Cutting residential HVAC costs without sacrificing comfort

Application Note

By Bill Dove, CM, HVAC trainer and installation specialist

Food and shelter have always topped the list of essentials for survival, and the modern HVAC industry has become a fundamental partner in providing that shelter. Now, as the 2008-2009 heating season envelops us, prepare yourselves for a new level of client counseling that will challenge your experience and knowledge. The escalation of crude oil prices is directly impacting residential "shelters." Your customers are going to ask you how they can control costs without sacrificing comfort and health. Let's review some of the most common solutions.

Temperature setting

Lower heating temperature setpoints reduces energy consumption. Even lower temperature settings during unoccupied periods or during sleep will further reduce fuel usage. What should these temperatures be, and what is reasonable?

Occupied period temperature settings for comfort are determined primarily by metabolic rate, clothing, air movement, humidity, the body's radiant heat loss/gain to cold/hot surfaces, sensory adaptation and expectation.

Many people are able to gradually lower winter temperature settings through the years to a new "comfortable" setting they may not have thought reasonable in prior years.

Setback settings are determined by structural requirements (don't let the pipes freeze), warm air furnace requirements (don't reduce return temperature to dewpoint in the primary heat exchanger), and recovery time (is the recovery time acceptable; which fuel will be used for recovery: heat pump or electric heat?).

More efficient heating equipment

Everyone should have the most energy efficient heating equipment available, but not all customers feel like they can afford it. If a home is heated by an old 80 % (or worse) heating plant, replacing that with a new 95 % heating plant will make a huge difference in fuel utilization. Often the energy savings can make the payments for the replacement equipment. Outdoor reset controls can be added to boilers to vary water supply temperature based on heat loss. New variable capacity furnaces can more closely match heat output with heat losses.

Contractors in northern climates who have never considered heat pumps are beginning to awaken to the fact that a dual fuel system can generate huge energy cost savings. A review of the bin data tables for your location in a colder climate will likely show that 50 % of the heating hours are over 40 °F. A heat pump operating 50 % of those heating hours will produce significant energy cost savings over a gas or oil warm air furnace. Furnaces and air handlers equipped with a modern "Electronically Commutated Motor" will also provide significant savings when applied to a well designed air distribution system.

Tune-ups

Small changes in steady state operation can result in significant energy usage savings over a season. Heat pumps must have clean coils and proper air flow indoors with uninhibited, non-recirculating air flow outdoors, and the refrigerant charge must be accurate.

Furnace heat exchangers and boiler flue passages must be clean for efficient heat transfer. No self-respecting oil burner mechanic would neglect using a combustion analyzer for the final stages of a tune-up. But how many do the same for gas burners? Gas burners are less likely to be optimized from the factory for the fuel being utilized than an oil burner. While most gas suppliers provide gas in the 1020 btu to1070 btu per cubic foot range, natural gas can be supplied anywhere from 900 btu to 1200 btu per cubic foot. LP gas is assumed to be about 2550 btus per cubic foot.

In order to set up a gas burner for optimum Net Thermal Efficiency, you have to measure the heat transfer medium mass flow rate. This is measured in gallons per minute of water for hydronic systems, or cubic feet per minute of air for warm air furnaces. A special fitting in the hydronic piping and a "capsulhelic"® gauge can determine water flow rate.

Blower performance design tables cannot be used for applied air flow measurements.

Taking Flue gas samples with the CO-220 Carbon Monoxide Meter and CO-205 Aspirator Kit.

A duct traverse is the only accepted method for determining air volumes with a pitot tube or a hot wire anemometer. Hot wire anemometers are preferred for measurements in residential air distribution systems.

Actual air/water volumes and temperature rise can be used to calculate Net Thermal Efficiency and efficiency improvements.

Furnace btu output = CFM x Temperature Rise x 1.08

Boiler btu output = GPM x Temperature Rise x 500

The optimum Net Thermal Efficiency is determined by the output rating on the product data plate, and CO (carbon monoxide) less than 100 ppm (ideally 10 ppm to 50 ppm CO), with manufacturer recommended excess air (typically 30 % to 50 %).

Vent systems must be inspected for proper performance and safety, and combustion air supply must be proven to be obviously adequate. Remember this: While a clean machine is a happy machine, a well tuned machine is ecstatic.

Air distribution system

Air distribution systems are typically the weakest link in the energy efficiency evaluation. It is difficult to find a tight and adequately sized air distribution system and correcting air distribution system faults can be an expensive undertaking.

Ducts concealed behind finished surfaces are usually off-limits for repairs, but ducts in unconditioned spaces require attention. Air leaks in ducts nullify duct insulation and are huge energy wasters at the least, and sometimes dangerous. Return duct air leaks in garages are potentially life threatening.

Return ducts in garages must be sealed air tight. Return and supply ducts in unconditioned spaces, such as attics, crawl spaces and knee walls must be sealed and insulated both for energy efficiency and the prevention of mold propagation.

Restrictive duct systems reduce blower efficiency and reduce heating equipment thermal transfer rates. At the very least, ensure that all conditioned air is delivered to the conditioned space, and that unconditioned air is not drawn into the conditioned air distribution system.

Envelope air leakage

Most heat loss is through air leaks in the conditioned space envelope, bypassing any insulation that may be present. Air infiltration and exfiltration is essential to a healthy indoor environment. We need good infiltration for healthy breathing air, odor control, combustion air supplies and contaminant dilution.

The key is to control the point and degree of infiltration and exfiltration, for both comfort and energy costs. Uncontrolled infiltration in a living space can produce drafts or cold spots that result in higher thermostat settings for compensation. A heat recovery or energy recovery ventilation system is the ideal choice, since it controls the point of infiltration and transfers heat from the outgoing air to the incoming air.

But a poor man's infiltration control can be as simple as a small round duct that connects the outdoor air to the return duct. The point of infiltration is controlled, the house will always be under a slight positive pressure so former infiltration points that affected comfort are now exfiltration points. And the slight positive pressure ensures a minimal amount of fresh outdoor air for breathing and combustion that is filtered by the furnace filter.

Conclusion

For most people, an energy evaluation results in a plan of action that may span several years. They want to know what is the most cost effective in regards to immediate energy savings and long term return on investment. Honest, educated, prioritized recommendations result in trust, repeat business, and word-of-mouth leads. Stay in tune with industry recommended practices and share your knowledge with all of your customers. Remember that you are a trusted advisor. Share facts and recommendations, but don't try to second guess your customers' needs. Let them decide.

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