Pre-Construction Phase, & the Laboratory or Field Mock-Up

Building Enclosure Commissioning:
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PRE-CONSTRUCTION PHASE LABORATORY PERFORMANCE MOCK-UP

Actual Installation is dramatically different from tested conditions.

JAMB DETAIL

Why test a system that has already been tested?

Typical Manufacturers information for window to wall interface and basis for reported test results.

Every building is unique, however performance testing identified in typical project specifications usually approaches the building enclosure in the same manner.

Pre-Construction Phase

Laboratory Performance Mock-Up

Allows for evaluation of the design prior to wide spread construction

Pre-Construction Phase


Typical test sequence:
- Static Air Infiltration Test (ASTM E 283)
- Static Water Test (ASTM E 331)
- Dynamic Water Test (AAMA 500.1-83)
- Uniform Load Test (ASTM E 1330)
- Static Water Test (ASTM E 331)
- Interstory Drift / Lateral and Vertical Movement (AAMA 501.3-98)
- Static Water Test (ASTM E 331)
- Dynamic Water Test (AAMA 500.1-83)
- Structural Overload Test
- Thermal Resistance Test (AAMA 1503)
Standards and Guidelines

Industry organizations:
- ASTM
- AAMA
- WDMA
- ANSI
- NFRC

Pass/Fail air Test
Precision to Air performance
International – CGSB – specimen calibrated (www.astm.org)

Testing for air infiltration

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

4.1 “The test consists of sealing a test specimen into or against one face of an air chamber, supplying air to or exhausting air from the chamber at the rate required to maintain the specified test pressure difference across the specimen, and measuring the resultant air flow through the specimen.”

Testing for water leakage

ASTM E331: Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtains Walls by Uniform Static Air Pressure Difference

4.1 “This test method consists of sealing the test specimen into or against one face of an air chamber, supplying air to or exhausting air from the chamber at the rate required to maintain the specified test pressure difference across the specimen, while spraying water onto the outdoor face of the specimen at the required rate and observing any water penetration.”

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Testing for water leakage

Water resistance tests are performed on specimens to check for water penetration under cyclic and static air and water pressure. These tests are intended to simulate actual natural weather characteristics such as normal and extreme rainstorm with wind events.

The spray rack is calibrated to deliver water application against the interior surface of the specimen at a rate of 3.48 L/min (0.5 U.S. gal/min) at the required cycle and pressure conditions.

Predetermined criteria for water penetration determines the pass/fail result.

Dynamic test

Observe for leaks at interior of chamber

Calibrated spray rack

Thermal testing
AAMA 503:05 Methods of Tests for Exterior Walk (Optional Test AAMA 501.1 – Thermal Cycling).

Typically this test is a part of the ASTM E2099 test sequence, followed by air and water infiltration resistance testing in accordance with ASTM E283 (optional) and ASTM E331 (at a minimum) respectively.


The AAMA 1503 test method is based on ASTM methodology. The U-value measurement is performed in an insulated test chamber with a test specimen. The specimen is set on a test platform, and air temperature on the interior and exterior sides of the specimen, is monitored.

The specimen is exposed to conditions that simulate wind, rainstorm, and cycles of temperature. Air leakage tests using thermocouples are taken on various locations on glazing and framing.

Mock-up tests

Tests for water, air and structural per ASTM E 2099.

Test sequence:
- Install exterior wall, interior curtain wall and TC panels, perform:
  - Static Air Infiltration Test (ASTM E283)
  - Static Water Test (AAMA 1503)
- Install insulation, TC panels & framing, perform:
  - Static Air Infiltration Test (ASTM E283)
  - Static Water Test (AAMA 1503)
  - Dynamic Water Test (AAMA 501.1-05)
- Install interior insulation & construct Thermal Chamber, perform:
  - Thermal Cycle (AAMA 501.1)
  - Thermal Resistance Test (AAMA 5020)
- Install coping, perform:
  - Static Air Infiltration Test (ASTM E283)
  - Static Water Test (AAMA 1503)

Mock-Up INTERIM TEST:
Opaque Wall Air Tightness

Specified Air Tightness Performance Requirements:
0.04 cfm / ft² at 1.57psf when tested in accordance with 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.

Mock-Up air leakage at Opaque wall = 0.01 cfm/ft² at 1.57psf.
Mock-Up INTERIM TEST:

**Fenestration Air Tightness**

**Specified Air Tightness Performance Requirements:**

Curtain wall and skylights have an allowable air leakage 0.06 cfm / ft² at 6.24 psf in accordance with 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.

Mock-Up air leakage at Fenestration = **0.08 cfm/ft² at 6.24psf.**

**Mock-Up RE-TEST (INTERIM):**

**Fenestration Air Tightness**

Mock-Up air leakage retest at Fenestration = **0.02 cfm/ft² at 6.24psf.**

Mock-Up INTERIM TEST:

**Water & Air Leakage**

**Specified Water Penetration Resistance Performance Requirements:**

Curtain wall has an allows zero water leakage at 8 psf in accordance with ASTM E331 Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

Air Leak Detection:


Mock-Up INTERIM TEST: Water Leakage

Mock-Up INTERIM TEST: Water & Air Leakage

Mock-Up: Opaque Wall Air Tightness

**Specified Air Tightness Performance Requirements:**

The air permeance of materials comprising part of the air barrier system shall not exceed 0.004 cfm / ft² at 0.3” wg 0.02 L/s.m² @ 75 Pa when tested in accordance with ASTM E2178 Standard Test Method for Air Permeance of Building Materials.

The air leakage rate of opaque assemblies that comprise the air barrier system shall not exceed 0.04 cfm / ft² at 0.3” wg 0.2 L/s.m² @ 75 Pa when tested in accordance with ASTM E2357 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies or, for assemblies whose structural integrity is otherwise determined, 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.

Mock-Up air leakage at wall assembly/curtain wall = **0.03 cfm/ft² at 1.57psf.**
Mock-Up: Fenestration: Air Tightness

Specified Air Tightness Performance Requirements:

Curtain wall and skylights have an allowable air leakage 0.06 cfm/ft\(^2\) at 6.24psf in accordance with 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.

The industry standard organization, AAMA typically allows for an increase in air leakage allowance of 150% of design conditions. This equates to an installed air leakage allowance of 0.09 cfm/ft\(^2\) at 6.24psf. Field Testing shall be performed in accordance with ASTM E783 Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors.

Mock-Up air leakage at Opaque wall and Fenestration = 0.01 cfm/ft\(^2\) at 1.57psf.

Mock-Up: Opaque Wall & Fenestration Air Tightness

Specified Air Tightness Performance Requirements:

Opaque wall has an allowable air leakage 0.04 cfm/ft\(^2\) at 1.57psf in accordance with ASTM E283.

Curtain wall and skylights have an allowable air leakage 0.06 cfm/ft\(^2\) at 6.24psf in accordance with ASTM E283.

Mock-Up air leakage at Opaque wall and Fenestration = 0.01 cfm/ft\(^2\) at 1.57psf.

Mock-Up: Water Leakage

Specified Water Penetration Resistance Performance Requirements:

Curtain wall has an allows zero water leakage at 15psf in accordance with ASTM E331 Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

The industry standard organization, AAMA typically allows for a decrease in differential pressure allowance of 2/3 of design conditions. This equates to an installed differential pressure of 10psf and no water leakage allowed. Field Testing shall be performed in accordance with ASTM E1105 Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Curtain Walls, and Doors by Uniform or Cyclic Static Air Pressure Differential.

Mock-Up: Water Leakage

Water Penetration Resistance Performance Requirements:

Curtain wall has an allows zero water leakage at 8psf in accordance with AAMA 501.1 Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure.

Mock-Up Fenestration: Condensation Resistance

Specified Condensation Resistance Requirements:

Condensation resistance (AAMA 1503-985) at winter design conditions: 0 degrees F exterior, 68 degrees F interior temperature and 30% Relative Humidity. Dew Point 35.4 degrees F.

No condensation or surface temperatures below the dew point.