University of Idaho
Cooperative Extension System

Wood as a Fuel No. 11

UI Extension Forestry Information Series

Fireplaces

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Gathering at the fireside for comfort, warmth and enjoyment is a custom as ancient as the use of fire. When fireplaces were developed they were an important part of human shelter, performing as a cooking center, heating system and relaxing and recreation area. They used large amounts of fuel which was then readily available. Today, fireplaces are still considered a place to gather for warmth and fellowship and also as a source of supplemental heat.

However, of the home wood-burning units, the open fireplace is the least efficient in terms of fuel consumed and usable heat produced. When no fuel is burning, a modestly sized open fireplace can send 18,000 cubic feet of expensively warmed interior air up the chimney every hour. When the fireplace is in use, approximately 90% of the heat from the fire escapes up the chimney – and the open draft siphons off 22% of the warm room air as well. By comparison, a small airtight stove will draw only 1/10th of the air, and will furnish several times the heat into the room rather than outdoors.

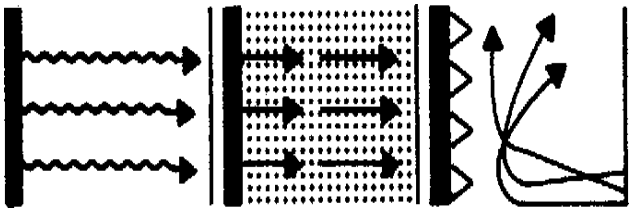
If the open flame is one of the main reasons you want a wood-burning unit, or if a fireplace is what you have, understanding the way they work may help you choose a unit or increase its efficiency.

A fireplace consists of a non-combustible fire box where the fire is built, a chimney to vent the combustion products, a damper which regulates the amount of air drawn from the burning fuel and a hearth extending into the room.

Heat Transfer. Heat transfers from the fireplace to the house three main ways: radiation, conduction and convection (Figure 1).

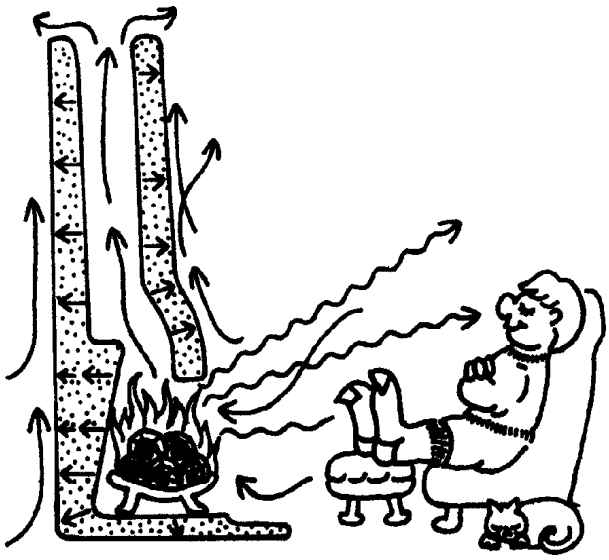
Radiant energy heats the room it is in. Heat in the hot flue gases may conduct through the chimney walls or fireplace walls into the house, and warm house air is pulled into the fireplace by convection and goes up the chimney. The ideal fireplace will maximize the radiation and the convected heat it emits, and minimize the amount air escaping up the chimney (Figure 2).

Figure 1. Graphic demonstration of how heat transfers from the fireplace to the house.



Types of Fireplaces. There are many variations and types of fireplaces and no clear distinction between fireplaces and stoves. There are openable stoves and closeable fireplaces, non-metal stoves and metal

Figure 2. How heat emits from a fireplace.



fireplaces, free standing fireplaces and stoves with visible fire boxes. Most of the time "fireplace" is used for a device intended to be usable open and with the flame visible. In this publication, fireplaces are divided into three types: masonry or built-in; manufactured or modified; free-standing or prefabricated.

Masonry. Masonry or built-in fireplaces are constructed completely on the site, generally when the home is built. It consists of the parts shown in cross-section in Figure 3.

Two basic theories of fireplace design are the conventional and the Rumford. About the time that Ben Franklin was modifying the cooking unit, Count Rumford had become an expert on repairing smoking fireplaces in Europe. His method was to construct or rebuild the fire box to be tall and shallow with sloping, outward flaring sides and a back with a gentle forward arc leading to a narrow throat. This resulted in maximum direct radiant energy release, increased secondary radiant heat from the increased absorbtive mass and smaller air loss through the narrow throat. The Rumford takes great skill to design as the open and shallow fireplace can require relatively large total airflow to prevent smoking. The conventional fireplace does not emit as much direct radiant energy. However, it also does not draw out as much warmed room air as the average taller, shallow one will (Figure 4).

Masonry construction, especially brick, absorbs large amounts of infrared radiation. This heat is in turn radiated (referred to as secondary radiation). To use

Figure 3. Fireplace cross section.

- *Flue and Flue Lining.* The chimney flue must be adequate in size and height to provdide the necessary draft. the area should equal 1/12th to 1/8th the area of the opening of the fireplace (width x height).
- *Smoke Shelf and Smoke Chamber.* This area is important to a smoke-free fire. Both sides slope to the flue. The smoke shelf is a horizontal surface in back of the damper that prevents downdrafts from reaching the fire and re-directs them back up the chimney.
- *Throat and Damper.* These are usually one and the same. The dampler covers the opening and is closed gradually to control the draft and keep out cold air when the fireplace is not in use.
- *Fire Box.* The fire box should be made of fire brick. It must be correctly proportioned, sealed, vented and well constructed.
- *Hearth.* The back hearth is where the fire is built. The front hearth extends into the room 8 inches on each side and 16 inches in front of the opening. Both must be fireproof material.
- *Ash Pit - Ash Dump.* The ash pit and ash dump are used for the removal of ashes from the hearth. This may be on an outside wall.
- *Support.* The fireplace and chimney must rest on a solid foundation. Concrete footings are recommended.

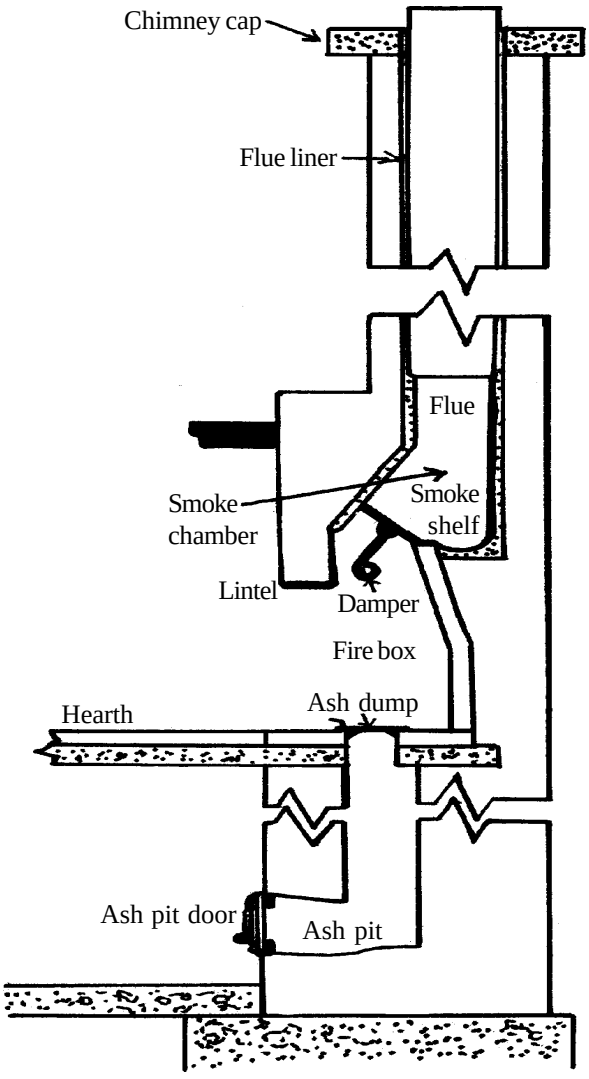
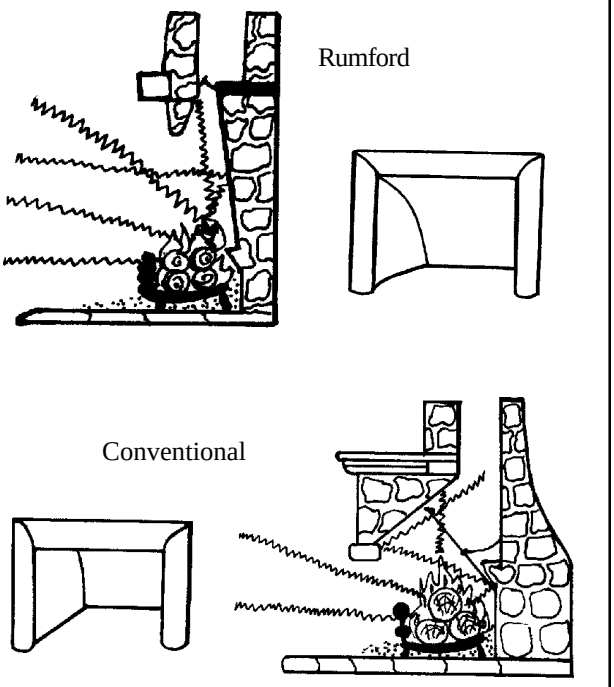


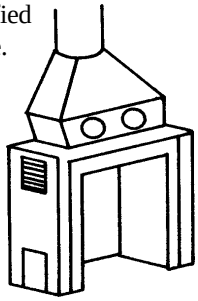
Figure 4. Rumford and conventional fireplace designs.



this secondary radiation and the conducted heat most efficiently, a fireplace should be on an inside wall.

Manufactured or Modified. The second type of fireplace is the manufactured or modified unit (Figure 5). These units, constructed of metal, are not finished and need to be built into the home using masonry or a material of your choice. Most of these units consist of multiple air chambers with double or triple wall construction with air spaces between. On some, the heated air circulates around the heated chamber and is vented into the room either by convection or by blowers. With some units, warm air can be moved by ducts into adjacent rooms also.

Figure 5. A manufactured or modified fireplace.

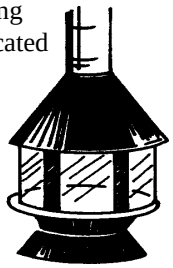


A manufactured unit known as the zero clearance fireplace is insulated so that it can be placed directly against combustible walls and floors. The insulation usually consists of an air chamber that opens to the outside by the chimney. The cool air circulating around the unit is the insulation. Mobile homes often use zero clearance unit since they require less bulk and weight to install.

One point to keep in mind is that because of the insulation, the convected heat will not be stored for secondary radiant heat even when masonry is used as a finish. With careful design, the manufactured fireplace that has room air circulating capability can approach the efficiency of some stove units. However, these units are unfinished shells that still need to be built in or faced with other material.

Free-Standing or Prefabricated. There is not a clear distinction between fireplaces and stoves in the free-standing or prefabricated category (Figure 6).

Figure 6. A free-standing or prefabricated fireplace.



They come in many shapes, sizes, materials and styles. Most are metal but some are pottery, tiled or masonry, and some are even made primarily of glass. Some have doors of glass or metal that open or remove. The Franklin Fireplace (or stove) is a good example of this type. Some are completely open as with the cone funnel or suspended (fire pit) types. The inverted funnel is capable of drawing tremendous amounts of warm air up the flue unless fitted with glass or metal shields. There are trade-off considerations. For example, the large area of heated metal above the fire is capable of a great deal of radiant heat emission. Another positive factor is that open wood burners do not generate as much chimney creosote as do closed stoves.

These factors, trade offs and considerations are presented to you to help you decide which is the right wood-burning unit for your particular needs.

This information first appeared as CIS 493 and was part of the *Wood as a Fuel* Series.

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