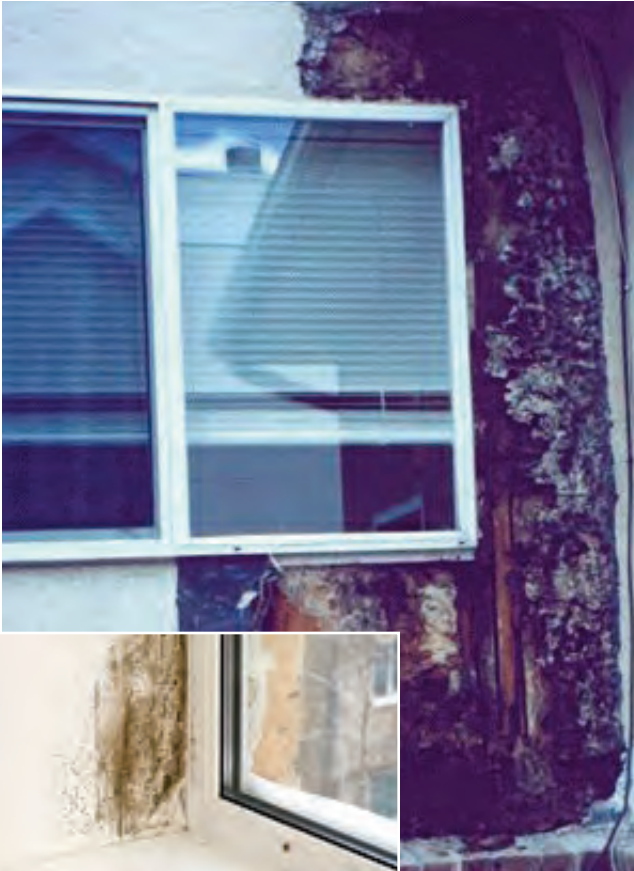




WEB BASED APPLICATION SPECIFIC INSTALLATION INSTRUCTIONS



Water Management to Control Mold and Mildew

Although all possible measures have been taken to insure the accuracy of the material presented, WIXSYS, and the author are not liable and do not assume any liability in case of misinterpretation of directions, misapplication, improper installation, or typographical error.

Water Management for Window and Door Installation in New Construction

Complex Installation and Flashing Techniques are required to make sure water does not penetrate the wall assembly either from the weather or from moisture laden vapor migrating from the warm-side of the wall to the cold side.

Probably the most consistent form of window failure in most climate zones is through water penetration from faulty or incomplete installations. Windows are one of the most difficult components of the building enclosure to incorporate into the water management system. If they are not, water intrusion can occur beyond the structure's ability to dissipate or absorb.

Leaks from windows have existed as long as windows have existed. Water not only leaked through the windows themselves, but also around the windows at the interface between the rough opening and the window frame. In many older solid masonry buildings this was not a problem due to the capacity of the construction to absorb moisture and dry out under more favorable conditions.

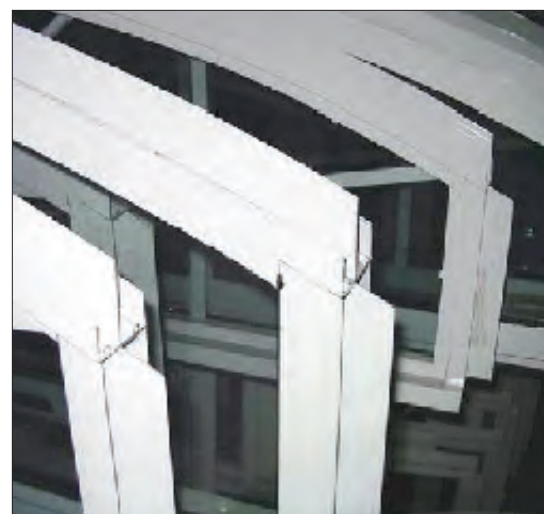
As the construction industry changed, materials and assemblies used had less of a capacity to manage moisture. The absorption capacity and the drying potential of assemblies were significantly reduced. This led to serious problems directly related to window leakage.

Risks associated with window leaks are affected by various characteristics — from the climate in which the window is installed, to the materials used, to the skill and attitude of the person doing the installation. Understanding these factors including the limitations and critical aspects of the installation is important in deciding the appropriate installation technique to use.

AWDI recommendations and standards rely heavily on all published work, including ASTM E2112, AWDI 1.3 (Revised), and field experience though years of certification, testing, and service work. Building Sciences Corporation in Westford, MA has also done extensive research on rain water management for windows and doors, and their observations are included in the text and illustrations used in this manual.

These descriptions and instructions deal with both the need to properly flash the installation and the need to maintain vapor barrier continuity. Flashing deals with water and moisture intrusion through weather related causes, and Vapor Barrier relates primarily to the migration of moisture laden warm air towards drier cold air and the resulting condensation that can introduce moisture and water into the installation cavity.

Installation has historically been the least respected of the disciplines in construction and is usually treated as a cost to be minimized – attracting low skilled workers, or a split in the trades doing the work eliminating consistency and continuity of care and responsibility. The skills and care needed to be successful in window and door installation require attention and should not be considered lightly.



There are two basic window installation strategies: a barrier approach or a drained approach.

The barrier approach works under the preconception that the installation will keep all the water out and is the approach traditionally used by much of the industry. In this approach, the window is sealed on all four sides in an attempt to create a perfect barrier against water infiltration. Experience has shown that most window installations do not have the ability to perform as a perfect barrier for the life of the window installation.

In addition, the ability to actually create the barrier is undermined by damage to or flaws in the frame of the window and door product either from manufacturer or on-site damage or both. Due to this, barrier systems, while a form of water management, are not generally recommended and should only be considered for use in certain assemblies such as mass wall assemblies.

Drained systems work under the concession that some water will leak through the window at some point in time, and provisions are to be made to direct the water back out to the exterior. This approach has been shown to be an effective method of water management, though care must still be taken in the design and application of the system.

AWDI recommends the drainage system approach.

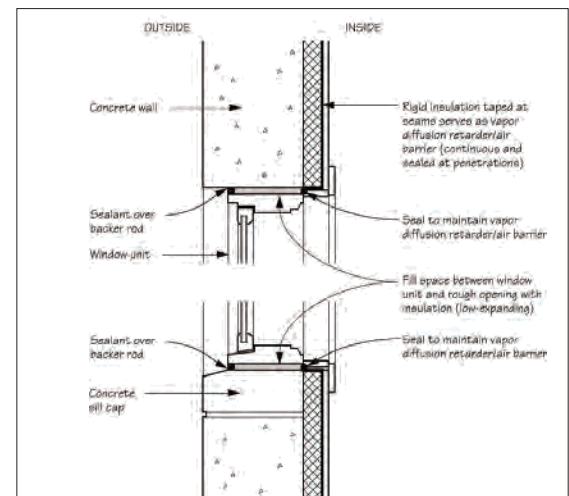
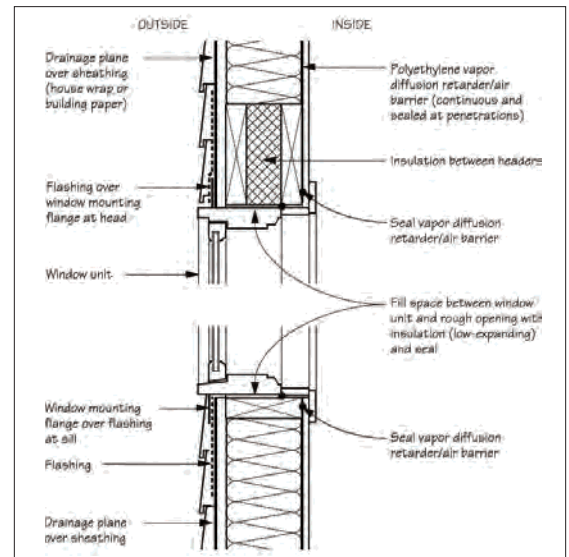
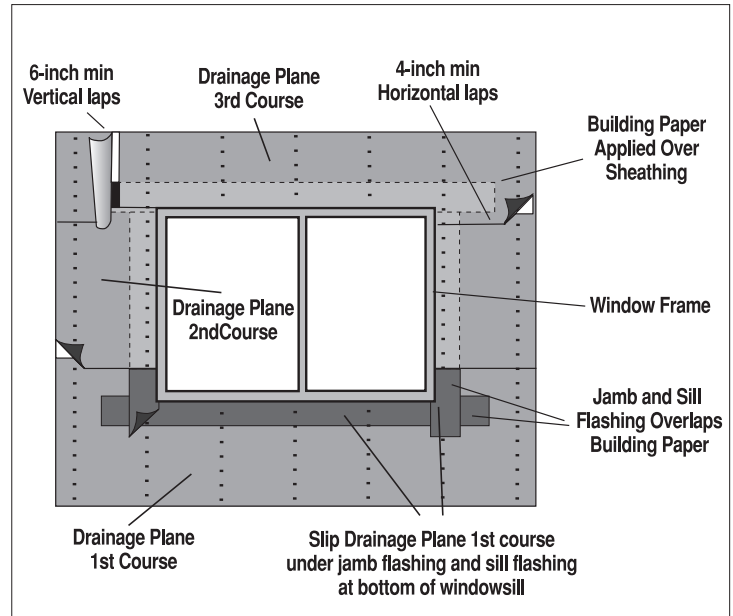
Most standards and practices for window and door installation focus on barrier techniques. This is due primarily to two reasons. First, theory and lab observations allow barrier techniques to work as designed. This is not true in the field. Second, window manufacturers are primarily concerned (understandably) that their products do not leak, and little concern for the performance of the wall.

While the construction of the wall and the application of the various wraps, barriers, and flashings on the wall are the responsibilities of others, the AWDI trained installer can mount the new window and door into the opening, and make sure that any water that enters is directed away from the interior and is given a path to drain properly to the exterior.

And, the AWDI trained installer can take care to maintain vapor barrier continuity to be sure any migration of moisture is out of the cavity between the window/door and the opening to a place where it can drain, dry or be absorbed to eliminate chance of rot, mold or other damage in the wall structure.

The AWDI drainage method, when its techniques and materials are applied to the window or door opening, assure that the installation will not leak, and that damage to the materials within the opening cavity are mitigated. It is the best method over the long haul, and superior to the barrier method in today's energy efficient constructions.

The proper approach to installation in replacement applications is addressed in detail in the AWDI Illustrated Guide to Installing replacement Windows. The material contained in this guide will deal with New Construction Applications exclusively.



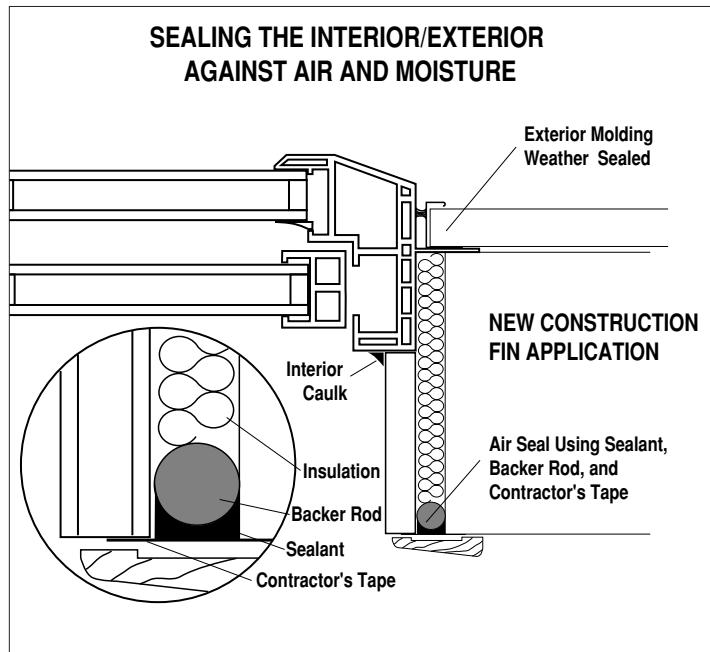
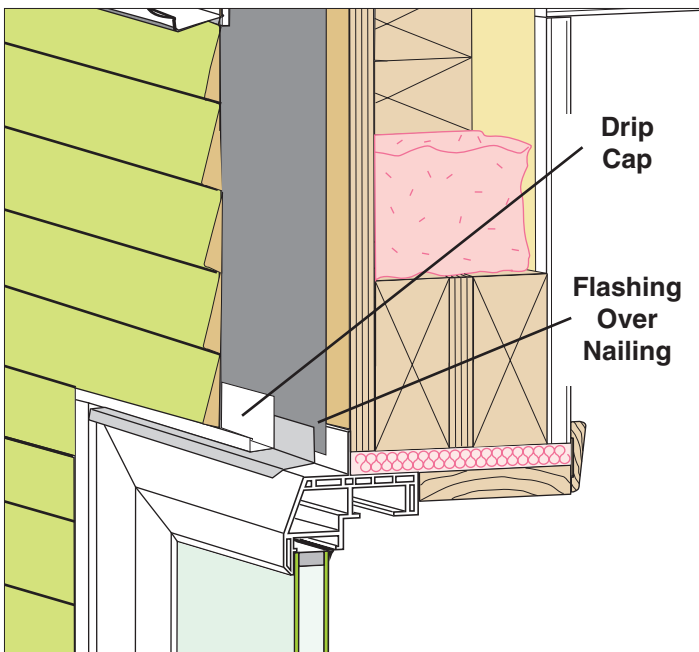
The Importance of the Nailing Fin

Most residential windows on the market are designed with a nailing fin to help with the installation of the window. The fin is intended to make consistently lining up the window in the same location in the rough opening easier. The fin, however, is often not structural and proper shimming and blocking of the window is required. This nailing fin has some advantages and some disadvantages associated with it. While it does make the installation easier, the water management strategies must be carefully considered.

The nailing fin should be considered a part of the drainage plane of the wall. It does work very effectively, as long as the fin is continuous around the entire window perimeter and integrity of the fin is maintained.

The nailing fin is usually a thin PVC or metal fin that is part of the frame extrusion and generally not very strong. These fins can be damaged, bent or broken during the delivery or installation of the window system into the wall assembly, or may not be continuous around the window depending on the assembly at the corner joints of the frame. Damaged and broken nailing fins can lead to fundamental failures in the integrity of the drainage plane of the wall assembly as membrane tapes and building papers/housewraps no longer have adequate area of material to adhere to or cover over the fin.

As long as the nailing fin is continuous and undamaged it can be effectively integrated into the moisture management of the wall assembly. Self-adhered membranes are often used to integrate the nailing fin into the drainage plane of the water management system of the wall assembly. Adhesive-backed flashing materials like Grace Vycor are used to seal to the nailing fin in a shingle lap fashion to prevent reverse laps that can create paths for water intrusion.



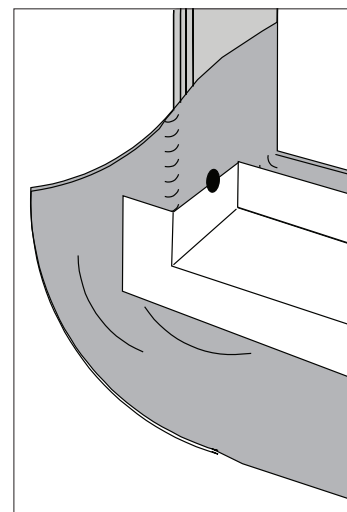
Most housewraps are not flashings. In fact, housewraps are vapor porous and are no better than air barriers. Use of a housewrap to create shingle-lapped flashing is inadequate and should not be relied on to work.

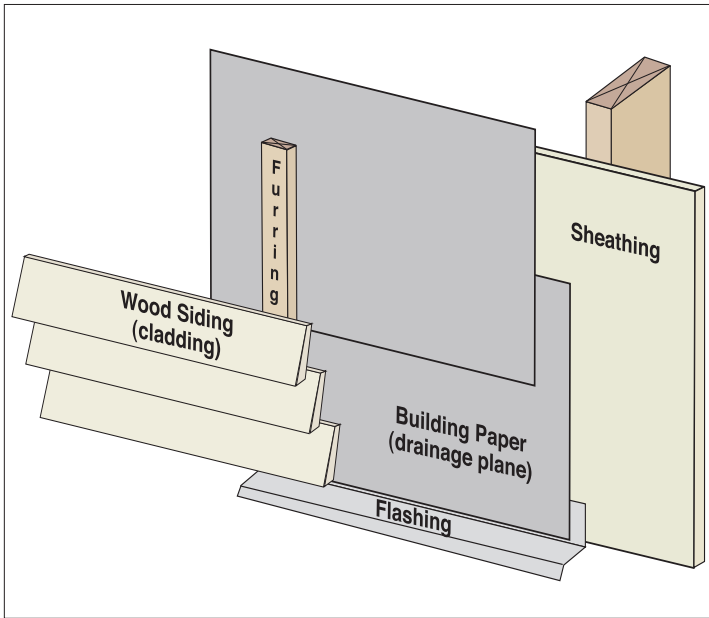
In addition, adhesive-backed flashing materials need to be fastened to the exterior wallboard (exterior plywood or oriented strand board). Fastening to the housewrap will only create a patch for the water to go under the flashing and into the interior.

Pan Flashing is Required

The installation of a pan flashing at the sill of the rough opening is critical to the design of drained window installations to protect the framing of the rough opening from moisture damage and to help direct any water back out to the exterior. Sill Pans can be created out of numerous materials, such as membrane flashings, and metal, but this requires additional skills and care that often lead to problems because of the irregularities of the framed opening. AWDI recommends use of a pre-formed sill pan, such as Jam-Sill.

Ideally, the pan flashing would be sloped to the exterior. This can be achieved through the use of a section of board siding laid flat under the pan flashing at best, or smart use of the shims used to level the sill pan between the jambs.





Vapor Barrier Continuity

The function of a vapor barrier is to retard migration of water vapor. Where it is located in an assembly and its permeability is a function of climate, the characteristics of the materials that comprise the assembly and the interior conditions. Vapor barriers are not typically intended to retard migration of air. That is the function of air barriers.

The fundamental principle of water control in the vapor form is to keep it out and to let it out if it gets in. This becomes complicated because the barrier method of window installation used in the past meant to keep water vapor out was found to trap water vapor in. This can be a real problem if the assemblies start out wet because of rain or the use of wet materials, but can be the principle cause of mold, rot and other decay in the cavity between the window or door and the rough opening. Moisture can also lessen the insulation value of fiberglass or other insulation materials placed in the wall.

The condition of the rough opening can affect the performance of the drainage of the pan flashing. The exterior sheathing must not extend higher than the sill framing. In this situation, even with a perfectly installed pan flashing, the drainage of the system will be compromised.

The preformed plastic sections usually have integrated back-dams. With these products the jambs and sill joint between the two pieces must still be sealed with membrane to prevent water intrusion below the pan flashing. The procedures are simple, but important. If done well, no water will back up into the interior.

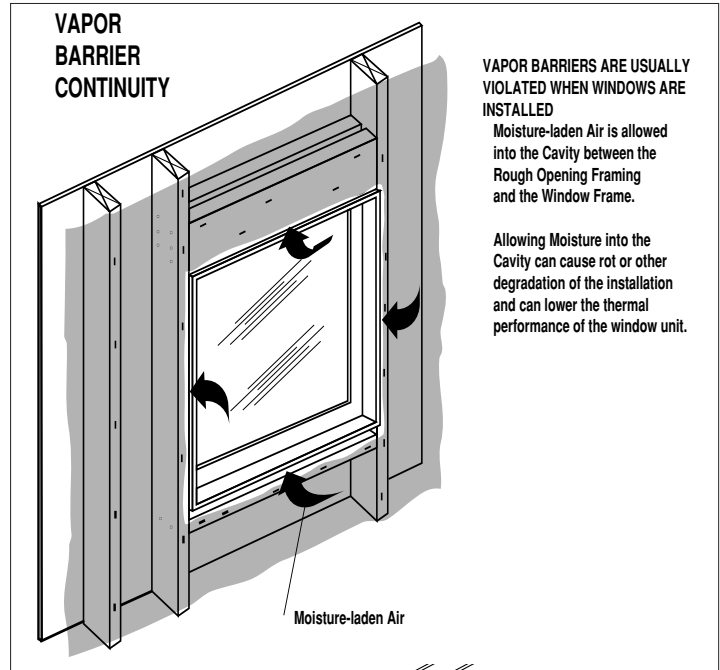
Accommodating Two Drainage Constructions

There are two basic drainage constructions. While the details are not germane to this manual, it is important to understand the differences as one is more often used in wood frame construction and the other in CBS or other masonry applications.

In wood frame, penetrating water is directed to a water resistant barrier (WRB) and directed downward and out of the building at the base of the wall. The WRB is traditional building paper. If house wrap is used, then the exterior sheathing must be water resistant.

In masonry and masonry block construction, the intruding water is absorbed in a non-water sensitive material, re-distributed and released to the outside and the inside in a controlled way. If covered with stucco, the masonry will need a bond-breaking building paper and a WRB to allow the moisture to pass between them. If it is a brick veneer, then there will be space between the brick and the exterior wall.

In either case, the window or door is mounted to a wood surround, and the instructions to follow make sure all water is directed away from the cavity and into the drainage system regardless of the drainage construction.



It becomes even more complicated because of climate. In general, water vapor moves from the warm side of building assemblies to the cold side. This is why insulation battes have building paper type surfaces on one side (used to staple to the studs). Determining the warm side/cold side needs different strategies for different climates, and differences between summer and winter.

For the purposes of window and door installation, AWDI proper installation will maintain continuity in the vapor barrier with regard to the window or door opening making sure any potential moisture migrating into the cavity between the window and door and the rough opening is not trapped, will not condense, and is free to dissipate before it can cause damage. It is an extra step not usually taken by window and installers, but necessary for proper and effective and long lasting installations.

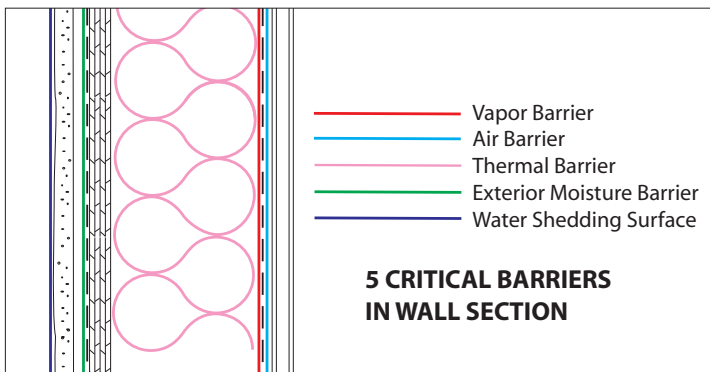
5 Critical Barriers in Building Construction

Proper Installation of Windows New Construction or Replacement requires complete interface of the 5 critical barriers of wall design.

Science, engineering and technology have produced methods for building walls for homes that keep out inclement weather and keep in warmth in winter and cool in summer which can last and perform acceptably for decades.

What have emerged are construction techniques that create 5 barriers in the structure from outside in:

1. Water Barrier
2. Moisture Barrier
3. Air Barrier
4. Thermal Barrier
5. Vapor Barrier



Turn the water barrier up, and it creates an ideal roof. Turn the water-side down, and it creates an ideal floor.

Today's homes, however, cut holes in these walls to install windows and doors. Each of the barriers is breached. While today's modern windows and doors are supreme examples of energy efficient and weather resistant mechanical wonders – containing counterparts to each of the 5 barriers in the wall in which they are installed – it is necessary that each and every one of the barrier components be interfaced with their counterparts to recreate and preserve the function of the wall system.

This complete interface of the 5 critical barriers is more easily attainable in New Construction. However, complete interface of all 5 is extremely difficult in replacement applications due to problems in accessing all the barriers that may be hidden in the layers of the wall, and skill levels of installers who know little more than mounting and exterior sealing techniques.

The simplest approach is external sealing of the new window to the old window frame or wall. This method, called the "Barrier Method" relies on sealants to keep water and moisture out of the wall. While this method is initially effective, if done right, it is limited in long

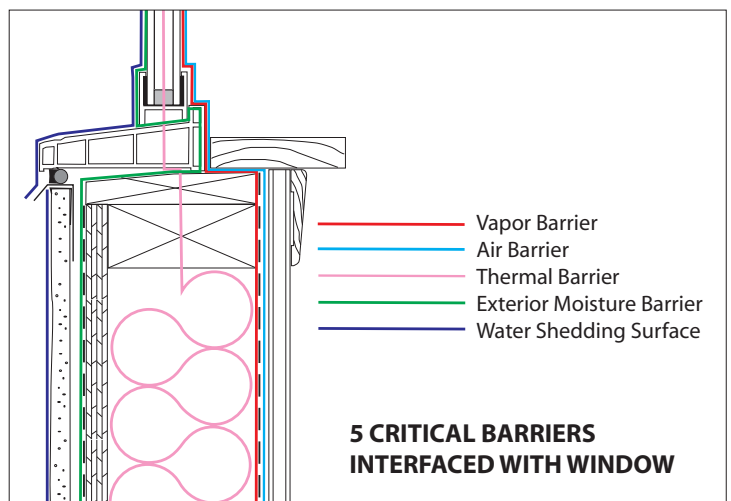
term effectiveness as the sealant begins to breakdown immediately eventually leading to water penetration into the wall.

A more effective and long-term solution depends on re-interfacing of the moisture barrier and the air barrier, behind the water barrier. This method is called "The Drainage Method" and involves the re-introduction of flashings, sill pans, and external air barriers. This method creates the necessary redundancy originally designed into the wall to handle inevitable water, air and moisture penetration into the wall, and direct it away from the window, and out of the wall. If not done, this water will leak into the home, or worse – stay in the wall and cause mold, mildew, rot, and insect problems.

Lastly, water vapor (water vapor molecules are smaller than air molecules and can seep through air barriers quite easily) will move from warm to cold and condense and deposit moisture inside walls, no matter how airtight. This moisture can reduce the effectiveness of the insulation in the wall.

Accommodation must be made to balance the needs of vapor barrier continuity as originally designed into the wall system. Therefore, the most complete installation of a replacement window or door will incorporate continuity in the flow or vapor. This method, called "Vapor Barrier Continuity" is the best, and most complete approach towards the reconstruction of the 5 barriers in the wall with their counterparts in the replacement window.

While each step increases the cost of the installation, each step increases the likelihood that the replacement window will return the wall to its original, optimum performance, and sustain it for the life of the products installed.



Picking the Proper Sealant

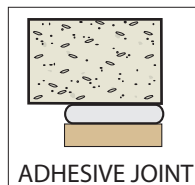
AWDI understands that the application of a sealant is as crucial as the choice of sealant. When a bead of sealant is applied to a joint there are three factors to consider:

- Adhesion
- Flexibility
- Durability

Within these three performance aspects there are countless combinations of applications, substrates and conditions a sealant is exposed to.

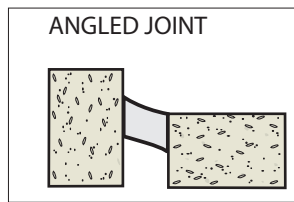
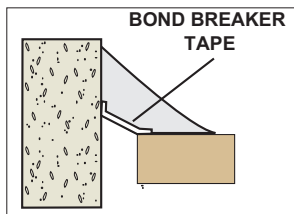
Bedding Joints:

For bedding joints, it is especially important that the sealant is of the right consistency and made up of 100% solids so it will not shrink after cure, unlike solvent and latex based sealants that shrink and create gaps after curing.



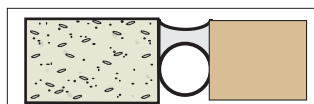
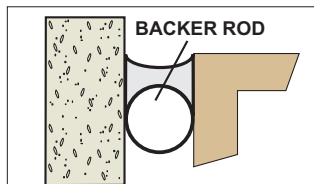
Fillet Joints:

A fillet joint is formed when two surfaces come together to form a right angle. The sealant used to join these two surfaces is triangular in shape. The sealant must adhere to the variety of substrates you're faced with. Without strong adhesion there is a high chance that the sealant will pull away from the substrate allowing for air and water infiltration.



Control Joints:

A control joint is formed when two similar or dissimilar materials meet or when substrates do not form a right angle. This joint will require both a backer rod and sealant for proper application. This joint can be as wide as 5/8 inch and be prone to extreme movement, a highly flexible sealant is necessary for a reliable seal with this application. In order to successfully install a window or door and effect a lasting weathertight seal,



AWDI recommends an ASTM C920, Class 50 sealant such as OSI® QUAD® MAX that is designed for exterior/interior use for sealing around windows, siding and doors. Sealants like OSI® QUAD® MAX bond best to a wide variety of materials and their versatility in performance provides valuable features and benefits for all installers.



Desired Properties

- No Shrinkage
- Locks out air and water infiltration to protect integrity of the seal
- Proven Wet Surface Application
- Ability to use the same sealant in warm and cold temperature situations to produce consistent results. 0F – 140F cold and warm weather application
- Strong Adhesion / All Surfaces Will stick to even the most difficult to bond building materials
- 5X stretch, 50% joint movement Long term durability assurance even with expansion and contraction of building materials
- 24 hour fast cure, paintable 1 HR. Fast cure to protect the building structure from outside forces and quick paintability saves time
- Achieves bubbling resistance faster to ensure optimal aesthetics
- 4,600 + Color Matches ensures perfect color match to all primary building materials
- Dirt & Dust Resistance ensures optimal visual appeal long after an installation
- UV Resistance
- Long term durability to compliment the durability of the building structure

Spray Foam Insulation

While the term “Spray Foam” is often widely used in construction, there are two different types and each has its advantages and disadvantage.

Spray foam has been shunned by window installers and manufacturers over the years because foams, in the past, have either continued to expand after trim has been applied deforming the more pliable vinyl window frames, or because they have been over used to fill the gaps left when old windows are removed and the underlying rough opening has been exposed.

Make sure the foam you use has been tested to industry standards and is labeled conforming to standards as a low expansion, low pressure foam.

Most standards applying to window installation do not delineate between open cell foam and closed cell foam, the more popular “minimal expansion” foams are most frequently used and they are mostly closed cell. More confusing yet, is when foams are recommended, the compressed foam tape alternatives are called out to be open cell.

When it comes to Spray Foams, it helps to understand the differences. Open-cell spray foam (ocSPF) has a cell structure where the cells are filled with air. The open-cell structure renders soft, flexible foam, with a density of about 0.5-0.8 pounds per cubic foot (pcf).

The R-value per inch of open-cell foam typically ranges from R3.6 to R4.5 per inch. Unlike fiberglass and cellulose, the fine cell structure of ocSPF makes it air-impermeable at certain thicknesses. The air-impermeability of ocSPF qualifies it as an air-barrier material, dramatically reducing air leakage through the building envelope, significantly lowering the building’s heating and cooling costs. However, ocSPF, like fiberglass and cellulose insulations, is moisture-permeable, and may require the installation of a vapor retarder in colder climates.

Closed-cell spray foam (ccSPF) has a closed cell structure which yields rigid hard foam, with a



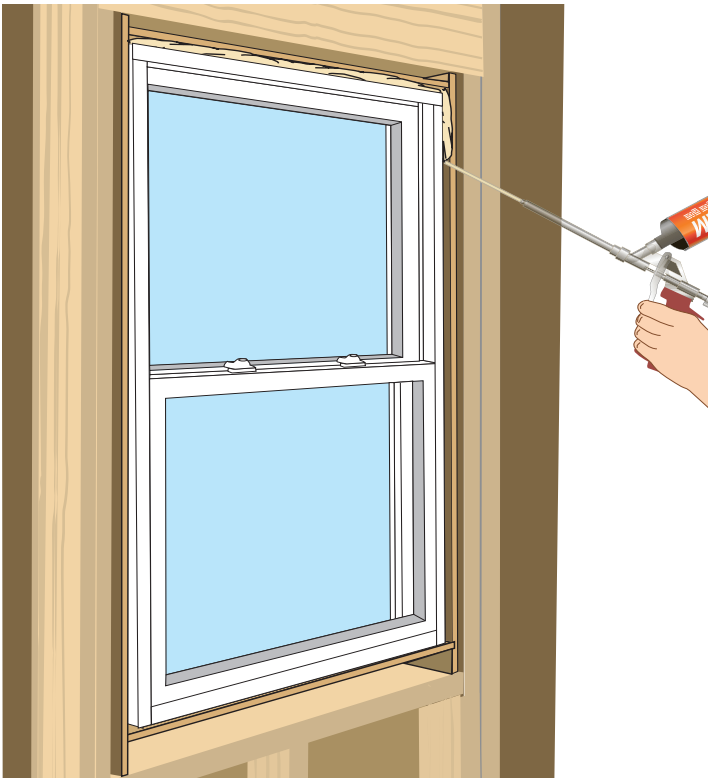
density of 1.8-2.3 pound per cubic foot (pcf), and can provide structural enhancement in certain framed buildings. The smaller cells trap insulating gas from the curing, which has a lower thermal conductivity than still air, and increases the R-value to anywhere from R5.8 to R6.9 per inch.

Like ocSPF, ccSPF is also air impermeable at certain thicknesses and can qualify as an air-barrier material. The bigger benefit is that the closed-cell structure of ccSPF also makes it water-resistant, and is the only spray foam that can be used where contact with water is likely.

At a thickness of 1.5 inches, no additional vapor retarder is required for most applications.

Desired Properties

- Industry tested and labeled as a Low Pressure/Low Expansion; i.e., will not warp or deform windows & doors
- Quick Setting Formulation: can be cut or trimmed in less than 1 hour
- Cold Temperature Application: can be applied in temperatures as low as 14F
- Insulation Value of R5: makes it an efficient method for stopping air and moisture infiltration
- Remains Flexible Once Cured: will not crack or dry out



Important tips:

- Similar to the sealant gun, it is critical that you balance the movement of the foam gun or straw barrel and how you dispense the foam so that the foam makes contact with both the rough or existing window frame and replacement window frame.
- If the dispensed foam does not make contact with both the rough frame and the window frame, there won't be an adequate bond to seal out water and air.
- Industry Standards suggest application of 1 inch beads, separated by an equal space. Be careful not to create two vapor barriers - one at the exterior and one at the interior. Make sure there is the ability for the opening to breathe to the cold side for drying and drainage. Use backer rod about one inch in the sill as a stop to make a workable back dam
- When applying foam around the perimeter of the window or door, you must maintain a minimum depth of 1 inch. This depth is required to provide the correct thermal performance, to help improve energy savings, and to protect against condensation problems.
- When applying foam as a back dam to the gap between the window frame and the rough sill, do not allow the foam to extend to the exterior edge of the opening. Maintain a minimum of a 1 inch gap between the foam and the exterior edge of the rough sill. If foam fills this gap at the sill, any water from leakage will not be able to drain to the drainage plane or exterior cladding surface. Place backer rod the length of the sill, 1" from edge and use it as a back dam guide.

Using Spray Foam

For the best installation, it is necessary for the gap around the window or door to be sealed to block out air, water and vapor penetration. ccSPF can do that well if selected and used properly. Improper use can create water traps, impede drainage and exert excessive pressure to the window frame during expansion.

Remember: Vapor barriers need to be applied on the warm side of the opening. Double vapor barriers (one on the warm side and another on the cool side) encourage condensation between and will trap the resulting condensation. Also, window installation cavities (the space between the window frame and the rough opening, or left-in-place old window frame) need to "breathe" to the outside, and allow drainage of collected water to the outside.

Used wisely, ccSPF can be the best solution. AWDI recommends ccSPF's like OSI® QUAD® Foam which is a polyurethane closed cell, low pressure/low expansion sealant to fill the gaps as protection against moisture and air. OSI's closed cell foam also achieves a thermal performance of R5 per inch.

Application

OSI® QUAD Foam is applied using a Foam Applicator Gun. This foam and gun combination allows for more precise application than the straw grade foam alternative. This gun offers a rear valve used to control the size of bead applied into the openings. The valve also allows the life of the foam to be extended by closing the opening of the barrel for future use.

For even smaller openings, a detachable screw on top is included with the gun to be able to fill gaps as small as 1/4" wide.

