Wingnut Test Facility – WTF
Field- and Benchtop-Testing of Building Materials & Systems

INTRODUCTION

WTF Mission:
To develop and apply practical, meaningful, affordable, and accessible tests that represent real-world installation/operation and stresses that determine true service life of building materials, assemblies, and systems.

WTF will be a fully-transparent testing organization supported in concept, development, implementation, and reporting by all those truly committed to building performance: architects, builders, trade contractors, and last but not least, building product and system manufacturers. The direction and details of WTF's work will be determined by the needs of the high performance building industry, with no influence from those with vested interest in a particular building product, material, or system.

Problem Statement:
- Building today is complex and demanding, and getting more so.
Builders, architects, trade contractors, and building product manufacturers are working with increasingly complex building assemblies and mechanical systems to produce buildings that are more energy-efficient, more durable, and safer for workers, occupants, and the environment. The folks in the field feel like guinea pigs; feel as though the most meaningful testing of building materials and systems happens on their job sites.

- The building industry lacks practical, in-the-field, performance information.
To assess the performance of individual building products or the combined performance of two or more products in assemblies or systems, the building industry relies largely on a vast array of consensus-based laboratory testing, which is practically inaccessible to building practitioners and may have very little relevance to field performance.

- Developing practical, meaningful performance tests requires a new approach.
The existing myriad of standardized lab testing does not work. The two toughest yet most important aspects of practical and meaningful performance testing are field installation conditions and service life. Standardized laboratory testing means:

- "Easy" and steady-state installation conditions: temperature, moisture (RH & liquid water), acid-washed substrates (as opposed to "hard" and dramatically changing installation conditions: cold, wet, dirty).
- Highly-controlled, steady-state or cyclic long-term conditions (as opposed to exposure to field conditions, what the products/systems will really see over time).

We need building practitioners and product manufacturers working together to develop field and bench-top testing that is practical, meaningful, affordable, and fully-accessible

to the folks who are actually specifying and installing the assemblies and systems into which building products integrate.

The Solution: Wingnut Test Facility - WTF:

- Two guys give real-world, field testing a whirl.

For the past year or so, two building professionals—Peter Yost of BuildingGreen, Inc. and Dave Gauthier, longtime President of a local SIPs manufacturing plant—have been developing and then testing pressure-sensitive adhesive (PSA) tapes used in building air and water barriers. Loosely adapting what they deemed the most relevant ASTM tests for PSA tapes, the self-proclaimed "Wingnuts" worked with local builders and architects in the SEON Builders Guild (www.seon.info) to mimic conditions they faced in the field and focusing on aspects of performance that would separate PSA tape "wheat from chaff."

- At least some in the building industry take WTF seriously.

Peter Yost wrote a BuildingGreen blog series on the issue of meaningful testing of liquid sealants and PSA tapes, including the work of WTF (http://www2.buildinggreen.com/blogs/2645/StickyBusiness). And Peter included WTF work in presentations at many regional trainings and conferences (NESEA's Building Energy, SeventhWave's B4). Frankly, Peter and Dave fully expected to be dope-slapped around by building professionals and fully chastised by PSA tape manufacturers. Instead, all we got from anyone in the building industry was at worst amusement and at best "attaboys; how can we help?"

Next Round PSA Tape Testing:

- In window installations, PSA tape spans the window flange & the exterior wall.

If the window is installed before the weather-resistive barrier (WRB) then the tape is adhering to the window flange and the structural sheathing. If the WRB is installed before the window, then the PSA tape spans the flange and the WRB.

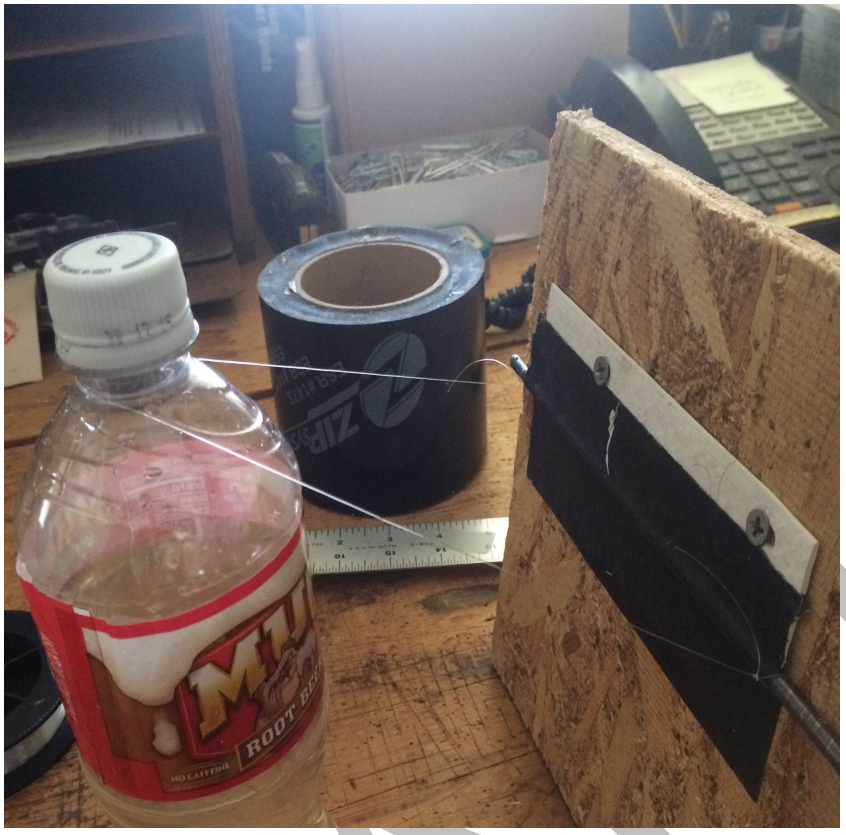
The window flanges are typically either aluminum or PVC. The interesting thing about both these materials—PVC and aluminum—is that they have a very smooth surface with low surface tension AND they both contract and expand quite a bit with temperature change.

- The "loading" of the PSA tape is primarily from cyclical pressurization/depressurization from wind.

In addition to the conditions of initial installation and daily/seasonal temperature and relative humidity changes, the stress the PSA tape will "see" is a pressure force PERPENDICULAR to the plane of the wall/tape/window.

WTF does not have the resources to build a pressure chamber that can cyclically pressure-load the set-ups, so Dave and I drafted up the set-up you see in the images below.

NOTE: The top image shows the PVC window flange; the bottom the aluminum. The bottom photo shows the test orientation: the substrate horizontal with the weight loading the setup with a gravitational perpendicular force.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Sodium 105mg 4%
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1. A 6-inch length of window flange (either aluminum or PVC) is fastened to the OSB rough side (or the WRB) through installation slots that allow the flange to move as needed with contraction and expansion of the flange.
2. An 8-inch long 1/4-inch diameter steel rod is placed just at the edge of the window flange.
3. A 2.25-inch wide length of the PSA tape is adhered just up to the fasteners on the flange, with the remaining tape humping up and over the metal rod (adhering to the rod) and adhering to the structural sheathing.
4. 10-pound test fishing line is tied around the exposed ends of the metal rod and looped around the neck of a soda bottle filled with enough water for the total suspended weight to be 1.0 pounds.

   NOTE: Since 1 Pascal = 1 Newton per square meter, and we agreed that the cyclical force should be no greater than 75 Pa.

   - 75 Newtons/sq m = 16.8 lbs.
   - Tape sample is 2.25 inches by 6 inches = 13.5 sq in.
   - 13.5 sq in = .009 sq m
   - 16.8 lbs * .009 sq m = 0.15 lbs

   Hanging a 1-pound weight is exerting approximately 6.6 times more force than what 75 Pa would exert, a factor to “simulate” accumulated stress/accelerated aging of the tape application?

5. The bottles would all sit on a shelf that could be easily lowered and raised to load and unload the bottle weights to simulate variation in the wind force.

   NOTE: Dave and I have not worked out just exactly how this shelf will be lowered/raised; could be down by hand or automated but our current “budget” for WTF testing is the pocket change Dave and I “pool” each time we get together, so much more likely for this to be manually accomplished.

WTF proposes to test with this new procedure for the following configurations:

1. Environmental: all setups to be located outdoors exposed to exterior temperature and relative humidity but protected from wind, precipitation, and UV/direct sunlight.
2. substrates:
   a. rough side OSB
   b. SBPO WRB (probably Tyvek or Typar)
   c. ZIP Wall sheathing
3. Tapes (premium acrylic PSA tapes)
   a. Zip Wall
   b. Pro Clima Tescon Vana
   c. Siga Wigluv
4. Window flanges
   a. Aluminum
   b. PVC
5. Installation conditions
   a. “ideal”

        i. 70F
        ii. 50% RH
        iii. 24-hour set time (adhere tape and not load with weight until 24 hours later)
        iv. substrate clean
    b. “job site”
        i. “cold” – record ambient and surface conditions on an upcoming fall day (target 40 – 50F)
        ii. “damp/wet” – spritz substrate with water and wipe with cloth
        iii. jobsite application: apply/adhere tape then load within 60 minutes

Remaining questions we have:

1. Should we periodically wet (spritz) the setups to simulate bulk water leaking onto the assembly past the cladding?
2. Is the 1 lb. weight what we should load the setups with; is there a justification for different loading that we should be using (we want to balance submitting the setups to realistic loads while “forcing” distinctions in performance)?
3. What sort of “cycle” should we employ for the loading/unloading?
4. Does the angle formed by the hanging weight based on the length of the fishing line make any difference in the loading of the setup (Dave and I think that since the ¼-inch rod demonstrates no visible flex with the 1-pound weight that the angle does not really matter…)?