# Ducts in the attic

## Overview

There are significant energy benefits for which builders can qualify when HVAC equipment and ductwork are moved into the conditioned space of the home. For HVAC ductwork to be considered in conditioned space, the IECC code offers several options. One such option is to create a 'conditioned' attic and keep the ductwork in the attic space.

Because of the space constraints of a typical large diameter duct system, moving the ducts into the 'actual' living space of the home is architecturally very challenging and costly (it requires the construction of multiple large bulkheads, chases and drops). A technique some builders are using is to seal the attic from the exterior using open or closed cell spray foam insulation—also incurring a significant cost penalty (~$5,000 per home or more) and has additional limitations from fire prevention related codes, and moisture management issues.

This approach does get the energy benefits of ducts in conditioned space, but when the ductwork is operating in this environment the risk for condensation on ducts and fittings emerges.

Another consideration with the insulated attic approach is that the HVAC load of the home increases significantly since the attic space now becomes part of the conditioned space of the home (even if it is not actually being conditioned).

## Condensation risk

Condensation risk depends on the type of insulating foam used at the roof deck transition (open cell or closed cell spray foam insulation), and the home's location. High humidity climate zones are very vulnerable, whereas hot dry climates area a much lesser condensation risk.

Open cell foam is vapor permeable presenting a high humidity risk in humid regions. Therefore, great care must be taken during installation to prevent condensation forming on cold surfaces such as register boots and areas where duct insulation is compressed such as at the point of contact of the strapping. A documented issue when using open cell foam in attics is the high risk of moisture accumulation. Moisture can accumulate in roof sheathing and migrate to the top of an attic causing potential durability problems. Recent code proposals from Building Science Corporation propose for climate zones 1through 3 to have some form of dehumidification or conditioned air introduced into the attic. Another added cost.

Closed cell foam is essentially non-permeable. When closed cell foam is applied, the risk of condensation is lower since moisture cannot be driven through to the interior. However, closed cell foam is significantly more costly than open cell foam.

In colder climate zones (zone 5 and greater), open cell foam is typically not used because warm moist air will migrate from the interior to the roof sheeting and condense. In these climates a vapor barrier over the open cell installations is required to prevent warm humid indoor air from coming into contact with the cold sheathing. Closed cell foam does not have this issue and can be used in all climates but is a more costly alternative.

Data from Allison Bales (of Energy Vanguard) showed the dew point of an attic encapsulated with open cell foam frequently above 65F. If this is found to be typical, then homes with attics

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encapsulated with open cell foam would need to have their ductwork insulated. Our measurements show the duct surface temperature to be around 60F for un-insulated ductwork.

## Rheia's compact solution

RHEIA offers a much simpler and cost-effective solution. All RHEIA ductwork is 3" in diameter making it much easier to route in the conditioned space of the home. This can be achieved by routing the ductwork in wall and ceiling/ floor cavities, and in shallow 'raceways' (dropped ceilings) strategically-located in closets, utility rooms and hallways.

This approach is significantly lower cost than insulating and conditioning an attic. In addition, the overall cooling loads of the home are lower, reducing the size of the equipment needed thus lowering the overall cost to the builder with the additional benefit of a reduction in HERS points.