

# TOOLBASE<sup>SM</sup> TECHSPECS

## Heating and Cooling Remodeling Options

Ductless (Mini-Split) Heat Pumps

High Velocity Mini-Duct Air Distribution System

### RESULTS FROM THE FIELD

Real-world demonstrations are ongoing ...

Page 2

### FOOD FOR THOUGHT

What to consider to be sure alternate HVAC systems are right for your project...

Page 2

### MAKING THE SWITCH

What it takes to incorporate alternate HVAC systems...

Page 2

### DOLLARS & SENSE

Average costs of alternate HVAC systems...

Page 3

### TECH CHECK

Steps to take if you decide to start using this building technology...

Page 3

## TECH @ A GLANCE

### BENEFITS (+)/DRAWBACKS (-)

- + Both technologies can simplify installation of central air conditioning in existing homes without ductwork
- + High-efficiency equipment available (SEER up to 21 and HSPF up to 11)
- + DUCTLESS SYSTEMS:
  - With variable speed compressors, on-off cycling losses can be avoided and heating without electric resistance back-up can be provided at outdoor temperatures down to 17°F
  - Eliminate the need for ductwork
  - Easy to zone
  - Convenient for additions if extra capacity is needed and/or ductwork is not easy to extend to the addition
  - More efficient and quieter than room air conditioners and don't block windows
  - Easier to install than ducted systems
- + HIGH-VELOCITY SYSTEMS:
  - Provide excellent dehumidification due to geometry of the cooling coil
  - Have small diameter ducts which may fit where conventional ductwork would not
- DUCTLESS SYSTEMS:
  - Have small air handlers in each room or zone, which may be aesthetically unappealing
  - Ductless room air handlers produce noise up to about 50 dB, which, although quieter than room air conditioners, may be objectionable; in low-speed mode, decibel ratings are much lower (down to about 20 dB)

### - HIGH-VELOCITY SYSTEMS:

- Deliver air at a higher flow rate which may be objectionable to some, although this issue can be avoided through careful placement of delivery outlets
- Some are exempt from the SEER 13 federal minimum; DOE has granted these products a lower efficiency requirement of SEER 12 / 7.4 HSPF<sup>1</sup>; equipment with a SEER of up to 17.9 is available
- Still require large supply plenum and central returns, which can reduce some of the benefit

### MAKING THE SWITCH

It is important to use contractors that are knowledgeable in the design and installation of high-velocity or ductless HVAC systems. Some manufacturers have a directory of qualified contractors. Although the ACCA Manual J sizing method applies to alternate HVAC systems, equipment selection is different than conventional. Some manufacturers have software for calculating loads, recommending equipment, and even helping with system layout.

### INITIAL COST

Ductless mini-split and high-velocity equipment costs more than conventional HVAC systems. However, installed costs can be equivalent or lower than conventional systems depending on existing site conditions (e.g., if eliminating large ducts also avoids the need for building or tearing down walls).

### OPERATIONAL COST

Compared to a conventional ducted heat pump having the same equipment efficiency, potential operating cost savings can be achieved with ductless systems due to zoning and reduced losses in distribution. Operating cost for a high-velocity system will depend greatly on its SEER rating. However, increased dehumidification and better air mixing can improve comfort.

### CODE ACCEPTANCE

Standard mechanical, electrical, and applicable energy codes apply to alternate HVAC systems. SEER ratings of matched systems can be found on the Air Conditioning and Refrigeration Institute's Certified Products Directory at [www.ahrirectory.org](http://www.ahrirectory.org). Federal minimum SEER ratings for some space-constrained systems are waived by DOE and, therefore, may have a SEER of 12.

DOE defines a space-constrained unit as a central air conditioner or heat pump:

1. That has a rated cooling capacity no greater than 30,000 Btuh
2. That has an outdoor or indoor unit having at least two overall exterior dimensions or an overall displacement that
  - a. Is substantially smaller than those other units that are
    - i. Currently usually installed in site built single-family homes, and
    - ii. If a similar cooling, and, if a heat pump, heating capacity, and

*Continued on page 2*

<sup>1</sup><http://www.secsupply.com/SEERrules.pdf>

## THE BASICS

Ductless mini-split heat pumps have outdoor units that, like conventional heat pumps, use electricity to heat or cool a refrigerant. Unlike conventional heat pumps—in which the refrigerant is delivered to an indoor coil to heat or cool air for subsequent distribution via ductwork—the refrigerant is delivered via very small piping to individual coils located in each room or zone. Each coil has its own blower to deliver heated or cooled air to the room or zone. The systems promote easy zoning, low distribution losses, high SEER ratings, and are an excellent alternative to window units.

High-velocity air conditioning systems have an outdoor condensing unit and indoor evaporator coil, just like conventional split-system air conditioners. What's different is the method for distributing the conditioned air. High-velocity systems are typically installed in older homes which were not originally equipped with ductwork. When compared to window or room air conditioners, high velocity systems are quieter and more convenient to operate. While the equipment for a high velocity system is more efficient than a standard room air conditioner, high velocity systems are commonly placed in attics and other locations, which can result in more energy losses when compared to being in a conditioned area. This detracts from the equipment efficiency, and makes high velocity systems less than ideal for energy focused retrofits. Due to the small ducts, installation is relatively simple and requires little, if any, demolition. High-velocity indoor equipment can be matched with nearly any type of heating and/or cooling equipment such as compressors, chillers, heat pump, geothermal systems, boilers, or water heaters.

In a high-velocity system, two-inch manufacturer-supplied duct and other air distribution components distribute air around the house. The small-diameter, flexible ducts can be snaked through walls and floor systems for ease of installation in retrofit situations. Noise-mitigating duct sections are employed at all registers to dampen the noise from the fast-moving air. Placement of registers is critical to avoid drafts and to promote even distribution of air. Variable speed blower fans improve efficiency, and efficiencies of up to 17.9 are currently available.

As with any HVAC system, detailed load calculations and careful installation are essential for system performance.

### TECH-AT-A-GLANCE *continued*

- b. If increased, would result in a considerable increase in the usual cost of installation or would result in significant loss in the utility of the product to the consumer; and
- 3. Of a product type that was available for purchase in the U.S. as of December 1, 2000.

Ductless mini-splits do not automatically qualify as space constrained and are subject to the 13 SEER/7.7 HSPF requirements unless they meet the above definition.

## RESULTS FROM THE FIELD

No PATH field studies have been conducted using these technologies. Other field studies are underway in the Pacific Northwest and Northeast.

## WARRANTY

**Mini-Split Systems:** Compressor warranties of up to 6 years, and parts warranties of 1 to 2 years are typical. Most warranties exclude labor.

**High-Velocity Systems:** Parts warranties of 1 to 5 years are typical.

## RESULTS FROM THE FIELD

*This technology has been evaluated by other builders in real-world building projects – learn from their experiences. For more information on Technologies in Practice, visit [www.toolbase.org](http://www.toolbase.org).*

Ductless mini-split field studies are ongoing in the Pacific Northwest and the Northeast. However, quantitative results are not yet available. Preliminary results show that consumers are accepting of the look and sound of the systems and the comfort they provide.

## FOOD FOR THOUGHT

*This section provides some things to think about before switching to this building technology – make sure it's the right choice for you.*

- Alternatives to conventional HVAC ducts make sense when cooling is desired in a home that does not have ductwork.
- Alternatives are not always the most energy efficient, but may be the most practical systems.
- HVAC retrofit alternatives offer benefits such as zoning, additional dehumidification, good air mixing, and ease of installation, which may outweigh the additional costs.
- Some manufacturers have a database of contractors who are qualified to design and install their equipment. Talk to these contractors to find out if the particular equipment meets the needs of your retrofit situation.
- Investigate conventional HVAC for your application by talking to local contractors.
- **Mini-Split Systems:**
  - o A heat pump is not always adequate for very cold climates and will require an auxiliary source of heat in very cold weather, although with optional efficiency features, systems can provide heating, without electric resistance backup, in very cold temperature (down to 17°F according to one manufacturer).
- **High-Velocity Systems:**
  - o Due to increased air movement, high-velocity systems work well with cathedral and other high ceilings where temperature stratification within a room is an issue.
  - o Finding a contractor is likely to be more difficult than finding a conventional HVAC contractor.

## MAKING THE SWITCH

*What is required to transition from your current building practices to using this technology?*

Conventional HVAC contractors possess the skills required for installing mini-split and mini-duct HVAC systems. However, there are factors unique to each system that are important for the contractor to understand. Be sure to find knowledgeable contractors through a manufacturer or distributor.

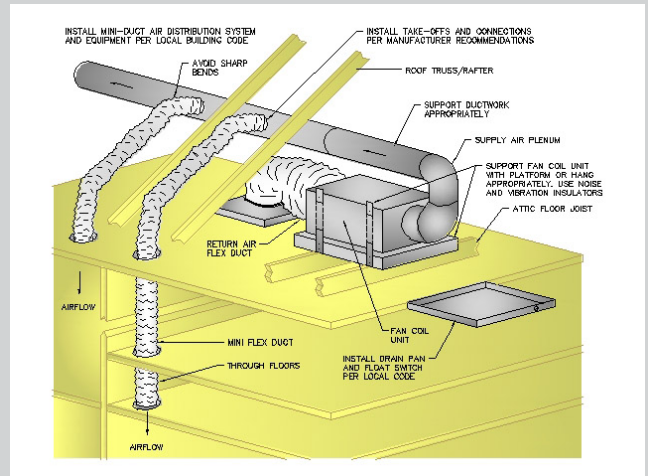
**DOLLARS AND SENSE**

Initial and operating costs of alternate HVAC systems will vary greatly based on the application and the equipment selected. Installed, a large single-zone ductless mini-split system costs about \$5,000, with multi-zone systems twice that or more.

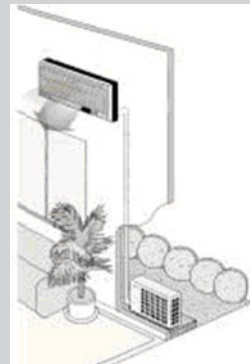
**TECH CHECK**

Below is a checklist of steps to follow in order to implement this technology in each of your projects.

- Before investing in new equipment, consider options, such as sealing ductwork, which can stretch the capacity of the existing system.
- Find a reputable contractor to discuss various HVAC remodeling options before deciding on a technology. This may require talking to several companies.
- Once you have decided on a technology, select a company that will conduct a detailed load calculation, is adept at installing the equipment you are seeking, comes highly recommended, and offers a good installation warranty.
- For mini-split systems replacing electric resistance heating, it may be more economical to install a single-zone heat pump in the main living area and keep resistance heating in little-used areas.

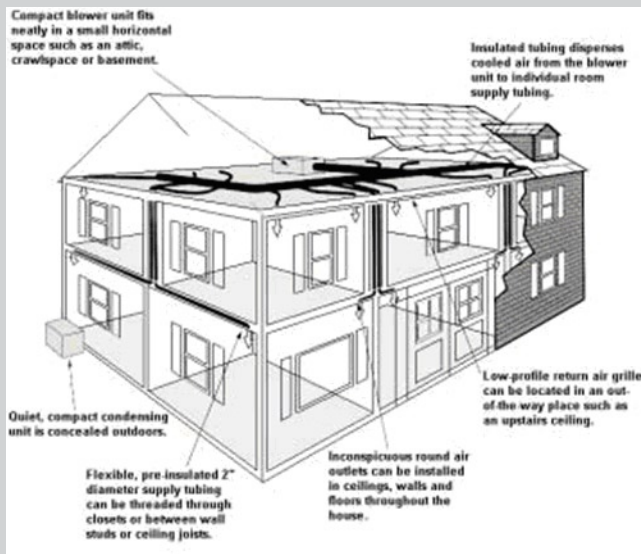


Mini Duct Air Distribution



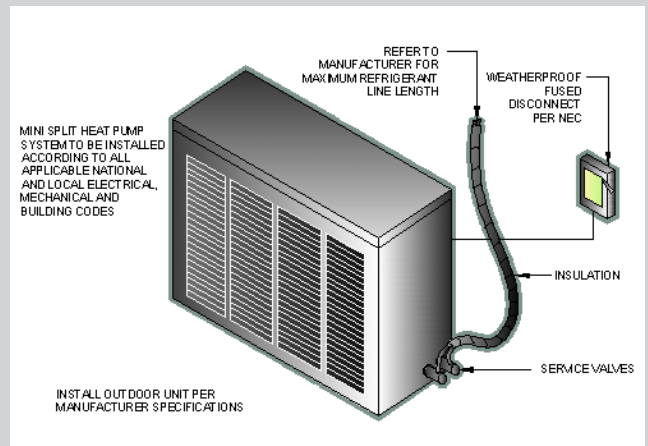
Ductless Split System

Source: "The Rehab Guide, Volume 8: HVAC/Plumbing", U.S. Department of Housing and Urban Development, 1999



Mini-Duct Distribution System

Source: "The Rehab Guide, Volume 8: HVAC/Plumbing", U.S. Department of Housing and Urban Development, 1999



Ductless Heat Pump Outdoor Unit

**DEFINITIONS**

**SEER – Seasonal Energy Efficiency Ratio**

A ratio of the cooling output, in BTUs, to the electrical input in watts. Federal minimum SEER for split system air conditioners is currently 13. Systems must have SEER 14 to be labeled ENERGY STAR.

**HPSF – Heating Season Performance Factor**

A ratio of the heating output of a split system heat pump to electrical input. Federal minimum HPSF is currently 7.7. Systems must have an HPSF of 8.2 to be labeled ENERGY STAR.

**RESOURCES**

*General information about heating and cooling remodeling options:*

**Energy Efficiency Improvements for Remodeling, HVAC Systems Module**

NAHB Research Center, 2006

[http://www.toolbase.org/PDF/DesignGuides/MDL\\_8\\_MechanicalSystems.pdf](http://www.toolbase.org/PDF/DesignGuides/MDL_8_MechanicalSystems.pdf)

**The Rehab Guide, Volume 8: HVAC**

U.S. Department of Housing and Urban Development, 1999

<http://www.toolbase.org/Design-Construction-Guides/Remodeling/hvac-plumbing-rehab-guide>

**Air Conditioning and Refrigeration Institute Directory of Certified Products**

– matches split system units and rates matched systems' efficiency

[www.ahridirectory.org](http://www.ahridirectory.org)



The Partnership for Advancing Technology in Housing (PATH) is dedicated to accelerating the development and use of technologies that radically improve the quality, durability, energy efficiency, and affordability of America's housing. Managed by HUD, the PATH partnership includes the homebuilding, manufacturing, insurance and financial industries, and Federal agencies concerned with housing.

PATH addresses barriers to innovation, provides information on advanced building technologies, and advances housing technology research; making affordable, quality American homes a reality.

For more information on the PATH program, visit [www.pathnet.org](http://www.pathnet.org).

*TechSpecs are prepared for PATH by the NAHB Research Center.*



400 Prince George's Boulevard  
 Upper Marlboro, MD 20774  
[www.nahbrc.org](http://www.nahbrc.org)