



Oil and Gas Central Heating Systems

Housing Fact Sheets

Recent advances in gas and oil central heating technology have resulted in highly efficient systems. But in conventional furnaces and boilers, efficiency losses can be substantial, and typically amount to 30 to 45 cents of every heating dollar. These losses result from leaky or uninsulated ducts, clogged registers and filters, and - most substantially - from using heated air to maintain chimney draft and combustion.

Conventional furnaces and boilers must sacrifice some efficiency in order to vent unwanted combustion products from the house (Figure 1). By allowing flue gases to retain high temperatures, the natural force of rising hot air creates chimney draft, which exhausts water vapor, carbon dioxide, and nitrogen: all products of combustion. At the same time, air from around the heating unit is drawn into the burner to maintain combustion. In most cases, this is heated air.

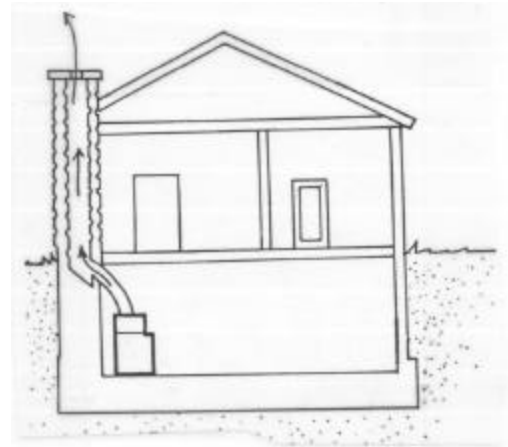


Figure 1

HEATING SYSTEM EFFICIENCY

Most likely, the efficiency of your present furnace or boiler can be improved. Have an efficiency inspection conducted on your system by a knowledgeable and reputable contractor. The following areas should be examined.

System Sizing

The correct match between a home and its heating equipment is like a balanced equation. A home's heating need is determined through heat loss calculations, which are based on local climatic conditions and thermal characteristics of the house (how much and what type of insulation, etc.). The results of heat loss equations are expressed in BTUs per hour, and refer to the rate at which heat must be supplied to a house during the coldest time of the year. Because furnaces and boilers are categorized according to their heat producing capacity in BTUs per hour, a close match between heat loss and heat

production is possible (Figure 2). Competent heating technicians can calculate a home's heating need either by hand or with the assistance of a computer.

Many houses are heated by systems with much larger heating capabilities than are required to maintain a comfortable temperature. These systems are said to be oversized. The "size" of a furnace refers to how many BTUs it can generate in an hour. What's wrong with oversizing? Two things: 1) It increases the operating cycle losses already mentioned, and 2) It results in high off-cycle losses. When the thermostat sends the proper signal to the burner, the combustion process stops -- essentially turning the system off. Hence the term, "off-cycle." But even though the system is off, the heated combustion chamber continues to send hot gases up the chimney. As this chamber loses air to the chimney, it replaces it with air from around the furnace or boiler. This in turn causes enough negative pressure in the house to result in cold outside air being drawn in through cracks and holes around windows, doors, and other openings.

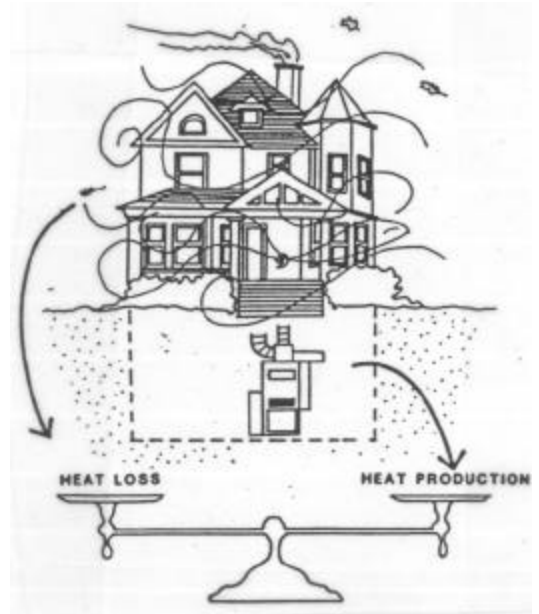


Figure 2

The problems of an oversized heating system can be partially corrected by derating. This refers to adjustments that reduce the rate at which fuel is burned. In an oil system, a smaller nozzle is installed in the burner. A gas system is derated by reducing the burner orifice size or by decreasing the pressure in the manifold, the pipe that distributes gas to the burners. Derating a gas system also involves installing a fixed flue damper to modify the flue opening.

Combustion Efficiency

The amount of heat extracted from fuel depends on the efficiency of the combustion process. A combustion efficiency test should be part of a heating system's annual tune-up. This diagnosis is performed by a heating system technician with special tools that analyze the composition of flue gas and measure its temperature, draft level, and smoke concentration. The efficiency of the combustion process is then calculated from these measurements. Standard tune-up procedures can usually result in a combustion efficiency rating of between 75 and 85 percent for oil and gas systems.

Seasonal Efficiency

A combustion efficiency test provides a measure of how completely the burner converts fuel to useful heat. Another indicator, known as seasonal efficiency, is a gauge of how well the entire heating system extracts heat from fuel and warms the living space with it.

This measure takes off-cycle losses and the integrity of the distribution system into consideration. Unfortunately, seasonal efficiency is extremely complicated to determine for an existing system, but it can be estimated. The typical seasonal efficiency for an existing system is between 10 and 15 percent less than its combustion efficiency rating. Manufacturers of new systems are required to present information on the efficiency of their furnaces and boilers, and to compare this efficiency with other units of the same size and type. The basis for comparison among units is a laboratory-tested seasonal efficiency known as the Annualized Fuel Use Efficiency (AFUE) rating, and is provided on the required Energy guide fact sheet attached to each unit.

UPGRADE OR REPLACE?

Improvements to space heating efficiency can often be achieved by upgrading an existing system. A yearly tune-up will insure that the maximum level of combustion efficiency is attained. Seasonal efficiency can be increased through a number of measures. A 5 to 15 percent increase, for example, can result from derating. Boiler pipes or furnace ducts that are leaky and uninsulated can waste over 10% of the heat produced by a system, especially if the pipes or ducts pass through unheated areas, such as a garage or crawl space. Furnace fan switches, automatic vent dampers, flue heat reclaimers, and set-back thermostats also result in increased seasonal efficiency. But if your present system is over 20 years old and cannot be tuned to a high level of combustion efficiency, potential improvements to seasonal efficiency may be limited, and system replacement should be considered.

High Efficiency Heating

There are now a number of new gas and oil central heating systems with AFUE ratings of between 80 and 95 percent. Primarily, these high levels of efficiency are obtained through designs that minimize on-cycle losses. Some of the features that make these furnaces and boilers different from conventional units are forced draft systems, pulse combustion, secondary heat exchangers, and heat transfer modules. Probably the most striking difference is that most of these furnaces don't require chimneys. Combustion products are vented through a wall, much like a dryer, with many furnaces using plastic pipe for this purpose. And because the water vapor resulting from combustion is condensed inside these furnaces, it must be drained away. This is achieved with a connection to a floor drain.

To select among several furnaces or boilers, obtain gas prices from your utility or supplier, or oil prices from your dealer; and use these prices to estimate annual heating costs from the Energy guide fact sheet for each unit. Obtain heating contractor estimates for installed prices of each unit. Compare purchase costs and operating costs of the different units.

You can calculate a simple payback by dividing initial cost differences by annual savings, but remember that the payback only tells part of the story. Savings continue to occur beyond the payback time and a high efficiency system is likely to increase the value of your home.

Written by Joe Laquatra, Extension Associate, Department of Design and Environmental Analysis, College of Human Ecology, Cornell University, Ithaca, New York. 1985. Reviewed and revised by Mark Pierce, 1999.