.97	74638.38	153.84	0.07		
46.00	156.92	166.20	9.28	161.56	15.02	975.07	8.14	314	68078.20	76.70	165.99	1.68	1.00	89.29	13.97	1248.85	74930.70	153.60	0.25		
47.00	157.30	166.46	9.15	161.88	15.01	974.99	8.14	312	67061.54	76.44	166.21	1.62	1.00	89.77	13.48	1211.96	72717.38	153.40	0.19		
48.00	157.02	166.29	9.26	161.65	15.03	975.04	8.14	313	67992.43	76.19	166.13	1.70	1.00	89.94	14.13	1272.31	76338.59	153.29	0.11		
49.00	156.78	166.11	9.33	161.44	15.09	975.10	8.14	312	68725.72	75.93	165.89	1.72	1.00	89.95	14.29	1287.02	77221.26	152.98	0.31		
50.00	156.83	166.07	9.24	161.45	15.00	975.11	8.14	316	67710.60	75.69	165.89	1.70	1.00	90.21	14.13	1276.32	76579.30	153.15	-0.17		
51.00	156.81	166.09	9.29	161.45	15.13	975.11	8.14	314	68600.09	75.44	165.93	1.67	1.00	90.50	13.89	1258.24	75494.14	153.01	0.14		



107.00	156.11	164.66	8.56	160.38	15.02	975.58	8.14	316	62789.81	72.15	164.43	1.52	1.00	92.28	12.68	1171.61	70296.67	143.49	0.16
108.00	156.22	164.70	8.48	160.46	15.01	975.57	8.14	316	62160.46	72.15	164.50	1.51	1.00	92.35	12.52	1157.91	69474.84	143.49	0.00
109.00	156.64	164.82	8.17	160.73	14.97	975.53	8.14	316	59767.48	72.12	164.62	1.52	1.00	92.49	12.68	1174.40	70463.99	143.18	0.31
110.00	156.77	164.90	8.12	160.84	15.11	975.50	8.14	316	59945.85	72.13	164.72	1.45	1.00	92.59	12.04	1115.91	66954.47	143.03	0.16
111.00	156.70	164.84	8.14	160.77	15.11	975.52	8.14	317	60059.59	72.14	164.65	1.52	1.00	92.51	12.69	1174.88	70492.61	142.85	0.18
112.00	156.50	165.03	8.53	160.77	15.12	975.46	8.14	316	62960.58	72.17	164.80	1.54	1.00	92.63	12.85	1191.47	71488.37	142.89	-0.04
113.00	156.57	165.09	8.52	160.83	15.11	975.44	8.14	315	62871.39	72.18	164.90	1.52	1.00	92.72	12.69	1177.67	70660.41	142.57	0.32
114.00	156.61	165.12	8.51	160.87	15.08	975.43	8.14	315	62655.63	72.21	164.95	1.51	1.00	92.75	12.52	1162.87	69772.41	142.42	0.15
115.00	156.48	164.97	8.49	160.72	15.04	975.48	8.14	315	62377.43	72.25	164.77	1.56	1.00	92.53	13.00	1204.40	72263.81	142.61	-0.18
116.00	156.44	164.95	8.51	160.69	15.02	975.49	8.14	316	62427.47	72.30	164.77	1.52	1.00	92.47	12.68	1173.98	70438.84	141.96	0.65
117.00	156.53	165.00	8.47	160.76	15.06	975.47	8.14	315	62336.08	72.34	164.79	1.52	1.00	92.44	12.68	1173.57	70414.37	141.91	0.05
118.00	156.62	165.09	8.47	160.86	15.20	975.44	8.14	316	62908.08	72.30	164.92	1.50	1.00	92.62	12.52	1161.17	69670.40	142.01	-0.10
119.00	156.85	165.35	8.50	161.10	15.00	975.35	8.14	317	62309.31	72.15	165.09	1.47	1.00	92.94	12.20	1135.08	68105.00	141.78	0.23
120.00	156.89	165.44	8.55	161.16	15.08	975.33	8.14	313	62961.74	72.05	165.23	1.51	1.00	93.18	12.52	1168.30	70097.78	141.35	0.43
121.00	156.78	165.33	8.55	161.06	15.02	975.36	8.14	314	62750.21	71.99	165.09	1.51	1.00	93.11	12.52	1167.38	70042.63	141.43	-0.08
122.00	156.77	165.36	8.59	161.06	15.01	975.35	8.14	315	62949.45	71.97	165.16	1.54	1.00	93.19	12.84	1198.13	71887.83	140.86	0.58
123.00	156.79	165.37	8.57	161.08	14.98	975.35	8.14	315	62741.20	72.00	165.14	1.52	1.00	93.14	12.68	1182.65	70958.98	140.82	0.04
124.00	156.84	165.37	8.53	161.11	14.98	975.35	8.14	313	62387.45	72.02	165.18	1.54	1.00	93.17	12.84	1198.13	71887.93	141.14	-0.31
125.00	156.59	165.07	8.48	160.83	15.09	975.45	8.14	314	62516.91	72.08	164.90	1.52	1.00	92.82	12.68	1178.46	70707.82	140.75	0.39
126.00	156.67	165.20	8.53	160.93	15.17	975.41	8.14	316	63184.25	72.14	165.02	1.52	1.00	92.87	12.68	1179.11	70746.35	140.43	0.32
127.00	156.61	165.10	8.48	160.85	15.00	975.44	8.14	315	62147.50	72.22	164.90	1.52	1.00	92.68	12.68	1176.71	70602.34	140.37	0.06
128.00	156.72	165.20	8.48	160.96	15.03	975.41	8.14	313	62243.78	72.27	165.02	1.52	1.00	92.75	12.69	1177.93	70676.03	140.22	0.15
129.00	156.65	165.15	8.51	160.90	15.12	975.42	8.14	313	62798.98	72.31	164.94	1.54	1.00	92.63	12.84	1191.04	71462.40	140.27	-0.05
130.00	156.59	165.12	8.53	160.86	15.09	975.43	8.14	313	62863.00	72.31	164.91	1.52	1.00	92.60	12.68	1175.95	70557.22	139.89	0.38
131.00	156.44	164.96	8.51	160.70	15.07	975.49	8.14	314	62668.34	72.30	164.76	1.51	1.00	92.46	12.53	1159.59	69575.40	139.87	0.02
132.00	156.70	165.16	8.47	160.93	15.06	975.42	8.14	313	62266.96	72.27	164.94	1.47	1.00	92.67	12.20	1132.28	67936.91	139.69	0.18
133.00	156.72	165.03	8.31	160.87	15.14	975.46	8.14	312	61449.97	72.25	164.86	1.51	1.00	92.61	12.53	1161.40	69684.24	139.44	0.25
134.00	156.55	164.95	8.40	160.75	15.13	975.49	8.14	313	62084.45	72.19	164.74	1.51	1.00	92.55	12.53	1161.02	69661.11	139.42	0.01
135.00	156.53	164.96	8.43	160.75	15.06	975.48	8.14	314	61989.81	72.12	164.78	1.51	1.00	92.66	12.53	1162.06	69723.62	138.82	0.60



# Hydronic Heating Appliances - Test Method ASTM 2618

## Fuel Moisture

Manufacturer: Central Boiler  
Model: Maxim M255 PE  
Tracking No.: 2423  
Project No.: 0117PS024E  
Technician: Central Boiler  
Run #: 4  
Test Date: August 19, 2020

Wet Weight (lb)	% Moisture				
39.4	4.78	4.78	4.78	4.78	4.78

Total Weight of Load (lb):

Total Moisture of Load (%):

Equipment Numbers:

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### ASTM E2618 Wood Heater Run Sheets

Client: Central Boiler Project Number: 0117PS024E Run Number: 4  
 Model: Maxim M255 PE Tracking Number: 2423 Date: 08/19/2020  
 Test Crew: AD JT  
 OMNI Equipment ID numbers: \_\_\_\_\_

#### Wood Heater Supplemental Data

Start Time: 1030 Booth #: E3

Stop Time: 1430

**Stack Gas Leak Check:**

Initial: good Final: good

**Sample Train Leak Check:**

A: 0.00 @ -29"Hg  
 B: 0.00 @ -34"Hg

Calibrations: Span Gas CO<sub>2</sub>: 16.94% CO: 4.32%

	Pre Test		Post Test	
	Zero	Span	Zero	Span
Time	<u>9:45</u>	<u>9:50</u>	<u>14:40</u>	<u>14:45</u>
CO <sub>2</sub>	<u>0.00</u>	<u>16.85</u>	<u>0.00</u>	<u>16.84</u>
CO	<u>0.00</u>	<u>4.26</u>	<u>0.00</u>	<u>4.29</u>

Air Velocity (ft/min): Initial: <50 Final: <50  
 Scale Audit (lbs): Initial: 10.0 Final: 10.0  
 Pitot Tube Leak Test: Initial: good Final: good  
 Stack Diameter (in): 6"  
 Induced Draft: 0.0  
 % Smoke Capture: 100

Flue Pipe Cleaned Prior to First Test in Series:

Date: 8/17/20 Initials: AD

	Initial	Middle	Ending
P <sub>b</sub> (in/Hg)	<u>30.06</u>		<u>29.99</u>
RH (%)			
Ambient (°F)	<u>78</u>		<u>83</u>

Tunnel Traverse		
Microtector Reading	dP (in. H <sub>2</sub> O)	T(°F)
<u>1/2</u>	<u>0.016/0.020</u>	<u>94</u>
<u>3/4</u>	<u>0.020/0.022</u>	<u>94</u>
<u>5/6</u>	<u>0.016/0.008</u>	<u>94</u>
<u>1/2</u>	<u>0.018/0.020</u>	<u>93</u>
<u>3/4</u>	<u>0.020/0.022</u>	<u>93</u>
<u>5/6</u>	<u>0.020/0.016</u>	<u>93</u>
Center:		
	<u>0.019</u>	<u>94</u>

Background Filter Volume: 23.513

Tunnel Static Pressure (in H <sub>2</sub> O):	
Beginning of Test	End of Test
<u>-0.174</u>	<u>-0.170</u>

Technician Signature: AD

Date: 9/21/20

*Model: Maxim M255 PE  
Central Boiler, Inc. WoodMaster, Inc.  
20502 160th Street  
Greenbush, MN 56726*

# **Section 5**

## **Testing Results**

**Table 1A - Data Summary Part A**

Category	Run No	Load % Capacity	Target Load	Actual Load	Actual Load	$\theta$	$W_{fuel}$	$MC_{ave}$	$Q_{inLHV}$	$Q_{inHHV}$	$Q_{out}$
			Btu/hr	Btu/hr	% of max	Test Duration	Wood Weight as-fired	Wood Moisture	Heat Input (LHV)	Heat Input (HHV)	Heat Output
						hrs	lb	% DB	Btu	Btu	Btu
I	2	< 15% of max	<28500	27846	14.7%	4.00	15.49	4.78	115237	124267	111356
II	3	16-24% of max	30400-45600	42670	22.5%	4.00	23.66	4.78	176048	189843	170677
III	4	25-50% of max	47500-95000	70570	37.1%	4.00	39.41	4.78	293227	316205	282278
IV	1	Max capacity	190000	182504	96.1%	4.00	109.85	4.78	817412	881467	730018

**Table 1B - Data Summary Part B**

Category	Run No	Load % Capacity	T2 Min	$E_T$	E	E	$E_{g/hr}$	$E_{g/kg}$	$\eta_{del}$	$\eta_{SLM}$
			Min Return Water Temp.	Total PM Emissions	PM Output Based	PM Output Based	PM Rate	PM Factor	Delivered Efficiency (HHV)	Stack Loss Efficiency (HHV)
			°F	g	lb/MMBtu Out	g/MJ	g/hr	g/kg	%	%
I	2	< 15% of max	172.3	0.9	0.02	0.01	0.2	0.1	89.6	82.5
II	3	16-24% of max	160.5	2.3	0.03	0.01	0.6	0.2	89.9	84.7
III	4	25-50% of max	156.2	6.1	0.05	0.02	1.5	0.4	89.3	84.4
IV	1	Max capacity	150.6	16.7	0.05	0.02	4.2	0.4	82.8	78.4

Model: Maxim M255 PE  
 Central Boiler, Inc. WoodMaster, Inc.  
 20502 160th Street  
 Greenbush, MN 56726

**Table 1C - Hang Tag Information**

MANUFACTURER:	Central Boiler		
MODEL NUMBER:	Maxim M255 PE		
MAXIMUM OUTPUT RATING	$Q_{MAX}$	190,000	Btu/hr
ANNUAL EFFICIENCY RATING:	$\eta_{avg}$	89.2%	<b>(Using higher heating value)</b>
		96.2%	(Using lower heating value)
PARTICLE EMISSIONS:	$E_{avg}$	0.9	GRAMS/HR (average)
		0.03	LBS/MILLION Btu OUTPUT
CARBON MONOXIDE:	CO	0.1286	GRAMS/MINUTE (average)

**Table 2 - Year-Round Use Weighting**

Category	Weighting Factor ( $F_i$ )	$\eta_{del,i} \times F_i$	$E_{g/MJ,i} \times F_i$	$E_{g/kg,i} \times F_i$	$E_{lb/MMBtu Out,i} \times F_i$	$E_{g/hr,i} \times F_i$	$CO_{g/min,i} \times F_i$
I	0.437	39.2	0.00	0.06	0.01	0.10	0.237
II	0.238	21.4	0.00	0.05	0.01	0.14	0.124
III	0.275	24.5	0.01	0.10	0.01	0.42	0.043
IV	0.05	4.1	0.00	0.02	0.00	0.21	0.110
Totals	1	89.3	0.01	0.2	0.03	0.9	0.514

## TEST RESULTS AND DISCUSSION

### Results

A total of four test runs were performed on the Maxim M255 PE boiler. Four test runs were conducted in the following categories based on the manufacturer's rated heat capacity: one in the 15% or less of maximum capacity (category I); one in the 16-24% of capacity (category II); one in the 25-50% of capacity (category III); and one within 10% of manufacturer's rated heat capacity (category IV).

The Maxim M255 PE furnace meets the 2020 particulate matter emission limit 0.10 lbs/mmBtu heat output for each individual test when tested with Pellet fuel.

Test Number	Output BTU/Hr.	Particulate Emissions lb/mmBtu Output	Delivered Efficiency (% HHV)
Run 2 / CAT I	27846	0.02	89.6
Run 3 / CAT II	42670	0.03	89.9
Run 4 / CAT III	70570	0.05	89.3
Run 1 / CAT IV	182504	0.06	82.8

### Precision

The precision and accuracy of the emissions and heating efficiency results presented in this report cannot be specified because of the unmeasured variability of results that would occur between identical appliances and fueling protocols. It is estimated, using precision data from similar sampling and measurement methods, that the precision of the results presented in this report are +/- 10 to 12 percentage points of the emissions values and +/- 3 to 4 percentage points of thermal efficiency.

Burn Category	Train A g/hr	Train B g/hr	Train A g/kg	Train B g/kg	Train Precision ≤ 7.5%	Train Precision ± 0.5 g/kg	Overall gram per hour
I	0.243	0.227	0.145	0.135	1.73	0.01	0.24
II	0.559	0.577	0.218	0.225	0.81	0.01	0.57
III	1.504	1.534	0.353	0.360	0.49	0.01	1.52
IV	5.040	5.187	0.424	0.436	0.72	0.01	5.11

### One-Hour Filter Discussion

§ 60.5476(c)(6) of 40 CFR 60 states, “For all tests conducted using ASTM 2515–11 the manufacturer and approved test laboratory must also measure the first hour of particulate matter emissions for each test run using a separate filter in one of the two parallel trains. The manufacturer and approved test laboratory must report the test results for the first hour separately and also include them in the total particulate matter emissions per run.

This appliance has an automatic fuel feed system that delivers pellet fuel at a fixed rate per hour depending on a constant heat draw. Emissions per hour would be approximately the same for first hour and the last, estimated first hour emissions would be total grams per hour divided by 4-hour test duration.

**First Hour Emissions Data**

Run Number	Burn Category	Emissions Rate (g/h)	Emissions Factor (g/kg)	Emissions Rate (lb/mmBTU) Output
1	IV	2.78	0.24	0.03
2	I	<sup>1</sup> 0.0	0.0	0.0
3	II	<sup>1</sup> 0.0	0.0	0.0
4	III	0.52	0.12	0.02

<sup>1</sup> Zero emissions indicate a value less than detectable by the test method for first hour, not that zero emissions were emitted. Negative first hour filter weights were caused by filter residue sticking to probe assembly.



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## **Section 6**

### **Example Calculations**

## Equations and Sample Calculations – Outdoor Wood-fired Hydronic Heater

Manufacturer: Central Boiler  
 Model: Maxim M255 PE  
 Run: 3

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.

BR	Dry burn rate, kg/hr
mn	Total particulate matter collected, mg
$V_{m(std)}$	Volume of gas sampled corrected to standard conditions, dscf
$v_s$	Average dilution tunnel gas velocity, ft/sec
$C_s$	Particulate concentration, g/dscf
E	Particulate emission rate, lbs/hr
$E_T$	Total particulate emissions, grams
$MC_{avg}$	Average Fuel Load Moisture Content, %
$Q_{in}$	Heat input, Btu
$Q_{out}$	Heat output, Btu
	Heat output rate, Btu/hr
$E_{g/MJ}$ , $E_{MMBTU input}$ , $E_{lb/MMBTU output}$ , $E_{g/hr 10,000BTU}$	Emission rates, g/MJ, lb/MMBTU, g/kg, g/hr
$\square_{del}$	Delivered Efficiency, %
$E_{avg}$ , $\square_{avg}$	Weighted Average Emissions and Efficiency, g/kg, %
	Average Btu/hr for 8 hour burn time, Btu/hr

### BR – Dry Burn Rate, kg/hr

Using equation 28-3:

$$BR = \frac{60 \times W_{wd}}{\theta} \times \frac{100 - \%M_w}{100}$$

Where,

- BR = Dry burn rate, lb/hr
- $W_{wd}$  = Mass of wood burned (wet basis) during test run, lb
- $\theta$  = Total time of test run, minutes
- $\%M_w$  = Average moisture content of test fuel charge, wet basis percent

### Sample Calculation:

Using the equation 28-2 for converting dry basis moisture to wet basis moisture,

$$\%M_w = \frac{\%M_D \times 100}{\%M_D + 100}$$

$$\%M_w = \frac{4.77 \times 100}{4.77 + 100}$$

$$\%M_w = 4.5531$$

$$W_{wd} = 23.656 \text{ lbs}$$

$$W_{wd} = 23.656 \times 0.4536 \text{ kg/lb}$$

$$W_{wd} = 10.7 \text{ kg}$$

$$BR = \frac{60 \times 10.7}{240} \times \frac{100 - 4.55}{100}$$

$$BR = 2.56$$

**$m_n$  – Total Particulate Matter Collected, mg**  
ASTM E2515 Equation (9)

$$m_n = m_p + m_f + m_g$$

Where:

- $m_n$  = Total particulate matter collected, mg
- $m_p$  = Particulate matter from probe, mg
- $m_f$  = Particulate matter from filters, mg
- $m_g$  = Particulate matter from filter seals, mg

Sample Calculation:

Using equation for Train 1:

$$m_n = 0.2 + 0.7 + 0.3$$

$$m_n = 0.9 \text{ mg}$$

Using equation for Train 2:

$$m_n = 0.3 + 0.8 + 0$$

$$m_n = 1.1 \text{ mg}$$

**$V_{m(std)}$  – Volume of Gas Sampled Corrected to Dry Standard Conditions, dscf**  
 ASTM E2515 equation (3) and (4), EPA Method 5 equation 5-1

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

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
- $P_b$  = Barometric pressure at the testing site, in. Hg
- $\Delta H$  = Average pressure differential across the orifice meter, in. H<sub>2</sub>O
- $T_m$  = Absolute average dry gas meter temperature, °R

Sample Calculation:

Using equation for Train 1:

$$V_{m(std)} = 38.791 \times 0.994 \times 17.64 \times \frac{(30.1 + \frac{2.19}{13.6})}{(88.34 + 460)}$$

$$V_{m(std)} = 37.53 \text{ ft}^3$$

Using equation for Train 2:

$$V_{m(std)} = 41.354 \times 1.00 \times 17.64 \times \frac{(30.1 + \frac{1.79}{13.6})}{(87.71 + 460)}$$

$$V_{m(std)} = 40.18 \text{ ft}^3$$

Using equation for ambient train:

$$V_{m(std)} = 24.375 \times 0.976 \times 17.64 \times \frac{(30.1 + \frac{0.26}{13.6})}{(85.44 + 460)}$$

$$V_{m(std)} = 23.17 \text{ ft}^3$$

**v<sub>s</sub> – Dilution Tunnel Gas Velocity, ft/sec**

ASTM E2515 equation (5), EPA Method 2 equations 2-6 and 2-7

$$v_s = F_p \times k_p \times C_p \times (\sqrt{\Delta P})_{avg} \times \sqrt{\frac{T_s(avg)}{P_s \times M_s}}$$

$$M_s = M_d \times (1 - B_{ws}) + 18.0 \times B_{ws}$$

Where:

- F<sub>p</sub> = Adjustment factor for center of tunnel pitot tube placement = V<sub>STRAV</sub> / V<sub>SCENT</sub>
- v<sub>s</sub> = Average dilution tunnel gas velocity, ft/sec
- k<sub>p</sub> = Pitot tube constant:  $85.49 \frac{ft}{sec} \left[ \frac{(lb / lb - mole) \times (inches Hg)}{(R) \times (inches H_2O)} \right]^{1/2}$
- C<sub>p</sub> = Pitot tube coefficient (0.99 for standard pitot tube; 0.84 may be used for S-type pitot tubes constructed according to Method 2 procedures), unitless
- P = \*ΔP measured during the pre-test flow traverse of the dilution tunnel; the square root of the ΔP values are averaged for this calculation, in. H<sub>2</sub>O
- P<sub>b</sub> = Barometric pressure at test site, in. Hg
- P<sub>g</sub> = Static Pressure of tunnel, in. Hg
- P<sub>s</sub> = Absolute tunnel pressure, = P<sub>b</sub> + P<sub>g</sub>
- M<sub>s</sub> = \*\*Molecular weight of tunnel gas; assume M<sub>d</sub>=29 lb/lb-mole (per method 5G)
- B<sub>ws</sub> = Moisture content of dilution tunnel gas, ratio; assume 2%
- T<sub>s</sub> = Dilution tunnel temperature, °R; (°R = °F + 460)

Sample calculation:

$$M_s = 29 \times (1 - 0.02) + 18.0 \times 0.02 = 28.78$$

$$V_s = 0.987 \times 85.49 \times 0.99 \times 0.141 \times \left( \frac{97.00 + 460}{\left( 30.10 + \frac{-0.156}{13.6} \right) \times 28.78} \right)^{1/2}$$

$$V_s = 9.48 \text{ ft/s}$$

\*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 M<sub>s</sub> as the dry molecular weight. It should be the wet molecular weight as indicated in EPA Method 2.

**C<sub>s</sub> – Particulate Concentration, g/dscf**

ASTM E2515 equation (8) and (9), EPA Method 5G equation 5G-2

$$C_s = 0.001 \frac{g}{mg} \times \frac{m_n}{V_{m(std)}}$$

Where:

$$\begin{aligned} C_s &= \text{Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, g/dscf} \\ m_n &= \text{Total mass of particulate matter collected in the sampling train, mg} \\ V_{m(std)} &= \text{Volume of gas sampled corrected to dry standard conditions, dscf} \end{aligned}$$

Sample calculation:

For Train 1:

$$C_s = 0.001 \times \frac{0.9}{37.53}$$

$$C_s = 0.000024 \text{ g/dscf}$$

For Train 2

$$C_s = 0.001 \times \frac{1.1}{40.18}$$

$$C_s = 0.000027 \text{ g/dscf}$$

For Ambient Train

$$C_s = 0.001 \times \frac{0.1}{23.17}$$

$$C_s = 0.0000043 \text{ g/dscf}$$



**Q<sub>sd</sub> – Average Dilution Tunnel Gas Flow Rate, dscf/hr**

ASTM equation (2), EPA Method 2 equation 2-8

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

Where:

Q <sub>sd</sub>	=	Gas flow rate corrected to dry, standard conditions, dscf/hr
3600	=	Conversion from seconds to hours
B <sub>ws</sub>	=	Moisture content of dilution tunnel gas, ratio; assume 2% (per method 5G)
V <sub>s</sub>	=	Average dilution tunnel gas velocity, ft/sec
A	=	Cross sectional area of dilution tunnel, ft <sup>2</sup>
T <sub>std</sub>	=	Standard absolute temperature, 528 °R
T <sub>s(avg)</sub>	=	Average absolute dilution tunnel temperature, °R, (°R = °F + 460)
P <sub>b</sub>	=	Barometric pressure at test site, in. Hg
P <sub>g</sub>	=	Dilution tunnel static pressure, in. Hg
P <sub>s</sub>	=	Absolute dilution tunnel gas pressure, in Hg, (Hg = P <sub>b</sub> + P <sub>g</sub> )
P <sub>std</sub>	=	Standard absolute pressure, 29.92 in Hg

Sample calculation:

$$Q_{sd} = 3600 \times (1 - 0.02) \times 9.48 \times 0.785 \times \frac{528}{97.00 + 460} \times \frac{30.10 + \frac{-0.156}{13.6}}{29.92}$$

$$Q_{sd} = 24501.3 \text{ dscf/hr}$$

### E, E<sub>T</sub> – Particulate Emissions

ASTM E1525 equation (10)

$$E_T = (c_s - c_r) \times Q_{std} \times \theta$$

Where:

E <sub>T</sub>	=	Particulate emissions, g
C <sub>s</sub>	=	Concentration of particulate matter in the stack
C <sub>r</sub>	=	Concentration of ambient particulate matter
Q <sub>sd</sub>	=	Average dilution tunnel gas flow rate, dscf/hr
θ	=	Total time of test run, minutes

Sample calculation:

For Train 1

$$E_T = (0.000024 - 0.00000432) \times 24501.3 \times 240 / 60$$
$$E_T = 1.93 \text{ g}$$

For Train 2

$$E_T = (0.000027 - 0.00000432) \times 24501.3 \times 240 / 60$$
$$E_T = 2.26 \text{ g}$$

Average

$$E = 2.09 \text{ g}$$

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

$$7.5\% \text{ of the average} = 1.57030312$$

$$\text{Train 1 difference} = 0.16647663$$

$$\text{Train 2 difference} = 0.16647663$$

**MC<sub>avg</sub> – Average Fuel Load Moisture Content, %**

$$MC_{avg} = \left[ \sum W_i \times MC_i \right] + \left[ W_{sp} \times MC_{sp} \right] \div W_{fuel}$$

Where:

- W<sub>i</sub> = Weight of individual fuel pieces, lbs
- MC<sub>i</sub> = Average moisture of individual fuel pieces, % dry
- W<sub>sp</sub> = Weight of spacers, lbs
- MC<sub>sp</sub> = Average moisture of spacers, 10% dry

Sample calculation:

$$MC_{avg} = ( 23.7 \times 4.78 + 0 \times ##### + 0 \times ##### + 0 \times \#DIV/0! + 0 \times ##### + 0 \times ##### + 0 \times \#DIV/0! + 0 \times ##### + 0 \times ##### + \dots + ( 23.656 - 23.7 ) \times 10 ) / 23.66$$

$$MC_{avg} = 4.77 \%$$

### PR - Proportional Rate Variation

ASTM E2515 equation (11), EPA Method 5G equation 5G-5

$$PR = \left[ \frac{\theta (V_{mi} V_s T_m T_{si})}{\theta_i (V_m V_{si} T_s T_{mi})} \right] \times 100$$

Where:

$\theta$  = Time of test, min

$\theta_i$  = Time of interval, min

$V_{mi}$  = Volume of gas sample measured by the dry gas meter during the "ith" time interval, dscf

$V_m$  = Volume of gas sample as measured by dry gas meter, dscf

$V_{si}$  = Average gas velocity in the dilution tunnel during the "ith" time interval, m/sec

$V_s$  = Average gas velocity in the dilution tunnel, m/sec

$T_{mi}$  = Average dry gas meter temperature during the "ith" time interval, °R

$T_m$  = Average dry gas meter temperature, °R

$T_{si}$  = Average gas temperature in the dilution tunnel during the "ith" time interval, °R

$T_s$  = Average gas temperature in the dilution tunnel, °R

Sample calculation (for the first 10 minute interval of Train 1):

$$PR = \left( \frac{240 \times 0.138 \times 9.476 \times (88.34 + 460)}{1 \times 38.791 \times 9.467 \times (85.00 + 460)} \times \frac{(96.00 + 460)}{(97.00 + 460)} \right) \times 100$$

$$PR = 85.8 \%$$

**Q<sub>in</sub> – Heat input, Btu**

$$Q_{in} = (W_{fuel} / (1 + (MC / 100))) \times HV$$

Where:

W<sub>fuel</sub> = Fuel charge weight, lbs

MC = Moisture content, %

HHV = Higher Heating Value, 8408 Btu/lb

LHV = Lower Heating Value, 7797 Btu/lb

Sample calculation:

For the Higher Heating Value

$$Q_{in} = ( 23.66 / ( 1 + ( 4.8 / 100))) \times 8408$$

$$Q_{in} = 189843 \text{ Btu}$$

For the Lower Heating Value

$$Q_{in} = ( 23.66 / ( 1 + ( 4.8 / 100))) \times 7797$$

$$Q_{in} = 176048 \text{ Btu}$$

**Q<sub>out</sub> – Heat output, Btu**

$$Q_{out} = \left| \sum (C_p \times \Delta T \times M \times t) \right| + (W_{app} \times C_{steel} + C_p W_{water}) \times (TF_{avg} - TI_{avg})$$

$$M = V_f \times \sigma$$

$$\sigma = (62.56 + (-0.0003413 \times T_{avg}) + (-0.00006225 \times T_{avg}^2)) \times 0.1337$$

$$C_p = 1.0014 + (-0.000003485 \times T_{avg})$$

Where:

- C<sub>p</sub> = \*Heat capacity of water, Btu/lb-°F
- C<sub>steel</sub> = Heat capacity of steel, 0.1 Btu/lb-°F
- ΔT = Temperature difference of water in/out, °F
- M = Mass flow rate of water, lb/min
- t = Elapsed time, minutes
- W<sub>app</sub> = Weight of appliance, lbs
- W<sub>water</sub> = Weight of water, lbs
- TF<sub>avg</sub> = Final average temperature of appliance and water, °F
- TI<sub>avg</sub> = Initial average temperature of appliance and water, °F
- T<sub>avg</sub> = Average temperature of water in the load side, °F
- V<sub>f</sub> = Volumetric flow rate of water, gal/min
- σ = Density of water, lb/gal

Sample calculation:

$$C_p = 1.0014 + (-0.000003485 \times 75.60)$$

$$C_p = 1.001 \text{ Btu/lb}^\circ\text{F}$$

$$s = (62.56 + (-0.0003413 \times 75.60) + (-0.00006225 \times 75.60^2)) \times 0.1337$$

$$s = 8.31$$

$$\left| \sum (C_p \times \Delta T \times M \times t) \right|$$

For the first 10 minute period:

$$= 1.001 \times (166.2 - 161.3) \times (15.1 \times 8.31) \times 10$$

$$= 6165.14 \text{ Btu}$$

$$\text{Total sum} = 170494 \text{ Btu}$$

$$Q_{out} = 170494 + (1297 \times 0.1 + 1.001 \times 632) \times (163.88 - 166.08)$$

$$Q_{out} = 168813 \text{ Btu}$$

**Heat output rate, Btu/hr**

Using Equation:

$$\text{Heat Output Rate} = Q_{out} / \text{test duration}$$

Sample calculation:

$$\text{Heat Output Rate} = 168813 / ( 240 / 60)$$

$$\text{Heat Output Rate} = 42203 \text{ Btu/hr}$$

E

)



## Emission rates, g/MJ, lb/MMBTU, g/kg, g/hr

Using Equations:

$$E_{g / MJ} = E_T / (Q_{out} \times 0.001055)$$

$$E_{lb / MMBTU \text{ input}} = (E_T / 453.59) / (Q_{in} \times 10^6)$$

$$E_{lb / MMBTU \text{ output}} = (E_T / 453.59) / (Q_{output} \times 10^6)$$

$$E_{g / kg} = E_T / (W_{fuel} / (1 + MC / 100))$$

$$E_{g / hr} = E_T / \text{Test Duration}$$

$$E_{g / hr \text{ 10,000 BTU}} = \frac{E_T}{(\text{Test Duration} \times (Q_{out} / 10,000))}$$

Sample calculation:

$$E_{g/MJ} = 2.1 / (168813 \times 0.001055)$$

$$E_{g/MJ} = 0.012 \text{ g/MJ}$$

Using higher heat value

$$E_{lb/MMBtu \text{ input}} = (2.1 / 453.59) / (189843 \times 10^{-6})$$

$$E_{lb/MMBtu \text{ input}} = 0.024 \text{ lb/MMBtu input}$$

Using lower heat value

$$E_{lb/MMBtu \text{ input}} = (2.1 / 453.59) / (176048 \times 10^{-6})$$

$$E_{lb/MMBtu \text{ input}} = 0.026 \text{ lb/MMBtu input}$$

$$E_{lb/MMBtu \text{ output}} = (2.1 / 453.59) / (168813 \times 10^{-6})$$

$$E_{lb/MMBtu \text{ output}} = 0.027 \text{ lb/MMBtu output}$$

$$E_{g/kg} = 2.1 / ((23.656 \times 0.4536) / (1 + 4.8 / 100))$$

$$E_{g/kg} = 0.204 \text{ g/kg}$$

$$E_{g/hr} = 2.1 / (240 / 60)$$

$$E_{g/hr} = 0.523 \text{ g/hr}$$

$$E_{g/hr \text{ 10,000 Btu}} = \frac{2.1}{((240 / 60) \times (168813 / 10,000))}$$

$$E_{g/hr \text{ 10,000 Btu}} = 0.031 \text{ g/hr 10,000 Btu}$$

$\eta_{del}$  – Delivered Efficiency, %

Using Equations:

$$\eta_{del} = (Q_{out} / Q_{in}) \times 100$$

$$\eta_{delLHV} = (Q_{out} / Q_{inLHV}) \times 100$$

Sample calculation:

$$\eta_{del} = ( 168813 / 189843 ) \times 100$$

$$\eta_{del} = 88.92 \%$$

$$\eta_{delLHV} = ( 168813 / 176048 ) \times 100$$

$$\eta_{delLHV} = 95.89 \%$$

$E_{avg}$ ,  $\eta_{avg}$  – Weighted Average Emissions and Efficiency, g/kg, %

Using Equations:

$$E_{avg} = \sum E_i \times F_i$$

$$\eta_{avg} = \sum \eta_i \times F_i$$

Sample calculation for efficiency year round use and high heating value:

$$\eta_{avg} = 89.61 \times 0.437 + 89.90 \times 0.238 + 89.27 \times 0.275 + 82.82 \times 0.05$$

$$\eta_{avg} = 89.247$$

# **Appendix A**

## **Reference Data, Negative filter weight verification.**

This data has been modified from values used to certify the appliance, it is presented as verification of compliance when negative filter weights are removed from calculations.

See section 1, page 7 for additional information.

## Hydronic Heating Appliances - Test Method ASTM 2618 Results

Manufacturer: Central Boiler  
 Model: Maxim M255 PE  
 Tracking No.: 2423  
 Project No.: 0117PS024E  
 Run #: 1  
 Date: 8/17/20

Equipment Numbers: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

### TRAIN 1 (First Hour emissions)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	E001	123.0	121.3	1.7
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe				0.0
E. Filter seals catch*	Seals				0.0

**Sub-Total**      Total Particulate, mg:      1.7

### TRAIN 1

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch (remainder)	Filter	E002	126.2	120.3	5.9
B. Rear filter catch	Filter	E003	121.2	121.1	0.1
C. Probe catch*	Probe	OES4	114148.7	114148.4	0.3
D. Filter seals catch*	Seals	S0007	3302.3	3302.1	0.2

**Sub-Total**      Total Particulate, mg:      6.5

Total Particulate, mg:      8.2

### TRAIN 2

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	E004	127.2	118.9	8.3
B. Rear filter catch	Filter	E005	120.9	120.9	0.0
C. Probe catch*	Probe	OES5	113572.0	113571.4	0.6
D. Filter seals catch*	Seals	S0008	3334.4	3334.1	0.3

Total Particulate, mg:      9.2

### AMBIENT

Sample Component	Reagent	Filter # or Probe #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch*	Filter	E006	120.1	120.1	0.0

Total Particulate, mg:      0.0

\*Any particulate catch that results in a negative number, is assumed to be zero

Component	Equations:
A. Front filter catch	Final (mg) - Tare (mg) = Particulate, mg
B. Rear filter catch	Final (mg) - Tare (mg) = Particulate, mg
C. Probe catch	Final (mg) - Tare (mg) = Particulate, mg

## Hydronic Heating Appliances - Test Method ASTM 2618 Results

Manufacturer: Central Boiler  
 Model: Maxim M255 PE  
 Tracking No.: 2423  
 Project No.: 0117PS024E  
 Run: 1  
 Test Date: August 17, 2020

Burn Rate	<b>11.89 kg/hr dry</b>
Average Tunnel Temperature	174 degrees F
Average Gas Velocity in Dilution Tunnel - vs	9.9 feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	15342 dscf/hour
Average Delta p	0.016 inches H2O
Average Delta H	2.17 inches H2O
Total Time of Test	240 minutes

### PARTICULATE EMISSIONS RESULTS

First Hour:	<b>2.78 g/hr</b> <b>0.24 g/kg</b> <b>0.03 lb/mmBTU output</b>
Complete Run:	<b>0.48 g/hr</b> <b>0.04 g/kg</b> <b>0.01 lb/mmBTU output</b>

	SAMPLE TRAIN 1	SAMPLE TRAIN 2	AMBIENT SAMPLE TRAIN
Total Sample Volume - Vm	38.79 cubic feet	41.35 cubic feet	23.64 cubic feet
Average Gas Meter Temperature	88 degrees F	88 degrees F	82 degrees F
Total Sample Volume (Standard Conditions) - Vmstd	37.5 dscf	40.2 dscf	15.1 dscf
Total Particulates - mn	1.3 mg	1.1 mg	0 mg
Particulate Concentration (dry-standard)	0.00003 grams/dscf	0.00003 grams/dscf	0.000000 grams/dscf
Particulate Emissions	2.13 grams	1.68 grams	
	0.531 g/hr	0.420 g/hr	
Difference from Average	0.22 grams	0.22 grams	
	0.04 g/kg	0.04 g/kg	
<b>Results Are Acceptable</b>			0.01

AVERAGE	
Total Sample Volume - Vm	40.07 cubic feet
Average Gas Meter Temperature	88 degrees F
Total Sample Volume (Standard Conditions) - Vmstd	38.9 dscf
Particulate Concentration (dry-standard)	0.00003 grams/dscf
Particulate Emissions	1.90 grams
7.5% of the average particulate emissions	0.14 grams

### ADDITIONAL ACCEPTANCE CRITERIA

Boiler Water Return Temperature >120 °F	<b>Acceptable</b>
Proportional Rate Variation >80%	<b>Acceptable</b>
90% of PR Values between 90-110%	<b>Acceptable</b>

SAMPLE TRAIN 1 - FIRST HOUR	
Total Sample Volume - Vm	9.59 cubic feet
Average Gas Meter Temperature	84 degrees F
Total Sample Volume (Standard Conditions) - Vmstd	9.37 dscf
Total Particulates - mn	1.7 mg
Particulate Concentration (dry-standard)	0.00018 grams/dscf
Particulate Emissions	2.78 grams
Burn Rate	11.79 (dry kg/hr)
Heat Output Rate	182522 BTU/hr

## Hydronic Heating Appliances - Test Method ASTM 2618 Results

Manufacturer: <u>Central Boiler</u>	Equipment Numbers: _____
Model: <u>Maxim M255 PE</u>	_____
Tracking No.: <u>2423</u>	_____
Project No.: <u>0117PS024E</u>	_____
Run #: <u>2</u>	_____
Date: <u>8/18/20</u>	_____

**TRAIN 1 (First Hour emissions)**

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	E007	120.4	120.4	0.0
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe				0.0
E. Filter seals catch*	Seals				0.0

<b>Sub-Total</b>	Total Particulate, mg:	0.0
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**TRAIN 1 (Post First Hour Change-out)**

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	E008	120.6	120.0	0.6
C. Rear filter catch	Filter	E009	119.7	119.7	0.0
D. Probe catch*	Probe	23	114077.9	114077.6	0.3
E. Filter seals catch*	Seals	S0010	3366.3	3366.3	0.0

<b>Sub-Total</b>	Total Particulate, mg:	0.9
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<b>Train 1 Aggregate</b>	Total Particulate, mg:	<b>0.9</b>
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**TRAIN 2**

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	E010	119.8	119.8	0.0
B. Rear filter catch	Filter	E013	119.4	119.4	0.0
C. Probe catch*	Probe	24	114128.2	114128.1	0.1
D. Filter seals catch*	Seals	S0011	4149.5	4149.2	0.3

Total Particulate, mg:	0.4
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**AMBIENT**

Sample Component	Reagent	Filter # or Probe #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch*	Filter	E012	120.2	120.2	0.0

Total Particulate, mg:	0.0
------------------------	-----

\*Particulate catch that results in a negative number, is assumed to be zero for probes and seals, negative numbers for filters are assumed to be part of the seal weight.

Component	Equations:
A. Front filter catch	Final (mg) - Tare (mg) = Particulate, mg
B. Rear filter catch	Final (mg) - Tare (mg) = Particulate, mg
C. Probe catch	Final (mg) - Tare (mg) = Particulate, mg

## Hydronic Heating Appliances - Test Method ASTM 2618 Results

Manufacturer: Central Boiler  
 Model: Maxim M255 PE  
 Tracking No.: 2423  
 Project No.: 0117PS024E  
 Run: 2  
 Test Date: August 18, 2020

Burn Rate	<b>1.68 kg/hr dry</b>
Average Tunnel Temperature	90 degrees F
Average Gas Velocity in Dilution Tunnel - vs	8.6 feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	22950 dscf/hour
Average Delta p	0.020 inches H2O
Average Delta H	2.18 inches H2O
Total Time of Test	240 minutes

### PARTICULATE EMISSIONS RESULTS

First Hour:	<b>0.00 g/hr</b> <b>0.00 g/kg</b> <b>0.00 lb/mmBTU output</b>
Complete Run:	<b>0.39 g/hr</b> <b>0.23 g/kg</b> <b>0.03 lb/mmBTU output</b>

	SAMPLE TRAIN 1	SAMPLE TRAIN 2	AMBIENT SAMPLE TRAIN
Total Sample Volume - Vm	38.46 cubic feet	41.06 cubic feet	22.82 cubic feet
Average Gas Meter Temperature	82 degrees F	82 degrees F	79 degrees F
Total Sample Volume (Standard Conditions) - Vmstd	37.7 dscf	40.4 dscf	22.0 dscf
Total Particulates - mn	0.9 mg	0.4 mg	0 mg
Particulate Concentration (dry-standard)	0.000024 grams/dscf	0.000010 grams/dscf	0.000000 grams/dscf
Particulate Emissions	2.19 grams	0.91 grams	
Particulate Rate	0.55 g/hr	0.23 g/hr	
Difference from Average	0.64 grams	0.64 grams	
Train Precision g/kg < 0.5	0.327 g/kg	0.135 g/kg	
<b>Results Are Acceptable</b>			0.19

AVERAGE	
Total Sample Volume - Vm	39.76 cubic feet
Average Gas Meter Temperature	82 degrees F
Total Sample Volume (Standard Conditions) - Vmstd	39.1 dscf
Particulate Concentration (dry-standard)	0.00002 grams/dscf
Particulate Emissions	1.55 grams
7.5% of the average particulate emissions	0.12 grams

### ADDITIONAL ACCEPTANCE CRITERIA

Boiler Water Return Temperature >120 °F	<b>Acceptable</b>
Proportional Rate Variation >80%	<b>Acceptable</b>
90% of PR Values between 90-110%	<b>Acceptable</b>

SAMPLE TRAIN 1 - FIRST HOUR	
Total Sample Volume - Vm	9.56 cubic feet
Average Gas Meter Temperature	80 degrees F
Total Sample Volume (Standard Conditions) - Vmstd	9.42 dscf
Total Particulates - mn	0 mg
Particulate Concentration (dry-standard)	0.00000 grams/dscf
Particulate Emissions	0.00 grams
Burn Rate	1.53 (dry kg/hr)
Heat Output Rate	27820 BTU/hr



## Hydronic Heating Appliances - Test Method ASTM 2618 Results

Manufacturer: <u>Central Boiler</u>	Equipment Numbers: _____
Model: <u>Maxim M255 PE</u>	_____
Tracking No.: <u>2423</u>	_____
Project No.: <u>0117PS024E</u>	_____
Run #: <u>3</u>	_____
Date: <u>8/18/20</u>	_____

**TRAIN 1 (First Hour emissions)**

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	E014	120.2	120.2	0.0
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe				0.0
E. Filter seals catch*	Seals				0.0

<b>Sub-Total</b>	Total Particulate, mg:	0.0
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**TRAIN 1 (Post First Hour Change-out)**

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	E015	121.2	120.4	0.8
C. Rear filter catch	Filter	E016	119.4	119.4	0.0
D. Probe catch*	Probe	28	114751.3	114751.1	0.2
E. Filter seals catch*	Seals	S0012	4180.2	4179.9	0.3

<b>Sub-Total</b>	Total Particulate, mg:	1.3
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<b>Train 1 Aggregate</b>	Total Particulate, mg:	1.3
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**TRAIN 2**

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	E017	121.7	120.9	0.8
B. Rear filter catch	Filter	E018	120.3	120.3	0.0
C. Probe catch*	Probe	29	114277.3	114277.0	0.3
D. Filter seals catch*	Seals	S0013	3301.3	3301.3	0.0

Total Particulate, mg:	1.1
------------------------	-----

**AMBIENT**

Sample Component	Reagent	Filter # or Probe #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch*	Filter	E019	120.7	120.6	0.1

Total Particulate, mg:	0.1
------------------------	-----

\*Particulate catch that results in a negative number, is assumed to be zero for probes and seals, negative numbers for filters are assumed to be part of the seal weight.

Component	Equations:
A. Front filter catch	Final (mg) - Tare (mg) = Particulate, mg
B. Rear filter catch	Final (mg) - Tare (mg) = Particulate, mg
C. Probe catch	Final (mg) - Tare (mg) = Particulate, mg

## Hydronic Heating Appliances - Test Method ASTM 2618 Results

Manufacturer: Central Boiler  
 Model: Maxim M255 PE  
 Tracking No.: 2423  
 Project No.: 0117PS024E  
 Run: 3  
 Test Date: August 18, 2020

Burn Rate	<b>2.56 kg/hr dry</b>
Average Tunnel Temperature	97 degrees F
Average Gas Velocity in Dilution Tunnel - vs	9.5 feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	25012 dscf/hour
Average Delta p	0.020 inches H2O
Average Delta H	2.19 inches H2O
Total Time of Test	240 minutes

### PARTICULATE EMISSIONS RESULTS

First Hour:	<b>0.00 g/hr</b> <b>0.00 g/kg</b> <b>0.00 lb/mmBTU output</b>
Complete Run:	<b>0.67 g/hr</b> <b>0.26 g/kg</b> <b>0.03 lb/mmBTU output</b>

	SAMPLE TRAIN 1	SAMPLE TRAIN 2	AMBIENT SAMPLE TRAIN
Total Sample Volume - Vm	38.79 cubic feet	41.35 cubic feet	24.38 cubic feet
Average Gas Meter Temperature	88 degrees F	88 degrees F	85 degrees F
Total Sample Volume (Standard Conditions) - Vmstd	37.5 dscf	40.2 dscf	23.2 dscf
Total Particulates - mn	1.3 mg	1.1 mg	0.1 mg
Particulate Concentration (dry-standard)	0.00003 grams/dscf	0.00003 grams/dscf	0.000004 grams/dscf
Particulate Emissions	3.03 grams	2.31 grams	
Particulate Rate	0.758 g/hr	0.577 g/hr	
Difference from Average	0.36 grams	0.36 grams	
Train Precision g/kg < 0.5	0.296 g/kg	0.225 g/kg	
<b>Results Are Acceptable</b>			0.07

AVERAGE	
Total Sample Volume - Vm	40.07 cubic feet
Average Gas Meter Temperature	88 degrees F
Total Sample Volume (Standard Conditions) - Vmstd	38.9 dscf
Particulate Concentration (dry-standard)	0.00003 grams/dscf
Particulate Emissions	2.67 grams
7.5% of the average particulate emissions	0.20 grams

### ADDITIONAL ACCEPTANCE CRITERIA

Boiler Water Return Temperature >120 °F	<b>Acceptable</b>
Proportional Rate Variation >80%	<b>Acceptable</b>
90% of PR Values between 90-110%	<b>Acceptable</b>

SAMPLE TRAIN 1 - FIRST HOUR	
Total Sample Volume - Vm	9.65 cubic feet
Average Gas Meter Temperature	86 degrees F
Total Sample Volume (Standard Conditions) - Vmstd	9.37 dscf
Total Particulates - mn	0 mg
Particulate Concentration (dry-standard)	0.00000 grams/dscf
Particulate Emissions	0.00 grams
Burn Rate	2.54 (dry kg/hr)
Heat Output Rate	42656 BTU/hr

## Hydronic Heating Appliances - Test Method ASTM 2618 Results

Manufacturer: Central Boiler  
 Model: Maxim M255 PE  
 Tracking No.: 2423  
 Project No.: 0117PS024E  
 Run #: 4  
 Date: 8/19/20

Equipment Numbers: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

### TRAIN 1 (First Hour emissions)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	E020	119.5	119.3	0.2
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe				0.0
E. Filter seals catch*	Seals				0.0

**Sub-Total**      Total Particulate, mg:      0.2

### TRAIN 1 (Post First Hour Change-out)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch (remainder)	Filter	E021	122.3	120.5	1.8
C. Rear filter catch	Filter	E022	119.2	119.2	0.0
D. Probe catch*	Probe	53	118273.0	118272.8	0.2
E. Filter seals catch*	Seals	S0014	3382.4	3382.2	0.2

**Sub-Total**      Total Particulate, mg:      2.2

**Train 1 Aggregate**      Total Particulate, mg:      2.4

### TRAIN 2

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	E023	122.1	120.1	2.0
B. Rear filter catch	Filter	E024	119.2	119.2	0.0
C. Probe catch*	Probe	56	118614.0	118613.5	0.5
D. Filter seals catch*	Seals	S0015	3284.7	3284.6	0.1

Total Particulate, mg:      2.6

### AMBIENT

Sample Component	Reagent	Filter # or Probe #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch*	Filter	E025	120.5	120.6	0.0

Total Particulate, mg:      0.0

\*Particulate catch that results in a negative number, is assumed to be zero for probes and seals, negative numbers for filters are assumed to be part of the seal weight.

Component	Equations:
A. Front filter catch	Final (mg) - Tare (mg) = Particulate, mg
B. Rear filter catch	Final (mg) - Tare (mg) = Particulate, mg
C. Probe catch	Final (mg) - Tare (mg) = Particulate, mg

## Hydronic Heating Appliances - Test Method ASTM 2618 Results

Manufacturer: Central Boiler  
 Model: Maxim M255 PE  
 Tracking No.: 2423  
 Project No.: 0117PS024E  
 Run: 4  
 Test Date: August 19, 2020

Burn Rate	<b>4.26 kg/hr dry</b>
Average Tunnel Temperature	96 degrees F
Average Gas Velocity in Dilution Tunnel - vs	9.3 feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	24561 dscf/hour
Average Delta p	0.020 inches H2O
Average Delta H	2.18 inches H2O
Total Time of Test	240 minutes

### PARTICULATE EMISSIONS RESULTS

First Hour:	<b>0.52 g/hr</b> <b>0.12 g/kg</b> <b>0.02 lb/mmBTU output</b>
Complete Run:	<b>0.76 g/hr</b> <b>0.18 g/kg</b> <b>0.02 lb/mmBTU output</b>

	SAMPLE TRAIN 1	SAMPLE TRAIN 2	AMBIENT SAMPLE TRAIN
Total Sample Volume - Vm	38.79 cubic feet	41.35 cubic feet	23.51 cubic feet
Average Gas Meter Temperature	88 degrees F	88 degrees F	80 degrees F
Total Sample Volume (Standard Conditions) - Vmstd	37.5 dscf	40.2 dscf	22.5 dscf
Total Particulates - mn	1.3 mg	1.1 mg	0 mg
Particulate Concentration (dry-standard)	0.00003 grams/dscf	0.00003 grams/dscf	0.000000 grams/dscf
Particulate Emissions	3.40 grams	2.69 grams	
Difference from Average	0.851 g/hr	0.672 g/hr	
Train Precision g/kg < 0.5	0.36 grams	0.36 grams	
	0.20 g/kg	0.16 g/kg	0.04
<b>Results Are Acceptable</b>			

AVERAGE	
Total Sample Volume - Vm	40.07 cubic feet
Average Gas Meter Temperature	88 degrees F
Total Sample Volume (Standard Conditions) - Vmstd	38.9 dscf
Particulate Concentration (dry-standard)	0.00003 grams/dscf
Particulate Emissions	3.05 grams
7.5% of the average particulate emissions	0.23 grams

### ADDITIONAL ACCEPTANCE CRITERIA

Boiler Water Return Temperature >120 °F	<b>Acceptable</b>
Proportional Rate Variation >80%	<b>Acceptable</b>
90% of PR Values between 90-110%	<b>Acceptable</b>

SAMPLE TRAIN 1 - FIRST HOUR	
Total Sample Volume - Vm	9.59 cubic feet
Average Gas Meter Temperature	81 degrees F
Total Sample Volume (Standard Conditions) - Vmstd	9.39 dscf
Total Particulates - mn	0.2 mg
Particulate Concentration (dry-standard)	0.00002 grams/dscf
Particulate Emissions	0.52 grams
Burn Rate	4.23 (dry kg/hr)
Heat Output Rate	70623 BTU/hr

*Model: Maxim M255 PE  
Central Boiler, Inc. WoodMaster, Inc.  
20502 160th Street  
Greenbush, MN 56726*

## **Appendix B**

### **Revision History**

Date	Project No.	Tech. & Evaluator	Report Sect.	Summary of Changes
1/7/21	0117PS024E <b>Edition 001</b>	B. Davis	Section 4	Negative first hour filter weights (where applicable) have been removed from the calculations so first hour emissions results show as zero, and not as a negative. Page 176 (Previously 174 and 184) and 189 were changed.
			Section 1 Section 5	A revised table has been added to page 5, and 217 showing individual test results. Final results are shown as based on all tests results less than 0.10 lb/mm BTU.  Hang tag information was left in place as information shown is used to populate the EPA Web Page.
			Section 4	Conditioning data page has been updated to show operation Categories as CAT II, and CAT III. In clause 11.1 of ASTM (shown here), it states to record and report hourly flue gas exit temperature data and the hours of operation. Real time fuel weight data is not required. Since this is a automatically fueled appliance, information provided by the manufacturer concerning fuel used has been added to conditioning data page number 161 (formally 160).
			Section 3	Information regarding Corn fuel has been removed from the manual and label. Page 43, 45, 47, and 103.
			Section 4	Calculation errors found in run 1 results have been resolved. Barometric pressure was incorrectly averaged.

				<p>The formula has been edited to correctly calculate the average barometric pressure for run 1. Page 164 – 165. This change did reduce emissions for run 1.</p>
				<p>Example calculations shown on page 225 (formally 213) incorrectly displayed dilution tunnel moisture as 4% and was labeled as dscf/m.</p> <p>The heading for this page has been corrected to dscf/hr. and dilution tunnel moisture was changed to 2%.</p>
3/22/21	0117PS024E Edition 002	B. Davis	Section 1	Explanation of zero emissions for first hour results was added to individual run summary for tests 2 and 3 on page 8.
			Section 5	One hour filter discussion and foot note updated on page 217 explaining zero emissions for first hour.
11/2/21	0117PS024E Edition 003	B. Davis	Section 2	<p>Calibration record for equipment number OMNI-00677 was added to page 41. Equipment number OMNI-00559 shown on page 40 is calibrated by installing a new vane, returning the instrument to factory specifications.</p> <p>This equipment is then used as a reference to show the presence of air movement at the test booth. If air movement is indicated, equipment OMNI-00677 is used to generate an actual value. Air movement is verified within 2 feet of the test appliance prior to starting a fire, and then again immediately following test run completion.</p>
			Section 3	Replaced both manuals with updated versions in section 3, page 43.
			Section 5	Added table showing train precision results on page 218.
12/23/21	0117PS024E Edition 004	B Davis	Section 1	Additional information on negative filter weights provided on page 7 due to an inquiry by EPA.
			Appendix B	Added reference data used to generated negative filter weight verification.