

# **Wood Heating**

**Safety, Savings and Comfort**



**Governor's Office of Energy Resources  
Georgia Forestry Commission**

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**Georgia Forestry Commission**

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## **Disclaimer**

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While installation specifications in this manual have been taken from national sources, safety codes and standards are being revised. You should always check with your local safety and building code officials prior to installing a wood heater and have these officials inspect the heater after it is installed.

This publication is based on materials from **Safe and Warm Wood Heat**, Third Edition, originally prepared for the Tennessee Valley Authority by the Georgia Institute of Technology in 1981.

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# Foreword

Since 1973, escalating fuel prices have forced more and more Americans to rediscover wood as a source of heat. Not only is wood a renewable resource in plentiful supply, it is also relatively cheap. In terms of heating capacity, it is estimated that a cord of hardwood burned in an airtight heater will deliver as much heat as 160 to 170 gallons of No. 2 fuel oil, or 260 therms of natural gas, or 6300 kilowatt hours of electricity. With hardwood selling for less than \$90 per cord in much of the United States, wood can offer substantial savings on heating costs.

The U.S. Bureau of the Census data for 1970 show that there were nearly 800,000 occupied housing units in the U.S. in which wood was used as the principal heating fuel. Of this number, almost one-third were located in the South Atlantic states.

In the early 1980's, a Gallup poll indicated that there were 5 million wood heaters in use in the U.S. The U.S. Environmental Protection Agency (EPA) has estimated that present wood heater use is 12 million, which is about 19 percent of all one- and two-family dwellings. Heater shipments averaged 2.2 million per year from 1981 to 1985, but have recently declined due to stabilized oil and gas prices and maturation of the wood heating market.

Georgia residences used about 1.6 million cords of fuelwood in 1986. During the first five decades of this century, fuelwood consumption had dropped sharply as oil, gas, and electricity were substituted for domestic heating and cooking. Recently, however, considerable demand for fuelwood has developed in both rural and urban areas for primary and secondary heating.

For the most part, owners of woodburning heaters can anticipate many years of adequate fuel supplies. U.S. Department of Agriculture Forest Service data indicate the area of commercial forest in the U.S. to be about 488 million acres, an area which is expected to remain relatively stable into the 21st century.

As manufacturers continue their research and development, the use of wood heaters is likely to increase. Equipment and methods to enhance the performance of new or existing wood heaters are being developed. The use of catalytic combustors, baffles, and firebrick linings are proving significant in increasing efficiency and decreasing emissions in wood heaters. These innovations indicate that wood is progressing as an important alternative energy source.

# INTRODUCTION

## Is Wood Heat for You?

For decades, all Georgians used wood, burned in a fireplace, to heat their homes. However, heating with a fireplace required large amounts of wood and work. Most of the heat escaped up the chimney and much of the house stayed uncomfortable. With the development of wood heaters (wood stoves, central furnaces, and fireplace inserts) more of the house could be heated with less wood.

Today over 380,000 Georgia homes have wood heaters. Heating with wood can save you money, especially if you have an economical source of firewood and rely on one of the more efficient wood heaters. Wood heat has other advantages, too. It can provide a backup during winter power outages as well as a warm conversation center where family and friends inevitably gather. Some people also enjoy the activity of cutting and splitting firewood and stoking the fire.

But there definitely is manual labor involved with wood heaters, and a fire-safe lifestyle is a must. Remember that a wood heater installation is nearly permanent, so if you rent or move every few years, the heater will probably remain behind. Adding a wood heater could also affect your homeowners insurance, and if the installation is not done properly, lessen the home's value.

Before switching to wood heat, consider the lifestyle changes you will have to make. Are you willing to gather wood? Is a high, medium, or low heat setting sufficient for you rather than the precise temperature control of conventional systems? Do you want the cheery warmth of a wood heater even if it means intermittent stoking of the fire, cleaning the flue, and emptying ashes?

If you're willing to accept these lifestyle changes and you have a low cost source of firewood and an efficient wood heater, then you should be able to save substantially on home heating costs. But remember, even with wood heating, you should adopt practical energy conservation measures. By saving energy, you will save money and improve comfort levels in your home

throughout the year. Follow the energy conservation guidelines presented in the publications listed in the references at the end of this book.

How much a wood heater saves you depends on how much you would pay to heat your home without wood. Many homeowners save 50 percent or more on electric or gas costs for heating by using wood.

The energy used for heating your home is commonly measured in British thermal units (Btu). A Btu is roughly equal to the amount of heat given off when a kitchen match is burned. Each year a typical 1800-square-foot home in Atlanta needs around 80 million Btu for heating. For Savannah, the house would need around 50 million Btu.

The cost of heating a home is determined by how much heat is needed, the price of the fuel to provide that heat, and the efficiency of the heating system. Assuming that the amount of heat needed does not vary according to how it is provided, then the fuel cost and efficiency determine home heating costs. The value of delivered heat for standard heating systems is given in Table 1.

**TABLE 1**  
**Average Cost of Home Heating**

Type of Heating System	Cost of Fuel	Cost of Heat Per Million Btu
Standard Wood Heater	\$60-\$80/cord	\$5-\$7
Gas Furnace (60% efficient)	\$.50-.75/therm	\$8-12
Gas Furnace (80% efficient)	\$.50-.75/therm	\$6-9
Electric Resistance Furnace	\$.06-.075/kWh	\$18-22
Electric Heat Pump(COP = 2.2)	\$.06-.075/kWh	\$8-10

# CHAPTER 1

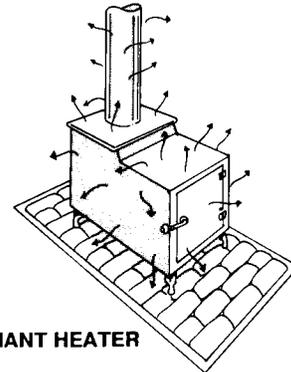
## Heating Your Home with Wood

**B**oth fireplaces and wood heaters are space heaters. They primarily radiate heat to people and objects close by. To a lesser degree, they heat the surrounding air. However, fireplaces lose much of their heat up the chimney. In fact, they can actually lose more heat than they furnish to the home. Wood heaters are much more efficient and can be an effective way of heating a home.

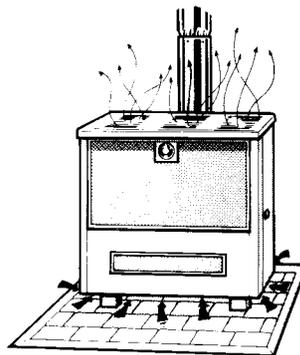
### Types of Wood Heaters

There are two categories of wood heaters -- radiant and circulating. Radiant heaters are the most common and heat a home by radiating heat directly from hot surfaces to the surrounding area. Circulating wood heaters are covered by an outer metal jacket. Room air is heated as it circulates between the jacket and the hot surfaces of the heater.

There are three basic types of radiant wood heaters -- open, box, and airtight. Open heaters are for watching the fire; box heaters are for occasional heating of

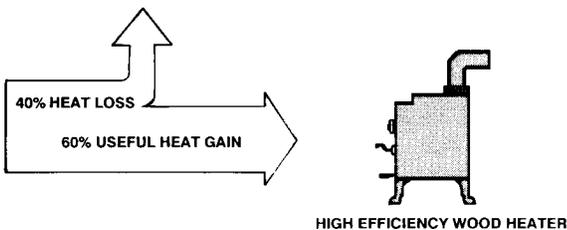
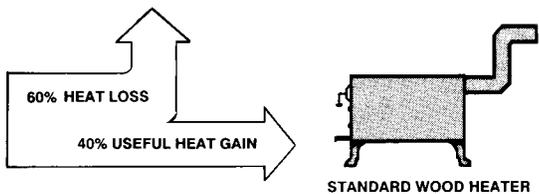
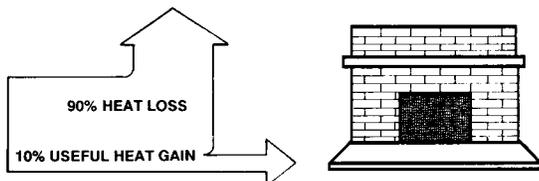


RADIANT HEATER

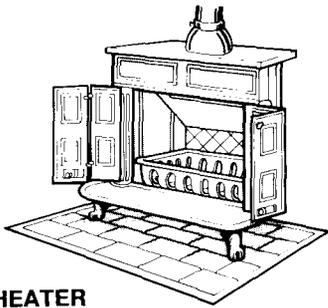


CIRCULATING HEATER

### WOOD HEATING EFFICIENCY

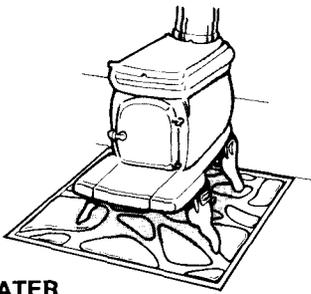


small areas. But if you are serious about supplementing a regular heating system and cutting the family fuel bill, you should use an airtight heater. An airtight heater is not really airtight, but rather controls both the location and amount of air entering the heater. Air leaks are almost always detrimental to combustion because they occur at the wrong place and the wrong time, cutting down your ability to control the heat output. The only practical test is a visual inspection. Look for cracks around the door or other movable exterior parts and around joints of the various fixed parts of the heater. Make certain the door has a high temperature gasket to minimize unwanted air leaks.



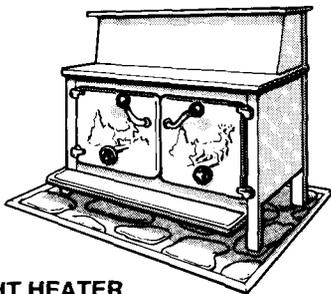
### OPEN HEATER

Open heaters, also known as open stoves, fireplace heaters and Franklin stoves, have doors that stay open when a fire is burning. An open heater attempts to combine the efficiency of an enclosed firebox with the romance of dancing flames. Open heaters are much more efficient than regular fireplaces, but not nearly as efficient as airtight heaters. They require frequent stoking to obtain a steady heating rate and cannot keep a fire overnight. A tightly constructed house can cause an open heater to smoke by restricting its air supply.



### BOX HEATER

Box heaters may be square, round, oval, or pot-bellied. Unlike Franklins they don't have doors for viewing the fire. Box heaters are also drafty, so control of the fire is determined primarily by the amount of wood added. Box heaters are for occasional use with constant attention.



### AIRTIGHT HEATER

The size and shape can vary, but airtight means no air can get into the combustion chamber except where it's designed to enter—at the air inlet dampers. This makes airtight heaters more efficient and controllable than open or box heaters. Airtights are for heating large areas over long periods of time with minimum supervision.

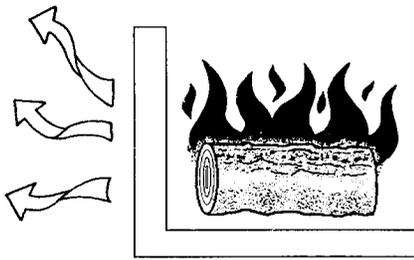
## How a Wood Heater Works

A wood heater warms your home by radiation, conduction, and convection. The burning fuel within the wood heater radiates and convects heat to the walls of the firebox. The heat is then conducted through the heater wall and radiates from the heater walls into the room. Heat is further transferred by convection. However, the wood heater is only part of the wood heating system. Heat transfer from the walls of the stovepipe and chimney must also be considered.

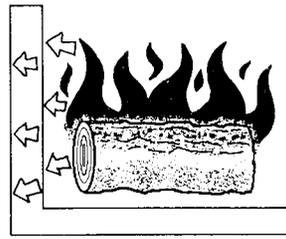
## Efficiency

Other things being equal, more efficient heaters use less wood to do the same heating job. Airtight doesn't automatically mean high efficiency. Overall heater efficiency is a combination of how much heat is generated from the wood (combustion) and how well that heat is transmitted to the room (heat transfer). Good combustion requires sufficient oxygen, good mixing, and high temperatures in the combustion zone (the area of the heater where the fire is contained). Good heat transfer requires proper removal of heat from the combustion zone and flue gases. A key factor is optimum use of inlet air.

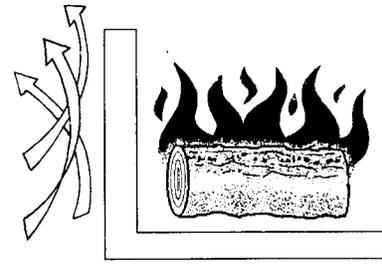
Heater manufacturers try to make their heaters more efficient with a myriad of designs using secondary air inlets, secondary combustion chambers, preheated inlet air, thicker walls, large fireboxes, baffles for turbulence, and various flow patterns. Not all of these really increase efficiency. But various heater-testing facilities exist around the country, so unbiased efficiency ratings are available. Jay Shelton discusses heater design and efficiency in his *Woodburners Encyclopedia*. His tests indicated that average efficiencies generally range from 45 percent to 65 percent for installations with six feet of stovepipe. Catalytic heaters usually show an additional 10 percent in efficiency. Higher efficiencies being quoted by sales brochures are most likely measured under ideal conditions such as oven-dried fuel and controlled chimney draft.



**RADIATION**



**CONDUCTION**



**CONVECTION**

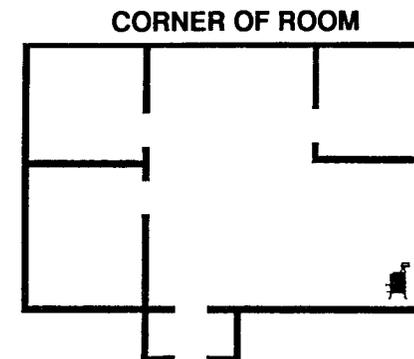
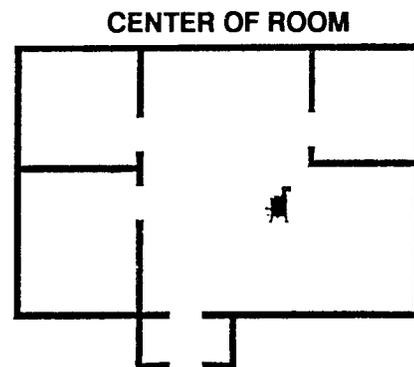
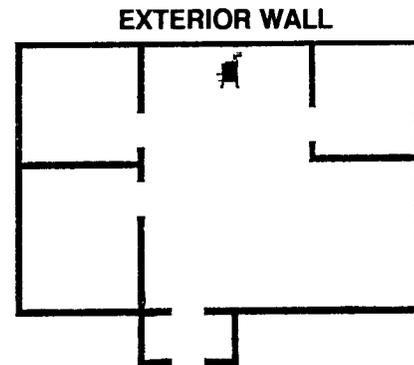
**OPTIONS FOR LOCATING A WOOD HEATER**

**Heater Placement – Where and Why**

Your heater should be located in a frequently used area such as the living room, family room, or den. You can stay warm and comfortable for most daily activities and still keep the bedrooms cooler for sleeping. Make certain that any location will provide for a direct escape route from the room in the event of fire. The placement should also provide quick access to safety materials such as fire extinguisher, sand bucket, gloves, and first aid kit.

Select a location in the room that will avoid your having to make major modifications to the house structure. The chimney is the key. Find a place that will minimize costs yet still provide good heat distribution to the home and be safe. When you have decided on a location, inspect the structural support under the floor on which the heater will be placed to make sure it is adequate.

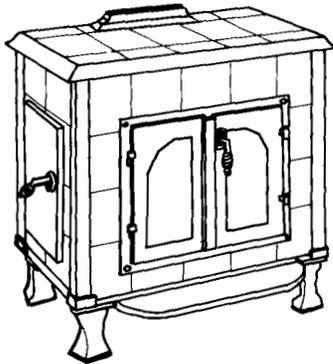
The ideal place for a heater is in the center of the room, where it can radiate heat in all directions. The location should also allow free air movement to other rooms. The worst place to put a heater is in a confined area such as an alcove. Heaters are often placed along the middle of an outside wall and vented straight up through the roof. The wood heater should not block the everyday traffic patterns for your family. Keep a safe distance to protect arms and clothes as people walk past. Remember, every installation requires proper clearance between heater system surfaces and the surroundings to keep your home fire-safe.



## Design Features

While there are many different types of design features, most do not affect the heating performance of the heater, but should be kept in mind for your own convenience.

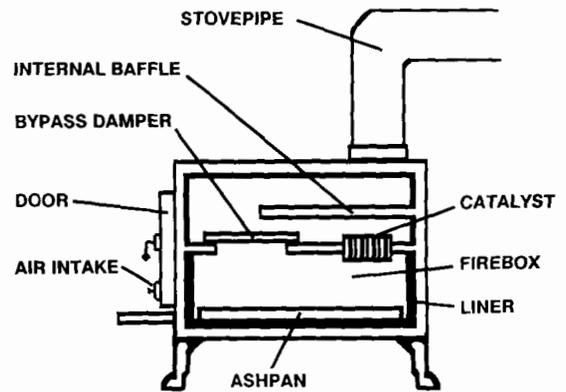
- Deciding between a stove made of cast iron versus one of plate steel is largely a matter of preference. Each has advantages and disadvantages. Cast iron cracks, plate steel warps, and both are susceptible to corrosion. But neither has proven more efficient than the other. Top quality, tightfitting construction rather than material is the key to a good heater. Generally, the heavier the heater of a given size the better the quality. Some heaters are made of ceramic or stone, such as the soapstone or European tile stoves. The masonry of these heaters stores heat well, but they do take longer to heat up.



**SOAPSTONE HEATER**

- You may prefer a circulating heater if you have small children because the hot stove surfaces are covered by an outer jacket.
- You can't go wrong with a flat black heater; they radiate heat well. But, other colors including white can be effective depending on their pigments and surface texture. Just be sure to avoid shiny metallics, both for heaters and for stovepipes, because they do not radiate heat well.
- The firebox holds the wood during combustion, so its size determines how big your wood pieces can be. The larger the pieces the less cutting you'll have to do.
- Door location and size determines how easily the wood fuel can be loaded. Most wood heaters have

## ANATOMY OF A WOOD HEATER



doors on either the front or side, or both. A few have doors on top, but these can cause problems with flames and smoke escaping when reloading.

- Liners, usually made of firebrick or steel, will extend the life of the firebox and are much less expensive to replace than the heater itself.
- An ashpan makes removal of the ashes simpler; without one you must shovel out the ashes.
- The use of internal baffles may aid in combustion and heat transfer in some stoves. Other models add secondary air to complete combustion. The effects of both features have varied widely in tests.
- A damper is a rotating plate, usually made of cast iron, that is installed in the stovepipe to control the draft on the heater. Dampers are necessary for the proper operation of nonairtight heaters but are not needed for airtight models. There are two types of damper controls--manual and automatic. The automatic is controlled by a bimetallic thermostat which senses heat and adjusts the damper opening as required to maintain good combustion. Both types have their own operating characteristics; but average temperatures of the room with comparable systems remains the same.
- Catalytic combustors lower the temperature required for smoke to burn, and thus reduce both heat escaping up the chimney and creosote accumulation. They are included in many new stoves and can often be added to an existing model. (See Chapter 10 for more details.)

## Accessories

**WOODBBOX**--Firewood is often dirty, so a container located near the wood heater can help keep your home cleaner. Be certain that the woodbox is a safe distance from the heater. Keep all wood and kindling in the woodbox and away from the fire. A metal liner helps keep insects and debris inside the woodbox.

**LOG CARRIER**--Firewood is heavy. Even a medium-sized log can weigh over 20 pounds. Logs are often dusty, harbor insects, and have loose bark which can easily crumble. A log carrier can help you carry more wood in one trip and keep you and your home clean in the process.

**FIRETENDING TOOLS**--Pokers, tongs, bellows, and other tools can prove handy in starting and maintaining a fire. Choose tools that are durable as well as attractive by the fireside. Make certain that the tools are actually intended for use in tending a fire. Some decorative tools may in fact be combustible and should never be used.

**CLEANING ACCESSORIES**--Cleaning ashes and coals from a wood heater can be messy and dangerous if not done properly. Remember, coals buried in ashes can stay hot for days after the fire has died. Use a metal coal bucket or scuttle to carry coals and ashes outside and douse them in water before disposal. Wood ashes are rich in minerals and can be used around many plants. An ash shovel is essential for cleaning your wood heater, and a stout hearth sweep helps you tidy up when the job is done.

**HEAT RESISTANT GLOVES**--Choose a pair that is asbestos-free and large enough to fit any family member. Keep them where they can be quickly found when needed. Welders' gloves are less heat resistant, but offer good protection at a low price.

**SURFACE THERMOMETERS**--These thermometers measure the surface temperature of either the firebox or stovepipe and can provide helpful guidance on the proper operation of your heater. They are particularly important if your heater has a catalytic combustor.

**FIRESCREEN**--Commonly used with fireplaces to prevent sparks from flying into the room, large firescreens can also protect people from accidentally brushing against the hot surfaces of a wood heater.

Firescreens are particularly suited if small children will be playing in an area near the wood heater.

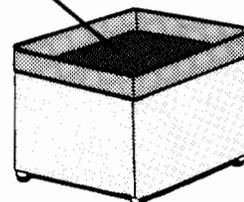
**SMOKE DETECTORS**--These inexpensive monitors save hundreds of lives and thousands of dollars worth of property each year. They are required by many local building codes for all new homes and are essential for a fire-safe lifestyle.

**HEAT RECOVERY DEVICES**--These are designed to increase the heat transfer of a wood heater either by increasing the surface area of the heater or stovepipe or by increasing air circulation over heated surfaces. The balance between heat transfer and combustion efficiency is carefully designed for most high efficiency wood heaters, so consult with the manufacturer before adding such a device. Many options can actually decrease performance and draft or contribute to creosote buildup.

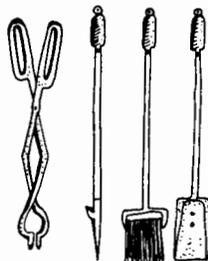


LOG CARRIER

METAL LINER

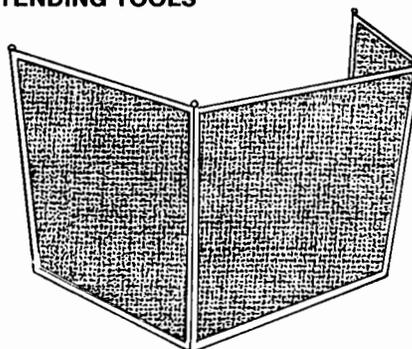
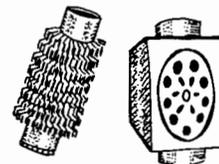


WOODBBOX



FIRETENDING TOOLS

HEAT RECOVERY DEVICES

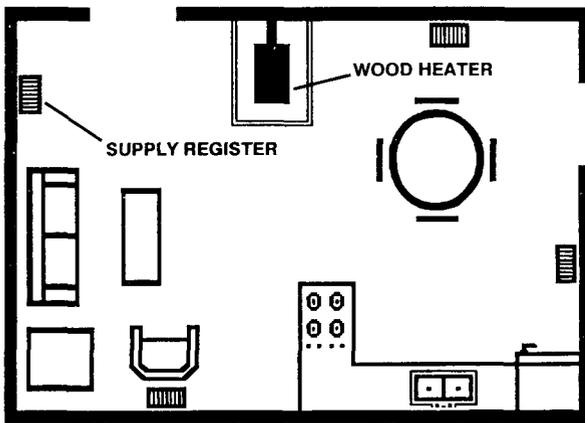


FIRESCREEN FOR A WOOD HEATER

## Size

Your heater should be sized to supply the heat you need -- no more, no less.

But how much heat do you need? This requires a heat loss calculation taking into account outdoor temperature, building construction, floor plan, and the indoor temperature you consider comfortable. Estimate your heat needs by Method A or B below.



FLOORPLAN OF AREA TO BE HEATED

$$4 \text{ SUPPLY REGISTERS} \times 6000 = 24,000 \text{ Btu/hr HEAT OUTPUT NEEDED}$$

## METHOD A: ESTIMATING HEATING NEEDS

### Method A

1. Decide what room or rooms you want to heat with the wood heater. The rooms should be adjacent, with air flow patterns that allow for good heat circulation.

2. If you have a warm air heating system, count the number of supply registers in the rooms (the registers which deliver heated air into the room). Do not include cold air return registers. Generally, there will be one supply register for a small or medium room and two to four for a larger one.

3. Multiply the number of supply registers by 6,000 to get heat needs in Btu per hour.

For example, in a home with 4 supply registers, the wood heater size needed is approximately:

$$4 \text{ supply registers} \times 6,000 = 24,000 \text{ Btu/hr output}$$

## Method B

If your present heating system is properly sized, then you can obtain more accurate numbers if you know its rated output:

1. Find the output of your present furnace on its identification plate. For electric furnaces, multiply kilowatt output by 3,412 to find Btu per hour. For space heaters, add the outputs from all units.

2. If you have uninsulated ducts in the attic or crawlspace, multiply by 0.75. If the ducts are insulated, multiply by 0.90.

3. Add the area of the rooms you want to heat with the heater and divide by the total area of your house. (Do not include rooms that are not presently heated.)

4. Multiply the number found in Step 3 by the number found in Step 2 to get your heat needs in Btu per hour. For example, using Method B:

**Step 1:** Furnace Output Rating = 60,000 Btu/hour

**Step 2:** Multiply Output Rating by Insulated Duct Factor of .90:  $(60,000 \times .90 = 54,000 \text{ Btu/hour})$

**Step 3:** Find Fraction of House Heated with Wood:

Total Living Area = 1,800 square feet

Area Heated with Wood = 800 square feet

Fraction =  $800/1,800 = .44$  (or 44% of the house)

**Step 4:** Size of Wood Heater (multiply result of Step 2 by result of Step 3)

Size of Wood Heater =

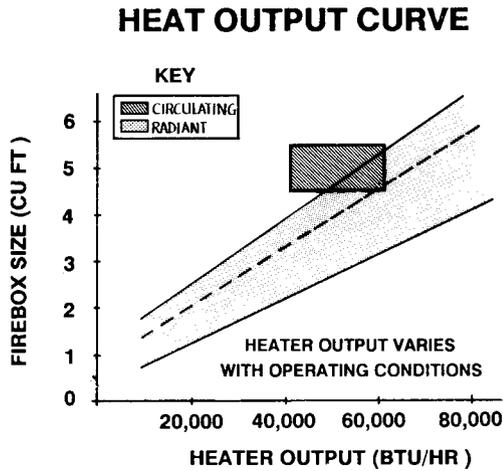
$$54,000 \times .44 = 24,000 \text{ Btu/hour output needed}$$

Now you know your heat needs, either by Method A or Method B. Choose a heater type from Table 2, matching heat output to your calculated heat needs. Some manufacturers provide heat output test data for each of their heater models. (Be sure to use "high fire" test data.) An alternative is to measure the firebox and estimate heat output from the Heat Output Curve.

In general, it's better to pick the right size, or a somewhat undersized stove. An oversized stove will tend to generate more creosote at low fire conditions, is more expensive, and will produce less comfort in mild weather. If you've added storm windows and insulation or more rooms, you may want to adjust your heat needs down or up.

**TABLE 2**  
**Average Values for Heat Output of Typical Heaters**

Small box	20,000 Btu/hr
Large box or open	30,000 Btu/hr
Small airtight	40,000 Btu/hr
Large airtight	60,000 Btu/hr



**How to Select a Wood Heater for Your Home**

Buying a wood heater is much like buying any major appliance for your home. You want to shop wisely so that you choose a model that offers quality and service at a fair price. Talk with others who are heating with wood to find out which features of their wood heater they recommend. Also, ask them if they found a particular dealer knowledgeable about a range of heater brands as well as proper installation guidelines.

Then take the time to sketch your home's floorplan. Also, write down the major energy features of your home such as insulation levels in the ceiling, walls, and floor; presence of insulating windows; and size of furnace. With this information and an estimate of the heat output, you are ready to shop. Talk with knowledgeable wood heating professionals who can determine the proper size heater for your home. Your floorplan sketches will also be helpful in deciding the heater's location, and hence the parts and accessories necessary for installation.

Visit several wood heater dealers to comparison shop. Keep in mind the total cost of a wood heater system--purchase price of the heater and accessories, cost of the chimney materials, and any installation fees. (See Table 3.) When deciding which model to buy, also consider the cost of fuel. While a more efficient wood heater is likely to cost more to buy, the savings it offers on fuel costs--not to mention savings on the time for cutting, splitting, carrying, and loading wood--may make it a sound investment. Other important considerations when shopping for a heater are the manufacturer's warranty and the reputation of the dealer who represents that warranty.

It's always wise to buy a heater and desired accessories listed by Underwriters Laboratories (UL) or other laboratories recognized by a national code organization such as the Building Officials and Code Administrators (BOCA), Southern Building Code Congress International (SBCCI), or International Congress of Building Officials (ICBO). Follow the manufacturer's instructions on listed heaters regarding clearances and installation. In addition, the Consumer Products Safety Commission requires all wood heaters which were manufactured after October 1983 to have a safety warning label. They also specify that detailed instruction manuals must be included.

**TABLE 3**  
**Typical Costs of Airtight Wood Heaters**

Type of Wood Heater	Purchase Price	Cost of Stovepipe and Class A Chimney Materials	Installation Fee
Freestanding	\$500	\$250	\$400
Freestanding with Catalyst	600	250	400
Fireplace Insert	500	100	250
Fireplace Insert with Catalyst	600	100	250

# CHAPTER 2

## Safe Chimney Design

A chimney has two basic functions: it carries combustion products such as smoke out of the house, and it creates the suction or draft necessary to draw air to the fire. Chimneys used with wood heaters must meet "all-fuel" standards, also called "Class A."

Do not confuse stovepipe sections with prefabricated chimney sections. Stovepipe has a single metal wall and may not pass through a ceiling, attic, closet, or concealed area. Chimney sections, on the other hand, have a protective layer of air or insulation between the hot interior surface and the cooler exterior surface and can be used safely in concealed areas with proper clearances.

This publication discusses two common types of chimneys -- masonry and prefabricated metal. A masonry chimney must be at least 4 inches thick (nominal dimension, solid brick or solid concrete block) and have a fireclay flue liner at least 5/8 inch thick. It is best to use solid masonry units, although hollow masonry units at least 6 inches thick may be used as long as the holes are completely filled with mortar. Metal chimneys, called "prefabricated chimneys," "manufactured chimneys," or "UL-listed, all-fuel chimneys," may be double-wall insulated or triple-wall; both have stainless steel inner liners. Metal chimneys were previously rated at 1700 °F. A new high temperature type is now available which is rated at 2100 °F, to better withstand chimney fires.

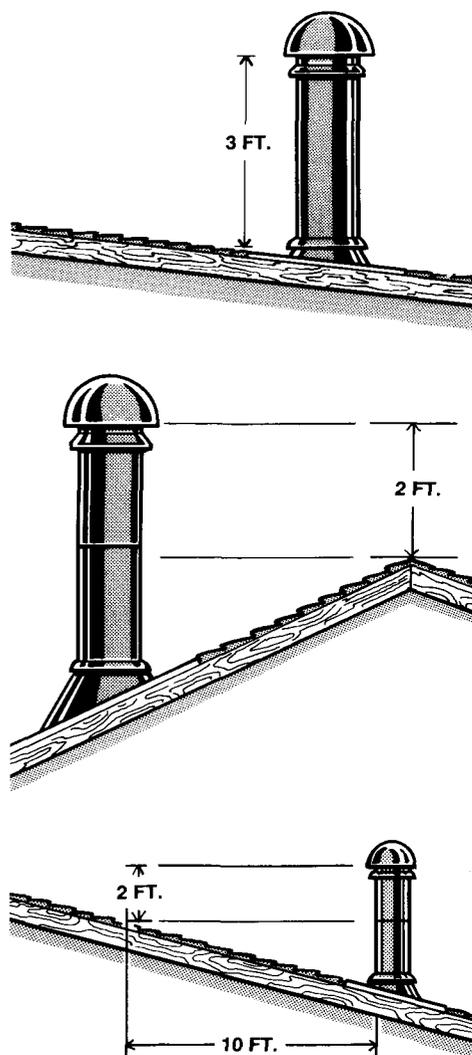
Metal chimneys are often less expensive than masonry ones and are more adaptable to installation in existing houses. Most masonry chimneys require the work of an experienced mason and are best built at the same time as the house. All chimneys benefit from chimney caps which reduce downdrafts and keep out rain and debris.

Unless the manufacturer specifies otherwise, use a chimney diameter equal to that of the flue pipe collar on the heater. A significantly oversized chimney can cause excessive water and creosote condensation.

If you plan to use an existing chimney, inspect it thoroughly. If you plan to install a new chimney, do it

properly. A chimney that meets fire and building codes will ensure a heater system that heats your home rather than one that burns it down.

No matter which type of chimney you connect to your wood heater, chimney height is critical to creating proper draft. A correctly designed and built chimney will prevent downdrafts during windy weather and eliminate smoking problems due to insufficient draft.



**THE 3-FOOT, 2-FOOT, 10-FOOT RULE**

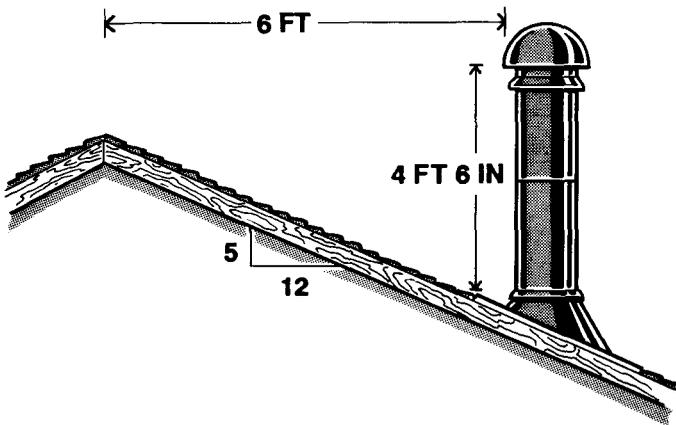
The 3-foot, 2-foot, 10-foot rule states that a chimney must be at least 3 feet high and at least 2 feet higher than any part of the roof within 10 feet, measured horizontally. This rule, required by national and regional codes, is depicted in the diagrams. Measurements are made from the high side of the roof to the top of the chimney wall.

If your chimney is 10 feet or more from the roof ridge, you may use Table 4 directly. If the ridge is closer than 10 feet, you can calculate the proper height using the following formula:

$$\text{Required Chimney Height} = (\text{Roof Slope} \times \text{Distance to Ridge}) + 2 \text{ feet}$$

In the example illustrated below, a chimney on a 5 in 12 pitched roof, located 6 feet from the ridge requires:

$$(5/12 \times 6 \text{ feet}) + 2 \text{ feet} = 4 \text{ feet } 6 \text{ inches height above the roof}$$



### CALCULATING CHIMNEY HEIGHT

Check the manufacturer's instructions carefully for a prefabricated chimney; if it extends more than 5 feet above the roof, you may need a brace. Unsupported sections of masonry chimneys subject to wind pressures may require special construction methods.

A chimney cap is added to keep out rain and prevent downdrafts by redirecting unfavorable winds. Caps for masonry chimneys are typically flat plates of

**Table 4**

### Minimum Chimney Heights

Roof Slope*	Height above roof for ridge 10 feet or more from chimney
FLAT	3'0"
1/12	3'0"
2/12	3'8"
3/12	4'6"
4/12	5'4"
5/12	6'2"
6/12	7'0"
7/12	7'10"
8/12	8'8"
10/12	10'4"
12/12	12'0"

\*Roof slopes are given in feet of rise per 12 feet of run. A 6/12 slope rises 6 feet per 12 feet of horizontal run.

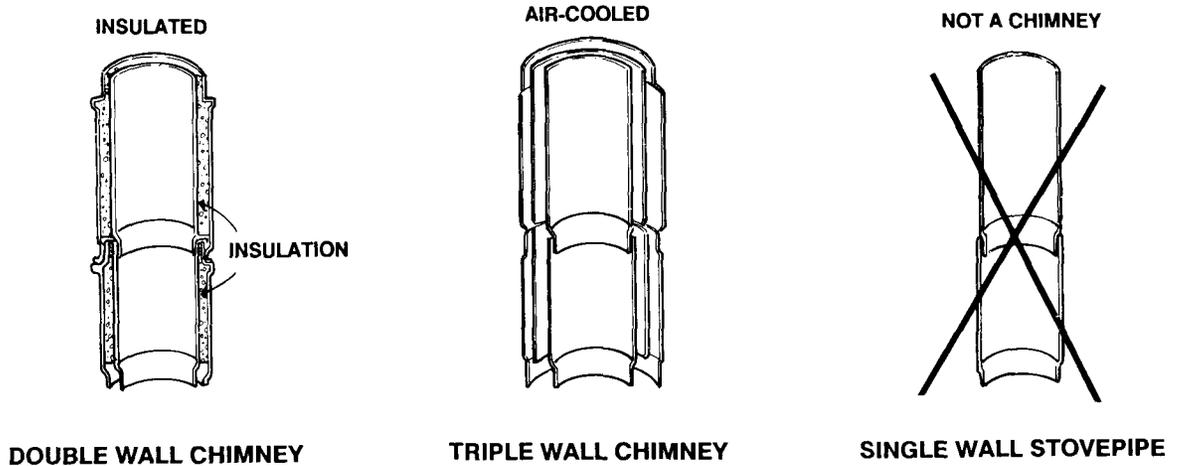
Caps for masonry chimneys are typically flat plates of steel or concrete. However, more stylish ceramic and metal caps are available. Caps for safety-tested and listed manufactured chimneys are also available. Some caps have spark arrestors designed to catch sparks and burning particles emitted with the smoke. If the mesh tends to become encrusted with creosote, clean it and investigate the cause of creosote generation. Check the inside of the chimney at the same time for creosote buildup. A chimney cap must be used with a listed metal chimney assembly if it is part of the listing.

Tree branches can also cause draft problems. Check your chimney every fall to make sure that summer growth is cut back 10 feet or more from the top of the chimney.

### Prefabricated Metal Chimneys

Prefabricated metal chimneys are a safe and relatively inexpensive way to move the smoke and gases from the stovepipe or chimney connector through your exit wall or roof to the outdoors.

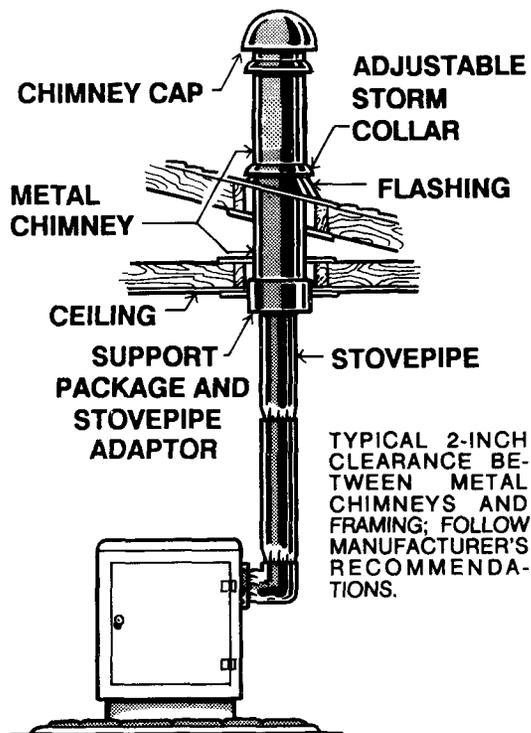
There are two types of air-insulated chimneys. One uses thermosiphoning to pull heated air out of the jacket and replace it with cool air. The other uses air trapped in each section. Both have similar performance characteristics. For high exterior chimneys, the double-wall insulated type is best to minimize heat loss.



Once the stovepipe vents into a chimney section, stovepipe may not be used in the system from that point on. The only exception occurs when stovepipe connects to a metal chimney section, which is used to pass through an interior wall, and is then connected

back to the stovepipe. However, this practice should be avoided because it usually makes the stovepipe run too long for safe and efficient operation.

When a stovepipe extends to a standard ceiling, support package and sometimes a stovepipe adaptor are installed at the ceiling, and one or more sections of prefabricated chimney are added to rise above the roof. An adjustable storm collar and flashing between the chimney and shingles are necessary to prevent roof leaks.



**STANDARD CEILING CHIMNEY INSTALLATION**

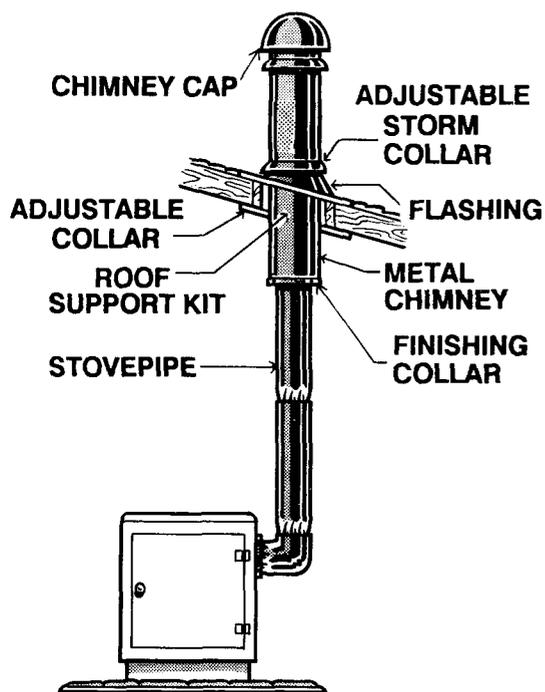
Stack the sections of stovepipe and chimney and lock them securely as the manufacturer specifies. Each joint should be secured with at least one sheet metal screw. A 2-inch clearance is required between the prefabricated chimney and wood framing in the ceiling and roof, unless otherwise stated by the manufacturer. The manufacturer's instructions on safety-tested chimneys will tell you how to install your prefabricated chimney safely, what clearances to combustibles must be used, and where and how to install firestops.

In rooms with cathedral ceilings, the roof and ceiling are combined. For this type of installation, manufacturers of safety-tested chimneys provide a special roof support kit with instructions that should be followed.

The third common type of installation is a through-the-wall arrangement. This requires a support kit composed of a listed tee section with cleanout plug and wall support kit. Before choosing this installation, you should consider that an exterior chimney is subjected

to cold outdoor temperatures, leading to greater heat loss and a higher accumulation of creosote deposits.

Single-wall steel chimneys, also called "smokestacks", are rarely acceptable on the outside of a house. They are made of much thicker metal than stovepipe and are typically found in commercial applications and require proper foundation and support. Smokestacks are not recommended because they have an inherent problem with wood fuel: they promote creosote formation through high heat loss from the pipe wall and provide low draft. Smokestack installations may not be allowed by local building codes.



**CATHEDRAL CEILING CHIMNEY INSTALLATION**

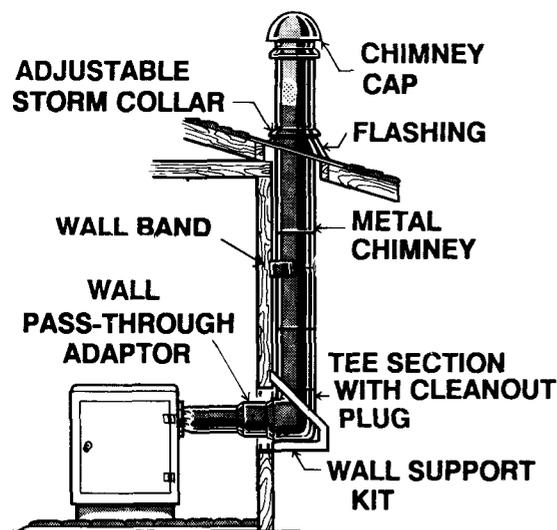
## Chimneys Built with Masonry

Masonry chimneys are durable, and some homeowners consider them more attractive than prefabricated chimneys. In addition, massive interior masonry chimneys store heat and continue to release this heat to the room long after the wood fire has subsided. But masonry chimneys have disadvantages, too. They are expensive to build and more difficult to inspect and maintain than prefabricated chimneys. In addition, masonry chimneys are often built on an exterior wall, reducing heating efficiency. This exposure to cold outdoor temperatures leads to greater heat loss and higher accumulations of creosote deposits. The seam between a masonry chimney and exterior wall can also be a major source of air leaks unless properly sealed.

## Construction

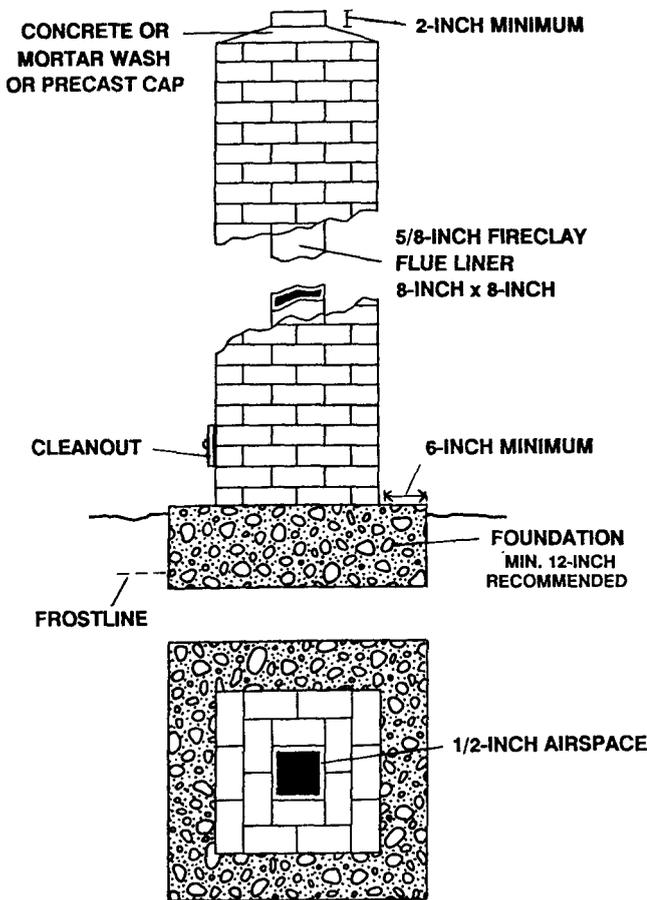
Whether you are having a masonry chimney built or are planning to use an existing one, safety should be your primary consideration. A masonry chimney is a heavy structure that must be adequately supported and able to withstand years of use, including occasional chimney fires in which temperatures may reach 2000°F. All chimneys require regular inspection for deterioration and creosote buildup. Even a correctly built chimney can settle and require repair with time; a poorly built chimney is dangerous from the start.

A masonry chimney consists of four basic parts: foundation, flue liner, walls, and cleanout. The foundation must rest on solid, undisturbed (not filled) ground. It can be specially poured for the chimney or it can be part of a solid masonry wall. The foundation should be properly designed using solid masonry, reinforced portland cement concrete, or refractory cement concrete. Building codes generally require that the

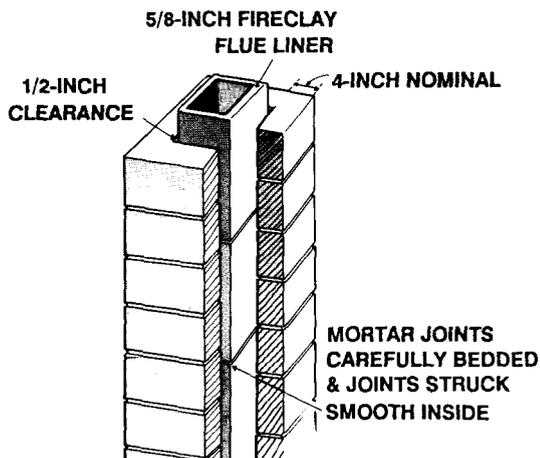


**EXTERIOR WALL INSTALLATION**

## ANATOMY OF A MASONRY CHIMNEY



## MODULAR CONCRETE FLUE BLOCK



Exposed exterior surfaces should be sealed against moisture. Consult your building official to assure the chimney meets code.

foundation be at least 12 inches thick and extend at least 6 inches beyond each face of the masonry resting upon it. The bottom of the foundation should extend below the frostline to reduce the possibility of heaving and cracking while the ground is freezing.

Masonry units will deteriorate after long periods of direct exposure to smoke, creosote, and other combustion products. A minimum 5/8-inch fireclay flue liner will shield the brick or masonry from this corrosive environment and ensure a long-lasting, safe chimney.

The fireclay liner should be spaced out from the chimney walls about 1/2 inch to allow for heat expansion and movement of the liner. The liner should begin at a point not less than 8 inches below the entry port or thimble. The liner sections should be carefully bedded, one on the other, in refractory or fireclay mortar. The joints between the sections should be close fitting and smooth on the inside surface. This is accomplished by positioning and mortaring each fireclay liner section before the surrounding masonry is laid to ensure that the joints are struck smooth inside. The liner should terminate at least 2 inches above the concrete cap or mortar "wash".

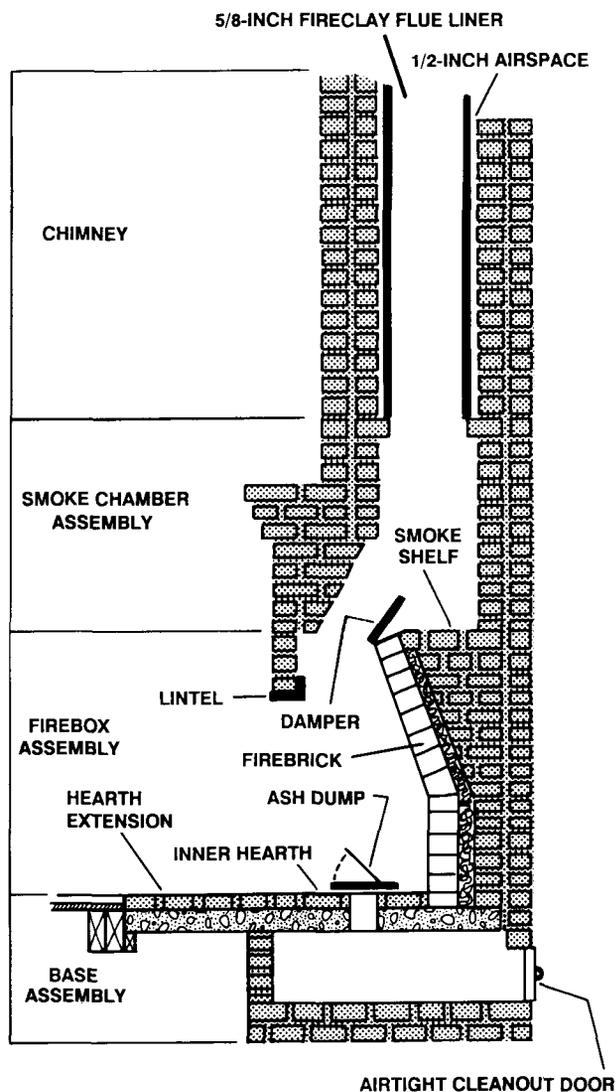
The thimble connects the stovepipe to the chimney. Like the liner, the thimble must be at least 5/8-inch thick fireclay or the equivalent and must be mortared into place. (See Chapter 4.) A good practice, just prior to installation, is to inspect thoroughly all liner sections, as well as the thimble, for cracks or other damage that may contribute to smoke and flue gas leakage.

Some chimneys are built with more than one flue. If two flues are built into the same chimney, each must have a flue liner and the joints of the two liners should be staggered by at least 7 inches. Where more than two flue liners are built into the chimney, a masonry wythe or partition must separate the flues into groups of not more than two. The wythe should be constructed of at least 4-inch (nominal) masonry; a 1/2-inch airspace should separate the liner from the wythe.

Masonry chimney walls should be made of solid masonry units or modular (preformed) concrete block.

The walls must be no less than 4 inches (nominal) thick for brick or solid units. Hollow masonry units must be no less than 6 inches thick and must be filled with mortar. Rubble stone may be used, but the walls

must be no less than 6 inches thick and must be filled with mortar. Rubble stone may be used, but the chimney walls must be at least 12 inches thick. In general, an 8-inch thick, all-brick chimney with a 5/8-inch flue tile liner spaced 1/2 inch away from the chimney is best in terms of strength and the capacity to hold heat and withstand chimney fires.



## FIREPLACE AND CHIMNEY

Heavy winds may cause a chimney to sway enough to create cracks; therefore, upper portions that are not protected by the house structure itself may be strengthened by adding a second 4-inch layer of brick or the equivalent via corbeling, although it's best to build the chimney larger from the foundation up. No change in chimney size is allowed within 6 inches above or below roof rafters or joists. When selecting a mortar for masonry chimneys, consider both weathering and thermal conditions. A high-to-medium temperature portland cement-lime mortar is recommended for temperate climates.

A cleanout opening is required by the codes and provides a convenient way to remove creosote after a chimney cleaning. The opening, which should be more than 2 feet below the thimble, should be made of a ferrous metal frame and door designed to remain airtight when the wood heater is in use.

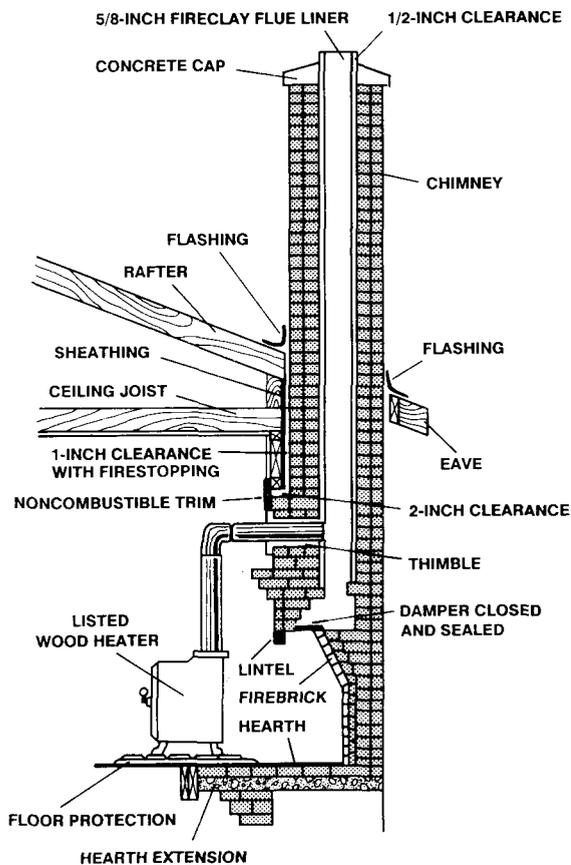
A masonry chimney may be built in combination with a fireplace. Like the chimney, the fireplace should be properly constructed and requires regular inspection and maintenance. The fireplace is composed of the base assembly, firebox assembly, and smoke chamber assembly. These components should be constructed in accordance with local building codes. Refer to the diagram to understand the basic construction of a fireplace. If you decide to install a wood heater in an existing fireplace, you must consider the condition of the fireplace and plan to meet required clearances to combustibles around the fireplace.

Further information on masonry chimney and fireplace dimensions is given in Chapter 12.

### Clearances

The information in this book is based on the National Fire Protection Association (NFPA) publication No. 211, *Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances, 1984*. The intent of standards or code requirements is to ensure reasonable safety and practicality; however, they are constantly undergoing revision. The 1984 edition of NFPA No. 211 supersedes the 1980 edition.

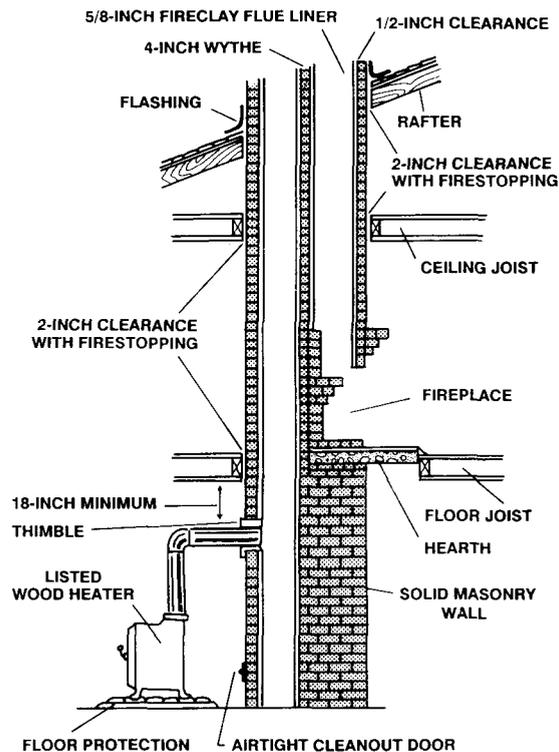
As recommended by NFPA, clearances from masonry chimney walls to combustibles in the surrounding house structure will depend upon the type of chimney you have. (See Chapter 3 for a complete discussion of combustible materials.)



## EXTERIOR MASONRY CHIMNEY

An exterior chimney is one that is entirely outside the building. Because the chimney wall is exposed to the outdoors, it will operate at cooler temperatures and therefore requires only a 1-inch clearance, with firestopping, to combustibles such as joists, studs, flooring, trim, rafters, and roof decking. The air space must be left empty between the chimney and combustibles. Firestopping is required where the chimney passes through roof rafters or joists. It can be made of galvanized sheet metal, at least 0.19 inches thick, or noncombustible sheet material (tile backerboard, etc.) less than 1/2 inch thick.

An interior chimney is one that has any portion of the flue lining inside the building. An interior chimney will store more heat, hold it longer, and release it to the interior of the house. The chimney walls, therefore, operate at higher temperatures and require a minimum 2-inch clearance, with firestopping, to combustible materials for a safe installation.



## INTERIOR MASONRY CHIMNEY

Noncombustible trim such as metal, tile, or tile backerboard (Duroc, Wonderboard, etc.) may be used at floors, ceilings, and walls to close up the gap for the chimney penetration. Decorative metal trim can include brass, copper, aluminum, painted steel, and metal trim moldings, such as those supplied with "tin" ceilings used in restoration remodeling.

Plasterboard and drywall are considered combustible because they generally have a paper backing. Consequently, these materials require a 2-inch clearance to interior chimneys. On new construction, using steel studs in the wall adjacent to the chimney or fireplace would remove the problem of structural wood clearance. However, the wall finish must also be noncombustible such as plaster on metal lath or tile backerboard. The noncombustible wall should extend one or two stud spaces from the chimney.

## Safety Do's and Don'ts

The homeowner must be aware of several special considerations when connecting a wood heater to a masonry chimney. For example, check the general condition of an existing chimney. Just because it has stood for decades does not mean it is safe for prolonged use with a wood heater. Look for loose bricks and cracks in the mortar that might allow sparks to escape and ignite dry structural wood close to the chimney. Have them repaired by a competent mason.

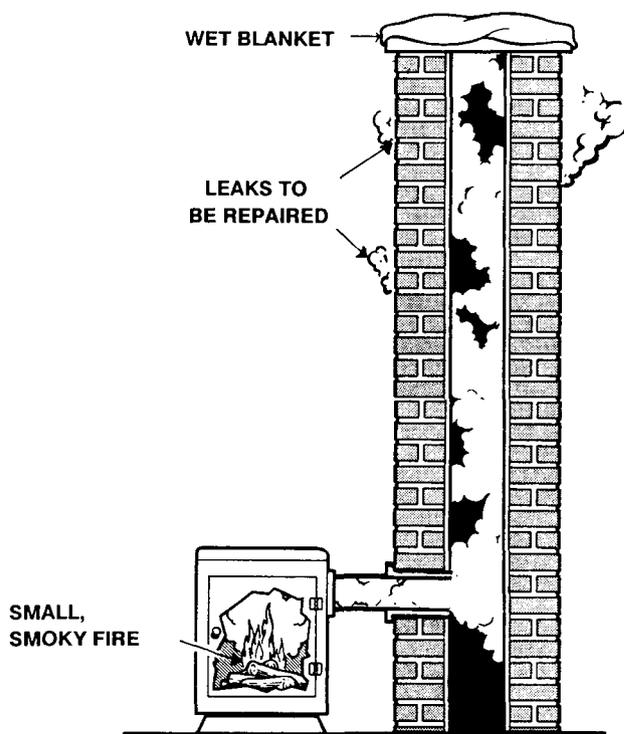
If you suspect leaks or cracks in your heater system, call in a professional to perform a leak test. This is best done by a chimney sweep after the heater, chimney, and pipe have been cleaned. If any cracks are found, have them repaired immediately to insure a safe, efficient heating system.

Many older homes have chimneys that are in good structural shape but do not meet "all-fuel" or "Class A" requirements. A typical example is a chimney constructed of 4-inch brick without a fireclay liner. These chimneys can be made safe by lining them with listed prefabricated chimney sections, pourable refractory, or commercially available stainless steel liners. NFPA requires that the lining material be able to resist corrosion and softening or cracking from hot flue gases.

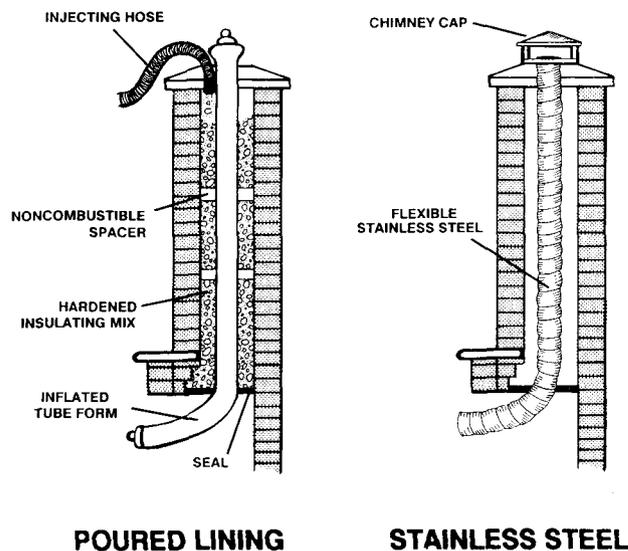
Use only chimney relining products that are listed. Of course, all materials should be installed per manufacturer's instructions. Stainless steel liners should be at least 26 gage. As with stovepipe, the crimped end should be installed downward to drain creosote and condensed water back to the heater. Flues with bends can be lined with flexible stainless duct made for that purpose. They can also be relined with a poured refractory material which is pumped around an inflated rubber bladder. In some cases, flue tile can be lowered from the top to reline a very straight chimney. You will need to call upon an experienced specialist for these last two methods. **If existing brick and mortar are not in good shape, it may be best to demolish and then rebuild the chimney.**

Each woodburning appliance must have its own flue. (A fireplace is considered an appliance.) The connection of two appliances to a single flue can affect the draft characteristics and cause smoke damage, poor heating, or ventilation problems. If you have more than one fireplace in your home, check the chim-

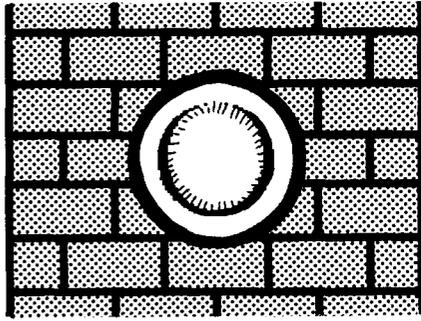
## TEST FOR LEAKS



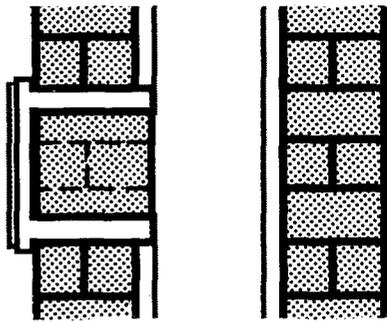
## CHIMNEY RELINING TECHNIQUES



## CHIMNEY WITH BREACHING



UNSAFE "PIE-PLATE" COVER

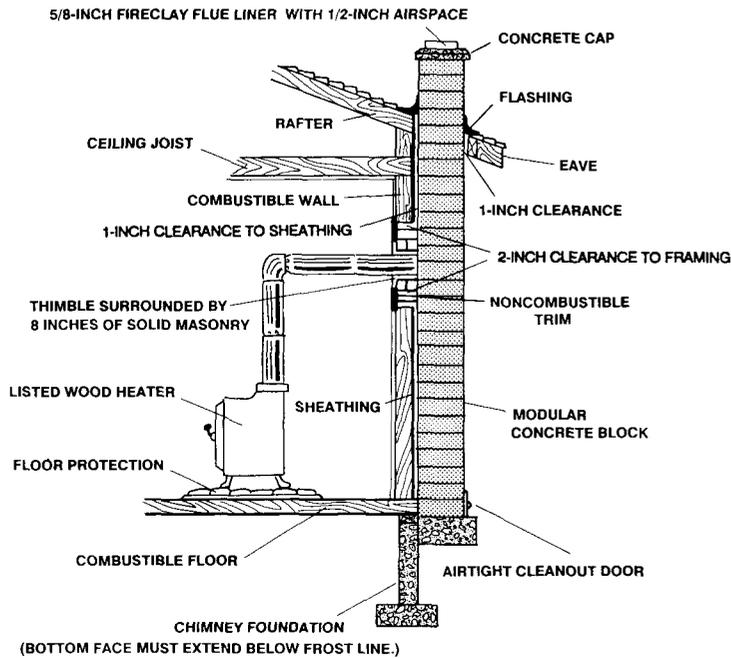


BREACHING SEALED WITH BRICK AND FIRECLAY MORTAR

appliance that you intend to use. For a further discussion on the use of an existing fireplace, see Chapter 4.

Frequently in older homes, an existing masonry chimney may have served more than one appliance in various rooms. It is critical to locate and seal these unused entry ports or breachings into the chimney. Unused breachings are often covered with a thin metal "pie-plate" cover. They may be hidden by paneling or plaster, especially if the house has been remodeled. Unused breachings should be sealed using masonry or brick and fireclay mortar to make the former entry port as sound as the rest of the chimney.

Use of modular concrete block, also known as "flue block," is a common practice. However, in some areas, this may not meet building codes. Consult your local building official before constructing a flue block chimney. Like other masonry chimneys, the modular concrete block chimneys must be lined with at least 5/8-inch fireclay flue liner. If hollow, the blocks must be filled with mortar. If you plan to build a modular concrete block chimney, be sure to prepare properly and seal exterior exposed surfaces. Failure to seal the block against moisture may cause heaving and cracking. Also, be sure to consult your local building official so that your chimney will meet "Class A" standards.



## EXTERIOR MODULAR CONCRETE BLOCK CHIMNEY

# CHAPTER 3

## Installing Your Wood Heater

Proper installation of a wood heater is critical to prevent a life-threatening house fire. Each year, dozens of fires occur in Georgia homes because of unsafe wood heater and fireplace installations. Following safe installation guidelines will protect your family and property, as well as ensure the durability of the wood heating system and reduce maintenance requirements.

Note: According to HUD regulations, only direct-vented wood heaters can be installed in mobile homes. That is, combustion air must be vented directly from outside the home to the firebox via special ductwork to prevent smoking inside the home. In addition, wood heaters for mobile homes have other special design features. See Chapter 13 for more information. Some houses which are specially built to reduce air infiltration may also have smoking problems if direct-vented heaters are not installed.

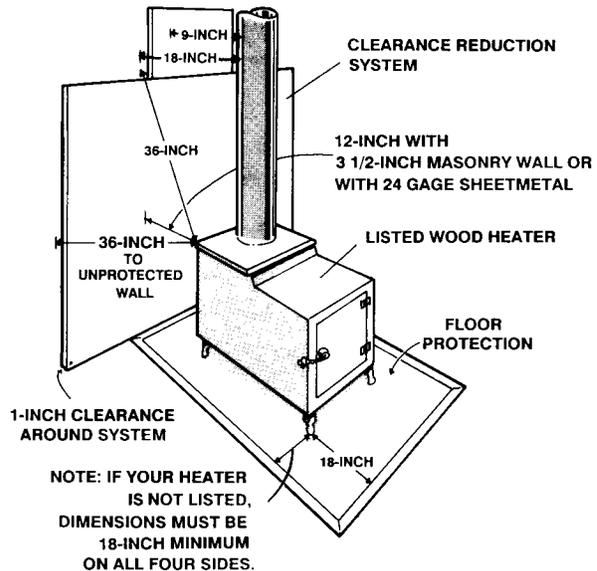
### Some Materials Burn, Some Don't

Constant exposure to heat will lower the temperature at which a material begins to burn. With time, a joist or rafter too close to the chimney walls or a stud in a wall too close to the heater and its stovepipe will become too hot and ignite. Clearances from all parts of a wood heating system are specified by safety codes to prevent overheating of combustible materials by keeping them at a safe distance. Installing a protection system or clearance reduction system (heat shields) will reduce the heat transferred to the combustible surface, allowing specified clearances to be lowered. Following recommended clearances closely will ensure a safe installation in your home.

A noncombustible material is defined as that which will not ignite or burn when subjected to flame or intense heat for long periods of time. Materials consisting entirely of steel, iron, brick, tile, concrete, slate, glass, or plaster, or any combination thereof are noncombustible. All walls containing wood framing are combustible, and this includes plaster and drywall finishes on wood lath or wood studs. In fact, even common drywall is considered combustible due to its paper facing. Nearly every wall and ceiling in residential

buildings contains wood. If you are unsure about your home, assume that the wall or ceiling is combustible and maintain proper clearance.

A floor is considered noncombustible if it is concrete, slab-on-grade design, or solid concrete with steel or concrete, but not wood, supports. An existing masonry hearth extension is noncombustible if no wood forms have been left in place below it, and if heater placement will allow at least 18 inches of hearth extension in front of the loading door. All wood floors, carpets, and synthetic flooring materials are considered combustible and must be protected in an approved manner. Other combustible materials include furniture, draperies, newspaper, and of course, firewood. Keep these at least 36 inches away from the heater.



### SUMMARY OF CLEARANCES

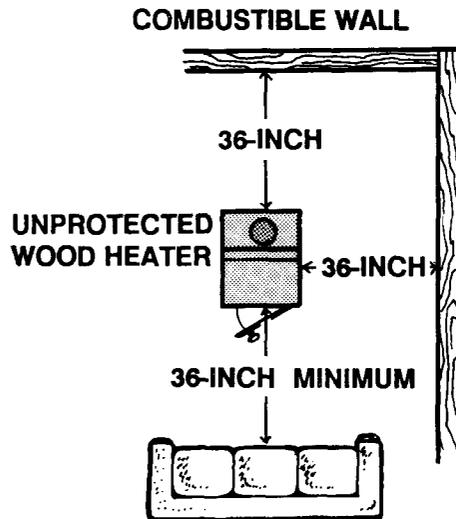
#### Clearances – A Must for Safety

The information in this section is based on NFPA publication No. 211. Each manufacturer of listed heaters is required to specify minimum clearances to combustibles. These clearances vary depending upon

the construction of the heater. When installing your wood heating system, be sure to compare clearances from combustibles in the manufacturer's installation instructions with the clearances recommended in this book. Use the manufacturer's clearance for listed heaters. For unlisted heaters, use either the information in this section or the manufacturer's clearances, whichever is greater.

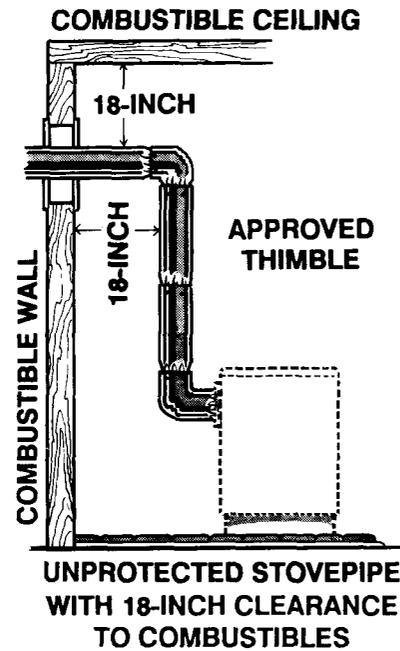
### Unprotected Walls and Ceilings

In terms of clearances, NFPA no longer makes a distinction between radiant and circulating wood heaters. All designs require a minimum 36-inch clearance between unprotected, combustible walls and ceilings and the top and all sides of the wood heater. A single wall stovepipe must have an 18-inch clearance to combustible walls and ceilings, measured at right angles to the pipe. No clearance is needed for heaters or stovepipes to noncombustible walls (i.e., concrete walls). However, it is good practice to allow 6 inches or more for good air circulation and dissipation of heat.



### Protected Walls and Ceilings

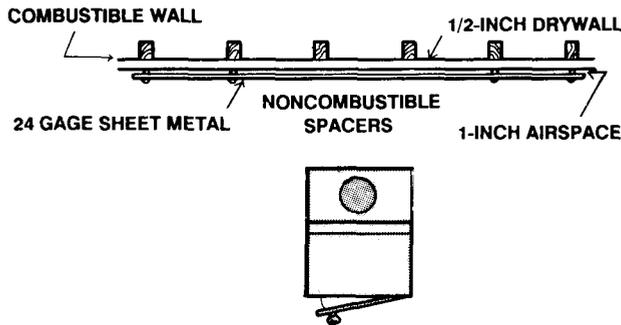
A wood heater and stovepipe may be placed closer to a combustible wall or ceiling that is protected in an approved manner with either a home-constructed or a prefabricated clearance reduction system. For listed



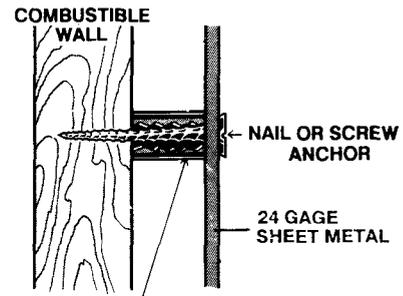
heaters, use the manufacturer's instructions. For unlisted models, follow the guidelines presented here or those of the manufacturer, whichever is greater.

The two most common types of home-constructed clearance reduction systems use either 24 gage sheet metal (galvanized steel, aluminum, copper) or a 3 1/2-inch (4-inch nominal) thick masonry wall. Either of these materials must be spaced out 1 inch from the combustible surface. That is, they must be anchored to the combustible surface so that a 1-inch airspace exists between the sheet metal or masonry and the combustible material. With sheet metal, noncombustible spacers are used to maintain the 1-inch airspace. With a masonry wall, use metal wall ties to anchor the brick to the wall. **Do not place noncombustible spacers or masonry wall ties directly behind the heater or stovepipe as they can conduct heat to the combustible materials behind.**

Be sure to remove any excess mortar between the masonry and the combustible wall so that the 1-inch clearance can properly provide for free air circulation. The 1-inch airspace is not intended to be a dead airspace. Provide complete ventilation by maintaining a



MASONRY WALLS MAY BE ATTACHED TO COMBUSTIBLE WALLS USING WALL TIES. DO NOT USE FASTENERS DIRECTLY BEHIND STOVEPIPE OR HEATER

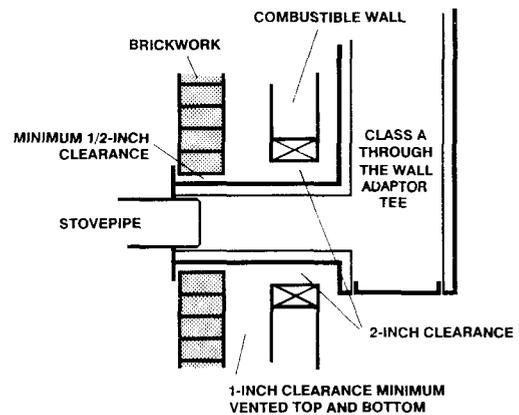


1-INCH NON-COMBUSTIBLE SPACER SUCH AS STACKED WASHERS, SMALL DIAMETER PIPE, TUBING, OR ELECTRICAL CONDUIT.

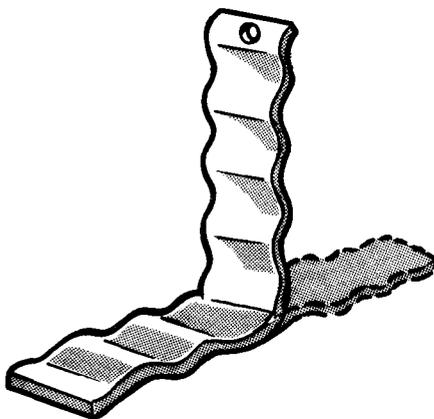
### SHEET METAL CLEARANCE REDUCTION SYSTEM

1-inch clearance between the edges of the clearance reduction system, and the walls, ceiling, and floor. This arrangement allows air to flow freely, removing heat by convection and ensuring a low enough temperature to avoid catching the combustible surface on fire.

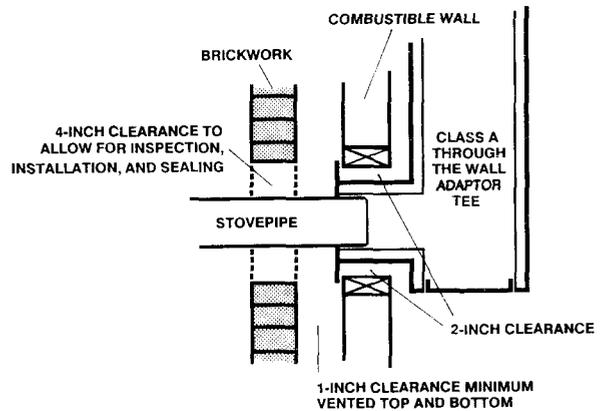
If a masonry wall with airspace is used and if the connector vents through the wall, a minimum 1/2-inch clearance is required between the brickwork and connector. To make it practical for placing, sealing, and inspecting the stovepipe, a 4-inch clearance is better. If a Class A metal chimney is used, bring it to or past the inside surface of the masonry wall shield and maintain a 1/2-inch clearance from the Class A chimney section to the masonry.



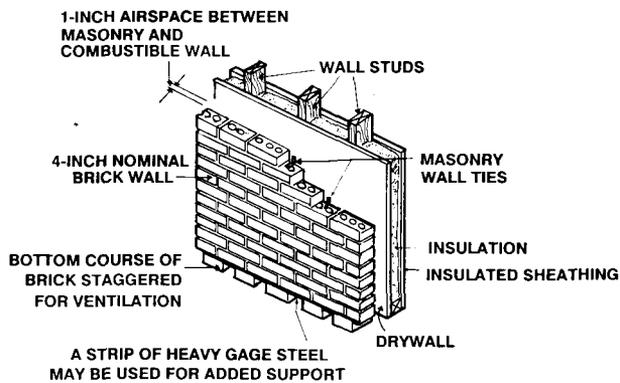
**BRICKWORK CLEARANCE REDUCER AND CONNECTOR (OPTION A)**



**MASONRY WALL TIE**

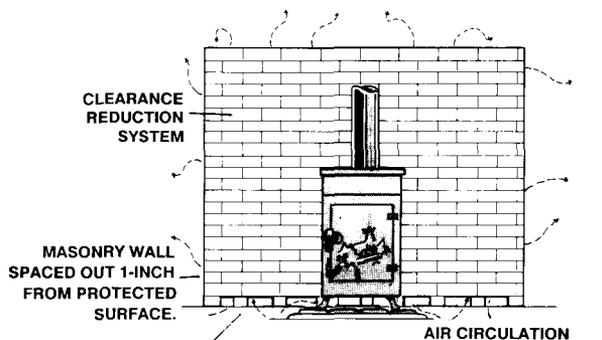


**BRICKWORK CLEARANCE REDUCER AND CONNECTOR (OPTION B)**

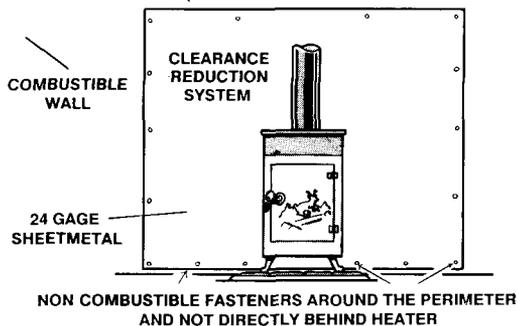


NOTE: Do not place masonry wall ties directly behind heater or stovepipe.

### MASONRY CLEARANCE REDUCTION SYSTEM



Leave 1-inch clearance to floor, adjacent walls, and ceiling for air circulation.



### MASONRY AND SHEET METAL CLEARANCE REDUCTION SYSTEMS

Sheet metal attached to the wall without a 1-inch airspace offers NO protection and cannot be considered a clearance reduction system. The same applies to "z brick" or other veneer brick and stone coverings. These materials provide adequate protection only when mounted on 24 gage or thicker sheet metal with a 1-inch minimum spacing to the wall. The code allows the use of unventilated solid masonry. However, only a small reduction in clearance results, so you won't save much space. While this method adds mass to a room, or allows the use of a wall already built, ventilated masonry is preferred. Materials for constructing clearance reduction systems can be obtained locally at hardware, building supply, and sheet metal shops. See NFPA No. 211 for lesser-used materials.

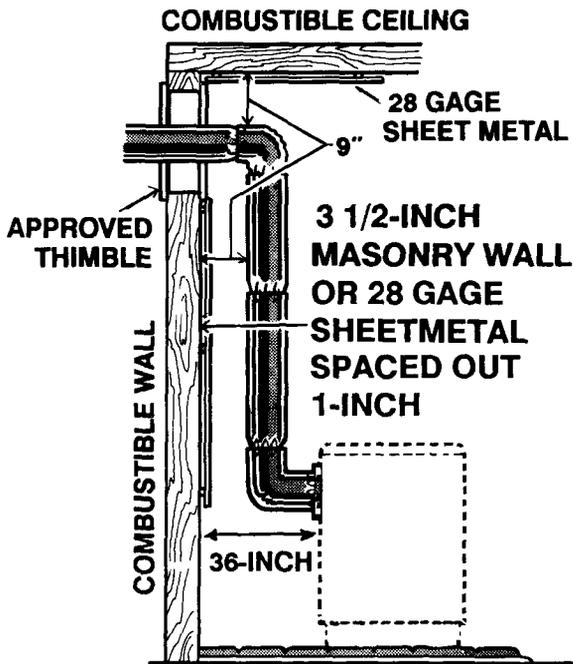
A variety of prefabricated clearance reduction systems are available through wood heater and fireplace dealers. Always look for the safety listing when selecting a prefabricated clearance reduction system and make sure it is designed to be used with a wood heater. The manufacturers of these tested and listed accessories provide specific installation instructions that must be followed.

Table 5 shows clearances required using clearance reduction systems on walls and ceilings. These clearances are also depicted in diagrams.

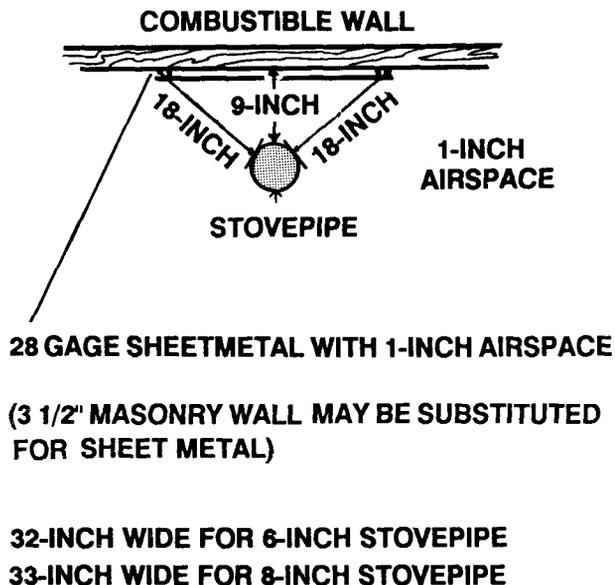
The clearance reduction system should extend 36 inches past the heater in height and width, measured diagonally. These are minimum dimensions when the heater is placed as close as the code allows. If the heater is placed farther from the wall, the width and height of the protection can be determined by measuring from the side and top edge of the heater to the unprotected wall: this distance should be no less than 36 inches for all heaters. (Some manufacturers may specify greater clearances.)

The clearance reduction system must be centered behind and above the stovepipe to protect the wall or ceiling. Table 6 shows minimum clearance reduction system widths for installation behind stovepipe.

## CEILING CLEARANCE REDUCTION SYSTEM



## STOVEPIPE CLEARANCE REDUCTION SYSTEM



## Unprotected Floors

The only base on which a heater can be installed without special protection is a noncombustible floor or properly built hearth extension. For listed heaters, use the manufacturer's instructions. For unlisted heaters, the noncombustible floor or hearth extension should extend 18 inches on all sides, or further if required by the manufacturer. This clearance prevents damage from sparks, embers, ash, or radiant heat. If you are converting a fireplace to wood heater usage, you may have to enlarge the existing hearth.

## Protected Floors

All combustible floors must be protected, and many types of materials are available for floor protection. Manufacturers of listed heaters specify the type and dimensions of material required for floor protection. If available, these materials should be used. If the manufacturer does not specify a material, you may purchase one or more of the safety-tested and listed prefabricated stoveboards on the market.

The type of floor protection recommended by safety codes depends on heater leg length. Listed heaters with legs less than 2 inches in height can only rest on floor protection as specified by the manufacturer or on a noncombustible floor. If your heater has legs 2 inches or greater in height, you are also allowed to use a combination of sheet metal and masonry as specified by NFPA publication No. 211. The arrangement of sheet metal and masonry for floor protection is dependent upon the length of the heater legs:

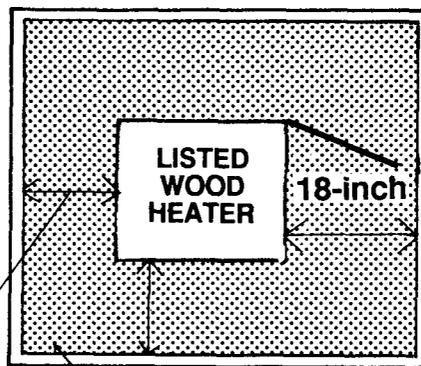
- Heaters with legs 2 inches to 6 inches -- Floor protection can consist of 4-inch (nominal) hollow masonry laid to provide air circulation through the layer and covered with 24 gage sheet metal. Another layer of masonry may be laid over the sheet metal for aesthetic appeal.
- Heaters with legs higher than 6 inches -- Floor protection can consist of closely spaced solid masonry units of brick, concrete, or stone which provide a thickness of not less than 2 inches. Such masonry must be covered by or placed over 24 gage sheet metal.

If you use a combination of sheet metal and masonry for floor protection, be sure that each heater leg has a firm and solid footing.

An unlisted heater requires 18 inches of floor protection on all sides, including the loading and ash doors. For listed heaters, follow the manufacturer's instructions for floor protection clearances and dimensions. If more than one safety-listed prefabricated stoveboard is needed to meet the clearance requirements, the junction between the stoveboards should be made using either a safety-tested and listed stoveboard adaptor or a strip of 24 gage sheet metal (approximately 4 to 6 inches wide).

The summary diagram on page 17 shows the overall relationships discussed above. The larger the distance between the heater or stovepipe and the wall, the smaller the clearance reduction system needs to be. For further information, contact your local building code inspector.

### RECOMMENDED FLOOR PROTECTION DIMENSIONS

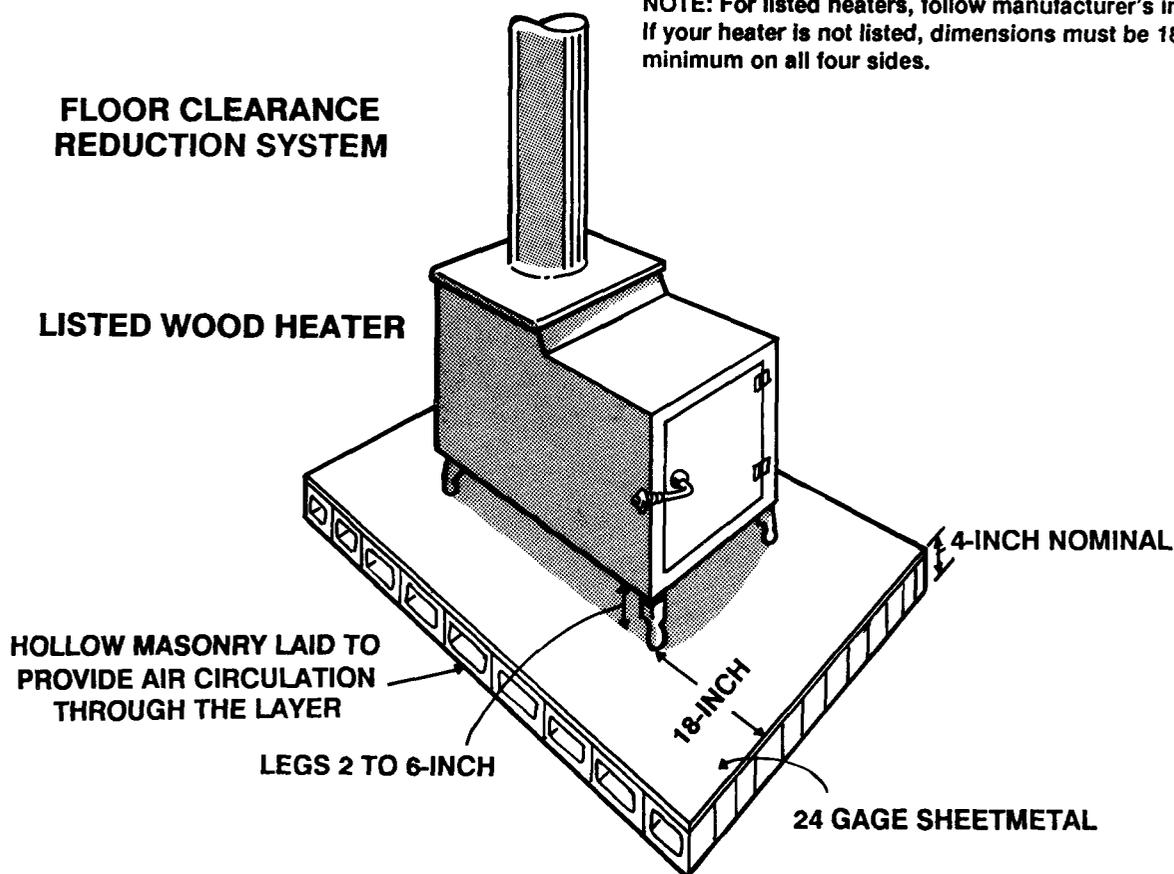


FLOOR PROTECTION TOP VIEW

NOTE: For listed heaters, follow manufacturer's instructions. If your heater is not listed, dimensions must be 18-inch minimum on all four sides.

### FLOOR CLEARANCE REDUCTION SYSTEM

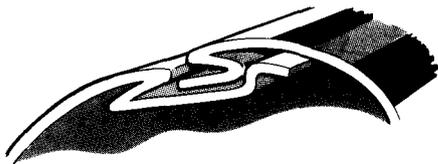
### LISTED WOOD HEATER



# CHAPTER 4

## Connecting the Wood Heater to the Chimney

The connection between the wood heater and the chimney is commonly known as the "stovepipe." Blue or black steel stovepipe is the most commonly used, and typically, is the least costly material for this purpose. This single-wall metal pipe is not a chimney. A stovepipe may never pass through a ceiling, closet, or concealed area; for these arrangements a "Class A" chimney is required. Once the stovepipe connects to the chimney, it must remain a chimney from that point on. No further use of stovepipe is allowed. Stovepipes must never pass through firewalls or fire partitions.



**SINGLE WALL STOVEPIPE**

The thickness of the stovepipe for a given diameter is as follows:

4-inch diameter	26 gage
6 to 10-inch diameter	24 gage

Note that the lower the gage number, the thicker the pipe wall. Use a U.S. or Manufacturer's Standard gage wheel to measure the thickness. These can be obtained at sheet metal supply stores. The pipe should be the same diameter as the pipe outlet on the heater.

For safety reasons, the stovepipe should be as short as possible, but installations with 5 to 7 feet or so of pipe are acceptable. The extra length raises the efficiency of the wood heater by reclaiming some heat from the stack gases before they enter the chimney. However, if the gases cool too much, excess creosote can form. The horizontal run of the stovepipe must be less than 75 percent of the height of the vertical chimney above the connector. Horizontal stovepipe should

rise 1/4 inch per foot away from the heater to allow condensation to drip back to the stove. Make sure seams are not on the bottom of horizontal runs.

It is usually best to begin installation from the heater end. Always install the crimped end of the elbow or straight pipe toward the heater. This allows creosote and water to drip back to the heater. Use nonadjustable elbows where possible: they are cheaper and last longer. Cut the pipe sections to length with metal shears.

Stovepipe is commonly made in both welded seam and snap lock versions in 2-foot lengths. To assemble the snap lock type, squeeze the seams together while pressing down on the pipe. The joint is made when you hear a snapping or clicking sound. Assemble each section separately. Start at one end, pressing and squeezing as you proceed to the other end. Occasionally, the stovepipe is defective and a tight joint cannot be made. Discard the stovepipe or break the joint and trim the crimped (male) side of the joint with sheet metal shears until it fits properly.

Connect the pipe sections in proper order. When you are satisfied with the fit, install three sheet metal screws at each joint and at least one screw at the collar connection of the heater.

If you install a nonairtight heater, you may need a damper in the stovepipe to help control the draft. In addition, an airtight heater equipped with a wire mesh firescreen may need a damper when the doors are opened and firescreen is used. Follow the manufacturer's instructions. Try the heater without a damper; if the chimney draft is excessive and control of combustion difficult, a damper is called for. To install it, drill a 1/4-inch hole through both sides of the stovepipe, position the damper inside the pipe section, insert the handle, and turn to lock it to the plate. Some heaters have a built-in outlet damper and do not require a second one in the stovepipe.

In planning your installation, keep in mind that the most trouble-free system will have few, if any, horizontal pipe sections and elbows. Long runs of horizontal

stovepipe should be avoided because they inevitably fill up with soot, ash, and creosote. A vertical stovepipe gives the best possible draft and allows creosote and soot to fall back into the heater to be burned. Cleaning this type of system is extremely easy and it is generally lowest in cost because elbows and tees are more expensive than straight stovepipe and chimney.

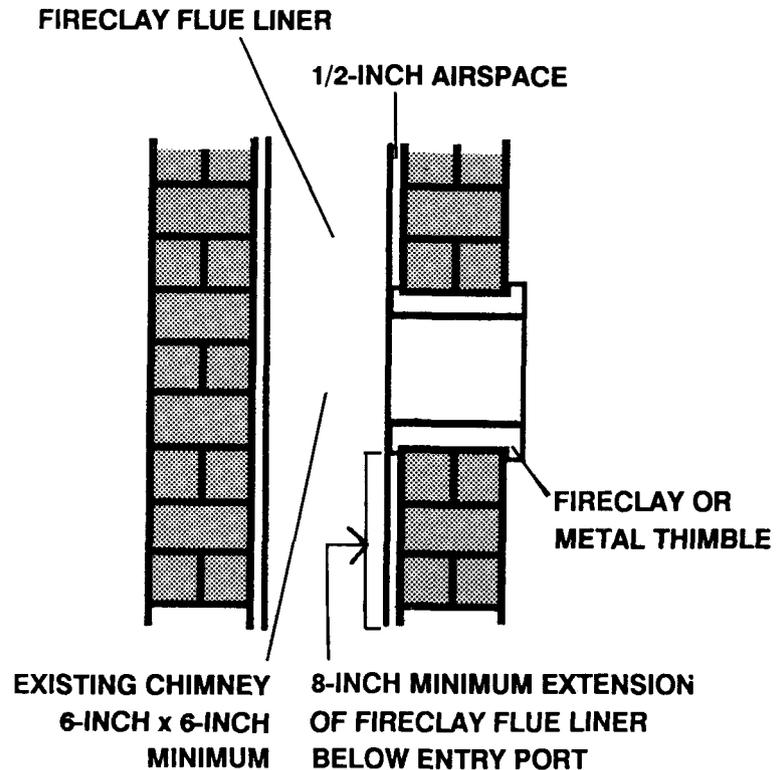
## Venting Through a Wall

Venting stovepipe through interior combustible walls is discouraged, because long horizontal runs result. Also, part of the stovepipe is in a room other than that containing the heater, hence it is not easy to monitor. If unavoidable, use a metal or fireclay thimble when passing a stovepipe through noncombustible walls such as solid brick or concrete. Other methods of passing through exterior or interior walls are noted in the Tentative Interim Amendment 211-84-1 to NFPA publication No. 211. These methods have not yet been accepted, but will be discussed at an NFPA meeting in November 1987.

If using a metal chimney, make certain that it is a listed Class A chimney and follow the manufacturer's instructions for connecting it to the stovepipe. A tapered, "slip-fit" section is often used to connect between metal chimney and stovepipe. This section is secured to the bottom of the chimney and has an outside diameter slightly smaller than the inside diameter of the stovepipe. This allows for adjusting the length of the final section without cutting the pipe. The stovepipe should be secured to the "slip-fit" section with sheet metal screws.

## Venting Into a Masonry Chimney

Metal or fireclay thimbles are used to connect between the stovepipe and a masonry chimney. The thimble should be permanently cemented into the chimney and extend through the chimney wall to the inner face or liner, but not beyond. Push the short section of stovepipe, crimped on both ends if necessary, into the thimble and secure it with high temperature sealant (such as furnace cement). The stovepipe should extend as far as possible into the thimble, but should not stick out into the chimney.

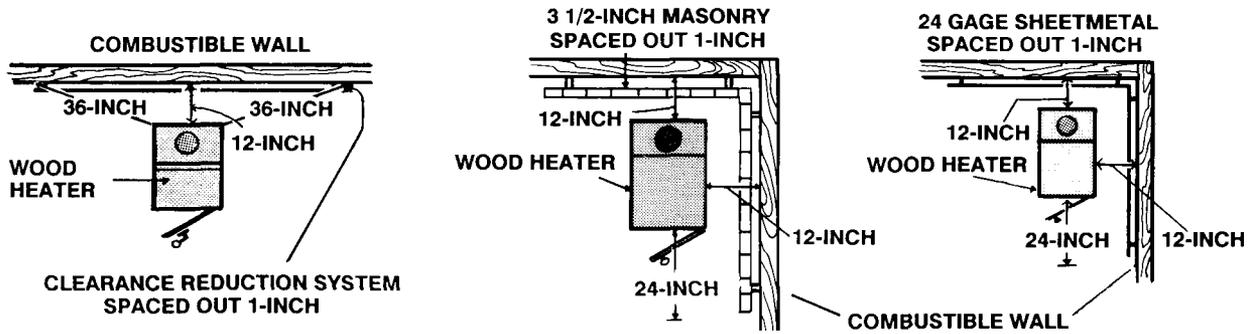


## VENTING INTO A MASONRY CHIMNEY

### Venting Into a Fireplace Chimney

Many people may wish to convert an existing fireplace to wood heater use. Usually, safe connection of stovepipe to a masonry chimney requires more effort than a connection to a prefabricated chimney. There are two methods (Type A and Type B) to accomplish this. No matter which method you choose, **the fireplace must be tightly closed and sealed at the damper in the flue.** Good sealants are high-temperature caulking, ceramic wool, and furnace cement. Always remember to inspect the masonry chimney and fireplace. If necessary, clean the flue and smoke shelf before beginning your installation. Install the wood heater into the fireplace so that the system can be dismantled for cleaning and inspection.

## CLEARANCES TO COMBUSTIBLE WALLS



NOTE: THE 24-INCH CLEARANCE IS FOR LOADING PURPOSES.

**TABLE 5**

### Clearances to Walls and Ceilings with Clearance Reduction Systems

Type of Protection	Wood Heater (inches)	Stovepipe (inches)
Without protection	36	18
3 1/2-inch masonry wall, without ventilated airspace	24	not allowed
3 1/2-inch masonry wall spaced out 1 inch	12	9
24 gage sheet metal spaced out 1 inch	12	9
28 gage sheet metal spaced out 1 inch	not allowed	9
Listed prefabricated system	Per manufacturer's specifications	

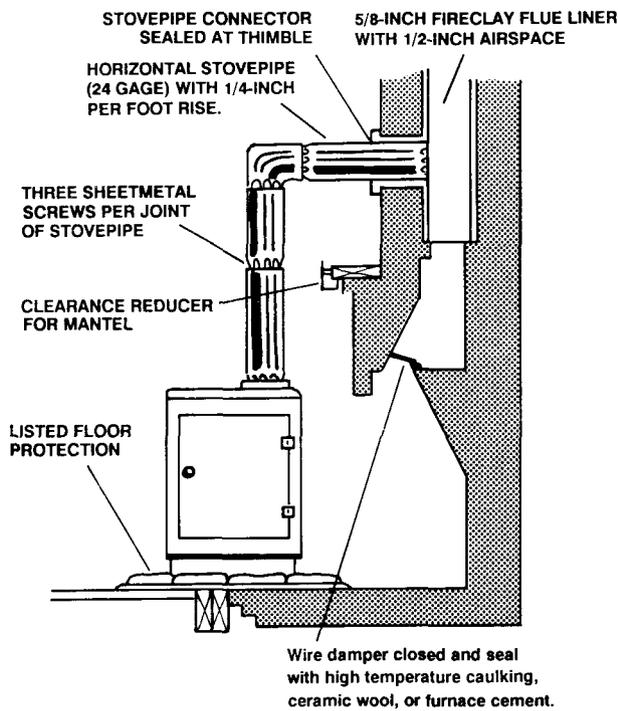
**Notes:**

1. These clearances are from the side of the heater or stovepipe to a parallel combustible surface.
2. Loading doors require at least a 24-inch clearance, even with clearance reduction systems or noncombustible surfaces, to allow room for loading the heater.
3. There must be at least a 36-inch clearance from the top of the heater to any unprotected combustible surface.
4. Use these clearances or those contained in the manufacturer's instructions, whichever are greater.
5. Masonry clearance reduction systems are used on walls, not ceilings.
6. 28 gage sheet metal may be used for clearance reduction for stovepipe only.

**TABLE 6**

### Minimum Wall Clearance Reduction System Widths for Stovepipe

Type of Protection	Distance from Pipe to Combustible Surface (inches)	6-inch Stovepipe (inches)	8-inch Stovepipe (inches)
3 1/2-inch masonry spaced out 1 inch	9	22	24
24 or 28 gage sheet metal spaced out 1 inch	9	32	33
Prefabricated system	Per manufacturer's specifications		



### Type A Fireplace Conversion

Connection of the stovepipe directly into the existing masonry chimney over the fireplace opening -- called a **Type A** installation -- is the most desirable method. This installation performs better, yielding better draft; it is also easier to clean and inspect for creosote. Before beginning this type of installation, plan carefully; a high degree of skill is required to ensure safety.

Cut an entry port for the stovepipe through the chimney with minimum damage to the fireclay liner. You will need to make some involved measurements to locate the flue liner exactly. Before cutting, take time to mark the size and position of the entry port. Position the entry port so that at least 8 inches of flue liner remain below the port.

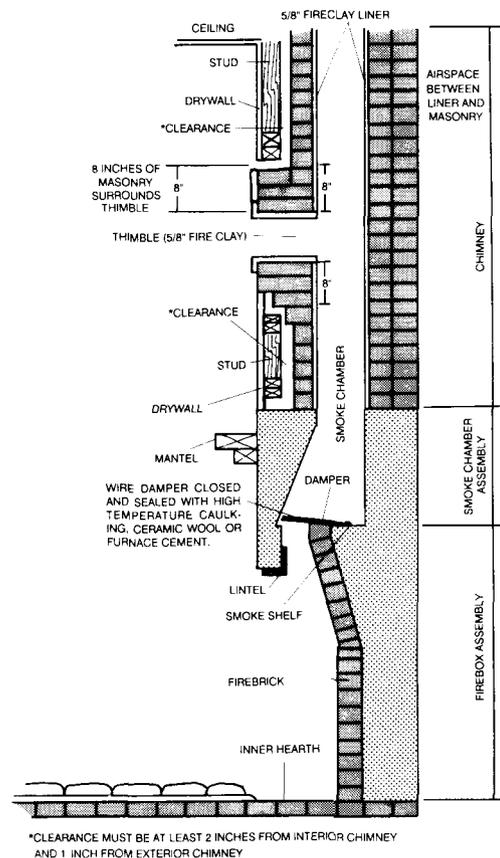
Keep in mind that wood mantels and combustible trim around the fireplace must have adequate clearances from the heater and stovepipe or must be protected in an approved manner. Also, leave at least an 18-inch clearance between the top of the stovepipe and the combustible ceiling or other combustibles. Placing the center of the entry port 2 feet below the ceiling will ensure proper clearance for 6-, 8-, and 10-inch stovepipes.

Next, install a fireclay (at least 5/8-inch thick) or metal thimble, being sure that the thimble is flush with the inner flue lining. Secure the thimble in place with refractory mortar.

Frequently, a wood frame wall is found above the fireplace mantel. NFPA has several methods for entering a frame wall above a fireplace (or through a frame wall into a chimney) in its Tentative Interim Amendment to NFPA publication No. 211. All are costly and complex. Perhaps the best solution at this time is to use the recently developed and UL-listed Class A through-the-wall thimbles specifically designed for connection to the chimney face. These cost approximately \$120.

Another way to pass through such a wall is to fasten headers to the framing around the entry port, allowing for the addition of 8 inches of masonry surrounding the thimble, plus a 2-inch airspace on all four sides to the headers. The brickwork is supported by corbeling or

### VENTING THROUGH A COMBUSTIBLE WALL OVER A FIREPLACE



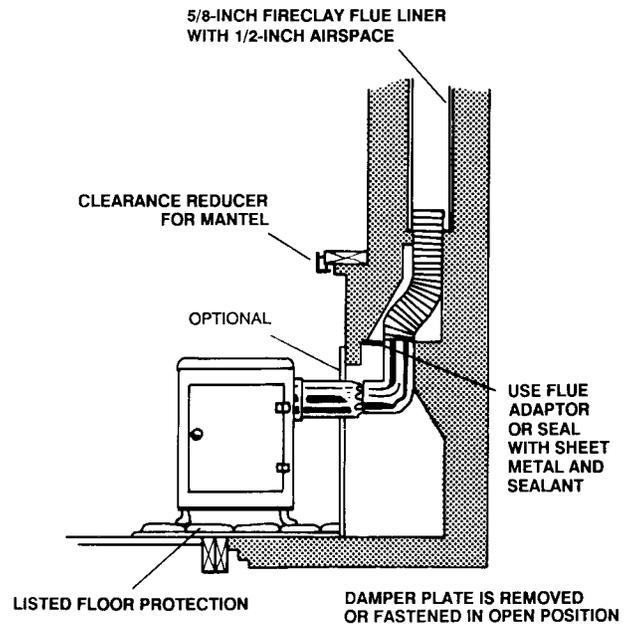
by a metal bracket securely bolted to the chimney face. The added brickwork should bring the chimney wall into line with the finished wall above the mantel. The 2-inch gap is a required clearance since the thimble is considered to be part of the chimney. (It is in full thermal and physical contact.) However, you can cover the gap with sheet metal or other noncombustible finish material 1/2 inch thick or less.

Install the stovepipe as far as possible into the thimble, but not past the inside of the flue lining. There should be a small airspace (approximately 1/2 inch) between the stovepipe and thimble, allowing for expansion of the stovepipe. Seal this airspace with high-temperature sealant or ceramic wool. Finally, be sure to wire the fireplace damper closed and apply the same sealant you used at the stovepipe and thimble junction.

### Type B Fireplace Conversion

The next method, **Type B**, is acceptable. Remove the damper and cut a piece of 24 gage sheet metal to rest on the damper frame. Cut a hole in the sheet metal to accept the stovepipe. Use adjustable elbows or flexible stainless steel duct to insert the stovepipe past the throat or damper plate until it is at or past the beginning of the flue liner (or beginning of Class A masonry flue). This is sometimes called the "direct connect" method of joining the stove to the Class A fireplace flue. Finally, fasten all junctions between the sheet metal and damper frame and between the sheet metal and stovepipe. To prevent leakage, be sure to seal these junctions with high-temperature caulking, ceramic wool, or furnace cement. A prefabricated flue adaptor of 12 gage, low-carbon steel or stainless steel may be installed instead of a sheet-metal closure at the damper. Complete flue adaptor sets are now available for this installation. Be sure to fasten and seal the stovepipe to the flue adaptor.

A better, but more expensive method of venting is to extend the stovepipe all the way to the top of the chimney. This is sometimes called the "continuous direct connect method" and is the same as relining the chimney. Use materials that are listed for the purpose and follow the manufacturer's instructions. This method increases draft, reduces creosote formation, and makes cleaning and maintenance easier. Some manufacturers now sell stainless steel liners with outer insulation jackets to keep the flue gases warmer and reduce creosote formation.



### TYPE B FIREPLACE CONVERSION

### Other Considerations

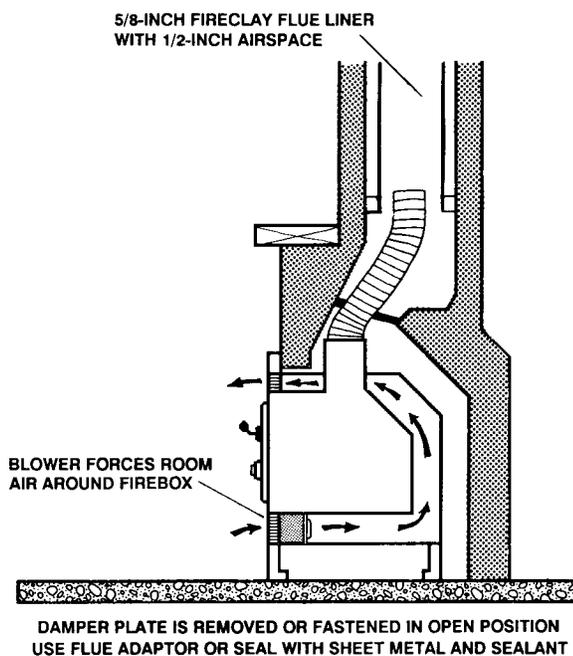
Before deciding to convert your fireplace, keep in mind that some fireplaces and existing chimneys are unsafe. They must be structurally sound, and the flue liner must be in good condition. Clearances to combustibles are explained in Chapter 2. If you have any questions regarding the condition of the chimney, consult a qualified engineer, competent mason, or knowledgeable inspector.

**Caution: Not all fireplaces are suitable for use with a wood heater.**

Many prefabricated fireplaces fall into the "zero-clearance fireplace" category. They are specifically designed to be used as fireplaces, and many have been tested by nationally recognized organizations. They have NOT been designed to handle the heat produced by wood heaters. In fact, venting wood heaters through zero-clearance fireplaces violates the safety listing and may void the manufacturer's warranty.

Steel-lined fireplaces, on the other hand, can be used with wood heaters. These units use a 1/4-inch firebox liner and an air chamber in conjunction with 8 inches of masonry to meet code. They contain all the essential parts of a fireplace: firebox, damper, throat, smoke shelf, and smoke chamber. Many of them look exactly like a masonry fireplace and must be checked closely for the above requirements before installing a wood heater into them.

Another method frequently used by some people is to vent the wood heater directly into the fireplace. This does NOT meet code since the heater is being vented into another appliance -- the fireplace. Never attempt this method because combustion products will deposit and build up in the firebox or fireplace. Be certain not to install a hazard in your house.



## FIREPLACE INSERT

## Fireplace Inserts

Most fireplaces are energy losers. Therefore, a great deal of interest has arisen over the use of fireplace inserts. These solid-fuel burning appliances fit into the firebox assembly and use the existing chimney for venting. They save space in a room and reduce heater-to-combustible clearance problems on three sides. Inserts vary as to how much of the firebox penetrates into the room. A number of inserts are designed to fit flush with the front of the fireplace opening in deep fireplaces. The fireboxes of some units intended for smaller fireplaces (occasionally called "outserts") extend more than half of their length into the room.

Some early fireplace models were single-wall, using the existing fireplace for circulation and heating of room air. This design loses heat to the brickwork and has potential problems with smoke and condensate leakage. More modern designs use a second wall (some with external insulation) to duct the air around the back, sides, and top of the firebox and return it to the room. Although some models can operate on natural convection in emergencies, the amount of air flow is small and efficiency suffers. Efficiencies for fan-equipped inserts are in the range of 40 percent to 45 percent, or about three-fourths the efficiency of most free-standing airtight stoves.

Follow the manufacturer's instructions for listed heaters when installing them in masonry fireplaces or steel-lined factory-built (not zero-clearance) fireplaces with masonry chimneys. The chimney and fireplace should be checked to verify that they are properly built with sufficient clearance to combustibles. Remember, inserts will run hotter than open fireplaces. Pay particular attention to the connection to the flue--the direct connect or continuous direct connect methods are preferred (see Type B Fireplace Conversions on the previous page). The hearth may need to be extended and existing mantle pieces protected.

# CHAPTER 5

## Operating Your Heater System



**T**here are many ways to build a fire. The basic principle is to set a match to easily ignitable tinder, such as paper, which ignites the fast-burning kindling, which in turn ignites the slow-burning firewood. One method that works is:

1. Place several wads of crushed paper in the front of the firebox.

2. Lay small dry sticks of kindling on top.

3. Open dampers fully.

4. Clear the immediate area of combustibles such as matches, cloth, and paper. Make sure the room is adequately ventilated and the flue is unobstructed.

5. If the stove tends to smoke on initial lighting, before lighting induce a draft by holding a lighted roll of paper as near as possible to the flue outlet inside the stove, or slightly open a window in the heater room.

6. Light the wadded paper in the heater and close the heater door. Don't ever light or rekindle a heater fire with kerosene, gasoline, or charcoal lighter fluid; results can be fatal.

7. Once the kindling is burning briskly, add several full length logs two or three inches in diameter. Be careful not to smother the fire. Stack the pieces of wood at angles -- near enough to keep each other hot, but far enough away to allow adequate air flow between them. Remember to burn seasoned wood. It will give you more useful heat and less creosote. Also, never

burn treated wood because its preservatives are toxic and can harm your health.

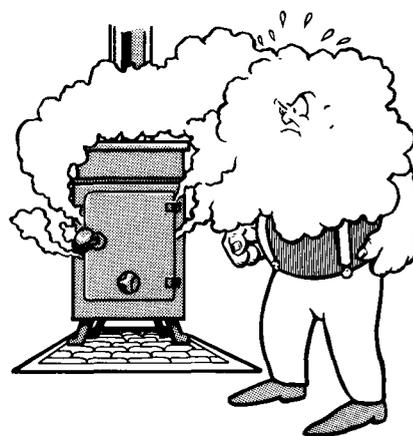
8. When ready to reload the heater, add more logs. Large logs burn slowly, holding a fire longer. Small logs burn fast and hot, giving heat quickly.

9. Adjust the draft control; the more you close down the control, the lower and slower the fire will burn. Experiment to determine the proper setting. A more open draft control will be needed if you have (a) wet or green wood, (b) no wind outside, (c) cold outdoor temperatures, or (d) a drafty house. For automatic heaters, see the operating handbook --you may have to calibrate your thermostat at the beginning of each heating season.

As long as there are hot coals, repeating Steps 8 and 9 will enable you to maintain a continuous fire throughout the season. A note of caution: most manufacturers of cast iron heaters recommend keeping the first fires small to break in new heaters gradually. New heaters always smoke on startup as the paint and sealants are heated. Be prepared to open windows and doors for ventilation.

### Do It Safely

- When refueling, open the damper and air inlet fully for 60 seconds before opening the loading door to ensure that smoke and combustible gases will not escape into the room. For airtight heaters, this is



especially important as a sudden rush of air into the fire chamber can trigger a small slow explosion known as backpuffing. Escaping gases can seriously burn anyone nearby. All openings in operating heaters should be opened slowly, and the operator's face should be kept well back from the heater for a few moments afterwards.

- Don't over fire the heater. Red hot stovepipes and overheated flues can cause chimney fires.
- Watch out for handles and surfaces too hot to touch with bare hands. Some heater manufacturers supply small metal rods with hooks to operate the handles. But it is always a good idea to keep a pair of stove gloves nearby. Train children to stay back away from the heater.
- Before going to bed or leaving the house, always check to see that the stovepipe damper is open, the heater door securely fastened, and combustibles a safe distance from the heater.
- Ashes that seem cool may contain concealed hot embers, so always place ashes in a metal container with a tight fitting lid. Coals can stay hot for several days in ash. (Leave an inch or more of ashes to protect the bottom of the firebox.) Place the container on a noncombustible floor or outside on the ground, away from combustible materials until final disposal.
- Don't burn trash. Chemicals in plastics and other synthetic materials can corrode interior surfaces and necessitate frequent and costly repairs.
- Do not put green or wet wood on top of the heater to dry. Such a practice is very dangerous. In fact, do not put anything on top of the heater unless it is absolutely noncombustible.
- Do not store flammable liquids near the heater. Be especially careful in workshops, basements, and garages.

### An Ounce of Prevention

- A fire extinguisher should be mounted in any room with a wood heater. Locate it so you can create an escape route if necessary. Inspect each extinguisher at least once a month.
- Keep a bucket of sand near the wood heater. Sand

is especially helpful in slowing down or extinguishing the fire in a wood heater. Use water on wood heater fires only in extreme emergencies because the water will turn to steam, scatter hot ash, and can crack heater parts.

- Install smoke detectors, especially near bedrooms if your heater provides heat all night long. According to NFPA, the majority of fatal residential fires strike between 9 p.m. and 6 a.m. when most people are asleep.
- Smaller, more frequent loadings and burning well-seasoned wood will keep creosote deposits to a minimum.
- Clean both stovepipe and chimney on a regular basis.

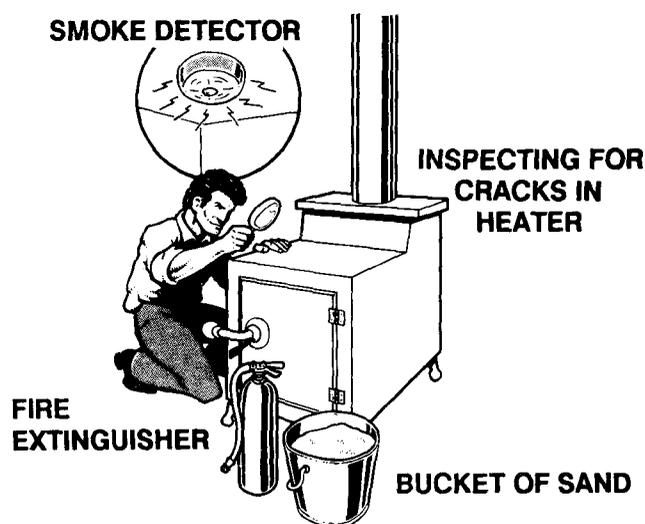
Wood heater users must commit themselves to a fire-safe lifestyle.

### Oh No, It Smokes!

Jay Shelton gives some basic remedies for smoking heaters in his *Woodburners Encyclopedia*. First, make sure the dampers are not shut and adjust house openings as follows:

- Open windows or doors a crack on the first floor or basement on the windward side if weather is windy.
- Close windows or doors on the upper floors of the house. If the heater only smokes in windy weather,

### WOOD HEATER USERS MUST COMMIT THEMSELVES TO A FIRE-SAFE LIFESTYLE



install a chimney cap if there isn't one, install a better chimney cap if there is one, or increase the height of the chimney.

If chronic smoking is a problem even in calmer weather:

- Check the entire venting system for obstructions and clean if necessary. Birds' nests and creosote are possible causes of blockage. Overhanging trees may also cause downdrafts.
- Make sure the stovepipe is not inserted too far into the chimney.
- Try opening a window or door in the same room as the heater; if smoking stops, direct ducting of outdoor air to the wood heater's vicinity may help.
- Try moving the heater closer to the chimney and eliminating elbows in the stovepipe connector. However, be certain to maintain proper clearances between the heater and stovepipe and all combustible materials.
- Weatherstripping and sealing upper floor windows and attic doors can help.
- Attic pulldown staircases and whole house fans can also cause upper story air leakage and should be sealed and weatherstripped.
- If more than one stovepipe is connected to a flue, provide each woodburning appliance with a separate flue.
- The last resort is to install a smaller heater or increase the diameter of the flue.
- Remember that tall, large chimneys take longer to heat and may provide little draft when cold.

## Watch Out for Chimney Fires

When combustion is incomplete, hot unburned gases and tar-like liquids go up the flue with the smoke. As these substances contact cooler surfaces, they condense much like water droplets on a glass containing an iced drink. When the water evaporates, it leaves behind a tar that builds up fire after fire into a crusty black layer called creosote.

Chimney fires occur when creosote on the inside of a chimney wall burns. They are most likely to occur during a very hot fire as when cardboard is burned. A crackling sound is often heard at the beginning. As intensity grows, the stovepipe may shake violently, air will be forcefully drawn in through the heater, and the stovepipe may glow red hot. A tall plume of flame and sparks will rise from the top of uncapped chimneys.

If a chimney fire starts, take action at once:

1. Close the dampers to limit the air supply to the fire.
2. If the fire doesn't go out **immediately**, get all persons out of the house and call the fire department.
3. Wet down the roof and other outside combustibles to prevent fires started by shooting sparks and flames.
4. Keep a close watch on all surfaces near the chimney.

Properly installed and well maintained stovepipes and chimneys are intended to withstand an occasional chimney fire, but this is a dangerous method to keep a chimney clean. There is always the risk of a house fire, and a chimney fire encourages cracking and corrosion of the flue.

To cut down on creosote deposits and avoid chimney fires:

- Burn dry, well-seasoned hardwood; use smaller, more frequent loadings.
- Keep a briskly burning fire; maintain a good draft.
- Add small loads of wood frequently rather than fewer large loads.
- Minimize the length of stovepipe connecting the stove to the chimney.
- Use the wood heater consistently without much time lapse between fires.
- Burn a hot fire for a half hour each day.

# CHAPTER 6

## Cleaning Your Wood Heating System

**R**emoving creosote from your wood heating system on a regular schedule is very important because:

- It acts like an insulator to reduce heat transfer efficiency.
- Large deposits can block the flue and make the heater smoke.
- It is highly flammable and causes dangerous chimney fires.

One-quarter inch of creosote buildup signals cleaning time, according to many chimney sweeps. Inspect the flue at both the heater end and the chimney top. Remember that cooler surfaces will have the thickest creosote deposits. Also, it is unfortunate, but efficient airtight stoves generate creosote much faster because of their long, slow burning characteristics. New heater installations should be inspected every few weeks until you determine creosote buildup rates. New truckloads of wood and switching from heavy heating (winter) to light heating (spring and fall) can affect the rate too.

### Chimneys First

Many professional chimney sweeps not only clean chimneys, but also inspect the entire wood heating system for safety and efficient operation. If you're ever in doubt as to the safety of your wood heater, call a knowledgeable professional before lighting a fire. To clean your own chimney, you'll need a brush, fiberglass extension rods or two ropes, and a ladder.

- A quality, bristled chimney brush is a good investment for serious wood heater users. You can also try a burlap bag filled with sand.
- Fiberglass rods or rope--attach the brush to either in order to scrape the chimney clean.
- Resting the ladder against the roof peak or eave is safer than against the sloping side.

Make sure the heater is cold and remove stovepipe sections as necessary. If you are using ropes, drop a small weight with one rope attached down the flue to a

helper. Tie the brush between the two ropes, and pull it up and down the entire length of the chimney, scraping off the creosote deposits until you're sure you have a "clean" chimney. Soot will tend to puff out of the heater and into the room while you are cleaning the chimney, so partially block the stovepipe with rags. Debris can be shoveled out at the ash door or at the stovepipe. Note: Never use tow or tire chains to clean a masonry chimney. They not only knock out creosote, but also bricks and mortar, and may damage the flue liner.

There is another cleaning method that doesn't require climbing the roof. You'll need a flue brush and flexible extension handles from your local heater shop. Lay a drop cloth around the heater area to protect the flooring from soot. Carefully remove the stovepipe, marking each joint if you take it apart. Set up a cardboard box or drop cloth under the flue opening in the wall to catch the soot and creosote. Attach the handle to the flue brush and push it into the flue. Work the brush up towards the top of the chimney adding extensions as required. Move the brush up and down the flue until no more creosote falls to the bottom. Collect the debris and toss it into the trash. (The extension handles can also be used from the roof to clean a chimney.)

### Then Stovepipes and Heaters

Cleaning stovepipes and heaters is a messy job, best done outdoors if possible. You'll need a flashlight, a wire brush, a dust pan, and a whisk broom. Make sure the pipe and heater are cold before starting.

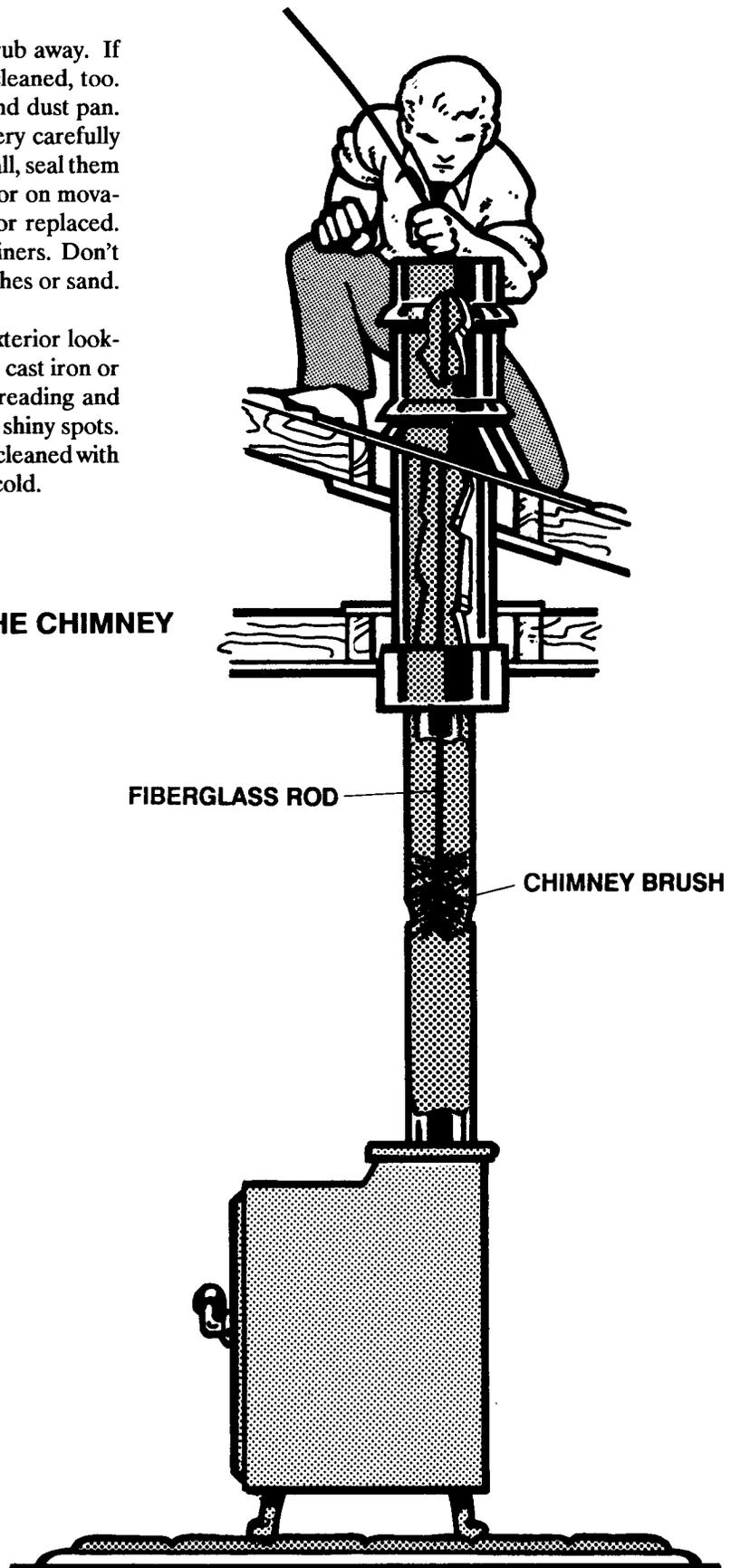
Mark all joints of the stovepipe. This will make re-assembly much easier. Remove the stovepipe carefully and put it in a cardboard box to keep soot from falling where it doesn't belong. Once you have the pipe outdoors, use the brush to scrape off deposits from the inside of each section. Replace any that are excessively corroded and reassemble using your marks as a guide.

Move the heater outside or cover the floor with a drop cloth. Shovel the ashes or sand into a bucket. Use the flashlight to see what the interior looks like. Then

reach inside with your wire brush and scrub away. If you have a baffle system, this should be cleaned, too. Remove the loose deposits with broom and dust pan. Now use the flashlight again to inspect very carefully for cracks and corrosion. If cracks are small, seal them with furnace cement. If cracks are large or on movable parts, it's best to have them welded or replaced. Replace damaged fire bricks or cast iron liners. Don't forget to replace the protective layer of ashes or sand.

Most heater owners like to keep the exterior looking new. Use a high temperature paint on cast iron or steel heaters; it will prevent rust from spreading and increase the radiant qualities by covering shiny spots. The more modern enamel cabinets can be cleaned with soap and water. Make sure the heater is cold.

### CLEANING THE CHIMNEY



# CHAPTER 7

## Obtaining Firewood

**F**irewood can be plentiful if you know where to look. The U.S. Forest Service permits the cutting of firewood for personal use in designated areas of the National Forests. Prior to cutting, obtain a permit from the District Ranger's office covering that area. The permit will state what, where, when, and how much you are permitted to cut.

Landowners can benefit by using or selling firewood on their tracts. Many small woodlots contain trees that are not profitable for commercial use such as undesirable species and diseased, forked, or crowded trees. Removing these trees upgrades the forest stand for future timber sale and at the same time produces income that would otherwise be lost. A professional forester, state or private, can advise the landowner on which trees to remove.

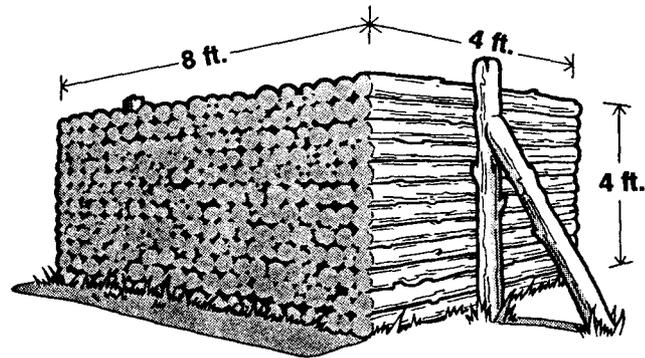
Normal logging operations leave behind excess logging slash (limbs and tops) unsuitable for commercial use. They can be unsightly and pose a wildfire hazard. Logging slash is often the right size for firewood or kindling, needing little or no splitting. Firewood seekers are sometimes allowed to cut or purchase the downed slash. Contact the individual landowner or company representative for permission.

Right-of-way clearings or new construction sites are also good places to get firewood. Obtain permission from the owner or contractor before cutting.

Occasionally, timber and paper companies will permit individuals seeking firewood to cut designated trees in designated areas. Prior to entering the area, get permission from the company.

In urban and suburban areas, tree removals and structural (but not pressure-treated) lumber from new construction and renovation create frequent opportunities for free wood supply. Some saw mills and wood manufacturing operations give away slabs and ends for free. To reduce the solid waste deposits, some county landfills may be willing to give you wood that is suitable for burning. Give them a call and find out.

Firewood has become a source of income for some individuals. They offer wood for sale that has been cut, split, and dried, and often will deliver it to your home. Check your local newspaper or yellow pages under "Firewood."



**A CORD = 128 CUBIC FEET**

### Get Your Money's Worth

- Know your species. Hardwood should cost more than softwood.
- Measure your wood properly. Remember: 1 cord equals 128 cubic feet, which measures 4 feet high, 8 feet long, and 4 feet wide. A rick, or face cord, is a half cord if cut in 2-foot lengths, a quarter cord if cut in 1-foot lengths. A pickup truck load is one-quarter to one-half a full cord.
- Seasoned wood is worth more than green wood.
- Get the landowner's permission before cutting wood.
- Know where the property boundaries are.
- If you are on someone else's land, treat it as though it belonged to you. You might want to return.
- Know which trees to cut.

For assistance in buying or selling firewood, contact your local forestry unit.

## Cutting Wood

According to a 1974 survey, 86 percent of wood cutting accidents were related to unsafe practices. The majority of these accidents resulted from loading wood and using chainsaws. Broken hands and feet, cuts, strains, and sprains resulted from loading accidents. Chainsaw accidents resulted in serious cuts to the legs, hands, arms, and face. The following are some general safety tips to aid you while cutting wood.

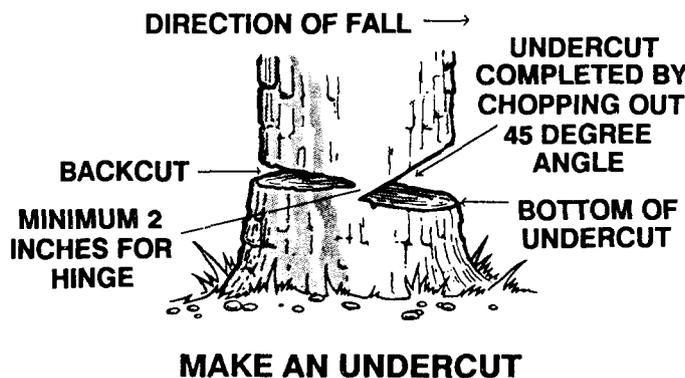
## Wear Protective Clothing

Dressing properly will ensure your comfort and safety. Items to include are:

- Hard hat
- Safety goggles
- Comfortable but close fitting clothes
- Work gloves
- Hard-toe shoes with nonskid soles
- Ear plugs -- when exposed to prolonged chainsaw noise.

Be prepared and plan ahead. You should carry the following items to the woods with you.

- Drinking water
- Snacks (nuts, fruits, and cheese are good for a quick energy boost)
- Tools needed for saw sharpening and minor repairs
- First aid kit



## Respect Your Chainsaw

Before using your saw, get to know it well. Read the owner's manual from cover to cover.

- When carrying a chainsaw any distance, be sure that you carry it by the handle with the motor off and the guide bar and chain to the rear.
- Never attempt to start a chainsaw placed on your knee or held in the air. Start the saw on solid ground that is level and clear of debris.
- When moving from tree to tree with the saw, make sure the chain is not moving and your finger is not on the saw trigger.
- Allow the saw to cool before refilling with gasoline. Refuel the saw in an area that has been cleared. Carry all gasoline in approved safety cans.
- Before restarting the saw, be sure that all gasoline spills have been wiped off.
- Use fresh gasoline. Last season's gas/oil mix can cause hard starting and frequent stalling.
- Sharpen the saw chain and check its tension frequently.
- Check the anti-kickback brake (if so equipped) to verify that it is operating properly.
- Take frequent rest breaks to avoid dizziness from prolonged exposure to noise and loss of hand coordination from chainsaw vibration.

## Know Your Logging Basics

1. Before felling, check the top of the tree to see if broken or dead limbs are present.

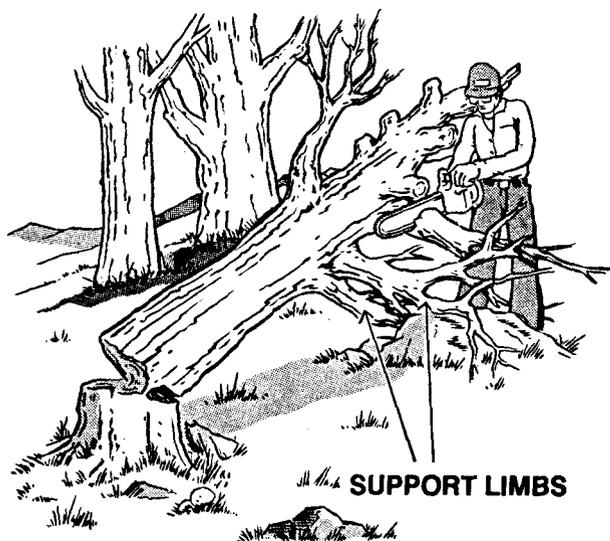
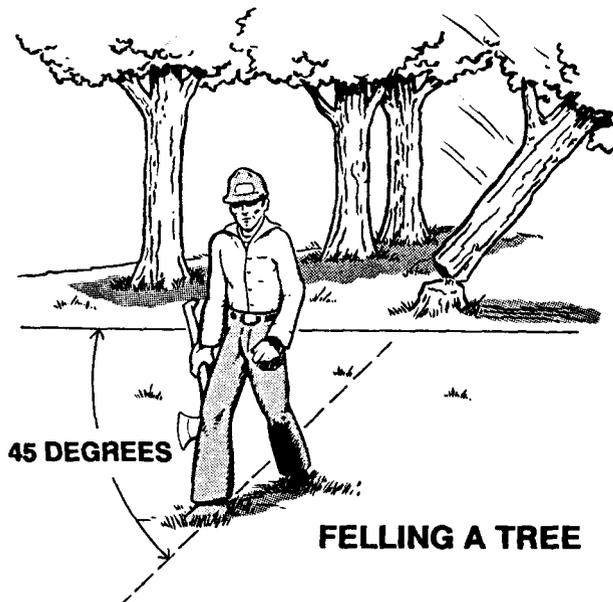
2. Consider the balance of the tree and its most likely path to the ground when cut.

3. Clear the area around the base of the tree and make sure that the surrounding brush will not hinder your line of retreat.

4. Make an undercut on the side in which direction the tree is most likely to fall. The cut should be at least one-third of the diameter through the trunk.

5. The back cut or felling cut should be at least 2 inches higher and not overlap the undercut. Leave approximately 2 inches of wood between the cuts for a hinge; otherwise the tree may kick back. If the tree does not fall, use wedges to topple it in the right direction.

6. When the tree begins to fall, move away at a 45-degree angle from the fall of the tree.



7. If a tree becomes lodged in surrounding trees, do not dislodge it by climbing or by cutting a section out of it. Try to pull it down with a truck or tractor.

8. Never attempt to fell trees on windy days.

Most accidents involving chainsaws occur during the limbing and bucking, which is the process of cutting the tree into sections. Kickback is the most common accident.

- Never attempt to limb or buck while standing on the downed tree. Stand on the ground and make sure that your footing is sound.
- Cut any support limbs with extreme caution and always stand on the uphill side.
- Never use the tip of the saw for limbing or bucking. A chainsaw with a safety break can help prevent kickback injury.

### Loading Safety

- When loading wood onto your vehicle, keep your back straight and lift with your leg muscles.
- Tumbling or rolling heavier pieces is much easier than trying to carry them.
- Never overload your vehicle.
- Before leaving the woods, make sure your load is stacked properly and balanced to avoid dangerous load shifts on the road.
- Check your brakes after you are underway to get the feel of the load and the stopping distance. Make sure your tires are inflated to carry the extra load.
- Drive defensively and maintain safe speeds.

Once you get the wood home, split it and stack it for at least six months of seasoning. Use a row of cement blocks or railroad ties underneath the bottom logs to prevent them from absorbing ground moisture and rotting. A roof overhead will keep rain off; but don't enclose the stack entirely, as good air flow through the stack is required to dry the wood to a 20 percent moisture content before burning. Generally, it is best to stack the wood away from the house because it may harbor insects, rodents, and other pests.

# CHAPTER 8

## Burning the Wood

**W**oodburning or combustion is the mixing of carbon and hydrogen from the wood with oxygen from the air to form carbon dioxide and water and release heat. Combustion has three requirements -- fuel, air, and heat. If any of these three are removed, burning ceases. When all three are available in the correct amounts, combustion is self-sustaining because the fuel releases more than enough heat to initiate further burning.

The rate at which wood burns is controlled by the amount of air available. The air-fuel ratio is defined as the amount of air to the amount of fuel used in combustion. There are limits on the amount of air under which combustion can proceed. With little or no air, there is insufficient oxygen to combine with the fuel and combustion stops. Too much air will cool the fire, remove the heat, or in essence blow the fire out. Typically, combustion proceeds best with a slightly excessive amount of air. Most heaters are designed with controls to provide air in the proper range of air-fuel ratios for good combustion.

Another important aspect of combustion is the heating value of the fuel. Heating value is a measure of the available chemical energy per pound and is expressed numerically in Btu per pound. Table 7 shows relative heating values for several common fuels. Wood has a low heating value, meaning it is not a concentrated source of energy. Seasoned, or dry, wood has a heating value almost twice that of wet wood.

Combustion efficiency, related to heating value, is a very important aspect of heater operation. Combustion

### BASICS OF BURNING

#### COMBUSTION PRODUCTS

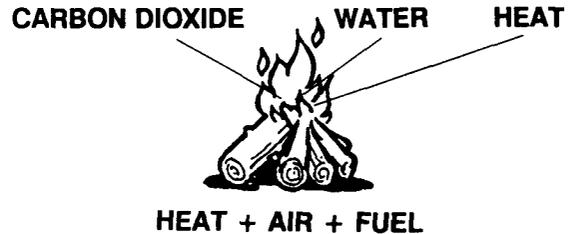


TABLE 7

#### Heating Values of Common Fuels

Fuel	Heating Value (Btu/lb)
Wood (Wet)	4,250
Wood (Dry)	8,500
Coal	13,000
No. 2 Fuel Oil	19,750
Gasoline	20,700
Natural Gas	22,800

tion efficiency is the percentage of the available chemical energy (the heating value of the fuel) converted to useful heat. Combustion efficiency is dependent on three parameters -- turbulence, temperature, and time.

Turbulence indicates the degree of mixing between wood and air in the combustion zone. Complete combustion requires that there be adequate oxygen to combine with each fuel molecule. Turbulence in the

COMPLETE  
COMBUSTION  
REQUIRES



TIME + TEMPERATURE + TURBULENCE

combustion zone reduces the amount of unburned fuel by encouraging contact between fuel and air.

Every combustible substance has a minimum ignition temperature that must be maintained if combustion is to start and continue. If the temperature drops, combustion is hampered or may cease entirely. Sufficient temperature to assure complete combustion in a wood heater can be maintained several ways:

- Lining a heater with firebrick to keep heat inside the firebox.
- Preheating combustion air.
- Recirculating flue gases.

Since chemical reactions proceed at different rates, not only must mixing and heat be adequate, but sufficient time must be provided for the combustion reaction to be completed. If the residence time of air and fuel gas in the combustion zone is inadequate, combustion efficiency will be adversely affected. Certain heaters use baffles to create flow patterns, such as the "cross" or "S" flow, which increase velocity and promote turbulence, and therefore improve combustion efficiency.

### Wood Burns in Four Stages

The surface of the wood does not ignite directly on heating, but first undergoes thermal breakdown -- resulting in vapors, gases, and mists -- some of which are combustible. The first stage or zone of combustion exists up to 395°F. (See Table 8.) In this zone there is a slow, steady weight loss as water vapor and other non-ignitable gases are driven off. In Zone B, temperatures range from 395° to 535°F. In this zone, gases continue to evolve and react giving heat. At first, they are too rich in carbon dioxide and water vapor to sustain flame, but secondary reactions occur forming combustible gases which ignite and flame (Zone C). Finally, all the gases and tars are driven from the wood, and pure carbon (usually referred to as charcoal) remains. Combustion of the charcoal occurs in Zone D, and the temperature of the wood surface rises above 900°F. Since all four stages of combustion occur simultaneously, many secondary reactions result which further complicate combustion.

### Words on Wood

Properties of the fuel play a prominent part in burning, and wood is no exception. The important properties of wood that affect combustion are species and moisture content.

Wood species affects combustion because density is species dependent. The available heat or heating value from a pound of any wood is about the same. However, wood is sold by volume; therefore, the density of the wood, not the heating value, is most important in establishing the available energy in a cord. The wood

### FOUR STAGES OF WOOD COMBUSTION

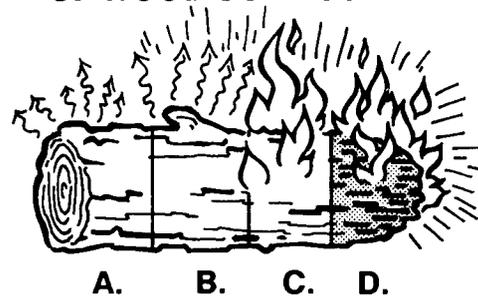


TABLE 8

### 4 Stages of Wood Combustion

#### Zone A (Below 395°F)

Water and noncombustible gases are given off.

#### Zone B (From 395 to 535°F)

Both combustible and noncombustible gases are given off; some heat is released but no flaming occurs.

#### Zone C (From 535 to 900°F)

Gases that are given off become ignitable, and flaming results.

#### Zone D (Above 900°F)

All gases and tars have been given off and remaining charcoal glows.

**TABLE 9**  
**Relation Between Available Heat and Density**

Species	Density (lb/ft)	Heating Value (Btu/lb)	Available Heat per Air Dried Cord (million Btu/cord)
White Oak	48	8,810	23.9
Yellow Pine	41	9,610	22.0
Red Oak	42	8,690	21.7
White Pine	26	8,910	14.2

species in Table 9 are ranked in order of decreasing available heat per air-dried cord. Note how a dense wood like white oak has more energy per cord than a light wood like white pine even though their heating values are about the same.

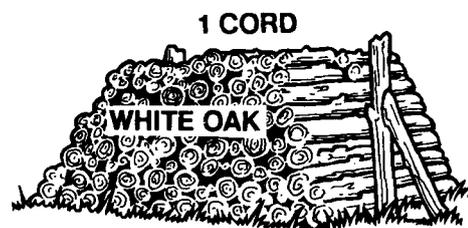
Burning rate and heating value are affected by moisture content. Most people are familiar with the difficulty of burning green wood versus seasoned or dry wood. Moisture content is how the "wetness" or "dryness" of wood is measured. The moisture content of green wood as cut in the forest can be as high as 50 percent. This means that up to one-half of the wood's weight is water. Moisture content is dependent on species, where the tree grows, and which part is burned. Green wood that is air-dried for at least six months decreases in moisture content to around 20 percent. Dried or seasoned wood starts burning easier, burns better once started, and provides more useful heat.

### More on Creosote

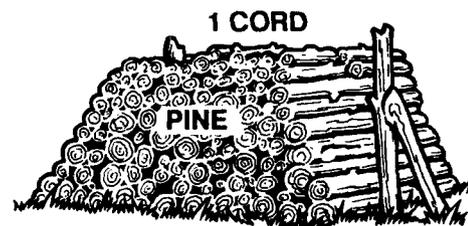
Ideally, wood combustion should be complete, and the products are carbon dioxide and water. In reality, combustion is never complete. Smoke is evidence of incomplete combustion, since it is made of unburned fuel -- combustible gases, liquid droplets, and solid particulates. Part of the organic compounds in smoke often condense in the chimney or flue pipe. This tar-like substance is called creosote. If the combustion zone temperature is sufficiently high, creosote burns along with the other organic compounds in the wood. However, creosote burns at a higher temperature than other chemicals in the wood. Thus, there are times when the other products burn but creosote does not.

The amount of creosote formed depends on the density of the smoke rising from the fire and the temperature of the surface onto which it condenses.

### AVAILABLE HEAT OF WOOD



AIR-DRIED 3620 LBS. = 23.9 MILLION Btu



AIR-DRIED 2120 LBS. = 14.2 MILLION Btu

Smoke production is greatest when fresh wood is added or when air supply is turned down low. When a fresh charge is added to the heater, heat will be subtracted from the combustion zone to warm the wood. Since the temperature in the combustion zone is lowered, combustion is not as complete and smoking results. As a remedy, you can add smaller pieces of wood and increase the air supply. More air will increase the burning rate of the existing wood and quickly ignite the fresh wood.

A similar condition occurs at night when you restrict the air flow to limit combustion and extend the available fuel. Combustion temperatures are lowered and smoke production increases. Admitting more air will raise the heater temperature, but the wood will burn faster. Control of smoke production and creosote formation requires detailed attention to heater operating conditions.

Adding a full charge of green wood before bedtime and turning the damper way down will generate large amounts of creosote. Instead, add the last charge of wood to the stove about an hour before retiring and create a fast-burning fire. In this way, the wood will be reduced sooner to cleaner burning charcoal.

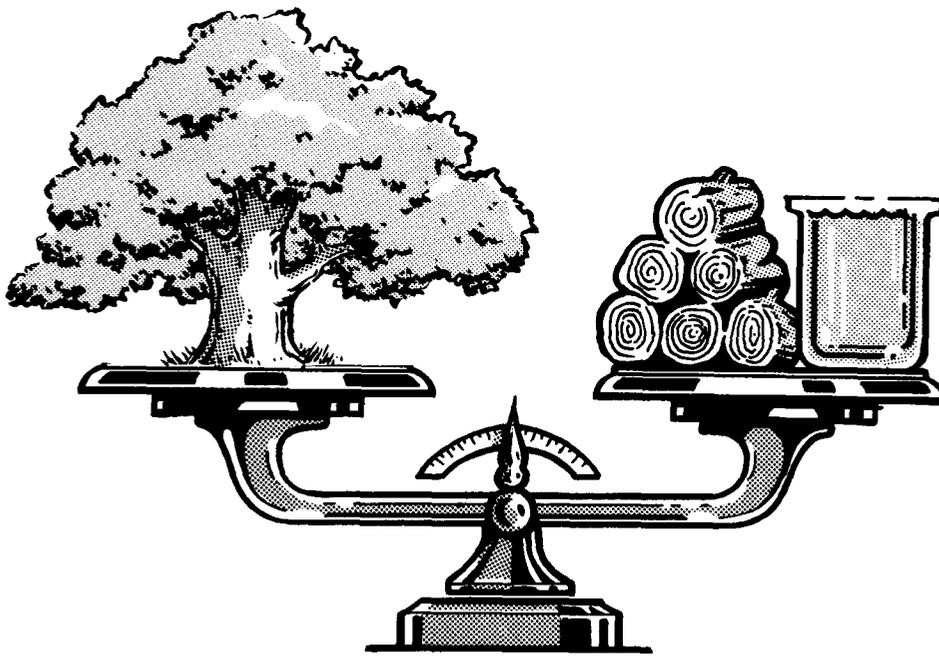
Since creosote is transported mostly as gases, you can limit deposits by preventing condensation on flue pipes. This involves insulating flue pipes to restrict heat loss thus maintaining the temperature of the flue gases.

Some wood heaters inject secondary air to help burn the creosote laden gases. They are not always successful in achieving secondary combustion. The most effective systems use more firebricks to keep the gases hot, and inject carefully controlled preheated air. Sec-

ondary air is unlikely to help in burning creosote under low fire conditions where low temperature and low turbulence occur.

Creosote formation is also a function of wood species, the type of stove, and how it is operated. Increased levels of creosote are associated with softwoods because of their high resin content. Softwoods tend to burn rapidly, and if large charges are used, users may have to reduce air inlet setting to control combustion, thus generating more smoke and creosote. While no wood can be burned free of creosote, dry hardwoods yield the best combination of efficiency and reduced creosote formation when burned at medium to high fire with frequent smaller fuel charges.

### MOISTURE CONTENT OF WOOD GREENWOOD = 1/2 DRYWOOD + 1/2 WATER

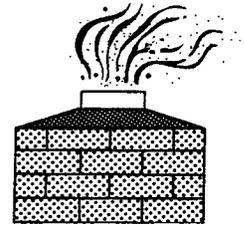


# CHAPTER 9

## Emission Standards for Wood Heaters

Wood heating can contribute to air pollution problems where the terrain, climate, weather patterns, and concentration of heaters promote accumulation of pollutants. Colorado and Oregon have experienced problems with air quality due to wood heaters and fireplaces and have pioneered testing for emissions. Oregon implemented wood heater regulations on July 1, 1986, and Colorado on January 1, 1987. Many wood heater models have passed tests for use in these two states.

The U.S. Environmental Protection Agency (EPA) has now set a nationwide standard for emissions from wood heaters. Nationwide, pollution reductions are expected to be 436,000 tons of particulate matter per year by the end of 1991. On February 18, 1987, EPA issued New Source Performance Standards for residential wood heaters (published in *Code of Federal Regulations Part 60*, beginning on page 4994). These standards regulate the levels of particulate matter (not carbon monoxide or polycyclic organic materials). Separate categories are used for catalytic and noncatalytic models and the standards are implemented in two phases. Phase I guidelines apply to wood heaters manufactured after July 1, 1988 or sold after July 1, 1990. Phase II guidelines apply to those manufactured after July 1, 1990 or sold after July 1, 1992. (See Table 10). Wood furnaces, boilers, open fireplaces, and coal-only equipment are not subject to these regulations.



**TABLE 10**

### EPA Particulate Emission Limits

	Phase I	Phase II
Catalytic heaters	5.5 grams/hr	4.1 grams/hr
Noncatalytic heaters	8.5 grams/hr	7.5 grams/hr

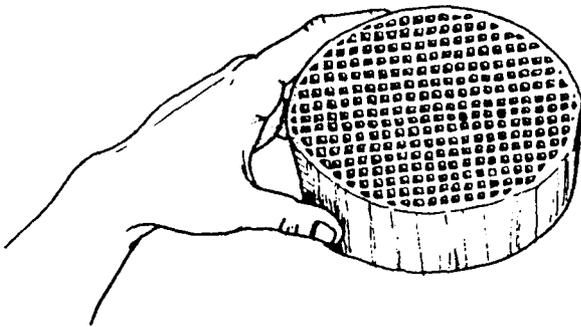
Typical current wood heaters emit 60 to 70 grams/hour of particulates, hence the 1988 standards will reduce emissions by 72 percent to 82 percent. EPA estimates that redesigning wood heaters will raise non-catalytic heater prices by \$120 and catalytic models by \$200. They predict that, in the long run, savings in chimney cleaning, chimney fires, and lower firewood consumption (due to higher efficiency) will produce a net savings to consumers.

# CHAPTER 10

## Wood Stove Catalytic Combustors

A catalytic combustor offers two major benefits: (1) more heat from the same amount of wood, and (2) less smoke pollution, which provides cleaner air, cleaner chimneys (less creosote), and less danger of chimney fires.

Just what is a catalytic combustor? By definition, a catalyst causes a reaction to take place at an altered rate or at a different initial temperature, without becoming a part of the reaction or its products. In this case, catalytic metals, such as platinum or palladium, are applied to a high temperature ceramic honeycomb or stainless steel mesh. This unit, often called a "catalyst" for short, is placed in the heater or stovepipe so that the smoke goes through it before going up the chimney. The catalyst causes the smoke to burn at a much lower temperature than usual.



Common catalyst designs are usually circular, from 5 to 8 inches across, and 1 to 3 inches thick, with 15 to 45 holes per square inch. Currently, ceramic devices are more advanced in design and last longer than metallic ones, but technology for the metallic products is advancing rapidly.

You'll get the best results from a wood heater specifically designed around a catalytic combustor--about a 10 percent increase in heat output and a 50 percent reduction in creosote accumulation. The percentage represents an average over the life of the catalyst and accounts for slow degradation. Tests under optimum conditions for new catalysts showed about twice these savings.

If you already have a wood heater, you can buy retrofit catalysts for about \$100. Internal retrofits (which fit inside the firebox) will increase heat output by 5 percent and reduce creosote accumulation by 35 percent. External retrofits (which fit inside the stovepipe) are slightly less effective.

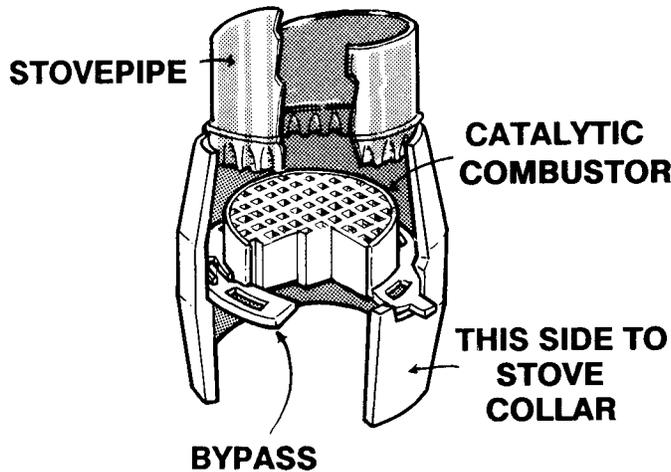
### How It Works

The catalyst is placed close to the fire, inside the firebox near the top of the heater or just outside the firebox inside the stovepipe. It is important that the catalyst be positioned close to, but NOT in contact with the actual flames. If the catalyst is too far from the fire, it may not become hot enough to play its role in the combustion process, and may actually become clogged with ash and creosote.

All catalysts have a bypass, which is essential during the startup of a fire for two reasons. First, the bypass provides greater air flow that is needed for startup in order to reach the proper operating temperature and to prevent smoke spillage. In addition, it helps prevent clogging of the catalyst, which can occur if too much unburned smoke passes through the catalyst at temperatures below 500°F.

In a catalytic heater, the bypass is commonly a pivoting door which automatically opens a path around the catalyst when you open the stove door. Retrofits are equipped with handles that you must move manually each time you add wood.

After the wood has begun burning well, you close the door or move the handles so that the smoke is directed through the catalyst. The smoke contacts the hot catalyst surface and begins to burn. The extra heat is "captured" before it goes up the chimney and is transmitted to the room, thereby increasing the heater efficiency. A surface-mounted thermometer that indirectly measures the catalyst temperature is very useful. It will tell you when the combustor is operating effectively. Some catalytic heaters have two thermometers, one positioned before and one after the catalyst to verify its operation.



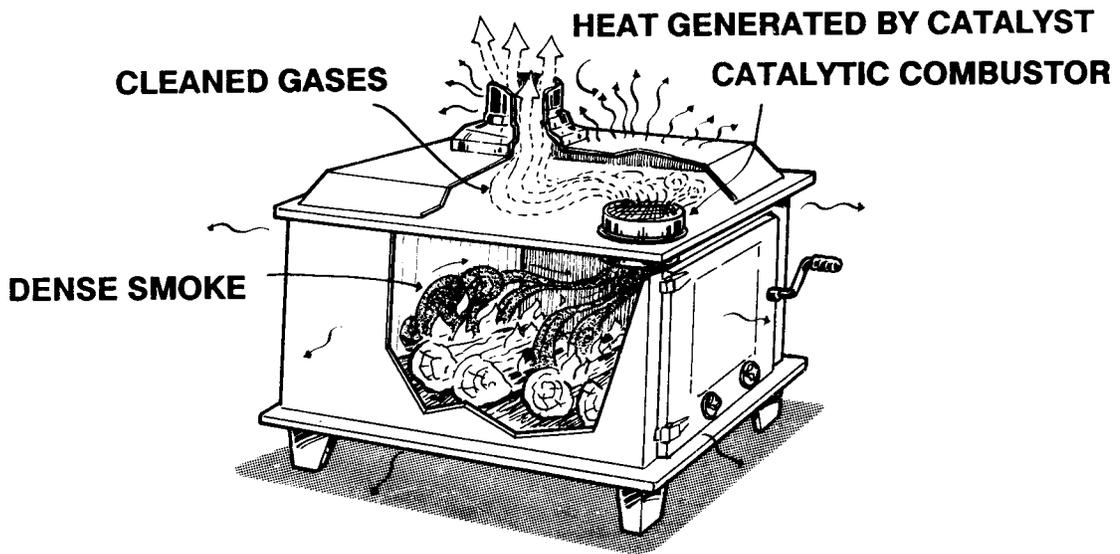
**IMPORTANT:** Heating the catalyst to temperatures above 1200°F will reduce its useful life. After first reaching 500°, the catalyst should continue to operate satisfactorily if it receives smoke at temperatures exceeding 350°F. The catalyst need not be hot enough to glow to continue working.

## How To Choose a Retrofit

Placement of the retrofit is important. It must receive the hot smoke as soon as possible without direct flame contact. The best choice is to mount the catalyst inside the heater where the wood gases are hot enough to burn--at the flue collar. However, in some models the firebox is not high enough or deep enough to keep the catalyst away from damaging flames. You must then use an external retrofit, which commonly replaces a short section of pipe just above the flue collar.

Retrofits require at least 2 to 3 feet of stovepipe following the catalyst to ensure that the heat is recovered. The pipe should be 24 gage or thicker (for 6-inch to 10-inch diameter stovepipe) to withstand the extra heat generated by the catalyst.

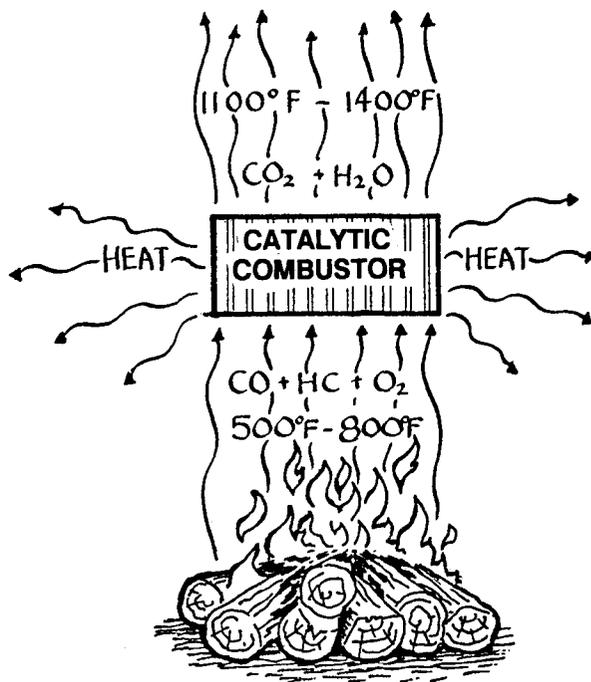
Retrofits change the draft conditions. If you have problems with smoke spillage, or if you can see the fire through cracks in the heater walls, a retrofit catalyst may not be a good choice.



## Getting the Most from a Catalyst

To get the best performance from a catalytic heater or retrofit, proper use and maintenance are important. The catalyst should last for approximately three years if the manufacturer's instructions and the tips below are followed:

- Be careful not to burn trash. Some of the chemicals in your trash can clog the catalyst. Do not burn painted wood, colored paper (such as wrapping paper or the Sunday comics), plastics, rubber, treated lumber, or coal. Metallic components and other chemicals in these materials poison the metal in the catalyst and cause it to lose its ability to burn the smoke.
- Always bypass the catalyst during startup and loading.
- Use as small amount of paper as possible to start your fire. Although burning regular (black and white) paper should not cause fouling, the large ash flakes (which are familiar to anyone who has burned paper) can collect on the entrance of the catalyst and prevent proper smoke flow.
- Avoid over/underheating. Having too much air flow can force much of the heat to go up the flue, without giving the catalyst sufficient time to react with the smoke. An automatic intake air regulator will help maintain a proper operating temperature and better catalyst performance by assuring a good mixture of intake air with the burning wood and smoke. Also helpful is a barometric draft control device (located above the catalyst) which regulates draft in the heater and helps limit the intensity of the fire. Another benefit of the barometric draft control is that soot and creosote are more effectively cooled and swept out of the chimney after leaving the catalyst, helping to further decrease creosote accumulation inside the flue pipe.
- Check the catalyst once a month to make sure it isn't clogged.
- Even with the greatest care, smoke particles and creosote may slowly collect on the catalyst.



## Keep the Catalyst Clean

See the manufacturer's instructions for the best way to clean your catalyst. Building a hot fire burns off the deposits on the catalyst. This is the one exception to the rule against overheating. Be sure your chimney is free of excessive creosote so you don't start a chimney fire. Burning a moderately hot fire each day will help prevent buildup on the catalyst, but occasional inspections to be sure that the catalyst remains fairly clean are still advisable.

If the danger of starting a chimney fire is too great, or if your attempt to clean the catalyst by burning a hot fire fails, you'll need to remove the catalyst from the heater or flue pipe for easier cleaning. If recommended by the manufacturer, you may use a propane torch to burn off the deposits. Lightly brush off any debris inside or around the catalyst. Avoid hitting the catalyst too hard because the supporting structures are fragile and may crack or break. Also, avoid scrubbing the catalyst too roughly--you may remove the catalytic coating.

## Economics

Although many of the benefits of a catalytic combustor cannot be measured in terms of dollars saved, it is helpful to consider the time needed to pay for the cost of the catalyst with the energy savings gained. This payback period is shown in the figure below using typical costs of \$100 for a retrofit installation and a \$200 premium for a catalytic designed wood heater.

If you are considering the purchase of a retrofit, then the graph shows the time needed to pay for \$100 of the original cost. To use the graph, first estimate the number of cords of wood used each year (in Georgia, usually between three and four), locate this number on the horizontal axis, then look up for the line representing the cost of the wood you buy. The number of years to pay back \$100 spent on a retrofit is then found by looking to the left axis. For example, if you use four cords of wood a year, and it costs \$75 per cord, the payback period for \$100 of the cost of a retrofit is about 3 1/2 years.

When considering the purchase of a catalytic wood heater, the graph can be used in the same way to estimate the time needed to pay for \$200 of additional cost of the heater. The same graph can be used because the

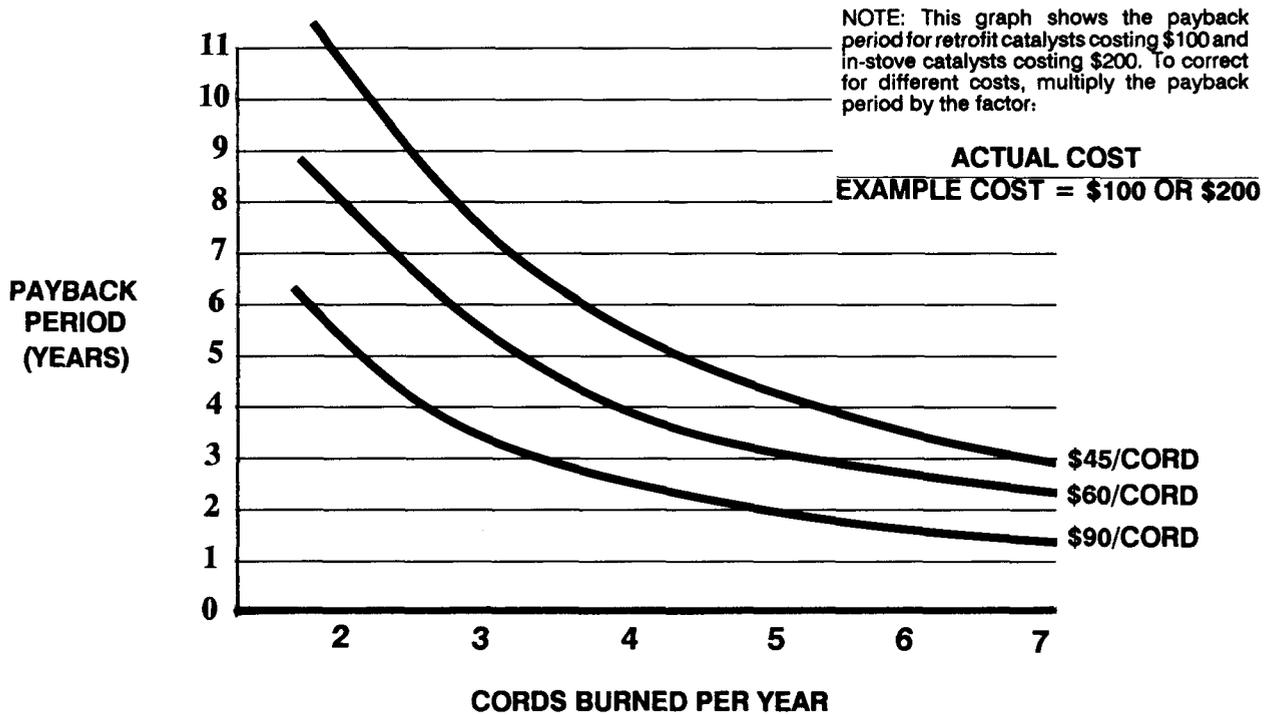
energy savings is about twice as great, but remember that the payback period is for each \$200 portion of the extra cost, not \$100 as for the retrofit.

The graph can be used as a guideline for determining the economic value of a catalyst. The important factor is whether or not the savings from the catalyst will pay its cost before the life of the catalyst ends. This life is for the actual honeycomb or mesh inset, and can be assumed to be about 3 years or 15 cords, whichever comes first.

Replacement catalyst elements are available at a cost of about \$50 to \$70 each, or about one-third the cost of the original installation. Hence, payback periods for replacement elements are three times faster (e.g., 1 year instead of 3 years).

Although estimates can be made of the economic benefits of a catalyst, it is difficult to describe in dollars the other benefits gained. Because creosote accumulations are reduced by such a large amount, the risk of chimney fire is reduced, as is the need for more frequent chimney sweeping. The value of reducing pollution is hard to estimate in dollars, though easy to understand in terms of protecting the environment.

**PAYBACK PERIOD FOR CATALYSTS**



# CHAPTER 11

## Furnaces, Boilers, Multi-fuel Appliances, and Central Systems

Central heating systems fired with wood improve heat distribution throughout the house and allow refueling without having to bring wood into the living area. However, they do not radiate heat into the house, have a much higher installed cost, and cannot operate during power outages. In general, central systems are better matched to large homes in colder climates such as New England where the heating requirements are twice those of Georgia.

The most popular central units are forced air furnaces which burn wood and are controlled by an automatic thermostat in the heated area of the home. When heat is called for, the air inlet damper to the heater is opened, the wood fire grows hotter, and the air circulation fan brings heated air to the house. Prices for a central wood furnace are typically in the \$1500 to \$2500 range without installation. These systems are large and complex and require a knowledgeable professional to ensure a safe and efficient installation.

Smaller wood furnaces are available which work in conjunction with an existing warm air furnace. While these are less costly, they are difficult to install properly and the control strategy can become complicated. Avoid installations where the warm air furnace's circulating fan places the firebox of the wood furnace under negative pressure. Smoke and carbon monoxide could enter the house if a leak developed. Some installations use parallel ductwork and backdraft dampers to isolate whichever furnace is inoperative. Follow the manufacturer's instructions carefully; again, homeowner installation is not advised.

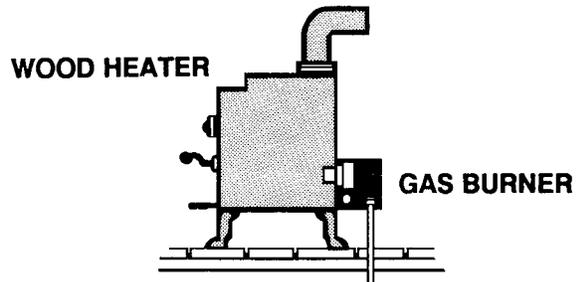
Combination units are available which burn oil or gas as well as wood. They allow startup without building a wood fire, and they provide heat even when the wood charge has been exhausted. In mild fall and spring weather, the fossil fuel can do the job at low cost without the problems associated with overheating or burning wood under smoldering conditions. These

units are several hundred dollars more expensive than wood only furnaces.

Boilers and hydronic heating systems are another wood heating option. However, these have little application in Georgia since few homes have radiators or hydronic convectors. While hydronic fireplace grates and hydronic heat exchangers for use with wood heaters are made, the output is too small to heat a home, and the high cost and safety problems far outweigh the benefits from heating domestic hot water.

A recent entry into the wood heater market is a hybrid of space heater and furnace technology. It is a heater with a built-in power gas burner. A thermostat in the room controls the gas burner. If the wood fire is

### COMBINATION WOOD AND GAS HEATER



sufficient, gas is not used. When the temperature drops (via the fuel being consumed or the fire being insufficient to handle the load in cold weather), the gas burner takes over. It can also be used to start the fire, and used without wood in mild weather. One model incorporates soapstone to help store heat. Prices of this combination heater are roughly double that of a comparable wood-only heater.

On a safety note, you should NEVER attempt to use a wood heater as a central furnace. Conversions, such as using a hood over the heater, are likely to violate the listing of the unit as well as safety codes for equipment design. Failure of the integrity of the heater could quickly send smoke and carbon monoxide throughout the house.

# CHAPTER 12

## Fireplaces

Fireplaces provide charm and ambience, not heat. Typical masonry fireplaces are 10 percent efficient, with less than one-fifth the heat output of a typical airtight wood heater. More efficient fireplace designs do exist. They include masonry types with internal heating passages, factory-built zero-clearance units with hot air ducts, and built-in fireplaces with glass doors (hybrids of a wood stove and a fireplace). These more elaborate units range from 20 percent to 40 percent in efficiency. In general, fireplaces cost approximately twice as much as a wood stove of comparable quality. New zero-clearance controlled combustion fireplaces are a hybrid of a fireplace insert, airtight woodstove, and zero-clearance fireplace. They are installed much like a zero-clearance fireplace but have tight-fitting glass doors, a large surface area to heat air for the room, and good control of combustion air.

The manufactured zero-clearance fireplaces are the least expensive types, and most easily installed in existing homes. Traditional brick fireplaces cost 50 percent to 100 percent more but are more versatile since they can accept a wood stove insert. Factory-built fire boxes, with or without heat reclaimers are also popular, offering more predictable operation. This type uses a thick steel (usually 1/4-inch) firebox, installed in a masonry surrounding, and either a factory-built Class A chimney or a standard brick chimney with a tile liner.

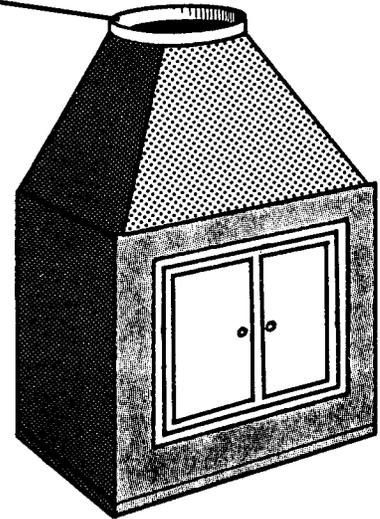
Much of the heat which is produced by a fireplace is radiant. A mesh firescreen will still allow most of this heat into the room, but glass doors will not. Glass doors are only useful when:

- The fire is out or nearly out, to cut air loss up the chimney.
- The fireplace is equipped with a fan to transfer heated air into the room.

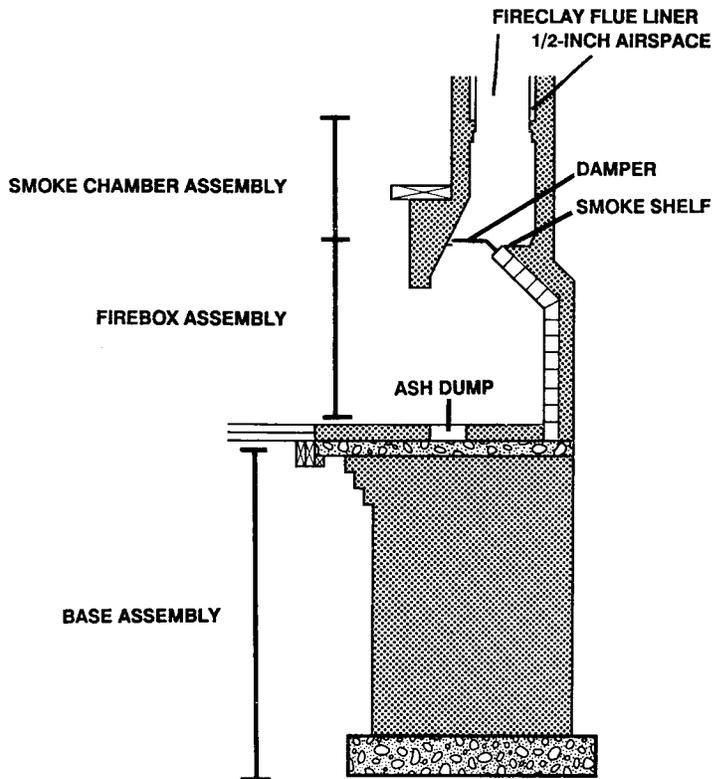
The design of masonry fireplaces is a fascinating and widely discussed subject. Since they are field-built and no two are exactly alike, the temperaments of two "identical" fireplaces may still vary. The major design variables have been defined over the years, however. For example, the flue size must be in the proper ratio to the opening of the fireplace; and the length, height, and depth of the opening must be in proportion as well.

CONNECT TO LISTED  
CLASS A CHIMNEY

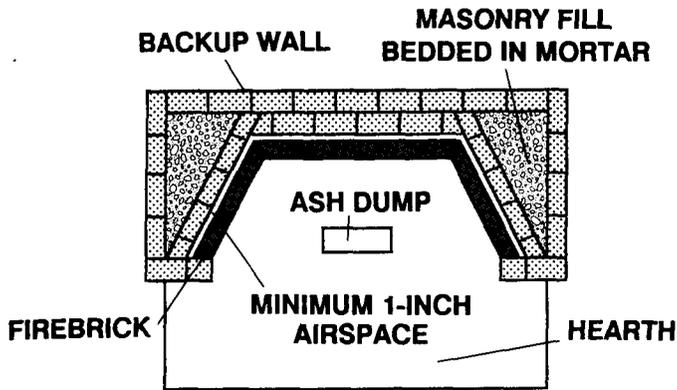
TYPICAL 2-INCH  
CLEARANCE  
TO FRAMING; FOLLOW  
MANUFACTURER'S  
RECOMMENDATIONS.



ZERO-CLEARANCE FIREPLACE



## FIREPLACE DESIGN - TOP VIEW



Selected information from NFPA, the Brick Institute, and the *One and Two Family Dwelling Code* on fireplace design is provided in Tables 11 and 12.

These dimensions are the major design elements. However, the taper of the opening from front to back, damper size, smoke shelf, taper of the rear wall, and many other variables are all important. For more detail on fireplace construction, refer to the *Brick Institute Technical Note 19*.

Masonry fireplaces must have the back and sides made of a minimum of 8 inches of solid brick or masonry when provided with a firebrick liner. Without a firebrick liner, a minimum of 12 inches of brick or solid masonry is required. In addition to the usual 2-inch clearance to combustibles and firestopping, a clearance of at least 4 inches is required from the back face

**TABLE 11**

### Standard Single Face Fireplace Dimensions (in inches)

Height	Width	Depth	Flue Size	Lintel
24	24	16	8 x 12	3 x 3 x 3/16
24	28	16	8 x 12	3 x 3 x 3/16
29	30	16	12 x 12	3 x 3 x 3/16
29	36	16	12 x 12	3 x 3 x 3/16
32	42	16	16 x 16	3 1/2 x 3 x 1/4
32	48	18	16 x 16	3 1/2 x 3 x 1/4

of the fireplace. Woodwork (such as mantels) or other combustibles should not be placed within 6 inches of the fireplace opening. Above the fireplace opening, combustible material projecting more than 1 1/2 inches must not be placed within 12 inches of the opening.

The dimensions given are for a standard fireplace. Many other types exist, including those open on two and three sides, the "Brickolator" with internal heating passages, and the "Russian" fireplaces or stoves which use massive amounts of masonry to store heat. While these fireplaces are attractive esthetically and may be more efficient, some have a greater tendency to smoke, and most cost substantially more than a standard fireplace. The higher efficiency is rarely a factor in the long run--few people serious about heating with wood ever use a fireplace for that purpose. Fireplaces are best for occasional use and holiday cheer, not for heating a home.

**TABLE 12**

### Masonry Fireplace Dimensions

Size of Fireplace Opening	Hearth Extension Length	Minimum Dimension (on side past opening)
Opening less than 6 sq ft	16 inches	8 inches
Opening 6 sq ft or larger	20 inches	12 inches
Type of Flue	Ratio of Flue Area to Fireplace Opening	Minimum Flue Area
Round flue tile	1/12 of fireplace opening	not less than 50 square inches
Square flue tile	1/10 of fireplace opening	not less than 64 square inches
Unlined or lined with firebrick	1/8 of fireplace opening	not less than 100 square inches

# CHAPTER 13

## Wood Heating for Mobile Homes

**M**anufactured homes, more commonly known as mobile homes, have special and more restrictive codes for the installation of woodburning equipment. Mobile home fires due to improper installation have been notably high. This type of housing tends to have smaller room sizes, more use of combustible building materials, and may have lower air infiltration rates. These factors require a different approach to wood heating equipment than for conventional housing. The U.S. Department of Housing and Urban Development (HUD) has developed standards for mobile homes to respond to these problems and enhance safety.

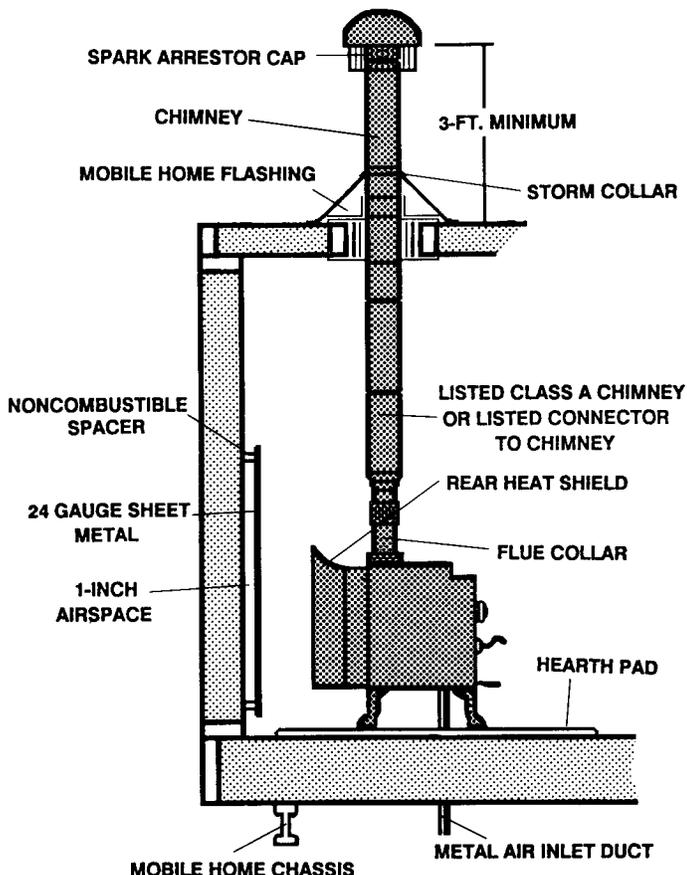
Factory-built fireplaces and wood heaters **must be listed for use in mobile homes.** The appliance must be

securely fastened to the structure. A listed, factory-built chimney with rain cap and spark arrestor must be installed. The appliance, air intake assembly, hearth extension, and chimney must be installed in accordance with the listing and manufacturer's instructions.

Outside combustion air is required for both wood heaters and fireplaces. **The air must be ducted directly from the outside of the dwelling to the combustion chamber.** The inlet should be screened to prevent animal entry, and no ashes or fuel must be able to drop from the fire chamber into the inlet duct or beneath the home.

Do not install the heater or fireplace in a sleeping room. Maintain clearances to combustible walls and ceilings according to the manufacturer's instructions.

### LISTED WOOD HEATER FOR MOBILE HOMES



Approved, noncombustible floor protection must be installed, at least 3/8-inch thick, extending at least 16 inches in front of the stove or fireplace and 8 inches on the remaining sides. On elevated fireplaces and for stoves, this floor protection must cover the entire area beneath the appliance.

Venting can be accomplished via an integral vent system listed as part of the appliance, or a venting system consisting entirely of listed components installed in accordance with the terms of the appliance listing and manufacturer's instructions.

Single-wall stovepipe is not allowed as a connector from the heater to the chimney. The chimney must connect directly to the heater or have double- or triple-wall pipe made specifically for connecting the appliance in mobile home service. If the chimney vents out the wall, it must be enclosed or protected to above 7 feet from ground level.

Chimney height follows the standard rules for wood heater installation. The chimney must extend a minimum of 3 feet above where it penetrates the roof, and at least 2 feet above any portion of the roof within 10 feet. Portions of the chimney more than 13 1/2 feet above grade may be removed for road shipment.

# Questions and Answers about Wood Heaters

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**Q. How much wood does a heater use during a cold 24-hour period?**

A. An airtight heater will use from 14 to 16 hardwood logs that are 24 inches long. A nonairtight heater will need considerably more. If you are burning pine or other softwoods, more logs will be consumed.

**Q. Will I have to stoke the fire during the night?**

A. Most people find this unnecessary as banking the fire and closing the damper will usually keep the house warm through the night.

**Q. How often do I need to check on the heater?**

A. Every time wood is put in is an appropriate time to do a quick check. When the owner is home during the day, wood is usually added two or three times. Wood heaters are rarely used when the owners are gone.

**Q. How accurately can the temperature of a stove be controlled?**

A. An airtight heater can usually be regulated to maintain room temperature within five degrees. The temperature of a nonairtight heater can fluctuate widely, and it is a good idea to have a damper installed in the stovepipe. Some heaters come equipped with an automatic thermostat; these are also accurate within five degrees.

**Q. Where do I get wood?**

A. A little imagination and a little effort can provide you with all the wood necessary to heat your home. Cutting wood from your own property or a friend's property is the most convenient. You can also pick up scrap lumber from new subdivisions or where houses are being torn down. Some people search on the side of the road and follow phone and power company trucks when they cut down trees.

**Q. How much does wood cost per cord?**

A. Price depends on how much of the work you want done for you. To have it delivered, cut, split, and stacked in your yard is more expensive than if you pick it up and split it yourself. On the average, wood costs \$60 to \$100 a cord.

**Q. What is the best way to store wood?**

A. Stack it, crisscross fashion off the bare ground with a cover on top to keep it dry and still allow for ventilation. Season it for at least six months after cutting.

**Q. Do most people use wood as a secondary heat source?**

A. Most wood heater owners keep their gas or electric furnaces in operating order in case of illness or extreme cold weather, even though wood provides a large percentage of their space heat. Homes with no conventional backup systems are generally in rural areas where wood is plentiful.

**Q. What complaints are heard most often about wood heaters?**

A. They take getting used to; an adjustment period is necessary. Initial problems with lighting the heater and excess smoking are most common, and temperatures fluctuate a good bit until the owners get to know their own heaters.

**Q. How often should I check my chimney or stovepipe for creosote buildup? How often do I have to clean it?**

A. On a new installation, check it every three to four weeks to determine buildup rate. Clean once a season or when a quarter-inch of creosote accumulates. If you're using considerable amounts of pine or green wood, the creosote may build up faster.

**Q. How big an area do people try to heat with a wood heater?**

A. Anywhere from 800 to 2200 square feet. How warm you stay will depend on the amount of insulation in the house and the air flow through the house.

**Q. Where do most people place their wood heaters?**

A. In the living room or den -- usually the largest room or gathering place for the family.

**Q. How much is really saved on heating bills?**

A. For those people who have converted to wood heat and use it regularly, the savings are 50 percent or better.

**Q. Why do people buy wood heaters?**

A. Most buy because they save on heating bills. Some buy them because their families have always had one. Many buy them to add charm to a room.

**Q. Does a wood heater contribute extra dirt or ashes in the home?**

A. The only excess dirt is from carrying in wood, but for many people a wood box has solved that problem. Remember to check each log for wood roaches or ants before you bring it in the house. Fine ash accumulation in the home can be a sign of bad draft or leaks in the heater system.

**Q. How often is ash disposal necessary?**

A. Anywhere from twice a week to once a month, depending on the type of heater you have and the rate of use. Remember to keep a thin layer of ashes on the bottom of the firebox to protect the metal from high temperatures.

**Q. What precautions can be taken to prevent fires?**

A. Have your chimney inspected by the fire department. A fire extinguisher and smoke detector are recommended. Follow directions from the wood heater manufacturer on clearances for installation, and instruct all family members on safe operation of the heater.

**Q. Are there codes or regulations that restrict placement of the heater?**

A. There are many regulations to follow. Manufacturer's instructions or NFPA publication No. 211 are good sources on heater installation. Many counties restrict installation to those units approved by a recognized testing agency such as Underwriters' Laboratory.

**Q. Do owners of wood heaters enjoy their benefits?**

A. Yes! The charm of having wood heat in the home, a warmer winter environment, and fuel savings are all benefits cited by wood heater owners.

# **Reference List for Woodburners**

## **Firewood and Forests**

### **HOW TO SELECT, CUT, AND SEASON GOOD FIREWOOD**

John Vivian  
Customer Service Dept., Stihl, Inc.  
536 Viking Drive  
Virginia Beach, VA 23452  
(804) 486-8444

### **THE MAINE WOODBURNING GUIDE**

Office of Energy Resources  
State House Station 53  
Augusta, ME 04333  
(207) 289-3811

### **WHAT YOU SHOULD KNOW ABOUT FIREWOOD--BEFORE YOU BUY**

Tennessee Valley Authority  
Director of Information  
400 West Summit Hill Drive  
Knoxville, TN 37902  
(800) 251-9242

## **NFPA Safety Publications**

National Fire Protection Association  
Batterymarch Park  
Quincy, MA 02269  
(800) 344-3555

### **CHIMNEYS, FIREPLACES, VENTS, AND SOLID FUEL BURNING APPLIANCES, No. 211**

### **HOMES, FOREST AREAS, No. 224**

### **HOUSEHOLD WARNING EQUIPMENT, No. 74**

### **PORTABLE EXTINGUISHERS, No. 10**

### **STORAGE OF FOREST PRODUCTS, No. 46**

## **Heaters and Chimneys**

### **SOLID FUELS ENCYCLOPEDIA, WOODBURNERS ENCYCLOPEDIA, and WOOD HEAT SAFETY**

Jay Shelton  
Shelton Research Inc.  
PO Box 5235  
Santa Fe, New Mexico 87502  
(505) 983-9457

### **MODERN AND CLASSIC WOODBURNING STOVES**

Bob and Carol Ross  
The Overlook Press  
Route #1, Box 496  
Woodstock, NY 12498  
(914) 679-6838

### **CHIMNEY AND STOVE CLEANING**

Storey Communications/Garden Way Publishing  
Schoolhouse Rd.  
Pownal, VT 05261  
(802) 823-5811

### **SAFE AND SOUND MASONRY CHIMNEYS**

Tennessee Valley Authority  
Director of Information  
400 West Summit Hill Drive  
Knoxville, TN 37902  
(800) 251-9241

### **FIREPLACES AND WOODSTOVES**

Time-Life Books  
541 North Fairbanks Court  
Chicago, IL 60611

**THE WOODBURNERS HANDBOOK**

D. Havens  
Harpwell Press, 132 Water St.,  
Gardiner, ME 04345  
(207)582-1899

**OER Energy Conservation Publications**

The Governor's Office of Energy Resources  
270 Washington St., NW  
Suite 615  
Atlanta, GA 30334  
(404) 656-5176

**HOME ENERGY PROJECTS: An Energy Conservation Guide for Do-It-Yourselfers**  
Southface Energy Institute

**HOMEOWNER'S GUIDE TO ENERGY EFFICIENT AND PASSIVE SOLAR HOMES**  
Southface Energy Institute

**A BUILDER'S GUIDE TO ENERGY EFFICIENT HOMES**  
Southern Building Code Congress, International Inc. and the National Conference of States on Building Codes and Standards, Inc.

**A BUYER'S GUIDE TO AN ENERGY EFFICIENT HOME**  
Mobius Corporation

**Directories and Organizations**

**BRICK INSTITUTE OF AMERICA**

Region 9  
8601 Dunwoody Place  
Dunwoody, GA 30350

**WOOD HEATING ALLIANCE**

1101 Connecticut Ave. NW, Suite 700  
Washington, D.C. 20036

# Wood Heating Checklist

## **Wood Heater Design**

- Airtight model with good efficiency rating.
- Tested by UL or other reputable agency.
- Catalytic combustor to increase efficiency and safety.
- Properly sized for area of home to be heated.
- Easy-to-understand manual that covers installation requirements, operating procedures, maintenance needs, and warranties.

## **Location in the Home**

- Adequate air circulation to distribute heat.
- Easy traffic flow around heater.
- Adequate access for loading wood and removing ashes.
- Away from central heating system thermostat.

## **Installation**

(Note: For listed heaters, follow the manufacturer's guidelines. For unlisted heaters, use the manufacturer's guidelines or the following recommendations, whichever are greater.)

- Minimum 36-inch clearance between heater and all unprotected combustible materials.
- Proper clearance reduction materials to protect combustibles, if clearances are less than 36 inches.
- Heater placed on a noncombustible floor or approved floor protection material.
- Minimum floor protection of 18 inches from the front, sides, and rear of the heater.

- Minimum 18-inch clearance between stovepipe and all combustibles, or combustible material is protected by clearance reduction system.
- Approved thimble or chimney section used to vent through walls.
- Chimney height at least 3 feet above the roof and at least 2 feet higher than anything within 10 feet.

## **Operation**

- Fires started with minimum paper and kindling. Only seasoned wood should be burned--never trash or artificial logs.
- Wood added frequently in small amounts.
- Air inlets opened for 60 seconds before adding wood to a fire.
- Coals and ashes completely extinguished before disposal.

## **Safety**

- Chimney and heater inspected and cleaned on a regular basis.
- Smoke detectors located between heater and bedrooms.
- Fire extinguisher, gloves, and bucket of sand near wood heater.
- All family members and guests know two fire escape routes from each room.
- Fire emergency telephone numbers beside all phones.
- First aid kit easily accessible.