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ABSTRACT:
Air barriers must be carefully selected to provide the expected performance. Carefully crafted details and specifications are required to ensure expectations are met by the installed assembly.

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KEYWORDS:
Air Barrier, Water Resistive Barrier, Vapor Retarder, Blower Door Test, Air Leakage, Rain Screen, Ultraviolet Light, UV

REFERENCES:
ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials
ASTM E1827 - Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door
ASTM E2178 - Standard Test Method for Air Permeance of Building Materials
ASTM E2357 - Standard Test Method for Determining Air Leakage of Air Barrier Assemblies

TIPS:
Use a vapor permeable air barrier when any insulation is installed on the interior side of the air barrier.
Use a vapor resistive (impermeable) air barrier when all insulation is installed on the exterior side of the air barrier.

Air Barriers

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Air Barrier Types

Air barriers are available in several forms and materials. The basic materials used for air barrier membranes are asphalt, polyurethane, silicone, and plastics. The membranes are available in liquid, self-stick sheets, and mechanically fastened sheet forms. The liquids are usually applied by spray or roller.

Air Barriers		
Material	**Form**	**Vapor**
Asphalt	Self-stick sheet or Liquid	Resistive or Permeable
Polyurethane	Liquid	Permeable
Silicone	Liquid	Resistive
Plastics	Mechanically fastened sheet or Self-stick sheet	Permeable

Membranes are available as vapor resistive and vapor permeable.

There is no pat answer about when to use each material and each form. The choice between liquid and sheets may depend on regional factors such as installer familiarity.

Function

Air barriers perform the primary function of preventing uncontrolled air infiltration into conditioned buildings. Eliminating infiltration allows the mechanical systems to be selected and sized to deliver the correct volume of ventilation air to the building occupants.
The International Building Code (IBC) requires buildings to be protected by water resistive barriers installed behind the exterior building skin. The water barrier functions to prevent liquid water from penetrating the envelope. By code, the water barrier can be one layer of Number 15 building paper, but this is only absolute minimum for acceptable construction. Air barriers are also designed to function as water barriers.

Some air barriers are also designed to function as vapor retarders. Vapor retarders restrict transmission of water vapor.

(See Tech Tips Vol 10.01.01 for discussion of vapor retarders.)

The International Energy Conservation Code (IECC) requires vapor retarders for building located in northern US climate zones 4 and greater. When air barriers are used as a vapor retarder, the building insulation is usually located entirely exterior of the air barrier. This location ensures that the dew point and condensation occurs outside the water barrier.

Combining the air barrier, water barrier, and vapor retarder functions

into one membrane installed over the wall sheathing or backup wythe allows all three functions to be continuous. Continuity helps assure optimum performance.

Performance

Building and energy codes do not require air barriers. The IECC requires the building envelope to be sealed. The IECC sets air leakage limits for openings, including doors, windows, skylights, storefront, and curtain wall, but not for the overall building envelope.

The Air Barrier Association of America (ABAA) publishes specifications that require the maximum air leakage to be 0.004 cfm/sf with 1.57 psf pressure differential (0.02 L/s/m^2 at 75 Pa) when tested according to ASTM E2178. For vapor resistive air barriers, AABA specifies the maximum permeance as 0.1 perms tested according to ASTM E96, considered to be vapor impermeable.

The ABAA specifications recognize that the installed air barrier assembly cannot meet the laboratory tested air leakage rate. The maximum leakage rate for the installed assembly is 0.04 cfm/sf, or 10 times the membrane leakage rate when tested according to ASTM E2357. Air barrier performance can be tested in the field using ASTM E1827 or ASTM E2357.

Air barriers must be capable of resisting the positive and negative pressures imposed on the building envelope. Negative pressures at building roofs and upper corners can be substantially greater than the majority of the wall surface. Consider the greatest combined effect from wind, fan, and stack pressures when selecting an air barrier. The adhesives and fasteners must retain the membrane in place.

Difficulties

The recent advent of open-joint rain screen wall assemblies complicates air barrier material selections. This type of rain screen assembly could allow the air barrier to be exposed to ultraviolet light (UV). Generally air barriers are not tested for long term UV stability. UV will degrade most construction materials over time. Be careful accepting UV stability claims. Understand that removing rain screen cladding to repair a failed air barrier is something that owners will not willingly accept as part of the building maintenance program.

Specifying and detailing air barriers with UV exposure may lead to unexpected premature failure and potential water intrusion into the building. UV has very short wavelength and is reflected by the atmosphere. This causes UV to be approximately 50% diffuse, impinging surfaces from every angle, and 50% in direct line from the sun. So the UV exposure through open joints extends beyond the width of the direct visible light penetrating the joint.

Several solutions may be available. Consider an overlapping joint design that blocks visible and UV light from penetrating the rain screen surface. This is not a popular choice among designers that want to express the façade joints by relying on the open joint shadow lines.

Or select a semi-rigid mineral wool insulation instead of foam insulation. Mineral wool is unaffected by UV exposure. Foam insulation will be degraded by UV exposure.

Pay Attention to Details

The membrane materials are carefully engineered to perform according to the manufacturer's published data.

The data do not account for transitions, terminations, penetrations, and openings. Careful detailing is required to ensure the air barrier is continuous, air tight and water tight. Be sure the membrane is properly flashed to ensure water sheds to the building exterior. Follow the manufacturer's instructions. Essentially, flash the membrane openings and penetrations shingle style, relying on the membrane overlaps to shed water instead of providing a path for the water to enter the building.

To help ensure an effective air barrier is installed, consider specifying ABAA certified installers or an ABAA accredited contractor.

When performance is critical, be sure to specify field testing to verify expectations are met.

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