Intolerable TOLERANCES

By Jeff Evans, RRC

At two recent roofing forums, presenters have observed and commented that the roofing industry certainly has "matured." These presenters reported that even upstart organizations like RCI and the Single-Ply Roofing Industry (SPRI) have recently celebrated 25-year anniversaries, and the National Roofing Contractors Association (NRCA) has been in existence for 124 years. These three organizations and others have contributed to that maturation and improvement of the roofing industry.

While commercial roofing may be maturing as an industry, that does not mean it is standing still. Roofing manufacturers have invested heavily in new equipment, manufacturing facilities, and processes, and continue to innovate. Having visited close to a dozen single-ply roofing manufacturers' plants, the author has been impressed by the manufacturing technology: computer-monitored formulating, precise measuring of compounds, and tight controls on everything from line speed to process temperature. Each plant visited stressed that its single-ply membrane formulation is exactly the same, batch after batch, and that lab testing of the end product is done to ensure every roll of product meets its published specifications.

Manufacturing of single-ply membranes seemingly has reached a state of maturity as well. Reports from field inspectors' observations of surface blemishes, out-of-flat membrane issues, and the like are quite rare. Consistency of membrane color, texture, and surface finish has become the norm.

So with the improvements in roofing membrane manufacturing and the increased control of the process, why do the applicable American Society for Testing Materials (ASTM) standards for the various single-ply membranes still allow a manufacturer to produce a membrane 10% thinner than its published nominal thickness? *Table 1* lists the applicable ASTM standards for different single-ply membranes, along with the allowable variation from the published membrane thickness "nominal" value.

It should be noted that the KEE standard has no thickness tolerance requirement, only that "agreed to between seller and buyer." The membrane thickness tolerance in each standard is arrived at by a consensus of ASTM subcommittee members.

All four individual ASTM standards for single-ply membranes reference another ASTM test standard, D751, to measure thickness. In this standard, the thickness of the membrane is determined by an average of measurements at multiple locations across the sheet (each standard is slightly different in terms of how to sample thickness); however, taking a single measurement of a membrane does not meet the standard testing protocol.

Rarely has it been reported that roof membranes are arriving at the job site 10% or even 5% above the nominal thickness. So, clearly, the membrane manufacturers have mastered the challenge of making roof membranes too thick.

In preparing this article, representatives from five single-ply membrane manufacturers were asked whether they needed, from a production standpoint, the -10% thickness tolerance. All five said no. When asked whether their current membrane as manufactured (their target thickness) might pass a -5% tolerance from the nominal thickness, one of the five said it would. The other four reported that they easily *could*, but it would be a special order.

By the producers' own admission, the current standards allow a wider tolerance than is required—so why the "sloppy" standard? All of the manufacturers contacted said they wouldn't mind if the standards were tightened, and several confided they wished the standards *were* tighter. Consider that if the standard definition of "nominal" were tightened to +/- 5% (reportedly an easy target), the result would generally

Product	ASTM Standard*	Thickness (min)	Thickness Tolerance	Thickness Over Scrim (min)
Polyvinyl Chloride (PVC)	D4434-09	45 mils	+/- 10%	16 mils
Thermoplastic Polyolefin (TPO)	D6878-08	39 mils	+/- 10%	12 mils
Ketone Ethylene Ester (KEE)	D6754-10	31 mils	min 31 mils	6 mils
Ethylene Propylene Diene Monomer (EPDM)	D4637-10	40 mils	+15/-10%	15 mils

*The last two digits indicate the year the standard was revised.

Table 1

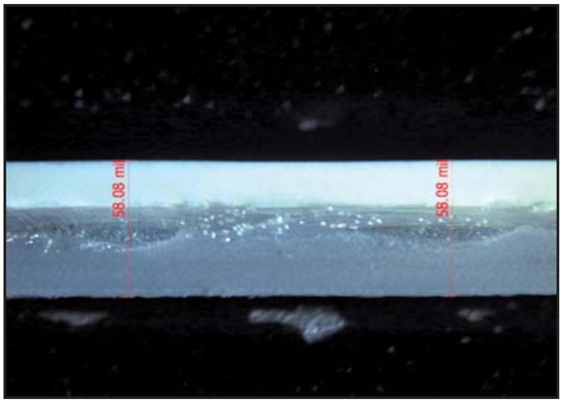

Figure 1 — Membrane meeting minimum thickness.

be a uniform membrane thickness within each generic category and, generally speaking, thicker roof membranes.

So what effect does thickness of a roof membrane have on its performance? It seems clear that the thicker a particular membrane is, the better its puncture and abrasion resistance, weathering, and aging properties. At some point, increased thickness interferes with seam welding, but our experience shows that a 96-mil membrane (the thickest membrane offered by thermoplastic membrane manufacturers) can be successfully welded.

If the ASTM standards were tightened, most membranes would have a greater thickness of polymer over the reinforcement. This "top side" of the membrane generally has the bulk of the membrane's weathering package—UV stabilizers, heat stabilizers, etc.

Of course, it is conceivable that manufacturers could respond by loading the backside of the membrane with filler to add thickness, adding little to the long-term performance of the membrane. It would be preferred to add all the additional thickness to the top side, but even splitting the added mil thickness between top and bottom would be a benefit.

Would there be any negative results from tightening the thickness requirement? Added thickness comes at a cost, somewhere between $.01 and $.015 per sq ft per added mil of thickness. On a nominal 60-mil membrane, the added cost for 3 mils (5% of 60) would be, at most, $.05 per sq ft. This is a very low incremental cost increase when compared to the overall cost of an installed roofing system. It would be a net positive for the manufacturers, as a tighter thickness tolerance would result in more pounds of product being produced and shipped.

More than one manufacturer polled indicated its company produced a roof membrane at the bottom of the 10% ASTM tolerance in thickness because of competitive pressures. Especially in this down market, if Manufacturer A's product is priced two or three cents per sq ft higher than Manufacturer B's, then Manufacturer A will likely lose the order. Thus, few manufacturers are going to "go it alone" and raise their target thickness. So, without consensus, specifiers and other end users will likely continue receiving 54-mil membranes when 60 mil is specified.

Does it have to continue this way? This author would like to challenge the ASTM Subcommittee D08.18 on Nonbituminous Organic Roof Coverings to consider tightening the membrane thickness tolerance when it recanvasses each single-ply standard. These standards must be reviewed every five years, or they may be reviewed any time a member puts forth a proposal. The standards should reflect what is reasonably possible; and as manufacturing technology improves, standards should reflect that improved precision.

In the meantime, specifiers can effect this change by requiring a minimum thickness rather than the nominal thickness. Since manufacturers are capable and generally willing to produce the membrane thickness desired, specifying a tighter tolerance of -5% seems a reasonable stopgap measure. Otherwise, specifiers will continue to represent (or explain) to their clients that a 40.5-mil membrane is the same as a 45-mil, and a 54-mil membrane is the same as a 60-mil.

Over the past 35 years, the quality of a

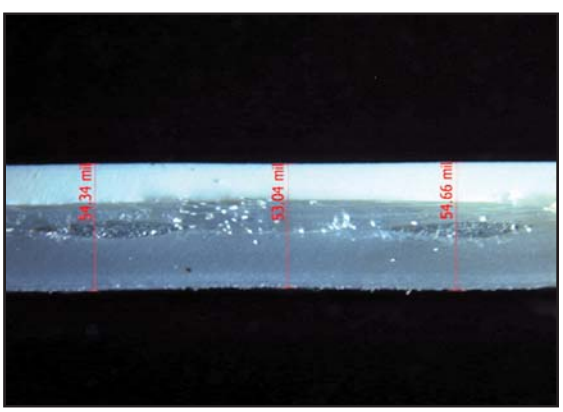

Figure 2 — Membrane not meeting minimum thickness over scrim.

single-ply membrane's chemical formulation and manufacturing, along with proper roof system design, have much more to do with the potential long-term performance of that system than thickness alone. But if those quality assurance issues are otherwise resolved, then producing a membrane with tighter thickness tolerances is simply the right thing to do.

Maturity doesn't just mean getting older; it also means stability, constancy, and refinement. Membrane thickness may be a small thing, but it represents a clear opportunity for positive change.

Jeff Evans, RRC

Jeff Evans, RRC, is a senior consultant, vice president, and partner in Benchmark, Inc., a roof and pavement consulting firm based in Cedar Rapids, IA. He received a bachelor's degree in construction administration from the University of Wisconsin at Madison in 1977. Jeff joined Benchmark in 1983 and has provided roof consulting services on a wide range of projects over the past 27 years. He has been a member of RCI since 1985 and was in the first class of Registered Roof Consultants, registration #0004, in 1988. Jeff is also an active member of SPRI and has served on the SPRI board of directors and as its Technical Committee chairman.

IBHS Holds Building Science Research Center Opening; Roof Research at the Forefront

The Institute for Business & Home Safety (IBHS) recently held a grand opening at its multirisk building science research center in Chester County, SC. The state-of-the-art, multihazard applied research and training facility will advance building science by enabling researchers to fully and accurately evaluate various residential and commercial construction materials and systems. The facility is entirely funded by the property insurance industry.

When fully operational, the IBHS Research Center will be able to simulate Category 1, 2, and 3 hurricane-force winds, extratropical windstorms, thunderstorm frontal winds, wildfire ember showers, wind-driven rain, and hailstorms within its 21,000-sq-ft test chamber. These capabilities largely derive from a massive array of 105 5.5-ft-diameter electric fans that can be accelerated up to 140 mph. The laboratory's 750,000-gallon water tank will supply the test chamber's 200 nozzles, capable of creating "rain" at a rate of up to 8 in per hour. In addition, hailstones, burning embers, and different types of "debris" will be introduced into the wind stream via a series of special ducts and other mechanical systems as part of a variety of tests.

"The new lab is a tangible, dramatic, generous demonstration of the property insurance industry's deep commitment to reducing and preventing losses that disrupt the lives of millions of home and business owners each year," said Julie Rochman, IBHS's president and CEO. "We are confident that IBHS's scientific research will greatly improve residential and commercial design and construction – and we are very excited to get to work."

The new IBHS multirisk building science center opened in Chester County, SC.

Initial research at the IBHS Research Center will focus on improved roofing performance. Because roof covers are replaced more frequently than other building components, changes in roofing products and installation requirements can produce significant paybacks within a short period of time. Priority areas of testing include looking at performance of shingles in various windstorm conditions, exploring the effects of short- and long-term aging on roofing material and systems, and developing cost-effective methods to retrofit various systems to reduce damage and losses.

"In addition to wind alone, damage from wind-driven hail, water, and fire will be core components of our research programs," said Dr. Timothy Reinhold, IBHS senior vice president of research and chief engineer. "There is so much to be learned about new construction, as well as how best to retrofit existing buildings now that we can closely watch building materials and entire systems perform in real-world conditions. We are pleased that, even at this early point in our initiative, we already are able to forge significant partnerships with leading public, private, and academic institutions that appreciate the quantum leap forward the findings from our lab will mean for building science in this country."

These two 1,300-sq-ft homes were constructed in the center's 21,000-sq-ft test chamber. The home on the left was built in accordance with typical U.S. building code requirements. The other home was built with certain code-plus features as outlined in IBHS's FORTIFIED for Safer Living® construction design. IBHS researchers created high-velocity wind gusts, straight-line winds reaching Category 2 hurricane strength, and wind-driven rain during the test. The traditionally built home was destroyed by winds reaching only Category 2 hurricane strength, while the FORTIFIED for Safer Living®-designed home remained intact.

Testing at the lab also will enable stakeholders in the insurance and construction industries to learn more about "green" building components and techniques. Research will focus on the durability and resilience of sustainable building technology, with particular emphasis on the potential for a technology to reduce property losses.