INSTALLATION AND OPERATOR'S MANUAL

WOOD GUN™ WOOD GASIFICATION BOILER

Models: E100 SF, E140 SF, E180 SF, E250 SF

IMPORTANT: IN ORDER TO ACHIEVE SAFE AND SATISFACTORY RESULTS FROM YOUR ALTERNATE HEATING SYSTEMS, LLC. 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.

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Record Model and Serial Number Below

Model:

Serial:

Date of Purchase:

Revision: February 15, 2012

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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.

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. Should your installation be a steam boiler, it is even more important that experienced personnel be consulted to ensure 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 Alternate Heating Systems, LLC. boilers can be supplied with the ASME "H" stamp and 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

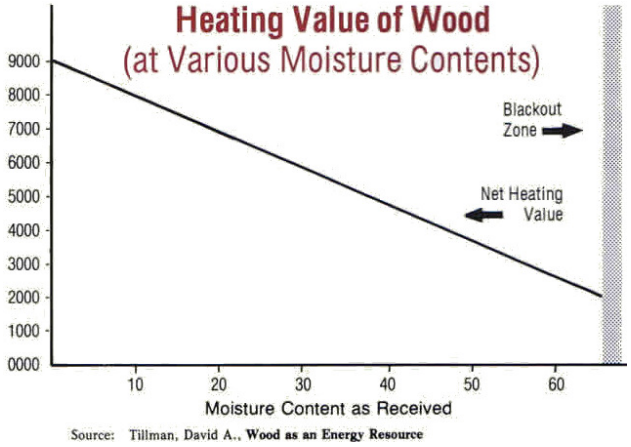
The burning of wood involves a series of very complex chemical reactions that are time and temperature dependent. The pieces of wood (or particles) may be thought of as containers that store combustible gases that are released when heat is applied. The various gases that emanate from heated wood have ignition temperatures ranging from 540^{o} F to 1125^{o} F. This helps to explain why high 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 Wood Gun™ 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 several 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 Wood Gun™ operating under normal load will produce only a small amount of smoke on startup and burn cleanly shortly thereafter.

WOOD MOISTURE CONTENT AND 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 30% is more likely to produce condensation issues and will produce markedly less BTU's per pound of fuel.



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 puffing" results in smoke being pushed out through the intake in intermittent, and often audible, puffs. Low moisture fuel (< 15% moisture) requires special considerations for a satisfactory burn. Dry sawdust and shavings are less of a problem than kiln-dried solid blocks or logs.

An optional secondary air tube installed in the rear of the boiler will reduce the problems associated with burning very dry fuels. This tube permits preheated air to pass from the firebox directly into the rear of the center combustion chamber. In rare cases, it may be necessary to add moisture to the fuel by storing it outside or by installing a water mist system on the auger of units using an automatic feed system

With medium moisture wood, 20-30%, 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 20-30% is optimum for burning wood in the gasification process.

Because of the downdraft design of the Wood Gun™, 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 Wood Gun™ operates on the well known principle of gasification which makes it possible to burn wood and wood waste products 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 contain the primary combustion zone. This combustion zone is linked to the fuel chamber by a series of openings. The gases produced from pyrolysis of the fuel charge are drawn through the openings 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 multiple tunnels in the refractory. These refractory tunnels make up the primary combustion area in the Wood Gun™. 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 produce re-ignition after a period of no demand. When the air valve closes 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 valve opens and the draft-inducing fan is powered on, provided 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 upon the size of unit and the temperature of the refractory at shutdown. By utilizing this combination of features, fuel is burned at maximum efficiency, only as heat is required, and never as a low smoldering fire. Smoldering fires, and colder than optimum fires, produce excessive amounts of creosote and smoke.

When a demand for heat exists, the operating aquastat will open the air valve and activate the draft induction fan. At this time, abundant air is provided for combustion. When the boiler temperature reaches the level set on the aquastat, 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 cyclone ash separator located at the discharge point of the heat exchanger. Most of the ash that remains after the wood is consumed is collected here.

The Wood Gun™ 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 Wood Gun will be practical for you.

If summertime hot water requirements are low it may be necessary to add a draft cycle timer to the electrical control circuit to make the unit run for 8 to 10 minutes every two to four 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. It does not override the high limit.

> Note: Some of the byproducts produced by incomplete combustion of wood are formaldehyde, formic acid and acetic acid, which are mildly corrosive. A Wood Gun™ 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 inspection doors or air valve may contribute to the formation of corrosive products. Therefore it is important to inspect your Wood Gun™ regularly to ensure that it is being operated in a manner that does not contribute to excessive corrosion of the steel. We recommend that boilers operating with lower duty cycles be manufactured with the stainless steel option.

It is essential that all combustion air be prevented from entering the Wood Gun™ at shutdown. 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 a gas. Water will likely be evident in the ash pan and, in severe cases, may even collect in the heat exchanger.

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 operating temperature minus 20° F

The Wood Gun™ is designed as a pressurized boiler system. Before leaving the factory, it is pressure tested for safety. Typical applications operate at pressures of about 12-15 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. The Wood Gun should always be operated in such a manner that the difference in return water temperature and the supply water temperature is no more than 20ºF.

Note: All Wood Gun™ models have the option of manual or automatic oil, or manual gas backups.

BOILER INSTALLATION

BOILER LOCATION

Wood & Coal Burning Boilers are designed to radiate as much heat as possible, but this heat can be dangerous if the boiler is improperly installed. The Wood Gun™ is designed and certified only for indoor installations and therefore must be protected from the elements by being located in a totally enclosed shelter. The Wood Gun™ 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 Wood Gun™ installation. Check local building codes for restrictions on installation.

A fire could be started if the boiler is installed too close to walls, furniture, carpet or draperies.

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 12 inches beyond the base of the boiler in the rear and on the sides and at least 36 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 lighted 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. 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.

Note: Ventilation fans in the boiler and fuel storage rooms must not create negative pressure, as this would adversely affect boiler operation.

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. Most Alternate Heating Systems boilers have a lifting lug in the center of the top while on some units two lifting lugs in the front and rear are provided.

Once on the floor level where it will be installed the unit may be rolled on pipe or may be moved by means of a pallet jack. 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. 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 Wood Gun™. Wiring on the boiler must be properly grounded.

COMBUSTIBLE CLEARANCES REQUIRED FOR SAFETY AND OPERATION

The required minimum combustible clearances for all models are 48 in from the front, 36 in from the back, 12 in from the left side, 18 in from the right side, 24 in from the top, and underneath the boiler. These measurements should be taken from the furthest protruding element on each respective side. 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.

It is necessary to adhere to the clearances and restrictions that are described in this manual.

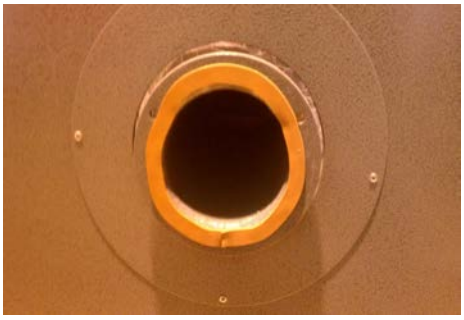
There has been extensive research and testing to assure that these units are safe when operated with the instructions of this manual.

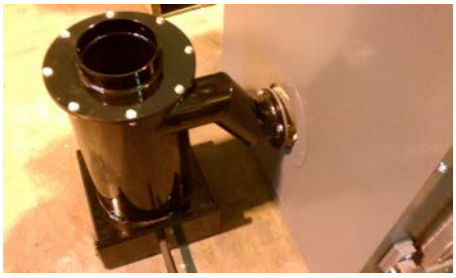
BOILER ASSEMBLY

Cyclone Ash Collector

Once the Wood Gun™ 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) 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, carefully remove the paper backing from the rubber strip to expose the adhesive. Overlap the strip approximately 1 in 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.





Air Valve

If the air valve was not installed at the factory, begin assembly by placing the stainless steel tube into the boiler opening (with the latch side up) and tighten the two setscrews.

> **IMPORTANT:** Make sure the tube protrudes into the fuel chamber a distance of from ½ in to 1 in when measured at the bottom of the tube. This will ensure that condensation produced in the tube will not run down the wall of the fuel chamber but will drip onto the refractory center brick.

Cement the joint with high temperature silicone sealant (included or available at a local hardware store) to prevent air leakage. A 5 in diameter, galvanized elbow is provided with a new Wood Gun™. This must be attached to the air valve inlet tube facing down. In addition, a 5 x 24 in galvanized tube is to be attached to the elbow such that combustion air is being pulled from the floor (see Appendix F: Boiler Piping Examples).

The wires from the damper motor must be inserted into the electrical box on the rear or side of the boiler and connected as documented in the wiring diagram for the model being installed. Wiring diagrams are found in Appendix B.

> **IMPORTANT:** Be careful when loading large pieces of wood that you don't hit the air valve tube and knock it out of place.

Draft-Inducing Fan Assembly

The draft-inducing fan assembly may be shipped in a separate box. See Fan Assembly under the Maintenance section on page 36 for

assembly guidance. The fiberglass rope gasket must fit neatly in the groove without overlap or wrinkles. When tightening down the fan assembly nuts, alternate between studs and apply equal pressure until the gasket seals firmly against the end of the swirl chamber.

IMPORTANT: Do not tighten the 5/16 nuts excessively as this may damage the gasket or the ceramic board heat shield.

The wires leading from the fan motor must be inserted into the electrical box on the rear of the unit and connected as according to the wiring diagram for the model being installed (see Appendix B: Wiring Diagrams).

INSTALLATION AND MAINTENANCE OF ELECTRICAL CONTROLS AND GAUGES

Insert the temperature/pressure gauge into the right side marked tapping (JJ) on model E100 and tapping (Z) on all other models. Refer to Appendix A for details on tapping sizes and locations. The high limit aquastat occupies the left (JJ) tapping on the E100 and the (AA) tapping on all other Wood Gun™ models. On all units not equipped with an oil burner, a L4006A single aquastat is used and occupies the same position. The boiler operating limit aquastat (L6006A) is located in tapping (GG) on the rear of the boiler. On units with an oil or gas burner a L6006A aquastat for switching from wood to oil is located in tapping (zz). For detailed wiring and control diagrams, consult Appendix B: Wiring Diagrams. When installing the L.W.C.O. refer to directions on page 12.

In some cases it may be necessary to test the controls and gauges. First turn the power off. To test an aqua stat. Turn the dial 20° past the boiler water temperature. Use an ohm meter 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 gage 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.

GENERAL CHIMNEY REQUIREMENTS

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.

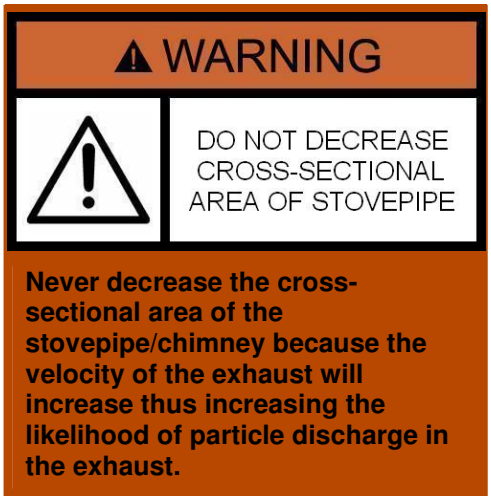
Specific Chimney Requirements for the Wood Gun™

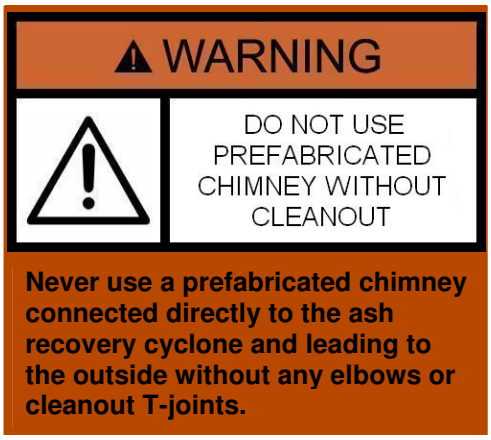
The Wood Gun™ creates its own draft; therefore having sufficient height in the chimney is generally not an issue. Excessive chimney height can allow for more cooling of exhaust gases and lead to condensation issues. Other aspects of chimney construction that lead to condensation include use of a masonry 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 Wood Gun, 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:

E100 to E180: not less than 6 in Dia.
E250 to E500: not less than 8 in Dia.

Using larger diameter stovepipe is generally not a problem.





For installations where the minimum chimney size cannot be met, Alternate Heating Systems, Inc. can provide, at additional cost, a larger cyclone. It is a good practice to run as long a vertical pipe as you can, coming off of the cyclone. You will want to avoid having an elbow or "T" immediately above the cyclone.

Having adequate combustion air is critical to boiler performance. This means that there must be either enough air infiltration to supply the boiler with combustion air, or other means must be put in place to provide this makeup air. There is usually sufficient leakage in older homes, typically around doors and windows. In well-insulated homes it may be necessary to provide additional outside air into the home. It is possible to duct outside air directly to the boiler. In such situations, it may be important to provide for some heating of this air.

FLUE PIPE

Use only 22-24 gauge pipe. We recommend stainless steel. Heavy gauge black pipe will not last very long (typically 1 to 2 years). Galvanized pipe is not recommended. Double or triple wall insulated pipe must be used for at least the first 36" above the cyclone. When using single wall fluepipe in open areas, assure the pipe passes no closer than 18 inches from combustible walls or ceiling. If the fluepipe 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 U.L. listed insulated fluepipe must be used. Fluepipe that runs along the outside walls of a building must also be U.L. 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 fluepipe, which in turn cools the rising smoke and causes condensation and creosote to form quickly.

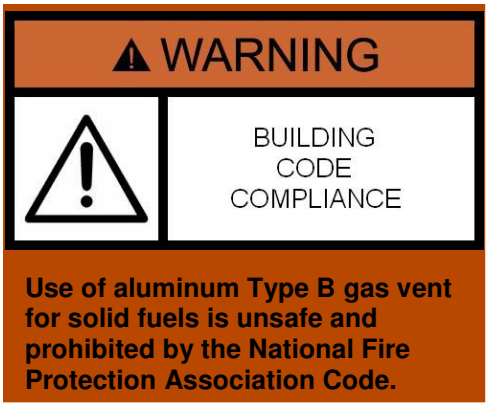
Warning

Do not connect to a chimney serving another appliance.

Do not connect more than one heating appliance to a single chimney. Be sure to check all local codes and your insurance provider's requirements for any additional restrictions and/or guidelines regarding your fluepipe.

PROPER CHIMNEY CONNECTION

The boiler must be connected to a class A chimney.



The recommended method for connecting the boiler to the chimney is to place a T-joint at the top of the vertical section leading from the cyclone. The opening on the T-joint should be fitted with a removable cap to enable cleaning and inspection. If the horizontal run to the chimney is inclined, it will encourage any fly ash, which drops in the pipe to fall back into the ash separator. In many cases it is acceptable to set the stack directly on the cyclone, especially if it is no more than eight feet. If a taller run is required it may be too heavy to be supported by the cyclone alone and will need additional reinforcement.

If a second change of direction is required before entering the chimney a cleanout "T" should be placed at this point also as indicated in Figure 1. Each joint should be secured with three sheet metal screws and sealed with high temperature furnace cement or "Troweleze" refractory cement or High Temperature Silicone. Any horizontal pipe should be pitched upward toward the chimney at least ¼ in for each foot of horizontal run. Be sure there are at least 18 in clearance between horizontal piping and combustible ceiling. Be sure that the chimney connection pipe extends at least 2 in into the chimney, but does not extend so far into the chimney that it blocks airflow.

In installations where the chimney draft is too strong, the problem may be eliminated by allowing air to pass up the chimney from an auxiliary valve located at floor level and connected to a "T": in the flue pipe or chimney.

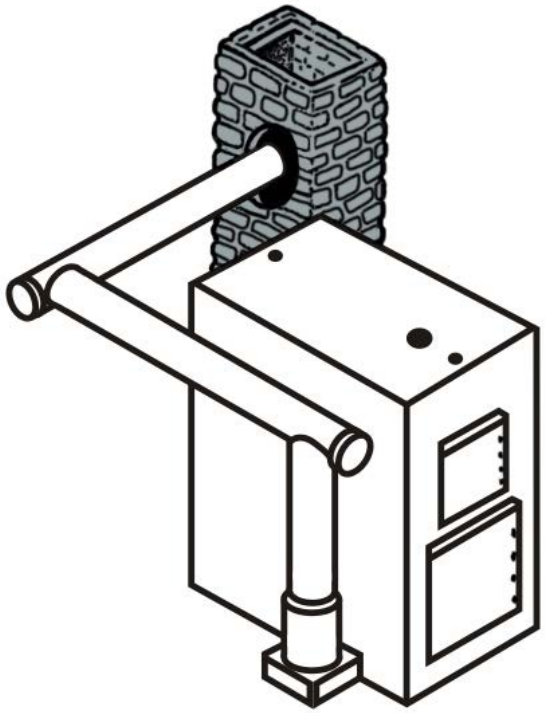


Figure 1: Proper chimney connection

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, which provides a diameter of not less than three times the diameter of the stove pipe. (See illustration below)

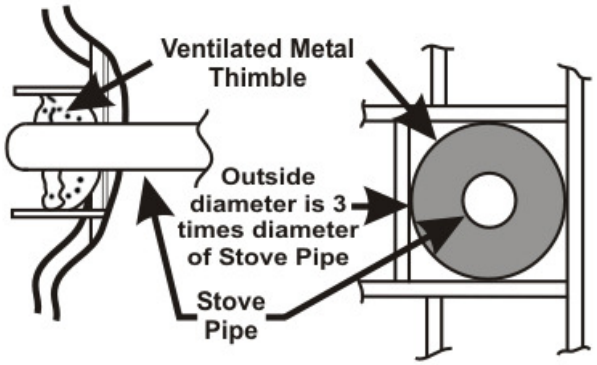


Figure 2: Stove pipe passing through wall

WARNING

The cyclone ash separator needs disassembled and cleaned each season.

The top of the cyclone should be removed. That will allow the body of the cyclone to be cleaned.

Picture 3 (Cyclone top)

The connecting tube that attaches to the boiler is another very important area that will need to be thoroughly cleaned. To clean the connecting tube, you will need a 4" chimney brush for models E100, E140, and E180. The E250 will need a 5" chimney brush. When the top is removed from the cyclone you will have access to clean the connecting tube.

Picture 1(connecting tube)

IN CASE OF CHIMNEY FIRE

1. 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.)
2. Shut the boiler down by turning the main power off.
3. If you have a chimney fire, use a chemical flare type fire extinguisher. If you don't have an extinguisher, go to step 4.
4. 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.
5. Contact a chimney professional to inspect your chimney for damages.

COMBUSTION AIR SUPPLY

It is important to make provision for adequate supply of combustion air, either natural infiltration through or around a door or window, or by ducting outside. If the air intake valve is not ducted to the outside, then the galvanized stove pipe elbow provided with the boiler must be attached to the collar on the air valve facing downward with a 2' section attached to the elbow with three sheet metal screws. If combustion air is ducted from the outside, then follow the same procedure as described for passing a smoke pipe through a combustible wall. Should the air valve malfunction and not close completely, there is a possibility that this conduit could act as an exhaust stack and heat up. Use **appendix F** for a **picture diagram**

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.

BOILER PIPING FOR HYDRONIC SYSTEMS

Due to the design requirements of the various Wood Gun™ models, the fittings and burner attachments 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.

An elbow and boiler drain should be inserted in the flush-out tapping U or Y on the bottom of the boiler near the front. Alternately, a "T" and short nipple could be attached to the return tapping for the location of the boiler drain.

Piping the Boiler in Parallel with another Boiler

The Wood Gun™ 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 Wood gun 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 Wood gun 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 Wood Gun boiler is on. Wire the circulator to the Wood Gun boiler in such a way that when the boiler switch is on the circulator will also run. The power to the Wood gun should then be controlled by an aqua stat located in the supply piping. This aqua stat should be set 10ºF above operating temperature of the existing boiler. That will shut the Wood gun 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 Wood Gun™. For sample illustrations of multiple boiler configurations, see Appendix F.

PRESSURE RELIEF VALVE

A pressure relief valve should be inserted into tapping DD on all models through E250 and in tapping CC on model E500 and larger.

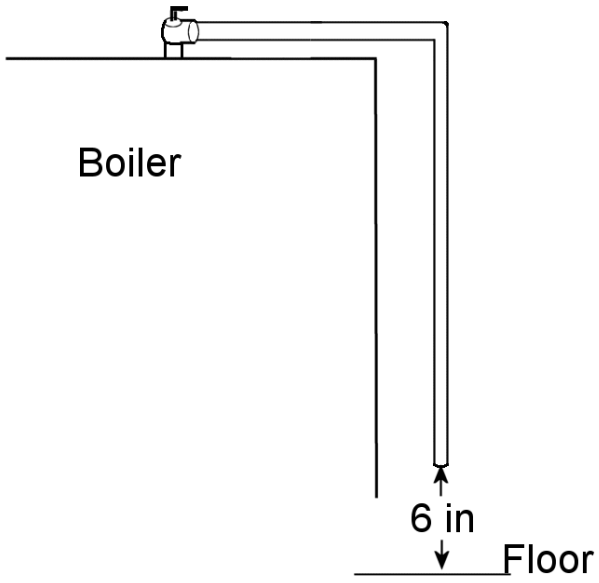


Figure 3: Pressure Relieve Valve

Note: A length of 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.

If the Wood Gun™ is installed as the primary boiler, it is necessary to provide for water supply using a pressure regulating valve and backflow prevention valve in the feed water line.

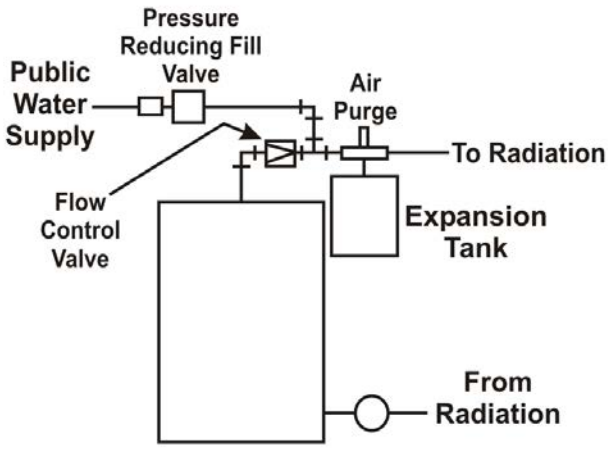
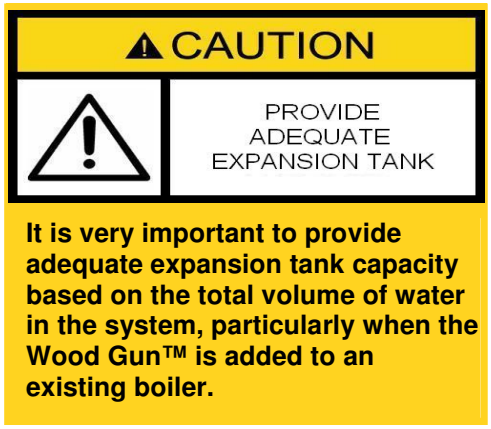


Figure 4: Pressure regulating valve and backflow prevention valve configuration



Refer to Appendix A: Additional Specifications to determine the water capacity of the Wood Gun™ installed (do not use the BTU rating). The expansion tank or air cushion tank that was originally installed may not be adequate for the additional volume of the Wood Gun™.

Recirculation loop

A recirculation pump or loop is recommended to keep return water temperatures up.

WARNING

A LOW WATER CUT OFF MUST BE INSTALLED

LOW WATER CUT OFF

To install a LWCO low water cut off. It should be located in a "T" placed in the supply riser just above the tapping in the boiler.

The low water cut off should be installed in the supply riser just above the tapping of the boiler. Place a Tee fitting 6" 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.

Run three wires from the L.W.C.O. to the main control box that corresponds with the wires/terminals in the control box. The wires needed are: Orange, Orange #2, White. These wires will terminate in the LWCO as follows.

1. The orange 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.

Terminate the wires in the control box with the corresponding wires (or terminal blocks that correspond with the wire).

1. The Orange wire will terminate on the terminal marked orange.
2. The Orange #2 wire will terminate on the terminal marked orange #2.
3. The White wire will terminate on the terminal marked white, L2 or neutral.

Recommended Boiler Control Settings in Hydronic Systems

The following control settings are recommended for parallel installations:

- ✓ High limit 200° F
- ✓ Operating control on the rear of the boiler is 180°.

Set the operating control differential set to 15° Φ, unless using cast iron radiators, for which a differential setting of 20° or more is recommended.

Additional settings may include:

- ✓ The optional circulator shutdown control 160° F
- ✓ An existing oil/gas boiler 140° F.

On Wood Gun™ models equipped with oil or gas backup, the control settings should be as follows:

- ✓ High limit = 200° F
- ✓ Operating Limit = 180° – 170° F
- ✓ Burner Control (L6006A) = 150° F

In this way the oil burner will function as a backup and only fire when the boiler temperature drops below about 150° F. The oil burner may be set even lower if desired to prevent it from firing except when the wood fire is almost completely out.

Wood Gun™ units supplied with automatic switchover (fuel oil only) are provided with a mode switch. When turned to either the "Wood" or "Oil" mode it will fire on the indicated fuel and not switch over. In the "Auto" position it will change from the wood mode to oil when the water temperature falls to the setting on the switchover aquastat (L6006A), and will stay in this mode until manually reset, at which time the boiler may be refueled with wood.

For units equipped with electric backup, follow the procedure outlined above with the exception that one of the electric element aquastats should be set about 5° F higher than the other. This will prevent all electric elements from being activated at the same time.

BOILER CONDITIONER / SEALANT

AHS provides two bottles of Boiler Conditioner/Sealant with the purchase of your boiler. When filling your boiler with water for the first time, mix the contents of each bottle with 2 gallons of warm water. Pour into boiler opening. Replace plug. A Material Safety Data Sheet (MSDS) is available upon request.

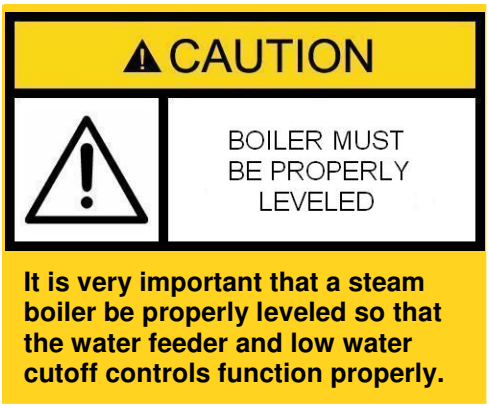
BOILER PIPING AND CONTROLS FOR LOW PRESSURE STEAM SYSTEMS

Wood Gun™ models E180 and larger are available with steam tappings and controls upon special order. When installing a low-pressure steam boiler, be sure that the installation conforms to all state and local codes.

All steam boilers will be supplied with a low water cut-off, which fits the ¾ inch tapping on the rear of the boiler. This control must never be hot wired or disconnected since it prevents the boiler from firing should the water level drop below the safe operating level.

A water level gauge glass is also provided to give a visual indicator of the level of water in the boiler. This gauge is located in tapping FF on the rear of the boiler and a section of piping, which originates from a tapping in the top of the boiler near the rear.

An automatic water feeder or combination water feeder/low water control such as a McDonnell-Miller model 47-2 is required to ensure that the proper water level is maintained. Some states or municipalities require two low water control devices in series. The two controls described above will meet this requirement.



It is very important that a steam boiler be properly leveled so that the water feeder and low water cutoff controls function properly.

For steam systems other than gravity return consult Alternate Heating Systems, LLC. for proper controls. Do not attempt to connect two different steam boilers in parallel since the water level in each boiler will not be the same.

Note that steam models are wired differently than hydronic models. See Appendix B for Wood Gun wiring diagrams. Contact Alternate Heating Systems if you need a diagram not included in this manual.

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

The Wood Gun™ 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.

DOMESTIC HOT WATER COIL PIPING

The Wood Gun™ may be fitted with one or more domestic hot water coils, which thread into 4 inch tapping's 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.

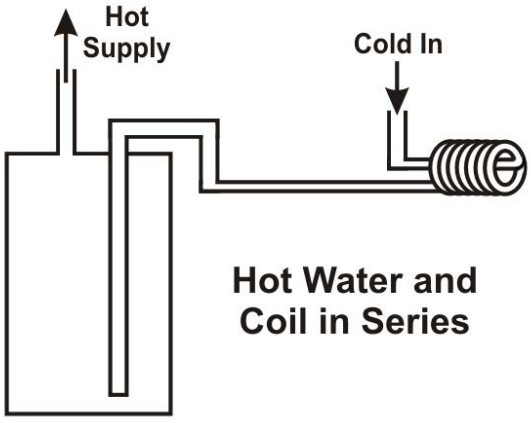


Figure 5: Plumbing – Coil in Series

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 Wood Gun™ is not being fired (for example in the summer).

The diagram below indicates how this can be done.

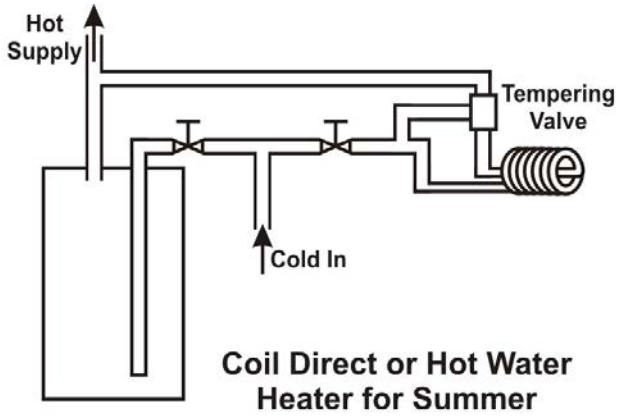


Figure 6: Plumbing – Coil in Parallel

⚠ CAUTION

BURN HAZARD

In installations where the coil discharges directly into the hot water distribution system a tempering valve must be included to limit the temperature of the water at the faucet to a safe level.

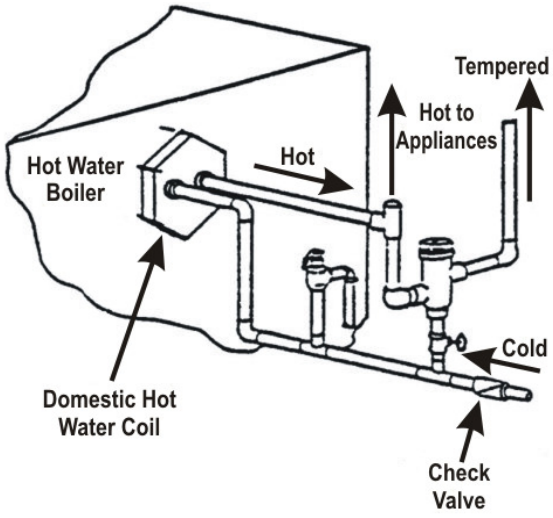


Figure 7: Tempering valve

The third method of plumbing the domestic coil uses a small pump to circulate water continuously between the coil and existing hot water heater. It is also necessary to include a tempering valve or temperature controller on the supply side of the storage tank/water heater to prevent super-heated water from reaching the domestic hot water tank and, ultimately, the faucets (see figure below).

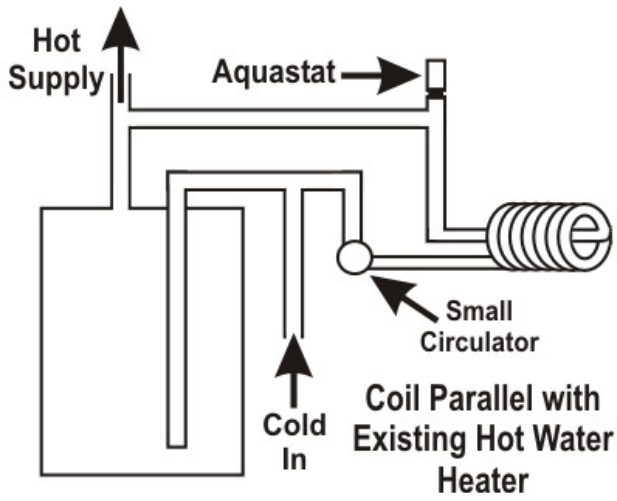


Figure 8: Plumbing – Coil with circulator

OIL BURNER ASSEMBLY

General Information

If an oil burner is supplied with the Wood Gun™, connection of fuel lines and the adjustment of the burner should be done by a qualified oil burner technician. The oil burner is normally shipped detached from the Wood Gun™ in a separate box. Refer to the Riello Burners Installation Manual included with your shipment for instructions on configuring the burner. Particular attention should be paid to the Oil Line Connections section of the Riello Installation Manual. Ensure that the correct size nozzle is in place on the burner before installing on the boiler.

Correct nozzle sizes for Riello Oil Burners are:

E100: 0.65 gph 45°, semi-solid
E140: 1.00 gph, 45°, semi-solid
E180: 1.10 gph, 45°, semi-solid
E250: 1.65 gph, 60°, semi-solid

Models E180, and E250

On models E180, and E250 the oil combustion chamber is built into the pressure vessel, so the burner is inserted into the firing tube on the rear of the boiler as shown below.

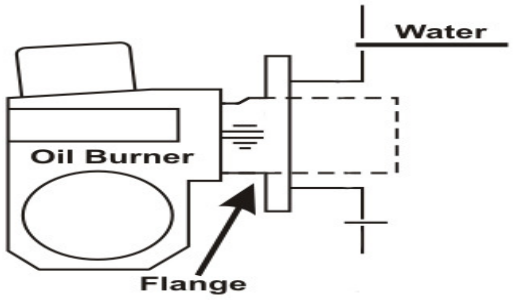


Figure 9: E180, E250 Oil Burner

Bolt the mounting flange into place using 4, 3/8 inch nuts, washers and lock washers. Ensure that the gasket that is furnished with the burner is placed between the flange of the Wood Gun™ and the mounting flange of the oil burner to prevent air leakage.

Oil/Gas Burner Combustion Chamber: Models E100 and E140

Wood Gun™ models E100 and E140 have an optional oil burner combustion chamber, which is exterior to the boiler and located on the right hand side of the boiler when viewed from the front. To mount the combustion chamber, apply the enclosed piece of 1/8 in x 1/2 in self-stick silicone strip to the combustion chamber flange just inside of the bolt holes. Attach the combustion chamber to the flange on the boiler using three 5/16 in x 1 in bolts and washers. The metal jacket cover and insulation on the combustion chamber must be removed to gain access to the holes in the flange as shown below.

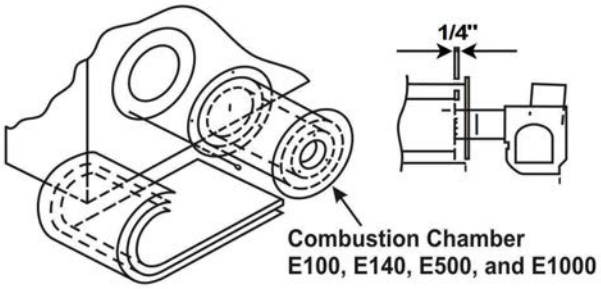


Figure 10: E100, E140 Combustion Chamber

After securing the combustion chamber to the boiler, replace the insulated jacket. The burner mounting flange should be bolted to the end of the combustion chamber using four 3/8 in x 1 in bolts. The burner should be positioned so that the end of the air tube is back approximately ¼ in from the inside of the ceramic lined chamber (see Figure 10)

Oil Burner Electrical Connection

Connect the burner in accordance with wiring diagrams found in Appendix B: Wiring Diagrams. The (T) terminals on the protector relay of the oil burner may need to be crossed with a jumper wire to activate the burner on certain models. The Aux (auxiliary) wire may not need to be terminated.

Oil Burner Fuel Line Connection

The fuel lines should be connected using copper flare fittings or threaded pipe.

⚠ CAUTION

DO NOT USE COMPRESSION FITTINGS TO CONNECT FUEL LINES

Never use compression fittings to connect the fuel lines since they have a tendency to vibrate loose during operation.

NOTE: If the oil tank has a two-pipe system, then it is necessary to insert the bypass plug into the burner pump as described in the manual for the oil burner. When using a Riello Burner, always use a two-pipe fuel line system.

Oil Burner Adjustment

For proper oil burner adjustment, refer to the burner installation manual.

Designing a multi-fuel boiler to burn both wood and oil/gas efficiently presents several problems not normally associated with a conventional oil or gas boiler. Wood combustion produces ash, which has a tendency to accumulate on all exposed heat exchange surfaces. Another significant factor is the presence of water, which must be evaporated from the fuel and carried out of the boiler in the exhaust gas stream. In addition, products of incomplete wood combustion, which result from initial start-up, re-ignition after a long "off" cycle, and inadequate or infrequent cleaning, will be deposited within the unit.

Every oil burner contains safety devices that are designed to prevent unsafe operation. When the burner is activated, fuel is pumped through the nozzle in the presence of an ignition arc produced by two electrodes and a high voltage transformer. In order to prevent raw fuel from being discharged into the combustion chamber should ignition fail to occur, a CAD cell is employed to "proof" the flame. If the CAD cell does not "see" a flame within a preset time period, usually 20-30 seconds, a relay will shut down the burner and it cannot attempt to re-fire until the reset button is pressed. When contamination from the wood combustion process coats the CAD cell it interferes with the proper functioning of this safety device.

If the Wood Gun™ is properly cleaned and maintained on a regular basis, then the adverse effects described above are minimized. However, neglect of the unit may result in disappointing performance. It is recommended that in instances where the owner intends to depend upon the oil burner as the primary fuel source, that the oil burner be cleaned and test fired several times to verify that the safety control system is not impaired. If wood is the primary fuel source, with oil a seldom used backup, Alternate Heating Systems strongly recommends the unit be fired on oil periodically to assure that the oil burner will function when needed. **Do not** assume that a unit operated solely on wood for an extended period of time will fire on oil without attention.

Note: It is a good idea to test fire the oil burner when weekly cleaning and maintenance is performed.

In all Wood Gun™ models, the draft-inducing fan increases the air velocity past the nozzle. Because of this increased air velocity, the Burner Adjustment Tables in the Riello manual are a good starting point for initial firing of the burner; however, fine-tuning of the burner settings may be needed.

For proper burner adjustment a combination test kit must be used. It is not likely that the CO_2 levels suggested in the burner manual can be achieved, but the net stack temperature will be very low, yielding a net efficiency well in excess of 80 %. Refer to the burner manual for information regarding wiring logic and individual components of the burner.

GAS BURNER ASSEMBLY

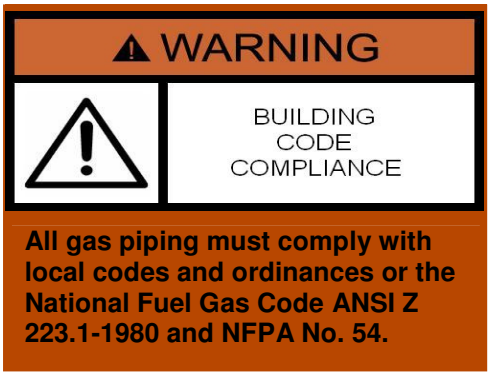
Models E100 through E250

Refer to the Riello Burners Installation Manual included with your shipment for instructions on configuring the burner. Gas burners must be installed as a manual switchover (automatic not available).

NOTE: The Riello gas burner has an air sensor that senses airflow through the burner. When a Riello gas burner is installed, then a variable speed induction fan control may need to be a necessary option.

The burner mounts to the flange on the boiler combustion chamber using three 3/8 in x 1½ in bolts provided. Make sure the gasket provided with the burner is placed between the flange on the Wood Gun™ and the mounting flange of the gas burner. Connect the burner according to the wiring diagram included with your boiler or found in Appendix B: Wiring Diagrams

For larger units consult the special instructions provided in the supplement to this manual.



Before allowing gas that is under pressure into the piping, all openings from which gas can escape should be closed. Immediately after turning on the gas, the system should be checked for leaks. This can be done by watching the ½ cubic foot test dial and allowing five minutes to show any movement or by soaping each pipe connection and watching for bubbles. Use a solution of dishwashing detergent and water for "poor man's" leak detection or use electronic detectors. Pay attention to any gas odor and follow up any observed odor with a check of all connections for leaks. Remember that ventilating an area when correcting a leak is normally a good idea. Keep in mind that propane is heavier than air and natural gas is lighter than air.

Note: Advice offered in this manual is NOT a substitute for securing the services of a professional installer.

Consult the burner manual for the proper procedure for purging air from the system and for initial start-up of the burner.

Gas Burner Adjustment

Please see the Riello Burner Installation Manual section entitled Setting up the Burner for information on gas burner adjustment.

OIL AUTOMATIC SWITCHOVER AND LOCKOUT CONTROL

The Automatic Switchover option automatically switches the Wood Gun™ into oil mode if it is unable to maintain temperature while firing with wood. The most likely scenario causing the switchover to take place is when the boiler has used up the wood fuel. The Wood Gun will also switchover to oil if the fire goes out, as may occur when the boiler has been inactive for hours, and the refractory has cooled to below the kindling temperature for wood. In this case, the boiler must be manually switched back to wood mode, and manually relit, in order to resume wood burning.

The Lockout feature prevents needless cooling from the induction fan running while in oil mode. Once this feature is engaged, the boiler switches to oil mode and will function continuously as an oil-fired boiler until manually switched back to wood mode. Automatic switchover is not available for use with gas backup. See Appendix B for wiring logic for units equipped with this feature.

SMOKE FLAP

The smoke flap (picture 2) must be installed before operating the boiler.

Picture 2 (smoke flap)

The smoke flap will help hold back some of the smoke when the front load door is opened.

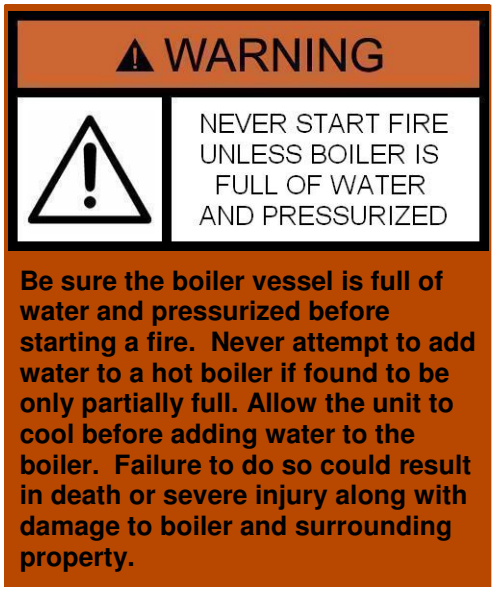
Picture 3 (smoke flap installed)

OPERATING INFORMATION

WARNING

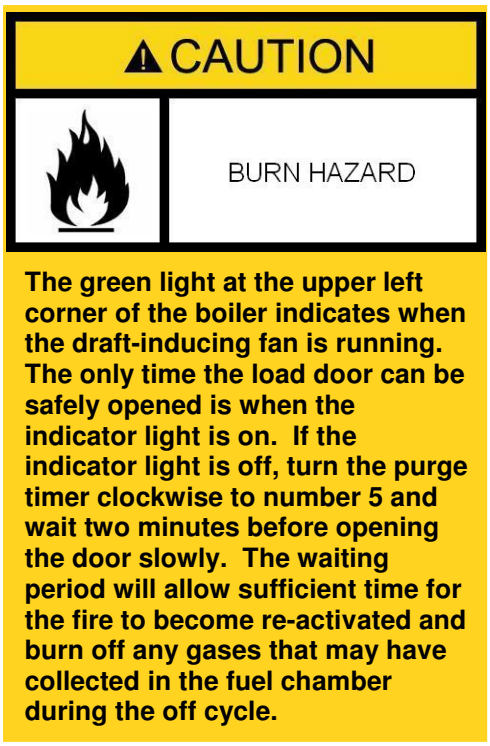
All cover plates, enclosures, and guards must be maintained in place at all times, except during maintenance and servicing. Always keep fueling and ash doors closed when the boiler is not being tended. Always maintain and keep all seals in good condition.

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



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).

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



On units that have a backup oil or gas burner, the green indicator light will only be on when the fan is running and the oil burner is not firing. If the indicator light does not come on when the purge timer is activated, it means the oil/gas burner is firing and **the door must not be opened**.

Once the Wood Gun™ has switched automatically or has been manually switched to a backup fuel, switching back to wood must be performed manually. This is accomplished by shutting the main switch off, turning the fuel selector switch back to wood, turning the main switch to on, and rekindling the boiler in the same manner as when the boiler was initially fired with wood. Be sure to only open the door when the green light is on. In order to permit the unit to continue firing in the wood mode, it cannot be switched to the “auto” position until

boiler temperature has exceeded the setting of the switchover aquastat.

Do not remove the smoke flap in the loading door while the Wood Gun™ is being fired. It is there for your protection and removing it may expose the operator to flashback under certain conditions. If the smoke flap is removed for cleaning or inspecting the refractory, be sure to put it back in place.

Do not open the doors or operate this unit during a power failure.

Never use chemicals or flammable liquids to start the fire. DO NOT burn garbage, other types of coal or any other fuel not approved for this unit.

STARTING A FIRE

Switch Positions: Cold Boiler Startup

	Before Lighting	After Lighting	Water Temp Has Risen to 150º-180º
Boiler Switch	Off	On	On
Start/Run Switch*	Start	Start	Run

* Units with Low Temp Shutdown

FUEL TYPE

The wood gun is designed to burn split or un-split log wood.

The Wood gun is designed to burn log wood. The Wood gun is able to burn both hard wood and soft wood fuel. Keep in mind that hard wood is typically a better fuel. Hard wood will usually give you longer burn times than soft wood. 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.

STARTING A FIRE

Starting a fire in the Wood Gun™ is similar to starting a fire in any wood fired boiler with a few important differences. Because the Wood Gun 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. Turn on the boiler switch. When the kindling is burning well, add more (and larger) pieces of wood.

Note: Always place wood in the Wood Gun™ lengthwise (from front to back). Never place wood in the fuel storage area crosswise.

When firing a cold boiler, it is important to concentrate heat next to the refractory. The Wood Gun™ 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 after the refractory has reached good gasification temperatures. 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 to last for ten hours.

When operating the boiler there is an actuated damper and a manually operated damper located at the rear of the unit. The boiler operates normal when both dampers are open completely. In some case when the wood fuel is rather dry the manual damper can be closed proportionally to slow the burn rate of dry wood and this will allow for a longer burn time.

Note: When starting a fire in a Wood Gun™ equipped with an oil or gas burner, it is first necessary to switch the fuel selector control to "wood" mode.

With Particle Fuel Delivery Option

Before beginning to burn sawdust, shavings, wood chips, or other wood waste, it is important to first create a bed of charcoal in the Wood Gun™ firebox to prevent these small fuel particles from being drawn unburned through the unit by the draft-inducing fan. Begin by turning on the main switch. Start the fire using kindling and newspaper in the same manner as described in the previous section. Once the kindling is going, add some larger chunk or log wood. Be careful not to shift the diverter bricks while loading the wood. Close the load door.

Allow this fuel charge to burn down and heat the refractory. When this occurs, ensure mode switches are in Auto, and then turn the feed system on to begin filling the firebox with particle fuel. After the unit is at operating temperature, secondary air may be activated as needed (if the boiler is so equipped).

If the fire must be restarted after a long dormant period (aside from normal on/off cycling), you must remove any unspent particle fuel from the firebox by hand and start the fire again from the beginning. If you try to add particle fuel before the refractory combustion chambers are hot, glowing particles may be discharged out of the stack. Sometimes, it is possible that the refractory mass is still above the ignition point of wood (usually within 4-6 hours of last on-cycle). If this is the case, the fuel may re-ignite automatically as with normal on/off cycling.

Note: Self Re-ignition time is dependent primarily on two variables (1) how hot the refractory is at shutdown (2) how big your refractory size (boiler size).

CHARGING THE BOILER WITH WOOD (MANUAL FEED)

Observe the warning label on the load door which cautions that it must not be opened unless the green indicator light is on.

When it is time to reload the Wood Gun™, note the indicator light above the purge cycle timer. If the indicator light is off, push the green Purge button or turn the purge timer clockwise to

number 5 and wait two minutes before opening the door slowly. 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 the green light is on, **open the door cautiously** since abruptly introducing air over the glowing fuel particles may cause it to temporarily flame up.

When reloading the Wood Gun™, it is a good idea to use the ash rake to make sure that all of the center slots are open and free from ash before adding more wood. Such raking is more often required when using softwood. When using hardwood, clear the slots at least daily. Clear the slots by raking charcoal pieces away from the slots. After raking the charcoal pieces away from the slots, rake ash into the slots, thus aiding the process of allowing the induction fan to pull the ash through. A vacuum that is rated for ash removal can also be used for removing ash that does not contain live embers.

> **Note:** Spent ash should not be allowed to build up on or in the refractory. Any ash buildup will insulate the fuel charge from the heat generated in the refractory, slowing the rate of gasification, and thereby reducing heat output.

Best results with fuel loading will be obtained if the charge of wood is limited to the amount needed to produce a 10-hour burn under anticipated heat load conditions. Adding more wood than can be utilized in 10 hours will likely lead to charcoal buildup and potential issues with "back puffing". The reason for this is that moisture is being evaporated from the fuel during the off cycle by heat radiating from the refractory. During the course of several hours of intermittent burning the entire fuel charge will have been dried down so that gasification can occur at a very rapid rate when the unit is firing. Under these conditions there may be insufficient oxygen present to adequately burn all the gas, which results in limited to extensive (and repeated) back puffing.

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

> Note: Guard against charcoal accumulation in your Wood Gun™ by keeping burn cycles at less than 12 hours.

Very dry wood of 15% moisture content or less, and fuel with a lot of surface area per volume such as slab wood or kiln-dried scrap from manufacturing, has the potential to produce back puffing as well. The optional secondary draft tube will help to alleviate this problem when burning wood that is very dry. It is sometimes helpful to keep the wood stacked toward the load door with an open area in the back of the center brick refractory. Closing the manual damper on the air intake tube may also alleviate back puffing.

ADJUSTMENT OF THE DRAFT-INDUCING FAN (BELT DRIVE ONLY)

The rate of burn (BTU output) for a given type of fuel is essentially determined by the amount of air drawn through the unit by the draft-inducing fan. The fan drive assembly on all large Wood Gun Models (and smaller Wood Guns with the belt drive option) has one or two variable sheave pulleys, which can be adjusted to change the speed of the fan. When the unit is assembled and tested at the factory an arbitrary setting is made to check for vibration. The final setting can only be made once a sample of the fuel to be burned is available. In addition to manipulating fan speed by swapping sheaves, Alternate Heating Systems also offers a VFD (Variable Frequency Drive) option for the induction fan motor.

Dry fuel and material having a high glue content will require less air (CFM) to achieve rated

output than will fuel of higher moisture. High-energy fuel can easily produce output higher than the BTU rating listed in the product literature. If the unit is operated continuously at higher than rated output, the life of the refractory will be shortened. It does not harm the Wood Gun to operate continuously at rated output. Selecting a burning rate that closely approximates the heating load will improve refractory life when compared to operating above rated output. Thermal shock created by heating and cooling of the refractory is more detrimental to the refractory than continuous operation at service temperatures.

OPTIONAL AUTOMATIC FUEL DELIVERY SYSTEMS

Automatic particle fuel feeding systems are available for all Wood Gun™ models that are factory equipped with a top fuel feed tube. An auger delivers the fuel to the top of the fuel chamber where it drops through a fuel tube to form a conical shaped pile. A patented fuel level control system comprised of several electrical control devices and a photoelectric eye monitors the level of the pile. As fuel is burned and the level drops, the auger is activated to replenish the fuel chamber.

When any type of particle fuel such as sawdust, planer shavings, wood chips, or biomass pellets is burned in the Wood Gun™, it is necessary to insert a refractory fuel diversion structure developed and patented by Alternate Heating Systems, LLC. There are several different types of fuel diverters available, and each one is designed for optimum performance on a given range of fuel. In most cases the original center bricks will need to be replaced to accommodate the fuel diversion block.

It is possible to burn both particle fuel and log wood at the same time. The general recommendation is to swap out the diverter brick and spacers when planning to use log wood for an extended period. If burning log wood for a limited time, with the anticipation of soon resuming particle fuel usage, it may be more convenient to let the diverter brick in the fuel chamber. If this is the case, special care must be taken when loading log wood so that the wedge shaped fuel diversion blocks at the bottom of the firebox are not displaced from their proper position. Boiler output will drop when operating the boiler with log wood while the diverter bricks are in place. If you desire to burn primarily log wood, simply remove the fuel diverter and spacer bricks from the firebox when the boiler is cool. To burn particle fuel, it is important to reinsert these diverter bricks to prevent particles from falling through the holes in the center brick.

Burning Particle Wood with a Low Moisture Content

Having the air to fuel ratio properly adjusted is particularly important when burning high-energy fuel such as particleboard, flake board, and MDF board because of the glue content. These fuels must be reduced to a particle size that can be delivered automatically through the fuel delivery system. Except for adding the incidental odd size piece through the load door, this type of fuel should not be hand-fired or batch charged.

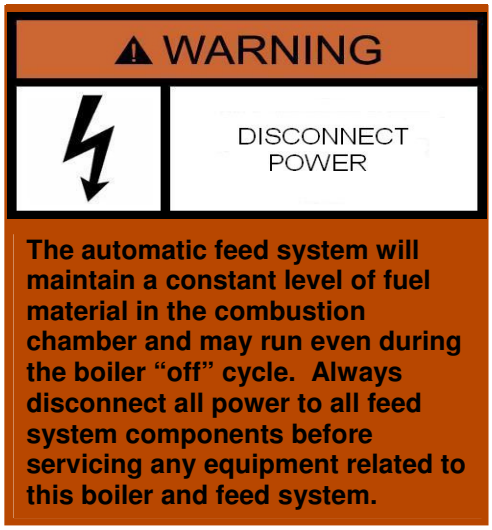
Note: Routine use of manufactured wood products (laminate, particle board, flake board, or any product containing glue based binders) will void the manufacturer's warranty for the Wood Gun.

Very dry wood of 15% moisture content or less, and fuel with a lot of surface area per volume such as slab wood or kiln-dried scrap from manufacturing, has the potential to produce back puffing. The optional secondary draft tube will help to alleviate this problem when burning wood that is very dry.

Use of Water Spray Kit

Note: If your application requires use of the water spray kit, be sure to enlist the services of a Wood Gun™ professional for assistance.

A water spray kit is available for all commercial Wood Gun systems and is normally recommended if you are burning kiln dried sawdust or shavings. The water spray system can be engaged upon heat rise to provide protection against the fire working its way into the fuel delivery system. In addition, when burning very dry fuel (< 18% moisture), a water spray kit can be used to add moisture to the fuel to help maintain a clean, controlled burn and to prevent buildup of dust on the photoelectric eye. Alternate Heating Systems suggests that a secondary air system should be the first choice for correcting issues related to using very dry fuel.



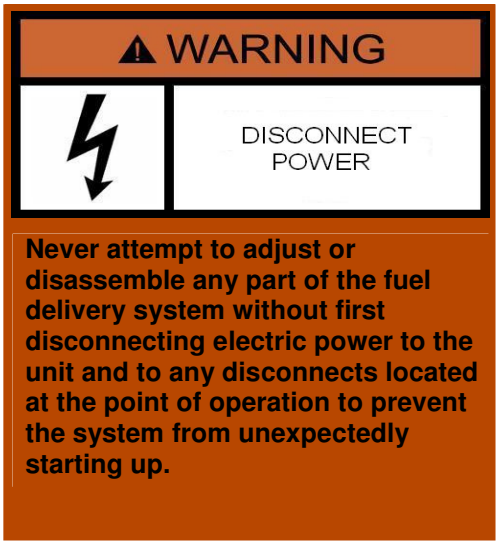
The automatic feed system will maintain a constant level of fuel material in the combustion chamber and may run even during the boiler "off" cycle. Always disconnect all power to all feed system components before servicing any equipment related to this boiler and feed system.

Operation and Sequence of Events for Automatic Feed Systems

Abbreviations used in this section:

- LR
- LT
- TDR
- CR

1. Photo sensors mounted on the two air valves control the feed system operation.
2. With the chamber empty the Light Receiver (LR) will pick up the signal from the Light Transmitter (LT) and begin the feeding cycle.
3. Time Delay Relay (TDR) – 2 delays any further action for about 20 seconds to prevent constant start/stop situations.
4. When the fuel valve is open, a switch in the fuel valve will close and activate the air lock motor. Time Delay Relay (TDR) –4 is also activated and when it times out in 10 - 15 seconds, the terminal to the feed auger control is energized (115 volts).
5. The feed system is now in full operation and will continue adding material to the combustion chamber until the fuel pile breaks the signal between the LT and LR photo sensors.
6. The feed auger immediately shuts down while the air lock continues cleaning itself until TDR –3 off delay times out. The fuel valve closes and the air lock stops until the photo eye sensors begin another feed cycle.



Never attempt to adjust or disassemble any part of the fuel delivery system without first disconnecting electric power to the unit and to any disconnects located at the point of operation to prevent the system from unexpectedly starting up.

Augers

The rate of discharge from the bin un-loader could be regulated by means of an adjustable gate and a repeat cycle timer. The timer should have an adjustment for both "run" time and "off" time and should be set so that the boot is

nearly empty before the un-loader discharges more fuel.

The lower end of the fuel delivery auger should remain covered with fuel at all times to provide an effective air seal and to prevent air from being drawn into the fuel chamber.

It is normal that fuel will continue to flow from the bin for several seconds after the un-loader stops, so the shutoff point should account for this fact. If the fuel level is allowed to build up in front of the discharge opening, it can cause a blockage that will become more compacted each time the un-loader runs.

> **IMPORTANT:** On the feed system, an auger temperature sensor is provided and must be installed.

Should the auger temperature sensor detect high temperature (indicating possible fire in the auger) it will activate a water spray system in the auger thus preventing fire from reaching the fuel storage area.

Photo- Eye Fuel Level System

The fuel level control system consists of a photoelectric beam generator, beam detector module, and time delay relay. The beam generator and detector are located on brackets on the cover of the air valve enclosure box.

> **NOTE:** It is important that the lens of both beam generator and the beam detector remain free of dirt, smoke and creosote to function properly. These should be wiped off daily if necessary.

The auger is controlled by a signal produced by the beam contacting the detector module of the photoelectric eye system. As the fuel level falls in the fuel chamber, the beam is detected and the auger delivers fuel until the pile interrupts the beam. The time delay relay prevents rapid cycling of the auger by permitting a pre-set delay period to elapse before restart. The relay is adjustable so that the length of delay can be set for different fuel conditions and boiler models.

The contacts do not close until the relay has timed out. When testing the system, the relay should be turned to the lowest setting to reduce the waiting time for the auger to activate. The photoelectric eye must have an electrical load in the circuit (such as the relay coil) in order to function.

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 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 the chimney for each 160-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, lowering significantly 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 outdoors 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. 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.

Do not store wood within the recommended clearances of the boiler or within the space required for loading wood and ash removal.

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 non-combustible floor or on the ground well away from all combustible materials, pending final disposal. If the ashes are disposed of by burial in soil or otherwise locally dispersed, they should be retained in a closed container until all cinders have thoroughly cooled to prevent inadvertently starting a fire.

CONDITIONING OF BOILER WATER

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, pretreatment 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.

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

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 10.5 and a maximum of 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 9.4 pitting of steel plates will 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

High boiler solids will lead to foaming, priming, surging, carry over or boiler sludge. 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.

(See http://www.p2pays.org/ref/34/33027.pdf)

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 $CaCO_3$.

High boiler alkalinity (in excess of 700 ppm $CaCO_3$) 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

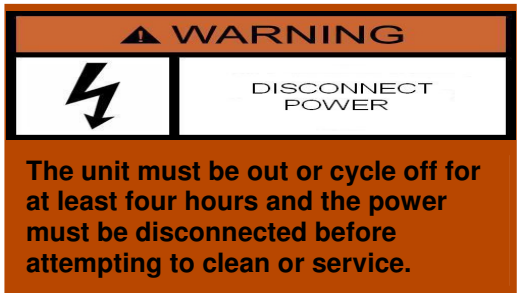
The hardness of water is caused by calcium and magnesium ions. Water hardness will vary greatly throughout the country depending on the source of the water. In boilers, hard water can cause the formation of scale and sludge or mud. Total hardness should not exceed 50 ppm.

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.

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.



Weekly Cleaning Procedure

Following is the recommended procedure for weekly cleaning:

1. Open front inspection door.
2. Place an ash receiver under the refractory at the front inspection door opening.
3. Use the ash rake to pull the ash from the center tube.
4. Inspect the outside refractory tunnels for ash buildup and remove with ash rake if necessary.
5. Inspect the refractory center plug that is inserted in the front of the combustion chamber (center refractory tube) and verify that it properly seals the front access opening.

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

6. Use a putty knife or scraper to clean ash from the bottom of the door openings.
7. Scrape condensation and creosote build-up from inside the air intake manifold using ash rake. On models with dual draft, use a putty knife or scraper inside the firebox.
8. Open the draft valve cover and inspect the valve gasket disk for evidence of air leakage. The disk should have some wobble, so it can move and find its own seal.
9. Inspect the fuel chamber and remove any ash residue. Pay special attention to corners as ash can easily become trapped here.
10. Remove ash pan from the cyclone separator and dispose of its contents.
11. Clean excessive ash out of fire box.

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.

Yearly Cleaning

Following is the recommended procedure for yearly cleaning:

1. Cleaning the heat exchanger.
   - Remove the draft fan assembly.
   - Use a wire brush or scraper to cleanout the heat exchanger.
2. Clean the cyclone ash collector.
   - Remove the top connecting flange from the cyclone.

- Clean the inside of the main body and funnel of the cyclone with a wire brush.
- Clean the tube that connects the cyclone to the boiler.
- Clean the boiler exit port where the cyclone attaches.

AIR VALVE CLEANING AND MAINTENANCE

The air valve may be inspected during the "run" cycle of the boiler. Any cleaning or service to the air valve should be performed when there is no fire in the combustion chamber and the power is turned "OFF".

TO OPERATE THE AIR VALVE MANUALLY FOR CLEANING AND SERVICE

1. Insert supplied hex key wrench in center as shown in photo.
2. Rotate in the direction indicated on cover.
3. When opened to the desired position, hold the hex key wrench to prevent the spring return from moving actuator.
4. With the hex key wrench held in place, use a screwdriver to turn the gear train lock pin in the indicated direction. Slowly allow the hex key wrench to rotate backwards until the detent is reached. At the detent position, the pin will lock the motor in place. In the locked position, cleaning and or replacement of the air valve disc can be performed.
5. To release the actuator, use the hex key wrench and rotate in the open direction ¼ turn. The lock is spring loaded to release. Remove the hex key wrench and allow the valve to close.

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 contact is made with cooler combustion air. 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. Clean off any deposit on the gasket disc with a cloth soaked in warm water and detergent. Do not scrape with a knife or other metal scraper as you may damage the silicone rubber seal. 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 ash rake as described in Step 7 of Weekly Cleaning Procedure.

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 gasket you require.

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 reinstallation as the new gasket needs some slight wobble to seal properly over the air inlet tube.

AIR VALVE MOTOR REPLACEMENT

Air Valve Motor Replacement Procedure

1-**Removing the old damper motor-** Using the supplied Allen wrench, crank the motor to the full open position.
2- Use a 10 mm wrench to loosen the mounting bolt
3-remove motor
4-**Installing the new damper motor-** These damper motors are reversible. 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 0 degree mark. Reinstall the clip. Use the Allen wrench to crank damper motor actuator to the 90 degree position. While holding the actuator at 90 degrees use a screw driver to twist locking mechanism which will hold actuator in position
5-Place motor onto air valve
6-Manually move the air valve disc to the open position, (see Figure 12) ensure that the jaws on the clamp align with the contour of the shaft as shown in Figure 11.
7-Tighten 10 mm bolt
8-Using the Allen wrench, release the lock. This is accomplished by rotating the wrench in the direction of the arrow one quarter turn and then let go. The motor will then rotate to the closed position
9-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.
10- 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 you will experience issues as such.

- Motor may not operate.
- Green Indicator light may not turn on when damper is in the open position.

Figure 11

Figure 12

DOOR ADJUSTMENT

For proper operation of the Wood Gun™, it is important to have an effective seal of the loading door and cleanout 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 doorframe and tighten the bolts. Be careful not to tighten so much as to prevent the latch side from closing properly.

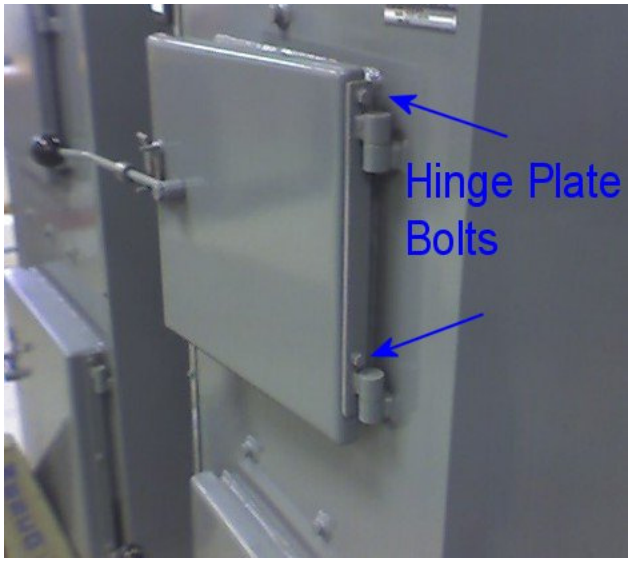


Figure 13: Hinge Plate Adjustment

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.

Figure 14: Door Latch Shims

A good method to use when trying to determine if the doors are sealing properly is to coat the doorframe 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. Periodically lubricate the door handle wear pad door hinges and door handle with the grease.

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.
4. Run a small bead of silicone into door groove. Place strips of fiberglass tape in grooves only on the straight sides. The strips will not cover the corners. The reason that the tape does not cover the corners is to allow for expansion that occurs in the gasket when it is bent at a 90° angle.

Figure 15

Figure 16

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

Figure 17

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 (bumps).

Figure 18

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.

Figure 19

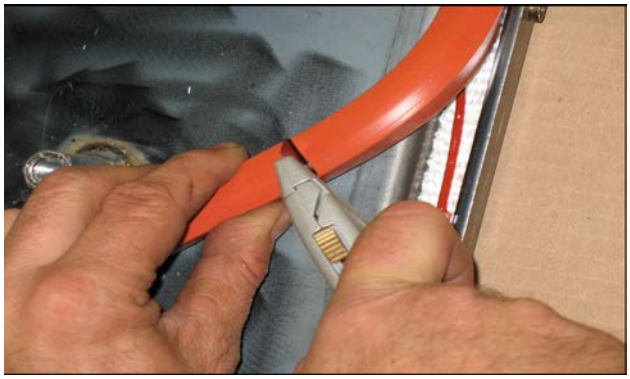


Figure 20

Figure 21

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.

Figure 22

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

Figure 23

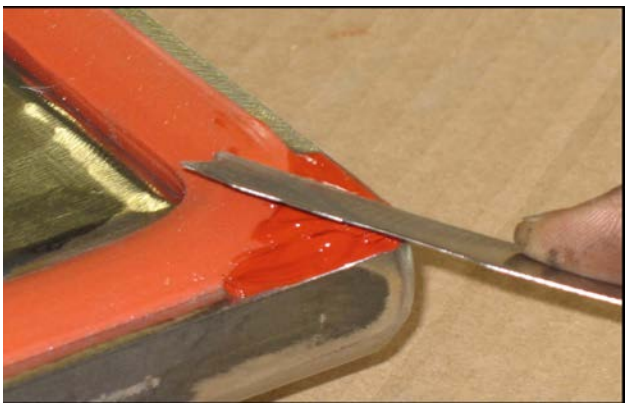


Figure 24

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

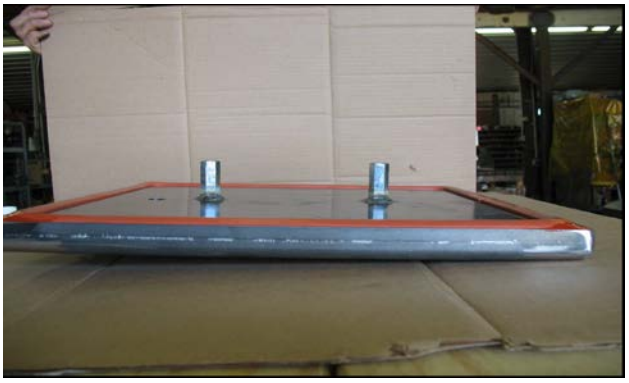


Figure 25

FRONT AND REAR INSPECTION DOOR HIGH TEMPERATURE ROPE INSTALLATION

The high temperature rope has fiberglass in it. You must wear gloves to protect your skin from irritation.

#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.

#2. Next you need to run a small bead of high temperature silicone in the center of the rope channel. A ¼ inch bead will work to hold the seal in place.

#3. The rope that was sent from the AHS factory will be too long and will need to be cut down. This is important because you need to start and finish with a straight end. Scissors will be best way to cut the rope.

#4. You need to 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 from the center of the door to the first corner. 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 or between the rope ends. The rope should protrude about 3/8" above the door frame. Gently Tap the rope with a hammer to push it in to position. It is very important that the tool you use does not cut the rope as you tap it into place.

#6. Look over the door to find any high spots or bumps in the seal. Use the hammer 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.

REAR INSPECTION DOOR (ABOVE)

FRONT INSPECTION DOOR (ABOVE)

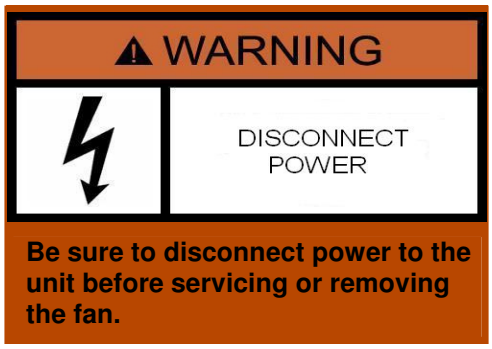
FAN ASSEMBLY

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

Figure 26: Direct-drive fan attached to boiler

Figure 27: Direct-drive fan removed from boiler exposing the heat exchanger.

Figure 28: Belt-drive fan assembly removed from boiler and showing white gasket



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

On units that have a shaft drive fan, the motor bearing will need to be replaced approximately every two years. On belt drive fans, the pillow block bearings and belt should be checked every three months. After the initial burn of two to six hours shut the boiler down and retighten the pillow block bearing set screws. To tighten the fan belt, loosen the four bolts that hold the motor to the bracket. Slide the motor down and re-tighten, being careful that the motor is properly aligned with the fan shaft. Some models have a hinged motor mount with adjusting screws. To check for proper alignment of the pulleys, use a straight edge lying across both pulleys.

After reattaching the fan motor assembly to the boiler, turn the fan over by hand to ensure that it does not bind. If a tight spot is evident, loosen the locking pillow block collars on the shaft and move the shaft in until the fan touches the boiler and mark the shaft. Then pull the shaft out until the fan touches the abrasion shield and mark the shaft. Finally, position the shaft midway between the two marks and re-tighten the collars. Be certain to replace the belt guard if it was removed for servicing.

Note: Pillow block fan shaft bearings are permanently sealed. Do not force grease into the grease fittings as you will break the seal and grease will run out when heated. Grease fittings are intended to be used only if/when the seals break due to age or heat.

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” locknuts located along the outer edge of the motor mounting plate (figure 28). Place the motor on a bench with the fan facing up. Remove the two set screws from the fan hub. Screw a one inch nut onto the threaded hub of the fan (Figure 29). Using a pulley puller, remove the fan from the motor shaft (Figure 29). 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. 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. 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. Once these bolts are removed, tap the mounting end of the motor on the side with a rubber mallet. This will separate the bearing housing from the motor body (Figure 30). Removing the two screws located beside the shaft will allow you to separate the shaft and the bearing housing (Figure 31). Use a pulley puller to remove the bearing from the shaft (Figure 32). Place the new bearing on the shaft and drive it on with a hammer and a 3/4" pipe until it is fully seated. (Figure 33&34) 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 (Figure 35). After assembling the motor, spin the shaft to insure that the shaft spins freely.

Figure 28

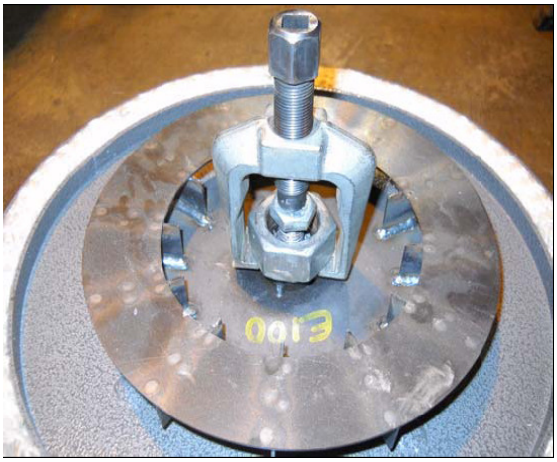


Figure 29

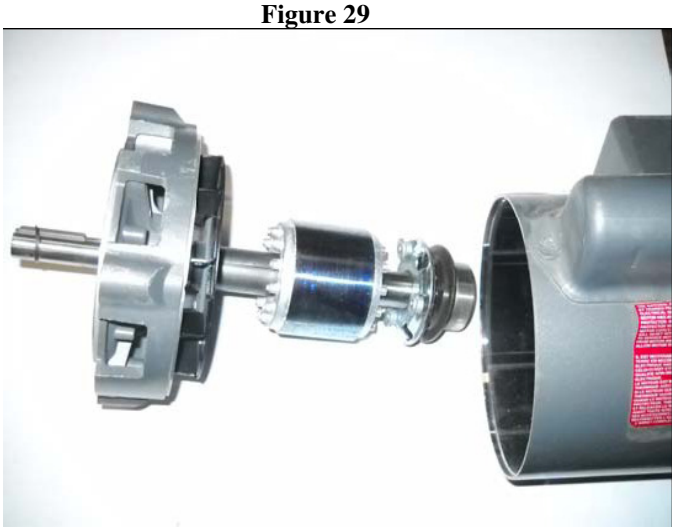


Figure 30

Figure 31

Figure 32

Figure 33

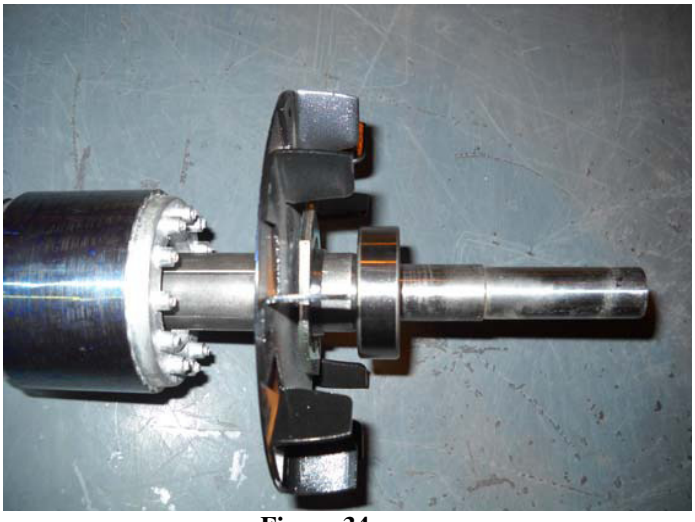


Figure 34

Figure 35

REFRACTORY

The refractory pieces in the bottom of the Wood Gun™ fuel chamber have two distinct shapes, as shown in the in the Appendix C: Exploded Parts Drawings.
The Center Brick contain the slots through which burning gases are drawn by the induction fan. The 16 in center bricks are a common component in models E100 through the E250. The E100 also contains a single 11 3/8 in brick. This brick should be placed to the front of the boiler. The center brick are subjected to the most severe flame erosion and highest temperatures and will most likely be the first refractory components to show signs of deterioration. Surface spalling is common under normal conditions and is not reason for concern. The center refractory pieces should be changed every 10-15 cords of wood and must be ordered from Alternate Heating Systems. They may be removed by simply lifting them out.
The large refractory (Side Bricks) should be replaced every 10-15 years in residential boilers. They are usually held in place only by their own weight resting against each other and a refractory cement seal between the front and back boiler wall and the bricks. To remove, you will need to break the cement seal. It is also a common occurrence for a brick to break in the removal process. If you are having trouble removing the old side brick follow these instructions. Remove the most deteriorated brick on each side. You may have to break it into smaller pieces to make it easier to remove. When you have an open gap in the brick you can then use a pry bar between the next two brick to break them loose. Once you have them loose remove them through the load door.

After the bricks are removed, check the ceramic blanket lining the bottom of the firing chamber for damage. If needed, this ceramic blanket can be ordered from AHS with your new refractory bricks. To install the new blanket, unwrap it and carefully mold it to the bottom of the firing chamber. When handling the blanket, you will want to use rubber gloves.

When replacing the refractory bricks, be careful to lay the pieces gently on the newly installed blanket since it may be easily torn or damaged. Alternately place right and left hand pieces so they will counter-balance one another. Be sure that the refractory tunnels and the center channels line up properly.

CENTER BRICK

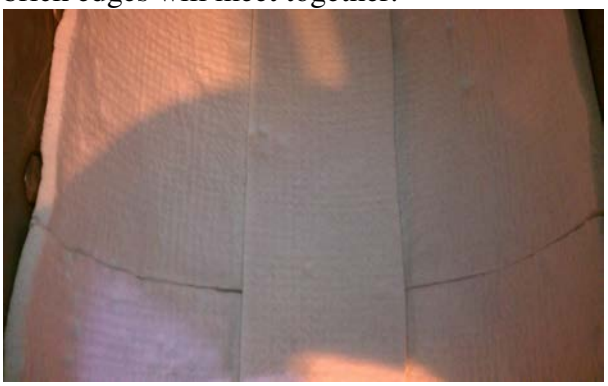
Place the Center Brick on the ledge created by the Side Bricks, smooth side up. After all the refractory pieces are in place, check to see if there is any space between the refractory and the boiler wall and the ends. If there is more than 1/16 inch gap, fill it with “Troweleze” refractory cement. Allow the cement to dry thoroughly for eight hours before firing the unit.

REFRACTORY REPLACEMENT

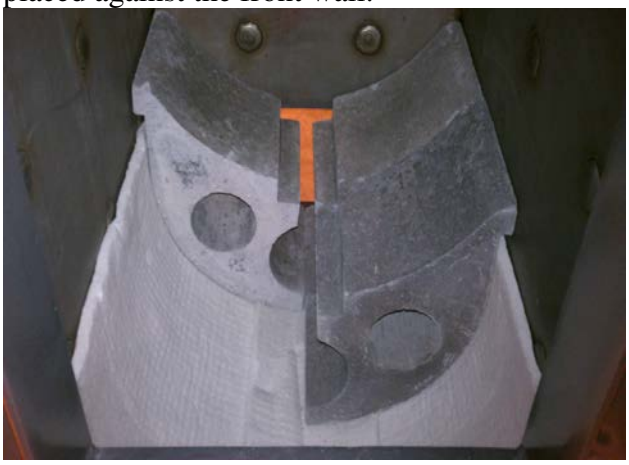
Please wear the proper safety equipment while performing this task. Proper equipment includes, work gloves, safety glasses, and steel toe boots.

#1 Installing the dry insulation blanket is the first step. The blanket is already cut to size when it is shipped from AHS. The first piece that is installed will start at the front load door and extend toward the rear door two feet. Make sure that the blanket is centered and reaches the same distance up each side of the firebox wall. The next strip to be installed can range in depth from three and a half inches to another full two foot piece or somewhere in between. It depends on what size boiler that you’re installing the bricks in. When this step is installed correctly there should be about a quarter inch to one inch gap from the boiler wall to the blanket. This will be true for the front and rear of the boiler. You may need to shift it one way or another to make it even. The last piece to be installed is an eight inch strip that runs the length of the boiler. It

needs installed at the bottom center of the firebox. This will be where the side refractory brick edges will meet together.



#2 Installing the side refractory bricks will be the next step. The refractory that was shipped to you is numbered. The numbers will either be 1, 2, 3, or 4. They are shipped so that when you install them you will have all the same number on one side. For example: If you were shipped eight side bricks and four of them had the number 1 on them and the other four had the number 4 on them. You would then install all the #4 bricks on the left side and all the #1 bricks on the right side. It does not matter whether the # 4 bricks are installed on the right or on the left. It matters that all the numbers on the right are the same, and all the numbers on the left are the same. After the bricks are separated and you know which side they need to be installed in. Start by placing the first side bricks against the back wall of the boiler. Be careful not to slide the bricks across the dry blanket. When you have one brick on each side placed in the rear of the boiler. Set the next two bricks just inside the load door against the front wall of the firebox. If you are installing bricks into an E100 model Wood Gun. You will have two side bricks that are smaller than the others. They will be put in place next. They set against the two bricks in the back. All other boilers will have identical brick and they will also set against the back first two bricks. Repeat this step working forward until all the bricks are in place and meet up with the two bricks you placed against the front wall.



#3 After the bricks are placed in the boiler they will need aligned. Align the first row closest to the front inspection door. Basically both bricks should be even. You will be able to measure the two outside tubes. Measure from the top of the tube to the top of the door frame and make both measurements the same. Be sure that the bricks are touching at the bottom. Depending on the model some of the tubes will set just above the door frame. This is fine; the important issue is that they are both even. After the first two are set, match the next set up to the set in front of them. When this is completed properly the tunnels will be even and you will be able to move the ash rake through them.

#4 Applying the Troweleze will be your last step. The Troweleze will fill in the gap between the brick and the vessel at the front and rear inspection door. This is also used to fill in and smooth out any transition from brick to brick. If there are areas in the tunnel that catch the ash rake just apply some Troweleze to smooth it out.

FUEL DIVERTER BLOCKS

Position the diverter block directly over the center of the center bricks. Start in the rear of the boiler and work toward the front of the boiler. Support each corner of the diverter block with a spacer support block. You may be able to use one spacer support block to support two blocks in the center where the diverter block butt against each other.

IMPORTANT: When cleaning or replacing the refractory, it is essential that the spacer bricks are properly positioned and the fuel diverter blocks are centered over the center bricks.

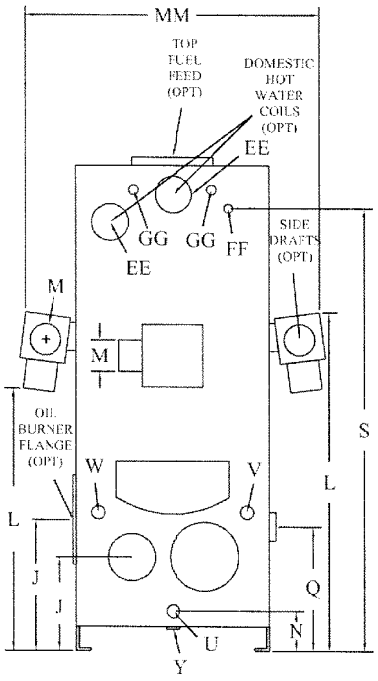
The spacer bricks may deteriorate in time allowing the fuel diverter to drop down onto the refractory combustion chamber bricks, thereby restricting airflow through the unit. Foreign material in the fuel such as sand, soil, metal or organic compounds may melt and fuse to the fuel diverter blocks causing restriction. Where unusual circumstances exist, special spacer bricks may be required to reduce the adverse effects of contaminated fuel. The gap under the fuel diverter block should be checked regularly to make sure blockage does not occur.

ADDITIONAL INFORMATION

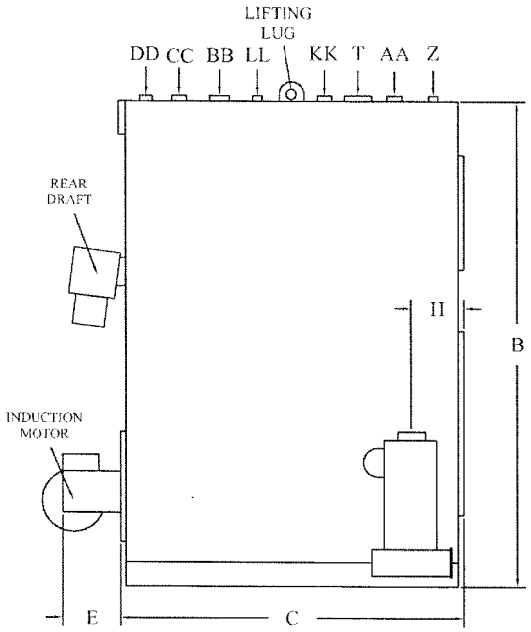
For additional information on using your boiler safely, obtain a copy of the National Fire Prevention Association publication “Using Coal and Wood Stoves Safely”, NFPA No. HS-8-1974. The address of the NFPA is 470 Atlantic Avenue, Boston, Massachusetts 02210.

APPENDIX A: BOILER SPECIFICATION DIAGRAM

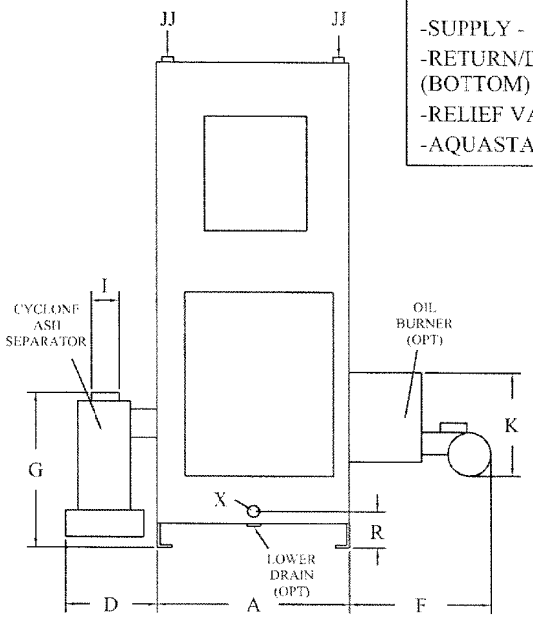
WOOD GUN SPECIFICATIONS DIAGRAM



REAR



SIDE



FRONT

FITTINGS

-SUPPLY - 1 ½" FITTING (TOP)
-RETURN/DRAIN - 1 ½" FITTING (BOTTOM)
-RELIEF VALVE - ¾" FITTING
-AQUASTAT - ½" FITTING

UNIT	A	B	C	D	E	F	G	H	I	J	K	L	M	N	Q	R	S	T	U	V	W	X	Y	Z	AA	BB	CC	DD	EE	FF	GG	HH	II	JJ	KK	LL	MM	MOTOR HP
E100	26	56	36	18	12	26	21	23	6	16	14	38	5	-	16	-	52 ½	1 ½	-	1½	1 ½	-	1 ½	-	-	-	-	¾	4	½	½	-	½	½	-	-	46	⅓
E140	26	64	40	18	12	26	26	19	6	16	14	38	5	-	16	-	55 ½	1 ½	-	1½	1 ½	-	1 ½	½	½	-	-	¾	4	½	½	-	½	-	-	-	66	⅓
E180	31	66	40	18	12	-	27	19	6	16	-	41	5	5 ½	17	5 ½	56 ½	1 ½	1 ½	1 ½	-	1 ½	1 ½	½	½	-	-	¾	4	½	½	4	½	-	-	-	52	⅓
E200	31	66	48	26	12	-	33	20	8	16	-	44	5	5	20	5	-	1 ½	1 ½	1 ½	-	1 ½	1 ½	½	½	-	-	¾	4	-	½	4	½	-	-	-	52	½
E250	31	73	56	28	16	-	33	27	8	19	-	49	5	5	23	5	-	2	2	2	-	1 ½	1 ½	½	½	2	-	¾	4	-	½	4	½	-	-	-	52	¾
E500	34	88	74	36	16	60	48	34	8	23	21	58	5	-	19	5	78	2	-	2	2	1 ½	1 ½	½	1 ¼	2	1	½	4	¾	½	4	½	-	½	½	64	1 ½
E1000	48	100	88	-	24	102	65	-	12	29	32	64	-	-	29	5	87	2 ½	-	2 ½	2½	2	-	½	-	-	2 ½	½	-	1 ½	½	4	½	-	1 ½	1 ½	74	2

All dimensions in inches unless otherwise specified.

ADDITIONAL SPECIFICATIONS

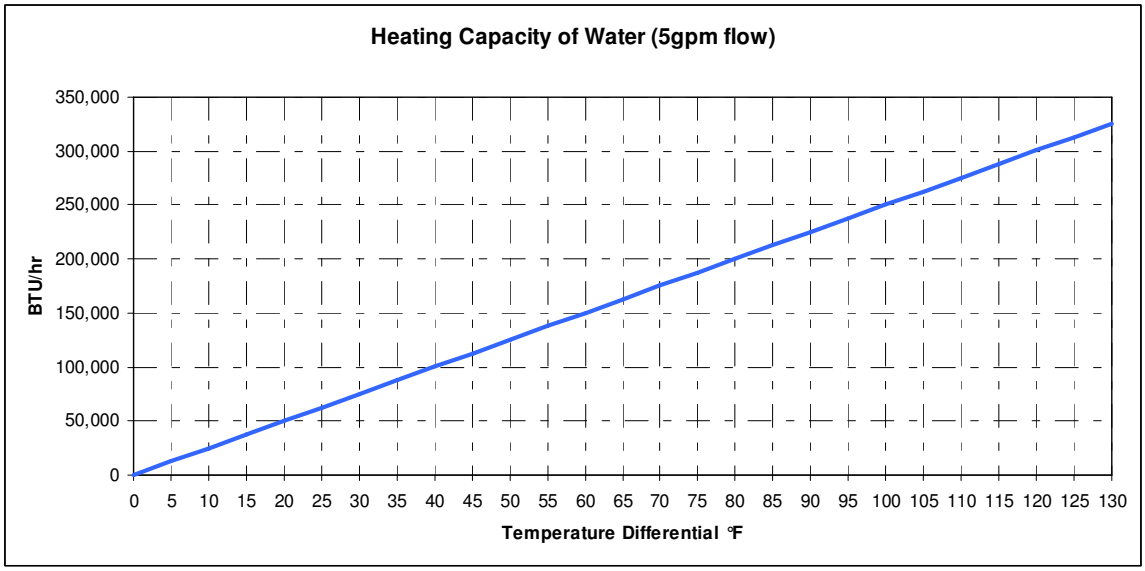
Pressure Drop

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.



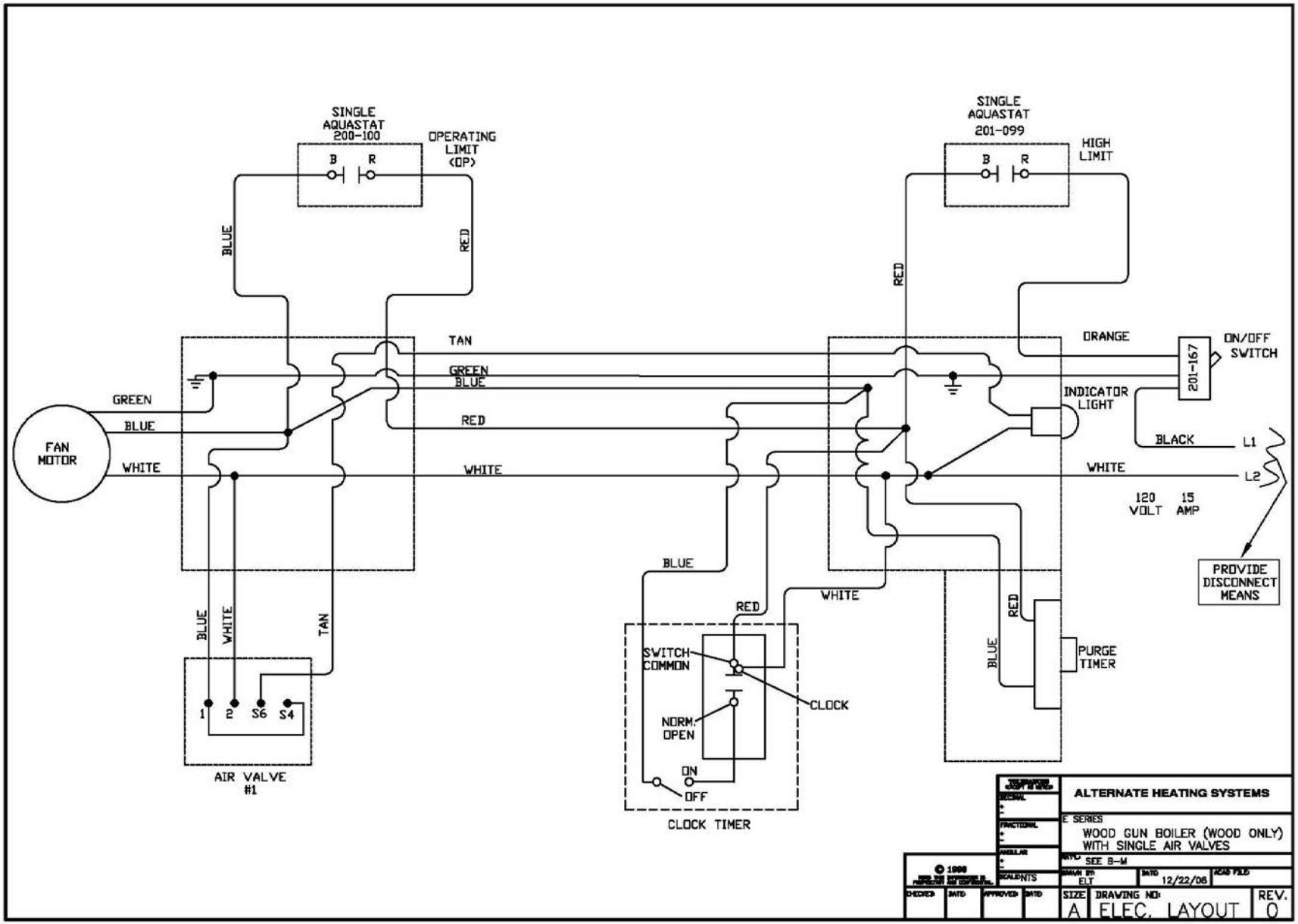
Wood Gun E Series Specifications

	E100	E140	E180		E250	E500	E1000
Nominal Max BTUs	100K	140K	150K		230K	500K	995K
Oil	80K	130K	160K		230K	500K	995K
Heating Surface, ft2	30	39	46		70	116	192
Water Capacity, gal	60	80	80		140	210	435
Fuel Capacity, ft3	6.5	10	14		22	28	61
Max Log Length, in	28	32	32		48	50	58
Standard Door, square	14 in	14 in	14 in		14 in	18 in	18 in
Height, in	58	64	66		74	90	102
Width, in	26	26	31		31	34	48
Depth, in	44	48	48		66	72	78
Flue connector diameter, in	6	6	6		8	8	12
Nominal Dry Weight, lbs	1400	1650	2100		3000	45000	9000

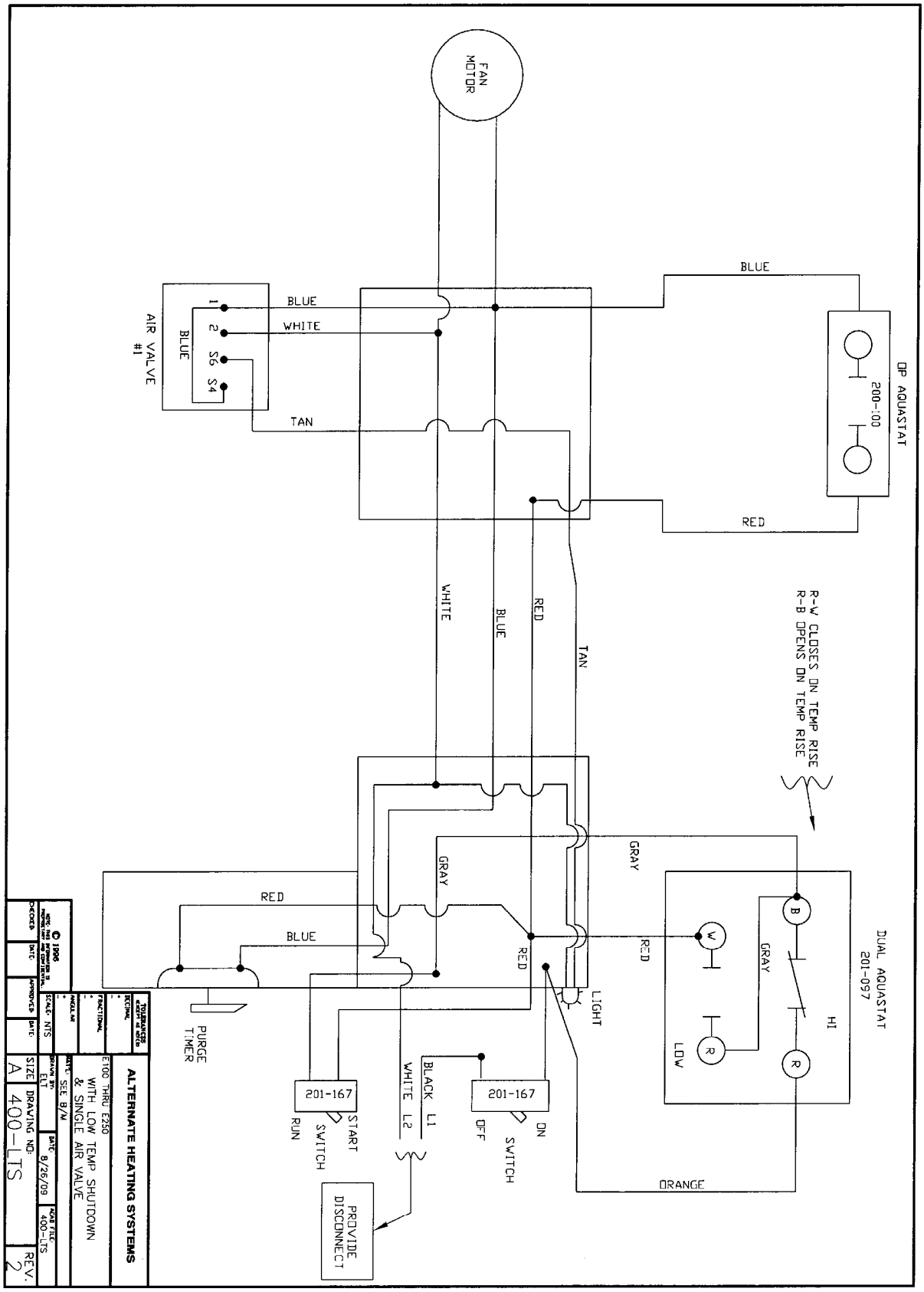
Specifications subject to change without notice

APPENDIX B: WIRING DIAGRAMS

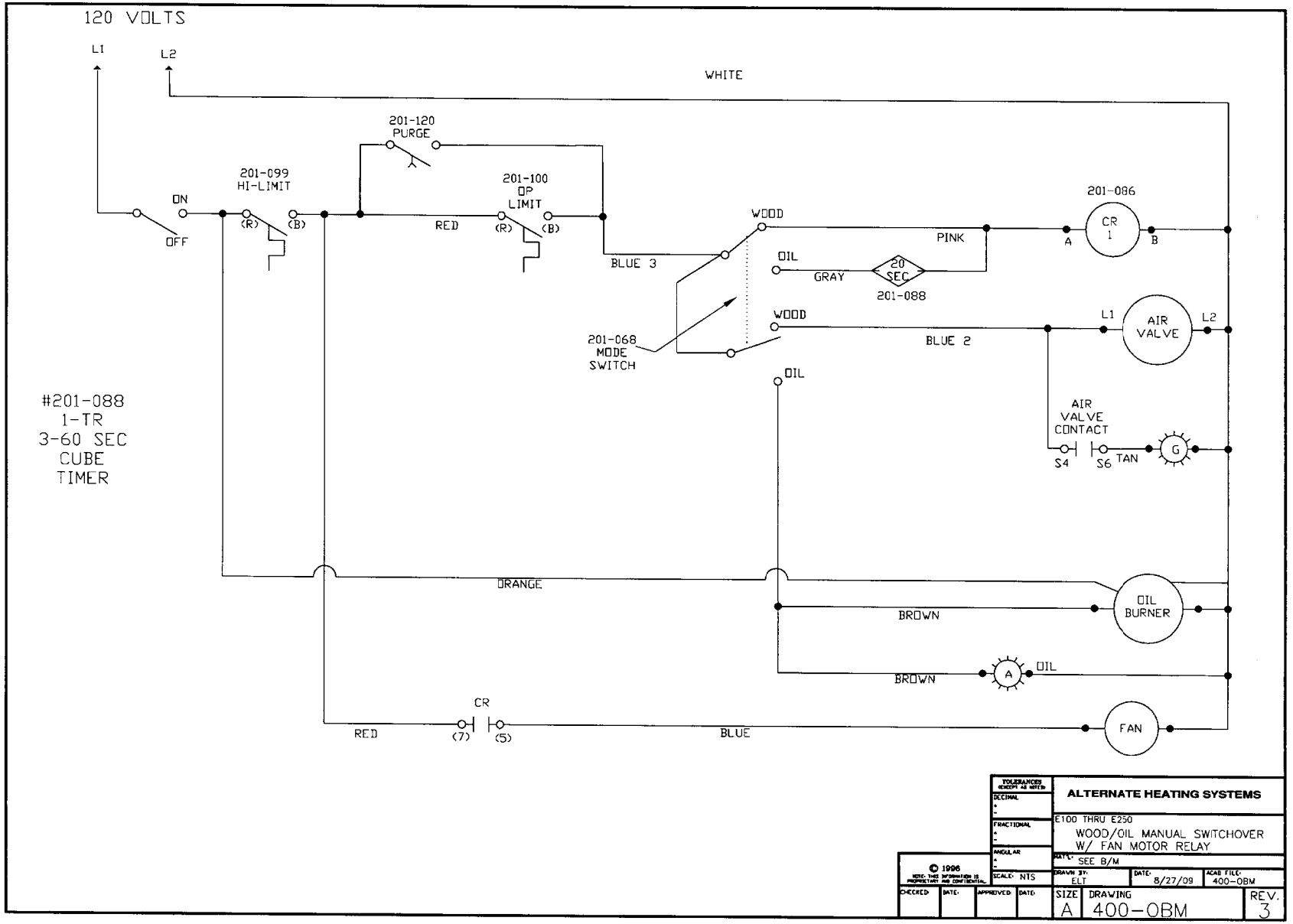
E SERIES WOOD GUN (WOOD ONLY) WITH SINGLE AIR VALVE ELECTRICAL LAYOUT FIG. 3.7

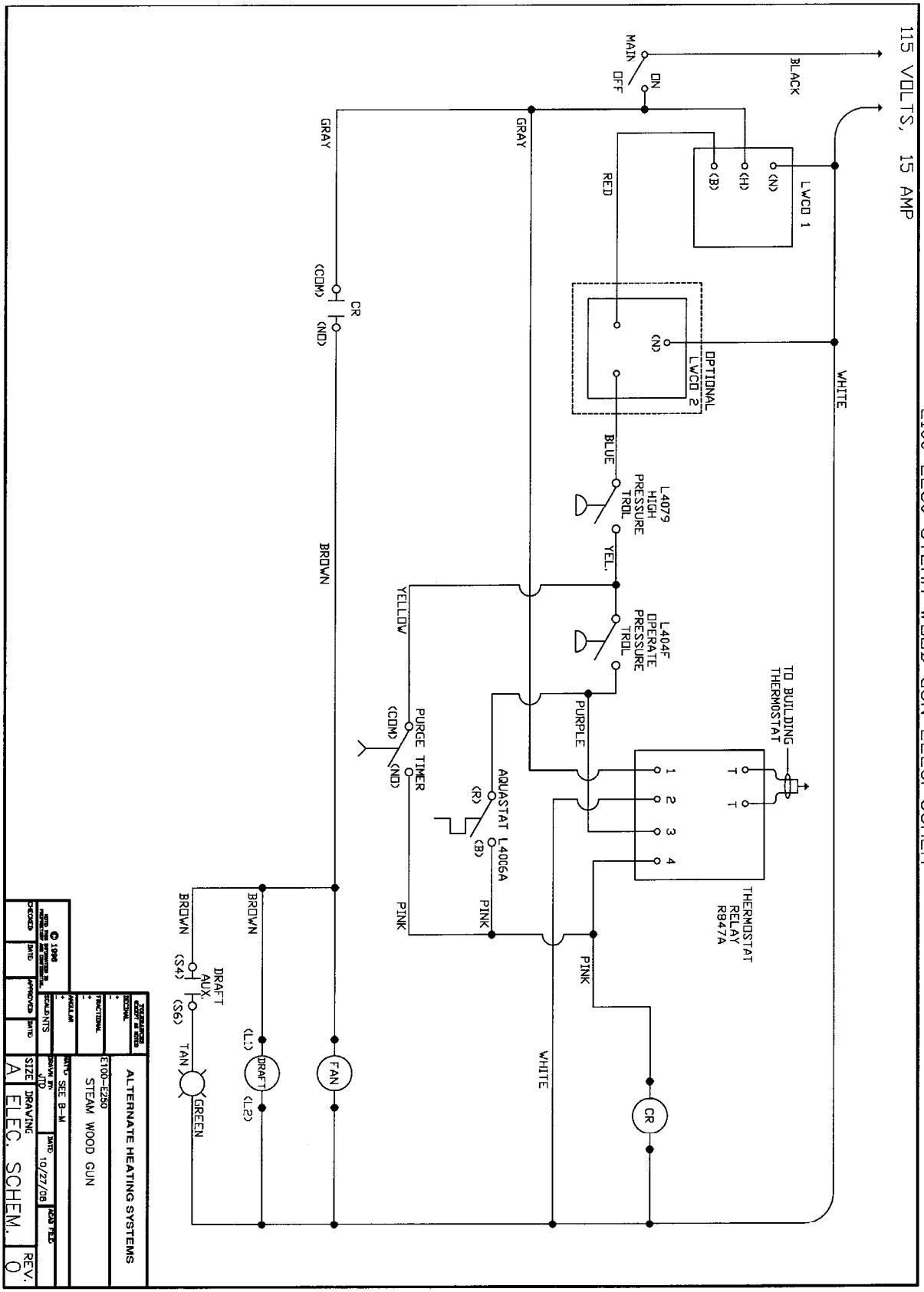


E-100 THRU E-250 WITH LOW TEMP SHUTDOWN & SINGLE AIR VALVE

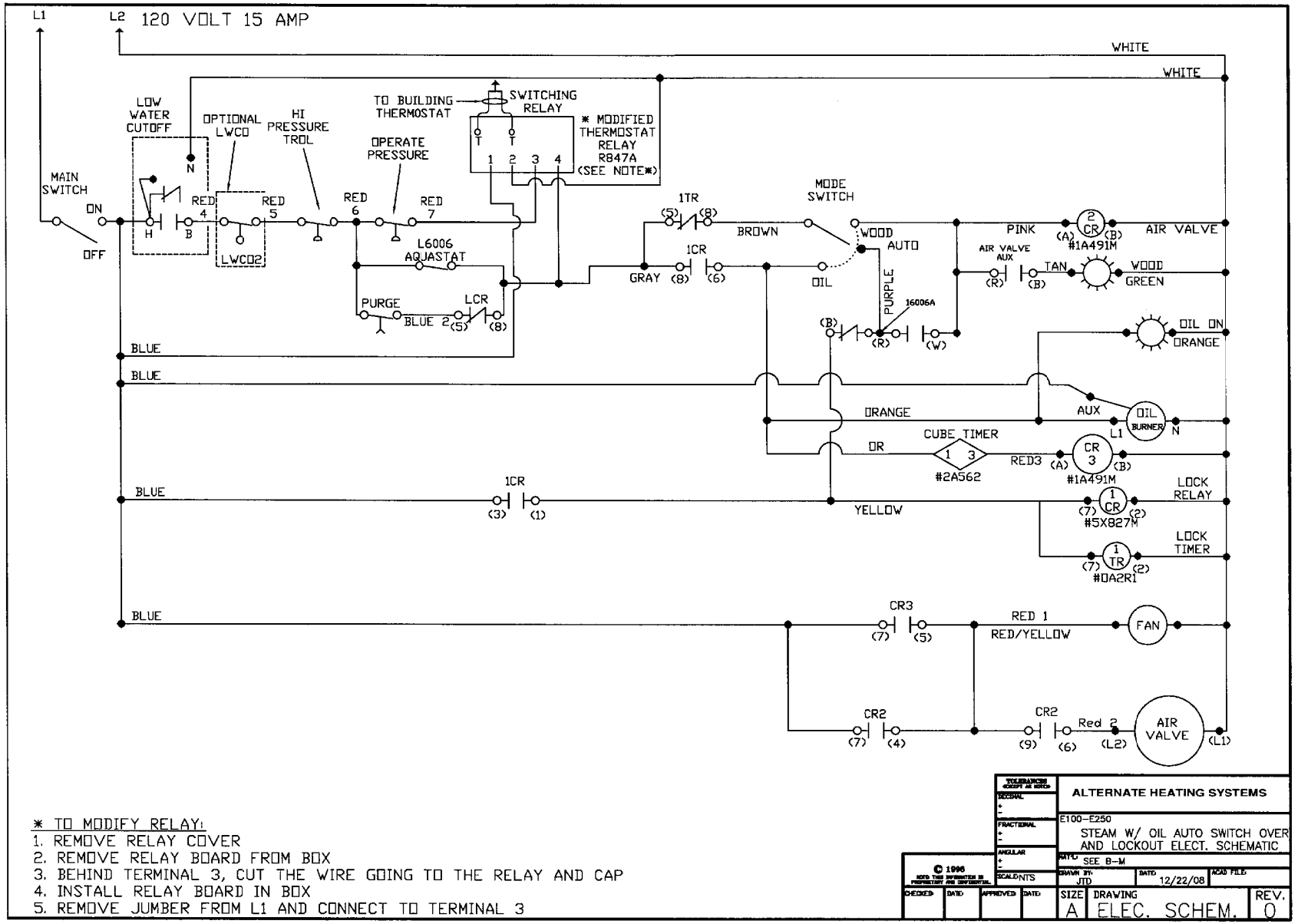


E-100 THRU E-250 WOOD/OIL MANUAL SWITCHOVER W/ FAN MOTOR RELAY ELECTRICAL SCHEMATIC




E100-E250 STEAM WOOD GUN ELEC. SCHEM
115 VOLTS, 15 AMP
MAIN
ON
OFF
BLACK
WHITE
LWCO 1
(N)
(H)
(B)
RED
GRAY
OPTIONAL LWCO 2
BLUE
L4079 HIGH PRESSURE TROL
YEL.
L404F OPERATE PRESSURE TROL
TO BUILDING THERMOSTAT
T T
1 2 3 4
THERMOSTAT RELAY R847A
PURPLE
PINK
AQUASTAT L4006A
(R)
(B)
PURGE TIMER
(COM)
(ND)
YELLOW
CR
GRAY
BROWN
DRAFT AUX
(S4)
(S6)
TAN
GREEN
(L1)
(L2)
DRAFT
FAN
CR
ALTERNATE HEATING SYSTEMS
E100-E250
STEAM WOOD GUN
SEE B-M
10/27/08
SIZE
A
DRAWING
ELEC. SCHEM.
REV.
O

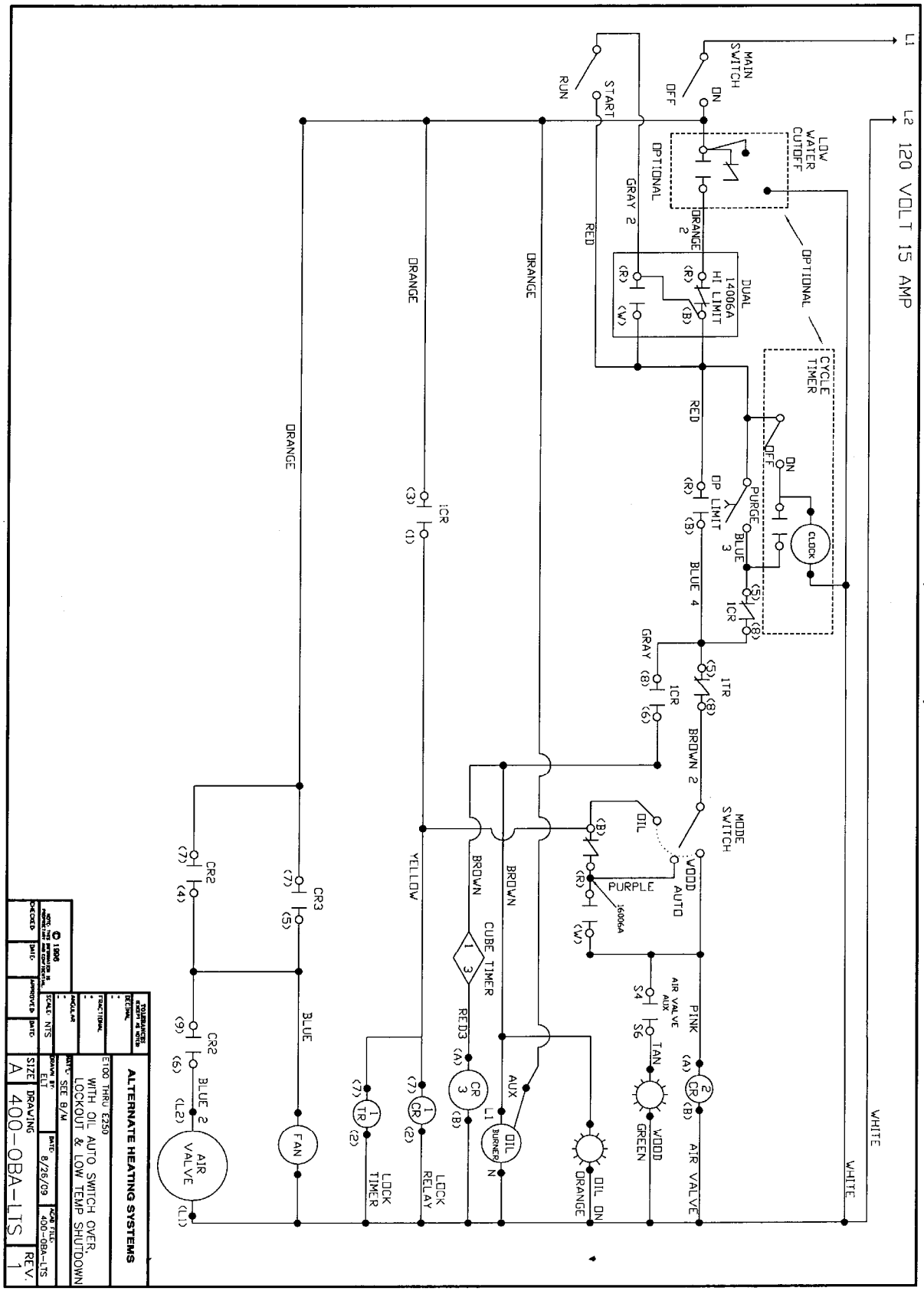
E-100 THRU E-250 STEAM WITH OIL AUTO SWITCH OVER AND LOCKOUT ELECTRICAL SCHEMATIC-



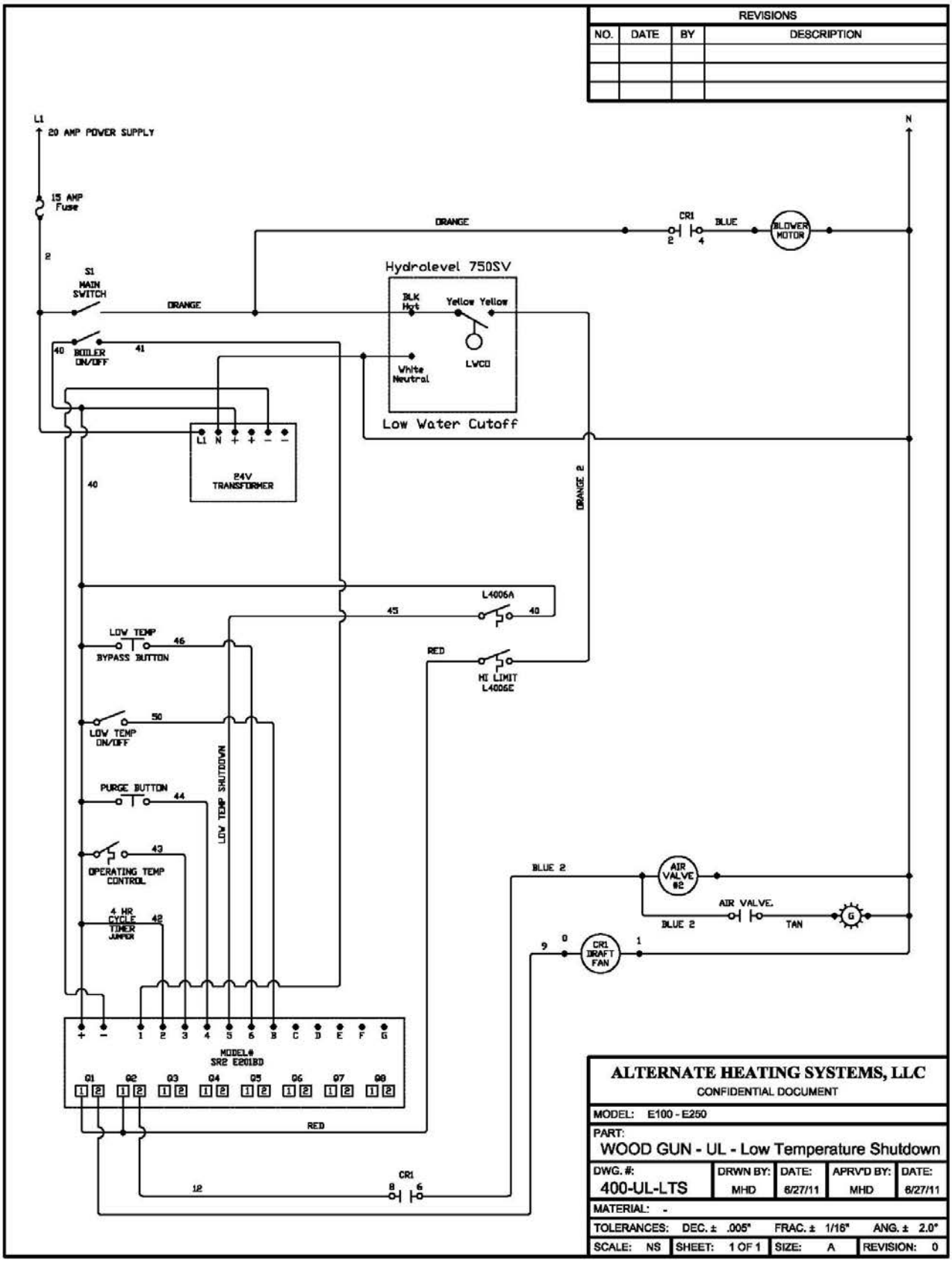
* TO MODIFY RELAY:
1. REMOVE RELAY COVER
2. REMOVE RELAY BOARD FROM BOX
3. BEHIND TERMINAL 3, CUT THE WIRE GOING TO THE RELAY AND CAP
4. INSTALL RELAY BOARD IN BOX
5. REMOVE JUMBER FROM L1 AND CONNECT TO TERMINAL 3

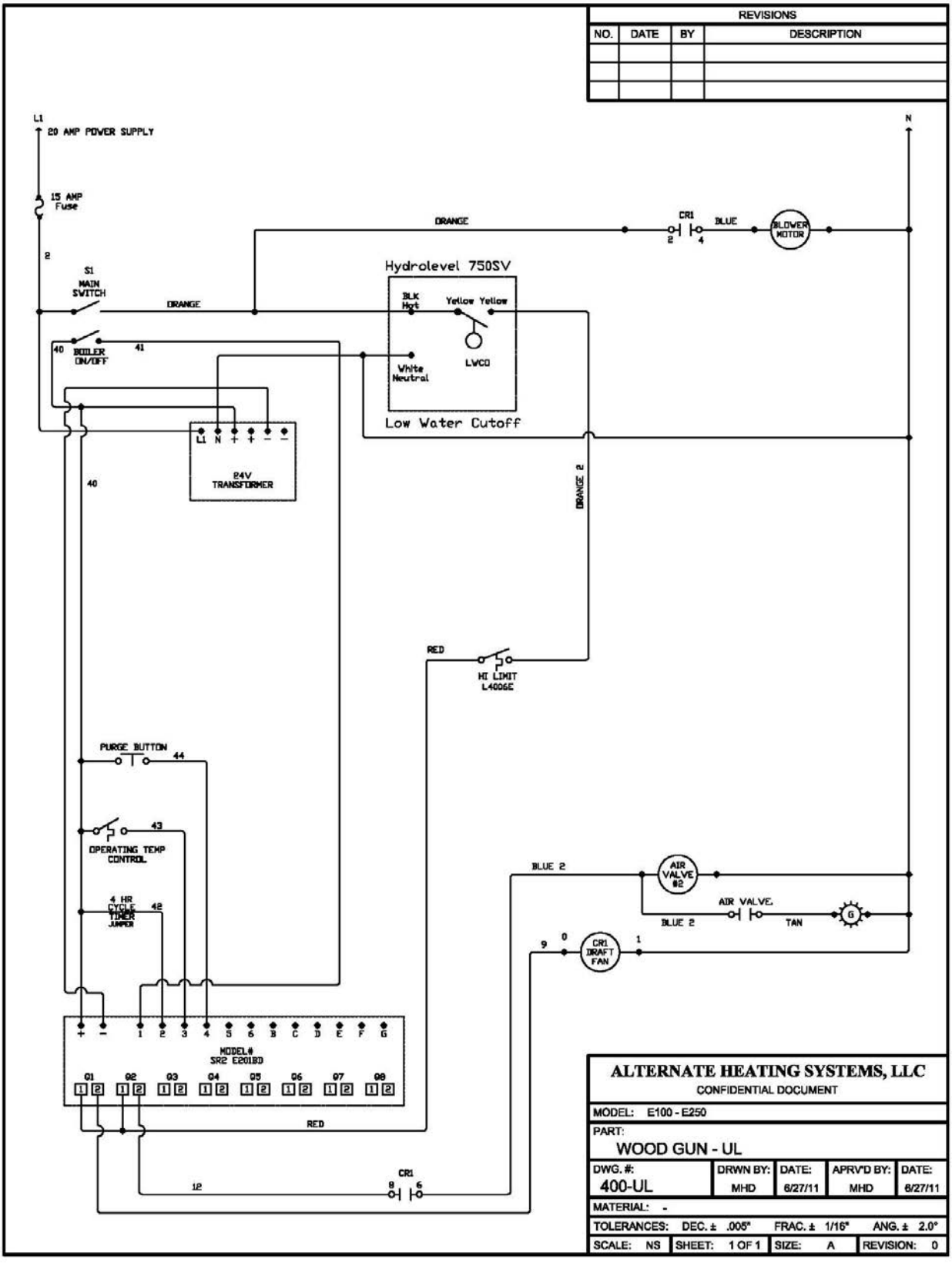
ALTERNATE HEATING SYSTEMS	
E100-E250	STEAM W/ OIL AUTO SWITCH OVER AND LOCKOUT ELECT. SCHEMATIC
MATL: SEE B-M	
SCALE: NTS	DRAWN BY: JTD — DATE: 12/22/08 — ACAD FILE:
CHECKED — DATE: — APPROVED — DATE:	SIZE: A — DRAWING: ELEC. SCHEM. — REV.: 0

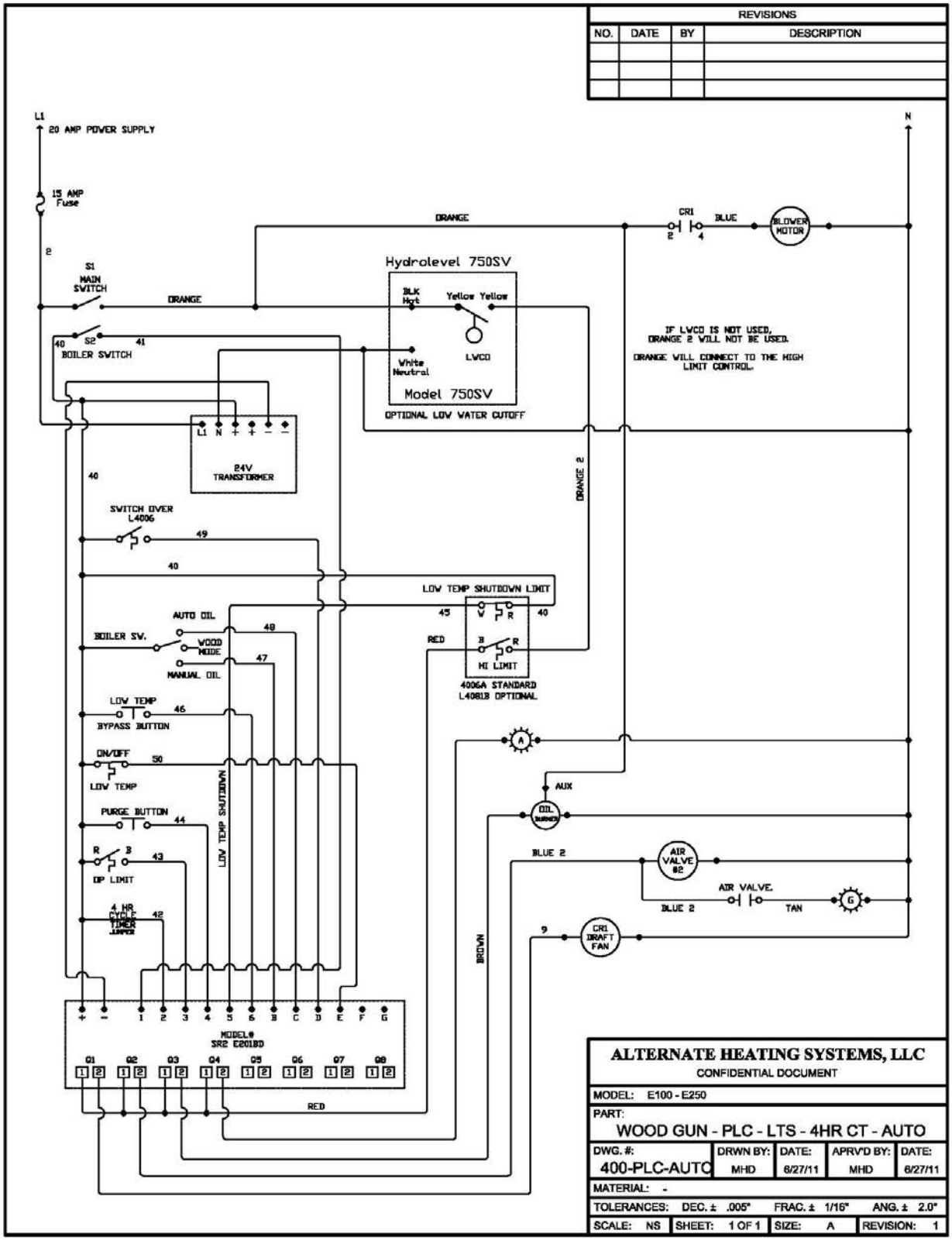
E-100 THRU E-250 WITH OIL AUTO SWITCH OVER, LOCKOUT, & LOW TEMP SHUTDOWN ELECTRICAL SCHEMATIC



TOLERANCES UNLESS OTHERWISE NOTED: DECIMAL: ANGULAR:	ALTERNATE HEATING SYSTEMS		
FRACTIONAL:	E100 THRU E250 WITH OIL AUTO SWITCH OVER, LOCKOUT & LOW TEMP SHUTDOWN		
SCALE: NTS	DRAWN BY: ELT	DATE: 8/26/09	PCB FILE: 400-OBA-LTS
SIZE: A	DRAWING: 400-OBA-LTS		REV: 1


REVISIONS
NO. DATE BY DESCRIPTION
L1
20 AMP POWER SUPPLY
15 AMP Fuse
N
ORANGE
CR1
BLUE
BLOWER MOTOR
Hydrolevel 750SV
S1 MAIN SWITCH
BLK Hot
Yellow Yellow
LWCO
White Neutral
Low Water Cutoff
40
BOILER ON/OFF
41
L1 N + + - -
24V TRANSFORMER
ORANGE 2
L4006A
45
40
LOW TEMP BYPASS BUTTON
46
RED
HI LIMIT L4006E
50
LOW TEMP ON/OFF
LOW TEMP SHUTDOWN
PURGE BUTTON
44
43
OPERATING TEMP CONTROL
4 HR CYCLE TIMER JUMPER
42
BLUE 2
AIR VALVE #2
AIR VALVE.
TAN
G
9
0
CR1 DRAFT FAN
1
+ - 1 2 3 4 5 6 B C D E F G
MODEL# SR2 E201BD
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8
RED
12
CR1
8
6
ALTERNATE HEATING SYSTEMS, LLC
CONFIDENTIAL DOCUMENT
MODEL: E100 - E250
PART: WOOD GUN - UL - Low Temperature Shutdown
DWG. #: 400-UL-LTS
DRWN BY: MHD
DATE: 6/27/11
APRV'D BY: MHD
DATE: 6/27/11
MATERIAL: -
TOLERANCES: DEC. ± .005" FRAC. ± 1/16" ANG. ± 2.0°
SCALE: NS
SHEET: 1 OF 1
SIZE: A
REVISION: 0


REVISIONS
NO. DATE BY DESCRIPTION
L1
20 AMP POWER SUPPLY
15 AMP Fuse
N
S1 MAIN SWITCH
ORANGE
CR1
BLUE
BLOWER MOTOR
Hydrolevel 750SV
BLK Hot
Yellow Yellow
LWCO
White Neutral
Low Water Cutoff
BOILER ON/OFF
40
41
24V TRANSFORMER
ORANGE 2
RED
HI LIMIT L4006E
PURGE BUTTON
44
43
OPERATING TEMP CONTROL
4 HR CYCLE TIMER JUMPER
42
BLUE 2
AIR VALVE #2
AIR VALVE.
TAN
CR1 DRAFT FAN
MODEL# SR2 E2018D
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8
12
ALTERNATE HEATING SYSTEMS, LLC
CONFIDENTIAL DOCUMENT
MODEL: E100 - E250
PART: WOOD GUN - UL
DWG. #: 400-UL
DRWN BY: MHD
DATE: 6/27/11
APRV'D BY: MHD
DATE: 6/27/11
MATERIAL: -
TOLERANCES: DEC. ± .005" FRAC. ± 1/16" ANG. ± 2.0°
SCALE: NS
SHEET: 1 OF 1
SIZE: A
REVISION: 0


REVISIONS
NO. DATE BY DESCRIPTION
L1
20 AMP POWER SUPPLY
15 AMP Fuse
N
ORANGE
CR1
BLUE
BLOWER MOTOR
S1 MAIN SWITCH
Hydrolevel 750SV
BLK Hot
Yellow Yellow
LWCO
White Neutral
Model 750SV
OPTIONAL LOW WATER CUTOFF
S2 BOILER SWITCH
IF LWCO IS NOT USED, ORANGE 2 WILL NOT BE USED.
ORANGE WILL CONNECT TO THE HIGH LIMIT CONTROL.
24V TRANSFORMER
ORANGE 2
SWITCH OVER L4006
LOW TEMP SHUTDOWN LIMIT
AUTO OIL
BOILER SW.
WOOD MODE
MANUAL OIL
HI LIMIT
4006A STANDARD
L4081B OPTIONAL
LOW TEMP
BYPASS BUTTON
ON/OFF
LOW TEMP
PURGE BUTTON
LOW TEMP SHUTDOWN
OP LIMIT
4 HR CYCLE TIMER JUMPER
AUX
OIL BURNER
AIR VALVE #2
AIR VALVE
BLUE 2
TAN
CR1 DRAFT FAN
BROWN
MODEL# SR2 E2018D
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8
RED
ALTERNATE HEATING SYSTEMS, LLC
CONFIDENTIAL DOCUMENT
MODEL: E100 - E250
PART: WOOD GUN - PLC - LTS - 4HR CT - AUTO
DWG. #: 400-PLC-AUTO
DRWN BY: MHD
DATE: 6/27/11
APRV'D BY: MHD
DATE: 6/27/11
MATERIAL: -
TOLERANCES: DEC. ± .005" FRAC. ± 1/16" ANG. ± 2.0°
SCALE: NS SHEET: 1 OF 1 SIZE: A REVISION: 1

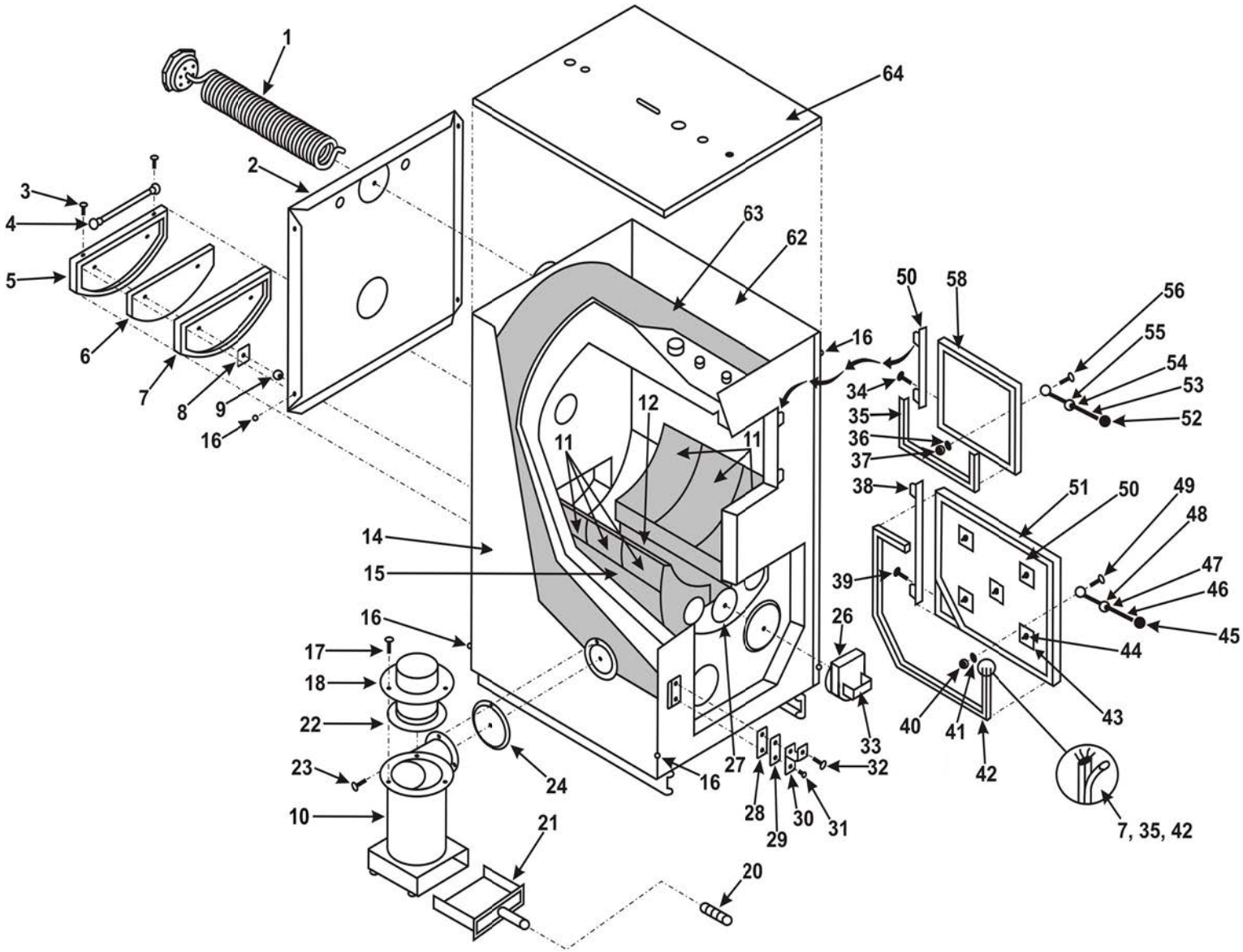
APPENDIX C: EXPLODED PARTS DRAWINGS

Appendix C: Exploded Parts Drawings

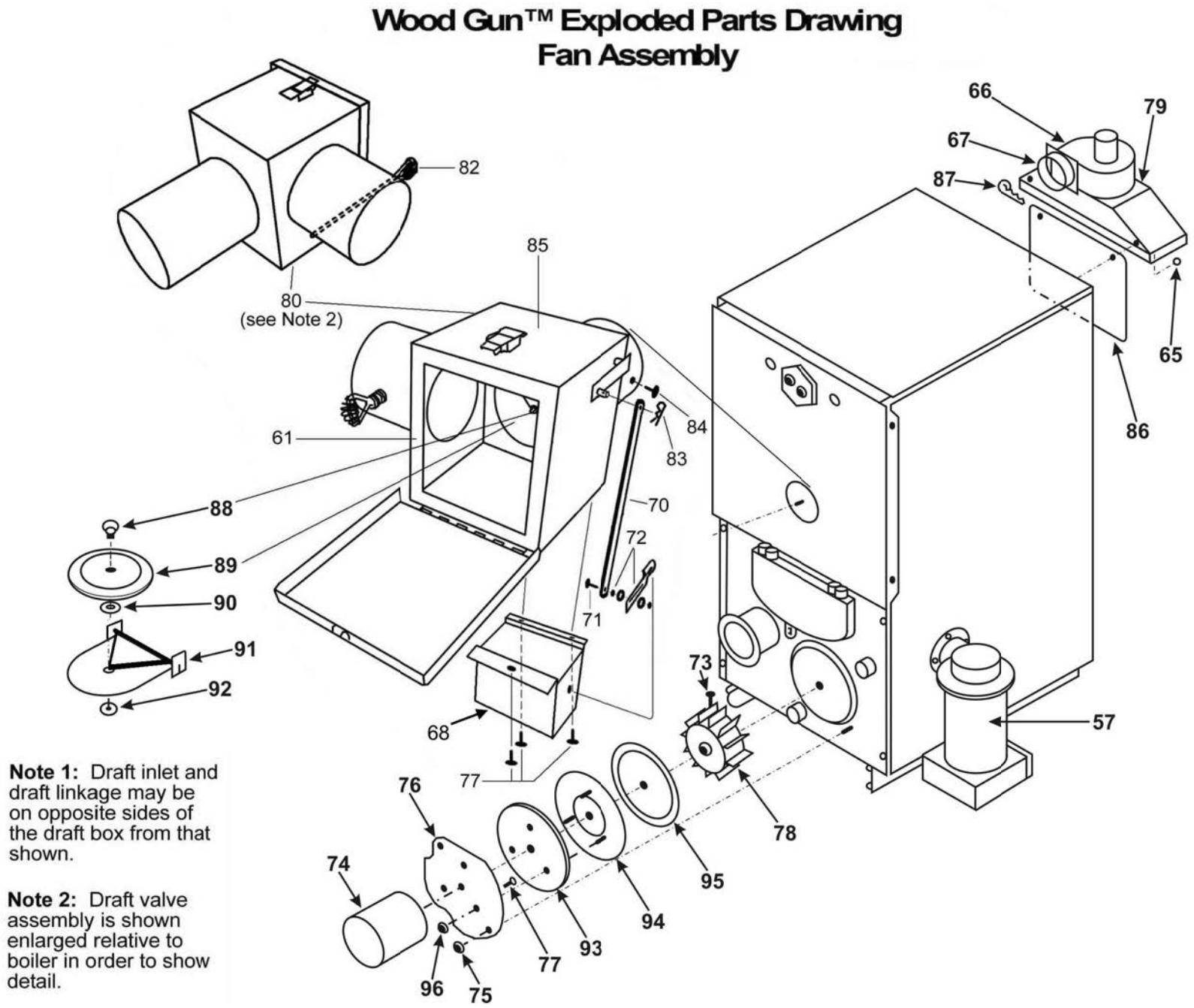
Note: Specifications subject to change without notice.

Note: Some parts shown are optional and may not be included with your system.

Wood Gun™ Exploded Parts Drawing



Wood Gun™ Exploded Parts Drawing
Fan Assembly



Note 1: Draft inlet and draft linkage may be on opposite sides of the draft box from that shown.

Note 2: Draft valve assembly is shown enlarged relative to boiler in order to show detail.

PARTS LISTING

(As Shown in Exploded Parts Diagrams)

1. Domestic Hot Water Coil
2. Rear Insulation Jacket
3. Rear Hinge Plate Mounting Bolt
4. Rear Hinge Plate
5. Rear Inspection door, complete
6. Rear Insp. Door Insulation Board
7. Door Gasket (5/8 in fiberglass rope and RTV silicone)
8. Insulation board Washer
9. Insulation Board Retaining Bolt
10. Cyclone Body
11. Refractory Side Bricks
12. Refractory Center Bricks
13. Model E100 Short Center Brick
14. Left Side Insulation Jacket
15. Ceramic Firebox Liner
16. Insulation Jacket Mounting Screws
17. Cyclone Flue Connector Mounting Bolts
18. Flue Connector Assembly
19. Unused
20. Ash Scoop rubber Grip
21. Ash Scoop
22. Cyclone Flue Connector Gasket
23. Cyclone Mounting Bolt
24. Cyclone Mounting Gasket
26. Center Plug – Replacement Ceramic Board
27. Ceramic Plug
28. Latch Shim (thick)
29. Latch Shim (thin)
30. Latch (specify door Req'd for)
31. Latch Mounting Bolt
32. Inspection Door Safety Stud
33. Refractory Center Plug, Complete
34. Load Door Hinge Plate Mounting Bolt
35. Door gasket (5/8 in fiberglass rope and RTV silicone)
36. Door Handle Washer
37. Door Handle Retaining Nut
38. Front Inspection Door Hinge Plate
39. Hinge Plate Mounting Bolt
40. Door Handle Retaining Nut
41. Door Handle Washer
42. Door Gasket (5/8 in fiberglass rope and RTV silicone
43. Insulation Board Washer
44. Insulation board Retaining bolt
45. Door handle Knob
46. Front Inspection Door Handle
47. ½ in Snap Ring
48. Door handle Roller
49. Handle Attachment Bolt
50. Front Insp. Door Insulation Board
51. Front Inspection Door, complete
52. Door Handle Knob
53. Load Door Handle
54. ½ in Snap ring
55. Door Handle Roller
56. Handle Attachment Bolt
57. Cyclone Assembly Complete
58. Load Door, complete
59. Load Door Hinge Plate
60. Draft Box Mounting Gasket
61. Draft Box Lid Gasket
62. Right Side Insulation Jacket
63. Fiberglass Insulation
64. Top Insulation Jacket

65. Exhaust Hood Attachment Bolts
66. Exhaust Hood Blower (wired)
67. Exhaust Hood Connecting Flange Assembly
68. Draft Motor with Mounting Bracket
69. Draft Motor Linkage Nuts
70. Draft motor Linkage
71. Draft Motor Linkage Bolt, Bottom
72. Draft Motor Arm Assembly
73. Fan Set Screw
74. Fan Motor
75. Fan Cover Retaining Nuts
76. Fan Cover Plate
77. Motor Mounting Bolts/Screws
78. Fan
79. Exhaust Hood, complete
80. Draft Valve Assembly, complete
81. Unused
82. Air inlet adjuster
83. Draft Linkage Pin
84. Draft Box Mounting Bolts
85. Draft Valve Cover Box, Complete
86. Smoke Flap
87. Smoke Flap Retaining Pin
88. Gasket Disk Mounting bolt
89. Gasket Disk
90. Gasket Disk Washer
91. Draft Flap assembly
92. Disk Retaining Nut
93. Fan Ceramic heat Shield
94. Abrasion Shield
95. Fan Assembly Mounting Gasket
96. Abrasion Shield Retaining Nut

APPENDIX D: 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.

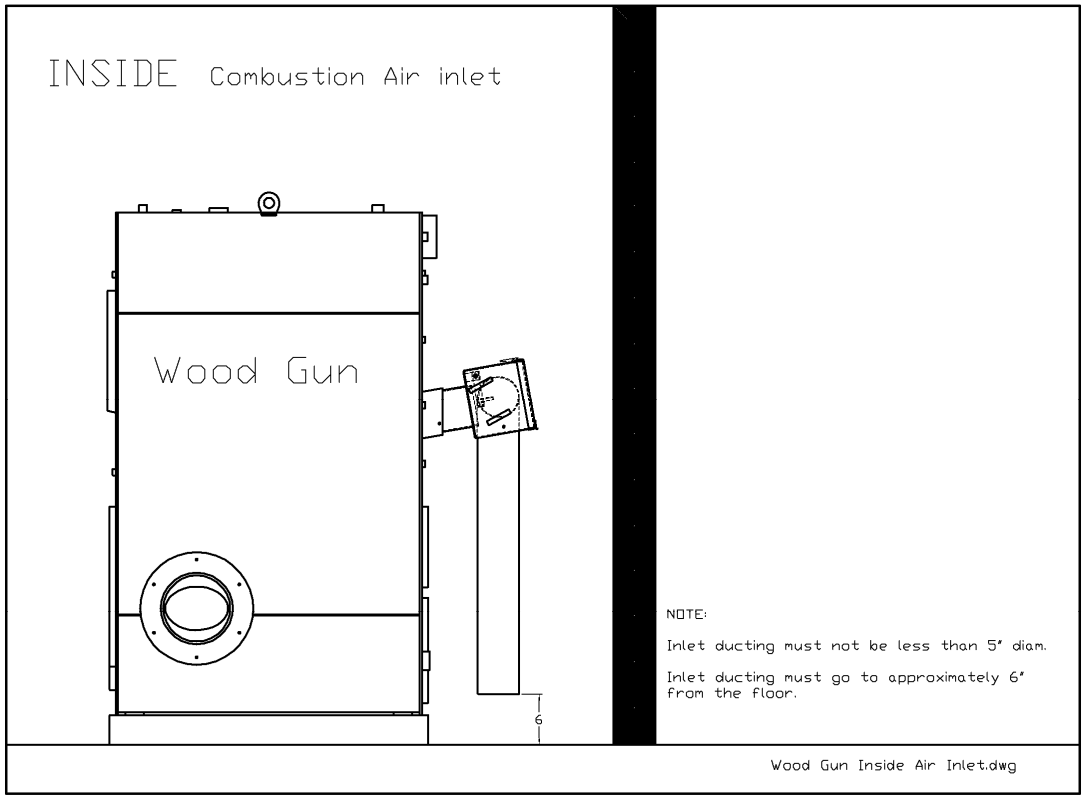
Problem	Possible Cause	Solution
1. Boiler Overheating	A. Control malfunction B. Incorrect control setting C. Intake air valve not closing properly D. Excessive chimney draft E. Load door not sealing properly	A. Replace malfunctioning control B. Adjust control setting C. Replace gasket or adjust linkage D. Reduce draft or see e) E. Adjust load door for proper seal, replace gasket if necessary
2. Back-puffing	A. Wood charge too large for heat load (back-puffing seen at end of burn cycle) B. Wood too small and/or excessively dry C. Improper loading of fire box D. Improper starting of wood	A. Fill with less wood B. Load larger fuel with higher moisture content C. Follow proper loading procedure 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. Ash 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. 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	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

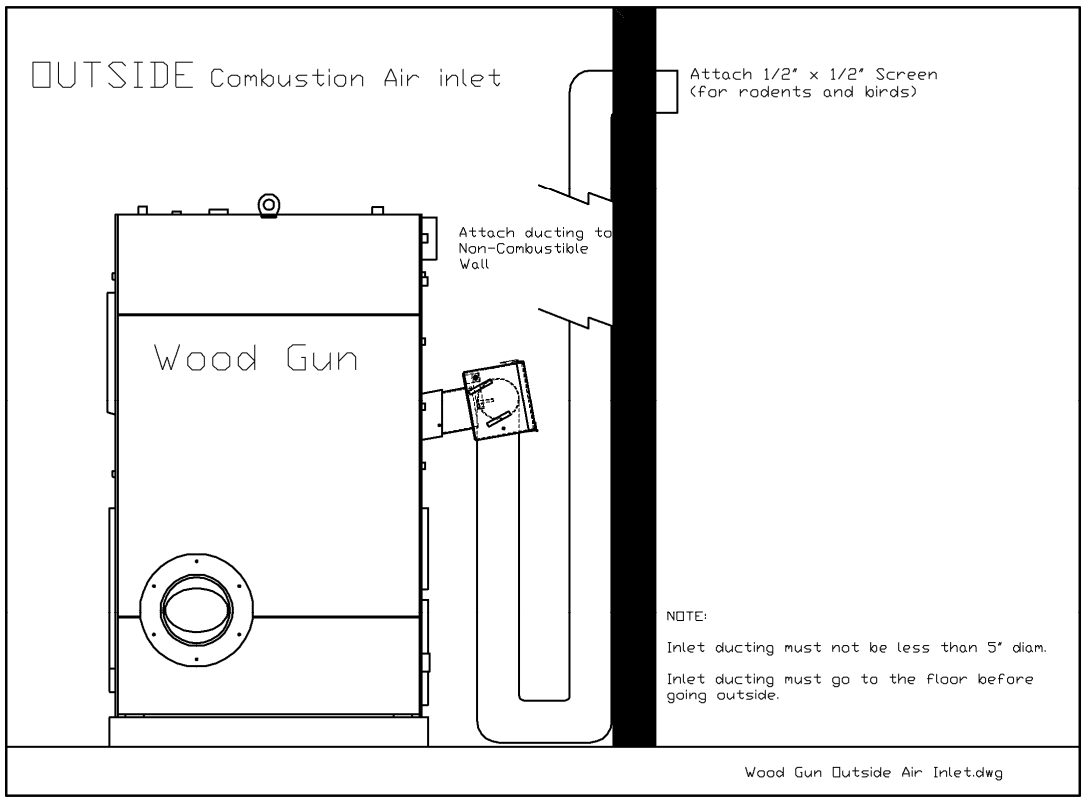
Problem	Possible Causes	Solution
7. Excessive water in the cyclone drawer	A. The stack temperature may not be high enough. B. The fire box is being filled too full for the heat demand. C. There may be a blockage in the flue, cyclone, heat exchanger, or refractory. D. The wood logs are too large and/or has high moisture content. E. Load door seal or air valve seal is leaking F. The boiler water temperature is too low. G. Water temperature difference between supply and return may be more than **20ºF**	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. C. Remove ash from fire box and refractory. Clean the heat exchanger, cyclone, or flue. D. Burn smaller wood, split wood, and/or dryer wood. Build a hotter fire. Remember that more wood does not always equate to more heat. E. Adjust load door, fix, or replace air valve. F. Raise the boiler operating temperature to 175-180 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 dryer wood. B. Try burning hard wood. C. Clean the heat exchanger.

Problem	Possible Causes	Solution
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. C. Replace or isolate the domestic coil.
10. There is smoke or creosote leaking out of air inlet connection.	A. The air valve assembly has been moved of knocked out of position.	A. Reposition and tighten the air valve and reseal the sleeve where enters the boiler. Be careful not to knock the air valve out of position when loading fuel into the boiler.
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 has very low moisture content. D. Load door seal or air valve seal is leaking E. The boiler water temperature is too low. F. 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. B. Only use small amounts of very dry wood.

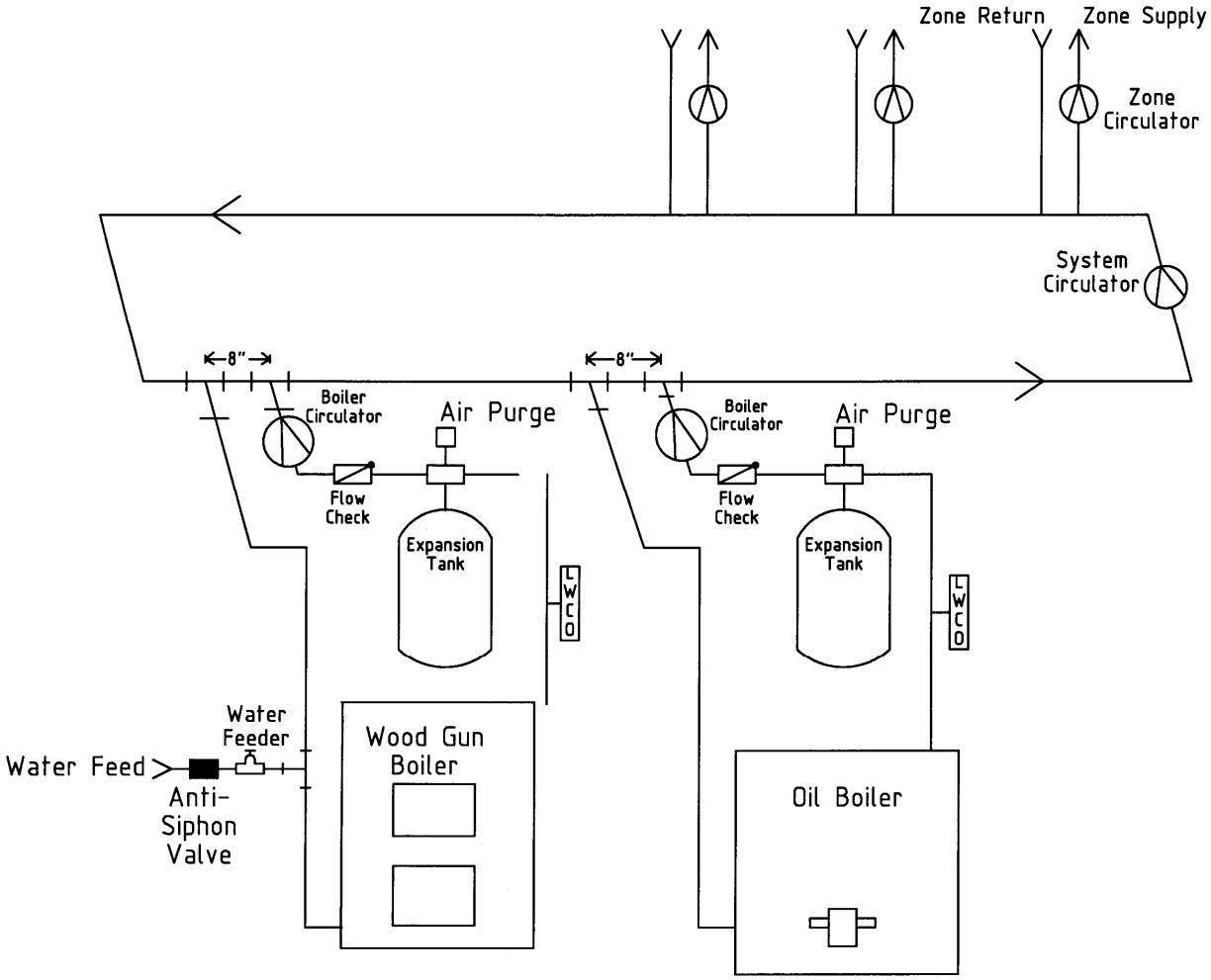
APPENDIX F: BOILER PIPING EXAMPLES

Wood Gun Air Inlet Ducting Installation





Wood Gun in Primary/Secondary System



Note:

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

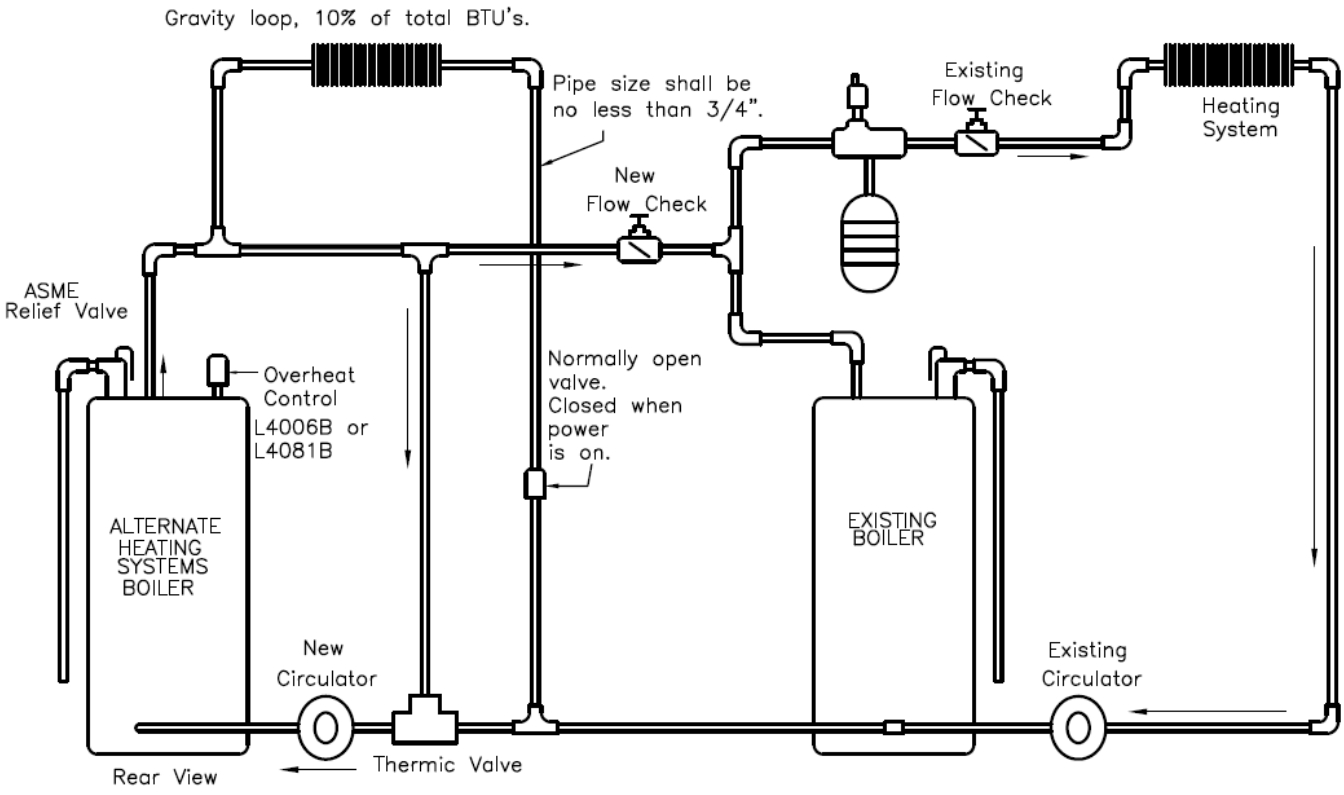
2. Each Boiler Circulator is also controlled by a low limit to prevent operation when the Boiler is cold.

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 Wood Gun™ 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 Wood Gun™ 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 E100 – E140. 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 Wood Gun. When power to the Wood Gun is on, the circulator should be running. An alternate option is to attach a strap on aquastat on the Wood Gun supply line that closes on temperature rise. This will automatically activate the pump at a given temperature. Overheat control (as pictured above) on the Wood Gun is optional

LIMITED WARRANTY

WOOD GASIFICATION BOILERS: E100 SF E140 SF E180 SF E250 SF

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.

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 <u>not</u> 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, LLC
1086 Wayne avenue
Chambersburg, PA 17201
(717) 261-0922

IMPORTANT: READ AND KEEP IN YOUR POSSESSION!

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