

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

**Robb Smith, RRO, RRC, FRCI • Amtech Roofing Consultants Inc., Seattle, WA**  
**Dan Varvais • Applied Polymer Systems, Placerville, CA**

## **ABSTRACT**

This paper discusses the range of conditions, proper inspection, roof evaluation, and how roof details that are customarily only addressed with bituminous materials can be addressed with spray polyurethane foam and provide a longterm, durable, and cost-effective low maintenance solution. SPF flashing applied in conjunction with elastomeric coatings also provide building owners with a “maintenance and repair” option that can better fit their budget restraints, provide tax incentives, and offer an energy efficient “cool roof” solution for their buildings.

Today’s economy has put significant restraints on capital expenditures related to the roofing industry. This paper will broaden the consultant’s exposure to Roof Asset Management and offer cost effective solutions for their clients. Using this approach as a viable tool can help increase the consultant’s client base.

## **Robb Smith, RRO, RRC, FRCI**

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

## **Dan Varvais**

For over a decade, Dan Varvais has been helping building owners, facility managers, architects, consultants, and other roof 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.

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## 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 specified to be approximately 4" high and large enough to provide approximately 2" clearance from the penetration. The base of the pan is specified to have a full 4" flange (including inside corners filled with sheet metal) and all joints/seams soldered.

While both coal tar and asphalt are thermoplastic materials, only Type I asphalt will exhibit cold flow similar to coal tar. Today, when there is only a rare 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 methods age through the process of oxidation and/or evaporation resulting in gaps between the metal surfaces and the filling 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 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 into the wall flashing system. As a result, a variety of conditions develop which are detrimental to the performance of the wall flashing. These include sagging, open lap seams, and fracturing. Because solar heat gain is



*SPF gun and foam from a portable foam kit.*

accentuated on the west and south slopes, 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 their position towards the sun, these areas of flashing will deteriorate more rapidly.

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

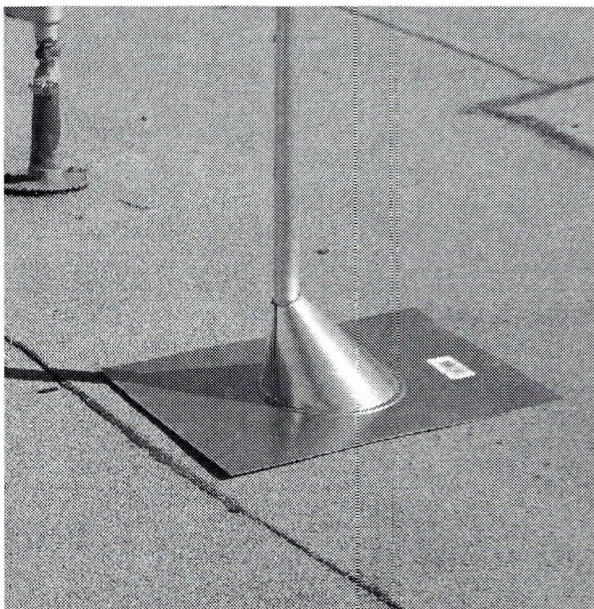
Betterment of these conditions can be achieved with application quality control and regular maintenance; however, this is more easily said than done. While more and more decision makers understand the benefits of a pro-active approach to roofing, the vast majority lives in a firefighter's mentality of responding to the greatest emergency first, and then moving onto the next. Issues



*Application of SPF from trailer-mounted spray rig.*

such as full time application observation and annual maintenance frequently are cut by necessity under tight budget constraints.

Observations of 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 paper. This paper 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.



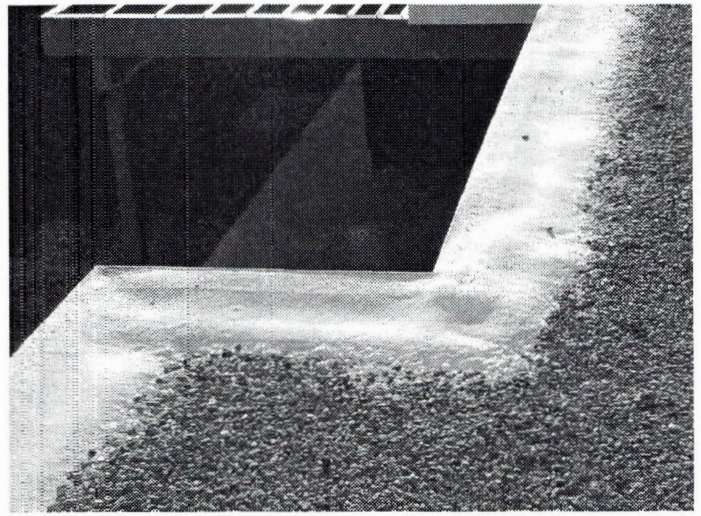
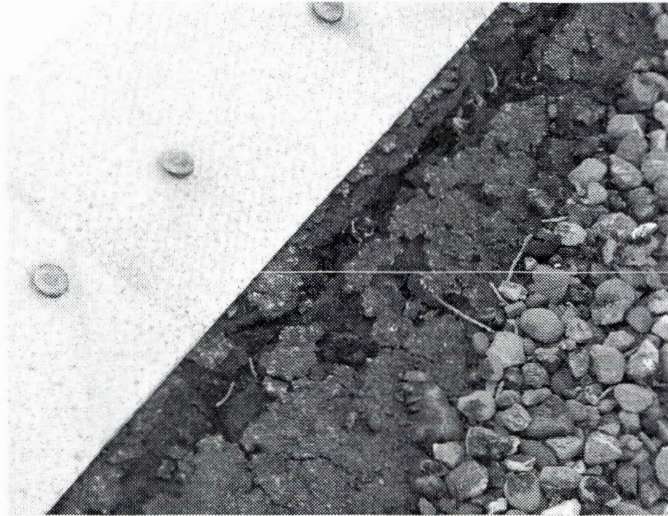
*New conduit penetrations.*

## 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 Brzozowski in an earlier *Interface* article, “The primary weathering mechanism of asphalt on the roof is the same oxidation which 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 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 in 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 of roofs. 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 provide seven to ten years of service with potentially no maintenance.



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

## WARRANTY CONCERNS

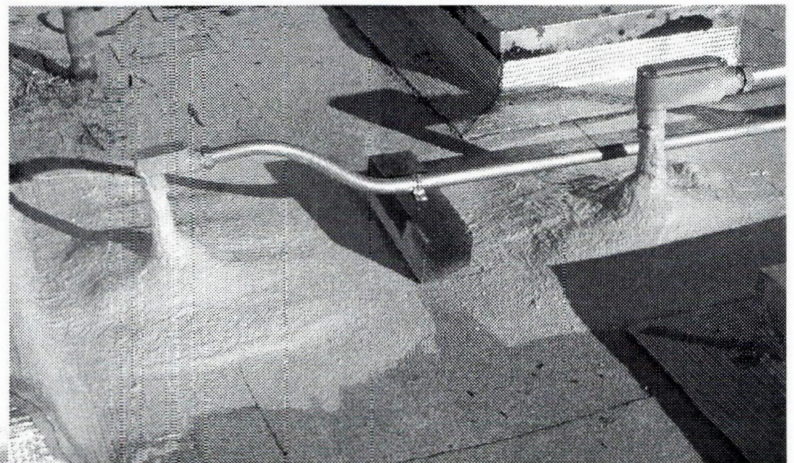
Traditionally, roofing manufacturers have required that all repairs to their roof system be completed by one of their approved/licensed applicators, using their materials. It is worth noting that many manufacturers specifically deny warranty claims that are associated with metal flashing which is not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

Any time consideration is given to repairing or in some way altering an existing roof, it is prudent to have the owner research the records for the existence of the roofing manufacturer's warranty to determine what limitations or restrictions are included in the roof warranty. This process might be informative on several fronts, and it is suggested that before undertaking any maintenance scope of work, one should have a release signed by the owner that indicates their acknowledgment and

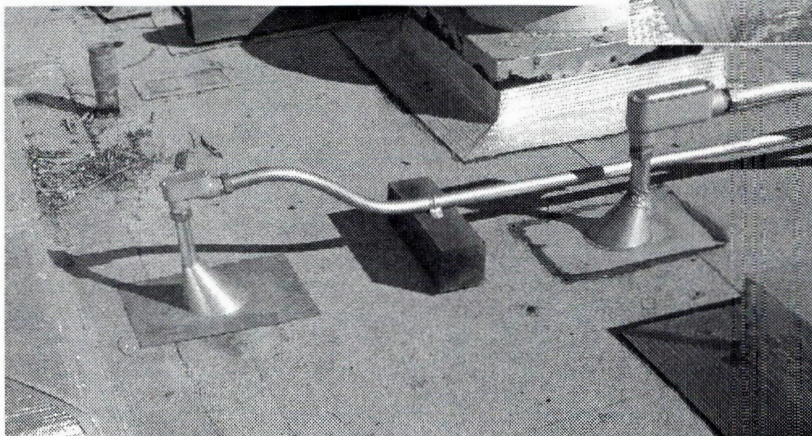
acceptance of the proposed work and how it will alter the existing roof system. Legal counsel should be contacted to address specific language and concerns.

## SPRAYED POLYURETHANE FOAM

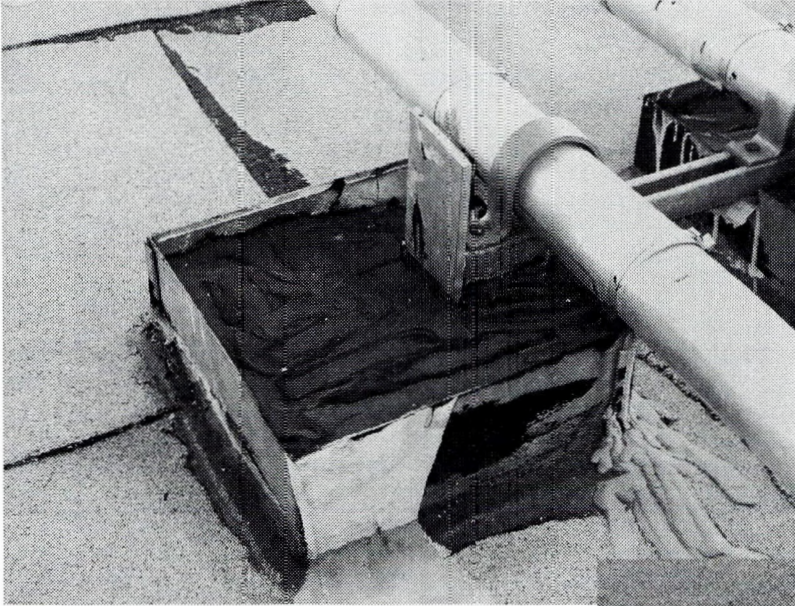
Without getting into detailed chemistry, SPF is the result of mixing two components, known as the 'A' and 'B' sides, in equal proportion. The resulting chemical reaction creates heat and the liquid expands and cools



*New conduit penetrations.*



into a solid, cellular plastic mass. The resultant foam is 90% closed cell, which is the basis of its waterproofing characteristic. Without coating, SPF will maintain a watertight seal. This fact has been proven over years of roofing with uncoated foam, surfaced only with loose river rock, similar to single ply ballast. Absent the



*Old pitch pan, with dried asphalt mastic.*

surface cover of rock or coating, SPF will degrade under UV light. Typically, 25 dry mils of coating are sufficient to protect SPF from UV light.

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.

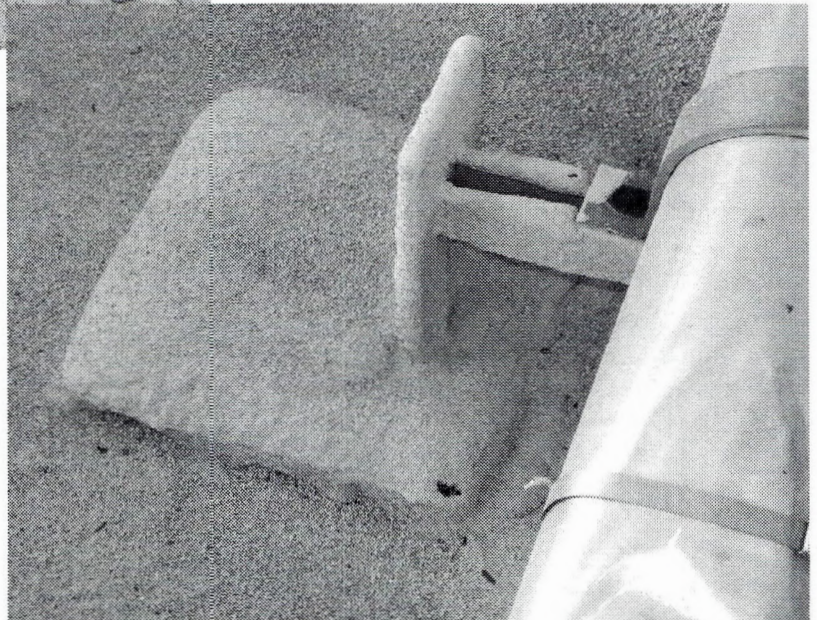
## **SPF APPLICATION**

Most SPF roofing is supplied by contractors which 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 applying entire new SPF roof, but

alternatives systems are available for smaller roof maintenance work.

The efficient and economical maintenance alternative to the above is found in 35-lb. cartons containing the 'A' and 'B' materials with six disposable spray guns. These are ideal for the application of SPF for small roof maintenance projects, repairing burned-out curb flashing, and sealing pitch pans and new penetrations.

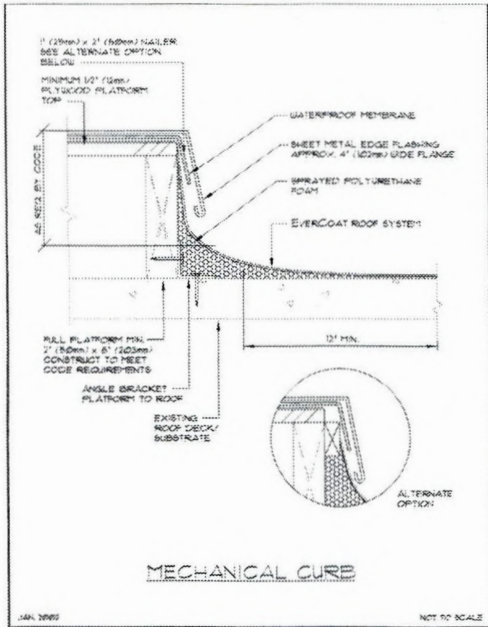
For about \$325, one kit of material contains approximately 100 board feet of 2.75 pcf density SPF. This volume will supply enough SPF to seal approximately



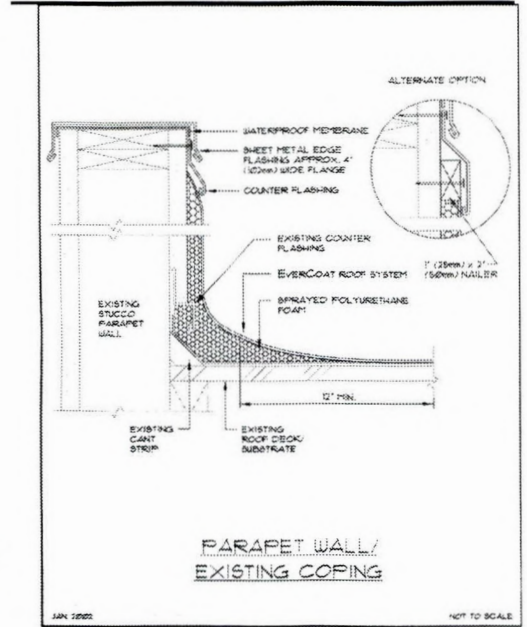
*SPF and acrylic coating with ceramic granules, used to seal the pitch pan in the photo at the top.*

75 typical 6"x 6" pitch pans or 100 3" plumbing vent pipes. SPF in these smaller kits is available in lower densities, but densities below 2.7 pcf are not recommended for roofing applications. Dow Chemical provides national distribution of this material, with regional distributors like DAS Products stocking product in Arizona.

As with any roof maintenance activity, if the desired goal is longterm durability, then surface preparation is key. 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 web. Moisture and SPF in a liquid state during application are not compatible, and blistering of the SPF will result.



**Left: Mechanical curb.**



**Right: Parapet wall with existing coping.**

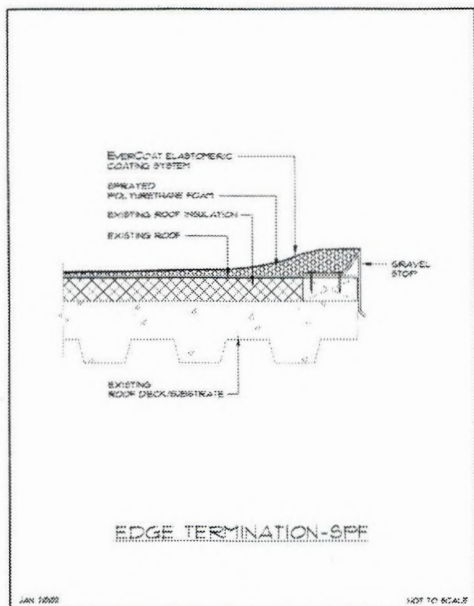
However, when the roof is dry, most surfaces only require sweeping to remove any dirt or debris or old coatings which are not well adhered. Some surfaces, such as smooth APP and galvanized sheet metal, may require the application of a primer. The foam manufacturer will guide you through these decisions.

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 one 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

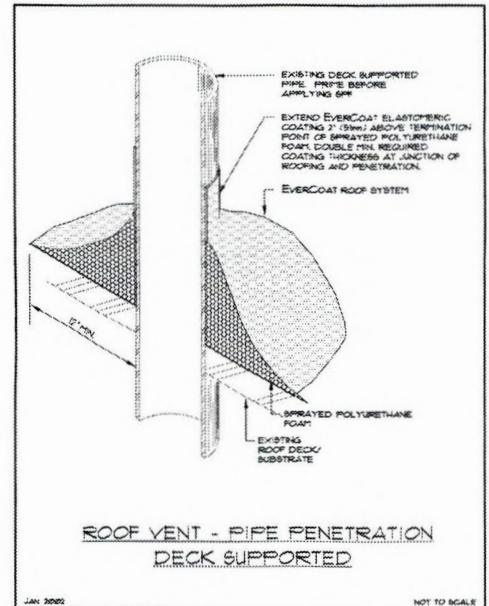
to attaining a continuous film of coating. Should some rough surfaces develop, these can be cut down with a long fillet knife or ground off with a powered sanding disk. These tools and practices are commonly used by SPF contractors and the work can be accomplished quickly only minutes after the foam is applied.

However, it is a very large step from sealing pitch pans and other roof penetrations and base flashings 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 parapet wall flashings, large mechanical units, duct work and or build crickets to assist in drainage.

After the foam is applied and smoothed as necessary, the SPF surface and a few inches of the surrounding roof



**Left: Edge termination - SPF.**



**Right: Metal counterflashing is not used when pipe is supported by roof deck.**

surface should be sealed with a roof coating. The most common coatings for this purpose are formulated from acrylic polymers, although polyurethane and silicone coatings are also available. 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. Two coats are recommended to achieve a sufficient mil thickness.

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

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## CONCLUSIONS

Bituminous-based products have inherent aging properties that require that they receive periodic maintenance. SPF is available in portable 35-lb. kits affording the use of SPF for small projects without the need for a large crew and extensive equipment. By fully covering pitch pans or sealing around pipe penetrations with sprayed polyurethane foam and coating, the 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.