High–Efficiency Boilers

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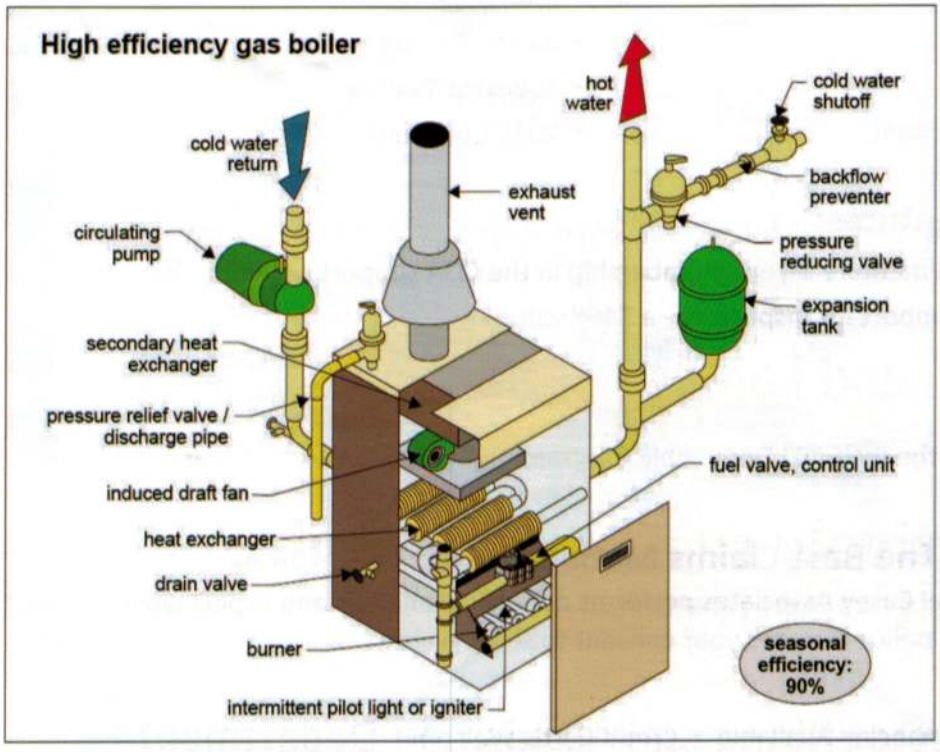
We've talked a lot about high-efficiency furnaces, but there are high-efficiency gas boilers as well. High-efficiency boilers are not as common as high-efficiency furnaces, however. High-efficiency boilers can cost twice the price of regular boilers, whereas high-efficiency furnaces cost only 30% to 40% more than lower-efficiency systems. There are fewer manufacturers of high-efficiency boiler equipment. Let's look at some of the advantages and disadvantages of high-efficiency hot water heating.

Direct Vent

High-efficiency boilers are typically direct-vent systems. Not only do the exhaust gases go straight through the wall, but combustion air is piped in from outside and the combustion chamber is sealed from the house air.

Low Operating Costs

The operating costs of high-efficiency boilers are considerably lower than conventional boilers. Seasonal efficiencies in the range of 85% to 95% are possible. The seasonal efficiency of conventional boilers may be 55% to 65%.



ADVANTAGES

No chimney needed

High-efficiency equipment needs no traditional chimneys. The combustion products are vented out through the house wall, typically through a plastic or metal vent.

DISADVANTAGES

Costly

High-efficiency boilers come with a high cost for installation.

Condensation

High-efficiency boilers are associated with the corrosion issue that comes up any time we deal with condensation. In a high-efficiency boiler, just like a high-efficiency furnace, corrosion may occur because it produces an acidic condensate.

High Maintenance Costs and Poor Reliability

Maintenance costs for high-efficiency boilers are typically much higher than for conventional equipment. Just like high-efficiency furnaces, high-efficiency boilers are complex and full of high-tech components. So far, the reliability of high-efficiency boilers has not been great. The exhaust gas path through the heat exchanger is longer and more restricted than with conventional heat exchangers. We expect problems with clogged heat exchangers.

Mismatch with Distribution System

Another common difficulty with high-efficiency boilers is the incompatibility of the boiler with the existing distribution system. You'll remember that high-efficiency furnaces use the latent heat of vaporization to grab heat from the exhaust gases to achieve their high-efficiency ratings. The combustion products of natural gas condense when the flue gas temperature drops to roughly 125°F. If the flue gases are hotter than that temperature, the boiler will not condense and efficiency diminishes.

Radiators Designed for Hot Water

Many radiator systems are designed to be supplied with water leaving the boiler at 150°F to 200°F. The temperature drop as the water goes through the system may be 20°F to 30°F. This is a typical temperature rise across a boiler as well.

Return Water too Hot to Cause Exhaust Gases to Condense

The return water temperature in many piping systems may well be higher than 125°F. Obviously, it's tough to cool the

than the dew point. Sometimes we get condensation at startup, but none when the system heats up to a steady state.

Small-Volume Boilers

Another difficulty encountered with high-efficiency boilers is the small heat exchanger volumes. Traditional boilers hold several gallons of water, but in most high-efficiency boilers, the volume is much smaller. This can cause problems. The rate of water flow through the boiler is critical on high-efficiency systems. The boiler may overheat if the water flow rate is not adequate.

Different Pumps

Typically, the water flow requirements of high-efficiency boilers are considerably higher than conventional boilers. As the water must move through the pipes faster, increasing the friction losses in the piping, the pump capacity of the new boiler may have to be considerably larger than the old pump. This needs to be sized for the existing distribution system.

Short Cycling

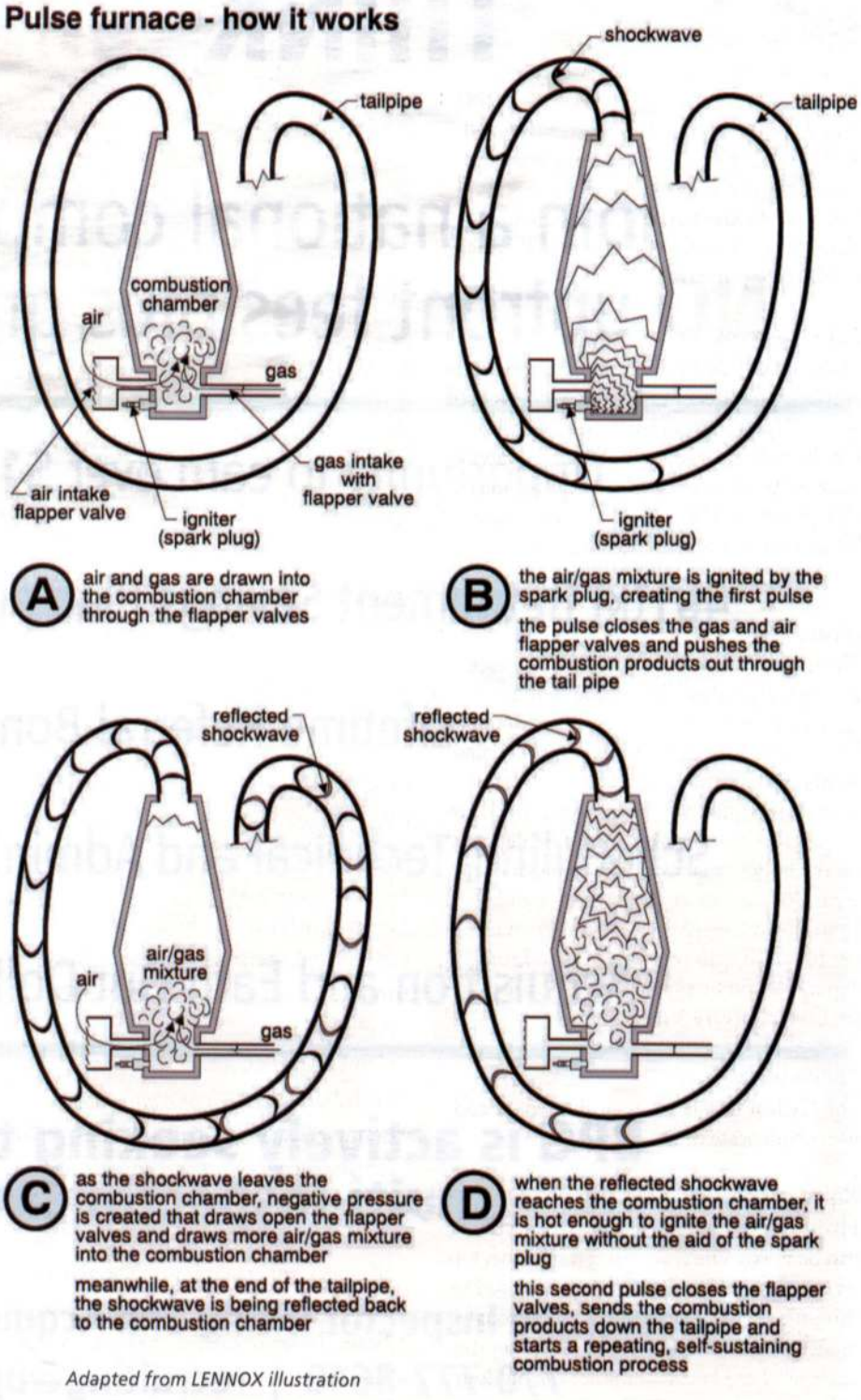
It's not easy for the boiler manufacturer to determine what pump is needed for all systems. If the boiler overheats because the water flow is too slow, the boiler will "short cycle." This means that the burner will go off and on several times before the thermostat is satisfied. This shortens the life of the heat exchanger and wears out the mechanical components in the system faster.

Similarities to High-efficiency Furnaces

High-efficiency boilers use many of the same components that high-efficiency furnaces do. There is often a second heat exchanger, as well as some form of intermittent ignition and a low-temperature venting system. Because the ignition systems are the same, the safety controls are also similar.

Forced-Draft rather Than Induced-Draft

Boilers tend to differ from furnaces in that there are some forced-draft, high-efficiency boilers. So far, forced-draft technology has not been widely used in high-efficiency furnaces.



Adapted from LENNOX illustration

Cupro-Nickel Heat Exchangers

Heat exchanger materials also can vary. Stainless steel is a common heat exchanger material for both boilers and furnaces, but some boilers also are made from copper-nickel alloys (for example, cupro-nickel). These alloys are more corrosion-resistant than stainless steel and have good thermal conducting properties.

Pulse Systems

We've talked about the Lennox Pulse high-efficiency furnace. Pulse combustion is used on the Hydrotherm HydroPulse or MultiPulse boiler, a high-efficiency hot water system. This boiler uses the same combustion process as the Lennox Pulse furnace. There is no burner, no pilot, no vent connector and no chimney.

Direct-Vent

The direct-vent system pictured here uses PVC pipe (or aluminum dryer vent or galvanized steel in some areas) to bring combustion air from the outside into the sealed combustion chamber. Exhaust is sidewall-vented through CPVC pipe, typically 1½ to 3 inches in diameter. The pipe size depends on the boiler capacity and the length of the vent. Both intake and vent pipes should slope down toward the boiler at ¼ inch per foot of length on the horizontal runs. Piping should be supported every 5 feet (in Canada, every 3 feet).

Condensing

The HydroPulse is a condensing boiler and uses condensate drain piping.

Noise

HydroPulse boilers, like Pulse furnaces, can be noisy. Vibration damping connectors on the distribution piping often are used to minimize the noise and vibration throughout the house. Mufflers can be used on the exterior of the house to reduce the outdoor noise.

Efficiency

Condensing boilers have efficiency ratings of over 90%. Non-condensing or partially condensing boilers have efficiencies in the 80% to 88% range.

Direct-vent system using PVC pipe.

Direct-vent using galvanized steel.

A quick list of conditions or problems associated with high-efficiency boilers.

- Cabinet problems
- Fuel supply and burner problems
- Combustion air and venting problems
- Ignition problems
- Heat exchanger problems
- Safety and operating control problems
- Induced-draft and forced-draft fan problems
- Condensate handling problems
- Distribution system problems (for example, expansion tanks, pumps, piping, radiators, convectors and baseboards)
- Inadequate water flow rate through the boiler (This problem is unique to high-efficiency boilers. You won't be able to recognize it during a home inspection.)
- Noise (Noisy operation is easy to detect. This is most common on pulse systems. This can be an issue inside and outside of the home.)

This boiler has a plastic intake and a steel exhaust–the condensate line on this one is not properly attached.