



# SEALING ROOF PENETRATIONS

By Phil Georgeau

**A**ll roofs have penetrations which are regarded as the weakest point in any roof and the greatest source of leaks.

Commercial roofs are often riddled with penetrations. Heating and air conditioning equipment, utility pipes, conduit,

communication equipment, signs, machinery screens, safety railings, and structural steel have created expensive and challenging waterproofing problems for all commercial roofers.

Although many sealing systems, such as witches' hats, molded rubber boots, and elevated curbs have been tried, the traditional NRCA-type pitch pan, or some variation of it, is still the most common penetration sealing system in use today.

Pitch pans are comprised of a flanged metal box four inches high. The box is secured with screws to the roof around the penetration and then filled with nonshrinking grout to a depth of four inches. When the grout sets, the top is usually filled with solvent-based asphalt mastic. Mastic is often mounded up around the penetration to shed water and to compensate for volume shrinkage when solvent in the mastic evaporates. The flange at the bottom is flashed with appropriate material for the type of roofing system used on the job. A rain cap is sometimes installed on the penetration to keep water and weather off the top of the pitch pan.

In the real world, pitch pans are seldom built to NRCA specifications. Sand, rocks, urethane foam, and old roofing materials are often used as base filler. Nonshrinking grout is usually substituted with a mortar mix that shrinks up to five percent.

Roofers often use whatever they can get their hands on and then top off the pan with asphalt cement. Under actual field conditions, the construction of pitch pans can become very creative.



*Above: NRCA pitch pans on a built-up roof.*



*Right: This pitch pan with a rain cap is close to NRCA specifications.*



*SPRI-approved pitch pan on EPDM.*

often wasted. Success with this system is often dependent on efficient mixing of the rubber and the flashing skill of the roofer.

In the past few years, packaged "penetration seal" kits have emerged in which all the components of a modified single-ply-type pitch pan are assembled as a ready-to-use unit. These kits include a mixing paddle, pourable sealer, gloves, and a finishing tool. The assumption is that if the contractor has everything he needs to do a job, he will do it right. The kits are described as penetration seals to distinguish them from traditional pitch pans.

An important feature of penetration seal kits is the replacement of the traditional square metal pan with round, pre-cast curb components that are bonded directly to the roof surface with a moisture curing adhesive. The bonded curb components are two inches high and two inches wide and are comprised of either hard structural urethane or polymer modified cement.

Because of low confidence in workmanship and high rates of failure, the NRCA discourages the use of pitch pans. They are defined as "perpetual maintenance items" by all roofing professionals. Until recently, few alternatives were available. Many consultants have even suggested banning roof penetrations altogether with such tactics as placing all HVAC equipment at ground level. The real world dictates otherwise.

With the advent of single-ply roofing, the pitch pan evolved to a more streamlined form. The pan became a two-inch-high metal flange filled with two-part urethane sealer. The SPRI-approved type metal pan is mechanically fastened and bonded to the roof surface. Its outer surface is then flashed with an appropriate membrane, thus sealing the flange and preventing corrosion on the metal box. The rubber seal in this new pan has proven to be more durable than asphalt mastic and does not shrink. Installation, however, is very labor intensive, with flashing details taking up to an hour.

Mixing the sealer is also time consuming, and improper mixing occasionally leads to failure. The use of a two-part rubber sealer increases the installed cost of the pan. Excess mixed rubber is

*Right: Penetration seals on machinery screen over built-up roof.*



*Right: The space between the penetration and roof deck must be sealed with an appropriate filler before pouring the interior seal.*

Because they are not subject to corrosion, these hard peripheral parts do not require flashing.

Straight segments and corner pieces permit the construction of various alternative shapes, such as squares, rectangles, and ellipses. The circular forms are the most efficient because they expose the least amount of surface area to the weather and require the least volume of rubber to fill and seal the interior cavity.

Although penetration seal kits cost a little more, the ease and speed of installation more than compensate for the expense. A penetration seal can be completed by an inexperienced roofer in under ten minutes.

Recent innovations in polymer technology have resulted in polyether-based, single-component, pourable sealants that can reduce the labor required to install a penetration seal to under five minutes.

Penetration seals contain no mechanical fasteners and are therefore totally dependent on the integrity of the chemical materials that hold them together and bond them to the roof and penetrations. Good bonds lead to very strong seals; poor bonds often result in problems. Here are some rules that will lead to success with penetration seals:

- Some roofing materials are not good substrates for a bonded penetration seal. Unacceptable substrates are TPO, Hypalon, and smooth APP Modified Bitumen. Smooth APP can be sealed only if a granulated "target" piece is heat welded around the penetration.



*Penetration seal on built-up roof.*

- All bonding surfaces must be clean and free of any materials that would interfere with adhesion. Asphalt cement as a night seal where a penetration seal is scheduled to be installed is prohibited. Shrinkage from solvent loss will create voids beneath the seal. Also, solvent escaping from such mastics will undercut the seal and may damage the surrounding membrane.
- Surface preparation requires that all bond surfaces be clean and sound. Asphalt, oils, cement, ice, loose paint, and dirt must be removed. Loose roofing granules will interfere with adhesion and lead to failure. To ensure adhesion, a coat of moisture-cure adhesive, provided by the manufacturer, should be applied to the roof and penetration surfaces prior to installing a penetration seal.
- The space between the penetration and roof deck must be sealed with an appropriate adhesive before pouring the interior seal. The poured seal must not be disturbed or subjected to movement for twenty-four hours after installation.

Following these rules, along with using proper considerations for weather and using common-sense workmanship, should guarantee that penetration seals should perform well on most single-ply, mod bit, or BUR roofing systems. ■



## ABOUT THE AUTHOR

**Phil Georgeau** has been an industrial chemist for over 30 years. He is currently president and principal shareholder of Chem Link Inc. His industry experience began as a product development engineer with US Polywood in its Weldwood Chemicals Division. He has continued in this field, with an emphasis on construction adhesives and sealants, at St. Clair Rubber, Contech-Sonneborn, Megaloid Chemical, Imperial Adhesives, and Chem Link. Georgeau holds six patents in the area of adhesives, sealants, and construction materials, including two patents for ChemCurb penetration seals.



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