

there are some drawbacks. One is that the refractory is not very impact resistant. Because of the high temperatures in the firebox, reloading often requires throwing the firewood in. This breaks up the refractory and causes it to fall apart over time. Because the refractory also protects the boiler shell, when it begins to crack and come apart, the shell is in jeopardy of being exposed to temperatures it wasn't made for. In this type of firebox, there is more residual heat that the water needs to absorb thereby requiring more water capacity which will increase the size and weight of the boiler.

#### IV. How much water capacity?

There should be sufficient water capacity in the boiler to absorb the heat that is still being emitted from the fire after the draft has shut down. Too much water (high mass) is not good because it has a cooling effect on the fire and also creates a demand lag. In burning wood or coal, low mass (too little water) is not a good idea either. This will lead to thermal shock to the boiler significantly shortening its life. Also, there usually isn't sufficient water to absorb the residual heat in the firebox. This often leads to boiling and other associated problems.

#### V. What type of construction?

##### A. Steel

Boiler plate is the industry standard for all pressurized heating systems. This is basically certified mild steel (A36). If the boiler is a pressurized system, it must have been tested by the manufacturer to sixty psi. If the boiler is an open system, there can be no pressure checks because the steel will not handle pressure. The boiler should be made out of .25" thick material for the water jacket and should not have places where there is steel that could get hotter than the temperature of the steel it is welded to. The exception

would be in the case of a fin type secondary heat exchanger. Even in this case, there should be expansion joints in the fins and they should not be in the firebox. Failure to abide by these principles results in cracking and premature failure of the heating unit.

##### B. Stainless Steel

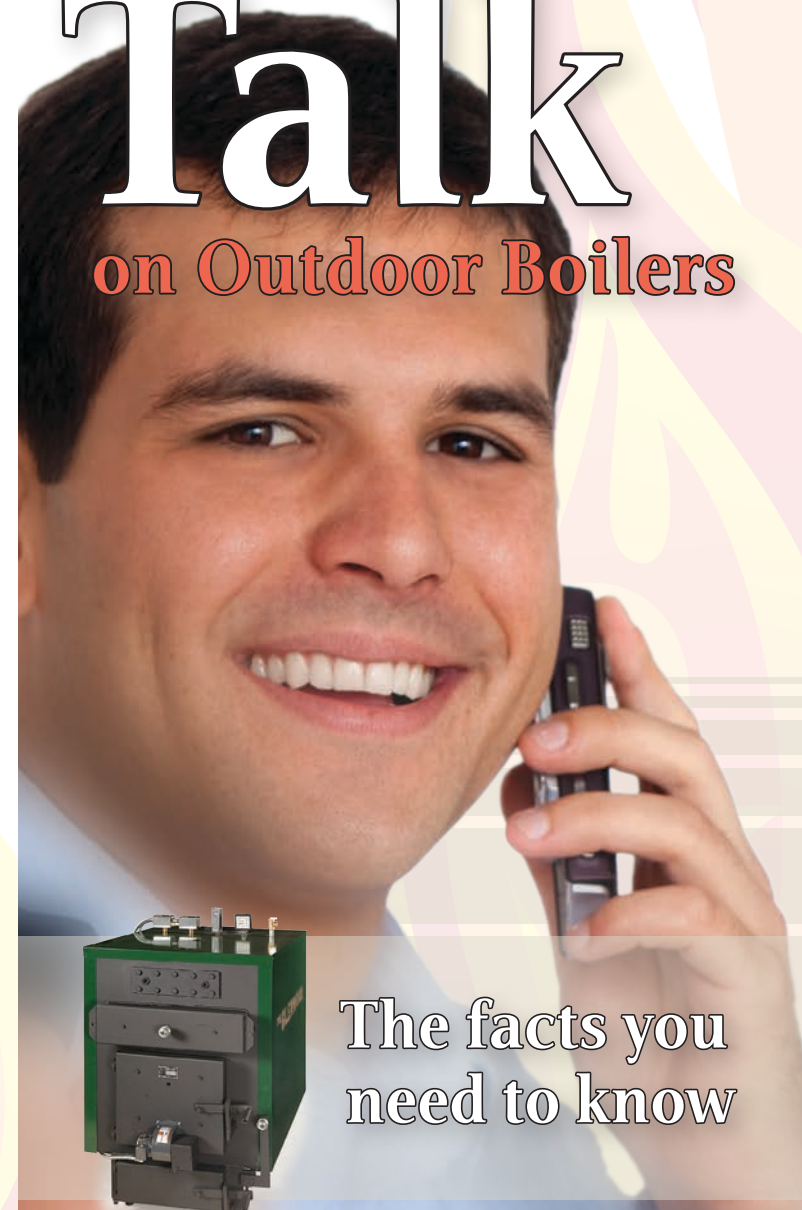
Some companies are touting the benefits of stainless steel in boiler construction. This is misleading. The only benefit is anti-corrosion which can be corrected by changing to a closed system. Stainless steel cracks easily (water leaks) when exposed to high heat and the heat exchange rate is slower for stainless steel than for mild steel. This results in reduced efficiency. Grades of stainless to steer clear of are 304 and 316. If the boiler is made from 409 stainless, there is a possibility that it will work but it must be born in mind that 409 is a poor grade and does corrode. The extra expense is often not worth it.

#### VI. What type of gasification?

Gasification type boilers are being touted as the route to take for high efficiency. There is high combustion efficiency and there is high heating efficiency. Make sure the heating efficiency is as high as the combustion efficiency. The best gasification boilers are the ones that burn the gases inside the firebox and not in a separate gasification chamber. "Upside down burn" gasification boilers have stringent requirements for quality and moisture of wood to the point that sometimes the wood has to be bought in. They also can be hard to start and during periods of low demand, the gasification chamber can cool down to the point that when the fire tries to restart there is not enough heat there to ignite the gases. In many cases the firebox gets very heavily tarred with creosote which becomes corrosive thereby shortening the life of the boiler. Firebox gas combustion boilers are usually more forgiving and offer more fuel options.

**GLENWOOD**  
**HEATERS** LLC  
Efficiency. Durability. Versatility.  
**(717) 587-1696**

# Straight Talk on Outdoor Boilers



The facts you  
need to know

**GLENWOOD**  
**HEATERS** LLC

## This info will save you time, headache and money...

In the last twenty years, outdoor boilers have become a popular means of heating with wood. There are many boiler manufacturing companies and each one has their ideas as to why theirs is better than those made by their competition. This is an effort to help buyers make an educated decision. The following are some key points to consider carefully when making a boiler purchase.

### Six things to ask...

#### *I. Is the system a closed system or an open system?*

##### **A. Advantages of a closed system over an open system**

1. No oxygen can get into the water thereby eliminating the possibility of corrosion through oxidation (rust)
2. No need to keep the outdoor boiler water separate from the indoor system. This eliminates the extra expense and inefficiency of a plate exchanger.
3. Does not need as big a circulator because of the pressure in the system.
4. Much longer life span without needing to treat the boiler water
5. No need to keep resupplied with water

##### **B. Advantages of an open system over a closed system**

1. If boiling occurs in the boiler, the water just steams off and is less likely

to rupture plastic underground piping. All closed systems, however, require a pressure relief valve that will blow if the boiler pressure gets too high.

2. Water temperature can't get as high as with a closed system. This could be an advantage or a disadvantage depending on the application. Greenhouses, livestock buildings, and lumber kilns require high water temperature for effective heating.

#### *II. What is the efficiency rating?*

##### **A. Combustion efficiency should be nearly 100%**

1. Combustion efficiency can be ascertained by ash content, creosote build-up, and smoke. If there is no smoke, very little ash, and little creosote deposits, the fire is burning at peak efficiency. In a solid fuel boiler, this is accomplished by proper amounts of combustion air injected into the firebox at the right spots. However, quality of wood will also affect the ash content and smoke level. Wood that is half rotten or wood with a lot of bark on it makes more ashes and smoke than good quality firewood.
2. A forced draft is usually necessary for proper fuel combustion.
3. A hot fire is also necessary for good combustion efficiency.
4. When a solid burns it goes through a chemical reaction that breaks it down into a liquid, a gas, and a solid. In wood, the liquid is the tar (creosote), the gas is wood gas, and the solid is charcoal. The creosote and gas leave the charcoal at the same time and produce the smoke. If the fire is a "cold" fire, the creosote will separate from the wood gas and condense as a tarry substance either in the chimney or in the boiler. A "cold" fire occurs when there isn't sufficient oxygen to burn the gases and produce a hot fire. The flames are the gases burning. If there isn't much flame soon after the firebox is filled, smoldering will occur, producing un-burnt smoke and creosote. Keep in mind that creosote is not a good thing to have to deal with even if it is only in the stove and not in the chimney. Aside from the fact of a fire hazard, creosote becomes acidic, which will cause corrosion, and retard heat transfer.

##### **B. Heating efficiency should be above 85%**

1. There must be sufficient heat exchange area to transfer all the heat from the fire into the water. In a hot fire, this is mostly accomplished through a multi-pass heat exchanger. This means that the heat from the fire is forced to pass through a set of tubes, fins, or a bank of water pipes. A rule of thumb is that the bigger the firebox the more tubes, fins, or pipes are necessary. If the boiler has water around the firebox, this is considered the first heat exchange pass. If it does not, the heat must make several passes through tubes, fins, or pipe banks before exiting through the chimney.
2. A clean heat exchanger is necessary for efficient transfer of heat.
3. It is important to discover what fuel was used to determine the efficiency rating of the boiler. If wood was used, the rating is only a best guess. The reason for this is that to get an efficiency rating, there must be a known input BTU to receive an output BTU. The difference between these numbers is the efficiency rating. Wood does not provide a reliable input BTU because of the great variation in wood (type, moisture content, forest or fencerow tree, kiln dried or air cured, etc.) Charts are available but they are inaccurate. Heating efficiency can only be accurately rated using a fuel like oil, propane, natural gas, or coal.

#### *III. What kind of Firebox?*

##### **A. Size**

The firebox should be big enough to last for ten to twelve hours but not so big that it can last for a couple of days. Oversized fireboxes result in smoldering, inefficient, smoky fires. They use more wood because the heating value from the burning gases is not available. When burnt hot, the stack temperature on these boilers can reach dangerous levels.

##### **B. Type**

The best firebox is the one with water around it. This provides the best heat exchange. Some fireboxes are lined with refractory. This is designed to make a hot fire with hot firebrick. This is a great idea for burning wood but not a good idea for burning coal. Even though this works relatively well for wood,