

Performance standards and code requirements for air barrier systems



KSA-7 – 1HR HSW



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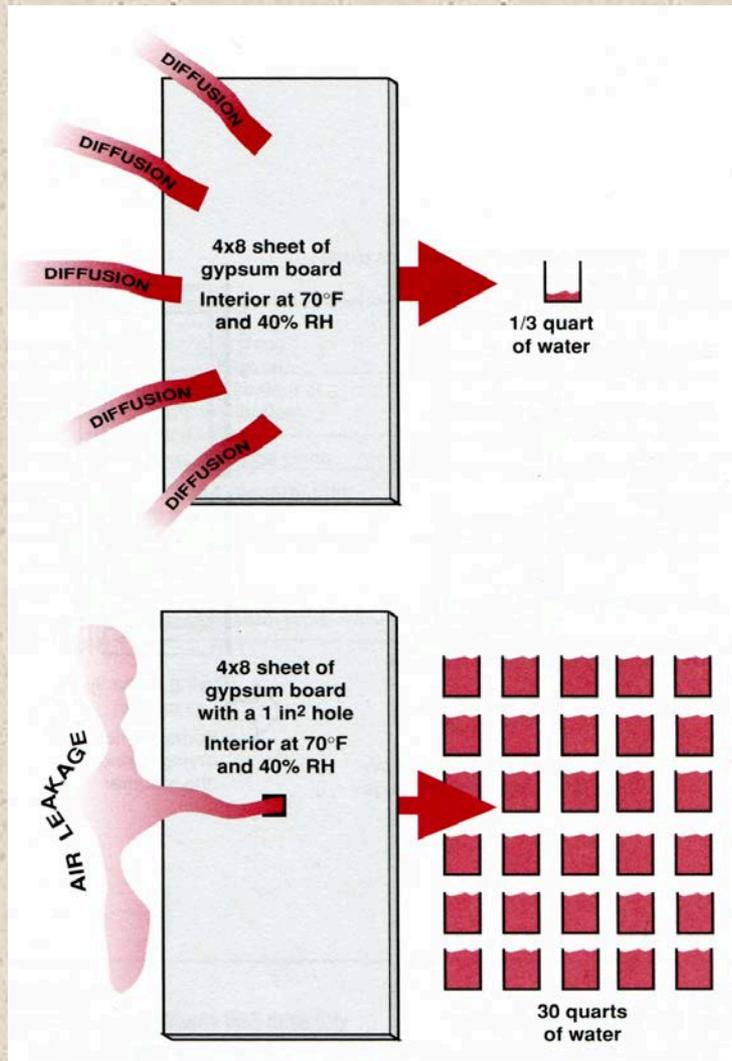
Learning Objectives

- Discuss the different systems to keep air and moisture out of the wall cavity.
- Understand the impact on the environment, building owner, and occupants provided by an air barrier system.
- Describe the performance test standards of an air barrier material, component, assembly and system.
- Understand building, energy, and fire code requirements relating to air barrier systems.

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Water Transport

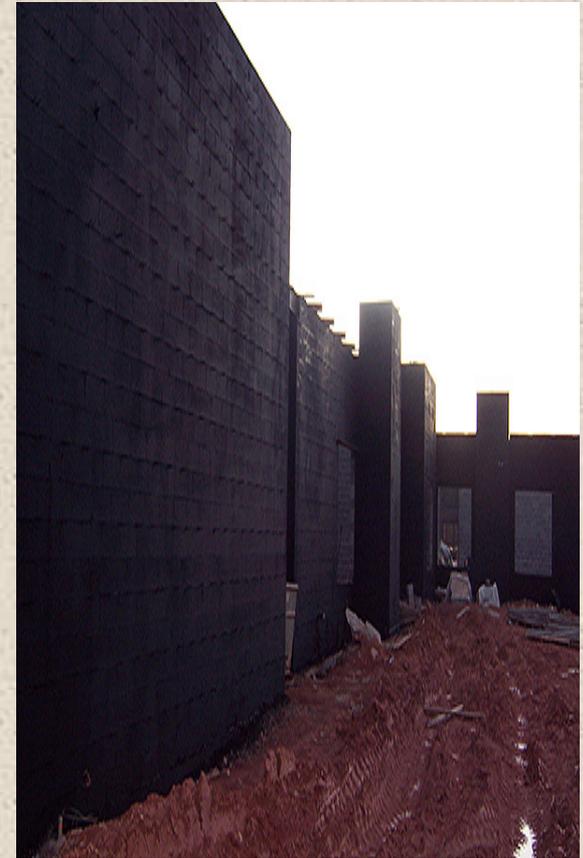


Water vapor moves only two ways – vapor diffusion and air transport

The system needs to be set up for “controlled diffusion of water vapor”, not wholesale movement of water vapor through the assembly.

Damp Proofing

- Water resistive barrier.
- Can only be used above grade.
- Stops only liquid water from entering wall assembly.
- Low grade asphalt emulsion used, offers little elongation, usually cracks over time.



Air Barrier System

- Stops air and liquid water.
- Can be fluid applied, sheet membrane, spray foam, or board stock.
- Fluid applied material has good elongation and can span cracks that develop.
- Can be applied on either side of wall.
- Reduces vapor flow by closing gaps.



Vapor Barrier System

- Stops air, liquid water, and water vapor.
- Usually is fluid applied, asphaltic membrane, foil, or plastic sheeting.
- Must be applied on hot/humid side of wall assembly.
- Not recommended in some climate zones.



Vapor Retarder Classes

- Class I: <0.1 perms (Impermeable Barrier)
Sheet polyethylene, non-perforated aluminum foil, etc.
- Class II: 0.1 to 1.0 perms (Semi-Impermeable Retarder)
Glass faced polyiso, kraft-faced fiberglass batt, some latex-based paint
- Class III: 1.0 to 10 perms (Semi-Permeable Retarder)
Latex or enamel paint

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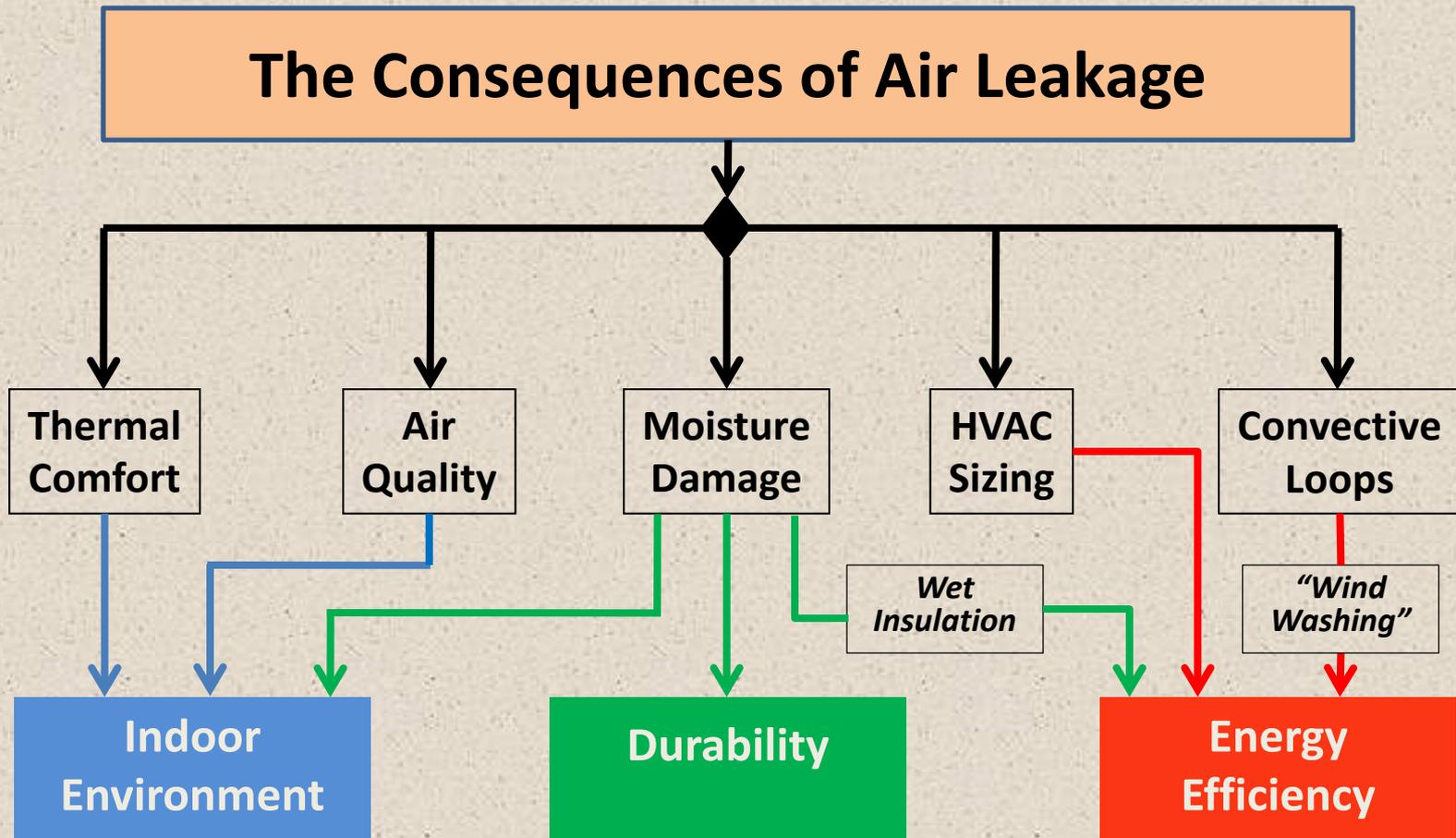
Uncontrolled Air Leakage

The three concerns of Uncontrolled Air Leakage:

- 1. Diminished “R” value - Energy efficiency**
- 2. Large amounts of water vapor - Moisture problems**
- 3. Pollution, pollen & dust - Indoor air quality**

Uncontrolled Air Leakage

Air Leakage through the Building Envelope



Interactive Question

Use of an Air Barrier System can provide benefits in which of the following categories?

- A. Building Occupant Comfort
- B. Energy Use
- C. Building Sustainability
- D. Reduction in Mechanical Maintenance
- E. Lower Initial Construction Costs

Interactive Question

Use of an Air Barrier System can provide benefits in which of the following categories?

- A. Building Occupant Comfort
- B. Energy Use
- C. Building Sustainability
- D. Reduction in Mechanical Maintenance
- E. Lower Initial Construction Costs
- F. All of these categories!!!**

Benefits of an Air Barrier System

The use of a continuous air barrier will:

- Reduce building heating and cooling costs
- Ensure better performing ventilation systems
- Potentially require smaller HVAC equipment capacities
- Reduce greenhouse gas production
- Improve acoustical isolation
- Improve indoor air quality
- Isolate the indoor environment
- Reduce building enclosure moisture problems
- Result in sustainable, durable buildings



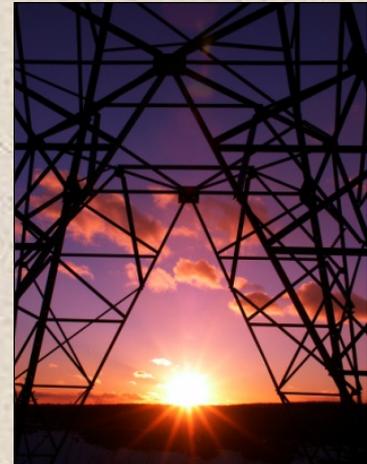
Building Occupant Comfort

- Reduces Drafts
- Indoor Air Quality: An effective air barrier keeps pollutants and allergens out of the building, leading to:
 - Healthier, more Productive employees
 - Fewer sick days
 - Fewer doctor visits
 - More alert employees



Energy Conservation

- According to the DOE controlling air leakage can reduce energy costs by up to 40%
- National Institute of Standards and Technology (NIST)
 - Air Barriers reduce air leakage by up to 83%
 - Reduce Gas Consumption by up to 40%
 - Reduce Electric Consumption by up to 25%



Reduce Maintenance Costs

- Less strain on Mechanical Systems.
- Reduction in moisture helps prevent:
 - Corrosion
 - Mold Growth



Lower Initial Construction Costs

- Air Barriers prevent the leaking of conditioned air, therefore, smaller mechanical systems are needed.



Learning Objectives

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What is an Air Barrier System?

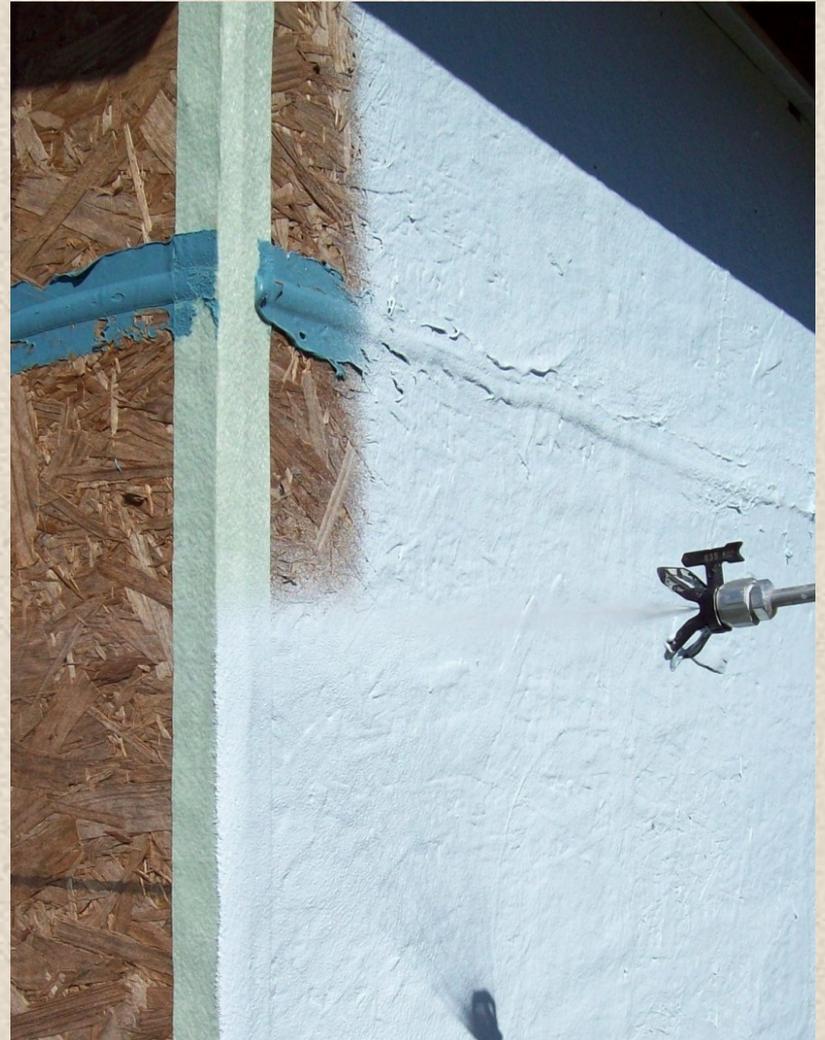
An Air Barrier System is a combination of an **air barrier assembly** along with other building components to create a plane of air separation between different environments.



Air Barrier Materials

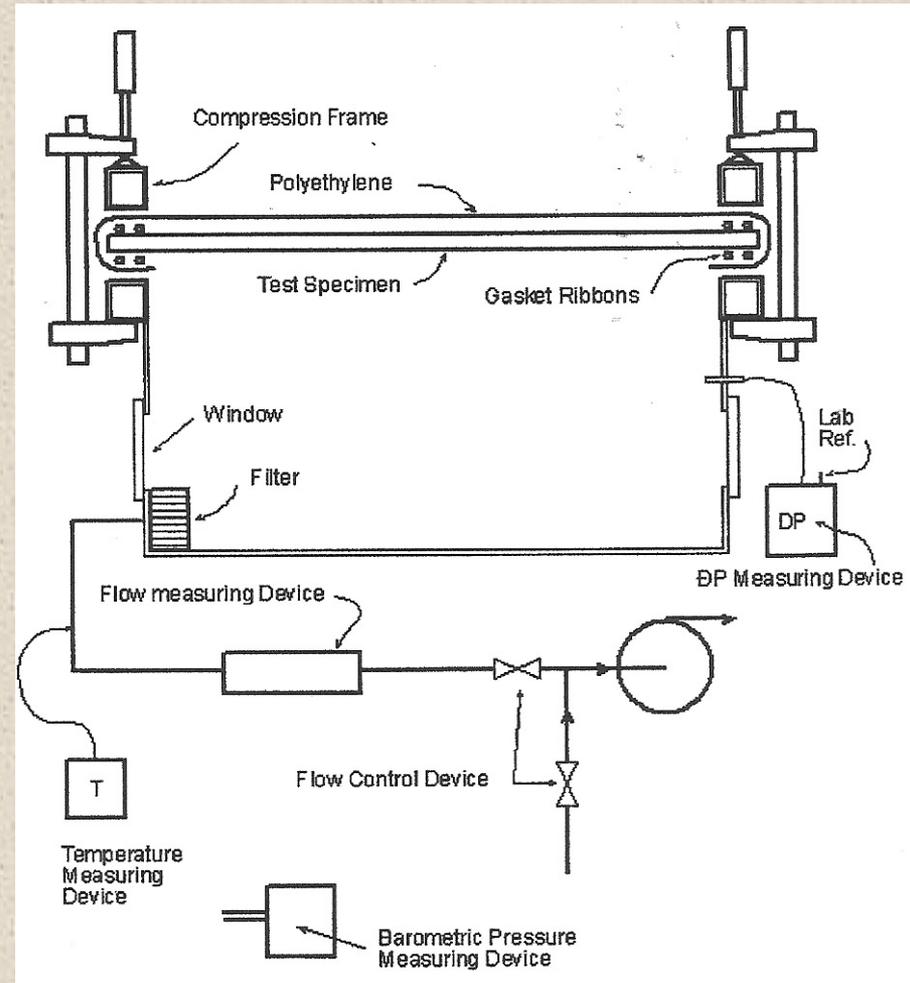
An Air Barrier Material is a material that has been designed to provide the primary function of controlling the air movement through a building assembly.

To qualify as an Air Barrier Material an air permeance of less than $0.004\text{CFM}/\text{ft}^2 @1.56\text{ lb}/\text{ft}^2$ as tested by ASTM E2178-01 must be met.



Testing – ASTM E2178

- Determines air permeance of a material at a pressure difference of 75Pa.
- Air leakage must not exceed 0.004cfm/ft^2 to be classified as an air barrier material.
- Only tests the air barrier material not the air barrier system.



Air Barrier Materials

- Self-Adhered Sheets



Air Barrier Materials

- Spray Polyurethane Foam



Air Barrier Materials

- Mechanically Fastened Building Wraps



Air Barrier Materials

- Rigid Cellular Thermal Insulation Board



Air Barrier Materials

- Factory Bonded Systems to Sheathing



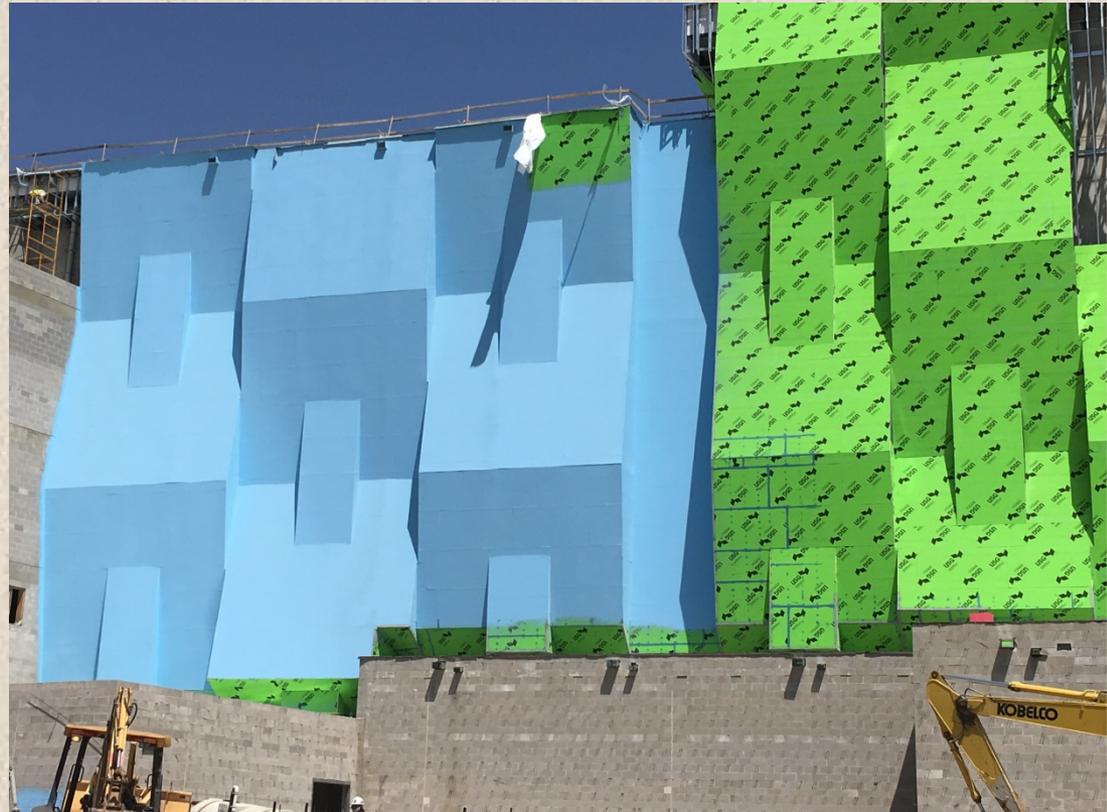
Air Barrier Materials

- Adhesive Backed Building Wraps



Air Barrier Materials

- Fluid Applied



Air Barrier Components



An Air Barrier Component is a material used to make connections between the primary air barrier material and other substrates.

The most common air barrier components are tapes and sealants.



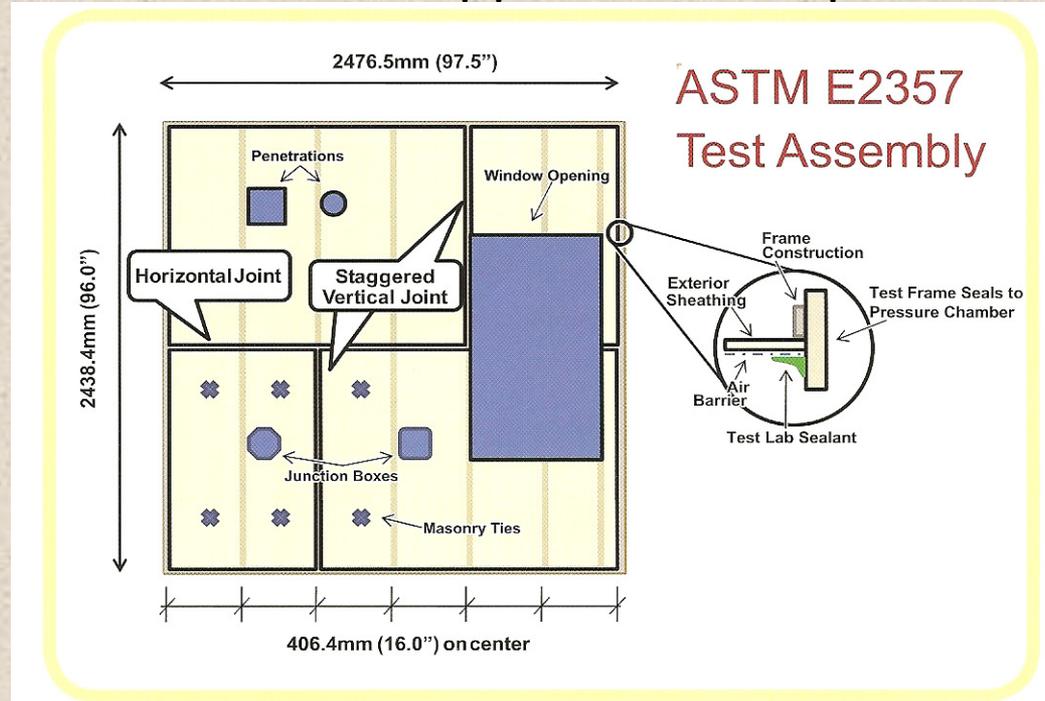
What is an Air Barrier Assembly?



An Air Barrier Assembly is the combination of the primary **air barrier material** and the **air barrier components**.

Testing – ASTM E2357

- Determines air permeance of an air barrier system.
- Uses negative and positive pressure in 3 testing phases.
- Simulates wind gusts up to 99 mph.
- Important to verify that air barrier systems are tested on the same substrate and same application as specified.



Testing – ASTM E2357



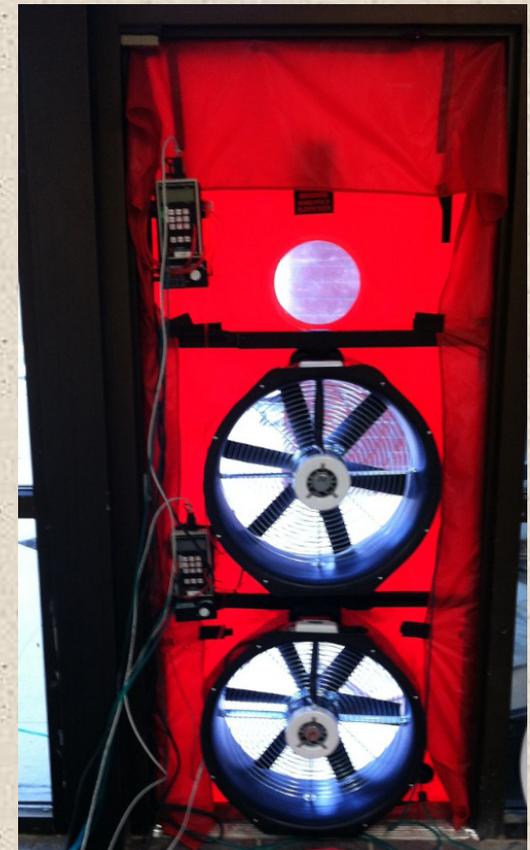
What is an Air Barrier System?



An Air Barrier System is a combination of an **air barrier assembly** along with other building components to create a plane of air separation between different environments.

Testing – ASTM E779

- Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
- Performance-based option that many designers are requiring.
- Required on all United States Army Corps of Engineers projects.



Interaction Activity

- ASTM E 779
- ASTM E 2357
- ASTM E 2178
- Materials
- Assembly
- Building

Interaction Activity

- ASTM E
- Materials

Interaction Activity

- ASTM E 2178
- Materials

Interaction Activity

- ASTM E 2178
- Materials
- ASTM E
- Assembly
- Building

Interaction Activity

- ASTM E 2178
- ASTM E 2357
- Materials
- Assembly
- Building

Interaction Activity

- ASTM E 2178
- ASTM E 2357
- ASTM E
- Materials
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- Building

Interaction Activity

- ASTM E 2178
- ASTM E 2357
- ASTM E 779
- Materials
- Assembly
- Building

Testing

Building Test:

0.40 cfm/ft² under a pressure differential of 0.3 inches water gauge (ASTM E779 or equivalent method).

100

10

Assemblies:

0.04 cfm/ft² under a pressure differential of 0.3 inches of water gauge (ASTM E2357, E1677, or E283).

1

Materials:

0.004 cfm/ft² under a pressure differential of 0.3 inches of water gauge (ASTM E2178).

ABAA



- Air Barrier Association of America
- Vision: We do air barriers right for energy efficiency, better buildings, and healthier communities
- ABAA lists air barrier materials that have passed their testing standards. Testing standards can be viewed on their website www.airbarrier.org/materials/assemblies_e.php.

ABAA

- Mission: “To promote the use and benefits of air barrier systems, educate the public about air barrier systems and develop a professional air barrier specialty trade and industry dedicated to the installation of effective air barrier systems in buildings on a nationwide scale.”
- **ABAA certifies contractors who have completed and passed their training sessions on proper installation.**
- ***For the best quality control only ABAA listed materials and ABAA certified contractors should be mandated in the specification.***

ABAA Performance Standards

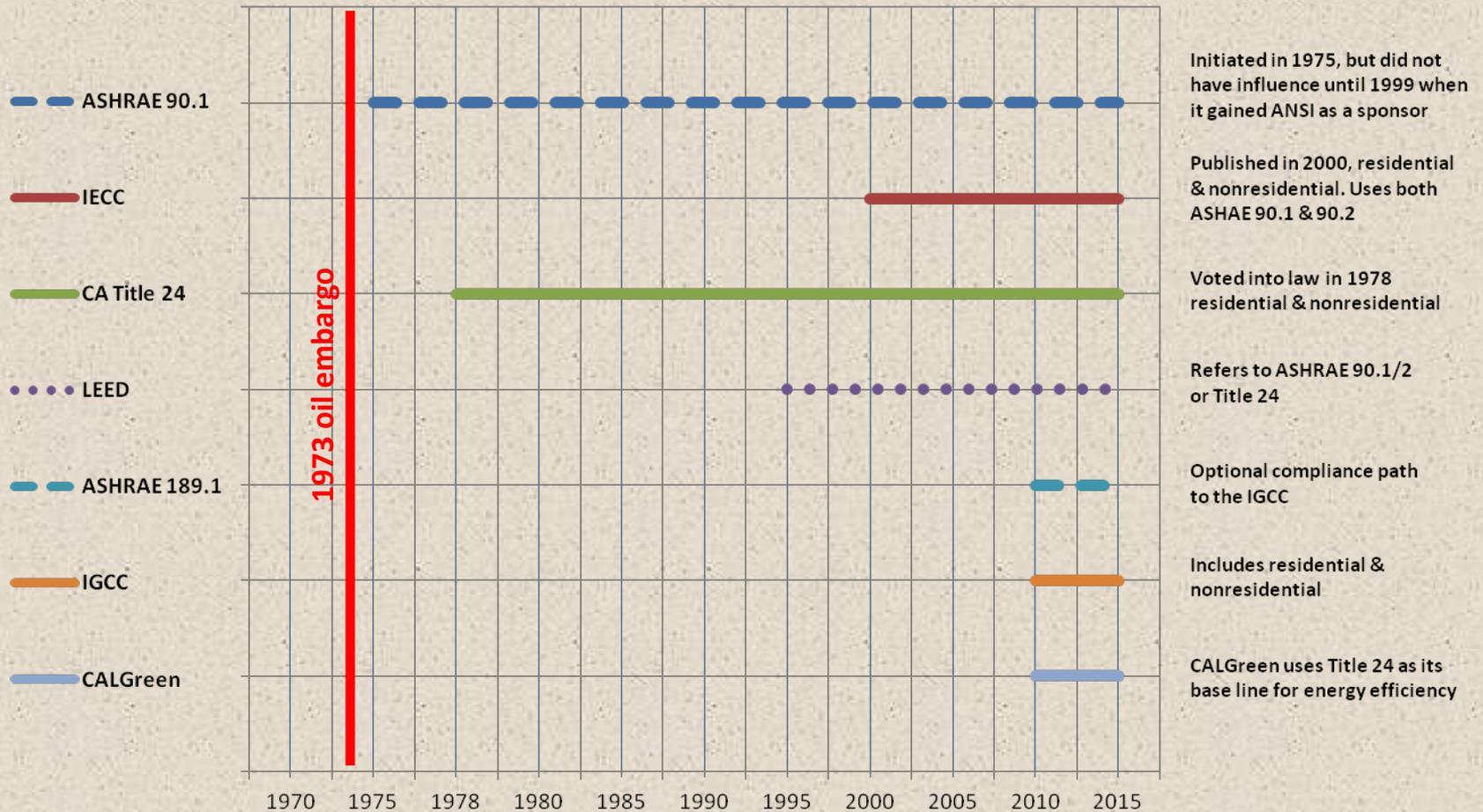
Liquid/Fluid Applied Membranes

| Air Permeance | ASTM E 2178-03 | Standard Test Method for Air Permeance of Building Materials |
|---|-----------------------|---|
| Water Resistance | AATCC 127 - 03 | Water Resistance: Hydrostatic Pressure Test for 5 h |
| Fastener Sealability | ASTM D 1970-01 | Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection - Section 7.9 Nail Sealability |
| Pull Adhesion | ASTM D 4541-05 | Modified Version of Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete using Portable Pull-Off Adhesion Testers– Specify substrates and surface preparation for glass fiber faced gypsum sheathing and concrete block. Declare failure mode. |
| Crack Bridging | ES-AC 212 | Acceptance Criteria for Water-Restive Coatings used as Water-Restive Barriers over Exterior Sheathing Standard Test Method for Crack Bridging Ability of Liquid Applied Waterproofing Membrane– Report thickness and joint treatment (158° for 2 weeks) |
| | OR ASTM C 1305 | |
| | | |
| Water Vapor Transmission (at applied thickness) | ASTM E 96-00e1 | Standard Test Methods for Water Vapor Transmission of Materials – Water and Desiccant Method |

Learning Objectives

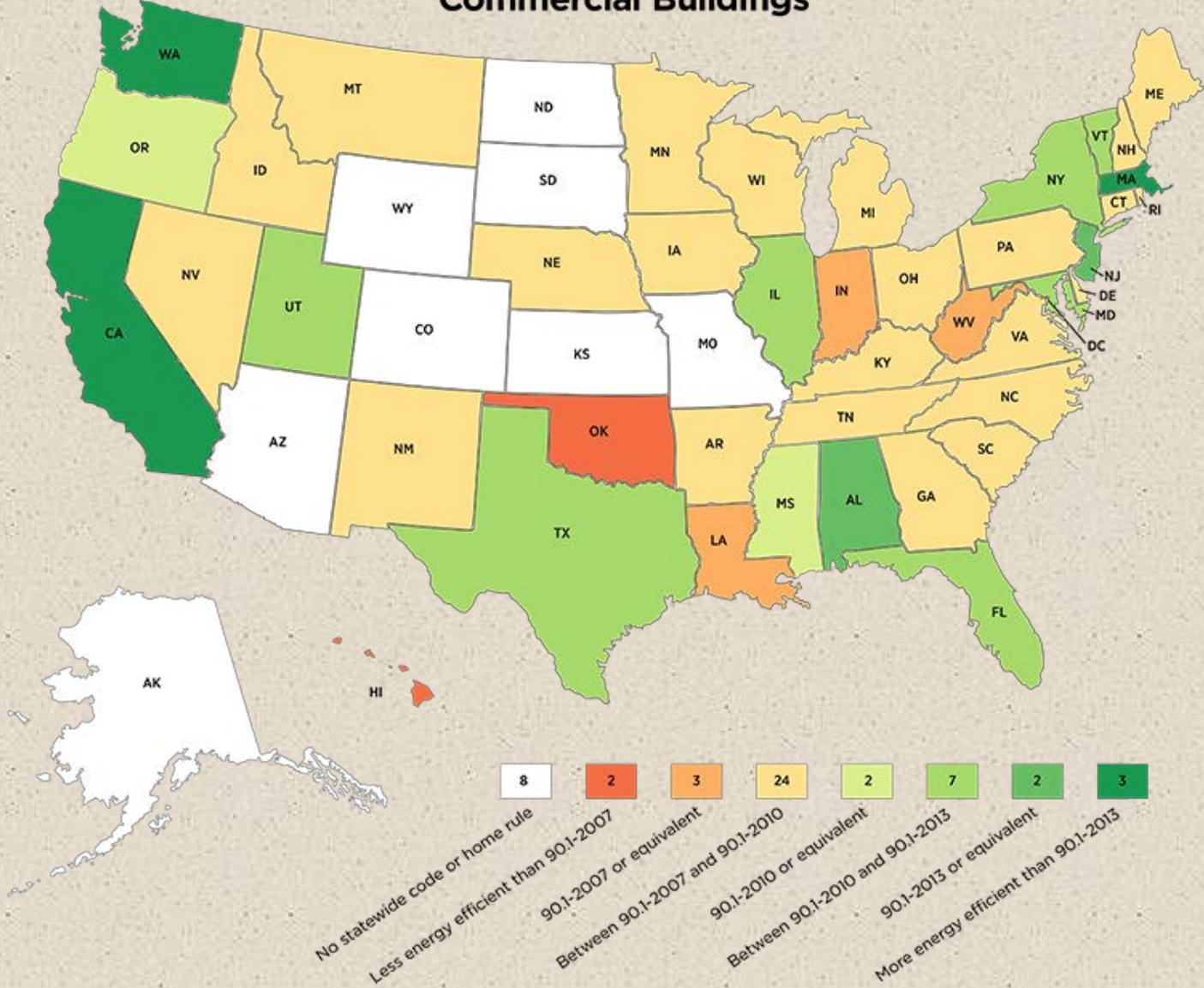
- Discuss the different systems to keep air and moisture out of the wall cavity.
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History of US Energy Codes & Standards



Energy Code Adoption by State

Commercial Buildings



IGCC

International Green Construction Code

606.1.2 Air leakage. Air leakage mitigation measures shall be provided in accordance with this section.

606.1.2.1 Sealing of the building envelope. *The building thermal envelope shall be durably sealed to limit infiltration.* The sealing methods between dissimilar materials shall allow for differential expansion and contraction. *The following shall be caulked, gasketed, weather-stripped, and additionally sealed with an air barrier film.*

1. All joints, seams and penetrations.
2. Site-built windows, doors and *skylights*.
3. Openings between window and door assemblies and their respective jambs and framing.
4. Utility penetrations.



LEED

- LEED references ASHRAE 90.1-2010 as the baseline standard for LEED buildings.
- LEED Buildings require air barrier systems as a mandatory building component.



ASHRAE 90.1 - 2013

American Society of Heating, Refrigeration, and Air-Conditioning Engineers

5.4.3.1 Continuous Air Barrier – **The entire building envelope shall be designed and constructed with a continuous air barrier.**

- Assemblies of materials and components shall have an air leakage not to exceed 0.04 cfm/ft² under a pressure differential of 1.57psf when tested in accordance with ASTM E2357, ASTM E1677, ASTM E1680, or ASTM R283.
- Materials shall have an air permeance not exceeding 0.004 cfm/ft² under a pressure differential of 1.57psf when tested in accordance with ASTM E2178.

Changes in 2015 IECC

WHY?

Changes related to improving energy efficiency

| | 2012 IECC | 2015 IECC |
|-------------|-----------|-----------|
| Commercial | +18% | +26% |
| Residential | +17% | +18% |

SECTION C402 BUILDING ENVELOPE REQUIREMENTS

C402.1 General (Prescriptive). Building thermal envelope assemblies for buildings that are intended to comply with the code on a prescriptive basis, in accordance with the compliance path described in Item 2 of Section C401.2, shall comply with the following:

1. The opaque portions of the building thermal envelope shall comply with the specific insulation requirements of Section C402.2 and the thermal requirements of either the *R*-value-based method of Section C402.1.3; the *U*-, *C*- and *F*-factor-based method of Section C402.1.4; or the component performance alternative of Section 402.1.5.
2. Roof solar reflectance and thermal emittance shall comply with Section C402.3.
3. Fenestration in building envelope assemblies shall comply with Section C402.4.
4. Air leakage of building envelope assemblies shall comply with Section C402.5.

IECC 2015

International Energy Conservation Code

- C402.5.1 Air barriers. A continuous air barrier shall be provided throughout the building thermal envelope. The air barriers shall be permitted to be located on the inside or outside of the building envelope, located within the assemblies composing the envelope, or any combination thereof.
- Exception: Air barriers are not required in buildings located in Climate Zone 2B.



C402.5 Air leakage—thermal envelope (Mandatory). The *thermal envelope* of buildings shall comply with Sections C402.5.1 through C402.5.8, or the building *thermal envelope* shall be tested in accordance with ASTM E 779 at a pressure differential of 0.3 inch water gauge (75 Pa) or an equivalent method approved by the code official and deemed to comply with the provisions of this section when the tested air leakage rate of the building thermal envelope is not greater than 0.40 cfm/ft² (0.2 L/s · m²). Where compliance is based on such testing, the building shall also comply with Sections C402.5.5, C402.5.6 and C402.5.7.

C402.5.1 Air barriers. A continuous air barrier shall be provided throughout the building thermal envelope. The air barriers shall be permitted to be located on the inside or outside of the building envelope, located within the assemblies composing the envelope, or any combination thereof. The air barrier shall comply with Sections C402.5.1.1 and C402.5.1.2.

Changes in 2015 IECC

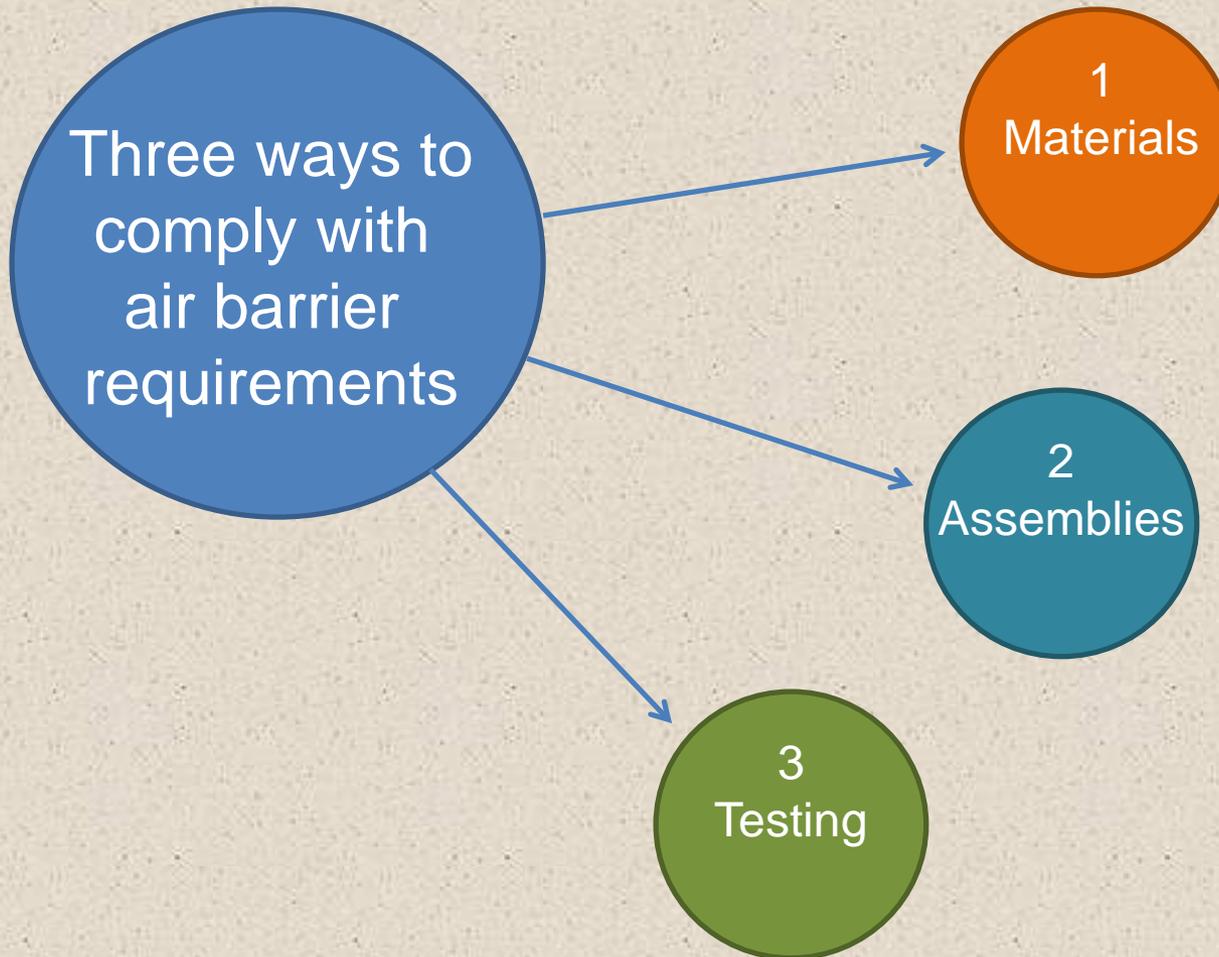
“the building & all joints must be durably sealed”

This is for Air Barrier Materials, not a system.

- The use of duct tape, packaging tape, scotch tape, and masking tape is not allowed.
- Sealing the building and joints must be done with a material that accommodate the anticipated building movement (needs to be elastomeric, >15/20% movement)
- Most universally compatible sealants

ASHRAE 90.1 2013 & IECC 2015

Commercial Air Barrier Compliance Options



Air Barrier Materials (Compliance)

Materials

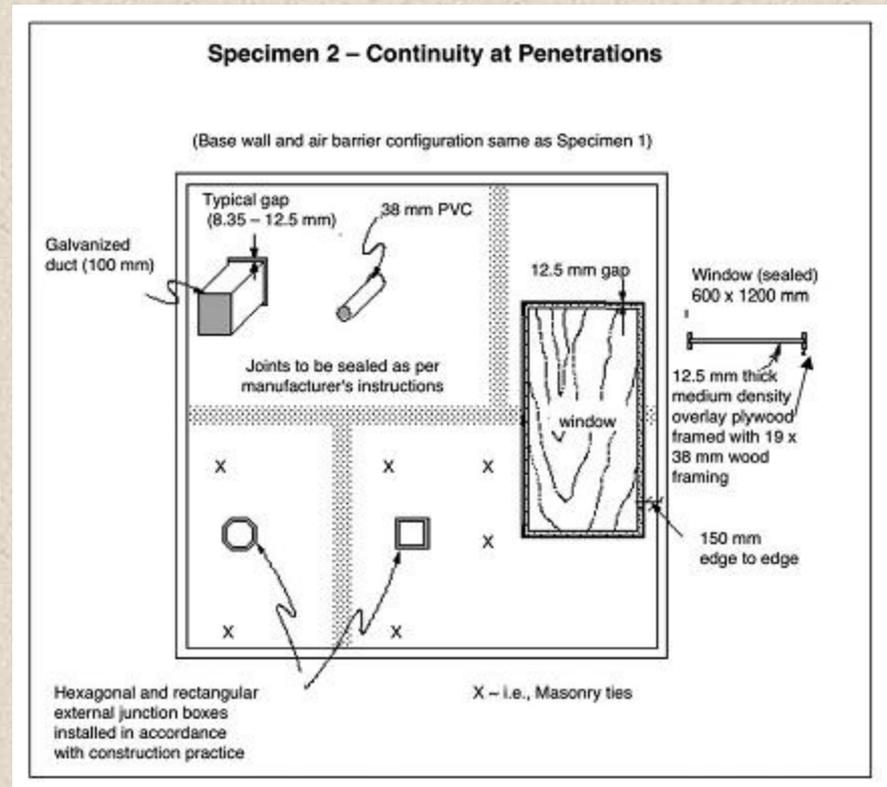
Using individual materials that have an air permeance not exceeding $0.004 \text{ cfm/ft}^2 @ 1.57 \text{ psf}$ ($0.02 \text{ L/s.m}^2 \text{ at } 75 \text{ pa}$) when tested in accordance with ASTM E2178



Air Barrier Assemblies (Compliance)

Assemblies

Using assemblies of materials, accessories and components that have an average air leakage not to exceed 0.04 cfm/ft^2 @ 1.57 psf (0.2 L/s.m^2 at 75 pa) when tested in accordance with ASTM E2357, ASTM E1677, ASTM E1680 or ASTM E283



Air Barrier Building Testing Alternative

Testing

Testing the completed building and demonstrating that the air leakage rate of the building envelope does not exceed 0.40 cfm/ft^2 @1.57 psf (2.0 L/s.m^2 at 75 pa) in accordance with ASTM E779 or an equivalent approved method.



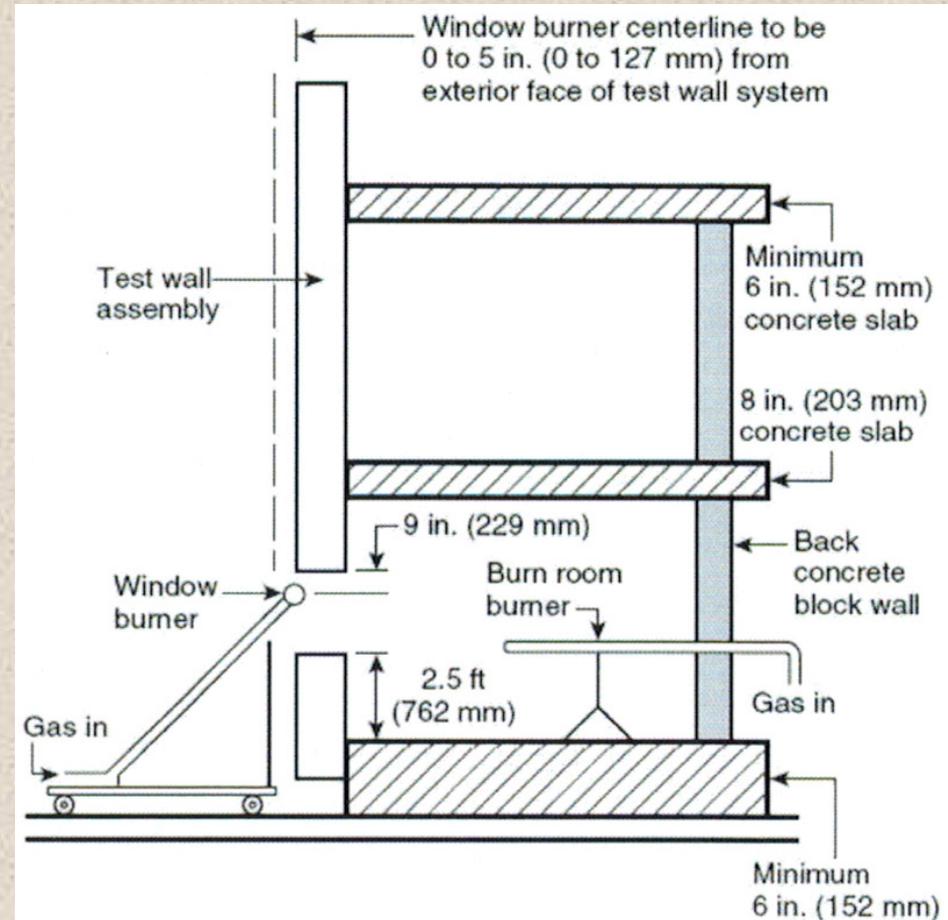
NFPA 285 Fire Tested Assemblies

- NFPA 285 is required in the International Building Code (IBC) when foam plastic insulation is used in the exterior walls of construction types I, II, III, or IV.
- These construction types must have exterior walls constructed of non-combustible materials, including the air barrier assembly.



NFPA 285 Fire Tested Assemblies

- The test is to determine that combustible materials, when exposed to fire on the exterior face of the wall does not spread flame over the surface or through the core of the otherwise non-combustible wall assembly.
- 30 minute test on a full scale two story wall assembly.



NFPA 285 Fire Tested Assemblies

- To pass, the wall assembly must demonstrate limited fire spread vertically and horizontally away from the window.



Specifications

- Specifications must be clear, and call out the appropriate test standards
- Scheduling among the trades must be communicated
- **Involvement of the manufacturers representative is strongly advised**



Thank you for your time!

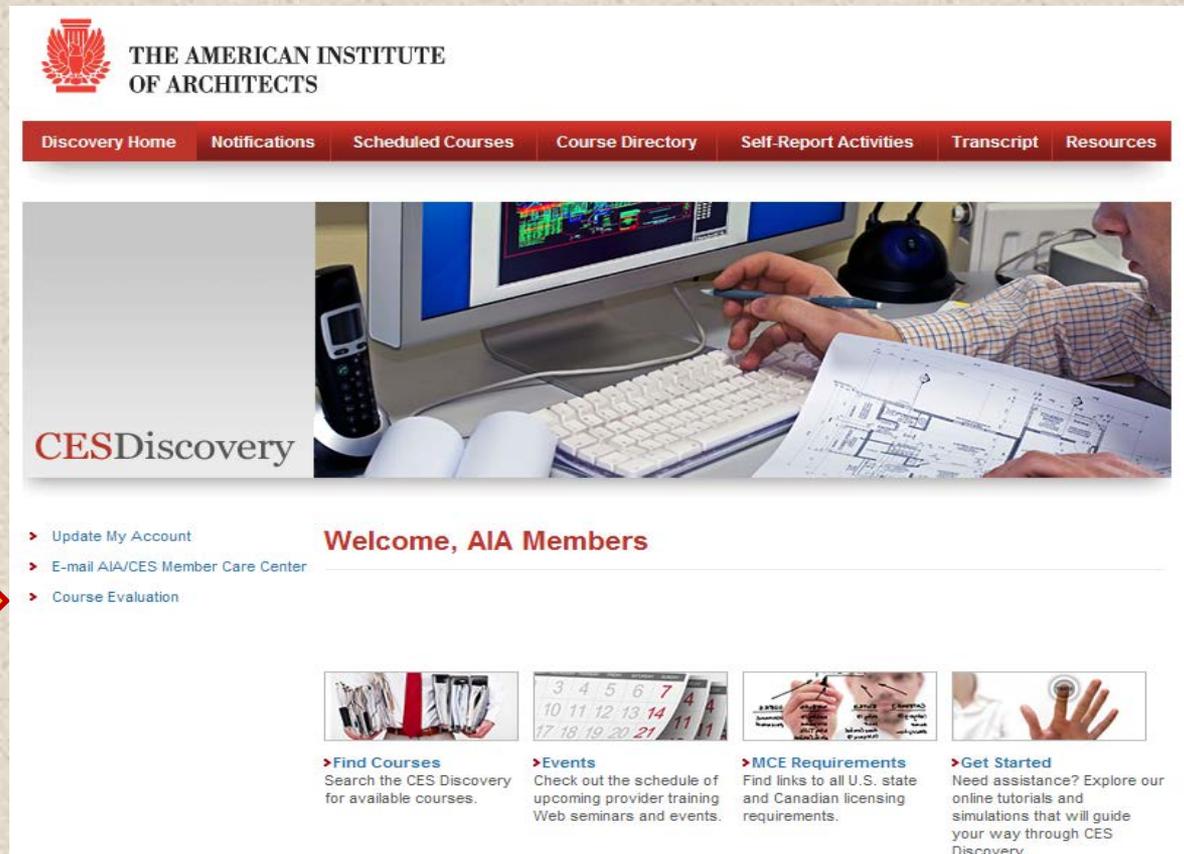
QUESTIONS??

**This concludes The American Institute of Architects
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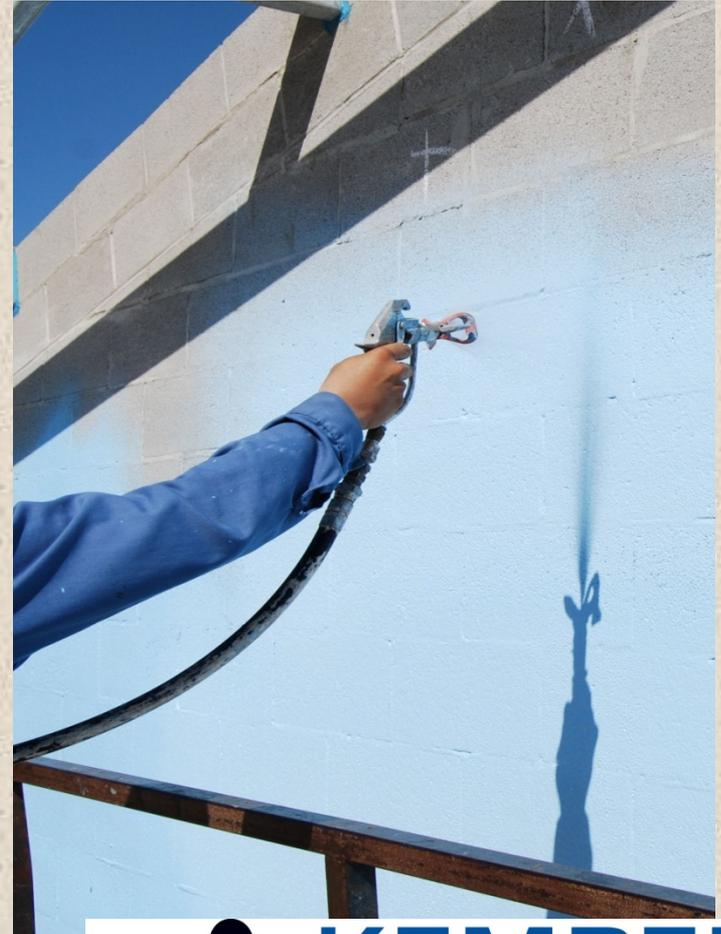
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Wall Guardian FW-100 A

FW-100A is a one-component acrylic based, liquid applied, elastomeric, air and water barrier, vapor permeable (breathable/retarder). It is designed for use on construction surfaces such as gypsum board, OSB sheathing, plywood, CMU and other construction surfaces.

Advantages of Wall Guardian FW-100A

1. Can be left exposed for **12 months**
2. EPA/VOC compliant, 25% Recycled Content
3. Water Vapor Permeance (E96B) 17.3 perms
4. No special application equipment
5. Water based, single component, and monolithic
6. Listed and approved by ABAA
7. Exceeds ASTM E2357, Specimen 2 testing.
8. Passes NFPA 285 in an approved assembly.



Wall Guardian Components

GreatSeal LT-100 Liquid Tape is a polyether based, moisture curing, elastomeric, vertical seam sealer. It forms a seamless, monolithic exterior working surface that will keep the structure water-tight until an air barrier system is applied. **LT-100 Liquid Tape** is for use on ASTM C 1177 exterior gypsum sheathing (SECUROCK® Glass-Mat Sheathing, Dens Glass Gold®), OSB, Foamular®, EPS and plywood construction materials.

GreatSeal LT-100 Liquid Tape can be left exposed for up to 6 months. It is compatible with asphaltic materials and can be used with thru wall copper flashing joints.



Wall Guardian Components

UT-40 Universal Tape Transition Membrane forms a positive and immediate moisture and vapor barrier protection system. UT-40 has excellent conformability characteristics to irregular surfaces, low temperature adhesion and high temperature flow stability. The super-aggressive adhesive provides excellent thermal resistance to high temperature environments.

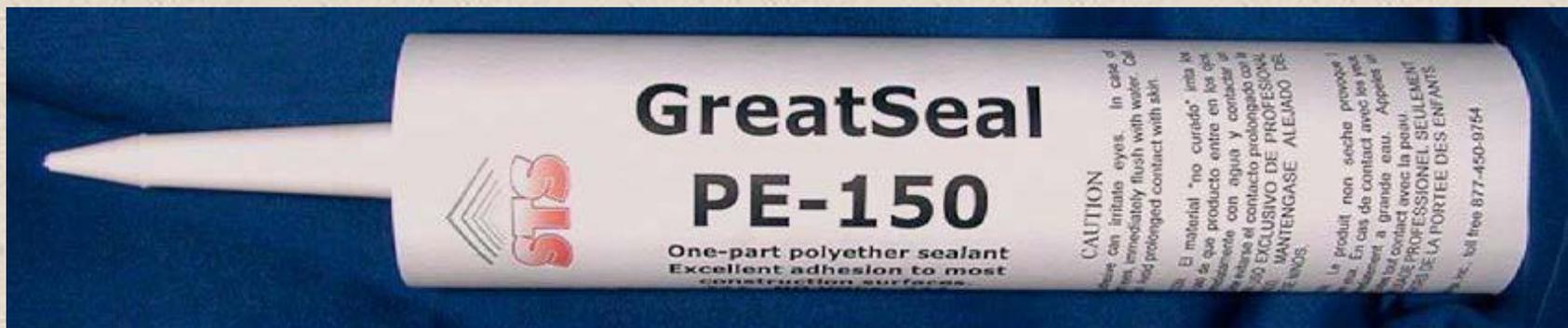
AP-42 Universal Tape Acrylic Primer is a high tack primer for use under UT-40 Universal Tape. Provides excellent adhesion to steel, OSB, exterior gypsum sheathing, dry concrete, wood and masonry.



Wall Guardian Components

GreatSeal PE-150 is a general-purpose polyether construction sealant designed for use on roofing, doors & windows, masonry, and siding. This premium sealant is specially formulated for application in damp, dry or cold job-site conditions at temperatures down to 30°F.

GreatSeal PE-150 is a non-shrinking, 100% solids, moisture-cure polymer and contains no solvents. It skins in one hour, cures completely in three to seven days (cure rate varies with temperature and relative humidity). GreatSeal PE-150 non-slump properties allow sealant installation in vertical or overhead working conditions. It tools easily and can cure though to 2 inches.



Real World Results

Journal of Building Enclosure Design (Summer 2011)

FEATURE ARTICLE

Feature

Improvement of Air Tightness in U.S. Army Buildings

By Alexander Zhivov and Dale Herron

IN THE RECENT PAST, ALL UNITED States (U.S.) Army facilities have increasingly been required to reduce site energy consumption in response to the Energy Policy Act of 2005 (EPACT), the Engineering and Construction Bulletin (ECB) 2010-14 (2010) and the Army Sustainable Design and Development Policy update, Environmental and Energy Performance (October 27, 2010).

EPACT 2005 requires new facilities these environments often experience significant problems with interior mold and mildew as a result of the inability to control relative humidity within the buildings. The major problem is created by a combination of leaky buildings and air conditioning systems operating at supply air temperatures below the dew point temperature. The army has been investing large sums of money to remediate mold and mildew damage and to maintain these facilities in buildings with interior entry ways (older Buildings A, B and C and newly constructed Building D), a modular barracks building (Building G), a newly constructed dining facility (Building E), and a two-story classroom training facility constructed in 1997 (Building F).

Data shows that the envelope leakage in Buildings A, B, C and D was in the range of 0.56 to 0.77 cu. ft./min. sq. ft. (at 0.3 in. of water (75 Pa.) pressure difference. The

TABLE 3. SAMPLE OF TEST RESULTS

| Location | Building Type | Air Barrier Envelope Size (sq. ft.) | Result, (cfm/sq. ft.) | % Better than 0.25 cfm/sq. ft. |
|-----------------------|--------------------------------------|-------------------------------------|-----------------------|--------------------------------|
| Fort Bliss, TX | Barracks | 71,312 | 0.05 | 81% |
| Fort Bliss, TX | Barracks | 71,312 | 0.06 | 76% |
| Fort Sam Houston, TX | Medical Education and Training, Dorm | 371,099 | 0.07 | 73% |
| Fort Bliss, TX | Barracks | 71,312 | 0.07 | 72% |
| Fort Bliss, TX | Barracks | 72,573 | 0.10 | 62% |
| Fort Polk, LA | Barracks (Renovation) | 52,476 | 0.10 | 60% |
| Fort Sam Houston, TX | Medical Education and Training, Dorm | 141,893 | 0.10 | 60% |
| Fort Bliss, TX | Maintenance Facility | 24,632 | 0.13 | 48% |
| Fort Riley, KS | Company Operations | 43,115 | 0.14 | 44% |
| Fort Leonard Wood, MO | Battalion HQ | 63,276 | 0.14 | 44% |

★ These jobs used Wall Guardian



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