

ADHESIVE FASTENING

Used in Commercial Roofing Applications

By Stan Choiniere

The commercial roofing industry has long used a variety of fasteners, fastening techniques, and methods to secure roof insulation to the deck. Historically, materials were affixed to building substrates with hot tar or asphalt-based materials, or they were held in place with pavers or stone ballast.

In the early 1980s, driven by Factory Mutual, mechanical fastening began to evolve as an approved method for attaching insulation and membrane roof covers. While mechanical fastening remains a dominant method for securing insulation and roof covers to steel and wood decks, it is not always the best option for other deck types. Adhesive fastening offers roof system designers, contractors, and building owners another option when it comes to installing insulation on various deck and building types.

LIMITS TO MECHANICAL FASTENING

Often, mechanical fasteners are not the best option for attaching insulation to concrete, gypsum, or cementitious wood fiber roof decks. Most concrete—lightweight and structural—and gypsum decks must be predrilled in order to accept most roofing fasteners. However, lightweight insulated concrete (LWIC) fasteners specially designed for the application can be installed without predrilling. This process and volume of fasteners required for LWIC applications are both time-consuming and labor-intensive, requiring roofing contractors to spend considerably more time installing fasteners. In addition, care is required when installing hammer-in style fasteners with either fluted shanks or split bulb ends. Such fasteners are nearly impossible to remove without considerable effort if improperly installed, often resulting in some level of damage to the roof deck.

Beyond specific deck types, however, there are several industries that preclude the use of fasteners that penetrate the roof deck for either insulation or membrane attachment (Figure 1). This is particularly true for medical and hospital facilities; some types of school buildings; freezer and cold-storage buildings; facilities containing sensitive, high-tech manufacturing; clean rooms; food processing plants; and



Figure 1 – Several industries preclude the use of mechanical fasteners that penetrate the roof deck. In addition, some owners and designers have gravitated toward environmentally sensitive “green” adhesive materials available on the market.

buildings containing potentially corrosive processes. It is also true for structures with electrical and/or data conduits or other hazardous devices attached to the underside of the deck, where the use of mechanical fastening is potentially dangerous.

Several factors, including noise, environmental concerns, odor, aesthetics, and thermal bridging, play a role in these decisions.

Noise – When it comes to hospital, healthcare, and educational facilities, noise is a great concern to facility owners and managers. Generally speaking, building owners do not want to disturb patients or students with drilling or hammering while a roof system is being installed.

Environment – The owners of certain structures, such as natatoriums, freezer buildings, food-processing plants, and baking facilities, typically do not allow drilling through the roof deck, exposing mechanical fasteners to the environmental conditions below the deck. And no one wants chunks of gypsum mixed into their bread dough.

Odor – Hot asphalt has long been used to attach insulation and roof covers to buildings. The asphalt is pumped to the roof and mopped down as an adhesive for roof

materials. Asphalt fumes can be disruptive to building occupants; and, as a result, some building owners shy away from this attachment method. As a secondary issue, asphalt also contributes fuel in the event of a fire and was the original driver for Factory Mutual to make the change to mechanical fasteners on steel decks.

Thermal Bridging – With the focus on green construction, thermal bridging has become a bigger issue among building owners. As a result, some owners prefer adhesive-fastening techniques.

A BRIEF HISTORY OF ADHESIVE FASTENING

Historically, there have been several different types of insulation adhesives on the market: solvent-based asphalt adhesives, solvent-based nonasphalt adhesives, water-based asphalt adhesives, water-based nonasphalt adhesives, polyurethane-based adhesives, and hot asphalt. While some of these have come and gone, it is important that specifiers and consultants fully understand the characteristics and limitations of the adhesive(s) being used.

Asphalt has been used widely in the roofing industry for more than 150 years, according to the Asphalt Roofing Manu-

facturers Association (ARMA). Hot asphalt is used to attach insulation to monolithic decks, as well as to bond multiple layers of certain types of insulation, rolled goods, and felt plies together. This offers a single-source adhesive for bonding to decks, insulation, and felt plies.

Cold asphaltic-based adhesives were first developed and used in the 1960s. These were originally developed primarily as an interlayer adhesive for use in BUR systems with organic felts and fiber mats but they later became the preferred method for adhering modified-bitumen roof systems. So-called “cold” adhesives are applied at the ambient temperature rather than being heated and are typically based on asphalt or coal-tar (i.e., bitumen).

Many modified asphalt-based adhesives achieved strong wind uplift resistance but had long and unpredictable cure times, particularly when used in multiple-layer applications. As with any adhesive, using the correct amount for the specific installation is critical. The roofing materials can slide out of place and take longer to cure if excessive amounts of adhesive are used. Trapped solvents can also soften the roofing materials. In contrast, using an insufficient amount of adhesive can result in an incomplete or weakened bond. In addition, asphalt-based products can be messy, especially when used in conjunction with a white or light-colored single-ply membrane.

The next generation of asphalt-based adhesives incorporated a moisture-cure urethane into the chemistry to help expedite the curing process. While the urethane helped to improve cure time, these adhesives typically relied on ambient temperature and humidity to cure. Under certain ambient conditions, it can take several days for moisture-cure adhesive to fully cure and provide any bond between the substrate and the insulation. When using adhesives with cure times that are influenced by ambient conditions, the waterproofing layer cannot be installed until the adhesive is cured. This was sometimes an issue in dry climates such as Arizona and Nevada, as well as under low-humidity conditions across the country.

Next on the market was a new generation of single-component polyurethane-based adhesives. These were typically cleaner to use than the asphalt-based adhesives, but they still relied on ambient temperature and humidity to cure. As such, geography and seasonal conditions could have a big impact on the project and cure



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Figure 2 – Two-component, urethane-based adhesives were developed in the mid 1990s as an alternative to single-component urethane. These adhesives do not rely on ambient temperature or humidity for curing and thus provide a more predictable cure time and are typically installed in beads with a maximum spacing of 12 inches on center.

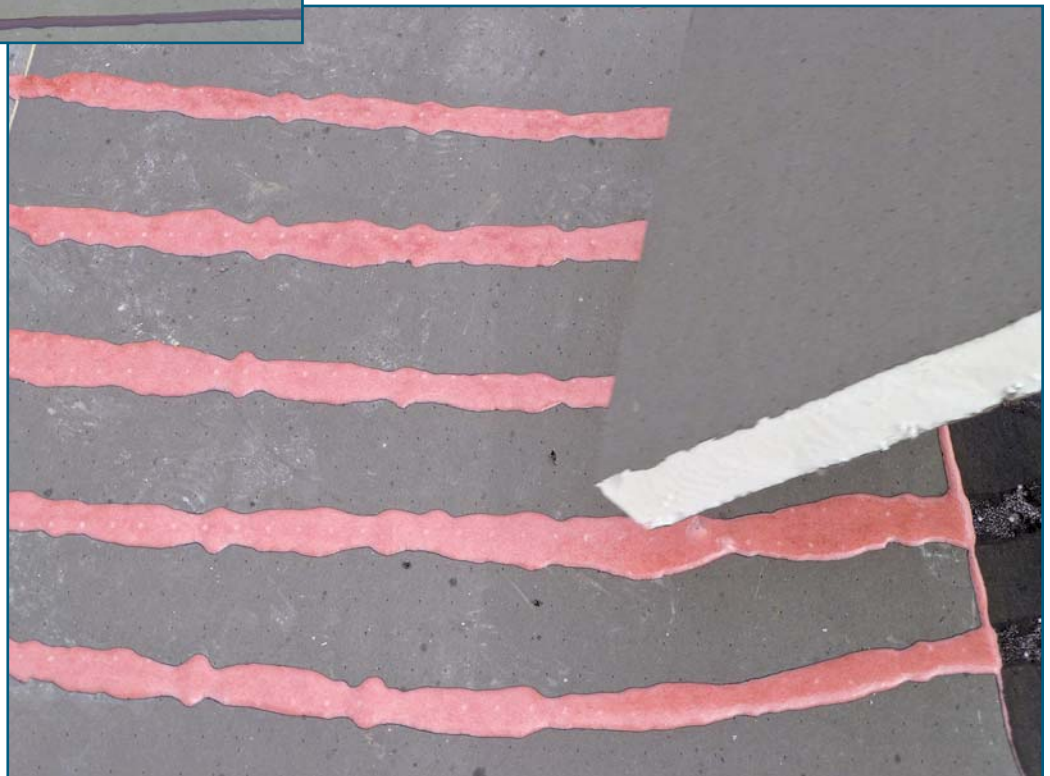
Figure 3 – Some two-component insulation adhesives are allowed to rise and spread from a liquid state to a foam state before the insulation board is placed into the adhesive. The foaming action develops cell structure which, when compressed, increases the contact area of the adhesive between the board and substrate.

time. Single-component polyurethane adhesives can be used in new and reroofing applications on a fairly wide range of substrates and temperatures. The same moisture-cure issues that limit the effectiveness of modified asphalts also have an impact on some single-component, urethane-based adhesives.

TWO-COMPONENT INSULATION ADHESIVES

Two-component, urethane-based insulation adhesives were developed in the mid 1990s as an alternative to single-component urethane options (*Figure 2*). These adhesives do not rely on ambient temperature or humidity for curing and, thus, provide a more predictable cure time.

Typically, these materials consist of Part-A and Part-B components that are mixed during the application procedure. A controlled reaction between the two chemical components ensures a quick setup and cure time. In addition, such materials can be applied either by spray (i.e., full coverage) or in bands typically



spaced 12 inches on center.

As with some other insulation adhesives, two-component urethane adhesives are virtually odor-free and can, therefore, be used on projects where strong odors cannot be tolerated, such as hospitals, medical facilities, and schools. In addition, these

materials are compatible with most insulation and deck types and are installed with relatively quiet application methods, allowing them to be used in noise-sensitive areas.

APPLICATION

Two-component insulation adhesives are typically applied either by spray or extrusion (Figure 4). Spray application is the oldest method of dispensing and requires certain equipment and precautions.

For example, operators typically must wear a respirator as well as a full personal protective equipment (PPE) suit, gloves, and boot covers to prevent exposure to airborne particles. In addition, contractors must take precautions to ensure that the over-spray does not cover nearby building components, vehicles, or equipment.

These cautions aside, spray application does provide full coverage, meaning that the entire surface of the insulation is in contact with the adhesive. This method of application is preferred by many contractors who have invested in sophisticated spray-rig equipment, and it typically provides the lowest installed cost option due to lower packaging costs. However, the cost of this equipment is extremely high when compared to other application options and requires extensive training and maintenance. In addition, such equipment requires operators who fully understand the need to keep adhesives “on ratio” and that using “off ratio” materials can result in a compromised installation. Depending on

the system being installed, such applications meet FM approval ratings that in certain configurations can exceed 900 psf.

Projects particularly well suited for this type of application include very large roofs with few obstructions, where a large area of insulation can be fastened with adhesive without frequent interruptions.

However, the most common method of applying a two-component insulation adhesive is by the extrusion method. For these applications, contractors typically use a hand applicator, similar to a large caulk gun, or a larger dispensing cart. Whereas full coverage units hold 50 gallons or more of each component of the urethane adhesive (i.e., Part A and Part B), carts typically hold five gallons of each part, and handguns typically hold 1,500-ml cartridges.

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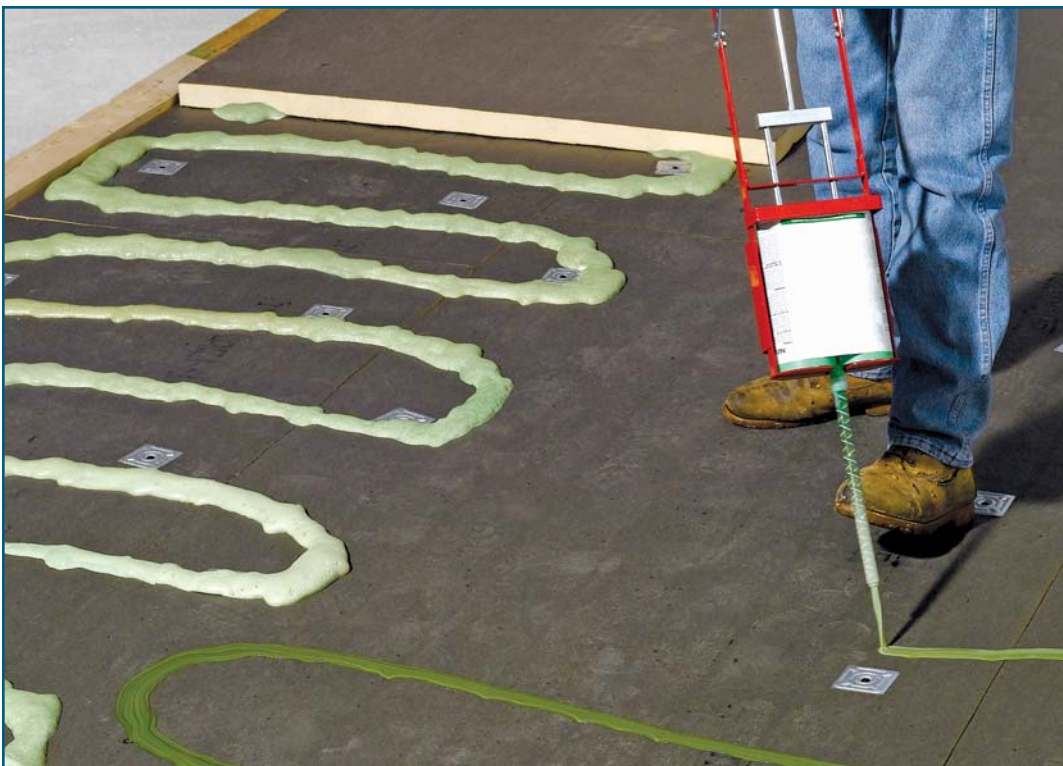


Figure 5 – Cartridges are particularly useful on smaller roofs, hard-to-reach areas, and on roofs with many penetrations and cutouts. Cartridge guns are lightweight and easy to maneuver.

to-reach areas, and on roofs with many penetrations and cutouts. Cartridge guns are lightweight and easy to maneuver (Figure 5).

Carts are ideally suited for larger projects where the roof is more open. Some carts have hoses as long as 30 feet, increasing mobility and production, so that moving around the roof and providing coverage around penetrations do not pose problems (Figure 6).

In either case—spray or extrusion—the Part-A and Part-B components are mixed at the point when they are dispensed, allowing the chemical reaction to take place. Because the adhesive is not atomized as it is with the larger spray units, PPE is typically limited to eye protection and gloves, and the risk of adhesive mist (i.e., overspray) being carried by the wind or air currents to unwanted surfaces such as walls and cars is eliminated.



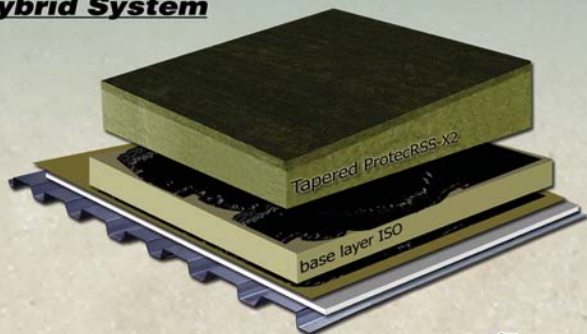
Figure 6 – Carts are ideally suited for larger projects where the roof is more open. Some carts have hoses as long as 30 ft, increasing mobility and production so that moving around the roof and providing coverage around penetrations do not pose problems.

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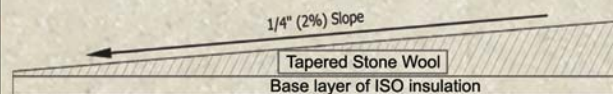
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Figure 7 – Today’s two-component insulation adhesives are designed for use on virtually every common roof deck – steel, wood, concrete, gypsum, lightweight concrete, cementitious wood fiber, smooth BUR, smooth and granular modified bitumen, asphaltic vapor barriers, and fleece-backed vapor barriers. In addition, many can be used to adhere layers of insulation together.

COMPATIBILITY

Today’s two-component insulation adhesives are designed for use on virtually every common roof deck. Most of the materials available on the market will adhere to steel, wood, concrete, gypsum, lightweight concrete, cementitious wood fiber, smooth BUR, smooth and granular modified bitumen, asphaltic vapor barriers, and fleece-backed vapor barriers (Figure 7).

Furthermore, they are highly compatible with today’s most popular insulation options: polyisocyanurate, EPS, XPS, wood fiber, perlite, foam glass, and hard boards such as DensDeck® and Securerock®, as well as high-density iso coverboards.

Unlike mechanical fasteners, these two-part urethane insulation adhesives will not provide a thermal short and offer a nonpenetrating application method.

ANSI/SPRI IA-1 2010

In 2005, a new industry standard outlining field test procedures was introduced for determining the bond strength of insulation adhesives over various substrates. The standard—ANSI/SPRI IA-1 2005—was developed by SPRI and canvassed through ANSI, becoming a national standard. In following ANSI protocol, the standard was

reaffirmed through the review and ballot process by SPRI in 2010. The test procedure encompasses various types of insulation adhesives, substrates, and insulations.


In order to conduct a pull test for an adhesive, the ANSI/SPRI standard calls for a very specific and detailed process. The procedure is available for free online at the SPRI Web site (www.spri.org).

THE ECONOMICS OF INSULATION ADHESIVES

Insulation adhesives are generally more expensive than mechanical fasteners. However, on decks that require predrilling, the adhesive will provide a lower installed cost for the insulation attachment. This is because more squares of material can generally be installed per man-hour, which provides greater production per shift with the same number of roof technicians.

A simple example is to fasten a 4- x 8-ft sheet of insulation to a concrete deck with a typical 16-fastener-per-board density. It will take about ten minutes to drill the 16 holes and install the fasteners. However, as the fatigue of repetitive bending over to drill and fasten increases, this time frame can expand significantly to more than 15 minutes. To fasten the same 32 sq ft of insulation using 4- x 4-ft boards with a two-part urethane adhesive typically takes less than one minute, and fatigue and ergonomic issues are not factors. This labor-saving and productivity increase easily outweighs the increased material cost.

SUMMARY

While mechanical fastening is the preferred method for many roof installations, adhesive fastening is an option for many specialty applications. Over the past few decades, adhesive fastening technology has evolved to the point that today there are many options and solutions for every building and deck type. 

Stan Choiniere



Stan Choiniere is national technical manager for OMG Roofing Products, Agawam, MA, and has 28 years of experience in the roofing industry with OMG. During that time, he has worked extensively with roof cover and insulation manufacturers to develop and test fastening systems to meet the changing needs of commercial roofing. Stan holds several fastener and equipment patents and has served on technical committees with NRCA, ASTM, and ERA. In addition, he has held several positions during his 26 years of association with SPRI, including vice president, president, and Technical Committee chairman. He was chair of the committees responsible for developing ANSI standards for *Field Testing for Fastener Withdrawal* (ANSI/SPRI FX-1), *Field Test Procedure for Mechanical Uplift Resistance of Insulation Adhesives* (ANSI/SPRI IA-1), and the *Standard for Retrofit Drains* (ANSI/SPRI RD-1). Stan is currently on the board of directors of SPRI and ERA and a member of Factory Mutual’s Industry Advisory Council. He has been a member of RCI for 21 years.