

Viridiant Lecture Series Ducted Mini Split Heat Pumps

Lessons Learned from Design, Testing, and
Monitoring at 150 Locations



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Ducted Mini Split Heat Pumps

cost

- Small, low-cost equipment
- Compact ductwork
- Low-cost filters
- Low energy costs

efficiency

- All variable speed equipment
- 24/7 high efficiency air filtration
- All ductwork in conditioned space
- Excellent Winter performance without inefficient backup heat

comfort

- Even heating and cooling
- Steady temperature, no cycling
- Very low noise
- Clean air

ducted mini split heat pumps

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Times are changing in residential heating, ventilation, and air conditioning (HVAC). Ground source heat pumps used to be the gold standard in residential heating and cooling but now only the most expensive equipment can compete with mini split heat pumps (i.e. fully variable speed). For homes with tight and well insulated enclosures, the economics of mini splits are hard to beat. When compared with conventional heat pumps, mini splits are a far superior product and can be installed for similar costs. As the outdoor temperature drops, conventional heat pumps quickly lose their capacity and rely on inefficient electric resistance backup heat. The best mini splits maintain a heat output higher than their nominal capacity well below 0°F and have no need for electric resistance backup when designed properly.

It is easy to look at the cost and efficiency ratings of ductless mini splits and look no further. However, real world testing shows underwhelming performance from ductless mini splits in cold climates for several reasons. On the other hand, Think Little's real world measurements from ducted mini splits show them outperforming their capacity ratings at record low outdoor temperatures (Figure 1). Ductless mini splits thrive in open floor plans but not so much in the typical home. Their less popular cousin, the ducted mini split, ends up as the goldilocks system for cost, efficiency, and comfort.

The drawbacks that remain for ducted mini splits can easily be overcome with a little bit of knowledge and careful designing. In fact, there are some idiosyncrasies about ducted mini splits that can be

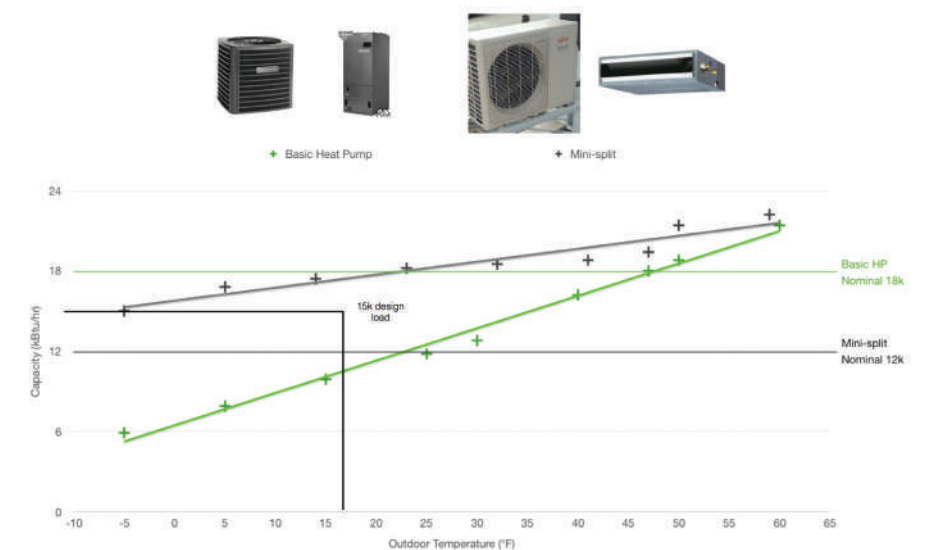


Figure 1: The variable speed mini split has 75% more heating capacity.

February 2018

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used as an advantage over typical systems. For example, even when these systems are not actively heating or cooling the indoor fan is still running at a very low and efficient speed. This allows the addition of a high efficiency return filter to achieve excellent air filtration around the clock for very low filter and energy costs. It also allows the supply air from an energy recovery ventilator (ERV) to be tied into the ductwork, reducing the cost of ERV installation while ensuring that fresh air gets evenly distributed throughout the home.

The two main limitations of ducted mini splits are:

- 1) Small Capacity
- 2) Low Fan Power

The first means that they are not very practical for leaky or otherwise inefficient buildings. This also means that they are perfectly suited for homes with tight enclosures. The second limitation, low fan power, is overcome by good duct design and ends up being a benefit because fan energy use remains very low.

When it comes to air filtration, most home heating and cooling systems have a low efficiency filter designed just to protect the fan and coil from hair and large dust particles. Think Little has focused on capturing fine and ultra-fine particles that are harmful to human health and has found a very inexpensive, high efficiency filter that also has a low resistance. This filter is designed to

be much larger than usual which further reduces its resistance, allowing large amounts of air to move through it without using much energy. When compared with the typical high efficiency filter box and filter, this approach can save a homeowner hundreds of dollars.

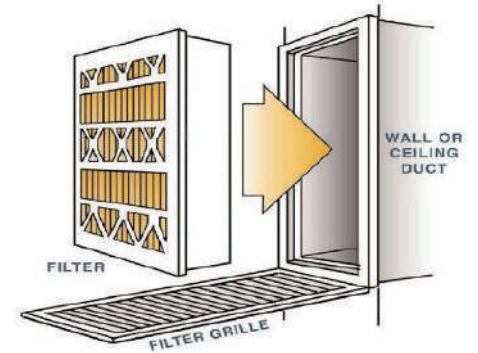


Figure 2: Return filter grille used by Think Little

When Think Little designs duct systems, they follow some “rules” that have been developed to ensure projects are successful and clients are happy. Here is the list:

- Keep all ducts in conditioned space
- One central return and transfer grilles when necessary
- No turns with flex duct
- Lower duct velocity from 900 fpm to 450 fpm
- Standard/mediocre takeoffs and boots for cost savings
- Size supply registers for throw (but don't hit people)
- Oversized return filter grille
- 2" deep high efficiency filter



Compact System in Ceiling Soffit (1300 sf)

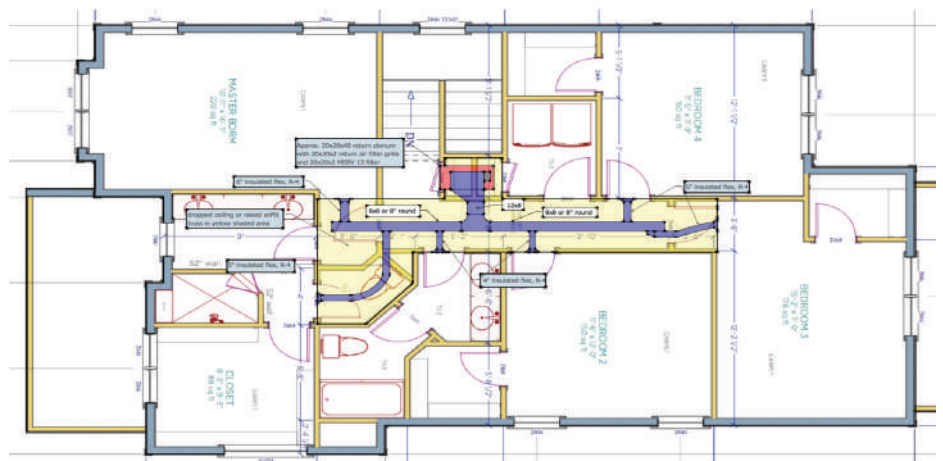


Figure 3: Supply air can be thrown to exterior walls, reducing ductwork and costs.