Sizing and Buying a Wood Stove
R. Topielec, T. Wykes, and L. Giardina

Before you buy a wood stove for your home, make sure you know the size and type of stove that best suits your house and your heating requirements. Don’t buy a stove based simply on an advertiser’s claims about how big an area it will heat.

The selection of a wood stove should be based on your home’s size and interior layout, on how well it is weatherized, and on how cold your winters are. Understanding these heating requirements will help you avoid buying a wood stove that is either too large or too small for your home.

A properly sized wood stove will save you money and provide the best performance. But getting a stove that is too big is worse than getting a stove that is too small.

If you already have a wood stove that is more than 5 years old, it probably doesn’t burn as cleanly and efficiently as the new certified stoves for sale today. Certified means that a stove has been tested for its operational characteristics and meets Federal Environmental Protection Agency (EPA) emission control standards.

All stoves sold and installed in Oregon must be certified. A list of certified stoves is available from many stove dealers or from the Oregon Department of Environmental Quality (1-800-452-4011). The list tells you stove types, average smoke emissions, heat output ranges, and burn times (how long a fuel load burns).

This publication will help you size and choose the right wood stove for your home.

Stove Performance and Labeling

A properly sized wood stove matches the heating needs of your home, generally operates more efficiently, and emits fewer pollutants. Before you buy, check performance data for any wood stove you are considering. New stoves display two certification labels indicating they’ve been tested and meet EPA emission control standards:

- A permanently attached label, usually displayed on back of the stove, indicates it has met EPA emission standards. This label also states the date of the stove’s manufacture, where it was tested for safety, and installation instructions.
- A removable showroom label, attached to the top or front of the stove, describes the stove’s emissions range, efficiency range, and heat output range.

Figure 1 illustrates the two types of labels found on new stoves. The removable label indicates that this particular stove’s emissions vary from a little over 1 to about 1.5 grams per hour over the stove’s heat output range. The label also shows that typical efficiency for this type of stove ranges from about 60 to 67 percent, and lists a delivered heat output range between 11,900 and 43,200 Btu per hour.

Older certified stoves should have labels with similar information but in different form.

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Figure 1.—Permanent (top) and removable (bottom) labels.

CONTACT YOUR LOCAL BUILDING OR FIRE OFFICIALS ABOUT RESTRICTIONS AND INSTALLATION INSPECTION IN YOUR AREA

Safety Testing (Listing) Laboratory Name

Manufactured by: Manufacturer’s Name

TESTED TO: UL STANDARD Type of Fuel: SOLID WOOD ONLY

House Fire Warning

Minimum Clearance to Combustible Materials (inches)

Clearance Instructions

Installation Diagram Showing Clearances

U.S. ENVIRONMENTAL PROTECTION AGENCY Certified to comply with July 1, 1990 particulate emission standards

DATE OF MANUFACTURE


Made in U.S.A. DO NOT REMOVE THIS LABEL

Manufactured by

U.S. ENVIRONMENTAL PROTECTION AGENCY Meets the particulate matter emission control requirements for noncatalytic wood heaters built on or after July 1, 1990.

SMOKE

0 (Grams Per Hour) 35

EFFICIENCY

50% 60% 70% 80% 90% 100%

Wood heaters with higher efficiencies cost less to operate.

*NOT TESTED FOR EFFICIENCY. THE VALUE INDICATED IS FOR SIMILAR NONCATALYTIC WOOD HEATERS.

HEAT OUTPUT

11,900 to 43,200 Btu/Hr

Use this to choose the right size appliance for your needs.

ASK DEALER FOR HELP

This wood heater will achieve low smoke output and high efficiency only if properly operated and maintained. See owner’s manual.

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Sizing Your Wood Stove

Wood stoves are space heaters. This means they are limited in their ability to move heated air around walls and over long distances. However, a wood stove can heat larger areas of your house if you use a fan to move heated air. You also can heat rooms above the stove if you have floor registers or stairwells to move air to and from the space.

Try to determine as closely as you can how big an area of your house you can actually heat with a wood stove.

**Step 1**

**Estimate floor area**

Basically, a stove placed in one room will heat adjacent rooms if air flow is unobstructed at both the ceiling and floor. This can be accomplished with vents large enough to permit natural air movement, with vents and fans to mechanically move the air, or simply (but much less effectively) through an open doorway. Evaluate your home’s floor plan to determine which rooms you can actually heat with a wood stove and determine the area in square feet.

**Step 2**

**Select weatherization level**

There are five basic weatherization levels:

- **Poor**—No wall, ceiling or floor insulation; single-pane windows.
- **Fair**—3½ inches of insulation in walls, 6 inches of insulation in ceiling, no floor insulation; single-pane windows.
- **Average**—6 inches of insulation in walls, 6 inches of insulation in ceiling, 6 inches of floor insulation; double-pane windows.
- **Good**—6 inches of insulation in walls, 12 inches of insulation in ceiling, 6 inches of floor insulation; double-pane windows.
- **High**—6 inches of insulation in walls plus exterior wallboard insulation, 12 inches of insulation in ceiling, 8 inches of floor insulation; double-pane windows.

If your home falls between two levels, choose the lesser of the two.

**Step 3**

**Determine average and maximum heat outputs**

Use Figure 2 to determine your stove’s average and maximum heat outputs. Locate square feet to be heated and read across to weatherization level of your home. Read down to “average” and “extreme” winter conditions for your area then left to the stove heat outputs in Btu per hour. These values will estimate the range of the stove’s output necessary to heat the home during average and extreme winter conditions.

**Step 4**

**Compare your results with performance data**

A properly sized wood stove should be capable of supplying the heat output needed for typical winter conditions of your locale. The stove also must have sufficient capacity to supply needed heat during the coldest periods of the year. Select a stove with a heat output range from 20 percent below what’s needed for average winter conditions to what’s needed for extreme winter conditions.

The stove also should have a burn-time between refueling that meets your expected use. For example, if you like to hold a fire overnight, select a stove that the Oregon DEQ lists as having at least an 8-hour burn-time at low burn rates.

You may choose to use your conventional heating system as backup on very cold days. If so, your wood stove could provide less than the maximum heat output determined from the graph.
Figure 2.—Wood stove sizing graph based on a single story, 1,800 square foot house with window area 15 percent of floor area.
Stove Sizing Example
A 1,400 square foot home in Eugene will be partially heated by a wood stove. The floor plan lends itself to heating 900 square feet of floor space. The homeowner has decided that the wood stove should be able to heat the space on the coldest day of the year.

The home has double-pane windows, no insulation in the floor, 3/8 inches in the walls, and 6 inches in the ceiling.

Follow the four steps outlined in the previous section to determine characteristics of a properly sized wood stove.

**Step 1**
We need to heat 900 square feet.

**Step 2**
Although this home has double-pane windows, its weatherization level is closest to the “fair” level.

**Step 3**
Locate 900 square feet on Figure 2 and read across to the “fair” weatherization level. Read down to “average” winter conditions in the Willamette Valley, then left to a stove heat output of 9,000 Btu/hour. This value is an estimate of the stove’s output necessary to heat the home during average winter conditions.

As the weather gets colder, the stove should have the capacity to meet the increased heating requirements of the home. To determine the necessary maximum heat output of the stove, extend the line from the “average” down to the “extreme” winter conditions line for the Willamette Valley. Now read across to 22,000 Btu/hour.

**Step 4**
In this example, the heat output needed for average winter conditions is 9,000 Btu/hour and about 22,000 Btu/hour for extremely cold days. The buyer should look for a wood stove that shows on its EPA certification label a heat output range from 20 percent below
what’s needed for average winter conditions to what’s needed for extreme winter conditions: 7,200 to 22,000 Btu/hour.

Buying Your Certified Wood Stove
Certified wood stoves are designed to meet new EPA emissions standards. They incorporate design features that reduce smoke emissions and increase operating efficiencies well above the older non-certified types. Typical efficiencies of certified wood stoves are 65 to 80 percent, well above the 40 to 50 percent efficiencies of the 1970s and early 1980s.

Three types of wood stoves are considered in this publication: non-catalytic, catalytic, and pellet. Non-catalytic and catalytic stoves are in the state certification program. Pellet stoves are exempt from wood stove certification regulations because they operate differently and more readily achieve high efficiency and low emissions. These three types are discussed in detail below.

**Non-catalytic wood stoves**
Non-catalytic wood stoves probably are the type of stove most people are familiar with (Figure 3). These stoves consist of a firebox, air controls, and baffles to contain and recirculate combustible gases for efficient combustion. Their design features allow them to achieve low emissions and high efficiencies if properly operated.
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Proper operation is critical for combustor life. Failure to ignite gases at the combustor or burning anything other than untreated wood can ruin it.

Primary combustion air entering these stoves is preheated to keep combustion temperatures high for more complete burning. The more complete the combustion, the more heat is extracted from the fuel and the less unburned gases emitted in the form of pollutants.

Baffles are metal plates positioned inside the stove that form barriers to the early escape of unburned combustible gases. The baffles keep combustible gases in the primary combustion zone for as long as possible, then route the unburned gases to the secondary combustion zones. Preheated secondary air also is introduced to the secondary combustion zones to ensure re-ignition of combustion gases.

Fireboxes generally are small to encourage the fuel to burn hotter fires. They often are insulated or contain firebricks to maintain high temperatures in the combustion zones. The air inlets usually have stops that prevent them from being completely closed. This feature ensures adequate air for combustion but shortens the burn time between refueling.

Figure 3.—Non-catalytic wood stove.

Catalytic wood stoves
Catalytic wood stoves (Figure 4) use a specially treated smoke combustion unit to achieve high efficiencies and low emissions. Properly operated catalytic stoves achieve nearly complete combustion. Catalytic stoves have large fireboxes, air controls, and can be operated at slow burn rates for long burns between refueling.

Catalytic stoves contain a ceramic, honeycomb-shaped combustor typically placed in a baffle plate out of direct contact with flames. The combustor is coated with a chemical catalyst (platinum or palladium) that promotes ignition of gases at lower temperatures (350-600°F).

Fires are started with dampers or other mechanisms disengaging the combustor unit and diverting smoke around it. Once the fire is hot enough for gases to ignite with the combustor's surface coating (350-600°F), the combustor is engaged and smoke is directed through it. Many catalytic stoves introduce preheated secondary air at the combustor to supply adequate oxygen for combustion.

Proper operation is critical for combustor life. Failure to ignite gases at the combustor or burning anything other than untreated wood can ruin it. Exposure to temperatures above 1,600°F also will damage the combustor.

Figure 4.—Catalytic wood stove.
Catalytic wood stoves cost about $200 to $300 more than non-catalytic stoves. Combustor units sold in Oregon must have at least a 2-year warranty. They cost from $100 to $200 to replace. Follow the manufacturer's recommendations for combustion unit cleaning and maintenance to extend its useful life under differing conditions.

**Pellet stoves**

Pellet stoves (Figure 5) burn wood pellets manufactured from wood waste. Pellets are loaded into a hopper where a motorized auger, controlled by a dial or thermostat, moves the pellets into a small burner in the firebox. Combustion air is blown or sucked into the firebox by fans that also exhaust unburned combustion gases through a small diameter stovepipe. Before being exhausted to the outside, the hot gases pass through a heat exchanger. Another fan blows air across the heat exchanger, warming air on its way into the house.

Pellet stoves require electricity to operate fans and augers, so they can't provide heat during power outages (unless they have a battery or generator backup system). The electric motor consumes about 150 watts of power and is part of the expense of operation.

Wood pellets must be purchased but are clean and easy to handle and store. Pellets are readily available throughout the state. Prices vary depending on location.

Pellet stoves are more expensive to buy and operate than other types of wood stoves. But they usually don't require as expensive a chimney system. Pellet stoves have much better controlled air-to-pellet ratios than other stove types and achieve nearly complete combustion. In addition, their heat transfer is excellent. These features rank them as generally the highest in efficiency and lowest in smoke emissions among stove types.

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**Other Things to Consider**

No matter which wood stove you choose, provide a direct connection of outside combustion air to the firebox. This will reduce the potential for polluting the air inside your house. It also will reduce the amount of warm indoor air drawn through your wood stove and sent out the chimney, so you eliminate a major source of heat loss.

If you live in an area classified as non-attainment, that is, an area that is more susceptible to lingering air pollutants and has difficulty achieving EPA air quality standards, be sure to find out if there are any restrictions or regulations that may influence your stove buying decision.
### Other Space Heating Options

A wood stove is not the only space heating option available. Figure 6 shows how some others compare.

<table>
<thead>
<tr>
<th>Heater Type</th>
<th>Fuel Type</th>
<th>Heating Cost per MBtu</th>
<th>Impact on Environment</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncertified wood stove; 40-50% efficient</td>
<td>Cut or purchase firewood</td>
<td>$7.04 @ $70.00/cord; $10.98 @ $75.00/cord</td>
<td>Emissions one third lower than uncertified wood stove; High efficiency means more heat from less wood; low emissions</td>
<td>Load less than a certified stove; Must reload every 2-3 hr; installation is against the law</td>
<td></td>
</tr>
<tr>
<td>Certified non-catalytic wood stove; 60% or more efficient</td>
<td>Cut or purchase firewood</td>
<td>$6.40 @ $70.00/cord; $9.90 @ $75.00/cord</td>
<td>Emissions one third lower than uncertified wood stove; High efficiency means more heat from less wood; low emissions</td>
<td>Small firebox; Must replace catalytic combustor; small firebox</td>
<td></td>
</tr>
<tr>
<td>Certified catalytic wood stove; 60% or more efficient</td>
<td>Cut or purchase firewood</td>
<td>$6.40 @ $70.00/cord; $9.90 @ $75.00/cord</td>
<td>Emissions one third lower than uncertified wood stove; High efficiency means more heat from less wood; low emissions</td>
<td>Small firebox; Must replace catalytic combustor; small firebox</td>
<td></td>
</tr>
<tr>
<td>Pellet stove; 80% or more efficient</td>
<td>Must purchase pellets</td>
<td>$10.00 © $125.00/ton; $12.00 © $150.00/ton</td>
<td>Very low emissions; burns wood waste; Thermostatically controlled</td>
<td>Requires small, through-the-wall vent or chimney; doesn't work during power failure</td>
<td></td>
</tr>
<tr>
<td>Electric space heater; 100% efficient</td>
<td>Purchased</td>
<td>$11.70 © $0.06/kWh; $30.00/ton; $0.04/kWh; $0.06/kWh; $0.06/therm</td>
<td>No venting required; good for periodic use; thermostatically controlled</td>
<td>Doesn't work during power failure</td>
<td></td>
</tr>
<tr>
<td>Natural gas insert/space heater; 70% or more efficient</td>
<td>Purchased</td>
<td>$6.00 © $0.60/therm; $0.60 @ $0.60/therm</td>
<td>Very clean burning; Some work during power failure; thermostatically controlled</td>
<td>Requires small, through-the-wall vent or chimney</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Uncertified kerosene heaters are not permitted for home use.

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