The Province of Testing

By Lyle Hogan, PE, RRC

There has always been a gulf between understanding what testing is and what it can imply. Service life prediction, based on one or more tests, is a barely useful exercise still being practiced. Yet who can adequately evaluate materials/systems without comparative product information?

The province of testing is arbitrary and manufacturing in compliance with standards is voluntary. The standards of testing are legally binding only when a government body references them in regulations or when they are cited in contract documents.[1] Yet, while arbitrary and voluntary, testing has merit when it is uniform. In the absence of a uniform testing environment, there is no basis for comparison. Even when the environment is uniform, the outcome may be misunderstood or, worse yet, manipulated.

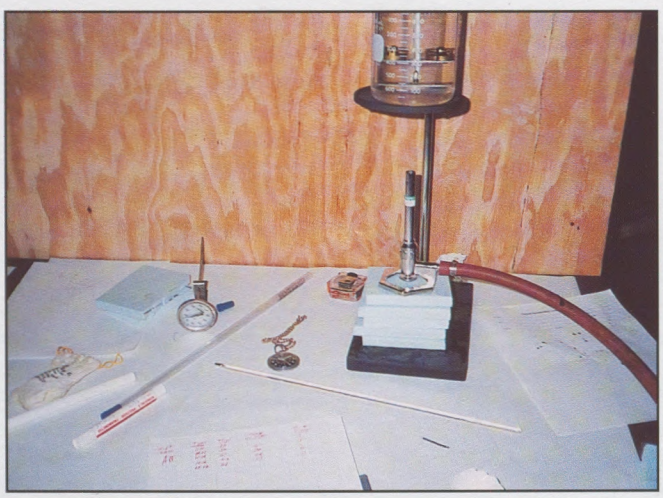

Photo 1: A softening point test underway. Often confused with "melt point," there is no relationship between these properties.

An example is the widely misunderstood softening point of roofing bitumens (Photo 1). This is often confused with the melting point of the material but there is no relationship between them.[2] Melt point is a fundamental physical property of homogenous, crystalline materials—an exact temperature. Softening point is a laboratory value derived from an arbitrary (but recognized) test.

The previously heralded practice of using roof cuts to determine acceptance of new builtup roofs has moderated. Similar destructive testing of one-ply membranes may be a helpful tool (Photo 2), but should be applied rationally. Shear and peel strength values may have a bearing on lap splice quality, surface preparation, and installer skill, but there are no universally accepted values which signal an inferior lap. Moreover, contractually requiring an installer to achieve a randomly selected value may set the specifier up for unfavorable consequences (the courts tend to construe an impossible contract against the author of such a spec).

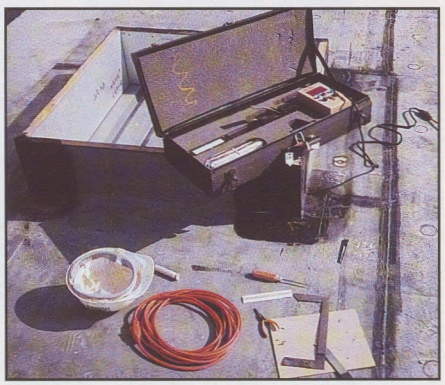

Photo 2: On-site T-peel testing of polymeric membranes. There are no universally accepted strength values.

Determining reasonable lap strength values is somewhat complicated by the dichotomies revealed in lab research. Rossiter[3] observed that many EPDM seams prepared with moisture, contaminated surfaces, and adhesive voids demonstrated shear strength values comparable to control specimens. Go figure.

A sample of aggregate surfacing may pass a gradation test and fail miserably in a hardness test. Ballasting aggregate is legendary for this; however, does failure of the test indicate certain failure of the material in service? Does freeze-thaw testing in a lab accurately simulate the environment to which walkway/ballast pavers will be subjected?

The QUV oven provides comparative insight into weathering properties of polymeric membranes. The difficulty here is in interpreting how many hours in the oven imply satisfactory performance in all or any part of the country. The Kesternich apparatus affords a corrosion resistance comparison of fastener coatings and base metals. In such a test, stainless devices fare satisfactorily. No clue is given concerning other modes of distress that may characterize stainless steel, such as crevice corrosion and hydrogen embrittlement.[4] Furthermore, the Kesternich

test sheds no light on back-out or withdrawal resistance—two quite different issues. Perhaps tests should be considered collectively rather than individually.

Some tests are not credible unless the fine print is carefully evaluated. Linear dimensional stability is reported as a percentage change in membrane specimen size after being subjected to a hot air bath for a given time (Photo 3). Unless there is identical energy/duration environment, two products may not be compared.[5] Since ASTM does not dictate the environment, it must be sorted out from the footnotes.

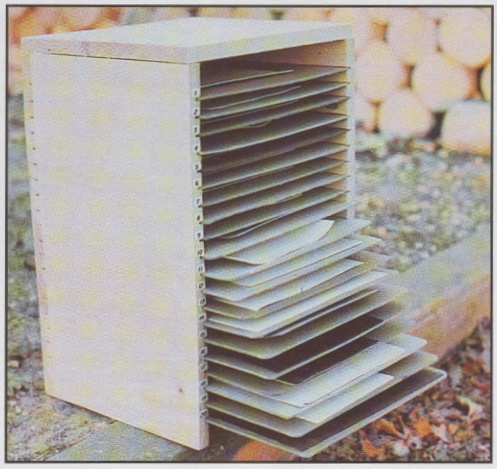

Photo 3: Linear dimensional stability is a frequently misunderstood test.

Low temperature flexibility is an important property for consideration of modified bitumen products. During testing, a sample is cooled and then bent around a mandrel. The outside radius is examined for cracking. A low reported temperature is desirable, suggesting good resistance to cracking during cold service temperatures. However, various mandrel sizes may be used. If cracking is observed on a 3/4-inch mandrel, changing to a 1-inch device may preserve the low figure sought for reporting and advertising.

Some tests are more tangible indicators of desired product behavior. For insulating concrete products, unit weight determination and related tests can be indicative of eventual physical properties such as compressive strength.

Other properties are more difficult to quantify. As shown in Photo 4, the "legs" of adhesive within a lap splice should be nicely formed (an issue few will debate). A lap separated and viewed under a light microscope can distinguish adhesive or cohesive failure. Though not universally acknowledged, this type of finding can pinpoint needed modifications to lap preparation techniques.

Some of the more useful tests may be merely a visual judgment of a property, as opposed to quantification by measurement. Wicking of water into internally-reinforced membranes is a mostly discounted behavior (Photo 5). The manner in which moisture in a scrim will affect sheet performance is inconclusive at this time. To that end, does the test have any value? Perhaps it will, after future unanticipated product behavior. Who would have postulated that a loosely-laid membrane capable of 300% elongation would experience distress in a shrinkage mode?

Conclusion

There are no less than seven test methods used for membrane tensile strength. There are multiple units of expression for the results. Which is stronger—a 160-mil product with 1,500 psi, or a 4-mm product yielding at 208 lbs. per linear inch of width? Perm ratings may be expressed as perms, perm inches, perm mils, or grains of water per square foot per hour per inch of mercury (pressure difference). And all this is not the same as "water vapor transmission rate." The confused reader is directed to ASTM E-96 for definitions and distinctions.

It has been argued that product costs and warranty terms are poor barometers of eventual roof performance. Physical property testing is certainly a preferred alternative; however, blind reliance on tabulated results for purposes of selecting materials/systems is a dubious practice.

Photo 4: Light microscope examination of adhesive "legs" within lap splice. This is an example of qualitative testing, there being no measurements.

[1] "Foreword" from the Annual Book of *ASTM Standards.*

[2] Puzinauskas, V.P., "Specifications for Roofing and Industrial Asphalt," *Proceedings from the 7th Conference on Roofing Technology,*" 1983, pg. 57.

[3] Rossiter, Walter J., "The Effect of Application Parameters on Adhesive Bonded Seams in Single Ply Membranes," (proceedings from the) *Second International Symposium on Roofing Technology*, 1985, pg. 386.

[4] Rossiter, Walter J., Streicher, Michael A., and Roberts, Willard E., *Corrosion of Metallic Fasteners in Low-sloped Roofs: A Review of Available Information and Identification of*

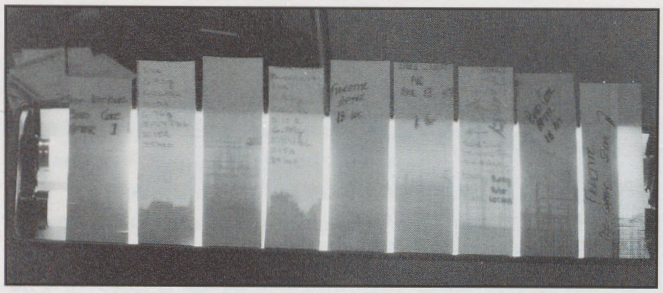

Photo 5: Wicking rates of reinforcing scrims. The correlation to in-service performance is not yet known.

Research Needs, NISTIR 88-4008, prepared for U.S. D.O.E., February 1989, pg. 23.

[5] Hogan, L. D., "Evaluating Polymeric Roofing Membranes for Linear Dimensional Stability," *Roofing Research and Standards Development* (2nd volume; STP 108), Wallace, Rossiter editors, 1990, pg. 56.

About The Author

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