Sealing and Insulating Ductwork

Construction Differences

In many areas of North America, it is not common to have conditioned basements or crawl spaces in residential and commercial construction. In southern climates or areas with high water tables, slab-on-grade construction is the norm. In many areas, the standard practice is to insulate floors over unconditioned crawl spaces, and vent those spaces to the outside with wall vents. Air conditioning ductwork systems for these buildings are often too large to be located within the walls and ceilings of the building itself, and are thus put in unconditioned crawl spaces and/or attics. Depending on materials used and the age of a system, this ductwork is poorly insulated and sealed. As such, it leaks air into unconditioned spaces, which increases energy consumption and system size.

Standard Practices and Materials

Supply air duct systems incorporate main trunks or plenums, typically running the length of a building, with many branch-runs usually extended to the perimeter. Return air systems are often far reaching to central locations of individual zones of the building. Regardless of materials used, all ductwork systems in unconditioned spaces involve many connections that require proper sealing. Duct tape is the most common method used to seal duct connections but leaks develop over time, as the tape falls off the joints due to temperature and humidity extremes. Some plastic flexible duct materials break down and leak over time due to the frequent temperature swings as well.

Conditioned Air Under Pressure

While HVAC equipment is operating, significant negative and positive pressures exist within the ducts. These pressures make even small leaks exchange large amounts of air. In the heating season, supply air leaking out of the ducts can be as hot as 150° F (65° C) while return ductwork draws ambient outdoor air into the conditioned space. During the cooling season, supply air at 55° F (13° C) is lost to the unconditioned space through leaks while hot, humid air from these spaces enters the return air duct. This often results in deteriorated ductwork and desirable conditions for mold and mildew growth.

Disproportionate Insulation Levels

Duct systems also lose or gain energy from unconditioned spaces through insulation. Consider that duct systems are typically insulated with R-5 to R-8 (RSI-0.86 to 1.38) fiber type material for protection in unconditioned spaces. However, the temperature difference between cold air inside the ducts and unconditioned spaces is often two to four times the temperature differences that exterior walls must deal with, and walls are typically insulated with two to four times more insulation! Consider an attic space in summer that is vented to the outside. The air temperature in the attic can be 150° F (65° C), compared to air inside the ducts at 55° F (13° C), for a difference of almost 100° F (52° C). At temperature extremes such as this, R-5 (RSI--0.82) insulation is virtually ineffective. Poorly insulated supply air ductwork in humid unconditioned spaces provides a cold surface for ambient air to condense on, leading to the same conditions mentioned above.

Air sealing and insulating with Icynene®

Icynene® is a low-density foam material that provides air sealing and highly effective insulation in a one step application (for metal ductwork, a vapor diffusion retarder is recommended on the warm side of the ductwork). Icynene® completely encapsulates and isolate ducts from unconditioned spaces, eliminating all of the traditional problems.

Icynene® provides an effective R-12 to 20 (RSI-2.07 to 3.45) with a 3 to 5 inch (75 to 125 mm) thick application. Along with air sealing, this level of insulation is sufficient to minimize heat transfer through the ducts themselves.

The result: Smaller, more efficient space conditioning requirement

By minimizing heat transfer and eliminating air leaks in ductwork, Icynene® allows the HVAC contractor to select smaller sized heating/cooling equipment for the building. In the case of two-story residential buildings, there is now the possibility of reducing cooling requirements substantially in humid climates and the number of zones needed. This can greatly reduce the initial cost to the building owner, and save on energy bills year after year for the life of the building (see also design note titled: Unvented Attic and Cathedral Ceiling Construction)