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Whole Building Airtightness Testing (WBAT) Overview for Construction Managers

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As building energy codes (along with high-performance standards) increasingly mandate quantitative air leakage targets, construction teams must move beyond simple visual inspections to verifiable performance. The Whole Building Airtightness Test (WBAT) meets this requirement by measuring air leakage through the building enclosure. For a Construction Manager (CM) new to this test, it can be intimidating. Keep in mind that this test is normally performed at the very end of a project, and in some areas of the country, failing the test can delay issuance of the Certificate of Occupancy. As CMs become accustomed to the WBAT requirements, they find that performing other quality assurance/quality control processes, such as commissioning the enclosure, helps them pass the WBAT the first time. This paper will focus on what a CM new to WBAT should know. A future paper is forthcoming that will provide more information on building enclosure commissioning (BECx) for the Construction Manager.

Whole Building Airtightness Testing (WBAT) has evolved from a voluntary quality check to a mandatory code requirement in some codes. Recent updates to the 2024 IECC and ASHRAE 90.1-2022 have eliminated "visual inspection only" paths for many commercial projects, mandating quantitative testing to specific thresholds (typically 0.35 cfm/ft²). The intent of this white paper is to delineate the critical operational differences between ASTM E 779, ASTM E 1827, and ASTM E 3158, provide a clear decision matrix for their use, and outline the specific preparation protocols specifically for ASTM E 3158.

Executive Summary: The New Regulatory Reality

It is imperative to know what building codes and standards you are building to and what your project requires. For instance, under the 2024 IECC, buildings between 10,000 and 25,000 ft² no longer have the option of "Design Review + Field Inspection" alone; whole-building airtightness testing is mandatory (see diagram 1). For larger buildings (over 50,000 ft²), testing a part of the building is permitted (ASTM E 3158), but the previously allowed "Design Review" path is restricted or eliminated depending on the climate zone.

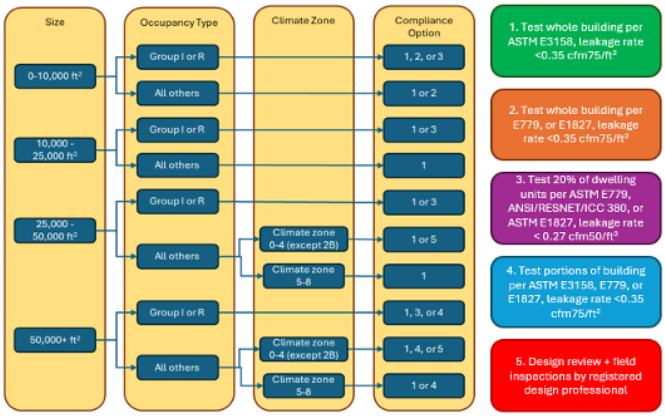


Diagram 1: *2024 IECC overview of WBAT testing, from Denali Jones - Whole Building Air Leakage Testing Updates (ABAA) - 2025 ASHRAE Whole Buildings Conference*

Selecting the Right WBAT Standard: ASTM E 779 or E 1827 or E 3158

Specifiers often default to the older ASTM E 779 standard because it is familiar. E 779 was intended for single-zone buildings, such as homes. It provides little guidance on building preparation and has strict weather limitations. Unfortunately, it is frequently misapplied to large commercial structures. ASTM E 1827 was developed in the 1990's specifically for residential applications and is not intended for large, multizone commercial buildings. ASTM E 3158 is intended for large multizone buildings and will be the focus of the paper. Using the wrong standard can invalidate results or lead to impossible testing conditions due to weather and physical properties of

the building (see diagram 2).

Feature	ASTM E779 (Legacy)	ASTM E1827 (Residential)	ASTM E3158 (Commercial/ Multifamily)
Intended Use	Single-zone buildings (homes, small commercial).	Homes use an orifice blower door.	Large, multizone, or high-rise buildings.
Building Type	Not intended for multizone buildings.	Not intended for multizone buildings.	Explicitly designed for multizone and large buildings.
Weather Limits	Strict weather limitations.	Not recommended for high winds or extreme temps.	Adaptable for almost any weather condition (wind/stack effect).
Guidance	Very little guidance on building prep.	Some guidance on building prep.	Extensive guidance on building prep and multizone handling.
History	Older standard (1980s origin).	Developed in the mid-1990s.	The only standard to undergo a round-robin repeatability study.

***Diagram 2** – Overview of the three main ASTM WBAT Standards.*

ASTM E 3158: Things to Consider

ASTM E3158 is more complex than its predecessors. For a Construction Manager to be successful, the Architect and Specifier need to provide a few critical decisions early in the project: Building Preparation, Test Pressure, Test Direction, and Test Method.

Building Preparation Procedures:

Two Ways to Prepare the Building

This standard defines two distinct preparations for the test boundary conditions.

1. **Building Envelope Test (The "Tight" Test – Most Commonly Used)**

- **Goal:** Measure leakage only through the construction materials (deficiencies in the air barrier system).
- **Protocol:** All HVAC-related openings are sealed with plastic and tape. (Photo 1)
- **Pros:** Gives the "tightest" results; isolates workmanship issues.
- **Cons:** Highly labor-intensive; generates significant waste from masking materials.
- **Use Case:** Commonly required for code compliance testing to prove the performance requirements of the building envelope.

Photo 1: Building Envelope Test: Sealing off the HVAC to test Building Enclosure Material Installation

2. **Operational Test (The "Real World" Test)**

- **Goal:** Measure leakage, including HVAC dampers.
- **Protocol:** HVAC dampers are closed (via controls) but not taped/sealed.
- **Pros:** Less labor-intensive (no masking); represents actual building performance.
- **Cons:** Results will be "leakier" because gravity dampers may be blown open by test pressure.
- **Risk:** Gravity damper can leak ~200 CFM per unit. In a 150-unit building, this can add 30,000 CFM of leakage, potentially causing a test failure.

Test Pressure:

1) 50 Pa

• Normally used for single-family buildings
• Difficulty with wind and stack effect

2) 75 PA

• Normally used on large commercial and multi-family projects
• Required by code for whole building or partial building tests
• Generally able to handle larger wind and stack effect

Test Direction: (ASTM E1827 & ASTM E3158 can use allow either direction or both)

1. Pressurization: Bringing more air into the building through the use of the test fans

- Normally causes higher leakage rates
- Can cause gravity dampers to open
- Can create issues with temporary seals over HVAC and all test-prepped penetrations

2. Depressurization: Pulling air out of the building through the test fans

3. Both (Required for ASTM E779)

Test Method:

1. Multipoint Regression:

- Testing at multiple pressure steps (e.g., 10 Pa to 75 Pa) to create a flow curve.
- This allows for accurate extrapolation and is the most robust method.

2. Repeated Two-Point:

- Measuring at two distinct pressures multiple times to average out wind and noise.

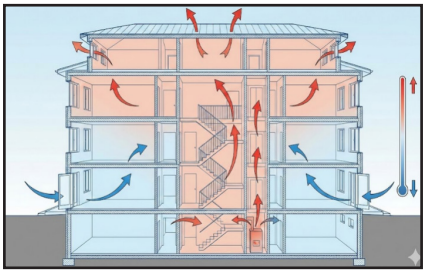
3. Repeated Single Point:

- Measuring at one target pressure multiple times.

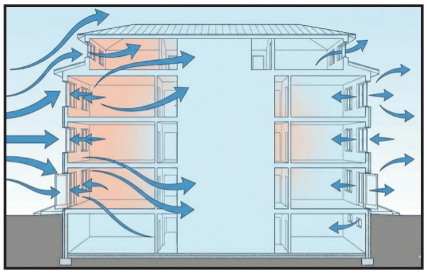
Why a New Test Was Needed

Large commercial and multifamily buildings are subject to higher winds and larger stack effect that do not affect single-family homes. These various types of uncontrolled air pressures can cause inaccuracies in test reports for the ASTM E 779 and ASTM E 1827 test methods if they are used on large commercial buildings.

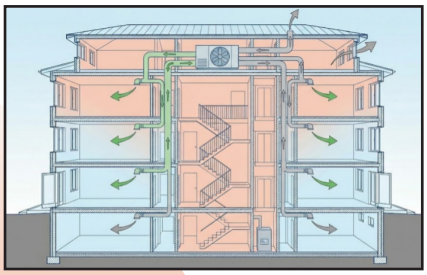
Stack Effect: Warm air rises, creating outward pressure at the top and inward pressure at the bottom. Seasons and temperature can increase these directional flows. In tall buildings, this pressure can exceed the fan's ability to pressurize the building.



Wind: Wind creates positive pressure on the windward side and negative (suction) on the leeward side/roof. ASTM E 3158 is designed to filter out this "noise," whereas ASTM E 779. & ASTM E1827 recommend NOT testing in windy conditions



HVAC: Mechanical systems must be verified as off, and dampers closed. A running exhaust fan can depressurize a room and skew results.



ASTM E 3158: Partial Building Testing Strategy

For buildings larger than 50,000 ft², you may not need to test the entire structure. The 2024 IECC allows "Partial Building Testing," but it requires careful selection of the test areas:

- **Mandatory Areas: You must test the entire envelope area of stories with:**

1. Conditioned space under a roof
2. Building entrances
3. Floors over unconditioned space
4. Loading docks
5. Below-grade walls

- **Representative Areas:** You must also test a representative sample of the remaining wall area (at least 25%).

- **Compliance:** The area-weighted average of all tested parts must meet the leakage requirements established for the project.

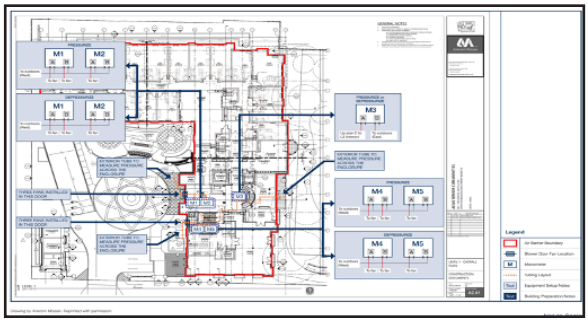


Photo of air barrier test boundary from ABAA Blower Door Technician Manual

WBAT: Things to Consider for the Construction Manager

This section presents actionable tasks for the Construction Manager to consider:

- **Confirm the Correct WBAT has been specified:** If ASTM E 779 or ASTM E1827 is specified for a high-rise or large commercial building, start discussions with the project team to ensure the correct standard will be used.
- **Define the Boundary:** Ensure the Project Architect has provided the "Test Boundary" on the prints (some codes require this). Are mechanical penthouses included?
- **Verify the target Air Leakage Limit** for a successful test (Pass). Is it 0.35 cfm/ft² (ASHRAE/IECC standard) or 0.25 cfm/ft² (Washington State/USACE), or did the project team specify something else?
- **Early Team Meeting:** Set a team meeting early in the construction project with everyone involved with the WBAT (Architect, 3rd Party Testing, Enclosure Consultant, Air Barrier, Glazer, Roofer, etc.)

Review which ASTM is to be used (see Diagram 1- page 1)
If using ASTM E 3158 Discuss the Test Requirements, including:

- **Which Test Boundary Conditions will be used**
  - -Building envelope
  - -Operational envelope
- **What Test Method**
  - -Repeated single point
  - -Repeated multi-point
  - -Multi-point regression
- **Determine the Test Pressure**
- **Determine the Test Direction (Pressurization, Depressurization, or Both)**
- **The Pass/Fail Requirements of the Test**
  - -If a Fail – what needs to happen
    - -Repair and retest
    - -Repair and report on what was done
    - -Other?

Review contracts for Who is Responsible for What in preparing the building

- Sealing/unsealing HVAC vents or other openings
  - -If required by the test method
- Ensuring doors between rooms are open,
- Close and latch all operable exterior doors and windows
- Removing ceiling tile (if installed – determine how many)
- Ensuring interior doors are propped open
- Who cleans up after the test and puts everything back to normal
- Is leak detection required immediately after the test – who will provide it, 3rd Party, CM?
  - -Will the 3rd Party Blower Doors be required to assist in finding the leaks?
  - -Recommend using ASTM E 1186 (smoke and/or Thermography)

Sequence Management: WBAT is normally performed at the very end of the project, meaning everything should be installed on or through the exterior of the building.
Project Quality Assurance/Quality Control: review enclosure details/specifications, testing requirements, make sure to hold preconstruction meetings, pre-installation meetings, meetings with Owner's enclosure consultants, meetings regarding all field testing (including the WBAT), and discuss who will witness on-site testing.

- **Mockups:** Encourage and assist in the development and performance testing of mockups, including foundation-to-wall, window-to-wall, and wall-to-roof intersections. There are numerous resources for more information on Mockups – including the ABAA (https://airbarrier.org/resource-library/)
- **First Look:** Discuss who will review and document the first installations of building enclosure materials for proper installation, especially connection points like the transition between the roof membrane and wall air barrier. This is the #1 point of air leakage failure location.
- **Field Testing:** Do not wait for the final WBAT test. Perform qualitative testing as the enclosure is being constructed, including various air and water tests like: ASTM E 783, ASTM E 1105, ASTM E 1186 (various tests), AAMA 501.1, and ABAA T0002, among others.
- **Technician Certification:** Review and insist that the testing agency for the WBAT be ISO 17024-compliant (certified) for Whole Building Airtightness Testing. Testing large buildings requires specialized skills and experience beyond residential blower-door experience. The ABAA provides this certification https://airbarrier.org/wba-overview/

Before the Actual WBAT Test:
Schedule the test well in advance and continually remind trade partners about it, including that no one may enter or exit during the test (the test is normally performed on a weekend or at night).

- **P-Traps:** Ensure all plumbing P-traps are filled with water. An empty trap is a direct hole to the sewer/outside.
- **Interior Doors:** Prop all interior doors OPEN to create one zone.
- **Exterior Openings:** Close and latch all exterior windows/doors. Seal temporary power cables passing through doorways.
- **Ensure all HVAC systems** are shut down and powered off.

- **Prep the Dampers:**
  If running a "Building Envelope Test" (Method 1), verify all dampers are taped off.
  If "Operational" (Method 2), verify they are powered closed.
- **Ceiling Tiles:** If suspended ceilings are installed, 1% of tiles (or at least one per isolated space) must be removed to ensure pressure reaches the roof/wall interfaces

Conclusion:

The suggestions and information in this paper are intended to assist a Construction Manager as they work through the WBAT process for the first time. The unfamiliarity of the WBAT can be intimidating and lead to potential issues and unanticipated additional costs at the end of the project. As noted earlier, if you fail the WBAT, in some parts of the country will not receive your Certificate of Occupancy. Which means your project will likely have to remove enclosure sections, repair air barrier materials or systems, and retest until it passes the WBAT. A strong correlation among Construction Managers who continually pass the WBAT with ease is that they incorporate a robust building enclosure-quality program (commissioning the building enclosure) that starts at project inception.

I would like to give a special thank you to Miachael Repka (Hoffman Construction), Denali Jones (ABAA), and Schuyler Wetmore (York Flashings) for their assistance with the paper.

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About the Author:

The author, Brian Stroik, is a husband and father of five. He is also the Past Chair & a Fellow for the Air Barrier Association of America, Past Chair of the National Building Enclosure Council, Vice Chair for the Building Enclosure Technology and Environmental Council, Secretary for the ABAA Standards Institute, Past Chair for Wisconsin Building Enclosure Council, a voting member of ASTM E06 – Building Performance, a Union Trained Carpenter and former Quality Assurance Manager for Billion Construction Manager.