

DuPont™ Tyvek® Commercial Air Barrier Assemblies exceed Air Barrier Association of America, ASHRAE 90.1 and IECC Air Leakage requirements when tested in accordance with ASTM E2357



DuPont test protocol for Tyvek® Fluid Applied WB+™, Tyvek® CommercialWrap® and Tyvek® CommercialWrap® D also includes rigorous thermal cycling and high-pressure testing.

Introduction

High performance air barrier assemblies are a vital part of any commercial structure building envelope. An air barrier assembly is a collection of air barrier materials and components assembled together in a specific manner and typically includes the primary air barrier membrane (such as DuPont™ Tyvek® Fluid Applied WB+™, Tyvek® CommercialWrap®, or Tyvek® CommercialWrap® D) in combination with other components to maintain air barrier continuity of the wall assembly. For example, flashings, tapes, sealants, primers, and mechanical fasteners are used to seal wall penetrations such as windows and doors, and for integrating the air barrier membrane with the roof and foundation.

Experts agree the performance of an air barrier assembly is of far greater importance than the air permeance of any single component of the system. The testing of a high performance air barrier assembly for air leakage is done in accordance with ASTM E2357 “Standard Test Method for Determining Air Leakage of Air Barriers”.

ASTM E2357 provides the end user information on the performance of an installed air barrier assembly. A manufacturer must specify each of the components in the system to declare that it provides an air barrier assembly tested in accordance with ASTM E2357. This is a major benefit to the product specifier as system issues such as material compatibility and wall assembly performance are addressed by the manufacturer rather than relying on trial and error.

ASTM E2357 — The Industry Accepted Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.

ASTM E2357 is intended to simulate the performance of various air barrier materials/accessories when combined into an assembly and measures the air leakage of a standardized air barrier assembly before and after exposure to specific pressure cycles. Air barrier assemblies when tested in accordance with ASTM E2357 methodology must not exceed ABAA, ASHRAE 90.1 and IECC maximum air leakage requirement of 0.2 L/(s·m²) @ 75 Pa. (0.04 cfm/ft² @ 1.57 psf), to be considered an air barrier assembly.

All DuPont commercial air barrier systems are tested per ASTM E2357. Third party testing is conducted using DuPont™ Tyvek® commercial air barrier products on opaque walls (with DuPont™ Tyvek® CommercialWrap® fastened with 2" DuPont™ Tyvek® Wrap Cap Screws, and sealed at the seams with 3" DuPont™ Tyvek® Tape) and penetrated wall assemblies (with window, standard penetrations and cladding fasteners (i.e. masonry ties)) installed or applied over exterior sheathing.

Overview of ASTM E2357 Test Methodology

The test method requires a minimum of two, 8' x 8' wall assemblies be tested, which include:

- **Opaque Wall** with horizontal and vertical seams, and
- **Penetrated Wall** with window, duct, electrical penetrations and cladding fasteners

Two wall configurations required for testing, are shown in Figure 1.

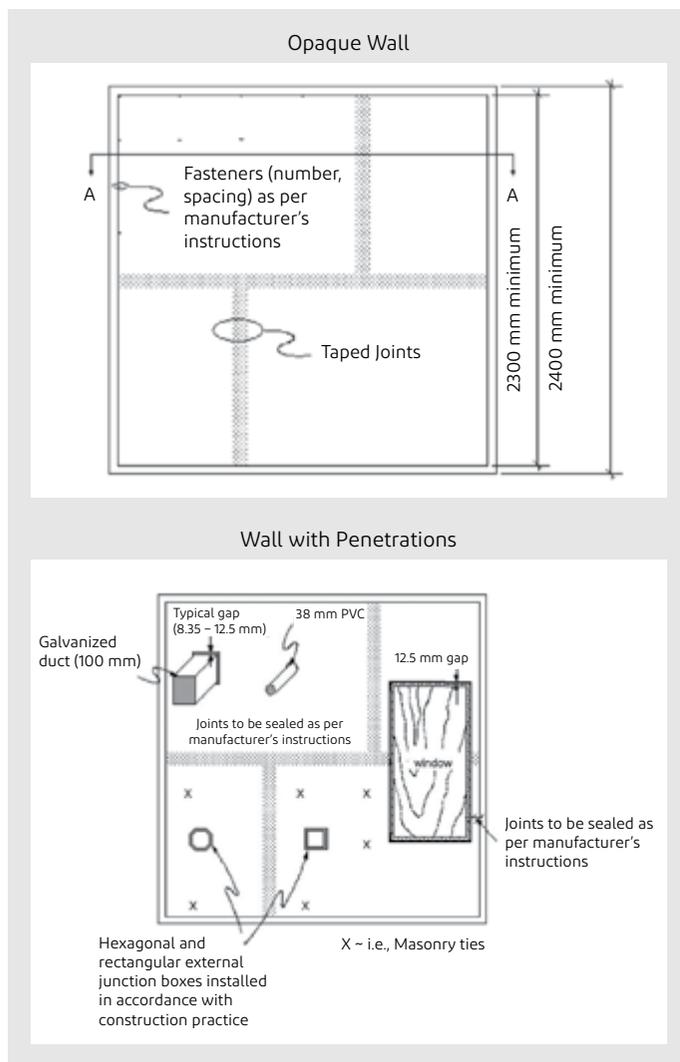


Figure 1: Wall Configurations for ASTM E2357 Testing

Opaque Wall Assemblies

DuPont™ Tyvek® CommercialWrap® Air Barrier Assembly

This assembly consists of an 8' x 8' wall with exterior gypsum secured to steel framing with sheathing fasteners and fastener schedule according to ASTM E2357 structural load testing. DuPont™ Tyvek® CommercialWrap® and Tyvek® CommercialWrap® D are installed over the sheathing according to the requirements of ASTM E 2357 with two (2) vertical and one (1) horizontal seam taped with 3" DuPont™ Tyvek® Tape. DuPont™ Tyvek® Wrap Cap Screws with 2" diameter caps are used to secure the DuPont™ Tyvek® Mechanically Fastened Air and Water Barrier to the metal framing according to the applicable fastener pattern included in *DuPont™ Tyvek® Mechanically Fastened Air and Water Barrier Installation Guidelines for Buildings Greater Than 4 Stories and High Performance Installations of Any Height (K-16160)*. When DuPont™ Tyvek® Mechanically Fastened Air and Water Barriers are installed, the exterior gypsum sheathing seams are not pretreated with a sealing material. An example of an opaque wall assembly with DuPont™ Tyvek® CommercialWrap® is shown in Figure 2.



Figure 2: Opaque Wall Configuration for ASTM E2357 Testing of DuPont™ Tyvek® Commercial Building Wrap Assemblies

DuPont™ Tyvek® Fluid Applied System Air Barrier Assembly

DuPont™ Tyvek® Fluid Applied WB+™ is applied to the exterior gypsum board sheathing by spraying, pressure rolling, or manual rolling to the recommended thickness of 25 mils per the *DuPont™ Tyvek® Fluid Applied WB+™ Wall and Substrate Guidelines (K-29398)*. The seams of the exterior gypsum sheathing are pretreated with DuPont™ Tyvek® Fluid Applied Flashing and Joint Compound+.

Penetrated Wall Assemblies

DuPont™ Tyvek® CommercialWrap® Air Barrier Assembly

The window and other penetrations in the penetrated DuPont™ Tyvek® mechanically fastened air and water barrier assembly are flashed using DuPont™ FlexWrap™ and/or StraightFlash™. In addition, DuPont™ StraightFlash™ patches are placed behind each cladding fasteners (e.g. masonry ties). The penetrated wall assembly is shown in Figure 3.



Figure 3: Penetrated Wall Configuration for ASTM E2357 Testing of DuPont™ Tyvek® Commercial Building Wrap Assemblies

DuPont™ Tyvek® Fluid Applied System Air Barrier Assembly

The wall penetrations and window openings can be flashed using DuPont™ self-adhered flashing products or DuPont™ Tyvek® Fluid Applied Flashing and Joint Compound+. DuPont™ Sealant for Tyvek® Fluid Applied System is used for the interior perimeter seal and for face sealing with the wall membrane. The penetrated wall assembly is shown in Figure 4.



Figure 4: Penetrated Wall Configuration for ASTM E2357 Testing of DuPont™ Tyvek® Fluid Applied Assemblies

DuPont commercial wall assembly test protocol

The wall assemblies are placed into a test chamber and secured for testing. An air supply will provide a positive or negative pressure differential across the test wall assemblies. The ASTM E2357 test method requires wall assembly testing under both positive and negative pressures, since a continuous air barrier will experience both positive and negative pressure loads. The negative load (under suction) is typically the most severe because, in effect, it tries to pull the air barrier assembly off the wall. When a mechanically fastened air barrier assembly is exposed to a negative load pressure, the forces are transferred through the membrane, onto the fasteners and then back to the structural supports (i.e. steel studs). The fasteners used when installing the Tyvek® CommercialWrap® or Tyvek® CommercialWrap® D are attached to the studs and provide additional sheathing holding power during structural loading. Because air barrier system fastening is not necessary for fluid applied air barrier systems, an appropriate sheathing fastener schedule and seam treatment must be employed for the DuPont™ Tyvek® Fluid Applied System wall assemblies. In general, air leakage is measured before and after exposure according to the ASTM E2357 test protocol. The complete ASTM E2357 test protocol is outlined below.

Summary of Standard Testing Under ASTM E2357

Requirements:

• Air Barrier Assembly

- 8' x 8' wall assemblies
- Opaque wall with horizontal and vertical seams
- Penetrated wall with window, duct, and electrical penetrations as well as several cladding fasteners
- DuPont™ Tyvek® Weather Barrier installed with no cladding

• ASTM E2357 Testing Procedure

- Initial Air Leakage Testing
- Structural Wind Pressure Conditioning
- Final Air Leakage Testing
- Deflection Measurements

• Structural Wind Load Cycles

- Sustained: 1 hr sustained positive & negative pressures @ 600 Pa (12.5 psf, 71 mph)
- Cyclic: 2000 cycles of positive & negative pressures @ 800 Pa (16.7 psf, 82 mph)
- Gusts: positive & negative pressures @ 1200 Pa (25 psf, 100 mph)

• Air Leakage Testing (ASTM E283)

- Measure air leakage @ 7 different pressures:
 - ±25 Pa (0.56 psf, 15 mph)
 - 50 Pa (1.04 psf, 20 mph)
 - 75 Pa (1.56 psf, 25 mph)
 - 100 Pa (2.09 psf, 30 mph)
 - 150 Pa (3.24 psf, 35 mph)
 - 250 Pa (5.23 psf, 45 mph)
 - 300 Pa (6.24 psf, 50 mph)

• Deflection Testing

- Measure maximum deflection @ 1440 Pa (30 psf, 110 mph) sustained for 10 sec

After initial air leakage testing, the wall assemblies are submitted to a structural loading schedule as indicated in Figure 5.

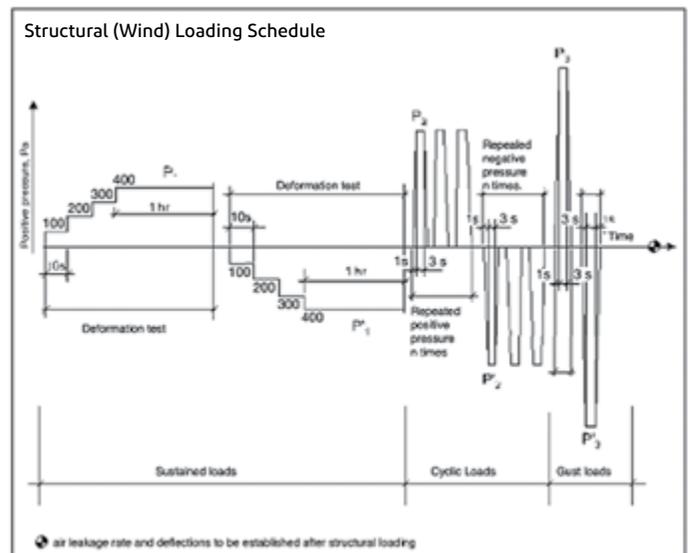


Figure 5: ASTM E2357 Structural (Wind) Loading Schedule

The structural loading of the wall assembly is based on the assumption that the air barrier assembly will take the full wind loads, that it will experience repeated cycling of high positive and negative pressure loads during its service life (e.g. thousand of cycles), and that the air barrier will see two severe storms in the first 15 years in service. Following the wind pressure conditioning, the assembly is retested for air leakage.

DuPont™ Tyvek® commercial air barrier ASTM E2357 testing results

Air barrier assemblies made with DuPont™ Tyvek® Fluid Applied WB+™, Tyvek® CommercialWrap® and Tyvek® CommercialWrap® D have averaged air leakage rates significantly below industry and code air barrier assembly requirements.

Third Party Independent ASTM E2357 Test Results for Tyvek® CommercialWrap®, Tyvek® CommercialWrap® D and Tyvek® Fluid Applied WB+™

Product	Industry and Code Requirement	Test Result	Meet or Exceed Requirement
Tyvek® Fluid Applied WB+™	Not to exceed 0.2 L/(s·m²) @ 75 Pa (0.04 cfm/ft² @ 1.56 psf)	0.001 L/(s·m²) @ 75 Pa (0.0002 cfm/ft² @ 1.56 psf) @ 25 mils wet	EXCEED
Tyvek® CommercialWrap®	Not to exceed 0.2 L/(s·m²) @ 75 Pa (0.04 cfm/ft² @ 1.56 psf)	0.05 L/(s·m²) @ 75 Pa (0.01 cfm/ft² @ 1.56 psf)	EXCEED
Tyvek® CommercialWrap® D	Not to exceed 0.2 L/(s·m²) @ 75 Pa (0.04 cfm/ft² @ 1.56 psf)	0.08 L/(s·m²) @ 75 Pa (0.016 cfm/ft² @ 1.56 psf)	EXCEED

Air Barrier Association of America Evaluated Air Barrier Assemblies

Air Barrier Association of America (ABAA) is a trade organization representing the center of excellence in the air barrier industry. Its mission is to promote the use and benefits of air barrier systems and to develop a professional specialty trade and industry dedicated to the installation of effective air barrier systems in buildings.

ABAA recently introduced an air barrier evaluation protocol, which requires air barrier manufacturers to provide 3rd party test reports for air barrier materials and assemblies. ASTM E2357 has been adopted by ABAA as a key element of its acceptance criteria. For a manufacturer to declare that it provides an air barrier assembly, the manufacturer must specify each of the components in the system. This is a major benefit to the design professional as issues such as compatibility are resolved by the manufacturer rather than relying trial and error.

ABAA Evaluated Air Barrier Assemblies are only those materials for which all required wall assembly testing has been submitted and ABAA evaluation has been successfully completed.

DuPont™ Tyvek® CommercialWrap®, and DuPont™ Tyvek® CommercialWrap® D, in conjunction with DuPont Flashing and Accessories, are the first mechanically fastened air barrier systems that have been evaluated and listed by ABAA as an air barrier assembly (www.airbarrier.org/materials/assemblies_e.php).

DuPont™ Tyvek® Fluid Applied WB+™, in conjunction with DuPont Flashing and Accessories, has also been evaluated and listed by ABAA as an air barrier assembly (www.airbarrier.org/materials/assemblies_e.php).

DuPont is the first manufacturer to offer both mechanically fastened wrap and fluid applied products that have been confirmed to meet ABAA requirements for commercial air barrier assemblies, earning the seal of “ABAA Evaluated”. DuPont™ Tyvek® CommercialWrap® and Tyvek® CommercialWrap® D have also completed ABAA evaluation as Water Resistant Barriers and are also listed under “ABAA Evaluated Water Resistive Barriers”.

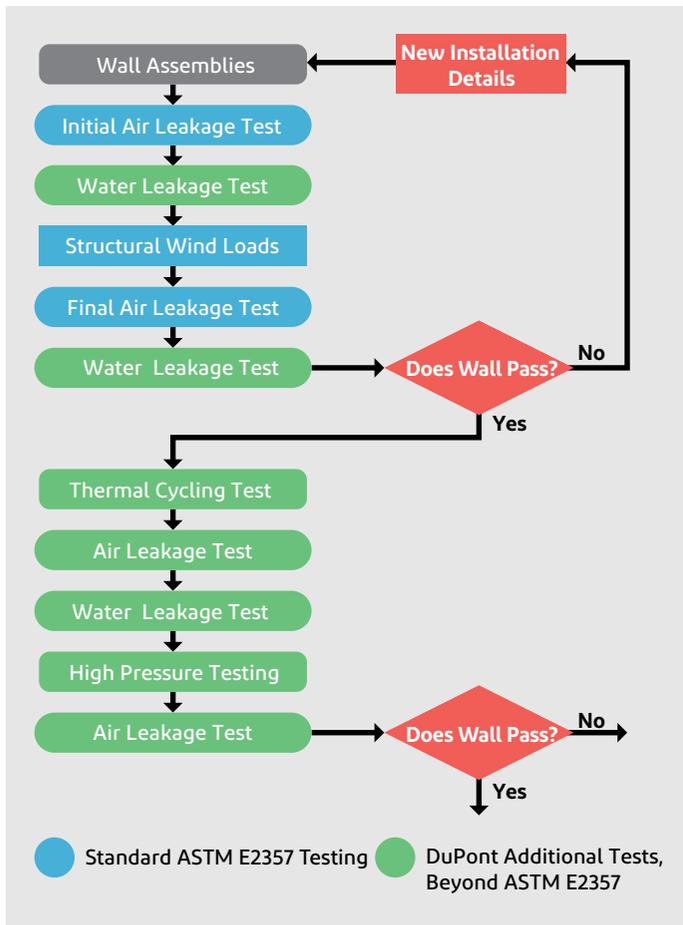


DuPont™ Tyvek® commercial air barriers undergo rigorous thermal cycling and high pressure testing in addition to ASTM E2357 test protocol

ABAA requires manufacturers to prove compliance with minimum standard requirements for air barriers primarily in accordance with ASTM E2357. The current air leakage standards for air barrier assemblies do not take into account the temperature variations an air barrier system may experience during use. However, DuPont believes that the expansion and contraction due to temperature variations may affect the continuity and performance of an air barrier assembly. Therefore, the DuPont test protocol routinely used for Tyvek® commercial air barrier systems goes well beyond the standard requirements to include rigorous thermal cycling and high-pressure testing.

DuPont test protocol for Air Barrier Assemblies

The following flow chart shows the test protocol used by DuPont to test Tyvek® commercial air barrier systems:



The blue blocks in the flow chart describe air leakage testing under conditions specified in ASTM E2357. In addition to air leakage measurement required by ASTM E2357 standard, DuPont routinely measures water leakage per ASTM E331, following the structural wind load and final air leakage testing.

All green blocks in the flow diagram are tests routinely performed by DuPont on wall assemblies and are not specified as a part of ASTM E2357. However green-colored blocks capture the performance level of wall assembly testing conducted by DuPont to offer a higher level of confidence in the use/ effectiveness of DuPont Building Envelope Solutions products. The wall assembly is submitted to thermal cycling, in order to simulate conditions that may be experienced by the air barriers during use. Following thermal cycling, the wall assembly is retested for air and water infiltration, as detailed in the summary below.

Summary of additional testing performed by DuPont to test Tyvek® Commercial Air Barrier Assemblies in addition to ASTM E2357

Thermal Durability Testing (7 days exposure, 4 cycles per days), based in part on AAMA 501.5

- Cycle
 - Transition - 1 hr from room temperature to 180° F
 - Hold - 1 hr at 180° F
 - Transition - 2 hr from 180° F to 0° F
 - Hold - 1 hr at 0° F
 - Transition - 1 hr from 0° F back to room temperature

- Air Infiltration / Exfiltration Assembly Test (ASTM E 283)
 - Measure infiltration and exfiltration at 25, 50, 75, 100, 150, 250, and 300 Pa.

- Water Infiltration Assembly Test (ASTM E 331)
 - Infiltration pressure of 0.56 psf (25 Pa) for 15 min
 - Infiltration pressure of 1.56 psf (75 Pa) for 15 min
 - Infiltration pressure of 6.24 psf (299 Pa) for 15 min
 - Infiltration pressure of 10 psf (479 Pa) for 15 min
 - Infiltration pressure of 15 psf (700 Pa) for 15 min

High Pressure Performance Testing

- Test Sequence:
 - Pressurize to 60 psf (~155 mph) for 10 sec
 - Measure Air Infiltration / Exfiltration @ 75 Pa
 - Pressurize to 90 psf (~190 mph) for 10 sec
 - Measure Air Infiltration / Exfiltration @ 75 Pa
 - Pressurize to Failure

Finally, the wall assemblies are tested to high pressures, as shown in figure 6, until they fail. These tests allow DuPont to validate the installation guidelines for our air barrier systems.



Figure 6. Phase II: Structural High Pressure Performance Testing

Conclusion

DuPont Building Envelope Solutions products are rigorously tested and, when used as a system, help to increase the air tightness of the building envelope, which can have a positive impact on a building's energy efficiency:

- DuPont is the only manufacturer that offers both fluid-applied and mechanically fastened wrap products that pass the industry air leakage requirements for air barrier assemblies when tested in accordance with ASTM E2357

- Consistent with the DuPont commitment to offer products that exceed current standards, in addition to testing per ASTM E2357, DuPont employs an additional rigorous air barrier assembly test protocol that includes water infiltration resistance testing to 15 psf before and after structural loading and thermal cycling. DuPont's commercial protocol is designed to provide confidence in the performance and durability of DuPont Building Envelope Solutions products.
- DuPont™ Tyvek® commercial air barrier systems are designed to work together to seal the building envelope, helping not only to improve energy efficiency but also to protect building structures from water damage and provide improved comfort and indoor air quality for occupants.

DuPont™ Tyvek® commercial air barriers play an integral role in increasing the overall sustainability of buildings. The energy consumed during building operation accounts for the major share of energy consumption over the life of a building — making energy efficiency one of the most critical components in reducing the environmental impact of commercial structures.



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