

# White Paper

The Performance Benefits  
of using Medium Density  
Spray Foam in Continuous  
Insulation Applications



**ICYNENE**<sup>®</sup>

The Evolution of Insulation<sup>™</sup>

# The Performance Benefits of using Medium Density Spray Foam in Continuous Insulation Applications

On occasion - during discussions with architects on using Icynene's medium density spray foam as exterior continuous insulation - comparisons are made to a system comprising of rigid foam insulation board and membrane materials (self-adhered or liquid).

The purpose of this white paper is to highlight several important performance and application facts that demonstrate why medium density spray foam is the superior choice in exterior continuous insulation applications. Findings within this white paper are based on field experience obtained on construction sites, and from testing and evaluations conducted for ICC-ES reports and Air Barrier Association of America (ABAA) programs according to appropriate industry and building code performance criteria.

## Exterior Continuous Insulation

Techniques for insulating exterior walls in commercial buildings have received considerable attention in recent years for many good reasons. Energy codes are requiring higher thermal performance values in walls, particularly in the form of exterior continuous insulation. This construction approach dramatically increases the effective thermal performance of a wall since most thermal bridging is eliminated, resulting in increased wall energy efficiency and occupant comfort. For example, the proper use of an exterior continuous insulation system would result in the elimination of large thermal bridges that often plague a building, such as perimeter concrete floor edges and exposed concrete and steel structural columns and beams.

With R-values for Icynene's medium density products ranging from R-4.9 to R-7 per inch of thickness, spray foam typically meets or exceeds the thermal performance of comparable thickness rigid foam insulation board products. With its greater thermal resistance, the use of spray foam insulation can lead to reductions in overall wall thickness over foam board designs, thereby providing a building owner with additional value. Furthermore, because it is fully adhered to the substrate, there are fewer opportunities for convection and/or air leakage to reduce its performance. This advantage becomes even greater when walls are non-rectangular/odd-shaped or the wall has penetrations like anchors, attachments, fasteners or piping that board products have a difficult time fitting around.

## Airtightness

For an exterior insulation application, medium density spray foam products have the advantage of creating a continuous insulation and air barrier layer in one step. With no board joints to tape, airtight performance becomes much easier to deliver along with cost and construction schedule savings that impress general contractors and owners alike.

All of Icynene's medium density spray foam products have been tested, evaluated and noted as air impermeable, a key feature of air barrier materials, in their ICC-ES evaluation reports. The thickness this characteristic is achieved varies from 1" to 1.4" according to product. Icynene MD-C-200 and Icynene ProSeal have been evaluated and listed by the ABAA as air barrier materials according to their air permeance (airtightness) test results according to ASTM E 2178. The testing of Icynene ProSeal Eco according to ASTM E 2178 also found a high level of airtightness that allows it too to be classified as "air impermeable".

## Air Barrier Assembly Performance

It is recognized by organizations such as ABAA that the use of medium density spray foam (as well as rigid foam insulation board) products in exterior continuous insulation wall applications requires membrane materials (self-adhered or liquid) to prove performance in key areas such as wall transitions and control joints. Consequently, Icynene goes to great lengths to define the components of such a system. Icynene ProSeal and Icynene MD-C-200 have been tested and listed by ABAA as the

key component of an air barrier assembly. Icynene ProSeal Eco is also in the process of being recognized. To qualify as an air barrier assembly the system:

- must demonstrate performance as a continuous air barrier
- shall perform as a liquid drainage plane
- shall accommodate movements of building materials, and
- shall provide connections to adjacent materials to prevent air leakage at all critical locations including connections, joints and penetrations

Among the many rigid foam insulation boards that exist in the marketplace, only four rigid foam insulation boards have currently received the air barrier assembly designation. To make an air barrier system, these products typically require sealants to be applied at all joints and penetrations - a very laborious process. Furthermore, the sealing tends to get applied on the exterior - the most challenging location in terms of temperature and humidity changes.

## Design Flexibility

An extensive number of tests were conducted to receive the air barrier assembly designation including an ASTM E 2357 test report. Part of the testing/approval required Icynene to prove that materials were chemically compatible and adhesively compatible with adjacent materials proposed for use.

As a result, the transition materials/membranes by the following manufacturers have been found to be acceptable for use:

- Carlisle Coatings and Waterproofing
- Grace Construction Products



- Henry
- Protective Coatings Technology Inc.
- Tremco Inc.
- W. R. Meadows Inc.

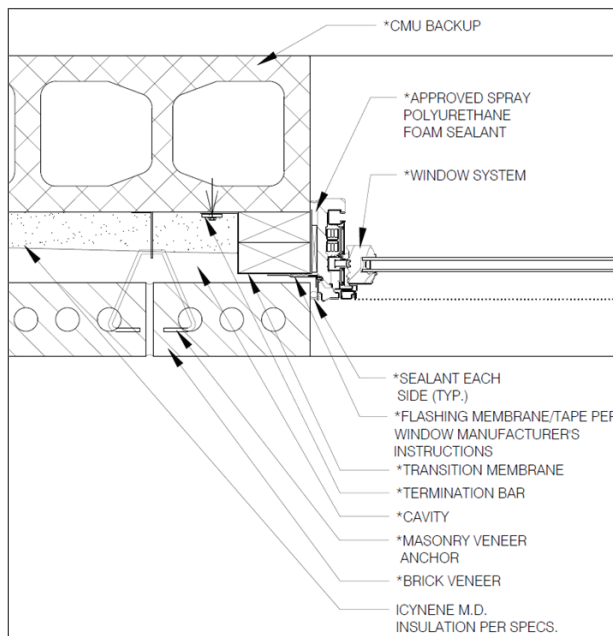
Proper use and detailing of spray foam insulation with transition membranes will create an effective and durable air barrier system. Construction details have been developed by Icynene to guide architects on how to best accomplish the air barrier assembly using our spray foam products. Our design and implementation recommendations for air barrier system details include:

- Provide transition membranes over flashings and movement joints and tie them in at the rear plane of the foam

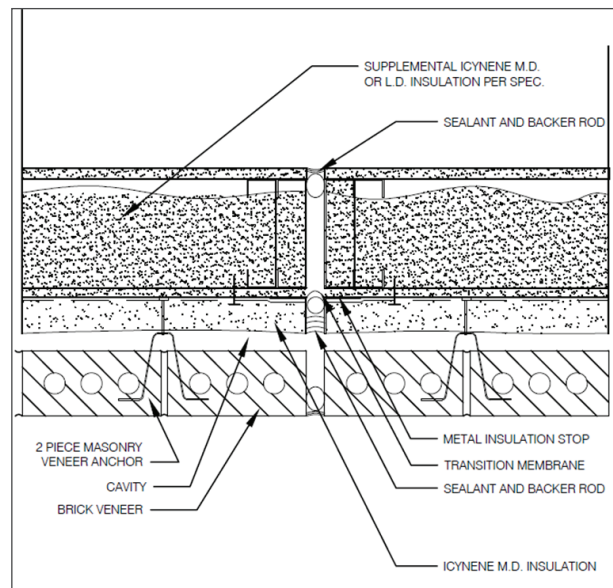
where the temperature and humidity conditions are most constant

- Provide termination bars (locking strips) at the leading edges of transition membranes to ensure a mechanical as well as adhesive bond
- Provide multiple lines of defense at key locations such as control and movement joints
- Ensure that details allow for expected building movements such as creep and settlement

Figures 1 and 2 are examples of construction details that architects can refer to meet these recommendations.



**FIGURE 1.** In this window jamb detail, the transition membrane connects the spray foam layer at its rear plane, at the CMU block, to the window flashing. A termination bar at the leading edge of the transition membrane ensures a long term mechanical bond. Expected building movements such as creep and settlement, and window system dimensional movement should not compromise the wall's airtightness.

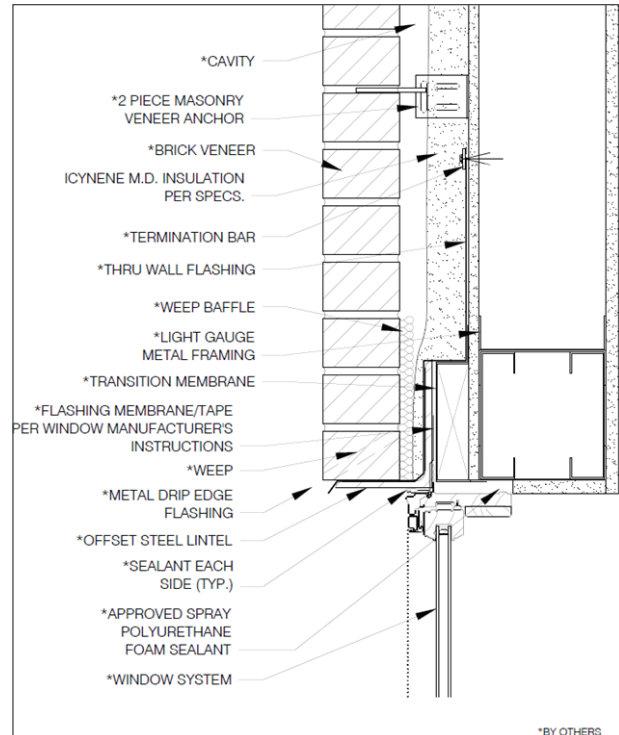


**FIGURE 2.** In this control joint detail, the air barrier system is maintained at the joint with sealant and transition membrane layers. Medium density spray foam is not expected to bridge this joint.

## Water Resistive Barrier

For design purposes, all of Icynene's medium density spray foam products are considered as water resistive barriers since they have very low water absorption per ASTM D 2842 and are capable of shedding water. Consequently when used as exterior continuous insulation, water that may have gotten past the cladding system would meet the water resistive barrier at the foam's exterior surface and drain down it and not continue progressing into the wall assembly where it could cause damage.

Icynene ProSeal and Icynene ProSeal Eco have been evaluated according to ICC-ES AC71, the Acceptance Criteria for Foam Plastic Sheathing Panels Used as Water-Resistive Barriers, and are officially designated as water resistive barriers. Figure 3 is an example of a construction detail that highlights the performance of the spray foam as a water resistive barrier.



**FIGURE 3.** In this window head detail, the spray foam working in conjunction with the thru wall flashing create a water resistive barrier that facilitates any accumulated moisture in the wall cavity to drain out via the weep and drip edge flashing systems.

## Water Vapor Permeance

Even though they can become a Class II vapor retarder (at noted thicknesses), all of Icynene's medium density spray foam products would allow an assembly to dry more easily than equivalent thicknesses of all faced/skinned rigid foam insulation boards (either aluminum or foil based) and most unfaced foam boards. Therefore, spray foam provides a wall with greater drying potential (to the outdoors) which should result in enhanced durability and longevity. If having a low water vapor permeance material on the exterior side of a wall assembly is a concern, note that the lesser the thickness of medium density spray foam, the greater the drying potential of the wall.

Also consider that membrane materials can be applied in vapor permeable or impermeable versions, so care is needed to ensure that the correct product is chosen for the wall assembly as its drying potential will be affected. For example, a very low water vapor permeance membrane material (class I vapor retarder) used over an entire wall surface, in conjunction with a rigid foam insulation board application, would restrict the drying of the wall much more than a medium density spray foam application of significantly greater thickness and thermal performance.

## Dimensional Stability

Icynene ProSeal Eco, Icynene ProSeal and Icynene MD-C-200 have tested positively for dimensional stability, which provides an indication how the foams change dimensionally at different and severe temperature and humidity environments. Therefore, an architect can have confidence that their use will result in stable, long term performance of the exterior continuous insulation layer. The following chart summarizes the dimensional stability information for these products.

### Dimensional Stability Testing Summary

Icynene ProSeal	No Shrinkage; Minimal Expansion at Typical Conditions; Expansion within Acceptable Limits at Extreme Relative Humidity *
Icynene MD-C-200	No Shrinkage; Minimal Expansion at Typical Conditions; Expansion within Acceptable Limits at Extreme Relative Humidity *
Icynene ProSeal Eco	Minimal Shrinkage; Expansion within Acceptable Limits at Extreme Relative Humidity *

\* Reference: CAN/ULC S705 and ICC ES AC 377

Since all three medium density spray foam products exhibited minimal shrinkage in testing, discontinuities in the air barrier and insulation system due to shrinkage of the spray foam will be minimized.

## Cold Temperature Applications

All of Icynene's medium density spray foam products can be applied in cold conditions and to cold substrate materials in accordance with their installation guidelines. Icynene ProSeal Eco is particularly useful for cold weather work since it can be successfully applied to substrates as cold as 5°F (-15°C). This capability makes it an industry leader for winter time use as exterior continuous insulation. Icynene ProSeal and Icynene MD-C-200 spray foams have cold temperature capabilities similar to or better than other medium density spray foams with substrates allowed to be a minimum of 22°F (-5.5°C) for an application. Icynene contractors are trained to take steps to optimize the installation of our foam products. For instance, sometimes an Icynene insulation contractor would use certain unique application techniques noted in installation instructions to compensate for cold weather including "following the sun" and using a thin first pass.



**FIGURE 4.** A cold weather exterior continuous insulation application of Icynene ProSeal Eco medium density spray foam in Michigan - November 2014.

## Fire Resistance

Spray foam and rigid foam insulation boards products are considered combustible and this installation is allowed in non-combustible assemblies provided that the thermal barrier requirements in the Building Code are met. All of Icynene's medium density spray (and low density) foam products have been evaluated for use in fire-rated assemblies (per ASTM E 119) and NFPA 285 compliant walls. Several of these compliant assemblies are noted in the QAI Directory of Listed Building Products. The QAI Directory can be accessed by this link: [http://www.qai.org/Listing\\_Directory\\_Pages/QAI\\_LD\\_CAT\\_Building\\_Products.htm](http://www.qai.org/Listing_Directory_Pages/QAI_LD_CAT_Building_Products.htm)

QAI Laboratories is an industry leader in such evaluations and act as our testing lab and internal product performance auditors. Other fire-rated assemblies and NFPA 285 compliant walls have been determined on a case by case basis through our fire engineering consultant's examination of assembly construction details. Consult with Icynene's Engineering department for further details or evaluations.

Note that Icynene medium density spray foam's fire performance characteristics are different than extruded polystyrene foam boards in that they do not melt at high temperatures. Furthermore, although Icynene's medium density spray foam products are considered combustible according to the Code, they will not sustain a fire once the fire-source is removed.

## Medium Density Spray Foam Advantages

As discussed throughout, use of medium density spray foam insulation in exterior continuous insulation applications provides architectural firms and commercial building contractors a great opportunity to positively impact their building schedules, budget and overall performance quality. Furthermore, medium density spray foam insulation in exterior continuous insulation applications:

- Meets or exceeds thermal performance of comparable rigid foam insulation products due to its high R-value, which can also lead to reductions in overall wall thicknesses
- Creates a continuous insulation, water resistive barrier and air barrier layer in one step
- Delivers consistent system performance for cost and construction schedule savings
- Can cover the widest range of exposed surfaces to prevent thermal bridging
- Features an approach to air and water resistive barrier creation that is not dependent on extensive use of joint sealants in exposed situations
- Has a much better ability to bond to the entire length of wall penetrations, such as brick ties and fasteners, thereby better ensuring thermal and airtightness effectiveness
- Is less likely to have air barrier discontinuity at transitions and control joints
- Has very low water absorption and is capable of shedding water
- Can be applied in cold temperatures as low as 5°F (for Icynene ProSeal Eco), and
- Can be installed in wall assemblies that are fire-rated or part of non-combustible construction.

Call **1.800.758.7325** or visit **icynene.com** to learn more about the application of Icynene's portfolio of open and closed cell spray foam insulation products.

Icynene is a registered continuing education provider. To complete an online continuing education course or for more information, visit: [www.icynene.com/en-us/continuing-education-architects](http://www.icynene.com/en-us/continuing-education-architects)

Icynene Inc. 6747 Campobello Road  
Mississauga, Ontario L5N 2L7 Canada

Ph: 1.800.758.7325 • ICYNENE.COM

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