

 **BASF**
The Chemical Company

Enershield®

Fastener Self-Sealing



Performance

The ability of an air/water-resistive barrier material to self-seal when punctured with fasteners is a key attribute of material performance. Unfortunately, there are few industry recognized test methods that measure self-sealing performance.

ASTM D1970 evaluates self-sealing of nail penetrations. This test involves puncturing the air/water-resistive barrier with two nails, partially withdrawing them, and determining whether leakage will occur when a defined amount of water pressure is applied for a 48-hour time period.

While ASTM D1970 provides useful performance data, and ENERSHIELD air/water-resistive barrier products have successfully met D1970 requirements both with and without SHEATHING FABRIC reinforcement, the diverse variety of fasteners used in construction creates a need for additional testing.

Testing Based on ASTM E331

First, a set of 59 fasteners commonly used in construction was selected for evaluation. Second, a set of 8' x 8' test panels were constructed per ASTM E331, using both wood and 16-gauge steel studs, and exterior-grade gypsum sheathing. ENERSHIELD and other air barrier materials were applied to the panels and allowed to dry. Once dry, the fastener set was applied to each panel. These panels were tested for resistance to simulated wind-driven rain.

ASTM E331 simulates wind-driven rain by applying a pressure differential across the test panel, then spraying the panel with water at a minimum rate of 5 gallons/ft² hour. Leakage of water through the panel constitutes failure of the test.

Four air barrier materials were compared using three pressure differentials. ENERSHIELD-HP, applied at the recommended 10-mils wet film thickness, was compared with a commercially available fluid-applied material applied at 90-mils wet film thickness, a 40-mil asphalt-based self-adhesive membrane and a mechanically-fastened wrap. All materials were applied in strict accordance with procedures outlined by their manufacturer for creation of an air barrier system.



ASTM D1970 test apparatus. This test measures the ability of a barrier material to self-seal around two nails in a manner sufficient to prevent a column of water from seeping through the penetration.

FASTENER TYPE
See Fastener Key

NOTE: 59 total fasteners per panel

FASTENER KEY

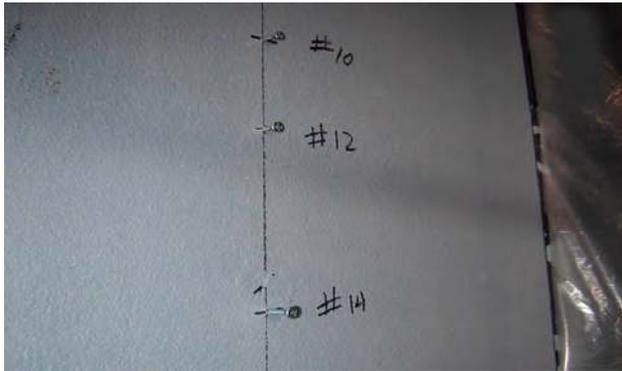
- 1 - #14 x 1 1/2" self drilling screw with 1 1/2" diameter washer, 1/16" thick
- 2 - #10 x 1 1/2" self drilling screw
- 3 - #12 x 1 1/2" self drilling screw
- 4 - #14 x 1 1/2" self drilling screw
- 5 - dovetail brick tie with #10 x 1 1/2" self drilling screw
- 6 - DW-10 brick tie with 2 - #10 x 1 1/2" self drilling screws
- 7 - 1 5/8" x 4" 20 ga C-stud with 1-#10 x 1 1/2" (top) and 1-#12 x 1 1/2" (bottom) self drilling screw
- 8 - #6 x 1 5/8" self drilling screw
- 9 - #8 x 1 5/8" self drilling screw
- 10 - 1 5/8" x 4" 20 ga C-stud with 2 - #10 x 1 1/2" self drilling screws
- 11 - 3" x 4" metal lath (2.5 lb) with 1 - #8 x 1 5/8" self drilling screw
- 12 - dovetail brick tie with #8 x 1 5/8" self drilling screw
- 13 - DW-10 brick tie with 2 - #8 x 1 5/8" self drilling screws
- 14 - corrugated brick tie with 2 - #8 x 1 5/8" self drilling screws
- 15 - #9 x 1 5/8" Hi-Low thread screw
- 16 - #6 (2 1/2") common nail
- 17 - 10d (3") common nail
- 18 - #8 x 2" wood screw
- 19 - #10 x 2" wood screw
- 20 - #12 x 1 3/4" wood screw
- 21 - #14 x 2 1/2" wood screw
- 22 - corrugated brick tie with 1 - 8d x 2 1/2" (top) and 1 - 10d x 3" (bottom) common nail
- 23 - dovetail brick tie with 10d x 3" common nail
- 24 - 3" x 4" metal lath (2.5 lb) with 1 - 16ga x 1 1/4", 7/16" crown staple
- 25 - DW-10 brick tie with 2 - 10d x 3" common nails

NOTES:

- All fasteners were installed into studs
- Individual fasteners not used to attach an object (ie brick tie, lath) were installed with fastener head held off of barrier 1/4 - 3/8"
- Fasteners used to attach objects were driven tight

An assortment of fasteners, 59 in all, were used to penetrate the ASTM E331 test panels.

Fastener Self-Sealing



Screws were partially driven through the air barrier materials



59 commonly used fasteners were tested

Pressure differentials of 2.86 psf, 6.24 psf and 12 psf were used. This simulates wind-driven rain traveling at 33mph, 50 mph and 69 mph respectively. Testing was run sequentially for 15-minutes at each pressure level, creating a 45-minute test procedure with steadily increasing severity. Over the course of 45-minutes, 240 gallons of water was sprayed at each panel, the equivalent of 6-inches of rain in 45 minutes!



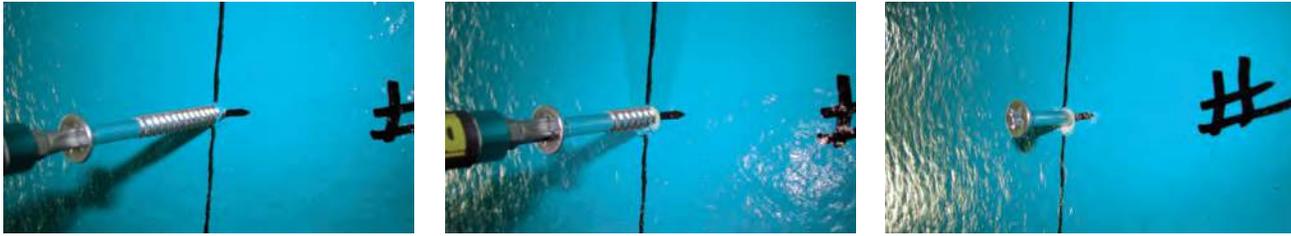
ASTM 331 test apparatus

ASTM E331 Test Results

Panels made using Enershield-HP and 40-mil asphaltic self-adhesive membrane did not leak at any pressure levels. All penetrations remained sealed.

Panels made with the thicker (90-mil wet film thickness) fluid-applied air barrier material had leakage at several screw penetrations. As the pictures on page 3 illustrate, this material adhered to some of the screws and was partially twisted off of the substrate, creating conditions that led to leakage.

Overall, the lowest level of performance was provided by the mechanically-fastened wrap, which exhibited leakage at numerous penetrations starting at the lowest pressure.



Air barrier leak caused by screw penetration

Several conclusions can be derived from this testing.

- Since the test was able to distinguish between the performance of different materials and rank them in terms of self-sealing capabilities, the method itself was shown to be robust and useful.
- Successful test results were obtained using ENERSHIELD-HP applied at 10-mils wet film thickness and a 40-mil self-adhesive membrane. Unsuccessful results were obtained with a 90-mil wet film thickness fluid-applied membrane and a thin mechanically-fastened sheet. Material thickness was therefore not a significant factor in determining self-sealing properties.
- ENERSHIELD-HP and 40-mil asphalt-based self-adhesive membrane offer high levels of self-sealing performance under the tested conditions.

Testing Performed According to ASTM E2357

The ASTM E2357 Air Leakage of Air Barrier Assemblies involves creation of an 8' x 8' mockup, then measuring its resistance to air leakage. A coated opaque panel is used as a reference. For this test, the opaque panel coated with ENERSHIELD-I was tested before and after penetration with 75 2" #8 screws sunk partially through the ENERSHIELD-I prior to testing. This panel allowed 0.0052 l/s/m² prior to screw penetration and 0.0059 l/s/m² after the screws were applied. These results easily exceeded the 0.2 l/s/m² maximum specified under ASTM E 2357.



ASTM E2357 panel made using ENERSHIELD-I with 75 penetrations

Conclusions

ENERSHIELD-HP and ENERSHIELD-I demonstrated self-sealing capabilities after penetration by nails, screws, and staples. While this test data does not replace the need for careful jobsite installation and professional inspection, it demonstrates that ENERSHIELD air/water-resistive barrier materials are capable of self-sealing when penetrated by a variety of screws and fasteners.

Note

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