



Greenwood Hydronic Furnace

MODELS 100, 200, 300

Owner's Manual

**BE SURE TO READ THIS MANUAL AND KEEP IT NEAR THE FURNACE FOR
EASY REFERENCE**

For the latest information and manual for your Greenwood Furnace, refer to the "SUPPORT"
section of the Greenwood website: www.GreenwoodFurnace.com

*Greenwood furnaces are certified to meet UL-391-1995 and CAN/CSA B366.1-M91 standards
for safety for solid-fuel fired indoor heating appliances*



**OMNI-Test Laboratories, Inc.
Report #302-S-01-2**

V 4.1

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SAFETY CERTIFICATIONS

OMNI-Test Laboratories, the leading independent test laboratory for wood-burning products, has tested Greenwood's hydronic wood furnace and certified its compliance with:

- U.S. standards for solid-fuel and combination-fuel central and supplementary furnaces (ANSI/UL-391-1995)
- Canadian standards for solid fuel-fired central heating appliances (CSA B366.1-M91)

The Greenwood test report number from OMNI-Labs is 302-S-01-2.



OMNI-Test Laboratories, Inc.

Tested & Listed By Beaverton Oregon USA OMNI-Test Laboratories, Inc. Report #302-S-01-2	Manufactured By: Greenwood Technologies, LLC Seattle, Washington, USA Test Standards: UL 391-1995, CAN/CSA B366.1-M91 Test Dates: Serial #: _____																																
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EMISSIONS CERTIFICATIONS

The Little Orange Tag that Could Mean Big Things for You and Your Family.

The US Environmental Protection Agency (EPA) has begun a voluntary program to rate outdoor wood-fired hydronic heaters. Models with the orange tag meet EPA's Phase 1 emissions level for the program. Heaters with the orange tag have been tested by an EPA-accredited laboratory and are cleaner than other models.

Prolonged exposure to wood smoke has been linked to heart and lung health problems. By purchasing units with the orange tag, you may be reducing your family's health risk from exposure to wood smoke.



This scale represents the smoke emissions range for outdoor wood-fired hydronic heaters, and the orange arrow indicates the performance level of this particular model. Models with lower emissions produce less smoke and are less harmful to you, your family and the environment.

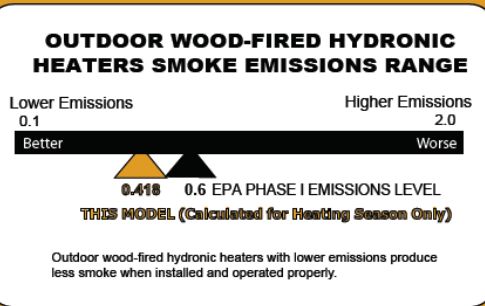
For more information about health and environmental effects from outdoor wood-fired hydronic heaters go to www.epa.gov/woodheaters.

FOR USE DURING HEATING SEASON ONLY U.S. Environmental Protection Agency 2007 Outdoor Wood-Fired Hydronic Heater Program

This Outdoor Wood-Fired Hydronic Heater has been tested and meets a certain air quality emissions level.*

By meeting this level this model is cleaner and pollutes less than those models that have not met this emissions level. Exposure to wood smoke has been associated with respiratory illness and other health problems. Models that have lower smoke emissions may reduce your family's risk.

For more information go to www.epa.gov/woodheaters



Calculated for Heating Season Use Only

MANUFACTURER:	Greenwood Technologies
MODEL NO.:	MODEL 100
8-HOUR HEAT OUTPUT RATING:	18,248 BTU/HR
EMISSIONS:	13.643 GRAMS/HR (Weighted Average) 0.418 LBS/MILLION BTU HEAT INPUT 0.863 GRAMS/HR / 10,000 BTU HEAT OUTPUT

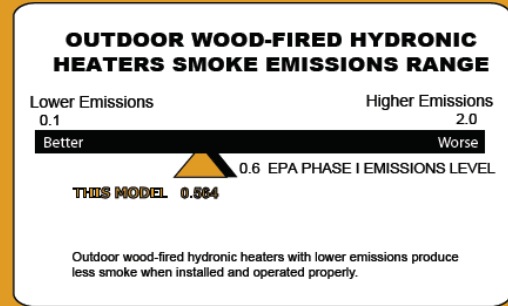
* - This model has been tested by an accredited independent laboratory according to the ASTM cordwood test method, i.e., the "cordwood exception" in lieu of EPA method 28 OWHH. This model qualifies under the U.S. EPA's Phase 1 Voluntary Program.

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For more information go to www.epa.gov/woodheaters



MANUFACTURER:	Greenwood Technologies
MODEL NO.:	MODEL 100
8-HOUR HEAT OUTPUT RATING:	15,205 GRAMS/HR (Weighted Average)
EMISSIONS:	0.564 LBS/MILLION BTU HEAT INPUT 2.046 LBS/MILLION BTU HEAT OUTPUT 1.090 GRAMS/HR / 10,000 BTU HEAT OUTPUT

* - This model has been tested by an accredited independent laboratory according to the ASTM cordwood test method, i.e., the "cordwood exception" in lieu of EPA method 28 OWHH. This model qualifies under the U.S. EPA's Phase 1 Voluntary Program.

INTRODUCTION

Congratulations on your purchase of this wood-fired hydronic furnace from Greenwood Technologies. With proper installation and maintenance, this US Environmental Protection Agency (EPA) Phase 1 emissions compliant furnace will provide years of low cost heat for your home.

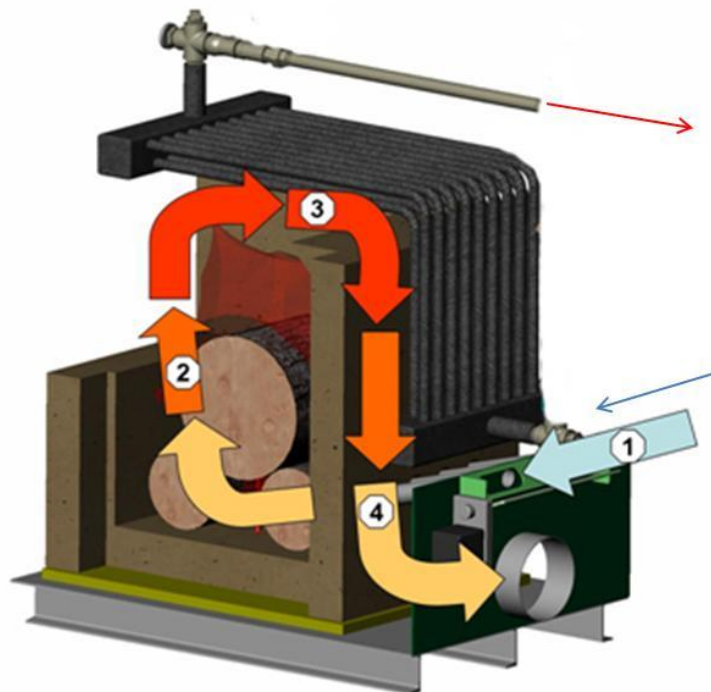
To insure correct installation and safe operation of your Greenwood hydronic furnace, you should:

1. **Hire a Greenwood approved licensed heating contractor** to install the furnace and integrate it with your heating system. This contractor should have experience with installation and operation of gas, oil, and solid fuel heating appliances and be familiar with local building codes, fire codes and other regulations.
2. **Read this manual** and learn how to safely operate and maintain your Greenwood furnace.

How the Greenwood furnace works

The Greenwood furnace produces few emissions and achieves a high level of heating efficiency because of its unique design. The ceramic firebox supports an internal temperature that allows the furnace to convert every bit of wood fuel into thermal energy. Then, the unique up and down draft flame path allows the heat exchanger to absorb the maximum possible energy from the superheated air. This simple, yet sophisticated design results in a highly efficient, clean burning furnace that will provide years of reliable, low cost heating for its owner.

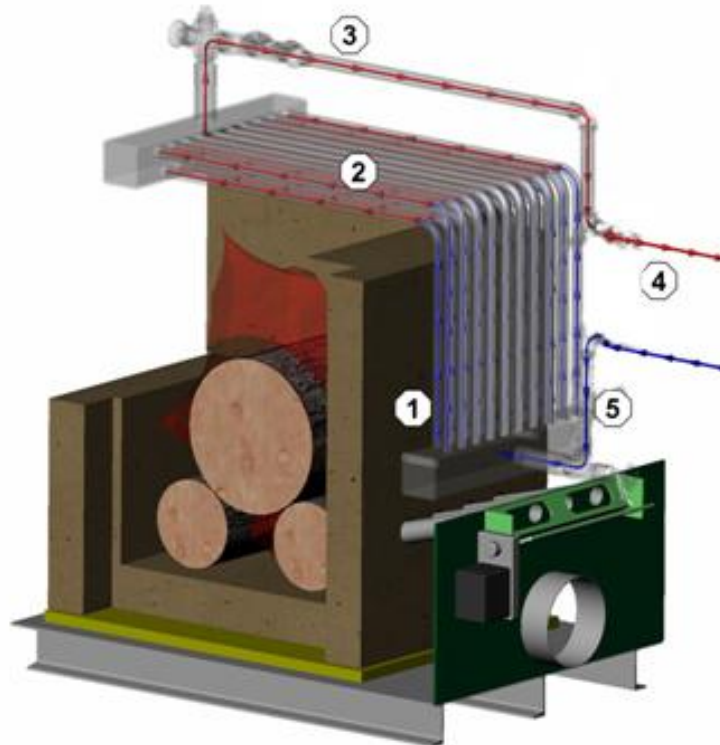
To understand how the Greenwood hydronic furnace works, we need to look at the flow of air and wood gases through the furnace and the transfer of heat from the superheated gases to the thermal transfer fluid circulating in the internal heat exchange manifold.



Air Flow through the Furnace

1. Heat from the burning fire draws fresh air into the furnace through a mechanically operated air intake manifold. An aquastat (a thermostat that works in water) opens and closes the damper to regulate the air entering the firebox and control the rate of burning.
2. As air flows through the firebox, its temperature rises to nearly 2000° F.

3. This superheated air rises upwards and then downward as it follows a path toward the furnace's exhaust vent. In the middle of this flame path is an internal heat exchange manifold with heat transfer fluid flowing through it. This fluid absorbs thermal energy from the superheated air.
4. By the time the exhaust air reaches the vent, most of its thermal energy has been absorbed, but there is still one last thing it does. Before exiting the furnace, the exhaust gas flows past the air intake tubes and preheats the incoming air. The final temperature of the escaping gas is only 350° F.



Fluid Flow through the Furnace

1. The Greenwood furnace uses a mixture of water and propylene glycol as a heat transfer fluid. Glycol is a non-toxic solution that works like the antifreeze in your car to prevent corrosion and freezing.
2. A pump pushes fluid through an internal heat exchange manifold located in the flame and exhaust path of the furnace, which absorbs heat from the combustion gases. The fluid exits the internal manifold at about 180° F.
3. The fluid flows past an aquastat (water thermostat) that regulates the burn rate of the furnace, to the home heating system.
4. The heated fluid provides warmth to your home, garage, basement and other structures; preheats your domestic hot water; and/or heats your pool.
5. Having transferred the heat to the home system, the fluid repeats its path through the internal manifold.

SPECIFICATIONS

Model:	Greenwood 100	Greenwood 200	Greenwood 300
Furnace Output (BTU/hour)	100,000 BTU	200,000 BTU	300,000 BTU
Heating Capacity *	Up to 4,000 ft ²	Up to 8,000 ft ²	Up to 12,000 ft ²
Furnace dimensions	32"w x 52"h x 48"d	42"w x 52"h x 48"d	52"w x 52"h x 48"d
Max log length (door width)	18 inches	28 inches	38 inches
Max log diameter (door height)	16 inches	16 inches	16 inches
Approximate Weight	2,350 pounds	3,000 pounds	3,700 pounds
Firebox Volume	19"w x 32"h x 24"d 8.4 cubic feet	29"w x 32"h x 24"d 12.9 cubic feet	39"w x 32"h x 24"d 17.3 cubic feet
*Heating capacity depends on many factors including home design, construction quality, insulation quality, local climate, type of wood burned, etc. Square footage based sizing is unreliable, always base sizing on sustained output and heat loss calculations.			

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INSTALLATION

Your Greenwood furnace should be installed by a Greenwood approved heating contractor who is thoroughly familiar with gas, oil, and solid fuel heating appliances. Also, be sure to comply with local building codes, fire codes and other regulations when installing the furnace.

Installation Requirements Summary Checklist

These are guidelines, please refer to appropriate manual sections for further details:

General

- Thoroughly read this entire manual and follow all instructions.
- Hire a licensed contractor with certified Greenwood installer training and experience in design and installation of hand-fired hydronic heating systems to install your Greenwood hydronic furnace.
- Use caution when moving this furnace. Greenwood furnaces weigh between 2,500 and 4,000 pounds and serious injury can occur if you do not have the proper equipment and experienced manpower available.
- Comply with local building codes, fire codes and other regulations when installing this furnace and observe minimum clearances to combustible surfaces.
- DO NOT** install the furnace in a mobile home or trailer. Instead, install the furnace outside in a covered enclosure and pipe the hot water into the mobile home.

Chimney and Venting

- Make sure to identify sources of make-up air in the room where the furnace is located. The Greenwood furnace, exhaust, fans and other appliances all draw air from the room. Be certain there is an adequate source of fresh air to offset these demands or you may create negative pressure in the room and starve the furnace of combustion resulting in draft problems in your flue.
- Connect the furnace to a properly installed and operating chimney and vent it to the outside. Use an approved masonry or a UL 103 HT and ULC S629 Listed Residential Type and Building Heating Appliance Chimney.
- DO NOT** vent the furnace to another room or inside a building. Install with a dedicated chimney only. **Do Not** share the chimney with another appliance. Be sure your chimney is safely constructed and in good repair. Before furnace installation, have the chimney inspected by a qualified inspector. **DO NOT** connect the furnace to an aluminum Type B gas vent
- DO NOT** operate the furnace with a draft of less than 0.05" WC (12.45 Pa) or more than 0.07" WC (17.44 Pa).

Plumbing and Controls

- Be sure to provide thermal spike protection for the furnace (see 'Wiring and Controls').
- Provide for loss of power by installing battery backup, fluid management tank, gravity dump zone, or other solution.
- As with all modern, high efficiency boilers, make sure that a 3 way thermostatic mixing valve set at 140° is properly installed to ensure that the temperature of water returning to the furnace is above 136°. This will prevent condensation that will lead to poor performance and potential damage.
- Ensure proper fluid flow rates through the Greenwood Furnace and Delta T (temperature differential) of 20°. Specified gallon per minute flow rates for the Greenwood Furnace models are: 10 gpm (Model 100), 20 gpm (Model 200), and 30 gpm (Model 300).

1. Unpack and inspect the furnace

When the furnace is delivered, inspect it for visible damage. If damaged, list the issues and date on the shipping document and ask the driver sign it. Check the packing slip for a list of items shipped with the furnace (some of the items will be found stowed inside the firebox). If you observe any damage or find any items missing, please you're your Dealer or Greenwood Customer Service for instructions (877-436-6191).

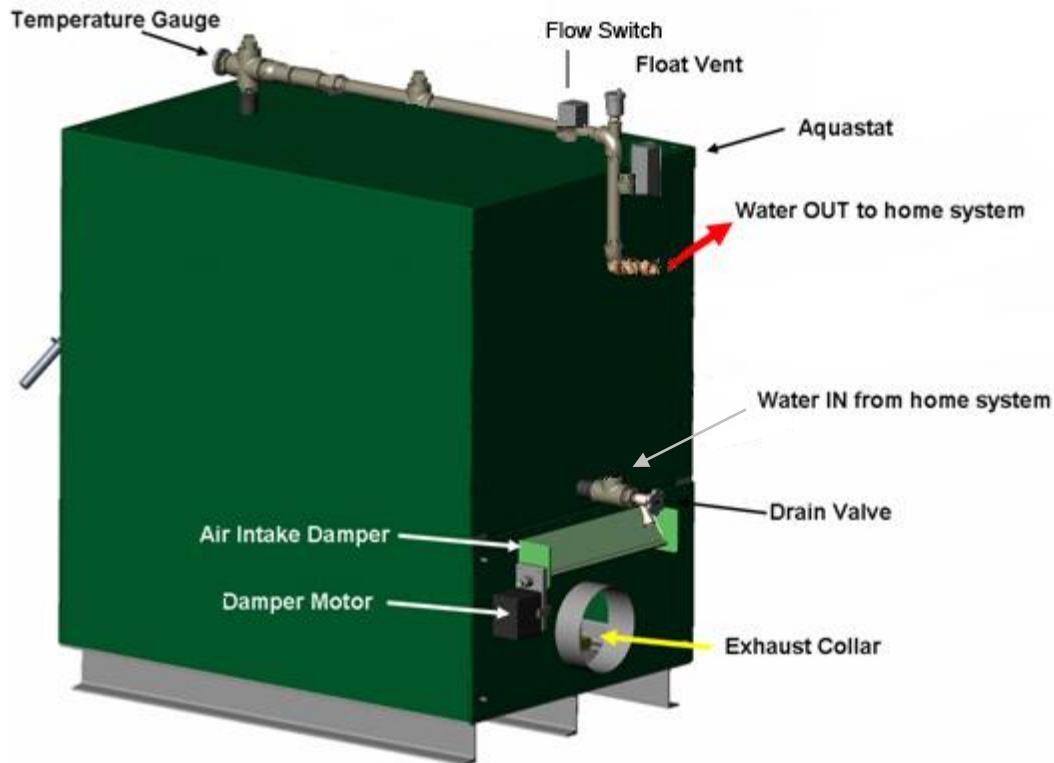
Each unit is wired for 115 volt operation and plumbed with a temperature gauge, aquastat, air vent, drain valve, and air intake damper motor.

Items packed inside the firebox include:

- Leather hearth gloves
- Owner's Manual
- Additional parts such strap-on aquastat or other items ordered with the furnace.

Additional parts required for system installation may arrive with the furnace or be shipped separately. These may include parts for an "Open System" or a "Closed System,"

Model 100 Greenwood Furnace



Note: This is a representative diagram of furnace components. Actual parts and configuration may vary. This diagram does not include standard installation components such as mixing valve, pressure release valve, pump, expansion tank, or balancing valve, etc.

2. Unloading and locating the furnace



CAUTION: These units are heavy! The Model 100 weighs about 2,450 pounds; the Model 200 weighs about 2,830 pounds; and the Model 300 nearly 3,700 pounds. Make sure you have proper equipment and sufficient manpower to prevent injury or damage when unloading and locating the furnace unit

When moving the furnace from the bottom, use a forklift with 5,000 lb or greater capacity and 5-6 ft. forks. Center the forks under the chassis, with the forks spread to minimize the overhang on either side. Move the loader as close to the furnace as possible without contacting the rack or the front of the loader. Pick the furnace up by keeping it level and lifting only as high as necessary to move the unit. Do not accelerate or stop the loader suddenly. Make slow and stable maneuvers with the furnace on the forks.



CAUTION: Never stand in the path of the load when lifting or moving the furnace, whether lifting from the bottom or the top.

When lifting the furnace from the top, use the two forged lifting eyes located at the top corners diagonal from one another. These eyes are rated for a straight pull, which means they are to be used in a VERTICAL LIFT ONLY. The use of a load spreader, or “strongback” is required to properly rig the furnace for top lifting. The lifting eyes must not be joined with slings or cables in any configuration that would pull and bend the lifting eyes, or in any load direction other than vertical. Failure to observe this safe lifting requirement could result in damage to the furnace or serious injury to personnel. Specified spreader bar lengths for Greenwood Models 100, 200, and 300 are 54”, 60”, and 67” respectively.



WARNING: If you are not a professional rigger or do not have experience with portable cranes, winches, hoists, or other lifting devices, and you have determined that a top lift is required to place the furnace in its installed location, you should use an equipment or machinery-moving company to set the furnace in its final location. If the furnace is dropped, the refractory ceramic firebox can be damaged. An experienced rigger can ensure that the furnace is safely lifted and set in place without damage.

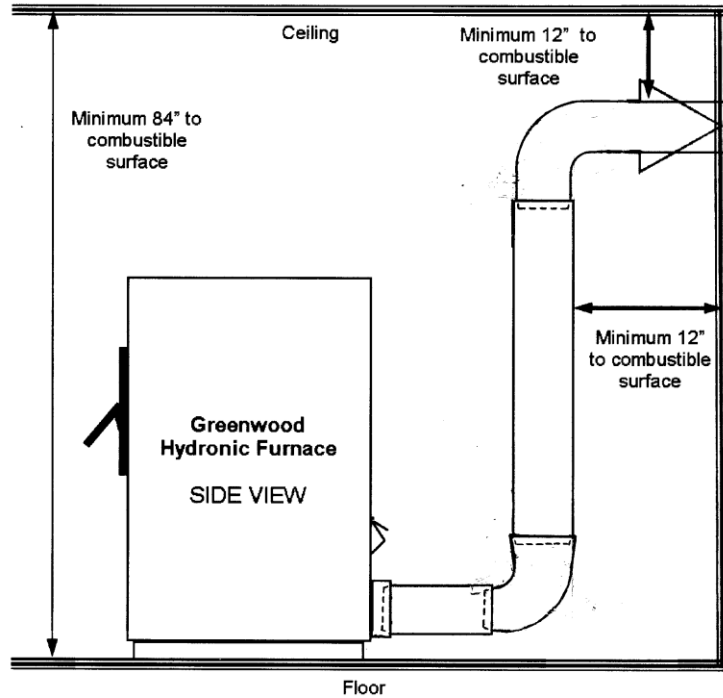
The Greenwood furnace is certified for safety as an INDOOR APPLIANCE, so you can install it in a walk out basement, shed, out-building or almost any location where the unit is sheltered from the weather and insulated from freezing intake air. **DO NOT** install this furnace in a mobile home or trailer. As with any furnace operated indoors, install a carbon monoxide monitor in the room where the furnace is installed.

NOTE: Installation must be completed in accordance with National Fire Protection Association (NFPA) installation standards No. 89M, 90B, 211, 70 (National Electrical Code) and Uniform Mechanical Code 913, 6-4 in states where applicable.

Place the furnace on a non-combustible surface, such as solid concrete or masonry. When deciding where to place the unit, consider the location of your chimney, access to electricity, and the convenience of retrieving and loading wood. In garages, the National Fuel Gas Code requires that the lowest point of ignition be elevated no less than 18 inches above the floor, except where furnaces are installed in separate, enclosed space and where combustion air is taken from outside the garage.

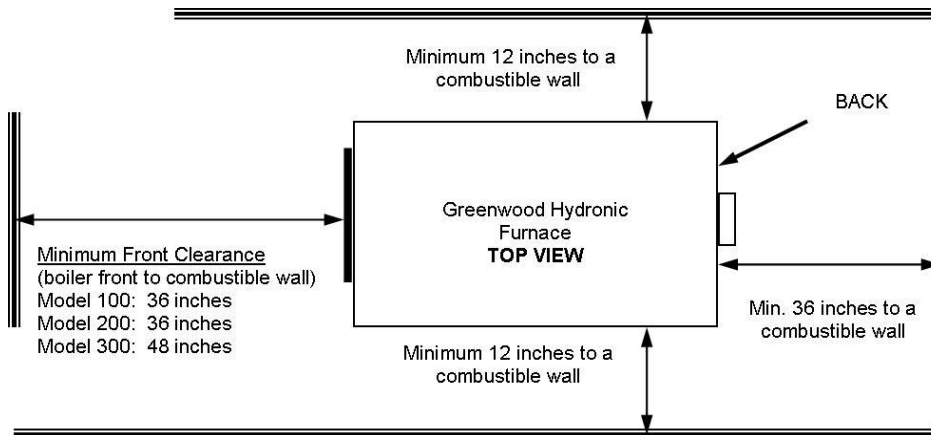
Check for clearances. Greenwood furnaces are tested to UL (Underwriters Laboratories) and CSA (Canadian Standards Association) standards of safety for indoor appliances. As a result, you can install your furnace with a minimum separation between the furnace and combustible surfaces. The following table and illustrations show the minimum clearances to combustible materials.

Minimum Installation Clearances (Side View)



Note: If using 24 gauge flue piping instead of metalbestos or double/triple wall flue material, a minimum 18" between flue pipe and back wall is required.

Minimum Installation Clearances (Top View)



Minimum Clearance to Combustible Materials

Furnace Face	Min Clearance ¹	Notes
Right and left sides	12 inches (30 cm) (all models)	
Rear	36 inches (90 cm) (all models)	Includes allowance for flue
Front	36 inches (90 cm) (Model 100/200) 48 inches (120 cm) (Model 300)	Allows firebox door to fully open
Top	33 inches (85 cm) (all models)	
Bottom	0 inches (0 cm)	Use non-combustible surface

¹Minimum distance from a combustible surface

NOTE: Installation of this furnace must comply with the latest edition of NFPA 211 for reduced clearances and/or your local building code rulings (use whichever minimum dimensions are LARGEST).

3. Install the chimney flue

Refer to the “CHIMNEY INSTALLATION” section for detailed instructions. Proper installation of the chimney flue is critical to the performance of your Greenwood furnace. The majority of problems encountered after installation are attributable to a flue that is improperly sized or otherwise provides inadequate draft to the furnace.

NOTE: The draft of the chimney flue must be .05” to .07” W.C. (12.45 to 17.44 Pa) measured near the exhaust collar of the furnace. There must also be adequate sources of make-up air for the room where the furnace is installed. See “CHIMNEY INSTALLATION” instructions for more information.

4. Plumb the furnace

You can plumb your Greenwood furnace to meet almost any heating need in the home. You can:

- Supplement an existing hydronic or forced-air central heating system,
- Produce domestic hot water;
- Heat your home, greenhouse, garage, outbuilding, basement or swimming pool.

NOTE: Proper plumbing of your Greenwood furnace requires the expertise of a plumber or HVAC professional that is Greenwood approved.

Plumb the furnace for either open system or closed system operation (see ‘PLUMBING INSTALLATION’ section). The furnace is leak-tested at the factory during final assembly, and the heat transfer fluid drained for shipment. The recommended fluid solution is a mix of 30% propylene glycol to 70% water, unless you are located in a very cold climate, or you plan to leave the furnace unused for a long period of time. A 30% solution of propylene glycol is adequate to lower the freezing point to 7° F and raise the boiling point to 217°F.



CAUTION: DO NOT use ethylene glycol-based (automotive antifreeze) coolant in your Greenwood Hydronic Furnace or in your home’s heating system. Always use **propylene glycol**-based coolants rated for a heat application. If your local HVAC supplier does not have this material, Greenwood Technologies will help you find a local source. Do not use any coolant other than **propylene glycol**. This solution is non-toxic to animals and humans.



CAUTION: Be careful not to spill fluid on the top of the furnace. It could leak around the fill port and saturate the firebox insulation inside. Wrap a towel or other absorbent material around the fill port to catch any spills.

5. Wire the furnace

Your Greenwood furnace arrives pre-wired for 115 volt, 60-cycle operation. The basic wiring consists of plugging the power cord into an available outlet or, if required by local code, a dedicated 20-amp circuit with a circuit protector device located in a convenient place near the furnace.

Additional wiring is required by your installer to integrate the furnace into your existing home heating system. See the “WIRING AND CONTROLS” section for more information.



WARNING: All electrical wiring for your Greenwood furnace must conform to the National Electrical Code and all local building codes and ordinances. Turn off electric power at the circuit protector box before making any line voltage connections. Do not plug the furnace in until the furnace is fully installed and the proper fluid has been added.

CHIMNEY INSTALLATION

A chimney performs two functions: it removes smoke and flue gases from the furnace, and it provides “draft” for the fire. Draft is the term used to describe the suction that occurs when hot air rises and creates a vacuum in the firebox. That vacuum draws fresh air into the firebox and feeds combustion of the wood. No furnace can operate properly without adequate draft.

NOTE: The Greenwood Furnace requires draft measuring between .05” and .07” WC (water column) (12.45 – 17.44 Pascals), measured with a manometer or similar device. Draft of less than .05” will starve the fire of oxygen and cause it to burn dirty (i.e., produce smoke and creosote). Draft of more than .07” will feed too much oxygen to the fire, causing it to over-fire and burn at less than optimum efficiency. Draft should be measured with a manometer following the prescribed warm up period. For specific measurement guidelines, see p. 18 ‘Measuring and Adjusting the Draft of the Flue.’

NOTE: The following instructions are guidelines only. A qualified HVAC contractor should determine the specific chimney requirements for your furnace installation and insure that it complies with local building codes and ordinances.

Flue Size

The chimney flue is a vital part of your furnace installation. A properly built and maintained masonry chimney or factory-built flue will assure a consistent draft under a variety of weather conditions.

NOTE: The furnace must connect to a code-approved masonry chimney with a flue liner or an appropriately sized factory-built chimney, which complies with requirements for Type HT (High Temperature), all fuel chimneys in the standard UL 103 or CAN/ULC-S629.

Flue Diameter

The outlet collar on all Greenwood furnace models is 8 inches. The model number of your Greenwood furnace determines the minimum size of the connector pipe and flue. **For the Model 100 and 200 Greenwood furnaces, a flue reducer is required to connect the 8-inch outlet collar to the appropriately sized connector pipe.**

Furnace	Min Flue Diameter
Model 100	6 inches (150mm)
Model 200	7 inches (180mm)
Model 300	8 inches (200mm)

Flue Height

The flue must be tall enough to draw, which typically means at least 12-15 feet tall (3.66m) [note: Add one foot (0.3m) to this minimum for each 1000 feet above sea level]. If you cannot control the height of the flue, it may be necessary to install a draft inducer fan (see “Measuring and Adjusting the Draft” later in this section).

Connecting to an Existing Chimney Flue

You may connect the Greenwood furnace to an existing flue or chimney subject to the following conditions:

1. A qualified professional has inspected, repaired (if necessary), thoroughly cleaned and determined the chimney is suitable for use with a residential heating appliance that burns solid fuel.
2. If possible, avoid using exterior chimneys (i.e., a chimney with one or more walls exposed to the outside below the roofline). If it is necessary to use an **exterior** chimney, the chimney flue size area must not exceed two times the minimum flue area for the furnace. If an **internal** chimney is used, the chimney flue size area must not exceed three times the minimum flue area for the furnace.

Furnace	Min Flue Diameter	Max Flue Area Internal Chimney	Max Flue Area External Chimney
Model 100	6 inches (15 cm)	85 in ² (177 cm ²)	56 in ² (116 cm ²)
Model 200	7 inches (18 cm)	116 in ² (241 cm ²)	77 in ² (160 cm ²)
Model 300	8 inches (20 cm)	151 in ² (314 cm ²)	101 in ² (208 cm ²)

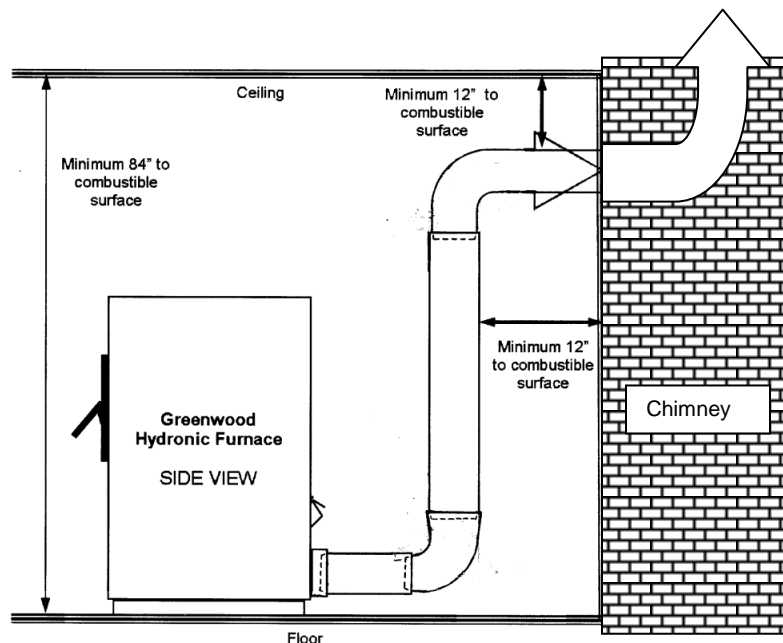
3. If your chimney flue exceeds the maximum area allowed, it must be lined with a suitable flue liner that complies with the requirements of Chapter 11 of NFPA 211 3-1.2 -- Standards for Chimneys, Fireplaces, Vents and Solid Fuel-Burning Appliances.
4. The chimney or flue should be at least 12 feet tall and sized correctly for the Greenwood Furnace model installed.
5. Do not share a flue with another furnace, appliance or fireplace. Do not use a flue that already provides make-up air to the cellar or basement.
6. Tightly close the cleanout opening in the base of the chimney.

Connector Flue Pipe

The connection between the furnace and the chimney must be at least 24-gauge stovepipe and elbows (not included with furnace). Maintain a clearance of at least 12 inches between the connector and combustible surfaces as shown on the following illustration.

Minimum Installation Clearances (Side View)

Note: If using 24 gauge flue piping instead of metalbestos or double/triple wall flue material, a minimum 18" between flue pipe and back wall is required.



Note: If it is necessary to use an **exterior** chimney, the chimney flue size area must not exceed two times the minimum flue area for the furnace. If an **internal** chimney is used, the chimney flue size area must not exceed three times the minimum flue area for the furnace.

Chimney Installation

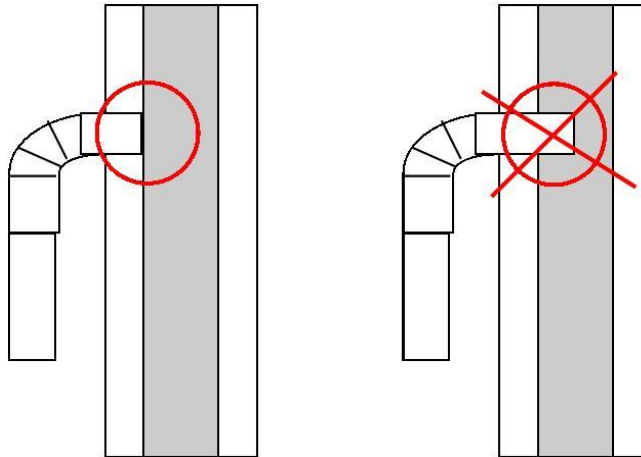
NOTE: Installation of this furnace must comply with the latest edition of NFPA 211 for reduced clearances and/or your local building code rulings -- use whichever minimum dimensions are LARGEST.

Observe the following rules when installing the connector pipe.

1. Where possible, use only corrugated (non-adjustable) elbows. These are more airtight and less likely to break. Use 90-degree elbows only as required and never more than two (they reduce the draft of the chimney).
2. Make sure all horizontal runs of connector pipe have a minimum outward rise of 1/4" per horizontal foot.
3. If the connector stovepipe must go through a combustible wall before entering the masonry chimney, consult a qualified mason or chimney dealer. The installation must conform to local building and fire codes and latest edition of NFPA 211.
4. Insert the crimped end of the stovepipe inside the furnace outlet collar. Install additional pipe and elbows with the crimped end towards the furnace.
5. Seal the connector pipe to the chimney with furnace cement.
6. Securely support the connector pipe and fasten joints with a minimum of three sheet metal screws or rivets per joint.
7. In all cases, follow the chimney manufacturer's instructions for installation.

When attaching the connector pipe to the chimney, do not push it into the chimney (it may plug the chimney and impede the draft). The following illustration shows proper installation.

Installation of the Connector Pipe into an Existing Chimney



Using a New Factory-made Chimney

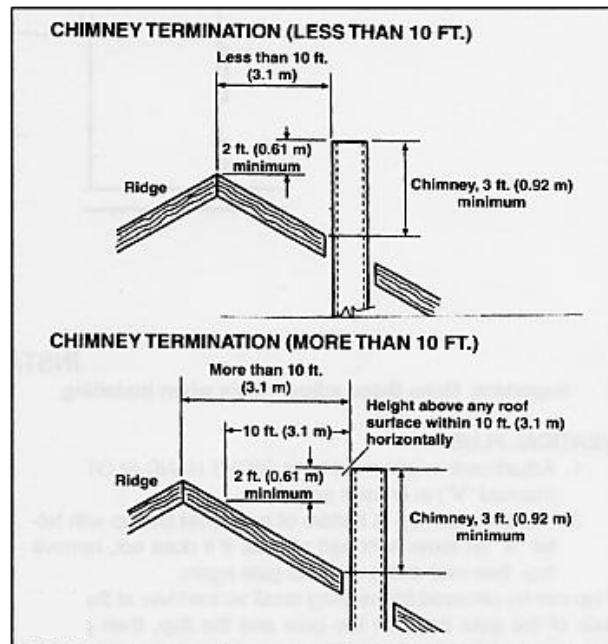
A properly sized and installed chimney flue will ensure adequate draft at all times for optimum performance of the furnace. For a new chimney, use an insulated stainless steel system that conforms to type HT (High Temperature) requirements of UL 103 and ULC S629 and complies with the requirements of Chapter 11 of NFPA 211, Standard for Chimneys, Fireplaces, Vents and Solid Fuel-Burning Appliances.

The factory-made chimney can be routed straight-up through the roof or routed through a side-wall and then straight-up. The chimney must be at least 12-15 feet tall (add 1 foot for each 1000 feet above sea level) and correctly sized for the Greenwood Furnace model installed.

Furnace	Min Flue Diameter
Model 100	6 inches (15 cm)
Model 200	7 inches (18 cm)
Model 300	8 inches (20 cm)

NOTE: Solid wood burning furnaces should not be side vented.

When installing a new chimney flue, be sure to observe local building codes and the National Fire Protection Association rule: The top of the chimney must extend at least 3.0 feet (0.9m) above the highest point where it exits the roof and be at least 2.0 feet (0.6m) taller than any point of the roof within 10.0 feet (3.04m).



Supplying Make-up Air

Fireplaces, other furnaces, clothes dryers, exhaust fans, and other appliances, all draw air from the room in which they are located. The Greenwood Furnace adds to that draw, so it is important to make sure there is an adequate source of fresh air to offset these demands. Otherwise, you may create negative pressure in the room and starve combustion in the furnace. Intake air temperature should be 40°F or above to prevent condensation and creosote on the air intake tubes.

To determine the requirement for makeup air:

1. Determine the volume of space (cubic feet) in the room. Include in the calculation adjacent rooms and areas not closed-off by doors.

$$\text{Volume (CF)} = \text{Length (ft)} \times \text{Width (ft)} \times \text{Height (ft)}$$

Chimney Installation

2. Determine the fuel input requirements of all appliances in the space. Add them and round the total to the nearest 1000 BTU per hour.
3. Determine whether the space is “confined” or “unconfined” by dividing the total volume of the room by the total fuel input requirement for all appliances in the room.
 - a. If the result is greater than or equal to 50 CF/1000 BTU per hour, then consider the space “unconfined.”
 - b. If the result is less than 50 CF/1000 BTU per hour, then consider the space “confined.”
4. For an “unconfined” space in a conventionally constructed building, the fresh air infiltration through cracks around windows and doors NORMALLY provides adequate air for combustion and ventilation, so no additional make-up air is required.
5. For a “confined” space or an “unconfined” space in a building with unusually tight construction, an additional source of make-up is required. Please refer to the table on the right and consult an HVAC professional to determine the best way to supply make-up air for your installation.

Required Makeup Air

Confined Space	
Model 100	<5000 Ft ³
Model 200	<10,000 Ft ³
Model 300	<15,000 Ft ³
Open Area	
Model 100	24 In ²
Model 200	48 In ²
Model 300	72 In ²
Screened Vent Area *	
Model 100	60 In ²
Model 200	120 In ²
Model 300	180 In ²
Filtered Vent Area	
Model 100	120 In ²
Model 200	240 In ²
Model 300	360 In ²

Measuring and Adjusting the Draft of the Flue

Draft is a function of the chimney flue, not the furnace. The natural draft generated through a chimney is dependent on several factors including chimney height, temperature of flue gases, cross-sectional area of the chimney, chimney wall insulation value, dilution air, and total volume of flue gases.

To operate properly, **the Greenwood furnace requires a draft of .05” to .07” WC** (water column) (12.45 – 17.44 Pa). Symptoms of an improperly designed or installed flue include visible smoke out the chimney, smoke escaping into the room, creosote buildup in the flue, and/or poor heating performance.

The following procedure describes how to measure draft using a manometer. (You purchase or rent a manometer from a local stove and hearth retailer or local equipment rental shop.)

1. Close all windows and doors in the building and turn on all appliances that remove air from the home (e.g., heat pump, air conditioner, exhaust fan, clothes dryer, fireplaces, etc.).
2. Drill a hole in the connector pipe (just large enough for the tube of the manometer) at least 1 foot above the furnace outlet collar.
3. **After all chimney connections, plumbing and wiring is complete**, build a fire and allow the furnace to settle into stable operation. If the boiler has been installed in conjunction with a Type A flue pipe, take the draft reading after 1 hour. For all chimneys other than Type A flue pipe, take the draft reading after 2 hours.
4. Using the manometer, measure the draft in the flue.
 - a. If the draft measurement is below .05” WC (12.45 Pa), there is too little draft and a draft inducer or other corrective measures are required to avoid air-starvation of the furnace. A

Chimney Installation

draft inducer fan (see picture on next page) mounts in the connector duct and adjusts to increase the draft of the flue. These devices can be purchased on-line or at a local HVAC supply center.

- b. If the draft measurement is above .07" WC (17.44 Pa), there is too much draft and a mechanical damper is needed to avoid over-firing of the furnace. This device also mounts in the connector duct and adjusts to reduce the draft.
5. Once needed adjustments are complete, seal the hole made for the manometer tube with furnace cement or a screw.

NOTE: Greenwood recommends use of a draft inducer during fuel reloading. The draft inducer provides extra draft that offsets reduced secondary combustion and minimizes the back-draft of smoke that can occur during re-loading. Many people use a wind-up timer that runs the fan for a few minutes during and after feeding. Except for these brief periods of reloading, running a draft inducer is not recommended for most installs. Natural draft will work well in most cases. To avoid over-firing the furnace, do not set a draft inducer fan to pull a draft of more than .07" WC (17.44 Pa).

Adjustable Draft Inducer Fan (Model AD-1) (Available on-line or at a local HVAC supply center)



References

Sources of Equipment*

1. Draft Inducer (Model AD-1): local building supply store or <http://www.draftinducers.com/index.htm>
2. Chimney flue components: local building supply store or <http://www.ventingsystems.com>
3. Other Chimney products: <http://www.chimneys.com/index.html> and <http://www.jacksonsystems.com>

More Information

1. Chimney Safety Institute of America (www.csia.org)
2. All About Chimneys (www.chimneys.com)
3. National Fire Protection Association (www.nfpa.org)
4. American Society of Mechanical Engineers (www.asme.org)

*Note – Greenwood Technologies provides these supplier references for your convenience only. We do not endorse the vendor, the equipment they sell, or their prices. Other suppliers may offer similar or identical components and we encourage you to comparison shop.

PLUMBING INSTALLATION

The Greenwood furnace is a clean-burning, high-efficiency, wood-fired furnace. It provides a steady flow of high-temperature heat transfer fluid to various devices in your hydronic heating system, including hot water tanks and heaters, baseboard or free-standing radiators, radiant panels, in-floor radiant heat loops, and many other devices. You can supplement an existing hydronic or forced-air central heating system; produce domestic hot water; heat your greenhouse, garage, basement, outbuilding, and/or swimming pool.

The furnace can be installed in either a “closed system” or “open system” configuration. A “closed system” configuration means the circulation system is sealed and closed to atmospheric pressure. An “open system” configuration means that the circulation system is open to atmospheric pressure.

Q: should I connect my system as an open system or closed system?

A: It is always best to install the Greenwood hydronic furnace as a closed system, if allowed by local codes and your local inspector. Some jurisdictions require ASME certification for closed systems. ASME is a test method and certification for boilers provided by the American Society of Mechanical Engineers. The Greenwood Furnace, while having the welds on the heat exchanger, is not ASME rated. This is also the case with most other wood-fired residential boilers. It is always best to check with your local code enforcement agent to see if they will allow you to operate your boiler as a closed system. Advantages of operating as a closed system are:

- 1) Higher boiling points when pressurized.
- 2) Mostly oxygen free system -- the combination of oxygen and iron creates a reaction that produces iron-oxide that can settle in the heat exchange manifold.

In the event that your inspector requires that you pipe the boiler as an open system, you will be operating under 0 PSI, also known as atmospheric pressure.

Q: When should I use a Flat Plate Heat Exchanger?

A: Flat plate heat exchangers are used to transfer heat between one circulation system and another. A flat plate heat exchanger is needed to:

1. separate pressure differences.
2. separate fluid differences.

Whether to use a heat exchanger in closed systems will depend on the pressure and fluid differences in your specific heating system. Greenwood recommends always using a heat exchanger with open systems.

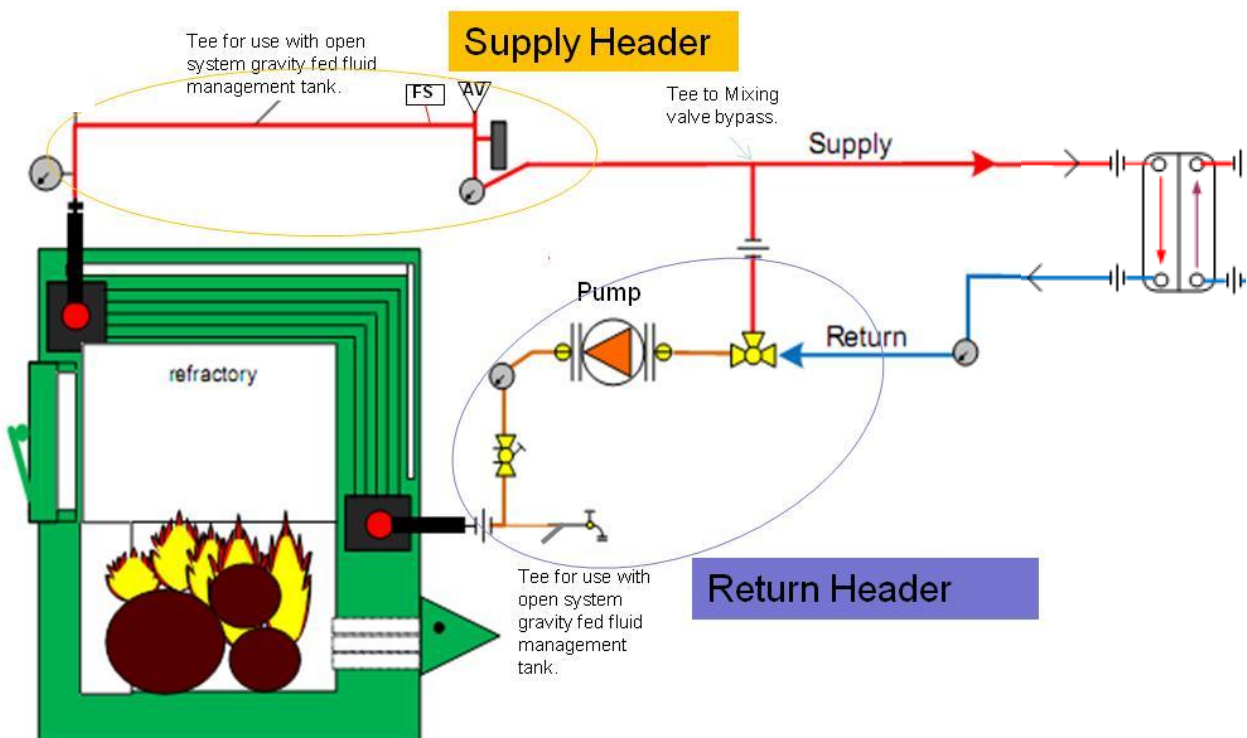
NOTE: The Greenwood furnace operates independently or as an add-on to an existing central furnace or boiler. If used as an add-on, the home system must be in good operating condition; meet all local building codes, ordinances, and safety standards; and be installed with required controls and in accordance with appropriate standards of the National Fire Protection Association.

NOTE: Installation of the Greenwood furnace must conform to the same standards and codes described above for a central heating system and meet the minimum clearances specified on the furnace serial number plate.

The following examples illustrate ways to configure the Greenwood hydronic furnace as an open or closed system to meet everyday heating needs. All plumbing schematics shown in this section are for illustration purposes only. Actual systems should be designed for your specific situation by a Greenwood certified plumbing and heating professional and may include control and safety devices not shown in these illustrations.

Basic “open system” configuration

An “open system” configuration means the circulation system is open to atmospheric pressure. In this illustration of an open system configuration, a mixture of propylene glycol and water flows through the manifold on the furnace side of the heat exchanger. This fluid does not mix with the water or fluid flowing through the home side of the heat exchanger. A mixing valve helps ensure that temperatures of returning fluid stays above 136°F—protecting the furnace from condensation.



Refer to p.28 for a legend of Schematic components.

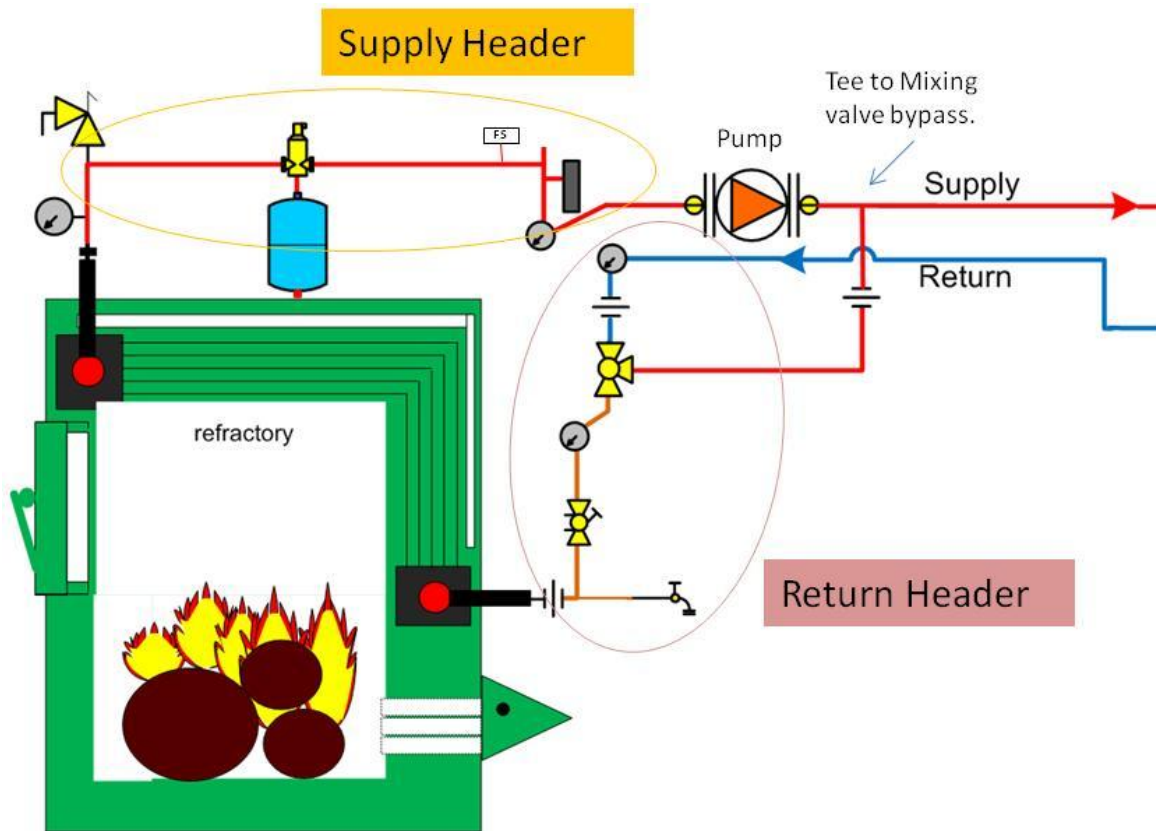
NOTE: All plumbing schematics shown in this section are for illustration purposes only. Actual systems may require control and safety devices not shown in these illustrations. Consult your Greenwood certified home heating and plumbing professional for home heating system design and installation.

Basic “closed system” configuration

The configuration below illustrates a Greenwood hydronic furnace plumbed as a closed system. A “closed system” configuration means the circulation system is sealed and closed to atmospheric pressure. As discussed in the previous section, a closed system may be plumbed with or without a heat exchanger, depending on the needs of the specific installation.

When plumbed as a closed system, a 30 PSI pressure release valve must be installed. The pressure relief valve should have a BTU rating at least as high as the rating of the boiler (100,000 BTUs for the Greenwood Model 100; 200,000 BTUs for the Greenwood Model 200; and 300,000 BTUs for the Greenwood Model 300. **The system must operate below 15 PSI.**

The fluid circulating through the system should still be a mixture of propylene glycol and water to provide protection against corrosion and freezing. Failure to protect the system will void the warranty. A mixing valve helps ensure that temperatures of returning fluid stays above 136°F—protecting the furnace from condensation.

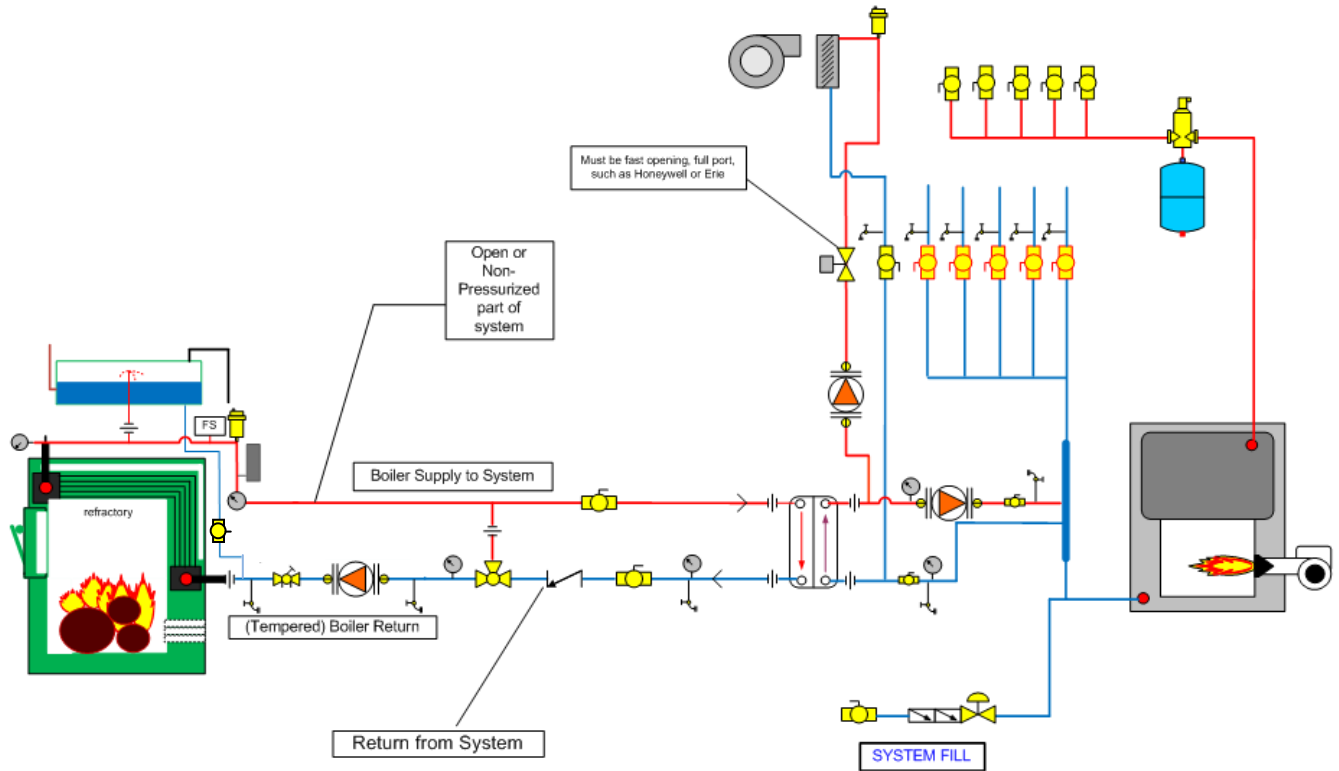


Refer to p.28 for a legend of Schematic components.

NOTE: All plumbing schematics shown in this section are for illustration purposes only. Actual systems may require control and safety devices not shown in these illustrations. Consult your Greenwood certified home heating and plumbing professional for home heating system design and installation.

Open to closed radiant heating system with boil over protection

The configuration below illustrates a Greenwood hydronic furnace plumbed as an Open system integrated with a Closed Fossil Fuel Boiler. A heat exchanger is used to separate the non-pressurized Greenwood furnace from the pressurized Fossil Fuel boiler circulation. Separate pumps power circulation of the open system and the closed system, delivering heated fluid for radiant heat. Power failure and boil over protection is addressed with the expansion and cooling tank provided as part of Greenwood's Fluid Management Kit. A Modine heater in the garage serves as a dump zone to even out thermal spikes and capture otherwise wasted heat.

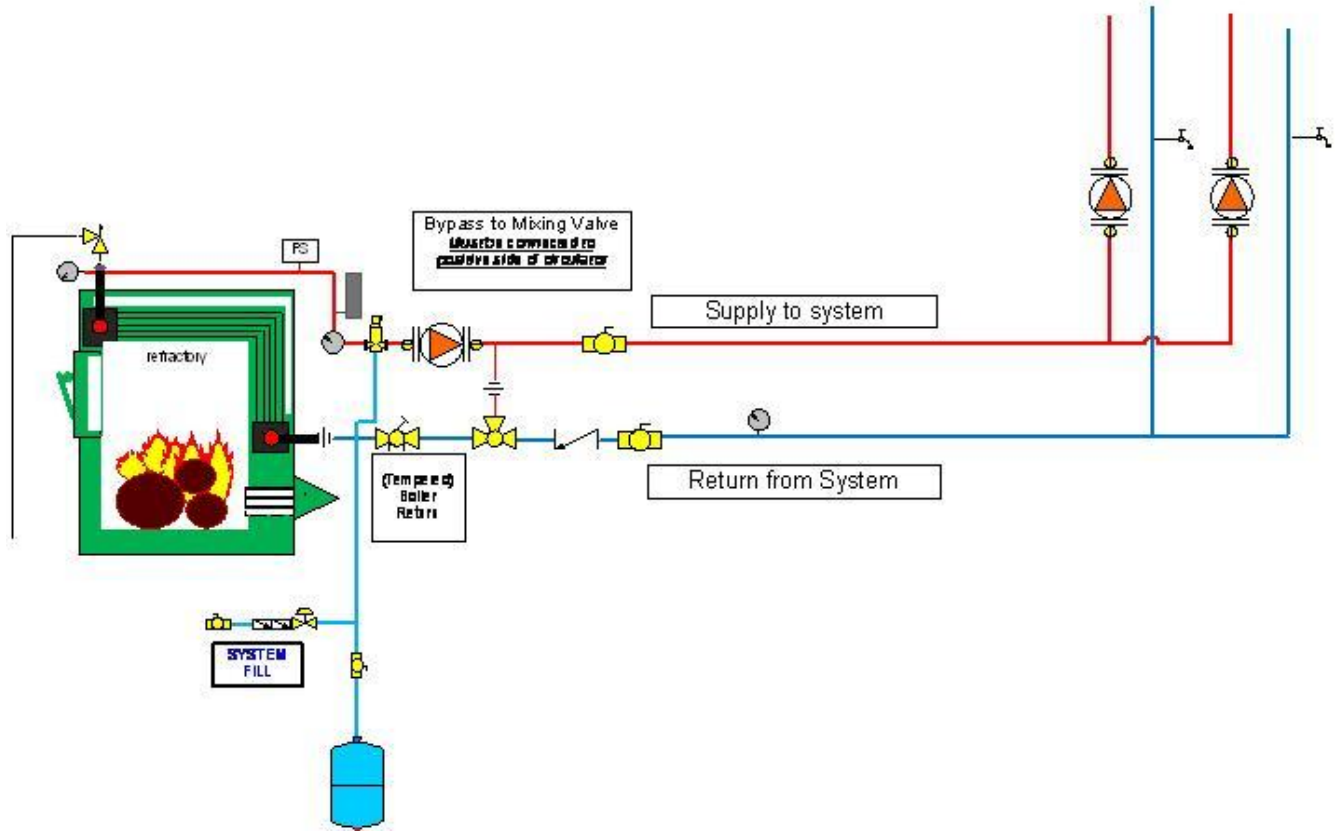


Refer to p.28 for a legend of Schematic components.

NOTE: All plumbing schematics shown in this section are for illustration purposes only. Actual systems may require control and safety devices not shown in these illustrations. Consult your Greenwood certified home heating and plumbing professional for home heating system design and installation.

Closed system connected to two zones without a heat exchanger

The configuration below illustrates the Greenwood furnace supplying hot water to a closed system connected to two zones without a heat exchanger. In this example, the entire system is pressurized. If the boiler is in a cold space, the entire system should be protected with Glycol.

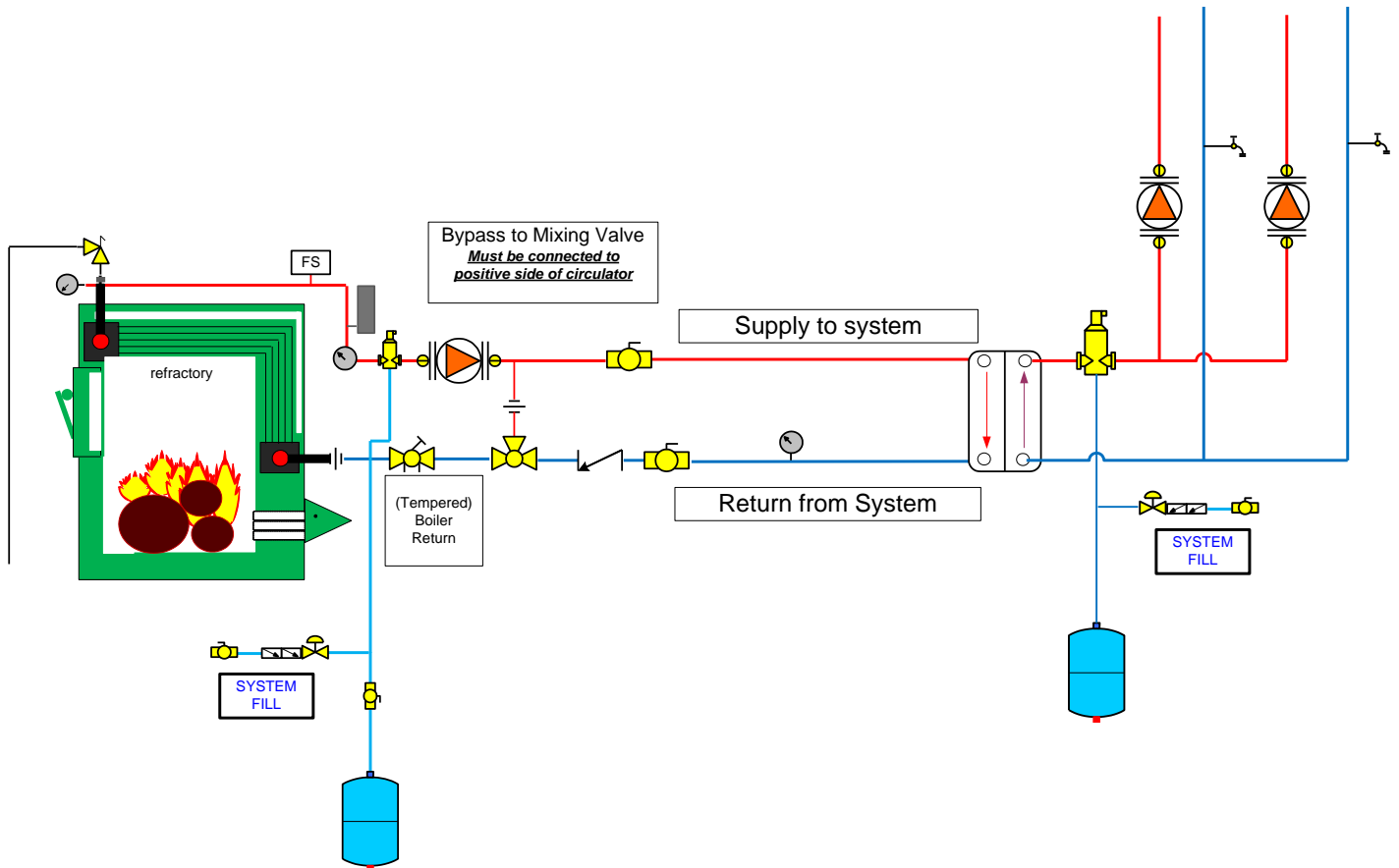


Refer to p.28 for a legend of Schematic components.

NOTE: All plumbing schematics shown in this section are for illustration purposes only. Actual systems may require control and safety devices not shown in these illustrations. Consult your Greenwood certified home heating and plumbing professional for home heating system design and installation.

Closed system connected to two zones with heat exchanger

The configuration below illustrates the Greenwood furnace supplying hot water to a closed system connected via a heat exchanger to the house side to separate the glycol in the boiler from the water in the house. The boiler side and the house side are both pressurized



Refer to p.28 for a legend of Schematic components.

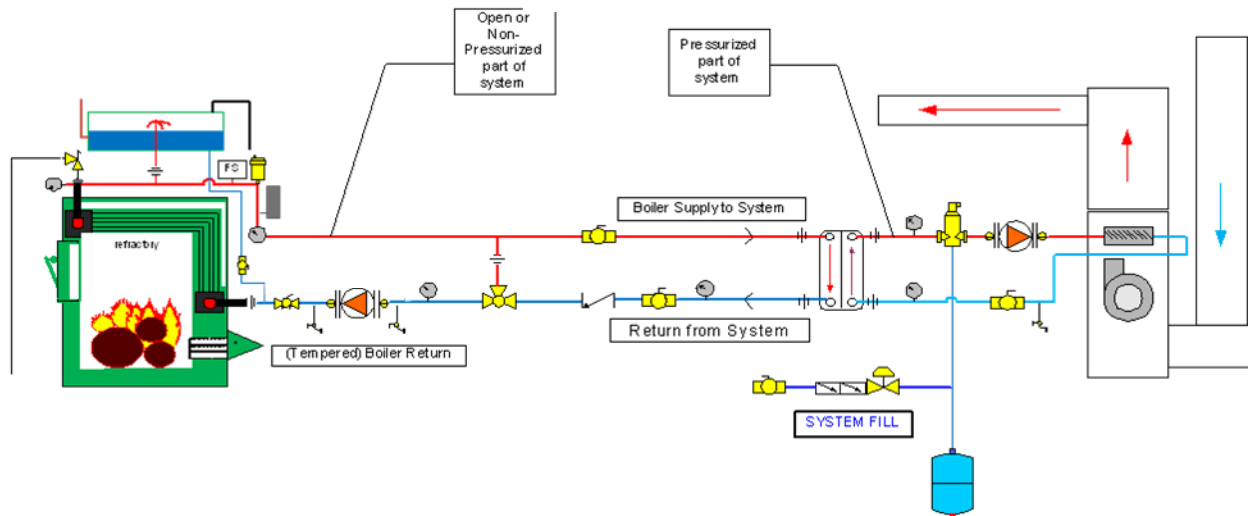
NOTE: All plumbing schematics shown in this section are for illustration purposes only. Actual systems may require control and safety devices not shown in these illustrations. Consult your Greenwood certified home heating and plumbing professional for home heating system design and installation.

Open system connected to closed forced-air heating system with heat exchanger

The configuration below illustrates the Greenwood furnace configured as an open system supplying hot water to a closed system forced-air heating system using a water-to-air heat exchanger mounted in the plenum (duct) of the forced-air system. This same type of loop can be used with hydronic space heaters (water-to-air heat exchanger with a fan) to heat a garage, basement or outbuilding.

Correctly size the water-to-air heat exchanger for the plenum and install it normal (90 degrees) to the air flow **on the hot air side of the fan**. Keep all four sides level so that air passes through the finned area of the heat exchanger evenly. After installing the plenum heat exchanger, it may be necessary to increase the airflow by changing the pulleys on a belt drive system or adjusting the speed of the motor on a direct drive system.

Do not tamper with the existing controls when installing heat exchangers. Have a qualified electrician or HVAC professional and follow all state and local codes. Wire thermostats according to directions provided by the manufacturer.



Refer to p.28 for a legend of Schematic components.



WARNING: Install the water-to-air heat exchanger on the warm-air side of the central furnace fan. Installing the exchanger on the cold-air return inlet may over heat components of the furnace and cause them to operate other than as intended.

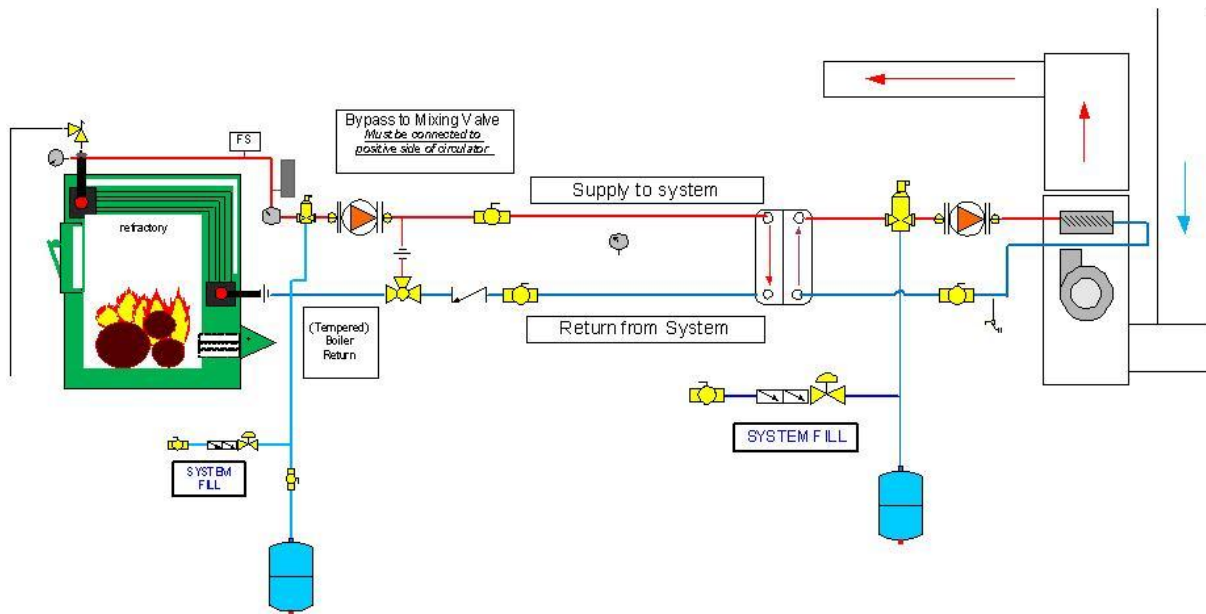
NOTE: All plumbing schematics shown in this section are for illustration purposes only. Actual systems may require control and safety devices not shown in these illustrations. Consult your Greenwood certified home heating and plumbing professional for home heating system design and installation.

Closed system connected to closed forced-air heating system with heat exchanger

The configuration below illustrates the Greenwood furnace configured as closed system supplying hot water to a closed system forced-air heating system using a water-to-air heat exchanger mounted in the plenum (duct) of the forced-air system. This same type of loop can be used with hydronic space heaters (water-to-air heat exchanger with a fan) to heat a garage, basement or outbuilding.

Correctly size the water-to-air heat exchanger for the plenum and install it normal (90 degrees) to the air flow **on the hot air side of the fan**. Keep all four sides level so that air passes through the finned area of the heat exchanger evenly. After installing the plenum heat exchanger, it may be necessary to increase the airflow by changing the pulleys on a belt drive system or adjusting the speed of the motor on a direct drive system.

Do not tamper with the existing controls when installing heat exchangers. Hire a qualified electrician or HVAC professional and follow all state and local codes. Wire thermostats according to directions provided by the manufacturer.



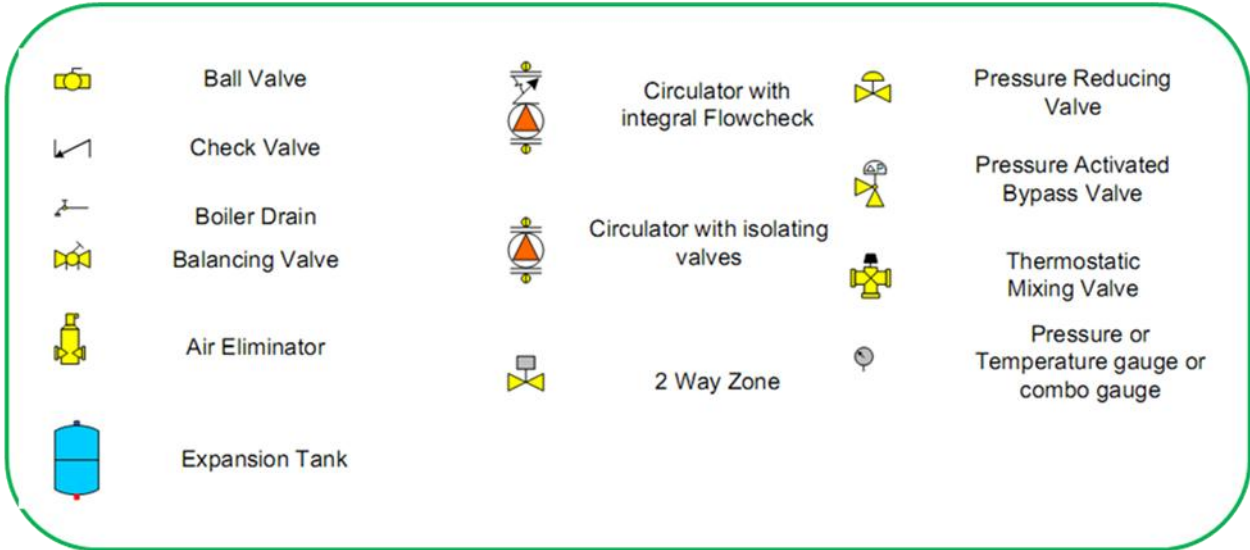
Refer to p.28 for a legend of Schematic components.



WARNING: Install the water-to-air heat exchanger on the warm-air side of the central furnace fan. Installing the exchanger on the cold-air return inlet may over heat components of the furnace and cause them to operate other than as intended.

NOTE: All plumbing schematics shown in this section are for illustration purposes only. Actual systems may require control and safety devices not shown in these illustrations. Consult your Greenwood certified home heating and plumbing professional for home heating system design and installation.

Legend of Schematic Components



WIRING AND CONTROLS

The Greenwood furnace is pre-wired for 115 volt, 60-cycle operation. Simply plug the power cord into an available outlet and the furnace is ready for operation. If local code requires a dedicated circuit for the furnace, install a 20-amp circuit with a circuit protector device located in a convenient place near the furnace.



WARNING: All electrical wiring related to your Greenwood furnace must conform to the National Electrical Code and all local building codes and ordinances. Turn off electric power at circuit protector device before making any line voltage connections. Don't plug in the furnace until it is fully installed.

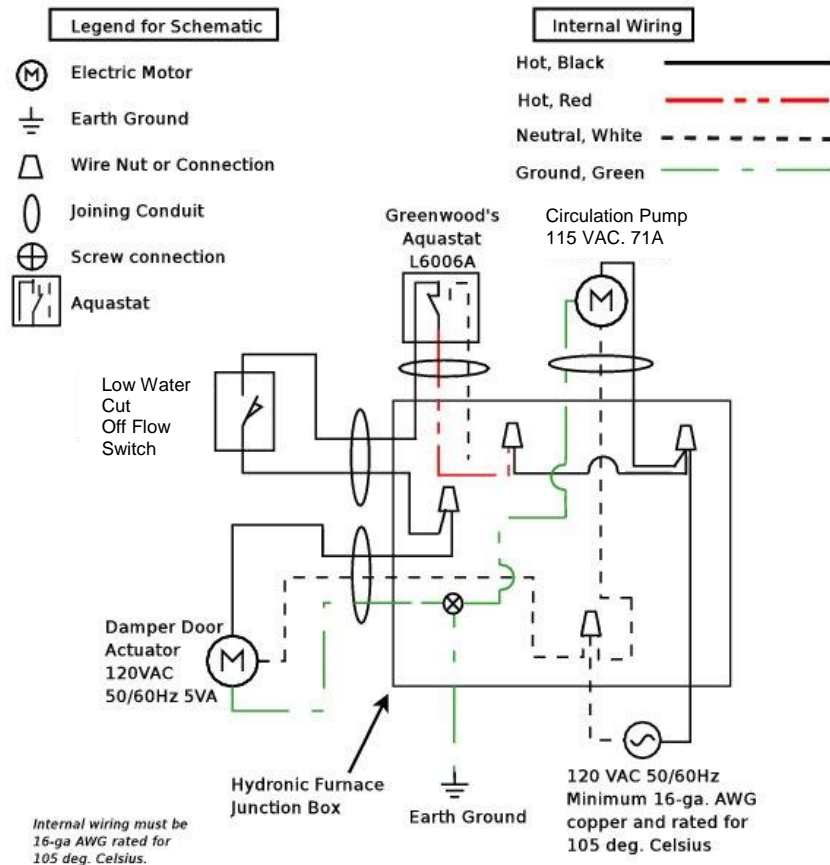
Basic furnace controls and wiring configuration

An aquastat regulates heat output of the furnace by opening and closing the air intake damper door. It is factory pre-set at 180°F with a 15-degree differential. When the internal manifold fluid temperature drops below 165° F, the aquastat signals the damper door actuator to open, allowing air into the furnace. When the fluid temperature reaches 180° F, the damper door closes to extinguish the fire.

Located between the aquastat and the damper motor is a flow switch. This switch will cut power to the damper motor, closing it, if the coolant flow is no longer detected.

A pump circulates the water and propylene glycol solution between the internal manifold and the rest of the system. It operates whenever the furnace has power.

An actuator motor opens and closes the air intake damper. In the event of a power outage, the damper motor automatically returns the air intake damper to the closed position.



Auxiliary wiring for thermal spike protection

At the end of each heating cycle, when the area to be heated has reached the desired temperature, the air intake damper closes. Robbed of oxygen, the fire dies down and goes into a dormant state until more heat is needed. This shutdown process is not instantaneous, so there must be a way for the system to off-load extra heat produced and keep the furnace from over heating and boiling off heat transfer fluid.



WARNING: Thermal spike protection is required for safe furnace operation. There are several ways to build this protection into a heating system and your installer should determine the method that works best for your home system.

A common method to provide “thermal spike protection” is to operate some or all of the home heating system for a short period after the damper door on the Greenwood furnace closes. By continuing to operate the hydronic system pump(s) or the blower in a forced-air system, excess heat quickly dissipates from the Greenwood furnace. The additional heat introduced to the house during this period is negligible and will not affect your comfort level.

Your installer should determine the best way to install thermal spike protection in your system. One option is to install a “strap-on” aquastat near the primary Greenwood aquastat (note: this strap-on aquastat is supplied with your furnace). The strap-on aquastat, set at 200° F with a 5° F differential, overrides the house thermostat and keeps the primary heating loop operating until the fluid temperature in the Greenwood furnace drops below 195° F.



WARNING: When using this method, the primary furnace and heating system pump must pull power through the optional aquastat so the total power draw is limited to 120VAC/8A or 240VAC/5.1A maximum. There is no need for an external relay to control the Greenwood furnace and the secondary furnace.

Auxiliary wiring for backup heat from the main furnace or boiler

Most owners want their existing central furnace or boiler to fire whenever there is insufficient output from the Greenwood furnace (i.e., the fire dies down and no one is available to stoke it). This backup protection is achieved with another aquastat and relay (note: these components are not included with the furnace).

The aquastat and relay keep the central furnace from firing unless there is insufficient heat coming from the Greenwood furnace. A strap-on aquastat, set to 100° F, breaks the link between the house thermostat and the central furnace. When the temperature drops below 100° F, the aquastat re-establishes the link, allowing the central furnace to fire.

Power Outages and Boil Over Protection

Greenwood furnaces, unlike a gas or oil-fired appliances, do not stop generating heat when power is interrupted and therefore require a provision to dissipate heat to avoid a boil-over of the water and propylene glycol mix. A boil-over can damage the aquastat, pump, and other furnace components and leave a mess to clean up.

Greenwood Furnace	Rated Output	Min. Power Outage Draw
Model 100	100,000 BTU/hr	> 25,000 BTU/hr
Model 200	200,000 BTU/hr	> 37,000 BTU/hr
Model 300	300,000 BTU/hr	> 45,000 BTU/hr

The Greenwood furnace automatically shuts down when the power goes off. The air intake damper on the furnace closes, robbing the fire of oxygen and damping down the burn. Since the home system also loses power, the thermal spike protection needed to keep the furnace from overheating is not functioning either. As a result, part of your installation should integrate a system for removing heat from the furnace in the case of power failure. Common power failure options follow.

If you experience frequent or prolonged power outages in your area, we recommend a backup generator. The generator would provide power to the Greenwood furnace as well as the pumps, blowers and other devices in your home heating system. Please consult a licensed electrician for the correct installation and wiring of your backup generator.



POWER OUTAGE WARNINGS: DO NOT open the firebox door; doing so may cause a backflow of smoke into the furnace area. **DO NOT** block open the air intake damper; doing so may cause the furnace to over heat, damaging components and voiding your warranty.

An experienced plumbing and heating contractor will be able to assist in implementing a solution. Please review the following options and use them as guidelines for deciding alternatives that will work best for your situation.

Universal Power Supply

UPS units provide 115V power to operate the Greenwood furnace and your home heating system when power is lost. While running on battery, an alarm beeps. The UPS can be configured with varying lengths of run time. UPS battery life differs based on usage and environment. It is recommended that the batteries be changed once every three years.

Pros: Will continue to operate the furnace and home heating system; is simple, with no moving parts.

Cons: Expensive, and will not work with forced-air fan systems. Cost will be proportional to duration of outage coverage.

Installation difficulty: Moderate. May require additional dump zones and valves. Both electrical and plumbing work may be required.

Source: www.apc.com



Greenwood Fluid Management Tank

The Gravity Fed Fluid Management Kit protects against thermal spike and boil over in power failure situations for open systems. The kit is easily installed with the Supply and Header Kit.

Pros: Does not require power

Cons: Will not heat the home during a power failure. Not designed for use with closed systems or Greenwood Model 300.

Installation difficulty: Moderate. Requires basic plumbing skills.

Source: Greenwood Technologies



Gravity Flow System

Gravity heating systems were the earliest systems used for heating living spaces. They incorporate radiators and the principle of density differences of heated water to generate flow in the system. This system incorporates additional zone valves and additional radiant heating devices.

Pros: Simple, with few moving parts

Cons: Will not heat the entire home.

Installation difficulty: Moderate. Will require additional radiant heater(s) and zone valves. It will also require additional plumbing from the furnace to the heater(s). Both electrical and plumbing work is required.

Source: Available for sale on-line and at many commercial heating supply outlets; you can also find used cast iron radiators.



City Water (Pressurized Water Supply)

This system flows cold city water into the Greenwood furnace as soon as the power is lost. It incorporates a 115V valve, backflow preventer and metering valve.

Pros: Basic, with few components, and will last until power returns.

Cons: Requires a drain and will result in loss of propylene glycol. Will not provide heat to the home and may not work with a non-pressurized well system.

Installation difficulty: Low; plumbing only, but may require a professional plumber.

Source: Parts kit is offered for sale by Greenwood.



Auto-start Generator

Complete home emergency power back-up systems have been packaged with auto-start generators and automatic power transfer switches. These systems will automatically start and provide power to the critical home electrical circuits when your power is lost. They will continue to operate until the power returns.

Pros: Will heat and power the entire home.

Cons: Expensive.

Installation difficulty: Will require a professional electrician.

Source: Home Depot or other commercial generator supplier.



OPERATING THE FURNACE

Safe Practices

1. Use kindling, paper and smaller split wood when cold-starting the furnace. Start three (3) small kindling fires and allow them to burn out before adding additional split wood. Once the fire is going, carefully follow the procedures described later in this section for adding more wood to the firebox.
2. **DO NOT** use chemicals, gasoline, lantern fuel, kerosene, charcoal lighter fluid or other flammable liquids to start or “freshen up” the fire.
3. Burn large, un-split wood. If the wood fits in the door, it will burn. Small pieces or finely split wood will burn hot and make it difficult to control cycling of the furnace.
4. **DO NOT** burn coal or anything other than whole wood in this furnace.
5. Observe the following procedure for opening the firebox door when the furnace is in operation. ***Failure to follow this procedure may cause smoke to back flow into the room.***
 - a. Check to see if the air intake damper on the rear of the furnace is open. You should only open the firebox door when the damper is open; otherwise, you are likely to get smoke back drafting into the room.
 - b. Unlatch the door and open it just 1 to 2 inches to allow the furnace air flow to adjust to the new source of air.
 - c. After about 10-15 seconds, carefully open the door the rest of the way.



WARNING EXPLOSIVE GASES

Gasses formed during solid-fuel combustion may cause a small explosion when the furnace is refueled. Always use your left hand to open the firebox door. Open the door slowly and keep your face and body well away from the door until it is completely open.

6. **BE CAREFUL** when working around an open firebox door. The refractory attached to the firebox door and the steel surrounding the firebox door are VERY HOT. Wear protective clothing, leather hearth gloves and eye protection whenever you open the firebox door and stoke the fire.
7. Follow proper procedure when adding wood to the fire: Carefully pick up the log and place it squarely on the bottom frame of the firebox door opening. Then roll or push the log into the firebox using a poker or other suitable tool.
8. **DO NOT** jockey wood into the firebox that is longer than the width of the firebox door. The firebox door surfaces are extremely hot and you risk severe burns.
9. **DO NOT** throw logs into the firebox. Though the refractory is very strong and durable, a thrown log may crack it. A thrown log may also stir up ash and cinders that can fly back into the room.
10. **DO NOT** overfill the firebox. The wood pile should never rise higher than the middle of the firebox door.
11. Keep the firebox door closed except when tending the fire.
12. **DO NOT** block open the air intake damper on the rear of the furnace. Doing so can lead to over-firing, which can damage the furnace and void your warranty.
13. Keep the furnace area clear of combustible materials, gasoline, and other flammable vapors or liquids.
14. **DO NOT** let ashes accumulate higher than the bottom of the draft holes at the lower rear of the firebox. Dispose of ashes in a metal container with a tight-fitting lid. Do not place other materials in this container. Store the container on a noncombustible surface, well away from all combustible materials. When cinders have thoroughly cooled, bury the ashes or dispose of them in the garbage.
15. **DO NOT** store wood within the appliance installation clearances or within the space required for fueling, ash removal, and other routine maintenance operations.
16. **DO NOT** allow anyone who is under the influence of drugs or alcohol or is unfamiliar with the correct operation of the furnace to add fuel or otherwise use this furnace.
17. **DO NOT** let children play around the furnace. To avoid burns or other injury, alert all persons to the hazards of hot furnace surfaces.

Operating the Furnace

18. **DO NOT** over-fire the furnace by leaving the firebox door open, blocking open the air intake damper, or burning fuel other than whole wood. If the stovepipe glows or turns red, the furnace is over-firing. If you observe signs of over-firing, turn up the thermostat(s) in the house to dissipate heat from the furnace as quickly as possible. Let the furnace cool to at least 165° F before opening the firebox door.
19. For more information on safe use of your wood furnace, obtain a copy of the National Fire Protection Association (NFPA) publication, “Using Coal and Wood Furnaces Safely” NFPA No. HS-10-1978. The NFPA address is: Battery March Park, Quincy, MA 02269.

First startup and cold startup each season

The Greenwood firebox is made of refractory material which is mixed with water during the manufacturing process. The casting is baked in a high temperature oven to cure the refractory and remove the water. However, some residual moisture remains trapped in the refractory and boils off during the first few days of furnace operation. Most of the moisture is vaporized, but some may condense and leak out around the base of the furnace. Sometimes it will mix with partially combusted flue gases, forming a black, oily liquid that can stain your floor. As a precaution, we suggest you lay down a sheet of aluminum foil around the base of the furnace and cover it with kitty litter or other absorbent material. You can remove this material after a few days of operation, when the curing process is complete. [Note: If you do find stains on the floor, please see the Support section of the Greenwood website for a Tech Note that outlines cleaning instructions.]

Building Your First Fire

You are now ready to start saving money on your home heating. To avoid problems, please follow these instructions which describe how to light your first fire, how to monitor the furnace performance, and how to adjust the amount of fuel to match the demand for heat from the furnace.

Pre-fire checks:

1. Make a mental note of the heating conditions – external temperature, thermostat setting, etc. These observations will be useful in understanding how much wood fuel your unit requires to satisfy the heating demand.
2. Check to see that the air intake damper (*located on the back of the furnace*) is open.
3. Disconnect the furnace from power and ensure that the air intake damper door closes completely flat against the frame. Reconnect the furnace to the power. The damper will open.
4. Perform a **Simple Draft Test**. (*If you do not pass the draft test, stop. Your system is not drafting properly. Consult the Troubleshooting Guide.*)



Simple Draft Test: In a cold furnace, take a small piece of newspaper and light it – stick it into the furnace and hold it up near the internal manifold (*ceiling of the firebox*) – if smoke does not come back in your face, your draft is probably adequate. If smoke exits the firebox door, consult the Troubleshooting Guide. **THIS TEST DOES NOT SUBSTITUTE FOR A MANOMETER READING.**

Start a cold furnace with three (3) consecutive small kindling fires

Wad up newspaper and place it near the back of the firebox. Place kindling on top of the newspaper (NOTE: Do not use any combustible fluids or catalysts, it may damage the firebox and void your warranty). This is identical to starting a fire in your fireplace.

1. Light the fire and allow it to burn out.
2. Close the loading door and let it burn 5 to 15 minutes (depending on kindling). Do this three (3) times.

3. As the third and final kindling fire is dying down, crack open the door an inch, wait to allow air to enter the firebox and then place 1-2 small to medium logs on the kindling fire, making sure that you do not block the air intake ports or smother the kindling fire.
4. Let the fire burn for 15-45 minutes.
5. At this point, the coolant should be up to a nominal operating temperature of 150° F - 170° F.
6. You can tell a fire is up to a nominal operating temperature by:
 - i. Checking the thermometer on the top of the furnace, or
 - ii. Looking inside the firebox or through the air intake damper, you should see bright yellow flames, or
 - iii. Looking at the flue on the outside of your home, there should be very little opaque smoke while the furnace is operating. As the fire becomes hotter, the smoke will diminish.

From this point, you need to determine the appropriate size fire for the heating demands of your house.



CAUTION: DO NOT completely fill the firebox with wood. Too much fuel, coupled with low demand for heat from your central heating system, may cause the furnace to over-heat. A Greenwood furnace is more efficient than most other wood burning appliances and therefore requires less wood to produce similar heat output. With a little practice you will develop a good sense for how much wood is required to meet your heating needs on any given day.

Build a Primary Fire.

1. Check to make sure the damper is open. Crack open the door an inch, wait a few seconds, then open it completely and add a small armload of wood (2- 3 medium pieces) to the fire.
2. Wait 15 - 45 minutes. During this time, periodically monitor the furnace.
 - i. Note the rising temperature on the thermometer on top of the unit – how quickly does it rise?
 - ii. Note the air intake damper – does it stay open or closed?
3. Assess the heating situation.
 - i. If the damper closes, the furnace is up to operating temperature and does not require any more wood fuel at this time. The thermometer will read approximately 180° F.
 - ii. If the damper has remained open AND the thermometer is still below 180° F, AND your home thermostat is not reaching temperature, add another small armload of wood.
4. Repeat steps 1-3 until the air intake damper closes and the furnace temperature has reached 180° F. *(NOTE: At no time should you load wood into the furnace above the middle of the firebox door.)*

With time and experience, you will develop a sense for the amount of wood required for a particular heating condition. Matching the amount of fuel loaded with the heating conditions will maximize the efficiency and burn time of the furnace and minimize the risk of producing smoke or creosote.

NOTE: If you are heating less than 2,500 square feet, you may never need to load the firebox more than halfway to the firebox door.

Common Observations

It is normal for the furnace temperature to rise as the air intake damper closes and the fire transitions to a dormant state. Your home heating system will dissipate this thermal spike within a few minutes (see Wiring and Controls pg. 30), and the temperature will begin dropping.

It is normal for the air intake damper door to open and close on a regular basis. It means the furnace is modulating its internal temperature.

Key Operating Points

1. Monitor the furnace temperature (via the thermometer mounted on top of the furnace) relative to the amount of wood you load into the furnace. If the furnace is holding a relatively constant temperature, it has adequate fuel. Only when the temperature drops below the normal range (165° F or lower) should you add more wood to the firebox. Understanding this relationship is essential to maximizing the performance of the furnace.
2. Make sure that the air intake damper is open when loading wood into the furnace or starting the fire. Note: If you have installed the Greenwood Heat Retention Kit, press the controller reset button prior to re-loading.
3. Ensure there is proper air flow into the furnace (i.e. do not block air intake ports at the back of the furnace).
4. Do not overload the firebox with wood fuel. Overloading causes incomplete combustion of the fuel resulting in smoke and possibly a build-up of creosote in the furnace. This can potentially void the warranty on your furnace.
5. Keep in mind the heating conditions (e.g. house thermostat, outside temperature, etc.) when considering the amount of wood fuel that will be loaded.
6. Except for cold-start kindling fires, burn only whole wood rounds or large splits. **DO NOT** burn wood chips, unseasoned/green wood, scrap wood, Duraflame logs, pallets, mill ends, railroad ties, or any other type of fuel. Also, do not burn old or rotten wood (e.g., cut and stored under a tarp for several years or more).
7. For optimum performance, burn only seasoned (dry) wood. Using wet, green or unseasoned wood is not recommended. If you must burn unseasoned wood, mix a small amount of it with larger loads of seasoned wood. Large loads of green wood will significantly lower the efficiency of the system, reduce heat output and cause the furnace to smoke and create creosote.



WARNING: Never use chemicals, gasoline, lantern fuel, kerosene, charcoal lighter fluid or other flammable liquids to start or "freshen up" the fire.

Warm Start

Open firebox door and stir the ash to see if live coals are present. If not, follow the procedure outlined above for a cold start, taking care not to touch surfaces that may still be hot.

1. If coals are present, stir coals carefully, add kindling and secure the firebox door.
2. Once the fire is burning briskly (5-10 minutes), carefully open the firebox door and add small to medium-sized logs to the fire. Use care not to smother the kindling fire.
3. When the temperature gauge reaches 150 - 170° F, carefully open the firebox door and add enough wood to match the current need for heat. Do not load more wood than is needed.



WHEN OPENING FIREBOX DOOR: To prevent smoke from back flowing into the room, ALWAYS take the following steps before opening the firebox door on a hot furnace:

Check the air intake damper; if it is closed, wait until it opens before you open the door (this will avoid drawing smoke into the room). Or, if you have a draft inducer fan, turn it on before opening the door.

Unlatch the firebox door and open it just 1 - 2 inches

Wait about 15 seconds while airflow in the furnace adjusts to the new source of air.

Open the firebox door fully, being careful not to touch hot surfaces.

Feeding wood into the firebox

1. If a fire is not already burning in the furnace, refer to instructions for “Starting the Fire.”
2. Using a coal shovel, carefully push the hot coals toward the back of the firebox. Take care not to block the air intake ports.
3. Carefully pick up a log and place it squarely on the bottom frame of the firebox door opening. Then roll or push the log into the firebox using a poker or other suitable tool.



WARNING: Be careful and keep children away when working around an open firebox door. The refractory insert in the firebox door and the steel surrounding the door are **VERY HOT**. Always wear protective clothing, leather hearth gloves and eye protection whenever working around an open firebox door.

4. Observe the following tips when feeding the fire.
 - a. If a fire is burning, let the wood load burn down as much as possible before refilling. This will reduce the amount of smoke that escapes into the room.
 - b. Always take care not to block the air intake ports at the lower rear of the firebox.
 - c. Do not put logs into the firebox that are longer than the width of the firebox door. The firebox door surfaces are extremely hot and you risk severe burns.
 - d. Do not throw logs into the firebox. Though the refractory is very strong and durable, a thrown log may crack it. It can also cause ash and cinders to fly back into the room.
 - e. Do not place logs in the firebox end first; it can damage the refractory.
 - f. Do not overfill the firebox. Logs should not reach higher than the middle of the firebox door frame or impede the flow of escaping gases at the top of the firebox.
5. The burn time between loads depends on the demand for heat in your home and the energy content of the wood burned. With a little experience, you will get a good feel for how often you need to reload the furnace.

What wood to burn

Your Greenwood furnace operates with greatest efficiency when burning large, un-split, seasoned wood logs. If the log fits in the door, it will burn. Small logs and split logs are fine too, but they tend to burn faster and slightly reduce the burn time of the load.

NOTE:

1. **Burn whole wood only.** **DO NOT** burn coal, wood scraps, pallets, corn, pellets, garbage, rubber, gasoline, oil products, or any other fuel. Failure to do so could result in voiding your warranty.
2. **DO NOT** use chemicals, gasoline, lantern fuel, kerosene, charcoal lighter fluid or other flammable liquids to start or “freshen up” the fire.

Do not burn unseasoned (green) wood as it can cause creosote buildup, marked reduction in heat output and visible smoke produced out the stack. Seasoned wood has a moisture content of approximately 20%, while freshly cut wood contains up to 50% moisture. It takes about 1,000 BTUs of heat to evaporate the moisture in each pound of wood, so the greener the wood, the greater the energy diverted from heating your home. This is why dry wood produces 10-30% more useable heat for your home.

Heat output varies with the species of wood burned, with hard woods generally producing more heat than soft woods. However, local availability is the most important factor in selecting a wood to burn. We recommend using whatever wood is most economically available in your area.

Here are some useful tips to help you in buying wood:

- A cord is a stack of wood 4 feet high, 4 feet wide and 8 feet long. The gross cubic measurement of a cord of wood is 128 cubic feet. However, allowing for air pockets, a cord is approximately 85 cubic feet of solid wood.
- On average, a pound of wood produces 8,600 BTUs of heat, regardless of species. So dense heavy woods frequently deliver more heat per cord. Always compare the wood heating value before purchasing your wood.
- A good time to cut or buy green wood is in late winter or early spring. Cut it to length, stack it so that air circulates through the pile, and shelter it from the weather. Seasoning usually takes about 18 months.
- If you cut your trees in the spring or summer, leave the limbs attached until the leaves wither. The withering process draws moisture from the wood. Then, cut the wood to the longest length that will roll through the firebox door. The longer the log, the longer the fire will hold.

The amount of heat extracted from a cord of wood varies with the species. The U.S. Forest Products Laboratory compiled the following figures, showing weights and energy content for various species of wood. The energy content figures assume seasoned wood with 20% moisture content.

Heat Content of Wood by Species

Wood Species	Cord Weight (lbs)	Energy Content (million BTUs/cord)
Alder	2,708	17.6
Apple	4,140	26.5
Ash, Black	2,992	19.1
Ash, White	3,689	23.6
Aspen	2,295	14.7
Basswood	2,108	13.5
Beech, Blue	3,890	26.8
Beech, High	3,757	24.0
Birch, Black	3,890	26.8
Birch, Gray	3,179	20.3
Birch, Paper	3,179	20.3
Birch, White	3,179	20.3
Birch, Yellow	3,689	23.6
Box Elder	2,797	17.9
Butternut	2,100	14.5
Cedar, White	1,913	12.2
Cherry	3,120	20.0
Cherry, Black	2,880	19.9
Cottonwood	2,108	13.5
Elm, American	3,052	19.5
Elm, Oyen	3,052	19.5
Elm, White	3,052	19.5
Fir, Balsam	2,236	14.3
Fir, Douglas	3,196	20.6
Hackberry	3,246	20.8
Hemlock	2,482	15.9
Hickory	4,327	27.7
Hornbeam, Eastern	4,267	27.3
Locust, Black	3,890	26.8
Maple, Red	2,924	18.7
Maple, Sugar	3,757	24.0
Oak, Red	3,757	24.0
Oak, White	4,012	25.7
Pine, Jack	2,669	17.1
Pine, Norway	2,669	17.1
Pine, Pitch	2,669	17.1
Pine, Ponderosa	2,380	15.2
Pine, Western	2,236	14.3
Spruce	2,100	14.5
Spruce, Black	2,482	15.9
Tamarack	3,247	20.8

Ash Removal

Your clean-burning Greenwood furnace requires less frequent cleaning than wood stoves or similar devices. However, when the ash build-up approaches the level of the air intake holes (at the lower rear of the firebox); it is time to clean them out. Please observe the following procedures.

Cold Furnace

1. Make doubly sure the furnace is cold.
2. Stir the ash to make sure there are no live embers.
3. Shovel the ash into a metal container with a tight fitting lid and move it outdoors. Do not place other waste in this container.
4. Use a shop vacuum to remove any remaining ash.
5. Bury or locally disperse the cold ashes on the ground or place them in the garbage.

Hot Furnace

1. Wear protective clothing, leather hearth gloves and eye protection.
2. Open the firebox door and stir the ash to determine if live coals are present. Push hot coals to the side.
3. Shovel the ash into a metal container with a tight fitting lid and move it outdoors. Do not place other waste in this container.
4. Place the closed container on a non-combustible surface and away from combustible materials. Allow it to cool for several days.
5. Bury or locally disperse the cold ashes on the ground or place them in the garbage.



WARNING: Use caution when working around an open firebox door. The refractory in the firebox door and the steel frame surrounding the door are **VERY HOT**. Wear protective clothing, leather hearth gloves and eye protection whenever you work around the open firebox door.

MAINTENANCE

Safe Practices

1. Establish a daily routine for storage of fuel and care of the furnace. Check daily for creosote buildup until experience shows how often cleaning is necessary. Be aware that the hotter the fire, the less creosote is deposited, and that weekly cleanings may be necessary in mild weather, even though monthly cleanings may be enough in the coldest months. Have a clearly understood plan to handle a chimney fire.
2. Clean out the flue pipe, chimney, and draft inducer (if used) at the end of each heating season, or more often if necessary, to remove any accumulation of soot, creosote or ash. Do not use chemicals for cleaning.
3. Inspect chimney, flue pipes, flue pipe joints, and flue pipe seals regularly to ensure that smoke and flue gases are not drawn into, and circulated by, your home's air circulation system. If you observe rust or smoke escaping, replace the pipe immediately.
4. Exercise the safety relief valve at least once a year; lift the handle and allow water to escape.
5. **DO NOT** clean furnace surfaces when the unit is hot. Wait until the unit cools and then clean with soap and water.

Heat Transfer Fluid

The heat transfer fluid used in the Greenwood Furnace is a mix of propylene glycol and water. The propylene glycol additive helps prevent rust and freezing in the heat exchanger. If you are using an open system expansion tank with a sight gauge, you should monitor the system fluid level throughout the heating season by checking the sight gauge daily on the side of the expansion tank.

If the furnace over fires and over heats, heat transfer fluid may boil out of the system. If this occurs, prepare a fresh mix of propylene glycol and water and add it to the expansion tank through the inlet port.



WARNING: Your furnace uses Propylene Glycol mixed with water as a heat transfer solution. It is an odorless, tasteless, non-toxic liquid which the FDA describes as "generally recognized as safe" for use in food. Do not confuse it with Ethylene Glycol, more commonly known as automotive antifreeze, which is odorless, sweet to the taste; and HIGHLY TOXIC. **DO NOT** use Ethylene Glycol in your furnace.

Annual Shutdown Maintenance

1. Top off the fluid level.
2. Clean all ashes out of the firebox.
3. Inspect all chimney and connector joints. Repair as required.
4. Clean the flue to remove any accumulation of creosote. Disconnect the connector pipe from the exhaust collar of the furnace and clean around the opening.
5. Place a cap over the chimney to prevent birds and debris from entering.
6. Clean the surface of the furnace with soap and water.
7. Unplug or switch-off the furnace.



CAUTION: CLEAN OUT THE FLUE PIPE, CHIMNEY, AND DRAFT INDUCER IF USED. HAVE A PROFESSIONAL CHIMNEY SWEEP CLEAN AND INSPECT THE CHIMNEY. THIS IS ESPECIALLY IMPORTANT AT THE END OF THE HEATING SEASON TO MINIMIZE CORROSION DURING THE SUMMER MONTHS CAUSED BY ACCUMULATED ASH.

System Flush

Every two years, drain the heat transfer fluid and remove any scale buildup in the internal manifold by flushing the system with a boiler treatment additive (available at most HVAC distributors and home improvement stores). Replace the fluid with a new mix of propylene glycol and water.

TROUBLESHOOTING

Furnace is not heating

1. Check the firebox to see if there is adequate fuel.
2. Check the pump on the rear of the furnace. If it is not circulating, turn off the power and repair or replace the pump.
3. Check heat transfer fluid level. If the level is low, inspect the piping for leaks and refill with a mix of 30% propylene glycol and 70% water.
4. Check the flue to see if there are any blockages.
5. Check the functionality of the draft inducer (if installed).
6. Check the air intake damper and motor for proper operation.

Creosote or condensation is forming

A small amount of condensation or creosote formation during cold start is normal; it will burn off when the furnace reaches operating temperatures. However, if it continues to form, the furnace is operating too cold.

1. Make sure that the system is protected against return temperatures dropping below 136 ° F by use of a mixing valve or some other protective system.
2. Make sure the firebox door is closed and secure.
3. Make sure the air intake damper is opening fully when there is demand for heat.
4. Check for blockages in the chimney, such as debris or a connector pipe pushed into the chimney.
5. Check to see that there are adequate sources of make-up air and no blockages in the system.
6. Measure the draft of the chimney using a manometer or similar device and make sure it is between .05” and .07” WC (12.45 – 17.44 Pa).
7. Make sure the draft inducer (if installed) is functioning properly.

If none of these conditions is evident, the problem may be short-cycling of the furnace caused by low demand for heat. Short-cycling is the frequent fire-up and shutdown of the furnace and it prevents the furnace from reaching optimum operating temperatures and warming the chimney to stimulate draft. It may be a sign the winter heating season is over, and it is time to shift back to your central heating system.

Furnace is over-heating

1. Confirm that adequate thermal spike protection installed.
2. Check to make sure the firebox door is closed and secure. Do not leave the door open.
3. Check the air intake damper for correct operation. Do not block the damper open.
4. Ensure the air intake damper door closes completely flat against the frame.
5. Check the fuel in the firebox. Do not burn scrap wood, pallets, pellets, or any fuel other than solid wood.
6. Check the functionality of the draft inducer (if installed).
7. Check the fluid level in the expansion tank. Over-heating may cause fluid to evaporate.
8. Check the draft to ensure that it is operating at 0.05-0.07 in. water column while the damper is open.
9. Check and adjust the aquastats to a lower temperature.

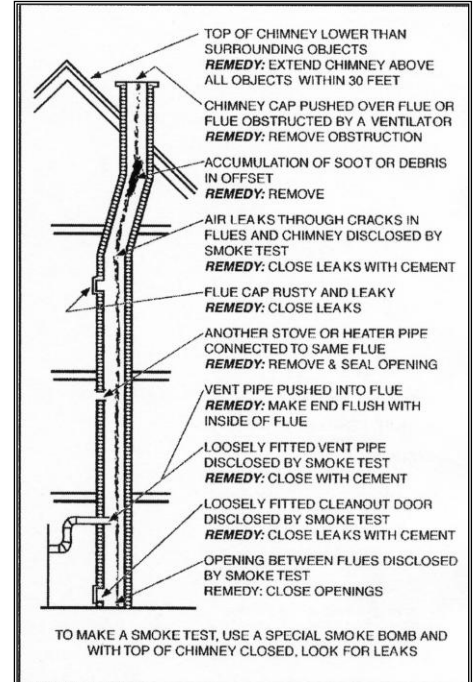
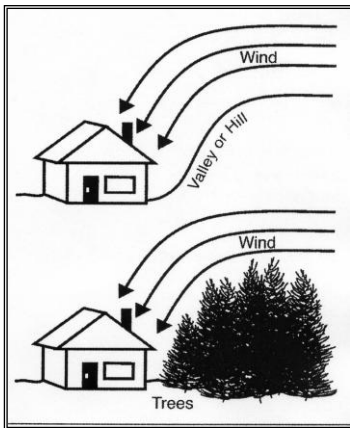
Cracks in the firebox refractory

Chips, small fractures and spalling in the refractory are a sign of normal wear and tear on the furnace. They do not affect the safety or performance of the unit. Some cracks can progress across the full length of the refractory side. These are not structural and will not affect furnace performance or life. If a crack continues to widen, call your local installer or Greenwood Customer Support.

Chimney problems

A good chimney system is essential to the efficient operation of your Greenwood furnace. If you have problems with smoke or a very strong smell in the room where the furnace is located, the chimney may not be drafting properly. Check the following:

1. **Cast iron flue damper** – If installed, use a manometer to ensure the chimney is drawing between .05” and .07” WC (12.45 – 17.44 Pa).
2. **Make-up air** – You must have a source of make-up air in the room where the furnace resides. Please see section on “Make-up Air” for more information.
3. **Cold outdoor chimney** – Sometimes in the spring and fall, or if you live in a mild climate, heat demands are small and the furnace does not fire hot enough to warm your chimney and induce a natural up draft. If so, you may need to install a draft inducer (available at building supply stores and www.draftinducers.com).
4. **Chimney not tall enough** – Your chimney must terminate at least 2 feet above the peak of the roof. Adding more chimney height can sometimes cure the problem.
5. **Chimney too tall** – escaping gases cool as they rise up the chimney. If the chimney is too tall, gases may cool before exiting out the top and impede draft.
6. **Home located on side of hill or adjacent to tall trees** – When the wind blows over a hill or tall trees toward your home, the wind can blow down your chimney and cause a downdraft. Some common solutions are to add a chimney cap with a weather vane, add height to the chimney, or add a draft inducer to offset the effect of the downdraft.
7. **Chimney too large** – Your chimney flue size must match the requirements of your furnace. If it is too large, the chimney may not heat up enough to create a natural draft, causing combustion gases to cool before escaping through the top of the chimney. See the “Chimney Installation” section of this manual for correct chimney sizing.
8. **Barometric draft control** – This control should be set at .07”. This is just a guide. Use a manometer to ensure the chimney is drawing between .05” and .07” WC (12.45 – 17.44 Pa).



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Greenwood Furnace Installation Checklist

Installer must satisfactorily complete this checklist and send a copy to Greenwood along with a completed warranty registration card to activate the Greenwood Limited Warranty. Please verify that all steps have been completed and information has been provided. Installer and operator must sign this document.

Please complete all information below:

Customer name:	.....	Greenwood model:	.....
Street address:	.....	Serial number:	.....
City/State/Zip:	.....	Installation date:	.....
Dealer:	.....	Installer name:	.....
Phone number:	.....	Phone number:	.....
Dealer City/State:	.....	

Boiler installation information

Describe how return fluid temperature protection has been implemented (e.g. mixing valve, shunt pump, etc.)

.....

.....

Describe how boiler fluid quality has been verified (e.g. water test, boiler treatment, etc.)

.....

.....

Power and fluid management have been implemented (Circle all that apply)

1 - Gravity dump zone of _____ BTUs	4 - Battery back up _____ Amps
2 - Fluid management tank	5 - Standby generator
3 - Pressurized water supply	6 - Other: _____

Chimney was inspected and certified for 350 deg F: Y N

Flue draft was checked with a manometer: Y N Manometer Reading: _____

Fluid flow control has been implemented: Y N Delta T: _____

Unit has been installed per local code: Y N

Heat retention has been installed: Y N

By signing below, you agree that you have installed the Greenwood Furnace per manufacturer's instructions and addressed the key installation parameters as outlined above.

Installer Signature: _____ **Date:** _____

By signing below, you agree that that the installer has discussed (1) each of the key installation parameters noted above, (2) shown you how they are implemented on this installation, and (3) discussed unit operation and proper fuel selection and use.

Customer Signature: _____ **Date:** _____

Please send/fax a copy of checklist along with the warranty card to: Greenwood Technologies, LLC 13427 NE 20th Street, Suite 120 Bellevue, WA 98005; Fax: 425-289-4740 or email to: Support@GreenwoodUSA.com; Please keep a copy for your records.

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LIMITED WARRANTY FOR NEW GREENWOOD RESIDENTIAL & COMMERCIAL HEATING EQUIPMENT (U.S. & CANADA ONLY)

GENERAL PROVISIONS

The warranties described below are provided by Greenwood Technologies LLC (“Greenwood”) to the original purchasers of new Greenwood Furnace, Aspen or Pelco Series hydronic furnaces from Greenwood or authorized Greenwood dealers. The warranty registration form and a copy of the original bill of sale must be signed by the customer and the dealer and sent to Greenwood within 30 days of purchase in order to activate this warranty. Under these warranties, Greenwood will, through its authorized dealers, repair or replace, at its option, any Greenwood manufactured part which is found to be defective in material or workmanship during the applicable warranty term. Warranty service must be performed by a dealer or service partner authorized by Greenwood to service the product involved, which will use only new or remanufactured parts or components furnished by Greenwood.

CUSTOMER RESPONSIBILITY

It is the customer’s responsibility to maintain the equipment in accordance with the instructions provided in the Owner’s Manual. Greenwood recommends that you keep records and receipts; you may be asked to prove that maintenance instructions have been followed to verify the warranty claim.

In addition, your responsibilities include operating the equipment in a safe manner, and for the purpose in which it was designed. If a defect in materials or workmanship occurs, it is your responsibility to cease operating the furnace until repairs may be made. Damage which occurs from continued operation may not be covered by this warranty. You should contact your authorized Greenwood dealer immediately so that repairs can be made in a timely manner.

In addition, to be eligible for warranty coverage, your responsibilities include:

- Ensuring that all installation and commissioning checklists have been completed and submitted to Greenwood.
- Ensure the fluid used in the equipment is maintained within Greenwood specifications.
- Providing low-temperature boiler protection of greater than 135 degrees F on the installation of a Greenwood hydronic furnace.
- Paying for freight costs incurred in returning a defective furnace or component part(s) to the point of purchase.
- Submitting a warranty registration card within 30 days of the receipt of the product.

WHAT THIS WARRANTY COVERS

All Greenwood manufactured parts of any new Greenwood product are warranted for the number of years specified below from the verifiable date of purchase. This warranty covers defects in materials or workmanship of a Greenwood manufactured part only. Greenwood will pay for replacement parts as noted above and ground shipment to the local authorized dealer. If the unit was purchased directly from Greenwood, Greenwood will pay for replacement parts as noted above and ground shipment to the original shipping address or the customer premise based on Greenwood’s discretion.

Table 1: Percentage of warranty amount paid by Greenwood based on year of purchase.

Product	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10
Greenwood Furnace	100%	100%	60%	60%	60%	30%	30%	15%	15%	10%
Aspen Series	100%	100%	60%	60%	60%	30%	30%	15%	15%	10%
Pelco Series	100%	100%	75%	50%	10%	-	-	-	-	-

WHAT THIS WARRANTY DOES NOT COVER

Greenwood Technologies does not warrant:

1. Any and all labor, lodging and transportation charges incurred by any person in connection with the examination or replacement of parts claimed by the purchaser to be defective.
2. Any electricity or fuel costs, or increases in electricity or fuel costs, for any reason whatsoever, including additional or unusual use of supplemental heat.
3. Greenwood boilers repaired or altered without prior written approval of Greenwood so as to affect adversely their reliability.
4. Any damages, malfunctions or failures resulting from:

- a. Over-firing the furnace or use of any fuel other than that specified in the owners manual.
 - b. Improper installation or failure to maintain and operate the Greenwood boiler in accordance with the printed instructions that accompany the unit or to install your Greenwood system in accordance with applicable building codes/ordinances or good plumbing and electrical trade practices.
 - c. Failure components that are not defective, but must be replaced during the warranty period as a result of reasonable wear and tear or routine maintenance. These include but are not limited to: firebrick and insulation.
 - d. Improper maintenance, misuse, abuse, accident, negligence, freezing, flood, fire, wind, lightning or Acts of God.
 - e. The lack of boiler low temperature protection as noted above.
 - f. Hard water scale buildup on the inside of the heat exchanger tubes.
5. Any parts not manufactured by Greenwood, including all electrical components which carry their own manufacturers' warranty, generally one year. The customer is responsible for all labor costs necessary to replace these parts.
 6. Any unit purchased from an unauthorized dealer or any online retailer.
 7. Units that have had their rating or certification labels removed. Greenwood products should not be used if the rating label is removed.
 8. Units installed outside the continental United States, Alaska, or the provinces of Canada without prior approval from Greenwood.
 9. Units installed, repaired or otherwise modified by persons other than a Greenwood trained or certified installer or technician.
 10. For Pelco Series biomass boilers, all moving parts (*including augers, sprockets, chain, ash ring, burner, bearings etc.*) have a 1 year warranty. The stir finger, as described in the Operator's Manual carries no warranty.
 11. Greenwood shall not be liable for any default or delay in performance under this warranty caused by any contingency beyond its control.

Greenwood reserves the right to make any changes to the Greenwood product at any time without incurring any obligation with respect to any product previously ordered, sold or shipped.

LIMITATION OF IMPLIED WARRANTIES AND OTHER REMEDIES

The installation of replacement parts under the terms of this warranty does not extend the original warranty period. Greenwood makes no express warranties other than the warranty specified above.

This limited warranty does not cover failure of your hydronic furnace if it is damaged while in your possession, damage caused by unreasonable use of the hydronic furnace and/or damage from failure to properly maintain the hydronic furnace as set forth in the owner's manual.

To the extent permitted by law, neither Greenwood nor any company affiliated with it makes any warranties, representations or promises as to the quality, performance or freedom from defect of the equipment covered by this warranty. IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, TO THE EXTENT APPLICABLE, SHALL BE LIMITED IN DURATION TO THE APPLICABLE PERIOD OF WARRANTY SET FORTH ON THIS PAGE. THE PURCHASER'S ONLY REMEDIES IN CONNECTION WITH THE BREACH OR PERFORMANCE OF ANY WARRANTY ON THE GREENWOOD EQUIPMENT ARE THOSE SET FORTH ON TABLE 1. IN NO EVENT WILL THE DEALER, GREENWOOD OR ANY COMPANY AFFILIATED WITH GREENWOOD BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES. (Note: some states do not allow limitations on how long an implied warranty lasts or the exclusion or limitation of incidental or consequential damages so the above limitations and exclusions may not apply to you.) This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

WARRANTY PROCEDURE

When warranty parts are required:

1. Be prepared to furnish a completed warranty request form which includes the following information:
 - a. Complete model and serial number.
 - b. Proof of required periodic maintenance, installation date and location.
 - c. An accurate description of the problem.
2. Contact your local Greenwood dealer or contractor.

If the installing dealer is unable to provide warranty parts refer to the Greenwood Technologies website at www.GreenwoodUSA.com to locate a dealer in your area, or contact Greenwood Technologies Customer Service directly at: (877) 436-6191

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