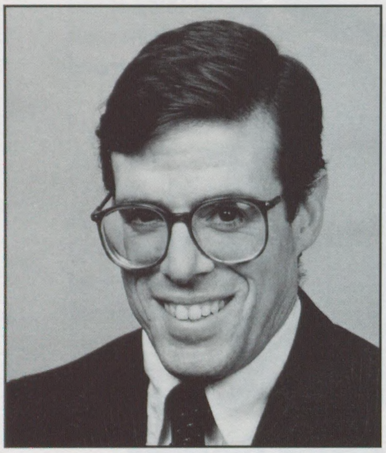
The Evolution of Seaming Technology for EPDM Roofing Membranes

By Joseph J. Kalwara and Chester T. Chmiel, Ph. D.



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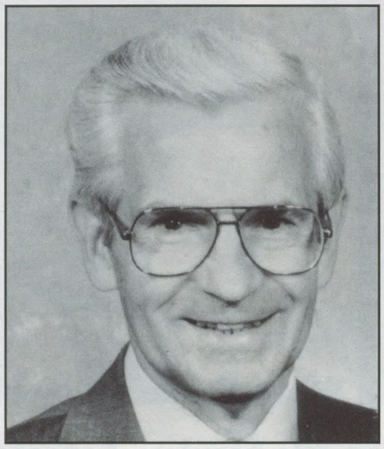


Chester T. Chmiel

Joseph (Joe) J. Kalwara, senior engineer of Firestone Building Products Company's Technical Department, is responsible for overall lab evaluation of adhesive, sealant and tape products. In this capacity, Mr. Kalwara oversees peel and sheer adhesion testing, destructive testing, wind uplift analysis, and general performance testing of adhesive related products. He also writes performance specifications and application instructions for Firestone's adhesive, sealant, and tape products. He has been employed by Firestone since May of 1983 and has been in the roofing industry for 15 years. Mr. Kalwara is a member of SPRI and sits on SPRI's adhesives technical subcommittee. He holds a B.S. degree in building construction from Syracuse University.

Chester (Chet) T. Chmiel, Ph. D., is a technical consultant for Firestone Building Products Company and is actively working on adhesive product development and applications. Prior to joining Firestone in 1992, he was instrumental in developing the first solvent-based roofing adhesives for the U.S. Rubber Company (now Uniroyal), where he worked from 1960 to 1989. During his tenure there, Mr. Chmiel headed the Engineered Systems and Adhesives departments and is the co-inventor of butyl-based adhesives used in the roofing industry today. He was also instrumental in the development of seam tapes for the commercial roofing industry. Mr. Chmiel retired in 1989, following which time he served as a consultant for Uniroyal until 1992. He holds both B.S. and M.S. degrees in chemistry from Canisius College, Buffalo, N.Y., a Ph. D. in chemistry from Cornell University, and an M.B.A. from Michigan State University.

EPDM seaming products today are far superior to products that were available in the past. This article discusses the chronological development of the two predominant methods available for the seaming of EPDM rubber roofing today — cured, 100 percent solids seam tapes and solvent-based liquid contact adhesives — to show how improved technology has led to a new generation of products that provide dependable performance. This article also explains why seam tapes are the product of choice in most EPDM applications.

What Makes a "Good" Seam?

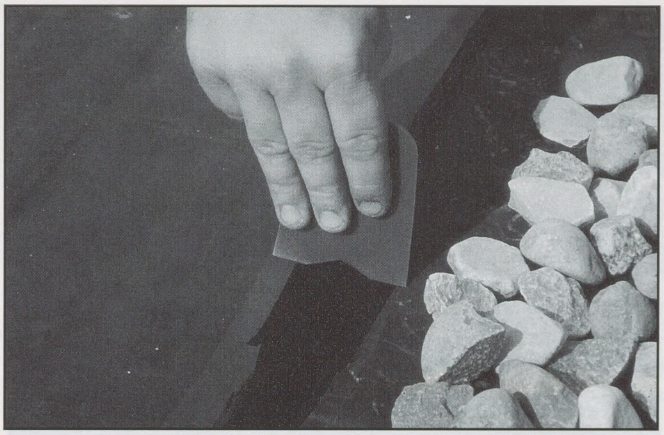
On almost every commercial EPDM roof installed, there is at least one field seam joining adjacent EPDM membrane panels together. In order to recommend a seaming method, it is first very important to understand the many factors that constitute a "good" seam.

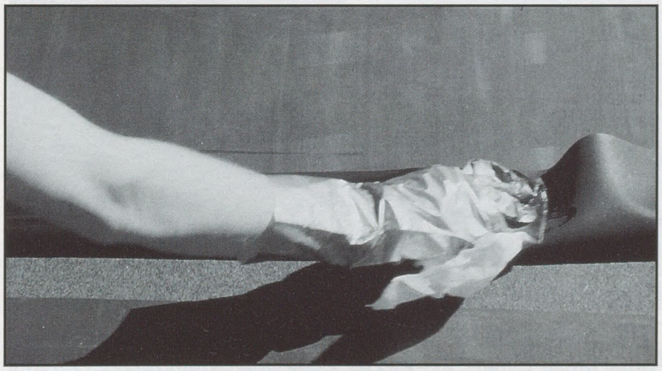
A field seam must be capable of a strong initial bond, as it may be exposed to weathering forces immediately upon completion of the seam. A seam must also be strong enough to withstand forces imposed upon it by exposure to high winds and weathering and to maintain its bond throughout the warranty period. Additionally, a good EPDM seam must be capable of withstanding surface temperatures ranging from -30 to in excess of 175 degrees F.

The most critical requirement of a field seam, however, is that it remain watertight. To test water tightness, Factory Mutual (FM) has developed a water leakage test which subjects seams to ponded water continuously for seven days. In this test, a seam section is weathered in an ultraviolet weatherometer (288 hours minimum) and then sealed in place under a cylinder (7.75 inches i.d.). The seam is then subjected to six inches of water for seven days and monitored. Passage of this test is required as part of qualifying a roof system for FM Class I rating.

Evolution of Seaming Alternatives

Thanks to advancements in research and development over the past several years, there are two EPDM seaming methods currently available to field-





(Clockwise starting with the bottom left photo) These four photos show adhesive seams. (1) With a one-part butyl seam adhesive, the seam area is first solvent washed. (2) The adhesive is then applied using a paint brush or roller. (3) The "touch-push" test is used to determine when a seam is ready to be mated. (4) Once the solvents have flashed off (15-45 minutes), the seam is mated and a lap sealant or caulk is applied to the lap edge.

splice EPDM membrane panels: Solvent- based, liquid contact adhesives and preformed, cured seam tapes. Both methods offer secure field seams when installed correctly, and both methods have been on the market for almost a decade with good overall performance histories. However, the performance of these two systems varies widely. Let's take a close look at the evolution of EPDM seaming methods and how the industry arrived at its current product choices.[1-2]

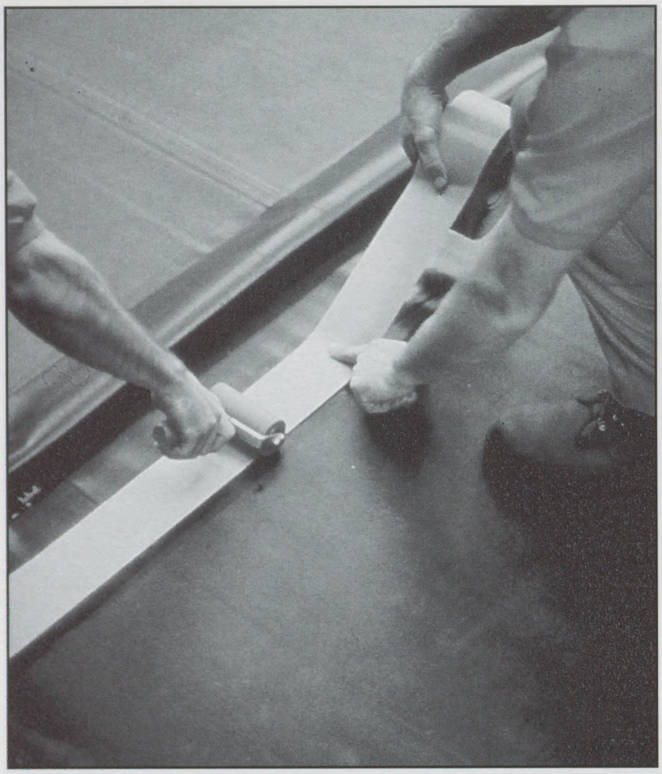
Two-part Butyl Adhesive with Rubber Tape

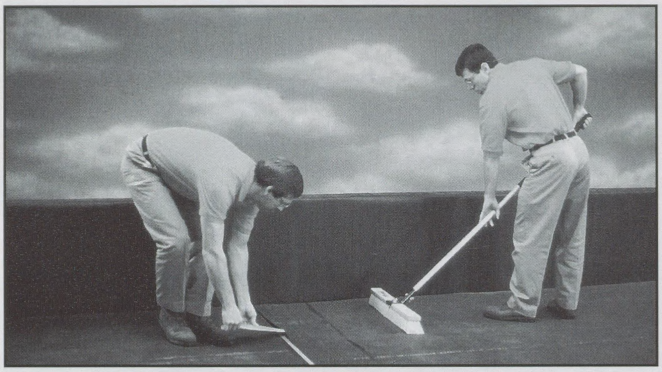
In the 1960's, EPDM field seams were fabricated of two-part butyl adhesives with an uncured rubber tape within the seam. The EPDM surfaces to be spliced together were cleaned thoroughly with a solvent to remove the dusting agent and dirt. After mixing, the two-part adhesive was applied to both splicing surfaces and allowed to dry until it no longer transferred to the finger when touched. A 4-inch wide rubber gum tape with its release paper face up was embedded into the adhesive on the bottom sheet of EPDM. The tape was then rolled with the release paper still in place to ensure good contact. After rolling, the release paper was removed from the gum tape and the top sheet of EPDM was mated to the tape and rolled again. To finish the seam, a sealant was applied at the lap edge.

This early seaming method provided adequate seam strength, but was very expensive due to the components and installation labor involved. There was a need for a simpler, less labor-intensive system. This search led to the development of a one-part polychloroprene adhesive system.

One-part Polychloroprene Seam Adhesive

In the mid-1970's, a one-part adhesive based on polychloroprene rubber was introduced and greatly simplified EPDM seaming operations. This seam





(Clockwise starting with photo to the left) These four photos show taped seams. (1) EPDM seam tapes simplify the seaming process by combining cleaning and priming into one step. (2) When the primer has had sufficient time to flash off (usually less than 10 minutes as verified by the "touch push" test), the tape is applied and rolled in place with a roller to ensure a tight bond with the EPDM. (3) Once the tape is applied, the seam is closed and the release paper is removed. Blooming of the lap promotes "wet-in" of the tape to the primed membrane. (4) The taped seam is finished by hand using a silicone roller to ensure good contact and mating. Taped seams can be installed twice as fast as liquid adhesive seams and offer twice the strength upon aging.

system required solvent cleaning of the membrane surfaces to be spliced, followed by the application — by brush or roller — of a solvent- based polychloroprene contact adhesive to both splicing surfaces. A brief flash-off period (20-45 minutes) was allowed for solvents to dissipate from the adhesive. Then, the seam was mated and rolled to ensure continuous contact. The seam was finished with a lap sealant.

In the late 1970's and early 1980's, research was directed toward improvement of seams made with a one-part polychloroprene adhesive to satisfy industry demand for EPDM roofing systems with stronger seams that were more impervious to moisture.

Primers and Primer Washes with One-part Polychloroprene Seam Adhesive

Research also began in the early 1980's to develop primers and primer washes in combination with one-part polychloroprene adhesives to increase the bond strength of the seam. Generally, primers are more concentrated solutions of primer washes. Previous seaming methods required washing the EPDM membrane before application of the adhesive using a solvent such as white gas, unleaded gas, or hexane. When a primer is used, it is applied after the solvent cleaner and before the adhesive, adding an extra step. When a primer wash is used, however, it replaces the solvent cleaner because it washes *and* primes the seam surface.

The roofing industry demanded a one-part seam adhesive that could be installed immediately after solvent washing and that offered sufficient seam strength for all EPDM systems. However, the one-part adhesive system had to show adhesion values similar to those of methods that used primers and polychloroprene adhesives.

One-part Butyl Seam Adhesive

In 1984, a one-part butyl-based seaming adhesive was introduced and is the liquid adhesive system currently in use. With this system, the seam area is solvent washed to prepare the EPDM membrane to receive the butyl adhesive. The seam adhesive is then applied using a paint brush. After the solvents are allowed to flash off, the seam is mated and a lap sealant is applied to finish the seam. When properly installed, this seam offers excellent overall strength and performance for all EPDM systems.

Roof-curing Seam Tapes

Also introduced to the commercial roofing market in the early 1980's were roof curing seam tapes. These tapes were introduced to take advantage of the 100 percent solids tape technology developed for other non-roofing applications. With this system, the EPDM membrane was solvent washed and primed or primer washed prior to the application of the uncured tape. Typically, no lap edge caulking was required.

Consistent mass fosters consistent adhesion and waterproofing characteristics.

This system was not offered very long, however, because it relied on heat and time to cure the tape once installed on the roof. Until the tape developed some cure, the system offered low tensile strength and was, therefore, vulnerable to rooftop forces such as wind. Performance problems with roof curing tapes developed before the tapes could properly cure.

Preformed, Cured Seam Tapes

In order to meet industry demand for a better seam tape system, preformed cured tapes were introduced in the mid 80's. Since that time, and particularly within the past five years, advancements in cleaning and priming the membrane surface have further enhanced overall seam tape performance.

Today's seam tapes are cured during the manufacturing process, typically in ovens, prior to installation on the roof. Cured tapes show high tensile strength and, unlike their uncured predecessors, high initial bond strength of the seam.

Current seam tapes are also wider than those first introduced. While applications of 2-1/2 inch wide tapes were commonly used, tape width was increased to three inches in 1993 to enhance performance and accommodate applicator and specifier preference. Seam tapes can be used with ballasted, fully-adhered, or mechanically anchored EPDM systems. Additionally, a 7-inch wide seam tape was introduced in 1994 for use with batten-in-the-seam and reinforced, mechanically attached systems. This is the widest seam tape available today.

In addition, many accessories incorporating tape are available for EPDM systems, including tape laminated to EPDM cover strips and flashing material for the waterproofing of batten bars and gravel stops. New accessory products are continuously being developed.

Advantages of Seam Tapes

Seam tapes offer significant advantages over liquid splice adhesives. Through factory-controlled manufacturing, seam tapes are preformed to provide consistent thickness within the seam — nominally 35 mils thick — as opposed to liquid adhesives which may show variability in film thickness by virtue of brush application.[3] Consistent mass fosters consistent adhesion and waterproofing characteristics.

Seam tapes also offer twice the peel strength of splice adhesives after simulated rooftop aging. To prove the superior strength and quality of seam tapes, a test was conducted in 1993. The test procedure performed was the Rubber Manufacturers Association (RMA) Minimum Peel Strength Requirements test protocol (RP-10).[4] In this test, seam samples were conditioned at room temperature for seven days. The seams were then subjected to hot-cold cycling (80 degrees C and -18 degrees C, respectively) and water immersion at 80 degrees C. This test, conducted under the supervision of Underwriters Laboratories, Inc., revealed that the tape system increased in strength and was found to be twice as strong as conventional liquid splice adhesives exposed to the same test protocol.

Taped seams can also be installed more than twice as fast as liquid applied seams. This minimizes the opportunity for contamination within the seam, reduces labor costs, and is a benefit during inclement weather. Additionally, with seam tape, there is no down time associated with waiting for the adhesive to dry properly. This reduces the amount of time it takes to complete an installation.

Volatile organic compound (VOC) emissions are reduced by 66 percent when installing seam tapes. The only VOC emission occurs during the application of the primer wash, since the tapes are 100 percent solids and, therefore, do not contain any VOCs. Liquid adhesives, on the other hand, emit VOCs at every step, including the solvent wash, application of the splice adhesive itself, and application of the lap sealant.

Seam tapes also have proven performance when exposed to weather conditions such as high heat, humidity, and extreme cold. This is a very important advantage given the fact that the surface temperature of black EPDM membranes can range from -30 to in excess of 175 degrees F.

Essentials for Installing Secure Field Seams

Regardless of your seaming preference for seam tapes or liquid adhesives, there are several basic tenets that should be followed. Both methods require that the membrane be thoroughly cleaned or primed, as specified by the manufacturer, prior to installation. All adhesive techniques require that the substrate (in this case, an EPDM membrane) be as clean as possible prior to seam installation.

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Prior to mating seams together, solvents should be allowed to flash off as much as possible. (Solvent washes flash off very quickly, as do primers and primer washes — usually in less than 10-15 minutes. Splice adhesives take a little longer to flash off — usually 20-45 minutes.) If a seam is mated when there is still solvent present from a primer or splice adhesive, a "fishmouth" or open area in the seam may occur. Fishmouths are readily visible and repairable, but can be avoided by proper monitoring during seam installation.

The "touch-push" test is a good method to gauge when a primer or adhesive is ready to be mated. If touching and pushing on a primer or adhesive reveals any movement within the layer, it is not ready to be mated. After mating, the seam should be rolled with a silicone hand roller to ensure that the adhesive or tape forms a continuous watertight bond with the membrane.

Conclusion

Research, development, and product testing of EPDM seaming products over the past two decades have yielded steady improvements in seam performance. As a result, seam tapes and liquid adhesives on the market today are proven, dependable products. But as more is learned about seam strength, the effects of weathering, application methods, and product formulations, seam tapes are emerging as the best alternative for EPDM seaming due to their higher strength, economical and environmental benefits, and overall proven performance.

Endnotes

1. Chmiel, C., "History of EPDM Splice Adhesives", presented at the 1986 Midwest Roofing Contractors Association convention.

2. Dupuis, R., "Splice Tape for Use in EPDM Roof Systems", presented at the 1994 Midwest Roofing Contractors Association convention.

3. Rossiter, W., "Characteristics of Adhesive Bonded EPDM Seams", *Contractor's Guide,* April/May, 1991.

4. Rubber Manufacturers Association, "Minimum Peel Strength Requirements for Adhesives Used in Black EPDM Sheets", RP-10, 1989.

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Region Two can boast the highest number of RCI members: 264. Region One follows a close second with 242 members. RCI's newest Region Eight (Canadian Chapter) currently has 47 members, but is growing fast.

RCI Brings Basic Roof Consulting to Baton Rouge

RCI's Basic Roof Consulting course was presented November 2-4 in Baton Rouge, La. RCI wishes to thank the following RCI members who gave their time and energy to teach this three-day course.

Michael Blanchette, RRC
Amtech Roofing Consultants

Joe Hale, FRCI
HDH Associates

Steven Kern, RRC
Georgia Pacific Corporation

Betty Lee, AIA
Louisiana Facility Planning and Control