Case Study | March 25, 2025

FIELD TESTING

ASTM E1105 + E783 Performance Validation of Multi-Module Fenestration

Envelope Field Testing (Air + Water): A Case Study

Whole-System Field Testing: Full Assembly, Full Confidence

Introduction

In modern construction, verifying that the building envelope performs as intended is often treated as optional. Performance is assumed—based on past experience, lab testing, or manufacturer certifications. But true performance doesn't exist on paper. It exists on site, under real-world conditions. Field testing remains one of the few tools that can directly confirm whether the as-built system meets project performance criteria for air infiltration and water resistance.

Even when specified, testing is too often applied narrowly—limited to a single module or an idealized segment of a larger system. These tests fail to challenge key transitions, terminations, and sequencing beyond the specimen itself. The result may satisfy the letter of the spec, but it reveals little about the behavior of the actual installed assembly.

On this project, the design and construction teams understood the difference. They opted to test the full ribbon window assembly—head to sill, jamb to jamb—exactly as delivered. That decision made the test meaningful, and the result consequential.

Value to Project Teams

Full-opening field testing offers more than a compliance checkbox. It verifies integration. It confirms that joints, receptors, anchors, and sealant details—often the weak points in performance—were executed correctly. For project teams, a passing result reduces leak risk, avoids post-occupancy issues, and provides documented assurance that the delivered assembly performs as intended. It's a rare opportunity to prove that product, process, and design have aligned.

Purpose

A mid-rise residence hall on a Chicago university campus underwent a full renovation in 2021, including replacement of its window systems with modern, performance-rated assemblies. To confirm that the installed fenestration met the project's specified criteria for air infiltration and water penetration resistance, the design team required field validation. Hightower Labs was contracted to perform ASTM E783 and ASTM E1105 testing—executed on a full ribbon window assembly, not a single unit—to provide meaningful performance verification aligned with project intent.

Code Context and Project Criteria

While model codes require that exterior walls be weather-resistant and protect against water intrusion, they do not mandate field testing to confirm these outcomes. Unless required by the project specifications, commissioning authority, owner directives, or other authorities having jurisdiction, there is no default obligation under code to validate the water resistance of any specific installed surface area.

On this project, however, the architect—likely acting as the delegated authority for performance assurance—required field validation of the installed ribbon window assembly. The goal was to confirm that the delivered system met its specified and contractually-obligated performance criteria for water intrusion resistance under defined test conditions.

Test Parameters

Category	Water Penetration	Air Infiltration
Test Method	ASTM E1105 (A)	ASTM E783
Press. Diff.	5.29 psf	6.27 psf
Equiv. Wind	46 MPH	50 MPH
Pass/Fail Criteria	E1105 W.P. Def. (int. plane)	Max. 0.15 cfm/ft² Fixed + Operable

Where Performance Lives

As informed by our work investigating and resolving deficiencies, we know that failures in building envelope systems rarely occur in the center of a product. They often occur at transitions—where systems meet other systems, where manufacturer tolerances collide with field conditions, where sequencing, workmanship, and substrate variation converge. These are weak points of real-world assemblies, yet most QA processes remain focused on isolated unit performance or lab testing environments that ignore those interfaces entirely.

The only way to measure and understand true performance is to test real assemblies—exactly as they're built, with all the risk, sequencing, and field integration that comes with them. Whether that understanding is genuinely pursued is up to each individual project team.

Product Ratings ≠ Field Performance

Labeling a window or other product as "[*Insert_Trade_Group*]-rated" may describe how that product performed in a lab, in isolation, under conditions that often diverge from real-world installations. Despite common interpretation, even some building code-recommended ratings do not endeavor to predict how that product will perform when installed with perimeter conditions such as receptors and sealant, or when splice joints, field-mulling of multiple units, or non-gateway sizes are introduced.

In the field, performance isn't inherited from a rating. It must be demonstrated—under pressure, in place, and as delivered.

Test Preparation

Prior to testing, a visual inspection was performed. No obvious visible deficiencies or signs of water intrusion were observed. Operable units were exercised through their full range five times. Ambient temperature and humidity were stable, and wind speeds were measured locally (not on an app. reading the weather measured at the nearest airport) and were minimal.

Due to inadequate site water pressure—an issue common on active construction sites—we deployed dual water reservoirs and independent pump assemblies to deliver the required spray volume for ASTM E1105 (5.0 gal/ft²/hr).

Many firms conducting ASTM E1105 are constrained by site water pressure, opting to test only partial openings using downsized spray racks. HTL's portable reservoirs and pump setup takes control of the water variable, and allows full-surface spray at the required rate, enabling testing of installed conditions at full scale.

Test Execution: ASTM E783 – Air Infiltration

The air infiltration test was performed using a custom wood & clear vinyl test chamber installed to the interior face of the full window assembly. The chamber was carefully sealed to the interior perimeter returns of the envelope's primary air/water barrier flashing at the head, sill, and jamb conditions—ensuring that the pressure field would act across the entire. The chamber was designed and assembled such that no portion of the chamber—including its clear plastic sheeting—would come into physical contact with the fenestration specimen once the chamber was depressurized.

A continuous, impermeable barrier (tare sheet) was applied across the exterior face of the assembly to prevent airflow through the specimen. With the tare in place, airflow through the chamber—including extraneous leakage from the apparatus and perimeter seals—was measured at the specified pressure differential of 6.27 psf to establish a baseline.

After the tare was removed, air was then allowed to flow through the window assembly, driven by the suction created by the air pressure differential (the depressurized chamber). A second airflow measurement was taken—this time with the full specimen exposed. The difference between this second measurement and the baseline represents the actual air infiltration through the installed system at the specified pressure differential.

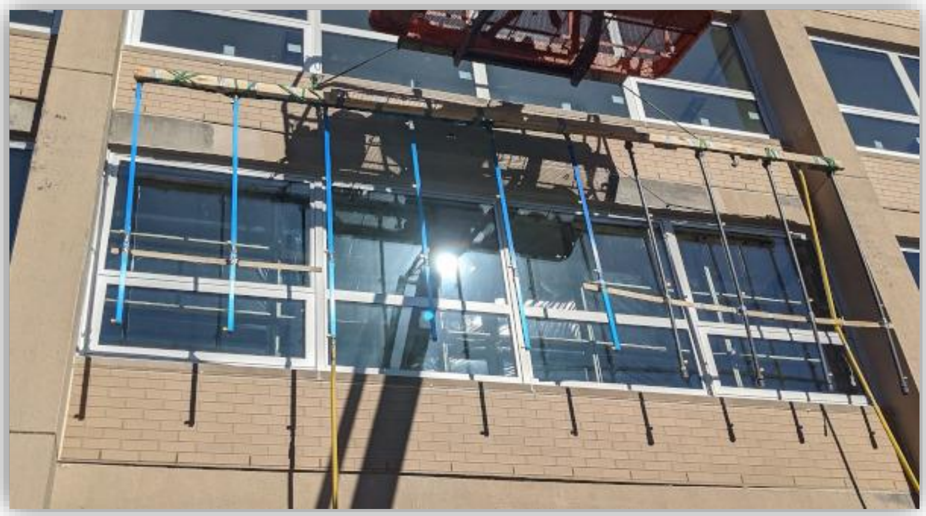
Pressure Differential: 6.27 psf (300 Pa) **Result**: 0.02 SCFM/ft² (< 0.15 CFM/ft² – *Pass*)

ASTM E783: Additional Commentary

While ASTM E783 remains the industry-standard method for measuring air leakage through installed windows and doors, it is frequently misunderstood—and often misapplied. In practice, the test is commonly executed in ways that omit critical variables or produce data that appear valid but fail to reflect real-world performance.

In practice, the majority of ASTM E783 data generated on U.S. job sites offers limited value. Even when executed to the letter of the standard, the test's usefulness is often constrained by specimen selection. Measuring the air leakage rate through a single structurally glazed unit—isolating only the SSG joint while omitting frames, gaskets, receptors, and other common leakage paths—rarely yields actionable insight. Most E783 field test reports do little to inform the project team's understanding of whole-envelope air performance. The result may look clean, but it's rarely complete.

Regarding Tare: ASTM E783 permits alternative methods for measuring extraneous air leakage—but only if agreed upon by all parties. The preferred (and procedure-sanctioned) method remains the use of a continuous polyethylene barrier (tare sheet) applied across the full specimen. Other methods, such as localized tape applications, often fail to isolate the correct flow paths and should be treated with skepticism.



Test Execution: ASTM E1105 – Water Penetration

Following air infiltration testing, the same full-opening specimen was evaluated for water penetration resistance in accordance with ASTM E1105, Procedure A. The chamber remained sealed to the interior returns of the air/water barrier system, encompassing the entire fenestration opening.

On-site water pressure was insufficient to support the required spray volume—a common limitation on active job sites. To overcome this, dual water reservoirs and pump assemblies were deployed to maintain uninterrupted delivery at the standard flow rate of 5.0 gal/ft²/hr. The spray rack system was assembled at grade and pre-tested to confirm capacity, with calibrated pressure gauges located on the rack assembly itself. This configuration allowed real-time monitoring and adjustment. Importantly, because raising the spray rack increases vertical head pressure requirements, system pressure was verified and adjusted to ensure that proper flow would be maintained at elevation.

With all pre-test checks complete—including verification that the chamber could achieve and sustain the target pressure differential, and that the spray racks could deliver the specified water volume for the full test duration—the calibrated spray racks were positioned on the exterior in anticipation of the scheduled start time.

The system was then tested under a sustained static pressure differential of 5.29 psf, equivalent to approximately 46 mph wind speed. This pressure acts uniformly across the entire specimen, creating the suction forces that drive water into deficient assemblies over the course of the full fifteen minute test.

ASTM E1105 Test in Progress – Full 15-Minute Test Duration

Test Results and Documentation

Under this test environment, the full ribbon window assembly—including fixed and operable units, mullions, receptor transitions, perimeter sealant, and all points of integration with the surrounding construction—exhibited no evidence of water penetration. A **'pass'** result.

Within 48 hours, project team members received Hightower Labs' comprehensive field test report. Full-page color images, clearly marked results, and well-organized summaries make it easy for recipients—whether deeply technical or just skimming—to grasp the outcome. With complete photographic coverage, thoughtful documentation, and clear, observation-driven analysis, the report offers a transparent view of the testing process. For many stakeholders, it's the next best thing to being there.

The passing result validated the performance of the installed fenestration system as a complete, field-integrated assembly. Unlike single-module tests, which isolate a single segment of an envelope system, this evaluation confirmed that the total delivered configuration—including receptors, field splices, and perimeter seals—met the water resistance criteria at the specified design pressure.

All parties—whether attending in person or reviewing the report—witnessed that the specified system, when installed per project details with the prescribed materials and sequencing, was, in fact, capable of delivering the required performance. The test provided not only verification, but shared validation: of the product, the process, and the assembled result.

Whole-System Testing Yields Real Insight

Testing a single module do not often adequately capture the behavior of a complete fenestration system. These tests may yield passing data on paper, yet fail to reflect reality. Full-opening testing eliminates that ambiguity.

Water Resistance = Performance Metric, Not Guesswork

ASTM E1105 is not a simulation or a theoretical benchmark. It is a defined test environment—controlled pressure and calibrated water volume—designed to verify a product's ability to resist water penetration under load. Just as speed is a measurable attribute of a vehicle, water resistance is a measurable attribute of an envelope system. Either the system delivers, or it doesn't.

Conclusion

This wasn't about chasing a pass. It was about demonstrating that the materials, installation, and sequencing—when executed as shown—were capable of delivering the required performance. The result wasn't assumed. It was proven.

That is the purpose of full-opening field testing: to validate what matters. That outcome—and the confidence it provided—was only possible because the test was executed correctly, comprehensively, and at full scale.

Ready to Test What Matters?

Hightower Labs brings precision, credibility, and real-world experience to building envelope QAQC. Our full-scale field testing programs, leak investigations, and consulting services help owners, architects, and contractors connect design intent to delivered performance.

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