TITLE: Fasteners and Self-Sealability of Weather-Resistive Barriers

DESIGNATION: IIBEC-TA-005-2014 (updated 2023)

OBJECTIVE: To provide informative advisory regarding the potential moisture and air infiltration associated with fasteners that penetrate both self-adhered and fluid-applied membranes installed as weather-resistive barriers or air barriers within an exterior wall assembly.

BACKGROUND

The use of air barriers within exterior wall assemblies of commercial buildings has become widespread in the construction industry as a practice for reducing heat/cooling energy consumption. As defined by ASTM, an air barrier is a material or system in building construction that is designed and installed to reduce air leakage either into or through the wall.

One of the performance characteristics that the Air Barrier Association of America (ABAA) requires for fluid-applied membranes, self-adhered membranes, and membranes factory-bonded to sheathing is self-sealability or fastener sealability. This property is determined by the test procedure outlined in paragraph 7.9, Self-Sealability (Head of Water Test) of ASTM D1970, *Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection*.

This test method specifically refers to self-sealability of sheet-applied membranes but can also be utilized for liquid-applied materials. The test consists of driving two galvanized nails positioned 1 to 2 inches apart through the air barrier material that is applied to a 12- by 12-inch, 3/8-inch thick piece of plywood. Then the pointed ends of the nails are tapped so that the heads of the nails are backed out approximately ¼-inch from the surface of the air barrier membrane. A 1-gallon container is attached over the nail heads and sealed to the air barrier material applied on the plywood. A second container is positioned below the pointed ends of the nails. The upper container is filled with water to a depth of 5 inches (which equates to 101-mph wind speed), and the specimen remains in this position for three days at 4ºC ± 2º (40ºF ± 5º). After the test, the lower container, the shanks of the nails, and the underside of the plywood are inspected for the presence of water. The upper container is removed from the air barrier material, which is then peeled from the plywood back to the nails. The underside of the air barrier material is inspected for the presence of water. Evidence of water at any of these inspected locations constitutes a test failure.

DISCLAIMER

CONSTRUCTION

Current construction of exterior wall assemblies includes the installation of glass-faced gypsum sheathing that is mechanically attached to light-gauge metal stud framing, and then the air barrier is applied to the gypsum sheathing. A variety of cladding or finish material is then installed over the air barrier, including but not limited to the following: metal lath and stucco, metal panels on furring strips, masonry with metal wall ties, etc.

Often, the intention is to install the various components so that they are attached with fasteners to the underlying metal stud framing. However, the various accessories that are common in plaster, and metal furring strips or ties that are used with other claddings, are mechanically attached with fasteners that are installed through the air barrier material and often do not penetrate into a metal stud. This condition may also occur due to poorly installed fasteners or fastener length exceeding the depth of the subframing member (i.e., hat- channel).

DISCUSSION

ASTM E283, *Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen*, and E2357, *Standard Test Method for Determining Air Leakage of Air Barrier Assemblies*, go beyond material testing and measure air leakage through an assembly of air barrier materials. In doing so, they encompass fastener penetrations—at least those that exist at the plane of the air barrier or those that are installed and can be sealed at the time the air barrier is being installed. The specimen is a realistic, 8- x 8-foot wall mock-up, complete with typical wall penetrations, including a window, galvanized duct, PVC pipe, post-applied brick ties, and hexagonal and rectangular electrical junction boxes. Most of the materials that are currently identified as air barrier materials successfully pass this test. However, the test does not encompass fastener penetrations that are not installed into a suitable substrate (i.e., metal stud).

Unlike securement into a plywood substrate, when a fastener is installed into and through gypsum sheathing and does not penetrate into a sound substrate, the fastener continues to spin. The gypsum sheathing is not substantial enough to allow the fastener to attain adequate compression against the air barrier material (either liquid-applied or self-adhering sheets), and the fastener hole is commonly enlarged. In addition, variability introduced during field installation of fasteners can create conditions that are not taken into account in lab tests. For example, if the fastener is not installed straight and true, it can tear the membrane, which can result in water leakage, even if the fastener is driven into a framing member.

The potential for water intrusion through fastener penetrations—particularly with claddings like siding, stucco, and adhered masonry veneer, where thousands of fasteners can be used to attach the siding or metal lath through the air barrier—can be minimized by following common practices as follows:

- Confirm fasteners engage with studs/framing or a sound substrate.
- Avoid the use of supplemental fasteners, sometimes used incorrectly to attach accessories between studs such as control joints and other accessories in stucco (required to be wire tied between studs).
- Avoid errant fasteners that do not go through studs or spin and create a larger opening, as well as loose connections (particularly in gypsum-based sheathing).

- Remove “loose” fasteners and seal the holes.

- Avoid the use of powder or power-actuated fasteners.

SUMMARY

While lab tests demonstrate the ability of properly installed fasteners to seal to some extent where they penetrate air barriers, penetrations can become sources of water intrusion, depending on many variables—type of fastener, angle at which fastener is driven, and the amount of water and pressure at the fastener penetration, regardless of material type and claims that may be made about *self-sealing* characteristics. Use air barriers that are fully and independently qualified as water-resistive barriers to diminish the risk of water penetration through fasteners.