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# AIR & VAPOR BARRIER

## Common Air Barrier Performance Tests and Evaluations

The following is a list of testing and diagnostic evaluations that consultants and testing agencies often perform. A description of each is provided, along with the purpose and precautions. Though this list is not exhaustive, it incorporates the most common testing.

### Substrate Acceptability

Much of this testing is visual. Verify that wall materials are secured in place, not damaged and free of gaps or voids. If there are gaps or voids, they must be addressed. Moisture content may also be evaluated. Moisture limit for wood is universally agreed upon at less than 20%, though some parties insist on a 15% limit. There is no universally agreed upon moisture limit for gypsum sheathing, concrete and masonry. However, most wall membrane manufacturers specify that these materials shall be dry to the touch and free of negative side moisture sources. Negative side moisture sources include open head of wall, flooding at base or excessive moisture within the building. Wall membrane installers are instructed not to proceed with work until substrates are acceptable.

### Pull Adhesion Testing (ASTM D 4541)

This is a destructive test in which a disc is glued to the wall membrane surface and a portable adhesion tester is used to pull the disc away from the wall. A load in pounds-force is generated, and PSI can be calculated based on the area of the disc. This test is useful for evaluating the bond strength of the wall membrane to the substrate. Often, a minimum value of 16 psi is expected. Exercise caution with this test. A poorly bonded disc or a weak substrate can produce low pull test values on a well-installed membrane. Also, field conditions such as hot or cold temperatures, or pull test technique can produce varied results. If this testing is done, it is important to perform the test early in the installation and set expectations moving forward. The pull adhesion test should be used for diagnosing problems of membrane adhesion or substrate integrity, rather than use as a numeric pass/fail test.

### Detection of Air Leakage Sites (ASTM E 1186)

This test method typically uses soap film (bubbles) or smoke to locate air leakage sites under pressure difference. Often called the “bubble gun” or “smoke pencil” test, its purpose is diagnostic; looking for the “big holes”. This testing can be done before or after assembly/whole building air leakage testing. It is useful before the testing to identify and fix leaks, making it more likely that the assembly/whole building will pass the test. It is also useful after a failed assembly/whole building test to identify areas of leakage that likely caused the failure.

***Notes on Assembly Air and Water Leakage Testing (ASTM E 783 and ASTM E 1105):*** These tests can be done on a mockup or on the actual construction. It is important that construction in the test area is representative of real conditions. The purpose of this testing is to establish components, assembly sequence, workmanship and detailing required to meet the performance criteria.

### Air Leakage through Assembly (ASTM E 783)

In this test, an area of the wall is fitted with a de-pressurization chamber, and air leakage is measured at a specified static pressure difference. Building Code (2012 or later IECC; 2010 or later ASHRAE 90.1) requires an air barrier assembly to have an air leakage rate no greater than 0.04 CFM/ft² @ 1.57 PSF (0.2 L/s*m² @ 75 Pa). The Project specification may call for even tighter performance. The Code minimum is generally quite easy to achieve with a properly installed, fully adhered wall membrane. Specifications calling for tighter performance may require detailing above and beyond a standard installation. The wall membrane installer should be well-informed about the performance requirements for the project.

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### Water Leakage through Assembly (ASTM E 1105)

In this test, an area of the wall is covered with a constant film of water and a static pressure difference is induced – either with a de-pressurization chamber on the interior side of the assembly or with a large fan that blows water spray at the exterior side of the assembly. The water is dispensed through an array of spray nozzles called "the spray rack". Duration and pressure difference are selected depending on the desired performance. A pressure difference of -2.83 PSF or -6.24 PSF held for 15 minutes was very common in specifications, as the performance matched that of fenestration. It is more common now that a test duration of 2 hours is specified, with pressure held at -6.24 PSF. In extreme environments (hurricane-prone areas), a test at -15 PSF for 15 minutes is added onto the 2-hour @ -6.24 PSF test. The water test is the toughest test to pass. Often, the 1st test is a failure. It is important that sources of leaks are identified and remedied in a manner that is practical in the "real" construction.

### The Whole Building Air Leakage Test (ASTM E 779)

In this test, the building is fitted with a blower door, or multiple blower doors and the building is de-pressurized to a specified level. The flow rate of the blower fans to maintain the pressure difference is the total air leakage through the building. Preparation for this test is quite involved – measuring the affected square footage, sealing mechanical leak pathways, breaking the building into zones if necessary and sizing/fitting the blower doors. Building Code (2012 or later IECC; 2010 or later ASHRAE 90.1) requires a whole building air leakage rate no greater than 0.4 CFM/ft² @ 1.57 PSF (2.0 L/s*m² @ 75 Pa). The project specification may call for even tighter performance. This is a test that you DO NOT want to fail. At this stage, the building envelope is constructed, and air leaks are difficult to find and fix. Therefore, a quality control program for continuity of the building envelope air barrier is essential. The whole building test should be a verification of the execution of this program.

### Standard for Determining Air Leakage Rate of Air Barrier Assemblies (ASTM 2357)

This measures the air leakage of a representative air barrier assembly before and after exposure to specific conditioning cycles and then assigns a rating dependent upon the results. It tests each of the elements in the air barrier assembly including the air barrier material, penetrations, terminations, and connections. It gives evaluators a more accurate picture of how a fully sealed air barrier assembly withstands simulated wind load conditions that are likely to cause leaks in real-world situations.

Both ABAA and the ASHRAE 90.1 Standard require that an air barrier assembly provide an air leakage rate not to exceed 0.2 L/s x m² @ 75 Pa when tested. Although this is a laboratory procedure, the method may also be applied to site mockups.

### Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials. (ASTM E2178)

This test method measures the air leakage rate of building materials that will be used in the air barrier at various pressure differentials. The accepted level of air permeance of materials defined in many local codes and standards is less than 0.004 cfm/ft² @ 1.57 lb/ft² (0.02 L/(s • m²) @ 75 Pa). This value is also used by the Air Barrier Association of America (ABAA) in its evaluation of air barrier materials.

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