

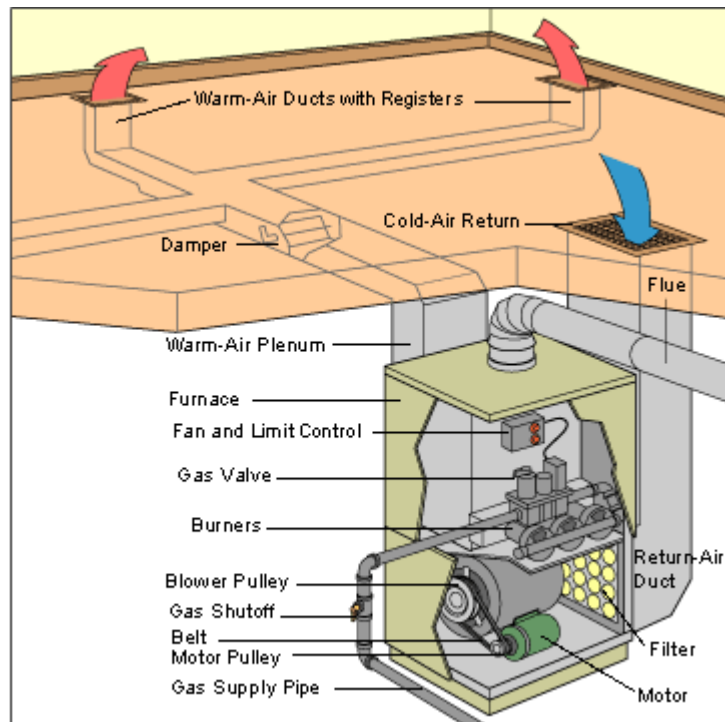
## High Efficiency Furnaces

Sky-high energy bills, diminishing resources and a healthy concern for our environment have brought a great deal of attention to the topic of home energy efficiency in recent years. Homeowners everywhere are struggling to spend less, use less and pollute less without giving up the warmth and comfort we've grown to cherish.

The measurement for efficiency is called an Annual Fuel Utilization Efficiency (AFUE) rating. All furnaces now come posted with this rating, generally in the form of a yellow "Energy Guide" label. AFUE ratings run from the 78% minimum to the Carrier SXC's 96.7%. Though most makers list their furnaces as "high efficiency," the DOE sometimes refers to units with an AFUE higher than 90% as "high efficiency" and lower-AFUE models as "mid efficiency."

With these new high-efficiency products available, many homeowners are replacing their outdated furnaces. Replacement costs can run anywhere from \$1700 to \$3500, depending upon the complexity of installation. High-efficiency models represent only about \$500 to \$1000 more in material costs than mid-efficiency units-- and some utilities offer rebates that cover much of the difference. The payback period depends on the price of the system, local energy costs, climate and the difference in efficiency between the old and new furnaces. Yellow Energy Guides list estimated annual operating costs for furnaces given specific conditions; they're meant for comparison only. When buying a system, you should ask your dealer to help you figure actual payback.

### Inner Workings



To understand how a high-efficiency furnace works, consider these basics. In principle, a forced-air furnace is a relatively simple device, somewhat like a gas oven that's hooked up to a fan. Natural gas is piped to a burner inside a combustion chamber where the gas is mixed with air and ignited by a pilot light, a spark or a related device at the request of a thermostat. A blower in the furnace pulls cool air in from rooms through air ducts, passes it through a metal "heat exchanger" where it's heated by the burner, and blows the warm air back into rooms through ductwork. Exhaust gasses from the burners are vented outside through a flue.

Additional devices can be added to nearly all forced-air systems to condition the air that passes through. An air-conditioning unit can cool and dehumidify the air, an electronic air cleaner will remove dust and particulates from the air, and a humidifier can add moisture to uncomfortably-dry winter air.

## Making a Furnace Efficient

During the past few years, manufacturers have used several innovations to boost efficiency. One early advancement was the move from the standing pilot light -- which burns gas even when the furnace is dormant -- to electronic spark ignition that fires the furnace on demand. Yet another step forward is "hot surface ignition," a method said to be more reliable than the electronic spark. Rather than using a spark plug that can corrode or be fouled by dirt or bugs, it ignites the gas mixture with a coil that glows white hot.

Lennox Industries' new Pulse21 furnace uses a technology called "pulse combustion." With this system, a refined spark system ignites an air-and-gas mixture in the combustion chamber 60 to 70 times per second, delivering heat at up to 96.2% AFUE.

Most furnace models operate either at AFUEs of 78% to 80% or at 90% and higher. The higher efficiency models are "condensing gas furnaces." They run exhaust gasses through a second heat exchanger to extract and use available heat that's otherwise sent up the flue. These models pull out nearly all of the heat, sending cool exhaust out the flue (or vent, in this case) and leaving behind condensed water in the heat exchanger and vent. This condensate -- 5 or 6 gallons per day on the average -- is drained or pumped away.

A key feature to look for when buying a condensing gas furnace is a long-term warranty on the heat exchanger; best types are built to resist the corrosive effects of moisture and chemical buildup for the life of the house. A bonus of condensing furnaces is that they may be vented out through a wall with inexpensive PVC pipe, an important feature that saves money and the hassle of routing a flue up through the roof.

The combustion side of furnaces-- the mixing of combustion air with fuel-- has also enjoyed technological advances. High-efficiency furnaces keep close control over the amount of air mixed with gas. For example, York's Stellar Plus furnace, with an AFUE of 92%, uses sealed combustion, bringing all combustion air from outdoors and mixing it with the fuel at a controlled rate to maximize heat from the fuel it consumes.

Gas valves have become more sophisticated, too. Carrier's Weathermaker Infinity has a two-stage gas valve that warms up the furnace quickly then drops back to a more economical flow.

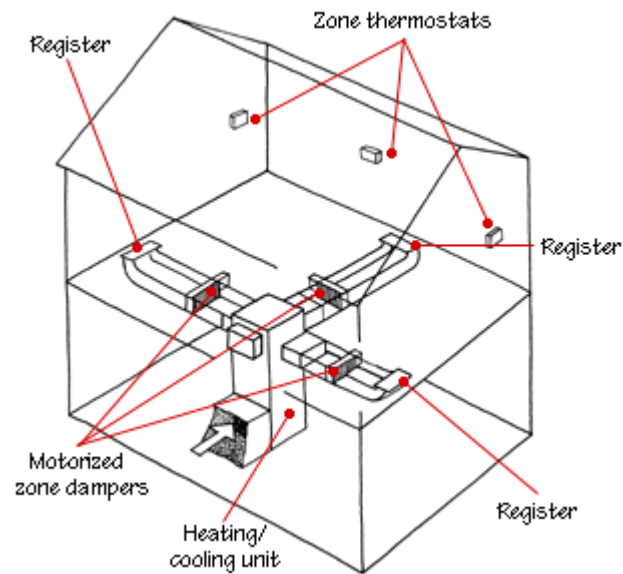
Many gas-fired, high-efficiency furnaces also save on the electricity required to power the blower motor, though this savings is not factored into the AFUE rating. They do this by coupling a sophisticated, programmable thermostat to a variable-speed motor. Unlike a conventional system, where the furnace goes on, blows hot air into the house at full force for a few minutes, then shuts off, a variable-speed or "variable capacity" system runs the blower for longer periods at lower speeds. It provides more even, quiet, comfortable heat than a conventional furnace and doesn't consume electricity unnecessarily because it rarely runs at full speed.

For homeowners who want to upgrade rather than replace an existing furnace, Emerson Electric offers an exclusive replacement blower motor called the Mark Z that can be set by the homeowner on a continuous, slower-than-normal speed. It offers three settings: 525 RPM for saving energy, 900 RPM for heating, or 1100 RPM for air conditioning. Emerson's Glenn Hoffmeister, V.P. of engineering says, "The slower circulation speed reduces energy consumption by 75%. . . the 1/2 HP motor costs no more to operate than a 150-watt light bulb."

The new furnace models with the highest efficiency ratings -- those with an AFUE greater than 90% -- combine several advancements into one package. For example, Carrier's Weathermaker Infinity (AFUE of 93.5%) is a condensing gas furnace with a microprocessor control board that automatically adjusts the furnace output and blower speed for optimum efficiency based on information from the thermostat. It comes equipped with General Electric's electronically commutated motors (ECMs). With programmable controls, these cut electrical consumption from a typical 625 watts per hour to 80 watts per hour. This variable-speed system also saves on electric bills when an air conditioner is added to the unit.

Zoned heating is one of the hottest new concepts in efficient energy usage. With a zoned system, you can independently control the air flow sent to various rooms or zones in your home, directing heating or cooling where you want it at various times of the day. To make this possible, a system needs a special, multi-zone programmable thermostat and a few motorized dampers. For best results, the furnace's output should be variable. The motor in the Lennox Pulse21V, for example, can be

controlled over an infinite range of speeds, automatically adjusting the amount of heating or cooling delivered throughout the house according to the need.



### Selecting a System

The size of a furnace is critical to efficiency. A system that's too large wastes energy warming up and cooling down as it continuously cycles off and on and a furnace that is too small will fail to warm the house on really cold days. A properly-sized system is designed as closely as possible to the needs of the house; on the coldest days of the year, it should run almost continuously.

The size of a heating system is measured by its "Btu" per hour input or output capacity, depending upon the manufacturer. A Btu (British thermal unit) is equal to the amount of heat required to raise 1 pound of water 1 degree Fahrenheit in temperature. Input capacity refers to the amount of gas burned without taking into consideration the percentage of heat lost through the flue. Output (or "bonnet") capacity refers to the total usable heat generated.

Most manufacturers make several sizes of each model. For example, the Lennox Pulse furnace is available in 40,000; 50,000; 60,000; 80,000; and 100,000 Btu input capacities. These furnaces come in "upflow," "downflow" and "horizontal" models designed to accommodate basement, attic or limited-space installation.

Choosing the right size and type is a job for a qualified air-conditioning contractor or dealer. Proper size should be based on energy-loss calculations figured from house size, window areas, insulation levels and related features. You can't just replace a furnace with a high-efficiency one that's the same size unless you match output capacities; high-efficiency furnaces often have smaller input capacities than their inefficient predecessors because they generate more usable heat. And, according to Dennis Aughenbaugh, Senior Furnace Product Manager at York, "Many older furnaces were vastly oversized for the requirements of the house. . . often 1 1/2 to 2 times larger than what was really required for the space."

### Buying Furnace

A new, high-efficiency furnace can save you money in the long run, so if your furnace needs replacement, it pays to get a new high-efficiency model. But does your furnace need replacement. Do you want a new furnace because your present one isn't heating properly or is making too much noise? You may find that simple repairs are all that's needed. If you're considering a new furnace to eliminate problems with an older one, first read through these common problems and their fixes--this information just might save you a bundle.

## Furnace Maintenance

According to the DOE, regular maintenance is the key to an efficient heating system. Dirty filters, clogged burner ports and improper settings can drastically reduce furnace efficiency. They recommend a yearly inspection by a qualified service technician and replacing or cleaning filters on a monthly basis. A permanent air screen or electronic air filter should be cleaned according to manufacturer's recommendations. Properly maintaining your heating system-- whether it's a conventional system or a high-efficiency one-- is the best way to ensure years of problem-free, economical, comfortable heating.

Most heating systems operate reliably for a long time if they are well-maintained. Before you call a furnace technician for a repair or roll up your sleeves to do the work yourself, call your utility or check their Web site—in many areas, the utility company will send a technician to your home to check minor furnace problems for free.

If you smell gas in your home or near your furnace, particularly if the odor is strong, immediately evacuate the house, leave the door open, and call your gas utility or the fire department from your neighbor's house or a cell phone. (Don't use the phone in the house or turn light switches off or on.)

Sometimes a furnace may not seem to be generating any heat. In this situation, check the master switch and circuit breaker or fuse. The electrical system may have overloaded. If you don't find a tripped circuit breaker or blown fuse, your thermostat may be faulty.

## Filter Care

Clean or replace a disposable furnace filter periodically during the winter—check the filter monthly. Brush and vacuum the heat exchanger surfaces every year, if recommended by your owner's manual. Before the heating season, clean the blower blades and seal any air leaks in ducts with several wraps of duct tape.

A little maintenance goes a long way toward keeping your forced-air equipment working properly. Start by cleaning or replacing the filter. With forced-air furnace systems, air returning to the furnace's blower first passes through an air filter designed to catch dust and debris and help clean the air before it's recycled to your home.

A good furnace filter can help reduce allergens but isn't designed to significantly improve air quality in your home. For that, you'll need a special air filter (talk to a heating specialist about this). When typical filters become clogged with debris, they cut down on a furnace's efficiency and, over time, can cause parts to wear out faster. Change filters quarterly or sooner if they look dirty. Pleated fabric filters are a good, inexpensive choice for reducing dust and allergens.

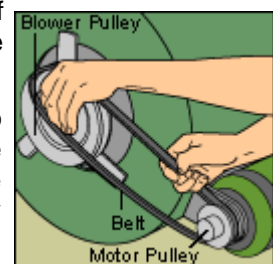
Here's how to change a replaceable filter:

- Turn off the power to the unit.
- Look for the door or panel that conceals the blower; sometimes this is marked "Filter." Lift this door or panel off of its holding hooks or unscrew its retaining screws to remove it. Standard filters are mounted next to or under the blower motor. Slide the filter out along its tracks. Check to see whether it is a disposable filter or intended to be cleaned and replaced--this should be marked on the filter's edge, along with directions for cleaning if applicable. If it's a disposable filter, its size will probably be printed on the frame's edge also. Make a note of its size.
- Buy a replacement and slide it back into place, noting that arrows stamped on the side indicate the proper direction of airflow; be sure you face these in the proper direction.

## Motor Care

Some fan motors and fans need oiling; some have sealed bearings. If recommended by your maintenance manual, oil the bearings according to the manufacturer's directions.

If the motor runs but the blower doesn't move air, the belt that connects the two probably has broken. Replacing it is an easy fix. First, turn off all power to the unit and turn off the gas at the gas valve that serves the furnace. Remove the door on the front of the furnace cabinet to give you access to the blower. (It may be on a slide-out drawer or the blower pulley and motor will be easily accessible.) Check the number stamped on the belt and get an exact replacement from a home center or heating supply outlet.



You can usually slip the belt on the motor's (smaller) pulley first, then start it on the blower pulley. Rotate the blower pulley by hand, holding the belt in place but keeping your fingers from being caught between the belt and the pulley. The belt should slip right into place. If it seems to be too tight or difficult using this method, it may be necessary to adjust the motor mount to provide more slack. Then re-tighten the tension once the belt is in place. Check the manufacturer's specifications for proper tension—in most cases, the belt should deflect about an inch when you press down on it.

**Reference:**

<http://www.hometips.com/cs-protected/guides/forcedair.html>