

The Application of Spray Polyurethane Foam and Elastomeric Coatings for Repair and Maintenance of Bituminous Roof Systems

By Robb G. Smith, RRO, FRCI, RRC, and Dan Varvais

INTRODUCTION

Bituminous products (asphalt and coal tar pitch) have been widely used for low slope roofing for over a century. Throughout the history of bituminous roofing, irregular or continuous pipe and conduit penetrations have been sealed (flushed) with “pitch pockets,” so-named because the sheet metal formed around the penetration became a “pocket” to hold coal tar “pitch.” The pocket, or pan as it is now called, is generally 4" high and large enough to provide approximately 2" clearance from the penetration. The base of the pan is typically specified to have a full 4" flange (including inside corners filled with sheet metal) and joints/seams soldered on the typical 24 ga. galvanized steel pan.

While both coal tar and asphalt are viscoelastic materials, only Type I asphalt will exhibit cold flow similar to coal tar. Today, when there is only a limited use of coal tar pitch and Type I asphalt as the interply bitumen, the same Type III or IV oxidized asphalt used for the interply adhesive is poured into the pocket or pan. In lieu of hot asphalt, the pan is filled with a combination of cementitious grout and topped off with either asphalt mastic or polyurethane sealant. All of these materials age through the process of oxidation and/or evaporation, resulting in gaps



SPF gun and foam from a portable foam kit.

between the metal surfaces and the filler, thereby requiring periodic maintenance to keep them watertight. Conventional pitch pans have their advantages and disadvantages, with the most common correlation to each being: advantage – low cost; disadvantage – regular maintenance required.

Another high maintenance flashing condition is found on parapets, particularly those over 24" high. These taller parapets present challenges for roofing mechanics to maintain asphalt at its proper equiviscous temperature (EVT) when attempting to adhere mineral-surfaced cap sheets or even ply felt. When asphalt is applied below the EVT, the felt and cap sheet will not properly laminate with the asphalt, resulting in large blisters forming in the wall flashing system. As a result, a variety of conditions can develop that are detrimental to the performance of the wall flashing.

These include sagging, open lap seams, and fracturing. Because solar heat gain is accentuated on the west and south faces, these conditions are more severe at those locations.

At raised or canted metal edges and equipment curbs, the conditions are similar, though not as critical when water is not directed to drain across them. Similar to parapets, relative to the orientation with the sun, these areas of flashing will deteriorate



Application of SPF from trailer-mounted spray rig.

more rapidly.

Why do we focus on curbs, penetrations, and perimeter flashing? Because we know that 80% to 90% of all roof leaks originate at roof terminations. Additionally, many roofing manufacturers' warranties exclude leaks from material and workmanship defects located at these points.

Improvement of these conditions can be achieved with application, quality control, and regular maintenance; however, this is more easily said than done. While more and more decision makers understand the benefits of a proactive approach to roofing, the vast majority live in a firefighter's mentality of responding to the greatest emergency first and then moving onto the next. Issues such as full-time application observation and annual maintenance are frequently cut by necessity under tight budget constraints.

Observations by the authors during the application of hundreds of SPF roofs over the last 15 years have furthered our understanding and support for the use of SPF for remediation and maintenance of BUR and modified bitumen roof assemblies and provide the basis for this article. This article will discuss alternative solutions to key flashing conditions, taking into consideration that the ultimate goal is to provide a roof system that requires the least amount of maintenance at a reasonable cost.

AGING OF BITUMINOUS MATERIALS

The advantages of using either asphalt or coal tar as an interply adhesive are not similarly found when used in flashing assemblies. In the long run, the negative performance traits of oxidation and evaporation during aging outweigh the low cost benefit. As described by Ken Brzozowski¹ in an earlier *Interface* article, "The primary weathering mechanism of asphalt on the roof is the same oxidation that takes place in the blowing step. There is, however, also some loss of lighter, more volatile asphalt components due to the high rooftop temperatures membranes experience. Both these mechanisms lead to a hardening of the asphalt." As asphalt oxidizes and



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New conduit penetrations.

loses volatiles, it shrinks in mass, leaving gaps between metal components it is supposed to be sealing. Coal tar evaporates during the aging process, but the net result is the same – loss in volume results in gaps between the metal and the bitumen.

LONG-TERM FLASHING SOLUTION

As discussed above, leaks in built-up and modified bitumen roof systems don't typically occur in the field of the roof, but rather at pipe, conduit, and equipment curb penetrations and around the perimeter. Given the inherent aging mechanisms of bituminous materials, it is logical to seal these points with an alternate material that isn't prone to shrinking *en masse* and remains adhered to applied surfaces. SPF, with good quality roof coatings, will typically provide seven to ten years of service with potentially no maintenance.

WARRANTY CONCERNS

Traditionally, roofing manufacturers have required that all repairs to their roof system be completed by one of their approved or licensed applicators, using their materials. It is worth noting that many manufacturers specifically deny warranty claims that are associated with metal flashing they did not supply. This typically applies to all edge metal, counterflashing, lead jacks, and pitch pans. Therefore, if a better solution is available, it should be seriously considered.

Anytime consideration is given to repairing or in some way altering an existing roof, it is prudent to have the owner research its records for the existence of the manufacturer's warranty to determine the limitations or restrictions included therein. This process might be informative on several fronts, and it is suggested that before undertaking any maintenance work, one should have a



Raised edge flashing repair, before (left) and after (right).

release signed by the owner that indicates acknowledgment and acceptance of the proposed work and how it will alter the existing roof system. Legal counsel should be consulted to address specific language and concerns.

SPRAYED POLYURETHANE FOAM

Without getting into detailed chemistry, SPF is the result of mixing two components, known as the “A” and “B” sides, typically in equal proportion. The resulting chemical reaction creates heat that expands the liquid approximately eight times in volume and then cools into a solid, cellular plastic mass. The resultant foam is 90% closed cell, which is the basis of its waterproofing characteristic. Even without coating, SPF will maintain a watertight seal. This fact has been proven over decades with uncoated foam, surfaced only with loose river rock similar to single-ply ballast. Absent the surface cover of stone or coating, SPF will degrade under UV light. Typically, 25 dry mils of a good quality elastomeric roof coating is sufficient to protect SPF from UV light.



New conduit penetrations.

SPF has been successfully used as a roofing system for over three decades. A majority of SPF roof applications consist of spraying foam over existing roof assemblies. SPF provides a number of advantages when reroofing over old roofs. These include: excellent adhesion to prepared surfaces, ease of adding slope to drain on flat roofs, enhancing the dimension of crickets, increasing roof insulation, covering of asbestos roofing materials, and sealing of penetrations and curbs. Importantly, in a study of 188 SPF roofs recently concluded by the National Roofing Foundation and SPFA, Dr. René Dupuis² stated that, “The use of metal counterflashing was not seen to be required as part of an SPF roof system.” Therefore, consideration of SPF repairs to penetrations and wall



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Old pitch pan with dried asphalt mastic.

flashing on bituminous roofs, particularly where counter-flashing is missing or in questionable condition, becomes more compelling and should be used more in the future.

SPF APPLICATION

Most SPF roofing is applied by contractors who have a 30 kW generator, a material and hose metering unit with heater, and high pressure 45:1 hydraulic pumps, all contained within a large, truck-mounted van or fifth wheel trailer. These types of rigs are necessary to supply large volumes of material when completing entire roof restoration projects or when applying entire new SPF roofs. Alternative systems are available for smaller maintenance projects.

The efficient and economical maintenance alternative to the above is found in 39-lb. cartons containing the "A" and "B" materials with disposable spray guns and nozzles. These are ideal for the application of SPF for small roof maintenance projects, repairing burned-out curb and wall flashing, and sealing pitch pans and new penetrations.

For about \$400, one kit of material contains approximately 175 board feet of 2.75-pcf-density SPF. This volume will supply enough SPF to seal approximately 100 to 120 typical 6" x 6" pitch pans or 150 to 175 three-inch plumbing vent pipes. SPF in these small kits is also available in lower densities, but lower density foam is used



SPF and acrylic coating with ceramic granules, used to seal the pitch pan in the photo at the top.

for the packaging industry and wall joint insulation. Importantly, densities below 2.7 pcf are not recommended on roofs. Densities above 3.0 result in a much lower yield of total board feet. While there may be others, the authors' research found that Dow Chemical (<http://www.dow.com/pusystems/product/fpport.htm>) is the primary manufacturer of a 2.75 pcf density foam that sells to companies with national and regional distribution. Dow purchased Flexible Products Co. and its brands, Insta-Stik (insulation adhesive) and Froth-Pak. Froth-Pak 180 (2.75# density) is the product commonly used for the roofing applications described in this article.

As with any roof maintenance activity, if the desired goal is long term durability, then surface preparation is crucial. Rule number one: SPF is not designed to solve active, wet condition leaks. On built-up and modified bitumen roofs, those conditions are still best suited for the application of coal tar mastic and fiberglass mesh. Moisture and SPF in a liquid state during application are not compatible, and blistering of the SPF will result. However, when the roof is dry, most surfaces require only sweeping to remove any dirt, debris, or old coatings that are not well adhered. Gravel should be spudded to provide a smooth surface for the SPF to adhere fully. Some surfaces, such as smooth APP and galvanized sheet metal, may require the application of a primer. The foam manufacturer will offer guidance if contacted.

The skill necessary to apply SPF is more refined than what is needed to apply spray paint, and if the applicator hasn't sprayed foam before, it is recommended that he or she practice on a sheet of plastic. With a cardboard box placed in the center of the plastic, one can gain experience in spraying vertical surfaces as well. This training exercise might consume half of the kit to develop sufficient skill. The goal is to apply the SPF with a fairly smooth surface, as the rougher surface is not conducive to receiving a continuous film of coating. Should some rough surfaces develop, these can be cut down with a long fillet knife or ground off with a powered sanding disk. These tools and practices are commonly used by SPF contractors, and this work can be accomplished quickly and only minutes after the foam is applied.

However, it is a very large leap from sealing pitch pans, other roof penetrations, and base flashing with a small box of foam to making more extensive repairs. It is worth the time and investment to hire a qualified SPF contractor when repairs include a 200' x 6' parapet wall flashing, large mechanical units, 100' of ductwork, and/or building crickets on a flat roof to assist in drainage. Contact the Spray Polyurethane Foam Alliance (SPFA) (www.sprayfoam.org) or call 800-523-6154 for a list of contractors for a particular area.

After the foam is applied and smoothed as necessary, the SPF surface and six inches of the surrounding roof surface should be sealed with a roof coating. The most common coatings for this purpose are formulated from acrylic polymers, though polyurethane and silicone coatings are also widely used. Acrylic exterior house paint will not provide the necessary performance characteristics to survive in this application long term as compared to a quality roof coating. Application by airless spray gun is efficient for a large quantity of repairs; however, painting the coating on by brush or roller is also acceptable for smaller projects and is frequently more efficient. Two coats are recommended to achieve the minimum 25-mil thickness.

Many situations justify the application of a coating system over the entire roof to reduce surface temperatures, decrease the degradation of the membrane, and reduce cooling loads. A quality oriented manufacturer will routinely offer a warranty for such restoration.

CONCLUSIONS

Bituminous-based products have inherent aging properties that require periodic maintenance. SPF is available in portable 39-lb. kits affording the use of SPF for small projects without the need and expense of a large crew and extensive equipment. By fully covering pitch pans or sealing around pipe penetrations with sprayed



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polyurethane foam and coating, the future maintenance requirement is greatly reduced. The application of foam and coating for sealing of penetration and curb flashing is economical and efficient and will provide durable, watertight flashing for many years of service. ■

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1. Brzozowski, Ken, "Asphalt vs. Coal Tar," *Interface*, October 1995.

ABOUT THE AUTHORS



**ROBB G. SMITH,
RRO, FRCI, RRC**

Robb G. Smith, RRO, FRCI, RRC, is a senior consultant with Amtech Roofing Consultants, Inc., in Seattle, WA. Smith, a past president of RCI, has been working in the roofing industry for over 25 years, 16 years of which he has been an independent roof consultant providing services to institutional and commercial clients. He has served on the Accreditation Committee of the Spray Polyurethane Foam Alliance for over seven years.

For over a decade, **Dan Varvais** has been helping building owners, facility managers, architects, consultants, and other roofing specifiers evaluate roofs for maintenance and repair options. Dan serves on the SPFA Accreditation Committee and has been a keynote speaker for the California Energy Commission and California Public Utility Commission's educational outreach program throughout the state on cool roof technologies.



DAN VARVAIS