**Sealing the HVAC system.**

*by Thomas A Westerkamp*

**Insulation application help facilities close the door on heating and cooling system leaks.**

Heating, ventilating and air conditioning systems demand costly energy 24 hours a day, 365 days a year for most commercial and institutional buildings. The task for engineering and maintenance managers is to hold the line on energy costs while continually increasing the functional capability and reliability of these systems.

They are aware that any losses are money, energy and repair time down the drain that could be better spent in more productive ways.

HVAC system insulation is a one-time investment that continues to generate savings year after year. Better to make the right investment once and reap the savings than to take shortcuts and pay additional, possibly unnecessary costs down the road.

**Insulation and efficiency**
Insulation allows boilers, piping and ducts to deliver heat or cooling to the intended space with minimal losses along the way. In addition to added occupant comfort, insulation can reduce noise levels, and installed properly according to the architect’s specifications, insulation systems can last for many years. Periodic checks and minor repairs, scheduled as a part of a preventive maintenance program, can extend the insulation life substantially.

The passage of time may cause system deterioration as equipment and insulation age. Periodic re-assessment, as well as comparisons with original building specifications, often reveal opportunities to upgrade and improve the system.

New, improved materials can be introduced into the system as they become available, increasing energy efficiency and occupant comfort, and ensuring a healthy IAQ environment.

**Looking for savings**
For energy-saving insulation applications, technicians should start with boilers, unit heaters, package air conditioners and chillers, and work through the system, following all of the energy paths. The energy source itself should be insulated and jacketed with protection from mechanical damage, as should pressure piping and condensate return piping for a steam or hot water system.

Along the way, technicians should check for energy loss. Traps that leak or discharge into a drain can result in big energy losses. Hot or cold spots that are not where they should be can be detected with contact pyrometers or, in remote locations, with infrared imaging instruments.

Also, have technicians trace air flow from the supply fans through ducts to building spaces and, finally, to exhaust fans.

Ducts should be checked for missing or damaged insulation and leaking duct joints. Single- and double-application foam sealants are available in polyurethane and silicone varieties that eliminate duct joint leakage better than duct tape, which almost always leaks with time.

High-temperature tape and cement are required near the boiler for sealing furnace gas vents. Managers should make sure than MSDS information about these materials is available to all users to ensure that technicians use proper care when applying them.

Sweating cold water piping or refrigerant lines also are signs of energy losses. Tape wrap or molded insulation is available to eliminate these problems.

Among the most important areas to pay special attention to are additions to the original HVAC system. Ifa valve or other fitting has been added, or if a new heating or air conditioning run has been added, technicians should be sure that all the insulation in these areas is in place.

**Sealing the envelope**
Once supply and exhaust systems are inspected and brought up to date, the next step is to check the building envelope. Building insulation is as important as HVAC system insulation. A tip-off of a big problem is when snow on a roof starts melting right after a heavy snow, even when the sun is not shining.

Heated warehouses and equipment garages should be insulated to conserve energy. Melting indicates heat is coming through the insulation. Usually, this is due to leaks in the weather seal that allow water to penetrate and soak the insulation.

Water is an excellent conductor. In dry cold, an infrared imaging detector can identify the heat signature of the roof areas.

If the deck is generally cold, check for leaks around equipment supports, air supply and exhaust ducts and other roof penetrations. Sealing leaks in these areas not only saves energy but extends the life of the weather seal, flashing, insulation and decking.

When specifying insulation materials, managers should make sure to specify the proper R-value for the application.

The higher the R-value, the better the insulation. R-value is a function of the insulation properties of the material and the thickness.

Some duct insulation materials are made for indoor use only and are not designed for exposure to ultraviolet light, even that which comes through atriums and windows. Managers should check local codes when selecting insulating materials because code compliance varies by location.

**Impact of HVAC insulation**
Facilities can make major strides by focusing simultaneously on energy use, occupant comfort, noise level and indoor air quality.

Energy use is the sum of the energy required to maintain the system balance plus the energy required to offset losses. Insulated systems have far fewer losses, so the energy demand for a facility is also far less.

The amount of energy lost is a function of the conductivity of the enclosure walls and the surface area exposed — that is, uninsulated. For example, duct walls are meant to direct airflow, not to provide insulation. They are very thin and conduct heat rapidly. When insulated, however, they pass more of the generated cooling or heating to the space intended and lose less along the way.

A closer look at windows An often unnoticed place for large energy losses is windows. Older window construction did not have the same insulation properties as newer construction. Cracks due to aging caulk and seals add to this source of energy loss.

Upgrading these areas with modern construction, the addition of good thermal barrier glass systems, and new caulking and sealing can lower energy demand substantially. This same benefit applies to roof insulation. Since heat rises, losses can be large if the insulation under the weather seal is deteriorated due to leaks in the weather seal. Once the insulation becomes water logged, much of its insulation value is lost.

Occupant comfort depends on the time it takes the system to respond to a call for heating or cooling. If there are many leaks or uninsulated sections of the system, the supply of heated or cooled air must meet two demands: demand caused by the temperature and demand caused by the losses.

If losses are reduced through the use of better insulation, the demand is satisfied more quickly. Occupants do not notice the difference because it is present for only a short period oftime, not long enough to be uncomfortable.

**Insulation and noise**
HVAC fans, blowers, pumps, power drives, steam and air flow contribute to higher noise levels in the nearby work spaces. To test for the noise level of the equipment, measure the noise level using a decibel meter, with the equipment running and then with the equipment shut down. The difference is the noise contributed by the equipment.

Noise is easily transmitted and even magnified by uninsulated ducts and piping. Technicians can measure the noise contribution from individual units by progressively operating each unit and measuring the increased noise level. Then it is possible to isolate the biggest offenders and concentrate on getting them properly insulated.

Noise levels should measure as low as 25-35 decibels on the A-scale for broadcast studios and schoolrooms, to as high as 40-55 in hospitals, private offices and restaurants. In some cases, 80 percent of the noise problem relates to only to 20 percent of the equipment. The most cost-effective solution is to fix the noisiest 20 percent first. Balancing equipment to reduce vibration or air velocity, along with adding dampers, sound traps and insulation, may be required if the HVAC equipment does not meet the specifications.

In HVAC systems with a large number of leaks and other losses, the air volume demand may be greater than the supply fans were designed to provide. Sealing joints with foam insulation and adding sheet or roll insulation to uninsulated sections of the ductwork can reduce the air volume demand.

The result of such efforts often is better, more efficient circulation into the building spaces, greater system efficiency and lower energy costs.

**Efficiency Checklist**
Managers can adapt and implement the following checklist points into preventive maintenance programs to help maximize energy efficiency by checking the condition of distribution ducts and insulation:

* Is duct work insulated?
* Are duct work seams sealed?
* Is duct work leaking air?
* Are duct connections to outlets tight?
* Is duct work accessible to repair leaks?
* Does the system have manual balancing dampers at zones? If not, how many would be required for balancing?
* Do supply outlets have dampers? If not, how many are needed?
* Do return outlets have dampers? If not, how many are needed?
* What is the velocity and CFM at each outlet with the system on full call?

To answer this last question, traverse each zone, test, and list the results with the system on full call. Compare the results with the original building specifications or the last inspection results to determine needed adjustments.

*Thomas A. Westerkamp is a contributing editor to Maintenance Solutions.*