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Standard Practice for Installation of Exterior Windows, Doors and Skylights¹

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INTRODUCTION

This document is intended to provide technical guidance to organizations that are developing training programs for installers of fenestration units in low-rise residential and light commercial structures. The majority of fenestration units selected for installation in these types of structures are certified as meeting specified performance characteristics in standardized laboratory testing. Experience indicates, however, that the performance of fenestration installations is frequently significantly inferior to the performance of the manufactured units in laboratory testing. Installation of fenestration units can significantly influence in-service performance.

The requirements promulgated in this practice have, by consensus, (of individuals with specialized knowledge concerning installation of fenestration units) been identified as necessary to ensure that as-installed performance is roughly equivalent to performance in laboratory testing. The task group responsible for development of this practice recognizes that building owners sometimes, accept as adequate, in-service performance of fenestration installations that are significantly inferior those of the units in laboratory testing. This practice is not intended for use in such circumstances, where owner expectations are modest. The intent of this practice is to provide guidance to those concerned with ensuring that as-installed performance is comparable to the capabilities of the units installed for a solid majority of installations.

A particularly noticeable behavior that indicates deficiencies in installation is rainwater leakage. Rainwater leakage has been the leading reason for dissatisfaction of building owners with performance of fenestration installations. For this reason, this practice places greater emphasis on preventing or limiting rainwater leakage than on any other single performance characteristic.

This practice emphasizes that the water-shedding surfaces of fenestration units must be adequately integrated with adjacent water-shedding surfaces of the building envelope. It does not, however, attempt to promulgate requirements for water-shedding surfaces of building envelopes other than those interfacing with fenestration units. The standard assumes that the basic design of the building's water-shedding system is adequate, that is, that either (1) there is a high probability that the outermost building surface will dependably prevent all water entry, or (2) the building envelope incorporates an effective concealed barrier that will dependably prevent further intrusion of incidental water that breaches the outermost surface. The practice further assumes that fenestration units can be dependably sealed to, and integrated with, at least one of these surfaces. If the basic design of the building's water-shedding system is inadequate, or does not allow for reliable integration of fenestration units into it, competent installation of the units is unlikely to nullify these deficiencies.

1. Scope*

1.1 This practice covers the installation of fenestration products in new and existing construction. For the purpose of

this practice, fenestration products shall be limited to windows, sliding patio-type doors, swinging patio type doors, and skylights, as used primarily in residential and light commercial buildings.

1.2 This practice assumes that the installer possesses basic woodworking skills and an understanding of wall and roof construction, sheet metal work, and joint sealant practices.

1.3 This practice attempts to instruct and familiarize the installer with the concepts of both Barrier Systems and

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*A Summary of Changes section appears at the end of this standard

Membrane/Drainage Systems, in order to ensure the continuity of the building envelope. This practice attempts to educate the installer, builder, architect, and other users in the identification and understanding of the water shedding system of the building envelope.

1.4 This practice covers the installation process from pre-installation procedures through post-installation procedures, for single units or factory-mulled multiple units in a single opening. It does not cover the fabrication or assembly of multiple units, whether such fabrication takes place in a factory or at the intended installation site. The installer should check with the manufacturer of factory-assembled units for instructions for anchoring. When using field-mulled units, follow manufacturer's recommendations and make certain that they meet applicable codes. This practice does not cover the selection of appropriate fenestration products for a given application, nor the selection of other products or systems for use in the installation.

1.5 This practice provides minimum requirements that will help to accomplish the installation of fenestration products in an effective manner. Actual conditions in buildings vary greatly and, in some cases, substantial additional precautions may be required. In the event that the manufacturer's installation instructions provided with the product conflict with requirements of this practice, the manufacturer's instructions shall prevail. This practice is not intended to limit or exclude other new procedures that may refine or further improve the effectiveness of fenestration installation.

1.5.1 This practice is intended to be used for background information in order to develop training manuals and training programs. Further, this practice attempts to consolidate and unify the various steps of construction, tying together the various trades involved with the continuity between fenestration products and the building envelope.

1.6 The text of this practice references notes and footnotes that provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of this practice.

1.7 This standard has not been created to address all issues related to every possible installation situation one might experience in the field. Furthermore, this practice does not purport to provide fail-safe installation methods, assurance or protection against installation deficiencies, or a standard by which architects can specify or ensure delivered performance.

NOTE 1—There are no ISO standards covering the primary subject matter of this practice.

1.8 *Design Professional*—This practice is not intended to limit the role and authority of a registered design professional to select a method of installation or to change, modify, or develop other methods of installation to meet the specific requirements of a building project for a particular location. A design professional retains the authority to prepare construction documents indicating window/door/skylight installations integrated with the water-resistive barrier (WRB).

1.9 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical

conversions to SI units that are provided for information only and are not considered standard.

1.10 *This practice does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and to determine the applicability of regulatory limitations prior to use.* For specific precautionary statements, see Section 5, Related Procedures. Where a lead hazard is known or suspected, refer to *ASTM Standards on Lead Hazards Associated with Buildings* and to applicable state and federal regulations. Where an asbestos hazard is known or suspected, refer to the *ASTM Manual on Asbestos Control*, and to applicable state and federal regulations.

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1.12 This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

2. Referenced Documents

2.1 ASTM Standards:²

A123/A123M Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
B456 Specification for Electrodeposited Coatings of Copper

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.

³ The last approved version of this historical standard is referenced on www.astm.org.

and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference

E1677 Specification for Air Barrier (AB) Material or Assemblies for Low-Rise Framed Building Walls

E2357 Test Method for Determining Air Leakage Rate of Air Barrier Assemblies

2.2 **AAMA Standards:**⁴

502 Voluntary Specification for Field Testing of Windows and Doors

711 Voluntary Specification for Self Adhering Flashing Used for Installation of Exterior Wall Fenestration Products

712 Voluntary Specification for Mechanically Attached Flexible Flashing

713 Voluntary Test Method to Determine Chemical Compatibility of Sealants and Self-Adhered Flexible Flashings

714 Voluntary Specification for Liquid Applied Flashing Used to Create a Water Resistive Seal around Exterior Wall Openings in Buildings

800 Voluntary Specifications and Test Methods for Sealants

808.3 Voluntary Specifications for Exterior Perimeter Sealing Compounds

809.2 Voluntary Specification for Non Drying Sealant

850 Fenestration Sealants Guide Manual

2.3 **ANSI/AAMA/WDMA Standard:**⁴

101/I.S.2 Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors

2.4 **AAMA/WDMA Standard:**⁴

1600/IS7 Voluntary Specifications for Roof Windows and Skylights

2.5 **ANSI/ASME Standard:**⁵

A39.1 Standard, Safety Requirements for Window Cleaning

2.6 **ANSI/EIMA Standard:**⁵

99-A-200 Exterior Insulation and Finish Systems (EIFS)

2.7 **ANSI/ISDI Standard:**⁵

102 Insulated Steel Door Systems—Installation Standard

2.8 **CSA Standards:**⁶

A440.4 Fenestration Product Installation

A440-M90 Windows—A National Standard of Canada

2.9 **CPSC Standard:**⁷

16 CFR 1201 USA Consumer Product Safety Commission, Code of Federal Regulations; Part 1201, Safety Standard for Architectural Glazing Materials, 1977

2.10 **FMA/AAMA Standards:**⁴

100 Standard Practice for the Installation of Windows with Flanges or Mounting Fins in Wood Frame Construction for Extreme Wind/Water Exposure

200 Standard Practice for the Installation of Windows with Frontal Flanges for Surface Barrier Masonry Construction for Extreme Wind/Water Conditions

2.11 **FMA/AAMA/WDMA Standards:**⁴

300 Standard Practice for the Installation of Exterior Doors in Wood Frame Construction for Extreme Wind/Water Exposure

400 Standard Practice for the Installation of Exterior Doors for Surface Barrier Masonry Construction for Extreme Wind/Water Conditions

2.12 **FMA/WDMA Standard:**⁸

250 Standard Practice for the Installation of Non-Frontal Flanged Windows with Mounting Flanges for Surface Barrier Masonry Construction

2.13 **WDMA Standard:**⁸

I.S.4 Industry Standard for Water-Repellent Preservative Treatment for Millwork

2.14 **OSHA Standards:**⁹

29 CFR 1926.62 Lead in Construction Standard

29 CFR 1926.1101 Asbestos Construction Standard

3. Terminology

3.1 **Definitions**—Definitions are in accordance with Terminology **E631** and Terminology **C717**, unless otherwise specified.

3.2 **Definitions of Terms Specific to This Standard:**

3.2.1 **accessory groove**, *n*—a shape included on a fenestration product frame that is designed to mate with installation accessories.

3.2.2 **air barrier**, *n*—the assembly of materials used in building construction to reduce or retard the uncontrolled passage of air into and out of the building.

3.2.3 **air barrier foam sealant**, *n*—an aerosol foam product dispensed as a bead into the air gap area around the fenestration perimeter to reduce the infiltration or exfiltration of air past the fenestration product.

3.2.4 **air leakage**, *n*—also referred to as *air infiltration*. According to Terminology **E631** in buildings, the passage of uncontrolled air through cracks or openings in the building envelope or its components, such as ducts, because of air pressure or temperature difference. See **Appendix X5**.

3.2.5 **anchor line (or anchor point)**, *n*—a line (or point) of reference on a fenestration product or the building, or both, where attachment is made.

3.2.6 **annealed glass**, *n*—raw glass used as a glazing product.

3.2.6.1 **Discussion**—Further processing is required to transform annealed glass into safety glazing material.

3.2.7 **anodic finishes**, *n*—clear or colored coatings composed of aluminum oxide that are electrolytically deposited and are an integral part of the aluminum substrate.

3.2.7.1 **Discussion**—Careful control permitted by the electrolytic anodizing process provides substantial improvement over a natural oxide film due to greater thickness, density, and

⁴ As of January 2020, AAMA organized with IGMA (Insulated Glass Manufacturers Alliance) with a name change to FGIA (Fenestration & Glazing Industry Alliance). AAMA Standards are now available from FGIA, 1900 E. Golf Rd., Suite 1250, Schaumburg, IL 60173, <https://fgiaonline.org>.

⁵ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁶ Available from Canadian Standards Association (CSA), 178 Rexdale Blvd., Toronto, ON M9W 1R3, Canada, <http://www.csagroup.org>.

⁷ Available from U.S. Government Publishing Office (GPO), 732 N. Capitol St., NW, Washington, DC 20401, <http://www.gpo.gov>.

⁸ Available from Window & Door Manufacturers Association (WDMA), 330 N. Wabash Ave., Suite 2000, Chicago, IL 60611, <http://www.wdma.com>.

⁹ Available from Occupational Safety and Health Administration (OSHA), 200 Constitution Ave., Washington, DC 20210, <http://www.osha.gov>.

hardness of these factory-produced finishes. Pre-anodic chemical treatments clean and prepare the aluminum for the anodic finish. The Aluminum Association classifies architectural anodic coatings depending on coating thickness and recommended use. Further detailed information and specifications on anodic finishes is available from the Aluminum Association and the American Architectural Manufacturers Association.

3.2.8 *apron, n*—a molding applied horizontally to the wall, directly below the window sill and used to hide the rough edge of the drywall or plaster below the window framing.

3.2.9 *backer rod, n*—a material placed into a joint, primarily to control the depth of the sealant, also serves as a bond breaker.

3.2.10 *barrier wall system, n*—a wall system that is intended to manage all water at the exterior surface.

3.2.10.1 *Discussion*—These wall systems consist of the exterior surface of the wall and the exterior surface of the fenestration product, usually connected by a sealant joint.

3.2.11 *bead, n*—sealant applied in a joint, such as sealant bead, glazing bead, and so forth. According to Terminology E631, in glazing, (1) a strip of metal or wood used around the periphery of a pane of glass to secure it in place (also referred to as a stop) and (2) a strip of sealant, glazing compound, or putty.

3.2.12 *bite, n*—amount of overlap between the stop and the panel or light. According to Terminology E631, the distance that the surround member (rail or stile) overlaps the glazing.

3.2.13 *blind nailing, n*—nailing in such a way that the nail heads are not visible on the face of the finished work.

3.2.14 *blind stop, n*—a rectangular molding attached to the side and head of a window to serve as a stop for storm windows and screens.

3.2.15 *block frame fenestration product (sometimes called box frame), n*—a type of non-finned fenestration product (either window or door) that has no factory-applied moldings and that is installed into the rough opening either by driving fasteners through shimmed side jambs or by use of installation clips or brackets.

3.2.15.1 *Discussion*—Exterior moldings or casings may be supplied with the fenestration unit (that is, by the manufacturer) for installation after the unit is secured in the rough opening. It is generally easier to ensure effective integration of a block-frame unit's water-shedding surfaces with the water-resistive barrier of a membrane/drainage wall system than it is to accomplish the same task with a non-finned unit to which exterior moldings have been factory-installed.

3.2.15.2 *Discussion*—Block-frame windows are commonly used in most of the Canadian provinces. They are relatively rare in residential construction in the United States, where nailing flange windows and windows with factory-applied brick moldings are more common.

3.2.16 *bond breaker, n*—a material used to prevent three-sided adhesion in sealant joints.

3.2.17 *brick mold, n*—an exterior trim molding which forms a boundary between bricks or other siding and a fenestration product.

3.2.17.1 *Discussion*—Brick mold fenestration units are a type of non-finned product (either window or door) with factory-supplied exterior moldings that are brick moldings. The unit may be supplied without the brick moldings attached, and intended for installation as a block-frame unit. More commonly, the brick moldings are factory-applied, and the unit is secured in the rough opening by nailing through the brick moldings into framing members.

3.2.17.2 *Discussion*—Ensuring that the water shedding surfaces of the fenestration unit are effectively integrated with the WRB of a membrane/drainage wall system can be challenging. This practice does not recognize the brick moldings on fenestration units as being permanently effective water-shedding surfaces; finger joints in wood brick moldings may open over time unless paint maintenance is meticulous, and upper-corner miter joints may open sufficiently to permit some water intrusion. This practice assumes that the water-shedding surfaces of a brick mold fenestration unit are the window sash or door, the top and side jambs of the unit, and the unit's sill. This practice further recognizes, however, that over the service life of the fenestration unit, water leakage may occur between the side jambs and sill, which is why pan flashings are recommended for use with these units (see 8.2).

3.2.18 *buck, n*—a rough wooden framework, built into a window or door opening in a concrete or masonry wall, to which the window or door frame is secured.

3.2.19 *building envelope, n*—the exterior of a building.

3.2.19.1 *Discussion*—According to Terminology E631, the outer elements of a building, both above and below ground, that divide the external from the internal environments.

3.2.20 *building paper, n*—a membrane material made of cellulose paper impregnated with asphalt (to inhibit passage of liquid water through the material) and which is commonly used as a concealed water-resistive barrier in membrane/drainage walls.

3.2.20.1 *Discussion*—Typically installed after windows and window flashing. Block or brick-mold windows may be installed after building paper (refer to manufacturer's instructions).

3.2.21 *buttering, n*—application of sealant compound to the flat surface of a member before placing the member in position.

3.2.22 *cap/capping, n*—see *pan/panning*.

3.2.23 *casing, n*—a trim molding used around doors and windows to cover the area between the wall and the edge of the jamb.

3.2.24 *caulk (non-elastomeric), n*—see *sealant*.

3.2.25 *cementitious material, n*—material binding aggregate particles together into a heterogeneous mass.

3.2.26 *channel, n*—a three-sided, U-shaped opening in sash or frame to receive a light or panel.

3.2.26.1 *Discussion*—In sash or frame units in which the light or panel is retained by a removable stop.

3.2.27 *channel depth, n*—the measurement from the bottom of the channel to the top of the stop, or measurement from sight line to base of channel.

3.2.28 *channel glazing*, *n*—the sealing of the joints around lights or panels set in a U-shaped channel employing removable stops.

3.2.29 *channel width*, *n*—the measurement between stationary and removable stops in a U-shaped channel at its widest point.

3.2.30 *cladding system*, *n*—the aesthetic covering of a building.

3.2.30.1 *Discussion*—According to Terminology E631, material assembly applied to a building as a non-load-bearing wall, or attached to a wall surface as a protective and ornamental covering.

3.2.31 *cohibition point*, *n*—a location where movement is restricted between the sash and the frame, such as at a hinge or lock.

3.2.32 *complete window replacement*, *n*—the installation of a replacement window where the previously-installed window is completely removed.

3.2.33 *composite materials*, *n*—fenestration members which contain two or more materials, structurally combined or connected so as to perform structurally as a singular material such as poured and de-bridged aluminum shapes, fiberglass and man-made wood products.

3.2.34 *compound*, *n*—a formulation of ingredients, usually grouped as vehicle or polymer pigment and fillers to produce caulking compounds and elastomeric joint sealants.

3.2.35 *consistency*, *n*—degree of softness or firmness of a compound as supplied in the container.

3.2.35.1 *Discussion*—Consistency varies according to method of application, such as gun, knife, trowel, and so forth.

3.2.36 *construction documents*, *n*—architectural drawings, specifications, shop drawings, manufacturing details, test reports, contracts, building permits, applicable codes.

3.2.37 *counter-flashing*, *n*—horizontally applied sheet (flashing) material that joins layers of flashings where they join the water-resistive barrier, enhancing drainage by gravity.

3.2.38 *cripple stud*, *n*—a short stud above or below a window or door opening.

3.2.39 *cross shims*, *n*—see *shim*.

3.2.40 *curing*, *n*—a chemical process which over time results in the ultimate properties of a finish or other material.

3.2.41 *curing agent*, *n*—one part of a two-part sealant which, when added to the base, will cause the base to change its physical state.

3.2.42 *drainage wall system*, *n*—see *membrane/drainage system*.

3.2.43 *drip*, *n*—any exterior horizontal course or molding that projects to the weather side of a wall or other surface to throw off water.

3.2.43.1 *Discussion*—A small drip groove is sometimes used on the underside of a drip cap or window sill to prevent water from running back under the cap or window.

3.2.44 *drip cap*, *n*—a molding or flashing commonly installed over windows and doors to direct water away from the building in order to prevent seepage; also called a drip molding.

3.2.44.1 *Discussion*—A rounded or beveled metal strip attached to the bottom of an exterior door to prevent water from draining or blowing under the door.

3.2.45 *drying*, *n*—the process of removing water from a material; usually accomplished with heated air.

3.2.45.1 *Discussion*—According to Terminology E631, the process of developing, solely by evaporation of volatile ingredients, ultimate properties of a finish or other material over a specified period of time; compare *curing*.

3.2.46 *durometer*, *n*—an instrument used to measure hardness of a material.

3.2.46.1 *Discussion*—Shore hardness is a commonly used hardness measurement scale.

3.2.47 *egress*, *n*—a means of exiting a room or building in an emergency.

3.2.47.1 *Discussion*—An egress window is one that is large enough for an adult to exit the room in case of an emergency. The size is defined by national or local building codes.

3.2.48 *EIFS*, *n*—see *exterior insulation and finish system*.

3.2.49 *elastomer*, *n*—an elastic, rubber-like substance, such as natural or synthetic rubber.

3.2.50 *elastomeric sealant*, *n*—a sealant that returns to its initial dimensions and shape after substantial deformation.

3.2.51 *end dam*, *n*—any means provided to stop the flow of water out of the ends of a sill, panning system or subsill and into the wall cavity, such as sealants, upstands, plates, or gasketing.

3.2.52 *exterior insulation and finish system (EIFS)*, *n*—according to Practice C1397, a non-load-bearing outdoor wall finish system consisting of a thermal insulation board, an attachment system, a reinforcement system, and a compatible finish.

3.2.52.1 *Discussion*—ANSI/EIMA Standard 99-A-200 further defines EIFS as consisting of five elements: adhesive, foam, reinforcement fiberglass mesh, base coat, and finish coat, which does not include exterior joint sealant per Terminology E631.

3.2.53 *fenestration product*, *n*—any transparent or translucent glazing material plus associated sash, frame, mullions, and dividers, in the envelope of a building, including but not limited to windows, sliding glass doors, French doors, skylights, curtain walls, and garden windows.

3.2.54 *flashing*, *n*—sheet material, integrated with the water-resistive barrier, that bridges and protects the joint (gap) between the window or door frame members and the adjacent construction for the purpose of preventing water penetration by draining water away from the window or door. For further discussion, see *Appendix X1—Window/Door Flashing Types*. (See also *pan flashing*.)

NOTE 2—Flashing is to be water-resistive and durable for the intended use. Flashing is to be a single component or a series of connected

components that provides a mechanism to direct incidental water penetration to the exterior. Flashing is used to direct incidental water to the exterior either directly or via the wall cavity between the water-resistive barrier and cladding to provide a water-shedding system.

3.2.55 *flashing system, n*—integrated system of flashings intended to move incidental water to the building exterior or to the drainage plane.

3.2.56 *frame, n*—the outside perimeter of a window or door consisting of 2 side jamb members, 1 head member, and 1 sill member which holds the glass lites or sash panels.

3.2.56.1 *Discussion*—According to Terminology E631, an assembly of structural members that surrounds and supports the sash, ventilators, doors, panels, or glazing that is installed into an opening in a building envelope or wall.

3.2.57 *frame liners, n*—covers or track assemblies, typically of vinyl or aluminum, designed to fit into an existing fenestration product frame for the purpose of accepting new sash or glazing. (Also known as *jamb liners*.)

3.2.58 *galvanic corrosion, n*—a form of deterioration of metal resulting from the electrochemical reaction that occurs when certain dissimilar metals are in contact with each other in the presence of moisture.

3.2.59 *glazing, n*—window sash and door panel in-fills that contain glass or glass-like materials.

3.2.59.1 *Discussion*—According to Terminology E631, a material installed in a sash, ventilator, or panel such as glass, plastic, and so forth.

3.2.60 *head, n*—the top of a fenestration product.

3.2.60.1 *Discussion*—According to Terminology E631, an upper horizontal member of a window or door frame.

3.2.61 *header, n*—a horizontal structural member (beam) that supports the load over an opening, such as that of a door or window. The header transfers that load to the vertical members at the sides of the opening.

3.2.62 *head expander, n*—an inverted U-channel fenestration installation accessory that may be fitted to the head of a replacement window to accommodate differences between rough opening height and product height.

3.2.63 *head flashing, n*—sheet material, integrated with the water-resistive barrier, that bridges and protects the joint (gap) between the window or door frame members at the head, and the adjacent construction for the purpose of preventing water penetration by draining water away from the window or door. For further discussion, see [Appendix X1](#)—Window/Door Flashing Types.

3.2.64 *house wrap, n*—a polymer-based sheet material provided in a variety of dimensions and used as a water-resistive barrier (user of this product should defer to manufacturer's instructions).

3.2.65 *inorganic, n*—designating or composed of materials that are derived from neither living organisms nor hydrocarbon sources.

3.2.65.1 *Discussion*—Most inorganic compounds do not contain carbon and are derived from mineral sources. Calcium carbonate (that is, limestone) is generally classified as an inorganic material, although it contains carbon. Fossil or

non-fossil remnants of dead organisms (for example, mollusks, limestone) are generally classified as inorganic materials provided that they are not composed of hydrocarbon molecules.

3.2.66 *installation accessories, n*—components that are specifically designed to *trim out* the product with various surrounding constructions.

3.2.67 *installation holes, n*—holes in window or door frames that are fabricated by the manufacturer to locate and accommodate installation fasteners.

3.2.68 *installer, n*—for the purpose of this practice the installer, of fenestration products is person or persons who do the installation labor and those who supervise such labor.

3.2.69 *integral fin, n*—a permanent appendage protruding from the body of a window or door, used as either an installation attachment feature or part of the water-resistive barrier interface between the product and the wall, or both. The term “fin” is also known as “flange.”

3.2.69.1 *Discussion*—Some fin designs allow them to be folded against the fenestration frame for shipping and *folded up* for installation.

3.2.70 *isolation coating, n*—a material which separates two adjacent materials to prevent galvanic corrosion of one of the materials by the other material. (See also *galvanic corrosion*.)

3.2.71 *jack stud, n*—a stud that does not extend from floor to ceiling, and which supports a lintel on its (the stud's) upper end.

3.2.71.1 *Discussion*—Jack studs are used in conjunction with king studs, and form the vertical surfaces of rough openings.

3.2.72 *jamb, n*—a vertical member of a fenestration product frame (side jamb); or the horizontal member across the top of a fenestration product frame (head jamb).

3.2.73 *jamb flashing, n*—sheet material, integrated with the water-resistive barrier, that bridges and protects the joint (gap) between the window or door frame members at the jambs, and the adjacent construction for the purpose of preventing water penetration by draining water away from the window or door. For further discussion, see [Appendix X1](#)—Window/Door Flashing Types.

3.2.74 *king stud, n*—the full length stud next to a door or window opening to which the jack stud or trimmer and lintel are nailed.

3.2.75 *level, n*—having a horizontally flat, even surface with no irregularities and no vertical tilt.

3.2.75.1 *Discussion*—No part of the surface is higher or lower than any other part. The end points of a line drawn on a level surface are equal distances from the center of the earth.

3.2.76 *lintel, n*—a horizontal member above a window or door that supports the exterior wall surface such as brick veneer.

3.2.77 *lite, n*—another term for a pane of glass used in a window; sometimes spelled light.

3.2.77.1 *Discussion*—According to Terminology E631, lite is one piece of glazing (preferred term); (synonym: *pane*).

3.2.78 *mastic/roofing mastic*, *n*—water-proofing material used to seal or decorate.

3.2.78.1 *Discussion*—According to Terminology E631, a material composition that, after application as a thin layer, is converted to a solid protective, or decorative, or functional adherent film.

3.2.79 *membrane/drainage system*, *n*—a wall system employing a concealed water-resistive barrier in which the exterior building surface is not the sole method of protecting the building from moisture penetration; that is, stucco, brick veneer, siding.

3.2.79.1 *Discussion*—The waterproofing and weatherability of the fenestration product is integrated into the system and is waterproofed and sealed to a surface that is behind the exterior building surface. The fenestration product is usually integrated (sealed) to an underlayment membrane or flashing system which is a water-resistive barrier that is not exposed directly to the weather. Incidental moisture that is collected at the underlayment membrane or flashing is drained to the exterior at the bottom most locations of each floor/story/level. Fenestration products and other wall penetrations are typically integrated (sealed) to the membrane, underlayment, or flashing system such that the membrane/drainage system provides continuous protection against wall moisture penetration. See also *primary seal*.

3.2.80 *mill finish aluminum*, *n*—uncoated aluminum that possesses a silvery, natural finish.

3.2.80.1 *Discussion*—This finish protects aluminum against most atmospheric corrosion. Atmospheric or certain job site conditions may affect the surface appearance of mill finish aluminum.

3.2.81 *modular opening (M.O.)*, *n*—nominal (callout) opening.

3.2.82 *modular size (M.S.)*, *n*—nominal (callout) size.

3.2.83 *molding*, *n*—a strip of wood or other material having a rounded or otherwise decorative surface used to conceal joints or to accent and highlight other surfaces.

3.2.84 *mallion*, *n*—a slender bar separating the compartments or apertures in a screen or window.

3.2.85 *multiple units*, *n*—single fenestration products mulled together to form a larger unit.

3.2.86 *muntin*, *n*—grids, or grilles

3.2.87 *new installation*, *n*—installation of a fenestration product in a new building or wall.

3.2.88 *non-fin window*, *n*—a fenestration product that has no integral appendage (fin) attached to the body of the window or door for the purposes of installation or air/water resistance. (Also called *block frame* or *box frame*.) See discussion under *block frame fenestration product*.

3.2.89 *organic*, *n*—designating any material derived from hydrocarbon sources (for example, petroleum, coal, or natural gas) or from living organisms (for example, carbohydrates, proteins, or lipids).

3.2.90 *organic finishes*, *n*—organic coatings such as paints, enamels, and resins having a wide range of colors achieved through the addition of pigments.

3.2.91 *pane, n*—see *lite*.

3.2.92 *pan flashing*, *n*—a type of flashing used at the base of rough opening to divert incidental water to the exterior or to the exterior surface of a concealed WRB.

NOTE 3—Pan flashings have upturned legs at the interior edge and ends of the rough opening to form a three-sided *pan*. They are intended to collect and drain water toward the exterior, including water that may enter through the window unit (for example, between the jambs and sill) or around the window (between the rough opening and the fenestration). The pan flashing must be integrated with other flashings and the window assembly to capture water that may otherwise penetrate to the sill framing and allow it to freely drain to the exterior. The window, flashings, and pan are to be sealed in a manner that reliably inhibits air and moisture flow to the interior.

3.2.93 *pan or panning, n*—cosmetic covering, usually found on the exterior of the fenestration product to achieve aesthetic sight lines or to integrate the fenestration product system into the building surface or weatherproofing system.

3.2.93.1 *Discussion*—If panning is being used for weatherability, the panning is not considered cosmetic, but part of the window system.

3.2.94 *partial window replacement, n*—the installation of a replacement window where a component of the previously-installed window frame will remain.

3.2.95 *plumb, n*—to make vertical.

3.2.95.1 *Discussion*—Aligned with an imaginary line through the center of the earth and the point of measurement.

3.2.96 *primary seal, n*—the seal beyond which no water is intended to pass.

3.2.96.1 *Discussion*—This is the location included in the building envelope construction which forms a water-resistive barrier that is ultimately responsible for maintaining water impermeability between the interior and exterior of a building envelope.

3.2.97 *prime window (primary window), n*—the first (main) window, completely installed in a rough opening, which is designed to function as the sole fenestration product.

3.2.97.1 *Discussion*—This is contrasted to a storm window, which serves as a secondary window in conjunction with a primary window.

3.2.98 *pultrusion, n*—fiberglass reinforced polymer (plastic) structural members having a constant cross-section.

3.2.98.1 *Discussion*—Pultruded fenestration product members are typically polyester polymer reinforced by continuous fiberglass filaments.

3.2.99 *rabbet, n*—a two-sided L-shaped opening used on a face glazed window sash to receive the glass.

3.2.100 *rack, v*—by application of force to adjust the form of a fenestration unit or the sash of a fenestration unit with respect to either: (1) squareness within a flat plane or (2) deviation from a flat plane (that is, twist).

3.2.100.1 *Discussion*—The term can be used to indicate adjustment to or from squareness and flatness, but is more commonly used to indicate the latter (that is, adjustment to an out-of-square or out-of-flat condition). The term is also sometimes used to denote unintentional application of force that deforms a unit or sash to an out-of-square or out-of-plane condition.

3.2.101 *R-point, n*—reference anchoring point which has a rigidity (strength) equal to double that of other anchors.

3.2.101.1 *Discussion*—This may be achieved by using two anchors instead of one or by using an anchor that is twice as rigid as those used at other points.

3.2.102 *R-value (thermal resistance), n*—(1) the resistance of a material to the flow of heat from warmer to cooler points. (2) a measure of thermal resistance, usually applied to insulation and other homogeneous materials.

3.2.102.1 *Discussion*—When applied to non-homogeneous combinations of building materials such as wall systems and fenestration products, the *effective R-value* is the inverse of the system U-factor (the sum of the individual component area-weighted thermal transmission values (that is, effective $R\text{-value} = 1/U_{\text{system}}$, where $U_{\text{system}} = (U_1A_1 + U_2A_2 + \dots)/(A_1 + A_2 + \dots)$), where 1, 2, and so forth represent the specific components of the system or product).

3.2.103 *registered design professional, n*—an individual who is registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws of the state or jurisdiction in which the project is to be constructed.

3.2.104 *release agent, n*—a petroleum-based liquid chemical, usually spray applied to a wall form or fixture, that prevents cementitious material from adhering to it.

3.2.105 *remodel, n*—to enhance the aesthetics and livability of a building by replacing or reconditioning its components.

3.2.105.1 *Discussion*—According to Terminology E631, to replace or improve a building or its parts.

3.2.106 *replacement installation, n*—installation of a fenestration product which is designed for replacement of existing similar type product, by either destructive or non-destructive installation methods.

3.2.107 *replacement window, n*—a window that is designed for and subsequently installed after removal of all or part of a previously installed window.

3.2.108 *retrofit, n*—according to Terminology E631, to add new materials or equipment not provided at the time of original construction.

3.2.109 *reveal, n*—the part of the edge of a door or window frame or jamb not covered by the casing.

3.2.110 *roof, n*—the top cover of a building; includes the roofing system.

3.2.110.1 *Discussion*—According to Terminology E631, roofing system—assembly of interacting components designed to weatherproof, and sometimes to insulate, the roof surface of a building.

3.2.111 *roof window, n*—sloped fenestration product with an operable sash.

3.2.112 *rough opening, n*—an unfinished fenestration opening in the building envelope.

3.2.113 *rough opening gap, n*—the space between the rough opening and the fenestration product frame.

3.2.114 *safety glazing materials, n*—materials that reduce the possibility of severe injury upon accidental impact. These materials shall meet 16 CFR 1201 and ANSI Z97.1.

3.2.115 *sash, n*—the moveable portion of an operable window.

3.2.115.1 *Discussion*—According to Terminology E631, an assembly of one or more lites of glazing, encompassed by surrounding edge members, which when operable, slides in the plane of the window. In the wood window industry, the term *sash* is used regardless of the mode of operation.

3.2.116 *seal (plug seal), n*—water-resistive barrier installed to prevent entry of water, snow, dust, or insects into a rough opening gap.

3.2.117 *sealant, n*—any of a variety of compounds used to fill and seal joints or openings in wood, metal, masonry, and other materials.

3.2.117.1 *Discussion*—As contrasted to a sealer, which is a liquid used to seal a porous surface. Some common types of sealants are: acoustical, neoprene, polysulfide rubber, silicone, acrylic latex, butyl rubber, polyurethane.

3.2.118 *setting block, n*—a small piece of neoprene or other suitable material used to position a piece of glass in its sash or frame.

3.2.119 *shim, n*—a thin, flat, or wedge-shaped piece of wood or other suitable material used to level or plumb a fenestration product frame during installation.

3.2.119.1 *Discussion*—Lateral shims are placed in the rough opening adjacent to the frame jambs. Setting shims are placed in the rough opening beneath the sill.

3.2.120 *shingle-lapped (fashion), n*—lapped in a water-shedding fashion (such as roofing shingles).

3.2.121 *shore hardness, n*—measure of firmness of a material determined by means of a durometer hardness gage.

3.2.121.1 *Discussion*—the range of 20 to 25 shore hardness is about the firmness of an art gum eraser; 90 is about the firmness of a rubber shoe heel.

3.2.122 *sill, n*—the horizontal bottom part of a window or door.

3.2.122.1 *Discussion*—According to Terminology E631, a lower horizontal member of a fenestration product frame.

3.2.123 *sill angle, n*—an L-shaped installation accessory that may be employed at the sill of a replacement window to accommodate the slope of the existing sill construction.

3.2.124 *sill horn, n*—the horizontal projection of a wood window sill that forms the base for the brick molding or other exterior casing.

3.2.125 *skylight, n*—sloped or flat application of fenestration products which allows for natural day-lighting and ventilation.

3.2.125.1 *Discussion*—Usually located on a roof where they are out-of-reach.

3.2.126 *spacer, n*—see *shim*.

3.2.127 *square, n*—two construction members that meet at a right (90°) angle.

3.2.127.1 *Discussion*—In fenestration, the condition in which the jambs are perpendicular to the head and sill.

3.2.128 *stool*, *n*—the flat narrow shelf forming the top member of the interior trim at the bottom of a window.

3.2.129 *stop*, *n*—the part of a fenestration product that controls or limits the position of the sash or panel.

3.2.129.1 *Discussion*—According to Terminology E631, in glazing, a strip of metal or wood used around the periphery of a pane of glass to secure it in place.

3.2.129.2 *Discussion*—Also defined as the narrow trim along the jamb and head of a hinged window or door which limits the swing of the sash or panel, or creates a channel for a sliding sash or panel.

3.2.130 *stucco*, *n*—cementitious mixture used for exterior plaster.

3.2.131 *sub sill*, *n*—a separate framing member that, when installed on the underside of a sill, becomes an integral part of the sill.

3.2.132 *terne metal*, *n*—an alloy of lead and tin applied to steel by dipping steel into molten terne metal.

3.2.132.1 *Discussion*—The alloy has a dull appearance resulting from the high lead content.

3.2.133 *thermal barrier*, *n*—an element made of material with relatively low thermal conductivity, which is inserted between two members having high thermal conductivity, in order to limit heat transfer.

3.2.134 *thermal bridge*, *n*—an entity that allows for large amounts of conductive heat flow (relative to the amount that would flow at that location if the entity were not present) between surfaces at different temperatures.

3.2.135 *through-wall flashing*, *n*—flashing that extends completely underneath the sill or over the head of a window, and has an upturned leg on the interior side.

3.2.136 *tooling*, *n*—the operation of pressing in and striking off the sealant in a joint.

3.2.136.1 *Discussion*—To press the sealant against the sides of a joint and secure good adhesion; the finishing off of the surface of a sealant in a joint so that it is smooth and flush with the surface.

3.2.137 *trimmer stud*, *n*—see *jack stud*.

3.2.138 *U-factor*, *n*—the overall coefficient of heat transfer of a material or system.

3.2.138.1 *Discussion*—In systems composed of non-homogeneous materials, such as fenestration systems, it is the area-weighted sum of the individual material U-factors (that is, $U_{\text{system}} = U_1 A_1 + U_2 A_2 + \dots / (A_1 + A_2 + \dots)$ where 1, 2, and so forth represent the specific components of the system or fenestration product. See also *R-value*.

3.2.139 *unit*, *n*—refers to complete or total assembly, such as for fenestration products including all frame, sash, glazing, door slabs, hardware or other elements defining the complete fenestration product.

3.2.140 *upstand*, *n*—the vertical portion of a panning, flashing, or subsill system that prevents the migration of collected water behind the membrane or into the wall cavity.

3.2.141 *vapor retarder* (commonly called *vapor barrier*), *n*—material used in a house building envelope to retard the passage of water vapor or moisture.

3.2.142 *wall*, *n*—one of the sides of a room or building connecting floor and ceiling or foundation and roof.

3.2.143 *water-resistive barrier (WRB)*, *n*—the surface or surfaces of a wall system responsible for preventing water infiltration to the building interior.

3.2.144 *water shedding system*, *n*—a system that prevents or limits to extremely small amounts, liquid water intrusion from the building exterior into parts of the building envelope where water accumulation would cause serviceability or durability problems.

3.2.145 *weatherability*, *n*—the capability of a building, assembly, component, product, or construction to resist the deteriorating effects of weather exposure; for example, sun, wind, rain, frost, heat, cold, and high and low humidity.

3.2.146 *weather barrier system*, *n*—a system design which integrates various components to provide a weather-resistive assembly including the fenestration product and the adjacent construction.

3.2.146.1 *Discussion*—In barrier wall systems, the exterior-most surface is the water-resistive barrier. In membrane/drainage systems, a membrane, which is the water-resistive barrier, is incorporated behind the exterior surface.

3.2.147 *window cleaner anchor*, *n*—an anchor, either single or double headed, conforming to ASME A39.1 Standard, Safety Requirements for Window Cleaning, that will allow a window cleaner to safely access the exterior of a window for cleaning.

3.2.148 *window/wall assembly*, *n*—the building envelope and the fenestration products incorporated into it.

3.2.149 *wired glass (fire resistant)*, *n*—flat, clear, transparent or translucent soda lime silicate glass which has a steel mesh welded at all intersections incorporated in the glass during its manufacturing process.

3.2.149.1 *Discussion*—To be considered as fire resistant this product shall be covered by an appropriate listing body and shall be labeled accordingly when installed.

3.3 Abbreviations:

3.3.1 *AAMA*—American Architectural Manufacturers Association

3.3.2 *ANSI*—American National Standards Institute

3.3.3 *ASME*—American Society of Mechanical Engineers

3.3.4 *ASTM International*—American Society for Testing and Materials

3.3.5 *CPSC*—U.S. Consumer Products Safety Commission

3.3.6 *CSA*—Canadian Standards Association

3.3.7 *EIFS*—Exterior Insulation and Finish System

3.3.8 *GFRC*—Glass Fiber Reinforced Concrete

3.3.9 *HMMA*—Hollow Metal Manufacturers Association

3.3.10 *IBC*—International Building Code



3.3.11 *ICBO*—International Conference of Building Officials

3.3.12 *ISDSI*—Insulated Steel Door Systems Institute

3.3.13 *NAMI*—National Accreditation and Management Institute

3.3.14 *NFRC*—National Fenestration Rating Council

3.3.15 *psf*—pounds per square foot

3.3.16 *UBC*—Uniform Building Code

3.3.17 *USOSHA*—U.S. Occupational Safety and Health Administration

3.3.18 *WDMA*—Window and Door Manufacturers Association

4. Significance and Use

4.1 This practice recognizes that the effective performance of installed fenestration products is dependent in part upon following proper installation procedures and appropriate workmanship.

4.2 This practice recognizes that the coordination of trades and proper sequencing are essential for effective fenestration installation. The general contractor shall be responsible for the necessary coordination of trades and proper construction sequencing of the installed fenestration product.

4.3 Improper installation of units contributes to excessive air, water and sound leakage, and condensation. It may promote the deterioration of wall constructions, insulation, fenestration products, and their respective finishes.

4.4 This practice presumes a working knowledge of applicable federal, state, and local codes and regulations, specifically, but not limited to required means of egress, requirements for safety glazing materials, and structural requirements of applicable codes.

4.5 This practice presumes a working knowledge of the tools, equipment, and methods necessary for the installation of specified fenestration products. It further assumes familiarity with flashing and sealing, glazing procedures, finishes where applicable, and an understanding of the fundamentals of construction that affect the installation of these units.

4.6 This practice presumes that the products that have been furnished for the installation and their locations within the structure comply with all the applicable building codes and regulations.

5. Related Issues and Procedures

5.1 *Continuity*—Continuity shall be maintained between elements in the fenestration product and the water-resistive barrier that provides weather protection, air leakage control, and resistance to heat flow and vapor diffusion. To ensure continuity with the water-resistive barrier, the installer shall identify the elements in the weather barrier system and the fenestration product that provide each of these functions. Where the installer is required to furnish or repair a vapor barrier, the material shall comply with the requirements of Practice **C755**.

5.2 *Joints and Anchorages*—Joints and anchorages between the building envelope (weather barrier assembly) and fenestration product shall be designed to accommodate differential thermal expansion (see **Table 1**) and moisture migration within the window/wall assembly.

5.3 *Moisture Entrapment*—At no time shall an exterior seal be installed in a manner that will trap moisture in the perimeter cavity between the fenestration product and the wall.

5.4 *Water-Resistive Barrier*—A water-resistive barrier shall be created to preclude entry of water into the fenestration product perimeter area, or promptly drain water that enters the fenestration product perimeter area, or both.

5.5 *Weatherability*—The capability of a building, assembly, component, product, or construction to resist the deteriorating effects of weather exposure, for example, sun, wind, rain, frost, heat, cold, high and low humidity.

5.6 *Construction Sequence*—Effective integration and continuity of the fenestration product and other components of the building envelope is dependent on proper construction sequencing.

5.7 *Construction Damage*—The installed water-resistive barrier shall be protected from damage during construction. Any damage to the water-resistive barrier shall be repaired prior to completing the installation of the fenestration product.

5.8 *Inspection*—Prior to installation, the installer shall inspect for racked corners, gaps, plugged weep holes, and fractured seals. The installer is responsible for inspecting before and after installation of the fenestration product, and re-sealing corners where necessary. Reseal or replace as directed by manufacturer.

5.9 Rough Opening:

TABLE 1 Guidance for Determining Thermal Expansion Requirements

NOTE 1—Example: If you have a 12 ft (3.657 m) wide aluminum window there would be 0.000013 in./in./°F (0.000023.4 m/m/°C) coefficient of expansion. To obtain the total movement for a 100 °F (55.5 °C) temperature change, multiply as follows:

Table factor \times 100 °F \times 12 in./ft \times 12 ft = movement $0.000013 \times 100 \times 12 \times 12 = 0.19$ in.

(Table Factor \times 55.5 °C \times 3.657 m = movement $0.000023 \times 55.5 \times 3.675 = 4.7$ mm)

Material	Coefficient of Expansion	
	Fahrenheit	Celsius
Aluminum	13.0×10^{-6} (in./in./°F)	23.4×10^{-6} (mm/mm/°C)
Carbon steel	6.5×10^{-6} (in./in./°F)	11.7×10^{-6} (mm/mm/°C)
Fiberglass pultrusion-longitudinal	6.0×10^{-6} (in./in./°F)	10.8×10^{-6} (mm/mm/°C)
Glass	5.0×10^{-6} (in./in./°F)	9.0×10^{-6} (mm/mm/°C)
Rigid PVC	22.0 to 44.0×10^{-6} (in./in./°F)	39.6 to 79.2×10^{-6} (mm/mm/°C)
Wood-longitudinal	1.7 to 3.0×10^{-6} (in./in./°F)	3.06 to 5.4×10^{-6} (mm/mm/°C)

5.9.1 Rough Opening Size:

5.9.1.1 The rough opening shall be larger in both width and height than the actual net dimension of the product to be installed. The installer shall obtain all available plan details and construction documents, as well as the manufacturer's rough opening requirements and instructions.

5.9.1.2 The installer shall notify his client if any conditions exist that would prevent the proper installation of the fenestration product, or prevent application of materials and components in accordance with this practice.

5.9.2 Insulating or Filling the Rough Opening Gap:

5.9.2.1 Rough opening gaps shall be insulated following the fenestration product installation to reduce air leakage and energy loss. The material used to fill the rough opening gap shall be selected to enhance the energy-saving performance of the fenestration product installation. See [Appendix X5](#).

5.9.2.1.1 Glass or mineral fiber insulation, one-component polyurethane foam sealants, or other code approved material shall be used to fill the rough opening gap as required by applicable codes or the contract documents or the fenestration product manufacturer.

NOTE 4—Excessive insulating material may distort the fenestration frame, requiring the removal and re-injection of the proper amount of insulation. Too little material will leave voids in the rough opening gap and permit excess air infiltration. See [Annex A1](#) for the recommended procedure for using one-component polyurethane foam sealants.

5.9.2.2 *Thermal Barriers*—Where thermally broken metal fenestration systems are used, exercise care to seal and insulate the interior metal framing from the location of the thermal barrier to the rear with insulation, protecting the interior side from the presence of exterior ambient temperatures. See [Fig. 1](#).

5.9.2.3 Adequate clearance shall be allowed for thermal expansion of the fenestration product. Joint size will vary based on the allowance for lineal thermal expansion. [Tables 1 and 2](#) provide guidance for determining the thermal expansion requirements of various materials.

NOTE 5—These tables are for readily available fenestration materials. Where other materials or composite materials are used, the fenestration manufacturer should be consulted for the coefficient of expansion and tolerances required. Adequate perimeter clearance must be allowed so that perimeter sealants are not damaged. A good rule of thumb is that the joint should be at least twice the expected movement dimension. See [5.18.1](#) for further information.

5.10 *Materials Protection*—Proper protection of the window or door during application of the building finish is important to ensure its intended function, aesthetics, and durability. It can expedite or eliminate any necessary cleanup, and it can prevent unnecessary damage. When it is likely that

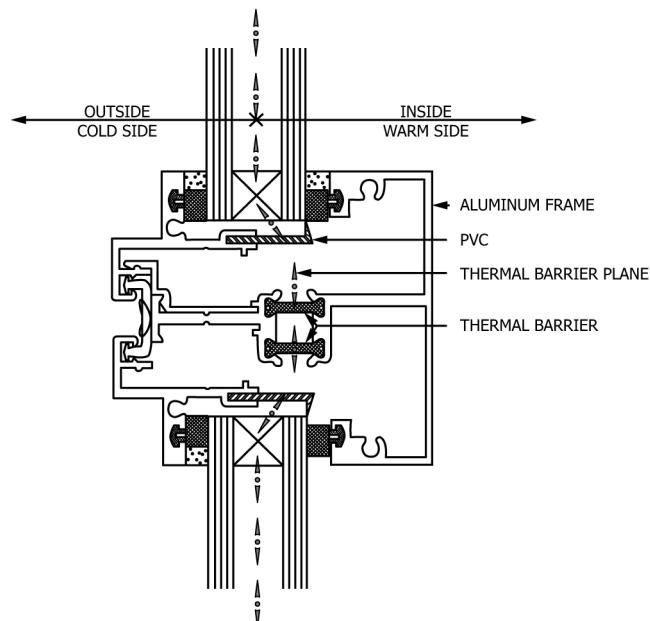


FIG. 1 Thermal Barrier

the fenestration units will be subjected to paint over-spray or harsh cleaning chemicals (as in masonry applications that are cleaned with brickwash), it is considered good practice to fully mask the unit, for example, with plastic film or paper, prior to the application of any potentially damaging exterior finish.

5.10.1 Use caution to avoid damage to fenestration products before and after installation. Many field-applied protective coatings can damage fenestration gaskets and sealants, especially insulating glass sealants, and are not recommended. Contact fenestration manufacturer before applying any such coatings. Brick wash (muriatic acid), which is commonly used to clean masonry, can etch glass and corrode hardware. Exterior surfaces of windows and doors should be poly-wrapped during masonry acid cleaning. Masking tapes may, when heated by sunlight, bake onto window surfaces, causing damage when they are removed. Masking tape shall not be allowed to remain on the product for an extended period of time as exposure to sunlight may make adhesive residue difficult to remove. Stucco left to cure on frames and glass may scratch these surfaces when being removed. Glass and aluminum surfaces and hardware exposed to leaching water from new concrete or stucco shall be rinsed immediately with clear water to prevent permanent staining. See [11.4](#).

NOTE 6—Cleaning from the highest part of the building down is most

TABLE 2 Rates of Thermal Movement for Common Materials

NOTE 1—This table is provided through the courtesy of AAMA.

NOTE 2—Based on a 100 °F (55.5 °C) temperature change using an 8 ft (2.438 m) section of material.

Material	Range of Movement	
	(IP)	(SI)
Rigid PVC	0.22 to 0.44 in. (7/32 to 7/16 in.)	5.6 to 11.1 mm
Aluminum	0.130 in. (1/8 in.)	3.2 mm
Steel	0.065 in. (1/16 in.)	1.6 mm
Wood	0.017 to 0.025 in. (1/64 to 1/32 in.)	0.4 to 0.8 mm
Glass reinforced polyester	0.100 to 0.140 in. (5/32 to 5/32 in.)	2.4 to 4.0 mm

appropriate so that water run-off does not affect areas previously cleaned. For each opening, the cleaning process should start at the top and work toward the bottom, followed by a thorough rinsing with clean water.

5.11 Cleaning and Maintenance—Cleaning of fenestration products shall be in strict accordance with the fenestration products manufacturer's installation instructions. Solvents shall be used in strict accordance with solvent manufacturer's instructions and applicable codes, safety regulations, and environmental regulations. (Warning—MEK (Methyl ethyl ketone) and similar solvents may damage organic sealants, gaskets, and finishes used on fenestration products. They shall be used with great care and should not be allowed to come in contact with organic materials. Their use shall be avoided on anodic finishes protected by clear organic coatings. Organic solvents should be used only in accordance with manufacturers' safety recommendations. Do not use solvents on painted aluminum, PVC, fiberglass, or other materials unless specifically recommended by the manufacturer.) (Warning—If lubricants are required, the installer shall ensure that the lubricant is compatible with the fenestration components.)

5.11.1 All parts of a fenestration product shall be cleaned as soon as the installation is complete. Exposed interior metal surfaces shall be washed down using a solution of mild domestic detergent in warm water, applied with a soft clean wiping cloth. Exposed exterior non-metal surfaces shall be cleaned as recommended by the manufacturer of the material.

5.11.2 Glass surfaces shall be cleaned soon after installation and regularly if surrounding construction leaves deposits on glass. Paint, plaster, and sealant spills or splashes shall be removed from the glass immediately. Glass shall not be cleaned with abrasive material or cleaners. Commercial glass cleaning products or household dishwashing detergents in water solutions will not normally harm glass or glazing sealants and may be used. Before using more aggressive cleaning chemicals or rubbing compounds, their compatibility and application techniques shall be verified with the typical fenestration product manufacturer and sealant supplier. Glass and aluminum surfaces exposed to leaching water from new concrete or stucco shall be rinsed immediately to prevent permanent damage.

5.11.3 If lubrication is required, hardware and tracks shall be lubricated according to the manufacturer's instructions after installation is complete. Tracks of wood windows shall be lubricated only after finishing because lubricant over-spray adversely affects the bond between the wood and the finish. When lubricating metal and vinyl track, silicone aerosol spray shall be prevented from contacting plastic locking mechanisms as these may be made of impact-resistant polycarbonate, which will begin to dissolve when coming into contact with the solvents contained in these sprays.

5.11.4 Correctly identify the material and finish to be cleaned when selecting an appropriate cleaning method. Check specifications or *as built* drawings, or both, if in doubt as to the finish. If this information is not available, contact the product manufacturer to determine the finish of the product.

5.11.5 Never use aggressive alkaline or acid cleaners on finishes, glass, or sealants. Do not use cleaners containing trisodium phosphate, phosphoric acid, hydrochloric acid, hydrofluoric acid, or similar compounds on anodized aluminum

finishes. Always follow the cleaner manufacturer's recommendations as to the proper cleaner and concentration.

NOTE 7—Always test-clean a small area first. Different cleaners should not be mixed.

5.11.6 It is preferable to clean the fenestration product when shaded. Do not attempt to clean hot, sun-heated surfaces since possible chemical reactions on hot surfaces will be highly accelerated and non-uniform. Also, avoid cleaning in freezing temperatures or when temperatures are sufficiently cold to cause condensation. Surfaces cleaned under these adverse conditions can become so streaked or tainted that they cannot be restored to their original appearance.

5.11.7 Apply the cleaning solution only to an area that can be conveniently cleaned without changing position. Thoroughly rinse the surface with clean water before applying cleaner. Minimize cleaner rundown over the lower portions of the building and rinse such areas as soon as practical.

5.11.8 Cleaners containing strong organic solvents will have a deleterious effect on organic overlay coatings, but not on anodized aluminum itself. The possibility of solvents extracting stain-producing chemicals from sealants and affecting the function of the sealants, however, shall be considered. Test a small area first.

5.11.9 Strong cleaners should not be used on glazing materials and other building accessories where it is possible for the cleaner to come in contact with the finish of the fenestration product. Solutions of water and mild detergents should be used. If an aggressive cleaner is required for some other component of the building, use care to prevent the cleaner from contacting the fenestration product's finish.

5.11.10 Do not use excessive abrasive rubbing to remove stubborn stains. Such procedures can produce an undesirable appearance or adversely affect the finish.

5.11.11 *Removal of Light Surface Soil From Aluminum Products*:

5.11.11.1 Removal of light surface soil may be accomplished by alternative methods as described in the following four paragraphs. Only trial and error employing progressively stronger cleaning procedures can determine which will be most effective.

5.11.11.2 The simplest procedure is to flush the surface with water using moderate pressure to dislodge the soil.

5.11.11.3 If the soil is still present after air drying the surface, clean the surface with a soft brush or sponge and water (concurrently spraying the surface with water and sponging).

5.11.11.4 If soil still adheres, a mild detergent cleaner should be used with brushing or sponging. The washing should be accomplished with uniform pressure, cleaning first with a horizontal motion and then with a vertical motion. The surfaces shall be thoroughly rinsed by spraying with clean water and thoroughly dried from top to bottom.

5.11.11.5 For anodized aluminum surfaces only, a cleanup with methyl ethyl ketone (MEK) or similar solvent using a clean cloth to wipe the surface is recommended if it is necessary to remove oils, wax, polish, and other materials. Always test-clean a small area first to determine the effect on the finish.

5.11.12 Removal of Heavy Surface Soil From Aluminum Products:

5.11.12.1 If surface soil still adheres on painted materials, a mild solvent such as mineral spirits may be used to remove grease, sealant, or caulking compounds. Stronger solvents or solvent containing cleaners may have a deleterious or softening effect on paints and should not be used. Consult with the coating manufacturer on recommendations pertaining to the use of solvents on their finishes.

5.11.12.2 Always spot-test the use of solvents on painted surfaces in inconspicuous locations. Exercise care to ensure that no marring of the surface is taking place when using solvents. Solvents shall be applied with a clean cloth and removed with a second clean cloth. Any remaining residue should be washed with mild soap and rinsed with water. Always use solvents sparingly.

5.11.12.3 If surface soil still adheres on anodized aluminum surfaces after using procedures for removal of light surface soil, cleaning with the assistance of a non-abrasive nylon cleaning pad can be employed. (**Warning**—The following procedures shall not be used on surfaces that are painted or have a factory applied clear protective coating (lacquer) unless the clear coating has deteriorated and the owner has specifically requested that it be removed.)

5.11.12.4 Hand-scrub the surface using a nylon non-abrasive cleaning pad. Thoroughly wet with clean water and a mild detergent cleaner. Start at the top and work down, rubbing the surface with uniform pressure in the direction of the grain.

5.11.12.5 Scrubbing with a non-abrasive nylon cleaning pad wet with surface protectant material is also suggested for removing stubborn soils and stains.

5.11.12.6 After scrubbing, the surface should be rinsed thoroughly with clean water or wiped with solvent to remove all residues. It may be necessary to sponge the surface while rinsing, particularly if the cleaner is permitted to dry on the surface.

5.11.12.7 The rinsed surface is either permitted to air dry or is wiped dry with a chamois, squeegee, or lint-free cloth.

5.11.13 Cleaning of Vinyl Products:

5.11.13.1 For more difficult stains and dirt, use readily available household cleaners. Before using mildly abrasive cleaners, test on an inconspicuous location, as the mild abrasive component may have a negative effect on the glass and vinyl surfaces.

5.11.13.2 Cleaners with aggressive organic solvents, such as chlorine bleach, liquid grease remover, strong detergents, and furniture cleaners should be avoided, due to the high probability of softening or surface damage on vinyl and glazing sealants.

5.11.13.3 For vinyl substrates laminated with wood veneer, PVC films, or pigmented coatings, consult the application, product, or manufacturer's recommendations for general clean-up, protection, and contact with incompatible materials.

5.11.14 Cleaning of Fiberglas, Pultrusion, Composites:

5.11.14.1 To clean black marks or residual adhesive from sash and frame surfaces after installation, use a non-abrasive liquid cleaner carefully applied with a clean plastic fiber rubbing pad. To avoid damage to the surface, do not use this

cleaning method repeatedly. Use of harsh, abrasive cleaning agents can result in surface dullness and discoloration.

5.11.14.2 For ongoing maintenance, wipe with a damp sponge or soft cloth and non-abrasive multi-purpose liquid or spray cleaner. Follow manufacturer's instructions for proper use of the cleaning agent. (**Warning**—Damage can also occur as a result of the cleaning process; for example, sand particles in stucco overspray on the glass can cause scratches in the glass while the overspray is being removed, if precautions are not taken.)

5.12 Dissimilar Materials:

5.12.1 Direct contact of aluminum surfaces with all incompatible materials shall be avoided. Aluminum shall be protected from incompatible materials by placing between the surfaces substances such as bituminous coatings of paint, caulking, non-absorptive plastic, elastomeric tapes, or gaskets.

5.12.2 Wood or other absorptive materials which may become repeatedly wet and which are in contact with aluminum should be painted with two coats of waterproof exterior paint and the joints sealed with a properly selected caulking compound.

5.12.3 Compatibility of caulk, sealants, and adhesives should be checked. As with any dissimilar materials, the applicator should consult both the manufacturer of the fenestration product as well as of the caulk, sealant, adhesive manufacturer. For cleaning procedures see 5.11. AAMA 713 provides a test method to determine the chemical compatibility of liquid applied sealants and self-adhered flashings that may come in contact with each other in the installation of fenestration products.

NOTE 8—See Annex A4 for additional information.

NOTE 9—Further information concerning the protection of aluminum from dissimilar materials can be found in the Uniform Building Code, Section 28.1. Dissimilar metals (except 300 series stainless steel, zinc, or a small area of white bronze) should be painted if used in locations where drainage from these metals passes over aluminum. Aluminum surfaces in contact with mortar, concrete, other masonry materials or pressure-treated wood framing shall be isolated with alkali resistant coatings, a vinyl liner, or other available method.

5.12.3.1 Incompatibility of Caulks, Sealants and Gaskets:

5.12.3.1.1 Refer to 11.4 and Annex A4. Self-adhesive type flashing products may not require the use of additional sealant during application to the substrate or the fenestration product as long as the flashing securely adheres to the materials. The surface that this flashing is applied to must be clean, dry, and frost-free. Where sealant is used near these materials (for example, at exterior facade installation joints), do not use sealant that contains solvent. Sealant that contains solvent can have an affect on the bond and performance of self-adhesive type flashing materials. Consult the supplier of these materials to determine what type of sealant or primer, or both, can be used with these products. Always consult the flashing supplier to determine compatibility with the various installation materials, and to obtain specific installation techniques.

5.12.4 Steel and Other Metals—Steel components such as framing, anchors, and other types of unexposed metal clips should be isolated from the fenestration product according to the manufacturer's recommendation.

5.12.5 *Stucco, Concrete and Mortar*—Stucco, concrete and mortar left to cure on frames, sash, and glass will damage these surfaces. Remove and clean all such materials from surfaces prior to curing. In addition, glass and frame surfaces exposed to leaching water from new concrete, stucco, or mortar shall be rinsed immediately with clear water to prevent damage.

5.12.6 *Wood and Wood Components*—Unless wood is moderately or appreciably decay-resistant, its surfaces should not be placed in direct contact with concrete, masonry units, mortar, or stucco, as these materials may hold substantial quantities of water for extended periods. Common *white woods* (such as pine, spruce, hemlock, or fir) have relatively low decay resistance and should be protected from direct contact with these materials by paint coatings, caulking materials, non-absorptive plastic or elastomeric tapes, or gaskets between the surfaces. For woods of moderate decay resistance, treatment with water repellent preservatives may afford sufficient protection so as to allow direct contact.

NOTE 10—Heartwood of redwood, cedars, cypress, or wood pressure-treated with preservatives may be considered appreciably decay resistant. Heartwood of Douglas fir is moderately decay resistant. See the Wood Handbook (USDA, Forest Service) for decay resistance of other species.

5.13 *Flashing Requirements:*

5.13.1 Proper flashing and sealing are necessary to prevent water from entering between the water-resistant barrier, the fenestration product frame, and the adjacent construction materials.

5.13.2 In no case shall a paper-based material be used as a waterproof membrane on surfaces or roofs having a slope of less than 60° from the horizontal. (See **Fig. 2**) (Warning—The use of a paper-based material in an application where water can

pool or collect on its surface may result in the degradation of this material and the penetration of water through the building water-resistant barrier.)

5.13.3 *Minimum Requirements for Flashing Material:*

5.13.3.1 Unless otherwise specified, flashing material shall provide twenty-four (24) hour minimum protection from water penetration when tested in accordance with Test Method D779 (see **Appendix X1**). AAMA 712 provides a specification for minimum performance criteria to evaluate mechanically attached flexible flashing products. AAMA 711 establishes test methods and minimum performance requirements for self adhered flashing (SAF) products including minimum widths. AAMA 714 establishes test methods and minimum performance requirements for liquid applied flashings.

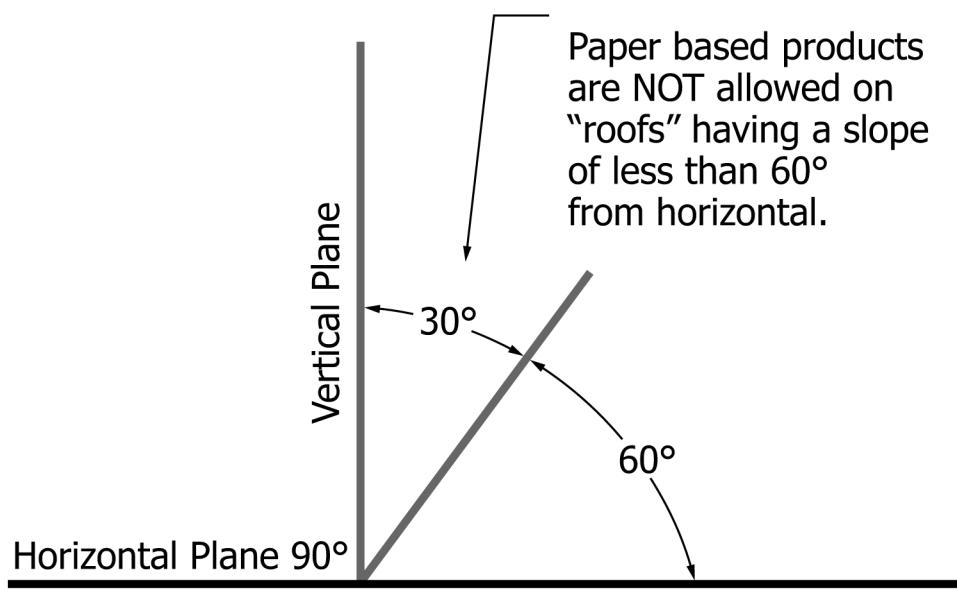
5.13.3.2 The flashing membrane shall be securely affixed to minimize any weather damage prior to the building's exterior treatment being applied. The fenestration product and flashing shall be integrated into the overall water-resistant barrier. The fenestration and flashing manufacturers shall be consulted for any special flashing requirements unique to their products.

NOTE 11—Numerous references to properly and securely attaching flashing materials are mentioned in the following sections. The building contractor is responsible for coordination of this work, as it is greatly dependent on the construction schedule. Once installed, local wind and weather conditions, as well as exposure to other trades, can have a detrimental effect on the permanent attachment of flashing.

5.13.3.3 Unless otherwise specified, when aluminum or copper sheet, or both, or step flashing is specified, it shall be no less than 0.040 in. in thickness. It can be mill finished if totally concealed but if exposed, shall be anodized or coated with an

**Paper based products
are approved for “walls”
within 30° of vertical.**

**Paper based products
are NOT allowed on
“roofs” having a slope
of less than 60°
from horizontal.**



NOTE 1—The use of a paper-based material in an application where water can pool or collect on its surface may result in the degradation of this material and the penetration of water through the building water-resistant barrier.

FIG. 2 Flashing on Sloped Surfaces

appropriate paint. In all cases the aluminum sheet shall be separated from dissimilar metals or masonry, or both, by tape, gasket, elastomeric sheet, a heavy coat of bituminous paint, or other approved separation materials.

5.13.3.4 When aluminum sheet or step flashing is specified for installation of skylights, it shall be installed in accordance with acceptable roofing practices or according to the manufacturer's installation instructions.

5.13.3.5 Unless otherwise specified, when aluminum, copper, or galvanized metal is specified for head flashing, it shall be no less than 26 gage in thickness. Galvanized metal shall be zinc coated on both sides and the coatings can be hot dipped galvanized or electroplated in conformance with Specification A123/A123M. It can be surface treated for painting by phosphatizing.

5.13.3.6 When terne metal is used, it shall consist of copper bearing steel, coated both sides with lead-tin alloy. Coating weights are typically 0.047 lb/ft² (0.23 kg/m²) (see [Appendix X1](#)).

5.14 Fastening Systems/Anchorages:

5.14.1 Important: When specifying or considering the structural load requirements for windows and doors, it is important to consider the method of fastening the unit(s) into the opening. Consult with the window/door manufacturer's fastening specifications to ensure units are installed properly to meet or exceed performance ratings. Selection of the appropriate fastening method is the responsibility of the installer, contractor, structural engineer, architect, building owner, or consumer, or combination thereof.

5.14.2 Fasteners shall be installed to secure the unit under service conditions (weight, wind load, temperature variations, and so forth). It is not recommended that horizontal surfaces of flashings be penetrated with fasteners. Fasteners passing through the interior sill shall be sealed by putting sealant in the hole before the screw, then tightly installing the screw, then sealing the top surface of the fastening head. Refer to manufacturer's instructions or construction documents in all cases. See [5.13](#) for further information.

5.14.3 To provide adequate protection against galvanic corrosion, use only fasteners that are compatible with the materials joined and that will not result in galvanic corrosion. Refer to [5.12](#).

5.14.4 Plated or coated steel fasteners or non-magnetic stainless steel fasteners shall meet the minimum requirements as indicated in [Table 3](#).

5.14.5 Fastener length shall be sufficient to penetrate the substrate to a depth designed to meet applicable building codes, manufacturer's recommendations, and structural calculations. Number and spacing shall be sufficient to meet loads. See [8.5.2](#) for anchoring of vinyl frames.

5.14.6 Fasteners shall not be installed through exterior sill tracks unless recommended by the fenestration manufacturer, as this could cause water penetration into the walls below. Fasteners passing through the interior sill shall be sealed by putting sealant in the hole before screw, then tightly installing the screw, then sealing the top surface of the fastener head.

5.14.7 The installation of fasteners or fastening systems shall not cause excessive distortion ($\pm \frac{1}{16}$ in. (1.6 mm)) of any frame or sash member, nor in any way impede the operation of the unit. However, when fastening windows to the building structure through an integral nailing flange, the frequency of said fasteners shall be as required to prevent excessive buckling ($\pm \frac{1}{16}$ in. (1.6 mm)) of the flange and ensure continuous and positive compression on perimeter caulking between flange and structure (see [8.5.2](#)). The integral nailing flange at the head of the window shall be fastened in such a manner as to insure that the window head will not bow downwards if the head beam over the window deflects. This can be accomplished by vertically elongated installation holes in the integral nailing flange at the window head or special flange clips that allow movement of the flange in a vertical direction. When units are nailed through the exterior wood casing during installation, set nails below the surface and fill nail holes with wood putty. Fill or finish any exterior holes such as staple or nail holes on exterior glazing beads or stops.

NOTE 12—When using an elongated hole or L-shaped slot, do not drive the fastener tight in order to allow freedom of vertical or horizontal movement.

NOTE 13—When interior trim is used, make sure the trim is attached to either the fenestration product or the framing, but not both; allowing for bowing of the header.

5.14.8 Anchoring of window or door products should always be done according to the manufacturer's instructions, the construction documents, or according to the recommendations of a qualified structural engineer. The following references may be used when determining the proper number, type, and size of fasteners to be used for anchoring window and door products. (Warning—Fasteners shall never encroach on the designed clearance for glass in the frame.)

TABLE 3 Fastener Selection

Fastener Material	Fastener Exposure	Performance Requirement
Steel—cadmium plated	not visible after installation visible after installation	Specification B766 (8 μ m thick) not recommended
Steel—zinc plated	not visible after installation visible after installation	Specification B663/B663M (8 μ m thick) not recommended
Steel—nickel/chrome plated	not visible after installation visible after installation	Specification B456 , Type SC 2 not recommended
Magnetic stainless steel	not visible after installation	recommended
400 Series min. 16 % chrome	visible after installation	not recommended
Non-magnetic stainless steel	not visible after installation	recommended
300 Series	visible after installation	recommended

(1) "Aluminum Design Manual, Section III"—The Aluminum Association.

(2) TIR A9-1991, "Metal Curtain Wall Fasteners"—The American Architectural Manufacturers Association.

(3) "Standard Handbook of Fastening and Joining"—Robert O. Parmley, P.E., McGraw Hill Book Company, 1977.

(4) "Fastener Standards" and "Manufacturer's Capability Guide," latest editions—Industrial Fasteners Institute.

(5) "Standard Handbook for Mechanical Engineers"—Baumeister and Marks, McGraw Hill Book company, latest edition.

5.14.9 Anchorage of multiple units or assemblies containing multiple units may involve additional fastening requirements from those specified for single units. See manufacturer's instructions for further explanation.

5.15 Shimming:

5.15.1 When required, shims shall be installed in a manner and in sufficient number to minimize deflection, distortion, or rotation of the frame to achieve proper operation of the fenestration products, or as recommended by fenestration manufacturer. (Warning—When perimeter sealants are used, take proper care that the shims are recessed into the perimeter sealant cavity so that they will not impede on the sealant joint. Make sure that a bond-breaker exists between the edge of the shims and the sealant. See [5.18](#) for more information. See [Fig. 3](#).)

NOTE 14—Proper shimming is extremely important. Under-shimming can cause the unit to sag out of square. Over-shimming can result in bowed jambs, head jamb, sill, or combination thereof. Both conditions can contribute to improper operation of the sash. See [Figs. 3 and 4](#).

5.15.2 Sill shims used with framing materials shall be made from materials capable of sustaining all loads placed on them by the fenestration products including a minimum compressive strength of 1100 psi (7600 kPa). High-impact plastic or metal shims are recommended for sill support. Wood shims under the sill are not permitted unless specifically recommended by the fenestration manufacturer.

NOTE 15—The compressive strength of wood shims may not be

sufficient to support the weight of the product.

5.15.3 The sill shall be supported in a straight and level condition at a minimum of three points. Shims shall be located 3 in. (75 mm) from each end and at midspan, or at 3 in. (75 mm) from each end plus one point per 12 in. (300 mm) of nominal width (see [Fig. 4](#)). Shim spacing shall never exceed 12 in. (300 mm). In the absence of manufacturer's instructions, shims shall never be closer than 3 in. (75 mm) from any corner of a fenestration assembly. The sill can be supported through the use of shims, support blocking, rough opening sill, or components of the pre-existing window. Refer to the manufacturer's instructions for recommended sill support system details.

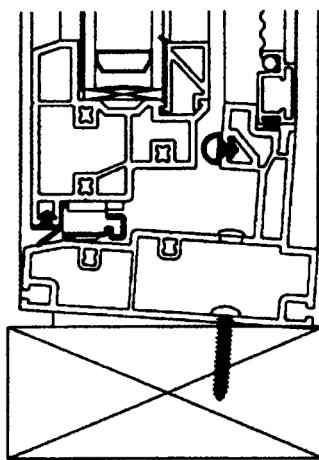
5.15.4 Do not over-shim. Check head/side jambs to be sure they are straight $\pm \frac{1}{16}$ in. (1.588 mm). Products shall not be racked more than $\frac{1}{8}$ in. (3.175 mm) out of square for dimensions up to 4 ft (1.3 m) or more than $\frac{3}{16}$ in. (4.763 mm) for dimensions greater than 4 ft. (1.3 m).

5.15.5 Refer to the manufacturer's instructions for unit shimming requirements. In the absence of manufacturer's instructions for shimming, the tolerances to the product dimensions after installation are given in [Table 4](#) as a guide only.

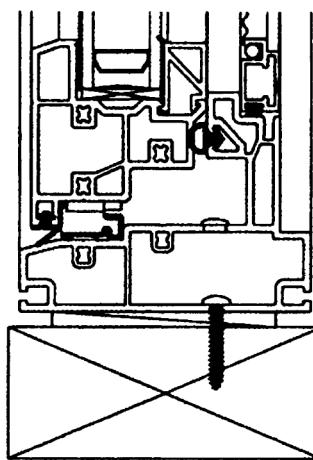
5.16 *Pan Flashing Systems and Subsills for Weatherability*—Where pan/sill flashings are provided, these flashings shall drain water to the drainage plane or to the exterior (see [Annex A3, Figs. A3.1-A3.4](#)). The interior side and the ends of the pan flashing shall be upturned to prevent water from flowing off the flashing into the wall or onto interior finishes. The height of the pan shall be appropriate for the fenestration product being installed, according to manufacturer's instructions or the advice of a design professional. To determine the minimum height requirements for interior height of pan flashing, refer to [Annex A3](#). See [Note 2](#).

5.16.1 A sloped pan, sill, and subsill is the preferred method to divert water to the drainage plane. See [Fig. 5](#).

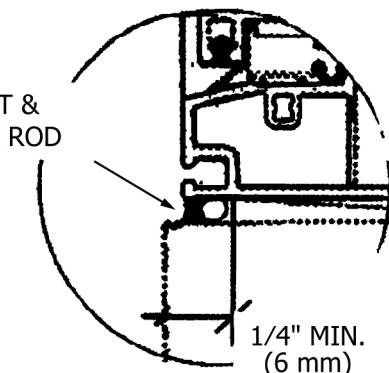
5.16.2 The pan flashing system and subsill ends shall prevent water from entering the walls at the lower corners of windows/doors. End dams shall be incorporated at both ends of



NOT ACCEPTABLE

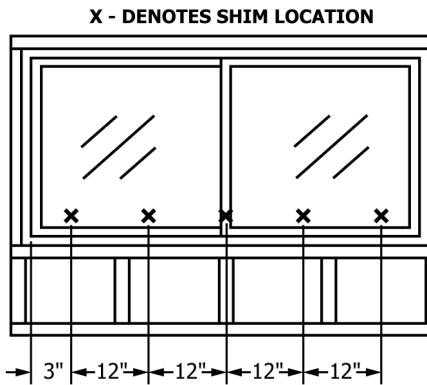


ACCEPTABLE



HOLD BACK OR CUT EDGE OF SHIM

FIG. 3 Shimming Recommendations


FIG. 4 Shim Locations
TABLE 4 Unit Shimming Tolerance (\pm in.) from Nominal

NOTE 1—Products shall not be racked more than $\frac{1}{8}$ in. (3 mm) out of square for dimensions up to 4 ft (1.3 m) or more than $\frac{3}{16}$ in. (1.6 mm) for dimensions greater than 4 ft (1.3 m).

	in./ft	in. Over 4 ft	in., max	Method of Measure
Level (horizontal measure)	$\frac{1}{32}$ in. (0.8 mm)	$\frac{1}{8}$ in. (3 mm)	$\frac{1}{8}$ in. (3 mm)	level and steel rule or tape
Plumb (vertical measure)	$\frac{1}{32}$ in. (0.8 mm)	$\frac{1}{8}$ in. (3 mm)	$\frac{1}{8}$ in. (3 mm)	level or plumb-line and steel rule or tape
True/Rack	$\frac{1}{32}$ in. (0.8 mm)	$\frac{1}{8}$ in. (3 mm)	$\frac{3}{16}$ in. (1.6 mm)	using two strings across corners
Straight (measure of straightness)	$\frac{1}{64}$ in. (0.4 mm)	$\frac{1}{16}$ in. (1.6 mm)	$\frac{1}{16}$ in. (1.6 mm)	level or plumb-line and steel rule or tape
Squareness (diagonal measure)	n/a	n/a	^A	steel rule or tape

^A $\frac{1}{8}$ in. up to 20 ft² (3 mm up to 1.8 m²)

$\frac{1}{4}$ in. over 20 ft² (6 mm over 1.8 m²)

the pan flashing system and subsills to restrict water entry. See **Fig. 5**, **Figs. 6-11**, and **Annex A3**, **Figs. A3.2-A3.4**.

5.16.3 Use of Pan Flashings—This practice recommends that pan flashings be used under all windows and doors, except where wall construction details incorporating fenestration drainage systems are provided by the building designer, or where wall construction details are specifically provided by fenestration manufacturers' installation instructions. Where used, pan flashings shall be integrated with the wall's water-resistive barrier in shingle-lap fashion (see **Fig. 5**). The pan flashing shall be continuously sealed to the water-resistive barrier.

NOTE 16—Pan flashings may not be applicable for certain installations, for example, surface barrier systems, window receptors, pre-existing subsills.

5.16.3.1 Do not alter the fenestration product without specific approval of the fenestration manufacturer.

5.16.4 Types of Pan Flashings Materials—Pan flashings materials can be categorized as either rigid sheets or flexible membranes, or combination systems. Within each of these two categories the fabrication of the materials can be classified as either 1-piece or multiple pieces. For purposes of this standard the material and fabrication types of pan flashings are shown in **Table 5**. See **Annex A3**, **Figs. A3.2-A3.4**.

TABLE 5 Types of Pan Flashing Materials and Fabrication

Rigid Sheet	1-Piece or Multiple Pieces	Type I
Rigid Sheet	Multiple Pieces	Type II
Flexible Membrane	1-Piece or Multiple Pieces	Type III
Combination Systems	Multiple Pieces	Type IV
Liquid Flashings	Fluid-Applied Coating	Type V

5.16.4.1 Rigid Sheet, 1-Piece or Multiple-Piece Pan Flashing (Type I)—These are typically fabricated from sheet metals, semi-rigid plastics or composites. Joints are continuously soldered, sweated, chemically or thermally welded as appropriate to achieve permanent watertightness. See **Fig. 6**.

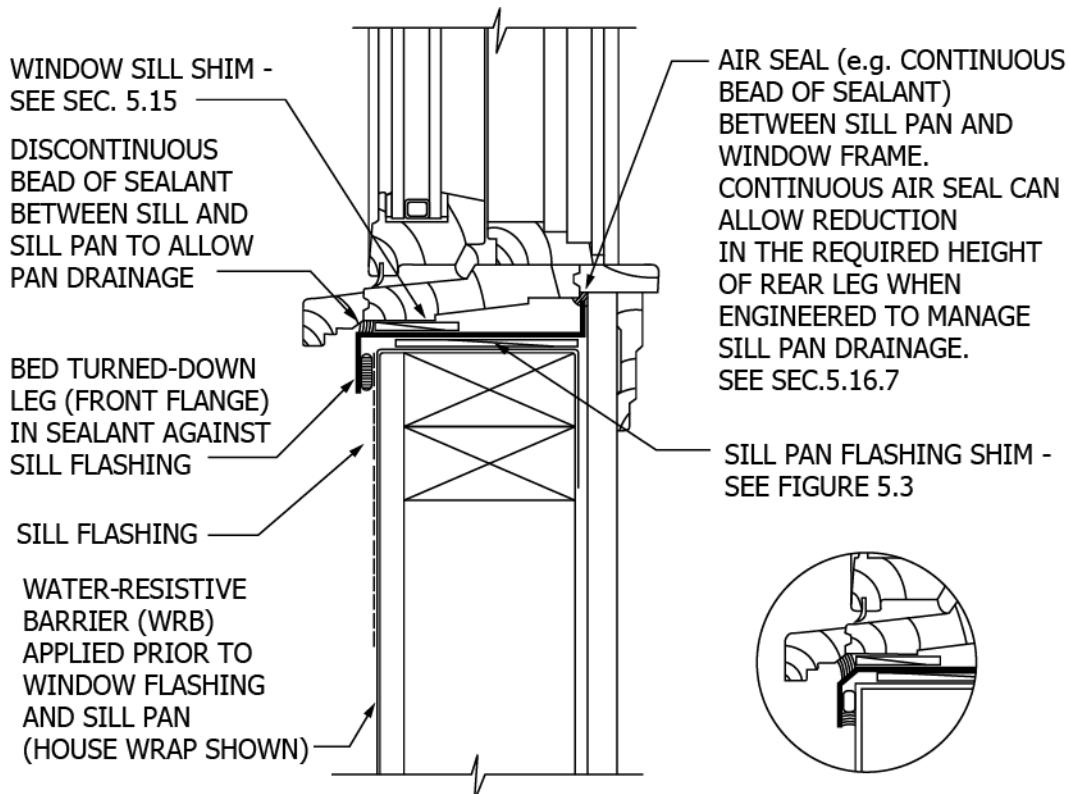
5.16.4.2 Rigid Sheet, Multiple Pieces Pan Flashing (Type II)—These pan flashings are made up of pieces of metal or plastic sills and ends that are lapped or joined and continuously sealed for watertightness (For examples, see **Fig. 8**, **Fig. 12**, and **Fig. 13**). **Warning**—Sealant selection and application are critical to performance (see **5.18**).

5.16.4.3 Flexible Membrane Pan Flashing (Type III)—These pan flashing systems are fabricated from one or multiple pieces of a self-adhering membrane and are applied to create a watertight end dam and rear leg. See **Fig. 9**.

5.16.4.4 Combination Pan Flashings (Type IV)—These pan flashings may be assembled from a variety of rigid, flexible, and self-adhering materials in order to achieve a watertight pan flashing. See **Fig. 10**.

5.16.5 Installation of Pan Flashings—The following are general criteria for the installation of pan flashing. The criteria and specific installation may need to be altered for specific window/door products and rough opening conditions. Pan flashings shall be integrated with the flashing system. See **Fig. 32**.

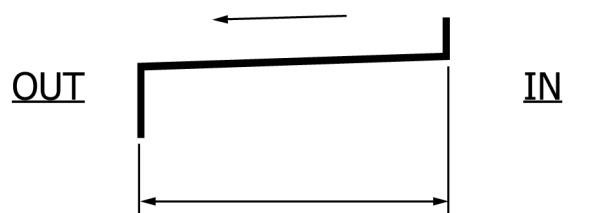
5.16.5.1 Rigid Sheet, 1-Piece or Multiple Pieces (Type I)—The sheet material is formed to fit into the sill rough opening and provide end dams up the jambs and a self-supporting rear leg. The pan flashing extends onto the face of the sill apron and jamb face forming a closed corner. A continuous bead of sealant is applied to the back side of the



NOTE:
REFER TO ANNEX A3 FOR INFORMATION
ON SILL PAN HEIGHT REQUIREMENTS.
TYPE II PLANS SHOULD ALSO BE
INTERGRATED WITH WRB.
PROPRIATEY TYPE III PANS MAY BE
APPLIED OVER WRB PER
MANUFACTURER'S INSTRUCTIONS

NOTE 1—Type II pans should also be integrated with WRB. Proprietary Type III pans may be applied over WRB per manufacturer's instructions.

FIG. 5 Membrane/Drainage System-Installation of Sill Pan



DEPTH > 6" SLOPE REQUIRED
DEPTH ≤ 6" SLOPE RECOMMENDED

FIG. 5 .2 Flat and Sloping Sill Pan (continued)

down-turned leg of the pan flashing. See Fig. 5, Fig. 12, and Fig. 32. Sealant selection and bead design shall be in accordance with 5.18.

5.16.5.2 *Rigid Sheet, Multiple Pieces (Type II)*—Apply the multiple pieces at sill and jamb corners to be lapped and sealed. The pan flashing shall be assembled, to fit into the sill rough opening and provide end dams up the jambs and a self-supporting rear leg. The pan flashing extends onto the face of

the sill apron and jamb face forming a closed corner. A continuous bead of sealant is applied to the back side of the down-turned leg of the pan flashing. This will allow the flashing to seal directly to the sill flashing. See Fig. 8, Fig. 12, Fig. 13, Fig. 32, and Fig. 33..

5.16.5.3 *Flexible Membrane System (Type III)*—Apply the flashing material to adhere along the sill and wrap into the rough opening to form a watertight pan flashing. The flashing

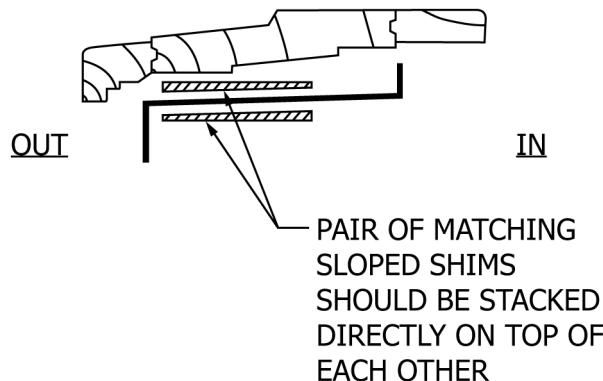


FIG. 5 .3 Paired Shims for Sloping Pan (continued)

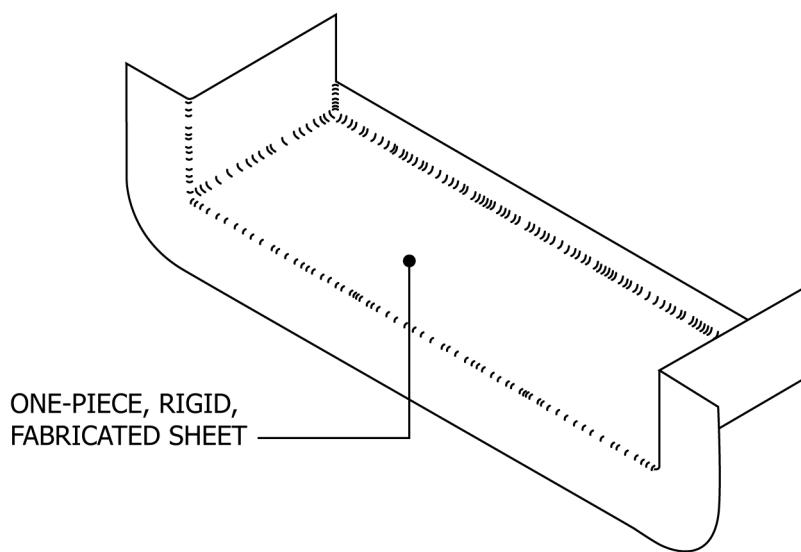


FIG. 6 Type I Pan Flashing—One-piece

material shall extend up the jambs and shall extend into the rough opening with provisions made to support the formation of a rear leg. The flashing shall extend onto the face of the sill apron and jamb face forming a closed outside corner. See [Fig. 9](#) and [Fig. 10](#). See [Annex A3](#) and [Fig. A3.4](#) for recommended pan flashing dimensions.

5.16.5.4 Combination Systems, Multiple Pieces (Type IV)—Apply the material(s) at the sill and jamb corner in a manner that they adhere to each other. Lapped seams shall be tight and flat. The end dam shall extend up the jambs. The flashing shall extend into the rough opening with provisions made to support the formation of a rear leg. The flashing shall extend onto the face of the sill apron and jamb face forming a closed outside corner. See [Fig. 11](#).

5.16.5.5 Liquid Flashings (Type V)—Apply the liquid flashing materials at the sill, jambs, and head where applicable. Apply the material such that it upturns at the sides of the openings and extends into the rough opening with provisions to support a rear leg and forms complete and uniform coverage without voids/pinholes. The liquid flashing shall extend out of the rough opening onto the face of the sill apron (where applicable) and jamb face forming a closed outside corner. The materials shall also integrate with the air/water barrier or

drainage plane of the wall, or both. Liquid flashings shall comply with AAMA 714 material specification. Apply liquid flashings in accordance with manufacturer's recommendations with the final application coverage similar in configuration to [Fig. 6](#).

5.16.6 Pan Flashing Seal Discontinuity—Where pan flashing is used, care must be taken to ensure a drainage path between the window and the sill pan. Therefore, the bead of sealant on the mounting flange at the sill must have at least 2 gaps at least 2 in. (50 mm) wide to permit drainage from the sill pan to the exterior or the drainage plane. The gaps in the bead of sealant must be no more than 4 ft (See [Fig. 6](#)) apart, such that additional gaps are required for windows/doors wider than four feet wide. See [Note 17](#).

5.16.7 Pan Flashings and Air Infiltration Seals—Air infiltration seals installed around window perimeters may, if incorrectly applied, obstruct drainage from pan flashings. To reduce the chance of this occurring, air infiltration seals shall be applied in such a manner that moisture is not trapped inside the established water-resistive barrier plane. (See [Fig. 5](#) and [Fig. A3.3](#).) How this is done will be greatly affected by the specific wall material and configuration. It is imperative that this sealing system is also applied in such a manner that the

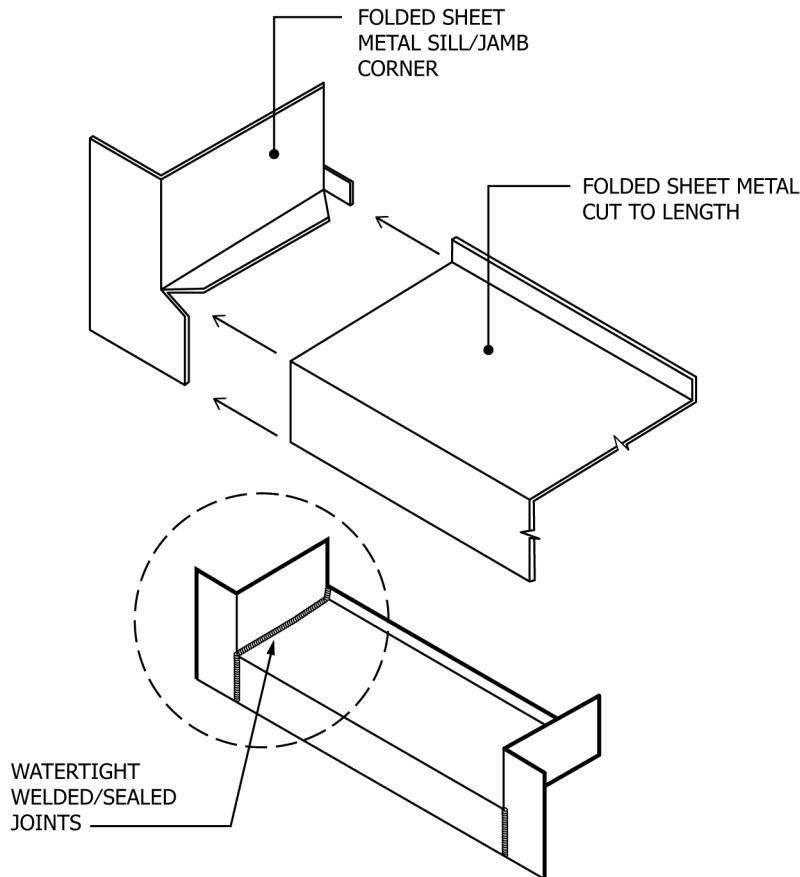


FIG. 7 Type I Pan Flashing—Multiple Pieces

window surfaces inside of the water-resistant barrier are protected from air leakage and moisture. Air infiltration seals can reduce the required pan heights. See [Annex A3](#) and [Appendix X5](#).

5.16.8 Pan Flashings as Thermal Bridges—Pan flashings, by design, extend through most of a wall's thickness. When fabricated from sheet metal, pan flashings will act as thermal bridges. Where this may pose a problem, (for example buildings in cold climates fabricating pan flashings from material with lower thermal conductivity than sheet metal will be required. Be aware that climate and special building occupancy requirements can influence the selection of pan flashing material.

5.16.9 Securing Pan Flashings—The pan flashing should be secured in place to prevent movement. Avoid penetration of the horizontal leg of the pan flashing. If through-pan attachment cannot be avoided, attach the pan through the end-dam jamb tabs above the upturned rear leg (See [Annex A3, Fig. A3.2](#)). Driving fasteners through the pan will compromise the watertightness of the pan. For this reason, attachment by driving fasteners through the pan shall be done carefully and with sealant at the fasteners.

5.17 Pre-Installation Procedures:

5.17.1 Control of Hazardous Materials—Hazards such as lead and asbestos are present on many older homes and shall be handled with caution. Any handling of these materials shall

comply with applicable codes and standards. See ASTM Standards on Lead Hazards Associated with Buildings.

5.17.1.1 Homes built prior to 1978 are likely to have been painted with paints containing lead. Studies have shown that windows, doors, and exterior trim have the highest quantities of leaded paints and disturbing these surfaces can result in significant exposures to workers and occupants (EPA, Lead Exposure Associated with Renovation and Remodeling Activities). OSHA's Lead in Construction Standard (29 CFR 1926.62) applies to all construction work where an employee may be occupationally exposed to lead. Installation should comply with the requirements set forth in ASTM Standards on Lead Hazards Associated with Buildings.

5.17.1.2 Asbestos-containing materials can be found throughout a building in shingle siding, drywall, drywall mud, and sealants. OSHA's Asbestos Construction Standard (29 CFR 1926.1101) applies in these areas. Any disruption of these materials also triggers OSHA requirements for asbestos control.

5.17.2 Preparation of the Opening:

5.17.2.1 The fenestration product manufacturer's detailed installation instructions shall be used as the fenestration installer's primary guide. In the absence of such manufacturer's instructions, the procedures outlined herein shall be followed.

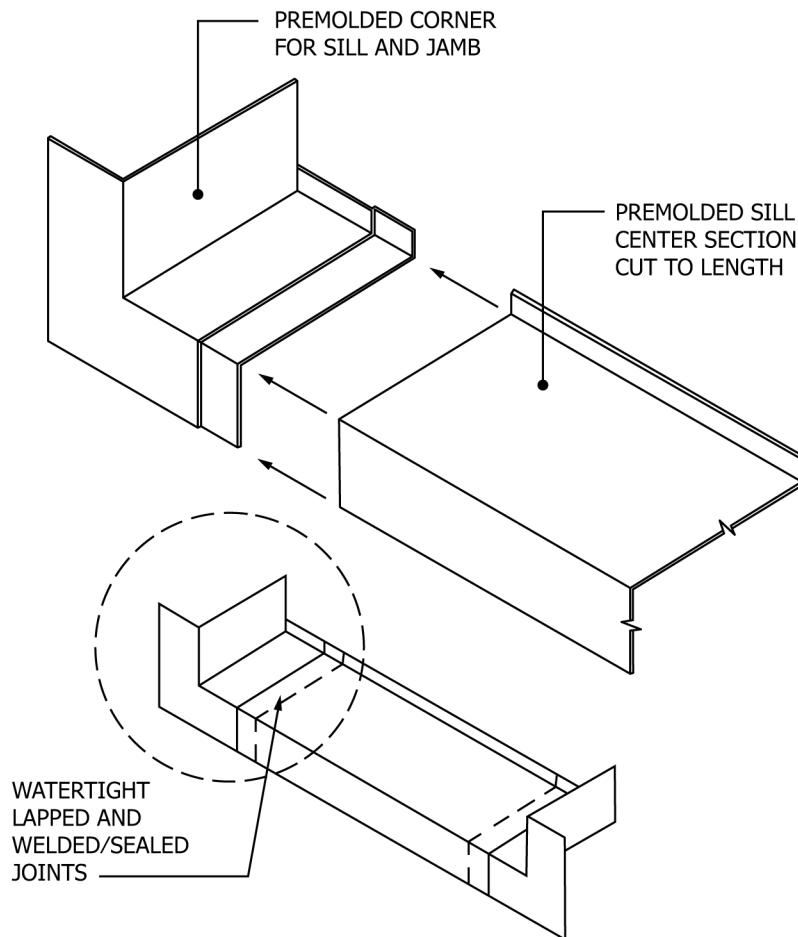


FIG. 8 Type II Pan Flashing—Multiple Pieces

5.17.2.2 Measure the rough opening to ensure that it will allow installation of the fenestration product in a square, plumb, and level condition in accordance with manufacturer's instructions. If the opening will not allow correct installation, correct these deficiencies before proceeding.

5.17.2.3 Check that the fenestration products are the correct size and type for the opening, including tolerances for plumb, level, and square installation. See **Fig. 6** and **Fig. 13** for plumb, square, and level tolerances. **(Warning—**Rough opening trueness/racking of fenestration unit—As a general rule, fenestration units should not be racked so as to permit installation in openings that are out-of-square or out-of-plane. This practice does not recognize as acceptable any racking that would interfere with intended operation (opening and closing) of sash or doors. Even if racking does not noticeably interfere with operation of movable sash or doors it may nevertheless render the unit prone to water intrusion, air leakage, excessive noise transmission, or degrade its ability to withstand design wind loads. Some units may, however, withstand being racked to limited degrees. Unit manufacturers will generally provide information on request concerning the tolerance of their units to being racked. The installer should obtain this tolerance information prior to beginning installation, so as to identify if rough openings will permit installation within manufacturer's tolerances. In the absence of information from the

manufacturer, the installer shall assume that the units have no tolerance for being racked.)

5.17.2.4 When specified, the installer shall verify that all interfacing components (such as panning systems, drip caps or moldings, and other weather barrier systems) have been installed.

5.18 Sealants—Selection and Use:

5.18.1 The ability of a sealant joint to provide durable continuity (see Section 6) between building envelope components depends on joint design, selecting the right sealant, and proper sealant installation. See **Table A4.1**.

5.18.1.1 The installer shall follow the approving authorities' or architects' recommendations for joint geometry, sealant type, and application. In the absence of such specific recommendations, the installer should contact the manufacturers of the fenestration product, other wall system components, and sealant manufacturer for recommendations. The installer shall consider the following criteria when selecting a sealant or sealants:

(1) Anticipated joint movement and the sealants' movement capability. See **Annex A4, Table A4.1**.

(2) Adhesion of the sealant(s) to all joint surfaces such as frame components, flashing, siding, and other wall components. See **Annex A4, Table A4.2**.

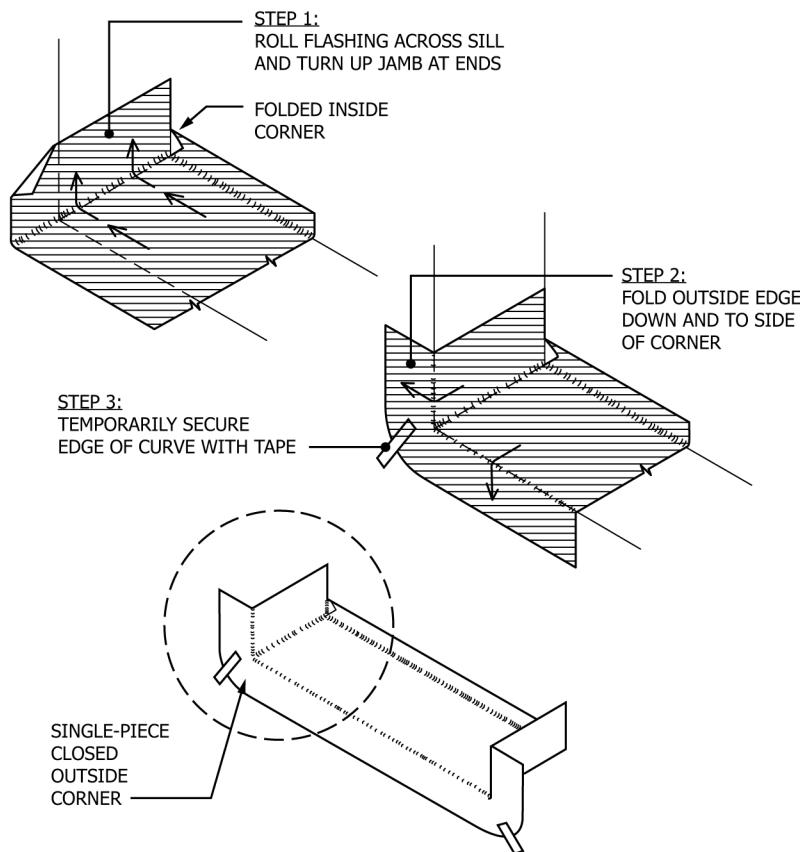


FIG. 9 TYPE III Pan Flashing—One Piece

(3) Compatibility of sealant(s) with coatings, adhesives, and other component surfaces.

(4) Need for primers and their use.

(5) Surface preparation such as cleaning (see 5.18.11 for guidelines on cleaning).

5.18.1.2 Sealants shall be applied and tooled in accordance with the sealant manufacturer's instructions with respect to surface preparation, application procedures, and application temperatures.

5.18.1.3 The installer shall obtain sufficient information to confirm the sealant is acceptable with respect to these criteria. Information is available from sealant manufacturer product information bulletins and web sites. See *Annex A4, Table A4.1*.

5.18.1.4 In barrier wall systems, the exterior joints between fenestration product frames and the building envelope shall be sealed.

5.18.2 There are four basic types of sealant joints encountered in installation: bridge, butt, fillet, and lap. Descriptions of each are given in Terminology C717. The installer should be familiar with and follow the guidelines of Guide C1193 unless the sealant manufacturer makes other recommendations. Guide C1299 provides a list of characteristics and properties of liquid applied sealants. See *Annex A4* and *Fig. A4.1*.

5.18.3 If not specified in the construction documents, design sealant joints and select sealant material to accommodate expected movements.

5.18.3.1 Joints, which are designed or engineered to accommodate movement, require an elastomeric sealant meeting

Specification C920. Blueprints or shop drawings should be obtained and followed to insure proper sealant joints. A Class 12-1/2 or Class 25 sealant should be used according to the movement expected. Refer 5.9.2.3.

5.18.3.2 In sealant joints with less than 15 % movement, sealants meeting Specifications C834, C1311 or AAMA 808.3 can be used if recommended by the manufacturers of the fenestration product and the sealant. Exercise caution when using any sealant where movement has not been anticipated and there is a lack of designed joints. The installer shall verify that movement will not exceed the capability of the sealant and that sufficient sealant dimensions are used.

5.18.4 For skylight and roof window installation where there may be accumulation of snow or the possibility of ice damming, a rubberized, asphaltic, or other weatherproofing membrane shall be used to seal the joint between the fenestration product and the building envelope prior to the installation of the roof covering. See Specification D1970/D1970M.

5.18.5 The selection and use of pre-cured silicone sealants or liquid applied sealants for bridge joints should carefully follow the sealant manufacturer's recommendations and instructions.

5.18.6 Applications where flashing, building paper, water-resistant barriers, or fins are *bedded* with sealant are typically low movement lap type joints where adhesion and compatibility are the primary sealant considerations. In a lap or guttering joint the sealant shall be non-hardening. For liquid-applied sealants, recommendations from the manufacturers of the

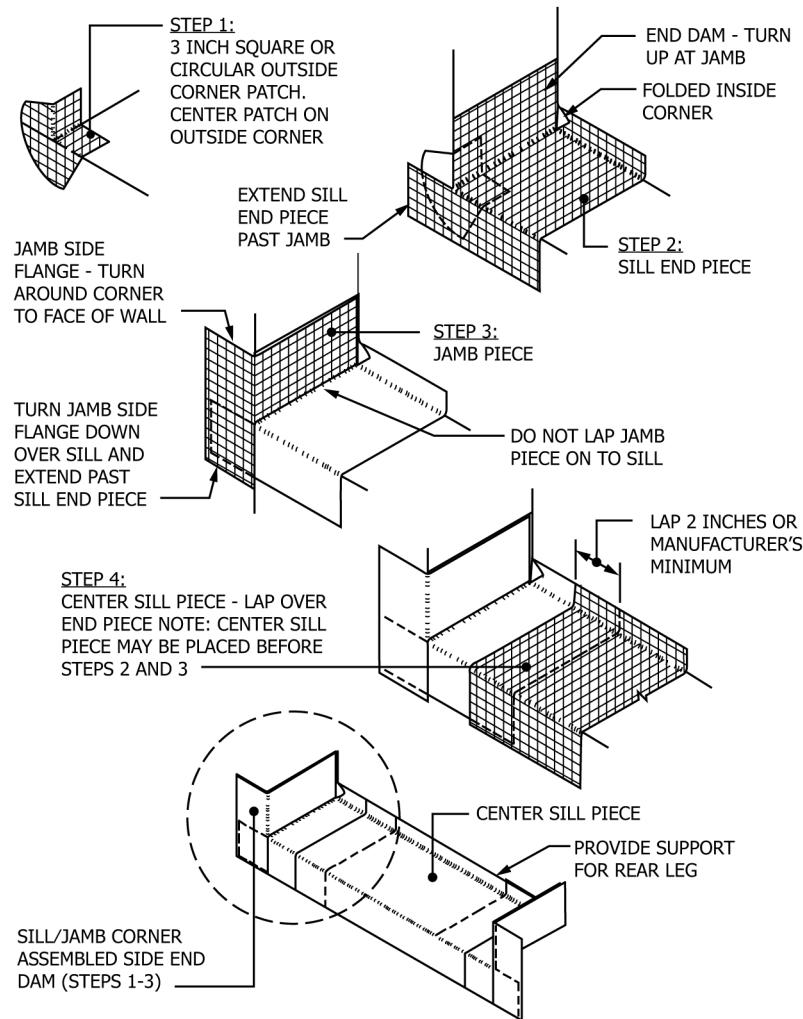


FIG. 10 TYPE III Pan Flashing—Multiple Pieces

components shall be followed. An application of a nominal $\frac{3}{8}$ in. (10 mm) diameter bead of sealant is recommended. Preformed butyl tape sealants shall meet Specification C1281 or AAMA 804.3. See also 5.18.3.1. See Fig. 14.

5.18.7 When a J-shaped molding, terminus cap, or stucco mold is installed to receive the wall cladding, the junction of these devices and the fenestration product shall also be sealed according to 5.18.10, joining both fenestration product and these devices together. When receivers are not used, a properly designed perimeter joint between the fenestration product and the wall cladding is still recommended (see Fig. 15). (Warning—The general contractor should determine which trade provides and installs these devices. This determination will in turn determine who is responsible for sealing between the termination devices and the fenestration unit. Coordination among the different trades is essential to ensure the completion and adequacy of these seals.)

5.18.8 For door sill sealant (where no sill pan occurs), a minimum of two $\frac{3}{8}$ in. (10 mm) parallel beads of sealant shall be applied below door sills, one on the exterior side and one on the interior side. Both beads of sealant shall make continuous contact with the door sill and substrate. The two continuous beads of sealant must be connected at both jambs, and not left

open. The heads of the attachments through the sill must be thoroughly sealed. The continuous beads of sealant are to stop blow-through water. The door sill anchor or other structural attachment system shall be between the lines of sealant. See Section 9 and Fig. 36.

NOTE 17—Where pan flashing is used, care must be taken to ensure a drainage path between the door and the sill pan. Therefore, the bead of sealant on the mounting flange at the sill must have at least 2 gaps at least 2 in. (50 mm) wide to permit drainage from the sill pan to the exterior or the drainage plane. The gaps in the bead of sealant must be no more than 4 ft (120 cm) apart, such that additional gaps are required for windows/doors wider than four feet wide.

5.18.8.1 When a sill extension is used, the slope of the sill shall be continued, and at the point of its junction with the sill, it shall be sealed against water leakage.

5.18.8.2 The joint between a sill or subsill end dam and the fenestration product frame shall be sealed.

5.18.9 Frequently the installer does not apply sealant between the outermost surfaces of the fenestration product and the building envelope. The siding installer or painter is often responsible for this sealing. In such cases there shall be a coordinated effort between architect, builder, fenestration product installer, and siding installer or painter to insure that sealant

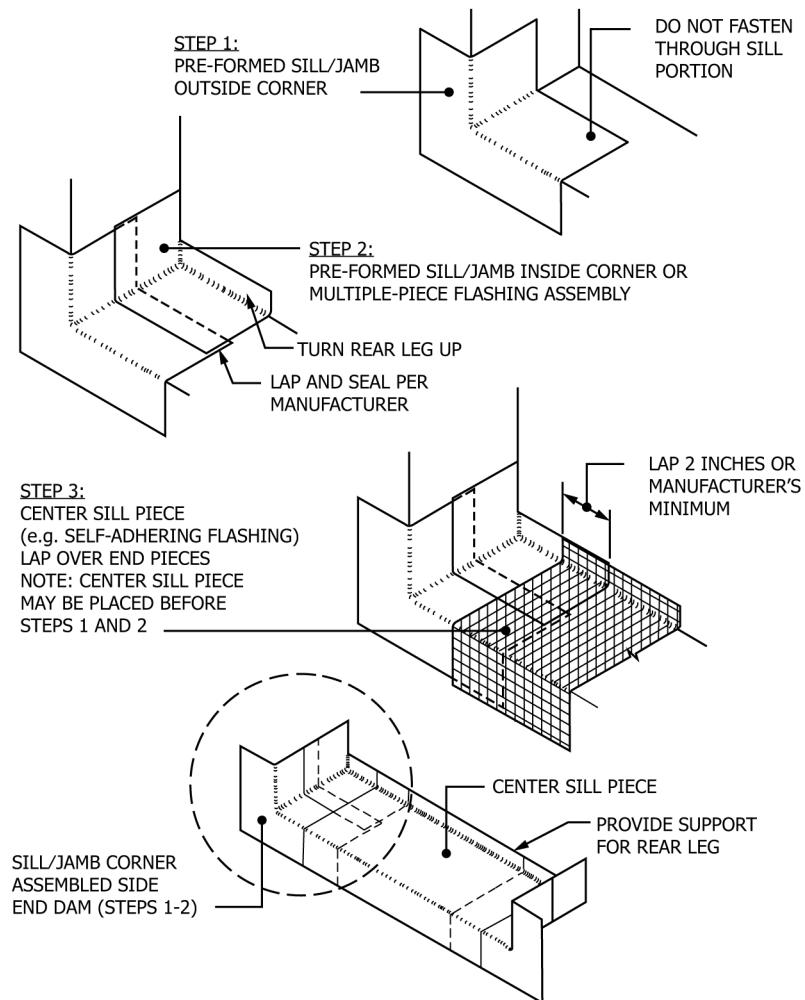


FIG. 11 TYPE IV Pan Flashing—Multiple Pieces

selection and use and compatibility between different sealants are in accordance with this practice and the sealant manufacturer's recommendations. Refer to 4.2.

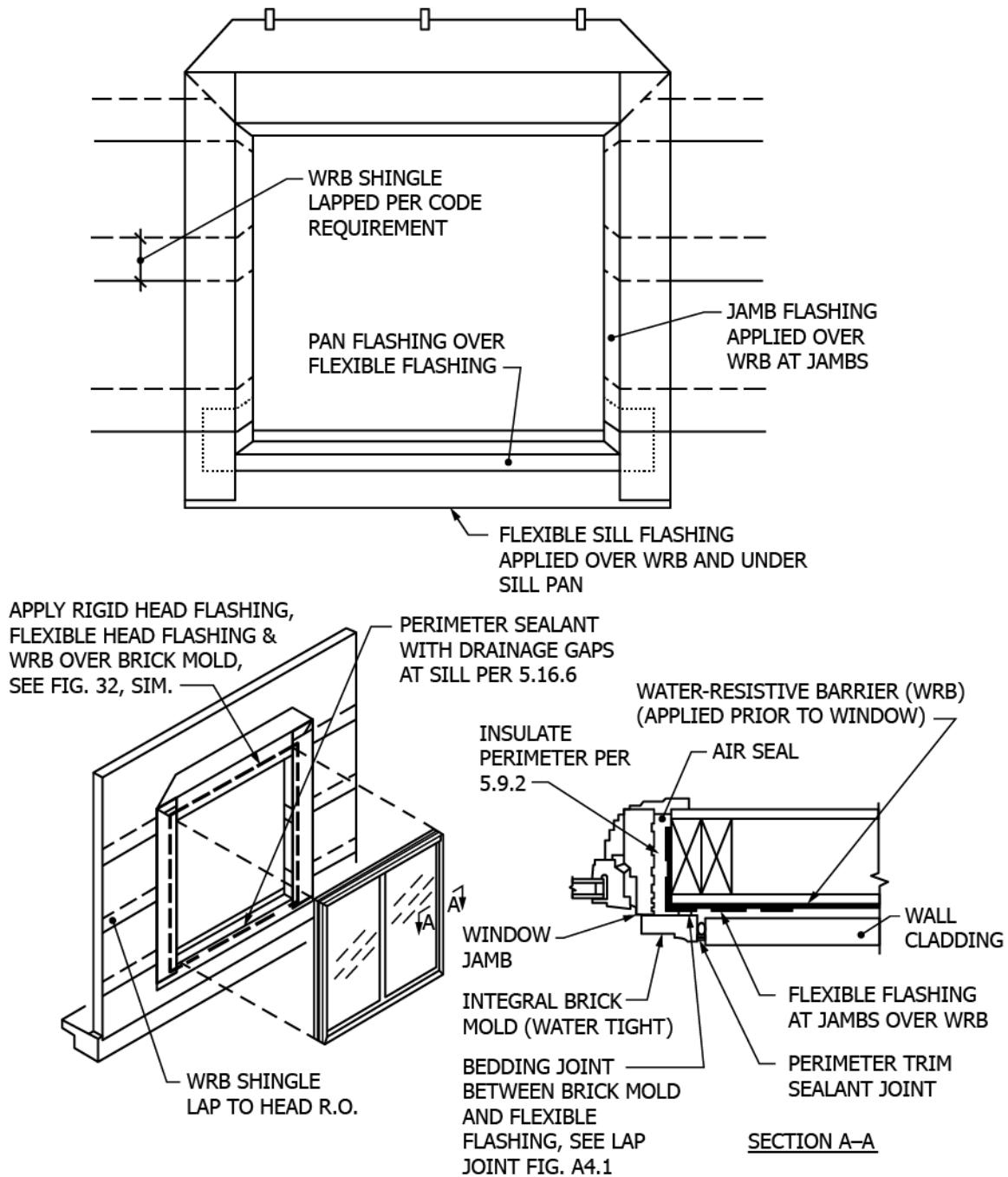
5.18.9.1 Some vinyl window manufacturers require a seal between the stucco product and the vinyl product. The coordination for the placement of this seal is the responsibility of the general contractor.

5.18.10 Most sealant joints require a sealant backing material to assure proper joint shape and sealant dimensions and to prevent "3-sided adhesion" (see figures 2, 3, and 4 of AAMA excerpt in Figs. 16 and 17). Joints should be a minimum of $\frac{1}{4}$ in. (6 mm) wide. If joints are less than $\frac{1}{4}$ in. (6 mm) wide, the sealant manufacturer shall be consulted for recommendations. Refer to Guide C1193 for guidelines on the use of sealant backing materials. In general, sealant backing should be installed in butt joints so that the depth of the sealant is no more than half the joint width. Sealant depth should not be less than $\frac{1}{4}$ in. (6 mm) nor more than $\frac{1}{2}$ in. (12 mm).

5.18.10.1 The following is an excerpt from AAMA 850 (Figure numbers in this section are retained from the AAMA document):

"In butt and perimeter joints, the width and depth-to-width ratio are both critical. The width shall be large enough to allow for a sufficient quantity of sealant. A general rule of thumb is $\frac{1}{4}$ in. minimum. Typically, the depth of the joint should be no smaller than half the width, but in no case should the depth be greater than the width."

"Joint depth is usually controlled by the installation of back-up material, as shown in figure 2 (Fig. 16). Backer rod is usually cylindrical and compressible. The diameter is larger than the joint and the rod is compressed when inserted into the joint. Compression of the backer rod provides the proper configuration for the sealant. Caution shall be exercised not to puncture the rod during insertion. The sealant should also not adhere to the backer rod. Three-sided adhesion will result if adhesion exists between the sealant and backer rod, as shown in figure 3 (Fig. 16). Joint movement might excessively stress the sealant if the sealant is unable to slide over the rod, resulting in cohesive failure."



BLOCK FRAME WITH INTEGRAL BRICK MOLD INSTALLATION SHOWN (NON-INTEGRAL SIMILAR)

NOTE 1—One of several options of Jamb and Pan Flashing shown.

FIG. 12 Wrapped Jamb Surfaces (Method B1, Non-finned Window)

"In cases where insufficient depth exists to insert a backer rod, as for example with an offset, then a bond breaker should be installed to accommodate sealant elongation as shown in figure 4 (Fig. 17)."

NOTE 18—Prevents three-sided adhesion and allows sealant elongation.

5.18.11 Surfaces must be clean, dry and sound for adequate sealant adhesion. Remove dust, dirt, and other loose particles by brushing or wiping. Remove oily substances by wiping with

a solvent dampened cloth. Change cloths frequently to prevent re-deposition and wipe dry with a clean cloth before solvent evaporates from the surface. Use caution when handling any solvent; be sure to understand and follow any safety statements on the solvent container. Be sure the solvent is compatible with, and will not attack, the surfaces. Abrasive cleaning may be required to obtain a sound, clean surface. Sanding, wire brushing, grinding, or cutting can be used to expose a good

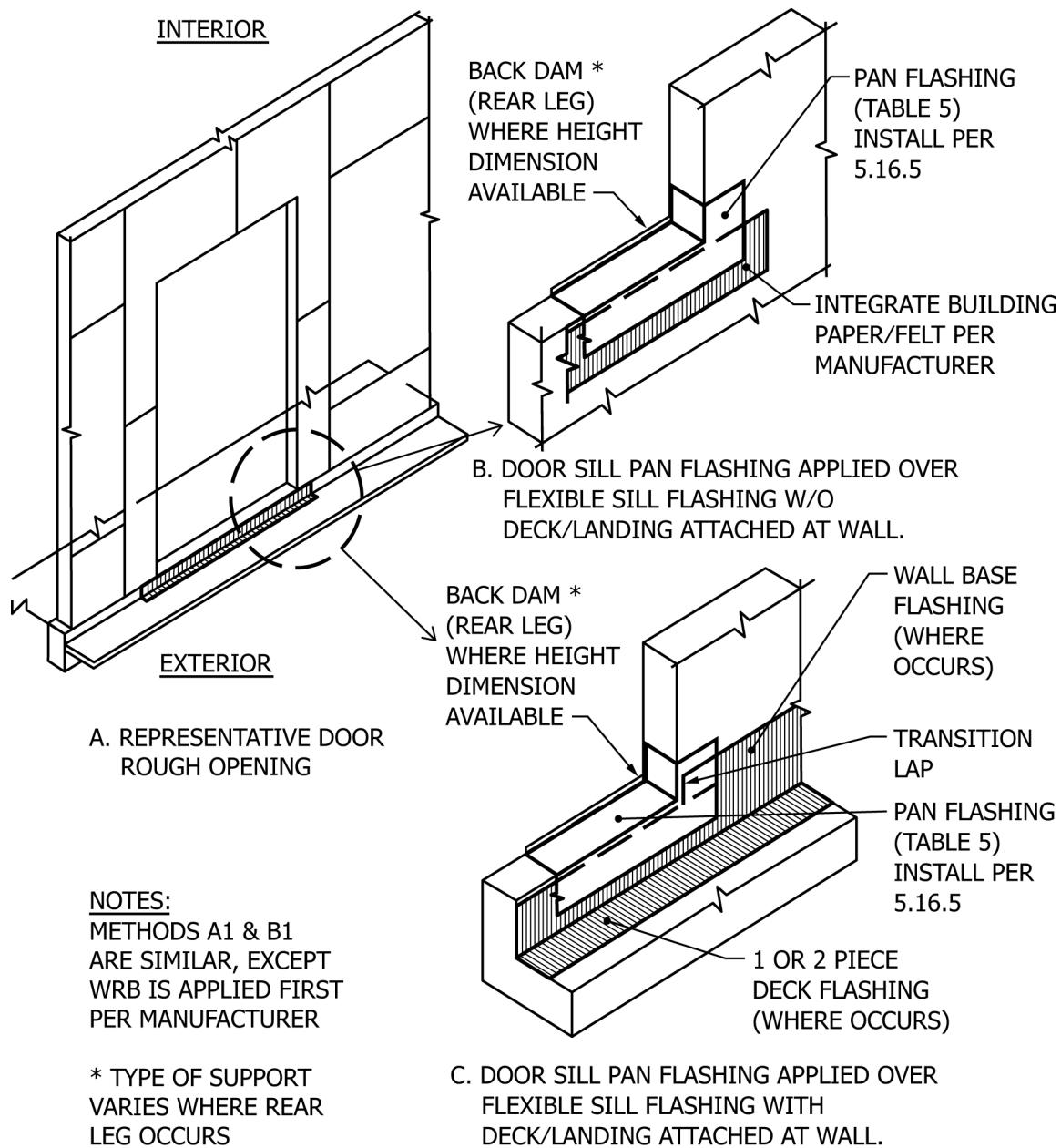


FIG. 13 Flexible Flashing at Sill of Door (Methods A and B)

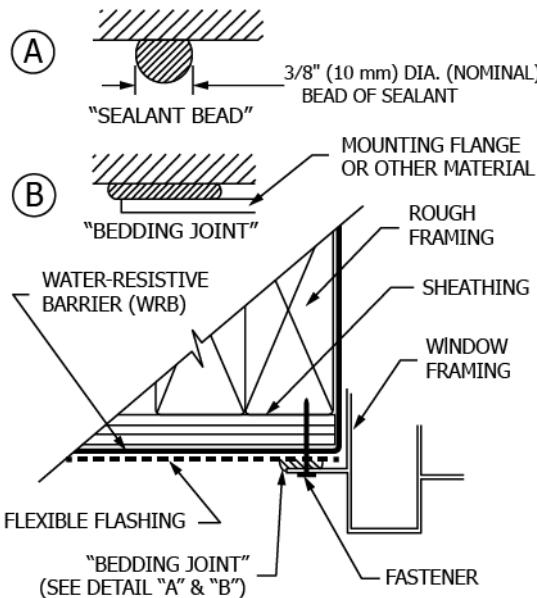
surface. Old sealant is removed by cutting or scraping. Silicone sealant residue must be removed by abrasion followed by a thorough cleaning with solvent. Be sure to allow residual solvent in porous surfaces to evaporate before applying sealant.

5.19 Window Cleaner Anchors and Related Safety Hardware—When a window cleaner anchor or a related item of safety hardware is to be installed as a part of the fenestration product, it shall be in conformance with the prevailing codes or the ASME A39.1 Standard. The window and building members

that will sustain the load requirements of these items shall be in conformance with the prevailing codes.

6. Continuity Between the Fenestration Products and Other Components of the Building Envelope

6.1 It is essential that the installer understand the building system employed to prevent water and vapor penetration through the envelope.



NOTE 1—Compress flange and look for squeeze out of sealant to confirm adequate bedding quality.

FIG. 14 Bedded Joint

JOINT WIDTH (W)	
1/4" - 1/2" (6 mm - 12 mm)	1/2" - 1" (12 mm - 25 mm)
$D = W$	$D = \frac{W}{2}$

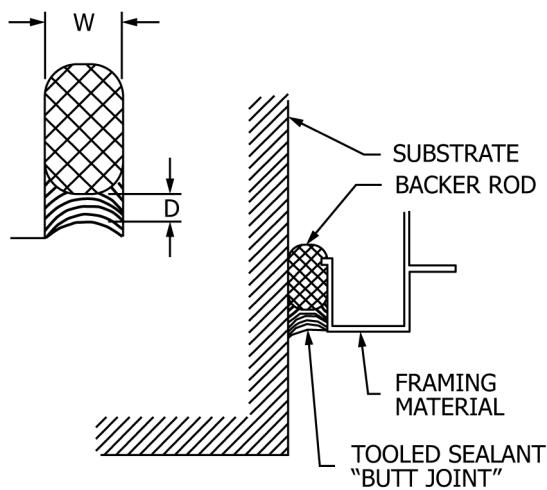


FIG. 15 Sealant Joint Depth-Width Ratio

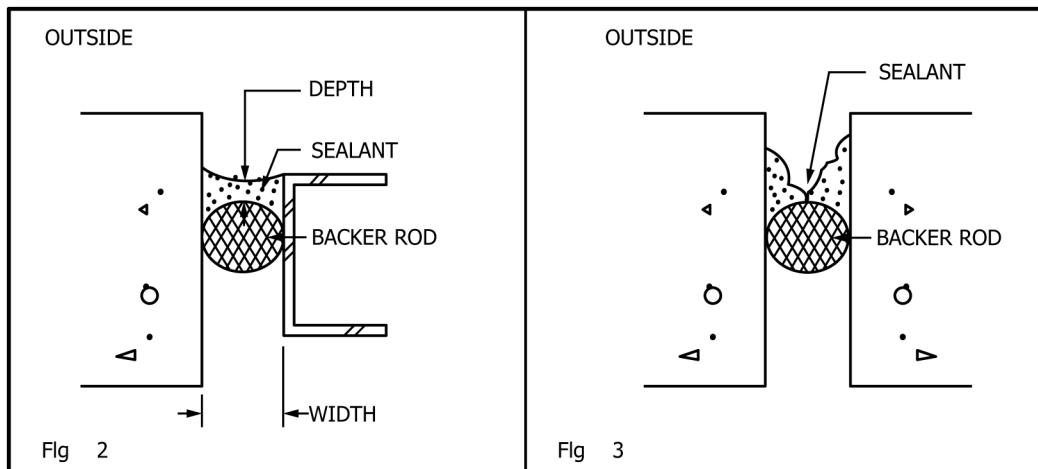
6.2 The installer shall have an understanding of the weatherability of the fenestration products to be installed.

6.3 The installer shall understand the recommended systems of sealant, flashing, pannings, or cappings employed to integrate the fenestration product correctly into the building envelope.

6.4 When installing into new construction, the installation system should be submitted to the approving authority(ies) as a plan check to allow those authorities to determine if the fenestration system has been properly designed to integrate into the building envelope. Drawings or details showing the

methodology used to connect both the fenestration product and building envelope and which clearly show the continuity of the entire installation as a continuous weather barrier system should be submitted to the approving authority. Types of sealant, flashings, membranes, cappings, and pannings should be clearly shown in these details, with notations made to indicate types of sealants and adhesives used and anchor location to perfect the installation.

6.5 When installing retrofit/replacement fenestration products into an existing building, the installer should clearly understand the existing weather barriers, exercising care to



Backer rod joint design

Cohesive failure due to adhesion to backer rod

FIG. 16 AAMA Excerpt (figures 2 and 3)

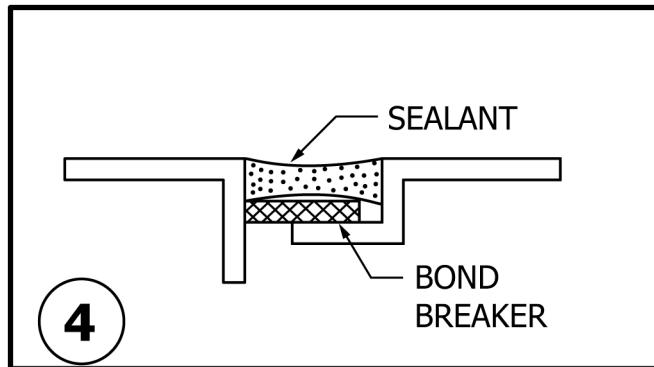


FIG. 17 AAMA Excerpt (figure 4)

ensure that the fenestration product has been installed into the previously designed and existing building envelope. Exercise precaution to ensure that the retrofit/replacement installation does not impair the existing system from working properly, or destroy the weatherability of the existing system.

6.5.1 If a non-destructive installation is used, proper and effective sealing between the existing fenestration product and the new unit is essential.

6.5.2 If a destructive installation system is employed for retrofit/replacement fenestration products, exercise caution to ensure that the new fenestration product is properly flashed and sealed to the elements of the existing building envelope employed as a water-resistive barrier.

6.6 There are two primary methods of integrating a building envelope. They are barrier systems and membrane/drainage systems. These systems are further described for clarity in Section 7.

NOTE 19—Where there is no concealed water-resistive barrier, treat as a surface barrier system (seal between the exterior surface of wall and window).

6.7 All component manufacturers' installation instructions shall be reviewed and adhered to. If the component manufacturers' instructions or details do not describe the integration of

the fenestration product to the building envelope, the component manufacturers should be contacted for installation details. If installation instructions cannot be obtained in this manner, the details set forth in this practice should be used.

6.8 Table 6 indicates details shown in the annexes for a variety of fenestration products integrated into various building envelopes (A = Windows, B = Doors, and C = Skylights). These details should be reviewed prior to installation of any fenestration product that has similar configurations and details as may be required.

6.9 Special construction details may be required for multiple units or assemblies containing multiple units. See manufacturer's instructions for further explanation.

6.10 *Air & Water Leakage Seal (Interior Air & Water Seal)*—Air barrier continuity to the fenestration unit shall be installed and maintained at the rough opening with a transition seal, e.g., air barrier foam sealant/tape or other methods. See Annex A1 and Appendix X5

7. Water Shedding Strategies of Wall and Roof Systems

7.1 The water shedding strategies employed by roof and wall systems can be broadly categorized as surface barrier

TABLE 6 Windows, Doors, and Skylights Installation Details

A—WINDOWS		
Window Type	Barrier Wall/First Surface	Membrane/Drainage Wall
Integral fin type—new construction	see figures: 13, 18, 19, 22	see figures: 2, 4, 7, 8, 9, 10, 11, 12, 15, 16, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 36, 37
Non-fin/block type—new and replacement construction	see figures: 1, 17, 18, 19, 20, 38, 39, 40, 41	see figures: 1, 2, 4, 5, 6, 7, 8, 9, 10, 1, 12, 13, 14, 17, 18, 19, 30, 32, 33, 34, 26, 27, 39, 40
B—DOORS		
Door Type	Barrier Wall	Membrane/Drainage Wall
Integral fin type—new construction	see figures: 3, 7, 13	see figures: 2, 13, 15, 16, 17, 18, 21, 22, 29, 36, 37, 42, 43 44, 45, 46, 47, 48, 49, 50, 51
Non-fin/block type—new and replacement construction	see figures: 3, 13, 17, 18, 19	see figures: 2, 4, 8, 13, 17, 18, 19, 36, 37
C—SKYLIGHTS		
Skylight Type	Flashing Procedure	Flashing Installed at Roof Line
Flush mount (Type 1)	mastic	figures 52, 56, 57
Flange mount/self flashing (Type 2 and Type 3)	mastic	figure 53, 58, 59, 64
Curb mount/integral curb (Type 2 and Type 3)	sheet flashing/mastic	figure 54, 60, 61
Curb mount/integral curb (Type 2, Type 3 and Type 4)	step flashing/mastic	figure 55, 62, 63

systems and membrane/drainage systems. It is important that the installer understand the essential features of surface barrier and membrane drainage systems, and which system is employed in the wall or roof in which the fenestration unit(s) will be installed.

NOTE 20—All types of wall systems are susceptible to water intrusion if the components are not assembled properly. The installer should become familiar with the various wall systems and materials, to be aware of potential problems.

7.1.1 *Surface Barrier Systems* can be identified as those systems in which the outermost surface of the wall or roof is the sole barrier to intrusion of liquid water. Barrier systems are designed to be sealed at the exterior surface to keep water out. Barrier systems rely on sealants around building penetrations to prevent moisture intrusion. Most systems make no provision for drainage of incidental moisture that does enter the system. In addition, they generally include an exterior coating that is relatively impermeable to moisture. Examples of barrier system include EIFS, concrete panels and single-wythe masonry. The two most common surface barrier cladding systems used on buildings are certain forms of EIFS (Exterior Insulation and Finish System) wall cladding and large panel cladding systems installed without water-resistive barrier membranes (see Fig. 18). In barrier systems, fenestration units are sealed to the outermost wall surface.

7.1.2 *Membrane/Drainage Systems* can be identified as systems which employ first surface water barriers and a water-resistive barrier. Examples include the types of building envelopes whose exterior surfaces are made from stucco, siding, veneers, panels, shingles, wood shakes, metal panels, tile or other applied exterior surfaces. In these applications the weather-resistive or backup surfaces behind the first surface become the area where the drainage or membrane system has been utilized. Building envelopes whose wall systems include a cavity between the exterior cladding system and the wall

sheathing, are generally included in this definition (see Fig. 19). In membrane/drainage walls, fenestration units are integrated with, and sealed to the water-resistive barrier; this includes the sealing of the flashing system and any installation accessories (see Fig. 18). Flashing systems shall direct all incidental water to the outer surface of the wall. The design of membrane/drainage wall systems may allow the flashing system to route incidental water to the drainage plane only. Use of pan flashing to direct incidental water onto the outer wall surface in membrane/drainage systems is acceptable and may be preferable.

7.1.2.1 The installer shall ensure that his installation does not allow moisture to penetrate the membrane/drainage wall. The installer, when installing into a multi-surface barrier system, shall ensure that the fenestration product has been tied homogeneously into the designed membrane/drainage system at the surface of that membrane/drainage cavity; that is, on the exterior surface of the interior wall or the exterior of the roof sheathing, using flashings, counter-flashings, and sealants that connect the fenestration product's first surface water shedding area directly to the membrane/drainage system employed.

7.1.2.2 The installer shall recognize that the exterior siding, veneers, stucco, shingles, and other exterior applications that are placed in front of the building envelope's membrane, waterproofing, and water shedding system are not the sole method of protecting the building from moisture; but act as a component of a system with the interior drainage surfaces. See Note 2.

7.1.2.3 This practice requires sealing and integration between the fenestration unit and the concealed WRB if the unit is being installed in a membrane/drainage system. More specifically, it does NOT recognize as acceptable the substitution of a seal between the unit and the outermost surface of the cladding in lieu of sealing and integration between the unit and the concealed WRB. (Warning—Installation to first surface

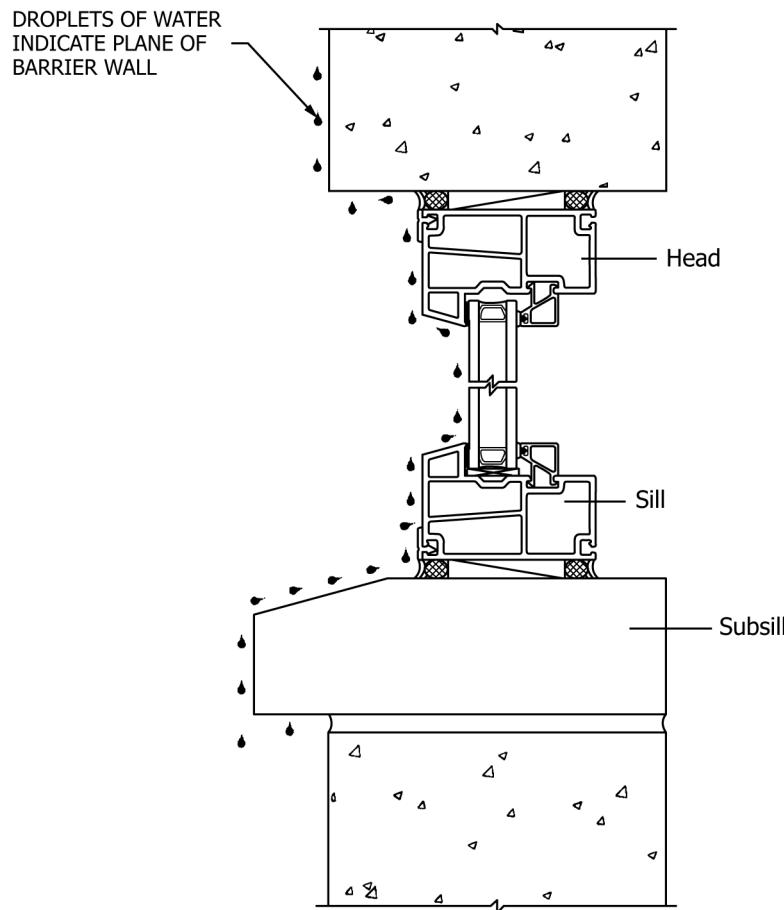


FIG. 18 Surface Barrier Wall (Head and Sill Detail)

architectural exterior surface walls such as stucco, siding, and veneers may inhibit and otherwise trap water inside the rain-shield system, allowing such water to drain to the interior of the building.)

7.2 Identification of Systems:

7.2.1 *Roofing Systems*—Some roofing systems (for example, elastomeric, built-up bituminous, neoprene or EPDM, and some metal roof systems) do not incorporate a water-resistive barrier membrane and can therefore be classified as surface barrier systems. Many wood shake, wood shingle, clay tile and concrete tile roofs incorporate a water-resistive barrier membrane and a drainage space and can be classified as membrane/drainage systems. Asphalt shingle roofs are installed with a water-resistive barrier (roofing felt and in some cases self-sealing water-barrier membrane). Asphalt shingle roofs therefore are generally viewed as membrane drainage systems, although they do not include a drainage space. In installation of skylights it is imperative that the installer does not permit wetting of the roof sheath.

7.2.2 *Wall Cladding Systems on Buildings*—The majority of wall cladding systems used on buildings incorporate a water-resistive barrier behind them, and therefore are membrane/drainage systems. Examples include: stucco (including adhered tile claddings in cementitious base), interlocking lap sidings

(such as vinyl, aluminum, and steel) lap sidings (such as lumber, plywood and hardboard), mechanically attached veneers (such as brick or tile), wood shingles and shakes, and some installations of panel cladding systems. Surface barrier cladding systems are relatively rare in light frame construction.

7.2.2.1 *Diagonal Installations of Siding*—Installation of sidings in a diagonal direction can result in appreciable water intrusion past the siding at fenestration units. The concentrated intrusion of water past the siding at window and door casings may well exceed the capacity of the membrane to prevent water intrusion further into the wall. Diagonal installation of sidings should be avoided or the project must be designed to accommodate the concentrated water exposures that can be expected at window and door casings when siding is applied diagonally.

7.2.2.2 *EIFS Claddings on Buildings*—EIFS systems installed in light framed construction can be either a barrier system or a system employing a drainage plane and water-resistive barrier. The installer can obtain information regarding the type of EIFS system to be installed from ANSI/EIMA 99-A-200.

7.2.2.2.1 EIFS cladding systems are proprietary and may not be compatible with all types of fenestration products, flashing systems or sealant. The installer should verify the

INSTALLATION OF WINDOW WITH FIN
(JAMB DETAIL REPRESENTS METHOD "A1" - OTHER APPLICATIONS SIMILAR)

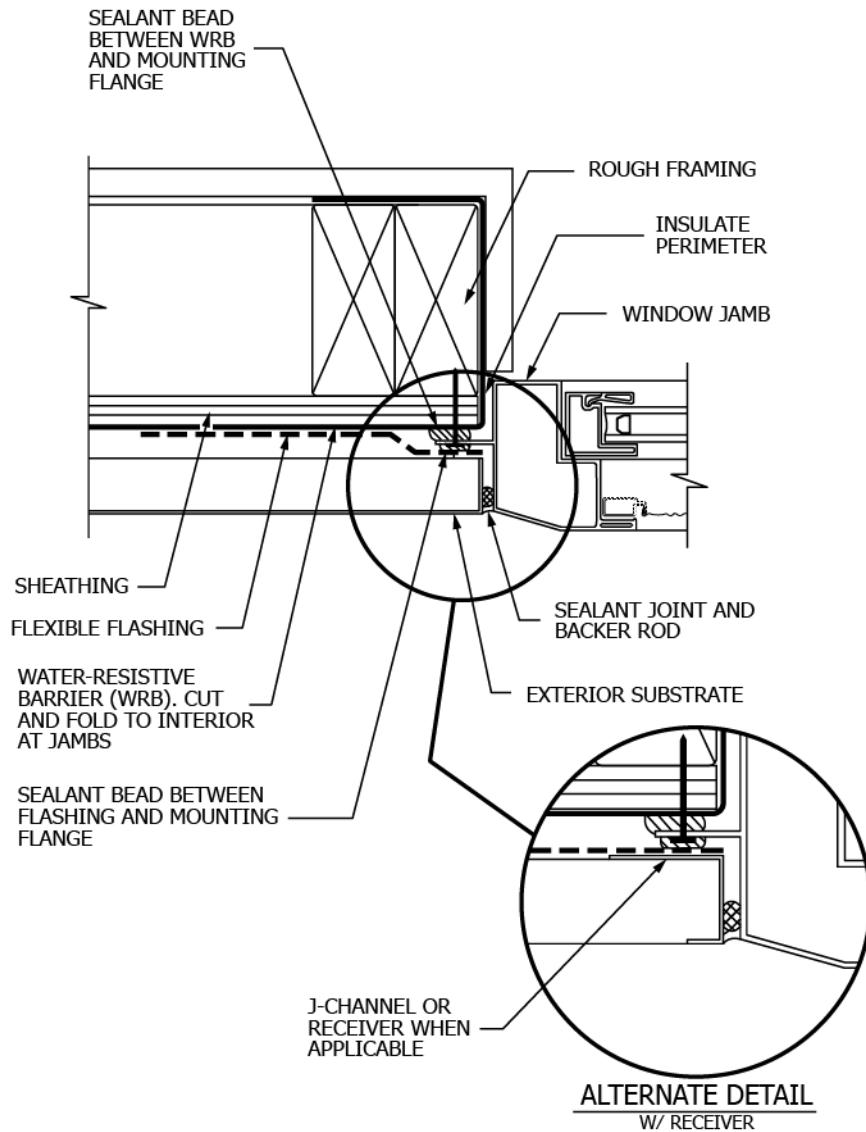


FIG. 19 Membrane/Drainage System

requirements of the fenestration, flashing, sealant and EIFS manufacturers for proper compatibility and installation requirements. If a problem with compatibility exists, the installer shall receive clarification on installation requirements before proceeding.

7.2.2.3 Large Panel Cladding Systems on Buildings—Large panel cladding systems have been installed on buildings without a water-resistive barrier, as a surface barrier system. Installation of fenestration units in buildings with this type of cladding system shall follow the requirements for surface barrier walls.

7.2.3 Wall Systems in Concrete and Masonry Buildings—Concrete and masonry buildings are commonly designed as having surface barrier type walls. Use of secondary water-resistive barrier membranes in these buildings is relatively rare.

An illustration of a generic window installation in a cast concrete surface barrier type wall system is shown in [Fig. 18](#).

7.2.3.1 EIFS Claddings on Concrete or Masonry Buildings—EIFS claddings are frequently used on concrete or masonry buildings. EIFS claddings used on these buildings generally are designed to function as surface barrier systems. EIFS systems are proprietary. The EIFS manufacturer should be consulted when fenestration units are to be installed in buildings clad with an EIFS system.

8. Installation Methods for Windows

8.1 Windows in Walls Utilizing a Membrane/Drainage System:

8.1.1 Windows with Perimeter Mounting Flanges (Nail Fins) in Drainage Type Wall Construction:

8.1.1.1 Windows with perimeter mounting flanges shall be installed with flashing, which shall be applied so as to integrate with the flanges on the window unit and with the water-resistant barrier materials in a shingle-lap manner. Four different methods (A, B, A1, and B1) may be used. These methods are described in this section.

8.1.1.1.1 Not all flanges are considered structural by the manufacturer; however, they still are integrated into the wall using the following procedures. Flanges are classified into the following categories:

- (1) Integral, structural flanges;
- (2) Integral, non-structural flanges;
- (3) Applied, structural flanges; and
- (4) Applied, non-structural flanges.

In this classification scheme, integral implies permanence, continuity, seamlessness, and being waterproof. Applied flanges may require more elaborate flashing and sealing details to ensure weather protection of the installed unit. When using applied flanges, follow the manufacturers' instructions for sealing the flange to the frame (see Fig. 20). Structural implies that the flange can be used as an anchoring device or nailing flange and that the flange is capable of sustaining the structural load requirements of the fenestration unit in its location in the building. Non-structural flanges must not be used as the sole means of anchoring the window. Follow manufacturer's installation instructions for anchoring the unit.

8.1.1.1.2 Selection of an installation method (A, B, A1 or B1) is based on the relative order in which materials are installed, and on whether the pieces of flashing sheet used alongside the window (the jamb sheets) are applied over or behind the window unit's side flanges. Windows with integral installation flanges may be installed either before or after the water-resistant barrier. Although window installers often do not install the water-resistant barrier, the window installation shall be integrated properly with the membrane. To avoid confusion between membrane installation and window installation crews, it is recommended that the relative order of their work be identified in advance and that the identified order be maintained for either an entire project or for clearly demarcated portions of the project. This will allow selection of an installation method for the project, and help eliminate errors caused by installers having to switch between methods. Once a method is selected, all of the procedures of that method shall be performed in the sequence indicated. Mixing or matching methods or altering the sequence of operations within a method is prohibited.

NOTE 21—Step 1 below recommends that flashings be precut to size (prior to installation). The purpose is to prevent the sealant from skinning over prior to getting the last section of flashing in place. If the installer knows that given the climatic conditions the sealant will not skin over, the installer may omit this step.

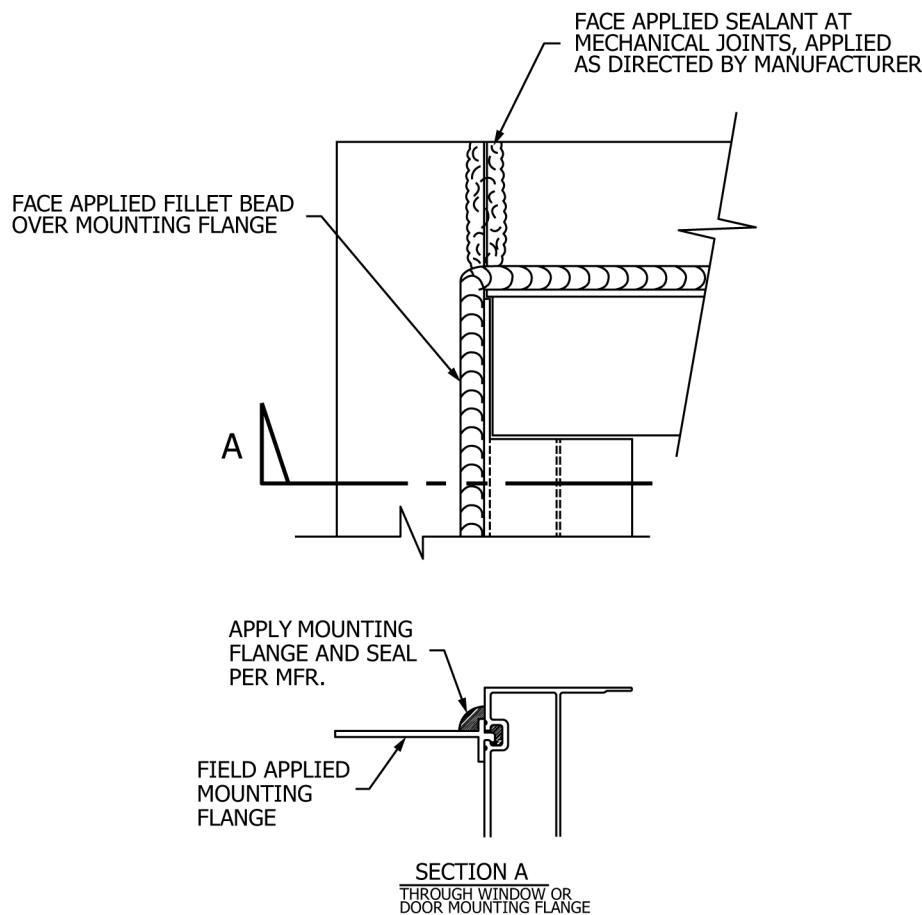


FIG. 20 Applied Flanges and Mechanical Joints

8.1.1.1.3 The references to the application of sealant under or over the mounting flanges refer to the use of “bedding joints.” A bedding joint consists of the application of a bead of sealant which is later compressed against the substrate or flashing materials. All bedding joints are to have a nominal diameter of $\frac{3}{8}$ in. (10 mm) prior to compression. During compression of a bedding joint, the installer should look for the sealant to “bleed out” or appear along the edge to ensure adequate bedding quality.

8.1.1.1.4 Use the flashing cut formulas (see **Table 7**) to determine the length of each strip of flashing for each window. The ASTM standard requires a flexible flashing minimum roll width of 9 in. (230 mm). Wider flashing materials, (for example, 12 in. (300 mm)) may be used, however the actual cut lengths figured by using the chart will increase. The use of self-adhesive type flashing is acceptable. Use of self-adhered flashings in widths other than 9 in. (230 mm) shall be permitted when accepted in writing by the window manufacturer and the flashing manufacturer, or specified by the design professional. Self-adhesive type flashing seals itself to the water-resistive barrier and to the mounting flange without the need for additional sealant applied to the exterior face of the flange. Self-adhesive type flashing materials must properly adhere, (creating a water tight joint) to the (WRB) and to the mounting flange material in order to be acceptable for use. Refer to **5.12.3.1**. (See **Note 22**). All notations of flashing placement, (for example, $8\frac{1}{2}$ in. (220 mm) up and $8\frac{1}{2}$ in. (220 mm) over) are based on the use of a 9 in. (230 mm) wide flashing.

NOTE 22—Tip: In order to save time and develop an efficient installation process, the flashing materials can be cut in advance using the rough opening dimensions and the formulas shown in the following table. Cutting flashing in advance also reduces the chance for the sealant to skin over prior to the application of flashing. The instructions in the installation section of this chapter assume that the flashing is previously cut to the appropriate length.

8.1.1.2 **Table 8** can be used to select the appropriate installation method.

8.1.1.2.1 *Alternate Installation Methods*—Refer to **Appendix X4** for examples of other installation methods that have a successful performance history or are based on sound waterproofing principles.

8.1.1.3 The following procedures should be followed completely and finished the day the procedure starts in order to avoid damage to the flashing and water-resistive barrier. If it is impossible to finish the complete process, the loose ends of the flashing and paper shall be temporarily secured into position using tape. The building contractor is responsible for the coordination of this work, as it is greatly dependent on the construction schedule. Once installed, local wind and weather conditions as well as exposure to other trades can have a detrimental effect on the permanent attachment of the flashing. The building contractor must inspect and maintain the flashing,

ensuring that it is secure and in proper working condition prior to being covered up by other materials.

NOTE 23—All methods described below require the use of a 9 in. (230 mm) (minimum) wide approved flashing material. Flashing cut lengths are to be increased respectively depending on the actual width of the flashing used on the job. Flashing is always to be lapped in a water shedding (weather board, shingle, or ship-lapped) fashion.

8.1.1.3.1 *Method A: Water-Resistive Barrier Applied after the Window Installation—Flashing Applied Over the Face of the Mounting Flange*:

8.1.1.3.1.1 Step 1: Apply the horizontal sill flashing material first, level with the top edge of the rough opening. Cut the sill flashing long enough to extend an equal distance beyond the 9 in. (230 mm) jamb flashing, which will be applied later. (See **Figs. 21 and 22**.) Fasten the top edge of the sill flashing to the framing. Place fasteners along the edge of the rough opening where they will be covered by the mounting flange of the window later.

NOTE 24—Do not fasten the bottom edge or the last 9 in. (230 mm) of each end, as the water-resistive barrier will be applied under the flashing in a water shedding fashion later. It is recommended that the corners and bottom edge be temporarily taped at 24 in. (610 mm) on center, to prevent wind damage.

8.1.1.3.1.2 Step 2: Apply a continuous bead of sealant to the back side (interior surface) of the mounting flange of the window. Sealant selection and bead design shall be in accordance with **5.18** of this practice. Immediately set the window into the opening, and apply shims as required to ensure the unit is plumb, level, and square. Fasten the window perimeter securely into position as described in **5.14** of the installation procedures.

NOTE 25—Apply the sealant in line with the pre-punched holes or slots on the mounting flange when provided. (See **Fig. 22**.)

8.1.1.3.1.3 Step 3: Next, apply a continuous bead of sealant to the exposed mounting flange (exterior surface) at the side jambs of the installed window. Continue the sealant bead at the jambs vertically $8\frac{1}{2}$ in. (220 mm) above the rough opening at the head of the window (to the face of the header), to allow for application of the top portion of the jamb flashing into sealant in the next step. For windows with mechanically joined mounting flanges, apply sealant to the full length of the joints or seam where the flanges meet. (See **Fig. 20**.)

NOTE 26—The application of sealant to the exterior face of the flange is not necessary if using self-adhesive type flashing over the mounting flange. A continuous bead of sealant shall be applied to the back side of the mounting flange prior to placing the window. Refer to **5.12.3.1**. Where a pan flashing is used, the bead of sealant at the sill must have discontinuity in order to permit drainage from the sill pan to the exterior or drainage plane. See **5.16.6** for further explanation.

NOTE 27—Apply the sealant in line with the pre-punched holes or slots on the mounting flange when provided and over the heads of the fasteners. Refer to **5.12.3.1**.

8.1.1.3.1.4 Step 4: Install the jamb flashings next, by pressing the flashing into the sealant beads previously applied to the exterior face of the mounting flanges. Attach the flashing into position to the rough opening framing using staples or other appropriate fasteners. Extend the bottom edge of the jamb flashing $8\frac{1}{2}$ in. (220 mm) beyond the rough opening sill, and

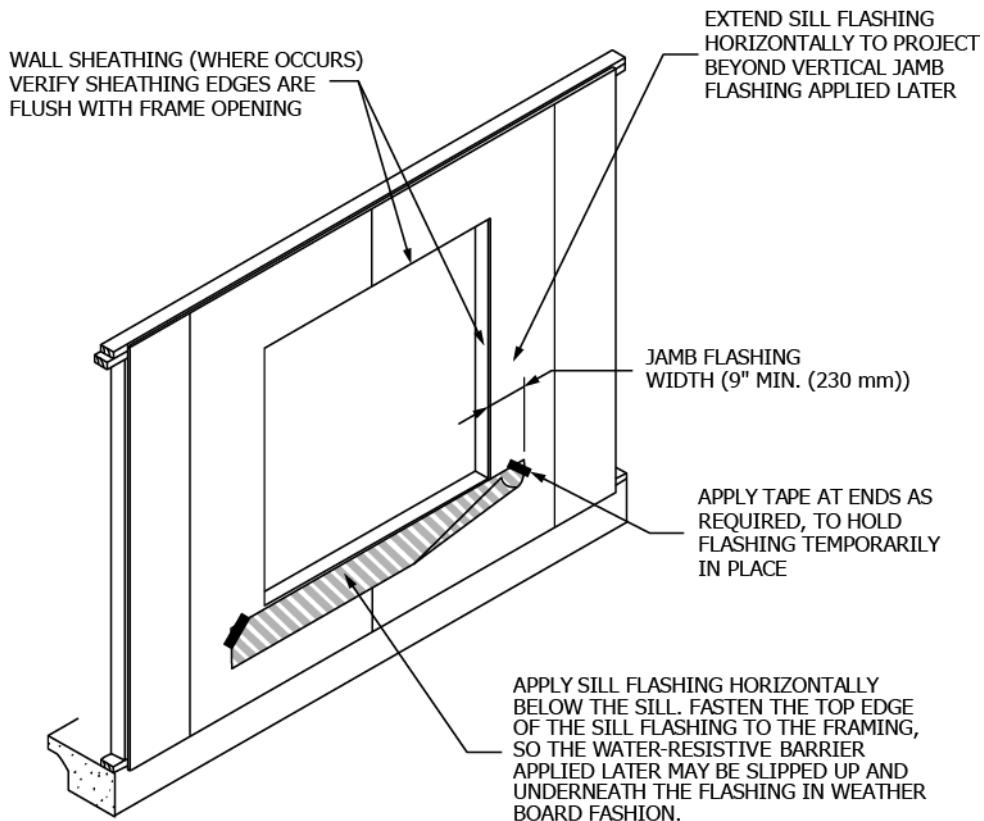
TABLE 7 Flashing Lengths and Cut Formulas

Sill flashing = R.O. width + (2 x flashing width)
Jamb flashing = R.O. height + (2 x flashing width) – 1 in. (25 mm)
Head flashing = R.O. width + (2 x flashing width) + 2 in. (50 mm)

TABLE 8 Installation Procedure Selection Chart (Finned Windows)

NOTE 1—Based on windows with integral fins being installed in drainage type wall systems.

	Head and jamb flashing will be applied over the face of the integral mounting flange	Jamb and sill flashing will be applied behind the face of the integral mounting flange
Water-resistant barrier is to be applied after window installation	use Method A	use Method B
Water-resistant barrier is to be applied prior to window installation	use Method A1	use Method B1



NOTE: FOR METHODS "A1" AND "B1" THE WATER-RESISTIVE BARRIER (WRB) HAS BEEN INSTALLED. A FLAP AT THE HEAD OF THE WINDOW HAS BEEN TEMPORARILY TAPE OUT OF THE WAY TO ALLOW FOR FLASHING AND WINDOW INSTALLATION.

NOTE 1—Where pan flashing is to be installed, install after sill flashing (before window installation).

FIG. 21 Sill Flashing (Methods A and B)

extend the top edge 8½ in. (220 mm) beyond the rough opening head. (See Fig. 23.)

NOTE 28—Do not attach the bottom of the jamb flashing until after the water-resistive barrier is applied later. See Fig. 21.

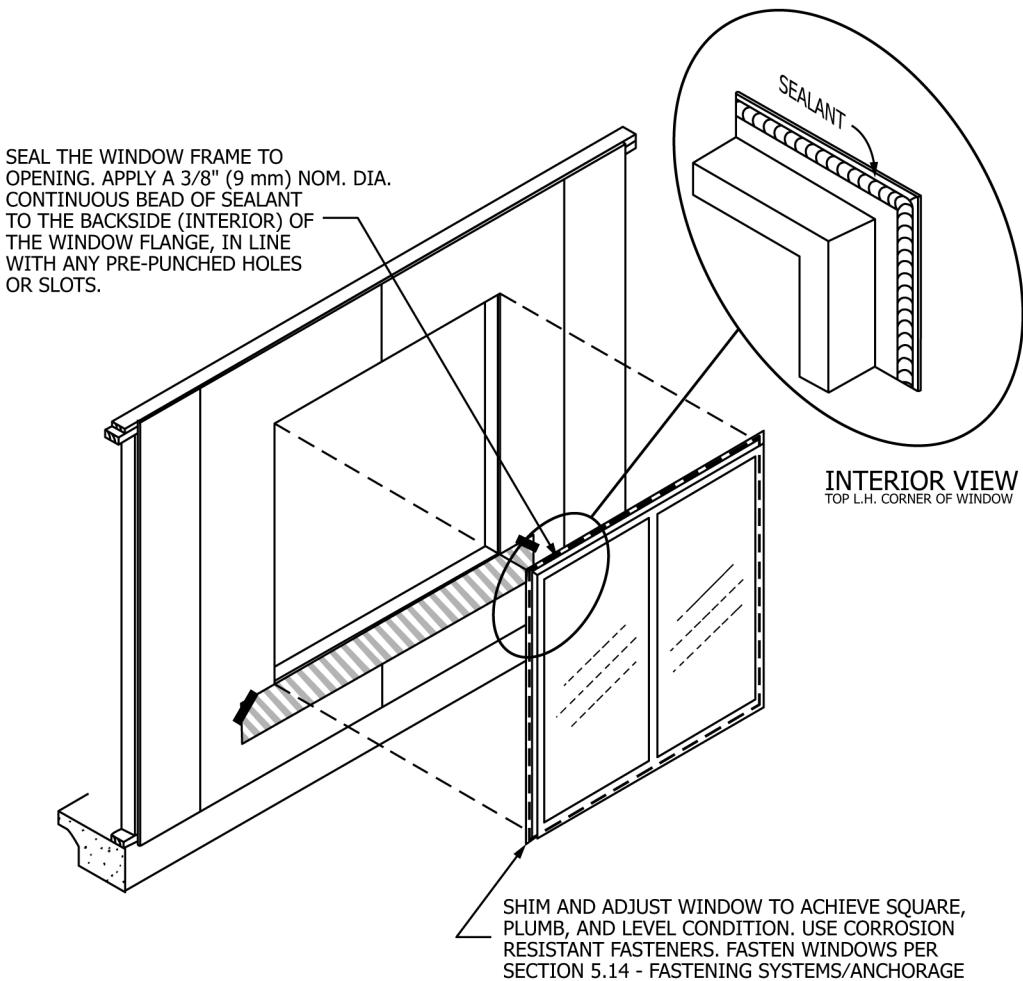
8.1.1.3.1.5 Step 5: Next, apply a continuous bead of sealant to the exposed mounting flange (exterior surface) at the head of the installed window.

NOTE 29—The application of sealant to the flange is not necessary if using self-adhesive type flashing over the mounting flange.

NOTE 30—Apply the sealant in line with the pre-punched holes or slots

on the mounting flange when provided and over the heads of the fasteners. (See Fig. 23.)

8.1.1.3.1.6 Step 6: Install the head flashing by pressing the flashing into the sealant bead previously applied across the mounting flange. When applying the head flashing, press the bottom edge of the flashing into the sealant until the sealant appears. This will ensure that no voids remain between the flashing and the mounting flange. Extend the ends of the head flashing 10 in. (250 mm) beyond the rough opening, over the top of the jamb flashing. Fasten the head flashing into place



NOTE 1—For Method A1 the water-resistive barrier has been installed. A flap at the head of the window has been temporarily taped out of the way to allow for flashing and window installation.

FIG. 22 Window Installation (Method A)

along the top edge using staples or other appropriate fasteners (see [Fig. 24](#)). **(Warning)**—The building shall be constructed in such a manner to secure or support the flashing to prevent destruction or displacement prior to installation of the water-resistive barrier. The flashing shall never be left unsupported and vulnerable to wind damage.)

NOTE 31—Where recommended as part of the exterior wall finish system, install the WRB as outlined. The application of the WRB may be by trades other than the window installer. The contractor shall coordinate this work as required.

8.1.1.3.1.7 Step 7: In water shedding fashion, starting at the base of the wall and working towards the top, install the water-resistive barrier to the face of the building framing or sheathing. At the sill of the windows, tuck the water-resistive barrier under the sill flashing and loose ends of the jamb flashing. Next, continue to apply the water-resistive barrier in water shedding fashion over the jamb flashing and over the head of the windows. (See [Fig. 25](#).) Attach the WRB into position using staples or other appropriate fasteners.

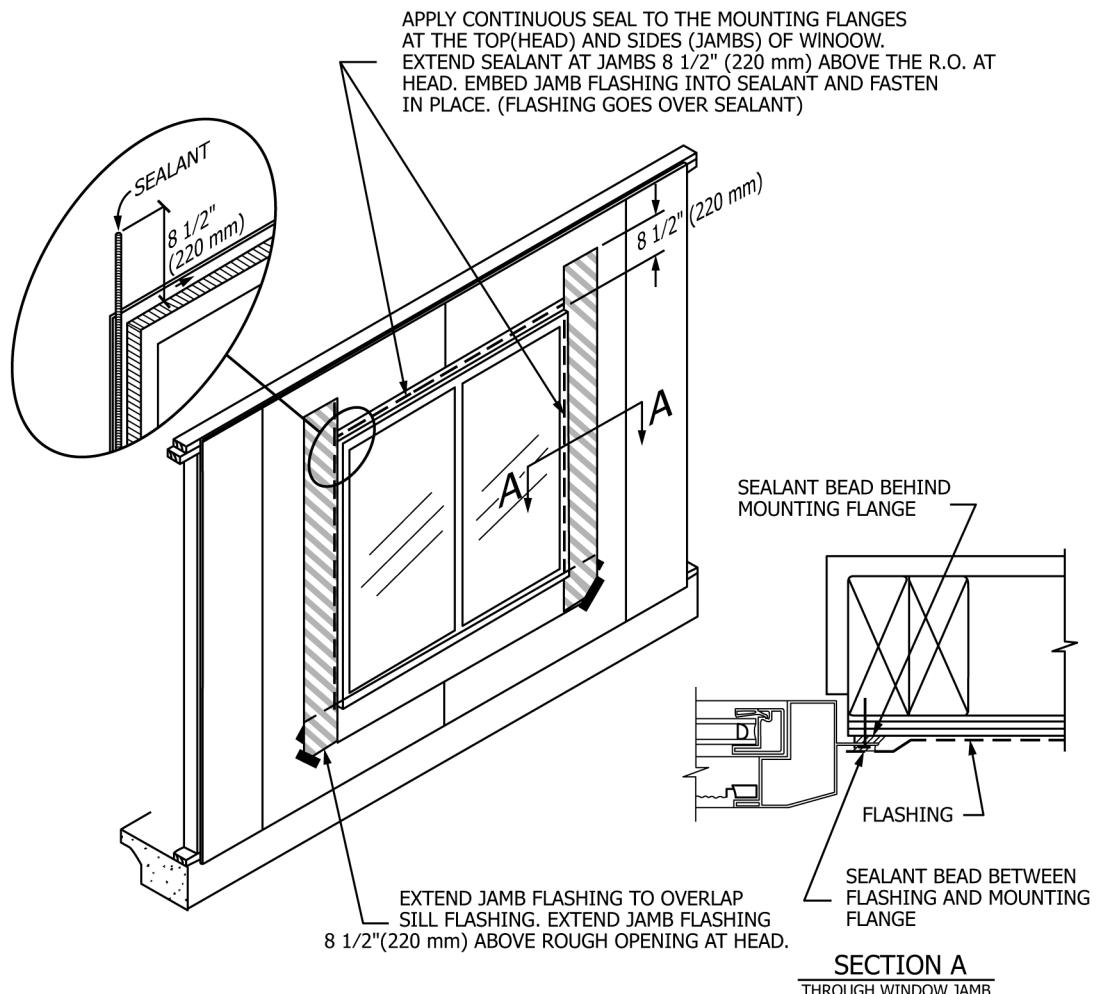
NOTE 32—Whenever applying the water-resistive barrier, flashing, or other materials do not penetrate the mounting flange with the fasteners.

8.1.1.3.2 Method B: Water-Resistive Barrier Applied after the Window Installation—Flashing Applied Behind the Face of the Mounting Flange:

8.1.1.3.2.1 Step 1: Apply the horizontal sill flashing material first, level with the top edge of the rough opening. Cut the sill flashing long enough to extend an equal distance beyond the 9 in. (230 mm) jamb flashing, which will be applied later. (See [Fig. 26](#).) Fasten the top edge of the sill flashing to the framing. Place fasteners along the edge of the rough opening where they will be covered by the mounting flange of the window later.

NOTE 33—Do not fasten the bottom edge or the last 9 in. (230 mm) of each end, as the water-resistive barrier will be applied under the flashing in a water shedding fashion later. It is recommended that the corners and bottom edge be temporarily taped at 24 in. (610 mm) on center, to prevent wind damage.

8.1.1.3.2.2 Step 2: Apply the jamb flashing to the edge of the framing at each jamb. Place fasteners along the edge of the rough opening where they will be covered by the mounting flange of the window later. Extend the jamb flashing 8 1/2 in. (220 mm) beyond the rough opening dimension at the head and



NOTE 1—For Method A1 the water-resistive barrier has been installed. A flap at the head of the window has been temporarily taped out of the way to allow for flashing and window installation.

FIG. 23 Jamb Flashing (Method A)

sill. The bottom end of the jamb flashing is to overlap the sill flashing ($2 \times$ Flashing Width) –1 in. (25 mm).

NOTE 34—Do not attach the bottom of the jamb flashing until the water-resistive barrier is applied later. (See Fig. 26.)

8.1.1.3.2.3 Step 3: Apply a continuous bead of sealant around the full perimeter of the back side (interior surface) of the window mounting flange. Sealant selection and bead design shall be in accordance with 5.18.

NOTE 35—Apply the sealant in line with the pre-punched holes or slots on the mounting flange when provided.

NOTE 36—Where a pan flashing is used, the bead of sealant at the sill must have discontinuity in order to permit drainage from the sill pan to the exterior or drainage plane. See Note 17 for further explanation.

8.1.1.3.2.4 Step 4: Immediately install the window into the opening, pressing the window against the framing to compress the sealant. Apply shims as required to ensure the unit is plumb, level, and square. Fasten the window perimeter securely into position as described in 5.14. For windows with

mechanically joined mounting flanges, apply sealant to the full length of the joinery or seam where the flanges meet. (See Fig. 20 and Fig. 27.)

NOTE 37—Caution shall be taken to avoid disrupting the continuous seal. Always install the window immediately after the application of the sealant.

8.1.1.3.2.5 Step 5: Apply a continuous bead of sealant horizontally across the face of the exposed mounting flange (exterior surface) at the head of the installed window.

NOTE 38—The application of sealant to the flange is not necessary if using self-adhesive type flashing over the mounting flange.

NOTE 39—Apply the sealant in line with the pre-punched holes or slots on the mounting flange when provided and over the heads of the fasteners. (See Fig. 24.)

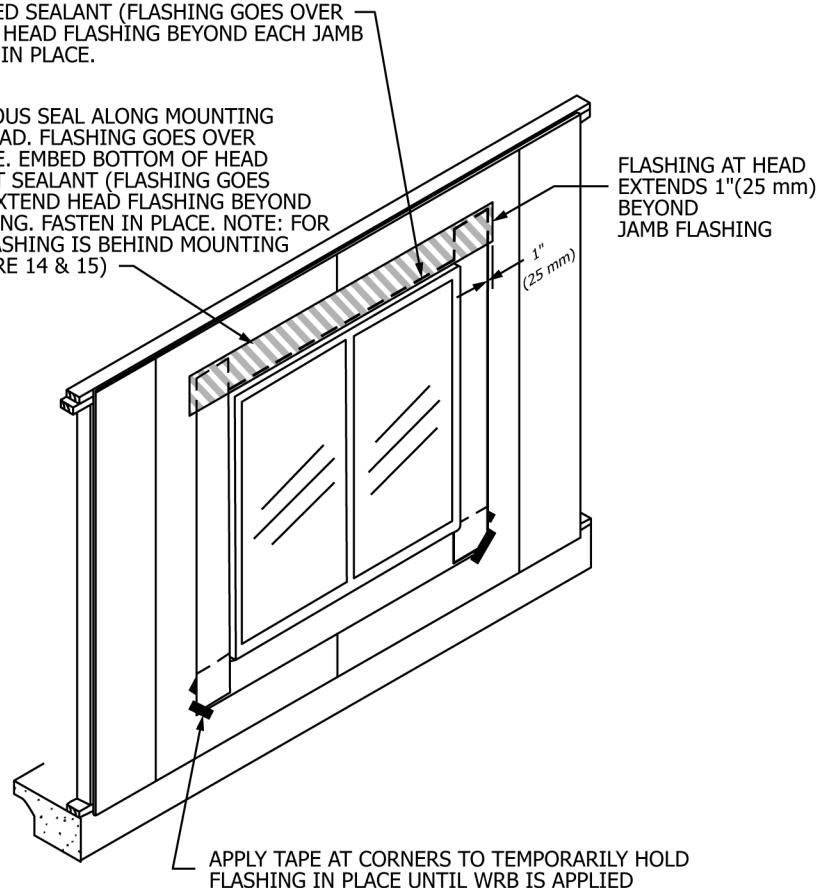
8.1.1.3.2.6 Step 6: Install the head flashing by pressing the flashing into the sealant bead previously applied to the mounting flange. When applying the head flashing, press the bottom edge of the flashing into the sealant until the sealant appears.

METHOD A:

EMBED BOTTOM OF THE HEAD FLASHING AGAINST THE PREVIOUSLY APPLIED SEALANT (FLASHING GOES OVER SEALANT). EXTEND HEAD FLASHING BEYOND EACH JAMB FLASHING. FASTEN IN PLACE.

METHOD B:

APPLY A CONTINUOUS SEAL ALONG MOUNTING FLANGE AT THE HEAD. FLASHING GOES OVER MOUNTING FLANGE. EMBED BOTTOM OF HEAD FLASHING AGAINST SEALANT (FLASHING GOES OVER SEALANT). EXTEND HEAD FLASHING BEYOND EACH JAMB FLASHING. FASTEN IN PLACE. NOTE: FOR TYPE "B", JAMB FLASHING IS BEHIND MOUNTING FLANGE. SEE FIGURE 14 & 15



NOTE 1—For Methods A1 and B1 the water-resistive barrier has been installed. A flap at the head of the window has been temporarily taped out of the way to allow for flashing and window installation.

FIG. 24 Head Flashing (Methods A and B)

This will ensure that no voids remain between the flashing and the mounting flange. Extend the ends of the head flashing 10 in. (260 mm) beyond the rough opening, over the top of the jamb flashing. Fasten the head flashing into place along the top edge using staples or other appropriate fasteners. (See [Fig. 24](#).) **(Warning)**—The building shall be constructed in such a manner to secure or support the flashing to prevent destruction or displacement prior to installation of the water-resistive barrier. The flashing shall never be left unsupported and vulnerable to wind damage.)

NOTE 40—Where recommended as part of the exterior wall finish system, install the WRB as outlined below. The application of the WRB may be by trades other than the window installer. The contractor shall coordinate this work as required.

8.1.1.3.2.7 Step 7: In water shedding fashion, starting at the base of the wall and working towards the top, install the water-resistive barrier to the face of the building framing or sheathing. At the sill of the windows, tuck the water-resistive barrier under the sill flashing and loose ends of the jamb flashing. Next, continue to apply the water-resistive barrier in water shedding fashion over the jamb flashing and over the head of the windows (see [Fig. 25](#)). Attach the WRB into position using staples or other appropriate fasteners.

NOTE 41—Whenever applying the water-resistive barrier, flashing, or other materials do not penetrate the mounting flange with the fasteners.

8.1.1.3.3 Method A1: Water-Resistive Barrier Applied Prior to the Window Installation—Flashing Applied Over the Face of the Mounting Flange

8.1.1.3.3.1 Step 1: Where a water-resistive barrier is used, apply the WRB in water shedding fashion, starting at the base of the wall and working towards the top. Install the water-resistive barrier to the face of the building framing or sheathing flush with the rough opening of the window head, jambs, and sill. At the head of the opening, starting at the top corner of the window, measure from the corner 9 in. (230 mm) up and 9 in. (230 mm) over and mark. At a 45° angle, carefully cut the barrier on a diagonal. Gently raise the top edge of the barrier up and temporarily tape the top corners and center to the exterior water-resistive barrier surface above. This is done in order to allow for installation of the window and flashing later. Once the water-resistive barrier is applied as described in this step, proceed immediately to Step No. 2. Alternatively, you can follow the same procedures as outlined for house wrap type WRB. Where the water-resistive barrier used is a building paper type material and covers the window, carefully cut the barrier in a modified "T" pattern as shown in [Fig. 28](#). Fold the

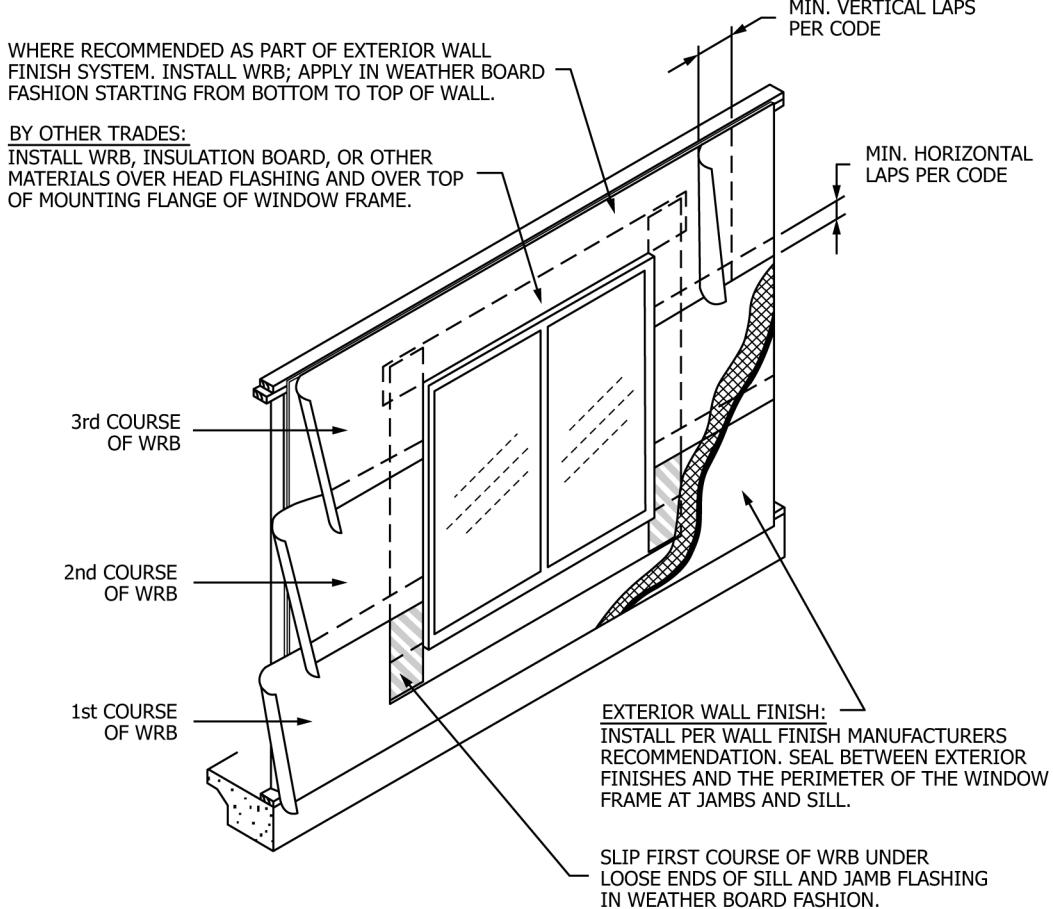


FIG. 25 Water-Resistive Barrier Application (Method A Shown—Method B Similar)

bottom and side flaps over and behind the interior side of the framing. Attach the barrier into position on the inside of the rough opening. At the head of the opening, starting at the top corner of the window, measure from the corner 9 in. (230 mm) up and 9 in. (230 mm) over and mark. At a 45° angle, carefully cut the barrier on a diagonal as shown in Fig. 28. Gently raise the top edge of the barrier up and temporarily tape the top corners and center to the exterior water-resistive barrier surface above. This is done in order to allow for installation of the window and flashing later.

8.1.1.3.3.2 Step 2: Apply the horizontal sill flashing material next, level with the top edge of the rough opening. Cut the sill flashing long enough to extend an equal distance beyond the 9 in. (230 mm) jamb flashing, which will be applied later (see Fig. 21). Fasten the top edge of the sill flashing to the framing. Place fasteners along the edge of the rough opening where they will be covered by the mounting flange of the window later.

8.1.1.3.3.3 Step 3: Apply a continuous bead of sealant to the back side (interior surface) of the mounting flange of the window. Sealant selection and bead design shall be in accordance with 5.18 of the installation procedures. Immediately set the window into the opening, and apply shims as required to ensure the unit is plumb, level, and square. Fasten the window perimeter securely into position as described in 5.14.

NOTE 42—Apply the sealant in line with the pre-punched holes or slots on the mounting flange when provided. (See Fig. 22.)

NOTE 43—Where a pan flashing is used, the bead of sealant at the sill must have discontinuity in order to permit drainage from the sill pan to the exterior or drainage plane. See 5.16.6 for further explanation.

8.1.1.3.3.4 Step 4: Next, apply a continuous bead of sealant to the exposed mounting flange (exterior surface) at the side jambs of the installed window.

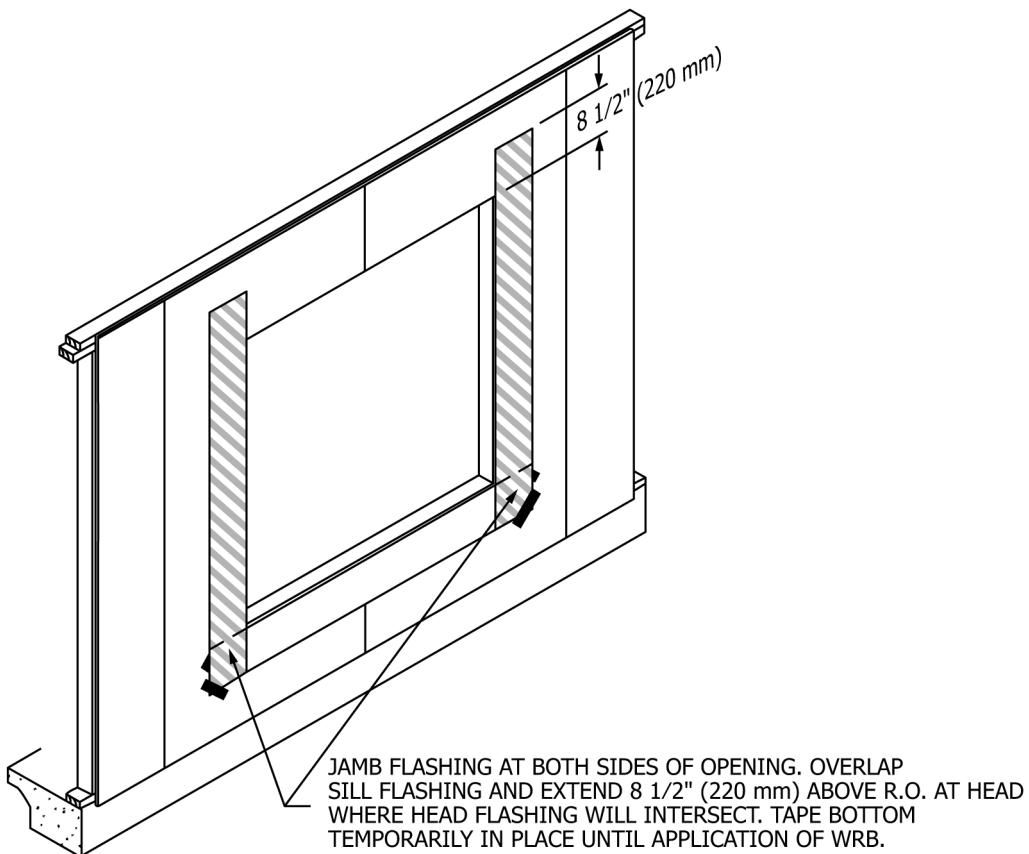
NOTE 44—The application of the additional bead of sealant to the flange may not be necessary if using self-adhesive type flashing over the mounting flange, as long as the flashing securely adheres. Some flashing manufacturers may require the use of primer materials to help facilitate the bonding to the various substrates. When using sealant near self-adhesive flashing, do not use sealant that contains solvent. Always consult with the flashing supplier to determine compatibility with the various installation materials and to obtain specific installation techniques. Refer to 5.12.3.1.2.

(1) Continue the sealant bead at the jambs vertically 8 1/2 in. (220 mm) above the rough opening at the head of the window (to the face of the header), to allow for application of the top portion of the jamb flashing into sealant in the next step.

NOTE 45—Apply the sealant in line with the pre-punched holes or slots on the mounting flange when provided and over the heads of the fasteners.

(2) For windows with mechanically joined mounting flanges, apply sealant to the full length of the joints or seam where the flanges meet. (See Fig. 20 and Fig. 27.)

8.1.1.3.3.5 Step 5: Install the jamb flashing next, by pressing the flashing into the sealant beads on the mounting flanges. Attach the flashing into position to the rough opening framing



NOTE 1—For Method B1 the water-resistive barrier has been installed. A flap at the head of the window has been temporarily taped out of the way to allow for flashing and window installation.

FIG. 26 Application of Jamb Flashing (Method B)

using staples or other appropriate fasteners. Extend the bottom edge of the jamb flashing $8\frac{1}{2}$ in. (220 mm) beyond the rough opening sill, and extend the top edge $8\frac{1}{2}$ in. (220 mm) beyond the rough opening head, where the head flashing will be placed next. Tuck the top of the jamb flashing under the flap of the water-resistive barrier at the head. (See [Fig. 23](#).)

8.1.1.3.3.6 Step 6: Next, apply a continuous bead of sealant to the exposed mounting flange (exterior surface) at the head of the installed window. (See [Fig. 24](#).)

NOTE 46—The application of sealant to the flange is not necessary if using self-adhesive type flashing over the mounting flange.

NOTE 47—Apply the sealant in line with the pre-punched holes or slots on the mounting flange when provided and over the heads of the fasteners.

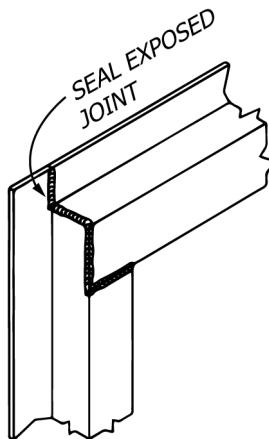
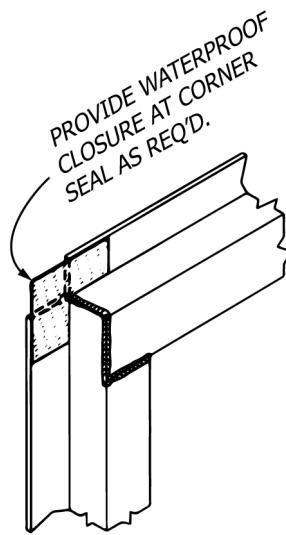
8.1.1.3.3.7 Step 7: Install the head flashing by pressing the flashing into the sealant bead previously applied across the mounting flange. When applying the head flashing, press the bottom edge of the flashing into the sealant until the sealant appears. This will ensure that no voids remain between the flashing and the mounting flange. Extend the ends of the head flashing 10 in. beyond the rough opening, over the top of the jamb flashing. Fasten the head flashing into place along the top edge using staples or other appropriate fasteners. (See [Fig. 24](#).)

8.1.1.3.3.8 Step 8: Remove the previously applied tape, which holds the flap of the water-resistive barrier at the head. Allow the flap to lay flat over the head flashing. Apply a new piece of sheathing tape over the entire diagonal cut made in the

water-resistive barrier. The tape should be compressed against the water-resistive barrier and the head flashing, which extends over the jamb. (See [Fig. 29](#).)

8.1.1.3.4 *Method B1: Water-Resistive Barrier Applied Prior to the Window Installation—Flashing is Applied Behind the Mounting Flange:*

8.1.1.3.4.1 Step 1: Where water-resistive barrier is used, apply the WRB in water shedding fashion, starting at the base of the wall and working towards the top. Install the water-resistive barrier to the face of the building framing or sheathing flush with the rough opening of the window head, jambs, and sill. At the head of the opening, starting at the top corner of the window, measure from the corner 9 in. (230 mm) up and 9 in. (230 mm) over and mark. At a 45° angle, carefully cut the barrier on a diagonal. Gently raise the top edge of the barrier up and tape the top corners and center to the exterior water-resistive barrier surface above. This is done in order to allow for installation of the window and flashing later. Once the WRB is applied as described in this step, proceed immediately to Step No. 2. Alternatively, you can follow the same procedures as outlined for house wrap type materials below. Where the water-resistive barrier used is a building paper type material and covers the window carefully cut the barrier in a modified “I” pattern as shown in [Fig. 28](#). Fold the bottom and side flaps over and behind the interior side of the framing. Attach the barrier into position on the inside of the rough


BUTT JOINT

OPEN ("NOTCHED") CORNER
FIG. 27 Common Frame Joints (Head-Jamb)

opening. At the head of the opening, starting at the top corner of the window, measure from the corner 9 in. (230 mm) up and 9 in. (230 mm) over and mark. At a 45° angle, carefully cut the barrier on a diagonal as shown in [Fig. 28](#). Gently raise the top edge of the barrier up and tape the top corners and center to the exterior water-resistive barrier surface above. This is done in order to allow for installation of the window and flashing later.

8.1.1.3.4.2 Step 2: Apply the horizontal sill flashing material next, level with the top edge of the rough opening. Cut the sill flashing long enough to extend an equal distance beyond the 9 in. (230 mm) jamb flashing, which will be applied later. (See [Fig. 21](#).) Fasten the top edge of the sill flashing to the framing. Place fasteners along the edge of the rough opening where they will be covered by the mounting flange of the window later.

8.1.1.3.4.3 Step 3: Apply the jamb flashing to the edge of the framing at each jamb. Place fasteners along the edge of the rough opening where they will be covered by the mounting

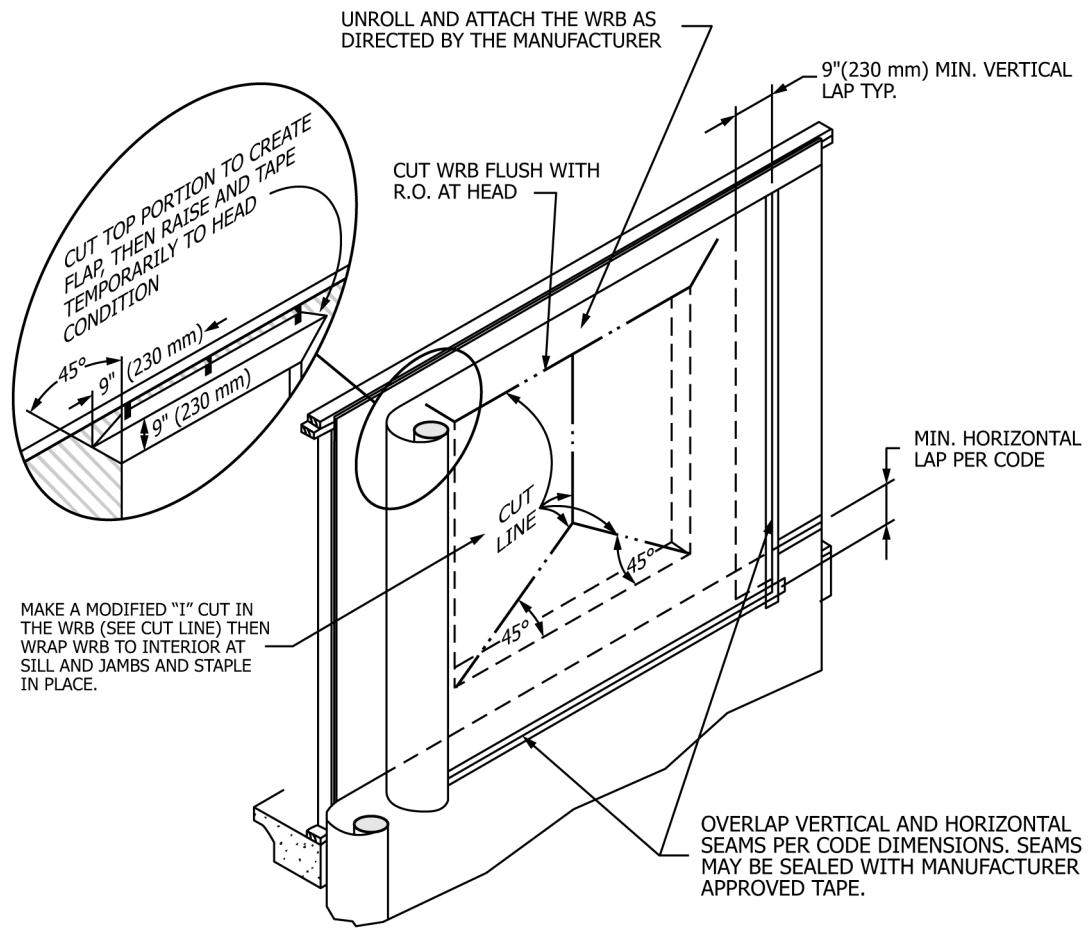
flange of the window later. Extend the jamb flashing 8½ in. (220 mm) beyond the rough opening dimension at the head and sill. The bottom end of the jamb flashing is to overlap the sill flashing. The head flashing applied next will overlap the top end of the jamb flashing. (See [Fig. 26](#).)

8.1.1.3.4.4 Step 4: Apply a continuous bead of sealant around the full perimeter of the back side (interior surface) of the window mounting flange. Sealant selection and bead design shall be in accordance with [5.18](#).

NOTE 48—Apply the sealant in line with the pre-punched holes or slots on the mounting flange when provided.

NOTE 49—Where a pan flashing is used, the bead of sealant at the sill must have discontinuity in order to permit drainage from the sill pan to the exterior or drainage plane. See [5.16.6](#) for further explanation.

8.1.1.3.4.5 Step 5: Immediately install the window into the opening pressing the window against the framing to compress the sealant. Apply shims as required to ensure the unit is



WRB FOR FLOORS OR LEVELS BELOW SHALL BE OVERLAPPED WITH WRB ABOVE IN WEATHER BOARD FASHION.

FIG. 28 Water-Resistive Barrier-House Wrap

plumb, level, and square. Fasten the window perimeter securely into position as described in [5.14](#).

NOTE 50—Exercise caution to avoid disrupting the continuous seal. Always install the window immediately after the application of the sealant.

(1) For windows with mechanically joined mounting flanges, apply sealant to the full length of the joinery or seam where the flanges meet. (See [Fig. 20](#) and [Fig. 27](#).)

8.1.1.3.4.6 Step 6: Apply a continuous bead of sealant horizontally across the face of the exposed mounting flange (exterior surface) at the head of the installed window. The sealant bead on the header should be placed in line where the top of the flashing (8½ in. (220 mm) above the rough opening) will be placed, so the top of the flashing can be pressed into the sealant in the next step. Continue the sealant bead over the top edge (exterior side) of the jamb flashing in order to fully integrate the head and jamb flashing together. (See [Fig. 24](#).)

NOTE 51—The application of sealant to the flange is not necessary if using self-adhesive type flashing over the mounting flange.

NOTE 52—Apply the sealant in line with the pre-punched holes or slots on the mounting flange when provided and over the heads of the fasteners. (See [Fig. 22](#).)

8.1.1.3.4.7 Step 7: Install the head flashing by pressing the flashing into the sealant bead previously applied to the mounting flange. When applying the head flashing, press the bottom edge of the flashing into the sealant until the sealant appears. This will ensure that no voids remain between the flashing and the mounting flange. Extend the ends of the head flashing 10 in. (260 mm) beyond the rough opening, over the top of the jamb flashing. Fasten the head flashing into place along the top edge using staples or other appropriate fasteners.

8.1.1.3.4.8 Step 8: Finally, remove the previously applied tape, which holds the flap of the water-resistive barrier at the head. Allow the flap to lay flat over the head flashing. Apply a new piece of sheathing tape over the entire diagonal cut made in the water-resistive barrier. The tape should be compressed against the water-resistive barrier and the head flashing which extends over the jamb. Refer to [Fig. 29](#).

USE SHEATHING TAPE TO SECURE THE TOP FLAP OF THE WATER-RESISTIVE BARRIER WHERE IT OVERLAPS THE HEAD FLASHING.

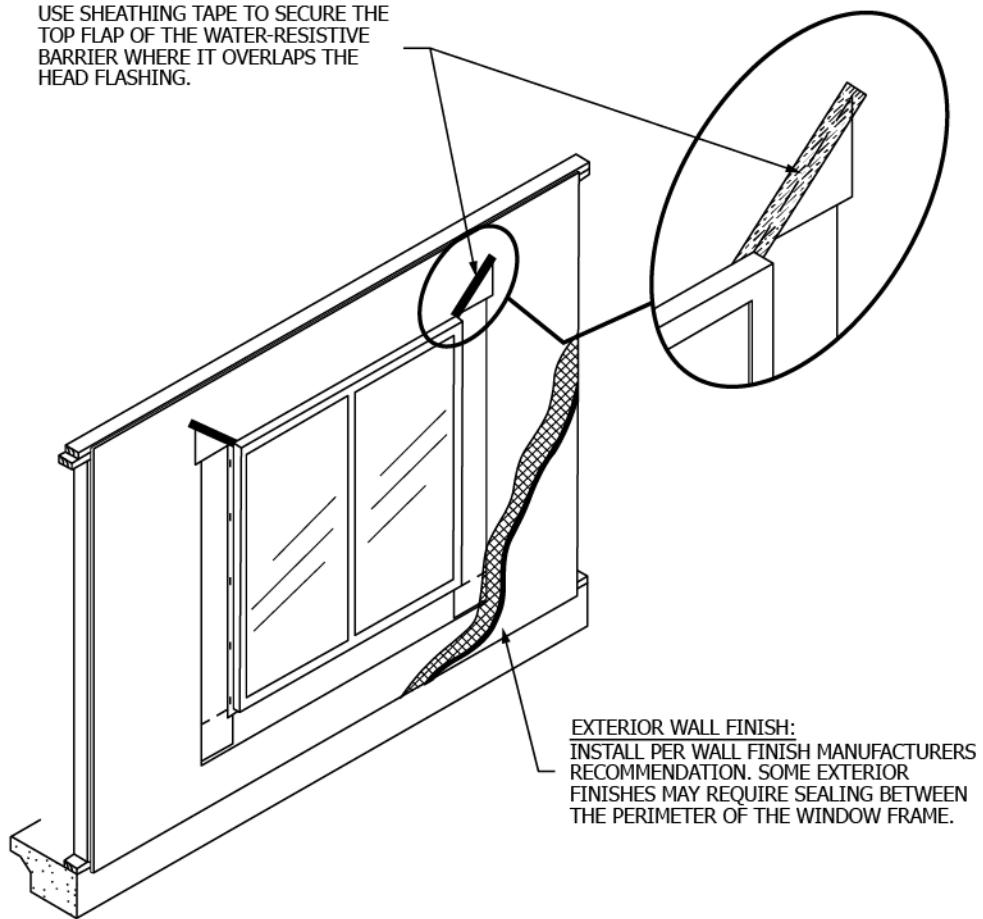


FIG. 29 Secure WRB at Head (Method A1 and B1)

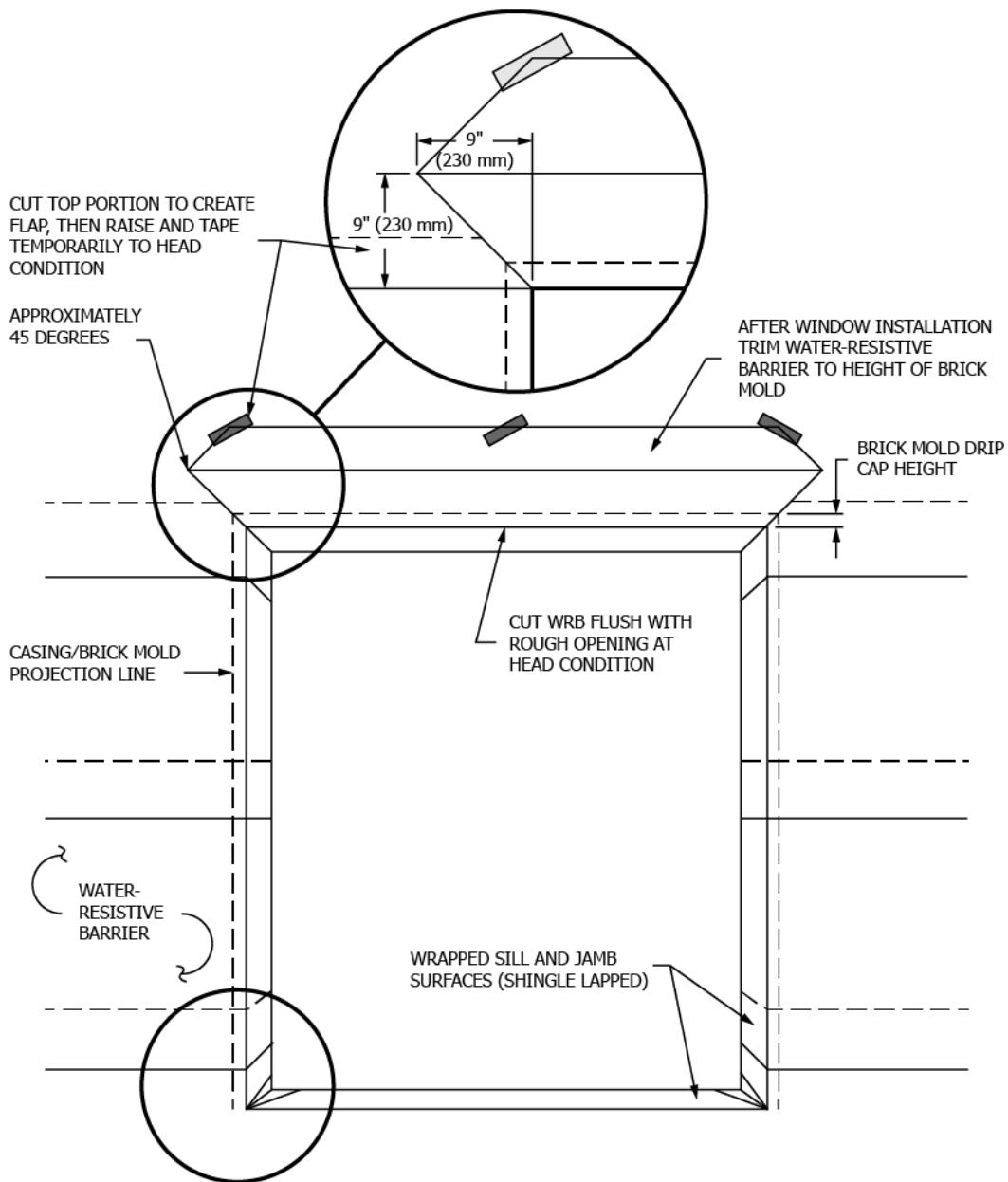
8.1.2 Non-Finned Windows in Membrane/Drainage Type Walls:

8.1.2.1 *Integration of Non-Finned Windows with the Drainage Membrane*—Non-finned windows do not have mounting flanges (nail fins), which are typically integrated with flashing sheets as outlined in 8.1.1. Non-finned windows should be sealed to the wall's water-resistive barrier at the jamb moldings and where the sill horn, if provided, extends beyond the sides of the rough opening. One way to meet this requirement is to install the window after the water-resistive barrier is installed. The WRB shall wrap into the rough opening at the base and sides of the opening. The WRB shall not, however, wrap into the top of the rough opening. Starting with the WRB trimmed even with the top edge of the rough opening, two diagonal cuts are made in the membrane at the top corners of the rough opening (see Fig. 30) to form a flap in the membrane above the rough opening. A horizontal strip equal to the width of the window unit's head trim is then cut off the bottom edge of this flap (see Fig. 30). This is to allow installation of the window unit without interference with or damage to the flap. The remaining flap will later be integrated with window head flashing.

8.1.2.2 *Installation of Pan Flashings*—Pan flashings are installed in a weatherboard fashion to integrate with the water-resistive barrier.

8.1.2.3 *Drip Caps*—Unless the window unit's head trim has a top surface that slopes toward the exterior and has a pronounced drip edge, a drip cap, which has these characteristics and extends outward beyond the head trim's outermost surface, shall be installed over the window unit's head trim. The end-grain surfaces of wood drip caps should be sealed with water-repellent or water-repellent preservative at time of installation, in accordance with WDMA I.S.4. (See Fig. 12.) If a drip cap is required, it shall be installed underneath the flap cut in the water-resistive barrier above the window.

8.1.2.4 *Head Flashing (see Figs. 32-35)*—The top edge of a wood drip cap (or the top edge of the window unit's head trim; if it meets the requirements outlined at the start of 8.1.2.2) should be covered with a rigid metal flashing, and the upper leg of this flashing shall be integrated with the wall's water-resistive barrier. This is performed by installing the head flashing underneath the flap cut in the WRB, trimming the membrane so that it will cover the upper leg of the head flashing but not extend below the upper leg of the flashing, sealing the barrier to the upper leg of the head flashing with a bead of sealant, and fastening the flap in place. Depending on the installation details, it may be possible to use a rigid metal flashing to serve the combined purposes of drip cap and flashing (see Fig. 32).



NOTE 1—See enlarged detail in Fig 30.1.

FIG. 30 Membrane/Drainage System-Wrapping of Rough Opening (Non Finned Window)

8.1.2.5 Trades Responsibility for Drip Cap and Flashing—
 This practice recommends that drip cap and head flashing be installed by the window installers. If these items are not installed by the window installers, the following undesirable events may occur: (1) water may intrude at the window head before the drip cap and head flashing are installed, (2) the flap in the barrier above the window may be damaged by wind or by workers installing or removing fasteners or batten strips used to temporarily secure it. Although it is less than ideal, head flashings are sometimes installed by the cladding system installers. Regardless of which trade group installs window head flashing, proper integration of it with the drip cap or window head trim, with the water-resistive barrier, and with the cladding system is essential. Special flashing details that are

specific to different cladding systems and their variations may be necessary (for example, jamb flashings on *downhill* sides of diagonally-applied wood siding). Such special flashing details are beyond the scope of this practice.

8.2 Sealant Method: Surface-Sealed Barrier Wall System (Water Contained on Exterior Surface)— In surface sealed systems water infiltration is prevented at the exterior (outermost) surface. Continuity between wall and fenestration components is attained by sealant joints. Note that this section does not address projected fenestration products such as bay, bow, or garden windows.

8.2.1 The following guidelines pertain to all openings:

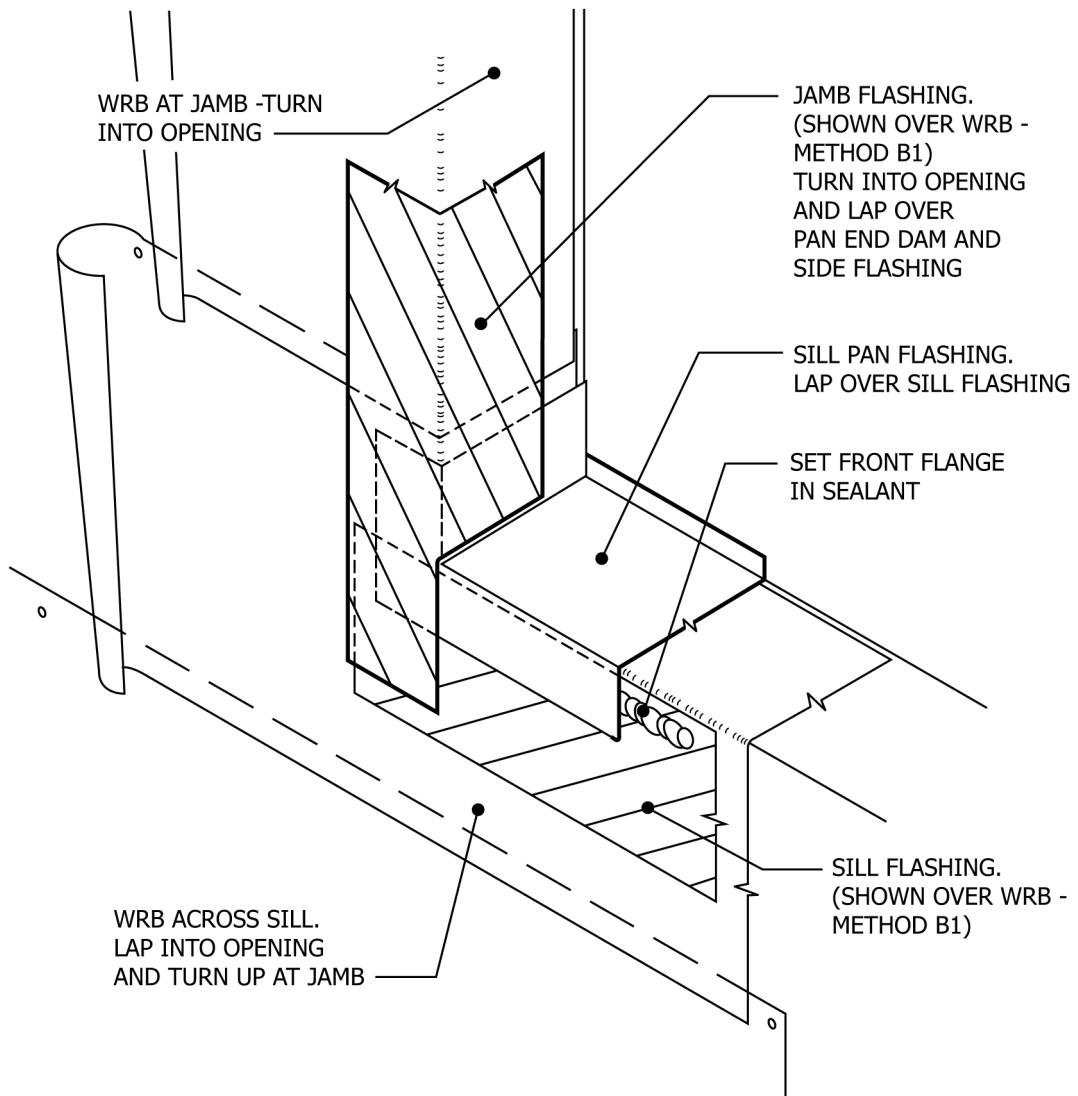


FIG. 30 .1 Sill-Jamb Corner with Sill Pan Flashing (Method B1) (continued)

8.2.1.1 Rough framing shall be structurally sound and free of damage or deterioration (for example, wood decay).

8.2.1.2 Use sealant recommended by the window manufacturer or use a sealant with adequate movement capability and adhesion to sash or frame and rough opening materials.

8.2.1.3 For proper sealant selection follow guidelines in **5.18** and **Annex A4**.

8.2.2 When installing in rough opening (not utilizing an existing frame):

8.2.2.1 Sealant dimensions in the gap between the new frame and opening perimeter should be $\frac{1}{4}$ in. by $\frac{1}{4}$ in. (6 mm by 6 mm) deep minimum. In no case should the sealant depth be greater than its width.

8.2.2.2 Use backer rod to control sealant depth.

8.2.3 Installing a replacement product where an existing frame will remain:

8.2.3.1 All sash, strips, hardware, and other obstructions shall be removed.

8.2.3.2 Existing frames shall be structurally sound and free of deterioration (for example, dry rot).

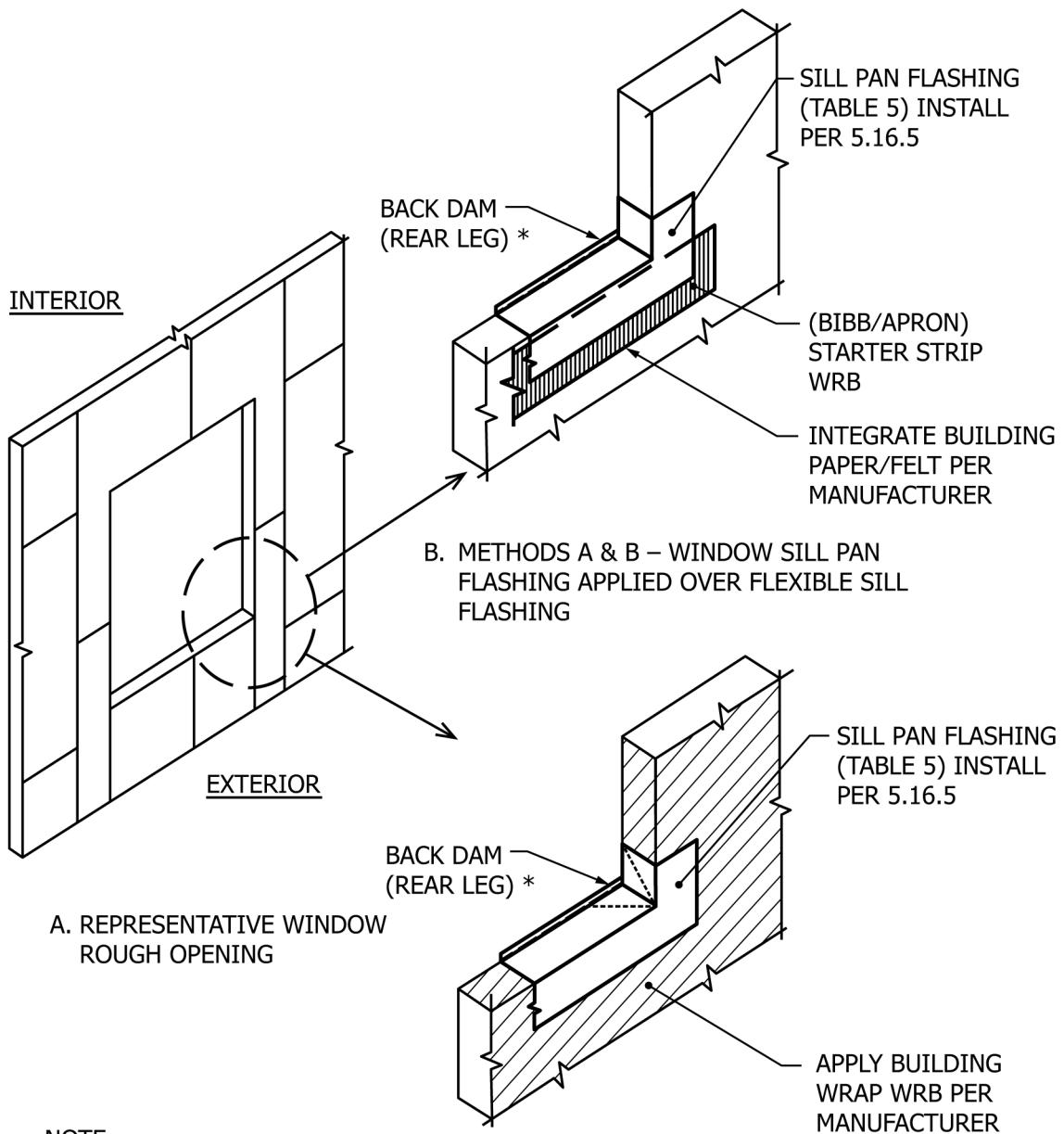
8.2.3.3 See **5.18** for sealant application.

8.3 *Windows in Walls Utilizing an Exterior Barrier System. (EIFS or Direct Applied)*—The EIFS industry is currently revising details with reference to fenestration products. When complete, those details will be reviewed. Contact the manufacturer of EIFS system for details, and fenestration manufacturer for particular EIFS details (see ANSI/EIMA 99-A-2001).

8.4 *Alternative Approved Installation Methods for the Installation of Windows*—Window & Door Industry associations have developed installation practices for specific window/wall combinations, and exposure conditions. The following documents provide alternative methods for specific conditions.

NOTE 53—The referenced documents are not exhaustive of all possible alternative methods for any specific condition.

8.4.1 *Extreme Wind/Water Conditions*—Certain climate regions, such as the southeastern/gulf and northwest coasts of the United States, are subject to extreme wind/water events such as tropical storms, hurricanes, and common occurrences of wind-driven rain greater than 70 mph. For installations of



NOTE 1—One of several options of Pan Flashing shown.

FIG. 31 Flexible Flashing at Window Sills

windows under these extreme conditions, the following standard practices are recommended for the specified window/wall condition:

8.4.1.1 *Membrane Drainage Wood Frame Construction*—FMA/AAMA 100, Standard Practice for the Installation of

Windows with Flanges or Mounting Fins in Wood Frame Construction for Extreme Wind/Water Exposure.

8.4.1.2 *Masonry Construction with Surface Barrier Stucco Facade*:

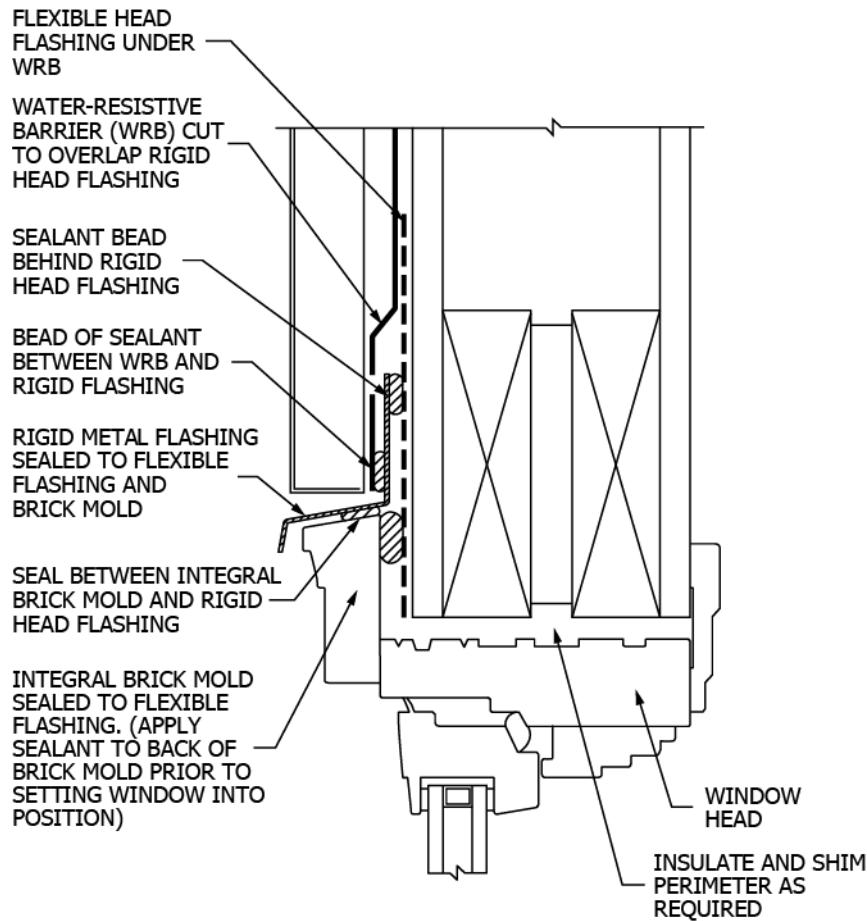


FIG. 32 Head of Non-Finned Window (Integral Brick Mold)

(a) FMA/AAMA 200, Standard Practice for the Installation of Windows with Frontal Flanges for Surface Barrier Masonry Construction for Extreme Wind/Water Conditions.

(b) FMA/WDMA 250, Standard Practice for the Installation of Non-Frontal Flanged Windows with Mounting Flanges for Surface Barrier Masonry Construction.

8.5 Special Considerations—Windows should be adequately sealed at the corners in the factory prior to arriving at the job site. Installer should inspect these seals for sealant integrity prior to installation. Reseal according to manufacturer's instructions, or reject if unable to repair.

8.5.1 Aluminum Framed Windows—Aluminum framed windows do not come from the factory with welded corners, with the exception of some types of casement windows. Special consideration should be given to the joinery of the frames, making sure that they are properly sealed to each other. Make sure when nailing window to a rough opening through a nailing flange, that the nailing fin is not cracked by the concussion of the hammer. If it is, make sure sealant is applied at the crack (Refer to [Fig. 20](#).)

8.5.2 Vinyl Framed Windows—Vinyl window manufacturers often offer a range of installation accessories designed to mate or trim out the window with the surrounding construction. Consult the manufacturer for available and appropriate installation accessories prior to product installation. Vinyl frames with integral nailing flanges shall employ fasteners of sufficient

length to penetrate the structural framing to a depth designed to meet the applicable design wind loads and codes. Utilize pre-punched holes on the flange, at intervals of a maximum of 12 in. (300 mm) on center, or according to manufacturer's instructions. Vinyl frames with integral nailing flanges shall require the use of shims to ensure that jamb, head, and sill members remain straight and plumb or level to within $\frac{1}{16}$ in. (1.588 mm). Use a minimum of three shims per frame member (head, sill, and jambs), including one at mid-span and one within 3 in. (75 mm) of each end. Windows with height or width in excess of 36 in. (900 mm) shall employ these shims on maximum 12 in. (300 mm) centers, while maintaining the mid and end of member requirements. An example of shim location requirements is illustrated in [5.15](#). The shims shall be fixed to the surrounding construction; this may be accomplished by way of the use of small fasteners or a gunnable sealant.

8.6 Replacement Window Installation—The following sections pertain to the subsequent installation of a window after removal of a previously installed prime or replacement window. Many combinations of construction detail variables exist for this type of installation. This practice does not purport to address every condition. The most common conditions are categorized here by the totality of previous window removal, the type of window being replaced and the type of surrounding construction.

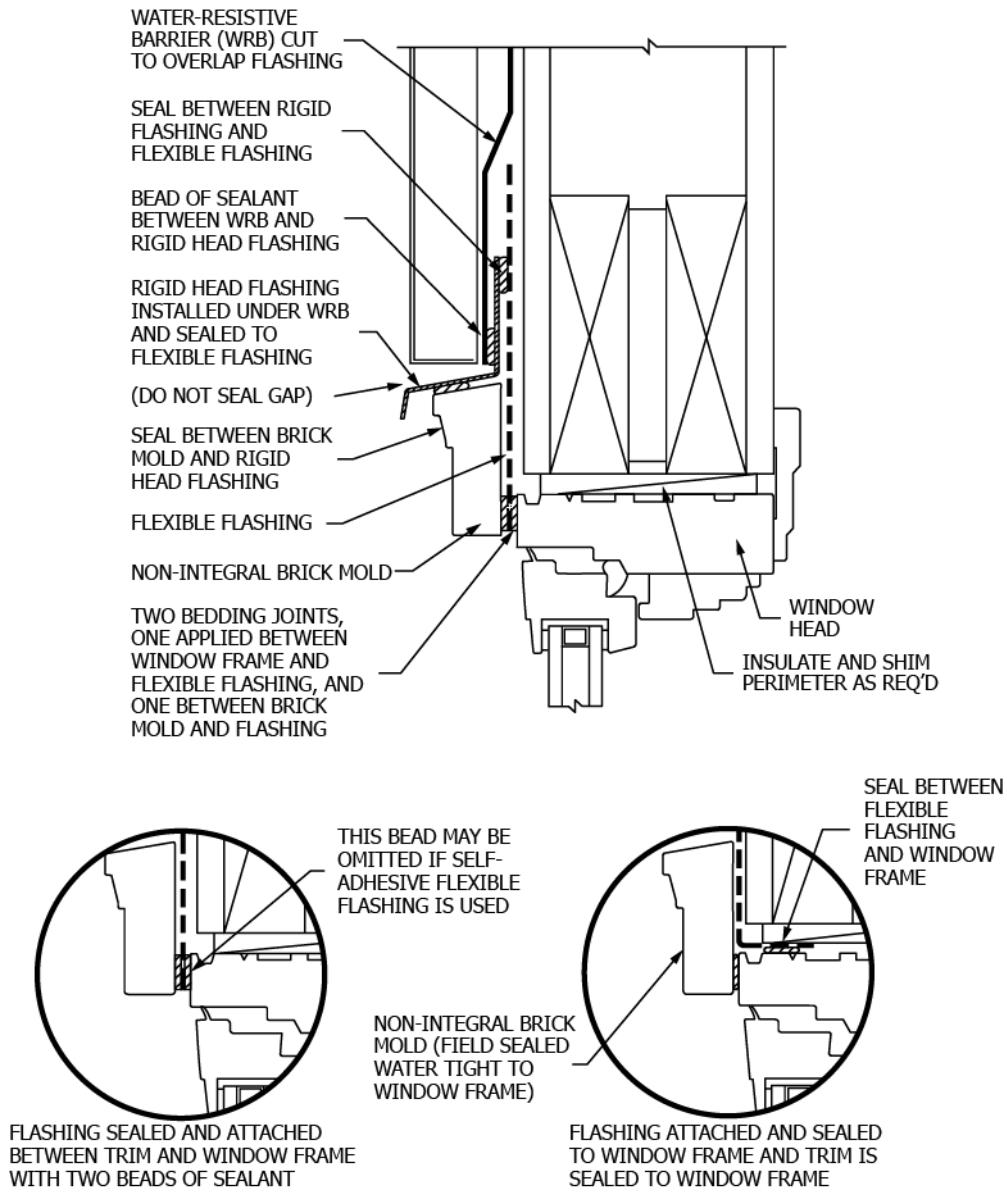


FIG. 33 Head Detail of Non-Finned Window (Non-Integral Brick Mold)

8.6.1 Partial Window Replacement for Existing Integral Flange Windows—When the existing window frame is to remain with the building and the seals have not been broken or disturbed between the window and the existing water-resistive barrier, that is, stucco/siding/exterior finish/membrane, it will be assumed that the existing seals are still functional. If it is determined during the pre-installation inspection that the existing seals and remaining frame are not intact and functional, or that the wall contents are damaged, then the installer shall contact the general contractor to ensure that repairs are made before installing the replacement window or door. (See Fig. 36.) When installing a new window, the new seals shall be between the new window and the existing frame or window, thus bridging the existing seals connected to the existing window with the new sash. (See Fig. 36.)

8.6.2 Partial Replacement of Mill Shop Wood Windows:

8.6.2.1 “Mill Shop” Wood Windows (Vertical or Horizontal Sliding)—Inspect the existing jambs, head, and sill for signs of damage, decay, or other deterioration. Extensive damage shall be repaired; if repairs are not possible, refer to 8.6.3.

8.6.2.1.1 Thoroughly inspect for indications of damage to interior trim finish, walls or flooring, or both. If damage is found to be caused by leakage from the exterior, as opposed to condensate, locate the source of the leakage and establish whether partial window replacement will correct the problem. If not, plan necessary corrective measures before proceeding, then correct the problem prior to installation.

8.6.2.1.2 Measure the clear width and height dimensions, as defined in Fig. 6, at three locations (at each end and the mid-point), the smallest of the three measurements will be the rough opening size. Note if the opening is out of square or not in plane. Adjust rough opening size (if necessary) to ensure the

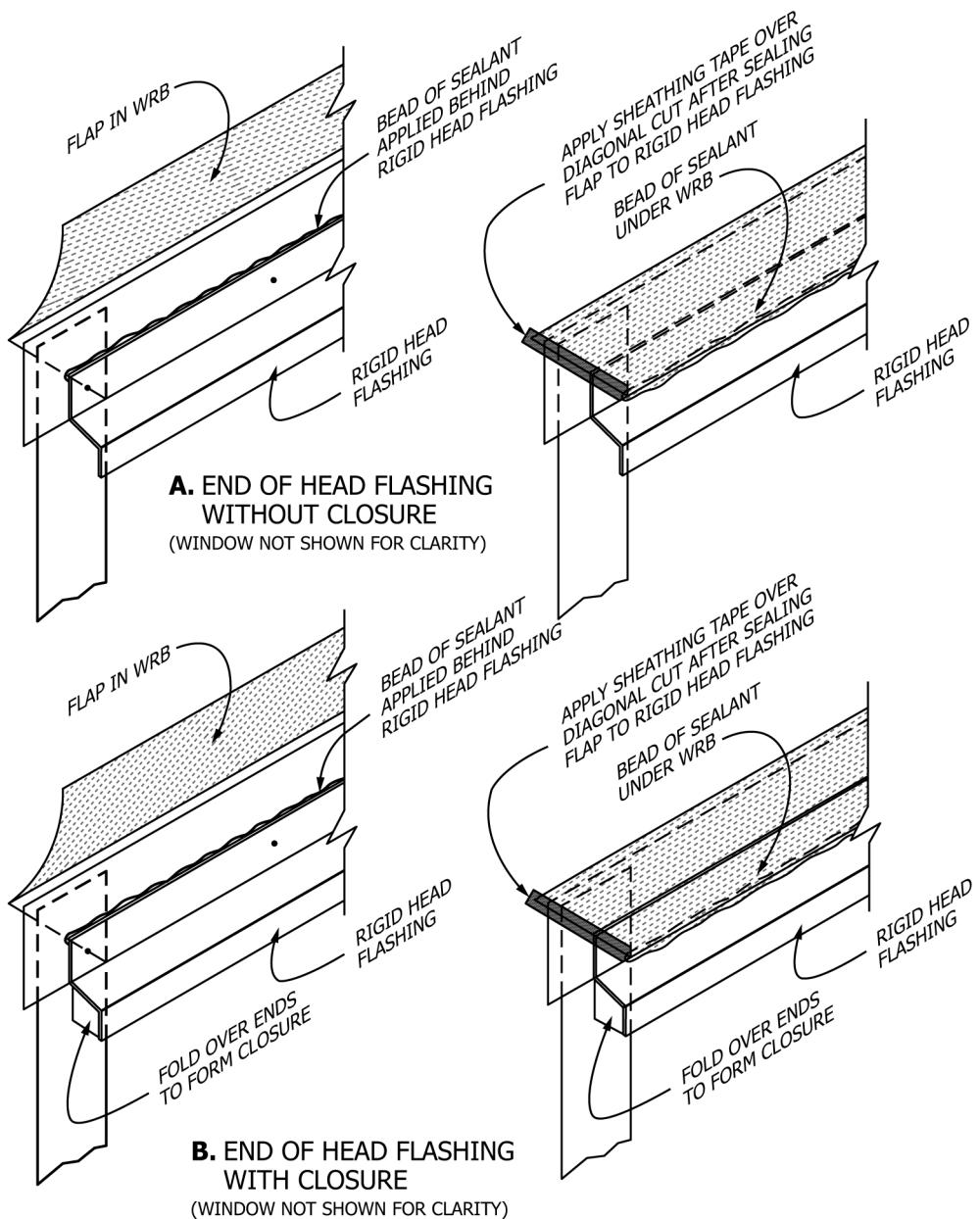


FIG. 34 Common Rigid Head Flashing Details

replacement window can be installed square, level, plumb in both directions, and with a straight sill.

8.6.2.1.3 The clear opening size after the sash has been removed is typically used when ordering replacement windows. The window manufacturer will then subtract a standard dimension that will allow for installation clearance. Discuss installation clearance when ordering according to the manufacturer's standard practice.

8.6.2.1.4 Ensure that the replacement window is the correct size and type for the opening, including tolerances and provisions for adjustments to out of square, plumb, or level.

8.6.2.1.5 If a storm window is present, first remove glass and screen panels, then carefully disconnect storm frame from window frame.

8.6.2.1.6 Score the joints, and then remove the interior sash stops from the jambs and head. Use special care when removing these stops if they are to be reinstalled after window installation (optional) (see Fig. 39).

8.6.2.1.7 Disconnect the sash from balances (if employed), remove the interior sash. Remove parting stop, disconnect the sash from balances (if employed), remove the exterior sash (see Fig. 40). The glass in fixed lites may need to be broken in order to remove, (always wear safety glasses and gloves) place drop cloths at the interior and exterior to catch the debris. **(Warning—**Some balancing devices may move rapidly and with great force when the weight of the sash is removed. Care shall be exercised to avoid serious injury.)

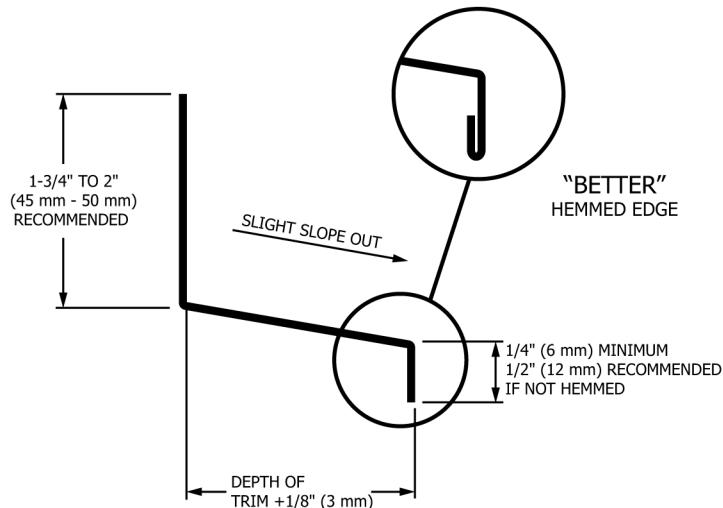


FIG. 35 Typical Head Flashing Detail

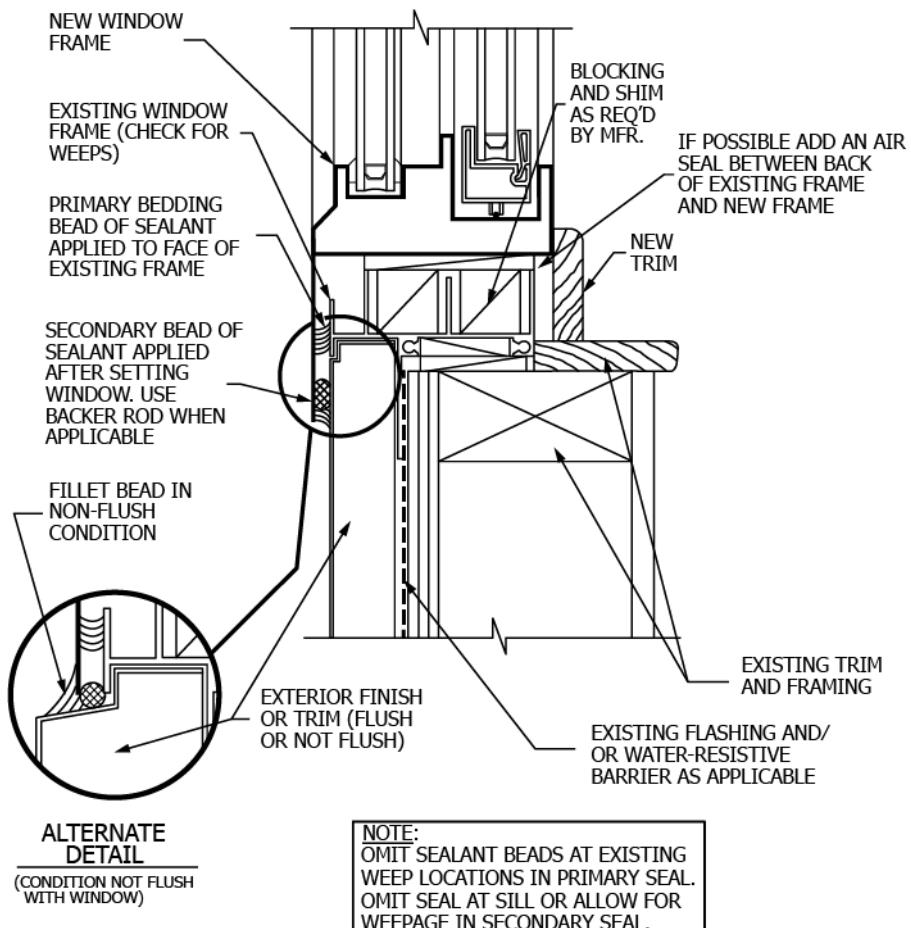
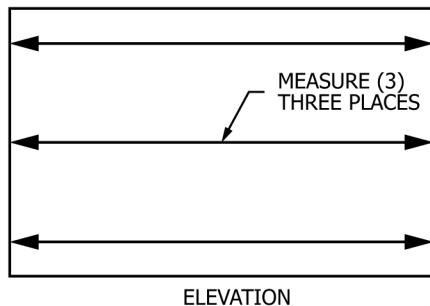


FIG. 36 Partial Window Replacement Detail Flush Fin or Stucco Flange (Sill Detail Shown—Jambs and Head Similar)

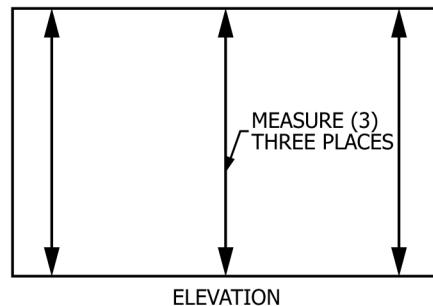
8.6.2.1.8 Remove remaining balance assemblies. Fill any large holes with insulation. Replace any unsound material. Remove debris. Use a carpenter's level to determine if the sill is level; apply shims as necessary to support the replacement sill in a level position at a minimum of three points.

8.6.2.1.9 Un-package the replacement window, remove the sash and screen from the frame (if possible). Set the frame into the opening against the exterior stops to confirm fit and to determine if a head expander or sill angle accessories, or both, are required. A head expander will be required if the head does

MEASURE WIDTH (REPLACEMENT)



MEASURE HEIGHT (REPLACEMENT)



NOTE: AT EXISTING METAL WINDOW FRAMES, MEASURE TO SMALLEST DAYLIGHT OPENING DIMENSION

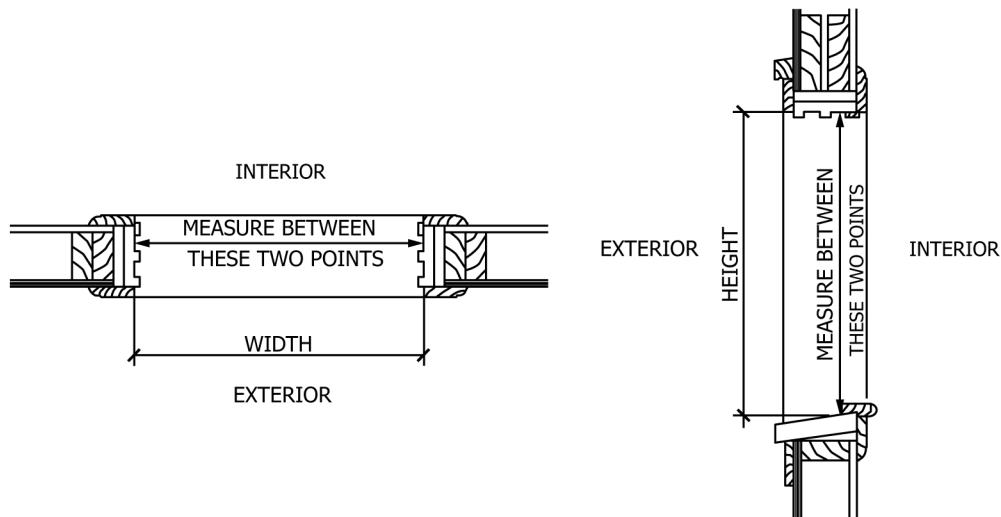


FIG. 37 Measuring Replacement Openings

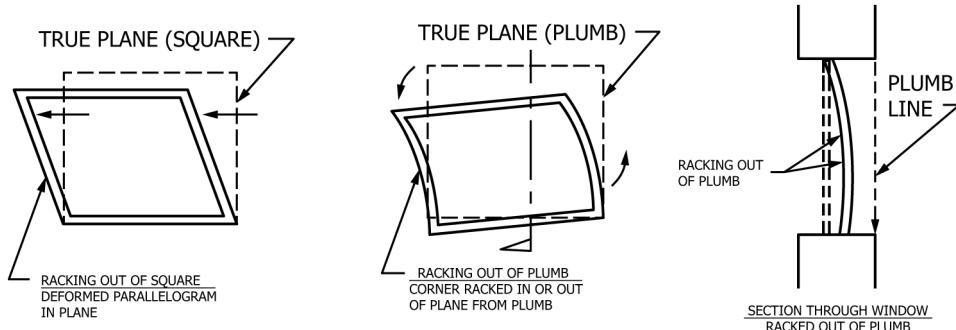


FIG. 38 Check for Racking

not contact the top exterior stop. Measure the sill gap as illustrated in [Fig. 41](#); a sill angle will be required if the sill gap exceeds $\frac{1}{8}$ in. (3 mm). Mark the sill angle location (if required) on the wood sill. Remove the frame.

8.6.2.1.10 If a sill angle accessory is required, place a bead of sealant along the length of the lower face and fasten to the

sill on marks with a minimum of three fasteners as illustrated in [Fig. 41](#). Apply breakable cladding to exposed exterior surfaces as necessary. Place a $\frac{1}{4}$ in. (6 mm) bead of sealant around the interior face of the exterior stops, and (if employed) across the top of the exterior face of the sill angle upturned leg (see [Fig. 41](#)).

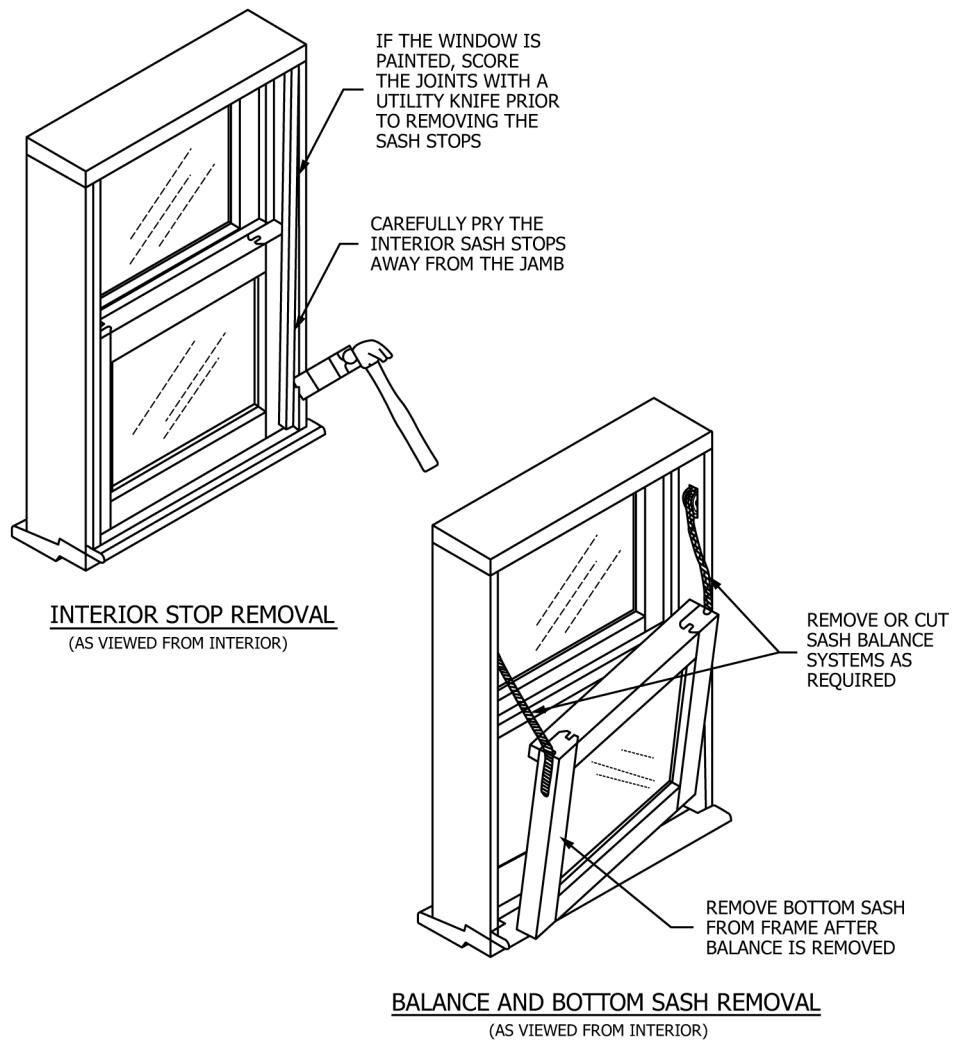


FIG. 39 Window Replacement-Bottom Sash Removal (Inside-Out Method)

8.6.2.1.11 Newly exposed surfaces of components of original window installation require protection from weathering. Such protection may consist of painting, priming, or break metal cladding.

8.6.2.1.12 Mount the head expander (if employed) to the window creating the minimum height. Place the window frame in the opening on the sill shims (if employed) and against the sealant on the exterior stops. The sill angle shall align behind the down-turned exterior sill leg as illustrated in [Fig. 41](#). Square the frame using a carpenter's square.

8.6.2.1.13 Install the number, type, and size fasteners at the locations prescribed by the manufacturer for this sized window model and location. Adjust the fasteners to create and hold window squareness while maintaining frame load bearing on the sill or sill shims. Do not over-tighten the fasteners.

8.6.2.1.14 Install the sash and screen, then check for proper operation, locking, and fit. Make adjustments to fasteners or hardware as necessary.

8.6.2.1.15 If a head expander accessory is employed, slide the expander up for maximum contact with the sealant, then secure to the replacement window head according to the manufacturer's instructions. If a sill angle accessory was not

employed, seal the full width of the sill to the sill construction with a bead of sealant. Fill the frame web perimeter voids with insulation. Install interior trim accessory parts or reinstall the interior sash stops removed according to [Fig. 39](#). If neither option is available then measure, cut, install and finish new interior sash stops.

8.6.2.1.16 Insulate the voids between replacement and existing framing members in accordance with [5.9.2](#).

8.6.2.2 *Wood Windows Containing Frame Liners (Vertical or Horizontal Sliding)*—Inspect the existing wood jambs, head, and sill for signs of damage, decay, or other deterioration. Also measure the interior to exterior jamb depth without the liners and exterior stop size/location to determine if the replacement window will mate with the existing frame. If a partial replacement is not feasible or if damage cannot be repaired, refer to [8.6.3](#).

8.6.2.2.1 Thoroughly inspect for indications of damage to interior trim finish, walls, or flooring, or a combination thereof. If damage is found to be caused by leakage from the exterior, as opposed to condensate, locate the source of the leakage and establish whether partial window replacement will correct the

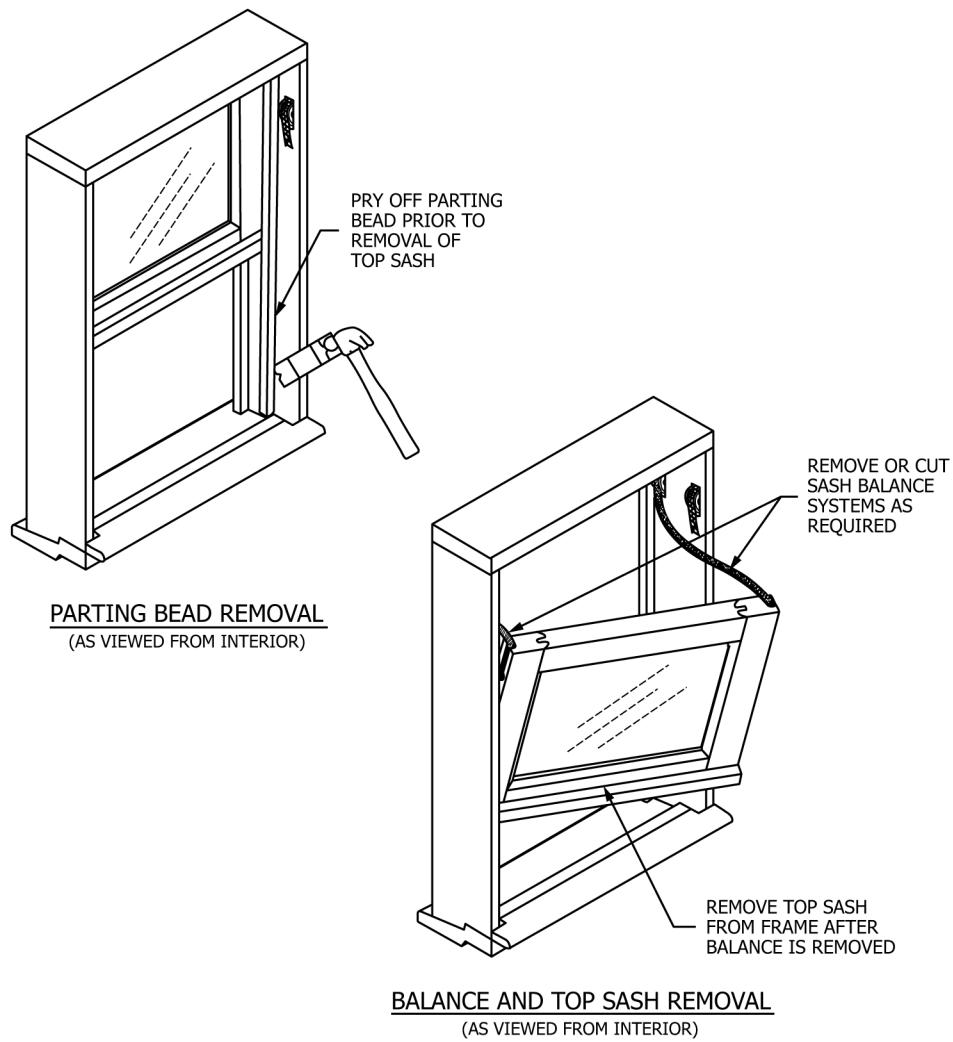


FIG. 40 Window Replacement-Top Sash Removal (Inside-Out Method)

problem. If not, plan necessary corrective measures before proceeding, then correct the problem prior to installation.

8.6.2.2.2 Carefully remove the interior trim and stops to reveal the jamb to jamb and head to sill dimensions without the liners. Measure the clear width and height dimensions, at three locations (at each end and the mid-point), the smallest of the three measurements will be the rough opening size. Note if the opening is out of square or not in plane. Adjust rough opening size (if necessary) to ensure the replacement window can be installed square, level, plumb in both directions, and with a straight sill (see [Fig. 13](#)).

8.6.2.2.3 The clear opening size after the sash is removed is typically used when ordering replacement windows. The window manufacturer will then subtract a standard dimension that will allow for installation clearance. Discuss installation clearance when ordering according to the manufacturer's standard practice.

8.6.2.2.4 Remove the sash. The glass in fixed lites may need to be broken in order to remove (always wear safety glasses and gloves); place drop cloths at the interior and exterior to catch the debris. Carefully remove the frame liners in a manner that will minimize damage to the remaining frame. Remove all

liner fasteners, and clear the rough opening of obstructions or protrusions that would interfere with the installation of the replacement window.

8.6.3 *Complete Window Replacement*—For complete window replacement, remove the existing window in a manner that will minimize damage to the remaining construction. Remove all window fasteners, and clear the rough opening of obstructions or protrusions that would interfere with the installation of the replacement window. If felts or other protective membrane are disturbed, patch all damaged areas with appropriate materials so as to maintain continuity of the water barrier. Avoid damaging any existing flashings inside the wall. Where existing openings are re-framed to a smaller size, insulate the voids between framing members and the window, and provide air barriers to control air movement. For cold climates, install a vapor retarder on the warm side of the installation. Provide interior and exterior coverings compatible with existing construction. Where new felts (or other building paper materials) are installed, place the new felts under the existing felts in shingle fashion, so as to shed water to the outside. Where two or more windows are installed in a horizontal series, provide appropriate blocking, gusset plates, or studs between the

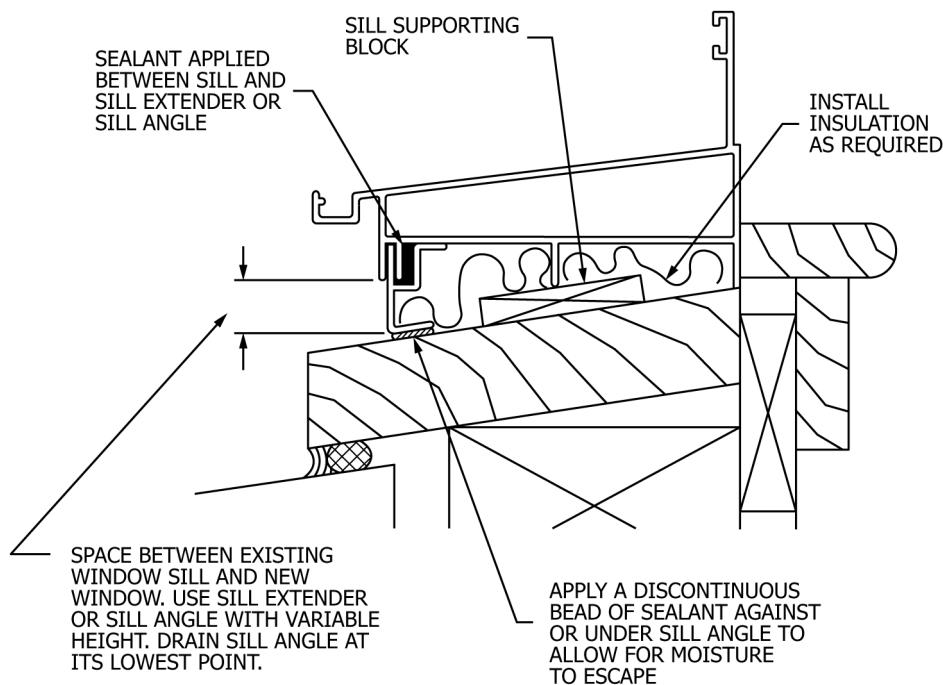


FIG. 41 Window Replacement-Sill Extender/Sill Angle Installation

windows. Extend head flashings to cover exposed joints between adjacent windows. For clad windows in a series, install exterior trim strips between windows, and cover the exposed top with appropriate flashing accessories. Do not install multiple windows without adequate intermediate supports to resist loads perpendicular to the plane of the windows. Where two or more windows are stacked vertically or mulled horizontally, consult the manufacturer's recommendations to ensure that the type of window used is appropriate for such stacking or mulling. Provide appropriate flashings to prevent leakage.

8.6.3.1 Destructive Window Replacement (Fin Type)— Destructive window replacement shall be accomplished by removal of the original window product and the carefully planned removal of building veneers with minimal damage to the surrounding veneers or framing. The removal of the building veneer is required to facilitate the installation of the new window product using an anchoring fin under the exterior veneer.

8.6.3.1.1 Remove the perimeter sealant both on the inside and outside perimeter edges of the installed window. Exercise care to avoid damage to the exterior and interior finished veneered surfaces. Wherever possible, sealant shall be cut away, not pulled from the opening with attendant possible damage to the surround.

8.6.3.1.2 Disengage the anchoring components of the window from the surrounding support framework. If the window was anchored through the window frame with fasteners which passed into the support framework, these fasteners shall be carefully cut through or removed starting at the bottom of the window and working upward. If the window was anchored with an anchoring fin, it shall be exposed by removal of the exterior building veneer(s) prior to disengaging the anchoring

fasteners. Removal of the veneer(s) shall be planned so as to minimize damage to the veneer and the building's exterior appearance.

8.6.3.1.3 Exercise care to temporarily support the window product so that it does not suddenly fall from the opening, possibly endangering the technician and damaging the surrounding veneers.

8.6.3.1.4 Ideally, the replacement of mounting flange windows would allow for the use of 9 in. (230 mm) wide flashing materials as required in new construction installation. Due to aesthetic reasons, however, this would require a much wider cut than might be acceptable to the building owner. Whenever it is practical to remove the exterior facade to allow for 9 in. (230 mm) wide flashing, the installer should do so, but in cases where the decision has been made to limit the amount of removal, the cutout can be reduced to a 3 in. (75 mm) minimum. When reducing the cutout to 3 in. (75 mm), the use of 4 in. (100 mm) wide (min.) self-adhesive flashing is required.

8.6.3.1.5 The veneer shall either be cut back from the opening using a sharp utility knife or saw; or in the case of discreet veneer components, removal of the components one at a time. The veneer shall be cut back a minimum of 3 in. (75 mm) or a distance to permit the installation of perimeter flashing and weathering materials using the following steps.

8.6.3.1.6 Remove the window product from the opening and set it aside for later disposal. Carefully examine the opening created by removal of the original window product. If there has been damage or deterioration of the supporting framework either due to the removal process or to the effects of weathering of the old installation, this damage shall be repaired before installation of the new replacement window is attempted. The

supporting framework shall be structurally sound prior to continuing with this installation.

8.6.3.1.7 In the event that portions of the water-resistive barrier were cut out during window removal (for example, cutting out around mounting flange windows), the installer should replace the water-resistive barrier. This can be accomplished by lapping a new piece of material over the remaining water-resistive barrier. The new piece of material should overlap the existing by a minimum of 1 in. (25 mm). Additionally, the overlapping edge should be sealed or taped to the existing material (for example, sealant in the case of building paper or taped in the case of house wrap).

8.6.3.1.8 Building air barriers and exterior veneer undersheathing shall be restored prior to commencing installation of the new window. The window opening shall be returned to at least the condition as originally constructed, prior to installation of the new product.

8.6.3.1.9 In some applications, it is possible that the installer can remove the existing window without causing any damage, leaving the existing flashing or water-resistive barrier, or both, materials in good condition. When this occurs, the installer can reuse the existing materials and reset the window.

8.6.3.1.10 After the completion of previous steps, the replacement window shall be installed and sealed as a new window product with perimeter installation fins. This installation process shall be accomplished according to the procedures outlined as follows.

8.6.3.1.11 When the exterior facade has been removed to allow for the installation of a full 9 in. (230 mm) piece of flexible flashing, the installation process will be treated much like installing a mounting flange in new construction. New mounting flange window installation instructions are outlined in 8.1, and will depend on the existing materials and the method selected.

8.6.3.1.12 When the cutout is smaller than 9 in. (230 mm) (3 in. (75 mm) minimum), new self-adhesive type flashing materials (4 in. (100 mm) minimum) can be used to integrate the existing water-resistive barrier and mounting flange together. The installation process used will be similar to new installation Method A1, assuming the existing water-resistive barrier is in place. In cases where the cutout is less than 9 in. (230 mm), the procedure follows.

8.6.3.1.13 Once the window is removed and repairs have been made to the existing water-resistive barrier, flashing is applied at the sill condition. In the event that the existing flashing is in good condition and is being reused, proceed with window installation.

8.6.3.1.14 When flashing has been removed or does not exist, apply a piece of self-adhesive sill flashing level with the top of the rough opening directly over the water-resistive barrier at the sill condition.

8.6.3.1.15 Prior to installing the window, cut a flap in the water-resistive barrier at the head. The cut will be from the corner of the rough opening to the corner of the cutout in the facade, at approximately 45°. Raise the flap up and tape it out of the way, allowing for the installation of the new window and the jamb flashing.

8.6.3.1.16 Seal and install the mounting flange replacement window according to the instruction outlined in 8.1 for Method A1. This process will include the sealing of the entire back side of the mounting flange prior to installation.

8.6.3.1.17 After the window is installed, apply a piece of self-adhesive flashing over the face of the mounting flange at each jamb. See 5.12.3.1. Place the jamb flashing under the flap in the water-resistive barrier at the head, and over the sill flashing in weather-board fashion. When required by the flashing manufacturer, allow the sealant to cure prior to flashing installation, as some flashing materials are not to come into contact with solvent-release sealants.

8.6.3.1.18 Apply the self-adhesive flashing over the mounting flange at the head. The head flashing will be installed similar to the jamb flashing, except the head flashing will be placed completely under the flap of the water-resistive barrier at the head.

8.6.3.1.19 After the window is properly positioned, sealed, flashed, and securely fastened in place, finish the opening by applying rigid head flashing, blocking, casing/trim, and perimeter seals as required.

8.6.3.1.20 Install blocking (filler strips) into the void that was cut out when removing the old window. The blocking should be flush with the exterior face of the façade.

NOTE 54—Tip: When removing wood siding, the old materials can be reused to fill the gap.

8.6.3.1.21 Apply new exterior casing/trim over the cutout made in the facade. In the case of a 3 in. (75 mm) minimum cutout, a new piece of 1 × 4 can be used to trim the opening. When reapplying trim, leave a minimum of a ¼ in. (6 mm) joint around the perimeter of the window to allow for the application of a perimeter sealant joint.

8.6.3.2 *Non-Destructive Window Replacement (Non-Fin Type)*—Non-destructive window replacement shall be accomplished by removal of the original window product without significant damage to the surrounding building veneers or framing.

8.6.3.2.1 Remove the perimeter sealant both on the inside and outside perimeter edges of the installed window. Exercise care to avoid damage to the exterior and interior finished veneered surfaces. Wherever possible, sealant shall be cut away, not pulled from the opening with attendant possible damage to the surround.

8.6.3.2.2 Disengage the anchoring components of the window from the surrounding support framework. If the window was anchored through the window frame with fasteners which passed into the support framework, these fasteners shall be carefully cut through or removed starting at the bottom of the window and working upward. If the window was anchored with an anchoring fin, the fin shall be cut through as close to the surface of the supporting framework as possible. This may be accomplished utilizing a sharp utility knife or a saw such as a reciprocating cut-off saw. Exercise care to temporarily support the window product so that it does not suddenly fall from the opening, possibly endangering the installer and damaging the surrounding veneers.

8.6.3.2.3 Remove the window product from the opening and set it aside for later disposal.

8.6.3.2.4 Carefully examine the opening created by removal of the original window product. If there has been damage or deterioration of the supporting framework either due to the removal process or due to the effects of weathering of the old installation, this damage shall be repaired before installation of the new replacement window is attempted. The supporting framework shall be structurally sound prior to continuing with this installation.

8.6.3.2.5 After the completion of steps 8.6.2.1 and 8.6.3, the replacement window shall be installed and sealed as a new window product in a punched opening. This installation shall be accomplished according to the procedures outlined in 8.1.2 for non-finned windows.

9. Installation Methods for Doors

9.1 Doors in Walls Utilizing a Membrane/Drainage System:

9.1.1 Doors with Perimeter Mounting Flanges (Nailing Fins) in Drainage Type Wall Construction:

9.1.1.1 Doors with perimeter mounting flanges shall be installed with flashing sheets, which shall be applied so as to integrate with the flanges on the door unit and with the water-resistive barrier materials in a shingle-lap manner. Four different methods (A, B, A1, and B1) may be used. These methods are described in this section.

9.1.1.1.1 Not all mounting flanges are considered structural by the manufacturer; however, they still are to be integrated into the wall using the following procedures. Mounting flanges are classified into the following categories:

- (1) Integral, structural mounting flanges
- (2) Integral, non-structural mounting flanges
- (3) Applied, structural mounting flanges
- (4) Applied, non-structural mounting flanges.

9.1.1.1.2 In this classification scheme, integral implies permanence, continuity, seamless, and waterproof. Applied mounting flanges may require more elaborate flashing and sealing details to ensure weather protection of the installed unit. When using applied mounting flanges, follow the manufacturer's instructions for sealing the flange to the frame.

9.1.1.1.3 Structural implies that the mounting requirements of the fenestration unit transfer the load from the window frame to the building. Non-structural flanges will require different anchoring methods to ensure the integrity of the installation. When using non-structural mounting flanges, follow the manufacturer's instructions for proper anchoring of the fenestration product.

9.1.1.1.4 Additionally, doors are often shipped to the job site (KD) or knocked down for field assembly. If the doors are pre-assembled, manufacturers often suggest removing the operable panels for ease of installation. Numerous references to the installation of the door (or door frame) are used in these instructions. As a point of clarification, the use of the terms door, and door frame are interchangeable.

9.1.1.2 Selection of an installation method (A, B, A1, or B1) is based on the relative order in which materials are installed, and on whether the pieces of flashing sheet used alongside the door (the jamb sheets) are applied over or behind the door unit's side flanges. Doors with mounting flanges may be installed either before or after the water-resistive barrier.

Although door installers often do not install the water-resistive barrier, the door installation shall be integrated properly with the membrane. To avoid confusion between membrane-installation and door-installation crews, it is recommended that the relative order of their work be identified in advance and that the identified order be maintained for either an entire project or for clearly demarcated portions of the project. This will allow selection of an installation method for the project, and help eliminate errors caused by installers having to switch between methods. Once a method is selected, all of the procedures of that method shall be performed in the sequence indicated. Never mix or match methods or alter the sequence of operations within a method.

9.1.1.2.1 The references to the application of sealant under or over the mounting flanges refer to the use of *Bedding Joints*. A bedding joint consists of the application of a bead of sealant which is later compressed against the substrate or flashing materials. All bedding joints are to have a nominal diameter of $\frac{3}{8}$ in. (10 mm) prior to compression. During compression of a bedding joint, the installer should look for the sealant to *squeeze out* or appear along the closest edge to ensure adequate bedding quality.

9.1.1.2.2 Use the flashing cut formulas (see Table 7) to determine the length of each strip of flashing for each window. This practice requires a flexible flashing minimum roll width of 9 in. (230 mm). Wider flashing materials, (for example, 12 in. (300 mm)) may be used, however the actual cut lengths figured by using the chart will increase. The use of self-adhesive type flashing is acceptable. Use of self-adhered flashings in widths other than 9 in. (230 mm) shall be permitted when accepted in writing by the window manufacturer and the flashing manufacturer, or specified by the design professional. Self-adhesive type flashing seals itself to the water-resistive barrier and to the mounting flange without the need for additional sealant. A continuous bead of sealant shall be applied to the back side of the mounting flange prior to placing the window. Self-adhesive type flashing materials must properly adhere, (creating a water tight joint) to the WRB and to the mounting flange material in order to be acceptable for use (refer to 5.12.3.1). (Warning—All notations of sealant placement, (for example, 8 $\frac{1}{2}$ in. (220 mm) up and 8 $\frac{1}{2}$ in. (220 mm) over) are based on the use of a 9 in. (230 mm) wide flashing.)

NOTE 55—Tip: In order to save time and develop an efficient installation process, the flashing materials can be cut in advance using the rough opening dimensions and the formulas shown in the table below. Cutting flashing in advance also reduces the chance for the sealant to skin over prior to the application of flashing. The instructions in the installation section of this chapter assume that the flashing is previously cut to the appropriate length.

9.1.1.3 Table 9 can be used to select the appropriate installation method.

9.1.1.3.1 *Alternate Installation Methods*—Refer to Appendix X4 for examples of other installation methods that have a successful performance history or are based on sound waterproofing principles.

9.1.1.4 The following procedures should be followed completely and finished the day the procedure starts in order to avoid damage to the flashing and water-resistive barrier. If it is impossible to finish the complete process, the loose ends of the

TABLE 9 Installation Procedure Selection Chart (Doors)

NOTE 1—Based on doors with mounting fins being installed in drainage type wall systems.

Procedure	Method	Method
Water-resistant barrier is to be applied after door installation	Head and jamb flashing will be applied over the face of the integral mounting flange use Method A	Jamb and sill flashing will be applied behind the face of the integral mounting flange use Method B
Water-resistant barrier is to be applied prior to door installation	use Method A1	use Method B1

flashing and WRB shall be temporarily secured using tape. The building contractor is responsible for the coordination of this work, as it is greatly dependent on the construction schedule. Once installed, local wind and weather conditions as well as exposure to other trades can have a detrimental effect on the permanent attachment of flashing. The building contractor must inspect and maintain the flashing, insuring it is secure and in proper condition prior to being covered up by other materials.

NOTE 56—All methods described below require the use of a 9 in. (230 mm) (minimum) wide approved flashing material. Flashing cut lengths are to be increased respectively depending on the actual width of the flashing used on the job. Flashing is always to be lapped in a water shedding (weather board, shingle, or ship-lapped) fashion.

9.1.1.4.1 Method A: Water-Resistive Barrier Applied after the Door Installation—Flashing Applied Over the Face of the Mounting Flange:

9.1.1.4.1.1 Step 1: Assumes mounting flange on door sill. (Go to Step 1a or 1b for pan flashings or sealant only method.) Apply the horizontal sill flashing material first, level with the top edge of the rough opening. Cut the sill flashing long enough to extend an equal distance beyond the 9 in. (230 mm) jamb flashing, which will be applied later. (See Fig. 13.) Fasten the top edge of the sill flashing to the framing. Place fasteners along the edge of the rough opening where they will be covered by the mounting flange of the door later.

NOTE 57—Do not fasten the bottom edge or the last 9 in. (230 mm) of each end, as the water-resistant barrier will be applied under the flashing in a water shedding fashion later. It is recommended that the corners and bottom edge be temporarily taped at 24 in. (610 mm) on center, to prevent wind damage.

9.1.1.4.1.2 Step 1a: Assumes no sill mounting flange on bottom of door sill or use of pan flashing. Apply continuous sealant beads across the full floor length of the framed opening (or along the bottom of the door frame) in a location where the floor makes contact with the door sill. Two $\frac{3}{8}$ in. (10 mm) diameter beads shall be used. Deposit a sufficient amount of the sealant at the framed opening corners so the bottom door frame corners are embedded in sealant when the door is installed. See 5.18 for sealant selection and use.

NOTE 58—All surfaces contacting sealant shall be free of dust and dirt prior to application of sealant. Sealant used shall be compatible with substrates both chemically and adhesively (see Annex A4).

9.1.1.4.1.3 Step 1b: Assumes no sill mounting flange, but uses pan flashing across the threshold. Apply two beads of sealant as noted in 1a above. Then apply a continuous pan flashing along full width of rough opening. Make sure each end of pan flashing is end dammed. See 5.16 through 5.16.5. If the

door is not sealed to the pan flashing with an air-infiltration seal, then the inside of pan flashing shall have an upturned leg at a height selected from Annex A3, depending on door rating or grade used.

9.1.1.4.1.4 Step 2: Apply a continuous bead of sealant to the back side (interior surface) of the mounting flange of the door. Sealant selection and bead design shall be in accordance with 5.18 of the installation procedures. Immediately set the door into the opening, apply shims as required to ensure the unit is plumb, level and square. Fasten the door perimeter securely into position as described in 5.14 and 5.15 in the Related Procedures Section.

NOTE 59—Apply the sealant in line with the pre-punched holes or slots on the mounting flange when provided (see Fig. 42). Refer to 5.12.3.1.

9.1.1.4.1.5 Step 3: Next, apply a continuous bead of sealant to the exposed jamb mounting flanges (exterior surface) at the side jambs of the installed door. Continue the sealant bead at the jambs vertically $8\frac{1}{2}$ in. (220 mm) above the rough opening at the head of the door (to the face of the header), to allow for application of the top portion of the jamb flashing into sealant in the next step.

NOTE 60—Apply the sealant in line with the pre-punched holes or slots on the mounting flange when provided and over the heads of the fasteners. Refer to 5.12.3.1. Where a pan flashing is used, the bead of sealant at the sill must have discontinuity in order to permit drainage from the sill pan to the exterior or drainage plane. See note after 5.18.8 for further explanation.

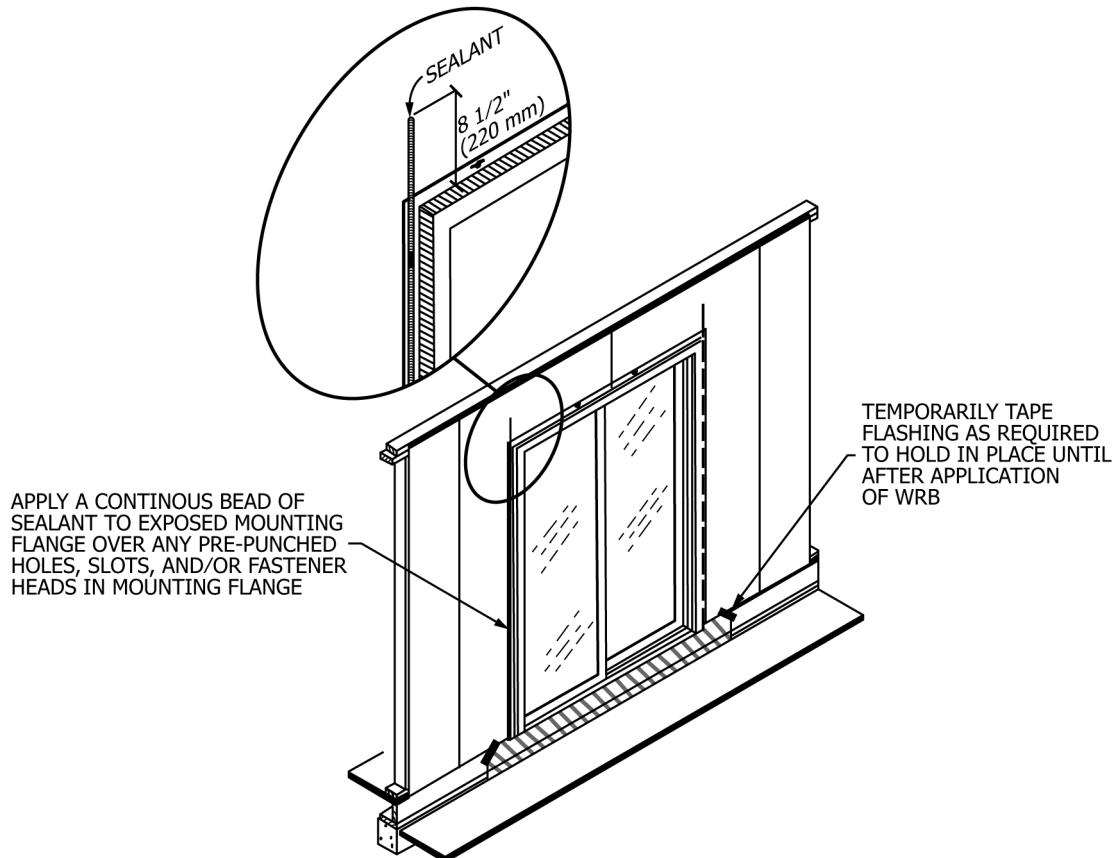
9.1.1.4.1.6 For doors with mechanically joined mounting flanges, apply sealant to the full length of the joints or seam where the mounting flanges meet the door frame and at the corner joints. (See Fig. 42.)

9.1.1.4.1.7 Step 4: Install the jamb flashings next, by pressing them into the sealant beads previously applied to the exterior face of the mounting flanges. Attach the flashing to the sheathing surrounding the rough opening using staples or other appropriate fasteners. Extend the bottom edge of the jamb flashing $8\frac{1}{2}$ in. (220 mm) beyond the rough opening sill, and extend the top edge $8\frac{1}{2}$ in. (220 mm) beyond the rough opening head. (See Fig. 43.)

NOTE 61—Do not attach the bottom of the jamb flashing until after the water-resistant barrier is applied later.

9.1.1.4.1.8 Step 5: Next apply a continuous bead of sealant to the exposed mounting flange (exterior surface) at the head of the installed door.

NOTE 62—Apply the sealant in line with the pre-punched holes or slots in the mounting flange when provided and over the heads of the fasteners. (See Fig. 44.) The application of sealant to the flange is not necessary if



NOTE 1—For Method A1 the water-resistive barrier has been installed. A flap at the head of the window has been temporarily taped out of the way to allow for flashing and door installation.

FIG. 42 Apply Sealant Over Mounting Flange at Jambs (Method A)

using self-adhesive type flashing over the mounting flange.

9.1.1.4.1.9 Step 6: Install the head flashing by pressing the flashing into the sealant beads previously applied across the mounting flange and 8½ in. (220 mm) above it. Press the bottom and top edges of the flashing into the sealant until it squeezes out at the edges of the flashing. This will ensure that no voids remain between the flashing and the mounting flange and between the flashing and the WRB. Extend the ends of the head flashing 10 in. (250 mm) beyond the rough opening, over the top of the jamb flashing. Fasten the head flashing along the top edge using staples or other appropriate fasteners (see Fig. 45). **(Warning)**—The building shall be constructed in a manner to secure or support the flashing to prevent destruction or displacement prior to installation of the water-resistive barrier. The flashing shall never be left unsupported and vulnerable to wind damage.)

NOTE 63—When used as part of the exterior wall system, install the water-resistive barrier as outlined below. Note that the application of the water-resistive barrier may be by trades other than the door installer. The contractor shall coordinate this work as required.

9.1.1.4.1.10 Step 7: When building paper is used, in water shedding fashion, starting at the base of the wall and working towards the top, install it onto the face of the building framing or sheathing. At the sill of the doors, tuck the building paper under the sill flashing and lower ends of the jamb flashing. Next, continue to apply the building paper in water shedding

fashion over the jamb flashing and over the head flashing of the doors (see Fig. 46). Attach the building paper to the sheathing using staples or other appropriate fasteners.

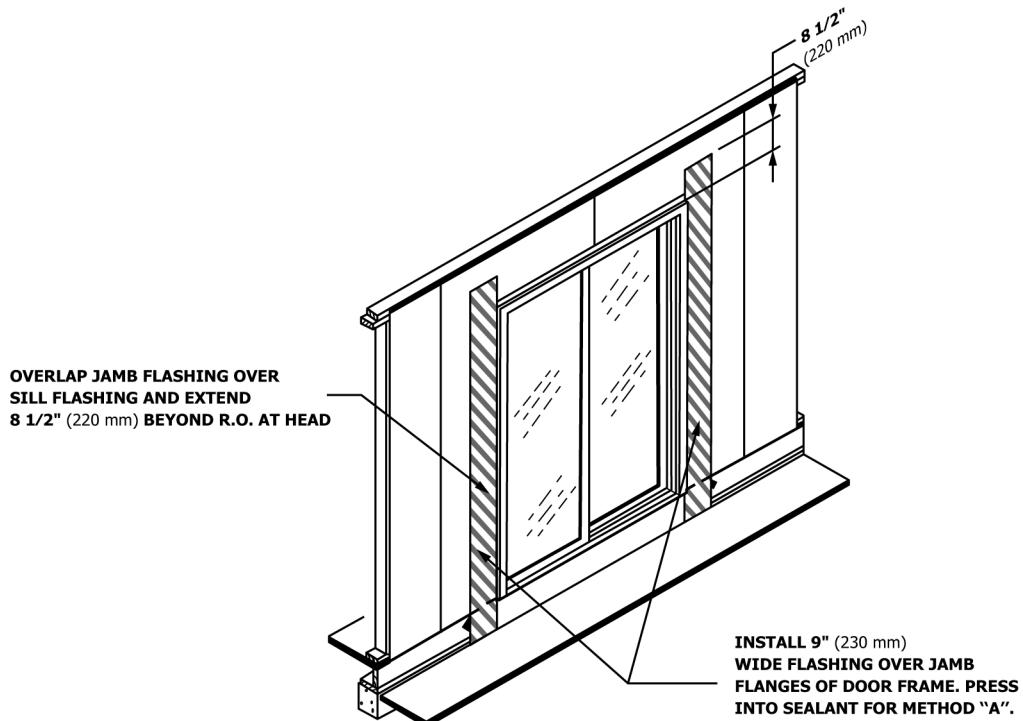
9.1.1.4.1.11 Step 7a: When one piece water-resistive barrier is used, install it under the sill flashing and over the jamb and head flashings as described above for building paper installation.

NOTE 64—Whenever applying the water-resistive barrier, flashing, or other materials do not penetrate the mounting flange with the fasteners.

9.1.1.4.2 Method B: Water-Resistive Barrier Applied after the Door Installation—Flashing Applied Behind the Face of the Mounting Flange:

9.1.1.4.2.1 Step 1: Assumes mounting flange on door sill. Go to step 12 or 16 for pan flashings or sealant-only method. Apply the horizontal sill flashing material first, level with the top edge of the rough opening. Cut the sill flashing long enough to cover the 9 in. (230 mm) jamb flashing, which will be applied later (see Fig. 13). Fasten the top edge of the sill flashing to the framing. Place fasteners along the edge of the rough opening where they will be covered by the mounting flange of the door later.

NOTE 65—Do not fasten the bottom edge of the sill flashing or the last 9 in. of each end, as the water-resistive barrier will be applied under the flashing in a water shedding fashion later. It is recommended that the corners and bottom edge be temporarily taped at 24 in. (600 mm) on center, to prevent wind damage.



NOTE 1—For Method A1, the water-resistive barrier has been installed. A flap at the head of the window has been temporarily taped out of the way to allow for flashing and door installation.

FIG. 43 Application of Jamb Flashing (Method A)

9.1.1.4.2.2 Step 1a: Assumes no sill mounting flange or use of pan flashing. Apply continuous sealant beads across the full floor length of the framed opening (or along the bottom of the door frame) at a location that will make contact with the door sill. Two $\frac{3}{8}$ in. (10 mm) diameter beads should be used. Deposit a sufficient amount of the sealant at the framed opening corners so the bottom door frame corners are embedded in sealant when the door is installed (see 5.18).

NOTE 66—All surfaces contacting sealant shall be free of dust and dirt prior to application of sealant. Sealant used shall be compatible with substrates both chemically and adhesively. See Annex A4.

9.1.1.4.2.3 Step 1b: Assumes no sill mounting flange, but uses pan flashing across the threshold. Apply two beads of continuous sealant as noted in Step 1a. Then apply a continuous pan flashing along full width of rough opening. Make sure each end of pan flashing is end dammed. See 5.16 through 5.16.2. The inside of pan flashing must have an air-infiltration seal or an upturned leg at a height selected from Annex A3, depending on door rating or grade used.

9.1.1.4.2.4 Step 2: Apply the jamb flashing to the edge of the framing at each jamb. Place fasteners along the edge of the rough opening where they will be covered by the jamb mounting flange of the door later. Extend the jamb flashing $8\frac{1}{2}$ in. (220 mm) beyond the rough opening at the head and sill. The bottom end of the jamb flashing must overlap the sill flashing.

NOTE 67—Do not attach the bottom of the jamb flashing until the water-resistive barrier is applied later. (See Fig. 46.)

9.1.1.4.2.5 Step 3: Apply a continuous bead of sealant around the full perimeter of the back side (interior surface) of

the door mounting flanges. Sealant selection and bead design shall be in accordance with 5.18 of the installation procedures.

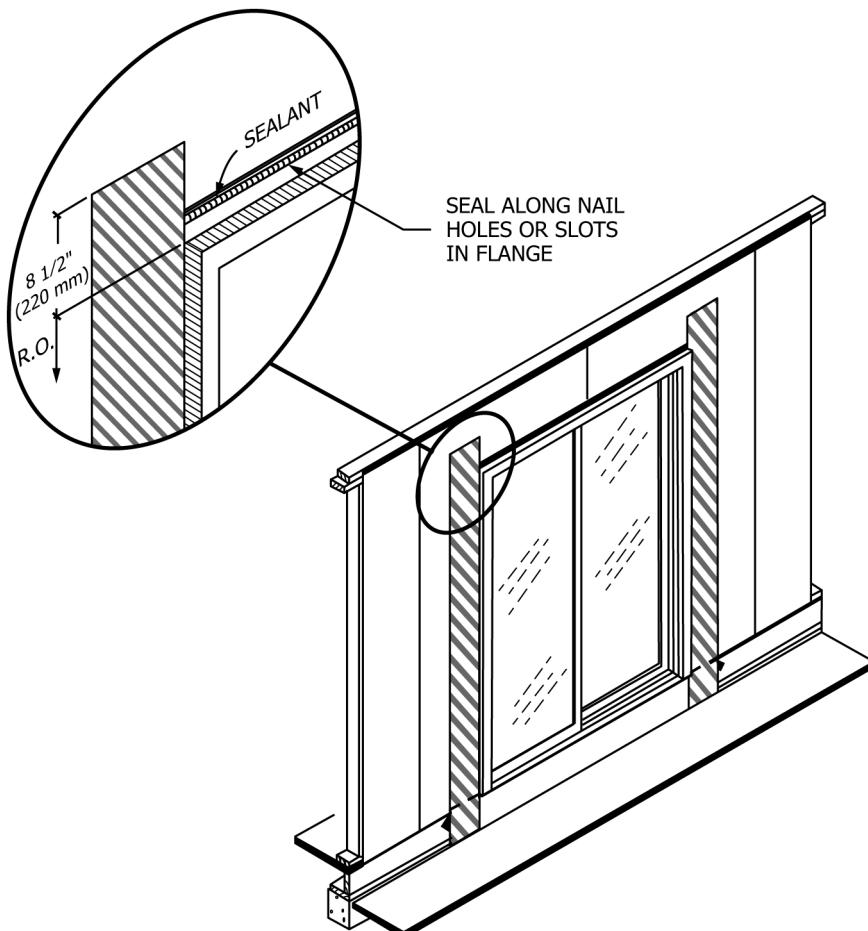
NOTE 68—Apply the sealant in line with the pre-punched holes or slots on the mounting flange when provided. Alternatively, you may seal around the entire perimeter of the opening at the location where the back side (interior surface) of the mounting flange will make contact with the perimeter seal. (See Fig. 47.) Where a pan flashing is used, the bead of sealant at the sill must have discontinuity in order to permit drainage from the sill pan to the exterior or drainage plane. See note after 5.18.8 for further explanation.

9.1.1.4.2.6 Step 4: Immediately install the door into the opening pressing the door against the framing to compress the sealant. Apply shims as required to ensure the unit is plumb, level, and square. Fasten the door perimeter securely into position as described in 5.14 and 5.15 of the installation procedures.

NOTE 69—Exercise caution to avoid disrupting the continuous seal. Always install the door immediately after the application of the sealant.

For doors with mechanically joined mounting flanges, apply sealant to the full length of the joinery or seam where the flanges meet (see Fig. 27).

9.1.1.4.2.7 Step 5: Apply a continuous bead of sealant horizontally across the face of the header at the top of the door rough opening and a continuous bead of sealant to the exposed mounting flange (exterior surface) at the head of the installed door. The sealant bead on the header should be placed in line with the top of the jamb flashing ($8\frac{1}{2}$ in. (220 mm) above the rough opening), so the top of the head flashing can be pressed into the sealant in the next step. Continue the sealant bead over the top edge (exterior side) of the jamb flashing in order to fully integrate the head and jamb flashing together (see Fig. 44).



NOTE 1—For Method A1, the water-resistive barrier has been installed. A flap at the head of the window has been temporarily taped out of the way to allow for flashing and door installation.

FIG. 44 Application of Sealant to Mounting Flange at Head (Method A)

NOTE 70—Apply the sealant in line with the pre-punched holes or slots in the mounting flange when provided and over the heads of the fasteners (see Fig. 48). The application of sealant to the flange is not necessary if using self-adhesive type flashing over the mounting flange.

9.1.1.4.2.8 Step 6: Install the head flashing by pressing the flashing into the sealant beads previously applied to the head mounting flange and 8½ in. (220 mm) above the rough opening. Press the bottom and top edge of the flashing into the sealant until it squeezes out at the edges of the flashing. This will ensure that no voids remain between the flashing and the header or mounting flange, which could potentially admit and trap water behind the flashing. Extend the ends of the head flashing 10 in. (250 mm) beyond the rough opening, over the top of the jamb flashing. Fasten the head flashing into place along the top edge using staples or other appropriate fasteners (see Fig. 45). **(Warning—**The building shall be constructed in a manner to secure or support the flashing to prevent its destruction or displacement prior to installation of the water-resistive barrier. The flashing shall never be left unsupported and vulnerable to wind damage.)

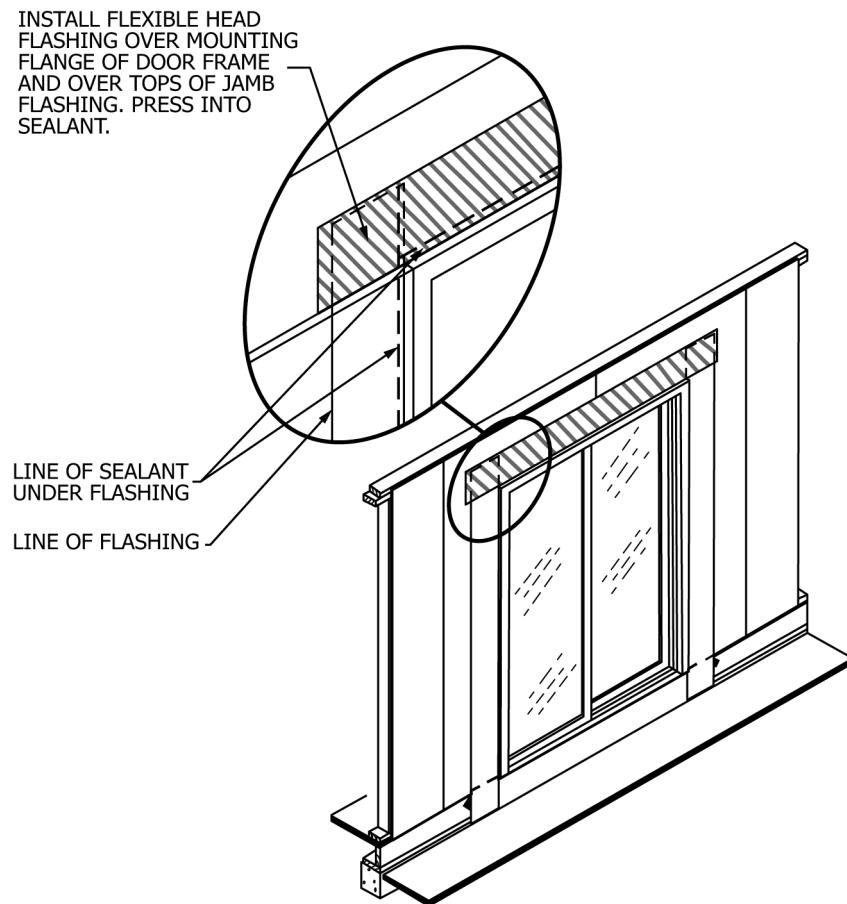
NOTE 71—When used as part of the exterior wall system, install the water-resistive barrier as outlined below. Note that the application of the water-resistive barrier may be by trades other than the door installer. The contractor shall coordinate this work as required.

9.1.1.4.2.9 Step 7: When building paper is used, in water shedding fashion, starting at the base of the wall and working towards the top, install it on to the face of the building framing or sheathing. At the sill of the doors, tuck the building paper under the sill flashing and lower ends of the jamb flashing. Next, continue to apply the building paper in water shedding fashion over the jamb flashing and over the head flashing of the doors (see Fig. 46). Attach the building paper to the sheathing using staples or other appropriate fasteners.

9.1.1.4.2.10 Step 7a: When one piece water-resistive barrier is used, install it under the sill flashing and over the jamb and head flashings as described above for building paper installation.

9.1.1.4.3 *Method A1: Water-Resistive Barrier Applied Prior to the Door Installation—Flashing Applied Over the Face of the Mounting Flange:*

9.1.1.4.3.1 Step 1: Where building paper is used as a water-resistive barrier, apply the barrier in water shedding fashion, starting at the base of the wall and working towards the top. Install the water-resistive barrier to the face of the building framing or sheathing flush with the rough opening of the door head, jambs, and sill. At the head of the opening, starting at the top corner of the door, measure from the corner



NOTE 1—For Method A1, the water-resistive barrier has been installed. A flap at the head of the window has been temporarily taped out of the way to allow for flashing and door installation.

FIG. 45 Application of Head Flashing (Method A)

9 in. (230 mm) up and 9 in. (230 mm) over and mark. At a 45° angle, carefully cut the building paper on a diagonal. Gently raise the top edge of the barrier up and temporarily tape the top corners and center to the exterior water-resistive barrier surface above. This is done in order to allow for installation of the door and flashing later. Once the building paper is applied as described in this step, proceed immediately to Step No. 2. Alternatively you can follow the same procedures as outlined for house wrap type water-resistive barrier below.

9.1.1.4.3.2 Where the water-resistive barrier used is a *house wrap* type material and covers the door, carefully cut the barrier in a modified "I" pattern. Fold the bottom and side flaps over and behind the interior side of the framing and secure with staples or other appropriate fasteners. Attach the barrier to the inside of the rough opening. At the head of the opening, starting at the top corner of the door, measure from the corner 9 in. (230 mm) up and 9 in. (230 mm) over from the door rough opening and mark. At a 45° angle, carefully cut the barrier on a diagonal as shown in [Fig. 49](#). Gently raise the top edge of the barrier up and temporarily tape the top corners and center to the exterior water-resistive barrier surface above. This is done in order to allow for installation of the door and flashing later.

9.1.1.4.3.3 Step 2: Apply the horizontal sill flashing material next, level with the top edge of the rough opening. Cut the sill

flashing long enough to extend to the edge of the 9 in. (230 mm) jamb flashings, which will be applied later. (See [Fig. 42](#).)

NOTE 72—Do not fasten the bottom edge of the sill flashing. It is recommended that the corners and bottom edge be taped at 24 in. (600 mm) on center, to prevent wind damage. Never apply the tape continuously, as this could potentially trap water behind the flashing.

9.1.1.4.3.4 Step 2a: Assumes no sill mounting flange or use of pan flashing. Apply continuous sealant beads across the full floor length of the framed opening (or along the bottom of the door frame) at a point that makes contact with the door sill. Two $\frac{3}{8}$ in. diameter beads should be used. Deposit a sufficient amount of the sealant at the framed opening corners so the bottom door frame corners are embedded in sealant when the door is installed. See [5.18](#) for sealant selection and use.

NOTE 73—All surfaces contacting sealant shall be free of dust and dirt prior to application of sealant. Sealant used shall be compatible with substrates both chemically and adhesively. See [Annex A4](#).

9.1.1.4.3.5 Step 2b: Assumes no sill mounting flange, but uses pan flashing across the threshold. Apply two beads of sealant as noted in 1a above. Then apply a continuous pan flashing along full width of rough opening. Make sure each end of pan flashing is end dammed. See [5.16](#) through [5.16.2](#). Inside

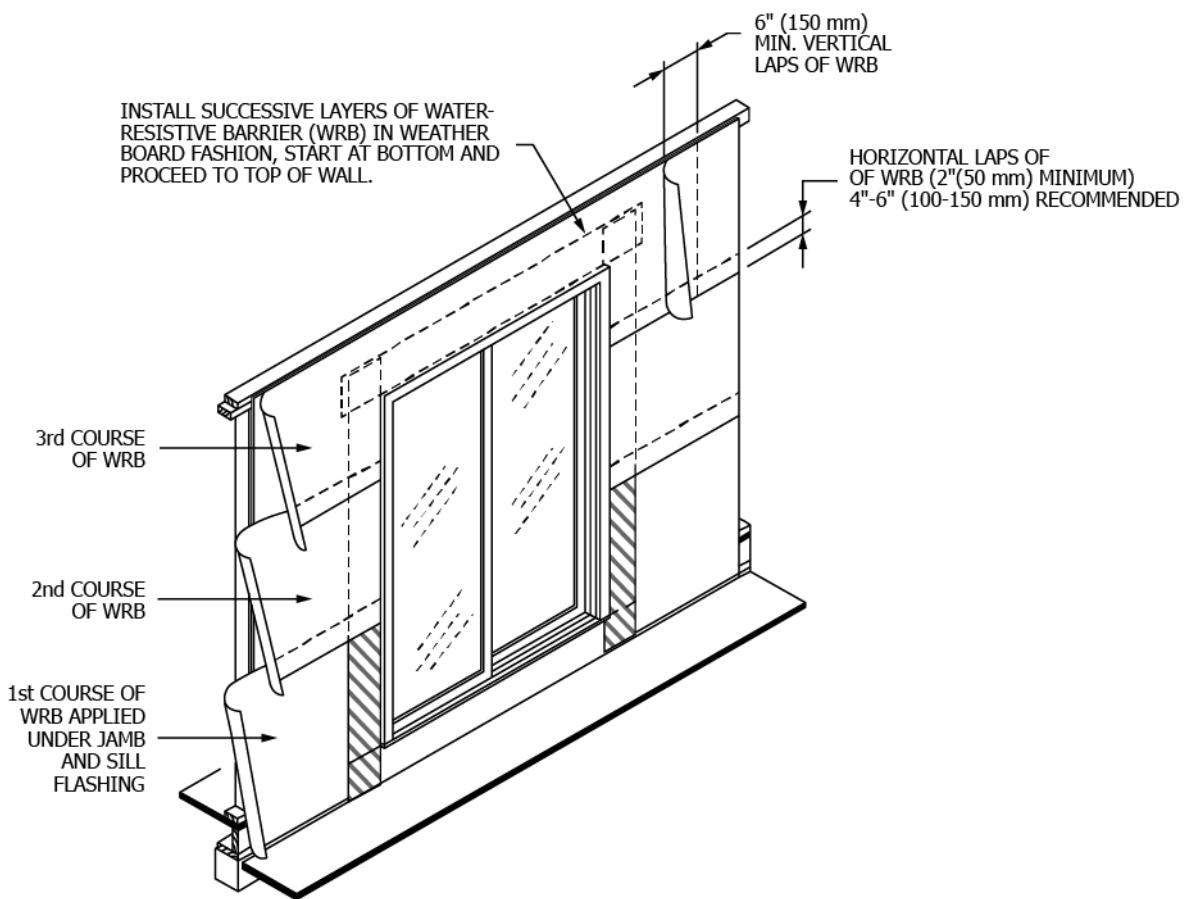


FIG. 46 Water-Resistive Barrier Application (Method A Shown-Method B Similar)

of pan flashing must have an air-filtration seal or an upturned leg at a height selected from [Annex A3](#), depending on door rating or grade used.

9.1.1.4.3.6 Step 3: Apply a continuous bead of sealant to the back side (interior surface) of the mounting flange of the door. Sealant selection and bead design shall be in accordance with [5.18](#) of the installation procedures. Immediately set the door into the opening, apply shims as required to ensure the unit is plumb, level, and square. Fasten the door perimeter securely into position as described in [5.14](#) and [5.15](#) of the installation procedures.

NOTE 74—Apply the sealant in line with the pre-punched holes or slots on the mounting flange when provided. (See [Fig. 48](#).) Where a pan flashing is used, the bead of sealant at the sill must have discontinuity in order to permit drainage from the sill pan to the exterior or drainage plane. See note after [5.18.8](#) for further explanation.

9.1.1.4.3.7 Step 4: Next, apply a continuous bead of sealant to the exposed mounting flanges (exterior surface) at the side jambs and head of the installed door. Continue the sealant bead at the jambs vertically 8½ in. (220 mm) above the rough opening at the head of the door (to the face of the header), to allow for application of the top portion of the jamb flashing into sealant in the next step.

NOTE 75—Apply the sealant in line with the pre-punched holes or slots on the mounting flange when provided and over the heads of the fasteners.

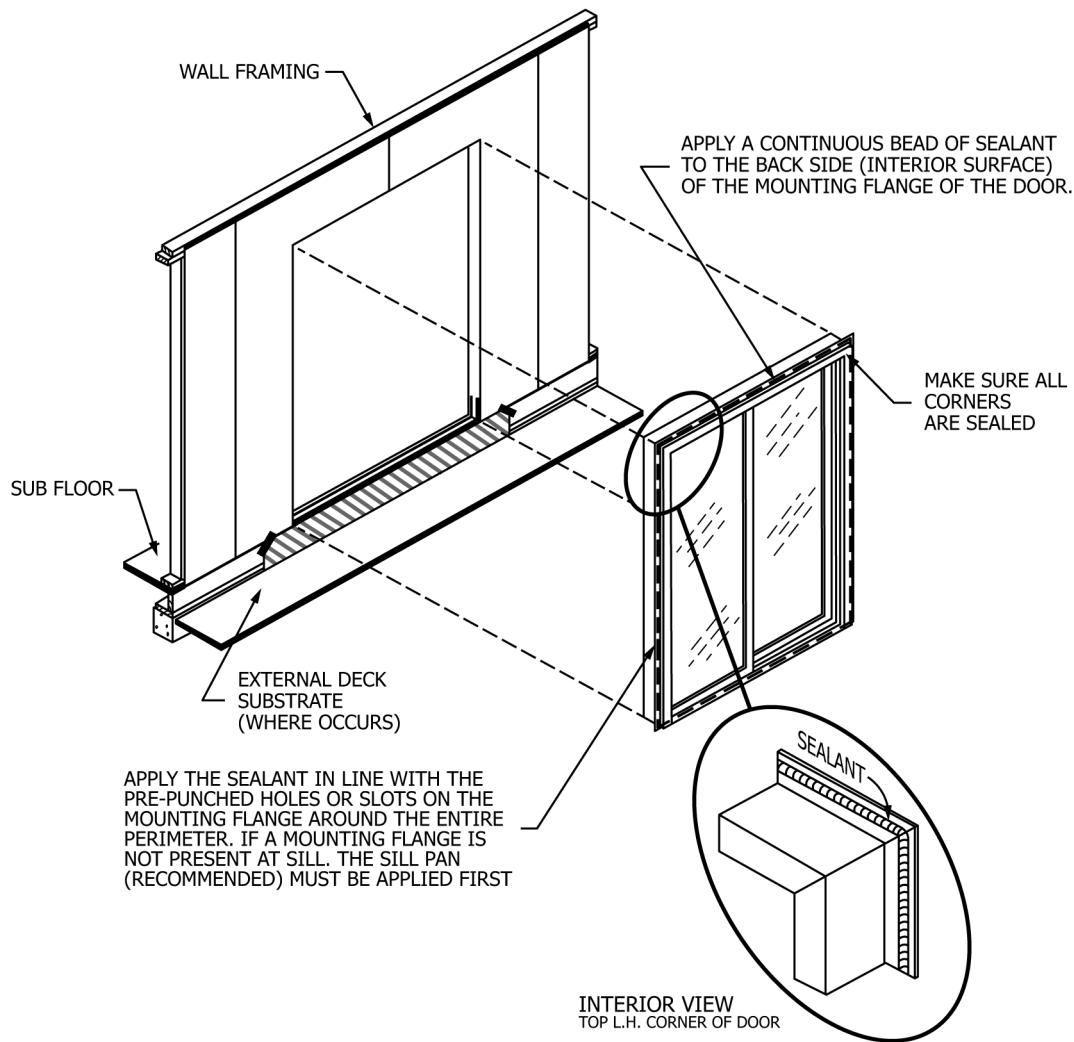
NOTE 76—The application of sealant to the flange is not necessary if using self-adhesive type flashing over the mounting flange.

9.1.1.4.3.8 For doors with mechanically joined mounting flanges, apply sealant to the full length of the joints or seam where the mounting flanges meet the door frame and at the corner joints. (See [Fig. 27](#).)

9.1.1.4.3.9 Step 5: Install the jamb flashing next, by pressing the flashing into the sealant beads on the mounting flanges. Attach the flashing to the rough opening framing using staples or other appropriate fasteners. Extend the bottom edge of the jamb flashing 8½ in. (220 mm) beyond the rough opening sill, and extend the top edge 8½ in. (220 mm) beyond the rough opening head, where the head flashing will be placed next. Tuck the top of the jamb flashing under the flap of the water-resistive barrier at the head (see [Fig. 42](#)).

9.1.1.4.3.10 Step 6: Apply a continuous bead of sealant horizontally across the face of the header at the top of the door rough opening and a continuous bead of sealant to the exposed mounting flange (exterior surface) at the head of the installed door. The sealant bead on the header should be placed in line with the top of the jamb flashing (8½ in. (220 mm) above the rough opening), so the top of the head flashing can be pressed into the sealant in the next step. Continue the sealant bead over the top edge (exterior side) of the jamb flashing in order to fully integrate the head and jamb flashing together (see [Fig. 44](#)).

NOTE 77—Apply the sealant in line with the pre-punched holes or slots in the mounting flange when provided and over the heads of the fasteners (see [Fig. 48](#)). The application of sealant to the flange is not necessary if using self-adhesive type flashing over the mounting flange.



NOTE 1—For Method A1, the water-resistive barrier has been installed. A flap at the head of the window has been temporarily taped out of the way to allow for flashing and door installation.

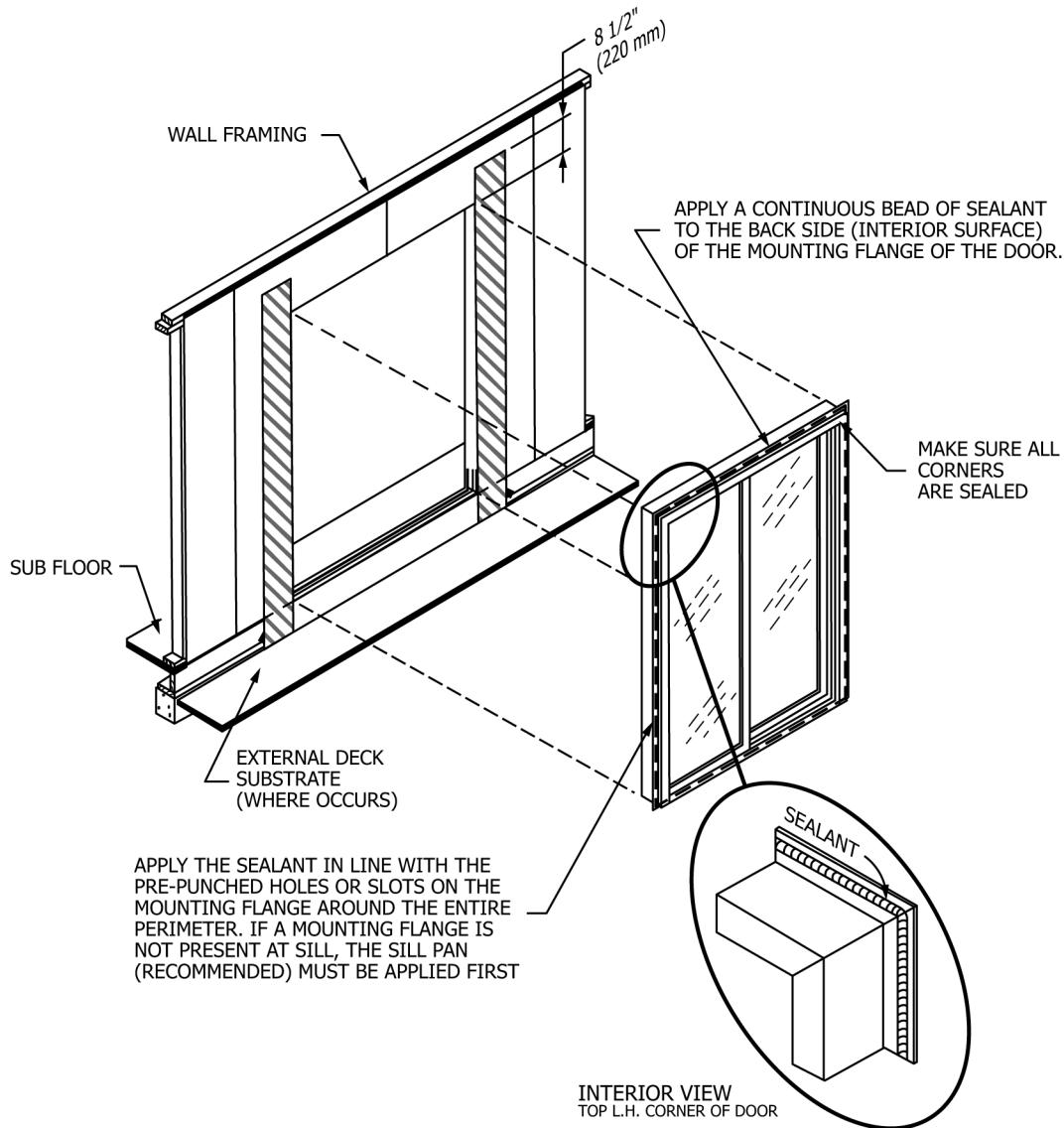
FIG. 47 Apply Sealant to Door and Install Sill Flashing (Method A Shown-Method B Similar)

9.1.1.4.3.11 Step 7: Install the head flashing by pressing the flashing into the sealant beads previously applied to the head mounting flange and 8½ in. (220 mm) above the rough opening. Press the bottom and top edge of the flashing into the sealant until it squeezes out at the edges of the flashing. This will ensure that no voids remain between the flashing and the header or mounting flange, which could potentially admit and trap water behind the flashing. Extend the ends of the head flashing 10 in. (250 mm) beyond the rough opening, over the top of the jamb flashing. Fasten the head flashing into place along the top edge using staples or other appropriate fasteners (see [Fig. 45](#)).

9.1.1.4.3.12 Step 8: Remove the previously applied tape, which holds the flap of the water-resistive barrier folded up at the head. Allow the flap to lay flat over the head flashing. Apply a new piece of sheathing tape over the entire diagonal cut made in the water-resistive barrier. The tape should be compressed against the water-resistive barrier and the head flashing, which extends over the jamb (see [Fig. 50](#)).

9.1.1.4.4 Method B1: Water-Resistive Barrier Applied Prior to the Door Installation—Flashing is Applied Behind the Mounting Flange:

9.1.1.4.4.1 Step 1: Where building paper is used as a water-resistive barrier, apply the barrier in water shedding fashion, starting at the base of the wall and working towards the top. Install the water-resistive barrier to the face of the building framing or sheathing flush with the rough opening of the door head, jambs and sill. At the head of the opening, starting at the top corner of the door, measure from the corner 9 in. (230 mm) up and 9 in. (230 mm) over and mark. At a 45° angle, carefully cut the barrier on a diagonal. Gently raise the top edge of the barrier up and temporarily tape the top corners and center to the exterior water-resistive barrier surface above. This is done in order to allow for installation of the door and flashing later. Once the building paper is applied as described in this step, proceed immediately to Step No. 2. Alternatively you can follow the same procedures as outlined for house wrap type water-resistive barrier below.



NOTE 1—For Method B1, the water-resistive barrier has been installed. A flap at the head of the window has been temporarily taped out of the way to allow for flashing and door installation.

FIG. 48 Application of Jamb Flashing and Door Installation (Method B)

9.1.1.4.4.2 Where the water-resistive barrier used is a *house wrap* type material and covers the door, carefully cut the barrier in a modified "I" pattern (see Fig. 49). Fold the bottom and side flaps over and behind the interior side of the framing and secure with staples or other appropriate fasteners to the interior surface of the wall around the rough opening.

9.1.1.4.4.3 At the head of the opening, starting at the top corner of the door, measure from the corner 9 in. (230 mm) up and 9 in. (230 mm) over and mark. At a 45° angle, carefully cut the WRB on a diagonal from the upper corner of the rough opening to the mark as shown in Fig. 49. Gently raise the top edge of the barrier up and tape the top corners and center to the exterior water-resistive barrier surface above. This is done in order to allow for installation of the door and flashing later.

9.1.1.4.4.4 Step 2: Apply the horizontal sill flashing material next, level with the top edge of the bottom member of the rough opening. Cut the sill flashing long enough to extend to

the outer edge of the 9 in. (230 mm) jamb flashing, which will be applied later. (See Fig. 13.) Fasten the top edge of the sill flashing to the framing. For non-adhered flashings, place fasteners along the edge of the rough opening where they will be covered by the sill mounting flange of the door later.

NOTE 78—Do not fasten the bottom edge of the sill flashing. It is recommended that the corners and bottom edge be taped at 24 in. on center, to prevent wind damage. Never apply the tape continuously as this could potentially trap water behind the flashing.

9.1.1.4.4.5 Step 2a. Assumes no sill mounting flange or the use of pan flashing. Apply continuous sealant beads across the full floor length of the framed opening (or along the bottom of the door frame) at a location that makes contact with the door sill. Use two (2) $\frac{3}{8}$ in. (10 mm) diameter beads. Deposit a sufficient amount of the sealant at the framed opening corners so the bottom door frame corners are embedded in sealant when the door is installed (see 5.18).

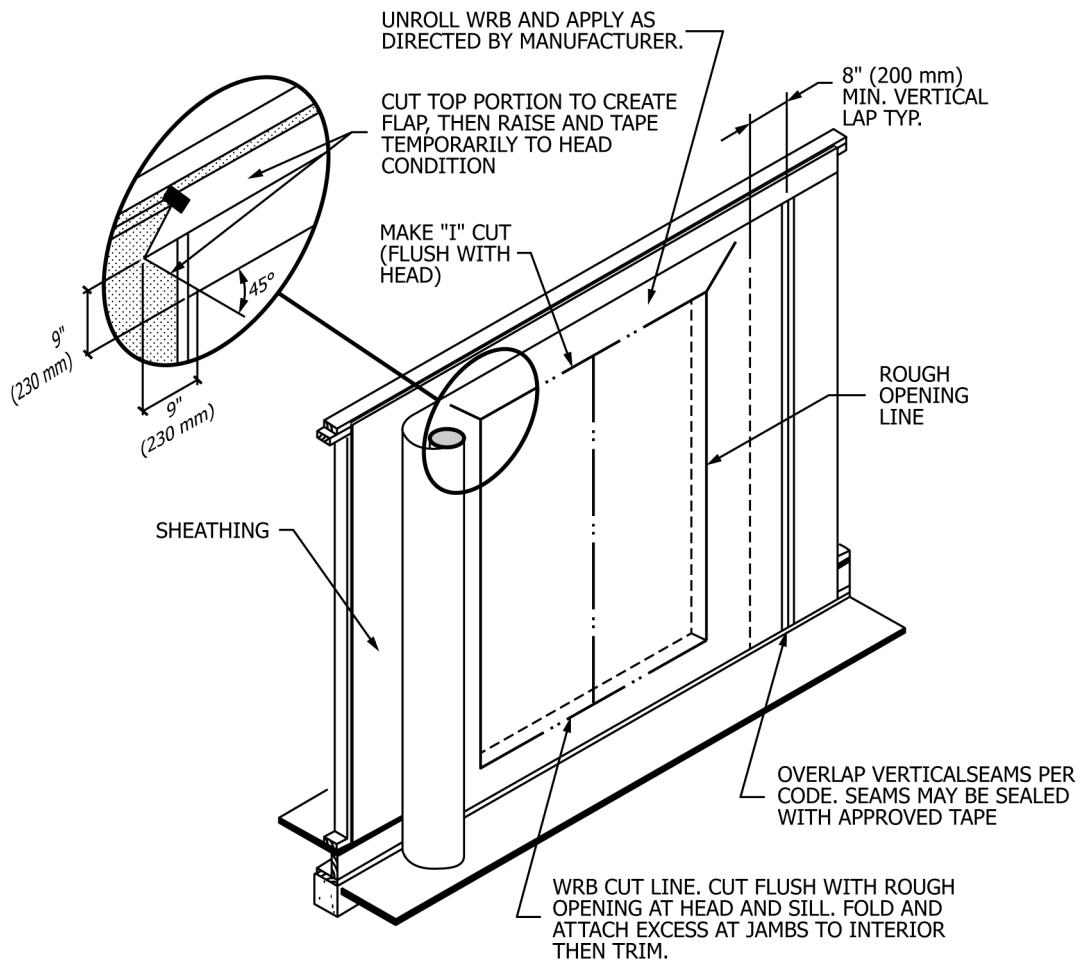


FIG. 49 Water-Resistive Barrier-House Wrap (Method A1 and B1)

NOTE 79—All surfaces contacting sealant shall be free of dust and dirt prior to application of sealant. Sealant used shall be compatible with substrates both chemically and adhesively (see [Annex A4](#)).

9.1.1.4.4.6 Step 2b: Assumes no sill mounting flange, but uses a pan flashing across the threshold. Apply two beads of sealant as noted in 1a above. Then apply a continuous pan flashing along full width of rough opening. Make sure each end of pan flashing is end dammed. See [5.16](#) through [5.16.2](#). Inside of pan flashing must have an upturned leg at a height selected from [Annex A3](#), depending on door rating or grade used.

9.1.1.4.4.7 Step 3: Apply the jamb flashing to the edge of the framing at each jamb. Place fasteners along the edge of the rough opening where they will be covered by the jamb mounting flange of the door later. Extend the jamb flashing 9 in. (230 mm) beyond the rough opening dimension at the head and sill. The bottom end of the jamb flashing is to overlap the sill flashing. The head flashing will overlap the top end of the jamb flashing. (See [Fig. 45](#).)

9.1.1.4.4.8 Step 4: Apply a continuous bead of sealant around the full perimeter of the back side (interior surface) of the door mounting flange near the outermost edge. Sealant selection and bead design shall be in accordance with [5.18](#) of the installation procedures.

NOTE 80—Apply the sealant in line with the pre-punched holes or slots

on the mounting flange when provided. Alternatively, you may seal around the entire perimeter of the opening at the point where the back side (interior surface) of the mounting flange will make contact with the perimeter seal. (See [Fig. 47](#).) Where a pan flashing is used, the bead of sealant at the sill must have discontinuity in order to permit drainage from the sill pan to the exterior or drainage plane. See note after [5.18.8](#) for further explanation.

9.1.1.4.4.9 Step 5: Immediately install the door into the opening pressing the door mounting flanges against the framing to compress the sealant. Apply shims as required to ensure the unit is plumb, level and square. Fasten the door perimeter securely into position as described in [5.14](#) and [5.15](#) of the installation procedures.

NOTE 81—Exercise caution to avoid disrupting the continuous seal. Always install the door immediately after the application of the sealant.

9.1.1.4.4.10 For doors with mechanically joined mounting flanges, apply sealant to the full length of the joinery seam where the flanges are attached to the frame and where the flanges meet at the corners. (See [Fig. 27](#).)

9.1.1.4.4.11 Step 6: Apply a continuous bead of sealant horizontally across the face of the header at the top of the door rough opening and a continuous bead of sealant to the exposed head mounting flange (exterior surface) at the head of the installed door. The sealant bead on the header should be placed

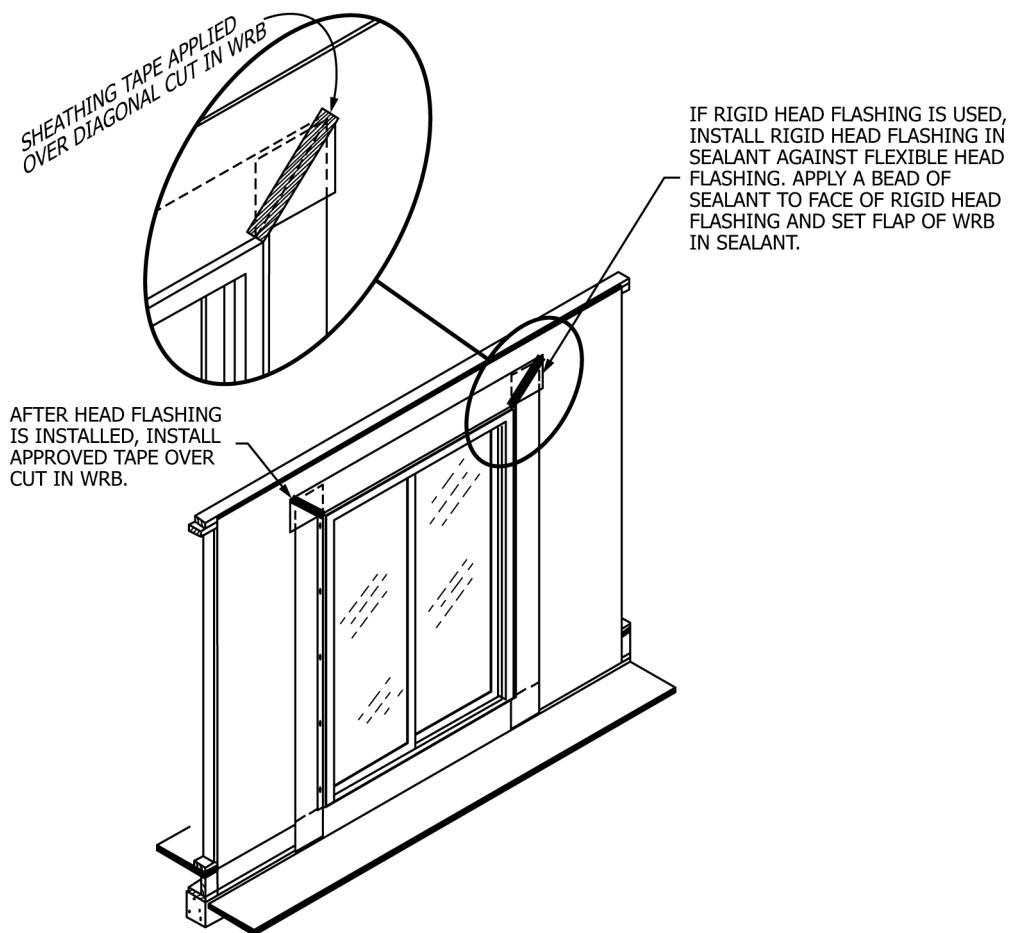


FIG. 50 Secure Water-Resistive Barrier at Head (Method A1 and B1)

in line with where the top of the head flashing will be placed (8½ in. (220 mm) above the rough opening), so the top of the flashing can be pressed into the sealant in the next step. Continue the sealant bead over the top edge (exterior side) of the jamb flashing in order to fully integrate the head and jamb flashing together. (See Figs. 44 and 45.)

NOTE 82—The application of sealant to the head mounting flange is not necessary if using self-adhesive type flashing over the mounting flange. Refer to 5.12.3.1.

NOTE 83—Apply the sealant in line with the pre-punched holes or slots in the mounting flange when provided and over the heads of the fasteners.

9.1.1.4.4.12 Step 7: Install the head flashing by pressing it into the sealant bead previously applied to the mounting flange. When applying the head flashing, press the top and bottom edge of the flashing into the sealant until the sealant appears at the edges of the flashing. This will ensure that no voids remain between the flashing and the header or mounting flange, which could potentially trap water behind the flashing. Extend the ends of the head flashing 10 in. (250 mm) beyond the rough opening, over the top of the jamb flashing. Fasten the head flashing into place along the top edge using staples or other appropriate fasteners. Attach the flashing along its top edge through the sealant bead under the flashing. (See Fig. 51.)

9.1.1.4.4.13 Step 8: Finally, remove the previously applied tape, which holds the flap of the water-resistive barrier folded up at the head. Allow the flap to lay flat over the head flashing.

Apply a new piece of sheathing tape over the entire diagonal cut made in the water-resistive barrier. The tape should be compressed against the water-resistive barrier and the head flashing which extends over the jamb.

9.1.2 *Hinged Swing Doors in Walls Utilizing a Membrane Drainage System*—The installer shall perform the following steps:

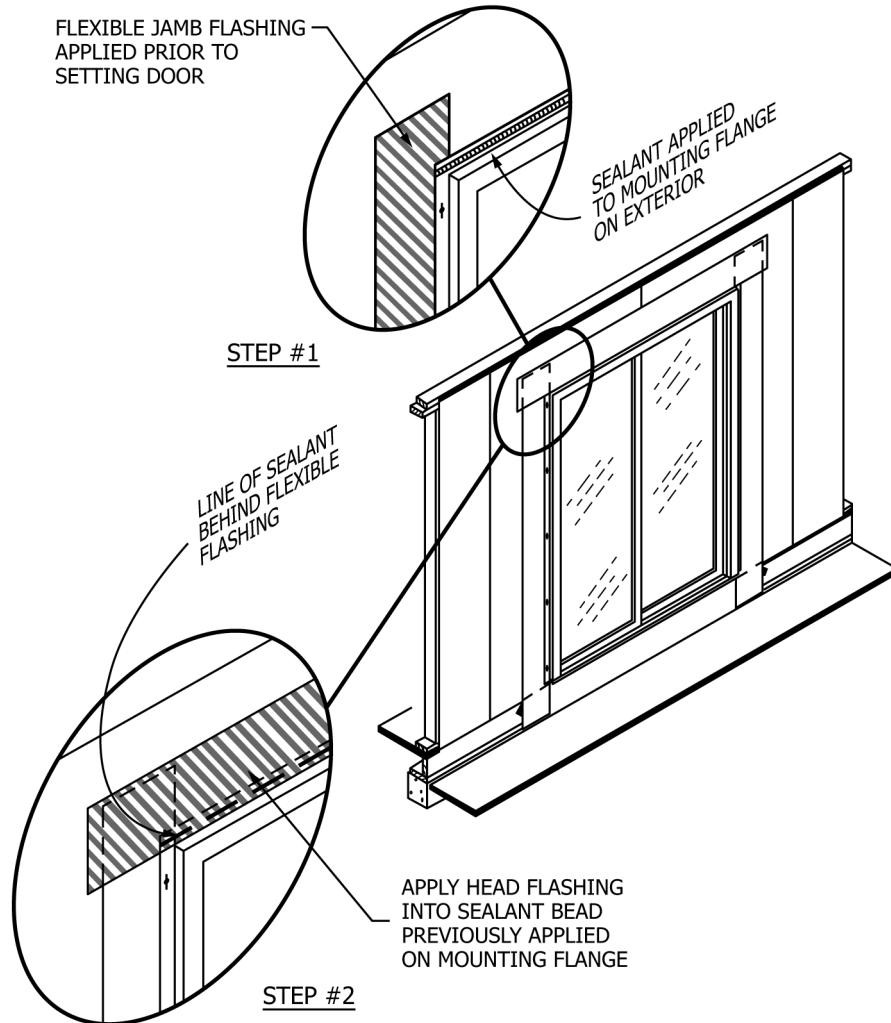
9.1.2.1 Check the rough opening: The floor and the header shall be level and true. If needed, level the sill using continuous wood blocking between the sill and the sub-floor. Do not use shims. The jambs shall be straight, plumb and square with the sill.

9.1.2.2 Diagonal measurements of the opening should be equal within ¼ in. (6 mm). Make sure that the rough opening dimensions are as the manufacturer recommends. Typically: Rough Opening Height = Door Frame Height plus ½ in. (12 mm).

Rough Opening Width = Door Frame Width plus ¾ in. (20 mm).

NOTE 84—It should be verified that sheathings, insulations, or other materials into or through which the fins are attached are appropriate for that use and that adequate structural support to the door is provided in accordance with 5.14.8. Refer also to 9.1.2.3 regarding door sill support.

9.1.2.3 Install wood blocking or metal sill support on the exterior of the box plate to support the outer edge of the door



NOTE 1—For Method B1, the water-resistive barrier has been installed. A flap at the head of the window has been temporarily taped out of the way to allow for flashing and door installation.

FIG. 51 Application of Head Flashing (Method B)

sill. Locate this blocking or sill support so that the upper edge is flush with the surface of the sub-floor.

9.1.2.4 Pan flashings are typically installed after installation of the water-resistive barrier and before the door is installed. See 5.16. They are placed at the sill of the rough opening, over the wrapped rough opening sill and jamb faces.

9.1.2.5 If the door uses a fin installation system, install (or bend up) fins according to manufacturer's instructions. Be sure to apply the fin corner sealing method recommended by the manufacturer. Flexible corner covers are provided by some manufacturers. Others give a recommended caulking procedure.

9.1.2.6 If door uses a clip installation system, install clips according to manufacturer's instructions. Note that it is more common to require closer clip spacing for a hinged door than for a window or sliding door, especially on the lock jamb. Caulk according to manufacturer's instructions at brick mould or drip cap.

9.1.2.7 Apply two beads of sealant to the sub-floor at location recommended by the manufacturer. These beads will be located so as to contact and seal the sill to the sub-floor (see Fig. 13).

9.1.2.8 Move the assembled and packaged door in front of the opening where it is to be installed and un-package it according to manufacturer's instructions. DO NOT remove bracing or spacers intended by the manufacturer to be left in place until the door is installed in the opening.

9.1.2.9 Set the door in the rough opening. Be careful not to smear the sealant on the sub-floor. The recommended method is for two installers to tip the top of the door away from the rough opening about 12 in. (300 mm) and gently set the sill into position. The top of the door may then be pivoted into place and secured temporarily with a nail or screw through the nailing fin or an installation clip.

9.1.2.10 Using at least a 4 ft (1.2 m) level, check that the sill is level and that both jambs are plumb. The door should also be

checked for squareness by measuring the diagonals. Diagonal measurements should be equal within $\frac{1}{8}$ in. (3 mm).

9.1.2.11 If the unit is not plumb and square, remove the temporary nail or screw and shift the frame until it is correct. Again temporarily secure the door, making sure that all corners are seated properly against the sheathing. An angle brace may be used on some products to hold them square until the installation is complete.

9.1.2.12 Open the hinged panel, remove any shipping spacers and re-close the panel. Just before the door panel is completely closed check for even contact between it and the weather-strip on the lock jamb and the head. If the door panel does not meet the weather-strip uniformly, the wall may be out of plumb and shall be realigned. Correct this situation before proceeding.

9.1.2.13 Check for uniform gap between door panel and frame. The gap should be approximately $\frac{1}{8}$ in. (3 mm) at the head and lock jamb (see manufacturer's instructions for specific recommendations).

9.1.2.14 Install shims between the door frame and framing studs. There shall be a shim at each hinge and the lock strike. If tapered shims are used, they shall be used in pairs with the taper pointing in opposite directions to make sure that the shim surfaces are parallel to prevent twisting the door frame. Install other shims as needed to keep jambs straight. DO NOT bow the frame.

9.1.2.15 When the door is square and plumb and the panel meets the weather strip properly, finish nailing or screwing the fins or installation clips into place. If brick mould is present it may be nailed at this time. EXERCISE CARE to ensure that you do not pull the frame out of its square, plumb and level condition when installing the nails or screws.

9.1.2.16 For doors hinged at the frame, many manufacturers supply one long screw for each hinge and one for the lock strike. If these are provided, drill a pilot hole at the open hole in each hinge or strike in to the stud and drive these screws into place. When installing these screws, EXERCISE CARE to ensure that you do not pull the frame out of its square, plumb and level condition.

9.1.2.17 At this point, if the operating clearances between the panel and the frame specified by the manufacturer have not been achieved, factory-installed shims under the hinges (if present) may be removed to achieve proper clearance. If clearances are too great, additional shims may be added.

9.1.2.18 If the manufacturer recommends caulking after installation, do so at this time. Install siding and apply sealant to the head and jambs of the door and the exterior siding. Be certain to seal the ends of the sill to support blocking and the siding.

NOTE 85—IMPORTANT: Do not plug weep holes.

9.1.2.19 Install hardware per the manufacturer's instructions.

9.1.2.20 Install screen door according to manufacturer's instructions.

9.1.2.21 If the door is not pre-finished, follow the manufacturer's instructions. Many manufacturer warranties are void unless finishing schedules are followed.

9.2 *Alternative Approved Installation Methods for the Installation of Doors*—Window & Door Industry associations have developed installation practices for specific door/wall combinations, and exposure conditions. The following documents provide alternative methods for specific conditions.

NOTE 86—The referenced documents are not exhaustive of all possible alternative methods for any specific condition.

9.2.1 *Extreme Wind/Water Conditions*—Certain climate regions, such as the Southeastern/Gulf and Northwest Coasts of the United States, are subject to extreme wind/water events such as tropical storms, hurricanes, and common occurrences of wind-driven rain greater than 70 mph. For installations of doors under these extreme conditions, the following standard practices are recommended for the specified door/wall condition:

9.2.1.1 *Membrane Drainage Wood Frame Construction*—FMA/AAMA/WDMA 300, Standard Practice for the Installation of Exterior Doors in Wood Frame Construction for Extreme Wind/Water Exposure.

9.2.1.2 *Masonry Construction with Surface Barrier Stucco Facade*—FMA/AAMA/WDMA 400, Standard Practice for the Installation of Exterior Doors for Surface Barrier Masonry Construction for Extreme Wind/Water Conditions.

10. Standard Practice for the Installation of Roof Windows and Skylights (Manufactured Sloped Fenestration Products)

Refer to and install roof window and skylight units in accordance with manufacturer's instructions. Prior to installation, determine from the manufacturer's instructions the proper rough opening size and orientation of the unit. A working knowledge of the different methods of installation and flashing of the sloped fenestration product unit will be beneficial prior to beginning any installation. (See AAMA/WDMA 1600/IS7).

There are four basic classifications of sloped fenestration products and four basic flashing methods. The sloped fenestration product classifications are Flush Mount (no curb), Curb Mounted (fabricated curb not included), Deck Mount (fabricated curb/mounting flange included) and Inset Mount (integral frame). The basic flashing methods are Installation with Mastic (Deck Mount), Aluminum/Copper Sheet (Curb/ Deck Mount/ Inset), Aluminum/Copper Step Flashing (Curb/Deck Mount/ Inset), and Membrane Roofing (All Types). (See Specification D2822/D2822M).

10.1 Product Types:

10.1.1 *Type 1 Flush Mount*—Fixed (non-operable) units designed for flush mounting. They are manufactured with or without integral condensation or weep gutters. They typically provide no means of carrying internal moisture to the exterior. They maybe furnished in multi-layer designs for the purposes of thermal improvement and minimizing condensation. (See Fig. 52.)

10.1.2 *Type 2 Curb Mount*—Fixed or operable units designed for mounting on a curb furnished by others. They may have condensation and weepage gutters and may provide a means of carrying internal moisture to the exterior. They may

TYPE 1

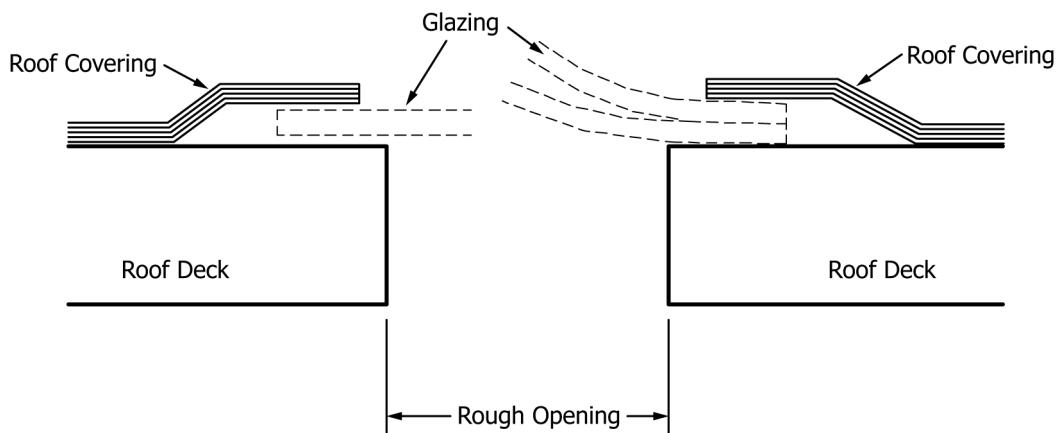


FIG. 52 Type 1-Flush Mount

be furnished in multi-layer designs for the purposes of thermal improvement and minimizing condensation. (See Fig. 53.)

10.1.3 *Type 3 Deck Mount*—Fixed or operable units supplied with a manufactured integral curb and a factory mounted flange, as a complete unit. They may have condensation and weepage gutters and may provide a means of carrying internal moisture to the exterior. They may be furnished in multi-layer designs for the purposes of thermal improvement and minimizing condensation. (See Fig. 54.)

10.1.4 *Type 4 Inset Mount*—Fixed or operable units with a manufactured integral curb. They may be mounted with the bottom of the curb at roof level or may mount inset into the rough opening. They may have condensation and weepage gutters and may provide a means of carrying the internal moisture to the exterior. They may be furnished in multi-layer designs for the purpose of thermal improvement and minimizing condensation. (See Fig. 55.)

10.2 Flashing Procedures:

NOTE 87—Acceptable-roofing practices should be followed at all times.

NOTE 88—Exercise caution to avoid penetrating any surface of the flashing material parallel to the plane of the roof. This includes, but not limited to, nails or screws used to fasten roofing material to the roof sheathing.

NOTE 89—In areas of snow accumulation and possible ice damming, the rough opening should be protected with a self-adhering adhesive membrane.

NOTE 90—A sheet metal water or snow diverter may be necessary on very shallow or steep roof with a large amount of roof area above the unit.

10.2.1 *Installation with Mastic*—This type of flashing installation is utilized with flush mount (Type 1) and Deck Mount (Type 3) sloped fenestration products.

10.2.2 *Flush Mount*—After the rough opening has been prepared, apply the mastic to the roof sheathing material, in a $\frac{1}{4}$ in. (6 mm) thick by 4 in. (100 mm) wide band around the

TYPE 2

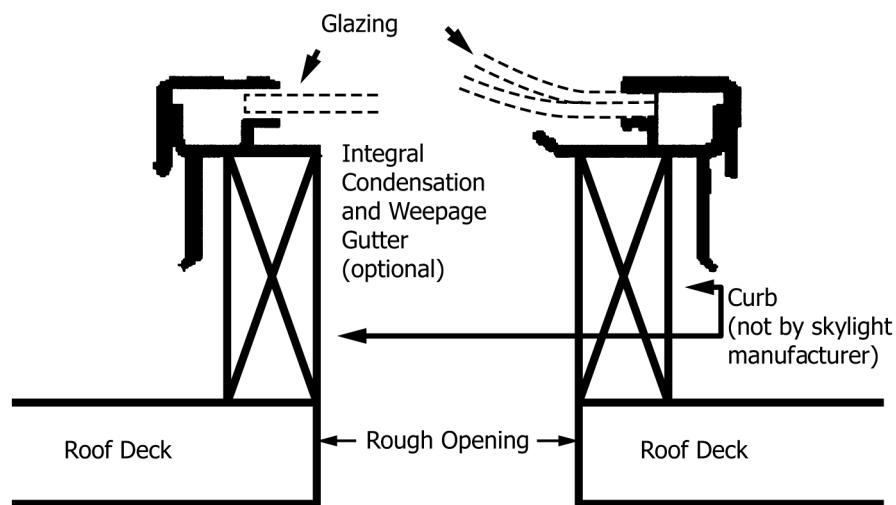


FIG. 53 Type 2-Curb Mount

TYPE 3

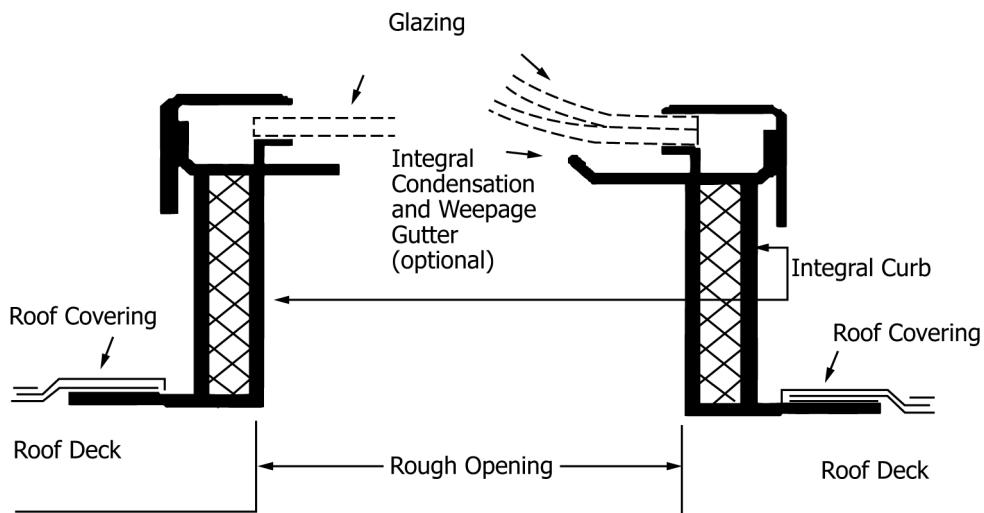


FIG. 54 Type 3-Deck Mount

TYPE 4

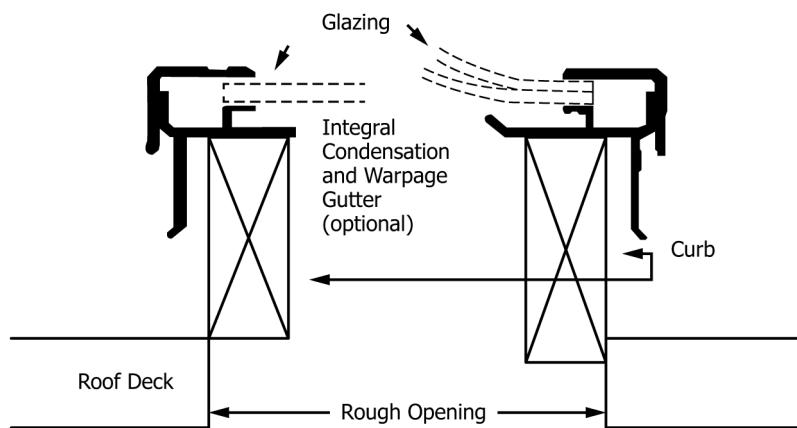


FIG. 55 Inset Mount

perimeter of the rough opening. Be sure to keep the mastic back $\frac{1}{2}$ in. (12 mm) from the rough opening. Use the mastic generously to ensure a watertight installation. After the sloped fenestration product has been mounted to the roof deck, install roofing material starting from the bottom of the unit and working toward the top. With the flush mount type product, the roofing material will be sealed to the flange of the unit with mastic. (See Fig. 56 and Fig. 57.)

10.2.3 *Deck Mount/Self Flashing Units*—Type 3 fenestration products with an integral curb and a factory-mounted flange should be sealed to the roof sheathing material with mastic. Apply the mastic in $\frac{1}{4}$ in. (6 mm) thick by 4 in. (100 mm) band around the perimeter of the rough opening. Be sure to keep the mastic $\frac{1}{2}$ in. (12 mm) back from the rough opening. Use the mastic generously to ensure a watertight installation. Once the sloped fenestration product has been mounted to the roof sheathing, the application of mastic over the flange, along the top and both sides, may be required in accordance with manufacturer's recommendations. The mastic,

when used, is to be placed in a 4 in. (100 mm) wide band, 2 in. (50 mm) on the flange and 2 in. (50 mm) on the roof sheathing. After the flange has been sealed to the roof sheathing and the roofing underlayment has been put in place, apply the roofing material starting from the bottom and proceeding to the top. Keep shingles back $\frac{1}{2}$ in. (12 mm) from the sides of the unit. The shingles/roofing material may be sealed to the flange with mastic as according to manufacturer's recommendations. If mastic is used on exterior surface of the flange and the roofing material, it shall not impede the watershed effect of the flange. (See Fig. 58 and Fig. 59.)

10.3 *Aluminum/Copper Sheet Flashing*—This type of flashing method is utilized with curb mount (Type 2), deck mount (Type 3) and inset mount (Type 4) sloped fenestration products. Flashing components are usually field fabricated. After the rough opening has been prepared, the curb is built in place (for Type 2) or the deck mount (Type 3) or inset (Type 4) unit is then mounted and secured over the rough opening. For deck

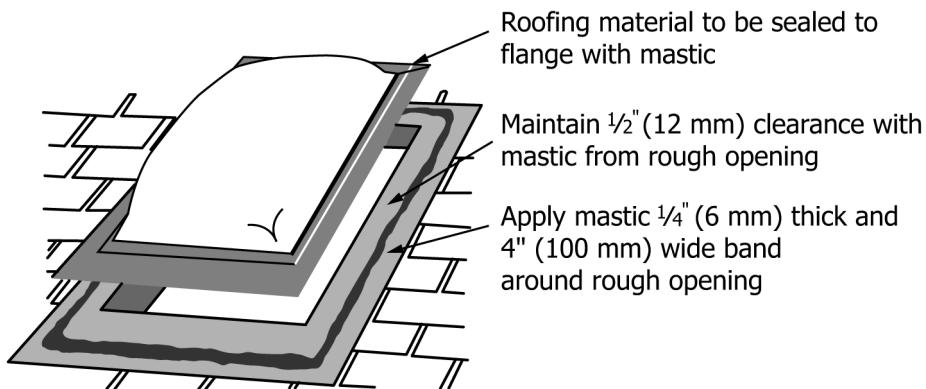


FIG. 56 Type 1 with Mastic

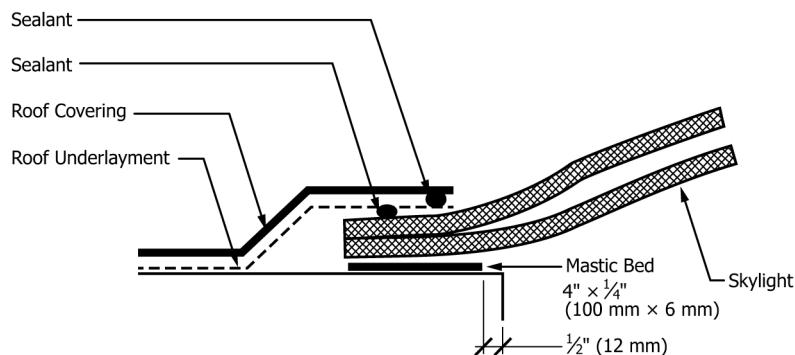


FIG. 57 Type 1, Flush Mount, Mastic

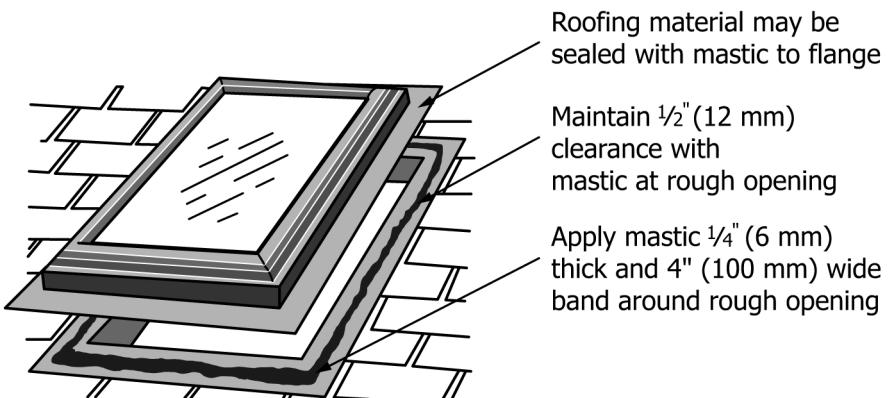


FIG. 58 Type 3, Skylight With Mastic

mount/self flashing units, the application of mastic over the flange may be required in accordance with manufacturer's installation instructions. Roofing felt should be extended up the curb or unit frame on all four sides. This will protect the rough opening from possible water penetration from intrusion of water under the roofing material.

10.3.1 Next, bring roofing material up to the bottom of the curb or unit frame. Fabricate the sill-flashing piece. The sill-flashing piece is to be installed on top on the roofing material in order to insure watershed effect. Corners of sill flashing should be watertight joints by using mastic, welding or

soldering of over lapping pieces. All pieces are to be fastened to the curb or roof sheathing, or both.

10.3.2 After installation of the sill flashing, continuous side flashing pieces are fabricated. These pieces should run the length of the curb or unit, over lap the sill-flashing piece and extend 6 in. (150 mm) above the top of the curb or unit. The side flashing pieces should be sealed with mastic to the sill-flashing piece where it overlaps. The sill-flashing piece shall be secured to the roof sheathing/curb/unit frame using acceptable roofing practices. Apply the roofing material up the sides and across the top of the curb or unit. (See Fig. 60.)

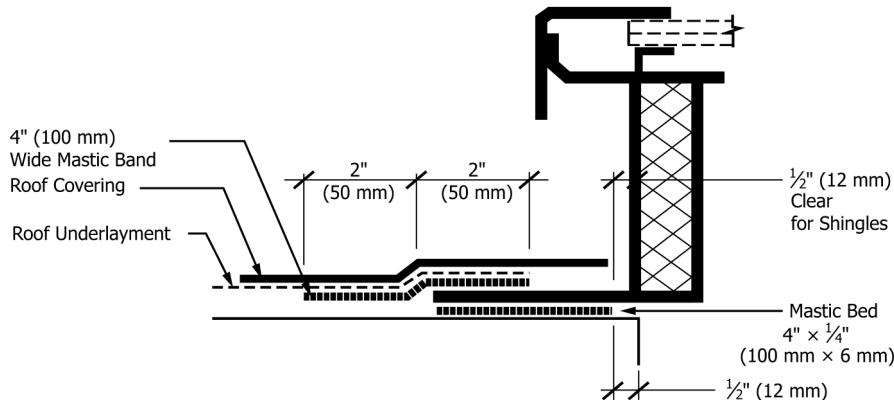


FIG. 59 Type 3, Integral Curb, Mastic

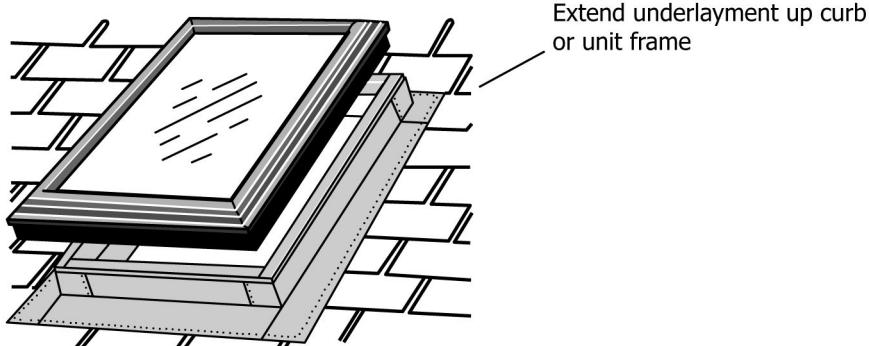


FIG. 60 Skylights with Sheet Flashing

NOTE 91—Roofing material should be sealed to the side flashing pieces with mastic according to manufacturer's recommendations.

10.3.3 Fabricate the head-flashing piece. The head flashing piece should overlap the side flashing pieces 6 in. (150 mm) and extend above the curb or unit at least 8 in. (200 mm). Corners of the head-flashing piece should be watertight joints by using mastics, welding or soldering of overlapping pieces. Corners that wrap around and overlap the side flashing pieces should be sealed with mastic. The head flashing piece extending above the curb or unit may be sealed to the roof sheathing with mastic or installed under the roofing felt to ensure proper

watershed effect of intrusion of water underneath the roofing material. Continue with the installation of the roofing material.

10.4 Aluminum/Copper Step Flashing (Field-Fabricated or Pre-Engineered)—This method of flashing is utilized with curb mount (Type 2), deck mount (Type 3) and inset (Type 4) sloped fenestration products. (See Figs. 61-63.)

10.4.1 After the rough opening has been prepared, the curb is built in place or the unit frame is mounted and secured over the rough opening. Roofing felt should be extended up the curb or unit frame on all four sides. This will protect the rough

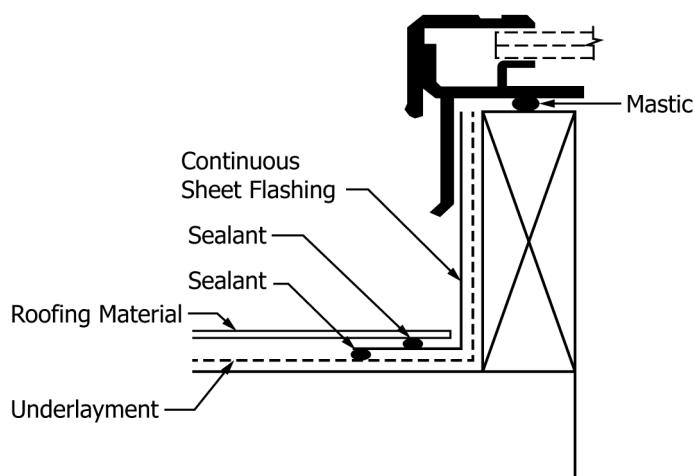


FIG. 61 Skylight with Sheet Flashing (Typical for Types 2, 3 and 4)

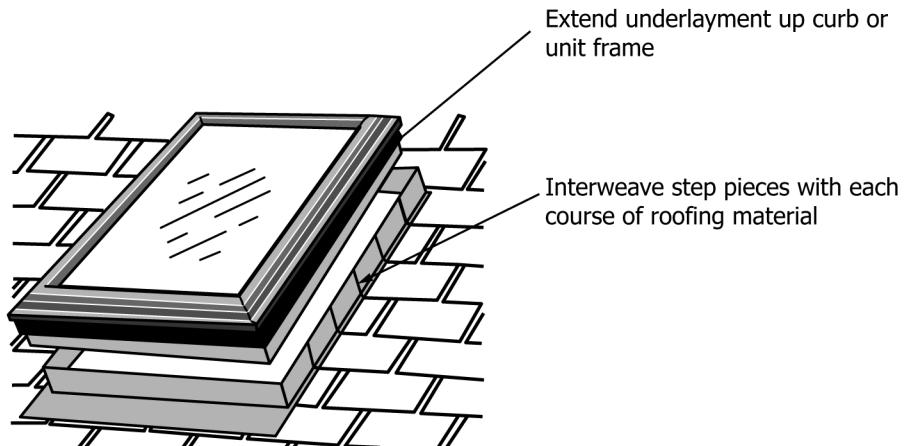


FIG. 62 Skylight With Step Flashing (Typical for Types 2, 3 and 4)

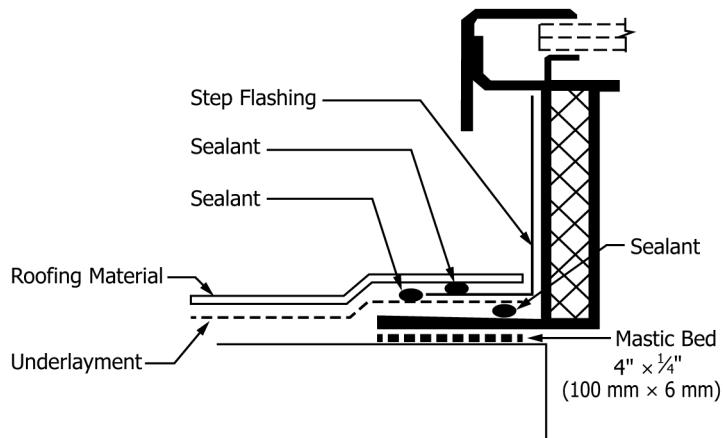


FIG. 63 Skylight with Step Sheet Flashing (Typical for Types 2, 3 and 4)

opening from possible water penetration from intrusion of water under the roofing material.

10.4.2 Bring roofing material up to the bottom of the curb or unit. Install the sill flashing piece, either field fabricated or pre-engineered. The sill flashing piece should be installed on top on the roofing material in order to ensure watershed effect. Corners of the fabricated sill-flashing piece should be watertight joints by using mastics, welding or soldering of overlapping pieces. Corner pieces that extend up the side frame of the curb or unit frame are to be installed in such fashion to interweave with continuing courses of roofing material and step flashing pieces. All pieces to be fastened to the curb or frame or roof sheathing, or a combination thereof, utilizing acceptable roofing practices or per manufacturers recommendations.

10.4.3 After installation of the sill-flashing piece, continue up both sides of the curb or unit frame, interweaving the step flashing pieces with the roofing material. Align the individual step-flashing piece with the shingle in accordance with acceptable roofing practices. Step flashing pieces to be fastened to the roof sheathing or unit frame, or both, or curb according to manufacturer's recommendation or in accordance with acceptable roofing practices.

10.4.4 Field-fabricate or install the pre-engineered head-flashing piece. The head-flashing piece should overlap the side flashing pieces a minimum of 6 in. (150 mm) and extend above the curb or unit at least 8 in. (200 mm). Corners of the fabricated head-flashing piece should be watertight joints by using mastics, welding or soldering of overlapping pieces. The head flashing section is to be installed in such a fashion so as to interweave with continuing courses of roofing material. The head-flashing section should be installed under the roofing felt to ensure watershed effect of intrusion of water underneath roofing material. All head-flashing pieces to be fastened to the curb or roof sheathing utilizing acceptable roofing practices or according to manufacturers recommendations.

10.5 *Membrane Flashing*—This method of flashing can be used with all four types of sloped fenestration products—Type 1 Flush Mount, Type 2 Curb Mount, Type 3 Deck Mount and Type 4 Inset.

10.5.1 Follow the flashing procedures for using mastic for Type 1 and Type 3 fenestration products, substituting a membrane tape for the mastic bed in methods shown in 10.2.2 and 10.2.3. See Fig. 64. It may also be recommended to extend the membrane material up the side of the curb or unit frame.

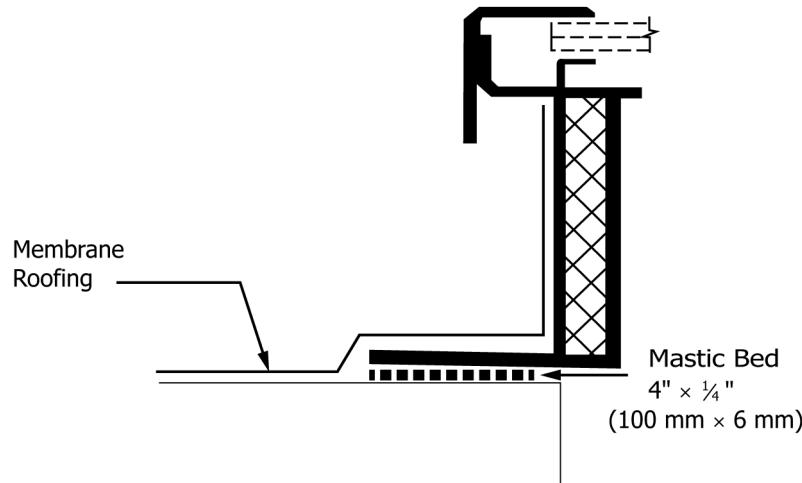


FIG. 64 Skylight With Membrane Roofing (Typical for Types 2, 3 and 4)

11. Post-Installation Procedures

11.1 The installer shall ensure that the fenestration product frame and sash are installed square, plumb and level within the specified tolerances.

11.2 If necessary to check all aspects of the installation, the installer shall remove all removable sash and screens. Any removed items shall be remounted or otherwise reinstalled by the installer prior to project completion.

11.3 *Check of Operable Elements*—The installer shall ensure that all sash move freely within their frames and that weather stripping or compressible seals make full contact with mating surfaces.

11.3.1 The installer shall ensure that operable hardware such as locks, cranks, latches and hinges, operate smoothly and that all locking mechanisms engage properly.

11.3.2 The installer shall ensure that all operable elements move freely and function correctly by operating the operable elements of the fenestration product and its hardware.

11.3.3 The installer shall ensure that all accessories and other components of the fenestration product assembly are present, such as screens and hardware.

11.3.4 Drainage holes shall be inspected for blockage and freed of any obstructions to allow drainage.

11.4 *Post-Installation Surface Care*—Exercise caution to avoid damage to fenestration products before and after installation. Many field-applied protective coatings can damage fenestration sealants, especially insulating glass sealants. Contact manufacturer before applying any such coatings. Brick wash (muriatic acid), which is commonly used to clean masonry, can etch glass and corrode hardware. Exterior surfaces of windows, doors and skylights should be poly-wrapped during masonry acid cleaning. Masking tapes may, when heated by sunlight, bake onto glass and frame surfaces, causing damage when they are removed. Stucco left to cure on frames and glass may scratch these surfaces when being removed. Glass and frame surfaces and hardware exposed to leaching water from new concrete or stucco shall be rinsed immediately with clear water to prevent permanent staining. See 5.10, Materials Protection.

11.4.1 Weather stripping, hardware components, tracks or vinyl components shall not be painted or stained.

11.4.2 Any chemicals, petroleum-based releasing agents or protective coatings made of petroleum or corrosive materials that are used in the installation of interior finishes or exterior cementitious products such as stucco or EIFS, shall not be applied to any portion of the fenestration product. These chemicals, agents and coatings could artificially age and deteriorate sealants, framing or other fenestration components.

11.5 Field Tests:

11.5.1 Building projects sometimes require testing of installed fenestration products either as a quality assurance procedure or as proof of compliance with project specifications. The test procedures used for field tests of air leakage and water penetration are defined in Test Methods E783 and E1105 respectively. AAMA 502-90 incorporates these test procedures, describes specimen selection and addresses methods for testing the product alone or the product including installation. The installer shall be familiar with these procedures and coordinate with and provide assistance to the general contractor when field testing of fenestration products is specified.

11.5.2 At the completion of installation and following all post-installation checks and testing, the installer shall deliver to the owner or owner's agent any and all materials related to the fenestration product. These materials include, but are not limited to: keys; extra hardware accessories; warranty materials; owner's guides; care and treatment specifications; and other related materials. (See Test Methods E283, E331, and E547).

12. Keywords

12.1 barrier system; continuity of water-resistive barrier; door anchorage, window; door flashing, window; door installation; door perimeter sealing; liquid-applied flashing; membrane drainage wall system, window; self-adhered flashing (SAF); skylight installation; water-resistive barrier; weather resistance; window installation

ANNEXES

(Mandatory Information)

A1. LOW PRESSURE AEROSOL FOAM SEALANTS AND PRE-COMPRESSED FOAM TAPES USED FOR AIR CONTROL IN THE ROUGH OPENING GAP

Type A Material = Aerosol Foam Sealants

Type B Material = Pre-Compressed Cellular Tapes

A1.1 Definitions:

A1.1.1 *sealant, aerosol foam, n*—in building construction, a foamed compound that is dispensed under pressure from a container.

A1.1.2 *cellular pre-compressed (open cell) impregnated tapes, n*—in building construction, a material supplied pre-compressed that expands in a joint to its original volume to form a seal.

NOTE A1.1—The air seal material is typically supplied in stick and roll form. The foam may be available from the manufacturer with or without a pressure sensitive adhesive surface on one side.

A1.2 Low-Pressure foam sealants (Type A) and Low Pressure pre-compressed cellular (Type B) tapes are used to insulate and reduce air leakage through the rough opening gap. When using these seals and sealants, the installer should consider the following factors prior to installation:

A1.2.1 “Low Pressure” refers to type A and B material and is the force exerted by the material on the fenestration frame during its curing time and or recovery time.

A1.2.2 Choose a low-pressure aerosol foam sealant or low pressure pre-compressed foam tape.

A1.2.3 Select a material that provides an airtight seal of the gap.

A1.2.4 The foam applicator for aerosol foam sealant should be controllable in terms of foam volume and foaming rate (see Figs. A1.1 and A1.2).

A1.2.5 The gap should not be overfilled.

A1.2.6 A suitable installed foam (Type A or B) fill should not distort the fenestration frame more than $\frac{1}{16}$ in. (1.5 mm) along any side. Before any material is used to fill the rough opening gap, test the window for ease of operation and cut off the excess portions of the shims.

A1.3 Fenestration Product Applications:

A1.3.1 Follow the fenestration manufacturers installation instructions taking special care with shimming and squaring of the fixtures. Trim and caulk around shims before foaming. In cases where no nailing flange is used, apply caulking at the exterior shim location before capping or installing exterior wall cladding material. Foam or apply pre-compressed tape tightly up to the shims to link with caulking. (Note: Consult the fenestration product manufacturer’s recommendation for filling the rough opening gap prior to application.) **(Warning—**

Compatibility with adjacent materials shall be verified by the manufacturers of the foam or tape.)

A1.3.2 Before and after tape installation or foam application, and at all stages of the installation, check to ensure the fenestration product operates properly. Do not foam or continue foam application/installing pre-compressed tape unless the window or door easily opens and closes. The window or door shall be closed during installation of Type A or B materials.

A1.3.3 If not familiar with a product then prior to applying the foam, dispense several beads onto drop cloth or newspaper to become familiar with the volume and flow rate of the foam. Allowing the bead to cure will indicate to the installer how much expansion to expect. Material Type B should be unwound and a small piece cut off to familiarize the user with the direction of tape recovery.

A1.3.4 The rough opening gap should be at least wide enough to permit insertion of the barrel of the foam applicator for Type A material. Gaps smaller than that recommended by the foam manufacturer should be sealed only at the interior face of the gap with a minimal size bead.

A1.3.5 Foam between the new frame and the old frame in a replacement window application (see Fig. A1.3).

A1.3.6 If the rough opening gap is overfilled, preventing the installation of trim members, the foam must be trimmed to remove the excess. Type A material must be manually removed using a sharp knife after it cures.

A1.3.7 If the rough opening gap is over 2 in. (50 mm) deep, the installer may decide to inject a second optional bead of Type A foam around the entire fenestration product perimeter creating an air sandwich (see Note A1.2). The first bead is allowed to become tack-free (at least 10 min) before the second bead is applied. On some fenestration products, one bead is applied from the outside and another from the inside. If windows are flanged, both beads are applied from the inside leaving an air gap between them (see Fig. A1.4).

A1.3.8 Type B material is supplied in various widths to accommodate rough opening depths that exceed 2 in. Some configurations of Type B materials require the material to be adhered on the perimeter of the window frame. Application of these pre-compressed tapes to the fenestration frame shall be placed flush to the back of the nailing flange prior to mounting the window in the rough opening (see Figs. A1.6-A1.8). A $\frac{1}{32}$ in. (5.5 mm) clearance between the fenestration frame and

the wall framing on each side of the rough opening is required when using type B materials. The installer should follow the installation instructions from the sealant manufacturer for proper operation of these Type B materials. A second run of tape can be installed if jamb extensions are utilized. The second pass can be applied after the jamb extensions are applied from the inside leaving an air gap between the Type B materials (see [Fig. A1.9](#)). Type B material can be cut and recessed into the shim space using a putty knife or box cutter (see [Fig. A1.10](#)). Type B material can be covered with an interior trim piece immediately after installation.

A1.4 Precautions:

A1.4.1 DO NOT OVERFILL THE CAVITY. With Type A material, allow for foam expansion during cure.

A1.4.2 If foam or tape is used between pan flashing and the window or door, the exterior foam bead/tape shall not distort the pan or obstruct proper drainage.

A1.4.3 Wait until foam has cured when using Type A material (consult manufacturer's recommendation) before cutting excess foam flush with wall and installing trim (see [Fig. A1.5](#)). Check operation of window or door one final time. **(Warning—**Foam cleaners or solvents may not be compatible with all fenestration materials. Consult the fenestration manufacturers' recommendations before using cleaners on fenestration products.)

A1.4.4 At the head rough opening gap, the installer should apply a single bead of foam sealant just sufficient to air-seal this area. This technique reduces the downward force transmitted to the head jamb of the window should the structural header tend to sag over time.

NOTE A1.2—Consult the fenestration product manufacturer's recommendation for filling the rough opening gap prior to application.

NOTE A1.3—For access reasons, some type B material must be installed prior to the fenestration product being fastened in the rough opening.



FIG. A1.1 Application of Aerosol Foam Sealant (Type A Material) In Cavity Between Window Frame and Rough Opening

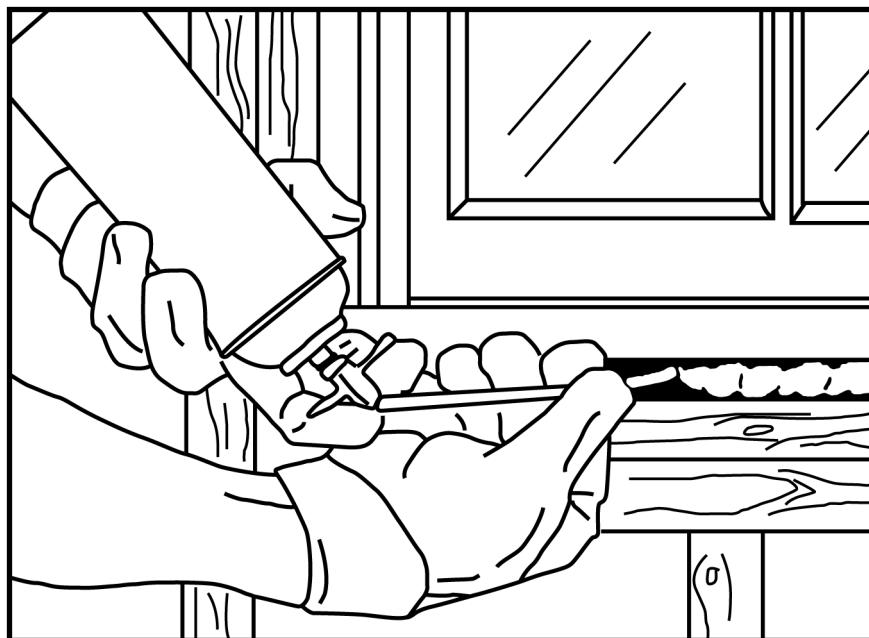


FIG. A1.2 Straw Applicator Type A Material

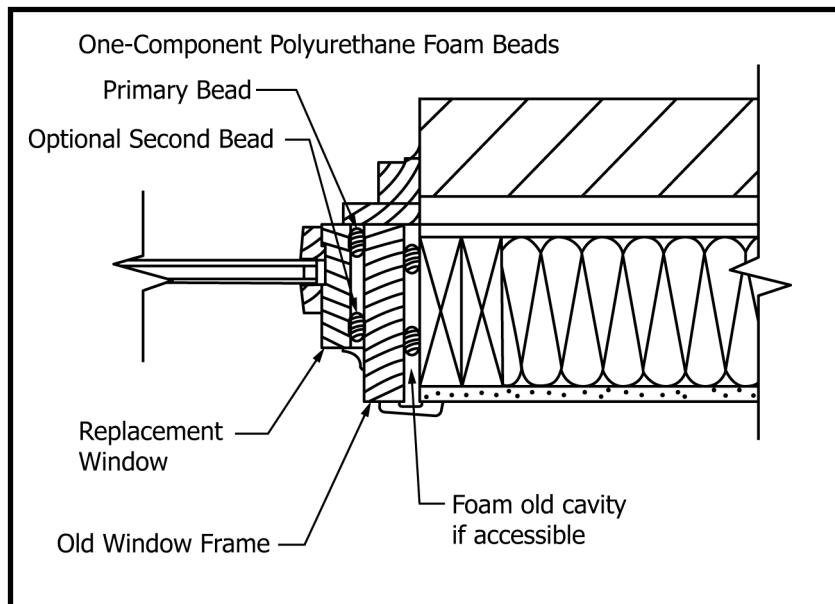


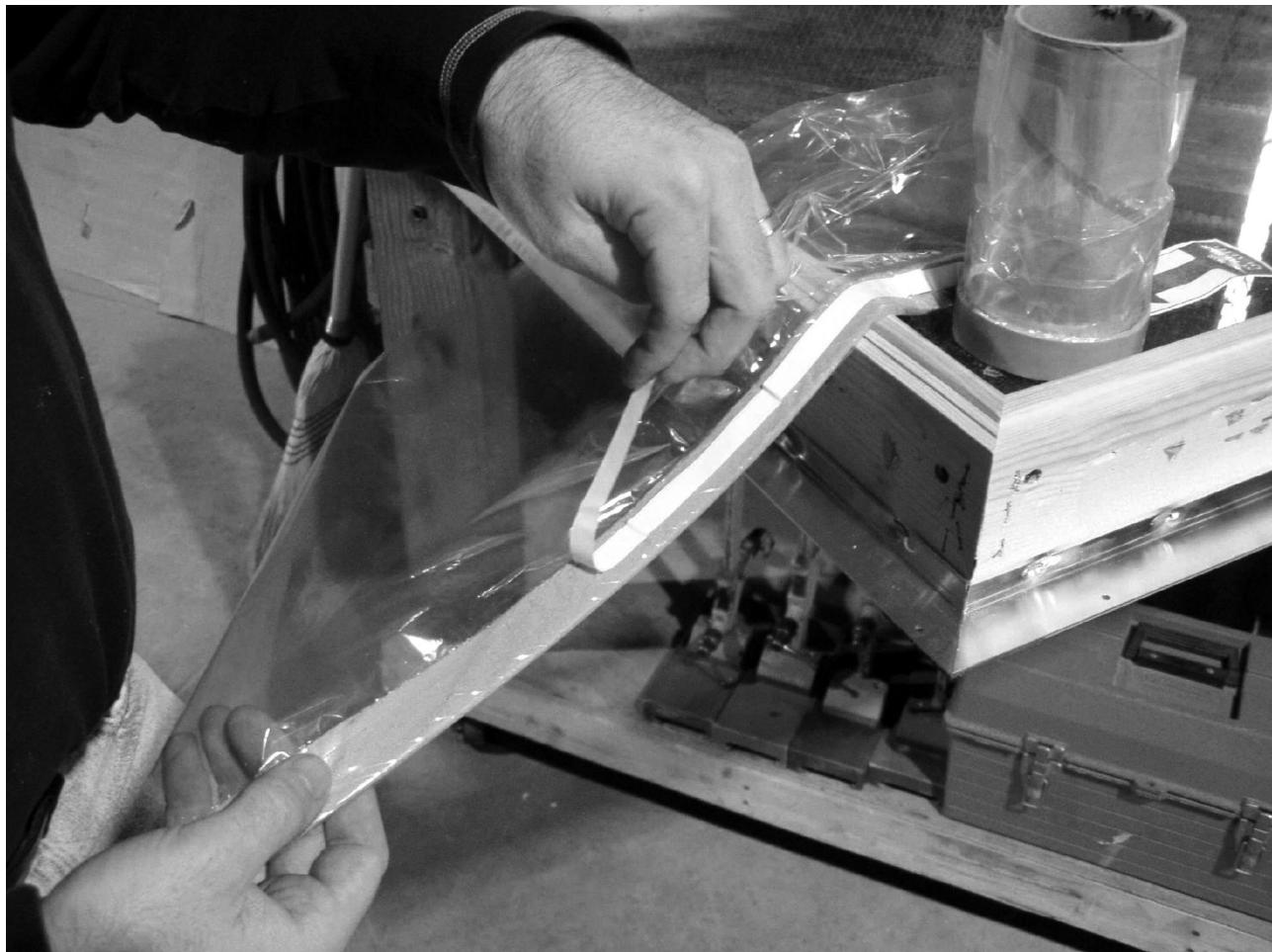
FIG. A1.3 Locations for Type A Material with Replacement Window



FIG. A1.4 Optional Second Bead Approach for Type A Material



FIG. A1.5 Excess Type A Material Trimmed with a Sharp Knife



NOTE 1—Install Type B materials around the head and jamb conditions flush to the backside of finned units. For access reasons, some type B material must be installed prior to the fenestration product being fastened in the rough opening. First remove the release liner from the pre-compressed tape.

FIG. A1.6 Type B Material Release Liner Removed from Tape



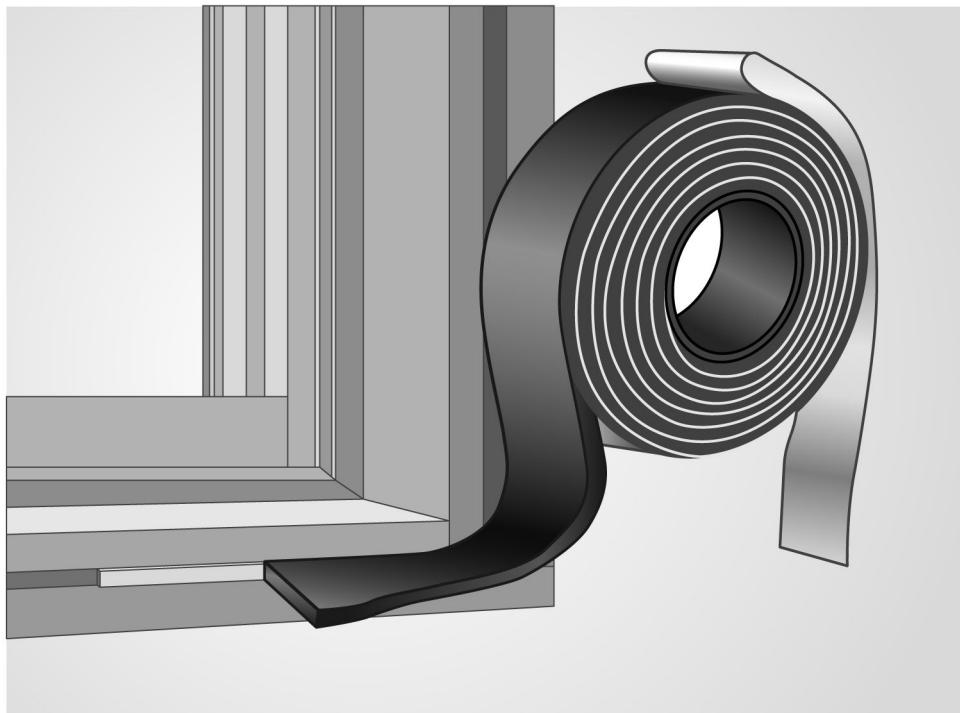
NOTE 1—Apply the tape with the pressure-sensitive adhesive side adhered to the frame of the fenestration product; keep the tape continuous around frame corners.

FIG. A1.7 Type B Material Applied to Window Frame



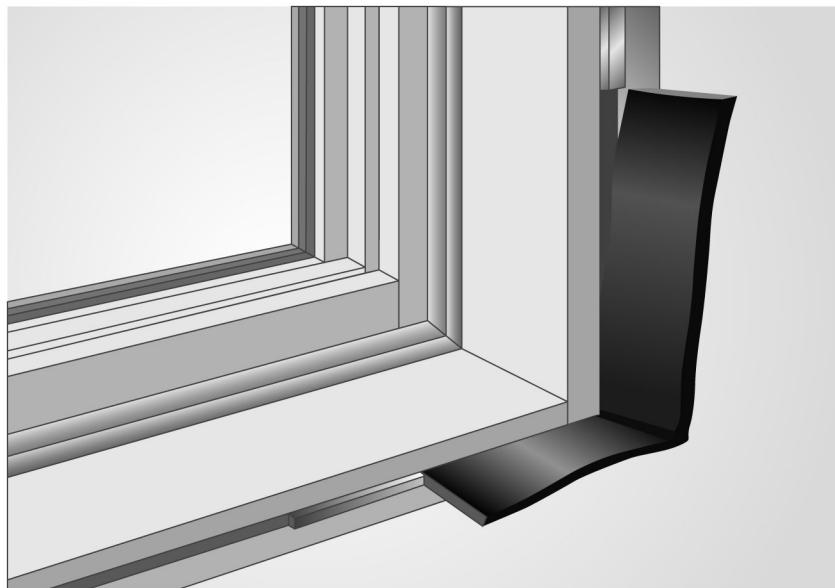
NOTE 1—Fold the poly to the interior side of the fenestration product. Pull the poly release after the fenestration product has been fastened in the rough opening to fill the rough opening gap with the pre-compressed tape.

FIG. A1.8 Type B Material Applied with Polyethelene Liner



NOTE 1—Installation of an optional second pass of tape can be installed to the interior side of the rough opening gap between the jamb extension and the stud.

FIG. A1.9 Type B Material Applied After Fenestration Frame



NOTE 1—Some Type B materials are pre-compressed to $\frac{3}{16}$ in. to fit into minimal gaps between the window frame and the wall.

FIG. A1.10 Type B Material to Fit Small Gaps

A2. EMERGENCY ESCAPE AND RESCUE REQUIREMENTS

A2.1 Windows shall meet applicable egress code requirements.

A2.2 Installing windows, especially when the existing window frame is left in place, can significantly reduce the size of the clear opening by as much as 2 in. (50 mm) of height and 3 in. (75 mm) of width. This may prevent emergency egress.

A2.3 Jurisdictions have specific egress requirements for windows. Know what the local building official requires before replacing an egress window.

A3. MINIMUM HEIGHT REQUIREMENTS FOR REAR LEG HEIGHT OF PAN FLASHING

H1 = CALCULATED PRESSURE DIFFERENTIAL
FOR WATER HEIGHT + 3 MM (1/8 INCH)

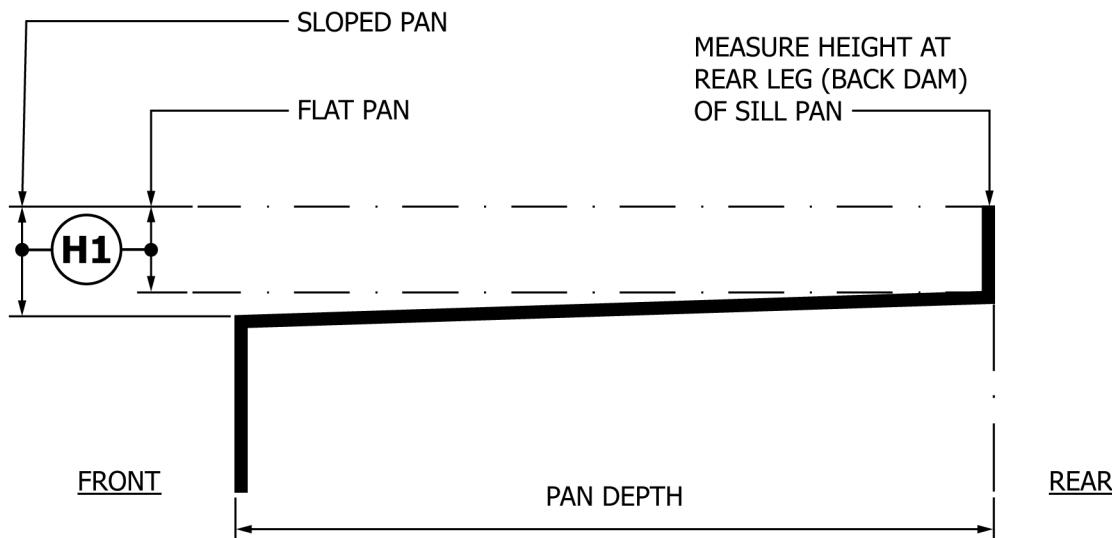


FIG. A3.1 Determining Rear Leg Heights

A3.1 Determining Interior Leg Heights—Table A3.1 is meant to be a guide to the installer. The pan flashing height represents the known rise of a vertical column of water with an unsealed pressure differential plus $\frac{1}{8}$ in. (3 mm) for a frame-levelling allowance. However, several factors may affect performance, and the flashing requirements may vary. (See Figs. A3.1-A3.4.)

Example: A DP-20 (assuming no coefficients) is rated for 20 psf (960 Pa). The required panning height, at 0.192 q, would be $3.84 \text{ in.} + \frac{1}{8} \text{ in.} (98 \text{ mm} + 3 \text{ mm})$, or about 4 in. (100 mm). Windows are normally tested at 15 % of design pressure, which in this example is 3 psf (150 Pa). $3 \text{ psf} \times 0.192 = 0.57 \text{ in.}$ or about $\frac{1}{16} \text{ in.} + \frac{1}{8} \text{ in.} = \frac{1}{16} \text{ in.} (14.36 \text{ Pa} \times 0.101 = 14.5 \text{ mm} + 3 \text{ mm} = 17.5 \text{ mm})$.

TABLE A3.1 Pan Height

WTP Water Test Pressure P.S.F. (Pa)	D.P. Design Pressure P.S.F. (Pa)	H1 Water Height and Minimum Leg Height, in. (mm)
2.86 (140)	15 (720)	$\frac{1}{16} \text{ in. (18 mm)}$
3.0 (150)	20 (960)	$\frac{3}{4} \text{ in. (19 mm)}$
3.75 (180)	25 (1200)	$\frac{7}{8} \text{ in. (21 mm)}$
4.5 (220)	30 (1440)	1 in. (25 mm)
5.25 (260)	35 (1630)	$1\frac{1}{16} \text{ in. (31 mm)}$
6.0 (290)	40 (1920)	$1\frac{5}{16} \text{ in. (34 mm)}$
6.75 (330)	45 (2160)	$1\frac{7}{16} \text{ in. (37 mm)}$
7.5 (360)	50 (2400)	$1\frac{5}{8} \text{ in. (41 mm)}$
8.25 (400)	55 (2640)	$1\frac{3}{4} \text{ in. (45 mm)}$
9.0 (440)	60 (2880)	$1\frac{7}{8} \text{ in. (48 mm)}$
9.75 (470)	65 (3120)	2 in. (50 mm)

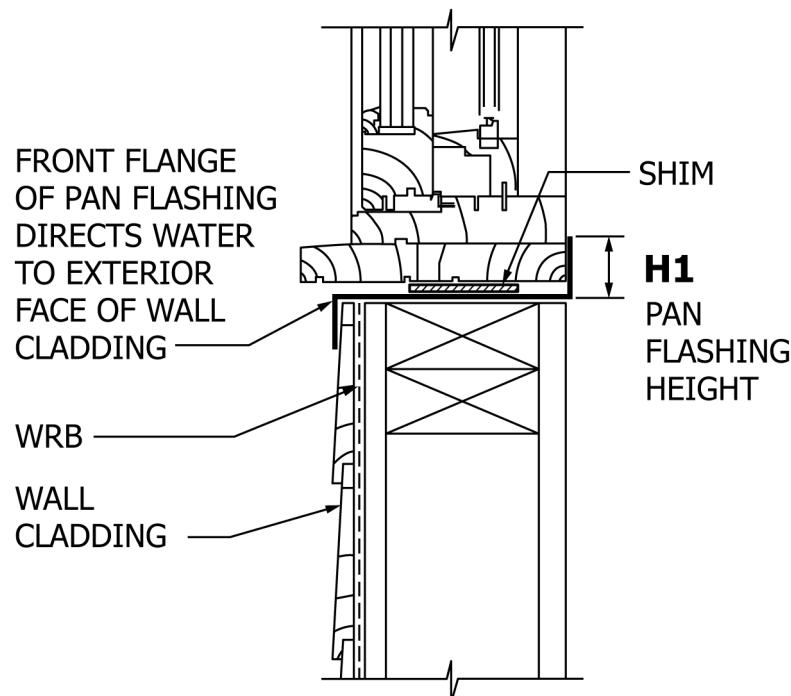


FIG. A3.2 Pan Flashing—Surface Barrier System

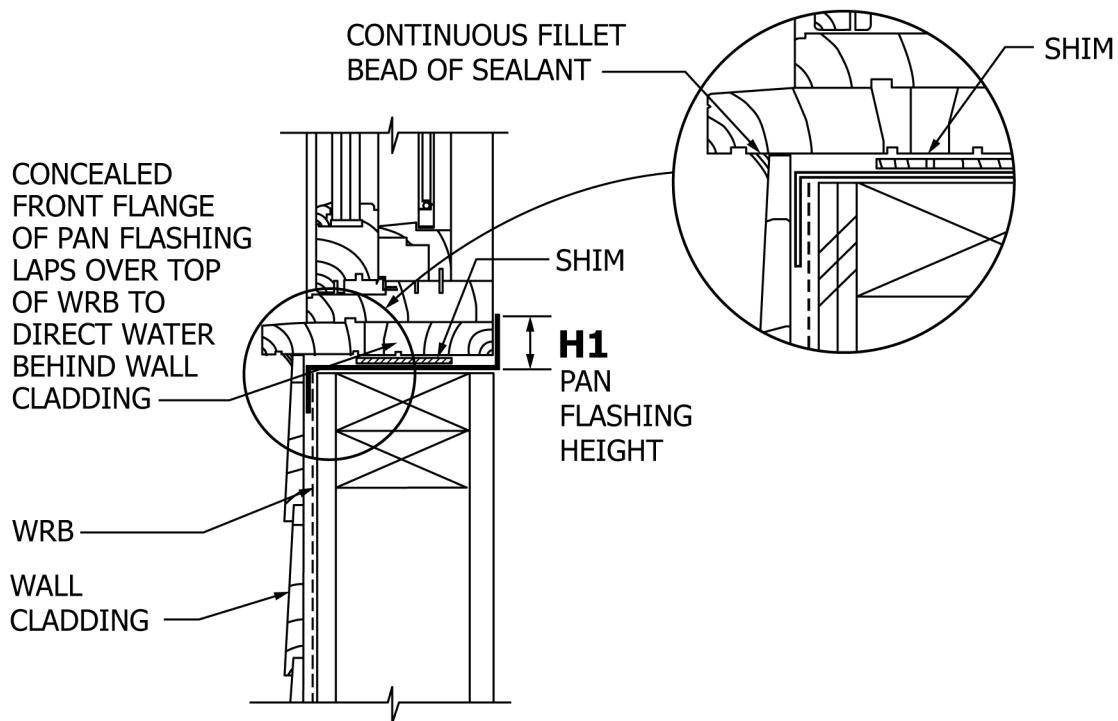


FIG. A3.3 Pan Flashing—Concealed Barrier System

A3.1.1 The designer of pan flashing should consider not only the anticipated level of contained water in the pan flashing during a maximum weather event but the sealing of all penetrations and joints. All joints should be located if possible so that they will not be exposed to standing water or heavy water concentrations. This can be accomplished by turning up sections of the material from which the flashing is made at the

back and ends of the pan flashing as illustrated in Fig. A3.2. Where sealants are used to seal the joints they should be located away from the bottom horizontal surface of the pan flashing. When designing the pan flashing the designer should provide anchor locations which are above the highest level of expected water accumulation and the lowest edge of the various water barriers provided. For example, if the rear

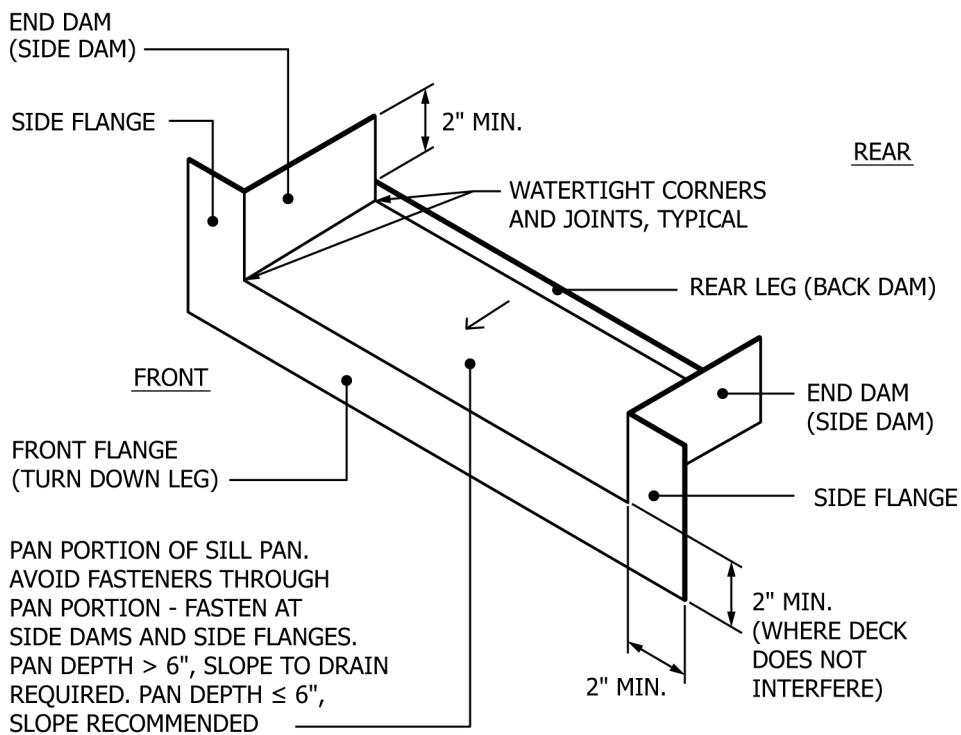


FIG. A3.4 Configurations of Typical Sill Pan Flashing—Isometric

upturned leg is to be 1 in. (25 mm) above the bottom of the flashing and the end dams are to be used for anchoring the pan flashing, then the end dams should be designed to extend sufficiently above 1 in. (25 mm) to allow the fasteners to be located above the top of the rear leg. This might require that the end dams extend as much as 3 in. (75 mm) above the bottom surface of the flashing and the anchor fasteners are located at least 2 in. (50 mm) above the bottom of the flashing. Designing

the pan flashing so that joints, sealants and fasteners are always above the highest expected water level prevents the sealants and penetrations from being exposed to standing water and increases the likelihood of long term performance of the pan flashing.

NOTE A3.1—Rear leg pan heights can be reduced by the use of continuous air infiltration seals or engineered sealant joints. See [Appendix X5](#).

A4. SEALANTS

A4.1 The following tables are provided to aid in sealant selection. This information should be used only as a general guideline to narrow down the number of sealants that may be suitable for a given use and substrate materials.

A4.2 Uses and applicable specifications are given in [Table A4.1](#). It should be recognized by the purchaser or design professional that not all sealants meeting a listed specification are suitable for the intended use. Commercially available products meeting a listed specification vary considerably in performance characteristics. Suitability of a specific product should be verified with the sealant supplier following the guidelines in [5.10.1](#).

A4.3 [Table A4.2](#) provides general adhesion characteristics for the most commonly used types of sealants. A wide variety of materials exists within most of the listed substrate categories, and commercially available sealant products within any one sealant type can vary considerably in adhesion to a given material. A range is provided where a significant variation in adhesion between products can be expected. For further information see [Terminology C717](#). (See AAMA 800).

TABLE A4.1 Applicable Specifications

NOTE 1—Where more than one specification is listed for an application, the sealant is required to meet at least one of the specifications.

NOTE 2—X = Applicable Specification.

Use	Perimeter Joints Total Cyclic Movement		Bedding of Fin, Flashing, Etc	Thresholds	Sills	End Dams Panning
Specification	>15 %	<15 %				
Specification C834 Emulsion (Latex)		X and AAMA 808				
Specification C920 Elastomeric	X	X and AAMA 808	X	X	X	X
Specification C1085 Butyl Solvent Release		X and AAMA 808	X	X	X	X
Specification C1311 Solvent Release		X and AAMA 808	X	X	X	X
AAMA 804.3 Butyl Tapes			X			
AAMA 808.3 Ext. Perimeter		X with above	X			
AAMA 809.2 Non-Drying			X			X
Applicable Sections	5.10.3.1, 7.2	5.10.3.2, 7.2.3	5.10.6, 8.1.1, 10.2.1	5.10.8	5.10.8.1, 5.10.8.2	5.10.8.2

TABLE A4.2 Sealant Adhesion

NOTE 1—N/A = Not Applicable

N/R = Not Recommended

G = Good = Adhesion of 5 PLI and 75 % cohesive failure minimum as measured by Test Method **C794**

F = Fair = Adhesion of 5 PLI and less than 75 % cohesive failure as measured by Test Method **C794**

P = Poor = Adhesion less than 5 PLI and predominantly adhesive failure

Sealant Type	Silicone	Latex	Poly-urethane	Solvent Release			Butyl Tape	Notes About Substrates
Specification	C920	C920	C834	C920	C1085	C1311	AAMA 809	AAMA 804
Aluminum Mill Fin- ish	G	G	F	G	G	P-G	G	G
Aluminum Anod- ized	G	G	F	G	G	P-G	G	G
Building Paper (As- phalt)	P-G	P-G	P-G	P-G	P-G	P-G	G	Compatibility with solvent release sealants shall be verified
Brick Concrete	G F-G	G F-G	F P-F	G G	G P-G	P-G NA	NA G	Adhesion in areas of prolonged moisture exposure shall be verified
Copper EIFS	P-G F-G	P-G F-G	P-F P-F	F-G F-G	G NR	P-G NR	G NA	Some sealants can produce corrosion Test Method C1382 is used to determine adhesion to finish or base coats
Steel Galvanized Glass	P-G G	P-G G	P-F F	P-G P-G	G F	P-G P-G	G NA	Test Method C794 after ultraviolet exposure is used to determine adhesion
Painted Surfaces	P-G	P-G	P-G	P-G	P-G	P-G	G	Adhesion of a specific sealant product and job site coating(s) should be verified
Polyethylene Stone	P G	P G	P	P-G G	P-G G	P-F F-G	G G	Resistance to vehicle migration and staining should be verified
Stucco	G	G	F	G	F-G	F-G	NA	
Vinyl	P-G	P-F	P-F	P-G	P-G	P-G	P-G	Cleaning by Isopropyl Alcohol wipe is recommended
Wood Raw	G	G	F-G	G	F-G	P-G	P-G	
Wood Treated	G	G	F-G	G	F-G	P-G	P-G	

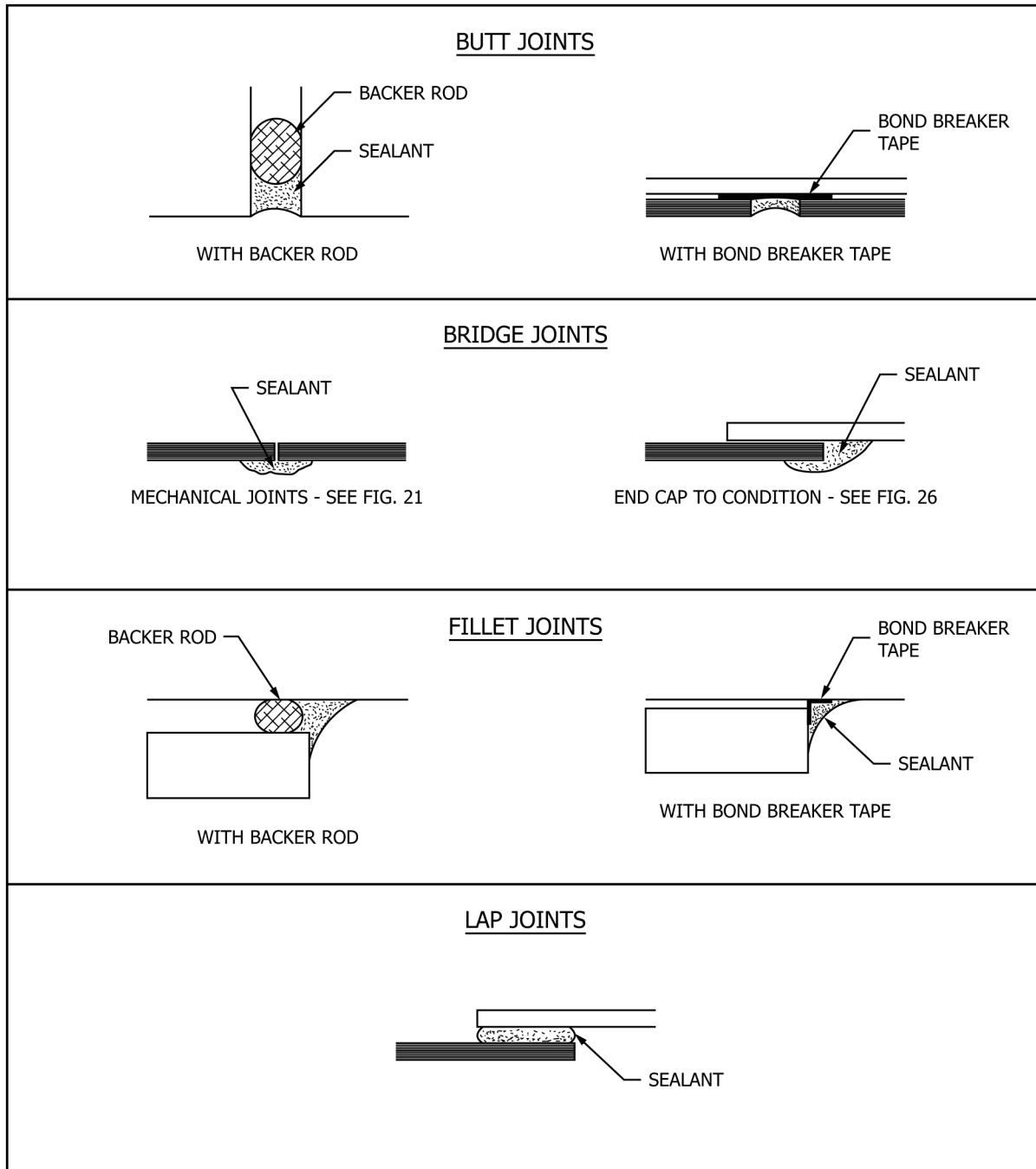


FIG. A4.1 Types of Sealant Joints

APPENDIXES

(Nonmandatory Information)

X1. WINDOW/DOOR FLASHING TYPES

INTRODUCTION

The following describes the various types of common window and door flashing products available on the market.

X1.1 Flexible Flashings—Mechanically Fastened

X1.1.1 *Paper Flashing*—Typically two sheets of kraft paper laminated with asphalt and reinforced with fiberglass yarns. These products shall meet Test Method D779, with a water resistance of at least 24 + h.

X1.1.2 *Polyethylene Coated Flashing*—These products have a polyethylene coated exterior. There are two qualities: one with polyethylene coating on both sides, with polyethylene coating on one side with kraft paper on the other side. Both of these types are reinforced with fiberglass yarns. These products shall meet Test Method D779, and those with two-sided coating shall have a water resistance of at least 48 + h.

X1.1.3 *Bitumen Flashing*—The flashing has a bitumen type filler between two sheets of polyethylene and/or polypropylene.

NOTE X1.1—Consensus material standards currently do not exist for some materials that may be used as flexible perimeter flashing. Consequently, these materials are not included in this version of Practice E2112 as recommended flashing materials. This does not mean that these materials should never be used but that if they are specified and used the burden of determining compatibility, adhesion, suitability and long term performance is the responsibility of the specifier. The specifier is cautioned to carefully investigate the applicability of all flashing materials. Since some materials may adhere to some framing and sheathing materials and not others, durability of materials may be affected by temperature and the cleanliness of building surfaces and materials, and some flashing materials may not be compatible with all gunnable sealants required in the designed flashing detail, the specifier should investigate suitability by testing the desired detail and materials using project materials and environmental conditions. This may involve mock-up testing, accelerated exposure testing and consultation with the suppliers of all contemplated materials. Some materials such as asphalt paper flashing can be specified by simply specifying the requirements of materials standards such as Test Method D779. Materials standards for other flashing materials are under development and will be incorporated into this standard when approved.

X1.2 Flexible Flashing—Self-Adhesive Type

X1.2.1 *Polyethylene Flashing with Adhesive Strip*—These products are coated (see X1.1.2). They are laminated and

reinforced. The product has a 3 in. adhesive strip designed to cover the window flange to provide additional sealing between the flange and either the flashing under the flange or the frame, or both, depending on which installation method is used to install the fenestration product. This type of flashing is used as a *system* in conjunction with other types of flashing. These typically are one of the materials described in X1.1.2.

X1.2.2 *Bitumen Type Flashing*—Bitumen flashing typically has a rubberized bitumen material applied to a sheet of polyethylene, polypropylene, or in some cases a foil. In the majority of these products, the release sheet is pulled off, exposing the rubberized bitumen adhesive, which is then put down on the flange or the frame, depending on the installation method being used.

X1.2.3 *Butyl Type Flashing*—Butyl flashing typically has a butyl adhesive applied to a sheet of polyethylene, polypropylene, rubber, woven cloth, non-woven cloth, foil, or in some cases a combination of these sheets. In the majority of these products, the release sheet is pulled off, exposing the butyl adhesive, which is then put down on the flange or the frame, depending on the installation method being used.

X1.2.4 Some elastomeric type flashings are formable so they can cover three-dimensional and non-linear shapes such as the heads of round top windows. Some other types of flashings have less than 100 % adhesive coverage integrated in the film or carrier that can be used in sill applications covering the bottom flange.

X1.3 Rigid Flashing

X1.3.1 Rigid flashings are generally of metal, most commonly either galvanized or copper. These products are often custom made in order to fit a particular window or door, or both.

X2. CAUTIONS FOR INSTALLATION

INTRODUCTION

The following list outlines specific cautions and issues of concern for the preparation and installation of fenestration products into building openings.

X2.1 Thermal Break Fenestration Products

X2.1.1 *Independent Frame Anchors*—Independently anchor the inner and outer metal frame portions of thermally broken fenestration systems to the building structure, where polyurethane thermal barrier material structurally joins the inner and outer metal frame portions in tension. Do not install anchorage fasteners through the thermal barrier material.

X2.1.2 *Weep Hole Location*—Inspect weep hole locations prior to installation. Do not drill weep holes through both the metal frame and the thermal barrier material. Do not install products with mislocated weep holes.

X2.1.3 *Cracks in Thermal Barrier*—Inspect the thermal barrier surface for visible defects prior to installation. Do not install thermally broken fenestration products with hairline or larger cracks, tears or splits in the thermal barrier material.

X2.1.4 *Aluminum Subsills*—Aluminum subsills should be thermally isolated from the fenestration product sill member and exposed interior surfaces. Independently anchor the subsill and the fenestration product. Do not install aluminum subsills with polyurethane thermal breaks.

X2.2 Weep Holes and Weepage Path

X2.2.1 Maintain free drainage openings for weep holes and weepage drain paths. Do not block weep holes with insulation.

Install insulation so that it does not get wet from weepage at weep holes and weepage paths. Do not seal weep holes or pan flashing drainage outlets with sealant.

X2.3 Mulled Windows/Doors

X2.3.1 *Edges of Flashings and Water-Resistive Barriers*—Integrate and seal perimeter flashings and water-resistive barriers to be weather tight and lapped shingle-fashion at vertically and horizontally mulled fenestration units. Do not allow the WRB or flashing edges to be unsealed with vertically mulled units placed less than 9 in. apart. Do not allow the WRB or flashing edges of horizontally mulled fenestration units to be lapped so that the laps are not counter-flashed.

X2.4 Curved Window / Door Heads

X2.4.1 *Flashing Curved Window/Door Heads*—Install a separate head flashing cap at the tops of curved window/door units which do not provide a continuous flashing fin.

X2.5 Wood and Plastic Frame Cracks

X2.5.1 *Frame Cracks*—Inspect the surface condition of wood and plastic framed units for visible cracks, splits or other defects which might interfere with the fastening or flashing of the product in the building opening.

X3. OTHER REFERENCED INSTALLATION GUIDES

X3.1 Residential Fenestration Product Installation Guide, Version 1.3:

AWDI, LLC (Association of Window and Door Installers),
11300 U.S. Highway One, No. 400,
North Palm Beach, FL 33408

X3.2 AAMA 2400 (CAWM 400)—Standard Practice for Installation of Windows with Integral Mounting Flange in Wood Frame Construction

X3.3 AAMA 2410 (CAWM 410)—Standard Practice for Installation of Sliding Glass Doors with Integral Mounting Flange in Wood Frame Construction

X3.4 Recommended Procedure for Installation of Vinyl Windows:

Vinyl Fenestration Product Institute Society of the Plastics Industry, Inc.,
1275 K Street NW, Suite 400,
Washington, DC 20005

X3.5 CSA A440.4—Fenestration Product Installation:

Canadian Standards Association,
178 Rexdale Boulevard,
Rexdale, Ontario M9W 1R3

X3.6 CEGS Section 08520—Aluminum Window Installation Guide Specification:

Department of the Army,
Army Engineer Division,
Huntsville CEHND-ED-ES (GS Section),
P.O. Box 1600,
Huntsville, AL 35807-4301

X3.7 ASTM Standards on Lead Hazards Associated with Buildings:

ASTM International, Customer Service,
100 Barr Harbor Drive,
West Conshohocken PA 19428-2959

X3.8 Product Rating Standards:

ANSI/AAMA/NWWDA 101/I.S.2-97, Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors

ANSI/ISDI-102-1993, American National Standard for Insulated Steel Door Systems—Installation Standard

CSA A440-M90, Windows—A National Standard of Canada SDI-I22-90, Installation and Troubleshooting Guide for Standard Steel Doors and Frames

X3.9 Reference Workbook:

Nail-on Windows: Installation & Flashing Procedures for Windows & Sliding Glass Doors, 1995, 1st Edition; Robert

Bateman, Revised 3rd printing, August 2016, <http://www.flashingdetails.com>.

X3.10 Product Certification Agencies:

AAMA American Architectural Manufacturers Association

WDMA Window and Door Manufacturers Association

NAMI National Accreditation Management Institute

NFRC National Fenestration Rating Council

CWDMA Canadian Window and Door Manufacturers Association

ITS-WH Intertek Testing Services—Warnock-Hersey

X4. ALTERNATE INSTALLATION METHODS

INTRODUCTION

The following illustrates schematic flashing Methods C and C1 that combine flashing techniques from ASTM E2112 Methods A, B, A1, and B1. Methods D and D1 add sill pan flashing or rigid head flashing, or both, to the details of C and C1.

X4.1 Basis of Design

X4.1.1 Methods C, C1, D, and D1 include a framed wall, typically wood studs or light-gauge metal framing; an exterior wall sheathing typically wood-based, gypsum core, or cement fiber; a single (punched) window or door opening; sealant; nail-on (finned) window or door frame; perimeter R.O. (rough opening) flashing and a sheet-applied water-resistive barrier (WRB).

X4.1.2 The schematic sequences of C and C1 do not include a complete sill pan flashing or a rigid head flashing (drip cap). When the schematic sequences include a complete sill pan flashing or a rigid head flashing (drip cap), these methods are identified as Methods D and D1.

X4.2 Perimeter Flashings

X4.2.1 Methods C, C1, D, and D1 show self-adhered flashings (SAF) as the perimeter flashing under and over the window or door fins. To provide air and water barrier continuity, the SAF is extended into the rough opening (R.O.) at jambs, head, and sill to at least the back of the fenestration unit to receive an interior air seal between SAF and the back of

the unit frame. Prior to the window installation, a strip of SAF is applied along the top of the R.O. head for continuity of the sheathing substrate SAF around the opening. A uniform substrate before the window installation provides consistency for the fin bedding sealant application. The SAF conforms to Appendix X1.2 and AAMA 711.

X4.3 WRB

X4.3.1 Methods C, C1, D, and D1 utilize a water-resistive barrier of building paper (or building felt) of approximately 3 ft. wide rolls for Methods C and D. Method C1 and D1 utilize polymeric-type WRB in approximately 9 ft. wide rolls. Other widths of WRB can be used for Methods C, C1, D, and D1. Each method anticipates a mechanically attached sheet-applied material for the WRB applied in a shingle fashion.

X4.4 Installation

X4.4.1 Unless otherwise noted in the figures, standard installation techniques described in the text of Practice E2112 or contained in the manufacturer's instructions apply to complete these alternate methods.

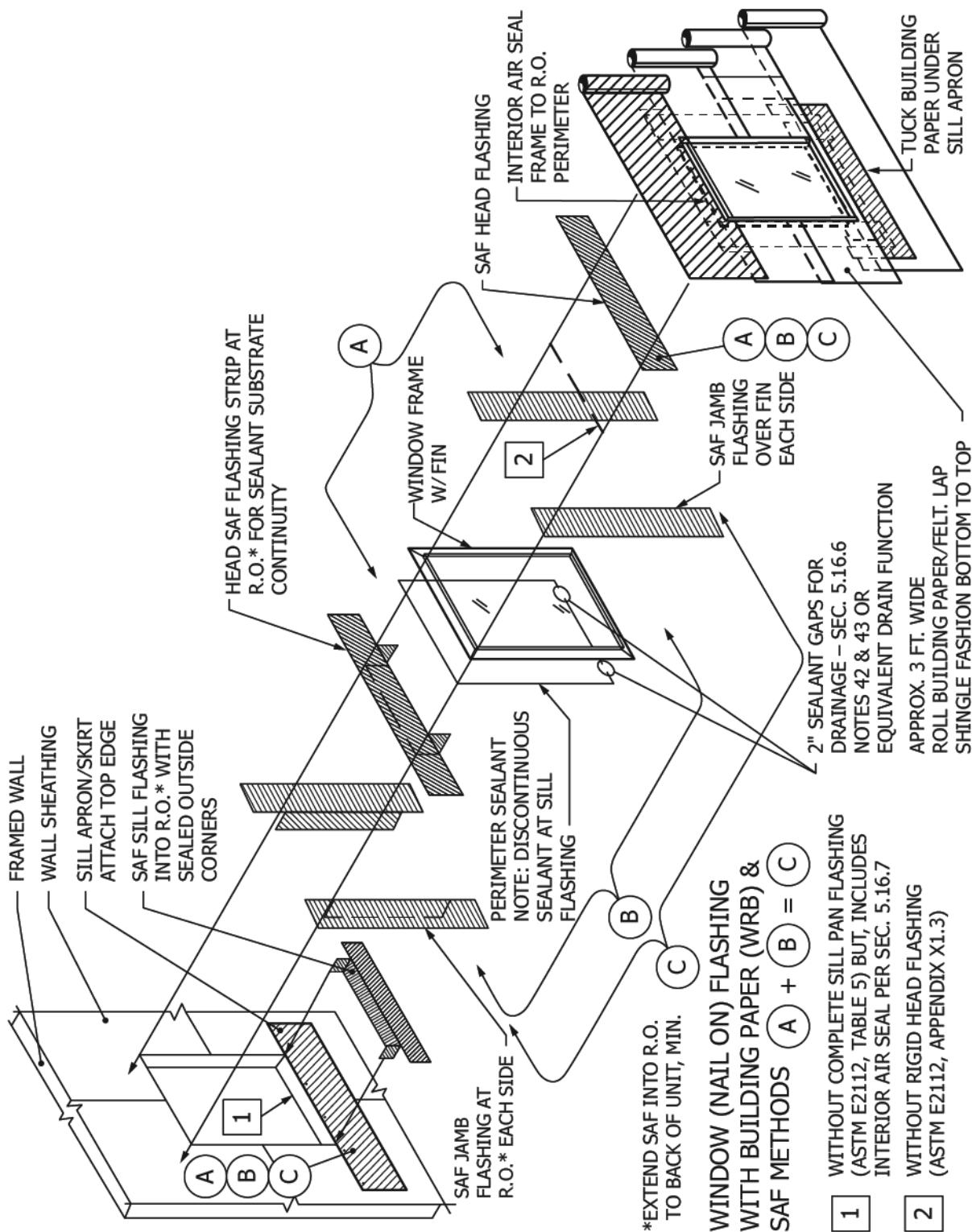


FIG. X4.1 Method C Window Flashing

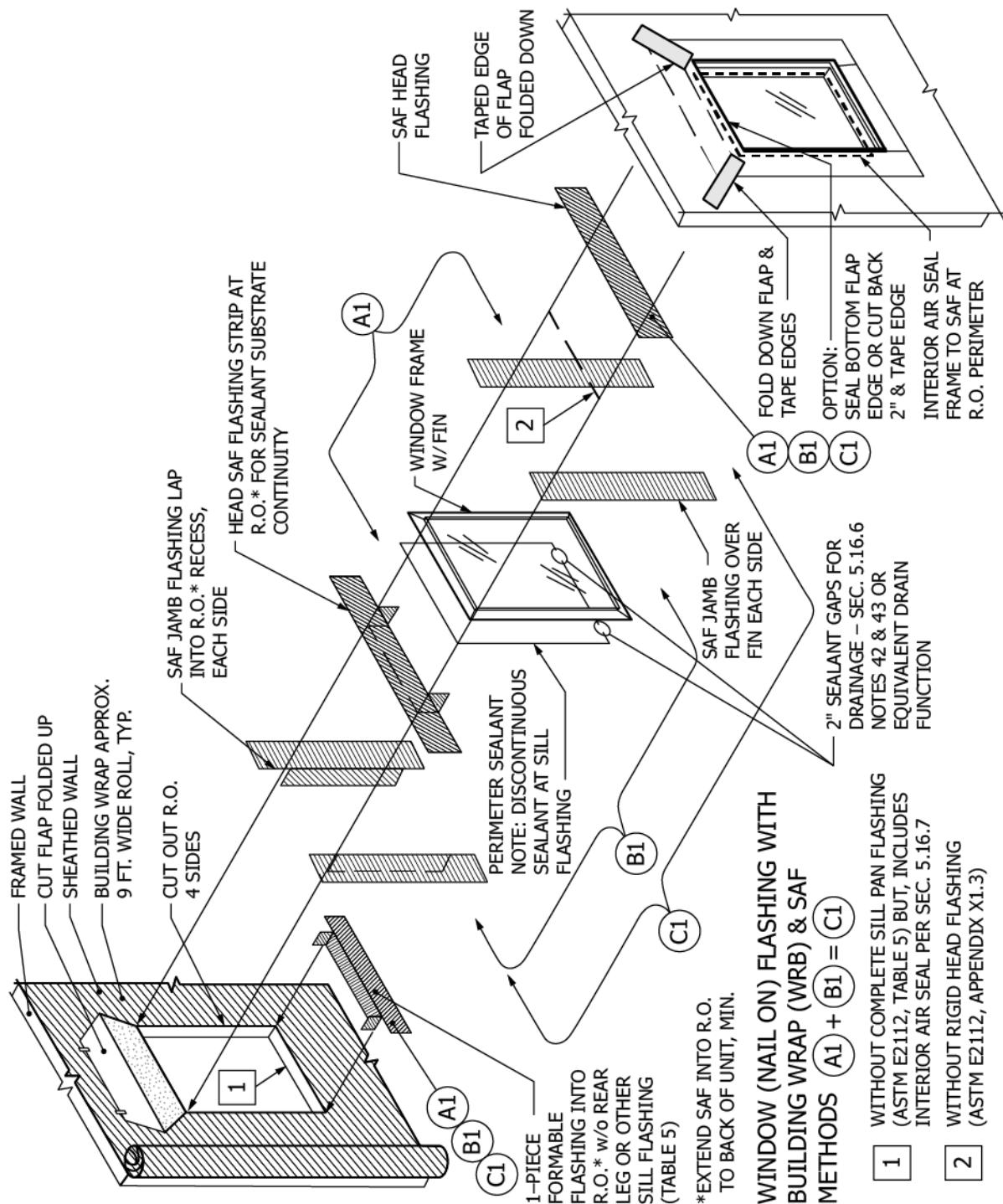


FIG. X4.2 Method C1 Window Flashing

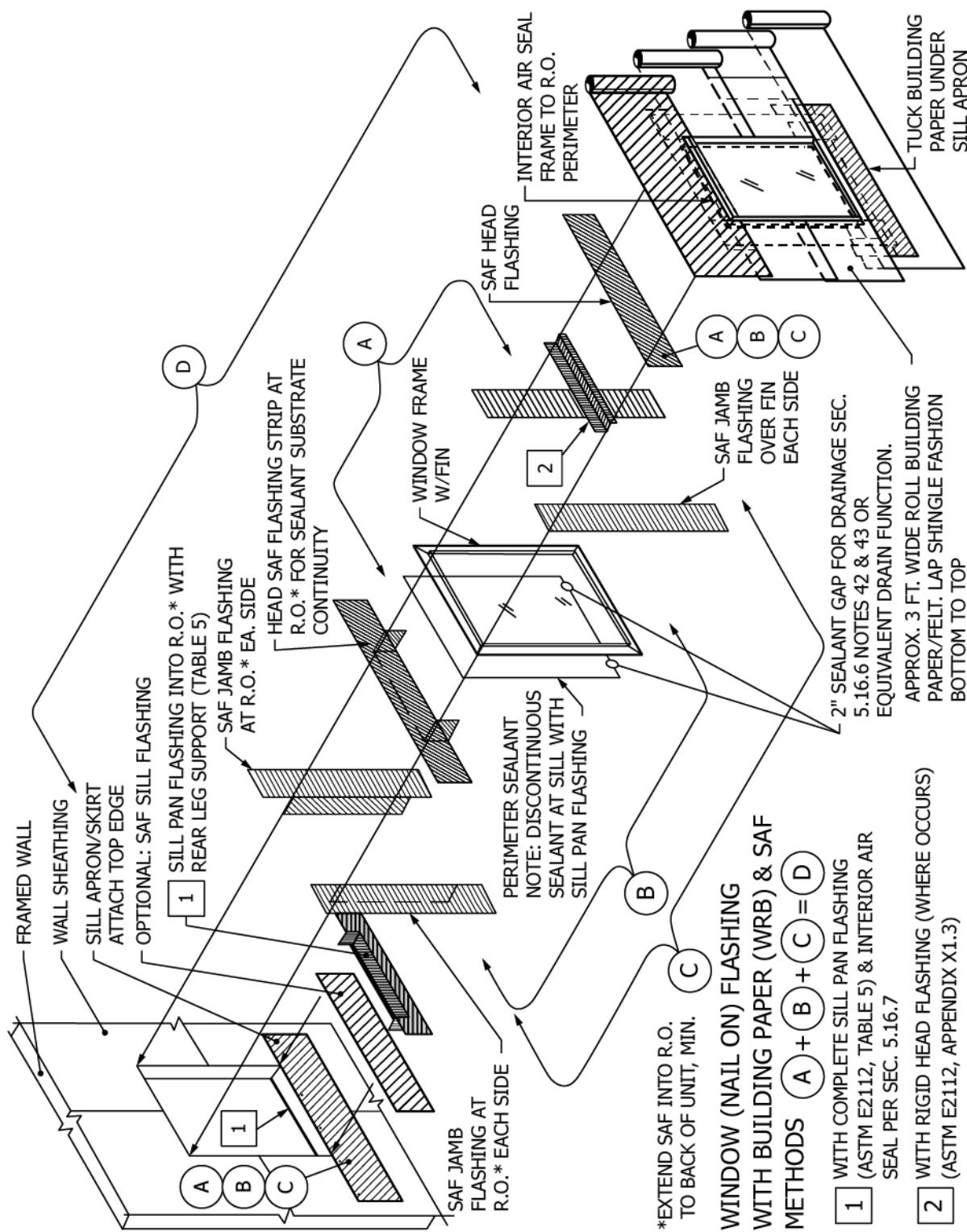


FIG. X4.3 Method D Window Flashing

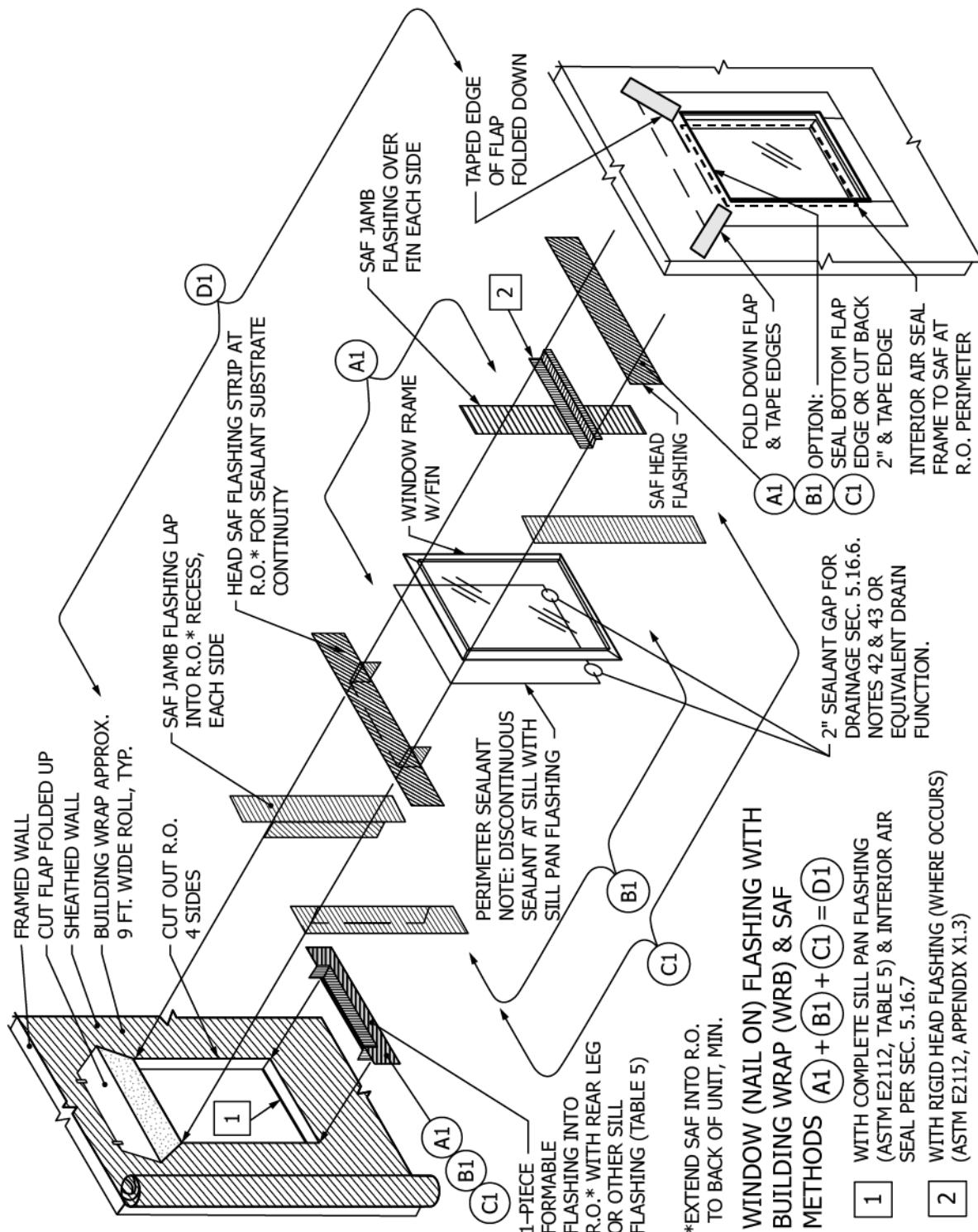


FIG. X4.4 Method D1 Window Flashing

X5. AIR LEAKAGE SEALING OF INTERIOR PERIMETER ROUGH OPENING (AIR & WATER SEAL)

INTRODUCTION

A fenestration air seal provides the transition or bridge between an exterior wall air barrier system and/or water-resistive barrier to the exterior window/door frame across the perimeter rough opening shim space to maintain air barrier continuity.

Appendix X5 is intended to address the air seal concept mentioned in E2112, but not fully explained at the time of the standard's initial (2001) development. This method outlined works with Self-Adhering Flashing (SAF) and Liquid-Applied Flashings (LAF), as well as mechanically-attached sheet type WRB's (building paper, building felt and polymeric housewraps), self-adhered WRB membranes, WRB panel sheathing, insulation board systems, as well as liquid-applied WRB's.

X5.1 Definitions—Definitions specific to this Appendix are located here. Other relevant definitions can be found in Section 3 or Terminology **E621**.

X5.1.1 Air Barrier, *n*—see Terminology **3.2.2**.

X5.1.2 Air Barrier Foam Sealant, *n*—see Terminology **3.2.3**. See **Annex A1**. Several industry terms are used which include aerosol foam sealant, air barrier foam sealant, low pressure build foam sealant, low pressure aerosol foam sealant, insulating foam sealant, and minimal expansion foam. All the terms are intended to represent the same thing in accordance with AAMA 812, Specification **C1620**, and Practice **C1642**.

X5.1.3 Air Leakage, *n*—see Terminology **3.2.4**.

X5.1.4 Air Barrier Seal, *n*—a continuous seal designed and constructed into the gap area (shim space) around the interior or both sides of the window/door perimeter to prevent the passage of air that may contain water vapor.

X5.1.5 Air Barrier System, *n*—a system, inclusive of the interior and exterior air seals, intended to prevent air and moisture leakage between a window/door assembly and the perimeter exterior RO flashing of an exterior wall air barrier or combination air and water barrier.

X5.1.6 Interior Air & Water Seal, *n*—an air barrier seal at the interior edge of the fenestration product, installed between the fenestration product integrated with the exterior perimeter flashing extended into a wall rough opening that does not allow air infiltration/exfiltration and/or water infiltration into the building. The exterior perimeter flashing extends to at least the interior edge of the fenestration product. The interior perimeter air seal also functions as a water seal, but is not a substitute or replacement for an exterior RO seal/flashing.

X5.1.6.1 Discussion—A fenestration/flashing/AB/WRB manufacturer approved sealant joint or equivalent can be used to form a back dam to a sill flashing provided it is part of a continuous air & water seal. See **Appendix X5**, Figs. X5.3B, X5.5, X5.6, and X5.9.

X5.2 Abbreviations

X5.2.1 AB—Air Barrier

X5.2.2 AWRB—Air and Water-Resistive Barrier with combined functions. AWRB can be one material or applied with one or two layers.

X5.2.2.1 Discussion—Other acronyms may be encountered in specifications and construction documents indicated as AB/WRB, A/WRB, AB-WRB.

X5.2.3 LAF—Liquid-Applied Flashing

X5.2.3.1 Discussion—Also known as Liquid Flashing; Refer to **5.16.5.5**; **Table 5**, Fluid-Applied Coating (Type V); **5.13.3.1**; and AAMA 714.

X5.2.4 RO (R.O.)—Rough Opening

X5.2.5 SAF—Self-Adhered Flashing

X5.2.5.1 Discussion—Refer to **5.13.3.1**; AAMA 711; and **Appendix X1**.

X5.2.6 WRB—Water-Resistive Barrier

X5.3 Interior Air & Water Seal Purpose

X5.3.1 The purpose of an interior air & water seal is to prevent air and moisture leakage into and through a RO shim space (air gap) due to a pressure differential between the building exterior and interior. Pressure differentials can occur during wind storms and windblown rain events, under negative building pressure and as a result of the stack effect in tall buildings. Uncontrolled air and moisture leakage can compromise exterior wall insulation values and increase energy consumption. Air and moisture leakage can result in interior wall and finish damage due to accompanying water vapor. Air leakage can allow water vapor penetration to promote decay to woodframed and wood-based exterior wall sheathing, as well as initiating corrosion to the metal wall framing and metal accessories.

X5.4 Air Barrier Continuity

X5.4.1 Continuity of the exterior wall air barrier system is critical throughout the building envelope and particularly window, door and other wall penetrations. The continuity of the air barrier at the RO may include a perimeter rough opening flashing. An air barrier may be durable enough to function as a rough opening flashing. This Appendix applies to both conditions, but details the interior air & water seal as separate from the exterior flashing. Maintaining continuity between the RO and the frame of the window, door or penetration component is required. An exterior seal and/or exterior RO flashing intended to prevent water penetration should not be counted on separately to provide an air & water seal.

X5.5 RO Shim Space

X5.5.1 The typical window/door opening is framed with a shim space (rough opening gap) on 3 (door) or 3 to 4 sides (window) to allow a maneuverable gap for the fenestration unit to facilitate installation and any subsequent movement of the fenestration assembly and the RO. The shim space is determined by various factors in consultation with window or door manufacturers but, is typically $\frac{1}{4}$ in. to $\frac{1}{2}$ in. each side of the frame. Gaps may vary due to construction tolerances from minimum $\frac{1}{8}$ in. up to $\frac{3}{4}$ in. or more. Refer to [5.9.1](#), Rough Opening Size; [5.14.8](#) Anchoring; and [5.15](#) Shimming. Air & water seal products should be selected with consistent gap bridging capacity. There may be minimal or no shim space after installation at sills and thresholds. The unsealed shim space can provide an open pathway for air leakage and water penetration to the wall cavity unless blocked, sealed or drained.

X5.5.2 The window/door assembly could have some air leakage and/or incidental water leakage through the frame joinery into the shim space. The adjacent wall condition could have some air leakage and/or incidental water leakage into the shim space.

X5.5.3 Thus, it is essential that the RO flashing, exterior RO seal and interior air and moisture seal are designed to manage incidental air and moisture intrusion to prevent leakage to the building interior and immediately direct water outside or drain to the exterior WRB/AB-WRB drainage plane.

X5.6 Shim Space Transition

X5.6.1 The exterior side of the RO is typically sealed with sealant or an exterior flashing between the window/door frame and the water-resistive barrier (WRB), air barrier (AB) or air/water-resistive barrier AWRB.

NOTE X5.1—The AB and WRB may be the same material and assembly. See Fig. X5.3.

X5.7 Interior Air & Water Seal Location

X5.7.1 The ideal location for most air and water seals is at the innermost edge of the back of the fenestration frame (depth of window/door frame) and connected to the turn-in of the RO flashing. An air & water seal in this location will manage and redirect any water leakage from the exterior opening, as well as any air and water leakage from the fenestration corner joinery. See Figs. X5.2 and X5.3. Window/door manufacturers may have other specific locations for interior air & water seal placement.

NOTE X5.2—For colder climates or some thermally-broken window/door frames the interior air & water seal may need to be located differently. Continuity of the air & water seal transition or bridge is best accomplished if the exterior WRB and/or AB extend into the RO to the back edge of the fenestration frame. It is important the flashing to the RO recess is fully adhered and is not just dry lapped. The potential air path underneath a sheet mechanically attached AB, WRB or AWRB needs to be sealed or blocked at the RO.

X5.8 Exterior Flashing Extension into RO Recess

X5.8.1 It is critical there be continuity between the exterior opening flashing extended into the RO recess and the window/door frame. The RO exterior flashing extending into the RO

recess at the sill, jambs and head should be continuously sealed in some manner to the RO wall frame opening. This is usually accomplished with a durable RO flashing material adhered to the RO recess perimeter on four sides (unless a sill pan flashing is included and part of the window/door installation). See [Annex A3, Fig. A3.2](#). Flanged windows and doors with interior air & water seals may have an additional exterior SAF/LAF flashing over jamb and head flashing fins (e.g., Methods A and A1).

X5.9 Interior Air & Water Seal Materials & Techniques

X5.9.1 Air & water seal products may vary widely in water resistance, insulation performance and adhesion properties to substrates (such as the RO flashing and window/door frame). Air & water seal products selected for use should be evaluated for compatibility with adjacent materials, whether they are indicated for use in accordance with window or door manufacturer installation guidelines, overall system performance of the assembly, and the climate characteristics of a given project location. The design professional should evaluate individual components, as well as the assembly as a whole during the specification and submittal approval processes to determine an appropriate assembly is specified.

X5.9.2 "Penetrations of the air barrier and paths of air leakage shall be caulked, gasketed, taped or otherwise sealed," in accordance with IECC, Section C402.4. Several materials and their installation techniques can function as an effective interior air and water seal. This includes low pressure build aerosol foam sealant (See [Annex A1](#), Type A); adhesive foam tape (See [Annex A1](#), Type B); backer rod & sealant; self-adhering flashing (SAF) tape and other methods. See Fig. X5.4.

X5.9.3 Some air & water seals can provide limited insulation performance in the perimeter shim space. However, some insulating materials used as an air seal (e.g., air-permeable fiberglass or rock wool insulation) do not provide an effective air and water seal unless combined with other air seal methods. This appendix does not address insulation of the RO shim space. See [5.9.2](#), Insulating or Filling the Rough Opening Gap.

X5.10 Interior Air & Water Seal & and Sill Pan Flashing

X5.10.1 The interior air & water seal at the RO prevents air and water leakage. When a sill pan flashing is provided as part of the fenestration installation, the height of the rear leg of the sill pan can be reduced when the rear leg is sealed to the interior perimeter RO and connected to the perimeter air seal at fenestration frame jambs and continuing to the head. See [Annex A3](#) and [Fig. 5](#). Sill pan flashing rear leg air & water seal will require sealant (or equivalent) to the fenestration frame to maintain continuity to the jamb air & water seal and may consist of different materials. See Figs. X5.7 and X5.8.

X5.11 Air Seal Testing

X5.11.1 All air barrier materials, including adhered AWRB material can be tested by ABAA test standards. Refer to Test Methods [E2357](#) for high wind/water exposure and commercial buildings. Refer to Specification [E1677](#) for standard residential exposures.

X5.12 Interior Air & Water Seal Standards & References

X5.12.1 See International Energy Conservation Code (IECC) Section R402.4 or International Residential Code (IRC) Section N1102.4 (R402.4) for low-rise residential buildings. See IECC Section C402.5 and ASHRAE Standard 90.1 for commercial and high-rise residential buildings. See [Annex A1](#) and AAMA 812 for low pressure, aerosol polyurethane foam sealants. See Test Method [Annex A1](#) and Specification [C1620](#) for aerosol polyurethane and latex foam sealants.

X5.13 Appendix X5 Related Materials

X5.13.1 This is a reading list which contains cited [Appendix X5](#) references and additional resources that may benefit the user.

ABAA—Air Barrier Association of America	T0002-2019 Test Method for Pull-Off Strength of Adhered Air and Water Resistive Barriers Using an Adhesion Tester T0004-2018 Standard Test Method for Determining Gap Bridging Ability of Air and Water Resistive Barrier Materials
ASHRAE—American Society of Heating, Refrigerating and Air-Conditioning Engineers	ANSI/ASHRAE/IES Standard 90.1-2019 Energy Standard for Buildings Except Low-Rise Residential Buildings
ASTM—ASTM International	ASTM C1620 Standard Specification for Aerosol Polyurethane and Latex Foam Sealants ASTM C1642 Standard Practice for Determining Air Leakage Rates of Aerosol Foam Sealants and Other Construction Joint Fill and Insulation Materials ASTM C1852 Standard Guide for Product Selection/Delivery Systems for Aerosol Sealants and Adhesives ASTM E1186 Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems ASTM E1677 Standard Specification for an Air Retarder (AR) Material or System for LowRise Framed Building Walls ASTM E2128 Standard Guide for Evaluating Water Leakage of Building Walls ASTM E2357 Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies ASTM C920 Standard Specification for Elastomeric Joint Sealants
FGIA—Fenestration and Glazing Industry Alliance (AAMA Technical Standards)	AAMA 502 Voluntary Specification for Field Testing of Newly Installed Fenestration Products AAMA 711 Specification for Self Adhering Flashing Used for Installation of Exterior Wall Fenestration Products – SAF as adhesive tape for air seal purposes AAMA 714 Voluntary Specification for Liquid Applied Flashing Used to Create a water Resistive Seal around Exterior Wall Openings in Buildings AAMA 812 Voluntary Practice for Assessment of Frame Deflection When Using One Component Polyurethane Foams for Air-Sealing Rough Openings for Fenestration Installations
FMA/AAMA Standards	FMA/AAMA 100 Standard Practice for the Installation of Windows with Flanges or Mounting Fins in Wood Frame Construction for Extreme Wind/Water Conditions

FMA/AAMA/WDMA Standards	FMA/AAMA/WDMA 300 Standard Practice for the Installation of Exterior Doors in Wood Frame Construction for Extreme Wind/Water Exposure
ICC—International Code Council	International Building Code (IBC) International Residential Code (IRC) International Energy Conservation Code (IECC)

X5.14 Representative Details

X5.14.1 The details in [Appendix X5](#) show four available methods for providing an interior air & water seal component to a WRB or AB and the window/door rough opening flashing in an example wood framed and sheathed wall with a wood block frame window. The flashing and air & water seal techniques of Practice E2112 and [Appendix X5](#) can apply to a sheathed wall with light-gage steel wall framing, as well. The interior air & water seal choices are not comprehensive and are intended to be illustrative only. Similar and alternate air & water seal techniques will be required for integral fin/flanged window and door frames.

X5.14.2 Mechanically attached sheet WRB or AB/WRB's should utilize a reinforcing SAF or LAF as the perimeter exterior RO flashing which transitions to the wall's WRB or AB/WRB. Liquid-applied WRB's may require the liquid-applied AB/WRB extend into the RO to act as the perimeter RO flashing. Some AB/WRB manufacturers have a separate LAF to make the RO flashing transition to the AB/WRB.

X5.14.3 There are three requirements for a complete interior air & water seal. First, the interior air & water seal must be continuous around the perimeter of the interior sides head, jambs and sill extending into the jambs and head RO shim space. Secondly, the interior air & water seal must have compatibility and adhesion to the window/door frame and to the RO substrate(s) or the RO flashing as this [Appendix X5](#) outlines. Third, the interior air & water seal needs continuity in connecting the air seal directly to the exterior RO flashing which transitions the flashing to the wall AB/WRB.

X5.14.4 For best practice, the exterior RO flashing should extend into the RO recess at least to the depth of the window/door frame on all sides in order to achieve direct contact between the air & water seal and exterior RO flashing. However, The details of the exterior opening flashing extended into the RO is not to supersede any of the details currently in E2112 or currently offered by window & door manufacturers where there may not be an additional or extended head flashing at the head RO before the AB/WRB. The advantage of a RO substrate with perimeter RO flashing (on four sides windows, three sides doors) extending into the RO is a consistent sealing surface for the interior air & water seal.

X5.15 Figure Notes – Figures X5.1 to X5.11

X5.15.1 *Figs. X5.1A & X5.1B Building Framing Schematic, Exterior View*—Exterior RO flashing (SAF or LAF) extends into the RO recess at least as far as the depth of the window/door frame. The perimeter exterior flashing at the RO head installs before the application of the AB/WRB at the RO

head as shown. Note—The exterior perimeter RO head flashing (e.g., SAF & LAF) does not lap over the AB/WRB at the head. The AB/WRB laps over the RO head flashing (See Fig. X5.3A). Interior perimeter air & water seal connects RO flashing with window/door frame. Air & water seal installed after window/door installation and bridges across the shim space on three sides with continuity to sill /threshold air & water seal.

X5.15.2 Figs. X5.1A & X5.1B do not illustrate a complete fenestration installation sequence, but are intended to orient the location of an interior air & water seal.

X5.15.3 The perimeter exterior flashing at the RO head installs before the application of the AB/WRB at the RO head as shown. The AB/WRB across the head RO requires head flap (e.g., polymeric housewrap) adjustment to fit and lap the rigid head flashing (where occurs) in shingle fashion. See Fig. X5.3A for windows (doors similar). Refer to [Figs. 33 and 34](#).

NOTE X5.3—The exterior perimeter RO head flashing (e.g., SAF & LAF) does not lap over the AB/WRB at the head. The AB/WRB laps over the RO head flashing (See Fig. X5.3A.)

X5.15.4 *Figs. X5.2A and X5.2B Building Schematic, Interior View*—Exterior RO flashing (SAF or LAF) extends into the RO recess at least as far as the depth of the window/door frame. The perimeter exterior flashing at the RO head installs before the application of the AB/WRB at the RO head as shown. Note—The exterior perimeter RO head flash-

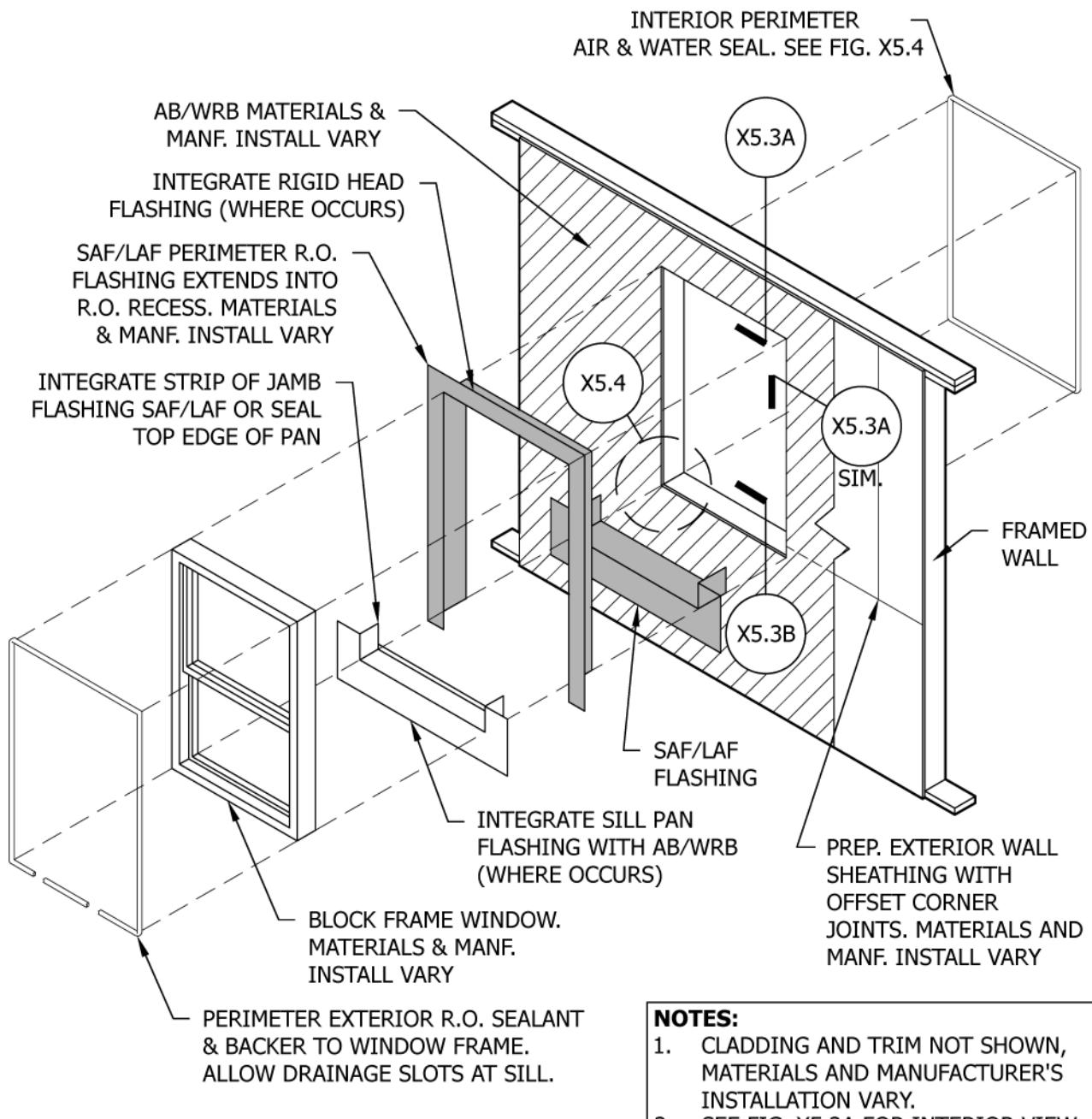
ing (e.g., SAF & LAF) does not lap over the AB/WRB at the head. The AB/WRB laps over the RO head flashing (See Fig. X5.3A). Interior perimeter air & water seal connects RO flashing with window/door frame. Air & water seal installed after window/door installation and bridges across the shim space on three sides with continuity to sill/threshold air & water seal.

X5.15.5 Figs. X5.2A and X5.2B do not illustrate a complete fenestration installation sequence, but are intended to orient the location of an interior air & water seal.

X5.15.6 *Figs. X5.3A and X5.3B, Interior Air & Water Seal at Wood Block Frame Window Section*—Mechanically attached or adhesive sheet AB, WRB or AB/WRB of building paper, building felt, polymeric (House Wrap) or liquidapplied flashing. R.O. flashing of SAF or LAF.

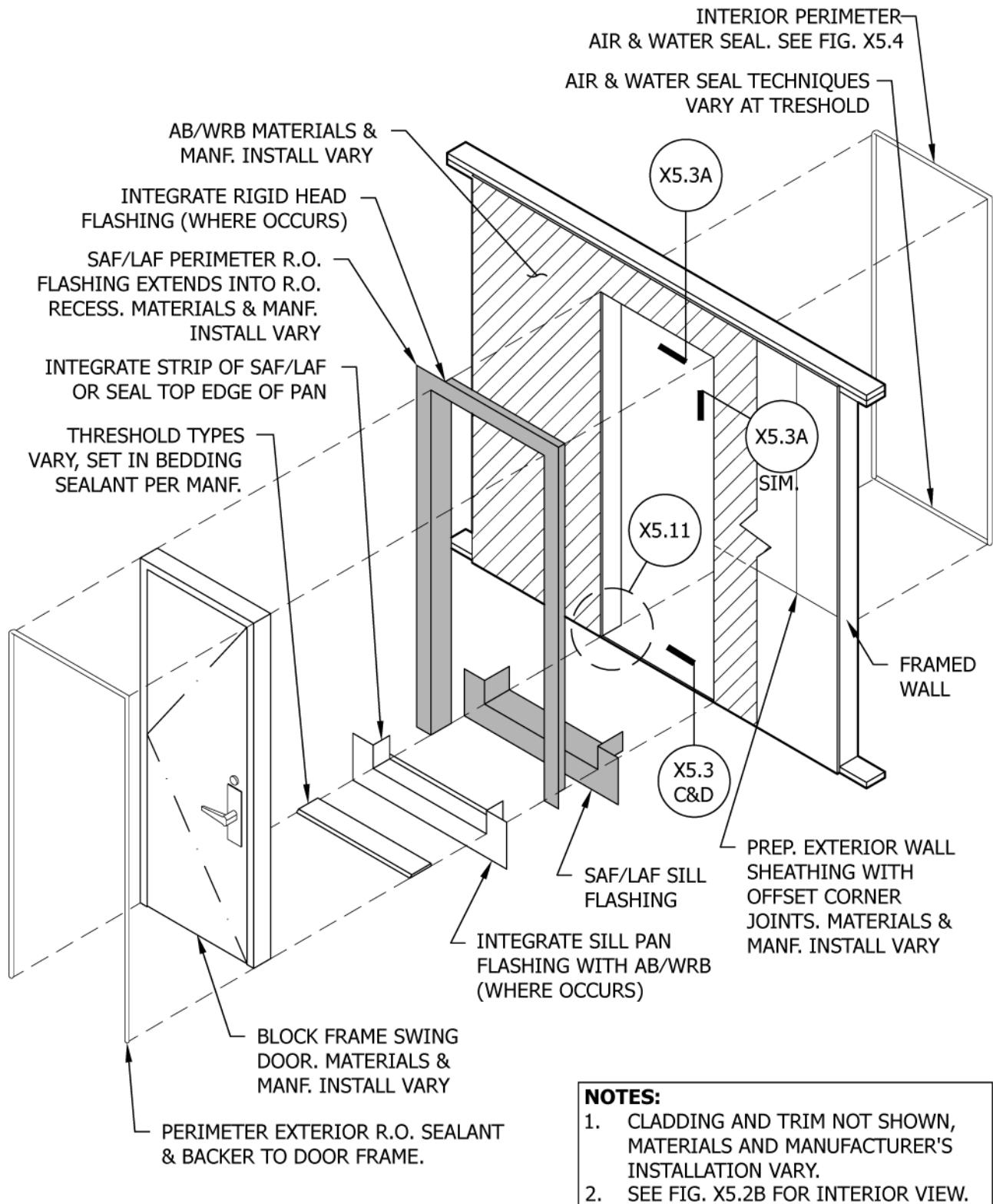
X5.15.7 *Fig. X5.3A*—Extend the exterior head flashing at head RO sufficiently onto the face of building (drainage plane of an exterior wall sheathing in most cases) so that it is underneath the AB or AB/WRB at the head; extends up the wall above the brick mold, rigid head flashing or integral mounting flange.

X5.15.8 *Figs. X5.3C and X5.3D, Interior Air & Water Seal at Wood Frame Door Section*—The rear leg of the sill pan may or may not be concealed depending on the flashing design, threshold selection and air & water seal testing.



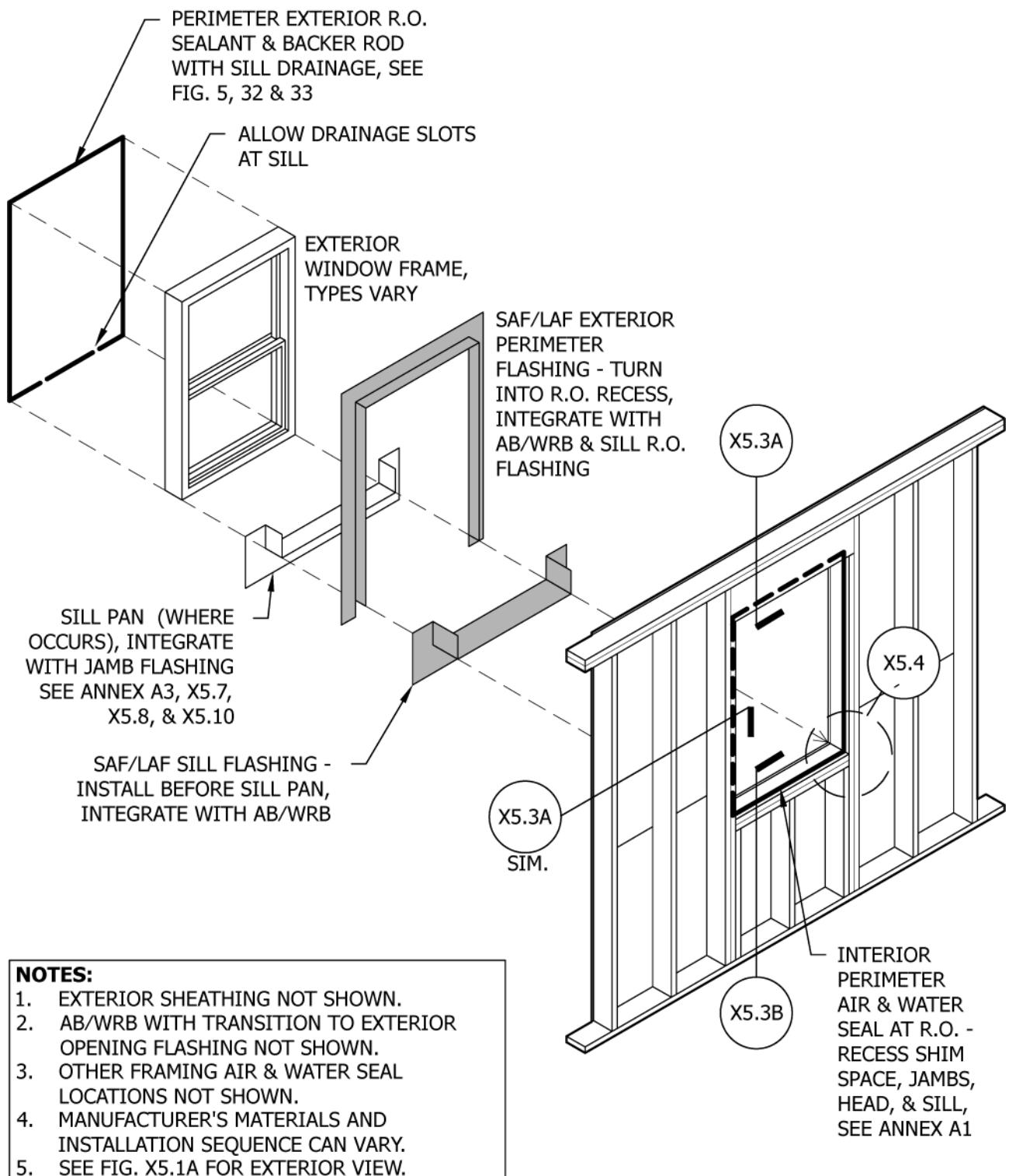
EXTERIOR VIEW

FIG. X5.1 A Air & Water Seal at Window



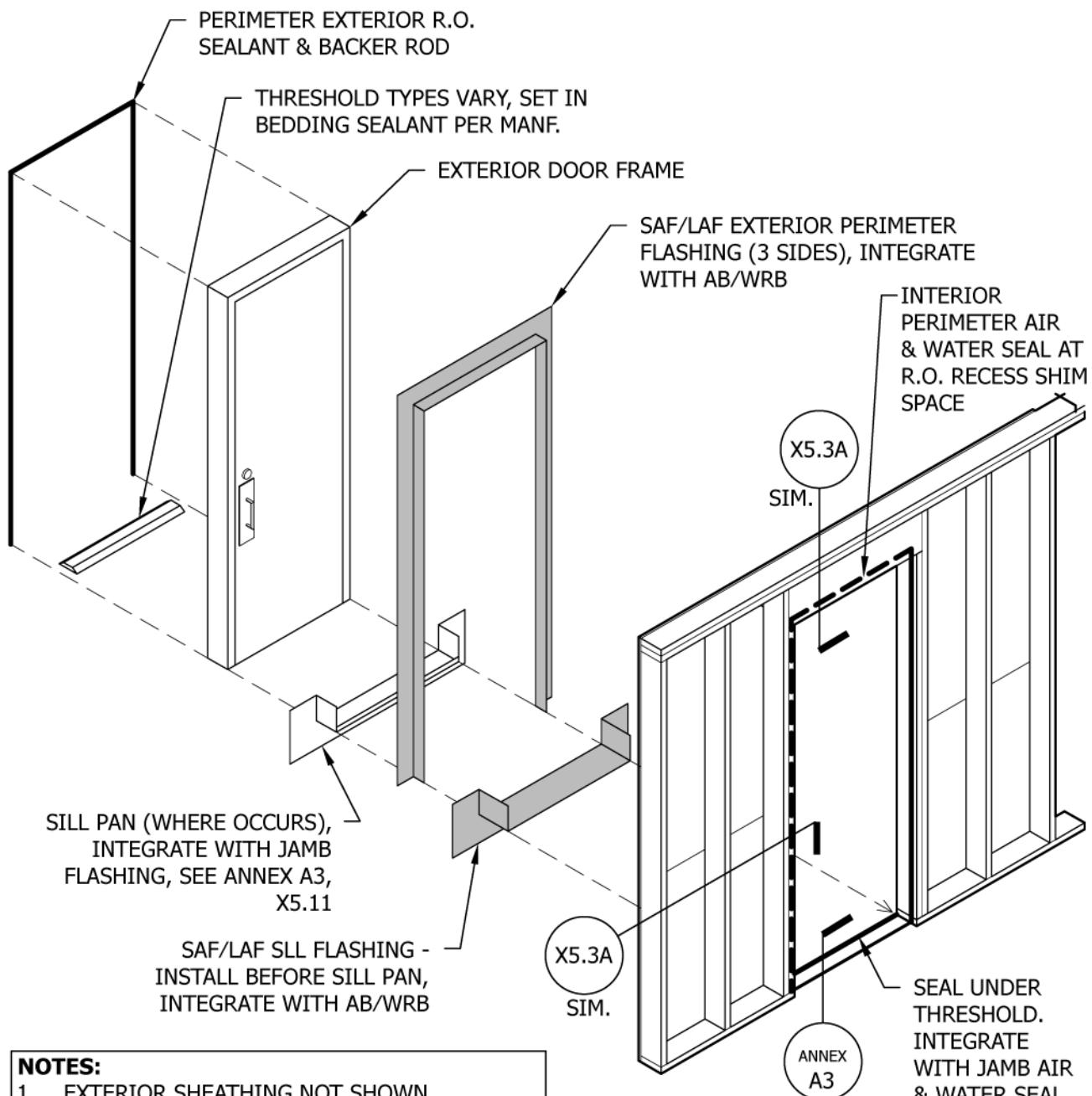
EXTERIOR VIEW

FIG. X5.1 B Air & Water Seal at Door (continued)



INTERIOR VIEW

FIG. X5.2 A Building Framing – Window Opening Assembly



NOTES:

1. EXTERIOR SHEATHING NOT SHOWN.
2. AB/WRB WITH TRANSITION TO EXTERIOR OPENING FLASHING NOT SHOWN.
3. OTHER FRAMING AIR & WATER SEAL LOCATIONS NOT SHOWN.
4. MANUFACTURER'S MATERIALS AND INSTALLATION SEQUENCE CAN VARY.
5. SEE FIG. X5.1B FOR EXTERIOR VIEW.

INTERIOR VIEW

FIG. X5.2 B Building Framing – Door Opening Assembly (continued)

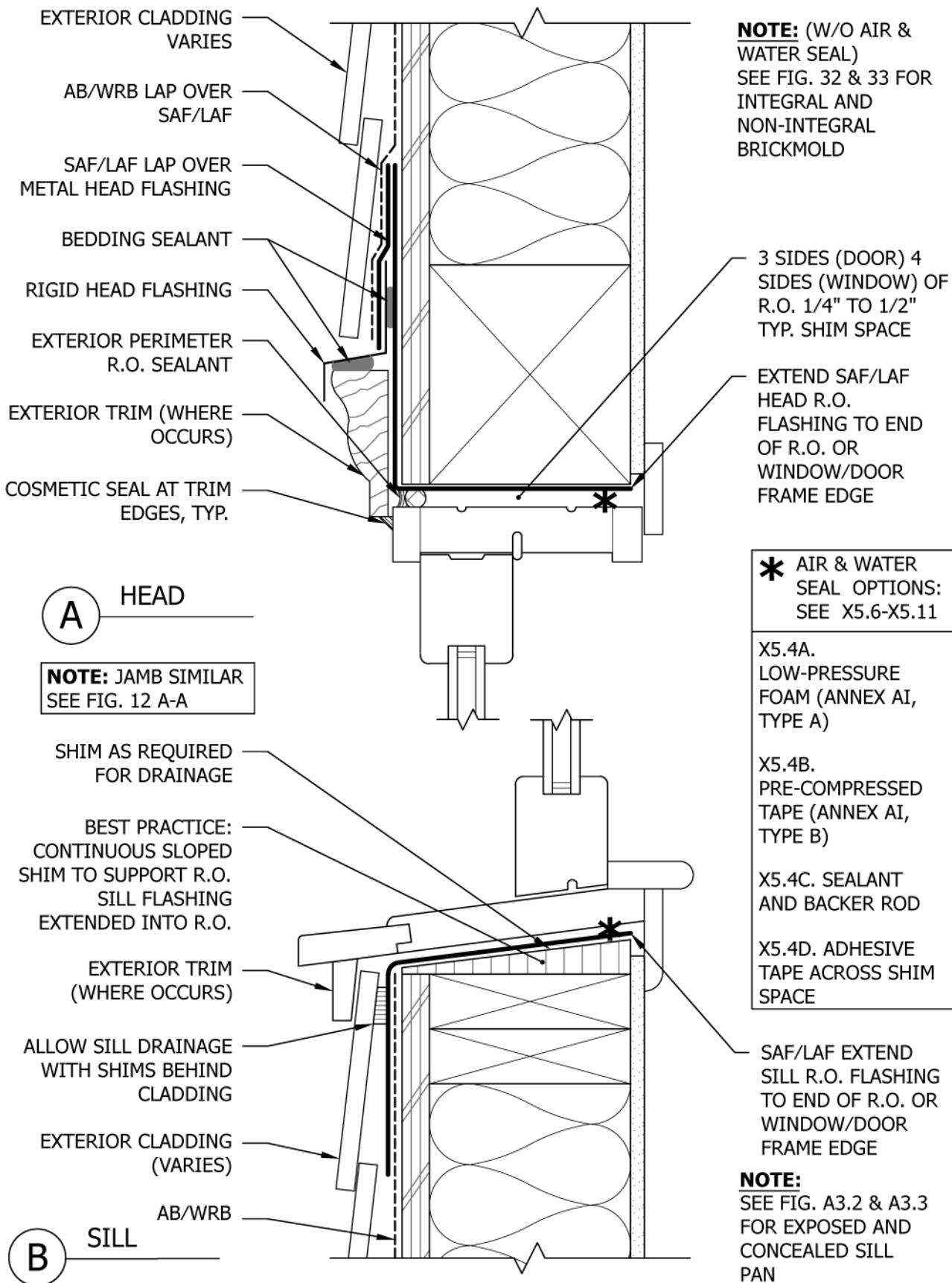
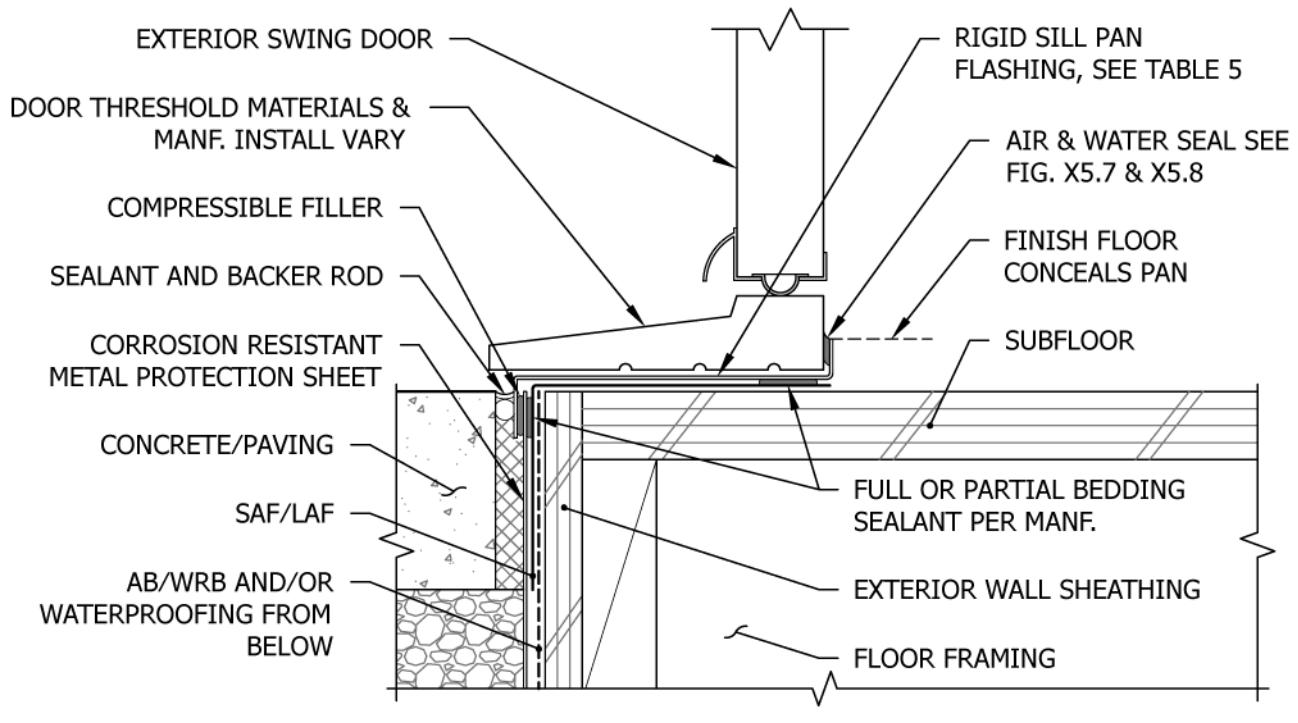
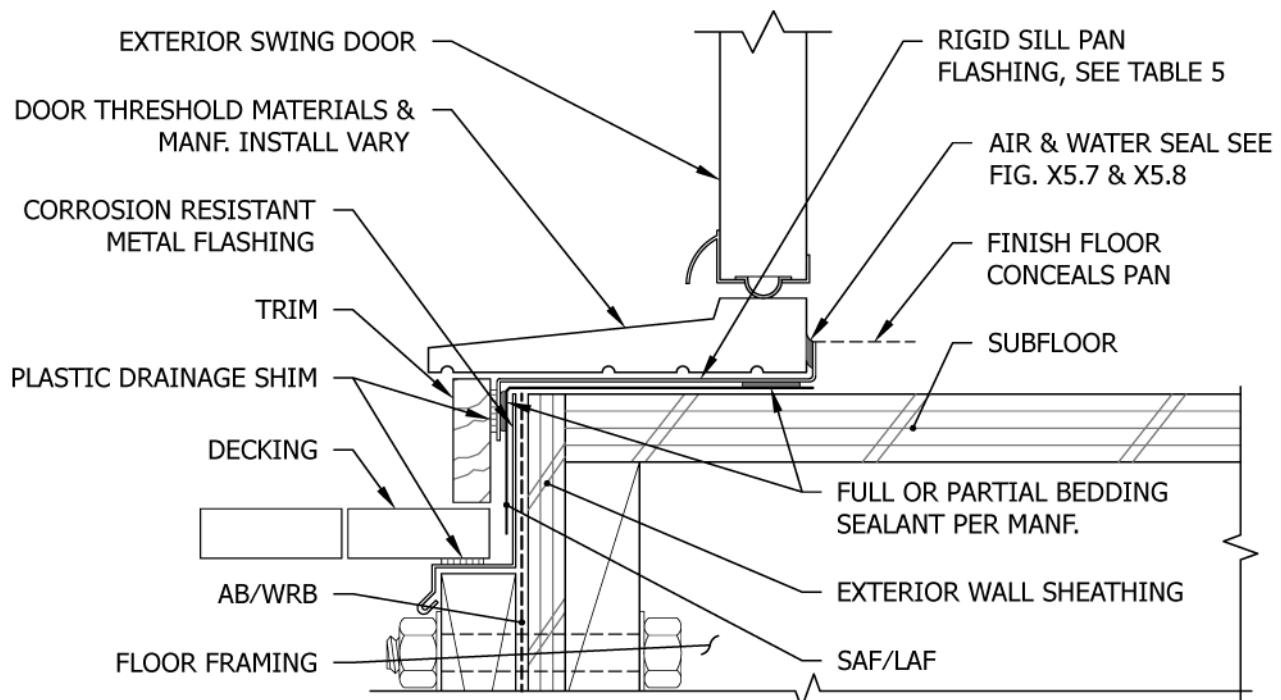


FIG. X5.3 A & B Air & Water Seal at Wood Block Frame Window Section



C THRESHOLD
AT LANDING/PAVING

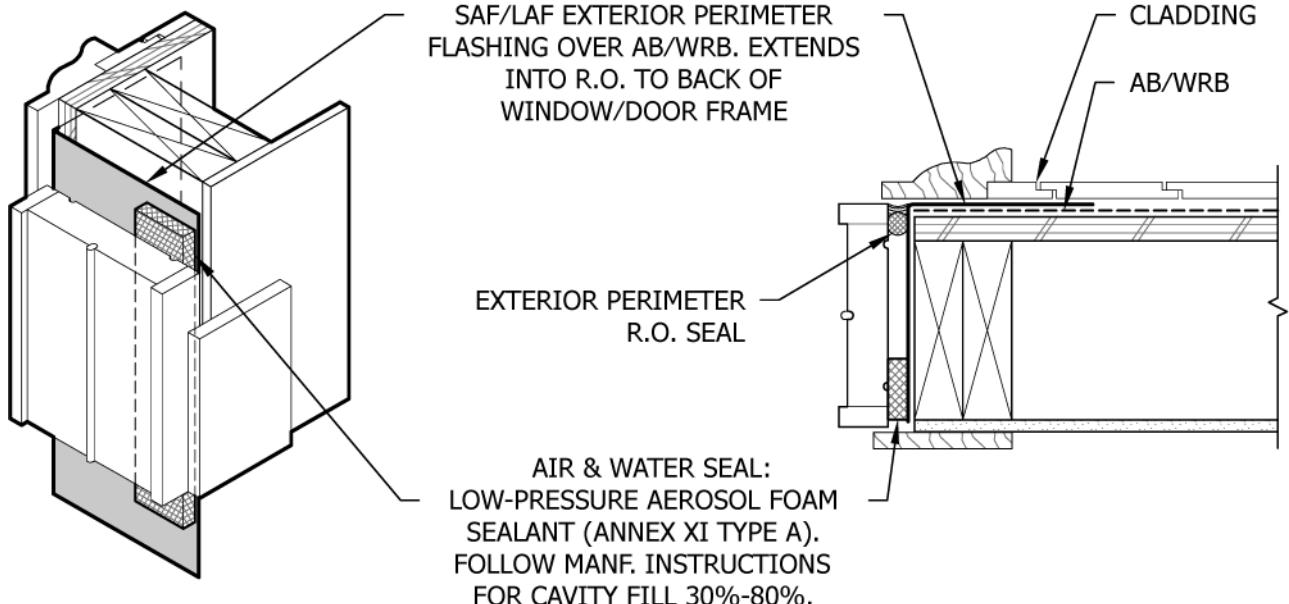
NOTE: FRAMING AND DECKING DETAILS SHOWN SCHEMATICALLY



D THRESHOLD
AT DECK LEDGER

NOTE: FRAMING AND DECKING DETAILS SHOWN SCHEMATICALLY

FIG. X5.3 C & D Air & Water Seal at Swing Door Threshold Section (continued)

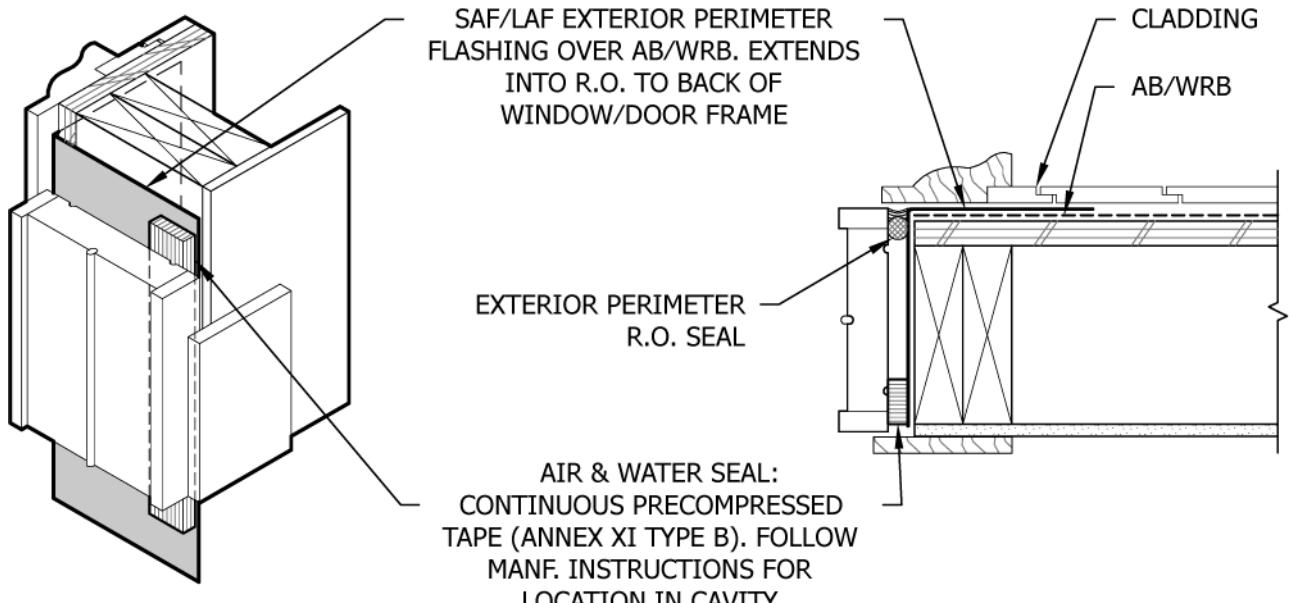


INTERIOR VIEW

JAMB

A

LOW PRESSURE AEROSOL FOAM SEALANT



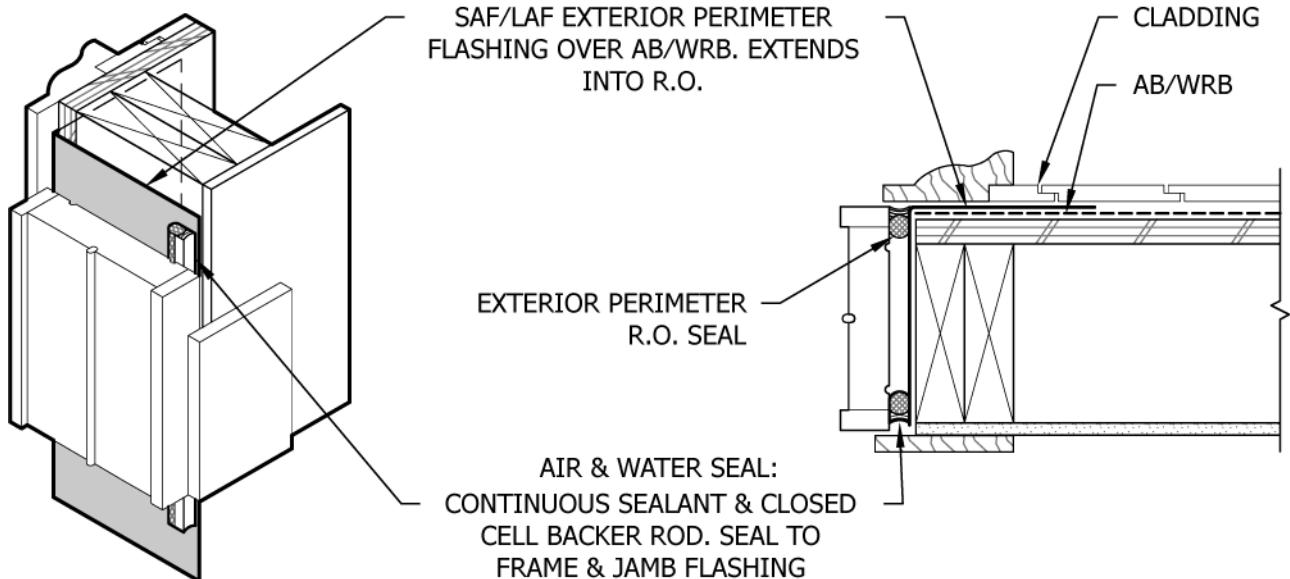
INTERIOR VIEW

JAMB

B

PRECOMPRESSED TAPE

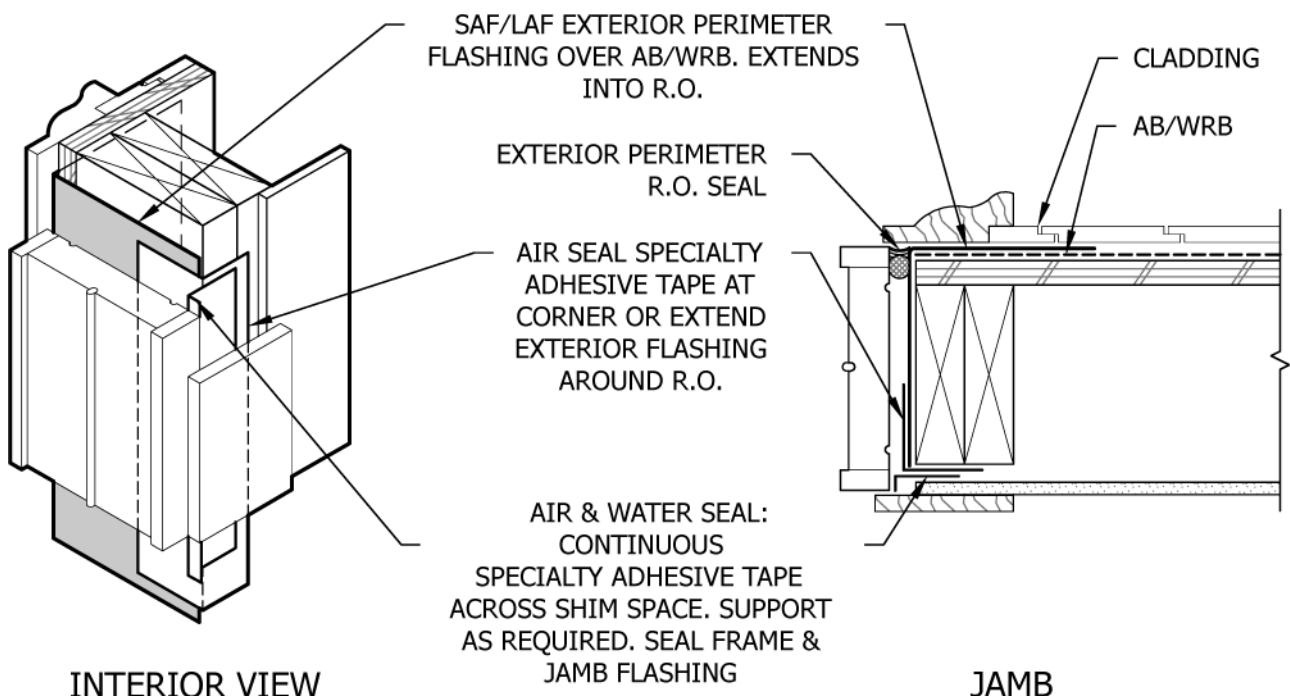
FIG. X5.4 A & B Air & Water Seal Material Options at Jamb R.O. With Wood Block Frame Window



INTERIOR VIEW

JAMB

C SEALANT AND BACKER ROD



INTERIOR VIEW

JAMB

D ADHESIVE TAPE

FIG. X5.4 C & D Air & Water Seal Material Options at Jamb R.O. With Wood Block Frame Window (continued)

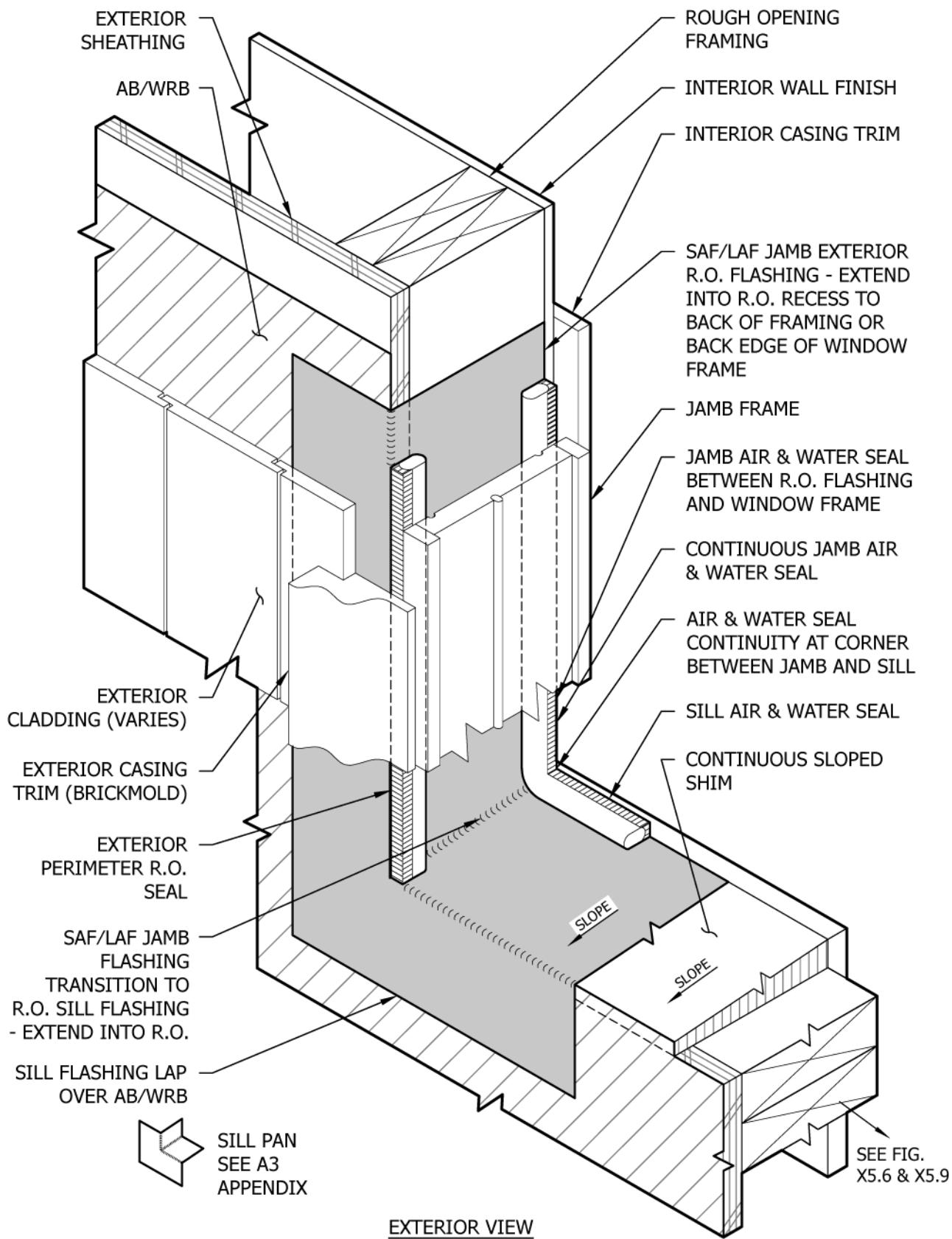
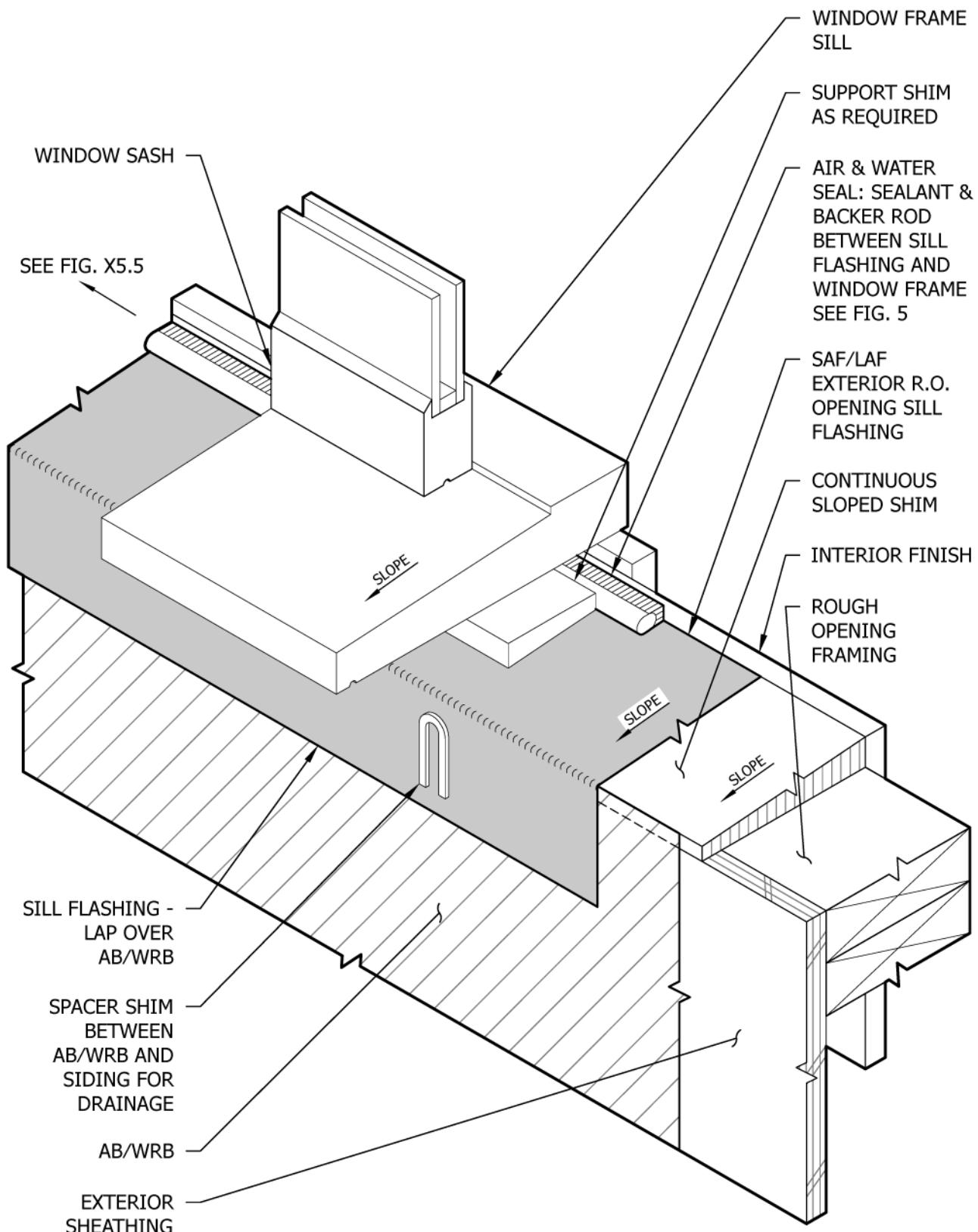


FIG. X5.5 Air & Water Seal at Jamb-Sill Corner Without Sill Pan Flashing



NOTE: EXTERIOR CLADDING & TRIM NOT SHOWN

EXTERIOR VIEW

FIG. X5.6 Air & Water Seal at Sill Flashing Without Sill Pan

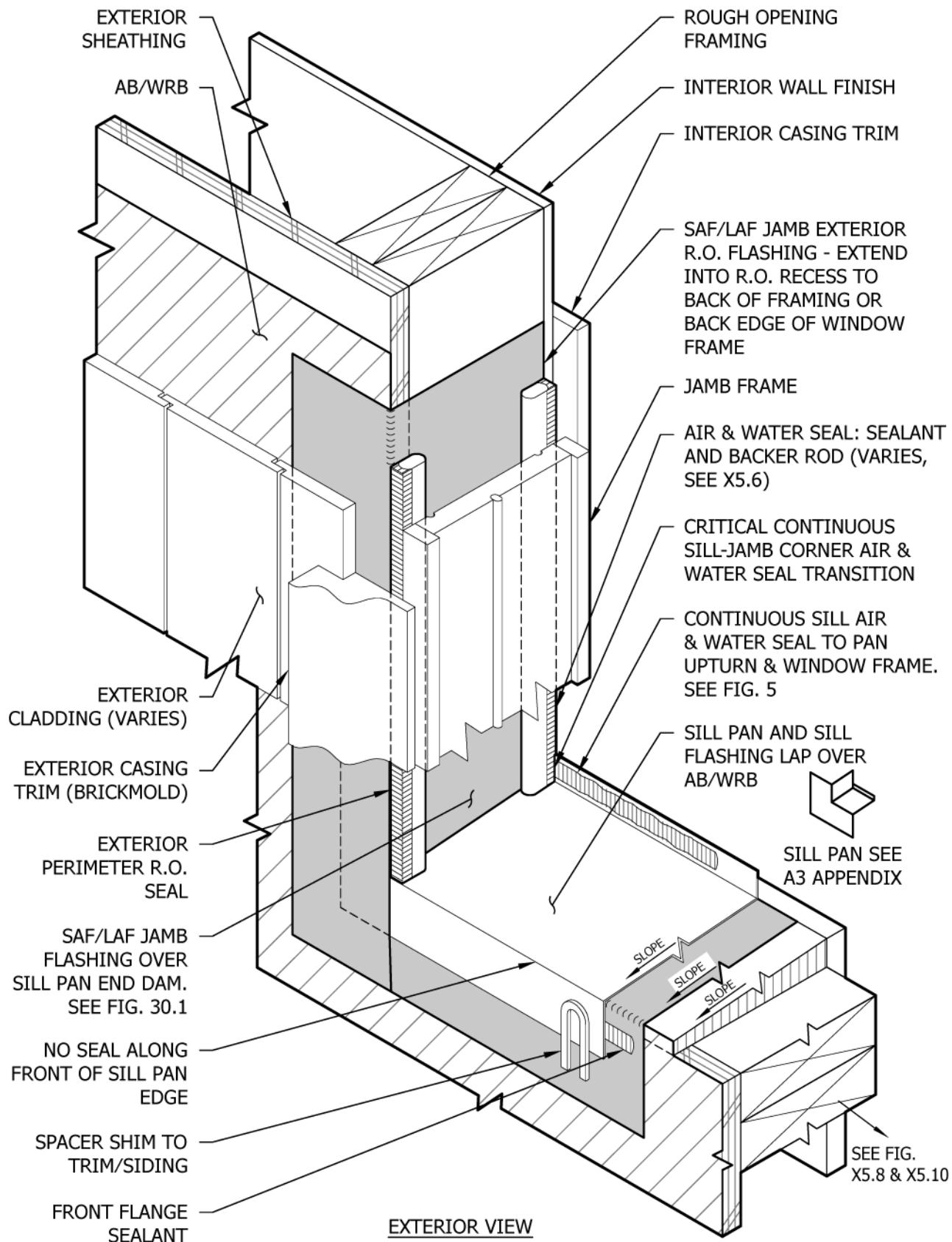


FIG. X5.7 Air & Water Seal at Jamb-Sill Corner With Sill Pan Flashing

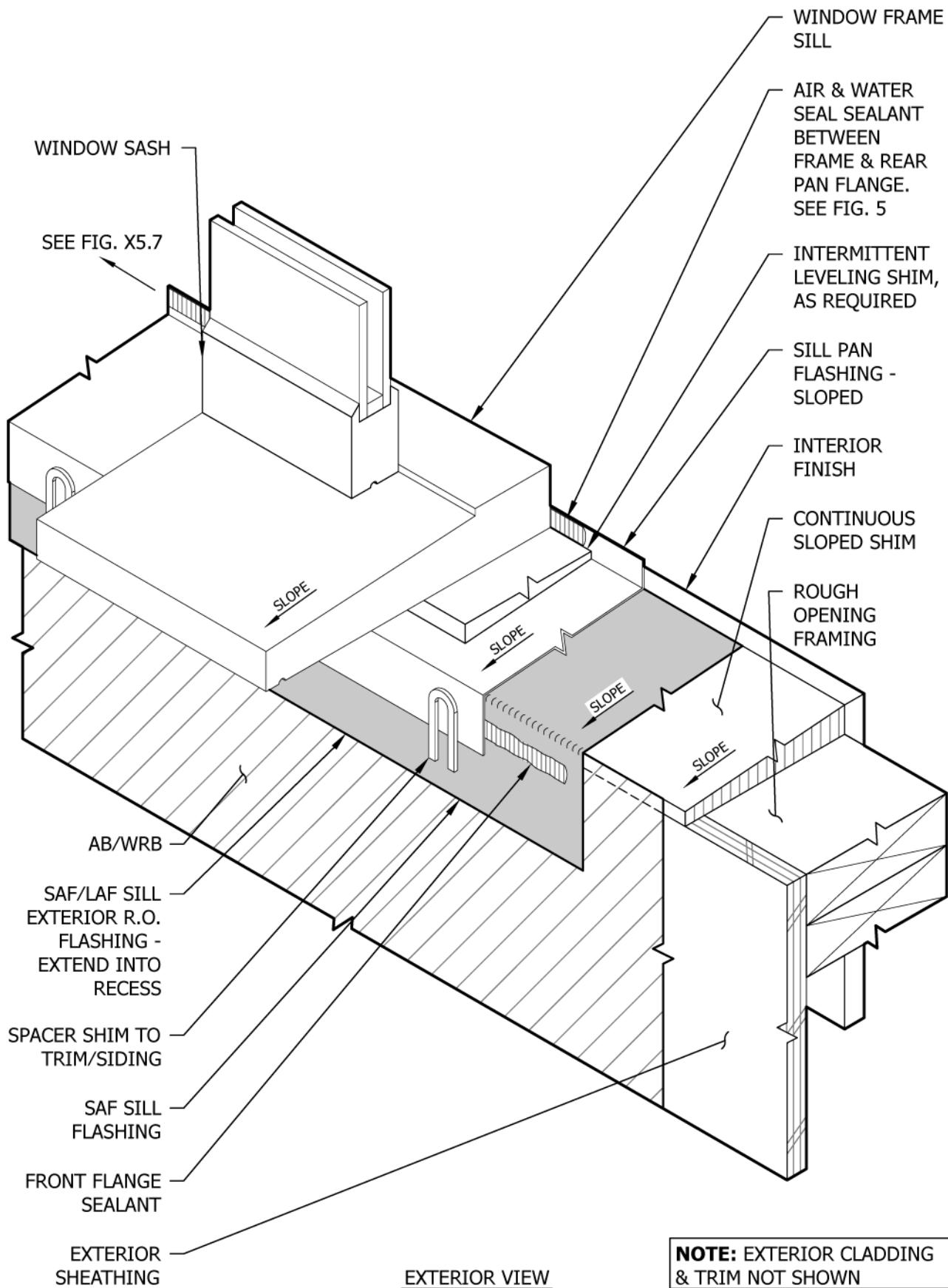


FIG. X5.8 Air & Water Seal at Sill Pan Flashing

NOTE: EXTERIOR CLADDING & TRIM NOT SHOWN

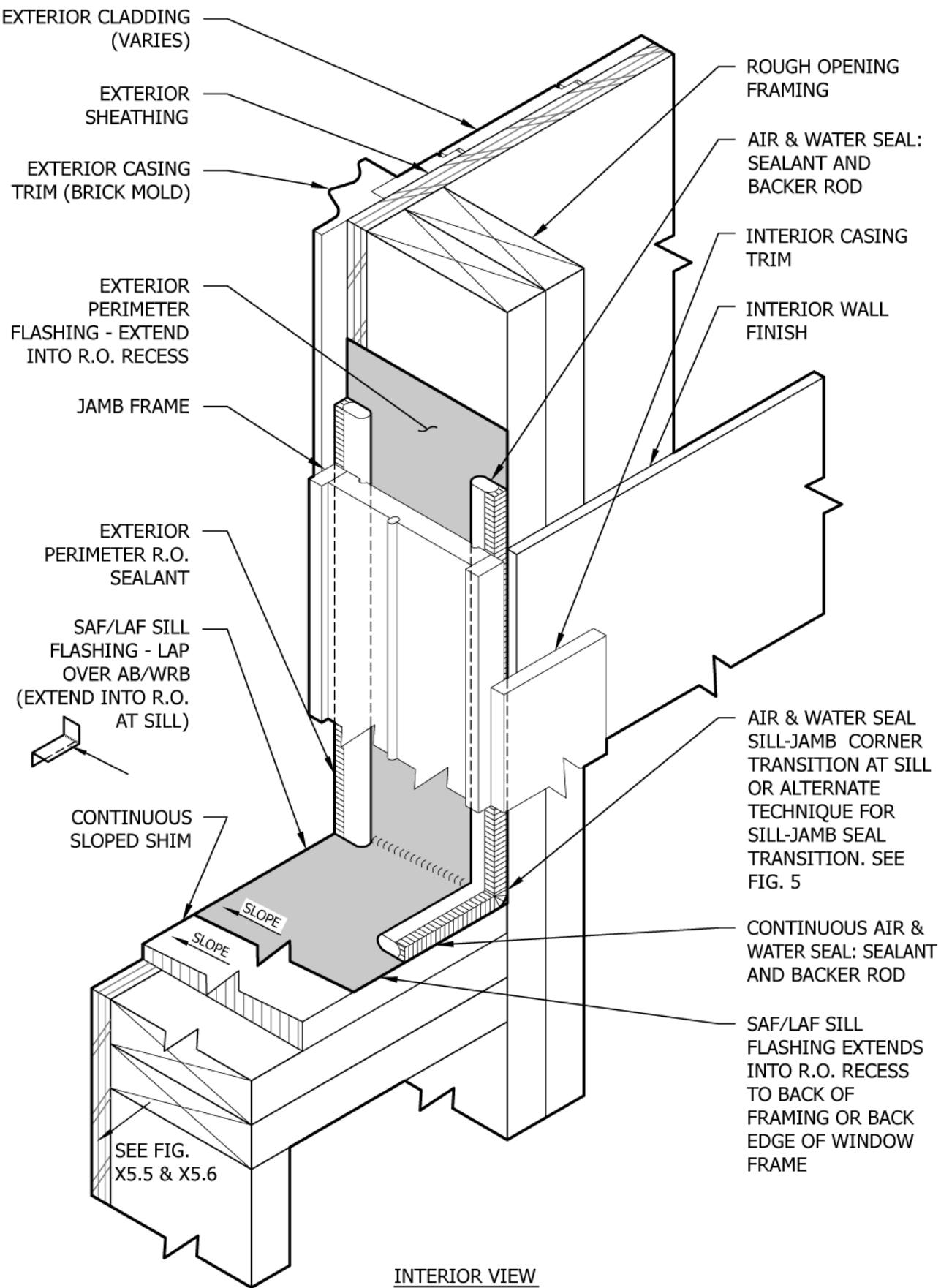


FIG. X5.9 Air & Water Seal at Jamb-Sill Corner Without Sill Pan

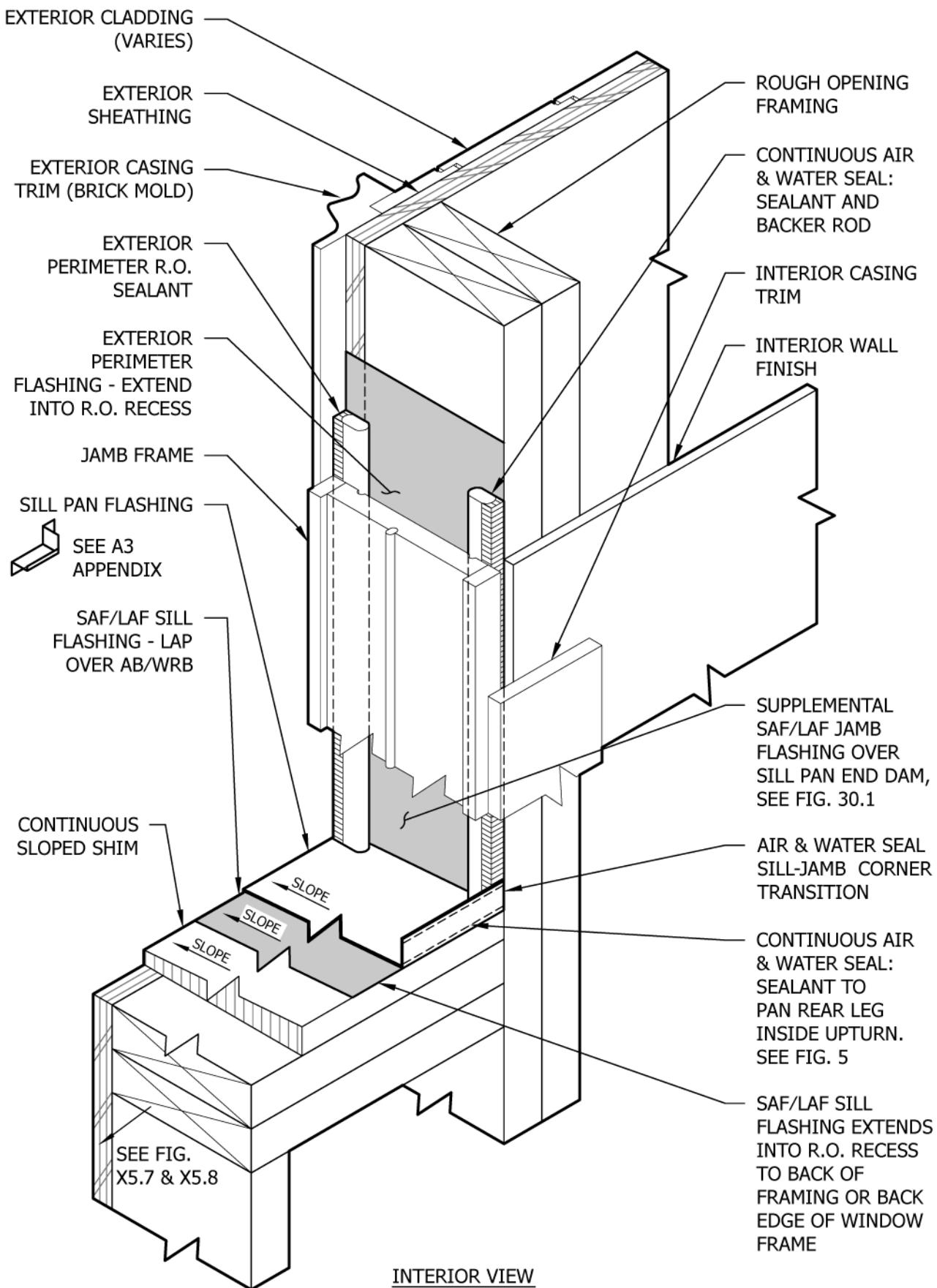
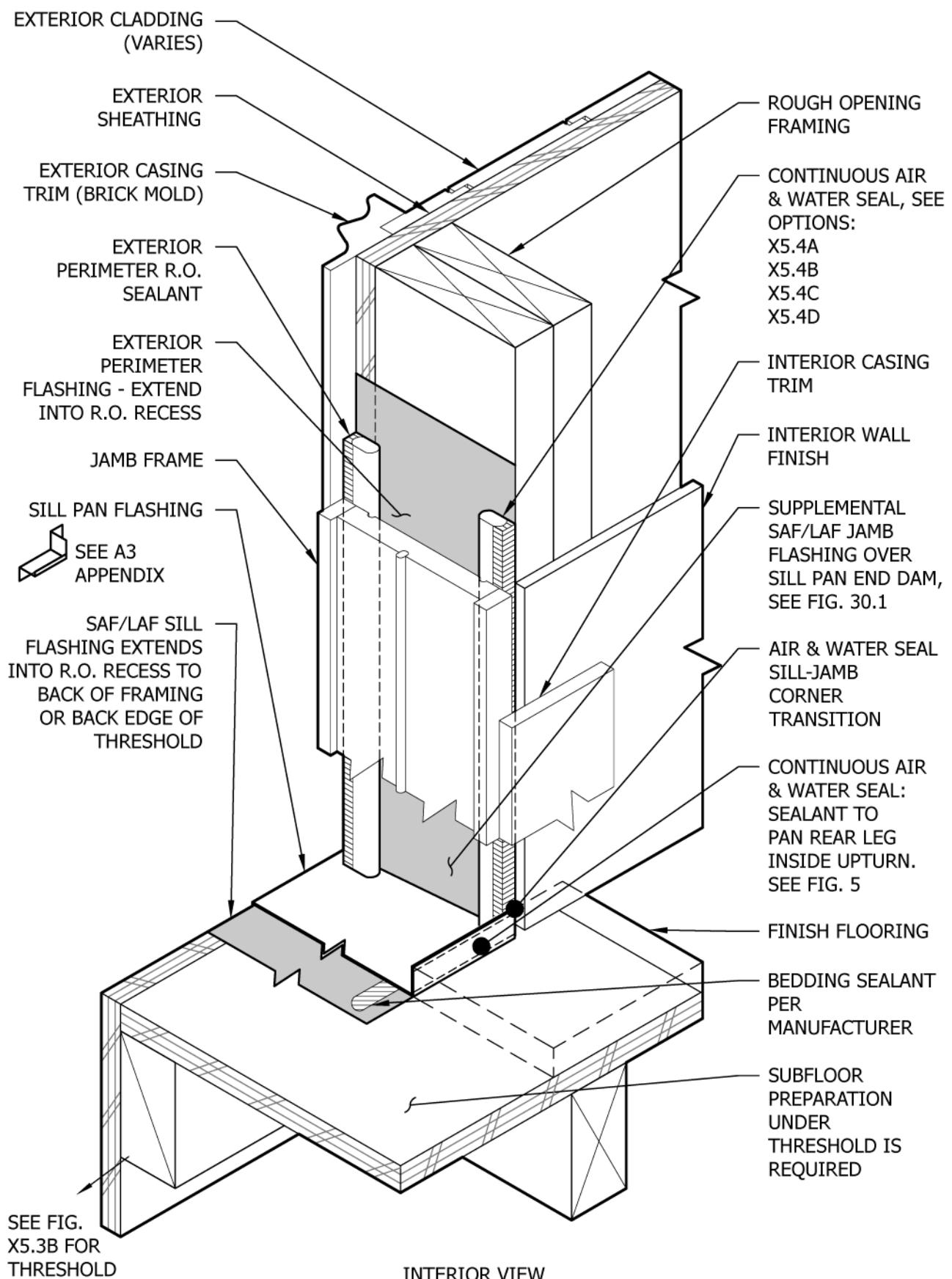


FIG. X5.10 Air & Water Seal at Jamb-Sill Corner With Sill Pan Flashing


FIG. X5.11 Air & Water Seal at Swing Door Jamb-Sill Corner

SUMMARY OF CHANGES

Committee E06 has identified the location of selected changes to this standard since the last issue (E2112 – 19) that may impact the use of this standard. (Approved April 15, 2023.)

(I) Added **Appendix X5** and related figures.

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