

# Wood Stove Selection

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Wood-burning stoves have recently become very popular due to rising energy costs and energy conservation concerns. A wood stove can be used to heat one room or a house, for cooking or just aesthetics.

Wood stove efficiencies range from under 20% for a poorly-designed stove (which allows 80-90% of heat generated to go up the chimney) to over 50% for a well-designed, efficient, draft-controlled stove. There are few, if any, regulations governing the design and construction or performance of wood stoves. Efficiency depends primarily on:

- design of stove
- design and condition of chimney
- wood used for fuel
- skill of operator

To understand wood stove efficiency, we must first understand the three phases of wood-burning. First, the wood is heated to evaporate and drive off moisture. This occurs under 500°F. Above 500°F the wood starts to break down chemically and volatile matter is vaporized. These vapors contain 50-60% of the heat value in the wood. At 1100°F these vapors burn. This high temperature must be maintained for maximum combustion efficiency. The third phase of wood burning occurs above 1100°F when the remaining material (charcoal) is burned. Actually, all three phases of burning may and usually do occur at or about the same time. For efficient burning, the volatiles must be mixed with air and kept at 1100°F or higher to burn completely within the stove. Wood burns with a long, yellow flame. By providing a long flame path within the stove, heat from these burning gases can be utilized before escaping up the chimney.

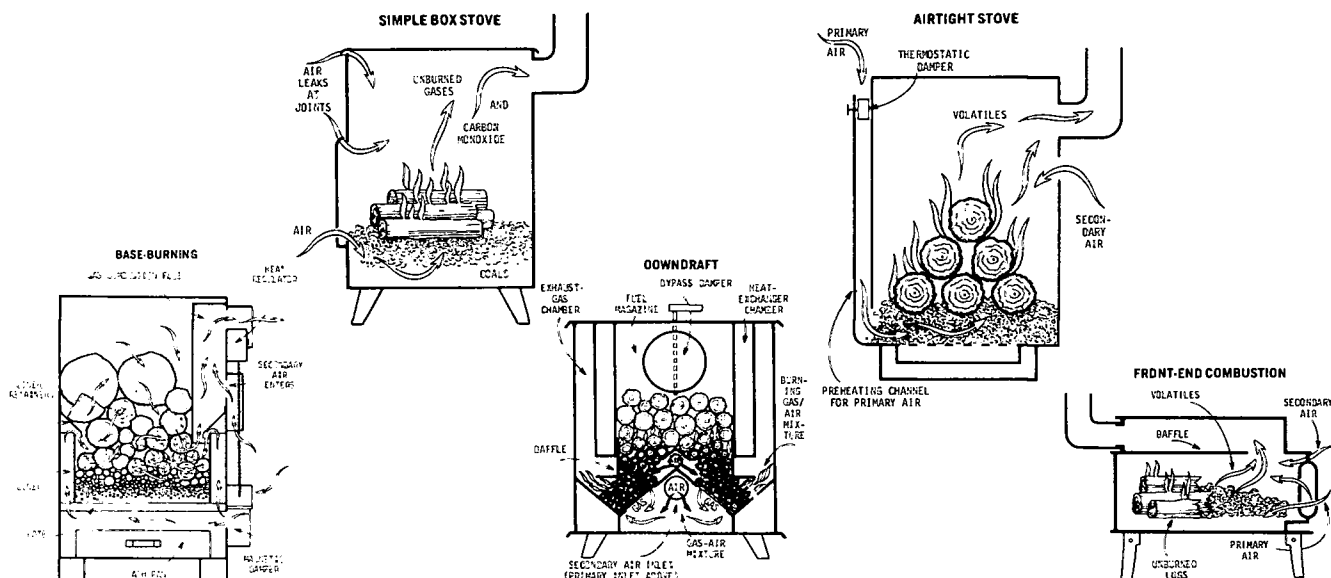
## Wood Stove Designs

**Box or chunk stoves** are the simplest and most common type available. They come in many forms including kitchen, Franklin, pot belly and parlor stoves. These generally do not have very positive draft control and consequently burn excessive amounts of wood. Most introduce air under the fire. Some introduce additional air over the fire to help provide needed oxygen to burn escaping volatile gases. Unburned gases carry large percentages of potential heat up the chimney.

**Airtight box stoves** have controlled-draft damper systems, some with automatic thermostats, to give more positive control of both primary and secondary combustion air. Most introduce air below and above the fire. Some designs preheat incoming combustion air. Others incorporate thermostatically-controlled heat exchangers to recapture heat for space heating.

**Base-burning airtight stoves** take the principles of the controlled-draft box stove one step further and add a second chamber for better combustion of the gases. These stoves bring secondary air through a pre-heating channel so it will not significantly cool the volatile gases. In addition, the flue outlet is located at the base of the fire box, forcing all exhaust products to pass by the hottest part of the fire before leaving the stove. Under proper conditions, these stoves can be fairly efficient but still need frequent tending.

**Down-draft airtight stoves** are relatively simple in design. Air is drawn down through air ports in the stove top, producing a blow torch effect. Volatile gases from fresh fuel are driven through the glowing coals. In some down-draft models, primary air enters above the



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fire but below main load of wood. This primary draft flows down and outward through the glowing bed of coals, pulling volatile gases with it. Secondary air is introduced under the coals where it can oxidize these superheated gases. Gases continue to burn in the secondary chamber. This draft pattern prevents heat of fire from rising up through fresh wood load, isolating it from fire until wood has dropped down into proper burning position. Thus, even a full load of fresh fuelwood will not cool the fire below. Volatile gases from the new fuelwood are also released more slowly for more efficient burning.

Some down-draft stoves use a thermostatically-controlled fan to circulate hot air through heat exchange chambers. This arrangement takes advantage of heat otherwise lost up the chimney.

**Front-burning airtight stoves** characterize the Scandinavian approach to efficient wood burning. Primary air is directed into the coals, forcing the volatile gases into the burning area. Secondary air is introduced above the fire for burning of escaping gases in a baffled secondary chamber. Since oxygen is consumed near front, burning toward back is delayed.

As a rough estimate, assuming dry wood is the fuel source, the following combustion efficiencies can be expected for the stove types discussed. These are also compared to standard fireplaces.

Standard fireplace	up to 10%
Simple box	20-30%
Airtight box	40-50%
Base-burning	40-60%
Down-draft	50-65%
Front-end combustion	50-60%

### Stove Construction

Wood stoves are constructed from sheet metal, plate steel, cast iron or combinations of these metals. Generally, the heavier the stove, the better the heat-holding and spreading capabilities.

**Sheet metal stoves** are relatively thin gauge. They are inexpensive and have a shorter life than plate steel or cast iron stoves. They will heat a room quickly, but they also cool rapidly as the fire burns down. Thin-wall stoves should never be heated red hot as they tend to warp and burn through. They should have several inches of dirt or sand in the firebox bottom to prevent burnout by hot coals. These stoves need to be examined frequently for thin spots.

**Plate steel stoves** 1/8-inch thick or thicker hold heat longer than sheet metal stoves. Many are lined with firebrick to provide more heat and to protect the metal—steel will warp if it is overheated repeatedly. Historically, steel stoves have been bolted together rather than welded in order to reduce warpage problems. In many cases, cast iron doors, door frames and cast iron or firebrick firebox liners have been used to extend the life of the steel stove.

**Cast iron** has long been considered the best material for wood stoves. Cast iron stoves warm up slowly and have good heat-holding capability. Designs and texture cast into plates can increase radiating surface by up to 25%. Cast iron holds up well under heat, has a long life, spreads heat away from hot spots in the fire and generally does not warp. The characteristics of a good cast iron stove are heavy, smooth castings, fully ground and fitted plates, tightly sealed seams and

tight-fitting doors with positive latches, internal baffles and side liners, tight and easily-adjusted draft controls and smooth, pit-free enamel finishes. Care should be used in handling cast iron because it cracks easily. In the long run, a finely cast, hand-fitted air-tight, well-designed cast iron stove is a good investment.

### General Considerations

All wood stoves should have sturdy legs, providing at least 4 inches and preferably 8 to 10 inches of air space between stove bottom and floor. Glass windows in wood stoves should be special safety glass designed to withstand thermal shock.

A stove designed to burn wood only should not be used to burn coal; some stoves are designed to burn either. The excessive heat of coal will soon burn out the grate or bottom of a stove designed for wood only. Burn manufactured logs only in an open fireplace—they contain wax that burns dangerously hot.

A wood stove needs ample air for efficient operation. A well-insulated home with tight doors, windows and weather stripping may not have enough air leakage to supply necessary air for proper combustion, causing poor burning and smoke. Where feasible, the simplest way to get combustion air to the stove is through an opening in the floor under or in front of the stove which provides an air passage for feeding outside air to the stove. The size of the passage should be roughly the same as that of the flue. A damper should be installed to adjust outside air flow and to close it off when stove is not in use. *Check with your local fire department for fire code requirements concerning size, location and type of outside air passages.*

Many manufacturers rate their stoves either by number of cubic feet or number of rooms the stove will heat. Any capacity rating must be used judiciously. As a general rule, 2.6 sq ft of firebox bottom is required for each 1000 sq ft of room area. Unless the rooms are very open, or a forced air duct system is installed between rooms, attempting to heat more than one room with a stove may well result in uneven temperatures and cold drafts along floors.

When stovepipe has been installed, perform the *tap test*. Simply tap the pipe with your fingernail and remember the sound it makes. Repeat this procedure every week during heating season. If the "ting" sound changes to a muffled "thud," it is time for a creosote inspection. Creosote tends to build up more quickly in the airtight stoves because combustion is not complete and unburned volatile gases go up the stovepipe and condense as creosote.

### Wood Stove Installation

Many people purchase wood stoves without considering the necessary steps or additional costs for installation. Temporary expediences—such as running a single-wall stove pipe through walls, ceilings, roofs or windows—do not meet fire codes and may result in serious fire or cancellation of fire insurance. Install your wood stove in compliance with your local building code or fire department requirements—and be safe rather than sorry. Then have your insurance company approve the installation.