INSTALLATION AND OPERATOR'S MANUAL

WOOD GASIFICATION BOILER

Model: SE110 UL Approved

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

IMPORTANT: IN ORDER TO ACHIEVE SAFE AND SATISFACTORY RESULTS FROM YOUR ALTERNATE HEATING SYSTEMS BOILER, READ SAFETY RULES AND INSTRUCTIONS CAREFULLY BEFORE INSTALLING AND OPERATING. ALL INSTALLATIONS MUST BE IN ACCORDANCE WITH STATE AND LOCAL CODES. SAVE THESE INSTRUCTIONS FOR FUTURE REFERENCE.

Your Alternate Heating Systems Boiler is capable of generating very hot temperatures. Boiler temperatures and flames in the ignition box area are capable of causing ignition or explosion of explosive or flammable products or explosion of the boiler itself if maximum safe water temperature is exceeded. Maximum safe water temperature is 200° Fahrenheit. Flammable or explosive products must never be stored in the same room or in the vicinity of a boiler, and the boiler water temperature must never be allowed to exceed 200° Fahrenheit.

ALTERNATE HEATING SYSTEMS 2395 LITTLE EGYPT RD HARRISONVILLE, PA 17228 717-987-0099 WWW.WOODGUN.COM EMAIL:SERVICE@WOODGUN.COM	**Record Model and Serial Number Below:** **Model: SE110** **Stainless Steel (Yes/No):** **Serial Number:** **Date of Purchase:____/___/_____**

Revision: 26-01-15

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⚠CAUTIONS AND WARNINGS: RISK OF FIRE, INJURY OR DEATH

WARNING: NEVER FILL A HOT BOILER WITH WATER, IF UNIT IS LOW IN WATER ALLOW UNIT TO COOL BEFORE FILLING WITH WATER. FAILURE TO DO SO COULD RESULT IN DEATH OR SEVERE INJURY AND DAMAGE TO BOILER AND SURROUNDING PROPERTY.

INSTALLATION IS TO BE PERFORMED BY A QUALIFIED INSTALLER AND WILL COMPLY WITH ALL THE REQUIREMENTS OF THE AUTHORITY HAVING JURISDICTION OVER THE INSTALLATION

ALL COVER PLATES, ENCLOSURES, AND GUARDS MUST BE MAINTAINED IN PLACE AT ALL TIMES, EXCEPT DURING MAINTENANCE AND SERVICING.

USE ONLY WITH SEASONED LOG WOOD WITH A MOISTURE CONTENT OF 19%-25%.

THE UNIT IS NOT TO BE CONNECTED TO A CHIMNEY FLUE SERVING ANOTHER APPLIANCE!

USE COPPER CONDUCTORS ONLY FOR FIELD WIRING

DANGER! RISK OF FIRE OR EXPLOSION – DO NOT BURN GARBAGE, GASOLINE, DRAIN OIL OR OTHER FLAMMABLE LIQUIDS!

WARNING! RISK OF FIRE – DO NOT OPERATE WITH FLUE DRAFT EXCEEDING -0.08IN WATER COLUMN!

WARNING! RISK OF FIRE – DO NOT USE CHEMICALS TO START UNIT FIRING!

WARNING! RISK OF FIRE – DO NOT BURN GARBAGE, GASOLINE, FUEL OILS OR OTHER FLAMMABLE LIQUIDS OR MATERIALS!

WARNING! RISK OF FIRE – DO NOT OPERATE WITH FUEL LOADING OR ASH REMOVAL DOORS OPEN!

WARNING! RISK OF FIRE – DO NOT STORE FUEL OR OTHER COMBUSTIBLE MATERIAL WITHIN MARKED INSTALLATION CLEARANCES!

WARNING! RISK OF FIRE – INSPECT AND CLEAN FLUES REGULARLY!

CAUTION! HOT SURFACES – KEEP CHILDREN AWAY!

CAUTION! HOT SURFACES – DO NOT TOUCH DURING OPERATION!

CAUTION! HOT SURFACES – MAXIMUM DRAFT MARKED ON NAMEPLATE.

DANGER – TO AVOID INJURY FROM MOVING PARTS, SHUT OFF THE BOILER BEFORE REMOVING/OPENING SERVICE PANELS AND DRAFT INDUCING FAN.

FOR INDOOR INSTALLATION ONLY!

IN THE EVENT OF A RUN-AWAY FIRE… CUT POWER TO UNIT, CLOSE LOADING AND ASH REMOVAL DOORS. IF POSSIBLE TURN ON CIRCULATION PUMPS/ZONE VALVES TO “DUMP” EXCESS HEAT.

USE COPPER CONDUCTORS ONLY

THIS WOOD HEATER NEEDS PERIODIC INSPECTION AND REPAIR FOR PROPER OPERATION. IT IS AGAINST FEDERAL REGULATIONS TO OPERATE THIS WOOD HEATER IN A MANNER INCONSISTENT WITH OPERATING INSTRUCTION IN THIS MANUAL

DO NOT TAMPER WITH OR REMOVE ANY COMPONENTS AND FOLLOW ALL INSTALLATION PROCEDURES IN THIS MANUAL.

THIS WOOD HEATER HAS A MANUFACTURER-SET MINIMUM LOW BURN RATE THAT MUST NOT BE ALTERED. IT IS AGAINST FEDERAL REGULATIONS TO ALTER THIS SETTING OR OTHERWISE OPERATE THIS WOOD HEATER IN A MANNER INCONSISTENT WITH OPERATING INSTRUCTIONS IN THIS MANUAL

WARNING: DO NOT OVER-FIRE! OVER-FIRING WILL CAUSE DAMAGE TO REFRACTORY AND GREATLY SHORTEN THE LIFE OF THE BOILER.

Introduction

The purpose of this manual is to assist you in the installation, operation and maintenance of your new boiler in order to achieve the best performance possible.

The SE110 is a wood gasification boiler designed to efficiently and easily burn cord wood. The SE110 was tested by Intertek laboratories according to: UL 2523, CAN/CSA B366.1-11, ASTM 2515-11, ASTM 2618-13. It was found to comply with the EPA 2020 particulate emission limits while burning cord wood. The SE110 is designed to produce 16,250-125,000 btu/hr.

We recommend that the unit be installed by a qualified installer who has a thorough knowledge of hydronic heating boiler systems and will comply with all of the requirements of the authority having jurisdiction over the installation ensuring that the necessary safety controls are installed and properly wired.

Read the entire instruction manual carefully and understand it thoroughly before installing or operating this unit. Save these instructions and review them periodically as an aid to maintaining your boiler and following safe operating practices.

All SE110 boilers can be supplied with the Warnock Hershey "WH" and/or the ASME "H" stamp with National Board number for an additional fee when requested prior to purchase. Alternate Heating Systems boilers are built to the most rigid quality control standard. You can be assured that you will receive the highest quality product.

EXPLANATION OF WOOD & BIOMASS COMBUSTION

The burning of wood involves a series of very complex chemical reactions that are time and temperature dependent. The pieces of wood (or particles) may be thought of as containers that store combustible gases that are released when heat is applied. The various gases that emanate from heated wood have ignition temperatures ranging from 540° F to 1125° F. This helps to explain why maintaining a high combustion temperature is so important in achieving "complete" combustion in burning wood. In a conventional wood stove a significant portion of the combustible gases released from the wood goes up the chimney unburned to become deposited on the chimney walls as creosote or escape as visible smoke. In the SE110™ a greater percentage of the combustible elements released from the wood are combusted due to the high temperatures attained, usually within even a few minutes of re-ignition.

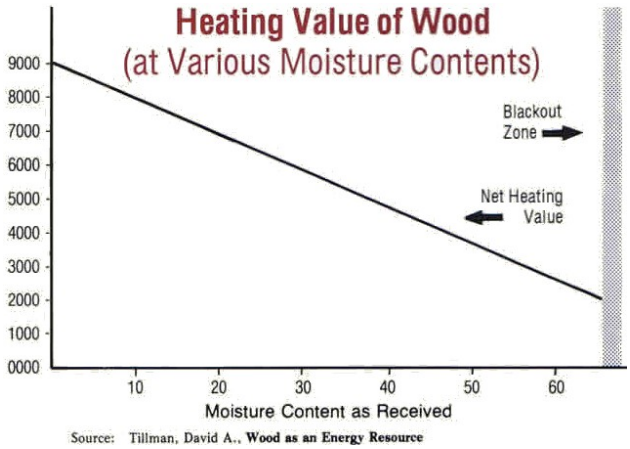
The time it takes for smoke to disappear from boiler exhaust on startup depends largely upon the temperature of the refractory. A boiler being fired from a cold start may emit some smoke for 10-30 minutes. When the boiler is reigniting after an off cycle (hot or warm start) there may be very little to no visible smoke. The length of the last firing cycle and the amount of elapsed time since the boiler last fired will affect refractory temperatures and the amount of visible smoke when the boiler re-fires. A SE110™ operating under normal load will produce only a small amount of smoke on startup and burn cleanly shortly thereafter.

WOOD MOISTURE CONTENT & WOOD GASIFICATION

The moisture content of wood is a critical factor affecting wood gasification, as it determines how rapidly pyrolysis (gasification) can occur. Wood moisture content moderates the rate of gasification by limiting the rate of heat gain in the wood. Wood with higher moisture content will gasify more slowly. Wood with excessive moisture content will not gasify until a large amount of water has been driven out of the wood. This consumes energy that would otherwise be usable heat. The dilemma that faces the boiler operator using higher moisture content wood is that the boiler must be operated so that more heat goes up the stack (in order to drive water vapor out of the system) or else the operator

will be faced with significant and troublesome condensation.

Wood with moisture content higher than 28% is more likely to produce condensation issues and will produce markedly less BTU's per pound of fuel.
You may not burn Unseasoned Wood!



Source: Tillman, David A., **Wood as an Energy Resource**

Very dry wood creates a different problem. With dry wood, pyrolysis temperatures are achieved more quickly and the rate of gasification is accelerated. This may result in the consumption of available oxygen faster than it can enter the boiler. The fire could then begin to release smoke due to a phenomena known as "back puffing"; "Back-puffng" results in smoke being pushed out through the intake in intermittent, and often audible, puffs. Low moisture fuel (< 10% moisture) requires special considerations for a satisfactory burn. Dry sawdust and shavings are less of a problem than kiln-dried solid blocks or logs.

With medium moisture wood, 19-29%, the combustion process is more constant, with pyrolysis and the combustion of gases and charcoal occurring close to a constant rate. This moisture content of 19-28% is optimum for burning wood in the gasification process.

Because of the downdraft design of the SE110™, the rate of air admitted to the unit is fairly constant regardless of the type and amount of fuel being burned.

Most pyrolysis occurs between 540° F (280° C) and about 900° F (500° C). The most abundant gases produced are carbon monoxide, methane, methanol, formaldehyde, and hydrogen as well as formic and acetic acids, water vapor and carbon dioxide. All of these elements must pass through the refractory combustion chamber where, in the presence of high temperatures and oxygen, they are reduced to carbon dioxide and water. By the time the temperature of the fuel reaches 900° F (500° C) pyrolysis is complete and the final solid product is charcoal, which is almost pure carbon.

MODE OF OPERATION

The SE110™ operates on the well known principle of gasification which makes it possible to burn wood at high efficiency and free of creosote formation in the chimney.

The bottom of the fuel chamber is lined with pieces of dense refractory casting, which make up the primary combustion zone. This combustion zone is linked to the fuel chamber by one opening. The gases produced from the pyrolysis of the fuel charge are drawn through the opening into the refractory combustion chamber where a very intense flame exceeding 1800° F (1000° C) is produced.

Heat generated in the combustion chamber radiates throughout the refractory mass heating the fuel charge above. As the fuel charge is subjected to heat, the moisture is driven from the wood and it begins to char, releasing a variety of combustible gases.

The gases produced during pyrolysis would not normally follow a downward path, so a draft-inducing fan is employed to create a partial vacuum that draws the flame through two tunnels in the refractory. These refractory tunnels make up the primary combustion area in the SE110™.

This long flame path provides sufficient retention time for the gases to cause near complete combustion to occur before the hot gases come in contact with the water-backed heat exchanger surface.

The mass of refractory that encompasses the combustion chamber also serves a second important function, acting as a heat store to initiate re-ignition after a period of no demand.

When the air valves close and the draft inducing fan stops, the fire is extinguished by lack of oxygen and becomes dormant. The fire will re-ignite once the air valves open and the draft-inducing fan is powered on, as long as the refractory still retains enough heat to cause combustion to take place. The fuel may remain dormant for periods of four hours or more depending on the temperature of the refractory at shutdown.

By burning wood in this way, fuel is burned at maximum efficiency, only as heat is required, and never as a low smoldering fire. Smoldering fires, and less than optimum fires, produce excessive amounts of creosote and smoke.

When a demand for heat exists, the water temperature will drop below Operating Limit, the air valves will open and the draft induction fan starts. At this time, abundant air is provided for combustion. When the boiler's water temperature reaches the level set on the Operate Limit, the fan stops and the air valve closes.

The fan that creates the negative pressure in the combustion chamber inversely produces positive pressure in the flue so it is very important to seal every joint of the stove pipe with silicone. This will ensure that no smoke or dust will escape into the room.

CAUTION! Positive pressure exists in the flue so it is very important to seal every joint of the stove pipe with silicone. Do not use barometric damper!

The SE110™ is very responsive to heat demand, especially when compared to conventional wood boilers. Because of this responsiveness, providing domestic hot water in the summer may be practical. Alternate Heating Systems cannot promise that summer time use of a SE110 will be practical for you.

If summertime hot water requirements are low it may be necessary to turn on the draft cycle timer to make the unit run for 15 minutes every 3.5 hours. This will prevent the fire from going out and more importantly will maintain sufficient temperature in the refractory to ensure complete combustion on start-up. This feature will provide heat until the timer reaches the end of the programmed cycle, or until the boiler temperature High Limit is reached.

Note: Some of the byproducts produced by incomplete combustion of wood are formaldehyde, formic acid and acetic acid, which are mildly corrosive. A SE110™ operating under light demand may never generate refractory temperatures sufficient to reduce these organic compounds to water and carbon dioxide. Any air leak around the doors or air valve may contribute to the formation of corrosive products. Therefore it is important to inspect your SE110™ regularly to ensure that it is being operated in a manner that does not contribute to excessive corrosion of the steel.

It is essential that all combustion air be prevented from entering the SE110™ at shutdown/off-cycle. Where a strong chimney draft is present during the off cycle, a unit with leaking door seals may allow a small amount of air to be pulled through the unit, supporting a low-grade fire. This produces two major undesirable results.

First, incomplete combustion yields creosote and other organic compounds, which are mildly acidic. These condense on the water walls of the load chamber and heat exchanger. If this situation is allowed to continue for any length of time, the heat exchanger will become coated to the extent that airflow and heat transfer are seriously impaired.

The second undesirable result is moisture condensation. This occurs because the low-grade fire produces insufficient heat to carry the water out the stack as water vapor. Water will likely be evident in the ash pan and, in severe cases, may even collect in the heat exchanger. This water comes not only from water moisture in the wood, but is formed as a byproduct of combustion. Excellent combustion will maximize the amount of the main byproducts of combustion, carbon dioxide and water. More water will be produced by good combustion than that

originally contained in well seasoned wood. Severe condensation can result in so much liquid water that it is misinterpreted as a boiler leak. When water is found in the cyclone and/or heat exchanger, attack the issue as one related to condensation.

Note: Condensation in the heat exchanger can be caused by wood that is too wet for the application and/or by low return water temperatures. Recommended return water temperature is 160F

Reduce or Prevent Condensation

Condensation has several causes, but can always be attacked systematically and greatly reduced or eliminated. Even in early fall and late spring, condensation can be kept under control. Keep in mind that because the SE110 swirl tube heat exchanger extracts so much heat from the exhaust, the gases leaving the system are often not far above temperatures that can lead to condensation, about 250F. Anything that compromises performance or cools stack gases further than normal can trigger condensation. Review this list and make changes that match your circumstances. Be sure to review the installation section of this manual that covers return water temperature.

- ✔ Increase return water temperatures (mixing valve, raise operating temperature)
- ✔ Increase overall boiler water temperature. Maximum recommended temp is 190F.
- ✔ Check for and correct any issues related to leaking door seals or Air Valve leaks
- ✔ Insulate stove pipe and/or chimney to preserve heat
- ✔ Increase heat load on boiler, which will increase run cycle length and decrease off cycle length
- ✔ Use wood that is 19-28% moisture.
- ✔ Clean boiler, or take other measures to improve air flow. Check your stove pipe and chimney.
- ✔ If you are observing back-puffing, take care of this issue promptly, as performance is compromised in a back-puffing boiler, possibly contributing to condensation
- ✔ Keep refractory relatively clear of charcoal and ash. The firebox should never have more than 1 in of ash in bottom. Scrap excess ash into center slot or shovel out.
- ✔ Watch loading technique and other firebox management aspects, making sure that the fire burns properly upside down.
- ✔ Do not overload the firebox. If you are getting more than 14 hr burn-times, lessen the amount of wood you load into the firebox. Fill only 1/4 – 1/3 full.
- ✔ Clean the boiler. Completely remove cyclone fan assembly and stove pipe.
- ✔ If you are experiencing water in the cyclone, removing the air turbulator may help.

Proper Pressurization of the SE110

The SE110™ is designed as a pressurized boiler system. Before leaving the factory, it is pressure tested for safety. Typical hydronic heating applications operate at pressures of about 12-18 psi. A pressurized system causes oxygen to be driven from the water reducing corrosion and oxidation. Rust and mineral buildup is avoided in a pressurized system because extra water is not continuously added to make up for evaporation losses. Keep the boiler and piping properly pressurized for long life. Be sure to review information in the installation section of this manual regarding expansion tank selection.

Boiler Installation

BOILER LOCATION

Indoor wood burning boilers are designed to radiate heat freely, but this heat can be dangerous if the boiler is improperly installed. The SE110™ is designed and certified only for indoor installations and therefore must be protected from the elements by being located in a totally enclosed and insulated shelter. The SE110™ must not be installed anywhere that gasoline, or other flammable vapors are present. Unless special preparations are made to partition off an area for the boiler and to prevent flammable vapors from entering the boiler area, a garage is not an approved location for a SE110™ installation. Check local building codes for restrictions on installation.

The boiler must stand on a noncombustible material such as brick, stone tile or concrete. NEVER place a boiler directly on a wood floor. The noncombustible material upon which the boiler stands should extend at least 6 inches beyond the base of the boiler in the rear and on the sides and at least 24 inches in front. The boiler must be installed in an area dedicated to the boiler and its related equipment. This area must be partitioned or separated from any living area of a residence. The room must have a constant fresh air supply to assure proper combustion of the fuel as well as ventilation of any by-products of combustion.

Boiler Room Requirements

1. The room should be well-lit and should have a source of emergency light.
2. A convenient water supply should be available for boiler flushing and to clean the boiler room floor.
3. Unobstructed floor drains.
4. A boiler must not be installed where there is the possibility of the accumulation of explosive vapors.
5. Must have adequate air supply, which must be kept clear at all times.

   a. Since the combustion process requires a supply of air at all times, it is essential that provisions are made to supply adequate air to the boiler room. This air supply is necessary to insure complete combustion and venting of any gases or smoke that would be emitted from this solid fuel-burning boiler in case boiler malfunctions. If fans are used in the boiler room or in the fuel storage room it is important they are installed in such a way that there is not a negative pressure in the room where the boiler is located.

6. Provide an electrical disconnect at point of entrance to boiler room.
7. Walls and ceiling must be of fire rated construction. Consult local or state codes for requirements.
8. It is recommended to have at least one week worth of fuel inside and kept out of the weather. Do not store fuel within the appliance installation clearances or within the space required for fueling, ash removal, and other routine maintenance operations.

RIGGING AND POSITIONING OF BOILER

Do not attempt to move or off-load the boiler without the aid of a crane or dolly. Your Alternate Heating Systems boiler has a lifting lug in the center of the top.

Once on the floor where it will be installed the unit may be rolled on pipe. Use caution whenever moving a boiler. Be sure to use proper equipment and have sufficient manpower available to prevent injury or damage that can be caused by improper handling heavy equipment. The boiler must be placed on a concrete slab or other rigid pad of non-combustible material with sufficient strength to adequately support the boiler including its contents of water. The boiler should be positioned as closely as possible to the chimney. The smoke pipe must pitch continually upward toward the chimney and be as straight as possible (no more than 2 elbows can be used before the chimney). Level the boiler after it has been positioned.

Before proceeding with installation, inquire with local building officials to confirm compliance with that building, plumbing and electrical codes. Alternate Heating Systems recommends that a qualified technician experienced in boiler installations perform the installation of the SE110™. Wiring on the boiler must be properly grounded.

CLEARANCES TO COMBUSTIBLES REQUIRED FOR SAFETY AND OPERATION

The required minimum clearances to combustibles for all models are:

Clearances to Combustibles

Front	**24 Inches**
Rear	**6 Inches**
Left	**6 Inches**
Right	**6 Inches**
Top	**6 Inches**
Under	**Noncombustible only**
Stovepipe	**18 Inches**
Flooring	**Noncombustible only**

Clearances to Combustible Flooring:

The noncombustible material upon which the boiler stands and under the unit should extend at least 8 inches beyond the base of the boiler in the rear and on the sides and at least 24 inches in front. If the chimney connector runs horizontally, the floor

protector must extend 2-in beyond each side of the connector.

Most municipalities require a specified clearance between the flue pipe and combustibles (normally 18 in). The customer/installer must follow all local and state building codes for clearances. The above dimensions are to be regarded as minimums.

Extra clearance is recommended to allow for easy movement around the boiler for cleaning and/or maintenance. Refer to Appendix A for exterior dimensions of the various models.

Recomended Clearances for Operation

- Front – 48 inches

- Rear – 30 inches

- Left – 6 inches (50 inches with backup)

- Right – 24 inches

- Top – 12 inches

Minumum recommended room size for the SE110 is 11 feet front to back, 6 feet (10 feet with backup) left to right and 6 feet tall.

It is necessary to adhere to the clearances and restrictions that are described in this manual. Extensive research and testing has been conducted to assure that these units are safe when operated according to the instructions included in this manual.

INSTALLATION AND MAINTENANCE OF ELECTRICAL CONTROLS AND GAUGES

- Temperature/pressure Gauge

Insert the temperature/pressure gauge into the tapping located on the top of the boiler at the front right. Refer to Appendix A for details on tapping sizes and locations.

- High Limit Aquastat

The high limit aquastat occupies the tapping on the top-left on the top of the boiler.

- Thermocouples

The boiler has two thermocouples one for the water and one for the exhaust. The water thermocouple will be in the top-right tapping of the rear of the boiler. The Exhaust thermocouple will be mounted on the cyclonic ash seperator along with the O2 sensor.

For detailed wiring and control diagrams, consult Appendix B: Wiring Diagrams. When installing the L.W.C.O. refer to directions in a later section.

Testing the Aquastat

In rare cases it may be necessary to test the controls and gauges. First turn the power off. To test an aquastat. Turn the dial 20° past the boiler water temperature. Use an ohmmeter to test the terminals for continuity. If the contacts are closed before you turn the dial it should open afterward. If it is opened before you turn the dial it should be closed afterward. It can be common that the contacts engage or disengage +/-5° from the reading of the temperature gauge due to slow water circulation in the boiler vessel. If the temperature difference is more than +/-5° than the aqua stat should be replaced. If there is a discrepancy in the temperatures, be sure that the temperature gauge is accurate. This can be done by testing the boiler water temperature with a second thermometer or temperature gauge.

Low Water Cut Off

A low water cutoff (LWCO) is an electrical device that can sense the presence of water, and then activates a switch. This switch will turn the unit off if no water is sensed. In a boiler water keeps the metal cool, if the boiler is low on water the steel, in some cases, can become super heated and will warp and crack. This problem is eliminiated by installing a low water cutoff.

A low water cutoff is not needed in every install. Check you local codes and with your insurance company to see if it is required.

For installation instructions find the Low Water Cutoff section later in this manual.

Boiler Controlled Circulator/Zone

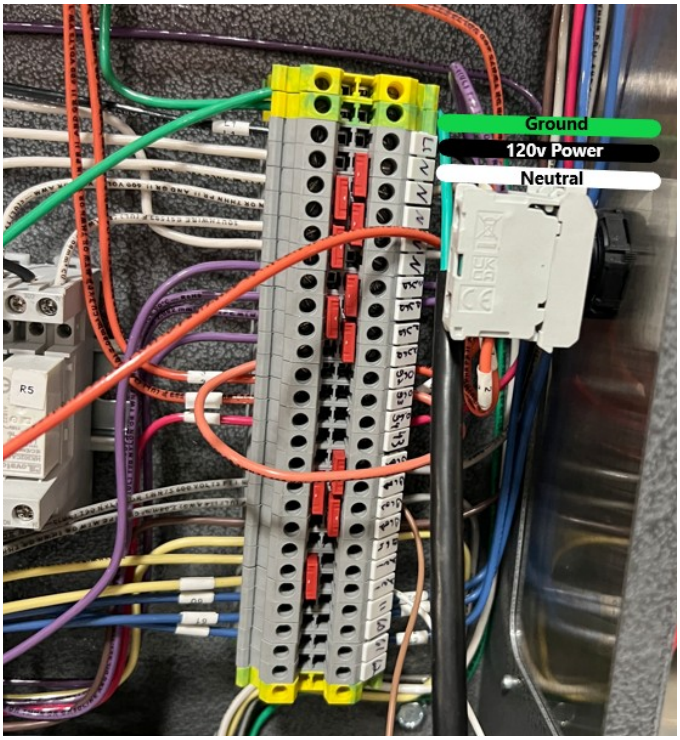
The SE110 has the ability to control a circulator or zone, which will circulate water through the boiler

when it is on and only if the water is above the set temperature. The Black 30 in the 4x4 junction box for accessories, pictured in the Smoke Hood Installation seciton, comes from the boilers circulator relay (R5) (amp @ 120vac). Power of your choice will need supplied to terminal #22 of the R5 relay via the Black **31**. Black **30** will then be used to power the pump/zone. This output can be turned on and off and the temperature can be changed from the "Operating Limits" screen.

CONNECTING POWER TO THE BOILER

Connect electrical service of 120VAC with a minimum circuit ampacity of 15 amp. Provide an electrical disconnect at the entrance of the room.

Connect the electrical service to the main control box on the left side of the boiler. You will need to remove both the access panel and the controller panel. Use an empty 7/8 inch knock-out hole to bring the wires into the control box. Land the Input 120vac power on the L1 terminal, land the neutral on the 'N' terminal and land the ground on the Yellow/green terminal.

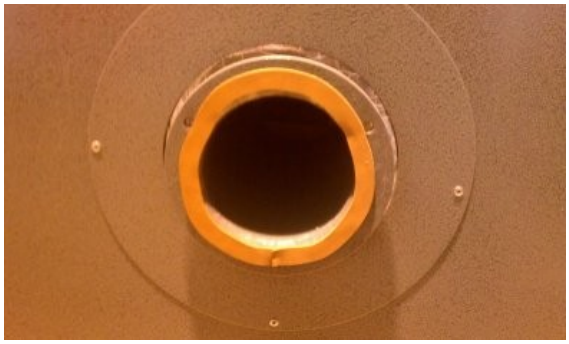


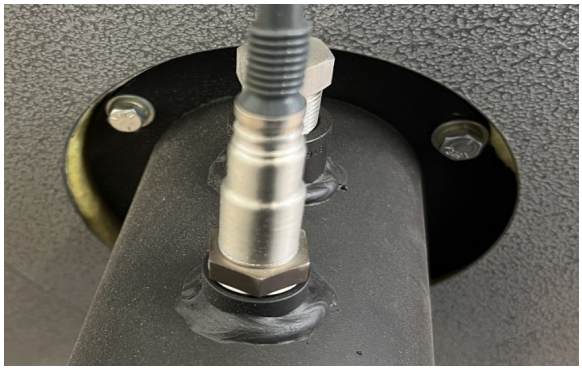
Power Input Wiring

CYCLONE ASH COLLECTOR

Once the SE110™ has been positioned, the cyclone ash collector should be attached to the flange on the left side of the boiler (see Appendix C: Exploded Parts Drawings).

Apply a strip of 1/8 in x 1/2 in self-stick sponge rubber (included with boiler) or a bead of RTV red silicone to the boiler flange inside of the mounting holes before attaching the cyclone to the boiler flange using three 5/16 in x 3/4 in bolts and washers. To apply sponge rubber, carefully remove the paper backing from the rubber strip to expose the adhesive. Overlap the strip approximately 1 inch and cut off the excess material with a knife or scissors. The adhesive will hold the gasket in place until the cyclone assembly is positioned.





Cyclone Installation

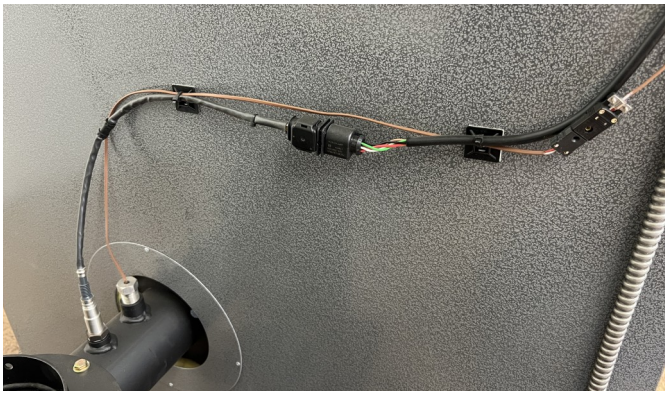
Installing the O2 Sensor and Flue Thermocouple

After the Cyclone is installed you can install the O2 sensor and the flue thermocouple. The cyclone has two threaded ports one is 1/2npt fot the thermocouple, the other is M18 x 1.5mm for the O2 Sensor. Befor threading these into their ports use a small amount of RTV silicone or nickel antisieze to seal the threads.

Once both are threaded you will need to plug them in. Their plugs will come out of the bottom of the main control box through the 1.25 inch hole.

The polarity of the thermocouple wires are critical.

After the oxygen sensor and the exhaust thermocouple are tightened connect their cables. Use the sticky pads and zip ties to organize the cables.



O2 Sensor and Thermocouple wires

INSTALLATION OF SMOKE HOOD OPTION

AHS recommends the Smoke Hood (exhaust) for most installations inside the home. The Smoke Hood functions in much the same manner as the range hood over a kitchen stove. It vents smoke escaping from an open load door directly to the outside. It must be separate from the chimney vent, and may go through a side wall or ceiling. Use 5 or 6 inch stove pipe and a vent flap to prevent outside air from entering when the smoke hood is turned off. Use of 6 inch stove pipe will require use of an adapter, but venting performance will be better with larger stove pipe.

Smoke Hood

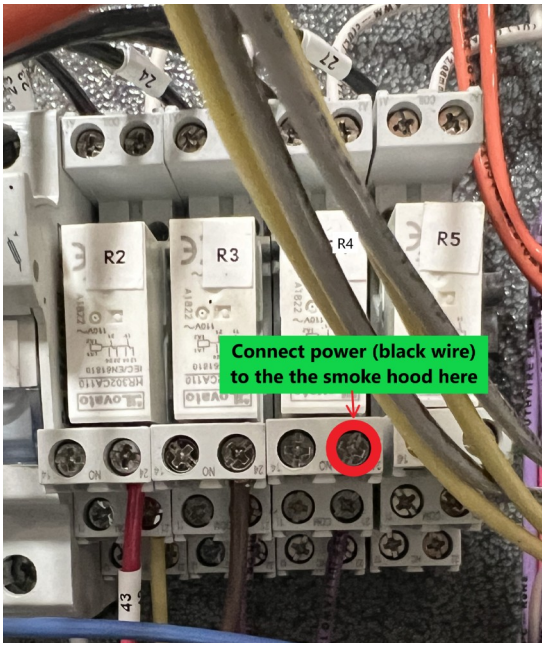
The smoke hood is turned on manually as needed, typically just before opening the load door to add fuel.

Smoke is most commonly seen when the load door is opened with considerable fuel still left burning in the firebox. Smoke escape is also common when refractory is at good operating temperature and the firebox is being filled completely.

Installation is easy. First remove the rectangular sheet metal knock-out in the top sheet metal. Using a long knife cut the fiberglass insulation along the newly created hole.

Center the smoke hood assembly over the hole and use the four phillips self-tapping screws to secure the blower assembly in place.

The 6' long conduit (this can be shortened if needed) will run into the top of the main control box. Connect the White into the 'N' terminals, Green into the Green/Yellow terminals, and Black will go to terminal 24 on the R4 Relay. See picture below.



Smoke Hood Wiring

INSTALLATION OF SMOKE DETECTORS AND CO MONITORS

Any fuel burning appliance produces smoke whether or not it is enough to see or not is a different question. The amount of CO and smoke emitted is somewhat dependent on the operator.

The levels emitted will increase if operated incorrectly. For best practices see the Operation Information section.

CO (carbon monoxide) is dangerous byproduct of all fuel burning appliances. CO is a colorless tasteless gas that settles on the ground, as it is heavier than oxygen. You will have absolutely no issues with either smoke or CO getting into your living spaces if you follow this manual entirely. But just to be safe we recommend installing CO monitors and smoke detectors.

Do not install the boiler in a sleeping room!

Install a CO monitor in the room where the heater is located, at about table height.

Install a Smoke detector in the room where the heater is located, if installed too closely to the heater it may false trip when loading the heater. It is also recommended to install smoke detectors inside each bedroom, outside each sleeping area and on every level of the home, including the basement.

General Chimney Introduction

One of the most important considerations in installing a boiler is the type of chimney that will be used. The condition and construction of the chimney is important to providing sufficient draft. It is very important not to connect to a chimney/flue serving another appliance.

CAUTION: DO NOT TO CONNECT THIS UNIT TO A CHIMNEY/FLUE SERVING ANOTHER APPLIANCE.

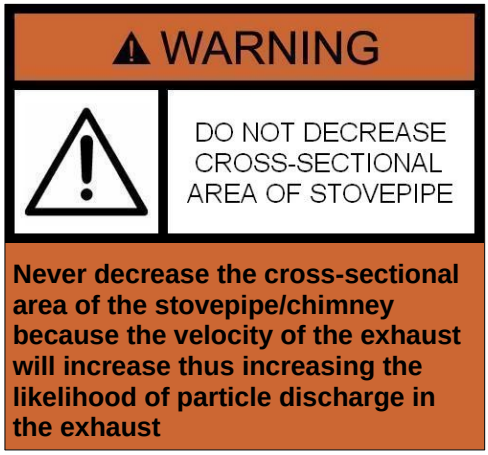
Specific Chimney Requirements for the SE110™

The SE110™ creates its own draft; therefore having sufficient height in the chimney is not an issue. We recommend a chimney height of no less than 15 feet and no more than 40 feet.

Excessive chimney height can allow for more cooling of exhaust gases and lead to condensation issues. Other aspects of chimney construction that lead to condensation include use of a masonry chimney that lacks an insulated liner. Having such a chimney on the outside of the house compounds this problem as well. Because of the high efficiency of the SE110, and resultant low stack temperatures, it is important to try to preserve exhaust heat. Always check with your local building inspector and insurance agent to assure compliance.

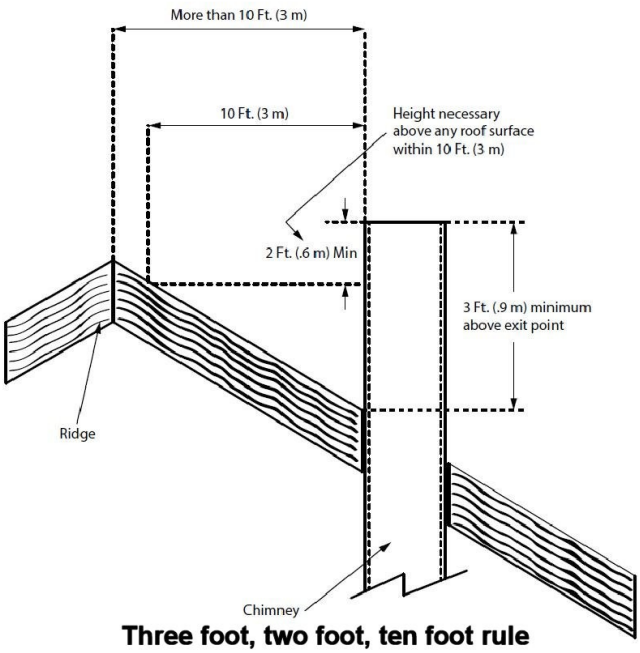
Stovepipe should be sized as follows:

✔ SE110 = 6 IN diameter.



Never decrease the cross-sectional area of the stovepipe/chimney because the velocity of the exhaust will increase thus increasing the likelihood of particle discharge in the exhaust

Technical Aspects of Chimney Performance



Three foot, two foot, ten foot rule

3-2-10 Rule for Chimneys

The chimney should extend several feet above the highest part of the roof to prevent downdrafts. Follow code requirements for your area and consult a chimney professional. Keep in mind the 3-2-10 rule, as depicted below. The chimney must be leak-free from the standpoint of air entering through cracks or other chimney defects or through loose stovepipe fittings.

Draft

Draft is created by a pressure differential between the bottom and the top of the chimney. Chimney height, air moving across the top of the chimney, and warmer air in the chimney than outside will all result in greater pressure differences and stronger draft. A warm chimney drafts better than a cold one. For this reason a chimney drafts best when kept warm. It is more difficult to maintain sufficient temperature in an exposed chimney. A larger chimney, or one with a lot of thermal mass will also present more problems than a chimney that is protected from outside temperature extremes. A chimney must be kept warm (about 250° F) for proper draft to occur. A

chimney's height, expressed as the difference between the top opening and the flue pipe connection on the appliance, contributes to draft because atmospheric pressure is naturally lower at the chimney top than bottom.

⚠ CAUTION

CREOSOTE BUILDUP PROBLEMS

Poor chimneys with cold walls can cause creosote buildup. Sharp bends and horizontal flues should also be avoided. The exhaust must be kept moving through the piping/flue to prevent creosote or fly ash buildup. If a horizontal section must be used, it must rise slightly to prevent dead air space.

Barometric Damper

A barometric damper is a device that allows room air to enter the chimney, bypassing the air intake on the heater. A heater and chimney combination that drafts well will occasionally produce more draft than is desired. Excessive draft can lead to burning out of control and excessive heat production. It will also lead to reduced efficiency, as more heat will end up going up the chimney. A barometric damper is used on a coal fired heater to limit maximum draft to -.08 column inches. However a barometric damper is not ever needed to be used on a SE110. The draft inducer produces the exact draft needed.

Manometer

A device called a manometer is used in measuring the technical performance of a chimney. A manometer is an instrument used for measuring the pressure of liquids and gases. An analog manometer consists of a glass tube filled with a liquid and mounted in front of a measuring scale against which the liquid level can be measured. If a manometer were connected to a leak-free chimney with a leak-free connection, then the draft in the chimney should exert enough pressure (or pull) against the water in the manometer to cause it to move at least -.04 inches in the tube. For units to be operated safely, limit maximum draft to -.08 inches.

Dwyer Manometer

Measuring the draft of the chimney connected to a SE110 is not as critical as it is to other types of appliances, but it does ensure there are no major leaks in the chimney where smoke can escape.

To measure the draft, fire the unit until the flue is at least 250F. Drill a hole in the connector pipe and attach a draft meter or manometer. First, check the draft above the barometric damper (if installed). Then check it below the barometric damper and make your damper adjustment to where it opens to prevent the draft from going higher than -.08 inches of water column. If the chimney is incapable of supplying the required draft of at least –0.04inWC, it will need to be improved. See the section on Common Chimney Problems for more information. Completely seal all holes created once finished checking draft.

Masonry Chimneys

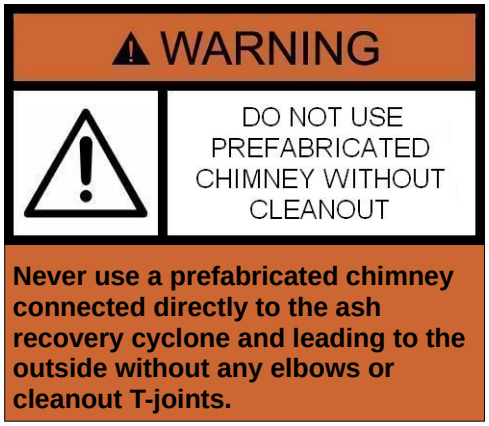
If you plan on using a preexisting masonry chimney, have it thoroughly inspected and cleaned. Any faults which make the chimney unsafe and unusable must be repaired prior to use. These can include improper height, structural defects, blockages, inadequate clearance to combustibles, unsealed openings into other rooms of the house, signs of creosote or smoke leakage, a loose or absent clean-out door, or absence of a liner.

When connecting to a masonry chimney, several provisions are standard. First, whether the chimney connector is vented to the chimney through a

thimble or a breech pipe, neither must pass beyond the inner surface of the chimney liner, and both must be firmly cemented in place with refractory cement. (A thimble is a masonry pipe which is inserted through the chimney wall, and is frequently the preferred method; a breech pipe is a piece of steel pipe used the same way.) In Canada, a breech pipe has ridges or protrusions to lock it firmly into the refractory cement. In either case, the chimney connector vents to the chimney through the thimble or breech pipe. See wall pass-through information in the section on stove pipe.

Prefabricated Chimneys

When venting your boiler using a prefabricated chimney, be sure to contact local building code authorities, and to follow the manufacturer's instructions exactly. Use only the manufacturer's parts; do not use makeshift installation techniques. All prefabricated chimneys must be tested to either the U.S. or Canadian high-temperature standards, UL 103 or ULC-629.

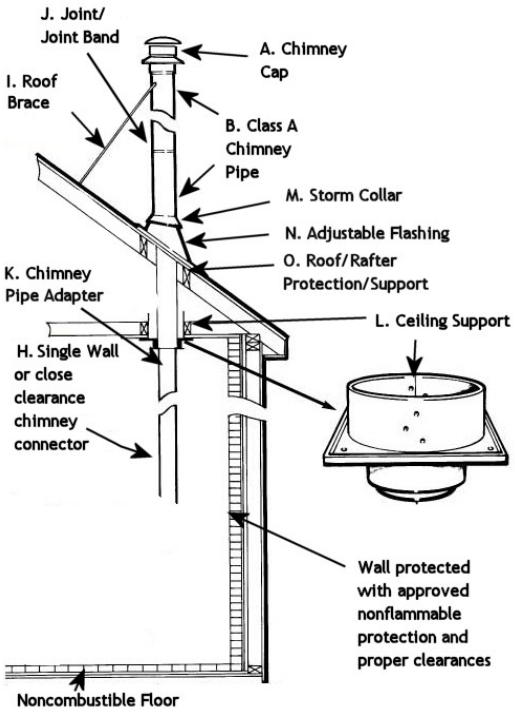


Never use a prefabricated chimney connected directly to the ash recovery cyclone and leading to the outside without any elbows or cleanout T-joints.

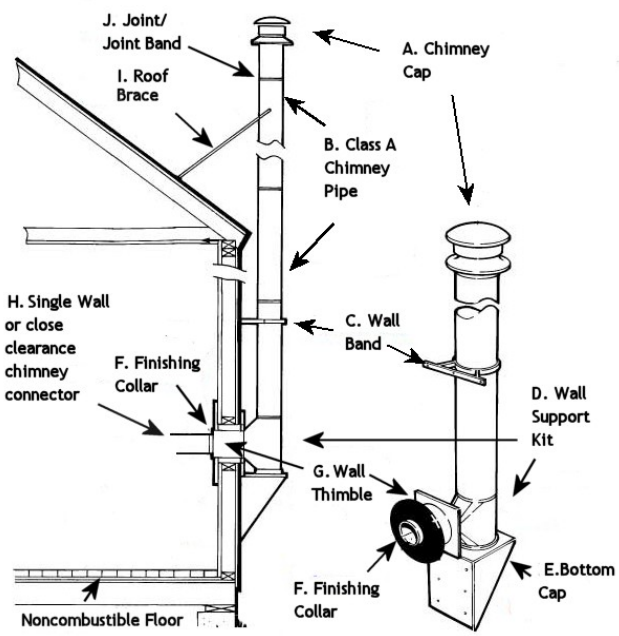
Your manufactured chimney may contain more parts than is shown in the subsequent diagrams. Include all required items in your installation. A chimney cap (A) serves to keep rain and snow from entering the chimney. An approved Class A chimney (B) is required for the SE110. Wall Bands (C) must be deployed for support per manufacturer's recommendations. A manufacturer's Wall Support Kit (D) will contain required items for supporting the chimney. Such kits will cost less than individual items purchased separately. A Bottom Cap (E, location marked, but actual cap not shown) allows for cleaning. A Finishing Collar (F) provides inside wall protection. A Wall Thimble (G) provides for required clearance between the chimney pipe passing through a flammable wall. The Chimney Connector (H) must be approved single wall, or a low clearance pipe, installed with required clearances in place. A Roof Brace (I) is required for chimneys that extend more than a certain distance, as referenced by the manufacturer's instructions, from the roof. Manufactured chimneys may feature a built in "twist lock" at each joint, but a Joint Band (J) is still normally required to secure pipe at the joint. An approved Chimney Pipe Adapter (K) is required. A Ceiling Support (L) will provide structural support for the chimney and is typically part of a kit that includes items that maintain required clearances to flammables. A Storm Collar (M), and Adjustable Flashing (N) prevent water from entering the home by running down the outside of the chimney. Additional items or a kit (O) provide additional mounting support or fire protection to the roof joists or other roof components.

Note: Do not decrease the diameter of chimney pipe to less than that of the flue collar! Chimney connector and flue must be 6 inches in diameter or greater

Inside Chimney



Outside Chimney



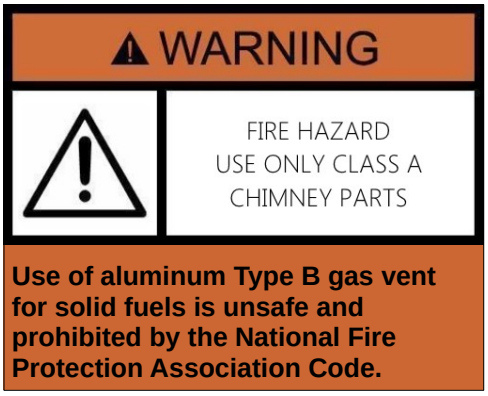
PROPER CHIMNEY CONNECTION

The boiler must be connected to a Class A chimney. Use of aluminum Type B gas vent for solid fuels is unsafe and prohibited by the National Fire Protection Association Code. There are three types of Class A chimneys:

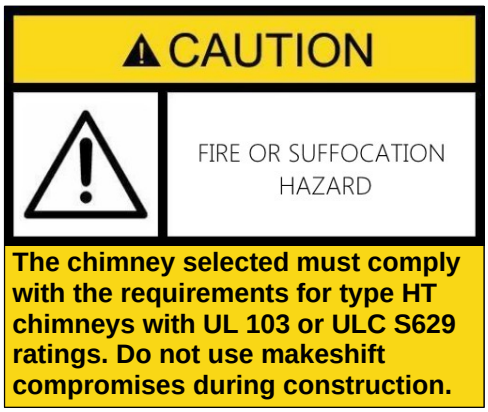
1. Masonry with a tile liner, including brick, block, stone, etc. It must be supported by a ground-level foundation.

2. Insulated "Class A" manufactured chimney, listed and certified by a national test agency (UL 103 or ULC 629).

3. Triple-walled metal "Class A" chimney, listed and certified by a national test agency(UL 103 or ULC 629).



If your masonry chimney has not been used for some time, have it inspected by a qualified person (building inspector, fire department personnel, etc.). If a listed and certified manufactured chimney is to be used, make certain it is installed in accordance with the manufacturers instructions and all local codes. Use only the manufacturer's parts, and use all parts required in order to follow the manufacturer's guidelines. Do not use makeshift installation techniques. A SE110 can perform only as well as its venting system allows it to.



STOVEPIPE

It is recommended that overall flue connecting pipe length be kept to a minimum. Any horizontal runs must slope upward towards the chimney, with a minimum rise of 1/4 inch per foot. Use a minimum number of elbows, preferably no more than two, to make the chimney connection.

Particular attention should be paid to the point where a flue passes through a wall or ceiling. The pass-thru should always be made with insulated pipe and the proper accessories or use of a thimble that provides a diameter of not less than three times the diameter of the stovepipe. If the chimney must go through a combustible wall, be sure to use a metal thimble specially designed for this purpose. The proper way to install a thimble is to cut an oversize hole in the Sheetrock about 6 or 7 inches larger than the thimble. However, be sure to follow the manufacturer's directions that come with the thimble. A metal ring shield is used to cover the hole. This way air can circulate and cool the area around the passageway.

Excessive weight of pipe placed on the boiler must be avoided. Utilize ceiling, roof or other supports to avoid adding too much weight to the boiler's flue connection.

Fires of low intensity, or low smoldering fires are likely to produce creosote buildup. Tars and other organic vapors combine with moisture from the fuel and from combustion byproducts to form creosote. The more time the boiler is fired with wood at low fire, the more opportunity for buildup of creosote inside the stove pipe and chimney. Inspect at least twice monthly, and remove if buildup occurs.

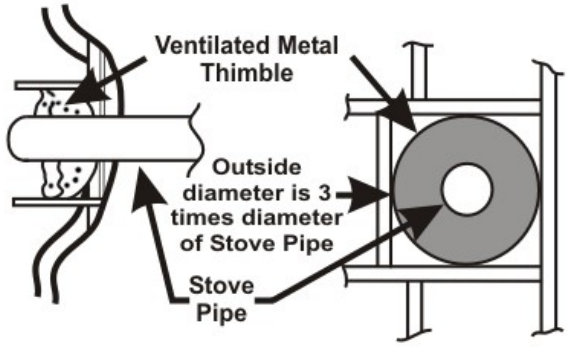
If creosote has accumulated it should be removed to reduce the risk of a chimney fire

Use 24 gauge or heavier single wall stove pipe in open areas no closer than 18 inches from walls or ceiling. If the stovepipe must be closer than 18 inches from the nearest wall or ceiling, or if it must go through walls, closets, or boxed in areas, then UL listed insulated stovepipe must be used. Pipe that runs along the outside walls of a building must also be UL listed insulated pipe, even if it runs along a non-combustible outside wall. This requirement is in place in order to prevent cooling of the stovepipe which in turn cools the rising smoke and causes creosote to form quickly. The diameter of stovepipe must be at least 6 inches.

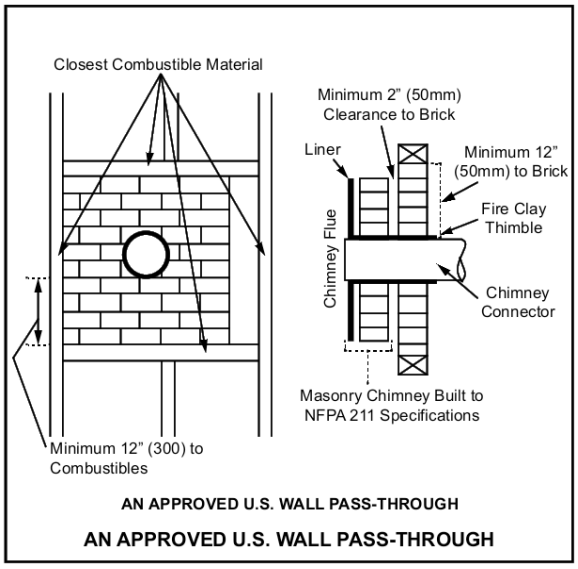
Wall Pass-Through: United States

In the U.S., the national code is NFPA 211. While many localities adopt this standard, be sure to check with local authorities before beginning your installation. The NFPA (National Fire Protection Association) permits four methods for passing through a combustible wall. A commonly used method to pass through a wall directly to a masonry chimney is to clear a minimum 12"(300 mm) around the entire chimney connector, and fill it with brick

masonry which is at least 3.5"(90 mm) thick. A fire-clay liner, minimum 3/8" (9 mm) wall thickness must run through the brick wall to the chimney liner (but not beyond the inner surface of the liner). It must be cemented in place with refractory cement. This method is illustrated. For details on the other three options, refer to the most recent edition of the NFPA 211 code.



Stove pipe passing through wall

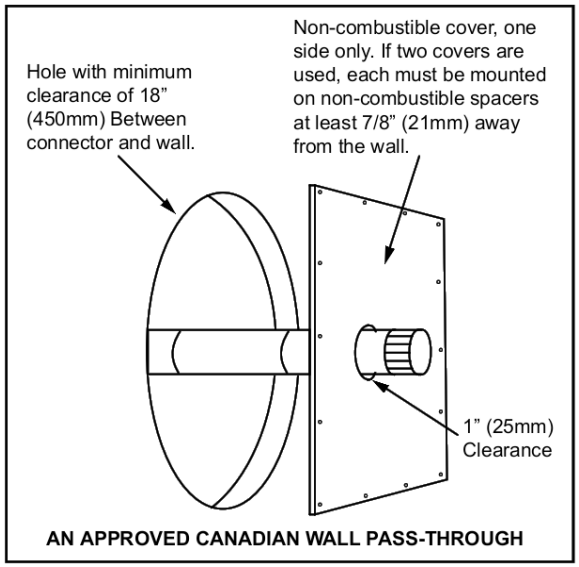


AN APPROVED U.S. WALL PASS-THROUGH

U.S. Wall Pass-Through

Wall Pass-Through: Canada

Three methods are approved by the Canadian Standards Association. The diagram following this paragraph shows one method requiring an 18" (450mm) air space between the connector and the wall. It allows use of one or two covers as described in the diagram. The two other methods are described in detail in the current issue of CAN/CSA B365, the national standard.



Canadian Wall Pass-Through

COMMON CHIMNEY PROBLEMS

In order to have a properly operating heating system, the chimney needs to be capable of providing sufficient, but not excessive draft. The approach to improving draft in an existing chimney may include one or more of the following: raising chimney height, adding or changing the flue liner, or selecting a different style of cap to be placed on the top of the chimney. Reasons for insufficient draft include (but are not limited to) the following:

Note: Chimneys need regular maintenance and cleaning. If a chimney is not cleaned on a frequent basis, it will affect draft, as well as be a contributing factor to a potential chimney fire.

1. Leaking chimney - Air leaking in around a loose fitting clean-out door, joints or seams in connector pipe are not secured properly, cracks or other defects in masonry.
2. Chimney needs to be cleaned.
3. Improper chimney height - Chimney does not extend to a sufficient height above the roof line. (Remember the 3 ft.-2 ft.-10 ft. rule)
4. Obstructions in the chimney - Make sure the chimney has been cleaned. Different animals have been known to build nests in chimneys.
5. Trees or other topographical barriers - Trees that are taller than the house can cause the

air currents to flow downward over the peak of the roof. This would lead to a down draft effect on the chimney. This can also be caused by adjacent buildings or structures. It could even be from a different peak on the same structure.

6. Improperly sized flue - Too small of a chimney is incapable of moving the volume of air necessary. Too large of a flue could have trouble warming up to create the necessary upward flow.
7. Chimney offsets - Offset chimneys should be avoided if possible. Not only can the offset affect draft, it is also a place for debris to collect over time.
8. Too many elbows - The flue connector has more than two elbows in it. Sometimes, depending on overall chimney performance, one elbow could be too many.
9. Vent sharing - No more than one heating appliance shall vent into a single flue.

If smoke is observed puffing out of the stove or connecting pipe, it is likely that there is an issue with draft. Review the above list for potential causes. If draft is excessive, review instructions on installing a barometric damper.

OPTIONAL DIRECT VENT INSTALLATIONS

The SE110 non-backup boilers can be installed with out the use of a traditional vertical chimney. SE110's are equipped with a powerful mechanical draft motor which creates a forced draft in the chimney. This is why you must seal all joints even in a traditional chimney setup.

To install your SE110 with a horizontal direct vent exhaust follow the steps and guidelines in this section. Always follow NFPA 211 guidelines as well as other national, state and local guidelines. You will also need to purchase the Direct Vent Kit from Alternate Heating Systems.

The Direct Vent Kit comes with the air intake adapter to duct the air down to the floor. It will also come with a differential pressure switch. This switch will need wired into the touchscreen contoller

CHECK WITH YOUR LOCAL BUILDING INSPECTOR FOR REGULATIONS CONCERNING FLUE INSTALLATIONS. SOME AREAS MAY ONLY ALLOW A TRADITIONAL VERTICAL FLUE AND SOME MAY HAVE MINIMUM FLUE HEIGHT REQUIREMENTS.

You may use 6" single wall stove pipe from the cyclone ash seperator to the wall but must maintain minimum 18" clearance to combustibles. To go through the wall us a 6" UL 103 rated insulated pipe and wall thimble. Most UL rated insulated pipe has a 2" clearance to combustibles. See the Wall Pass Through section of the manual.

Support the horizontal 6" stove pipe at least every 6 feet.

All joints, both inside and outside of the building, must be caulked with silicone caulk and sealed With self-adhesive aluminum tape.

Strictly follow the flue manufacturer's installation instructions. A 2" clearance must be maintained around the insulated flue.

Support all flue components to ensure structural integrity during the life of the flue. Use only noncombustible (i.e. steel, aluminum, etc) materials for such supports and generally follow the flue manufacturer's recommendation.

Exhaust Discharge Clearances

As with any wood heating device, sparks may be occasionally expelled from the flue of the SE110; therefore it is important to comply with the following requirements. Flue gas discharge clearances are defined in NFPA 211 as well as national and state codes:

- Flue gas shall be discharged a minimum of 36" above grade.
- Flue gas shall be discharged must not be less than 2 ft (0.61 m) from an adjacent building

and not less than 7 ft (2.1 m) above grade where located adjacent to public walkways

- The exit terminal shall be arranged such that flue gases are not directed so they jeopardize people, overheat combustible structures, or enter buildings.
- Forced draft systems and all portions of induced draft systems under positive pressure during operation shall be designed and installed to be gastight or to prevent leakage of combustion products into a building.
- Through-the-wall vents for gas appliances shall not terminate over public walkways or over an area where condensate or vapor could create a nuisance or hazard or could be detrimental to the operation of regulators, relief valves, or other equipment.

A horizontal flue shall **NOT** be used and flue gas should **NOT** be discharged horizontally:

• Within 20' of any air inlet into any building

• Within 20' horizontally of any door, window, inside corner or gravity air inlet into any building or structure.

• Into a confined space between two buildings or structures.

• Into an area that naturally collects leaf, paper or other air borne debris that is combustible.

• Onto a parking lot or into an area where vehicles may park.

• Closer than 24" from building siding when the discharge is aimed away from the building.

• When the siding is wood, vinyl, or any combustible material.

• When soffit is vented and/or constructed of combustible material.

• Into the wind as sparks may blow back against the building during higher wind conditions. Always locate the horizontal flue so that exhaust gases move away from the building in the downwind direction during the heating season.

The flue will extend horizontally through the wall using UL rated insulated pipe and UL rated thimble. The flue should terminate no closer than 24" from the building's siding. A single wall, 6" diameter, adjustable stainless steel elbow will be used to divert the flue gases downward into the metal container. Fasten the elbow to flue with three self-tapping sheet metal screws.

For a horizontal flue installation, a metal container partially filled with sand must be placed below the angled stainless steel elbow to catch any fly ash or sparks that may exit the exhaust. Do not use a plastic or any combustible container. A spark arrestor of ½" mesh wire screen must be fastened over the top of the container to prevent the entrance of dry leaves, animals, birds, etc into the container.

The metal container must be at least 2' laterally from any surface and the top of the container must be 6' below any surface (such as a soffit). The metal container must be equipped with a spark arrestor. The spark arrestor is as simple as a 316 stainless steel mesh with ½" square holes. Cut a hole the size of the elbow in the screen where the flue enters the metal container.

Make sure the spark arrestor complies with NFPA 211 "Standard For Chimneys, Fireplaces, Vents, And Solid Fuel-Burning Appliances"(2013) section 4.6.4 *Spark Arrestors.*

Care should be taken that the hot surfaces and gases do not present a hazard to any person who might frequent the area.

Support all flue components to ensure structural integrity during the life of the flue.

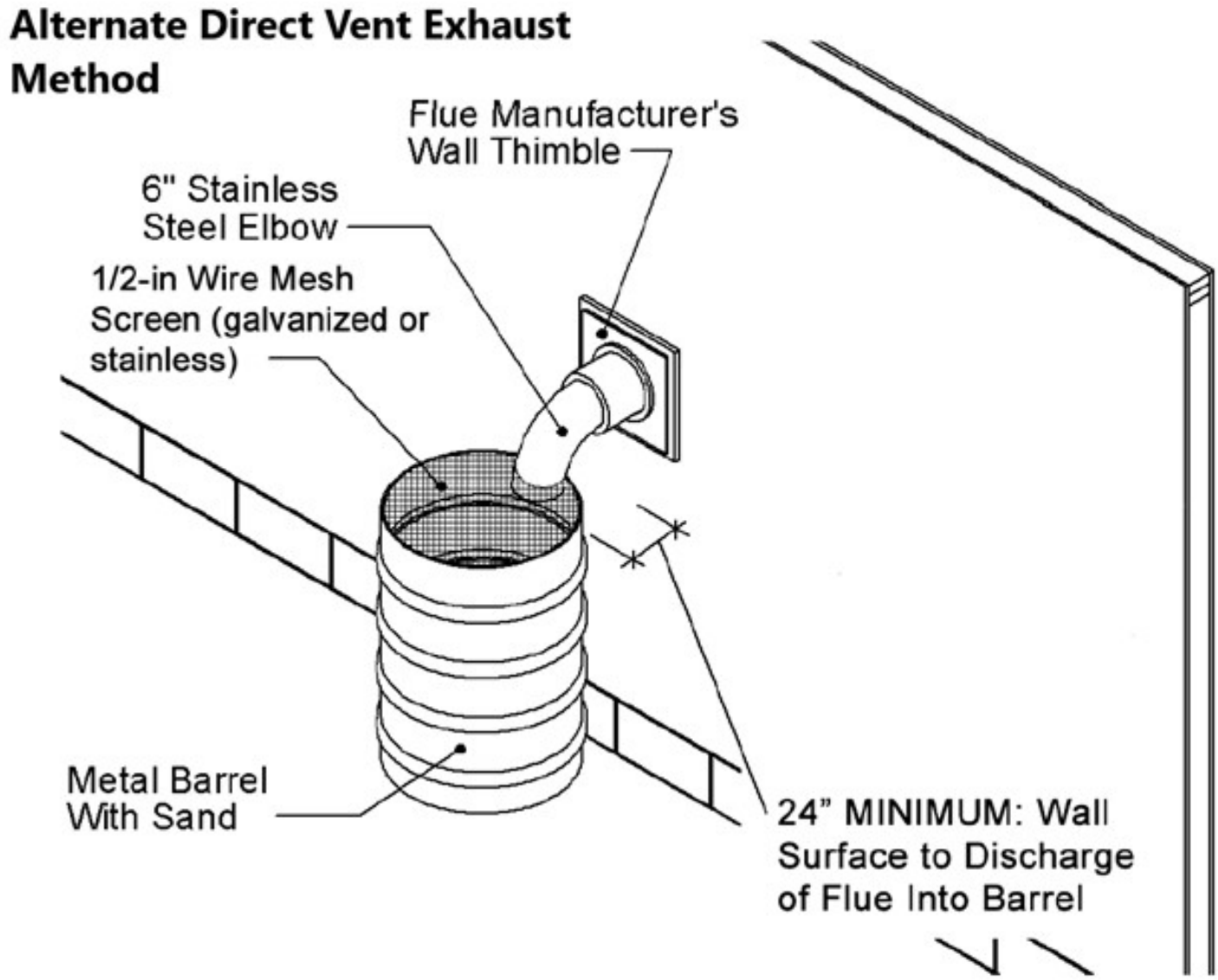
Use only noncombustible (i.e. steel, aluminum, etc) materials for such supports.

Depending on the fuel used and frequency of firing, the volume of initial smoke coming from a horizontal sidewall flue may be a nuisance. If windows or doors are in or near the smoke path, a

vertical flue must be used. **Some staining of siding materials will occur.**

MAINTAIN A CLEAN AREA FREE OF ANY COMBUSTIBLE DEBRIS SUCH AS LEAVES, TREES, PLANTS, GRASSES, PAPER, WOOD, TIRES, OIL, ETC FOR A MINIMUM DISTANCE APPROXIMATED BY A CIRCLE WITH A RADIUS OF AT LEAST 20' CENTERED ON THE FLUE ELBOW DISCHARGE.

ANY ACCUMULATED ASH AND CREOSOTE ON THE METAL CONTAINER SHOULD BE REMOVED PERIODICALLY TO MINIMIZE THE POTENTIAL OF A CREOSOTE FIRE.



Direct Vent Exhaust Diagram

IN CASE OF CHIMNEY FIRE

1. Be sure everyone is out of the house.
2. Call the fire department. (In the event the fire is out before they get there, you will want them to inspect the structure and make sure there is no latent damage or hazard.)
3. Shut the boiler down by turning the main power off.
4. If you have a chimney fire, use a chemical flare type fire extinguisher. If you don't have an extinguisher, go to step 5.
5. Using a water hose, wet down the area of the roof surrounding the chimney. Do not wet the chimney itself or try to put water down the flue as it will very likely damage the flue tiles.
6. Contact a chimney professional to inspect your chimney for damages.

IN CASE OF RUNAWAY FIRE

1. Cut power.
2. Be sure the draft inducer is off, that both Air-Valves are completely closed and/or make sure the barometric damper opens (if equiped). Excessive draft can cause a runaway fire.
3. Shut loading and ash removal doors.
4. Maintain continued circulation of boiler water to remove heat from the boiler and if boiler is equipped with a domestic coil run hot water.

IN CASE OF POWER LOSS

Do not open the loading door even in power outage, until the power is restored and the green "Purge" turns on!

If you loose power the SE110 will shutdown, air-valves will close and draft motor will stop. If the power is not restored within 4-6hr you will probably need to restart the fire, with match, paper, and kindling. Still wait for green light to turn on even before restarting.

A backup power source may be used to operate the SE110 in a power outage. Backup power must also support both the controls and circulators.

It is important that the system works even when unattended to guard against overheating. Backup power must be provided in a way that satisfies local code requirements and prevents back-feeding of electricity into the power grid.

If no means of dissipating heat exists, close all doors, and verify automatic dampers are closed.

Note: If backup power is provided by a generator, always operate the generator well outside the home to avoid carbon monoxide in the home.

MAKE-UP OR COMBUSTION AIR

The airflow through the system and out the chimney means that oxygen is leaving the home and will create an oxygen deficit if this air is not replaced. Adequate combustion air is critical for the performance of your heater. There is usually sufficient leakage in older homes to provide for this, but in well-insulated homes it may be necessary to provide additional outside air into the home. A louvered vent can also be used.

Adequate supply of combustion air can come from, either natural infiltration through or around a door or window, or by ducting outside. Ducting from outside will require an adapter purchased from Alternate Heating Systems.

When the intake air is ducted from the outside, inspect the opening regularly to be sure that it does not become obstructed by debris. Units that have outside combustion air ducts must have this duct routed close to the floor in the boiler room to prevent the possibility of smoke coming through in the event of a control malfunction.

Installing the Combustion Air Adapter

The adapter can be purchased from Alternate Heating Systems. You will first need to open the back insulating panel of the air intake box. Once open you will install the intake opening blockoff. This will simply lay in the bottom of the air intake box. You may need to trim the yellow fiberglass insulation to allow the bock off to fit.

Once the block off is in place you will need to remove the 5 inch knock out located on the side of the air intake box. You may need metal snips or a cutoff wheel on a grinder. Then cut the yellow fiberglass insulation at the cut out.

After the hole has been made use the supplied self tapping screws to attach the 5 inch adapter.

You can use 5 inch stovepipe or using a 5-6 adapter 6 inch stovepipe can be used to duct the combustion air in from outside. Be sure to run the pipe to the floor before going outside. Running the duct to the floor to prevents the possibility of smoke coming through in the event of a control malfunction.

Attach 1/2 x 1/2 inch screen to the inlet to prevent rodents and birds from entering pipe.

Boiler Piping for Hydronic Systems

Due to the design requirements of the various SE110™ models, the fittings are not always in the same location on each boiler model. See Appendix A for the location of these attachments. This diagram provides exact locations for all fittings. The flush-out fittings in the bottom of the unit are a requirement of the ASME boiler code and must be closed before filling the unit with water.

Note: Be sure to close all fittings in the unit before filling the unit with water.

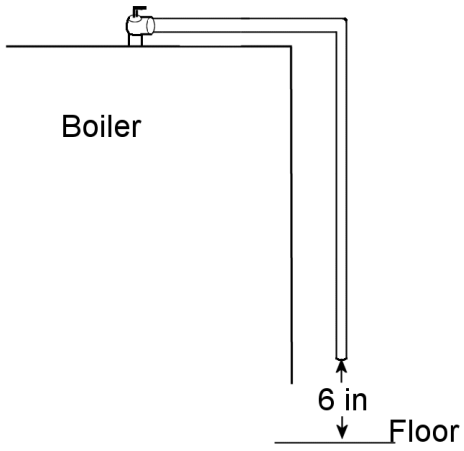
Piping the Boiler in Parallel with Another Boiler

The SE110™ may be connected to a heating system supplied by one or more boilers that are already in place. To connect the boiler to the existing boiler run the supply pipe with a flow check from the SE110 and Tee into the supply pipe of the existing boiler. This pipe will carry hot water to the existing boiler when there is no heat demand and will in turn keep the existing boiler from turning on. The return pipe with a circulator pushing toward the SE110 will Tee into the return line of the existing boiler. It is required that the piping be such that excessive pressure will not be developed in any portion of the boiler or system. The circulator will constantly run when the SE110 boiler is on. Wire the circulator to the SE110 boiler in such a way that when the boiler switch is on the circulator will also run. The power to the SE110 should then be controlled by an aqua stat located in the supply piping. This aqua stat should be set 10°F above operating temperature of the existing boiler. That will shut the SE110 down if it runs out of fuel. The aqua stat will need to have a bypass switch that will allow the wood boiler to have power and enable it to be started so that it can be warmed to its operating temperature.

There are many possible configurations that allow for an existing boiler to function as a backup to the SE110™. For sample illustrations of multiple boiler configurations, see Appendix F.

Pressure Relief Valve

A pressure relief valve should be inserted into tapping DD on the SE110.



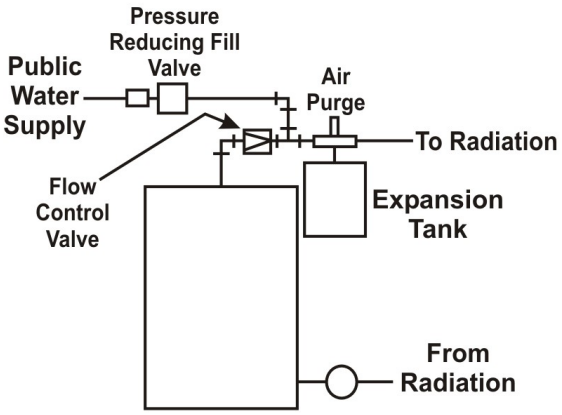
Pressure Relief Valve

Note: A length of ¾" copper pipe must be connected to the pressure relief valve continuing to a point 6 in from the floor as shown in Figure 3 above.

The purpose of extending the pipe to the floor is to direct any blowout of scalding water downward instead of outward. This reduces the likelihood of exposing bystanders to a scald hazard.

Pressure Reducing Fill Valve

If the SE110™ is installed as the primary boiler, it is necessary to provide for water supply using a pressure regulating valve and back-flow prevention valve in the feed water line. Set the pressure regulating valve to 12-18psi.



Pressure regulating valve and back-flow prevention valve configuration

Expansion Tank Selection

Closed loop systems require the use of an expansion tank. The SE110 holds roughly 60 gallons of water. The expansion tank or air cushion tank that was originally installed will not likely be adequate for the additional volume of water added to the system with the inclusion of a SE110™. The tank must be sized based on total water volume and the difference between the low and high temperatures of this water. When properly sized, it will accommodate the thermal expansion of the water being heated without creating an over-pressure situation. Some closed loop systems are isolated from an open (atmospheric) side of the system, or another closed loop, by a heat exchanger. For calculating system volume, only the volume in each respective closed loop is calculated, with each closed loop receiving its own dedicated expansion tank capacity.

If the auto-fill valve engages and adds water to the system when cold, and the boiler subsequently builds too much pressure when hot, you do not have adequate expansion capacity.

We recommend at minimum to install a #90 expansion tank (14 gallon capacity).

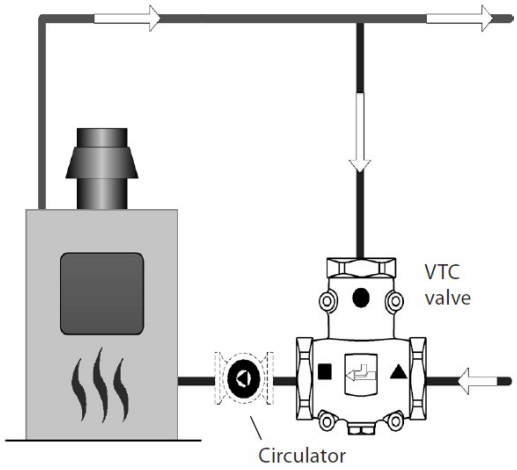
RETURN WATER TEMPERATURE

As a rule, water returning to the boiler must be not more than 20° F less than supply water temperature going to the system. Additionally, the water returning to the boiler must never be lower than 140F and highly recommend no less than 160F. Carbon steel boilers the return water temp must not be less than 160F.

Recommended return water temperature is 160F

A re-circulation loop is a requirement to maintain optimum return water temperatures. This would optimally include a thermometer on the return line entering the boiler for monitoring purposes, and a mixing valve to maintain minimum return water temperatures. Return water temperature near or below 140° F creates the risk of severe condensation issues. This will often produce unpleasant odors and possible liquid runoff in the boiler room. More seriously, it will lead to creosote formation on heat exchange surfaces and inside the chimney, with accompanying risk of a chimney fire.

View the following diagram for a sample piping layout utilizing a mixing valve on the boiler return. The mixing valve shown is a cartridge type. Water temperature is regulated by the use of a specific cartridge installed in the valve to control temperature of the water returning to the boiler.



Three Mixing Valve: Return Water Protection

ADDITIONAL SPECIFICATIONS

Pressure Drop through Boiler

Pressure Drop (Line Loss) within the boiler is less than the pipe rating of the pipe within the boiler, so there is no appreciable pressure drop.

Explanation of GPM Flow

The following are given as examples of gallons per minute water flow required to deliver hot water in order to provide heating of a given number of degrees and at a certain BTU level:

- 500K BTU's at 20 degrees temperature differential requires 50 gallons per minute.
- 250K BTU's at 20 degrees temperature differential requires 25 gallons per minute
- 1M BTU's at 20 degrees temperature differential requires 100 gallons per minute.

LOW WATER CUTOFF

Photo: Low Water Cutoff Installation

The low water cut off should be installed in the supply riser just above the tapping of the boiler, as shown above. Place a Tee fitting 6" - 15" above the boiler in the supply line. Install the L.W.C.O. so that it is accessible and the indicator lights can be seen.

There will be a piece of conduit coming from the High Limit aquastat with three wires. The wires are: Orange#2, Orange #3, White, green. These wires will terminate in the 200-411.2 LWCO as follows:

1. The orange #2 wire will be terminated with the black wire and one of the Yellow wires.

2. The orange #2 wire will terminate with the remaining yellow wire.

3. The White or neutral wire will terminate with the white wire in the LWCO.

If the conduit is not run from factory. You will need a piece of conduit with 3 wires labeled as above. Run the conduit from the high limit aquastat through the hole in the sheetmetal (the insulation will need to be drilled out) to the LWCO.

Terminate the wires in the aquastat with the corresponding wires as follows.

1. The Orange#2 wire will terminate on the wire marked orange #2.

2. The Orange #3 wire will terminate with the wire marked orange #3.

3. The White wire will terminate with the wire marked white, L2 or neutral.

Low Water Cutoff Testing

After installing the unit operate the system. Carefully observe the operation of all components through at least one complete cycle. Be sure to include a check to the operating limit switch operation (shuts down at operate limit set point). Make any corrections needed then repeat the checkout. Repeat until system operates properly.

Low Water Cutoff Troubleshooting

If the boiler does not shut down when the water drops below the probe:

1. Remove power immediately and re-check wiring.

2. Remove power and check for adequate clearance from the probe to any surface within the boiler or tee.

IF THE BOILER DOES NOT FIRE

(A) Make sure water is at probe and probe lead wire is properly secured to the terminal.

(B) Check for proper ground between probe and boiler shell. Excessive use of Teflon tape or sealing

compound may insulate the probe from the boiler shell.

3. Re-check wiring and test for correct incoming voltage. IF THE RED LED LAMP IS ON The red LED lamp indicates that the control is locked-out. This feature will activate if the boiler experiences a low water condition exceeding 30 seconds in duration. IMPORTANT: Do not reset control until the cause of the low water condition is corrected.

CAUTION: Do not add water until boiler is cool.

Low Water Cutoff Maintenance

To ensure optimum performance, inspect probe annually. Clean any scale or build-up from the probe using a scouring pad or steel wool. Re-install the probe and test .

FORCED HOT AIR SYSTEMS (WATER TO AIR COIL IN DUCT)

The SE110™ boiler may be easily adapted to any forced hot air heating system by installing a heat exchange coil in the supply duct. The size and type of coil required may be determined after several factors are determined. These factors include: the heat output required (BTUH), the capacity of the existing fan blower (CFM) and the size of the duct or plenum where the coil will be installed.

The coil creates increased resistance to air flow, so this factor must be considered when determining the final airflow. Design water temperature is usually 180° F and a desirable output air temperature is 115° - 125° F.

Tip: To increase coil performance, increase boiler water temperature.

The coil is connected in the same manner as in other types of radiation heating equipment. The thermostat should be wired to both the fan blower and the circulator pump or a temperature-sensing switch on the heat exchange coil. If a hole was cut in existing ducting to install the coil, the opening should be closed tightly with a metal cover and sealed with duct tape.

THERMAL STORAGE BASICS

The following section is intended for customers who purchase the CARBON steel SE110.

The carbon steel SE110 CS is intended only for true batch burn operation. This means that mid-burn off cycles are to be prevented whenever possible. **Corrosion from the fire side of the boiler vessel (firebox and heat exchanger) will not be covered under warranty (for carbon steel vessels only)**, however, the stainless steel vessel's warranty does cover corrosion from the fire side of the boiler vessel. Corrosion will occur during off cycles, or when/if poor boiler maintenance and operation lead to condensation issues. Batch burn operation is made possible with the inclusion of thermal mass that will be heated separately from zone requirements, and used as a heat battery, from which heat will later be drawn for space or water heating requirements.

Thermal Storage Types

Thermal storage will most often involve storing heat energy produced by the SE110 in water or water/glycol mixtures. The water/mixture can be stored in open or closed (pressurized) tanks. Pressurized tanks normally will accommodate higher water temperatures, and can therefore store more heat energy in smaller tank sizes. Such tanks are built heavier in order to accommodate the higher pressures. Tanks may be purchased new, or pressure-rated recycled tanks may be used. Used propane tanks are sometimes repurposed for use with thermal storage.

There are many types of open (sometimes referred to as "atmospheric") tanks available for thermal storage as well. These include insulated, prefabricated tanks that are site-assembled and made of fiberglass or metal, concrete tanks, recycled tanks of a wide variety, and even used bulk milk tanks. Open storage is subject to a hard limit on water temperatures due to the boiling point of water and is subject to water loss due to evaporation. Because the SE110 is designed for use as a pressurized system, use of open storage requires the use of a heat

exchanger to isolate the boiler water from the open storage components of the system.

The SE110 must be installed and maintained as a pressurized boiler.

Other types of thermal mass can be used to store heat energy from your SE110. Green building designs make use of sand, concrete and sometimes earth, for thermal storage. Such designs can replace or complement water based thermal storage. Whatever combinations of thermal storage are employed, always aim for true batch burn operation, and the elimination of mid-burn off cycles.

Sizing Your Thermal Storage

There are several criteria to keep in mind when sizing thermal storage. These include elimination of mid-burn off cycles for the SE110, the quantity of storage desired beyond this minimum to provide for firing flexibility, the heat load in question, and the cost of the various elements that are combined to meet your storage strategy and goals. This cost will include components and materials, plumbing labor, and the footprint associated with the storage. The amount of temperature spread you can tolerate in your heating and storage system will impact the amount of heat utilized from a given quantity of storage as well.

An individual burn cycle, using high quality fuel that is tightly packed into the SE110 CS firebox, can produce as much as a 700,000 BTUs. As a practical matter, to accommodate a full load of wood, you should be prepared to store 700,000 BTUs. If in consulting the charts that follow, you choose to provide less storage, you should plan on a firing pattern and fuel load amounts that meet the objective of avoiding mid-burn off cycles, even if this means partial loads of fuel. In the chart below, ΔT ° F represents the temperature spread between high and low temperatures in thermal storage.

Never allow Carbon Steel units to have a return water temperature less than 160F.

BTUs Stored Based on Gallons and Δ T ° F

Gallons → ΔT ° F ↓	500	1000	1500
20º	80,000	160,000	240,000
40º	160,000	320,000	480,000
60º	240,000	480,000	720,000
80º	320,000	640,000	960,000

The chart that follows gives you the number of hours until the next firing cycle, based on a starting temperature for thermal storage of 190º F.

Lowest Usable Water Temp → Heat Load in BTU/hr ↓	110º F	130º F	150º F
15,000	44.7	34.0	23.3
25,000	27.6	21.2	14.8
35,000	20.3	15.7	11.1
45,000	16.2	12.6	9.1
65,000	11.8	9.4	7.2
100,000	8.4	6.8	6.4
150,000	6.3	5.2	5.0

CONDITIONING OF BOILER WATER

Note: The guidelines in this section are to be used in conjunction with the advice of a water treatment specialist.

Proper treatment of feed water and boiler water is necessary to prevent deposits and corrosion within the boiler. The neglect of adequate external and internal treatments can lead to operation faults or total boiler failure. Where a choice is available, pre-treatment external to the boiler is always preferred and more reliable than treatment within the boiler.

Instructions for feed water treatment as prepared by a competent feed water chemist should be followed. Do not experiment with homemade treatment methods or compounds.

Representative samples of feed water and boiler water need to be analyzed frequently to ensure that they are within specified ranges.

Strict monitoring of boiler water is more important for steam applications (and for open systems) where there is a continuous influx of makeup water. For hydronic units, typical installations utilize the boiler water in a closed system, which only occasionally requires the addition of makeup water over the lifetime of the boiler.

Note: For hydronic situations where the system is not closed, the following water treatment guidelines still apply and become even more critical!

pH

The pH value of your boiler water is a number between zero and fourteen. Values below seven are acidic while values above seven are basic.

The pH factor is the most important factor influencing scale forming or the corrosive tendencies of boiler water. It should be adjusted to between a minimum of 9.0 and 11.0 to prevent acidic corrosion of boiler tubes and plates and to provide for the precipitation of scale forming salts.

Below a pH of 5.0 the water is acidic enough to dissolve the steel boiler plates. Under these conditions the steel gradually becomes thinner and thinner until it is destroyed. At a pH between 5.0 and 9.0 pitting of steel plates is likely to occur at a rate dependent upon the amount of dissolved oxygen in the boiler.

Dissolved Oxygen

Aeration of city water supply is frequently used to remove noxious gases, however, aeration results in saturation of the water with oxygen. A majority of corrosion problems are directly related to the quantity of dissolved oxygen in the boiler water. Elimination of the corrosive effect of dissolved oxygen can be accomplished either directly or chemically.

Direct or mechanical removal of dissolved oxygen is done through the use of a de-aerator. Chemical de-aeration is done through the introduction of specific chemicals in the boiler to react with the oxygen. The dissolved oxygen content should be maintained at a minimum but at no time should it exceed 0.007 mg/l.

Sodium sulfite is commonly used for the chemical removal of dissolved oxygen within the boiler water. To assure the rapid and complete removal of the oxygen entering the boiler feed water system the concentration of sulfite in the boiler should be maintained at a minimum of 120 ppm.

Solids (Primarily for Steam Boilers)

High boiler solids will lead to foaming, priming, surging, carry over or boiler sludge in steam boilers. Occasional blow downs of the boiler may remedy these conditions. We recommend you utilize the services of a local professional plumbing service for this boiler maintenance task.

Solids can be categorized as either suspended or dissolved. Suspended solids are those that can be removed by filtration while dissolved solids are in solution with the water.

The best way to determine the dissolved solid content of boiler water is a conductance test. The conductance of boiler water varies proportionately with the amount of various ionized solids present.

Another way to determine the dissolved solids content is to measure the chlorides present in the boiler water. The chloride test is less sensitive than the conductance test for measuring small concentrations of dissolved solids. The results of both tests should be averaged for accuracy.

Alkalinity

The alkalinity of boiler water should be sufficiently high to protect boiler steel against acidic corrosion, but not so high as to cause carryover (basic) corrosion. A minimum value for alkalinity for adequate protection is 200 ppm CaCO3.

High boiler alkalinity (in excess of 700 ppm CaCO3) should be avoided. Values higher than this can cause the steel to become brittle.

Phosphates

Phosphates are used to counteract hardness in the boiler water. It is important to maintain a pH of at least 9.5 to not hinder the reaction of the phosphates with calcium hardness. Try to keep the concentration of phosphates in the water to 30-50 ppm to enable complete reaction.

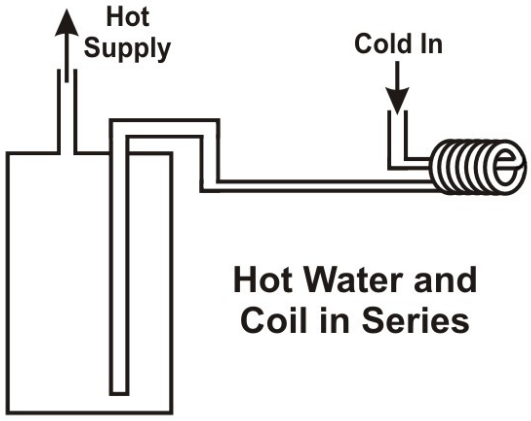
Hardness

The hardness of water is caused by calcium and magnesium ions. Water hardness will vary greatly throughout the country depending on the source of the water. In boilers, hard water can cause the formation of scale and sludge or mud. Total hardness should not exceed 50 ppm.

Oils

Every effort should be made to prevent oils from getting into the boiler water. Oil causes foaming or combines with suspended solids to form a sludge, which can cause the overheating of boiler plates. If oil does get into the boiler, the boiler should immediately be taken out of service and thoroughly cleaned.

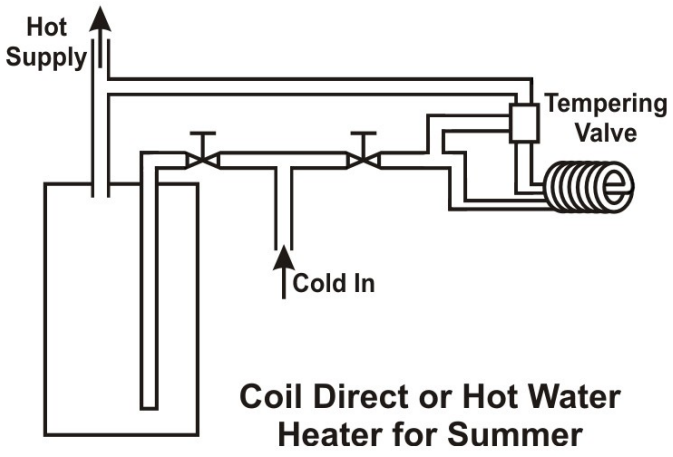
DOMESTIC HOT WATER COIL PIPING



Plumbing – Coil in Series

The SE110™ may be fitted with one domestic hot water coils, which thread into 4 inch tapping in the boiler. There are three methods for plumbing the domestic coil. One way is to connect the coil in series with an existing hot water heater.

A second method of plumbing the domestic coil is to connect the coil in parallel with an existing water heater so that the conventional water heater may be used when the SE110™ is not being fired (for example, in the summer). The diagram below indicates how this can be done.



Plumbing – Coil in Parallel

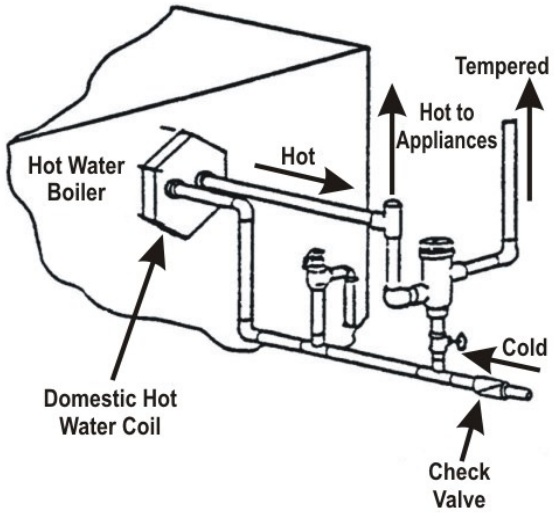
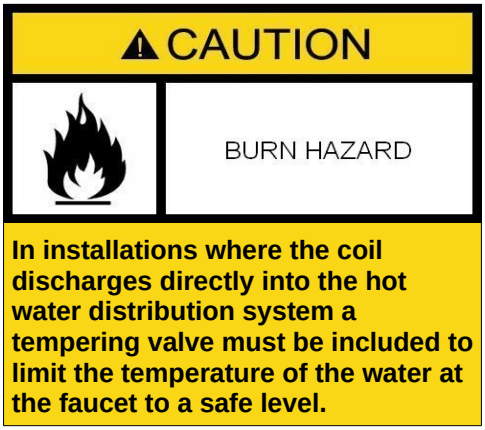
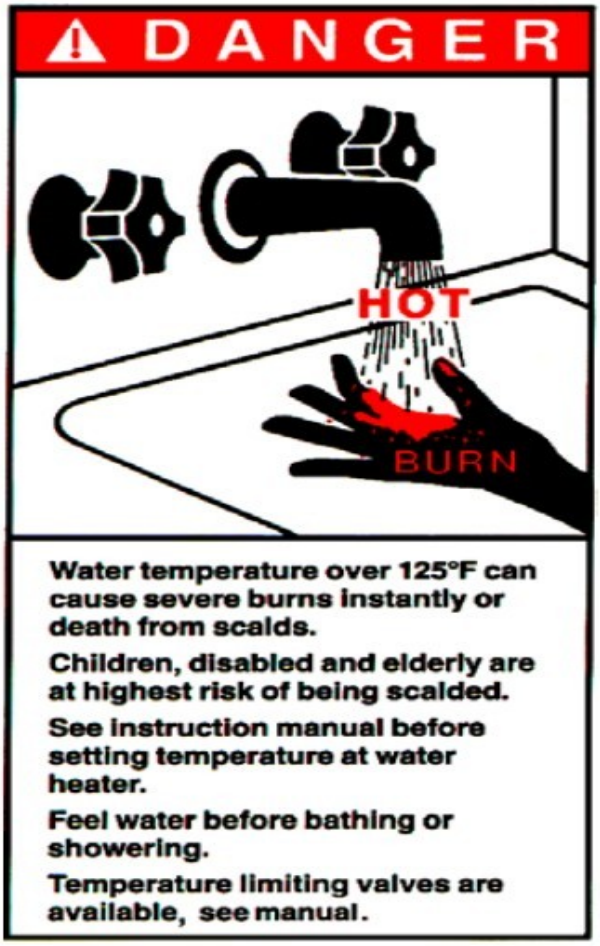
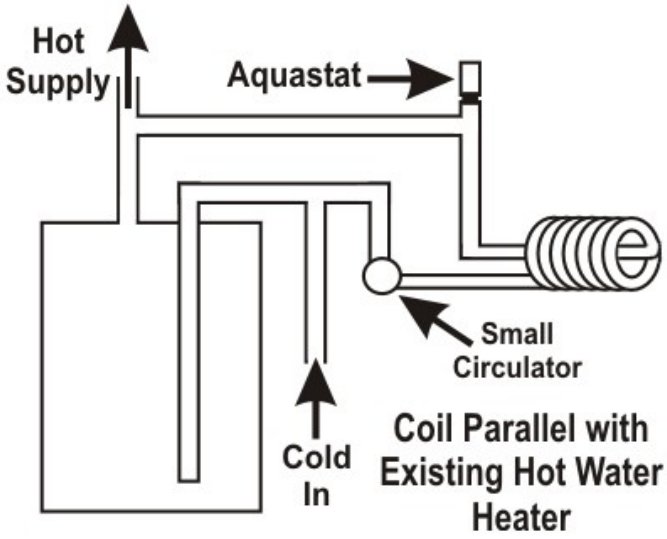


Figure: Domestic Coil Tempering Valve







Plumbing – Coil with circulator

Operating Information

Please read this entire manual before operating the boiler. It contains important requirements and instructions must be followed for safe and satisfactory operation of the boiler.

All cover plates, enclosures and guards must be maintained in place at all times, except during maintenance and servicing. Always keep fueling and ash doors closed when the boiler is not being tended. Always maintain all seals in good condition.

Be sure the boiler vessel is full of water and pressurized before starting a fire. Never attempt to add water to a hot boiler if found to be only partially full. Allow the unit to cool before adding water to the boiler. Failure to do so could result in death or severe injury along with damage to boiler and surrounding property.

Never attempt to add water to a hot boiler if found to be only partially full. Allow the unit to cool before adding water to the boiler. Failure to do so could result in death or severe injury along with damage to boiler and surrounding property.

NOTE: It is recommended that several small charges of wood be used initially to ensure that maximum durability of the refractory lining is achieved.

The bottom of the fuel chamber contains dense cast refractory blocks. The refractory is baked in a kiln at the factory to dry out nearly all moisture before it is placed in the boiler, but it does not reach maximum strength unless heated to operating temperature gradually (cured).

EXPLANATION OF SWITCH AND BUTTONS

The SE110 uses a simple easy-to-use touchscreen interface which will be explained below. There is also an ON/OFF switch (the “Main” switch) and the green “Purge” light located in the cabinet to the left of the loading door.

Home Screen

Explanation of Buttons:

Wood: It initially turns on all necessary functions to burn wood. Once the wood function is on, the button simply takes you to the “Wood” screens.

Exhaust Hood: When equipped with the exhaust hood. You can turn the blower on and off with this button.

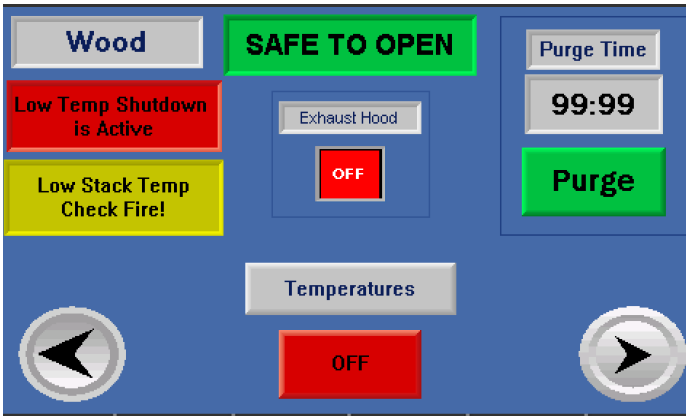
Safe To Open: this is not a button, it simply tells you when you may open the loading door.

Temperatures: This button will take you to the “Temperatures” screen.

OFF: This button will turn off the wood burning functions. It is only visible if the boiler is in wood mode.

Settings: This button will take you to the "Settings" screen.

Wood Screen (first)



Explanation of Buttons:

Safe To Open: this is not a button, it simply tells you when you may open the loading door.

Low Temp Shutdown is Active: this is not a button. It is a notification that the boiler is shutdown based on the Low Temp Shutdown feature.

Low Stack Temp Check Fire!: this is not a button. It is a notification that the boiler is shutdown based on the Low Temp Shutdown feature.

Purge: this green button when pushed will take you to the "Wood Purge" screen and starts the Purge function. This will turn the boiler on if in off-cycle so you may safely check or load more wood into the fire. The timer above shows time remaining before the boiler shuts off.

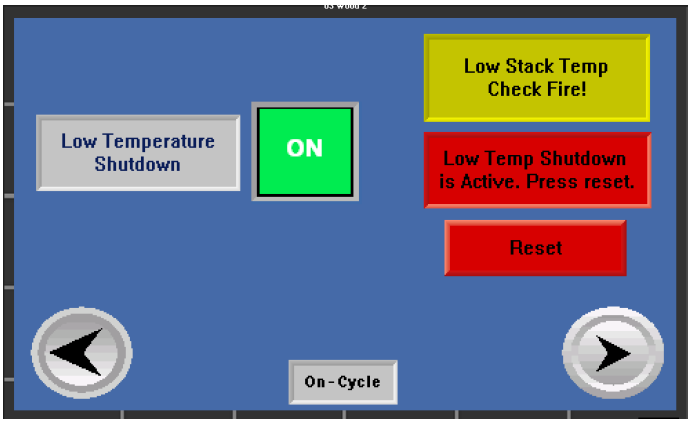
Temperatures: This button will take you to the "Temperatures" screen.

OFF: This button will turn off the wood burning functions, and takes you to the "Home" screen.

Back Arrow: when pushed it will take you back to the "Home" screen.

Forward Arrow: when pushed it will take you to the second "Wood" screen.

Wood Screen (second)



Explanation of buttons:

ON (beside Low Temp Shutdown): this button allows you to turn on or turn off the LTSD function.

Reset: this button resets the LTSD function and allows the boiler to turn on so you may restart the fire. It is only shown when the LTSD function is on and it has been engaged due to the exhaust temperature being too low.

Back Arrow: when pushed it will take you back to the first "Wood" screen.

Wood Purge Screen

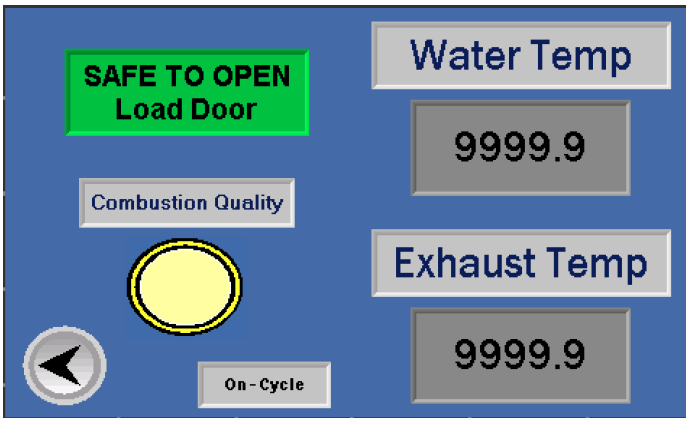
Explanation of buttons:

Up Arrow: This button allows you to increase the purge time by 1 minute each time it is pressed with a max of 15 min.

Down Arrow: This button allows you to decrease the purge time by 1 minute each time it is pressed with a min of 1 min.

Safe To Open: this is not a button, it simply tells you when you may open the loading door.

Back Arrow: when pushed, it will take you back to the first "Wood" screen.



functions, and takes you to the "Home" screen.

Back Arrow: when pushed it will take you back to the "Home" screen.

Temperatures Screen

Explanation of buttons:

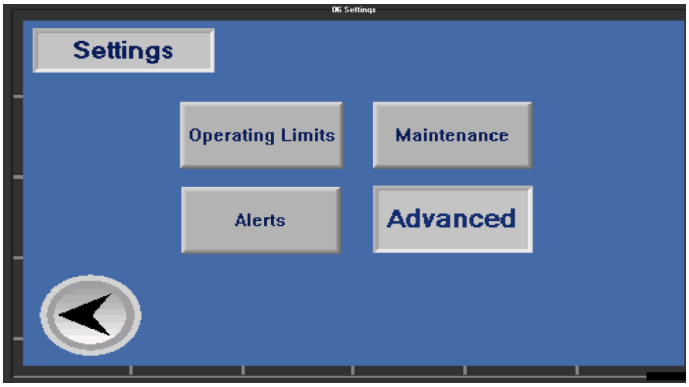
Note: Water and Exhaust temperatures are shown in Fahrenheit.

Safe To Open: this is not a button, it simply tells you when you may open the loading door.

Home: this button takes you to the "Home" screen.

Back Arrow: when pushed, it will take you back to the screen you were on before coming to the "Temperatures" screen.

Setting Screen



Explanation of buttons:

Operating Limits: this button will take you to the screen where you can change the temperatures and fan speeds at which the boiler operates.

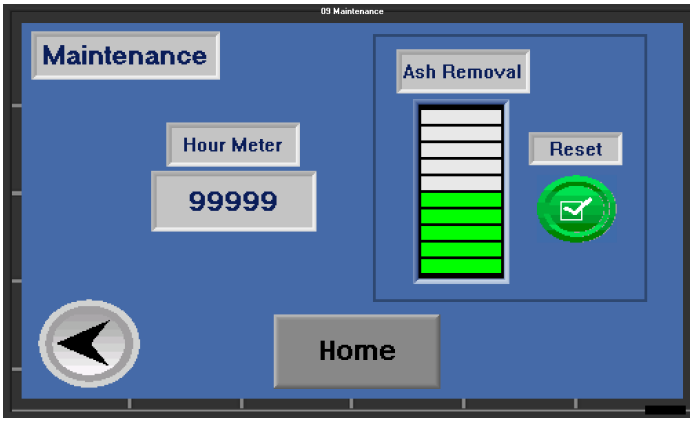
Maintenance: this button takes you to a diagnostic screen that estimates when your boiler may need cleaned, and how many hours are on your boiler.

Alerts: this takes you to another diagnostic screen that shows any problem with the system.

Advanced: This button takes you to the advanced setting that should only be accessed by qualified personnel. It is password protected.

Back Arrow: when pushed it will take you back to the "Home" screen.

Maintenance Screen



Explanation of buttons:

Hour Meter: This show the total run time of the draft inducing motor in hours

Ash Removal: The bar graph shows when the boiler needs to be cleaned. Remove the ashes out of the firebox and both of the upper and lower refractory chambers.

Reset: After you have removed the ashes, press the reset button to reset the bar graph.

Back Arrow: when pushed it will take you back to the "Settings" screen.

Home: this button takes you to the "Home" screen.

SEQUENCE OF OPERATIONS

Now that you have a good understanding on the buttons and what they do lets talk about the different function and how they work together.

The boiler regulates itself to operate in an efficient manner and at the same time is able to keep up with high demand situations. The boiler will shut down at 185F. It will sit dormant until enough demand is used to drop the water temperature to 160F, we call this Off-Cycle. Once below 160F, the boiler will turn on. The actuated dampers will begin to open and the blower motor will turn on. The unit will continue to operate until it overcomes demand and reaches 185F. When it reaches 185F the boiler will go into Off-Cycle.

The green "Safe To Open Load Door" message will appear when the loading door is safe to open. **Never open the loading door unless the green "SAFE TO OPEN Load Door" message is visible.**

Do not open any of the doors when the message says **DO NOT OPEN Load door.**

If you need to check the fire when the boiler is in Off-cycle and the screen says DO NOT OPEN. You can go to the Wood screen and press the **PURGE** button. This will allow the boiler to come on so you can safely check the fire or load more wood into the firebox.

Note: if the boiler is in Off-Cycle and the "PURGE button is not working, this means the boiler is in a Cool-down Period. Please wait 3 minutes and try the "PURGE" button again.

Low Temperature Shutdown (LTSD)

The E110 is equipped with Low Temp Shutdown, the unit will shut the boiler down because of low exhaust temperature at 220F. This temperature is adjustable.

If this happens press the LTSD reset button. The LTSD can be turned on, off and reset from the second "Wood" screen.

When the Low Temperature Shutdown (LTSD) button is "ON" the low temperature function will allow the boiler to operate normally until the exhaust temperature falls below the set point. When the boiler is running with no fire the cool air moving through the unit will cool the water. This is especially inefficient if there is a backup boiler (in most cases oil or gas fired) is trying to maintain heat in the system.

Other Functions

The SE110 has the capability to control your circulators. R5 relay in the main control box can turn on and off a circulator based on the boilers temperature. Power of your choice will need supplied to terminal #22 of the R5 relay via the Black 31. Black 30 will then be used to power the pump. This output can be turned on and off and the temperature can be changed from the "Operating Limits" screen.

Resetting the Controls

To reset the control system turn the "MAIN" switch to the "OFF" position and wait 4 min, then turn the "MAIN" switch back on.

FUEL TYPE

The SE110 is designed to burn split or unsplit wood

The SE110 is designed to burn log wood. The SE110 is able to burn both hard wood and soft wood fuel. Keep in mind that hardwood is typically a better fuel. Hardwood will usually give you longer burn times than softwood, due to greater energy density per unit volume. Oak, Maple, and Cherry are a few of the hardwood types that can be burnt. Cedar fir and pine are a few of softwood species that can be burnt. A well managed SE110 will not produce creosote from burning softwood.

Wood dimensions

The log wood must be cut and split so that the length is 22”-26” and so that the diameter is less than 10”. The log wood must be seasoned to an average moisture level of 18%-28%

Prohibited fuels

No person is permitted to burn any of the following materials in an EPA Step 2 certified wood burning appliance such as the SE110.

- Residential or commercial garbage.
- Lawn clippings or yard waste
- Materials containing rubber, including tires
- Materials containing plastic
- Wast petroleum product, paints or paint thinners or asphalt products
- Materials containing asbestos
- Construction or demolition debris
- Paper products; cardboard, plywood or particleboard. The prohibition against burning these materials does not prohibit the use of fire starters made from paper, cardboard, sawdust, was and similar substances for the purpose of starting a fire.
- Railroad ties or pressure treated lumber
- manure or animal remains
- Salt water driftwood or other previously salt water saturated materials
- Unseasoned wood
- Any materials that are not included in this manual.
- Any materials that were not included in the certification tests

Burning these materials may result in release of toxic fumes or render the heater ineffective and cause smoke.

Wood Fuel Characteristics and Wood Storage

Although the boiler will burn green or wet wood, this practice is discouraged because of the substantial amount of heat energy required to evaporate the moisture before combustion can take place. When the first cut, the moisture content of wood may range from 40 to 60% as compared with air-dried wood at 25% to 35%. Each extra 25% of moisture represents approximately five gallons of additional water that must be evaporated and passed out of the chimney for each 120 pound charge of wood. The heat that must be used to evaporate any extra water, is heat that is then not available for your heating application. This significantly lowers the maximum heat output of the boiler. It is advantageous to let the sun remove that extra 100 to 250 gallons of water found in a cord of wood. Generally, wood should be stored s in a dry place with only a limited supply kept indoors.

Using wood that has a moisture content of greater than 30%, can be detrimental to the operation of the boiler. Results of using wood with too high of a moisture content are likely to include loss of BTU

output, reduced efficiency, and condensation issues. Using high moisture wood will reduce the service life of carbon steel boilers.

Determining wood moisture levels can be tricky without the use of a wood moisture meter. Dry wood will have split or cracks on each end and bark may be loose. For exact wood moisture levels use a wood moisture meter. To use a wood moisture meter you will need to split a piece of wood then stick its probs into the freshly split sides at a few different points. Make sure the probs are running parallel with the grain of the wood. Meters are most accurate when the wood is above 50F.

The best way to season (dry) your wood is to cut and split it to proper length and diameter for your SE110. Once the wood is cut and split, stack it and cover the top of your pile. This needs done 6-12 months before you need to burn it. During the heating season it is recommended to have at least one week worth of fuel inside and kept out of the weather.

Do not store fuel within the appliance installation clearances or within the space required for fueling, ash removal, or other routine maintenance operations.

STARTING A FIRE: PROCEDURE

The “MAIN” switch should be in the “ON” position. Once the “Main” switch is on the touchscreen will power up and will display the “Home” screen.

If you are starting a wood fire. Simply press the “Wood” button. The boiler will start-up and you may begin starting a fire.

Starting a fire in the SE110™ is similar to starting a fire in any wood fired boiler with a few important differences. Because the SE110 incorporates a downward draft, successful fire starting requires recognizing that fact and layering kindling accordingly. Place kindling wood on the refractory in a lengthwise orientation. Add a layer of crumpled up newspaper followed by another small layer of kindling. Light the paper. When the kindling is burning well, add more (and larger) pieces of wood.

Note: Always place wood in the SE110™ lengthwise (from front to back).

When firing a cold boiler, it is important to concentrate heat next to the refractory. The SE110™ depends on high refractory temperatures for driving the gasification process. Using drier, smaller wood will help to accomplish this. Add larger pieces only after the fire is well established. Only fill the fuel storage area (firebox) after the refractory has reached good gasification temperature indicated by an exhaust temp above 220F.

Keep in mind that a small intense fire is preferable to a large smoldering one to reduce the amount of creosote deposition. This will be accomplished by building the initial fire with wood no higher than the door frame. When the starting charge is burning hot, add the rest of the charge in sufficient quantity to last for up to 10 to 14 hours.

Longer cycles are possible, but you will want to plan for utilizing shorter burn cycles periodically to provide for good firebox management. Best practices include keeping ash and charcoal build-up to a minimum.

When demand is moderate to low, simply load charges of fuel that are just adequate for the length of the anticipated burn cycle. Do not overfill fuel storage area (firebox).

Charging the Boiler with Wood

When it is time to reload the SE110™, make certain the green "SAFE TO OPEN" message is on. If the "SAFE TO OPEN" message is off, push the "**PURGE**" button which can be found on the Wood screen. Wait for the Load Door message to say SAFE TO OPEN.

Always open the load door slowly by cracking it open just a bit to allow air to flow in smaller quantities through the opening. After 5-10 seconds, you may open the door fully. This waiting period will allow sufficient time for the fire to become re-activated and burn off any gases that may have accumulated in the fuel chamber during the off cycle. Even if SAFE TO OPEN is visible, **open the door cautiously,** since abruptly introducing air over the glowing fuel particles may cause it to temporarily flame up.

When reloading the SE110™, it is a good idea to use the ash rake to make sure that the center slot is open and free from ash and charcoal before adding more wood. Such raking is required more often when using softwood, or any wood with a high ash content. Wood bark has a very high ash content relative to the centers of wood pieces. When using hardwood, clear the slot at least daily.

Clear the slot by first raking charcoal pieces away from the slot. After raking the charcoal pieces away from the slot, rake all the ash into the slot, thus aiding the process of allowing the induction fan to pull the ash through.

Once the center slot have been cleared and the coal bed leveled you may load wood into the firebox. Place the wood in the firebox length-wise and centered (front-to-back) and stack the wood neatly and tightly.

Note: Spent ash should not be allowed to build up on or in the refractory. NO MORE THAN 1 INCH OF ASH.
Any ash buildup will restrict the airflow and insulate the fuel charge from the heat generated in the refractory, slowing the rate of gasification, and thereby reducing heat output, and may even produce excess smoke, condensation and creosote!

Best results with fuel loading will be obtained if the charge of wood is limited to the amount needed to produce a 14-hour burn under anticipated heat load conditions. Adding more wood than can be utilized in 14 hours will likely lead to charcoal buildup and potential issues with "back-puffing", smoke, condensation and creosote.

Note: Guard against charcoal and ash accumulation in your SE110™ by keeping burn cycles at less than 14 hours. Utilize occasional short cycles, as short as 4 hours, for good firebox management.

Long burn cycles will also lead to accumulation of charcoal in the fuel storage area. Excess charcoal will tend to block airflow through the slot in the center brick. Furthermore, soft, crumbly charcoal can also be pulled through the refractory, resulting in tiny, live embers being emitted from the boiler.

Very dry wood of 15% moisture content or less is likely to produce back puffing as well. Preferred options follow, as included in this back-puffing prevention/resolution checklist.

Back-Puffing/Condesation Prevention Checklist

- ✔ Use fuel with higher moisture content,
- ✔ Load wetter fuel on the top of your fuel charge
- ✔ Use a good percentage of full rounds, as large as 10 inches.

- ✔ Stack wood tightly, using a combination of full rounds and split pieces to form a more solid block of fuel inside the fuel chamber
- ✔ Utilize shorter burn cycles, to prevent over drying of the fuel charge that occurs with long cycles

Remember, the SE110 utilizes a down draft design, and optimum combustion takes place when the flame is properly inverted.

REMOVAL AND DISPOSAL OF ASHES

Ashes should be placed in a metal container with a tight-fitting lid. The closed container of ashes should be placed on a noncombustible 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.

For instructions on removing ashes see mainenance section.

RECOMMENDED BOILER CONTROL SETTINGS IN HYDRONIC SYSTEMS

The following control settings are recommended for parallel installations:

- ✔ High limit (aquastat on rear of unit) 200° F
- ✔ Operating Limt – 180°F.
- ✔ Low Temperature Shutdown Limit 220° F

Additional settings may include:

- ✔ Optional circulator shutdown control 150° F

WARNING: if the operation procedures and wood requirements are not followed it may result in: poor combustion, low btu output, creosote in chimney, debris buildup in heat exhanger, and very poor efficiency.

*FOR CARBON STEEL BOILERS

Condensation – Causes and Prevention

Excellent combustion will maximize the amount of the main byproducts of combustion, carbon dioxide and water. Keep in mind that a great deal more water will be produced by good combustion than what was originally contained in your well seasoned wood. These two sources of water, added together, must be removed from the system in the vapor state to avoid condensation. If the exhaust gases cool to the condensation point, you will see liquid water in your chimney and/or cyclone, and possibly even inside the boiler's heat exchanger. Severe condensation can result in so much liquid water that it is misinterpreted as a boiler leak. When water is found in the cyclone and/or heat exchanger, attack the issue as one related to condensation.

Note: Condensation in the heat exchanger can be caused by wood that is too wet for the application and/or by low return water temperatures. Recommended return water temperature is 160F. Use a mixing valve for boiler return water temperature protection.

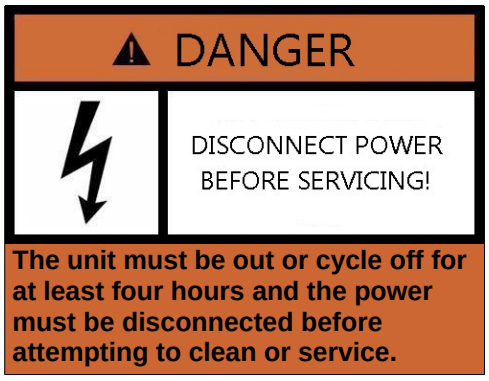
Reduce or Prevent Condensation

Condensation has several causes, but can always be attacked systematically and greatly reduced or eliminated. Properly utilized thermal storage will assure steady load when firing, and assist in keeping condensation under control. Keep in mind that because the SE110 swirl tube heat exchanger extracts so much heat from the exhaust, the gases leaving the system are often not far above temperatures that can lead to condensation. Anything that compromises performance or cools stack gases further than normal can trigger condensation. Review the list below and make changes that match your circumstances. Be sure to review the installation

section of this manual that covers return water temperature.

- ✔ Increase return water temperatures (mixing valve, raise operating temperature)
- ✔ Check for and correct any issues related to leaking door seals or Air Valve leaks
- ✔ Insulate stove pipe and/or chimney to preserve heat
- ✔ Insulate cyclone
- ✔ Increase load
- ✔ Never allow mid-burn off cycles to occur
- ✔ Use drier fuel
- ✔ Clean boiler, or take other measures to improve air flow
- ✔ If you are observing back-puffing, take care of this issue promptly, as performance is compromised in a back-puffing boiler, possibly contributing to condensation
- ✔ Keep refractory relatively clear of charcoal and ash
- ✔ Watch loading technique and other firebox management aspects, making sure that the fire burns properly upside down
- ✔ If you are experiencing water in the cyclone, removing the air turbulator may help.

Maintenance



It is important to establish a routine for the storage of fuel, starting the fire, and caring for the unit so as not to overlook important aspects of safety, and to maintain the unit in optimum condition.

Maintaining the load door seal and air valve gasket seal are very important for efficiency, and for safety.

WEEKLY CLEANING PROCEDURE

Following is the recommended procedure for weekly cleaning:

Refractory

1. Allow the Boiler to cool and use gloves.

2. Remove excess ash from fire box.

- You can have the draft fan running and using the scraper push the ashed into the center slot.

3. Open front inspection door.

4. Place an ash receiver under the refractory at the front inspection door opening.

5. Remove the both plug and restrictor plug. Use the ash rake to pull the ash from the both tunnels.

6. Re-insert the plug in the right tunnel and verify that it properly seals the opening.

7. Re-insert the restrictor plug in the left tunnel.

Note: The front of the top combustion chamber must be properly sealed to prevent gas from being drawn directly into the heat exchanger thereby bypassing the refractory.

8. Use a putty knife or scraper to clean ash from the bottom of the door opening.

9. Empty the ash pan located in the bottom of the cyclone.

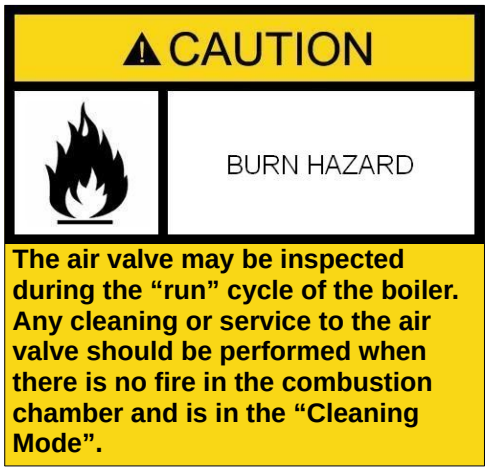
Air-Valves

The air valve should be inspected and cleaned **weekly** to ensure that it is sealing properly. A leaking air valve or load door can produce a number of undesirable consequences, including a low smoldering fire.

When the air valve is open and the unit is operating, moisture released from the fuel will condense when it comes in contact with cooler

combustion air. This moisture and creosote can collect on the gasket disk and on the end of the air valve tube and in time produce a deposit that prevents the gasket from sealing tightly.

If the silicone rubber gasket shows evidence of deterioration it should be replaced. When requesting a replacement, be sure to specify the size (diameter) of disc you require.



To Operate the Air Valves Manually for Cleaning and Service:

1. Remove the air-valve covers and inspect the valve gasket disks for evidence of air leakage. The disk should have some wobble, so it can find its own seal. See below.

2. Scrape condensation and creosote build-up from inside the air-valve boxes using a long handled screw-driver.

3. Make sure the SE110 is not in Wood mode, that the water temp is below 130F and that the exhaust temp is below 95F.

4. Go to the "Maintenance" screen and press "Cleaning Mode"

- Once in the "Cleaning Mode" you will see buttons for the 1st Air-Valve, 2nd Air-Valve, and the Draft fan. When you turn on the Air-Valves, they will open so you can clean or replace their discs.

5. Clean off any deposit on the gasket disc with a cloth soaked in warm water and detergent. Scraping with a knife or other metal scraper may damage the silicone rubber seal. Be careful.

6. Clean off any deposit on the end of the tube by using a putty knife. Any accumulation in the tube should also be removed by using the long handled scraper as described in Step 10 of Weekly Cleaning Procedure.

To replace the gasket simply remove the center bolt and nut as indicated in the exploded assembly in this manual. Do not firmly tighten the nut on re-installation as the new gasket needs some slight wobble to seal properly over the air inlet tube.

Creosote – Formation and Need for Removal –

When wood is burned slowly, it produces tar and other 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 connector and chimney should be inspected at least twice monthly during the heating season to determine if a creosote buildup has occurred.

If creosote has accumulated it should be removed to reduce the risk of a chimney fire.

Per CSA requirement : Check daily for creosote buildup until experience shows how often cleaning is necessary

CLEANING

Following is the recommended procedure for cleaning:

Yearly

1) Clean the heat exchanger.
   a. Remove the draft fan assembly.
   b. Use a wire brush or scraper to clean out the heat exchanger.
2) Clean the Cyclone
   a. Unplug the thermocouple and O2 sensor.
   b. Disconnect the stove pipe

c. Remove the cyclone and disassemble to clean.

3) Clean the Stove Pipe

4) Clean and inspect chimney and rain cap

5) Check all seals on boiler and replace if needed

a. Load door

b. Air-Valve Discs (primary and secondary)

c. Front Inspection Door seal and ceramic board

d. Draft fan gasket

Every 3 Months

1. Check stove pipe and cyclone for excess ash buildup.
   a. Run the cleaning brush through it, and all the way down to the heat exchanger exit.

AIR VALVE MOTOR REPLACEMENT

Removing Old Damper Motor

1. Turn power off to the unit.

2. Disconnect wiring.

a. Primary (1st) air-valve - Use a #2 phillips screwdriver to remove the screw in the center bottom of the red cap. With the screw out, pull the cap off.

b. Secondary (2nd) air-valve – Disconnect the wires leading to the motor at the 2 x 4 junction box. Once wires are disconnected, also disconnect the conduit.

3. Use a 10 mm wrench to loosen the mounting bolt.

4. Remove Motor. (For 2nd air-valve motor removal only… remove and save the piece of conduit attached to the motor. You will need it for the new one)

Installing the New Damper Motor

Note: Before starting this procedure make sure that the spring return will operate in the correct direction. To change the direction, just remove the clip that holds the clamp in place. Pull the clamp out flip the motor over and reinstall the clamp making sure that the arrow is pointing at the 0º mark. Reinstall the clip.

1. Remove power from the boiler.

2. Remove red cap on new motor (you will not need this as you will use the cap wired to the boiler)

3. Reconnect wiring (if needed). See wiring diagram in the back of this manual.

a. Primary (1st) air-valve – Carefully align the pins in the red cap with the holes on the bottom of the motor. Use a #2 phillips screwdriver to install screw in the center bottom of the red cap.

Note: Make sure the correct input is selected. Input **#3** needs to be selected (See Figure below)

Primary Air-valve Input Selection

b. Secondary (2nd) air-valve – Install the conduit that was removed from your old motor. Re-install the conduit connector nut. Reconnect the wires to the 2nd air-valve. Use a #2 phillips screwdriver to reinstall the cover for the 2×4 junction box.

4.Restore power to the Boiler.

5. Using the touchscreen. Enter the “Cleaning Mode”, make sure the spring return will operate in the correct direction.

6. Turn on the damper you are working on. Allow the motor to open fully and stop.

7. Once the motor stops opening. Install clamp into the motor, **so that the arrow is pointing at the 80° mark and install the retaining clip**.

8. Place motor onto air valve. Make sure the motor clips on at the bottom.

9. Use your hands to open the air valve disc completely to the stop. Ensure that the jaws on the clamp align with the contour of the shaft.

PRIMARY Air Valve Disk in Open Positioning

SECONDARY Air Valve Disk in Open Position

10. Tighten the 10 mm bolt of the motor's clamp down on the hex shaft.

11. Exit Cleaning Mode.

12. Inspect to insure that the air valve is sealed properly. The disc should have pressure allowing for a complete seal against the air intake collar.

Note: the air-valve disc should '**wobble**' on its mounting arm. The mounting bolt should be loose. Use a lock nut.

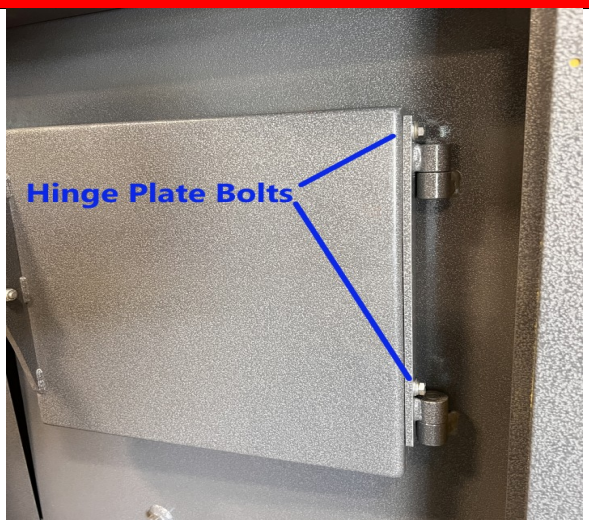
CRITICAL: IF THE AIR-VALVE DISCS ARE NOT PROPERLY ADJUSTED YOU WILL GET CREOSOTE IN THE HEAT EXCHANGER AND IN THE AIR-VALVE BOX.

NOTE: For the primary air-valve, it is very important that when placing the red end cap on the motor. The pins must align properly. If the pins do not align properly the valve will not work.

DOOR ADJUSTMENT

For proper operation of the SE110™, it is important to have an effective seal of the loading door and clean-out door. All have a simple adjustment mechanism on the hinge plate and latch keeper that permits the door to be adjusted as the gasket compresses during service. To adjust the hinge, open the door, loosen the bolts that hold the hinge plate, and bump the door toward the door-frame and tighten the bolts. Be careful not to tighten so much as to prevent the latch side from closing properly.

CRITICAL: IF THE LOAD DOOR IS NOT PROPERLY ADJUSTED YOU WILL GET CREOSOTE IN THE HEAT EXCHANGER!



Door Hinge Plate Adjustment

To adjust the latch side of the door, remove the two bolts that secure the latch keeper in place and remove one of the spacer shims. Shims are inserted at assembly. Remove the thin one first and if more adjustment is required at a later time, then it can be used to replace the thicker one to gain the additional adjustment.

Door Latch Shims

A good method to use when trying to determine if the doors are sealing properly is to coat the door-frame edge with chalk or similar marker and close the door against the frame. Any unmarked portion of the gasket indicates a low spot, which can be built up using the high temperature silicone sealant.

LOAD DOOR SEAL REPLACEMENT

1. Allow door to completely cool before you touch or start installation, remove door.

2. Cut flat fiberglass tape (white tape) into 4 equal strips. The tape shall stop 1” from each corner.

3. Insert silicone tube into a Caulking Gun.

Load Door with Old Seal Removed and High Temperature Silicone

4. Run a small bead of silicone into door groove. Place strips of fiberglass tape in grooves only on the straight sides. Lay the strips in as shown below, falling short of reaching into the corners. This is necessary because when the preformed gasket bead is pushed into place, it naturally expands outward away from the door where it is forced to bend around the corners.

Load Door with Fiberglass Braid Tape

5. Run a small bead of silicone on top of the fiberglass tape in the entire length of the door groove.

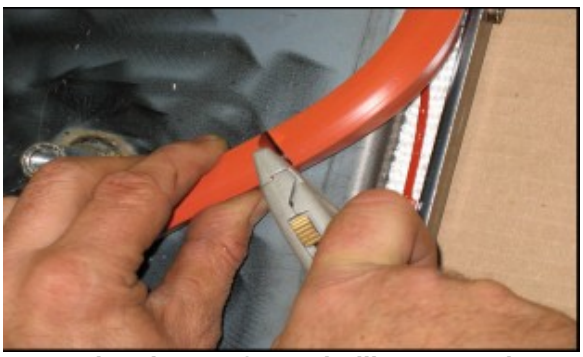
Load Door with Fiberglass Braid Tape and More High Temperature Silicone

6. Start the gasket in the middle of the hinge side. Squeeze the gasket into place on top of the bead of silicone. The rounded side faces downward towards the silicone. The whole length of the door groove should be filled with gasket. The gasket should have an even plane around the entire top surface. Be sure to squeeze the gasket into the groove evenly around the entire door to prevent any raised or uneven areas. These appear as bumps in the contour of the silicone bead.

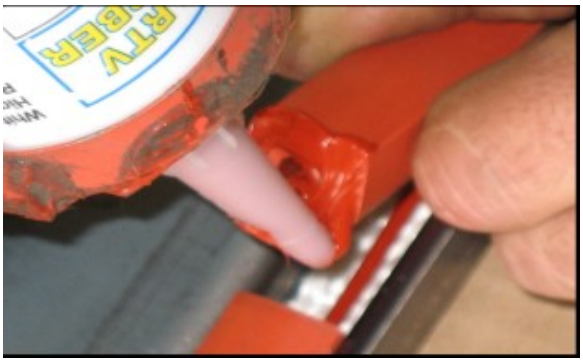
Adding Preformed Silicone Bead to Door

7. The gasket should meet evenly (if it doesn't you may trim excess). Place a small amount of silicone on one of the edges to create a seal.

Marking to Trim



Trimming Preformed Silicone Bead



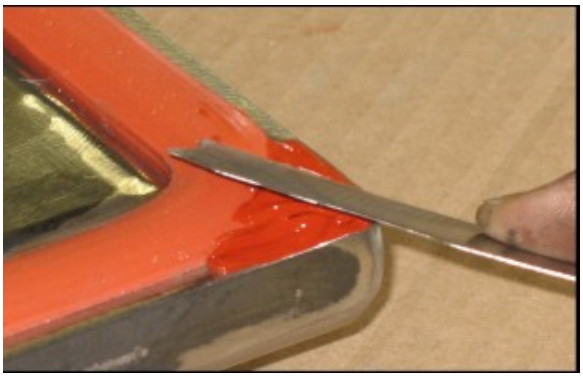
Adding High Temperature Silicone to Butt Joint of Trimmed Bead

8. Once the gasket is in place put a small amount over top of where the edges meet to create a seal. Smooth with a flat edge tool.

Finished Joint

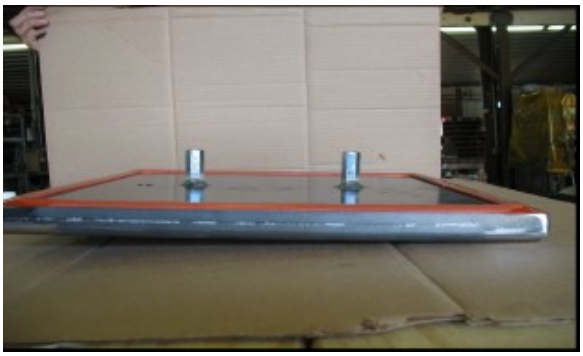
9. Place a small amount of silicone around the corner edges and smooth with a flat edge tool.

Reinforcing Corners with High Temperature Silicone



Finishing the Corners

10. Allow silicone to dry for at least 2 days before reinstalling.



Finished, Level Bead

FRONT INSPECTION DOOR HIGH TEMPERATURE ROPE INSTALLATION

The high temperature rope is made from fiberglass. You must wear gloves to protect your skin from getting strands of fiberglass embedded under the skin from handling.

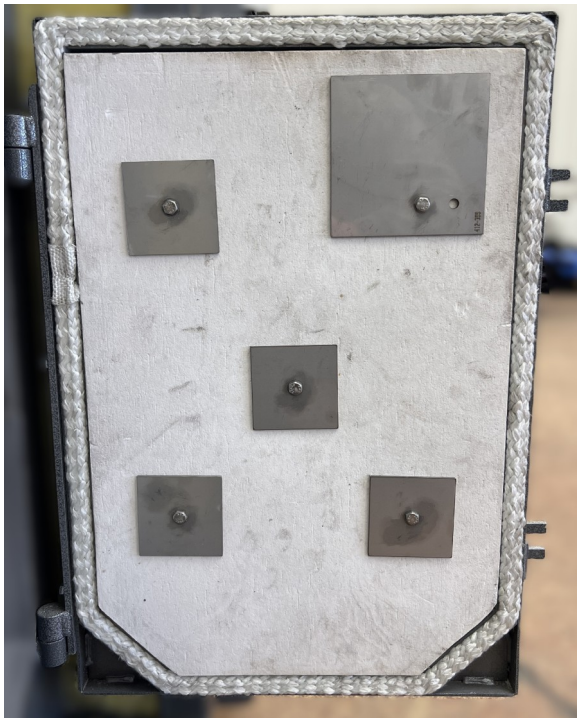
1. The first step for installation is to make sure that the rope channel is clean. Remove any rust or loose debris from the channel.

3. The rope sent from the AHS factory will be too long and will need to trimmed to the proper length. This is important because you need to start and finish with a straight end. Use sharp scissors to cut the rope.

4. Start with a clean cut rope end. Place the rope end in the rope channel mid way up on the hinge side of the door. Press the rope in by hand or with a flat-headed screwdriver. Stretch the rope as much as you can while pushing it in. Go from corner to corner until reaching the end. When putting the two ends together tuck all loose ends down inside the channel. The rope should protrude about 3/8” above the door frame.

6. Look over the door to find any high spots or bumps in the seal. Use the mallet to tap any and all of the high bumps down. This will give an even, straight surface the whole way around the door gasket.

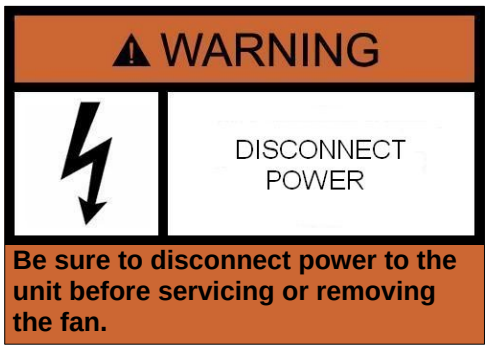
7. The new gasket is now in place. The last step will be placing the door on the boiler and adjusting it as you would in a normal maintenance. The gasket will settle and will need adjustment in the next few weeks. It is recommended that the door adjustment should be checked every three days for the next few weeks.



Front Inspection Door

FAN ASSEMBLY

The fan-motor assembly may be removed by loosening the nuts from the studs.



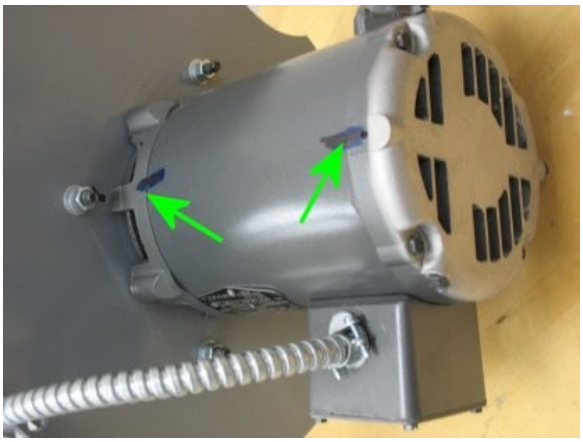
Direct-drive fan attached to boiler

If the fan assembly gasket is damaged, all of the old material must be removed and a new gasket inserted. Use 5/8inch high-density or 1inch low density fiberglass rope.

DIRECT DRIVE FAN BEARING REPLACEMENT PROCEDURE

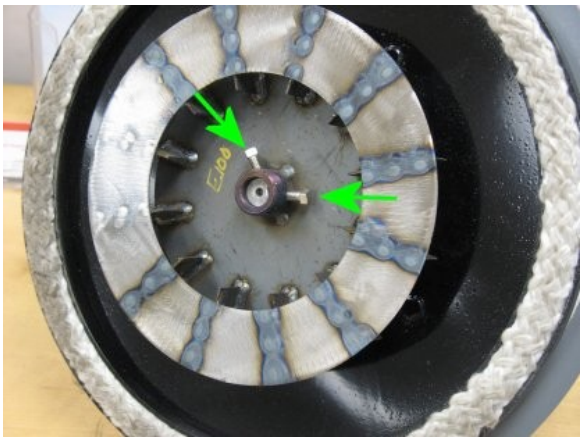
Make sure the power is turned off and/or disconnected. Disconnect the wire from the motor. Remove the motor end cap (3 screws). Remove the motor assembly by removing four 3/8" lock-nuts located along the outer edge of the motor mounting plate.

It is a good idea to mark orientation of components for reassembly.



Mark Assembly Orientation

Place the fan assembly on your workbench with the fan facing up. Remove the two set screws from the fan hub. It might be a good idea to let a good penetrate soak down into the area between the hub and the shaft. Letting it soak in for an hour or longer is recommended.



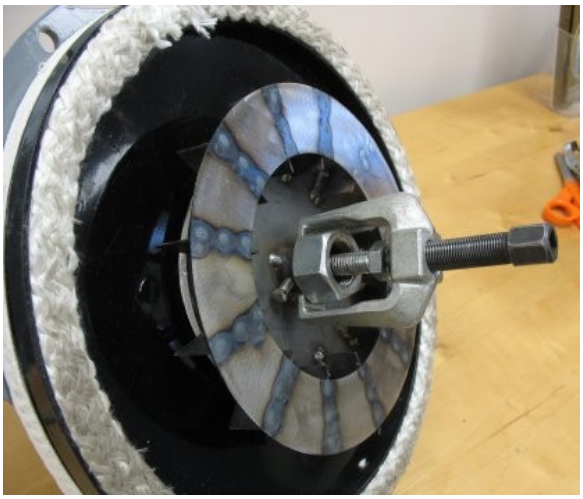
Fan Hub Set Screws

At this point, you have a choice of two methods for removing the fan. You may use a separate nut and jaw type puller, or you may use the economical AHS Fan Puller Tool. The photos below show each in turn, respectively. A bit of heat on the fan hub from a propane torch may be necessary.

Screw a one inch (fine-thread) nut onto the threaded hub of the fan.

One Inch Nut for Pulling Fan

Using a jaw type puller, remove the fan from the motor shaft:



Jaw Puller at the Ready

Or, use the AHS Fan Puller:

AHS Fan Puller Tool

AHS Fan Puller Tool at the Ready

Remove the (4) 5/16" nuts and washers from the motor plate allowing you to remove the abrasion shield and the heat shield from the motor plate. Be careful when removing the ceramic heat shield. It is very fragile. It is advisable to use a putty knife to separate the heat shield from the motor plate.

Separate Heat Shield from Motor Mount Plate

To remove the motor from the motor mounting plate use an allen wrench to remove the four motor mounting bolts that are counter sunk into the motor plate.

Closeup of Motor Mounting Bolts

To separate the motor housing you must remove the four bolts from the end of the motor opposite of the shaft. These bolts have a 5/16 bolt head.

Motor Frame Assembly Bolts

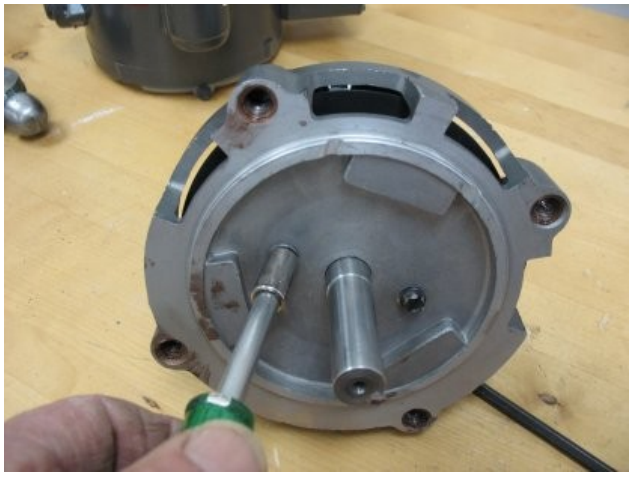
Once these bolts are removed, tap the mounting end of the motor on the side with a rubber mallet, or use a regular hammer along with a block of wood. This will separate the bearing housing (end shield) from the motor body.

Loosening Motor End Shield from Motor

The end shield, along with the armature, can then be lifted gently out of the motor frame. Be sure that the beveled waster remains inside the motor housing.

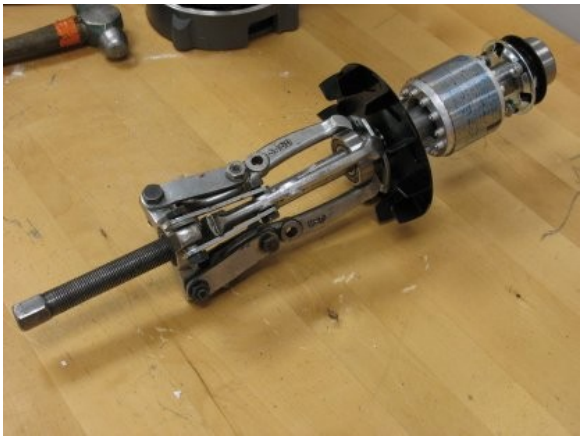
Lifting the End Shield with Armature

Removing the two screws located beside the shaft will allow you to separate the shaft, with the still attached bearing, from the end shield.



Loosening Screws Securing Bearing to End Shield

Use a pulley puller, or our custom bearing puller tool [01-100-80 101] to remove the bearing from the shaft. You can use it on the motor bearing on either end of the shaft. The bearing on the shaft end is the one needing replacement in most instances. You may by routine choose to replace the bearing on the fan end every other time you replace the shaft bearing.



Jaw Puller at the Ready on Motor Bearing

AHS

Bearing Puller

Place the new bearing on the shaft and drive it on with a hammer or mallet and a 3/4" pipe until it is fully seated. Use of the properly sized pipe or tube allows you to drive the bearing onto the shaft by the inner race. Any significant force or impact applied to the seal or the outer race will possibly damage the bearing.

Place the bearing housing over the bearing and replace the two screws that were removed earlier.

Before setting the shaft and bearing housing back into the motor body make sure that the spring washer is still in place. It should be located in the rear bearing cavity.

After assembling the motor, spin the shaft to insure that it spins freely.

REFRACTORY REPLACEMENT

Please wear the proper safety equipment while performing this task. Proper equipment includes, work gloves, safety glasses, and steel toe boots.

Center Brick

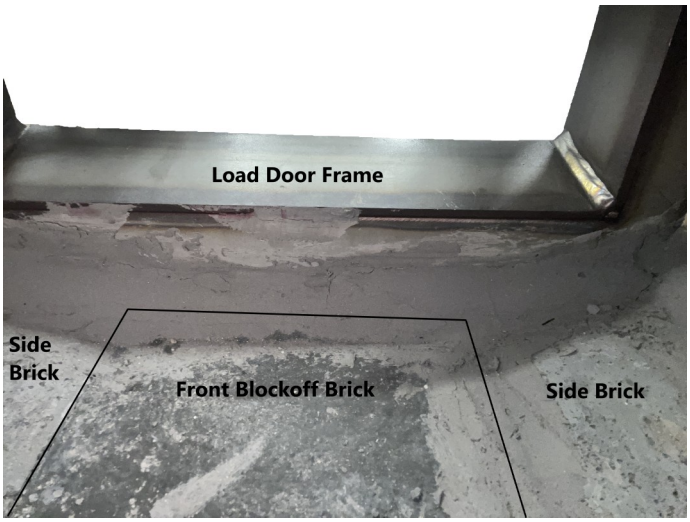
The Center Brick contain the slot through which burning gases are drawn by the induction fan. The center brick is subjected to the most severe flame erosion and highest temperatures and will most likely be the first refractory component to show signs of deterioration. Surface spalling is common under normal conditions and is not reason for concern.

The Center Brick refractory piece should be changed every 20-30 cords of wood and must be ordered from Alternate Heating Systems. Its part number is 492-085. Please order a quart of Trowleze with the Center Brick.

The Center Brick is likely to have become snug, as wood ash will settle into voids around it. They are likely to require just a bit of effort to loosen enough that it may be lifted upward.

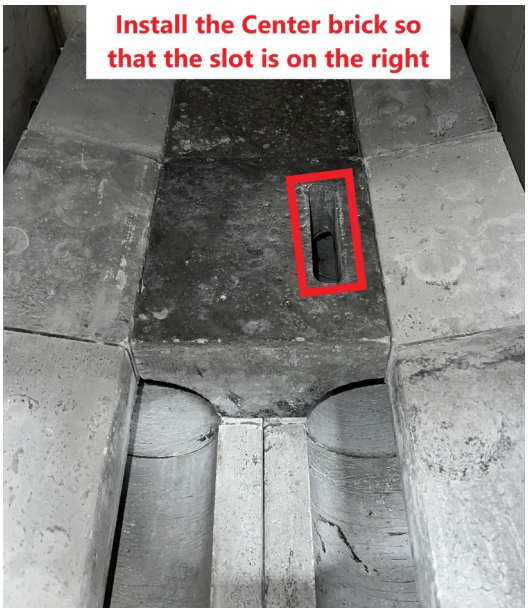
To remove the Center Brick

1. Clean out the firebox thoroughly.
2. Loosen morter that holds in the Front Block-off Brick at the front of firebox. Picture below is inside the firebox looking out.



3. Using a large flat headed screw driver, pry the front Block-Off Brick up. Use the side brick under the Block-Off Brick to pry against.
4. Once the Front Block-Off Brick is remove the Center Brick is easily removed.

5. With the Center Brick and the Front Block-off Brick removed. Instal the new Center brick. **Ensure the slot is on the right side of the boiler.**



6. After the Center Brick is installed. Place the Front Block-off Brick in its place.
7. Lastly using Trowleze mortor. Seal the front of the firebox to the steel wall. Also seal and gaps between the bricks. See Picture Below.

Side-Wall Firebrick Replacement

The 1.25 inch firebrick along the left and right sides of the firebox only need replaced if the bricks break so that they fall out. Cracking is normal. You can buy these from Alternate Heating Systems. Each SE110 take 3 per side. Their part number is 3-40-900 450 125. Please order a quart of Trowleze with the Side-Wall Firebrick.

You will need to remove the broken brick and completely clean out it area of ash, creosot and old Trowleze.

The new brick will fit into place. Use Trowleze as a mortor to hold the bottom of the side-wall firebrick in place.

Side-Wall Firebick Mortored

Complete Refractory Replacement

Complete refracory replacement will need done every 10-15 years. See the Parts diagram below. The refractory may crack but this is normal and of no concern. It is time to replace the refractory when the brick are deteriorated so that there are wholes through the bricks or they are falling apart.

You will need to order the ceramic blanket and two quarts of Trowleze. With the complete set of refractory.

Follow these steps to remove the complete refractory in the SE110

1. Clean out all ashes from firebox and tunnels
2. Remove the air diverter in back of firebox. Simply push the diverter up.
3. Remove the three side-wall brick on both sides of the firebox. Total of six.
4. Remove the Front Block-Off Brick.
    1. Follow the instructions for replacing the Center Brick above.
    2. Use a flat head screwdriver to pry the brick up
5. Remove the Center Brick
6. Remove the Bypass brick and its spacer.
7. Now remove the all six Side Brick.
8. Remove the 3 layers of ceramic blanket

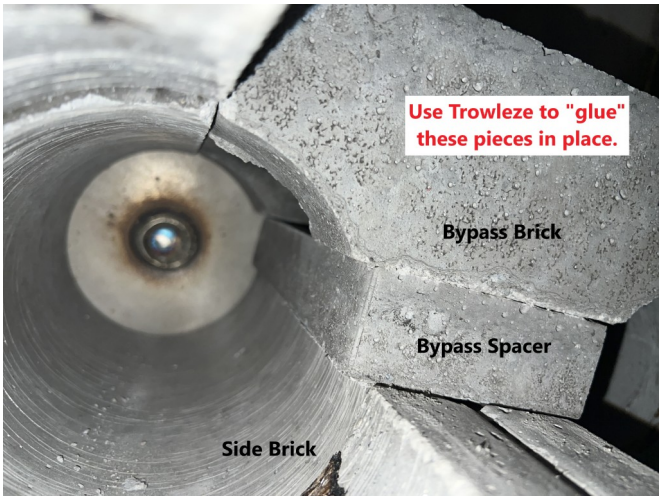
Follow these steps to Install the complete refractory in the SE110

da

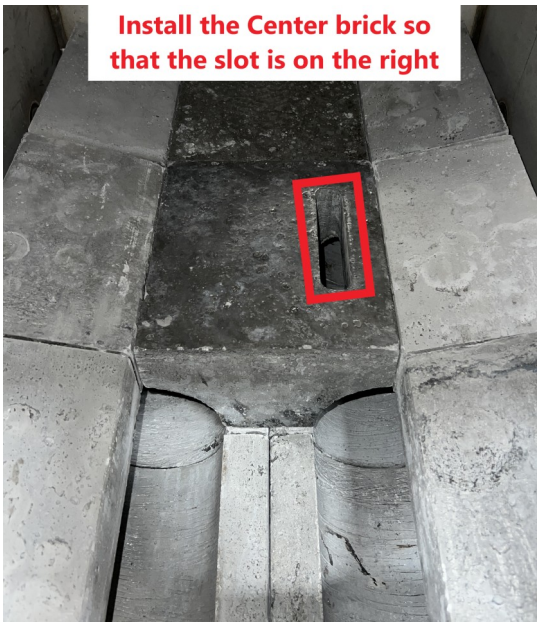
1. install the 3 layers of Ceramic Blanket.
    1. Each layer will have an eight inch strip.
    2. The eight inch strips will go in between each layer.

2. Install the six Side Brick.
    1. Be sure the tunnels are the same height at the front door frame
    2. Align the tunnels so there are little to no ledges between the bricks

3. Instal the Bypass spacer and the Bypass Brick in the back of the firebox.
    1. The spacer and brick will need a little Trowleze so that the spacer will not get moved when the boiler is cleaned.

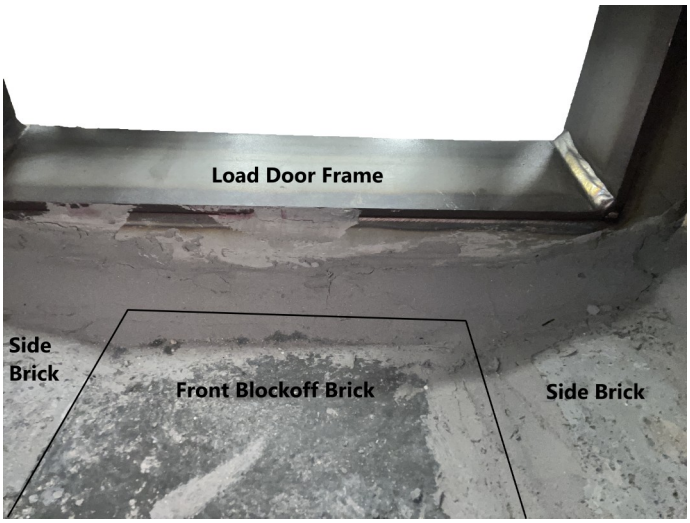


4. Install the Center Brick. Do not mortor this brick in place. You may need to replace it in 3-5 years.



5. Install the Front Block-off Brick.
6. Use Trowleze to seal the bricks to the steel firebox walls
    1. Seal along the left and right sides
    2. Seal the Back wall

3. Seal the front wall. **This is an important area to seal well!**



4. Open the Front Inspection door and seal the seam where the Block-off brick sits on the Side Brick.
5. Cover the three layers of Ceramic Blanket with Trowleze. You may need to cut the ceramic blanket back so you can get a thick coating of Trowleze over the blanket.

7. Make sure both tunnel plugs fit.
8. Reinstall Air Baffle in back of Firebox.
9. Allow cement to dry for 24-48 hours before firing boiler.

FRONT INSPECTION CERAMIC INSULATION

There is a piece of 1/2 inch ceramic board in the front inspection door area. This board insulates the steel to keep the flame hotter. The board helps with combustion efficiency.

To replace the 1/2 inch ceramic board you will need to remove the clips on the left and right side. Push the clips up and out of their holder.

With the clips removed pull the top of the ceramic board out and lift to remove.

To install a new board you may need to use a wood rasp to shape the board to fit your boiler and around the firetube. Sit the bottom of the board behind the retaining bar and push the top back against the boiler, Gently! Reinstall the clips.

AIR TURBULATOR

The SE110 is equipped with an air turbulator in the fire tube. This should be removed for yearly cleaning and then replaced.

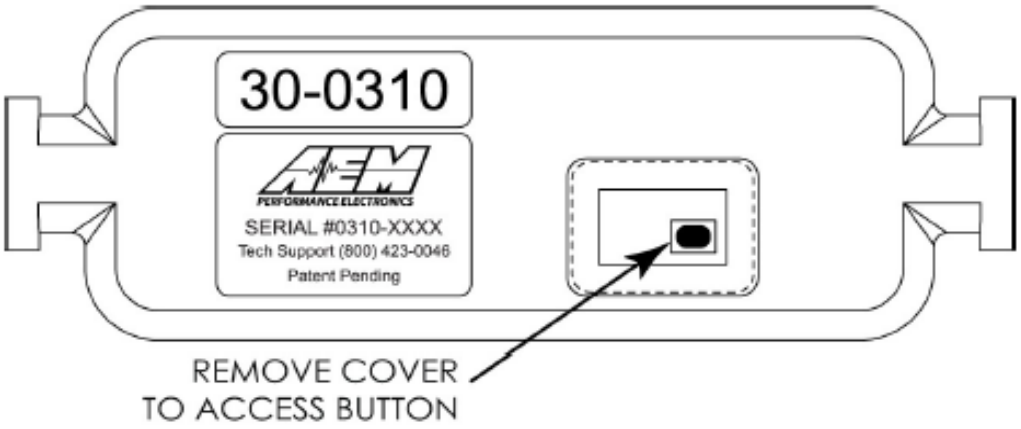
If you are experiencing water in the cyclone, removing the air turbulator may help.

Operation

The minimum wiring connections required to operate the X-Series UEGO Inline are switched +12V, ground, and one of the outputs: 0-5V Analog, AEMnet / CAN, or Serial. There are two LEDs on the top of the unit which describe the present operating status of the device as follows.

RED Status	*GREEN* Ready	Description
OFF	SOLID ON	Normal Operation
MEDIUM	MEDIUM	(Simultaneous flash) Power up, flash count = AEMnet/CAN ID #
SOLID ON	OFF	Fatal Error, Restart Required
SLOW	OFF	Error, No Sensor Detected
OFF	FAST	Warm Up, Stabilize, Equalize the heater
MEDIUM	MEDIUM	(Simultaneous flash) New Free Air Calibration Required
FAST	FAST	(Simultaneous flash) Free Air Calibration in Progress
ALTERNATING	ALTERNATING	(Alternating Flash) While in AEMnet/CAN Learn Mode

A button is located beneath an access cover on the rear of the unit for the following procedures. Carefully pry the cover off with a small screwdriver or similar and replace when done.



Change to Free Air Calibration Mode

1. Remove oxygen sensor from exhaust but keep it connected to controller.
2. Apply power to controller and wait for the sensor to warm up as indicated by a solid green 'Ready' LED.
3. Press and hold the button until both LEDs begin to flash rapidly in unison.
4. The LEDs will stop flashing once the calibration is complete and the unit will return to Normal Operation mode with only the green 'Ready' LED illuminated solidly.

Change to Resistor Calibration Mode (Default)

This is only necessary if you have already performed a free air calibration and wish to return to resistor calibration mode. The units are shipped from the factory in resistor calibration mode as default - this is the recommended mode for most users.

1. Remove power from the controller and verify that both LEDs are off
2. Press and hold button.
3. Apply power to the controller while holding button.
4. The green 'Ready' LED will flash to confirm resistor calibration mode

ADDITIONAL INFORMATION

For additional information on using your boiler safely, obtain a copy of the National Fire Prevention Association publication "Using Coal and Wood Stoves Safely", NFPA No. HS-8-1974. The address of the NFPA is 470 Atlantic Avenue, Boston, Massachusetts 02 210. You may also visit:

http://www.nfpa.org/codes-and-standards/free-access

EXPLANATION OF EFFICIENCY

There are different types of efficiencies, namely, Overall (Delivered) Efficiency and Combustion (Stack Loss) Efficiency.

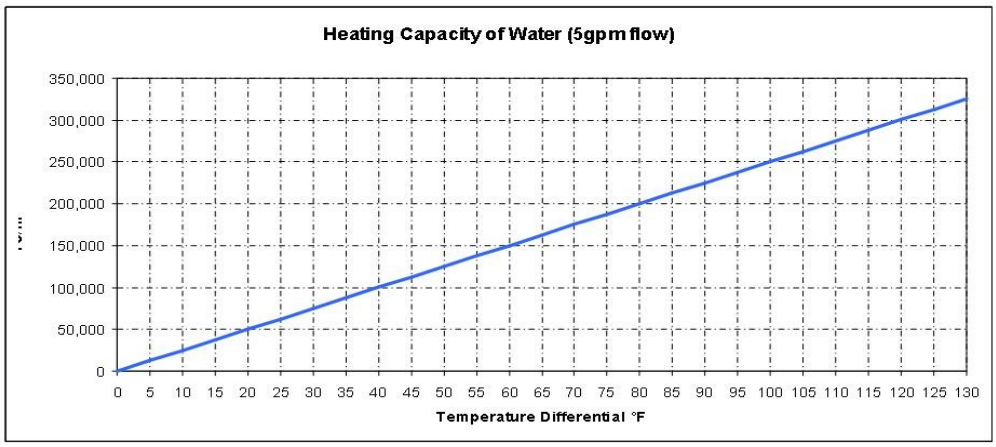
Combustion Efficiency is how well a fuel burning device is converting its fuel into usable heat. It does not reflect how much of the usable heat produced is transferred to the home. For instance when the SE110 is running at 16-100% of its heating capacity the average Combustion efficiency is 96.8% HHV

Overall efficiency is the percentage of heat that is transferred into the space to be heated when a load of fuel is burned. Actual efficiency will vary depending on factors such as wood moisture, appliance operation and installation (e.g., outside piping, chimney height). For instance when the SE110 is running at 16-100% of its heating capacity has an average Overall (stackloss) Efficiency of 80.0% HHV.

Overall efficiency is a better measure than combustion efficiency. It more accurate shows the amount of heat that is delivered to the home.

The efficiencies listed in this manual are determined using the higher heating value (HHV). The Lower Heating Value (LHV) may also be used to determine efficiencies. The HHV and LHV are referring to the heating value of wood (BTU/lb). The HHV of wood is 8600 BTU/lb and the LHV of wood is 7988 BTU/lb.

Appendix A: Boiler Specifications



SE110 Specifications

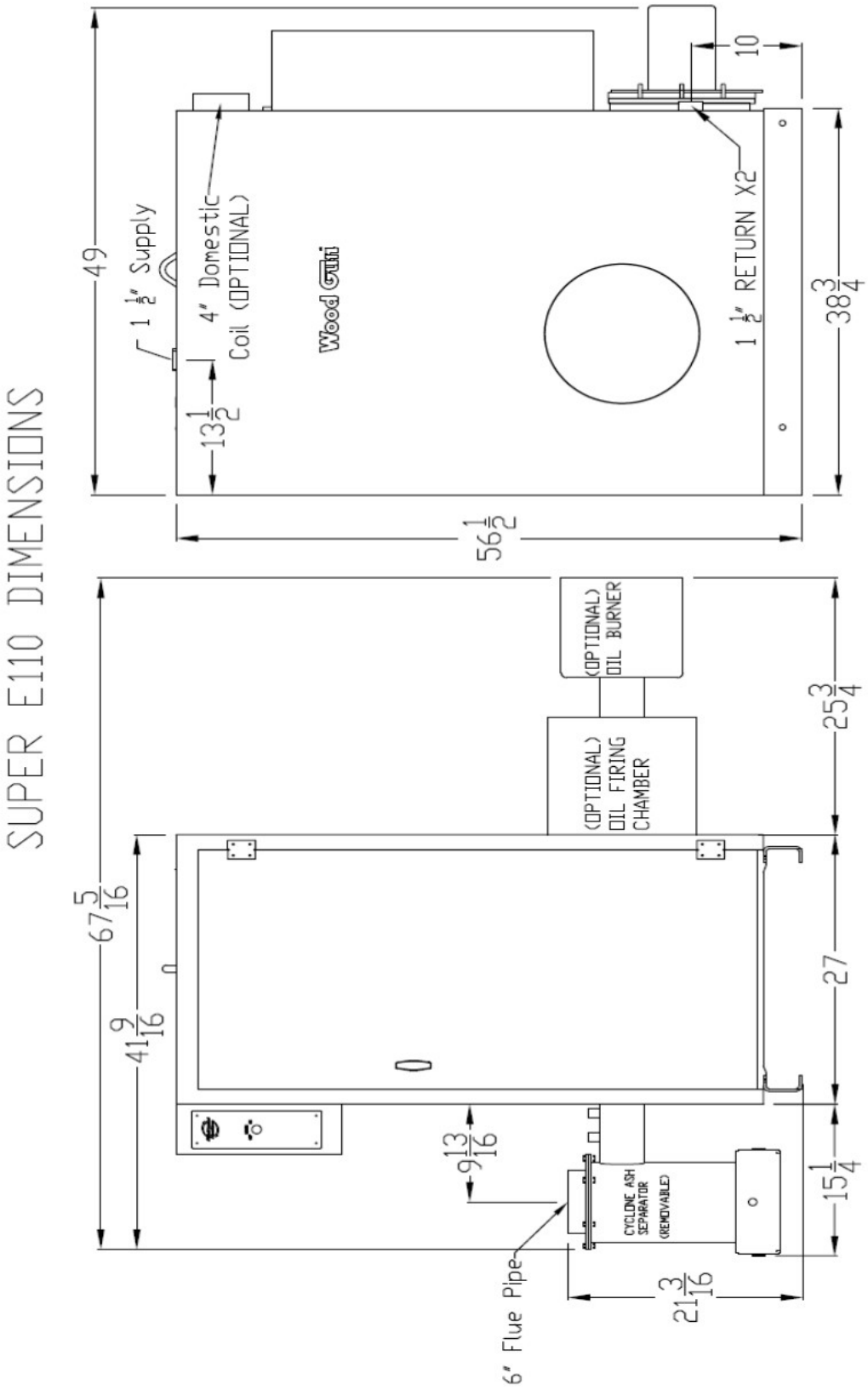
	SE110
BTU/Hour Range	16,250 – 125,000
BTU 8 Hour Avg Output*	50,000
Water Capacity	60 gallons
Fire Box Capacity	5.42 ft^3
Fire Box Length	26"
Standard Door Opening	14" x 14"
Height	58"
Width	28"
Depth	49"
Flue Size	6"
Weight	1,650 lbs
Typical Heating Capacity**	1,000-3,000 ft^2
Heating Efficiency @ high output	82%

*Based on loading firebox with seasoned firewood **Subject to building design/construction

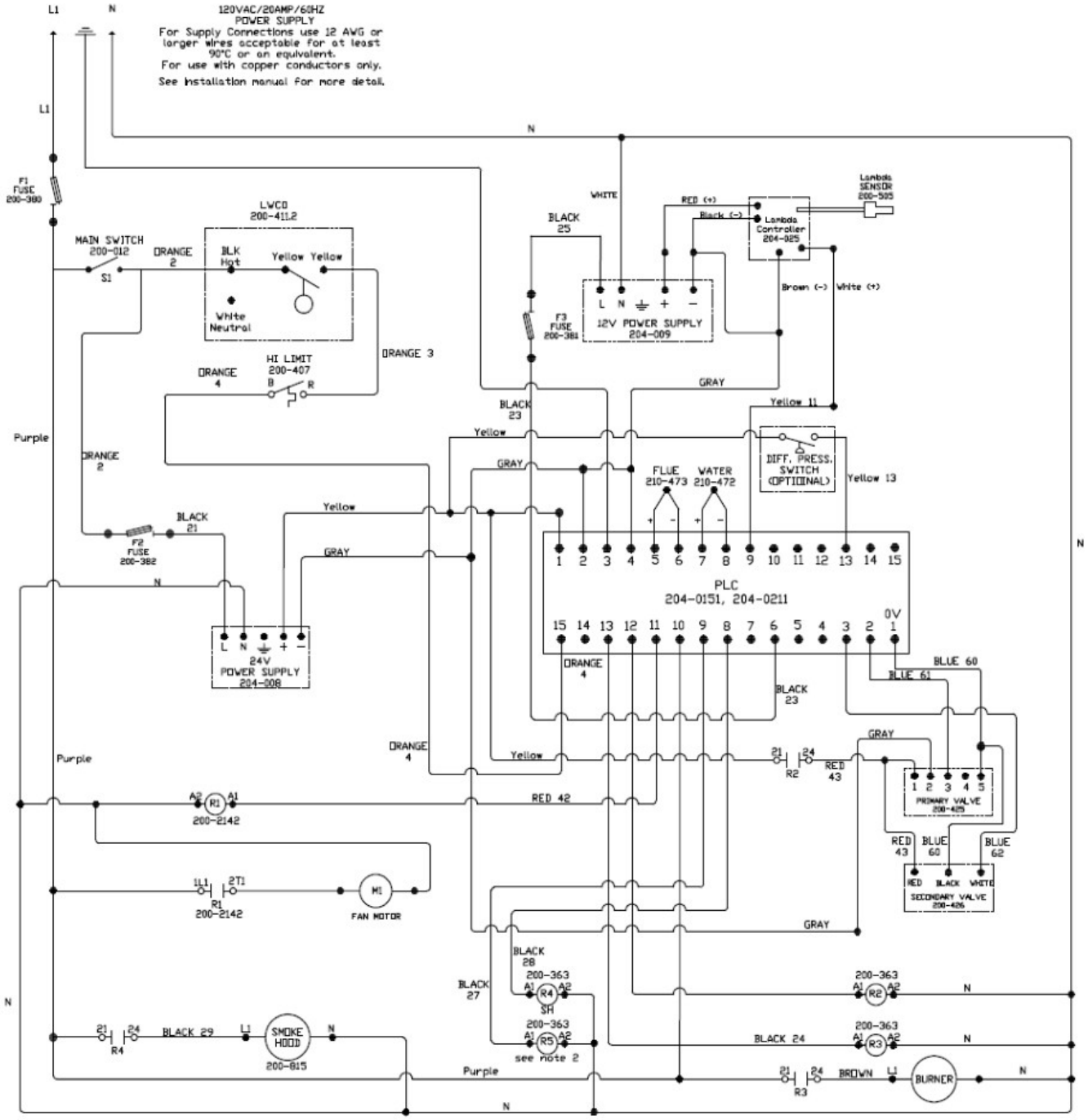
Emission Results

			$T2_{Min}$	E_T	E	E	$E_{g/hr}$	$E_{g/kg}$	η_{del}	H_{SLM}
Category	Run No	Load % Capacity	Min Return Temp	Total PM Emissions	PM Output Based	PM Output Based	PM Rate	PM Factor	Delivered Efficiency	Stack Loss Efficiency
			°F	g	lb/mmBTU Out	g/MJ	g/hr	g/kg	%	%
I	2	< 15% of max	151.0	9.8	0.084	0.036	0.62	0.47	65.2%	77.5%
II	3	16-24% of max	149.7	9.6	0.081	0.035	1.02	0.47	67.8%	79.7%
III	4	25-50% of max	146.3	9.7	0.078	0.034	1.55	0.45	67.6%	80.6%
IV	1	Maximum	158.4	8.3	0.060	0.026	3.31	0.40	77.4%	82.2%

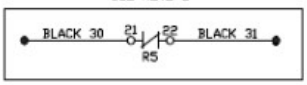
Boiler Dimensions



Appendix B: Wiring Diagrams



Note 2: RELAY R5 CAN BE USED TO CONTROL THE BOILER CIRCULATOR. IT IS A DRY CONTACT (6AMP @ 120VAC). BLACK WIRE #30 CAN BE USED TO BRING 24V OR 120V TO THE REAR JUNCTION BOX. YOU WILL NEED TO SUPPLY POWER TO TERMINAL #22 OF THE R5 RELAY



ALTERNATE HEATING SYSTEMS
CONFIDENTIAL DOCUMENT

MODEL: WOOD GUN E100-E250				
PART: WOOD GUN - SM43 WITH 2ND AV				
DWG. #: 400-UNI	DRWN BY: CWG	DATE: 8/15/24	APRV'D BY: CWG	DATE: 8/15/24
SCALE: NS	SHEET: 1 OF 1	SIZE: A	REVISION: 2	

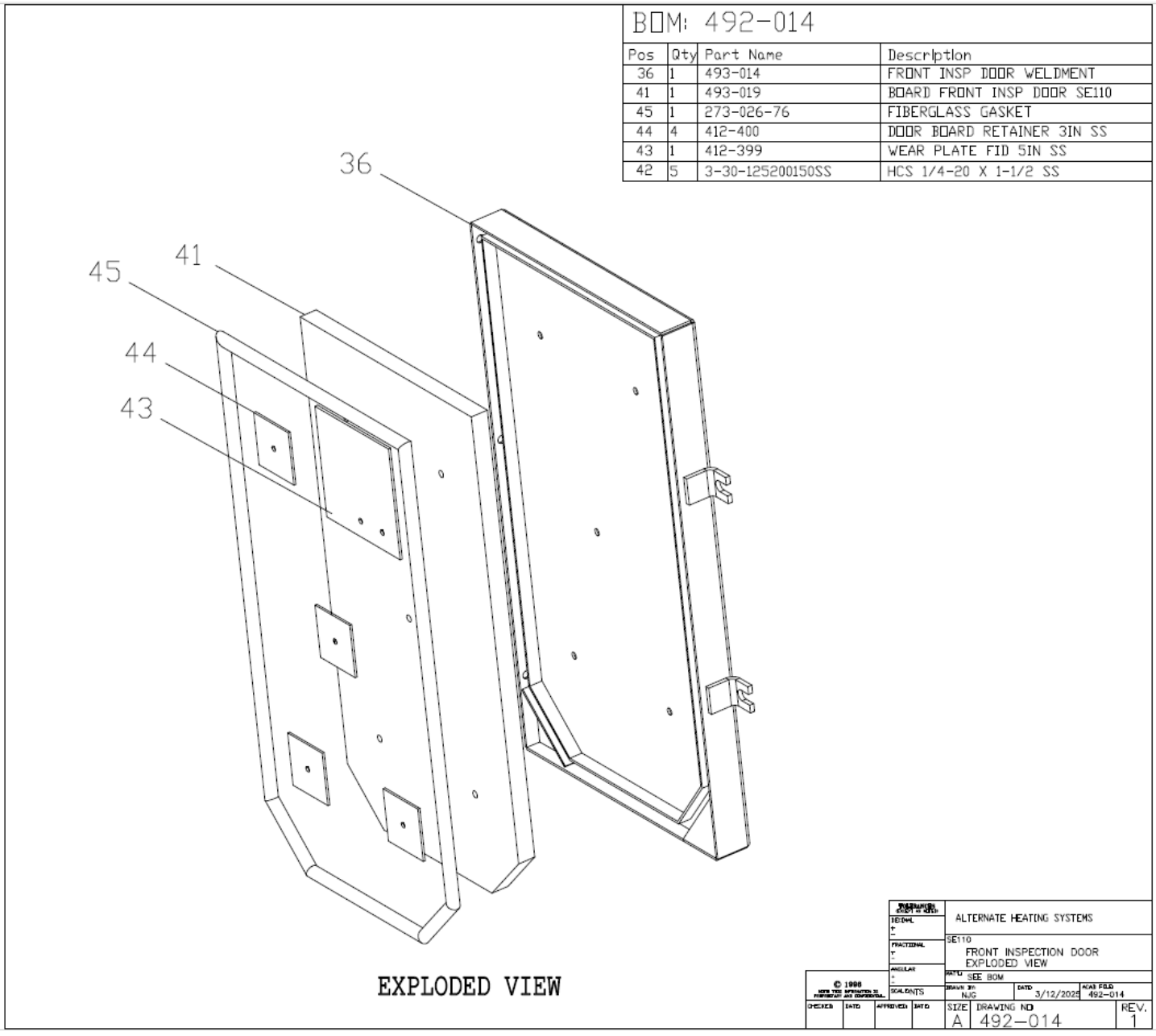
Appendix C: Parts Listing

	Item Description		Item ID	Qty Needed	UNIT
1	SE110 VESSEL SF NC		. 494-001	1.00	pieces
2	FRONT BOTTOM BRACKET SE110		. 492-047	1.00	pieces
3	FRONT TOP BRACKET SE110		. 492-048	1.00	pieces
4	RIGHT INSULATION COVER SE110		. 492-051	1.00	pieces
5	LEFT INSULATION COVER SE110		. 492-052	1.00	pieces
6	REAR INSULATION COVER SE110		. 492-053	1.00	pieces
7	REAR TOP INSULATION CVR SE110		. 492-054	1.00	pieces
8	REAR BTM INSULATION CVR SE110		. 492-055	1.00	pieces
9	FRONT DOOR INNER SE110		. 492-056	1.00	pieces
10	FRONT DOOR OUTER SE110		. 492-057	1.00	pieces
11	REAR COVER SE110		. 492-058	1.00	pieces
12	SE OUTER DOOR STRIKER PLATE		. 482-052	1.00	pieces
13	YELLOW INSULATION 1 1/2in BOARD		. 200-901	54.00	sqft
14	TEKS 1/4- #14 X 3/4 (SELF-TAPPING SCREWS)		. 3-30-512514075	8.00	pieces
15	PPH TCS 10-32 X 3/8 IN L (SELF-THREADING SCREWS)		. 3-30-803701032	6.00	pieces
16	RIVET BLIND 1/8 DIA .063-.125		. 200-313R	14.00	pieces
17	REFRACTORY BRICKS			1.00	pieces
18		SIDE BRICK SE110	. 492-083	6.00	pieces
19		BLOCK OFF BRICK SE110	. 492-084	1.00	pieces
20		SLOTTED CENTER BRICK SE110	. 492-085	1.00	pieces
21		BYPASS BRICK SE110 and Spacer	. 492-086	1.00	pieces
22	FAN ASBY COMP DD SE110/E140/180 NEW		. 423-022A	1.00	pieces
23		FAN MOTOR 1/3HP 1PH BALDOR	. . 200-482.1	1.00	pieces
24		FAN COVER PLATE	. . 422-102A	1.00	pieces
25		ABRASION SHIELD 4HOLE	. . 423-023-2	1.00	pieces
26		FAN HEAT SHIELD (1/2IN CERAMIC)	. . 422-125	1.00	pieces
27		HN 5/16-18 Z 5	. . 3-30-80311813	4.00	pieces
28		FHSCS 3/8-16 X 7/8 SS	. . 3-30-7371601	4.00	pieces
29		FW 5/16 Z 11/16OD SAE	. . 3-30-02003113	4.00	pieces
30		HCS 1/4-20 X 1/2 SS SET SCREW	. . 3-30-12520050	2.00	pieces
31		LW 5/16 IN	. . 3-30-010031516	4.00	pieces
32		FAN - SE110/E140/E180 DIRECT DRIVE	. . 423-009A	1.00	pieces
33		GASKET FAN ASBY E100-E200	. . 273-028-42	1.00	pieces
34	FIREBOX AIR DIVERTER SE110		. 492-081	1.00	pieces
35	FRONT INSP DOOR COMP SE110		. 492-014	1.00	pieces
36		FRONT INSP DOOR WLDMT SE110	. . 493-014	1.00	pieces
37		HINGE FRONT INSP DOOR E100-250	. . 413-029A	1.00	pieces
38		HCS 5/16-18 X 3/4	. . 3-30-1311807513	3.00	pieces
39		FW 5/16 Z 11/16OD SAE	. . 3-30-02003113	3.00	pieces
40		LW 5/16 IN	. . 3-30-010031516	3.00	pieces
41		BOARD FRONT INSP DOOR 1IN HS	. . 493-019	1.00	pieces
42		HCS 1/4-20 X 1-1/4 SS	. . 3-30-125200125SS	5.00	pieces
43		WEAR PLATE FRONT INSP DOOR SS	. . 412-399A	1.00	pieces
44		DOOR BOARD RETAINER 3IN SQ SS	. . 412-400A	4.00	pieces
45		GASKET FRONT INSP DOOR SE110	. . 273-026-77	1.00	pieces
46	BOARD INSP INSUL SE110		. 492-091	1.00	pieces
47	FIRE TUBE TURBULATOR SE110		. 492-388	1.00	pieces
48	LOAD DOOR COMP HL OBE/SE		. 443-140	1.00	pieces
49		LOAD DOOR WLDMT HL CARBON	. . 412-140	1.00	pieces
50		HINGE LOAD DOOR S/A E100/250	. . 413-028	1.00	pieces
51		HOOK LATCH HANDLE FOR WOOD	. . 482-141	1.00	pieces
52		WOODEN HANDLE 1.25 X 6.5	. . 200-386	1.00	pieces
53		HLN 1/2-13 X 3/4W	. . 3-30-8305013075	1.00	pieces
54		LW 5/16 IN	. . 3-30-010031516	2.00	pieces

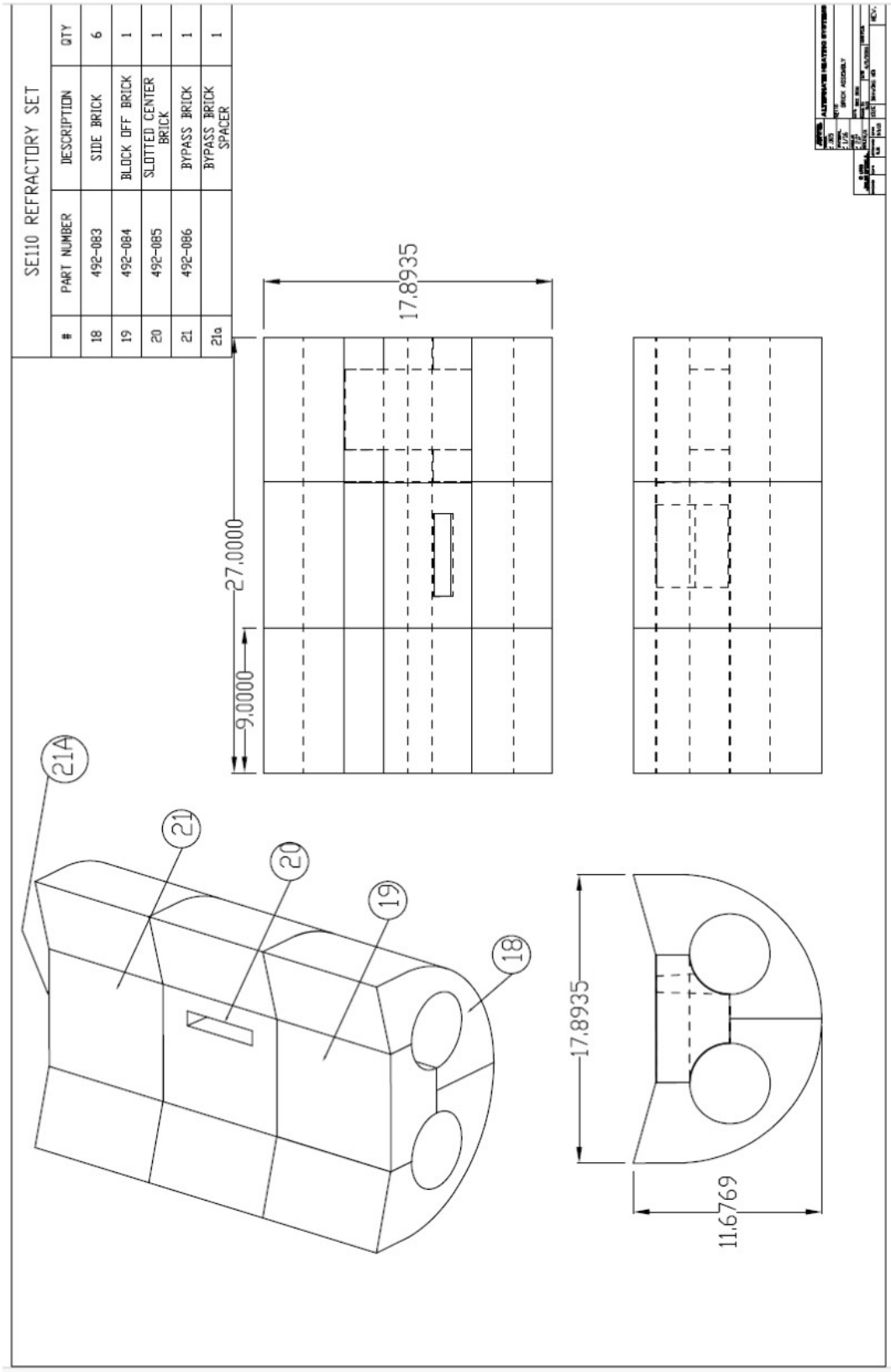
55		FW 5/16 Z 11/16OD SAE	. . 3-30-02003113	2.00	pieces
56		HCS 5/16-18 X 3/4	. . 3-30-1311807513	2.00	pieces
57		HCS 3/8-16 X 3/4	. . 3-30-13716075	2.00	pieces
58		UNTHREATHED SPACER 1/2ID	. . 412-143-1	1.00	pieces
59		INNER PANEL REMVBLE LOAD DOOR	. . 412-228-14	1.00	pieces
60		FIBERGLASS TAPE 1/2IN W/PSA	. . 273-027	4.00	pieces
61		HCS 1/2-13 X 2 FULLY THREADED	. . 3-30-1501302	1.00	pieces
62		SILICONE CORD 3/4IN	. . 200-054	4.60	per foot
63		HN 1/2-13 JAM NUT	. . 3-30-835013	1.00	pieces
64		SILICONE HI TEMP SEALANT 10OZ	. . 200-802	0.15	per tube
65		FW 1/2IN 1-3/8IN OD	. . 3-30-020500137	1.00	pieces
66	REPLACEMENT LOAD DOOR SEAL				
67		SEAL KIT LOAD DOOR 14IN NEW	200-8011	1.00	pieces
68	Steel Knurled Grip Knob 1/2-13		. 200-910	2.00	pieces
69	EYE BOLT 1/2-13 X 2		. 3-30-150130300	1.00	pieces
70	HCS 3/8-16 X 1-1/2		. 3-30-1371615013	2.00	pieces
71	HLN 3/8-16		. 3-30-8303716	2.00	pieces
72	HOOK LATCHKEEPER SE		. 482-142	1.00	pieces
73	HCS 1/2-13 X 1-1/2		. 3-30-150130150	1.00	pieces
74	LW 1/2 IN		. 3-30-01005012	1.00	pieces
75	RADIAL BALL BEARING LATCH HAND		. 200-4931616	1.00	pieces
76	HLN 1/2-13 X 3/4W		. 3-30-8305013075	1.00	pieces
77	HCS 5/16-18 X 1/2		. 3-30-1311805013	2.00	pieces
78	CYCLONE ASBLY SE110		. 493-016	1.00	pieces
79	HCS 5/16-18 X 1		. 3-30-131181	3.00	pieces
80	LW 5/16 IN		. 3-30-010031516	3.00	pieces
81	FW 5/16 Z 11/16OD SAE		. 3-30-02003113	3.00	pieces
82	CYCLONE SEAL KITS				
83		CYCLONE TOP FLANGE GASKET	200-052-38A	1.00	pieces
84		CYCLONE ASH SCOOP GASKET	200-052-37	1.00	pieces
85		CYCLONE MOUNTING GASKET	200-052-19A	1.00	pieces
86	CONTROL BOX ASBY WG O2		. 493-230	1.00	pieces
87		12X15 CONTROL BOX LID TOUCH	. . 492-746	1.00	pieces
91		POWDER COATING (Time) GRAY	. . . POWDER COATING	5.00	pieces
97		POWDER COATING (Time) GRAY	. . . POWDER COATING	8.00	pieces
98		POWER SUPPLY 24V/50W	. . 204-008	1.00	pieces
99		POWER SUPPLY 12V/75W	. . 204-009	1.00	pieces
100		PLC SAMBA	. . 204-0151	1.00	pieces
101		FUSE HOLDER 10X38MM 32A	. . 200-2137	3.00	pieces
102		FUSE 20A MIDGET FLM 250V	. . 200-380	1.00	pieces
103		FUSE 2A MIDGET FLM 250V	. . 200-381	1.00	pieces
104		FUSE 1-1/2A MIDGET FLM 250V	. . 200-382	1.00	pieces
105		CONTACTOR NO 3P 12A AC1 120/60	. . 200-2142	1.00	pieces
106		SELECTOR 2 POSITIONS 0-1	. . 200-009	1.00	pieces
107		MOUNTING ADAPTER	. . 200-015	1.00	pieces
108		TERMINAL SCREW AUX CONTACT 1NO	. . 200-012	1.00	pieces
109		RELAY SOCKET FOR HR30	. . 200-362	3.00	pieces
110		MINITURE RELAY FOR SOCKET HR5	. . 200-363	3.00	pieces
111		DIN RAIL 35MM X 7.5 X 2 METERS	. . 201-337	0.25	pieces
112		GROUND TERMINAL BLOCKS	. . 201-349	3.00	pieces
113		TERMINAL BLOCK	. . 201-329	22.00	pieces
114		BRIDGE 2 POSITION	. . 201-332	10.00	pieces
115		TERMINAL BLOCK BLANK MARKER	. . 201-347	22.00	pieces
116		GROMMET 1-1/4 IN SE	. . 200-227	1.00	pieces
117	SE LAMBDA SENSOR CONTROLLER		. 3-20-00964	1.00	pieces
118	REPLACEMENT LAMBDA SENSOR		3-20-00965	1.00	pieces
119	THERMOCOUPLE J TYPE 2.5IN WATER		. 210-472	1.00	pieces
120		THERMOCOUPLE WELL	. 210-471	1.00	pieces
121	THERMOCOUPLE J TYPE 2IN FLUE		. 210-473	1.00	pieces

122		THERMOCOUPLE J TYPE FEMALE CON	. 210-478	1.00	pieces
123		THERMOCOUPLE J TYPE MALE CONN	. 210-477	1.00	pieces
124	AQUASTAT SINGLE L4006A		. 200-403	1.00	pieces
125	AQUASTAT WELL 123869A		. 200-406	1.00	pieces
126	3/8 ALUM FLEX CONDUIT		. 3-20-25043	1.00	pieces
127	FLEX CONNECT 3/8IN STR		. 200-633	10.00	pieces
128	FLEX CONNECT SQZ 3/8-90 DEG		. 3-20-2000	6.00	pieces
129		ANTI SHORT BUSHING	. 200-755	6.00	pieces
130	PLUG 3/4IN NPT		. 200-114	1.00	pieces
131	RELIEF VALVE 3/4 IN 535000		. 3-10-77382	1.00	pieces
132	PRESSURE/TEMP GAUGE (LOWER)		. 200-408	1.00	pieces
133	ASH RAKE E100 E200		. 423-026A	1.00	pieces

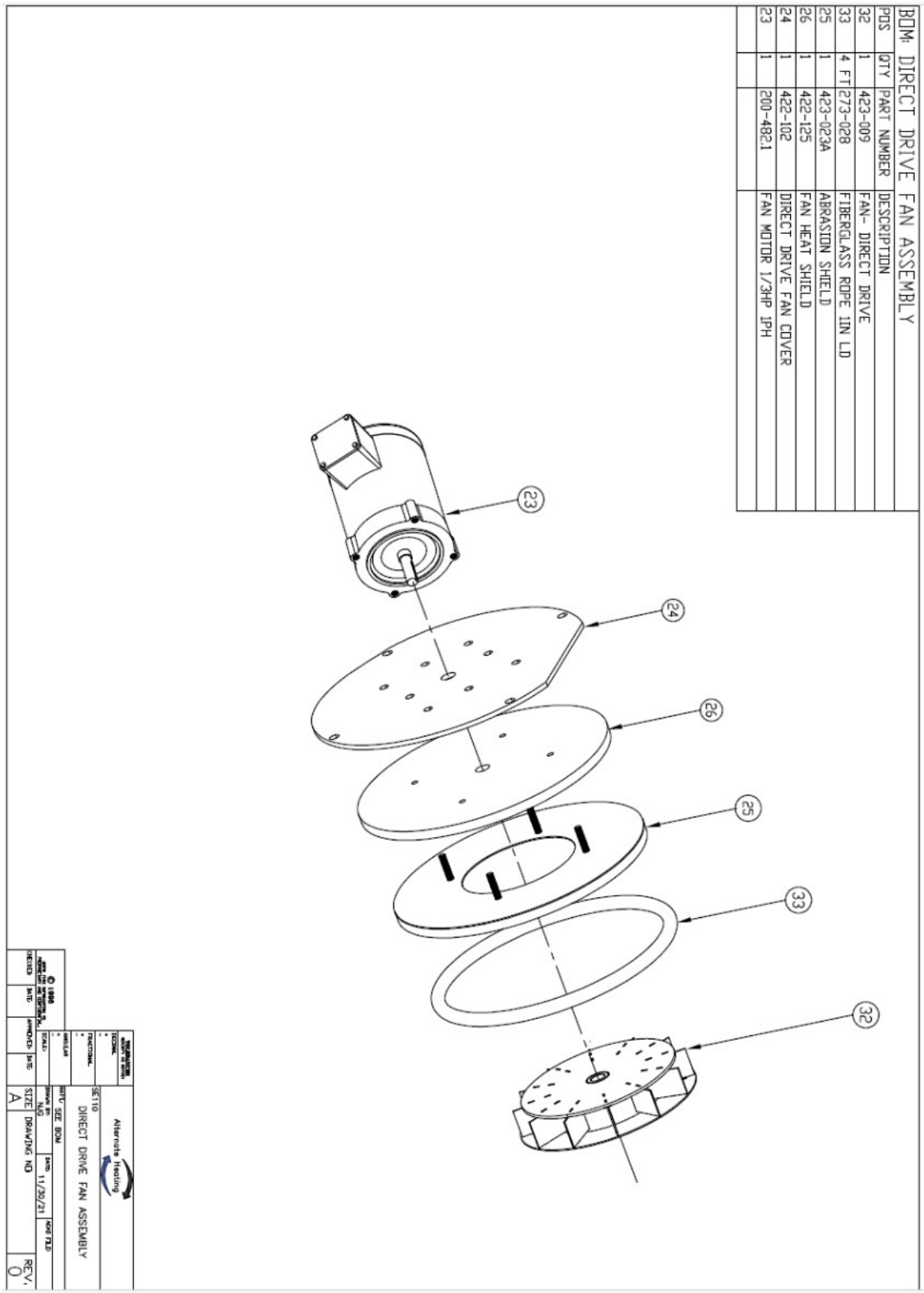
Exploded Parts Diagram – Front Inspection Door



Exploded Parts Diagrams – Refractory



Exploded Parts Diagram – Fan Assembly



BOM: DIRECT DRIVE FAN ASSEMBLY

POS	QTY	PART NUMBER	DESCRIPTION
32	1	423-009	FAN- DIRECT DRIVE
33	4 FT	273-028	FIBERGLASS ROPE 1IN LD
25	1	423-023A	ABRASION SHIELD
26	1	422-125	FAN HEAT SHIELD
24	1	422-102	DIRECT DRIVE FAN COVER
23	1	200-482.1	FAN MOTOR 1/3HP 1PH

Appendix E: Troubleshooting Guide

This guide is intended to help you diagnose and repair basic problems with you boiler. If you believe your problem is serious or the problem persists after following all the procedures specified in this guide, contact AHS for support.

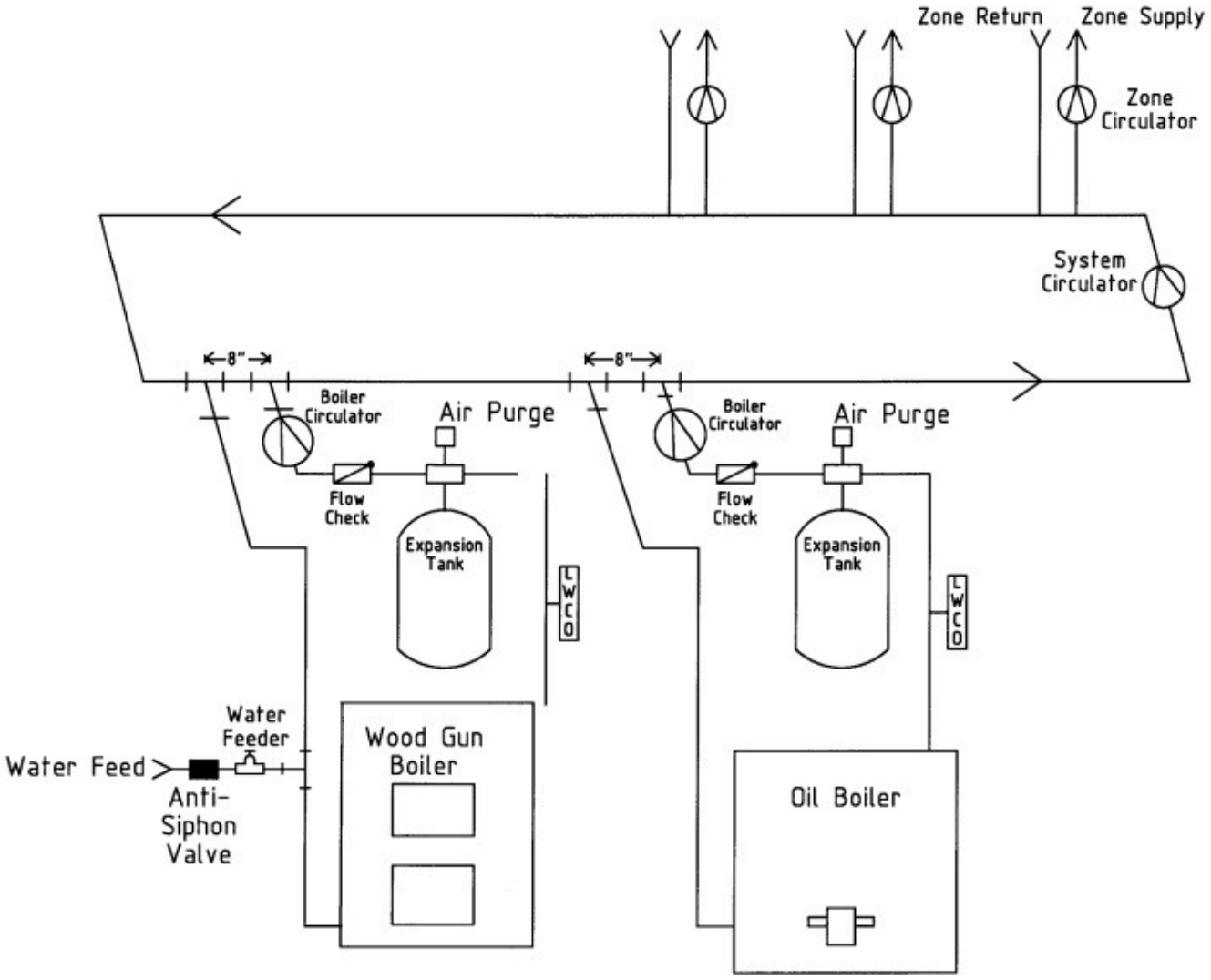
Problem	Possible Cause	Solution
1. Boiler overheating	a) Control malfunction b) Incorrect control setting c) Intake air valve not closing properly d) Excessive chimney draft e) Load door not sealing properly	a) Replace malfunctioning control b) Adjust control setting c) Replace gasket or adjust linkage d) Reduce draft or see e) e) Adjust load door for proper seal, replace gasket if necessary
2. Back-puffing (Also see section on Charging Boiler with Wood and the Back-Puffing Checklist)	a) Burn cycle too long/Too much wood b) Wood too small and/or excessively dry c) Improper loading of fire box d) Improper starting of wood	a) Fill with less wood to shorten burn cycle b) Load larger fuel with higher moisture content c) Follow proper loading procedure d) Follow proper starting procedure so as to attain high refractory temperatures
3. Smoke visible at stack	a) Refractory not hot enough b) Refractory not properly sealed in fuel chamber c) Center cleanout plug not properly sealed d) Leaking load door e) Leaking air valve f) Ash or charcoal buildup on or in refractory	a) Allow refractory to come up to operating temperature; refer to instructions for building a fire b) Seal refractory with “Trowleze” refractory cement. c) Replace damaged ceramic pad at center cleanout plug d) Check doors for airtight seal e) Repair/replace air valve gasket disc f) Clean ash from boiler. See “weekly maintenance routine”
4. Fire goes out	a) Boiler not cycling frequently enough (refractory cools to below kindling temperature) b) Wood bridging in fuel chamber	a) Increase heat load or install draft cycle timer (contact AHS) b) Reposition wood (always load wood length-wise front to back in chamber)
5. Smoke leakage at doors	a) Improper gasket seal b) Door not tight enough, or is out of adjustment	a) Repair seal with high temperature RTV sealant added at low point on door gasket b) Adjust door
6. Fan vibration	a) Bearing or motor loose b) Fan out of balance c) Creosote buildup in area of fan impeller	a) Tighten all bolts b) Inspect fan for damage c) Raise return water temperatures or use drier wood
7. Excessive water in the cyclone drawer (Also see condensation checklist)	a) The stack temperature may not be high enough. b) The fire box is being filled too full for the heat demand. c) There may be a blockage in the flue, cyclone, heat exchanger, or refractory. d) The wood logs are too large and/or has high moisture content (>30%). e) The wood is too dry.(<10%) f) Loading the wood incorrectly. Wood	a) The boiler should be in an insulated room. The flue stack needs to be insulated (If the room is typically cold.) b) Fill the fire box only half full or enough to burn for eight hours or less (shorten cycles). a) Remove ash from fire box and refractory. Clean the heat exchanger, cyclone, or flue.

7. continued	is too short f) Load door seal or air valve seal is leaking h) The boiler water temperature is too low or Water temperature difference between supply and return may be more than 20ºF	b) Burn smaller wood, split wood, and/ or dryer wood. Build a hotter fire. Remember that more wood does not always equate to more heat. c) Too dry of wood <10%. can also cause this especially is pieces are splitt too small <2 inches. d) Wood should be cut to 80% of the firebox length, so that it utilizes the firebox completely front to back. e) Adjust and/or replace load door seal and/or Air Valve f) Raise the boiler operating temperature, (Max 200º F)
8. The boiler burns more wood than usual	a) The wood has a higher moisture content level than normal. b) The wood is dry but has less weight per piece of wood (soft wood). c) The heat exchanger needs cleaned.	a) Try burning drier wood. b) Try burning hard wood. c) Clean the heat exchanger.
9. The pressure relief valve is releasing (Boiler pressure keeps rising)	a) Pressure reducing valve is malfunctioning. b) There is not enough expansion capacity. c) The domestic coil is leaking.	a) Replace pressure reducing valve. b) Add an expansion tank or replace a malfunctioning one. c) Replace or isolate the domestic coil.
10. There is smoke or creosote leaking out of air inlet connection.	a) The air valve disc bolt is too tight. b) The airvalve disc is old or dirty. a) Motor is not adjusted properly	a) Loosen the bolt so that the disc has play. b) Clean or replace airvalve disc a) See section about motor replacement to readjust.
11. There is excessive creosote buildup on boiler vessel located behind the lower front inspection door area.	a) The fire box is being filled too full for the heat demand. b) There may be a blockage in the flue, cyclone, heat exchanger, or refractory. c) The wood logs are too small and/or have very low moisture content. d) Load door seal or air valve seal is leaking. e) The boiler is operated with water temperature too low. The stack temperature may not be high enough.	a) Fill the fire box only half full or enough to burn for eight hours. b) Remove ash from fire box and refractory. Clean the heat exchanger, cyclone, or flue. c) Burn larger wood, unsplit wood, and/ or green wood. d) Adjust load door, fix, or replace air valve. e) Raise the boiler operating temperature to 180-190 F
12. Steel has etching or pitting	a) Heating domestic water in the summer time with a carbon steel boiler.	a) Increase operating temperature in boiler. Only use small amounts of very dry wood to burn straight through the fuel charge with no cycling.
13. Boiler is not coming to temperature or not keeping house warm	a) The wood is too short. b) Thermocouple malfunction or installed incorrectly. a) Boiler is dirty/plugged	a) Wood must be 22-28 inches long b) Inspect water and flue thermocouple replace if necessary, verify they are installed correctly. c) Remove fan and cyclone. Clean boiler thoroughly

Index of Photos and Illustrations

Appendix F: Boiler Piping and Ducting Examples

SE110 in Primary/Secondary System



Note:

1. A call for heat from any zone activates Boiler Circulators, System Circulator and Zone Circulator.

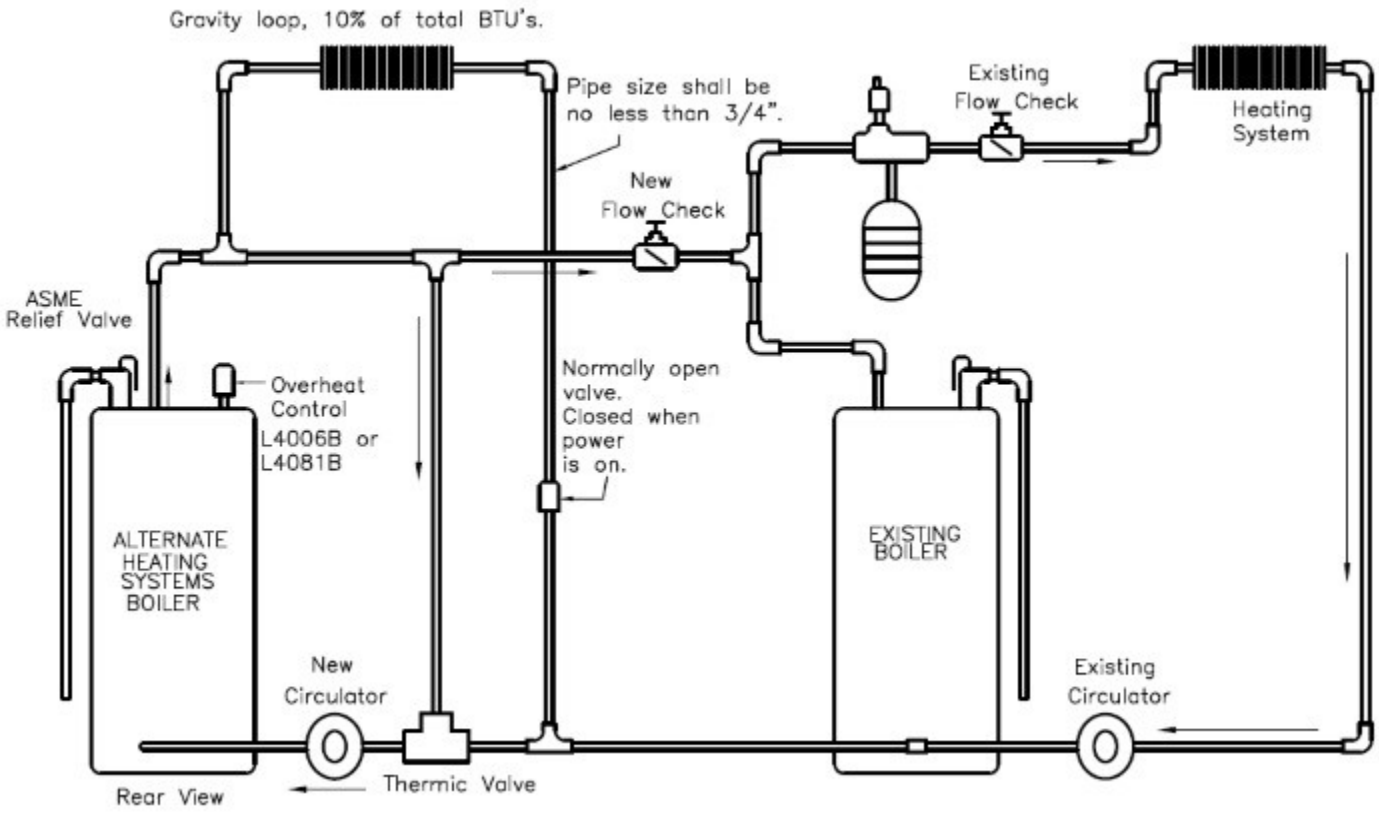
2. Each Boiler Circulator is also controlled by a low limit to prevent operation when the Boiler is cold.

3. Dump zone operation will activate one or more zones, System Circulator and Boiler Circulator.

4. Do not bypass temperature supply control system on radiant heat system. In radiant heat applications, permit activation of a call for heat but allow system controls to regulate water temperature.

Not all system components, valves and devices are shown in this drawing. Actual conditions and application requirements will vary. Please consult a heating expert or your Alternate Heating Systems for additional information.

Operating an Alternate Heating Systems Boiler in Tandem with Existing Boiler



Note: The above illustrates one possible method of connecting the SE110™ with an existing boiler. This connection is as follows: using a small circulator (and with the backup boiler piped into the return tapping) run another pipe from the supply tapping T, of the SE110™ to the supply line, of the existing boiler on the lower side of the flow control valve. A minimum of 1 in diameter pipe should be used for this connection on the model SE110. The pipe size must be determined by taking into account the distance involved and flow required. The new circulator should be wired to the power for the SE110. When power to the SE110 is on, the circulator should be running. An alternate option is to attach a strap on aquastat on the SE110 supply line that closes on temperature rise. This will automatically activate the pump at a given temperature. Overheat control and the gravity loop (as pictured above) on the SE110 is recommended but is optional.

The installation of a hot water circulation loop that would dissipate at least 10% of the estimated rated heat output of the solid fuel boiler in the event that circulation is reduced because of an electrical power failure. This loop shall be such that it can only be made inoperative by a deliberate manual action. The design parameters for sizing this loop shall be a minimum pipe diameter of 18 mm (0.75 in), a room ambient temperature of 18 °C (65°F), and a mean water temperature of 82 °C (180°F)

It is recommended that the gravity loop be positioned above the boiler and includes features that promote natural thermal circulation of the water.

APPENDIX G: Markings

Use Copper Conductors Only
Utilisez uniquement des conducteurs en cuivre

For Supply Connections Use 12 AWG Or Larger Wires Acceptable For At Least 90°C
Pour les connexions d'alimentation, utilisez des fils de calibre 12 AWG ou plus, acceptables pour au moins 90 °C

CERTIFIED BY:
Alternate Heating
MAWP 15 PSI–STEAM
MAWP 30 PSI–WATER
MWT _____ °F
HS _____ SQ.FT.
MRVC _____ MBH
MSN _____

SE110 FUSES FUSIBLES

TIME-DELAY
FUSIBLE À RETARDEMENT

PRINCIPAL
F1 (MAIN): FNM020 - 20amps

ALIMENTATION 24 V
F2 (24v POWER SUPPLY): FNM01.5 - 1.5amps

ALIMENTATION 12V
F3 (12v POWER SUPPLY): FNM002 - 2amps

Wood Gun Super E110

Manufactured by Economical Energy Consultant INC
DBA Alternate Heating Systems
2395 Little Egypt Road Harrisonville, PA 17228

Certified To: UL 2523, CAN/CSA B366.1-2011 (R2020), ASTM 2515-11, ASTM 2618-13
U.S. ENVIRONMENTAL PROTECTION AGENCY Certified to comply with 2020 particulate emission standards using cordwood.
Certified as an ad-on model: Oct 2025
Model: SE110
Serial No. 24843686
Date of Manufacture: October 9, 2025

Intertek
W/N 25334

Installation Clearances to Combustibles:
FRONT – 24in; LEFT – 6in; RIGHT – 6in; REAR – 6in; TOP – 6in; CHIMNEY – 18in
(Only install on a **noncombustible floor.** Concrete, Etc.)
For Supply Connections use 12 AWG or larger wires acceptable for at least 90°C or an equivalent.
For use with copper conductors only.
See installation manual for more detail.

Specifications :		REFER TO OWNER'S MANUAL
Voltage: 120	Minimum Circuit Ampacity (MCA): 15A	✓ For basic operating and maintenance instructions, see the owner's manual.
Amps: 6.0A	Max-over Current Protective Device: 15A	✓ This unit burns seasoned logwood.
Frequency: 60 Hz	Emissions (lb/MMBtu):	✓ Maximum -.08 inches of water column draft
Phase: 1	Cat 1: 0.084	✓ Minimum -.04 inches of water column draft
Max. wire temperature: 90°C	Cat 2: 0.081	✓ Field assembly of low water cut-off and cyclone (See installation manual for details)
Minimum Flue Diameter: 6"	Cat 3: 0.078	
	Cat 4: 0.060	

Refer to the Intertek Directory of Building Products (https://bpdirectory.intertek.com) for detailed information.

DANGER: RISK OF FIRE OR EXPLOSION:

WARNING FIRE DANGER:

- **Do NOT use chemicals for starting a fire.**
- **Do NOT burn garbage, gasoline, fuel oils, or other flammable liquids or materials.**
- **Do NOT store combustibles within marked installation clearances.**
- **Do NOT allow explosive vapors to accumulate in boiler room.**
- **Do NOT operate if flue draft exceeds .08 inches of water column.**
- **Do NOT touch during operation.**
- **Do NOT operate with Load door OR Ash door open.**
- **Do NOT interchange chimney manufacturers**
- **DO NOT CONNECT TO A FLUE SERVING ANOTHER APPLIANCE.**

CAUTION:

- **Do not open the loading door even in a power outage, until power is restored, and the green "Purge" turns on.**
- **Keep children away.**
- **Keep Clothing, furniture, and other combustible materials away.**
- **Load wood carefully or damage may result.**
- **Do NOT alter this equipment in any way.**
- **Inspect and clean the flue and chimney regularly.**
- **Caution Hot Surfaces.**
- **This equipment may only be installed by qualified personnel.**

WARNING – FIRE DANGER:

All flue connections must meet all the requirements of NFPA Standard Number 211 and UL 103. The appliance must be connected to an approved chimney made of masonry or manufactured chimney listed for solid fuel.

IMPORTANT:

- For INDOOR use only.
- Unit requires a supply of combustion air.
- This vessel is an ASME-certified boiler. The vessel is not suitable for heating potable water without the use of a domestic water exchanger.
- Unit will not operate without electrical power.
- Disconnect power before servicing. Keep shields and covers in place unless servicing boiler.
- The heat exchanger, flue pipe, and chimney must be in good condition and cleaned regularly to remove accumulated creosote and ash. Clean at the end of the heating season to minimize corrosion during the summer months.
- The appliance, flue pipe, and chimney must be in good condition. These instructions also apply to a draft inducer if used.
- This wood heater needs periodic inspection and repair for proper operation. Consult the owner's manual for further information. It is against federal regulations to operate this wood heater in a manner inconsistent with the operating instructions in the owner's manual.
- Unit may be connected to an existing boiler system. Do not relocate or bypass any of the safety controls in the original boiler installation.
- Use **CO (carbon monoxide) detector** in any boiler installation to detect the presence of gas that may accumulate in the area around the boiler.

In case of **runaway fire:**

1. Cut power.
2. Make sure automatic air controls are tightly closed and the draft motor is off.
3. Shut loading and ash removal doors.
4. Maintain continued circulation of boiler water to remove heat from the boiler and if the boiler is equipped with a domestic coil run hot water.

In a case of **power loss:**

Do not open the loading door even in a power outage, until the power is restored, and the green "Purge" light turns on!

If you lose power the Wood Gun will shut down. If the power is not restored within 4-6hr you will most likely need to restart the fire, with match, paper, and kindling. Still, wait for the green light to turn on even before restarting.

A backup power source may be used to operate the Wood Gun in a power outage. Backup power must support both the controls and circulators. (Do not run a backup generator in the same area with the boiler or in any confined space).

The system must work even when unattended to guard against overheating. Backup power must be provided in a way that satisfies local code requirements and prevents back-feeding of electricity into the power grid.

If no means of dissipating heat exists, close all doors, and verify automatic dampers are closed.

Stainless Steel LIMITED WARRANTY

WOOD GASIFICATION BOILER: SE110 SS

The manufacturer, ALTERNATE HEATING SYSTEMS, warrants to the original owner, for the periods specified below, that the boiler to which this warranty applies is free from defects in materials and workmanship when installed, operated, and maintained in accordance with the printed instructions supplied with the unit.
This warranty is void if the unit is used to burn materials for which the unit is not certified by the EPA and void if not operated according to the owner's manual.

A. WHAT IS COVERED AND FOR HOW LONG (all from date of original installation)

1) VESSEL:
STAINLESS STEEL BOILER VESSEL, TWENTY (20) years pro-rated (pro-rated as follows: 1st to 10th year – full: 11th year – 40%: 12th year - 30%: 13th year – 20%: 14th year – 10%: 15th – 20th year – 10%). This does not cover any corrosion or deterioration in boiler vessel due to improper pH levels in water or oxidized water (heating systems that have plastic piping).

2) Doors (excluding gaskets, knobs, and ceramic insulation board), draft regulation mechanisms, insulation jacket, draft fan assembly (excluding ceramic heat shield), stack/cyclone assembly, firebox refractory side brick and center brick – ONE (1) year.

3) All electrical and plumbing components and controls such as temperature/pressure gauge, safety relief valve, aqua stat controllers, electric motor, domestic hot water coil, oil burner, fan shaft bearings, timer, draft motor, etc. purchased by Alternate Heating Systems from other manufacturers are Limited to warranties offered by those manufacturers, typically One (1) year.

4) V-belt, pulleys, ceramic board door and fan heat shields, ceramic blanket firebox lining, fasteners, sight glass, smoke flap, door gasket and silicone rubber seal, door handle knobs, paint, wiring, and wiring devices -Thirty (30) days.

B. WHAT WE WILL DO AND NOT DO

1) Alternate Heating Systems will repair and replace, at our option, units or component parts found defective after inspection by Alternate Heating Systems or our authorized representative during the periods outlined above.

2) Alternate Heating Systems SHALL NOT BE LIABLE UNDER THIS WARRANTY IF:

a) the unit or any of its component parts have been subject to misuse, alteration, unauthorized repair, neglect, accident, or damage from handling.

b) the unit is not installed, operated and maintained in accordance with the printed instructions supplied with the unit and in accordance with local plumbing and/or building codes.

c) the unit is operated above its rated output which is shown on the nameplate attached to the unit and listed in Alternate Heating System's printed literature.

d) the unit is fired with fuels other than those recommended by Alternate Heating Systems. This includes fuels recommended by dealers and distributors selling Alternate Heating Systems products if these are not fuels recommended by Alternate Heating Systems.

C. WHAT THE CUSTOMER MUST DO

1) Contact the dealer who sold you the unit.

2) If said dealer cannot be located, contact any other Alternate Heating Systems dealers in your area.

3) If you are unable to locate a dealer, submit your warranty claim directly to Alternate Heating Systems at the address listed below.

4) When you make an inquiry or warranty request, be sure to include the following information:

a) Unit model number
b) Serial number
c) Date of installation
d) Dealer's name
e) Type of fuel burned

5) The OWNER and not Alternate Heating Systems or its dealers will be liable for the following costs involved in repair or replacement of the defective unit or component part

a) All necessary costs in returning the defective unit or component part to the factory or other location designated by Alternate Heating Systems.

b) All freight and delivery costs of shipping a new or required unit or replacement component part to the owner.

c) All labor and other costs incurred in the removal of the defective unit or part and installation of a new or required unit or part.

d) Any material required to complete installation of new or required unit or replacement part.

D. LIMITATIONS AND STATE LAW RIGHTS

1) Alternate Heating Systems neither assumes nor authorizes any representative or other person to assume for it any other obligation or liability in connection with its products other than expressly written here.

2) Implied warranties of merchantability and fitness for a particular purpose are limited to the duration of this LIMITED WARRANTY.

3) Alternate Heating Systems shall not be liable for any incidental or consequential damages such as water, smoke or heat damage to property arising directly or indirectly from any defect in its products or their use.

4) Some states do not allow limitation on how long an implied warranty lasts and the exclusion or limitation of incidental or consequential damages, so the above limitations and exclusions may not apply to you.

5) This warranty gives you specific legal rights. You may also have other rights, which vary from state to state.

6) The remedies set forth herein shall be the exclusive remedies available to the owner.

ALTERNATE HEATING SYSTEMS
2393 Little Egypt Rd
Harrisonville, PA 17228

IMPORTANT: READ AND KEEP IN YOUR POSSESSION!

Carbon Steel LIMITED WARRANTY

WOOD GASIFICATION BOILERS: SE110 CS

The manufacturer, ALTERNATE HEATING SYSTEMS, warrants to the original owner, for the periods specified below, that the boiler to which this warranty applies is free from defects in materials and workmanship when installed, operated, and maintained in accordance with the printed instructions supplied with the unit.
This warranty is void if the unit is used to burn materials for which the unit is not certified by the EPA and void if not operated according to the owner's manual.

A. WHAT IS COVERED AND FOR HOW LONG (all from date of original installation)

1) VESSEL:
CARBON STEEL BOILER VESSEL, TWENTY (20) years pro-rated (pro-rated as follows: 1st to 10th year – full: 11th year – 40%: 12th year - 30%: 13th year – 20%: 14th year – 10%: 15th – 20th year – 10%). This warranty does not cover any corrosion or deterioration in boiler vessel due to improper pH levels in water or oxidized water (heating systems that have plastic piping, OR are installed and maintained as open systems). This warranty does not cover corrosion from inside the firebox or heat exchanger areas of the vessel.

2) Doors (excluding gaskets, knobs, and ceramic insulation board), draft regulation mechanisms, insulation jacket, draft fan assembly (excluding ceramic heat shield), stack/cyclone assembly, firebox refractory side brick and center brick – ONE (1) year.

3) All electrical and plumbing components and controls such as temperature/pressure gauge, safety relief valve, aqua stat controllers, electric motor, domestic hot water coil, oil burner, fan shaft bearings, timer, draft motor, etc. purchased by Alternate Heating Systems from other manufacturers are Limited to warranties offered by those manufacturers, typically One (1) year.

4) V-belt, pulleys, ceramic board door and fan heat shields, ceramic blanket firebox lining, fasteners, sight glass, smoke flap, door gasket and silicone rubber seal, door handle knobs, paint, wiring, and wiring devices -Thirty (30) days.

B. WHAT WE WILL DO AND NOT DO

1) Alternate Heating Systems will repair and replace, at our option, units or component parts found defective after inspection by Alternate Heating Systems or our authorized representative during the periods outlined above.

2) Alternate Heating Systems SHALL NOT BE LIABLE UNDER THIS WARRANTY IF:

a) the unit or any of its component parts have been subject to misuse, alteration, unauthorized repair, neglect, accident, or damage from handling.

b) the unit is not installed, operated and maintained in accordance with the printed instructions supplied with the unit and in accordance with local plumbing and/or building codes.

c) the unit is operated above its rated output which is shown on the nameplate attached to the unit and listed in Alternate Heating System's printed literature.

d) the unit is fired with fuels other than those recommended by Alternate Heating Systems. This includes fuels recommended by dealers and distributors selling Alternate Heating Systems products if these are not fuels recommended by Alternate Heating Systems.

C. WHAT THE CUSTOMER MUST DO

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2) If said dealer cannot be located, contact any other Alternate Heating Systems dealers in your area.

3) If you are unable to locate a dealer, submit your warranty claim directly to Alternate Heating Systems at the address listed below.

4) When you make an inquiry or warranty request, be sure to include the following information:

a) Unit model number
b) Serial number
c) Date of installation
d) Dealer's name
e) Type of fuel burned

5) The OWNER and not Alternate Heating Systems or its dealers will be liable for the following costs involved in repair or replacement of the defective unit or component part

a) All necessary costs in returning the defective unit or component part to the factory or other location designated by Alternate Heating Systems.

b) All freight and delivery costs of shipping a new or required unit or replacement component part to the owner.

c) All labor and other costs incurred in the removal of the defective unit or part and installation of a new or required unit or part.

d) Any material required to complete installation of new or required unit or replacement part.

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3) Alternate Heating Systems shall not be liable for any incidental or consequential damages such as water, smoke or heat damage to property arising directly or indirectly from any defect in its products or their use.

4) Some states do not allow limitation on how long an implied warranty lasts and the exclusion or limitation of incidental or consequential damages, so the above limitations and exclusions may not apply to you.

5) This warranty gives you specific legal rights. You may also have other rights, which vary from state to state.

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