

Heat Pump Operation 101

Many homes in the [Miami Valley](#) are heated and cooled by Heat Pumps, but few homeowners understand how they work. Hopefully I can dispel some of the mystery here. Let's start with the basics.

What is a heat pump?

A heat pump is basically an air conditioner with a reverse gear. In the summer, a heat pump or air conditioner cools the indoors and heats the outdoors by pumping heat from inside the home to the great outdoors. In the winter, a heat pump "shifts" into reverse and pumps heat into the home. The process is identical to air conditioning only backwards.

How does a heat pump work?

A Heat pump contains an outdoor expansion valve that reduces the pressure of the refrigerant in the outdoor coil until the coil is much colder than outdoors. This coil is actually warmed by the cold outdoor air. As amazing as this seems, a heat pump coil can reach temperatures as low as 20F below zero which makes a Dayton winter day seem warm and balmy.

After picking up as much heat as possible from the outdoors, the heat pump compresses the refrigerant to very high pressures which raises the temperature to as high as 130 degrees. This hot gas is then pumped (hence the term heat pump) indoors to heat your home.

[Heat pump defrosting](#)

This super cooling of the outdoors coil does create one little problem. Although cold winter air holds little humidity, the super cold heat pump coil

turns that little bit of water vapor into frost. After an hour or two, the heat pump coil will collect enough frost and ice to block airflow. Reduced airflow results in a colder coil and more frost – a real snow-ball effect. This snowball slashes efficiency and greatly damages the compressor.

To combat this frost, iced-up heat pumps must shift from heating mode to cooling mode for a few minutes every hour or two. This heats the outdoor coil and melts the offending ice and frost. You may have guessed that this process wastes a lot of energy. Older heat pumps employ a crude timer mechanism to initiate the heat pump defrost cycle every hour whether it needs it or not. [Trane heat pumps](#) have electronic sensors that defrost only when needed. This greatly increases the heating efficiency of the heat pump.



Heat pump efficiency

Trane heat pumps achieve efficiency ratings between 300-400%. How can any system exceed 100% efficiency? Rather than burning fuel to create heat like a gas furnace, a heat pump uses electricity to move/transfer/pump existing heat from outside to inside. Because it is only **transferring heat**, a heat pump can burn 100 watts of electricity to produce as much as 400 watts of heat. By comparison, a gas furnace would burn 100 watts of natural gas to produce only 95 watts of heat. Heat pumps are awesome!

You can think of this outdoor to indoor heat transfer like a car driving uphill. On a steeper hill, the car must work harder. Likewise, colder outdoor temperatures require more work from your heat pump. This relationship between outdoor temperature and heat pump efficiency means that efficiency is a curve rather than a set number. For this reason, the industry has established HSPF (Heating season performance factor) as an average measure of heat pump efficiency throughout the winter heating season.

Next week I'll discuss heat pump capacity and sizing as well as backup fuels.