

SPF and Non-Vented Attics

By Steve Easley, Owner of Steve Easley & Associates Inc.

Q: How do non-vented attics work, and how is SPF properly used and applied in them?

A: To better understand why spray polyurethane foam (SPF) is a viable solution for non-vented attic insulation in both hot and cold conditions, let's take a look back at the origins and science behind the traditional vented attic. Attics are vented to: remove moisture, reduce the potential for ice damming, and vent excess heat.

The basic idea behind code requirements for attic ventilation is to remove moisture-laden air that leaks into the attic from living spaces before it has a chance to condense on a cold roof deck. Most homes have the living space insulated at the ceiling or attic floor level. The roof deck, then, is cold because the insulation is on the attic floor and the attic space is exposed to outdoor air conditions. Even with traditional cathedral ceilings, a one-inch air space is usually found between the top of the insulation and the bottom of the roof deck for ventilation. In non-vented attics, the air space is not needed because the SPF creates attic conditions almost identical to living spaces.

Cold Climate Issues

Heat migrates from warmer areas to colder areas. Warm air is lighter and more buoyant than cold air, and, as a result, in cold weather, the heated air inside your home rises into the attic via hundreds of attic bypasses or air leaks in your ceiling. Attic by-passes – holes into attics such as can lights, wire and plumbing penetrations, and gaps between drywall and framing – are pathways for air (that you paid to heat or cool) to flow into attics. Therefore, attic ventilation is supposed to provide a path for this warm, moisture-laden air outside before it can accumulate on the bottom of roof sheathing and cause moisture problems.

This air flow can cause other problems, too. Ice dams occur when warm air ex-filtrating through attic by-passes warms the bottom of the roof deck. The snow on the roof melts and flows down until it freezes at the colder overhang area of the roof. This ice slowly dams up, and water can work its way up under shingles, which creates leaks.

The bottom line is: To make a vented attic work, make sure you have enough ventilation equally distributed throughout the attic to remove moisture-laden air that may get into attics.

Today's roofs are more complex and more difficult to ventilate well. Homes today also are tighter and, therefore, have higher humidity levels than before. High moisture levels can create mold and moisture problems in attics. Ultimately, attic ventilation is often inadequate in solving moisture problems.

This is where a proactive approach on your part comes into play. Spray foam insulation can be an effective solution in dealing with moisture issues in today's roofs, as well as making a home more energy efficient. SPF helps in the following areas:

1. Moving the insulation or thermal barrier from the attic floor to the roof sheathing creates a warm attic and a cold roof deck. The result is that the bottom of the insulation is warm, and if you have enough insulation, there will be little chance of condensation on the exterior of the building. In terms of condensation and heat loss, this is no different from an exterior wall.
2. Often, duct work is located in attics. If you have return air duct leaks in a traditional vented attic, you are drawing non-conditioned outdoor air into the HVAC system, which drives up heating and cooling costs. With SPF, non-vented attics with insulation on the underside of the roof deck can turn the attic area into a conditioned space, thus reducing the negative effects of cold or hot air that is drawn into the HVAC system.
3. SPF can reduce ice damming, which can help prevent warm air from coming in contact with the roof deck or sheathing. This can substantially reduce – if not eliminate – the potential for ice dams.
4. When properly protected against fire, SPF in a non-vented attic can create a semi-conditioned space that is more climate-friendly for treasured belongings.
5. Closed-cell SPF greater than about two inches (5.1 cm) thick is a vapor retarder with a permeance rating less than one perm. Any moisture in the attic space stays in a vaporous state and can't diffuse through it. With traditional insulation, air easily blows through insulation. As it does, it scavenges away heat and reduces its effective R-value. This wind-washing should not degrade the R-value of SPF.

No matter what type of attic you have or insulation you choose, it's always important to control the moisture at its source. Most moisture in homes comes from baths, kitchens, and humidifiers. The use of bath fans with controls that automatically run for a preset time may help to ventilate excess moisture. Also, instructing homeowners not to over-humidify their homes can be beneficial. In cold weather, the indoor relative humidity shouldn't reach above 40 to 45 percent. Some health experts recommend that humidity not get above 30 to 35 percent.

Warm Climate Issues

In warm climates, vented attic temperatures can easily reach 140°F (60°C). Many attics have return air ducts, which draw this

hot and often humid air into the HVAC system. The result is higher air conditioning costs. It takes a lot more energy to cool 140°F (60°C) air than 90°F (32.2°C) air.

Non-vented attic spaces insulated with spray foam, on the other hand, are going to be cooler than attics insulated with other products. This is because SPF attics will essentially be the same temperature as the indoor air. In traditional ventilated attics, the relative humidity in the attic is the same as the outdoor relative humidity. Surface relative humidity greater than 70 percent is more conducive to mold growth. Non-vented attics insulated with SPF would have lower temperatures and humidity than attics without SPF. They are also tighter and, as a result, have less air infiltration by warm, moisture-laden outdoor air.

Additional Benefits

Closed-cell SPF has been proven to increase the up-lift or blow-off resistance of roof decks. This is of value in storm-prone areas. Dr. David Prevatt at the University of Florida conducted research that shows that closed-cell spray foam sprayed to the underside of roof sheathing will effectively bond the roof deck to the roof framing. He found that spraying three inches of foam created a 300 percent increase in uplift resistance.

Both open- and closed-cell spray foam can be useful products for non-vented attics. An advantage of closed-cell foam in non-vented attics is that it absorbs negligible amounts of moisture and acts as an air barrier. Closed-cell SPF has been used on commercial roof decks for 50+ years with great success.

However, under a sloped roof deck, insulation can raise the temperatures of shingles. There have been several studies that show this increase in temperature ranges from 2°F (-16.6°C) to 7°F (-13.9°C), depending on the location. While increased surface temperature can decrease the life of asphalt shingle roofs, the increase in shingle temperatures caused by non-vented attics may only decrease the service life by five to 10 percent. This cost should be weighed against the energy savings provided by non-vented attics.

These studies also show that other more significant factors affect shingle temperature and service life, including solar exposure and roof color.

Contractors should always discuss the shingle warranty with the homeowner and builder before applying SPF under a roof deck.

Tips for success:

1. Make sure the surfaces are dry. SPF will not adhere to wet or damp surfaces.
2. Use ignition barriers as required by codes.
3. Ensure applicators are properly trained and have experience with spraying non-vented attics. Retrofitting existing attics with SPF requires extra safety considerations for the contractor (e.g., stepping through attic floors). **SF**

Steve Easley has specialized in helping builders reduce construction defects, reduce call-back costs, and refine construction practices for over 30 years. He was a professor of building construction and contracting at Purdue University for 10 years, where he received several teaching awards.

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