Version 1.0 | January 30, 2025

BEAM03 PROCEDURE INTRODUCTION

Water Resistance Testing for Substantial Building Envelope Areas

Executive Summary

The BEAM03 procedure represents a practical, scalable, and innovative approach to evaluating building envelope water resistivity. Developed to address critical gaps in traditional QAQC practices, the procedure adapts oversight methodologies to modern construction practices and systems. BEAM03 provides a comprehensive solution for testing larger portions – or even the entirety – of a building envelope under static pressure differential. By blending elements of ASTM E779 and ASTM E1105, and leveraging advancements in air-moving equipment, this open-source procedure enhances statistical reliability, transparency, and relevance in building envelope performance evaluations.

BEAM03 is designed to overcome the limitations of traditional water testing methods. Its processes allow stakeholders to efficiently assess the water-resistivity of complex geometries, system transitions, and concealed vulnerabilities across expansive specimen areas, delivering reliable, conclusive, and repeatable data that withstand scrutiny.

This procedure is particularly valuable for building owners, prospective owners, developers, contractors, architects, and legal professionals. By providing actionable insights into envelope water-resistive performance, it empowers stakeholders to make informed decisions about envelope durability and quality.

As an open-source resource, BEAM03 (and others in the BEAM series) reflects Hightower Labs Inc.'s commitment to advancing industry quality and fostering collaboration within the construction and owner/manager communities.

To access the full BEAM03 procedure and learn more about its applications, visit: https://www.hightower-labs.com

INTRODUCING THE BEAM03 PROCEDURE

Water Resistance Testing for Large Building Envelope Areas Under Static Pressure Differential

V1.0 (01.30.25)

INTRODUCTION

Open Source Solutions for Improved Building Assessments

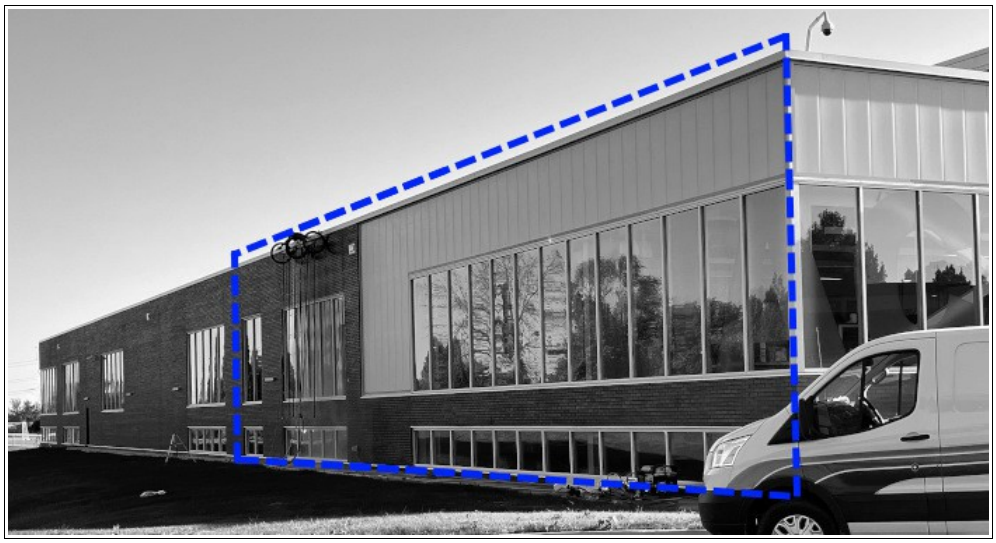
Building envelope air, water, and thermal performance are critical to durability, maintenance costs, occupant comfort, air quality, and energy efficiency of the built environment. Yet the field testing and inspection processes of the industry's status quo QAQC oversight increasingly fall short in the purpose of identifying quality risks and deficiencies. Consequently, more buildings are being delivered with latent deficiencies and maintenance/energy cost exposure.

In an effort to counter this trend, we developed a set of practical tools for evaluating building envelope performance. These were primarily intended to standardize an evolving set of internal working protocols to streamline distribution, improve coordination, and accelerate client absorption. Now they are distributed freely and available to reinforce existing suites of building envelope performance evaluation procedures in the modern environment.

What is the BEAM03 Procedure?

BEAM03 is a building envelope water-resistivity assessment method that integrates pertinent elements of ASTM E779 and ASTM E1105 – two established standards in air and water performance testing. ASTM E779 provides methods for air leakage testing for whole building enclosures, while ASTM E1105 observes water penetration resistance in localized areas. By merging technical and procedural aspects of these approaches (depressurization methods from E779, water delivery apparatus from E1105), BEAM03 provides a practical and scalable option for evaluating the water-resistive capabilities of building envelopes across large surface areas. This combination provides a more comprehensive water-resistivity testing methodology to supplement the QAQC regime commonly specified.

Unlike ASTM E1105, which requires labor- and material-intensive chamber construction to depressurize relatively small portions of an envelope, many applications of the BEAM03 procedure eliminate the need for chambers altogether. Instead, it allows depressurized testing of much larger areas, including entire elevations or even the full envelope. This not only reduces unit costs ($/ft² tested area) for QC verification, but also provides stakeholders opportunities to test expansive combinations of wall systems and envelope geometry (e.g. parapets) that would otherwise be unfeasible or cost-prohibitive to test with chambers.



Specimen Area Evaluated Under BEAM03 Procedure in One Mobilization

CHALLENGES WITH CURRENT WATER TESTING PRACTICES

Limits of Specimen Selection
ASTM e1105 and AAMA 501.2 specimen selections are often limited in size and scope, which can constrain a stakeholder's ability to evaluate the overall envelope and undermine the effectiveness of progress construction quality control. Common test specimen examples include the following:

- A single module of a unitized curtain wall or window wall.
- A single glazing infill within a stick-framed curtain wall or storefront.
- One terrace door, excluding critical elements such as the transom or adjacent sill terminations (e.g. end dams).
- A punched window with the chamber taped to the window frame, thus omitting critical transition and perimeter detailing and excluding adjacent walls entirely.
- A single horizontal-to-vertical mullion intersection in a curtain wall system.

Specimens that are too small or limited in quantity may fail to provide meaningful insights into a building envelope's overall performance. This often leads to miscalculation of the broader envelope's functionality under certain environments.

Knowledge Gaps and Misunderstandings in QAQC
Field testing practices are often misunderstood, with confusion surrounding critical aspects such as specimen selection, chamber position/terminations/design, applicable procedures, test pressure justification, and the actual effects imposed by the test. Even some envelope consulting professionals may lack a full understanding of what is being evaluated under certain test conditions, how to interpret results, or whether a specimen represents a statistically significant and representative portion of the envelope. There exists an industry-wide knowledge gap that can compromise quality assurance. A more comprehensive test encompassing broad envelope areas negates the impact of this gap, allowing observers and managers to focus on action and interpretation of the results.

Compromised Testing Scope
A lack of understanding of or emphasis on QAQC value often results in reduced field testing scopes, presented as cost-saving VE (“value engineering”) measures. These reductions can compromise the thoroughness of performance evaluations during construction, leading to incomplete assessments of the envelope’s water-resistive capabilities under testing conditions.

Potential or Perceived Conflicts in Third Party Observations
Field testing agencies frequently conduct field evaluations of products by manufacturers who are also clients for off-site lab testing and product certification. Further, the specified “independent field QC” scope is regularly subordinated into the subcontractor's scope, effectively relying on the contractor to police their own work.

Consequently, a stakeholder's vision of a building enclosure's water-resistivity may be limited solely to the details of a narrowly-scoped test report provided by a field testing agency under contractual obligation to the installer that is the subject of the tests.

Evolving Challenges in Envelope Technology
Shifts (ostensible advancements) in building envelope technology and economics have rendered some QAQC templates (specifically test procedures, volume, and quantity) insufficient.

Inconsistent QC Resolution
When items of concern are identified during testing, their implications for the broader envelope are often overlooked. Remediation efforts are frequently limited to surface-level, field-applied sealant fixes that improve the specimen's ability to pass the test, but fail to address the root cause of the issue. These quick fixes often lead to same- or subsequent-day "passing" results, the achievement of which may be construed as sufficient to "close" the deficiency. Similar at-risk conditions across the balance of the envelope are unlikely to be evaluated unless specifically required (e.g. "*failure must result in testing of two like conditions,*" etc.).

Even when additional testing on like conditions is conducted, preemptive preparation by the contractor (employing the surface-level, field-applied fixes already proven to yield passing results) can induce subsequent "passing" test reports and obscure underlying issues and their frequency. This practice undermines the integrity of the evaluation process and may incline overestimation of the envelope's true water-resistive performance.

The responsibility for broader implementation of remediation across the envelope typically rests with the construction team, which may not always consistently address these obligations. The BEAM03 procedure, among other things, counters this potential by enabling the testing of much larger specimens. This approach reduces the viability of pre-test specimen improvements (e.g. face-sealing an entire elevation versus a single module) and increasing statistical weight of findings (e.g. 3 of 7 sill receptor inside corner miters leaked, rather than 0 of 1 that had received pre-test enhancements). Larger specimens support a more comprehensive and representative evaluation of the building envelope's water-resistive performance.

BEAM03 IMPROVEMENTS

The BEAM03 procedure provides several benefits for stakeholders interested in evaluating a building envelope's water resistivity:

Scalable Testing
BEAM03 enables static pressure differential water-resistivity testing of large portions—or even the entirety—of a building envelope. This approach accommodates logistically challenging projects, unconventional geometries, and complex assemblies that might be otherwise unfeasible for chamber construction. This procedure provides stakeholders with critical data to address key questions:

- *Was a statistically significant area of the building envelope evaluated for water resistivity?*
- *Were a sufficient quantity of potentially risky details evaluated for water resistivity?*

Cost Effective
On a per-square-foot basis, BEAM03 is more efficient than traditional methods. It enables testing of significantly larger surface areas in roughly equivalent mobilizations, delivering more comprehensive insights and increasing the statistical significance of results.

Transparency and Fairness
Traditional water resistivity evaluations, such as ASTM E1105 and AAMA 501.2, typically involve small specimens - sometimes limited to single modules - representing only a diminutive fraction of the total envelope. The efficacy of these evaluations is further compromised when specimens are pre-prepared in ways that might not be representative of the project's broader construction practices.

BEAM03's large-scale approach reduces the feasibility of such manipulative practices. It reduces the potential influence of test chamber isolation and selective specimen preparation, which can distort the interpretation of results. By enabling testing across larger areas, BEAM03 renders these practices inapplicable or impractical, delivering more representative and accurate performance evaluations of the building envelope as constructed.

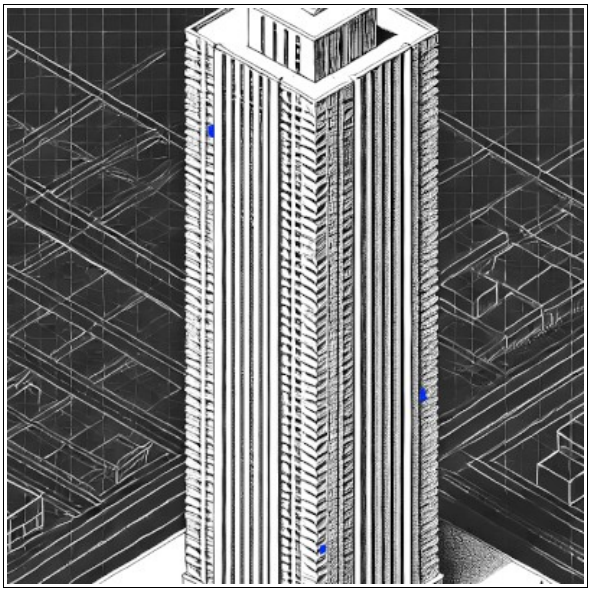
Evaluate Complex Geometry
Attempts to chamber, depressurize, and observe elements such as wall cantilevers, soffits, dual-stage sealant cavities, canopy penetrations, and other concealed primary barrier conditions are often deemed cost prohibitive and yield inconsistent results. Parapet walls, for example, are frequently not considered for ASTM E1105 testing scope.

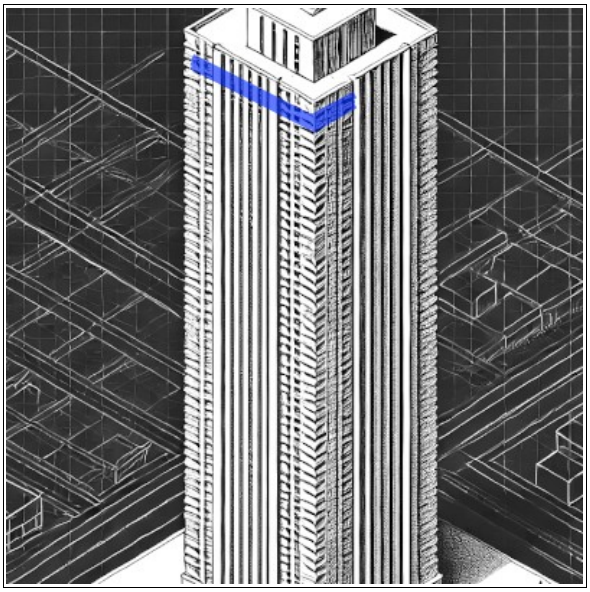
The BEAM03 procedure enables the depressurization of substantial portions of the envelope air barrier (which often coincides with the water barrier, depending on individual project details), wherever it may lead, including parapets and other hard-to-test areas. With the BEAM03 procedure, these often-overlooked and frequently problematic building details can be thoroughly evaluated.

Incorporate Wind and Precipitation Variability
BEAM03 embraces the real-world environmental factors of wind and precipitation, providing *optional* accommodation for testing conditions that may more closely mirror the lively effects of actual real-world performance scenarios and variations. The procedure allows the relatively low pressure differential to fluctuate (within reasonable durations and magnitudes) during testing due to wind gusts. With a default baseline target pressure of merely 1.57 psf, wind gusts are unlikely to push the total combined pressure differential to exceed the performance capacity of most building envelopes.

These dynamic effects contribute to more “realistic” conditions, offering stakeholders insights into how the building envelope performs under situations more representative of weather luctuations. This flexibility maintains a controlled test environment for generating conclusive data, while enhancing the test's relevance and practical value in assessing envelope water resistivity.

Evaluate System Transitions
BEAM03 facilitates the testing of multiple systems or modules that are interconnected, allowing for a more comprehensive evaluation of building envelopes comprising multiple modules or different systems. Unlike traditional chamber-based methods, which often limit interior depressurization to specific areas (for example, if the pressure drop occurs at a window jamb substrate, then the system transition at the jamb is not being evaluated for conditions where both the window and adjacent wall are depressurized simultaneously), BEAM03 enables a broader analysis of how different systems interface and perform together. This provides critical insights into the water management capabilities of transitions, which are among the most vulnerable points in a building envelope. By addressing these connections holistically, BEAM03 ensures a more complete understanding of envelope performance at system or module transitions.


Area Tested Under Typical QC Testing (3 Tests)


Area Tested Under Single BEAM03 Mobilization

ADDITIONAL BENEFITS AND CONSIDERATIONS FOR BEAM03

For Building Owners
Gain actionable insights into envelope performance during acquisition due diligence, maintenance planning, or replacement assessment. BEAM03 provides a valuable compliment to the field test reports and QAQC documentation, design, submittal documents, and other materials provided by the construction team.

For Developers
Validate contractor execution above and beyond the contractor's VE'd and controlled QAQC program. BEAM03 ensures an objective evaluation of envelope performance, mitigating some of the potential for conflicts in contractor- and subcontractor-controlled field testing.

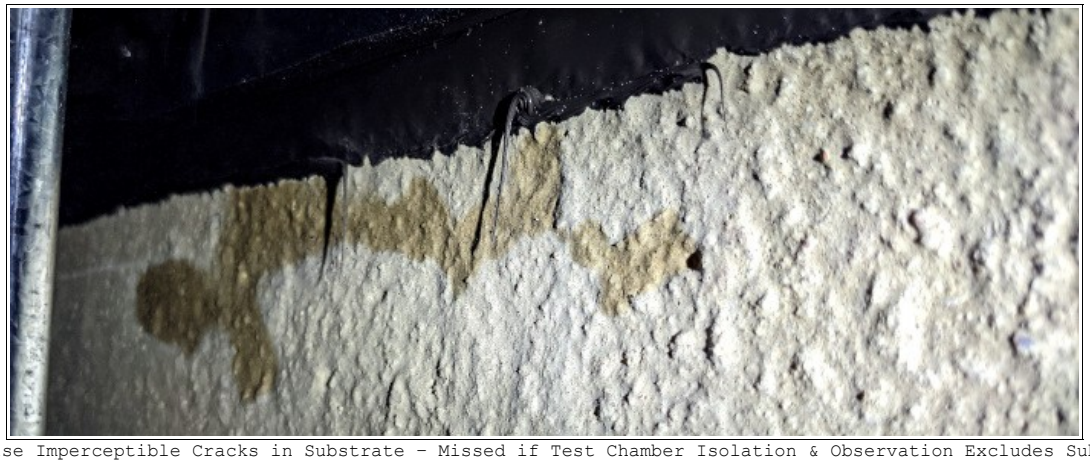
For Contractors
After successful AAMA 501.2 or ASTM E1105 tests or other QAQC data, assess subcontractor workmanship on a larger scale and increase confidence at a critical milestone (e.g. substantial enclosure) before releasing retention, or before interior finishes, or before corrective costs compound.

For Architects
Evaluate critical envelope primary barriers, system transitions, and atypical geometry for water resistivity under pressure differential. Gain insights into the building envelope's behavior in conditions, details, and scale that were previously unattainable.

For Occupants
Increase confidence in delivered building envelope integrity and durability, elevating the safety, health, and comfort of living and working environments for the occupants.

For Legal Professionals
BEAM03 provides highly accurate and defensible data, offering critical support for legal professionals considering whether a building leaks under specific conditions. By testing larger portions of envelopes, the procedure allows for a comprehensive analysis of full system behavior, including the abilities of system transitions to manage water and the recreation of reported leak events under storm conditions. The data furnished under the standard conditions of this test are reliable, repeatable, and can withstand rigorous scrutiny. This level of clarity and thoroughness is invaluable for resolving disputes, determining liability, and building strong cases involving water intrusion claims or construction defects.

For Building Envelopes Containing Exposed Concrete
Buildings that are evaluated solely based on narrowly defined and limited fenestration test results may lack sufficient data to determine the water-resistive performance of the envelope areas *outside* those test specimens. On buildings with with exposed concrete surfaces—whether coated or uncoated— these envelope areas carry significant potential for latent water management concerns. BEAM03 addresses this potential directly by enabling testing that encompasses broader surfaces, enabling a better understanding of that performance.



Otherwise Imperceptible Cracks in Substrate – Missed if Test Chamber Isolation & Observation Excludes Substrate

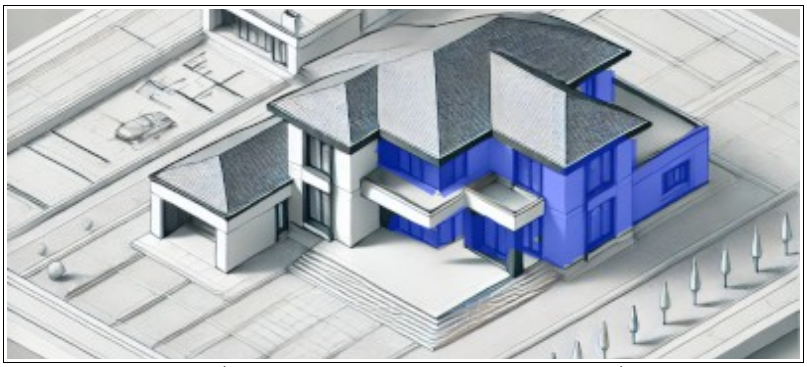
For Manufacturers, Trade Organizations Thereof, Contractors, and Trade Partners alarmed at the prospect of having *more* of their delivered product's surface area evaluated objectively, it is important to understand that the test pressures recommended under the BEAM03 procedure are capped at or below 100 pascals. The unmodified standard's default pressure differential is 75 pascals – equivalent to just 1.57 psf.

The vast majority of envelope systems on the market, especially when considering fully constructed assemblies (rain screen installation, flashing, coping etc.), and the capacities of the substrates and structures supporting them, are rated and marketed to function in pressures far exceeding those imposed by the BEAM03 test standard.

Among the considerations for this procedure, in comparison to ASTM E1105, is balancing the tradeoff between the increased volume of tested area and a reduction in the static pressure differential. The BEAM03 procedure caters to those who prioritize more comprehensive data and flagging of critical failures identified under environments more amenable than the as-sold performance criteria dictate. The intent is to support confidence in the assumption that the building envelope has a functional and continuous water management system.

Contractors should consider embracing the BEAM03 procedure because it is less stringent than the typical ASTM E1105 test. It offers a more reasonable evaluation of whether or not portions of the envelope are capable of withstanding an interior/exterior pressure differential of 1.57 sustained for 15 minutes (the standard's default pressure and duration), while a continuous volume of water is simultaneously applied. By participating in or commissioning their own BEAM03 tests, contractors and system manufacturers can showcase their ability to deliver high-quality, leak-free buildings in alignment with their marketing materials and contractual obligations.

The BEAM03 procedure offers an opportunity to differentiate the contractors and product manufacturers committed to long-term durability and excellence. This procedure provides a platform and objective support documentation, enabling those who deliver superior workmanship and products to stand out, while also giving building stakeholders increased confidence in the integrity of the envelope.



Evaluating Envelope Systems Comprehensively

COMPLIMENTING, NOT REPLACING, EXISTING STANDARDS

The BEAM03 procedure is not intended to replace ASTM E1105 or AAMA 501.2. These procedures, when performed correctly, still serve important functions in the QC process. These procedures are also more appropriate and feasible in earlier construction phases (e.g. site mockup, testing and scrutiny of initial installed units, early verification that contractor is capable of producing an envelope that meets the full field test requirements of the contract), whereas BEAM03 is most effective at or after milestones delivering substantial enclosure of large (or whole) building zones.

The BEAM03 procedure works alongside existing standards to provide a more comprehensive assessment tool. While ASTM E1105 is excellent for verifying envelope systems' full performance capacity, it is typically limited in scope – the evaluated area amounting to a rounding error in the overall envelope surface area. Using whole numbers, a substantial quantity of new construction and remediation work delivered in this era is evaluating the water resistive properties of 0% of the overall envelope. The BEAM03 procedure leverages advancements in air moving equipment to enable stakeholders to evaluate more statistically significant areas of the envelope.

OPEN SOURCE INNOVATION

Hightower Labs is, in narrow and select capacities, dedicated to fostering collaboration and advancing meaningful innovation within the industry. As part of this commitment, the BEAM03 procedure is provided as an open-source resource. After more than two years of successfully utilizing this tool to deliver valuable insights to clients, we have now formalized the procedure to achieve two primary objectives: to communicate expectations and deliverables to clients more effectively and consistently, and to provide broader accessibility to the method. By documenting BEAM03 in detail, we aim to move beyond informal narratives, project-specific summaries, and modified E1105 test reports, offering a clear and comprehensive framework that stakeholders can adopt and others with experience in air and water testing can critically evaluate and improve.

While the basic concept (to pair blower door testing with spray racks) is simple, those familiar with the means and methods will recognize that the proper execution of blower door depressurization – a critical component of this test – can present challenges. Our intention is to address key nuances and reduce the learning curve for users (e.g. exterior reference tube to the exterior environment, rather than the hallway into which the fan is exhausting). By pre-empting those challenges, the BEAM03 procedure becomes more accessible to practitioners with varying levels of familiarity with these techniques and equipment, enabling broader evaluation of more buildings at a larger scale.

LEARN MORE ABOUT BEAM03

The BEAM03 procedure is now available as an open-source resource, designed to advance industry practices in building envelope assessment. To access the full procedure and supporting documentation, you can:

- **Download the Full BEAM03 Procedure**: Visit https://www.hightower-labs.com/beam/BEAM03_V0100.pdf to download the full procedure. *This document is openly licensed via CC BY 4.0 (https://creativecommons.org/licenses/by/4.0/)*
- **Learn More**: Visit https://www.hightower-labs.com/ to learn more and download the full procedure.
- **Access Supplementary Resources**: review the ASTM E1105 and ASTM E779 procedures at https://www.astm.org
- **Connect With Us:** Have questions? Reach out for additional guidance on how to implement the BEAM03 procedure on your projects. Phone: 312.897.3742