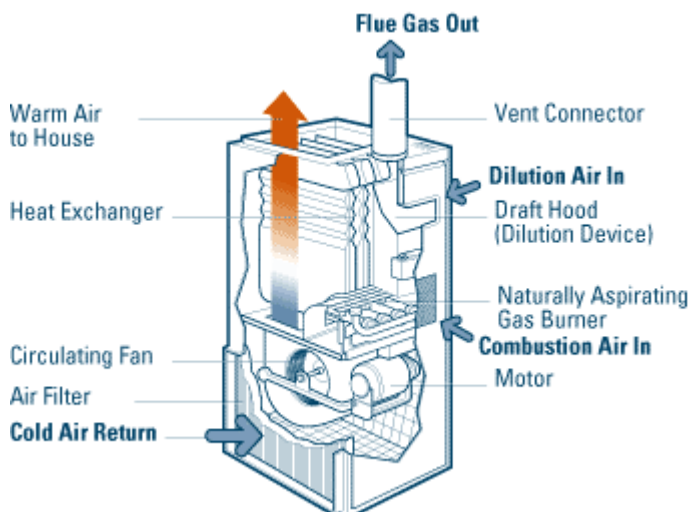


Gas Furnace

The combustion of natural gas produces certain by-products, including water vapour and carbon dioxide. In a conventional gas furnace, such by-products are vented through a chimney, but a considerable amount of heat (both in the combustion products and in heated room air) also escapes through the chimney at the same time. Heat is also lost up the chimney when the furnace is off. The newer designs have been modified to increase energy efficiency by reducing the amount of heated air that escapes during both the on and off cycles and by extracting more of the heat contained in the combustion by-products before they are vented. Furnaces with these design modifications use much less energy than conventional furnaces.

Conventional Gas Furnace

This system consists of a furnace with a naturally aspirating gas burner. Older units were equipped with a standing (continuously lit) pilot light; the newer ones feature electric ignition. The combustion gases pass through the furnace where they give up heat across a heat exchanger and are exhausted to the outside through a flue pipe and vent. A draft hood serves to isolate the burner from outside pressure fluctuations at the vent exit by pulling varying quantities of heated house air into the exhaust as required. A circulating fan passes cooled house air from the return ducts over the furnace heat exchanger, where the air is warmed up and passed into the ductwork that distributes the heated air around the house.



Notice that there are two entirely separate air movement paths: the combustion path supplies air to the burner and to the draft hood and carries hot combustion gases through the burner, heat exchanger, and flue pipe to the vent and out of the house; the heat distribution and cold air return path circulates and heats the air inside the house.

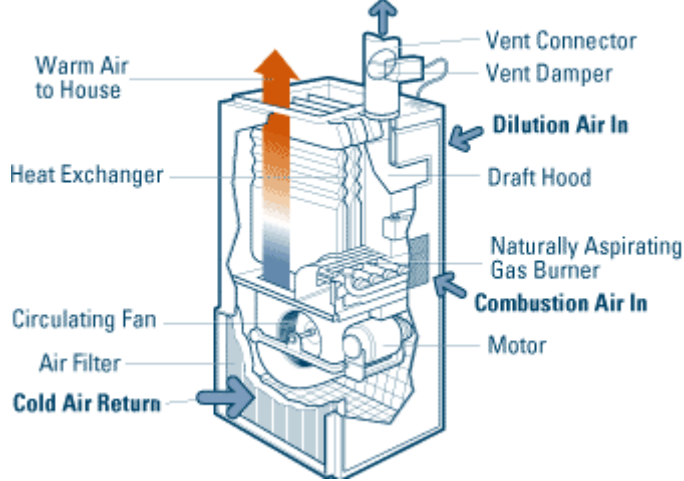
Conventional gas furnaces have a seasonal efficiency of about 60 percent. While the majority of Canadian homes have gas furnaces similar to this type, such equipment does not meet the new seasonal efficiency standards and is no longer sold in Canada.

The other common type of gas-fired system is an oil-fired furnace that has been converted to natural gas, usually with either a power burner or a power-assisted burner. This type of unit has a fan with a burner to assist in the combustion process and in the development and maintenance of an adequate draft. The dilution device is a double-acting barometric damper, rather than a draft hood, but it performs a similar function.

Oil furnaces that have been converted are generally more efficient than conventional gas furnaces, with seasonal efficiencies in the 63 to 68 percent range; however, they are not nearly as efficient as the new types of mid- and high-efficiency gas furnaces.

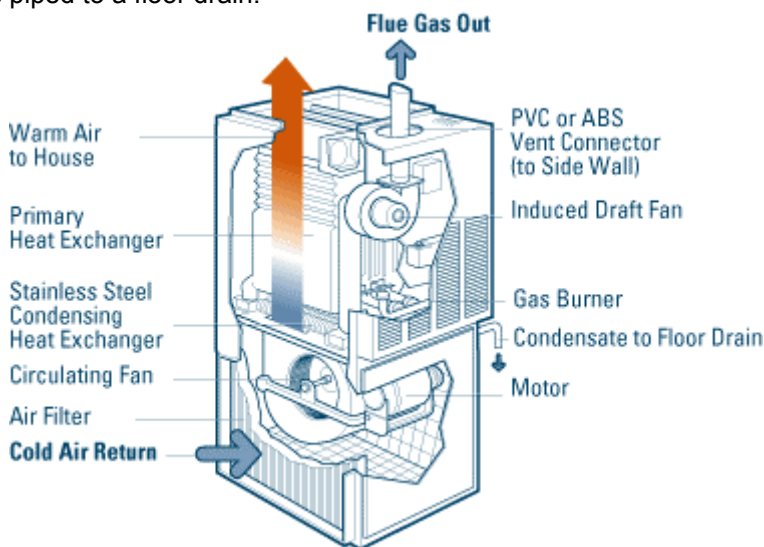
Gas Furnace with Automatic Vent Damper

A vent-dampered gas furnace has a vent damper in the flue exhaust, downstream of both the furnace heat exchanger and the draft dilution device. A thermostat controls the damper: when the gas burner turns off, the damper is closed automatically after a period of time; when the thermostat signals to start the furnace, the damper opens before the burner ignites. By closing off the vent during much of the off cycle, the damper prevents some of the warm household air from being drawn up the chimney and lost to the outdoors. These furnaces usually have an electric or electronic ignition. Fuel savings are generally in the three to ten percent range, compared to a conventional furnace. However, some of the savings can be lost if a conventional gas-fired water heater is also connected to the same chimney. The water heater is still vented and is burdened by an increased draft, augmenting the heat lost through the water heater. The vent-dampered gas furnace does not meet the now-applicable minimum standards for energy efficiency.



High-Efficiency Condensing Gas Furnaces

Condensing gas furnaces are the most energy-efficient furnaces available, with seasonal efficiencies between 89 and 97 percent. Most have burners similar to conventional furnaces, with draft supplied by an induced draft fan. There are additional heat exchange surfaces made of corrosion-resistant materials (usually stainless steel) that extract most of the heat remaining in the combustion by-products before they are exhausted. In this condensing heat exchange section, the combustion gases are cooled to a point where the water vapour condenses, thus releasing additional heat into the home. The condensate is piped to a floor drain.



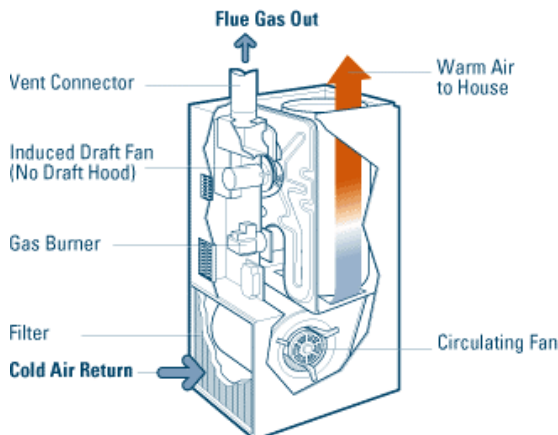
A chimney is not needed and energy efficiency is further increased. Because the flue gas temperature is low, the gases are vented through a PVC or ABS plastic pipe out the side wall of the house. Depending on the combustion and heat exchange design, fuel savings of up to 38 percent relative to a conventional gas furnace can be achieved. Furthermore, polluting emissions released into the environment are also reduced.

A second type of condensing furnace uses a pulse combustion principle. The technology relies on igniting small amounts of gas at frequent intervals; otherwise, it is essentially similar to the previously described condensing furnace.

Mid-Efficiency Gas Furnaces with an Induced Draft Fan

Mid-efficiency gas furnaces mainly use a naturally aspirating burner and do not have a continuously lit pilot light. They are equipped with a powered exhaust, usually with a built-in induced draft fan, and they do not have a draft hood. With more heat exchange, no dilution air, and high resistance to flow during the off cycle, seasonal efficiency is much higher for mid-efficiency gas furnaces than for conventional furnaces, offering energy savings of 23 to 28 percent over conventional gas furnaces.

These systems can be vented through a properly sized chimney or out the side wall of the house using high-grade stainless steel.



However, there have been problems associated with the use of high-temperature plastic vent pipes with mid-efficiency furnaces. Regulations may forbid the use of certain vent materials in your area. You should discuss all options with your local serviceperson, approvals agency, or gas utility. Due to these venting concerns, the high-efficiency condensing furnace has become the new furnace of choice among Canadians.

Note that if this type of mid-efficiency furnace is installed, local or provincial building codes may require direct combustion air for the furnace.

Contrary to conventional and mid-efficiency furnaces, where efficiency decreases with furnace oversizing, condensing furnaces are actually more efficient when they are oversized and run for shorter periods. Thus, if you are choosing a new condensing furnace, you can get a furnace that is slightly larger than the house heat demand, without suffering an “efficiency penalty.”

Today, many new homes have less than optimally efficient gas furnaces. This is due to a number of factors, including pricing disincentives for builders and the mistaken belief among home buyers that a new home automatically has an energy-efficient furnace and that less efficient furnaces are still a bargain because of today’s relatively low gas prices. There is also the misconception that high-efficiency furnaces are more complex and have higher maintenance costs than mid-efficiency furnaces. For these reasons, the number of inefficient and mid-efficiency furnaces is still far greater than that of condensing appliances.

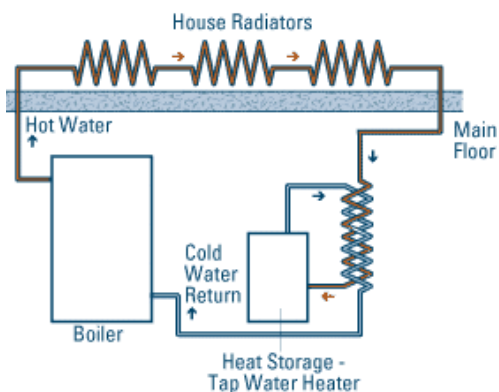
Sealed Combustion

Heating costs may be reduced slightly by decreasing the amount of combustion air drawn from inside the house. One way to do this is to use outside air brought in through plastic piping directly to the combustion chamber. This is known as a sealed combustion system and is now applied to many new condensing furnaces both with an induced draft fan and with the pulse combustion types described previously.

In provinces where the building code calls for “tighter” homes and the use of heat exchangers, flue gas spillage or backdrafting of combustion appliances caused by exhaust fans (such as kitchen and bathroom fans, clothes dryers, etc.) can be a hazard. Sealed combustion units can be used to help prevent this problem.

Combined Space and Water Heating Systems

A high-efficiency integrated space and water condensing gas-fired heating system, using water from municipal mains as the driving mechanism to condense the flue gas, can have efficiencies of over 90 percent for both space and water heating. Space heating can be hydronic or forced air (through a fan coil). The overall capital cost of this system may be lower than for individual appliances, the need for multiple exhaust systems is eliminated, and the efficiency of operation can be maximized.



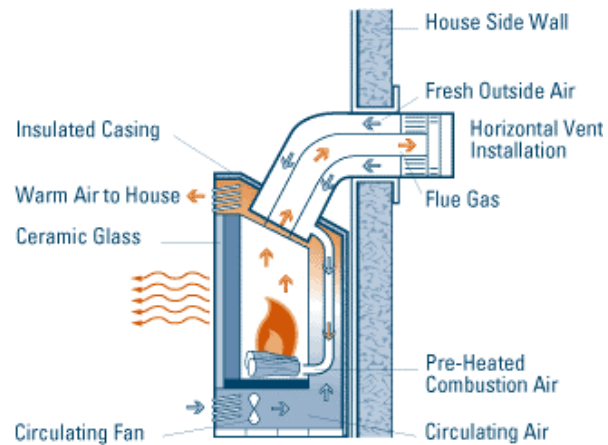
Condensing gas-fired boilers in hydronic heating systems can have difficulty condensing in practice because the return water temperature is above the dew point of the flue gases. By installing a water-to-water heat exchanger and storage tank for tap hot water upstream of the boiler, the return water temperature can be brought below the dew point, flue gases will condense and the efficiencies will be improved significantly.

Some combined systems use a gas-fired water heater instead of a boiler as the energy generator and are then coupled with a fan coil to supply heat to the house through a warm air duct system. One promising combination, with a sealed combustion, instantaneous, mid-efficiency water heater as the energy generator, has an external tank and fan coil. An even more efficient system has a condensing water heater as the energy generator, with potential efficiencies near 90 percent. On the other hand, if a conventional, natural draft water heater is used, the resulting combination ("combo") system will have much lower efficiencies and higher gas bills than if a mid- or high-efficiency water heater is used or when compared to a new gas-fired boiler installation.

Direct-Vent Wall Furnaces

Direct-vent wall furnaces are self-contained sealed combustion heating appliances that draw in combustion air and discharge combustion products through a vent to the outside. They are permanently attached to the structure of a building, recreational vehicle, or mobile home, and are not connected to ductwork. These units circulate heated air by gravity or with the help of a circulating fan. Units with a circulating fan yield higher efficiencies.

Wall furnaces are compact and less expensive than central furnaces. They come in a variety of heating capacities with efficiencies that range from that of a standard efficiency unit with a pilot light to a mid-efficiency unit with electric ignition and induced draft. The AFUEs can range from 70 to 80 percent. Generally, high-efficiency central furnaces are much more efficient.



Reference:

http://oee.nrcan.gc.ca/publications/infosource/pub/home/Heating_With_Gas_Section4.cfm