Air Barrier Assembly Testing to Replicate Real World Conditions

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Air Barrier

A barrier to prevent or reduce uncontrolled air flow through a building enclosure. Effective air barriers are installed on all six sides of the building.
Layers of an air barrier system

Air Barrier System

Air Barrier Material

Air Barrier Material

Air Barrier Material

Air Barrier Material

Air Barrier Assembly

Air Barrier Assembly

Air Barrier Assembly
Air Barrier Material and Assembly Testing
Air Barrier Material Testing

ASTM E2178 - Standard Test Method for Air Permeance of Building Materials

75 Pa (0.3 in. WC), 1.57 PSF, 25 MPH

FIG. 2 Flexible Sheet Test Specimen
Air Permeance (Air Leakage Rate) of an 8 foot by 8 foot Air Barrier Assembly is Reported when Subjected to an Air Pressure Differential of 75 Pa (0.3 in. water column) across the Air Barrier Assembly

- Air Permeance Reported in L/(s x m²) @ 75 Pa or cfm/ft² @ 1.57 psf
Wall Substrate

• Representative of a typical wall to receive and air barrier assembly

• Two possible wall types:
  • Wood or Steel Frame
  • Masonry
Three Wall Substrate test Specimens

Specimen 1

- For framed walls – one horizontal joint in sheathing and two staggered joints are required
- For masonry walls – a vertical expansion control joint is required and masonry ties if air barrier assembly is dedicated to concrete block assemblies with brick ties

Specimen 2

- Joints in sheathing or control joint, penetrations and window opening

Specimen 3

- Joints in sheathing or control joint, tie-in to foundation and roof and post applied brick ties or other cladding fasteners

Specimen 2 & 3 May Be Combined
Air Barrier Assembly

- Seams
- Post Applied Masonry or Brick Ties
- Roof Interface
- Foundation Interface
- PVC penetrant
- Duct Penetrant
- Window Flashing
- Electrical Box Penetrations
Specimen 1 – Base wall with no penetrants

Seams in sheet type air barrier materials are required – one horizontal and two staggered vertical

Combination of Specimen 2 and Specimen 3
ASTM E2357 Assembly Testing Summary

Roof and Foundation

- Concrete Beam at bottom of wall to simulate air barrier assembly and foundation wall interface

- Metal Plate at top of wall to simulate tie into a roof
Penetrations

- Galvanized steel duct, 4 in. by 4 in. (100 mm square)

- PVC Pipe, 1.5 in. diameter (38 mm)

- Electrical boxes, one hexagonal and one rectangular

- 1/3 to 1/2 in. annular space between penetrants and edge of opening
Window Opening

- 2 foot by 4 foot rough opening

- Window opening flashed and then a plywood buck is inserted into opening

- 1/2 in. (12.5 mm) gap between plywood buck and flashing
Post Applied Brick-Ties

- Brick ties fastened through the air barrier assembly into the framing or CMU wall

- Types and sizes of ties is to the test sponsors discretion
• Air Leakage Rate measured in accordance with ASTM E283

• Air leakage rate measured in the positive and negative direction at the following pressures:
  • 25 Pa
  • 50 Pa
  • 75 Pa
  • 150 Pa
  • 250 Pa
  • 300 Pa
Wind Load Schedule

Positive and negative direction

- Sustained Load - 600 Pa (70 MPH, 12.53 PSF) for 1 hour
- 2000 Cyclic Loads - 800 Pa (81 MPH, 16.7 PSF) for 3s
- Wind Gusts - 1200 Pa (99 MPH, 25 PSF) for 3s
Typical Forces Applied onto Buildings

- Air Flow
- Negative Pressure
- Positive Pressure
- Wind/Air Flow
- Stack Pressure
- Plan View of a Building
- Wind Pressure
- Negative Pressure
- Fan Pressure
• Air Leakage Rate measured in accordance with ASTM E283

• Air leakage rate measured in the positive and negative direction at the following pressures:
  • 25 Pa
  • 50 Pa
  • 75 Pa
  • 150 Pa
  • 250 Pa
  • 300 Pa

• Air Leakage Rate reported in L/(s x m$^2$) converted to cfm/ft$^2$
ASTM E2357 Air Barrier Assembly Testing – Case Study
Third Party Accredited Laboratories –
Intertek in Madison, WI
Architectural Testing, Inc. in York, PA

Air Barrier Products Tested:
• Peel and Stick Sheet Membrane
• Spray-Applied Vapor Impermeable Coating
• Spray-Applied Vapor Permeable “breathable” Coating
• Peel and Stick Vapor Permeable “breathable” Membrane
ASTM E2357 – Product installation
PVC Pipe and Duct Penetrants
Foundation Tie-In

ASTM E2357 – Product installation
Window Opening Flashing
Post Applied Brick Ties
ASTM E2357 – Product installation

Finished Assemblies
Air Barrier Products Tested:
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- Spray-Applied Vapor Permeable “breathable” Coating
- Peel and Stick Vapor Permeable “breathable” Membrane

The air barrier assemblies tested had an air leakage rate of less than 0.02 L/s*m² (0.004 cfm/ft²).

This air leakage rate is well below the passing requirements of the Air Barrier Association of America (ABAA) for approval of an air barrier assembly, which is 0.2 L/s*m² (0.04 cfm/ft²).
Conclusions and Recommendations

- ASTM E2357 evaluates assemblies rather than materials
- Positive and Negative Air Pressure Loads provide more realistic product exposure conditions
- Products tested on a realistic wall mock-up
  - Penetrations
  - Roof/Foundation Tie-ins
  - Window opening
  - Post-applied brick ties
- ASTM E2357 Provides a more realistic and better evaluation of the performance of an installed air barrier assembly than the smaller scale material tests, and should be used as a performance metric in specifications and air barrier performance requirements.
Thank you.

QUESTIONS?