Contractor Dave Yates (left) and his son, Mike, prepare to run a copper refrigerant lines to the air handler of the new cooling system.

On the spot

A ductless mini-split does the job when a room over an unheated garage becomes living space.

SPECIAL TO CONTRACTOR

When the Thomas family built their home six years ago, they were sure that the bonus room above the three-bay garage would be used for storage. But eventually their interest in using most of the space as a media room won the tug-of-war.

The problem was, it was set up to be heated and cooled as storage space, not a place where the family would be spending major portions of their time. When Dave Yates, president of F. W. Behler Inc. in York, Pa., and CONTRACTOR plumbing columnist, was called in for his

expert opinion, he recommended a ductless split system heat pump.

The Thomas residence in rural Lancaster County, Pa., sits within a large, nicely landscaped lot near Amish fields and horse meadows. But recently, the hydronically heated home "had issues," Yates says.

The two-story, 3,000-sq.-ft. home has radiant heat throughout the basement and first floors, with hydro-air heat fed through ducts that convey central air in the summer. The home has two central HVAC systems, one for the first floor and a separate one for the upper floor.

Yates determined that the new media room — because of its size, the challenge of heating and cooling the space above a non-conditioned garage and with so much exposure to western wind and sun — was a larger load than the existing equipment could handle without major changes.

Yates compared the cost of a separate ductless mini-split heat pump system with changes that could be made to the home's existing comfort systems. Working with the equipment already in place, Yates found that he would need to install a zoned damper system, new ductwork to be routed through restrictive attic spaces, wiring and an extra thermostat.

"Financially, they were almost a coin-toss apart," Yates says. "But there were many unique advantages to the use of a new mini-split."

A ductless mini-split heat pump would avoid ceiling registers and the energy losses that come with holes through the home's R-45 attic insulation (attic ductwork insulation values are typically R-8). Ceiling registers hold the potential for cold drafts in winter and the likelihood, in summer, of ducted hot air blasts following an off-cycle. Any alteration of the ducts serving the sleeping quarters would affect air flow with the possibility of throwing the system out of balance.

Spot cooling and heating

Ductless technology is ideally applied for spot cooling and heating, conditioning interior spaces right where home or business owners want it, Yates says. The technique saves energy by containing the heat or air conditioning. Other lesser-used areas of a home or building aren't overcooled or heated unnecessarily. At night, energy dollars are saved by conditioning only the rooms that are used at night and allowing the temperature to rise (or fall) in the rest of the structure.

Mini-splits are ideally suited for home improvement, whether an existing central air system is installed, or not, he says. This approach can be less expensive and less disruptive than retrofitting an existing HVAC system, but it's not commonly used for new construction because central systems are, for the most part, effective and invisible. Central air systems have come a long way in the past couple years, offering variable-speed control and efficiency ratings that approach those of the mini-splits.

"We calculated that the Thomas' home's second floor central HVAC system could handle the added heat loss and gain for the media room," Yates says. "But to get the job done, a zone damper system would be needed to deliver the a/c or heat. Yet that couldn't change the fact that their six-year-old central air conditioning equipment runs at one speed only — full tilt.

"Micro-loading zone damper systems require that a bypass relief damper be added so that enough air can move around to the return side for proper air flow through the air conditioning coil. The result would be wasted energy as the HVAC system short-cycles, greatly reducing the system's efficiency."

Frequent short-cycling of the equipment also increases wear and tear, reducing life-span. Then there's the question: Why turn on and run a large central heating air conditioning unit when it's really just one room where new comfort conditioning is needed?

Sleek, new mini-splits with variable-speed "inverter" technology have been in use for several decades in Asia and Europe, and now they're catching on in the United States as energy costs continue their upward spiral.

Punch the gas, or feather it?

"Old school, on-off technology for any type of HVAC equipment is rapidly losing its appeal here in the land of plenty," Yates says. "With this old-style technology, it's like driving your car with the gas pedal glued to the floor and controlling it purely by turning the ignition key on or off!"

The new approach — and one that made sense to the Thomas family — is the use of equipment that continuously modulates its energy production to match heat loss and gain. Sticking with Yates' car analogy, that's like feathering the gas pedal in your automobile to meet the speed you need. Toss in new "automatic modulation" and you get ultra-high efficiency operation, complete with the chauffeur to drive the car.

Inverter technology in air conditioners and heat pumps is accomplished through a single-phase 220V circuit that is run to the outdoor condenser where it's converted to 300V DC and is then channeled through a bank of capacitors to provide a stable, clean electrical current. Then the DC current is inverted to 200V three-phase current. Three-phase motor speeds are then accurately controlled, with refrigerant flow metered to match blower and compressor speeds.

All the homeowner needs to do is to set the desired temperature or humidity level and leave the rest up to the equipment. The "brain" behind it all is a computerized logic module in the outdoor unit that communicates with system sensors and the indoor unit. Together, the indoor and outdoor units are continually monitoring indoor humidity and indoor/outdoor temperatures.

Dave Yates drills a hole in the garage wall through which he will run a refrigerant lines to the outdoor unit. Since the system uses R-410a refrigerant, it can run at a higher pressure and the line sets can be smaller.

Sensors feed this information to the logic module. If anything goes wrong, a fault code indicates what's wrong with the equipment. That way, homeowners can often take care of minor issues without the need to call for service. Or, if a technician is needed, they can access more detailed fault codes with diagnostic equipment.

Before the Thomas family agreed to have the system installed, Yates offered some details about the advantages of these inverter mini-splits, including the 12,000 Btuh Fujitsu split system he proposed for the Thomas home:

- There's no need for resistance back-up heating elements.
- The systems offer superb air filtration and — because they're ductless — there's no downstream concern about contaminated ducts.
- They're great at removing humidity. The Thomas' new unit would offer a dry mode setting for dehumidification without altering room temperatures by more than 4°F, and operation with low ambient as low as 0°F.
- It would provide precise programmable comfort control using a wireless remote controller.
- Installation is simple and fast.
- There would be no need for ductwork.
- Use of electrical energy would be at its most efficient.

The Thomas family was satisfied with Yates' explanation and agreed to have him install the system. On a muggy summer day in June, Dave Yates, his son Mike and technician Bob Sieger went to work on the install. Three hours later, the job was done and operational.

Stealth conditioning

"The room was noticeably cooler within minutes, and water was streaming steadily through the outside con-

densate line," Yates says. "But when the homeowners checked on us toward the end of the job, they couldn't believe the system was running — both the indoor fan coil and outside condensing unit operate so quietly that you have to strain to hear them."

Mini-split air conditioning is accomplished not by moving cooled, dehumidified air through a network of ducts, but by circulating a small amount of refrigerant through thin, insulated copper tubes that run from the outdoor unit to the air handler inside.

"This manufacturer smartly went with significantly more efficient R-410a refrigerant and automatic inverter technology," Yates says. "Other suppliers stuck with R-22 refrigerant, which will be phased out in just three years. And now those firms with the more advanced technology are eating their lunch.

"Rising energy prices and concerns over global warming have pushed consumer attention beyond a focus exclusively on initial cost. Returns on investment have increased significantly as energy costs continue to rise. It's not uncommon to see an ROI of 15% to 25% [comparing difference in cost between old and new technology to the fuel savings that can be achieved], which rivals the best of what's happening in the stock market. As an added bonus, the ROI is tax-free!"

Yates explained that R-410a systems run at higher pressure, so line sets can be smaller.

"And that's no small savings with current copper prices," he says.

The new refrigerant compound permits higher operational efficiency and the compressor can be ramped up to 130% for short periods, transferring more heat into or out of the interior living space. The 1-ton heat pump has an Heating Seasonal Performance Factor of 10.55 in the heating mode, and a 21 Seasonal Energy Efficiency Rating for cooling.

"Those ratings are almost off the charts for air-sourced heating and cooling equipment," Yates says. "While the newly established U.S. standard dictates a minimum of 13 SEER, those manufacturers that chose to develop inverter technology managed to leave that efficiency rating in the dust."

Members of the Thomas family enjoy the comfort of their new media room above the garage of their home. Note the air handler in the wall in the upper right of the photo.

The unit Yates installed for the Thomas family offers energy efficiency that's equal to or higher than many, substantially more expensive and site-disruptive geothermal systems, he says.

Typically today, central heat pump systems have HSPFs of 5 or 6, and SEER ratings of 13 to 18, and many just have single-speed on-off control. Each rise of 1 SEER represents roughly a 10% improvement in energy consumption.

Another facet of this advanced equipment is that inverter technology runs all key components at variable speeds, enhancing efficiency and extending the life of the unit.

The homeowner's price for the equipment ran about $1,800 for the 12,000 Btuh heat pump. Add $250 to $400 for the materials, including the ¼-in. and ⅜-in. copper line sets, insulation for the tubing, the plastic condensate line and three-phase electric wire.

Total for the homeowner, installed, might be in the $2,200 to $4,500 range, depending primarily on the size of the unit and complexity of the installation.

Ultimately, the homeowner is rewarded with a whisper-quiet comfort system that sips electrical current, is better for the environment and goes in fast. Professionals like it for the same reason, which makes it truly a win-win, Yates says.

For information circle **XXX**