TARM BIOMASS™
Innovative Leaders in Alternative Heating Solutions

SOLO PLUS

Models 30, 40, and 60

Wood-fired central heating boiler

Installation and Operations Manual

Tested & Listed By O-T-L C Beaverton Oregon USA
OMNI-Test Laboratories, Inc.

Tarm Biomass · 4 Britton Lane · Lyme, NH 03768

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Dear Customer:

Thank you for purchase of a Tarm Biomass boiler. The Solo Plus boiler is the result of over 80 years of Danish engineering and is highly regarded for its quality and engineering. Combined with 25 years of expertise and customer support from Tarm Biomass, we know you will enjoy many years of reliable heat.

Your installing contractor will point out, explain and demonstrate the various features and benefits of your new heating system once the installation has been completed. Please make sure you are comfortable with the operation of the boiler and sign the Warranty and Boiler Commissioning form with your installer. The contractor will return the form to us and your boiler warranty will be registered.

We would appreciate any feedback on the boiler and your purchasing experience that you would like to provide us. Please fill out our short on-line survey and as a token of our thanks, we will send you a free pair of heavy duty gloves. Made from thick leather, these gloves are just what you need to service your new Tarm Biomass boiler.

Thank you again for your purchase and welcome to the growing family of happy Tarm Biomass boiler owners!

Sincerely,

The Tarm Biomass Team

TO BE FILLED OUT AND RETURNED BY INSTALLING CONTRACTOR

Solo Plus	Boiler Commissioning Check List and Warranty Registration

Customer Information

Name: Email:	Address: Phone:

Dealer/Installer Information

Name:	Address: Phone:

Installation Data

Boiler Serial No:		Boiler Set-point Temperature:
Boiler Model No:	Software Version:	Boiler Lo-Limit Temperature:
Installation Date:	System Pressure (cold):	External Backup Temperature:
Invoice Date:	Storage Tank Manufacturer:	Storage Tank Serial No:

Commissioning Check List at Time of First Firing	**OK**		**OK**
Confirm water circulation and pump function.	□	Confirm correct position of ceramics (page 18).	□
Confirm no leaks on piping or thermal storage tank (s).	□	Confirm positioning and tightness of doors.	□
Confirm balancing valve position above port 1 on the K4440A3 Termovar Valve is in the 45º position (page 86).	□	Confirm tight fit of flue pipe (joints sealed, 3 screws per joint, 24 ga. stainless or black pipe).	□
Confirm boiler control programming and function (Section 4).	□	Confirm tightness of heat exchanger cover.	□
Confirm adequate flue draft when cold (-.025 to -.5" WC) (Section 3.2).	□	Confirm free movement of draft fan air damper.	□
Confirm proper air supply (Section 3.2.1).	□	Confirm fuel quality and moisture content (<20%).	□
Confirm the dump zone (s) are connected.	□	Pressure relief valve is installed properly and tested.	□
		Confirm the boiler and all exhaust pipes meet all safety clearances.	□

With Customer Present (The customer should understand and be able to do the following tasks:	**Yes**
Describe how the system works (wood boiler, back-up boiler, Termovar, Thermal Storage Tank).	□
Describe and demonstrate the operation of the boiler.	□
Describe and demonstrate on-going maintenance (ash removal, brush boiler tubes).	□
Discuss and demonstrate fuel quality.	□
Describe and demonstrate how to start a fire.	□
Operation of the boiler control (setting of boiler, lo-limit, external burner start temperatures).	□
Describe and demonstrate the operation of the by-pass damper (opening before loading fuel, locking it closed during operation).	□
Describe and demonstrate how to turn on the draft fan when the boiler is at its set-point temperature (page 42).	□

Installer Signature_____ Date:_____

Owner Signature_____ Date:_____

Please complete a short survey at www.tarmusasurvey.blogspot.com and receive a:

FREE PAIR OF HEAVY-DUTY GLOVES

1.0 Introduction

1.1 Foreword

SAVE THIS INSTRUCTION MANUAL FOR FUTURE REFERENCE

Congratulations on your purchase of the Scandtec Solo Plus log wood boiler from Tarm Biomass!

The Solo Plus boiler is produced using the highest quality materials and a modern production system. The use of high technology laser cutting and robotic welding system, accompanied by time honored European design, craftsmanship and attention to detail, results in a long lasting boiler with unmatched fit and finish.

With proper installation, operation and maintenance your Tarm Biomass Solo Plus log wood boiler will provide years of safe, dependable, economic and earth friendly heating.

This manual contains paragraphs that require your special attention. These paragraphs are marked with the symbols described below:

Warning: there is a risk of an accident of personal injury or serious damage to the property.

☼ Caution: there is a risk of damaging the boiler or its individual components.

1.2 Units of Measurement

Most hardware and fittings on the boiler are metric (some plumbing fittings are British Straight Thread). In this manual the convention used for dimensions is that values are presented in English units, followed by metric units in parenthesis, for example: 6” (152 mm).

Note: A conversion table between Centigrade and Fahrenheit is provided in Appendix A. In this manual temperatures are presented first as degrees Centigrade then as degrees Fahrenheit in parenthesis, for example: 80°C (176°F).

1.3 Installation and Warranty Requirements

It is strongly recommended that the installer resist the temptation to simply get started without reading this manual. Hours of time and frustration can be prevented by a simple understanding of this product. This manual has been written with much care and thought. We want the first time installer to find installation as simple as for the experienced installer. Time spent reading now will save more time in the long run. **Failure to follow these instructions could result in property damage, bodily injury, or death.**

This product is provided with a limited warranty which is described in Section 7.0 of this manual. The warranty is contingent upon the successful and legal installation of the boiler At a minimum:

- **The installation, adjustment, start-up, service, and maintenance of this product must be performed by a licensed professional heating system installer. Where applicable, the installation must be inspected and accepted by the legally responsible entity.**

- **The instructions in this manual and in supporting documentation (additional instructions, diagrams, and component information provided by Tarm Biomass) must be explicitly followed. However, where the instructions are in conflict with local code requirements, the local code requirements will prevail. When in doubt, contact your local dealer or Tarm Biomass.**

- **The manual and supporting documentation must be retained by the owner/ system operator for reference and future use.**

- **The installer is responsible for familiarizing the owner/ system operator with all aspects of boiler operations, safety procedures, monitoring and cleaning requirements, shut down procedures, and annual maintenance requirements.**

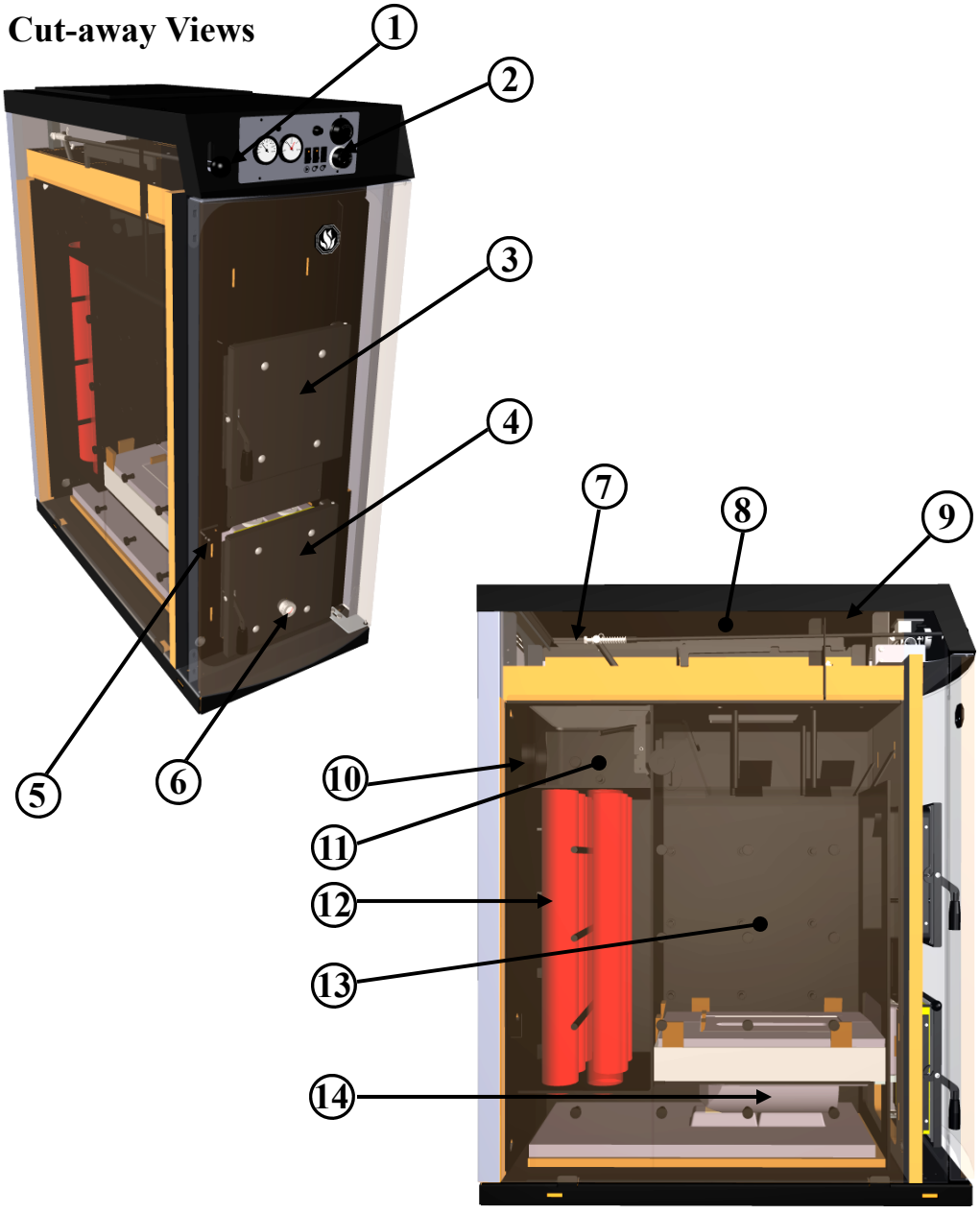
- **Conditions described in the text of the warranty for keeping it in force must be followed by the owner/ system operator.**

2.0 System Description/Requirements

This section presents a general overview of the system, suitable fuels and installation requirements for your Solo Plus boiler.

2.1 Boiler Overview

2.1.1 Cut-away Views



1. By-Pass Damper Handle
2. Control Panel
3. Load Door
4. Ash Door
5. Secondary Air Control
6. Sight Glass
7. Clean Out Cover
8. Boiler Serial Number Plate
9. Draft Fan
10. Flue Outlet
11. Smoke Box
12. Heat Exchanger Tubes
13. Firebox
14. Gasification Tunnel

2.1.2 Boiler Fabrication and Testing

The boiler is shipped on one pallet that includes the assembled boiler. Depending on accessories purchased with the boiler, additional packages for accessories may be loaded into the firebox or attached to the pallet. The boiler is shipped with the refractory bricks installed.

Solo Plus boilers have been tested and listed for safety and performance for the U S and Canadian markets by OMNI Test Laboratories, Inc.. The test standards used are UL 391 and CAN/CSA B366, and 1-M91. The boilers are UL listed. The boiler is not ASME stamped. The installer should follow local or state installation requirements.

The Solo Plus wood gasification boiler is a log wood fired boiler designed and constructed for highly efficient combustion of log wood. Do not burn other fuels in the Tarm Biomass Solo Plus boiler. The Solo Plus **is not** a self contained weather-tight boiler. It should be installed within the heated building.

2.1.3 Models and Applications

Three Solo Plus models are available (the model 30, 40, and 60), with rated heat outputs of 102,000Btu/hr (30 kW), 140,000Btu/hr (40 kW), and 198,000Btuh/hr (60 kW), respectively. Specification data for each Solo Plus boiler is provided in Section 6.3.

The boilers can be utilized as a single heat source, or in parallel with another boiler. They are appropriate for both residential and nonresidential applications, as well as applications using heat storage.

2.2 Boiler Function

2.2.1 General Operation

Provided below is a simplified discussion of operation of the boiler to provide a brief familiarization with operation. Please refer to the cut-away view of the boiler in Section 2.1.1.

With the by-pass damper open **(1),** a small fire is kindled in the firebox **(13).** After the fire has been established, the firebox is opened **(3)** and loaded with the batch of wood to be burned during this firing. After loading, the load door **(3)** is then closed. The by-pass damper **(1)** is pushed shut and the draft fan **(9)** is turned on to force combustion gasses down through the base of the firebox where secondary air is injected. After leaving the firebox, the gases and secondary combustion air enter the refractory tunnel **(14)** where in a turbulent environment the gasification combustion takes place. This gasification combustion produces gases with temperatures exceeding1800 ºF (980 ºC). This high temperature combustion is extremely efficient and virtually smoke and creosote free. The hot gases then pass along the bottom of the boiler toward the back, where they rise upward through the heat exchanger tubes **(12)** transferring heat to water in the boiler and exit through the flue outlet **(10)**.

The boiler serial number plate **(8)** indicates factory no. and type and other information required to order spare parts. Factory no, and type can be noted in **Section 8**.

Detailed instructions for operating the Solo Plus boilers are given in Section 4 of this manual.

2.2.2 Safety Systems

The boiler has internal safety systems to prevent damage to equipment in case two unlikely conditions occur. The conditions prevented are:

- Pressure in the boiler exceeding 30 psi (2 bars) (over pressure)
- Boiler water temperature exceeding 212ºF (100 ºC)

To prevent an **over-pressure** condition, an ASME stamped pressure relief valve (provided) installed on the boiler supply piping opens at 30 psi (2 bars) to relieve the boiler pressure (each boiler has been designed and factory tested to 65 psi or 4 bars).

In an **over-temperature** situation, where the boiler reaches 201 ºF (94 ºC), the boiler's control will activate the circulator controlling the largest heating zone to help cool the boiler.

A gravity over-heat dump loop is also required. In the event of a power failure this loop should provide dissipation for at least 10% of the boiler's maximum rated output, assuming an ambient temperature of 65 ºF (18 ºC). in the area heated by the loop, and a mean water temperature of 180 ºF (82 ºC) **(see Section 3.4.2)**.

2.2.4 Accessories

The boiler is shipped with loose and installing parts. See **Section 3.3.2** for a complete listing of these parts. Cleaning tools are provided with the boiler.

A **barometric damper** (draft stabilizer) is available for regulating chimney draft.

Plumbing around the boiler must include a three-port mixing valve in the orientation shown on installation drawing. The valve must be a **Termovar Model 4440A-3** or equal with a 140-160 ºF (60-72 ºC) element. Tarm Biomass provides this valve at an extra cost.

Thermal storage systems are available from Tarm Biomass. The most efficient and convenient operation of gasification cordwood boilers is one that includes a thermal storage tank . Therefore, while not required for operation of the Solo Plus boiler, the use of a thermal storage tank is encouraged by Tarm Biomass. Cordwood boilers are typically sized so that the boiler's maximum heat output is greater than the heating requirements of the house. "Extra" heat produced by the boiler is transferred to the storage tank for use later. Water in the insulated thermal storage tank absorbs the heat produced at maximum boiler output until the wood is consumed and the boiler shuts off. Heat is recovered from the storage tank as needed for heating and domestic hot water use. By storing boiler heat in an insulated thermal storage tank, you gain increased operating flexibility and you can burn the boiler at full output with the cleanest and most efficient operation. Because of the heat buffer provided by the heat storage system, you are free to fire the boiler when it is convenient. On most days in the winter you will only need to load the boiler once in 24 hours with some tank packages. In summer you will be able to go 4-10 days between firings to heat all your domestic hot water.

Tarm Biomass offers both open atmospheric and pressure type thermal storage tank systems. Please contact Tarm Biomass or your local Tarm Biomass dealer to help recommend a thermal storage system for your Solo Plus gasification boiler.

2.3 Fuels

The Solo Plus is made to burn natural **firewood**. Both hardwood and softwood are suitable, but oak should not be burned as the only source of wood for long periods because of its high acid content.
Do not burn other fuels in this boiler!

Wood is an environmentally desirable fuel as it is locally produced, renewable, and CO_2 neutral. The boiler will burn natural cord wood with high efficiency and low emissions. To fully realize the best operation and clean burning potential of the boiler, wood should be dry and properly split. With wet wood, above 20% moisture, the boiler will be much less efficient, produce less heat and may result in problematic operation. Burning wet wood uses a substantial amount of the wood energy to evaporate the water present in the wood, reducing the available energy for heat **(Fig 2.2)**. **Dry wood gives big returns!**

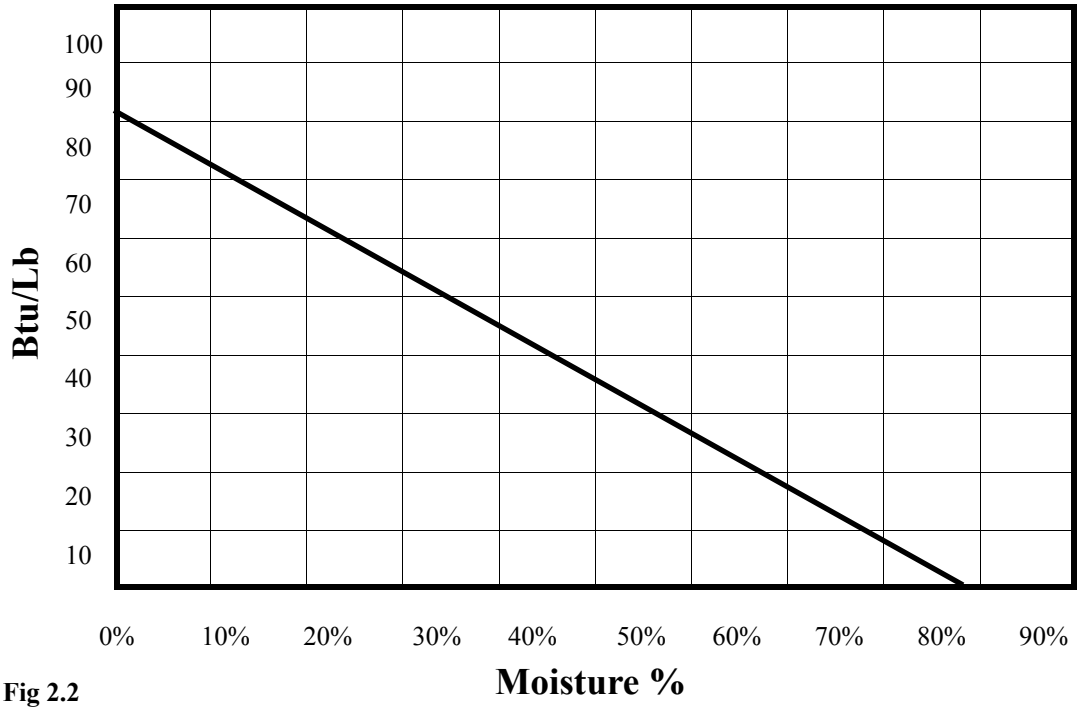


Fig 2.2
This chart shows how many Btu's are lost by burning fuel with higher moisture content. We recommend fuel with a moisture content of 20% or less.

- Log length should be approximately 18 to 20" (460-510 mm).
- Pieces over 5 to 6" (130-150 mm) in diameter should be split.
- Moisture content should be 15-25% for best operation.

To promote faster drying of firewood, it should be cut to length, split and stacked loosely off the ground with maximum exposure to the sun and wind circulation through the stack. Cover only the top of the stack (at an angle to allow moisture to run off) to keep out rain and snow. If during the heating season wood is stacked in the basement, using a fan to circulate air around it will facilitate faster wood drying.

WARNING

If a fan is used in the fuel storage area, they should be installed so as not to create negative pressures in the room where the solid-fuel burning appliance is located.

Always try to have two years of wood supply on hand so that the wood being burned has been cut, split and stacked under cover for a year. Some varieties of wood may take 1½ years to dry adequately.

If live trees are cut in the spring or summer let them lie for a while, until the leaves wither. As the leaves wilt, they will draw moisture from the bark and wood, drying it more quickly than if the trees are limbed immediately. If buying firewood, spring or early summer is usually the best time to purchase it.

No matter what species of tree it comes from, roughly the same amount of heat is produced from a pound of wood. But wood is not sold by the pound; it is sold by volume—by the cord. Therefore, the dense, heavy woods are the best ones to buy because they have more pounds per cord.

2.4 Building Requirements

WARNING

This boiler is designed to burn wood. Both hard and soft woods may be used, but under no circumstances should coal or small pieces of wood waste that can fall through the center slot in the refractory be burned. Do Not Burn Coal, Painted, Creosoted, or Pressure Treated Wood

- The boiler must be connected to a tile-lined masonry **chimney** or to a factory-built Type UL 103 HT (ULC S629 in Canada) approved chimney in good condition. See the details in Section 3.2
- A dedicated supply of **fresh combustion** air provided near the boiler is recommended for efficient, safe operation. This supply must not be directly connected to the boiler.
- A dedicated 120 VAC **power supply is required. (See Section 3.4.9)**
- Revision of **existing heating system** piping may be appropriate to properly utilize the equipment. Although Tarm Biomass can provide advice and design detail on the integration of this boiler with the heating system of the building, the ultimate responsibility for the performance of the system rests with the installer.
- Please observe the guidelines and the various **national and local regulations.**
- **Solo Plus** boilers are designed and approved as heaters for hot water systems with permissible outflow temperatures of up to 203 ºF (95 ºC).

2.5 Owner Responsibilities

Successful operation of this boiler will require daily involvement by the owner/system operator. Biomass boilers operate differently from fossil fuel boilers, requiring more oversight and a diligent cleaning regimen. Not following the instructions can result in lower efficiency and environmental pollution because the desired clean flue gas is not obtained. Furthermore, misapplication will reduce the boiler's life. The correct operation and installation is the best guarantee of a properly operating boiler with a long lifetime and less pollution. It is a prerequisite that the user has the will and the right attitude towards firing with wood.

- The owner/system operator is responsible for correct operation of the boiler per guidelines in Sections 4.0 and 5.0 of this manual.
- Incorrect operation can reduce the boiler life.
- If an unsafe condition occurs it is to be repaired as soon as possible by a qualified serviceperson. Outlets, ventilating ducts, fresh air conduits and others must not be closed or clogged.

CAUTION

☼ Throughout this manual, safety considerations are noted and discussed. A few **general safety considerations** to be considered are:

- Safety faults or deficiencies with the boiler or installation must be rectified as quickly as possible. Either by the owner/system operator or the installer.
- Outlet pipes, ventilation channels, fresh air openings, etc. must not be closed or blocked.
- Do not burn garbage, gasoline, gasoline-type lantern fuel, kerosene, charcoal lighter fluid, drain oil, or similar liquids to start or "freshen up" a fire in the boiler.
- **BOILER IS HOT WHILE IN OPERATION. KEEP CHILDREN, CLOTHING, ANIMALS, AND FURNITURE AWAY. CONTACT MAY CAUSE SKIN BURNS. DO NOT TOUCH DURING OPERATION.**
- Keep all flammable liquids and combustibles well away from the boiler while it is in use. Do not store fuel or other combustible material within the described installation clearances.
- Do not operate with flue draft exceeding –.10" (-2.54 mm) water column.
- Do not operate with fuel loading or ash removal doors open.

3.0 Boiler Installation & Start-up

This section describes the steps to installing and starting-up the boiler. **This section is directed at the installer.**

Before beginning installation contact local building or fire officials, as the installation must be done in accordance with local ordinances that may differ in some ways from this manual. The local building official is the final authority for approving installations as safe and determining that it meets local and state codes.

The metal testing and listing label, permanently attached to the top of your Solo Plus boiler indicates that the boiler has been tested to current UL and CSA standards and gives the name of the testing laboratory. When the boiler is installed according to the information both on the label and in this manual, local authorities in most cases will accept the label as evidence that the installation meets codes and can be approved.

Failure to follow these installation instructions and guidelines may result in a dangerous situation. Follow the instructions and do not allow makeshift compromises to endanger property or personal safety.

Please note that the installation instructions refer to specific makes of controls and accessories. Equivalent makes and models of these devices may be used successfully. The installing contractor is the best judge of a system's specific requirements, as well as of local availability of different devices. However, be certain that no substitutions are made for the standard safety equipment, control panel and relief valves that we have supplied with the boiler. The installation of these devices is absolutely necessary for safe operation of the boiler and for protection of the heating system.

3.1 Planning

3.1.1 Sizing the Boiler

It is critical to size the boiler properly. A proper, up to date heat load calculation is advised. An accurate history of building fuel usage over several years can help to calculate the proper size boiler. **Boiler sizing is the responsibility of the installer.** Tarm Biomass bears no responsibility for boiler sizing, but can provide sizing input.

3.1.2 Choosing an Installer

Choosing a competent, licensed installer is critical to the successful installation of the boiler. The installer is responsible for all planning, installation, start-up, troubleshooting, owner training, and annual maintenance for the boiler. Some aspects of the system piping, start-up, and operation may differ from normal practice in fossil fuel boiler installation. To be successful, the installer must study this manual, follow conceptual drawings and instructions provided, understand the installation tasks, and contact Tarm Biomass for help when necessary.

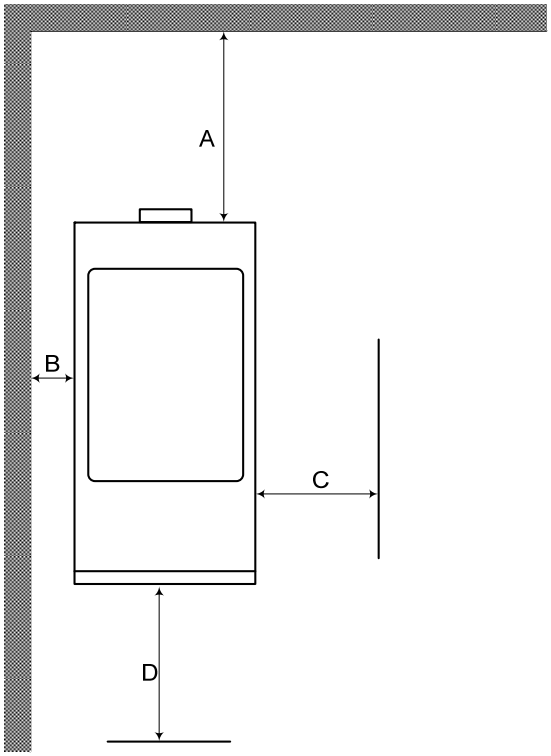
3.1.3 Locating the Boiler and Boiler Clearances

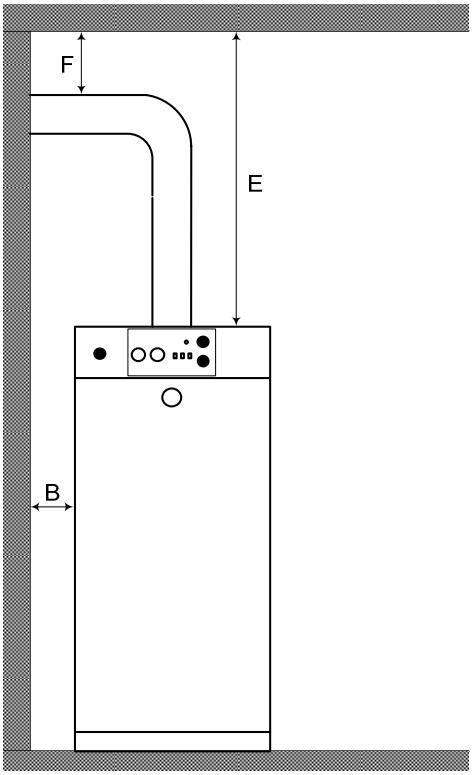
The boiler must be installed with the **minimum installation clearances** to combustible materials outlined on the next page. Clearances may only be reduced by means approved by the regulatory authorities.

- The boiler is not suitable for outdoor installation. It must be located in a weather-tight, protected space.
- The boiler must be placed on a level, non-combustible floor, such as a concrete slab on earth. If you have the boiler 8” (203 mm) above the floor it makes it easier to load and clean the boiler.
- If the boiler is placed near inhabited rooms, so that flue gas can easily penetrate into these rooms, a carbon monoxide alarm must be installed that can give a warning regarding possible escapes of carbon monoxide into the inhabited rooms.

CAUTION
☼ **DO NOT INSTALL THIS BOILER IN A MOBILE HOME.** There is no safe way this boiler can be installed inside a mobile home.

The boiler must be installed with the **minimum installation clearances** to combustible materials outlined below. Clearances may only be reduced by means approved by the regulatory authorities.





Clearances to Combustibles		
Measurement	Minimum Distance	Notes
A-Backwall to Appliance	18”	Minimum Distance
B-Sidewall to Appliance	8”	Minimum Distance
C-Sidewall to Appliance	21”	Minimum Distance on left or right side to allow clearance for Cleaning and Maintenance Tasks.
D-Front of Appliance	36”	Required Distance for Cleaning the Boiler.
E-Ceiling to Appliance	18”	Required Distance for Cleaning the Boiler.
F-Combustibles to Pipe	18”	Minimum Distance

3.1.4 Plumbing and Mechanical

The boiler must be connected to a suitable **chimney.** Chimney requirements are discussed in **Section 3.2.**

A dedicated supply of fresh **combustion air** should be provided near the boiler for efficient and safe operation, but must not be directly connected to the boiler. **(See Section 3.2.1).**

For the heating system piping, it is possible to use either copper or iron piping materials. The supply and return pipe should be insulated to avoid heat loss. Included in **Section 6.5** are conceptual piping diagrams showing the correct layout for a variety of situations. Tarm Biomass can provide additional conceptual plumbing diagrams

A permanent pressurized domestic **water supply** must be provided with proper automatic filling and pressure reduction valves.
Use of a suitable **antifreeze mix** is allowed, but will cause a loss in heat transfer efficiency.

CAUTION
☼ Any plastic or rubber tubing used with a Tarm Biomass boiler must have an **oxygen barrier**, or boiler corrosion will occur. If radiant tubing without an oxygen barrier is installed, water in the tubing part of the heating system must be separated from the boiler. Separation of system components is typically done by using a heat exchanger. Use of radiant tubing without an oxygen barrier will void the boiler warranty.

If **water quality** is poor, water treatment additives should be considered. Boiler system water pH should be 8.0-8.6.

A **thermostatic mixing valve,** set to open at 140-160 ºF (60-72 ºC), is required to temper return water to prevent cold return water from reaching the boiler. This valve helps prevent boiler corrosion. Tarm Biomass can provide this valve (part # **K4440A3**), at an additional cost

A **circulator** (Size and brand to be determined by the installer (not provided)) should be installed as C3 per drawings suggested by Tarm Biomass.

A **tankless hot water coil** is available for the Solo Plus, at an additional charge.

Tarm Biomass recommends the use of the **BLTCONTROL** (available through Tarm Biomass) when burning the Solo Plus in conjunction with a back-up boiler and **thermal storage system**. The **BLTCONTROL** is a three position control that allows switching between wood only, wood with automatic back up, or back up only, by controlling the operation of the back up (auxiliary boiler). **BLTCONTROL** takes input from a zone relay control and determines, based on thermal storage system temperature, whether to pull heat from the **thermal storage system** or the back up auxiliary boiler. The **BLTCONTROL** easily integrates the Solo Plus boiler and **thermal storage system** with an existing fossil fuel heating system.

3.1.5 Electrical

For the Solo Plus boiler a **120 VAC, 60 hertz, 2-wire power supply is required**. This electrical connection should be from a dedicated 15 amp, circuit breaker. A master service switch for the boiler, mounted on the wall in the proximity of the boiler, is recommended. Locally enforced electrical codes must be followed.

3.2 Preparing the Chimney

The chimney is one of the most critical factors in the successful operation of any solid fuel heater, including the Solo Plus boiler. A good chimney will provide a continuous and dependable draft to pull the exhaust gasses out of the building.

NOTE

The boiler must be connected to a tile-lined masonry chimney or to a Factory-Built Type UL 103 HT (ULC S629 in Canada) approved chimney. The chimney must be in good condition. If the boiler is connected to a dirty or inadequate chimney, it can present a serious fire hazard. All chimneys and connections must conform to NFPA standard #211. No other appliance should be connected to this flue unless allowed by the local code authority. Consult your local inspector for chimney requirements and install the boiler in accordance with all applicable codes. Please review the following diagram before connecting the boiler to the chimney.

Follow manufacturer's installation instructions for installing and supporting any specific chimney product.

Flue gas exhaust temperatures can be low enough to cause condensation in chimneys. Condensation will, over time, damage a masonry chimney. Accordingly, installation of a stainless steel chimney liner (made with 316 or AL-294C alloys) inside the chimney flue is strongly recommended.

At the connection to a factory-built chimney, a dripless adaptor must be used.

The chimney draft must be stable and between -0.025" (-0.6 mm) and -0.05" (-1.25 mm) water column.

The top of chimney must be 3 feet (0.9 m) above the roof and 2 feet (0.6 m) above any structure within 10 feet (3.0 m) measured horizontally.

For the Solo Plus 30 and 40 best draft will be provided by a chimney which has an 6" (152 mm) ID round flue, is 20-30 feet (6.0-9.0 m) in height and which is located inside the heated structure. The Solo Plus 60 will need an 8" (203 mm) ID round flue. The chimney must be capable of maintaining a breech draft of -0.05" WC (-1.25 mm) during normal boiler operation.

Your Solo Plus gasification boiler is designed to burn efficiently and with virtually clear emissions, but under certain conditions creosote deposits can form in your chimney. Chimneys that are too large, are poorly insulated, or have bends in the flue passages are especially prone to problems with draft and/or creosote.

The smoke pipe connecting the boiler to the chimney flue must be black or stainless, have a minimum thickness of 24 gauge, and rise a minimum of ¼" per foot of run toward the chimney **(Fig3.1).** Smoke pipe sections must be attached to one another with a minimum of three sheet metal screws. The smoke pipe should not contain more than two 90º elbows (45º elbows are preferred over 90º elbows).

MASONRY CHIMNEYS: Masonry chimneys must be lined, either with code-approved masonry or pre-cast refractory tiles, stainless steel pipe, or poured in place liner. Do not use an unlined chimney

FACTORY BUILT CHIMNEYS: Factory built chimneys must be tested and listed for use with solid-fuel burning appliances to the High Temperature (HT) Standard (2100 ˚F (1148 ˚C)), UL 103, for the United States and High Temperature (1200 ºF(650 ˚C)) Standard ULCS-629 for Canada. Factory-Built chimneys must be installed as per the manufacturers instructions.

Strong winds blowing across the top of a chimney or a chimney which has a particularly strong natural draft can cause the Solo Plus boiler to continue burning (heating) when the draft fan is off. This should not be allowed to happen because it can cause creosote formation and/or overheating of the boiler. The solution to this problem of excessively high or irregular draft is to use a barometric draft regulator in the smoke pipe.

Installation requirements for a barometric damper (draft regulator).

- The diameter of the draft regulator must be equal or greater than that of the chimney connector.
- The draft regulator should be installed as close as possible to the boiler, on the chimney connection or on chimney itself.
- The draft regulator adjustment should be made with a vacuum gauge, if possible, with the boiler operating at full output. If the start-up is made in warm weather, a readjustment may be necessary in cold weather.
- If, at the maximum adjustment (maximum opening of the shutter of the draft stabilizer), the draft is always higher than 0.05" (1.25 mm) of water column, a second draft regulator may be required.
- Recommended draft regulator locations are shown in **Fig 3.1** (position 1 or 2).

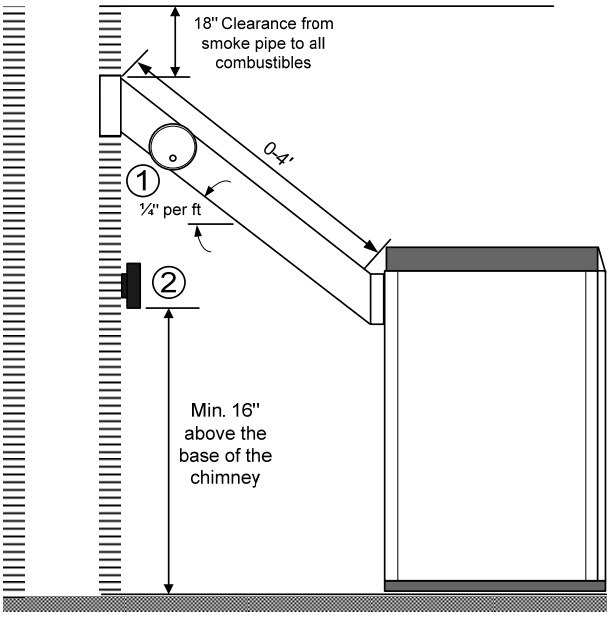


Fig 3.1

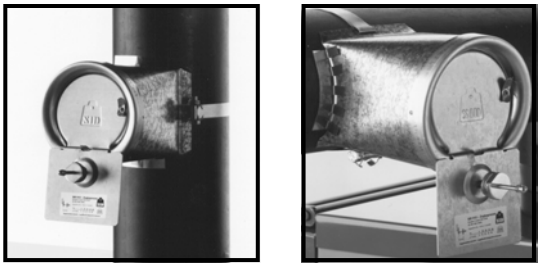


Fig 3.2 Examples of Barometric Dampers

3.2.1 Outside Combustion Air

Provision for outside combustion air may be necessary to ensure that fuel-burning appliances do not discharge products of combustion into the house. Guidelines to determine the need for additional combustion air may not be adequate for every situation. If in doubt, it is advisable to provide additional air.

Outside air may be required if:

1. The solid fuel fired appliance does not draw steadily; experiences smoke roll out from the loading door, burns poorly, or back-drafts whether or not there is combustion present.
2. Existing solid fuel fired equipment in the house, such as fireplaces or other heating appliances smell, do not operate properly, suffer smoke roll out when opened, or back-draft whether or not there is any combustion present.
3. Any of the above symptoms are alleviated by opening a window slightly on a calm (windless day.
4. The house is built very tightly with a well sealed vapor barrier or foam type insulation and tight fitting windows and/ or has any powered devices which exhaust in the house.
5. There is excessive condensation on windows in the winter.
6. A non-balancing ventilation system is installed in the house.
7. Where fans are used in the fuel storage area, they should be installed so as not to create negative pressures in the room where the boiler is located.

If these, or other indications, suggest that infiltration air is inadequate, additional combustion air should be provided from the outdoors.

Solo Plus boilers are not suitable for direct connection to outside air. Outside air should be ducted to no closer than 12” (305 mm) from the boiler. A 6” (152 mm) duct should be large enough for all sizes unless the duct run is over 25 feet (7.6 m).

If a mechanical ventilation system (air exchange or heat recovery) is already present in the home it may be able to provide sufficient combustion make-up air for the solid fuel fired appliance. The ventilation system may need to be re-balanced after installation of the Solo Plus.

NOTE
Canadian installations must conform to ANSI/NFPA outside air requirements of 1 sq. inch (2.5 cm) per 1,000Btu/hr (.30 kW/hr).

3.3 Setting the Boiler

3.3.1 Receiving the Boiler

Boilers are shipped on a single skid. Loose materials are consolidated into boxes strapped to the skid or placed inside the combustion area of the boiler. Please unpack the boxes and verify that the items on the checklist have been supplied with the boiler (separate checklist is located on page 14). Make certain that any damage or shortage is noted to the shipping receiver.

To move the unit into the boiler room the lift ring on the top of the boiler can be used.

To move the boiler around the inside of the boiler room rollers can be used under the boiler.

3.3.2 Boiler Checklist

Solo Plus Boiler Kit Checklist		
Item Description	**Quantity**	**Included**
Refractory Combustion Chamber (installed)	1	
Ash removal/scraper tool	1	
Cleaning Brush	1	
By-Pass Damper (installed)	1	
By-Pass Damper Bakelite Knob	1	
Installation Manual	1	
Leveling Studs	4	
Draft Fan	1	
Front Panel (installed)	1	
Side Panel (installed)	1	
Rear Panel (installed)	1	
Top Panels (installed)	1	
Loading Door (installed)	1	
Ash Door (installed)	1	
Boiler Control Panel (installed)	1	
Boiler Pressure Relief Valve (Combraco 10-407-05, 30 psi)	1	
Flue Collar Adapter	1	
Purge Vent (installed)	1	
Unipac Hemp and Pipe Dope Kit	1	
Pressure/temperature Indicator	1	

Please contact your dealer or Tarm Biomass immediately if any of the above items are missing! Tarm Biomass reserves the right to substitute equivalent equipment for any of the accessories listed above.

3.3.3 Temporary Storage

If the boiler installation is going to take place at a later date the boiler and components need to be stored in a safe, dust-free, dry location. Moisture can damage the insulation, electrical components, and ceramics. If boiler is subjected to this kind of environment, it could void the warranty.

3.3.4 Moving the Boiler

See **Section 6.3** Specification Data for weights and measurements of the Solo Plus boiler. **The boiler is heavy and large.** Moving the boiler into place requires planning and resources. The boiler may be unloaded using a pallet jack or forklift. Alternately, it can be lifted from above by utilizing the lifting rings welded to the top of the boiler.

WARNING

When the boiler is being moved or if a jacket panel is removed, the boiler's outer front door must be secured to the boiler with tape or removed to prevent the door from falling off and getting damaged.

3.3.5 Boiler Set-up

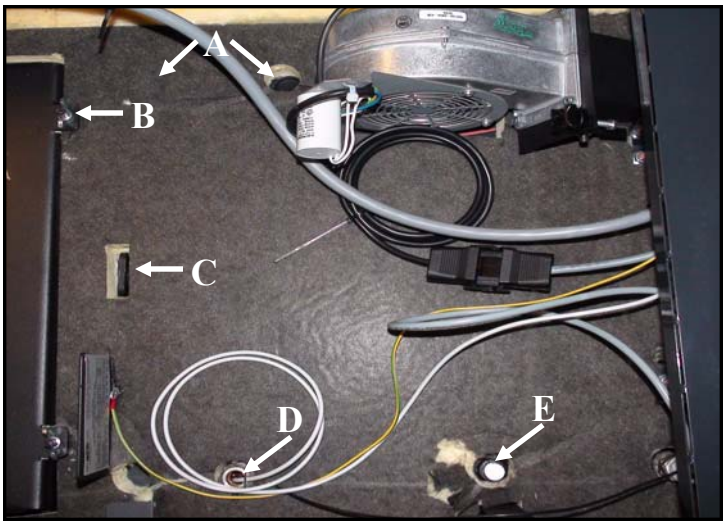
After the packaging is removed, place the boiler in it's planned location on a non-combustible floor and positioned for the proper chimney connection. The guidelines in **Section 3.1.3** of this manual should be observed!

Using the leveling studs that came with the boiler, level the boiler both front to rear and side to side.

The boiler's electrical junction box comes pre-wired to the back of the boiler. The junction box needs to be mounted on either the left or the right side of the boiler by utilizing one of the domestic hot water knock-outs.

The wires will need to disconnected from the junction box to be able to feed the box through the side panel. This is done by inserting a small screwdriver into the hole below the wires **(pictured)**. All of the wires are numbered to correspond to the numbers on the terminals (They are labeled on the top of the terminals).

Mount the junction box as shown. Remove the bottom round knock out. The box can be installed on the right or the left hand side of the boiler. Use the enclosed screws located in the box to attach the box to the jacket. The wires must be re-attached to the terminals by following the instructions in the previous step. Image also shows a service switch installed (as recommended).

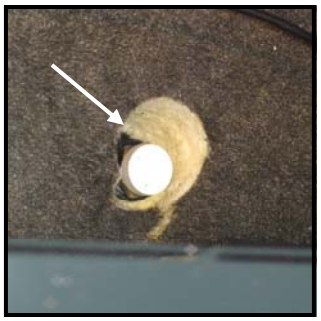


Boiler Tappings on Top of Boiler:

A-Extra tappings (Tapping #5 and on the Solo Plus 60 there is an additional tapping #23).
B-Location for the Lo-Limit Thermostat probe.
C-Lift ring.
D-Tapping #24 Temperature sensor for control panel.
E-Air Purge Vent (Tapping #22).

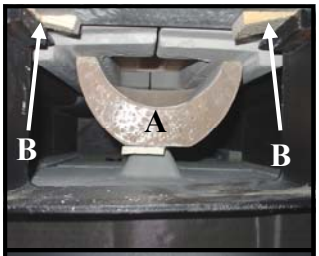
Tapping #5 is an extra tapping. Plug with a ¾" black iron plug if not used. On the Solo Plus 60 there is an additional extra tapping #23. This should also be plugged with a ¾" black iron plug.

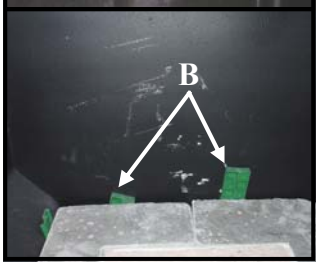
The boiler is shipped with the Lo-Limit thermostat probe in a dry well located over the smoke box **(pictured).** Make sure that the probe is inserted completed into the well. If there is a "C" clip attached to the sensor; it must be removed. The sensor must be pushed to the bottom of the well for accurate temperature readings.



Bleeder Valve is located in tapping #22 (front left). Air should be purged from the boiler during the start-up phase. It is also good practice to check for air on a yearly basis or if any changes were made to the system.

If not installed, install a ½" plug in tapping #10 (front of boiler, just left of the ash door).
There must be no valve used in this tapping. A valve or other fitting could accidently be damaged by a dropped piece of fuel.





Open the lower ash removal door and inspect the refractory chamber bricks for damage or cracks (hairline cracks are ok and normal). Check to make sure the combustion tunnel brick is slid fully to the rear as it may have shifted out of place during shipping **(A).** It is not necessary to remove the wooden shipping wedges **(B)** in the combustion chamber. They will burn up within a few hours of initial firing.

NOTE

When the Solo Plus is being fired, the possibility of boiler overheating does exist. Should this happen, the boiler control (at 201 ºF (94 ºC)), must turn on an overheat zone and the C-3 circulator to dissipate heat through the heating radiation to cool the boiler. IF MORE THAN ONE ZONE EXISTS, THE OVERHEAT CONTROL MUST BE CONNECTED TO THE RELAY OR ZONE VALVE THAT CONTROLS THE CIRCULATOR FOR THE LARGEST ZONE.

WARNING

DO NOT USE SELF CONTAINED, NON ELECTRIC ZONE VALVES IN THE ZONE CONTROLLED BY THE OVERHEAT CONTROL! SUCH VALVES WOULD PREVENT THE OVERHEAT CONTROL SYSTEM FROM COOLING THE BOILER WHEN NECESSARY.

3.3.6 Jacket Removal

Follow these instructions if the boiler's jacket needs to be removed or the boiler has to be moved.

First loosen the two front top jacket screws while holding the front outer jacket door.

Next, carefully remove the front outer jacket door by lifting the boiler's top jacket. Place the door in a safe location. The door is removed to prevent the door from slipping off from the hinges when the top panel is raised.

The door should also be removed whenever the boiler is moved.

Now remove the four top jacket screws and remove the top panel.

Now remove the two screws holding the side panels to the rear panel.

The side and rear panels can now be removed.

3.4 Connections to the Boiler

The following connections must be made to the boiler, in order for it to function:

- The boiler flue gas exhaust collar must be connected to the chimney system.
- The heating system piping must be connected to the boiler supply and return connections.
- Electrical power must be provided at the boiler electrical terminal box.

3.4.1 Chimney Connection

CAUTION
☼ Do not install a flue damper in the exhaust venting system of this unit.
☼ Do not connect this unit to a chimney flue serving another heating appliance, unless approved by the local code authority.
☼ Do not connect the boiler to any air distribution duct or system.
☼ Install vent at clearances specified by the vent manufacturer.

The connection between the boiler and the chimney system should be single wall 24 gauge (minimum) stainless or black pipe, unless prohibited by the local code authority.

- The single wall chimney connector must not pass through an attic, roof space, closet or similar concealed space, or a floor, or ceiling.
- Where passage through a wall or partition of combustible construction is desired, the installation must conform to NFPA 211 or to Canadian CAN/CSA B365
- The chimney connection pipe must be placed over the outside of the boiler's flue gas exhaust pipe **(Fig. 3.3).** A boiler flue with an internal dimension of 5.8" (149 mm) is used – see specification data in **Section 6.3**.
- The chimney connector sections must be attached to the boiler and to each other with the crimped (male) end pointing towards the boiler. All joints, including the connection at the boiler collar, must be secured with three sheet metal screws.
- A barometric regulator (draft damper), if used, should be incorporated into the connector (Refer to **Section 3.2** for more information).

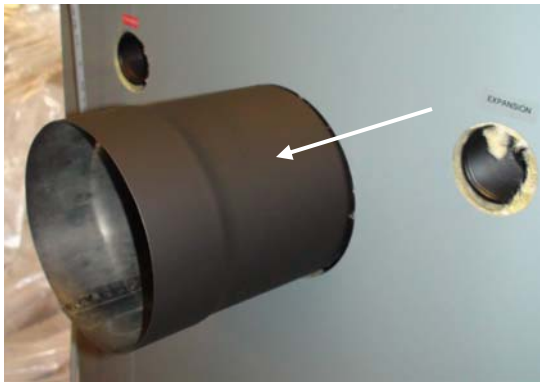


Fig. 3.3 Flue Outlet with collar (SP 40 shown)

3.4.2 Safety Plumbing

NOTE

SYSTEM DESIGN: Consider first provisions for handling excess heat produced by an over-heating boiler both with electricity and during a power failure.

OVERHEAT LOOP: NO ELECTRICITY: The piping and controls must be connected to the boiler in such a way that in the event of a power failure there is one loop of radiation available for gravity circulation. This loop must not be obstructed by any valves or other accessories which would prevent gravity circulation during a power failure. The piping is plumbed in such a way that excessive pressure will not be developed in any portion of the boiler or system. The loop must be large enough to dissipate at least 10% of the boiler's maximum rated heat output, assuming an ambient temperature of 65 °F (18 ºC) and a mean water temperature of 180 ºF (82 ºC).

The minimum pipe size for this loop is ¾" and if possible, the loop should be located and pitched to maximize natural thermal convection of the water. The loop must be positioned above the boiler. The design of the loop must be such that it can be made inoperative only in a deliberate manual action. If large enough, an existing heating radiation zone may be used for the over-heat loop. The loop must be equipped with zone valves which will open automatically during a power failure. We recommend AUTOMAG zone valves for this application (offered as an accessory).

OVERHEAT LOOP: WITH ELECTRICITY: The boiler control provided with this boiler must be wired in parallel with a thermostat on the zone with the most heating capacity in the main living area (dump zone). Upon reaching 201 ºF (94 ºC), the dump zone will be activated, pulling heat away from the boiler. The home owner is alerted to a potential problem with the boiler by an overly warm living space. Refer to **Section 6.4.1** for wiring.

Do not use self contained, non electric zone valves in the zone controlled by the overheat control! Such valves would prevent the overheat control system from the cooling the boiler when necessary.

NOTE

THE THERMAL STORAGE SYSTEM MAY NOT BE USED AS A DUMP ZONE!

One potential for overheating the boiler is if the boiler operator were to load too much wood into the firebox for the heating system and/or the thermal storage system to absorb all of the heat produced by the load of wood. With minimal experience, most Solo Plus owners will learn how to operate their boilers so over-heating problems are rare.

3.4.3 Plumbing Connections

There are numerous possibilities for connecting your Solo Plus boiler to your heating system. BioHeat USA provides diagrams **(located in appendix) as concept diagrams only.** The Solo Plus may be used either as a stand-alone boiler or in conjunction with an existing oil, gas, electric or other solid fuel boiler with or without a thermal storage tank. Typically the Solo Plus boiler serves as the primary boiler and the existing unit as the back-up system The type of installation chosen will depend upon the requirements of the given heating system. This section will cover necessary connections at the boiler.

NOTE

Any radiant tubing used with the Solo Plus boiler must have an oxygen barrier! Non oxygen barrier tubing must be separated from the boiler using a heat exchanger.

NOTE

All pipe between the wood boiler and the heating system must be 1¼"

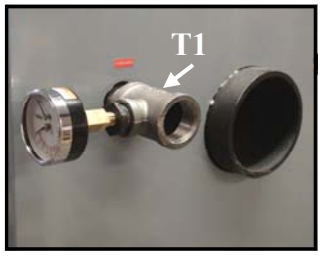
NOTE

All piping connections to the boiler and the Termovar must be sealed with the wicking and pipe dope supplied with the boiler or at least 5 turns of Teflon tape.

The following instructions are for both **ONLY BOILER** and **ADD-ON** (two boiler) installations. Please refer to the plumbing concept diagrams in the appendix.

Part	Qty	Supplied	Tarm Part #
1¼"X3" Black Iron Nipple	3	No	X
1¼"X1¼"X¾" Black Iron Tee	2	No	X
1¼"X¾" Black Iron Reducer	1	No	X
1¼"X1¼"X1" Black Iron Tee	1	No	X
1¼"X1" Black Iron Reducer	1	No	X
1"X1" Black Iron Street Elbow	1	No	X
Pressure Relief Valve (30Psi)	1	Yes	1040705
¾" Boiler Drain Valve	1	No	X
¾"X¼" Black iron Reducer	1	No	X
Pressure/Temperature Gauge	1	Yes	PT1088

Recommended parts needed for connections **at** the boiler (other parts will be needed to install boiler):

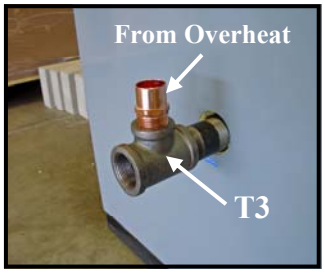


Supply Connections

Using a 3" nipple, pipe out from the supply tapping #2 of the boiler to a 1¼"x ¾"x 1¼" tee **(T1).** From the ¾" outlet of **(T1)**, install a ¾" x ¼" reducer and install the included pressure/temperature gauge (**Part # PT1088).**

Overheat and Pressure Relief Valve Connections

Using a 3" nipple, pipe out from tapping #16 of the boiler to a 1¼"x ¾"x 1¼" tee **(T2)**. From the ¾" outlet of **(T2),** install the Conbraco 10-407-05 30psi supplied pressure relief valve. **The relief valve must be installed within 6" of the boiler in the vertical position. THIS VALVE MUST BE INSTALLED TO INSURE SAFE OPERATION OF THE BOILER AND FOR PROTECTION OF THE HEATING SYSTEM**. Pipe the ¾" discharge line from this valve to within 6" of the floor with no reduction in pipe size. Using a 1¼" x 1" reducer pipe out from **(T2),** install 1" street elbow. From elbow pipe to a normally open Automag zone valve and then to the supply of the overheat zone, downstream of any flow check valve.



Return Connections

Using a 3" nipple, pipe out from the return tapping #1 of the boiler to a 1¼"x 1¼"x 1" tee **(T3).** From the 1" outlet of **(T3)** pipe the return from the overheat zone. You might have to angle the tee slightly to navigate around the flue pipe.

Boiler Drain

Using a 1¼"x ¾" reducer, pipe out from tapping #18 of the boiler. Install boiler drain into reducer. This is the best connection for filling the boiler with water.

3.4.4 Pipe Connections – Choice of Material

A copper/steel mixture can be used for the heating side. Copper followed by galvanized piping (in the direction of the water flow) should be avoided for hot water for reasons of corrosion protection. However, galvanized cold water piping and copper piping can be used for hot water. The supply and return flows must be carefully insulated to avoid heat loss.

3.4.5 Expansion Tank

The size of the expansion tank is determined by the total water content of the heating system.

3.4.6 Pump Size

The size of the circulation pump is determined by the size of the system and the pipe dimensions.

3.4.7 Installation of Optional Domestic Hot Water Coil

A tankless coil for heating domestic hot water is available as an option on the Solo Plus boiler. For ready access to the coil, remove the boiler's jacket (refer to **Fig. 3.4** for piping).

Pipe the cold water to tapping #15, and hot water from tapping #14 (or vice versa). It will be necessary to drill holes into the boiler's side panel for the hot and cold water lines. It is desirable to install unions to the boiler in both the cold and hot water lines.

NOTE

If a separate hot water heater will be used to heat domestic water during the warmer months, cold water must not flow through the domestic coil if the Solo Plus is unheated! Condensation and corrosion of the boiler body can result if water flows through the unheated boiler.

Cold water must be piped separately to the separate water heat, not through the coil in the Solo Plus boiler.

Install a Pressure Relief Valve (Conbraco 17-402-01 100psi, supplied with coil kit) in a tee on the cold water supply to the tank-less coil. There must be no shut-off valve or check valve between the relief valve and the tank-less coil.

NOTE

The Relief Valve discharge line must be piped to within 6" (152 mm) of the floor near a drain, and must be ¾" pipe with no reduction. If this valve operates, hot water or steam will be discharged. It should be piped to an open drain; so that this water will not damage the room in which the boiler is located.

CAUTION

☼ **To prevent the possibility of a person sustaining serious burns from domestic hot water, a tempering valve (Watts 70A or equivalent), and or an appropriate anti-scald device must be installed to protect against dangerously high domestic water temperatures.**

NOTE

In certain areas, water supplies may have a high mineral content. This will lead to lime build-up in the coil and blockage depending on the mineral content, boiler temperature, and the amount of water passing through the coil. Coils should be cleaned or replaced as soon as there is any indication that the hot water supply is being restricted. Coils can be cleaned with hydrochloric acid, but is very dangerous and should be attempted only by qualified and experienced person.

DOMESTIC HOT WATER PIPING WHEN A SEPARATE DHW HEATER IS USED IN THE SUMMER MONTHS (Fig . 3.4)

IN SUMMER: (or when the Solo Plus boiler is shut-down) CLOSE Valve B and OPEN Valve A.
IN WINTER: (or when the Solo Plus is in operation) OPEN Valve B and CLOSE Valve A.

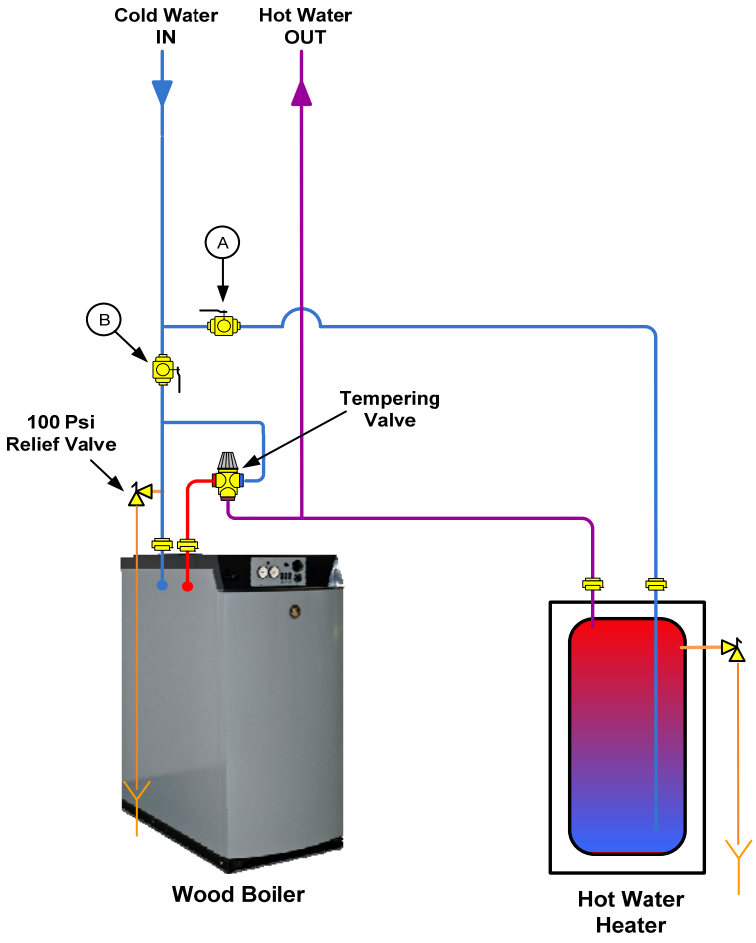


Fig. 3.4 Domestic Hot Water Piping

3.4.8 Installing the 339N Probe Thermometer

The 339N Probe Thermometer (Part # **339N**) is to be installed just downstream of the boiler's flue collar. Drill a ¼" hole in the side of the pipe and insert the probe all the way in (see **Fig. 3.5**). This thermometer indicates of how well the wood is burning and when to clean the heat exchange tubes. If burning dry wood that is split, it should achieve temperatures of 500-600 ºF (260-316 ºC) or more on the probe thermometer.

If operation of the boiler is not achieving temperatures this high, check the following things:

1. Is the by-pass damper latched tightly closed?
2. Are the vanes on the draft fan clean and not filled with ash or dust?
3. Are the primary air channels open (see **Section 4.16.5**).
4. Is the wood dry (<20%) and split to the proper size?
5. What is the condition of the firebox ceramics?

In most instances, low stack temperatures are an indication that the wood is not dry.

If boiler operations have been producing consistent temperatures and the flue temperature has been creeping upward, this is an indication that it is time to clean the heat exchange tubes by brushing.

Fig. 3.5 **339N Thermometer Installed**

3.4.9 Installing the Optional Turbulators

The 3" turbulators **(part # 092244)** are used to increase the heat exchange efficiency of the Solo Plus boiler connected to a thermal storage tank system.. They are typically not used when a thermal storage tank is not present.

To install the turbulators, remove the access cover above the heat exchange tubes. After brushing the tubes place a turbulator in each heat exchange tube.

NOTE
Tarm Biomass recommends that the turbulators not be installed when a boiler is first installed. Operate the boiler without the turbulators installed until you maintain a consistent flue temperature of 500 ºF (260 ºC). Constant flue temperatures of less than 300 ºF (148 ºC) are too low when the turbulators are installed.

3.4.10 Control Logic

TYPICAL CONTROL LOGIC FOR USE WITH BLADDER LINED COIL-TYPE THERMAL STORAGE SYSTEMS (Refer to Plumbing Diagram STSS1 or STSS2):

The process begins when a fire is lit in the boiler and the boiler's control is reset. Water within the boiler begins to warm. Hot water from the boiler will begin to circulate to the heating system when the water temperature reaches approximately 165 ºF (74 ºC). Depending on the return water temperature at the **4440A3** Termovar valve **(TV1),** water will either circulate back into the return of the boiler or will continue on to the supply manifold.

TV1 is a three way thermostatic tempering valve. Port 3, which is the return to the boiler, always stays open. Port 1 remains open until it senses 165 ºF (74 ºC) water. At temperatures above 165 ºF (74 ºC), Port 1 on **TV1** begins to close and Port 2 begins to open. Port 2 is fully open when the return water reaches 172 ºF (78 ºC).

The thermostatic element in the Termovar prevents cold water returning to the boiler until the boiler reaches operating temperature. The Termovar then gradually opens, blending hot boiler supply water with the cold return water. Once system temperature equalizes, the Termovar opens fully to allow full flow to and from the heating load (the house and/or a heat storage system). Please note: The balancing valve shown as a 1 ¼" ball valve upstream from port 1 is essential. Start with this valve closed ½ way and adjust more open or closed as necessary. Never fully close or fully open this valve. For customers who have chosen the LOADING UNIT TERMOVAR **4832S** the balancing valve is built in and balances automatically.

Assuming that **TV1** is hot, the water being circulated by C3 is now heading for the supply manifold. If no zones are calling for heat the Honeywell **V8043F1101** zone valve **(ZV1)** will remain closed. All of the hot supply water being moved by **C3** must travel through the heating coils in the thermal storage system moving from top to bottom and then back through Port 2 of the Termovar and back to the boiler.

Tarm Biomass recommends the use of the **BLTCONTROL** (available through Tarm Biomass) where the Solo Plus boiler is used with another backup boiler. **BLTCONTROL** is a three position control that allows switching between wood only, wood with automatic back-up, or back-up only, by controlling the operation of the back-up auxiliary boiler. **BLTCONTROL** takes input from a zone relay control and determines based on thermal storage system temperature or second stage thermostat reading, whether to pull heat from the thermal storage system or the back up auxiliary boiler. **BLTCONTROL** simply integrates the Solo Plus boiler and thermal storage system with an existing fossil fuel heating system.

If at any point while the boiler is in operation, a zone calls for heat, **ZV-1** opens and circulator **C1** is energized. Heat flows directly from the boiler to the supply manifold. If the boiler has burned through its wood and has cooled, Port 2 of the **TV1** valve will close and **C3** will stop. Flow through the boiler will cease. Once the boiler is eliminated from the plumbing circuit, any zone that calls must pull heat through the thermal storage system. Return water passes into the bottom of the heating coils and exits the top of the coils, re-heated by the thermal storage system, and moves to the supply manifold. If however, upon a call for heat, the temperature in the thermal storage system is below the aquastat (HONEYWELL **L4008A** or equivalent) set point, **C1** will cease operation and **ZV-1** will close. The back up boiler will be energized through the switch control to meet the heat demand.

Tarm Biomass recommends the use of an additional Termovar valve model **6440AF (TV2)** for most installations. Without **TV2** it is possible that when a small zone is the only zone calling, a master bathroom zone for instance, all of the heat the boiler is producing is drawn to the small zone. The result is that a 100,000 – 175,000 Btu (30-50 kW) boiler is sending all of its output to a 2,500 Btu (0.73 kW) load. The boiler could quickly reach operating temperature and shut off, which must be avoided. **TV2** solves this problem. It operates much the same way that **TV1** operates except that it is a diverting valve. Port 1 of **TV2** receives water from the return manifold. Port 2 of **TV2** is connected to the supply manifold. Port 3 of **TV2** is connected to the return to the boiler and to the thermal storage system. When the **TV2** senses water 165 ºF (74 ºC). and above, it shunts water from Port 1 to Port 2 (back to the supply manifold). Because water returning to the boiler from the return manifold is diminished, the remaining flow from the boiler is forced through the heating coils in the thermal storage system. The result is that both the zone and the thermal storage system receive hot water and the boiler may continue to burn with a demand equal to or greater than its output. The end result is that the heating load is always prioritized over the thermal storage system, but heat not used will be stored in the thermal storage system for later use.

Please note the use of two opposing weighted check valves on the same pipe leading from the top of the heating coils in the thermal storage system. Their purpose is to act as a thermal trap preventing heated water from migrating out of the thermal storage system by convection. A "U" shaped pipe trap usually will not have a useful effect. If check valves are used, we recommend that they be cast iron bodied universal style flow checks. They **must not** be swing type check valves, as natural gravity flow of water will push swing check valves open.

TYPICAL CONTROL LOGIC FOR USE WITH PRESSURE TANK THERMAL STORAGE SYSTEMS (Refer to Plumbing schematic PT1 or PT2):

The process begins when a fire is lit in the boiler and the boiler's control is reset. Water within the boiler begins to warm. Hot water from the boiler will begin to circulate to the heating system when the water temperature reaches approx. 165 ºF (74 ºC). Depending on the return water temperature at the **440A3** Termovar valve **(TV1),** water will either circulate back into the return of the boiler or will continue on to the supply manifold.

TV1 is a three way thermostatic tempering valve. Port 3, which is the return to the boiler, always stays open. Port 1 remains open until it senses 165 ºF (74 ºC) water. At temperatures above 165 ºF (74 ºC), Port 1 on **TV1** begins to close and Port 2 begins to open. Port 2 is fully open when the return water reaches 172 ºF (78 ºC).

The thermostatic element in the Termovar prevents cold water returning to the boiler until the boiler reaches operating temperature. The Termovar then gradually opens, blending hot boiler supply water with the cold return water. Once system temperature equalizes, the Termovar opens fully to allow full flow to and from the heating load (the house and/or a heat storage system). Please note: The balancing valve shown as a 1¼" ball valve upstream from port 1 is essential. Start with this valve closed ½ way and adjust more open or closed as necessary. Never fully close or fully open this valve. For customers who have chosen the LOADING UNIT TERMOVAR **4832S** the balancing valve is built in and balances automatically.

Assuming that **TV1** is hot, the water being circulated by **C3** is now heading for the supply manifold. If no zones are calling for heat the **C1** pump will be off (If used, **ZV-1** will also be closed). All of the hot supply water being moved by **C3** must travel through the thermal tanks from top to bottom and then back through Port 2 of the Termovar and back to the boiler.

Tarm Biomass recommends the use of the **BLTCONTROL** (available through Tarm Biomass) where the Solo Plus boiler is used with another backup boiler. **BLTCONTROL** is a three position control that allows switching between wood only, wood with automatic back up, or back up only, by controlling the operation of the back up auxiliary boiler. **BLTCONTROL** takes input from a zone relay control and determines based on thermal storage system temperature or second stage thermostat reading, whether to pull heat from the thermal storage system or the back up auxiliary boiler. **BLTCONTROL** simply integrates the Solo Plus boiler and thermal storage system with an existing fossil fuel heating system.

If at any point while the boiler is in operation, a zone calls for heat circulator **C1** is energized (If used, **ZV-1** will open). Heat flows directly from the boiler to the supply manifold. If the boiler has burned through its wood and has cooled, Port 2 of the **TV1** valve will close and **C3** will stop. Flow through the boiler will cease. Once the boiler is eliminated from the plumbing circuit, any zone that calls must pull heat through the thermal storage system. Return water passes into the bottom of the thermal tanks and exits the top of the tanks, re-heated by the thermal storage system, and moves to the supply manifold. If however, upon a call for heat, the temperature in the thermal storage system is below the aquastat (HONEYWELL **L4008A** or equivalent) set point, **C1** will cease operation (If used, **ZV-1** will close). The back up boiler will be energized through the **BLTCONTROL** to meet the heat demand.

Tarm Biomass recommends the use of an additional Termovar valve model **6440AF (TV2)** for most installations. Without **TV2** it is possible that when a small zone is the only zone calling, a master bathroom zone for instance, all of the heat the boiler is producing is drawn to the small zone. The result is that a 100,000 – 175,000 Btu (30-50 kW) boiler is sending all of its output to 2,500 Btu (0.73 kW) load. The boiler could quickly reach operating temperature and shut off, which must be avoided. **TV2** solves this problem. It operates much the same way that **TV1** operates except that it is a diverting valve. Port 1 of **TV2** receives water from the return manifold. Port 2 of **TV2** is connected to the supply manifold. Port 3 of **TV2** is connected to the return to the boiler and to the thermal storage system. When the **TV2** senses water 165 ºF (74 ºC). and above, it shunts water from Port 1 to Port 2 (back to the supply manifold). Because water returning to the boiler from the return manifold is diminished, the remaining flow from the boiler is forced through the thermal tanks in the thermal storage system. The result is that both the zone and the thermal storage system receive hot water and the boiler may continue to burn with a demand equal to or greater than its output. The end result is that the heating load is always prioritized over the thermal storage system, but heat not used will be stored in the thermal storage system for later use.

3.4.11 Electrical Connections

Electrical connections to the boiler are all made to the large junction box that was mounted on the side of the boiler **(Fig.3.6)**. See the connection diagram in **section 6.4.1**. The boiler requires a dedicated 120V 15 amp circuit.

Fig. 3.6

3.4.12 Boiler Control Panel Connections

Insure that all of the sensor bulbs from the boiler's control panel that are pre-installed are pushed all the way to the bottom of their wells. **VERY IMPORTANT!** The thin stainless sensor for the Lo-Limit thermostat is preinstalled in the drywell over the flue collection box. Leave it in this location. The Lo-Limit is set to **90 ºC (194 ºF),** if the boiler is operated with a thermal storage tank. If the boiler will be operating without a thermal storage tank, the Lo-Limit needs to be set to **60 ºC (140 ºF)**. (refer to **Section 4.2.4)**.

3.5 Commissioning the Boiler

3.5.1 Safety Plumbing

The boiler pressure relief valve (provided, part # **1040705**), must be installed as shown in **Fig. 3.7**. This is to ensure that excessive pressure will not be developed in the boiler.

Fig. 3.7 Installed Relief Valve

NOTE
The Normal Operating pressure is between 12-15psi.

3.5.2 Thermostatic Mixing Valve

A thermostatic mixing valve (accessory, part # **K4440A3** or **4832S**), and boiler circulator (included with the 4823S) should be incorporated into the heating system piping as shown in **Fig. 3.8.** When the **K4440A3** is used a ball valve **(I)** (not provided) must be installed upstream of Port 1 of valve **TV-1**. The valve should be set at half open (and the handle removed), in order for the tempering loop to function correctly. If accessory **K4440A3** Termovar mixing valve is provided for use as **TV-1**, the unions supplied with the valve have internal valves which must be fully open.

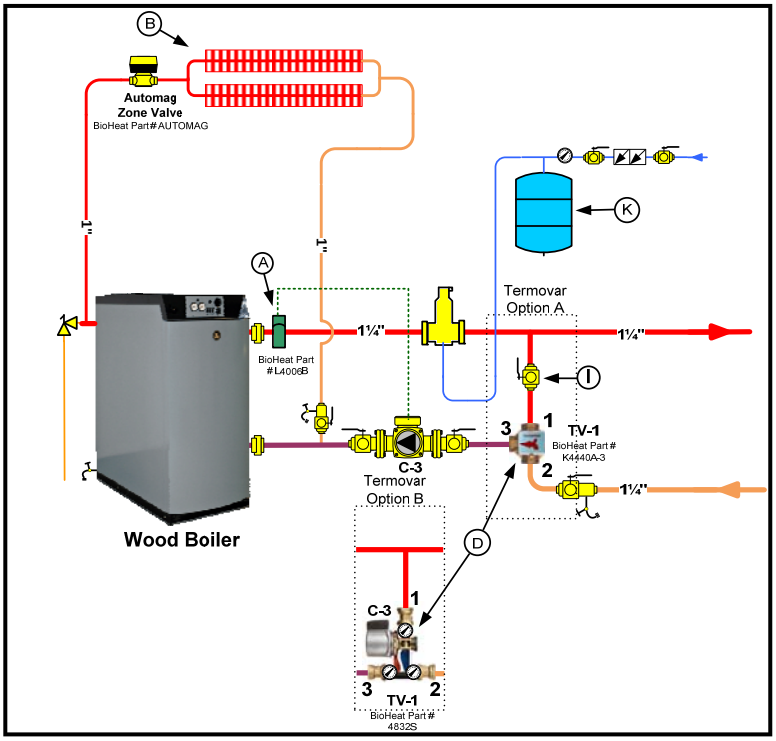


Fig. 3.8 **Typical Plumbing Schematic**

3.5.3 Filling and Venting

The best connection for filling the boiler with water is at the boiler drain. During filling the circulation pump is switched off. Filling takes place through a hose which is screwed onto the boiler drain and connected to a water supply faucet. Fill the hose prior to filling the boiler, otherwise air in the hose will be pushed into the boiler system. Remove the hose after filling up. High quality air elimination equipment is recommended in the heating system installation.

NOTE

The heating system main supply and return piping will need to be at least 1.25" (32 mm) for correct boiler heat output distribution. All field-run piping should be back-flushed to clean and remove debris. Adequate filling and venting ports should be added so that air can be removed from the system. The system should be pressure tested before being placed into service.

NOTE

If water quality is poor or PH unsatisfactory, the installer should consider water treatment additives during filling and water testing as part of annual maintenance.

3.5.4 Final Installation Checklist

This final installation checklist should be reviewed before starting up the boiler for the first time:

- **General Boiler Installation**
  - Boiler set and level.
  - Clearances to Combustibles maintained.
  - Combustion make-up air provided.

- **Chimney**
  - Appropriate chimney connector installed.
  - Chimney and termination meet requirements.
  - Proper chimney draft.

- **Plumbing**
  - Plumbing fittings tight.
  - Termovar mixing valve or loading unit installed and orientated correctly.
  - Pressure relief valve installed and tested.

- **Electrical**
  - Boiler connected to dedicated 120V, 60 hertz 15 amp power supply.
  - Functional testing performed satisfactory.
  - Dump zone connected.

4.0 Boiler Operation, Maintenance, and Service

Maintenance

It is also the responsibility of the user that the boiler be cleaned and maintained according to:

- Normal practice.
- The instructions of this manual.
- Instructions for the controls or equipment from other manufacturers.
- Other circumstances described in the written warranty.

4.1 Control Panel Orientation

Letters in brackets () in this section refer to the button with the corresponding letter on the control panel. All temperature values are in degrees Centigrade.

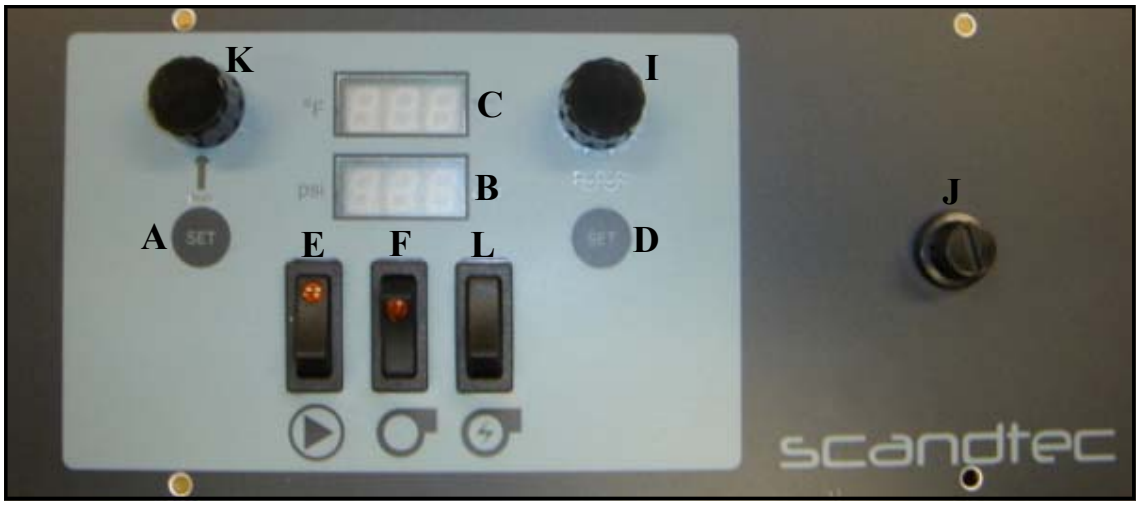


Fig 4.1

(A) Set Button

Set Button-Used to set the low temperature shut-off based on lo-limit aquastat sensor.

(B) Flue Gas Temperature Display

The Flue Gas Temperature Display shows the boiler's flue gas temperature.

(C) Boiler Temperature Display

The Boiler Temperature Display shows the boiler's temperature.

(D) Set Button

Set Button-Used to set the boiler's operating set-point (water temperature).

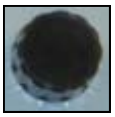
(E) Switch for Circulator Pump

ON/OFF switch for extra pump output. This switch is not used in the North American Market.

(F) Fan Switch

ON/OFF switch for the fan. When the fan switch is turned off when the boiler's flue temperature is below the lo-limit temperature, the fan and the circulator pump will need to be reactivated by pressing the reset switch **(L)**.

(I) Adjustment Knob

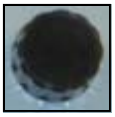


Adjustment knob used to adjust the boiler's operating temperature (adjustable between 140-194 ºF).

(J) Overheat Thermostat

The overheat thermostat switches off the fan when the boiler temperature is approximately 100 °C (212 ºF). wait until the boiler temperature has fallen to 75 °C (165 ºF). To switch on again, unscrew the protective cap and push in the ejected pin.

(K) Adjustment Knob



Adjustment knob used to adjust the boiler's flue gas temperature (adjustable between 140-248 ºF).

(L) Reset Switch

The fan switches off automatically if the boiler has burned out and the boiler/flue gas temperature falls.
In units with a thermal storage tank, the fan switches off when the temperature at the sensor in the flue gas has reached 90 °C (194 ºF).
If the temperature at the sensor falls below 90 °C (194 ºF) the reset switch **(L)** must be pressed to restart combustion in the boiler. If the fan switch **(F)** is turned off before the boiler reaches the Lo-Limit temperature; the reset switch **(L)** must be pressed.

4.2 Control Panel Set-up

4.2.1 DIP Switch Programming.

Position	Switch 1	Switch 2	Switch 3	Switch 4
OFF	European Units	-	Storage Tank System	Back-up boiler start on low boiler temperature
ON	US Units	Pressure sensor zero set*	Direct System	Back-up boiler start on low flue temperature

*When a new pressure sensor is installed and wired, set the switch to ON. After the sensor is calibrated 0.0 appears in the lower display; set the switch back to the OFF after calibration (see Section 4.2.5).

Standard Setup to the US

	Switch 1	Switch 2	Switch 3	Switch 4
US Setup	ON	OFF	ON	OFF

Switch 1: Verify that the switch is set to "ON", US Units.

Switch 2: The default position is "ON". Please refer to section 4.2.5 for pressure sensor resetting.

Switch 3: Set to OFF if there is a Storage Tank System installed. After the combustion cycle is completed in this setting the function of the circulator pump (pump 2) is to take away the remaining heat of the boiler water until the boiler temperature set point **(T_{boiler} set)** is reached.

Switch 3: Set to ON-After the combustion cycle is complete in this mode the function of the circulator pump (pump 2) is to cool down the boiler until the minimum boiler temperature **(T_{boiler} min)** is reached.

Switch 4: If the boiler is used as a stand alone boiler (no thermal storage) this switch can be set to the "OFF" position Back-up boiler will start on low boiler temperature **(T_{boiler} min)** (Please see Section 4.2.2)

4.2.2 External (back-up) Boiler Set-up (T_{boiler} min)

Contacts are used to start the back-up boiler when the wood boiler is cold. The use of these contacts are recommended when the wood boiler is large enough to handle the building's heat load.

Minimum boiler temperature method-(T_{boiler} min)
This method is **recommended** for connection to a system without thermal storage. DIP switch 4 is in the OFF position (**see section 4.2.1**).

To view the minimum boiler temperature set-point:

1. Press and hold both buttons **(A)** and **(D)**- A continuous light will show behind the wave symbol **(H)** and the temperature will show in the temperature display **(C).**
2. Release both buttons **(A)** and **(D)** to return the temperature display back to normal.

To adjust the minimum boiler temperature set point -(T_{boiler} min) (adjustable between 104 ºF and the boiler's set-point*):

1. Press and hold both buttons **(A)** and **(D)** - A continuous light will show behind the wave symbol **(H)**.
2. Turn the knob **(I)** until wanted value is indicated in the display **(C)**. A recommended setting to start with is 20 degrees below the boiler's set-point.
3. Release both buttons **(A)** and **(D)** to return the temperature display back to normal.

*The minimum boiler temperature set point can never be adjusted higher than the actual boiler set-point. If the boiler temperature set-point is adjusted downwards and below actual set-point of the minimum boiler temperature, the set-point of the minimum boiler temperature will automatically achieve the same value as the boiler temperature set-point.

4.2.3 Setting the Boiler's Set-Point (T_{boiler} set)

To show the boiler's set-point:

1. Press and hold button **(D)** - the boiler's set-point is shown in temperature display **(C)** and the wave symbol **(H)** is lit.
2. Release button **(D)** to return the temperature display **(C)** back to normal.

To adjust the boiler's set-point (T_{boiler} set) (adjustable between 140 –194 ºF):

1. Press and hold button **(D)** -the wave symbol **(H)** is lit.
2. Turn knob **(I)** until wanted value is shown in temperature display **(C)**. The recommended temperature setting is **180-185 ºF**.
3. Release button **(D)** to return the temperature display **(C)** back to normal.

4.2.4 Setting the Boiler's Lo-Limit Thermostat (T_{flue} min)

The Lo-Limit Thermostat switches off the fan and the pump when the wood has burned out. It is set to 140 ºF if there is **no** thermal storage tank and 194 ºF if there **is** a thermal storage tank.

To show the flue gas minimum temperature set-point:

1. Press and hold button **(A)** the set-point of the flue gas minimum temperature is shown in temperature display **(C)** and the chimney symbol **(G)** is lit.
2. Release button **(A)** to return the temperature display **(C)** back to normal.

To adjust the flue gas minimum temperature set-point (T_{flue} min) (adjustable between 140 - 248 ºF):

1. Press and hold button **(A)** - the chimney symbol **(G)** is lit.
2. Turn knob **(K)** until wanted value is shown in temperature display **(C)**. The recommended temperature setting is **140 ºF** for systems **without** thermal storage tanks and **194 ºF** for systems **with** thermal storage tanks.
3. Release button **(A)** to return the temperature display **(C)** back to normal.

4.3 Control Panel Function

4.3.1 Starting a Combustion Cycle (complete starting sequence in section 4.5)

1. Switch on the fan **(F)**.
2. Press the Reset Switch **(L)**. The light on the fan switch will light.
3. The fan and the boiler's circulator **(C-3)** have now started.

If the fan switch **(F)** is switched off before the flue gas minimum temperature is reached **(T_{flue} min)**, the reset switch **(L)** must be pressed to restart the combustion cycle.

If the fan switch **(F)** is switched off beyond the flue gas minimum temperature **(T_{flue} min)**, only the fan turns off and can be restarted by turning the fan switch **(F)** back on. The reset switch **(L)** does not have to be reset unless during this process the flue gas temperature falls below the **(T_{flue} min)**.

4.3.2 Normal Operation with a Thermal Storage Tank System

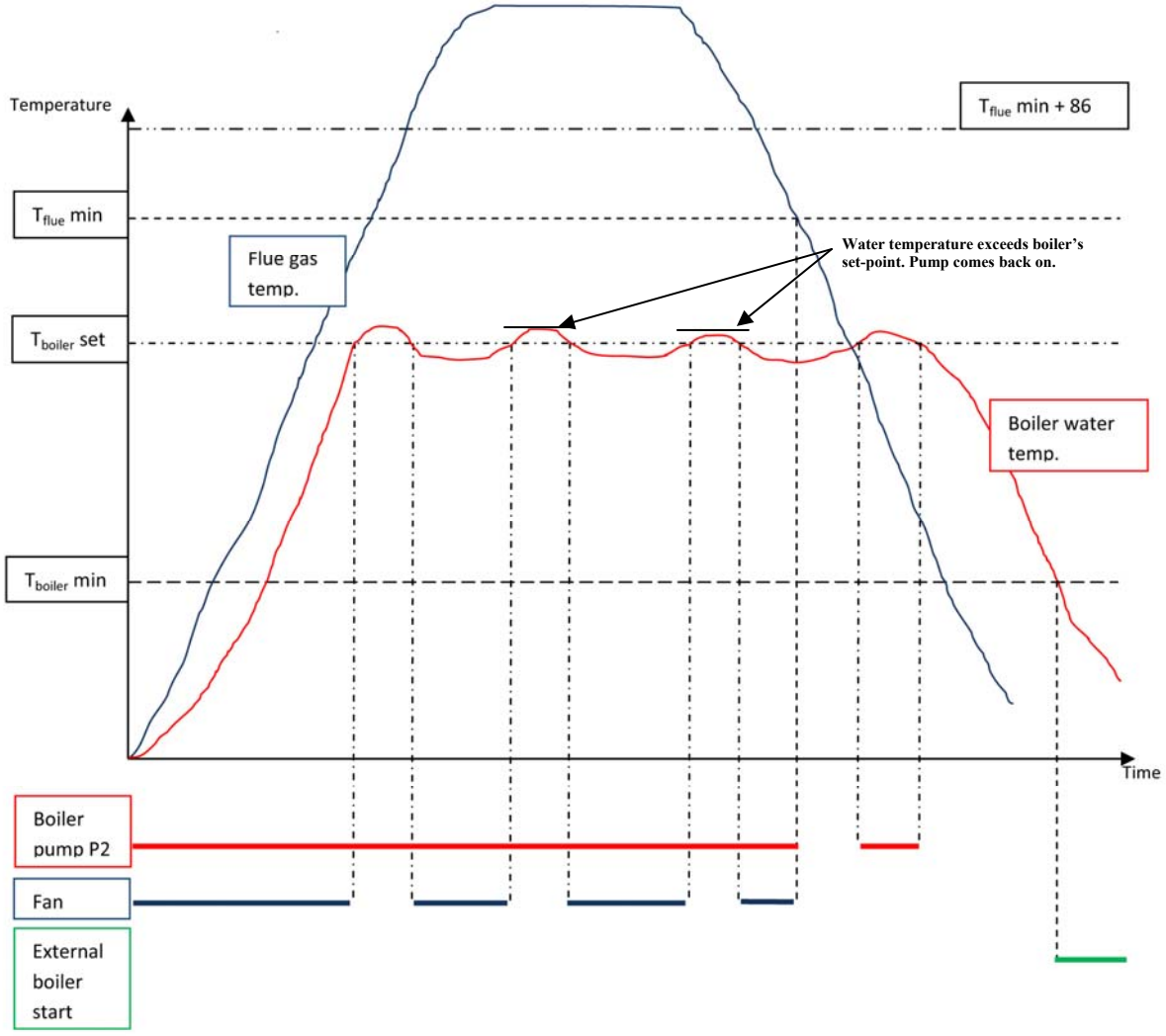


Fig 4.2

The operation cycle begins with the start of the fan and circulator. When the boiler reaches a flue gas temperature of **(T_{flue} min + 54° F)** the control will shift into **normal operation mode**.

In this mode the fan keeps running as long as the boiler temperature is below **(T_{boiler} set + 2° F)**. As the temperature falls below **(T_{boiler} set - 5)** the fan will start-up again.

As the combustion reaches its final stages, the flue gas temperature drops. As it drops below **(T_{flue} min)** the fan stops and will only start again when the reset switch **(L)** is pressed. The boiler's circulator will stop when the boiler drops below **(T_{boiler} set)**. If, after the flue gas temperature has gone below **(T_{flue} min)**, and the boiler temperature rises above **(T_{boiler} set + 5)**, the circulator will start again and will only stop when the boiler temperature drops below **(T_{boiler} set)**.

When the boiler temperature reaches **(T_{boiler} min)** the back-up boiler output dry contacts are energized.

4.3.3 Normal Operation <u>without</u> a Thermal Storage Tank System

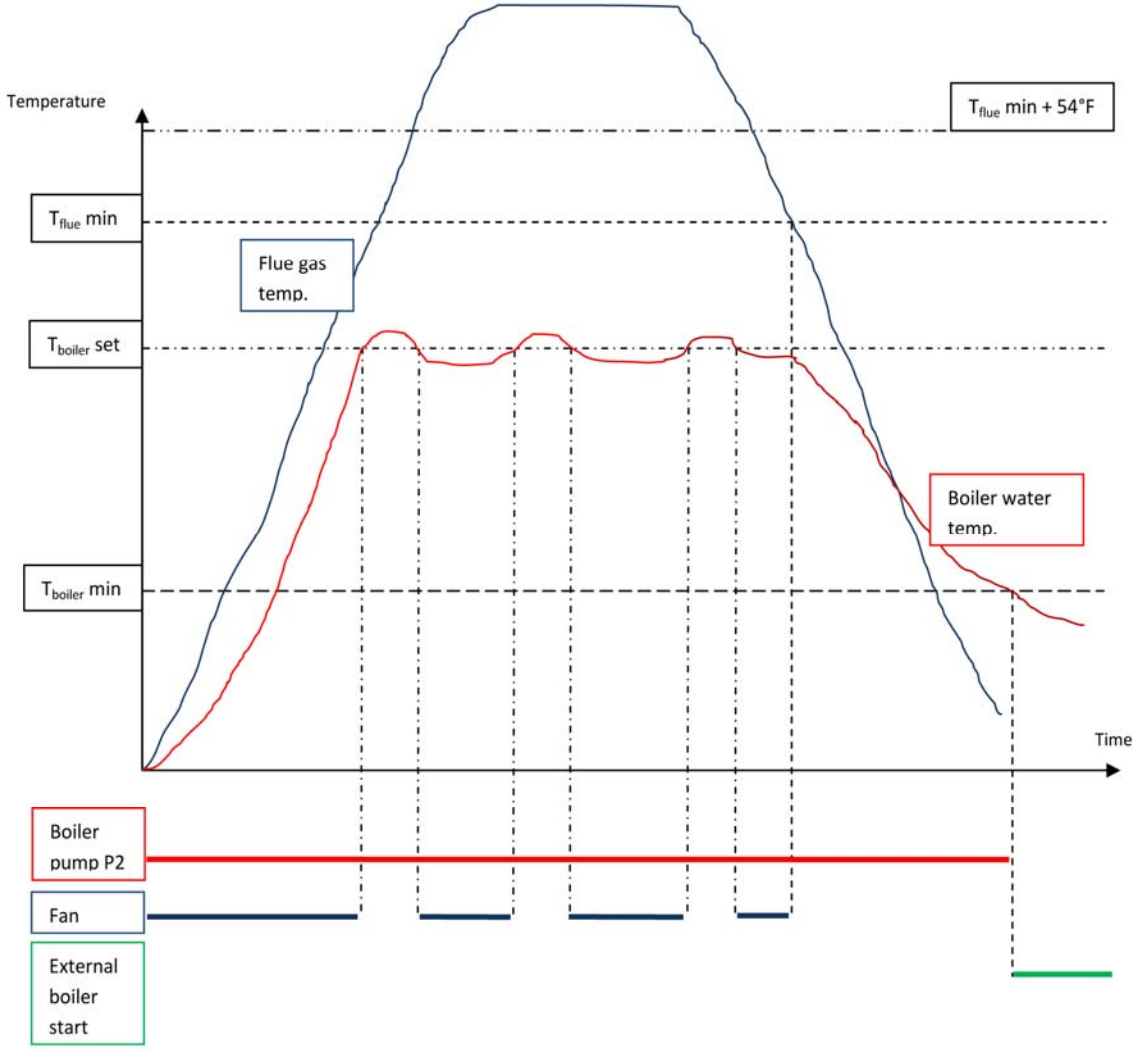


Fig 4.3

As the combustion reaches its final stages the flue gas temperature drops. As it drops below **(T_{flue} min)** the fan will stop and will only start again by pressing the reset switch **(L)**. The circulator **(C3)** will continue to operate.

When the boiler temperature reaches **(T_{boiler} min)** the back-up boiler dry contacts are energized and the circulator pump **(C3)** will cycle off.

4.3.4 Abnormal Operation-Dump Zone Activation

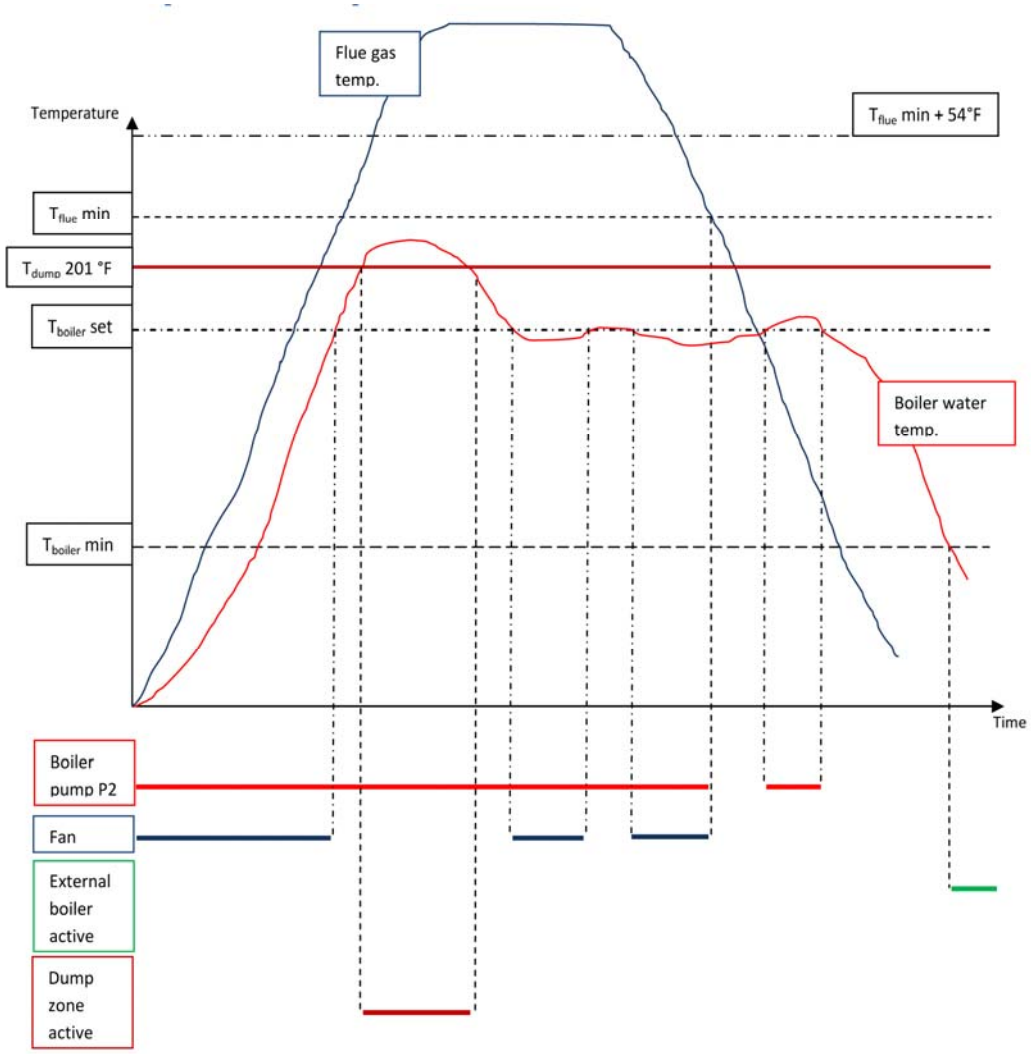


Fig 4.4

If, after a normal start-up of a combustion cycle, the boiler temperature rises above 201 ºF, the dump zone contacts are activated.

As the boiler temperature falls below 192 ºF, the dump zone contacts are deactivated.

4.3.5 Forced Boiler Start

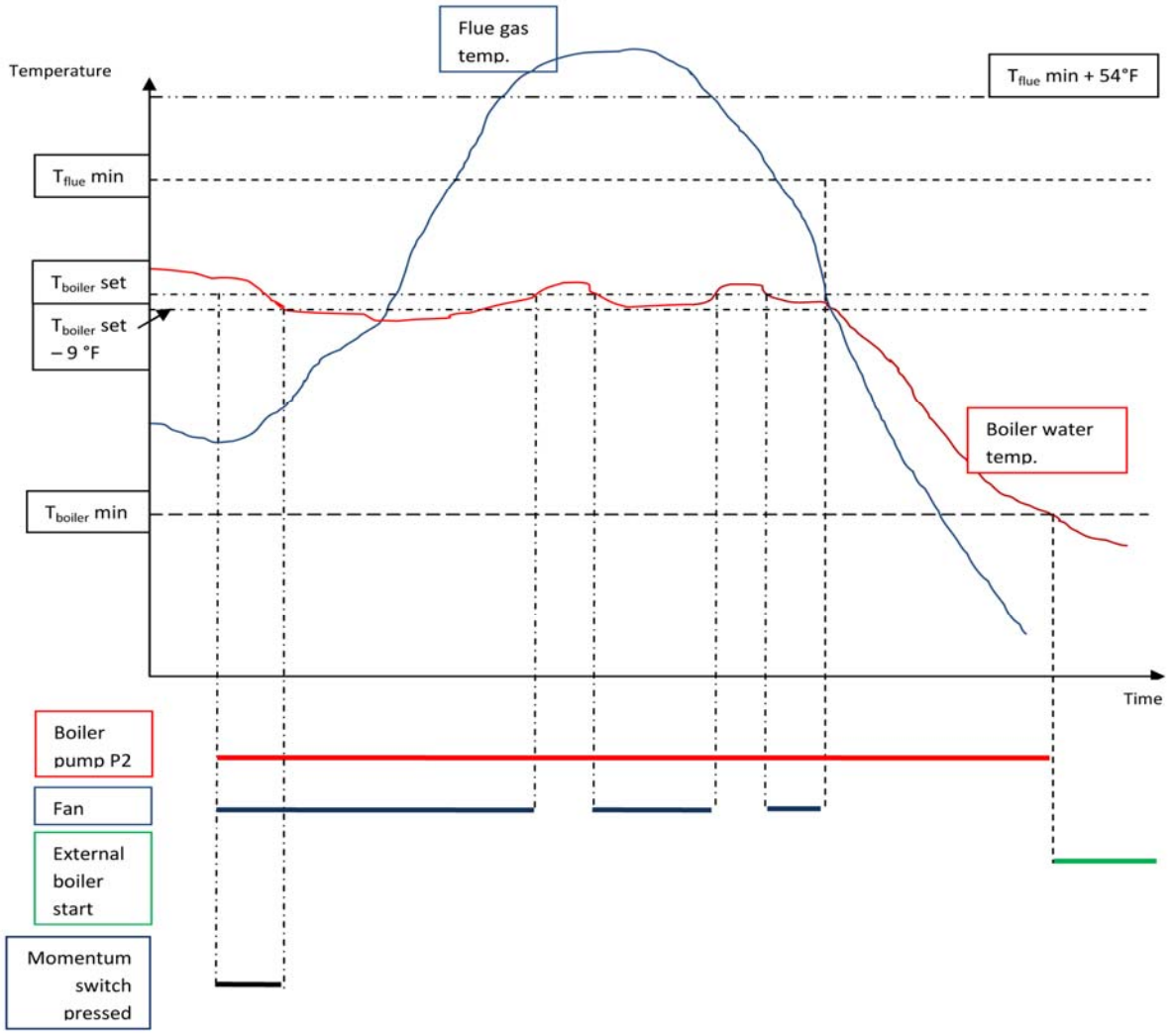


Fig 4.5

The figure shows a forced start of the boiler with the flue gas temperature below minimum value, and the boiler temperature above the set point.

As the reset switch **(L)** is pressed both the fan and the pump are running. Keeping the switch pressed; both the fan and the pump will continue to run.

If the reset switch **(L)** is pressed and the boiler temperature is above the **(T_{boiler} set)**, only the pump will continue running, If the operation of the pump can lower the boiler temperature, the fan starts as the temperature drops 9 ºF below **(T_{boiler} set)**.

4.3.6 Alarm Codes

To avoid critical situations when there is a problem with the temperature sensors because of sensor breakage or shortage; the following modes are activated.

Category	Sensor	Breakage	Shortage	Display	Function	Remarks
1	T flue	X		743	Possible	Measurement value>>normal range; fan will only stop if T boiler > T boiler SET + 2 °F
1	T flue		X	Black Display	Possible	Measurement value = 0; boiler will never enter normal operation mode
2	T boiler	X		743	Normal, but operation can-not be started	Measurement value >> normal range; fan will not start, dump zone pump is activated
2	T boiler		X	Black Display	No Function possible; start and running is blocked	Measurement value = 0 => leads to critical boiler temperature if function was allowed
3	T flue and T boiler	X		743/743	Normal, but operation can-not be started	Measurement value >> normal range; fan will not start, dump zone pump is activated
3	T flue		X	Black Display /743	Normal, but operation can-not be started	Measurement value >> normal range; fan will not start, dump zone pump is activated
	T boiler	X				
4	T flue and T boiler		X	Black Display	No Function possible; start and running is blocked	Measurement value = 0 => leads to critical boiler temperature if function was allowed
4	T flue	X		743/Black Display	Normal, but operation can-not be started	Measurement value >> normal range; fan will not start, dump zone pump is activated
	T boiler		X			

Fig 4.6

In situations having a failure falling under category 3 or 4, only repairing/replacing of the sensors can bring the boiler into operation again.

In situations having a failure falling under category 2, an emergency combustion can be made by swapping the flue gas sensor with boiler temperature sensor; in this way a breakage or a shortage in the flue gas sensor instead of the boiler sensor will make operation of the boiler possible.

In situations having a failure falling under category 1, function of the boiler will continue but unintended continuous running of the fan will be present.

4.4 Items to Check Before Using

1. Check the heating system water pressure before using the system. Note: Water may not be added to the boiler while it is running.
2. Ensure that the chimney connector pipe is connected to the chimney and that the chimney is free of obstructions.
3. Ensure that the circulators are connected and operational.
4. Turn on the main electrical service switch.
5. Open any valves that may have closed temporarily during set-up.
6. The transport protectors for the ceramic bricks are made of wood and will quickly burn. Do not try to remove them.
7. Check that the boiler's set-point and flue gas temperature are set properly.
8. **Confirm correct operation of bypass damper (Removal of top cover and cleanout cover is necessary).**

NOTE
Please be advised that simply lifting the bypass rod and pushing it inward will not completely close and lock the bypass damper. You may hear the clang sound of the bypass damper hitting the bypass door opening, but that does not guarantee the bypass door is closed fully and locked. You must, after lifting and pushing forward on the bypass rod, lift the rod again and push inward against the tension of the spring and downward on the rod, locking the bypass mechanism. Hard inward pressure against the spring tension may be required. If you do not feel as though you are compressing a spring, you have not lifted the bypass rod before pressing inward a second time. The bypass damper must be fully locked closed during normal operation.

4.5 Starting the Boiler

NOTE
The wooden shipping shims holding the refractory in place will burn up. Do not try to remove them!

1. Set the by-pass damper lever in the open position by lifting up and pulling the lever fully forward.
2. Turn "ON" the electrical power service switch mounted on the boiler (if installed).
3. Switch "ON" the draft fan with switch **(F)** on the control panel (The fan will not start at this time).
4. Open the loading door and line the bottom of the firebox with several pieces of crumpled newspaper. Place several pieces of kindling and small pieces of dry wood on top of paper.
5. Place 6 or 8 more crumpled sheets of paper on top of kindling. Light the paper and close the load door.
6. Immediately, push the reset switch **(L)** on the control panel. The draft fan will then start.
7. Partially close the by-pass damper leaving it slightly open and unlatched.
8. After about 5 to 6 minutes, open the by-pass fully and turn "OFF" the draft fan switch **(F)**. Immediately open the upper door slowly and carefully to see that the fire is established. If it is, add several more small pieces of dry firewood. Close the upper door.
9. Immediately turn "ON" the switch **(F)** to start the draft fan. Close and lock the by-pass damper by pushing in and down firmly so that the spring will keep it closed.

10. Wait approximately 5 more minutes, and then look through the sight glass in the ash door. A full active flame should be seen filling the combustion tunnel. If not, give the fire a few more minutes before loading with larger fuel. When loading wood, place it close together and uniformly front to back and not crosswise.
11. First fire should be low and slow.

With experience, users may well develop their own techniques for lighting and loading the boiler that may be quicker and easier than described above.

NOTE

It can take up to ten complete burn-cycles for the combustion stones to "break-in". Do not expect a perfect fire the first time.

WARNING

If there is a fire in the firebox, do not leave the boiler with the main power switch "OFF" This must be left "ON" so the overheat circuit can function, if necessary.

CAUTION

☼ **The Load and Ash doors must remain closed except when loading fuel or removing ash. Door gasket seals are very important to the operation of your boiler. They must be maintained in good condition and replaced if necessary in order to maintain an air tight seal.**

NOTE

If wood is stored in the boiler room, ensure that it is not stored within the clearances to combustibles or in a way that will impede daily firing or maintenance.

4.6 Adding Wood

4.6.1 Adding Wood When the Draft Fan is OFF (Boiler at Operating Temperature)

1. **OPEN THE BY-PASS DAMPER.**
2. **TURN UP THE BOILER'S SET-POINT TEMPERATURE** by holding down the set button **(D)** and turning up the adjustment knob **(I)** to 194 ºF. This should activate the draft fan, to help prevent the risk of a gas explosion when the door is opened. Let the fan run for 2-3 minutes to vent the hot gasses before the door is opened. If the fan does not start a heat load must be placed on the boiler to lower the temperature of the boiler.
3. Turn the draft fan off by switching the fan switch **(F)** to "OFF" on the control panel.
4. Without delay, open the load door ¾" with your **left** hand.
5. Wait approximately 20 seconds.
6. Open the load door slowly, fully, and **cautiously!**
7. Load the firebox if the previous load of wood has burned down to coals, placing the wood uniformly front to back and tight together, not crosswise. If the wood has not burned to low coals, do not load more wood.
8. Close the loading door.

9. Turn the draft fan back on by switching the fan switch **(F)** to "ON" on the control panel.
10. Close and lock the by-pass damper by pushing in and down firmly so that the spring will keep it closed.
11. VERY IMPORTANT! The boiler's set-point must be turned back to the original setting of 180-185 ºF. Hold down the set button **(D)** and turn the adjustment knob **(I)** to **180-185 ºF.**

4.6.2 Adding Wood When the Draft Fan is OFF (Boiler Temperature **below** 140ºF (60ºC))

1. **OPEN THE BY-PASS DAMPER.**
2. Push the reset switch **(L)** on the control panel to activate the fan. Let the fan run for 2-3 minutes to vent any hot gases.
3. Turn the draft fan off by switching the fan switch **(F)** to "OFF" on the control panel.
4. Without delay, slowly and cautiously open the loading door ¾" with your **left** hand and wait approximately 20 seconds.
5. If there is sufficient live coals left in the firebox to re-ignite the next load of wood, there will not be the need to use paper to restart the fire. Place several pieces of dry kindling in the center of the firebox over the slot in the refractory and rake the live coals from the sides of the firebox to the center on top of the kindling.
6. Add enough firewood to carry the estimated heat load for the next 8 hours, as per the "Daily Firing" on **page 43**, which are very important.
9. Close the load door and immediately turn "ON" the fan switch **(F).** Close and lock the by-pass damper by pushing in and down firmly so that the spring will keep it closed.
10. HOWEVER, if you find very few live coals left in firebox after opening the load door in step #3 above, follow steps 3-#10 in **Section 4.5** to restart the fire.

4.6.3 Adding Wood When the Draft Fan is ON

1. **OPEN THE BY-PASS DAMPER.**
2. **WAIT,** 2-3 minutes with the draft fan running.
3. Turn off the draft fan by using the fan switch **(F)** on the control panel.
4. Without delay, open the loading door ¾" with your **left** hand.
5. Wait approximately 20 seconds.
6. Open the load door slowly, fully, and **cautiously!**
7. Load the firebox with wood, placing the wood uniformly front to back and tight together.
8. Close the load door.
9. Immediately turn the draft fan back "ON" by fan switch **(F)** on the control panel.
10. Close and lock the by-pass damper by pushing in and down firmly so that the spring will keep it closed.

CAUTION

☼ **RISK OF WOOD GAS EXPLOSION as explosive gases may be present. When burning a Solo Plus boiler, the operating thermostat turns off the draft fan when the boiler gets up to temperature. This cuts the supply of oxygen to the fire and the flame goes out. This remains, however lots of hot coals and a red hot refractory which will continue to bake the wood creating a build up of hot gas in the firebox. Any person dealing with a Solo Plus boiler needs to keep in mind that hot explosive gases may be present. These gasses are hot enough to burn, but without a source of oxygen they can't burn. After the draft fan has been off for 15-20 minutes when the gases are hot and explosive, opening the door may provide enough oxygen for a sudden back flash or puff (wood gas explosion) to occur. This is the reason behind the safety precaution of NEVER OPENING THE LOAD DOOR UNLESS THE FAN HAS BEEN RUNNING IN THE LAST FEW MINUTES to vent hot explosive gasses from the firebox first.**

4.7 Daily Firing

The following firing procedures should be followed, especially when the boiler has excess capacity (as it will have during milder weather).

1. **Load the boiler with wood at least 3 times a day.**
2. **Only load the boiler with the amount of wood needed for approximately 8 hours of burning to cover the heating load caused by the weather and the heat loss of the house.** The wood should be totally burned and reduced to low coals so that the slot in the refractory is exposed before reloading the firebox with wood. The ability to judge the correct amount of wood for each installation is somewhat unique. Your goal should be to keep the firebox as dry as possible by not overloading the boiler with wood in periods of lower heat demand.
3. If steps 1 & 2 above are followed, the heating surfaces of the wood firebox will have a chance to dry out as it will burn down to charcoal at the end of each load of wood.
4. If steps 1 & 2 above are followed there will be no problems with smoke spilling out of the load door because only coals will be present when reloading. The next batch of wood will ignite easily and quickly because of the presence of the coals remaining from the previous load.
5. If steps 1 & 2 above are followed, the by-pass damper will open easily and won't be stuck shut with creosote.
6. Maintain a high boiler temperature of at least 180-190 ºF (82-88 ºC).
7. Clean the boiler frequently as per the instructions elsewhere in this manual **(see section 5)**. Routine cleaning will help maintain boiler efficiency. Accumulated ash and soot act as an insulator and reduce boiler combustion and heat exchange efficiency.
8. Due to greatly reduced heat demand, it is not wise to fire the wood in the summer. Smoke and odors are more noticeable during the warmer months. Therefore, we do not recommend burning wood in the summertime. Save your wood fuel for colder weather, or equip your boiler with a thermal storage tank system. Contact Tarm Biomass or your local dealer for more information.

The refractory tunnel must be kept free of ashes and charcoal so that there enough room for the gasification flame. Use the ash rake to pull the ashes and coals out of the tunnel. Leave the coals on the boiler floor and they will burn up with the next fire.

Keep in mind that the refractory bricks are hardest when they are new. The refractory bricks will soften with age. When loading wood into the boiler and using tools around the refractory areas keep this in mind.
Do not break the refractory by:

1. Throwing wood directly onto the refractory (place the first few pieces into the boiler gently).
2. Digging or prying at the refractory in the areas of the slot or the tunnel.

WARNING

It is important to keep the load and ash doors closed during operation and to maintain the door seals in good condition.

4.8 Shutting Down the Boiler

Switch off the boiler by turning off the fan switch on the control panel. The circulating pump will shut off when the boiler is cool. Take care not to shut off power to the boiler circulator if there is any chance that the boiler may heat up again.

4.9 Operation with Thermal Storage System

Tarm Biomass recommends the use of a Thermal Storage Tank System with the Solo Plus boiler. The boiler will always be able to discharge its heat resulting in better combustion, less depositing of soot and tar, and longer boiler life. Operation is simplified as the filling chamber can be completely filled. The boiler can be fired when you have time and the house can be supplied with heat as required from the thermal storage system. An added benefit is that domestic hot water can also be created in the reservoir. Keep in mind that the amount of wood placed in the boiler's filling chamber depends on the size and the temperature of the thermal storage reservoir. The boiler should not be fired beyond the reservoir's heat storage capacity. Do not add wood until the temperature in the thermal storage system has fallen to 140-160 °F (60-72 ºC), so that the reservoir will again be able to absorb heat. Set the boiler temperature to a maximum temperature of 180 °F (82 ºC).

4.10 Creosote

Tar deposits are not normally a problem in a Solo Plus boiler when it is fired as directed. Your firebox will form creosote on the walls. During combustion, when the draft fan is running, gasses and smoke are created which make up the main part of the wood's heat value. Formic and acetic acids and other gasses are mixed with the right quantity of combustion air at very high temperatures producing boiler efficiency of around 80%. This highly efficient combustion process produces virtually no smoke or creosote.

If soft or tar like creosote is found in the firebox it can be a symptom that the boiler is being filled with more wood than is necessary. Glazed, crunchy and scaly creosote in the main firebox is common and expected. Glazed, crunchy, or scaly creosote should never be found in the lower combustion chamber, heat exchange tubes, or in the chimney. When wood is burned slowly, it produces tar and organic vapors, which combine with expelled moisture to form creosote. The creosote vapors condense in the relatively cool chimney flue of a slow-burning fire. As a result, creosote residue accumulates on the flue lining. When ignited this creosote makes an extremely hot fire. The chimney and chimney connector should be inspected daily for creosote buildup until experience shows how often cleaning is necessary. If creosote has accumulated it should be removed to reduce the risk of a chimney fire.

4.11 Combustion Process

Solo Plus boilers have excellent combustion efficiency.

When the boiler gets up to temperature, the draft fan shuts down and stops the supply of combustion air to the firebox. The fire shuts down due to the lack of oxygen and does not continue smoldering to cause smoke, creosote or overheating. When the boiler temperature drops, the fan will turn on re-igniting the coals which have been resting on the refractory. During the off cycle, the coals stay hot enough to burn but they will be dormant because of the lack of oxygen. The combustion process of the Solo Plus allows to burn wood as efficiently, as clean and as controlled as many fossil fuel heating systems.

4.12 Heat Output

The Solo Plus boiler is designed to operate in an output range from as low as 17,000 BTU's (5 kW's) per hour. At maximum output, the fan will operate continuously. At lower outputs, the fan and the fire will cycle on and off just as an oil or gas burner does to meet the heating demand. However, trying to operate the Solo Plus boilers during periods of lower heat demand can be problematic due to lower chimney draft.

4.13 Burn Time

Burn time is dependent of the type of fuel, the heat load on the boiler as well as how full the firebox is loaded. However, the recommended maximum burn time is approximately **8 hours**. Remember to only load the boiler with the amount of fuel that will be fully consumed in approximately **8 hours**.

NOTE
The chimney draft must always be strong enough to prevent reversed flow in the boiler's primary and secondary air supply ducts. Otherwise, smoke may be forced backwards through the boiler and emitted out of the fan when it is off. This reversed flow will maintain a smoldering fire in the boiler and can lead to partial or complete blockage of the air supply ducts, causing inefficient and problematic operation. It may also result on an objectionable smell of creosote or smoke in your home. These problems are eliminated entirely when operating the boiler with higher demand on it, such as a thermal storage tank system, and have a chimney which maintains proper draft.

4.14 Primary Air Adjustment

The primary air should be set to open fully when the draft fan is running. The stop **(B)** should not touch the adjustment bolt **(A)** when the damper is the open position. However, if are regularly seeing temperatures at the flue collar of the boiler of over 600 °F (315 °C) when the boiler is clean, we suggest decreasing the primary air to lower the flue temperature. Adjust the stop in front of the draft fan under the top front jacket panel. Loosen the locking nut and turn the bolt **(A)** in for less primary air lowering the flue temperature to approximately 600 °F (315 °C). Tighten the locking nut when adjusted properly.

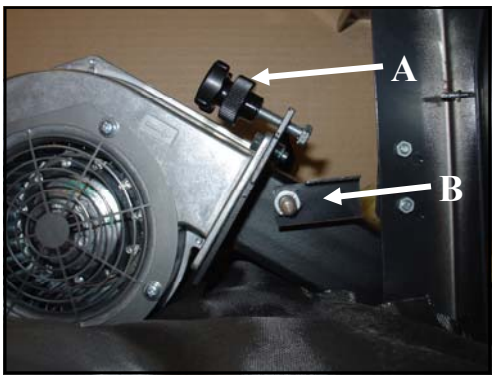


Fig 4.4 Primary Air Adjustment

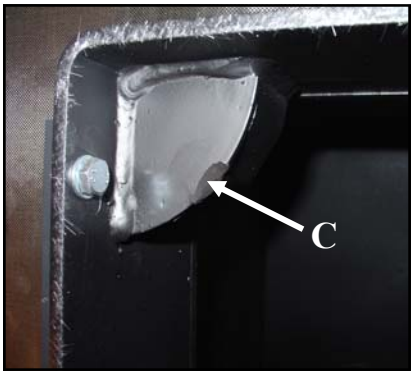


Fig 4.5 Primary Air Ducts (Holes)

4.15 Secondary Air Adjustment

The primary air coming through the holes behind the loading door **(C)** and the total quantity of air normally should not have to be changed if the boiler is kept clean.

Correct secondary air adjustment is essential for optimum combustion and efficiency. Adjustment is by means of the bakelite knob on the front of the boiler next to the top left corner of the ash door (see diagram at top of page 40). To adjust, pull the knob down and slide left (more air) or right (less air). The drier the wood is, the more secondary air required.

After approximately 45 minutes of operation with a load of wood, the boiler and refractory should be heated. Observe the flame through the observation port or open the lower door carefully **while the fan is still running**. Adjust the secondary air as needed. Once the proper adjustment has been set, it should only be necessary to re-adjust when changing the type or quality of fuel. Use diagrams in **Fig. 4.7** as a guide to help in setting the secondary air.

The basic rules for setting the secondary air are as follows: If the wood is dry, add more secondary air. If the wood is greener, use less secondary air. To have the knob in the center, usually covers most situations.

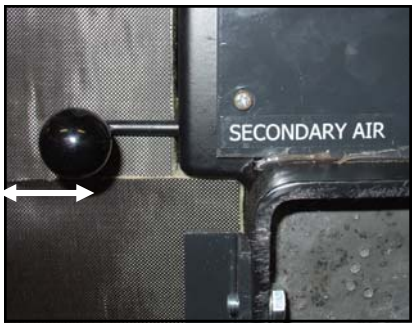
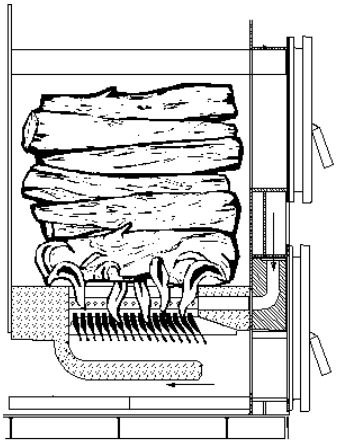
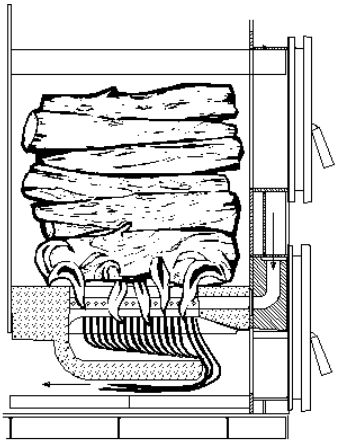


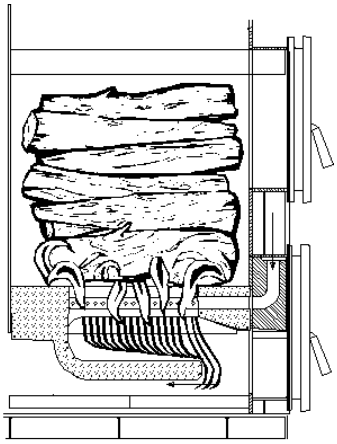
Fig 4.6 Secondary Air Adjustment



Too Much Air
The flame is blue and too short. Adjust knob to the right



Too little Air
Flame too long and reddish yellow Adjust knob to the left.



Correct setting
The flame is yellow and pale bluish.

Fig. 4.7

4.16 Firing Tips

It is important to use wood of an appropriate size (length and diameter) and to stack it properly so that there are no “holes” and “hanging pieces” in the wood stack, which must then be regularly stirred with the poker to form it into a compact mass. The diameter of the wood ideally should not exceed 4-6 inches (100-120 mm) as “holes” would then form more easily in the wood layer, creating a risk of reduced heating output. Thick pieces of wood ideally should be split to a diameter of 4-6 inches (100-120 mm).

See **Figure 4.7** for correct flame length.

4.17 Operation During Summer

WARNING

We recommend not firing the Solo Plus boiler in the summer or other times of low heat demand unless used with a Thermal Storage System.

Operation at lower output will cause greater creosote formation in the firebox. This creosote, if excessive, can lead to shortened boiler life.

Solo Plus boilers will operate at highest efficiency burning wood during the cooler months, but, because of the characteristics of the gasification combustion system, it is possible to operate the boiler through the fall and spring whenever the outside night temperatures require central heating. Proper chimney draft and gasket seals are more critical to operation during the times of low heat demand. If the chimney draft is too high or air leaks around the fan or doors, the boiler may tend to overheat. If the chimney draft is too low, the fire will tend to either go out or smoke back-up through the fan and into the building. The key to operating the boiler in the warmer months and even in the summer is to install a Thermal Storage Tank System. Contact Tarm Biomass or your local dealer for more information on Thermal Storage Tank Systems.

4.18 Cleaning and Maintenance

4.18.1 Ash Removal

The boiler must be cleaned regularly. Lack of cleaning can result in loss of boiler efficiency, malfunctioning and reduced boiler life.

Most ash produced during boiler operation will be drawn down into the gasification chamber where it can be removed. Ash should be cleaned out of the gasification chamber, from both the combustion tunnel and the refractory floor, through the ash door as needed, typically every 3-5 days.

Clean the firebox once or twice a month. Ash remaining in the firebox can be worked from the sides of the firebox to the slot at the center of the refractory where it can fall down to the lower gasification chamber with the tool provided - use care not to damage the refractory slot. Do not allow a deep build up (more than 2" (50 mm)) of ash on the surface of the refractory.

WARNING

Before performing any cleaning or maintenance on the boiler, allow boiler to completely burn through all fuel and to normally cool down and shut off.

NOTE

Turn off power to the boiler before performing any cleaning or maintenance.

For ash removal, open the insulating door and the ash door, place your ash pan on the floor in front of the ash door and pull the ash in this area into the pan using the ash removal tool. Be sure to remove ash buildup under the heat exchange tubes behind the combustion tunnel. The amount of ash produced by the boiler will depend on the type of fuel used.

WARNING

Ashes removed from the boiler should be placed in a metal container with a tightly fitting lid The closed container of ashes should be placed on a non-combustible floor or on the ground, well away from all combustible materials, pending final disposal. If the ashes are disposed of by burial in soil or otherwise locally dispersed, they should be retained in the closed container until all cinders have thoroughly cooled. Other waste should not be placed in this container.

4.18.2 Smoke Box and Heat Exchange Tube Cleaning

The smoke box, the flue outlet and the heat exchange tube areas should be cleaned twice a month with the boiler brush. Let the boiler cool and shut off the power to the boiler. First, remove the top cover. Next, remove the four wing nuts to the clean-out cover and remove. If you have turbulators, remove from the heat exchange tubes. Insert the brush into each heat exchanger pipe and work back and forth thoroughly. Push the brush all the way through, but be careful not to damage the bottom plate underneath. Remove fly-ash from the smoke box area above the heat exchange tubes. Ash that falls down to the bottom of the heat exchanger tubes during cleaning can be removed though the ash door as described above. When finished, replace the clean-out cover and the top cover.

Fig. 4.8 Smoke Box and Heat Exchangers

NOTE
Clean heat exchanger tubes and smoke box mean better heat transfer from the flue gas to the water and thus better operating economy.

NOTE
Elevated flue gas temperatures above 600 ºF (315 ºC) may indicate the need to brush the heat exchange tubes.

4.18.3 Cleaning the Draft Fan

The draft fan **(Fig. 4.9)** must be inspected **yearly** and cleaned as necessary. Dust and ash buildup on the fan blades can significantly reduce fan performance.

Remove the screen by removing the four screws **(Fig. 4.9).** Clean the blades with a soft bristle brush (paint brush) and a vacuum cleaner. If there is creosote on the fan you may have a chimney draft problem that needs to be fixed.

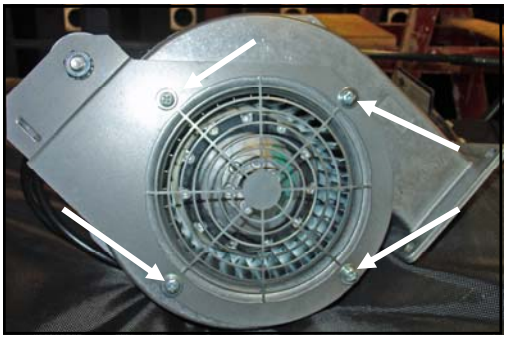


Fig. 4.9 Draft Fan

NOTE

Please inspect the draft fan carefully – even a thin coating of ash significantly reduces the air flow and must be removed.

4.18.4 Maintaining Door Seals

It is very important to maintain tight seals on the doors. Check the loading door and ash door gaskets regularly to insure that they are sealing well and that there is no unwanted air leakage into the boiler. Poor seals can result in air leakage into the boiler and lead to inefficient burning of the boiler or the escape of smoke and gasses from the boiler. The rope seal used to on doors should be inspected regularly.

Check the seal for alignment on the door frame by examining the imprint made by the frame on the seal.

Steps to Replace the Door Seals:

1. Remove the two hinge bolts and take off the door.
2. Remove the old sealing with a screwdriver or a chisel.
3. Clean the sealing groove.
4. Press new sealing into the groove. When half the sealing has been inserted, adjust the end and press in the rest.
5. Secure the sealing by gently tapping with a hammer.
6. Replace the door.
7. Close the door and check its seal.

4.18.5 Cleaning the Primary Air Duct and Channels

The primary air channels (on both sides of the load door) can occasionally become blocked reducing the primary air flow to the firebox (Only perform this cleaning if needed).

Checking the Primary Air Openings:

1. Open the outer door and load door.
2. Check the Primary Air duct holes **(Fig.4.10 & 4.11)** for unobstructed airflow.
3. If necessary, clean the openings and air channels.

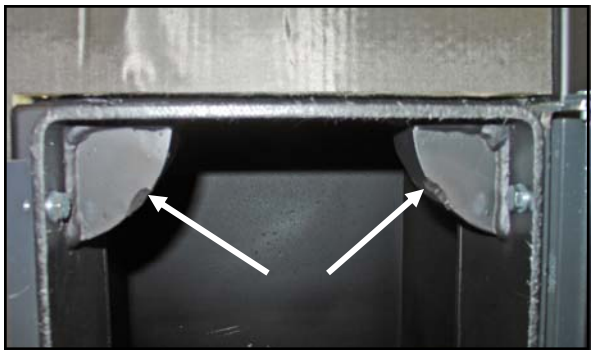


Fig. 4.10 Primary Air Ducts

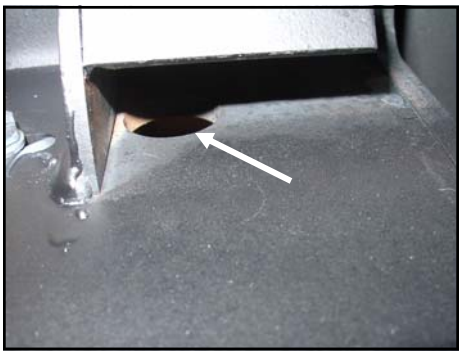


Fig. 4.11 Primary Air Hole

How to Clean the Primary Air Channels (some clear 100% silicone will be needed):

1. Remove the cover to the air distribution box which is located between the loading and ash doors **(Fig.4.12)**. This is performed by removing the 4 corner nuts and carefully breaking the silicone seal on bottom of diffuser.
2. The air channels (**Fig. 4.13)** can then be cleaned with a brush or piece of wire.
3. After cleaning the channels the cover can be reinstalled. Remove the old silicone around the perimeter of the cover on the back side.
4. Place a new bead of silicone around the perimeter of the cover.
5. Screw cover back into place.

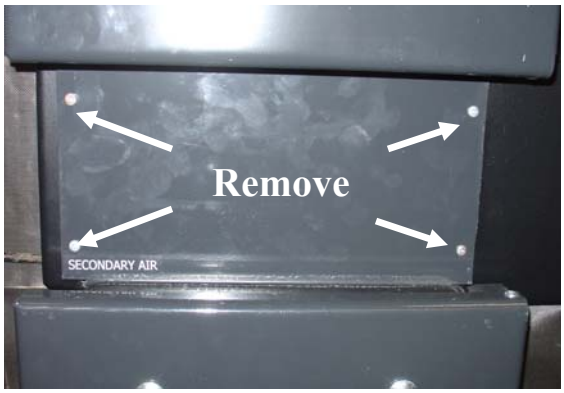


Fig. 4.12 Air Distribution Cover

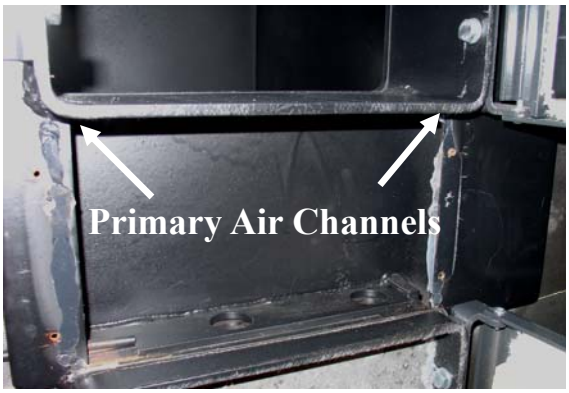


Fig. 4.13 Cover Removed

4.18.6 Smoke Pipe Inspection and Cleaning

The chimney and the chimney connector must be inspected and cleaned annually. Annually disassemble the stove pipe and clean ash accumulation and inspect for corrosion. If any pipe is substantially corroded, this section must be replaced. Cleaning the connecting pipe between the boiler and the chimney is very important for horizontal smoke pipes!

NOTE
Chimney inspection and maintenance is a critical part of any wood-burning maintenance schedule. Make sure that the chimney connection is secure and airtight. Inspect chimney regularly and clean as needed.

WARNING
Solid-fuel burning appliances need to be cleaned frequently because soot, creosote and ash may accumulate.

4.18.7 Chimney Fires

Chimney fires are caused when excessive buildup of creosote in the chimney connector pipe or the chimney is ignited by a racing fire, or when a burning piece of material is swept out of the firebox into the chimney. If you have a chimney fire, you will hear a roaring sound in your chimney, almost like a jet airplane. In addition, sparks may be seen flying from the chimney outside the house. Chimney fires can set fire to the interior of your house or your roof. They are potentially very dangerous, and the following procedure should be followed if you think you have a chimney fire:

1. Call the fire department.
2. Shut all doors and close all air inlets on your boiler.
3. Evacuate your house.
4. If possible, wet your entire roof with a garden hose.

Chimney fires can be avoided by following the recommendations in this manual for minimizing ash formation, by maintaining your chimney in good condition, and by cleaning your chimney regularly. **A chimney fire should never happen with a Solo Plus boiler!**

4.18.8 Checking the Barometric Damper

Annually check the barometric damper flap for ease of operation. The barometric damper flap should operate freely and maintain a chimney draft between -0.025 to -0.05 inches water column.

4.18.9 Cleaning the Jacket

Soot on the jacket and the doors can be removed with a cleaner containing ammonium chloride and acetic acid. Clean the jacket regularly as required to preserve the boiler's appearance.

4.18.10 Check for Creosote Build-Up

Check for creosote buildup in the heat exchange tubes, the smoke pipe and the chimney twice a month. If during cleaning and maintenance a buildup of creosote is noted anywhere besides the firebox, something is wrong with the boiler operation. Check the seal of the door gaskets, the load door to the smoke duct and the smoke box cover.

4.18.11 Seasonal Shutdown Procedure

If the boiler is not being used during the summer season, it is important that the boiler be properly cleaned. The upper and lower combustion chambers, heat exchanger tubes and upper smoke baffle should all be cleaned. After the boiler is cleaned, keep all doors and air dampers closed. Remove the flue pipe and stuff insulation into the flue collar. If you notice condensation forming on the inside of boiler, hang a 15-25 watt light bulb inside boiler.

4.18.12 Checking the Pressure Relief Valve

The pressure relief valve protects the system from dangerously high pressure by opening at a preset pressure rating to allow fluid to be safely released. The pressure relief valve should be seated properly and not drip system water. The pressure relief valve should be inspected and maintained according to the manufactures recommendations.

4.18.13 Checking System Pressure

The system expansion tank in a closed system allows for the thermal expansion of the fluid in the heating system. See the expansion tank's operating instructions for maintenance requirements.

4.18.14 Heat Storage System Maintenance

Please follow the recommended maintenance schedule for these parts of the heating system. Specific maintenance items for the heat buffer will be specified by the system manufacturer, but items may include checking any safety valves, anode in any connected hot water reservoir, or system water level and system PH in static water storage systems.

4.19 Power Outages

The boiler will not operate in the event of a power failure. Do not open the loading or ash doors until power is reestablished. The fan needs to be able to operate to remove combustible gasses.

5.0 Troubleshooting

5.1 Troubleshooting Guide

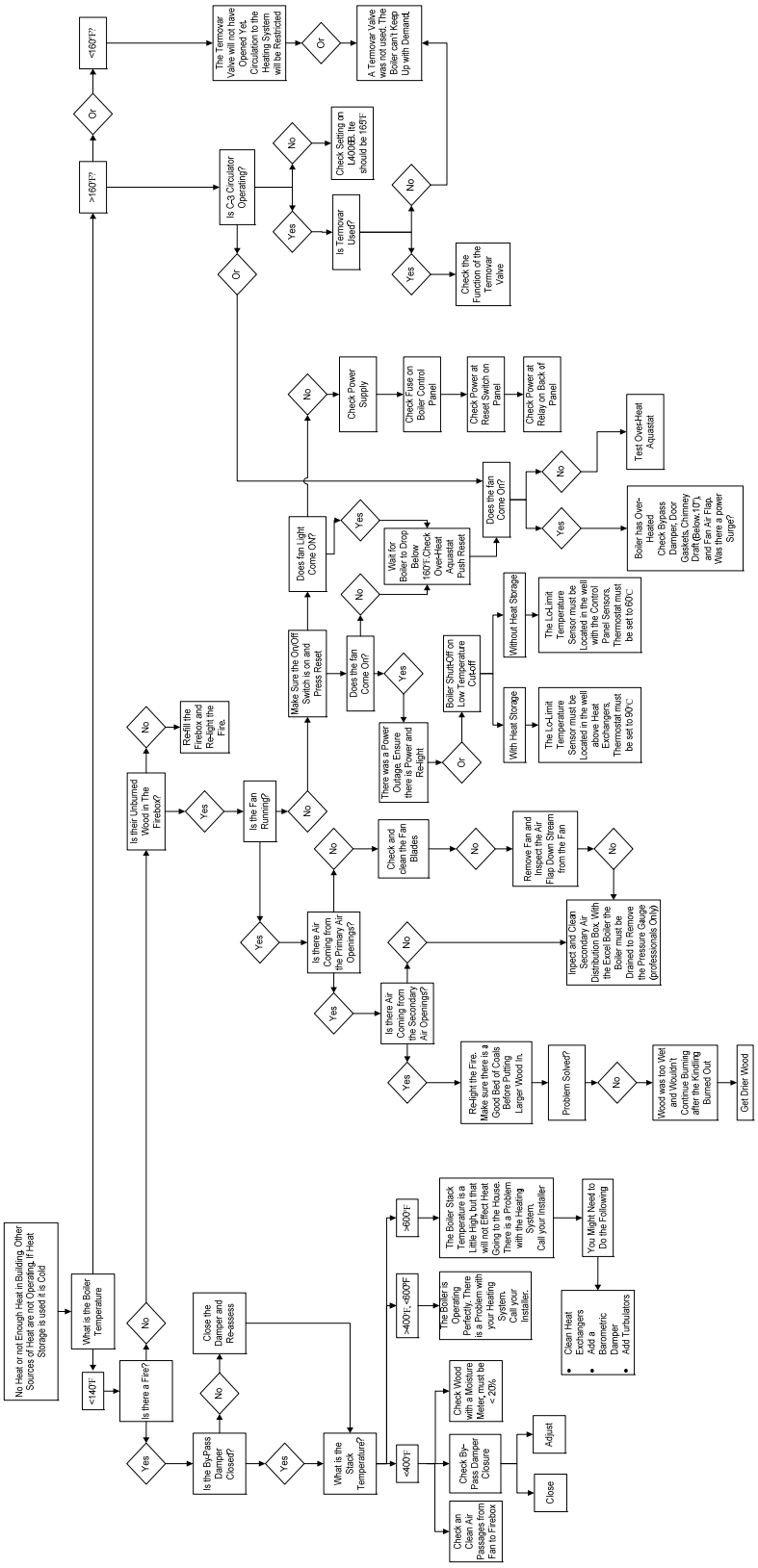
Symptom	Possible Cause	Remedy
No Heat in House Boiler Temperature is Below 150 ºF (65 ºC) While Burning Wood.	No Fuel in Boiler. Low Fan Output.	Restart or re-light fire. Fan wheel Dirty-CLEAN. Air Ducts Plugged-CLEAN.
	Fan Does not Operate.	Check Power and Control Panel Components with Multi-Meter.
	By-Pass Damper Open, not Sealing.	Close By-Pass Damper-CLEAN.
	Combustion Chamber is Obstructed.	Clear Ash and Other Obstructions through lower Door.
	Boiler is Dirty	Clean Ash off Refractory. Clear Ash from floor of Boiler. Brush Heat Exchange Tubes.
	Wood is Un-split or Unseasoned.	Split Wood and Season to 20% moisture or less.
	Fan Operates Slowly.	Bad Motor Capacitor-REPLACE.
Boiler Temperature is Below 140 ºF (60 ºC), Fan does not Shut Off.	Wrong Setting on Lo-Limit Thermostat.	Set Lo-Limit Thermostat at 60 ºC (140 ºF) without storage and 90 ºC (194 ºF) with storage.
	Boiler Didn't Reach Operating Temperature on Cold Start-up.	Be sure to Fire Boiler so it heats to above 175 ºF (79 ºC) after a cold start.
Boiler Temperature above 150 ºF (65ºC).	Air in Piping.	Call Serviceman.
	Circulator not Operating.	Call Serviceman.
	Not Enough Radiation in House.	Add Radiation as Needed.
Boiler Functions Well with Good Burn Times but Inadequate on Coldest Days.	Boiler temperature is Set Too Low.	Increase Boiler Water Temperature by Adjusting the Operating Thermostat to 190 ºF (88 ºC).

5.0 Troubleshooting

5.1 Troubleshooting Guide (Cont'd)

Symptom	Possible Cause	Remedy
Boiler Functions Well with Good Burn Times but Inadequate on Coldest Days.	Boiler temperature is Set Too Low.	Increase Boiler Water Temperature by Adjusting the Operating Thermostat to 190 ºF (88 ºC).
Excessive Heat Dumped into Overheat Zone.	Overheat Control Set to Low.	Increase Setting on L4008B to 210 ºF (98 ºC).
Short Burn Times.	Wood not Seasoned Adequately.	Season Wood for at Least 8 Months Under Cover. Cut, split and Stacked.
	Firebox not Filled Adequately.	Cut Wood to Full Length of Firebox
	Poor Quality Wood.	Choose Maple, Hickory, or other Dense Hardwoods for Longest Burn.
Wood Fire goes Out Before being Completely Burned.	Inadequate Draft.	Increase Chimney Draft
	No Demand on Boiler for an Extended Period of Time.	Burn Back-up Fuels or Turn House Thermostat up so the Boiler fan will Operate more often.
Excessive Smoke out of Load Door When Loading.	Too much Wood left in Firebox from last Stoking.	Load less wood.
	Weak Chimney Draft.	Make Chimney Higher or Warmer.
Sticking Bypass Damper.	Damper Not Fully Closed	Close Bypass Damper Completely.
Low Stack Temperatures During Fan Forced Combustion.	Damper Not Fully Closed	Close Bypass Damper Completely.
Over-heating.	Damper Not Fully Closed	Close Bypass Damper Completely.
Creosote in the Chimney.	Damper Not Fully Closed	Close Bypass Damper Completely.
Boiler Fan will not shut off after the boiler has cooled.	Damper Not Fully Closed	Close Bypass Damper Completely.
Boiler is shutting off before the wood is completely burned.	Damper Not Fully Closed	Close Bypass Damper Completely.
Visible smoke from the chimney when the combustion blower is off.	Damper Not Fully Closed	Close Bypass Damper Completely.
High wood consumption.	Damper Not Fully Closed	Close Bypass Damper Completely.

5.2 Troubleshooting Flow Chart



6.0 Data and Drawings

6.1 Measurement Data

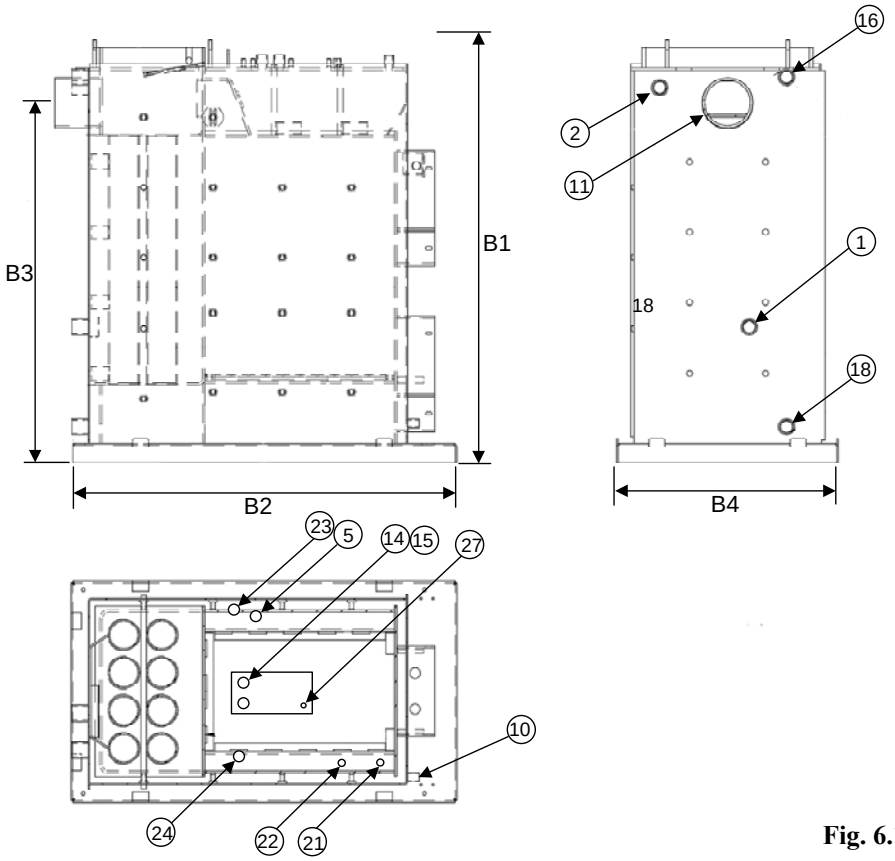


Fig. 6.1

Description	Units	30	40	60
1 Return Connection	inches	1¼	1¼	1¼
2 Supply Connection	inches	1¼	1¼	1¼
5 Tapping-Overheat	inches	¾	¾	¾
10 Extra Tapping (Not Used)	inches	½	½	½
11 Flue Pipe, External Diameter	Inches	6	6	8
14/15 Domestic Coil Fittings (optional)	inches	¾	¾	¾
16 Tapping-Overheat-Pressure Relief	inches	1¼	1¼	1¼
18 Tapping-Boiler Drain	inches	1¼	1¼	1¼
21 Tapping-Pressure Gauge	inches	½	½	½
22 Tapping-Bleeder Vent	inches	3/8”	3/8”	N/A
23 Extra Tapping	inches	N/A	N/A	¾
24 Tapping-Control Panel/Lo-Limit	inches	¾	¾	¾
27 Tapping-Bleeder Vent	inches	N/A	N/A	3/8
B1 Measurement (Overall Height)	inches	55½	55½	55½
B2 Measurement (Length)	inches	46½	46½	50½
B3 Measurement (To Center of Flue)	inches	41¾	41¾	41¾
B4 Measurement (Width)	inches	21	25	25

6.2 Positioning Data

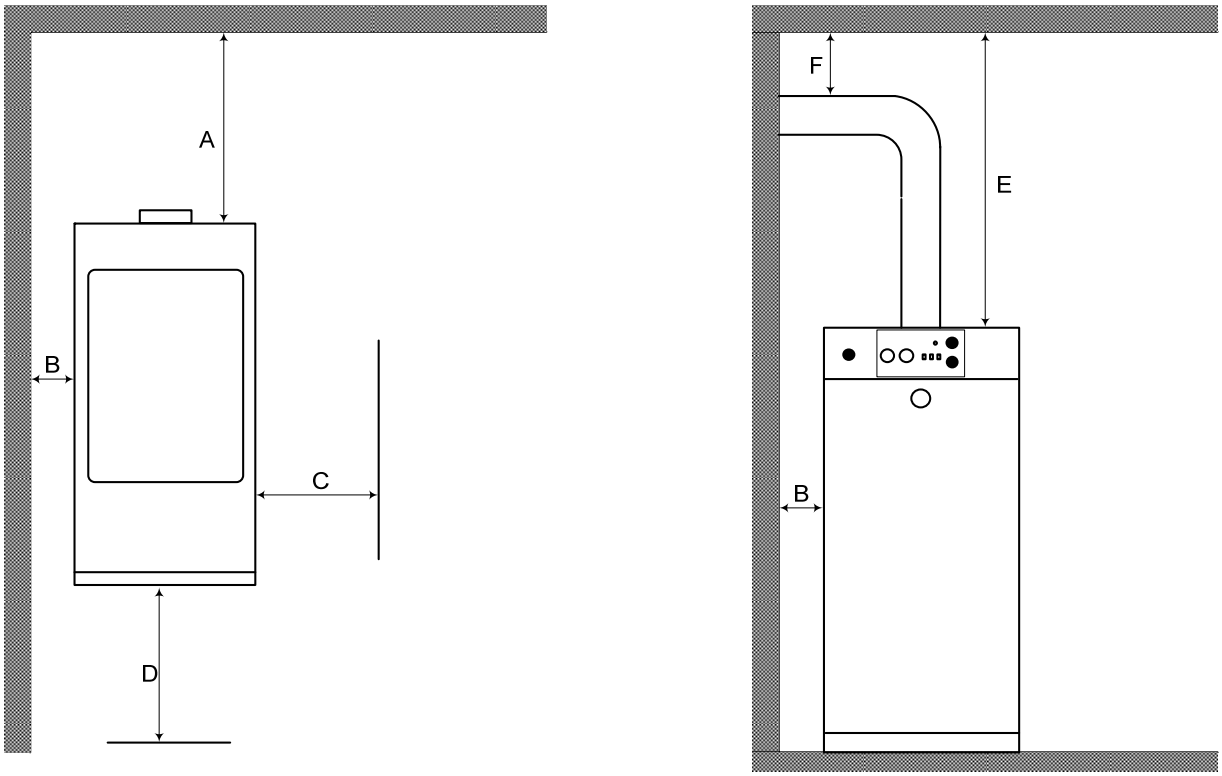


Fig. 6.2

Clearances to Combustibles		
Measurement	Minimum Distance	Notes
A-Backwall to Appliance	18”	Minimum Distance
B-Sidewall to Appliance	8”	Minimum Distance
C-Sidewall to Appliance	21”	Minimum Distance on left or right side to allow clearance for Cleaning and Maintenance Tasks.
D-Front of Appliance	36”	Required Distance for Cleaning the Boiler.
E-Ceiling to Appliance	18”	Required Distance for Cleaning the Boiler.
F-Combustibles to Pipe	18”	Minimum Distance

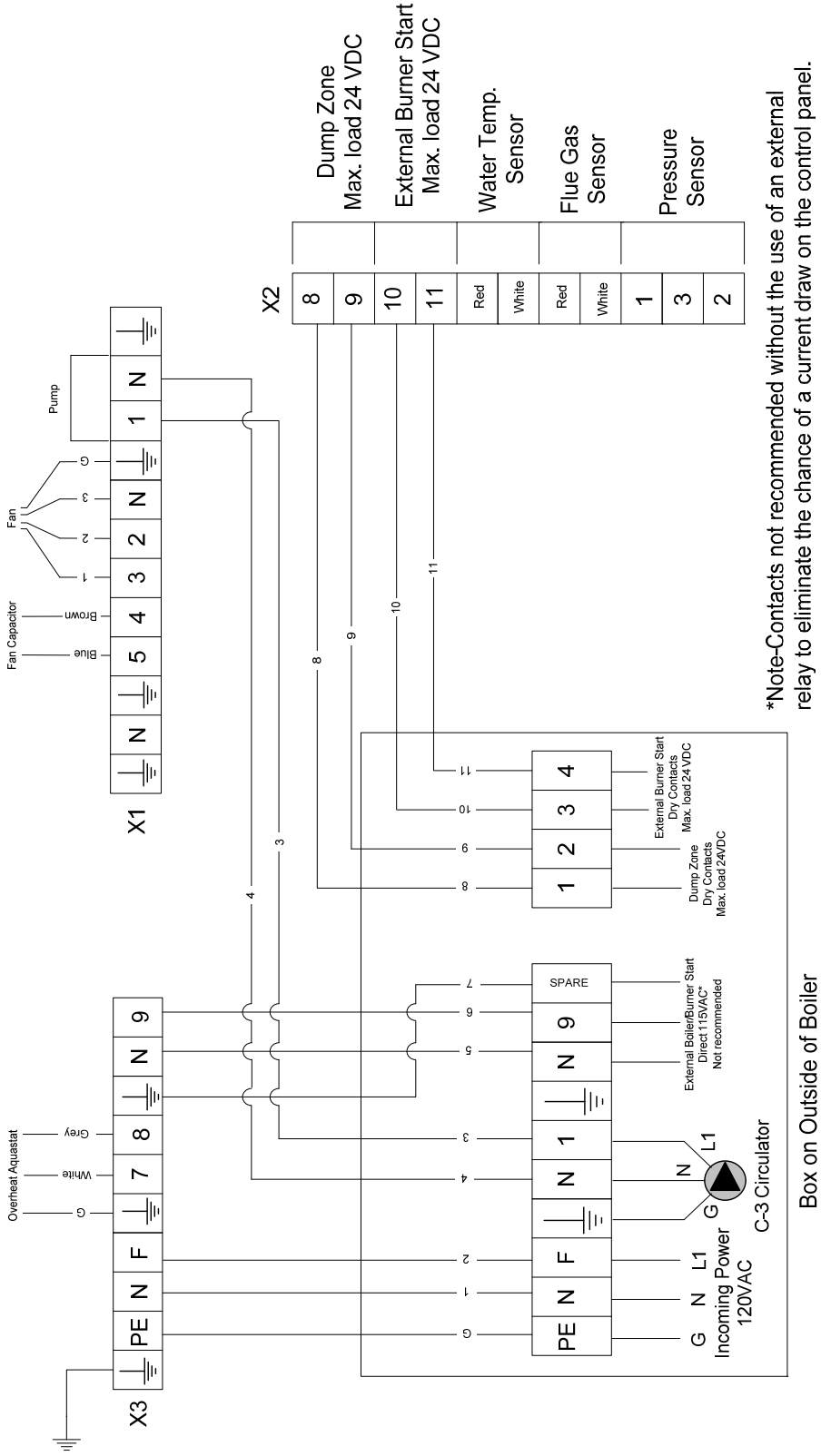
6.3 Specification Data

Fig. 6.2

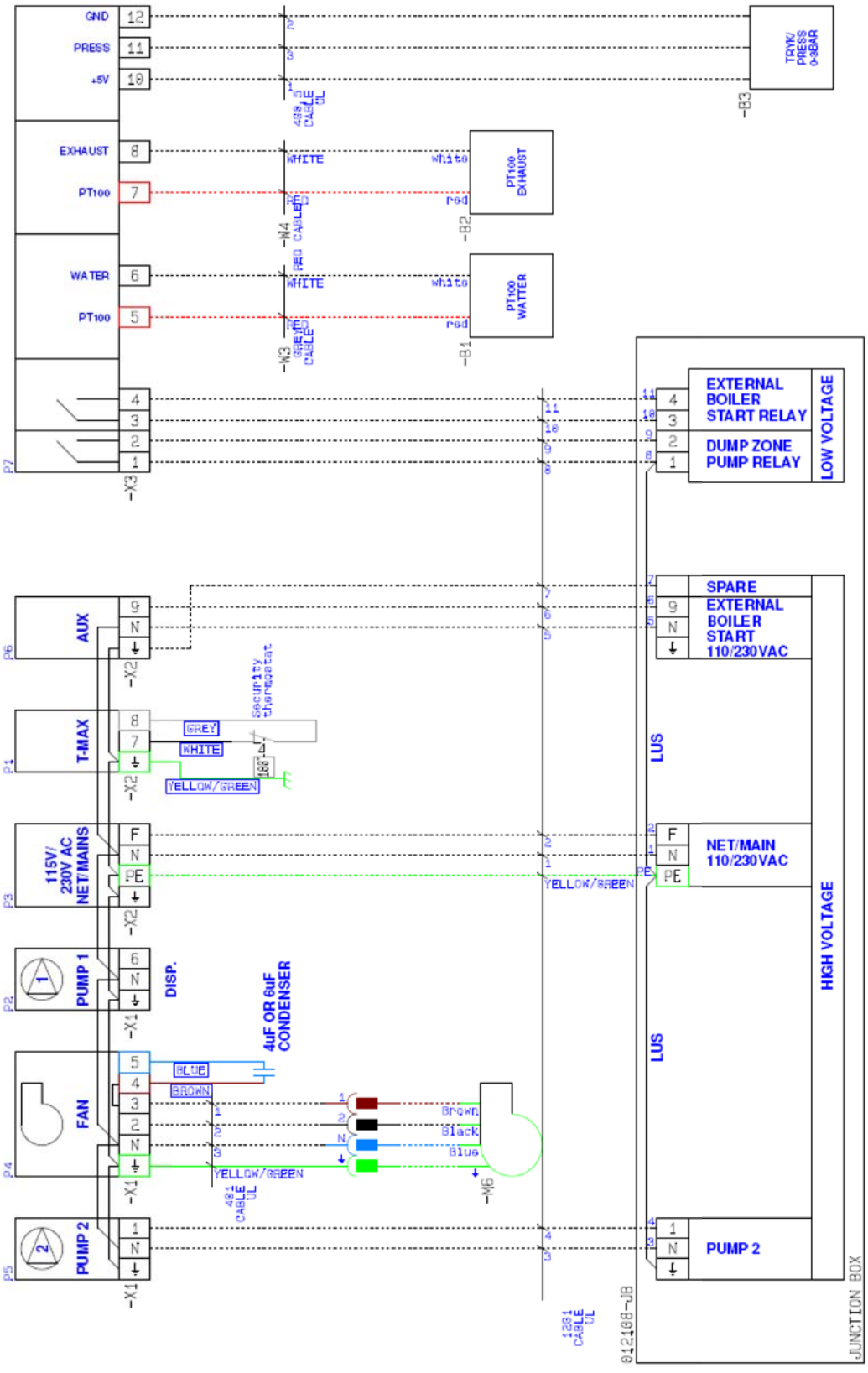
Technical Data	Units	30	40	60
MEASUREMENTS				
Depth- Boiler -Total	inches	46½	46½	50½
Width- Boiler -Total	inches	21	25	25
Height to Chimney Connection	inches	41¾	41¾	41¾
Smoke Pipe Stub outside diameter	inches	6	6	8
Weight- Empty	lbs	1080	1180	1230
Water Contents	gallons	41	54	60
Loading Door	inches	10 X 12	10 X 12	10 X 12
Combustion chamber Depth	inches	21	21	21
Combustion Chamber Volume	Cu ft	4.01	5.35	6.02
Wood Length	inches	20	20	20
Wood Diameter (Max)-Softwood	inches	4	4	4
Wood Diameter (Max)-Hardwood	inches	6	6	6
OPERATING DATA				
Operating Temperature-Water	Fº	180-190	180-190	180-190
Nominal Output	Btu/hr	102,000	140,000	198,000
Required Draft	inch WC	-.025 to -.05	-.025 to -.05	-.025 to -.05
Safety Listings	-	UL 391-1995, CAN/CSA B366.1-M91,UL726, ANSI Z21.13-200, CSA 4.9-M2000	UL 391-1995, CAN/CSA B366.1-M91,UL726, ANSI Z21.13-200, CSA 4.9-M2000	UL 391-1995, CAN/CSA B366.1-M91,UL726, ANSI Z21.13-200, CSA 4.9-M2000
ELECTRICAL DATA				
Boiler Power Requirement		120V-60Hz/15A	120V-60Hz/15A	120V-60Hz/15A
Blower	W	35	105	105
PIPING DATA				
Boiler Test Pressure	psi	65	65	65
Boiler Relief Valve Setting	psi	30	30	30
Supply & Return pipe stub size (male npt)	inch	1.25	1.25	1.25
Minimum Boiler Loop size	inch	1.25	1.25	1.25
Mixing Valve Opening Setting	Fº	140	140	140
Internal Overheat Aquastat Setting	Fº	212	212	212

6.4 Electrical Diagrams

6.4.1 External Connections to the Boiler.

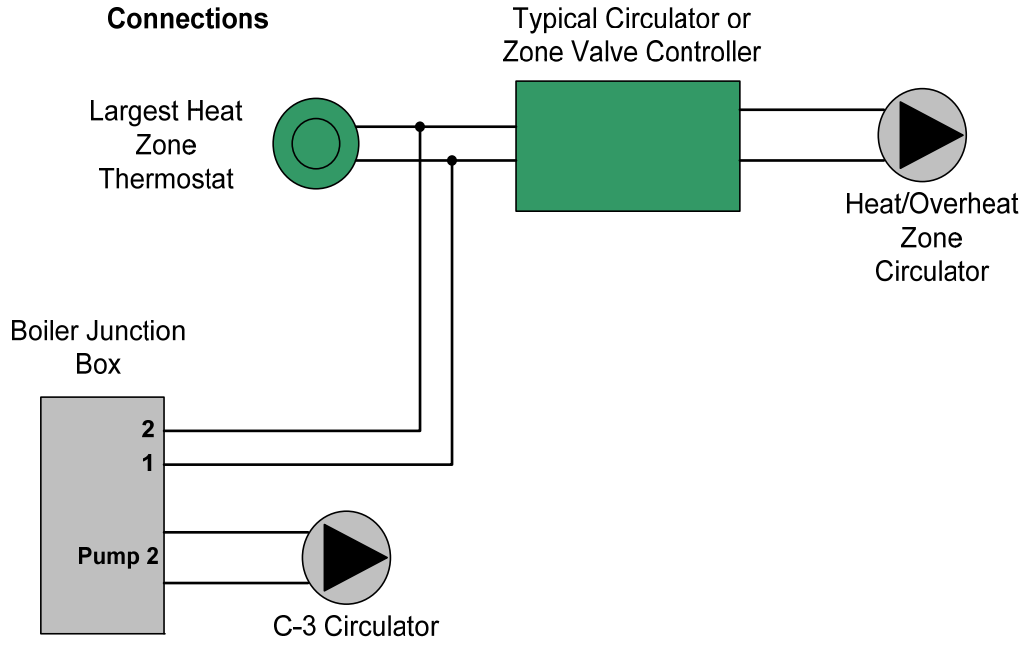


6.4.2 Wiring Diagram A (Boiler Circuit Ladder Diagram)

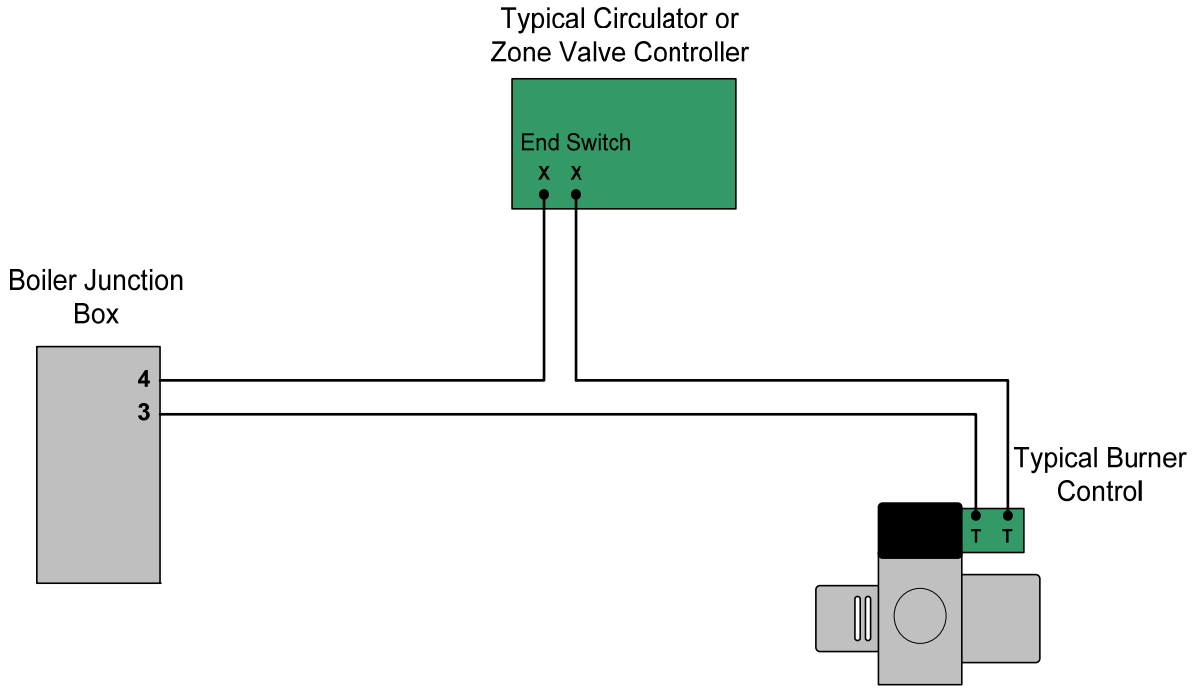


6.4.3 Overheat, Circulator, and External Burner Start Connections

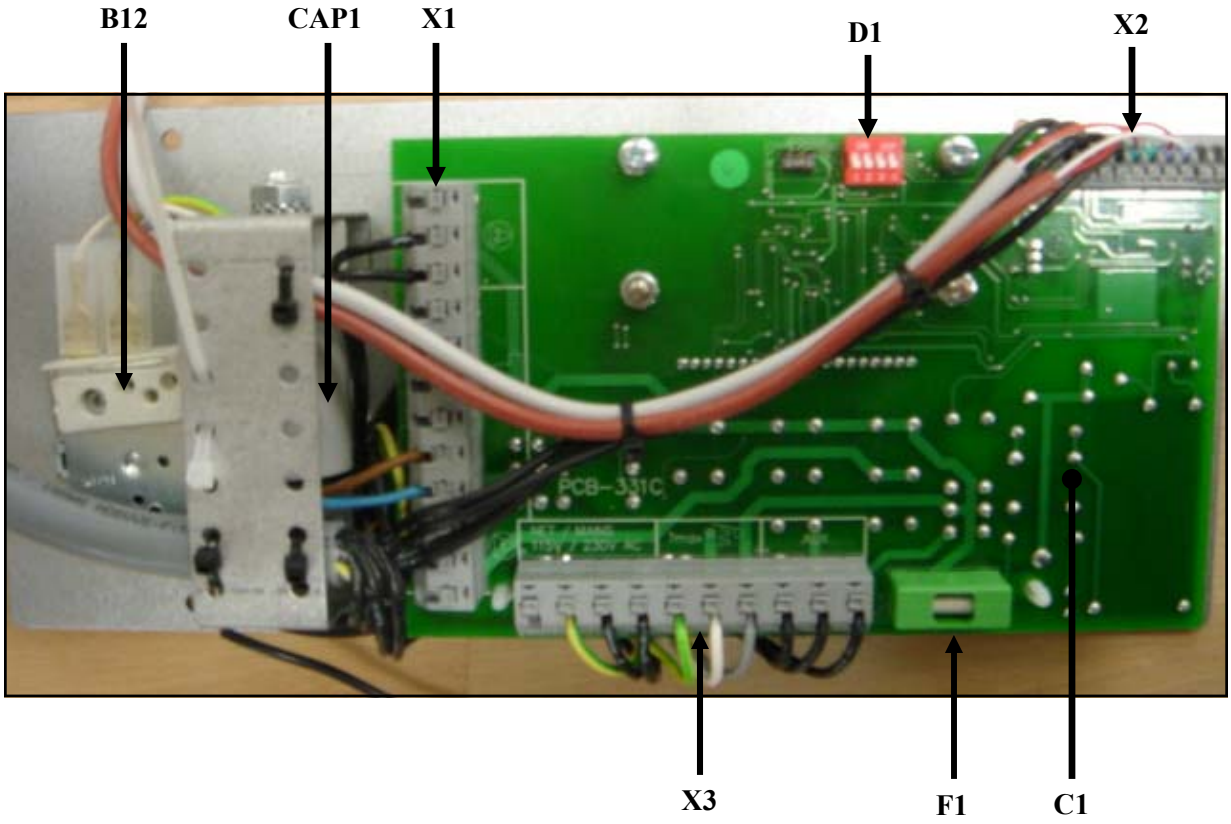
Overheat Aquastat and Circulator Connections



External Burner Start Connections



6.4.4 Control Panel

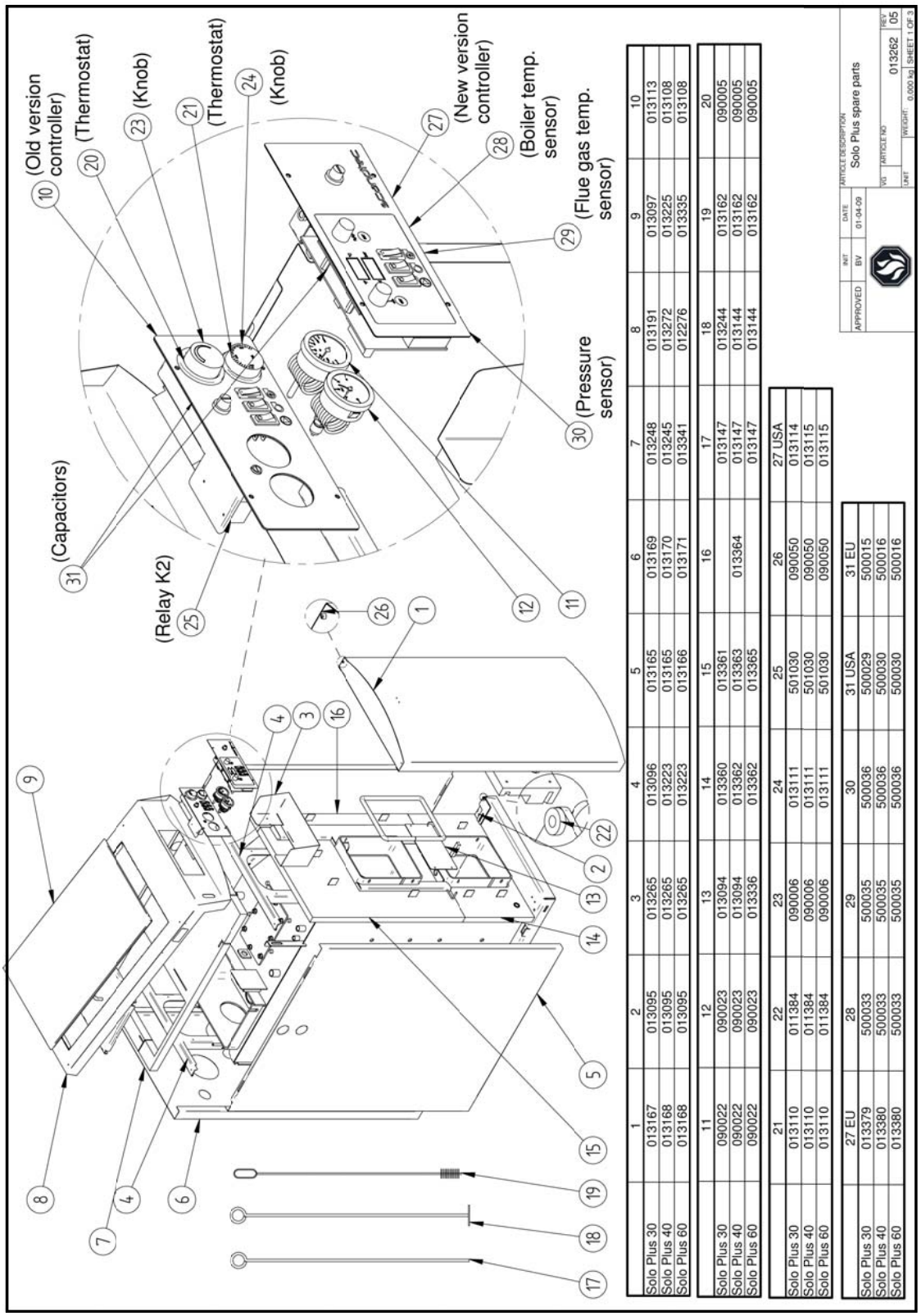


Explanation for Control Panel

B12-Overheat Aquastat/Circuit Breaker (Part #08007)
CAP1-Capacitor for the Fan (SP 30: 4µF; SP 40/60: 6µF)
C1-Boiler Control Board
D1-Dip Switches
F1-Fuse 6.3 A (sand Filled) Protects Control Board
X1-Terminal Block (High Voltage)
X2-Terminal Block (Low Voltage)
X3-Terminal Block (High Voltage)

6.5 Parts List

6.5.1 Solo Plus 30, 40, 60 Parts List

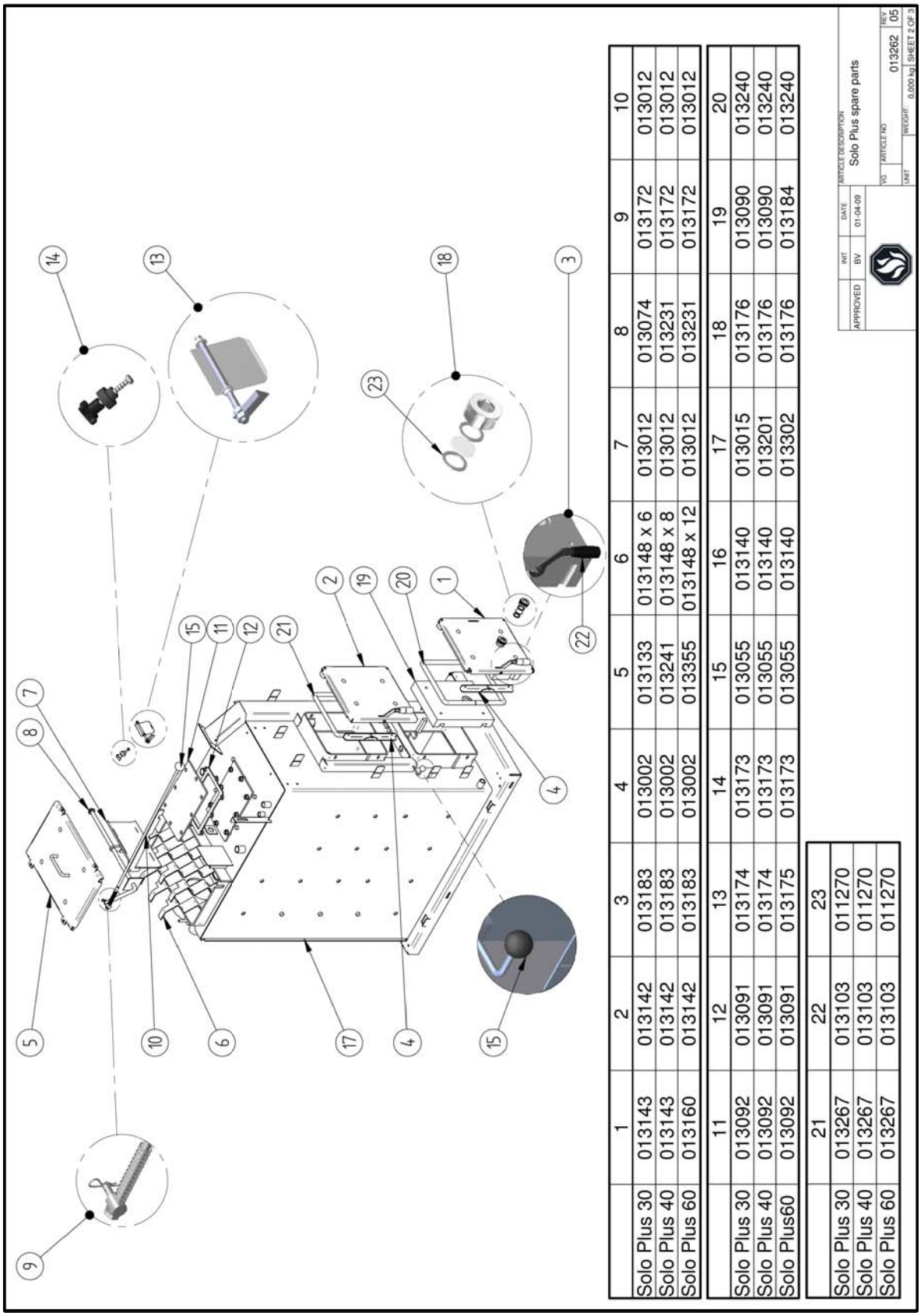


	1	2	3	4	5	6	7	8	9	10
Solo Plus 30	013167	013095	013265	013096	013165	013169	013248	013191	013097	013113
Solo Plus 40	013168	013095	013265	013223	013165	013170	013245	013272	013225	013108
Solo Plus 60	013168	013095	013265	013223	013166	013171	013341	012276	013335	013108

	11	12	13	14	15	16	17	18	19	20
Solo Plus 30	090022	090023	013094	013360	013361		013147	013244	013162	090005
Solo Plus 40	090022	090023	013094	013362	013363	013364	013147	013144	013162	090005
Solo Plus 60	090022	090023	013336	013362	013365		013147	013144	013162	090005

	21	22	23	24	25	26	27 USA
Solo Plus 30	013110	011384	090006	013111	501030	090050	013114
Solo Plus 40	013110	011384	090006	013111	501030	090050	013115
Solo Plus 60	013110	011384	090006	013111	501030	090050	013115

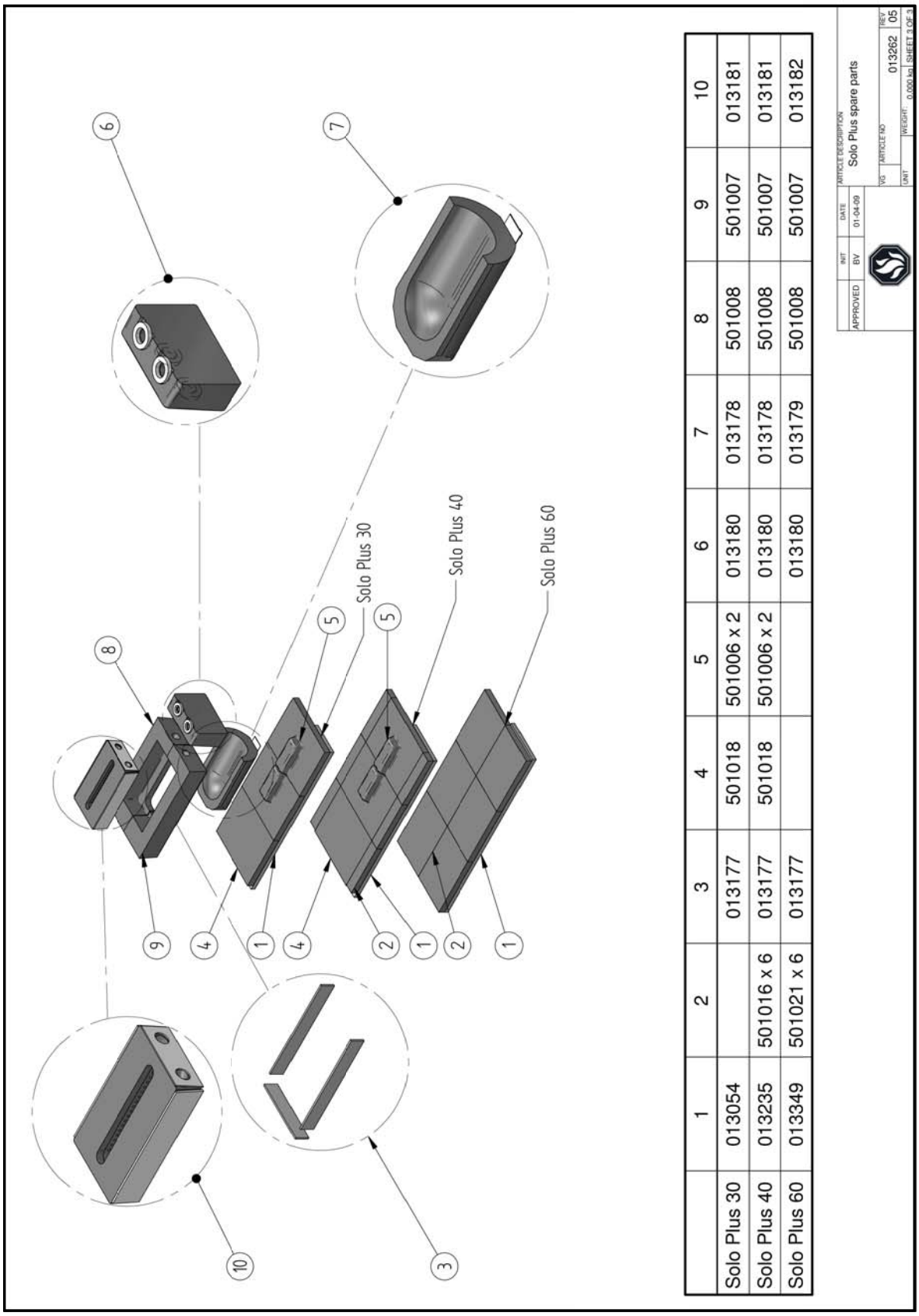
	27 EU	28	29	30	31 USA	31 EU
Solo Plus 30	013379	500033	500035	500036	500029	500015
Solo Plus 40	013380	500033	500035	500036	500030	500016
Solo Plus 60	013380	500033	500035	500036	500030	500016



	1	2	3	4	5	6	7	8	9	10
Solo Plus 30	013143	013142	013183	013002	013133	013148 x 6	013012	013074	013172	013012
Solo Plus 40	013143	013142	013183	013002	013241	013148 x 8	013012	013231	013172	013012
Solo Plus 60	013160	013142	013183	013002	013355	013148 x 12	013012	013231	013172	013012

	11	12	13	14	15	16	17	18	19	20
Solo Plus 30	013092	013091	013174	013173	013055	013140	013015	013176	013090	013240
Solo Plus 40	013092	013091	013174	013173	013055	013140	013201	013176	013090	013240
Solo Plus60	013092	013091	013175	013173	013055	013140	013302	013176	013184	013240

	21	22	23
Solo Plus 30	013267	013103	011270
Solo Plus 40	013267	013103	011270
Solo Plus 60	013267	013103	011270



	1	2	3	4	5	6	7	8	9	10
Solo Plus 30	013054		013177	501018	501006 x 2	013180	013178	501008	501007	013181
Solo Plus 40	013235	501016 x 6	013177	501018	501006 x 2	013180	013178	501008	501007	013181
Solo Plus 60	013349	501021 x 6	013177			013180	013179	501008	501007	013182

	INIT	DATE	ARTICLE DESCRIPTION
APPROVED	BV	01-04-09	Solo Plus spare parts

VG: ARTICLE NO: 013262 REV: 05
UNIT: WEIGHT: 0,000 kg SHEET 3 OF 3

7.0 Warranty Information

7.1 Warranty

LIMITED WARRANTY - FOR USE ONLY IN UNITED STATES

Tarm Biomass warrants the steel boiler identified below and its component hot water tank or coil and cast iron doors and ceramic refractory against defects in material and workmanship under normal use and service ***TO THE ORIGINAL PURCHASER AT THE ORIGINAL INSTALLATION SITE*** in the United States under the following terms.

BOILER BODY -- LIMITED 20 YEAR WARRANTY: Subject to the below limitations, Tarm Biomass warrants the steel boiler body (not including cast iron doors, coil, or other components) against defects in materials or workmanship causing breaks or leaks that significantly impair the boiler's performance. During the first five years of the warranty period Tarm Biomass will pay for all required labor at the usual and customary rate paid by Tarm Biomass for similar labor performed in Lyme, NH, and provide or pay the cost of all materials for the repair of the warranted unit. In years six through twenty Tarm Biomass will pay the below stated percentage multiplied times the retail price of the warranted unit on the date of purchase to the original purchaser toward of the cost of repair of the warranted item or, if Tarm Biomass and the original purchaser agree, use the resultant sum as a partial allowance toward Tarm Biomass' replacement of the warranted item. The original purchaser shall be responsible for all shipping and installation charges in connection with any replacement or repair.

Warranty Year (beginning from date of purchase)	Percentage Tarm Biomass will pay
1-5	100%
6	60%
7	50%
8	40%
9	30%
10-20	20%

Example 1: Repair costing $250.00 in year 7, Tarm Biomass will pay $125.00 (50% of this repair).
Example 2: Boiler (original retail $4,000.00) needs major repair in year 9. Tarm Biomass will pay $1,200 (30% of $4,000) toward replacement with similar warranted unit or up to 30% of the repair cost ($1,200 maximum).

OTHER COMPONENTS -- LIMITED THREE YEAR WARRANTY
Subject to the application of the following percentages to parts and/or labor, Tarm Biomass provides the following limited warranty of each of its boiler's cast iron doors, hot water coil, refractory and combustion chambers against defects in materials or workmanship causing breaks or leaks that significantly impair the boiler's performance.

Warranty Year (beginning from date of purchase)	Percentage Tarm Biomass will pay
1	100% of parts and labor
2	100% of parts ONLY
3	50% of parts ONLY

Tarm Biomass' LIMITED EXPRESS WARRANTY IS ONLY EXTENDED TO AND COVERS THE TARM USA PRODUCT'S END USER WHO OWNS THE BUILDING IN WHICH THE TARM USA PRODUCT IS INSTALLED, AND COVERS ONLY REPAIRS OR REPLACEMENTS RESULTING FROM DEFECTS IN MATERIALS AND WORKMANSHIP.

THERE ARE NO WARRANTIES THAT EXTEND BEYOND THE DESCRIPTION IN THIS LIMITED WARRANTY, AND Tarm Biomass' LIMITED WARRANTY IS IN LIEU OF AND TO THE EXCEPTION OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, WARRANTIES OF MERCHANTABILITY OR WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE. EXCEPT AS OTHERWISE PROVIDED BY THIS LIMITED WARRANTY, Tarm Biomass TAKES NO RESPONSIBILITY FOR THE QUALITY OF Tarm Biomass PRODUCTS OR THAT THE GOODS WILL BE FIT FOR ANY PARTICULAR PURPOSE FOR WHICH YOU MAY BE BUYING THESE GOODS. UNDER NO CIRCUMSTANCES SHALL TARM USA BE SUBJECT TO INCIDENTAL, CONSEQUENTIAL, INDIRECT, SPECIAL, PUNITIVE, ENHANCED COMPENSATORY, OR CONTINGENT DAMAGES, WHETHER A CLAIM IS BASED ON CONTRACT, TORT, STRICT LIABILITY, OR ANY OTHER THEORY OF LAW, ALL SUCH DAMAGES AND CLAIMS BEING SPECIFICALLY DISCLAIMED.

Tarm Biomass' limited warranty is void if a Tarm Biomass product is installed by someone other than a qualified contractor whose principal occupation is the sale or installation of plumbing and heating equipment, or if the original purchaser fails to have the boiler serviced or inspected at least once every two years by an experienced and qualified service person. Repairs or replacements under this limited warranty must be performed by your dealer or someone authorized by him. You may be required to present this limited warranty to the dealer before any work is performed. You must pay for any work performed that is not covered by this limited warranty or that is not authorized by the dealer. Tarm Biomass' limited warranty shall be construed under the laws of New Hampshire. Any dispute arising out of this warranty shall be tried only in a court in the State of New Hampshire, including the United States District Court for the State of New Hampshire. If any legal action is brought in connection with this limited warranty, the prevailing party shall be entitled to recover all reasonable expenses it incurs in the action, including its reasonable attorneys' fees, from the nonprevailing party.

TARM USA'S LIMITED WARRANTY EXPRESSLY EXCLUDES COVERAGE FOR THE FOLLOWING:

1. Ordinary wear and tear and repairs or replacements necessitated by normal use.
2. Repairs or replacements arising from corrosion including, but not limited to, the effects of a corrosive water supply or corrosive by-products of combustion formed when a boiler is run during warm weather temperatures or under other conditions that do not permit the boiler to reach necessary operating temperatures on a frequent basis as described in the Owner's Manual provided by Tarm Biomass.
3. Repairs or replacements of fittings, motors, fuel units, oil and gas burners, any and all controls, relief or regulating valves, transformers, and accessories.
4. Repairs or replacements to repair damage caused by (i) operation with inadequate draft, (ii) having installed a boiler model that is incorrectly sized for the application (too few or too many BTU's under normal operating conditions) or that is otherwise inappropriate for the application, (iii) excessive boiler internal temperature from burning improper materials as fuel or operating the boiler without appropriate draft control (for example, burning the boiler too hot when the boiler is coming up to temperature from a cold start), or (iv) any similar use that violates or is not recommended in the Owner's Manual provided by Tarm Biomass.
5. The repair or replacement of any component furnished by any other manufacturer or damage caused by the functioning or malfunctioning of any such component.

This warranty gives you specific legal rights. You may also have other rights that vary from state to state. This warranty shall not be construed as inconsistent with any federal, state, or municipal law, regulation, or code that was applicable to the original installation site on the date the Tarm Biomass product was installed.

Questions regarding this warranty may be referred to:
Tarm Biomass, 4 Britton Lane, Box 285, Lyme, NH 03768 U.S.A. (603) 795-2214

KEEP THIS INFORMATION FOR YOUR RECORDS:
Model: _____ Place of Purchase:

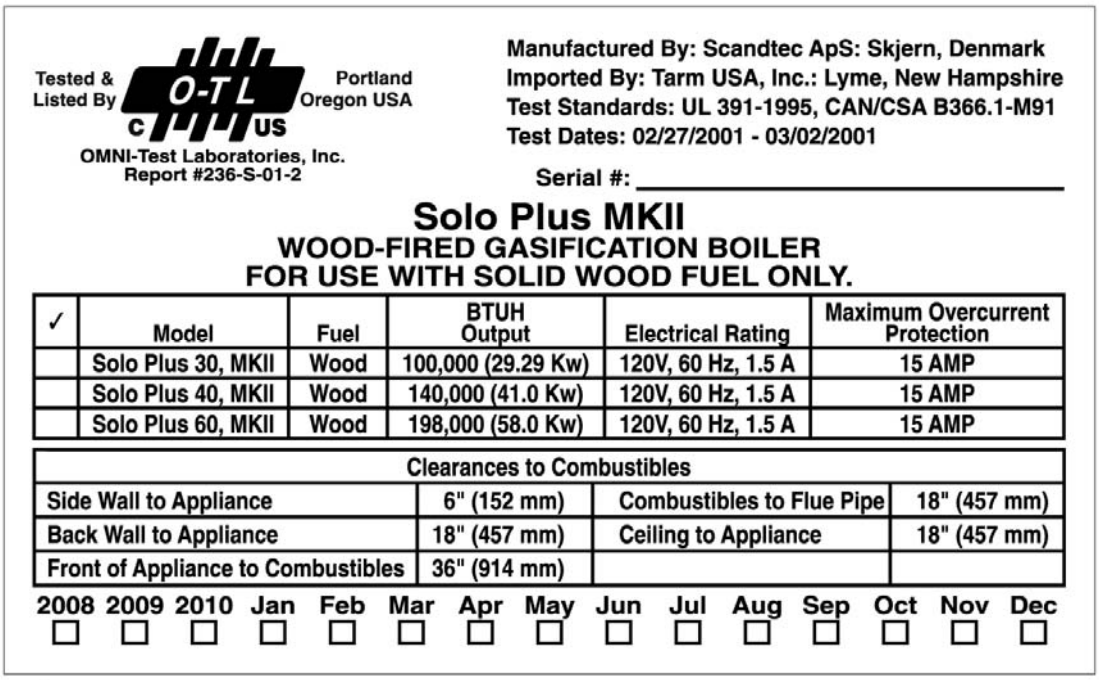
Serial No.: _____ Installation Date: _____ Installer

Appendix A-Temperature Conversion

Temperature Conversion Table

°C	°F		°C	°F		°C	°F		°C	°F
40	104		80	176		135	275		220	428
45	113		82	179.6		140	284		225	437
50	122		84	183.2		145	293		230	446
52	125.6		86	186.8		150	302		235	455
54	129.2		88	190.4		155	311		240	464
56	132.8		90	194		160	320		245	473
58	136.4		92	197.6		165	329		250	482
60	140		94	201.2		170	338		255	491
62	143.6		96	204.8		175	347		260	500
64	147.2		98	208.4		180	356		265	509
66	150.8		100	212		185	365		270	518
68	154.4		105	221		190	274		275	527
70	158		110	230		195	383		280	537
72	161.6		115	239		200	392		285	545
74	165.2		120	248		205	401		290	554
76	168.8		125	257		210	410		295	563
78	172.4		130	266		215	419		300	572

Appendix B-Boiler Listing Label



Tested & Listed By O-T-L C US Portland Oregon USA

OMNI-Test Laboratories, Inc.
Report #236-S-01-2

Manufactured By: Scandtec ApS: Skjern, Denmark
Imported By: Tarm USA, Inc.: Lyme, New Hampshire
Test Standards: UL 391-1995, CAN/CSA B366.1-M91
Test Dates: 02/27/2001 - 03/02/2001

Serial #: _____

Solo Plus MKII

WOOD-FIRED GASIFICATION BOILER
FOR USE WITH SOLID WOOD FUEL ONLY.

✓	Model	Fuel	BTUH Output	Electrical Rating	Maximum Overcurrent Protection
	Solo Plus 30, MKII	Wood	100,000 (29.29 Kw)	120V, 60 Hz, 1.5 A	15 AMP
	Solo Plus 40, MKII	Wood	140,000 (41.0 Kw)	120V, 60 Hz, 1.5 A	15 AMP
	Solo Plus 60, MKII	Wood	198,000 (58.0 Kw)	120V, 60 Hz, 1.5 A	15 AMP

Clearances to Combustibles			
Side Wall to Appliance	6" (152 mm)	Combustibles to Flue Pipe	18" (457 mm)
Back Wall to Appliance	18" (457 mm)	Ceiling to Appliance	18" (457 mm)
Front of Appliance to Combustibles	36" (914 mm)		

2008 ☐ 2009 ☐ 2010 ☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐

Notes: