



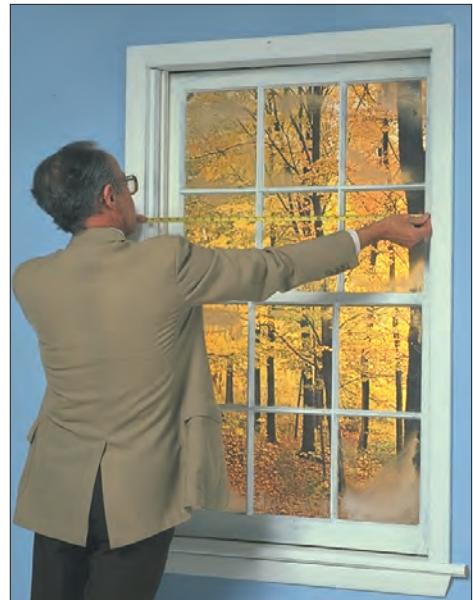
WEB BASED CORE APPLICATION SPECIFIC INSTALLATION INFORMATION AND METHODS



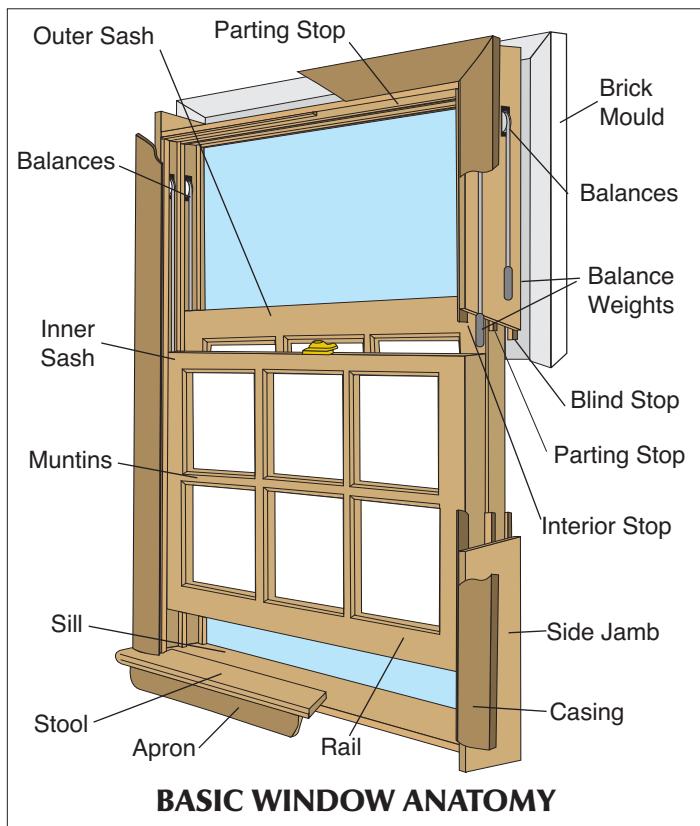
Proper Measurement

Although all possible measures have been taken to insure the accuracy of the material presented, WIXSYS, and the author are not liable and do not assume any liability in case of misinterpretation of directions, misapplication, improper installation, or typographical error. Pictures and Diagrams are meant to represent typical situations and are for guidance. Actual product dimensions, representations and specifications are to be supplied by the manufacturer.

Accurate Measurement is the Key to Quality Installation.

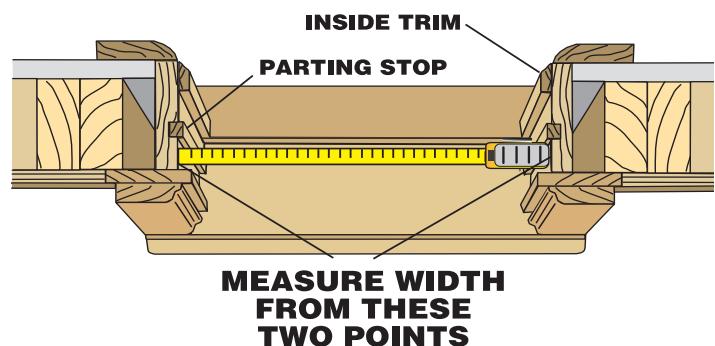
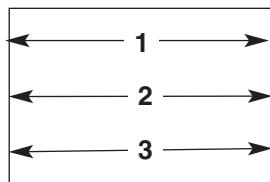


When you specify a replacement window, it is made to fit the particular opening and it is important to correctly measure the opening. There are three primary critical measurements involved: Width, Height and Square.



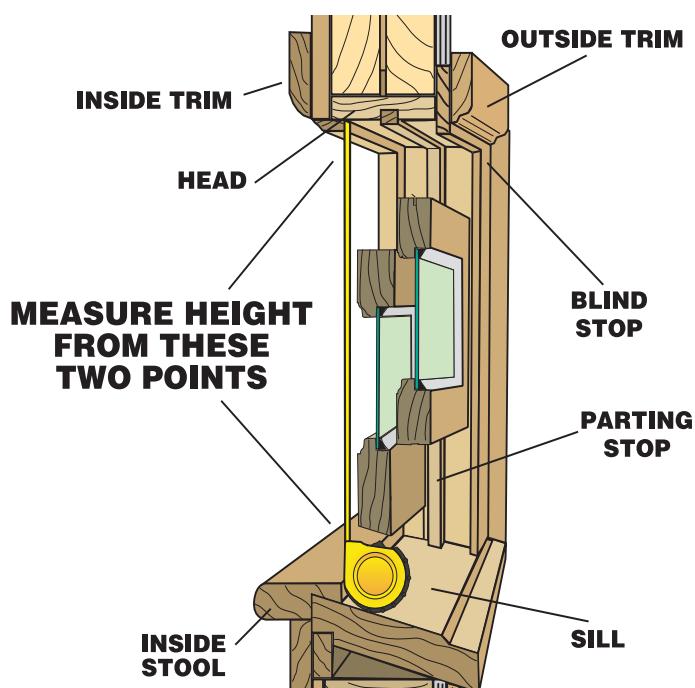
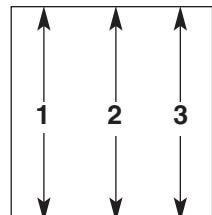
Width

This is the measurement that is given first when ordering a window. Because the inside stops and parting stops are removed, the width must be measured from jamb to jamb as shown. Measure at the top, middle, and bottom and use the smallest dimension.



Height

The height of the window is taken from the sill (from the point against the stool) to the header (at the point against the inside stop) as shown. Measure at the left, middle, and right and use the smallest dimension.



Often the success or failure of window installation begins with the proper measurements and opening status information – or lack of it.

Most installers or measurers are trained and record accurately the width and height of the opening. These measurements should be done with regard to the type of window and construction of the wall.

Whatever method is used and/or described, it should be consistent between installers or measurers and openings and wall construction. In this way, the specified window is consistent and regardless of who measures and specifies, any installer working for the company will have the proper window and expectations at the job site. No surprises.

In addition to the width and height, there are 6 other states or conditions of the opening that need to be measured, observed, and recorded so that the natural (or otherwise) idiosyncrasies of the opening are non ahead of time and can be accommodated in the specification of the needed window or door, and so that the proper materials and tools for correction will be known and provided at the job.

Square

Because some openings have become out-of-square over the years, it is important that the “squareness” of the opening be accurately measured. Measure the diagonals (upper left to lower right, and upper right to lower left) as accurately as possible from a point inside the stool to a point against the inside stop at the header. Record the two dimensions.

If they are roughly equal, the opening can be assumed to be square. If they are not, then it is possible that the opening is out-of-square enough to cause the new window to be forced into an out-of-square condition during installation.

If the new window is forced out-of-square, the interlock, sill and header seals can leak air and possibly water. Also the cam locks will not operate correctly and the window will wear out prematurely.

Determine Square by measuring the corner diagonals (upper left to lower right, and lower left to upper right). Record both dimensions. The difference between them is the square condition.

If the diagonals are not equal use the following simple equation. If the difference between your measured diagonals is greater than the allowable value, it may be appropriate to order a window 1/8" to 1/4" smaller than indicated by your measured width. This will allow the new window to be installed square in the opening. Then adequate sealing of the perimeter of the new window will complete the air-tight installation.

Formula:

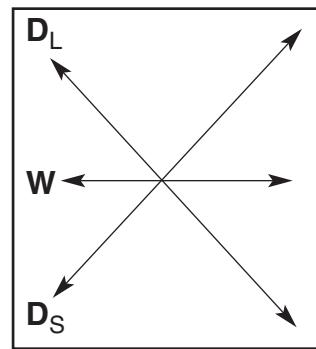
$$D_L^2 - D_S^2 = W$$

D_L = Longer Diagonal

D_S = Shorter Diagonal

W = Width of Opening

The difference between the sum of the *squares* of the measured diagonals cannot be greater than the opening width.



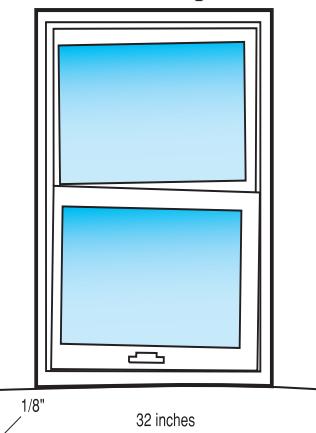
Example 1: Opening 36" wide by 48" high. The Long Diagonal is 60-3/8" and the Short Diagonal is 60-1/8". Squaring the Long Diagonal (60.375 x 60.375) equals 3,645.14". Squaring the Short Diagonal (60.125 x 60.125) equals 3,615.02". Subtracting them finds a difference of 30.12". The difference is **less** than the width of 36" so the opening is square enough to accept a window designed to fit a 36" x 48" opening.

Example 2: Opening 28" x 60". The Long Diagonal is 66-3/8" and the Short Diagonal is 66-1/8". Squaring the Long Diagonal equals 4,405.64". Squaring the Short Diagonal equals 4,372.50". Subtracting equals 33.14" which is **greater** than the opening width of 28". The opening is out-of-square enough to warrant consideration of a window 1/8" to 1/4" narrower than a window designed to fit an opening 28" x 60".

Level

When installing a vinyl window, it is important that the sill on which the window is resting be level. Out of level sills can cause havoc in the operation of large windows, casement windows, awning windows, sliders, and even double and single hung windows. The main reason for this problem is that out of level sills will distort the frame to an out-of-square situation.

Imagine a sill that slopes and the sides of the window are made plumb. By definition, the window frame will become a parallelogram where the header and the sill will be parallel, and the sides will be parallel, but the sides will not be at right angles (90°) to the sill or header. This will make it nearly impossible for the sash, which will be square at the corners, to nest properly, lock properly, and seal out wind and moisture properly.



As the sash is “forced” into the out of square frame, undue pressure will be placed on the corners, the hardware, and even the glass and its seal.

32" Sills can be 1/8" out of level & still meet code. Some sills are even worse.

Measuring for Full Frame Removal

Most instructions show measurements taken within the tracks from one side to the other, and from top to bottom.

These measurements are sufficient for box frame or pocket replacement - i.e., "Frame-In" replacement. However, windows are installed initially against the rough framing (the rough opening), before the interior wall board and exterior siding is installed and trimmed out.

If the old wood window has weights, there is a weight pocket behind the jambs. The outer surface of the sloped sill of old wood windows is considerably above the rough sill; and depending on the thickness of the window sill itself, it becomes difficult to estimate the real rough opening dimensions unless the old window was totally removed. And, certainly you don't want to be removing the old window and then measuring in order to properly size the new window.

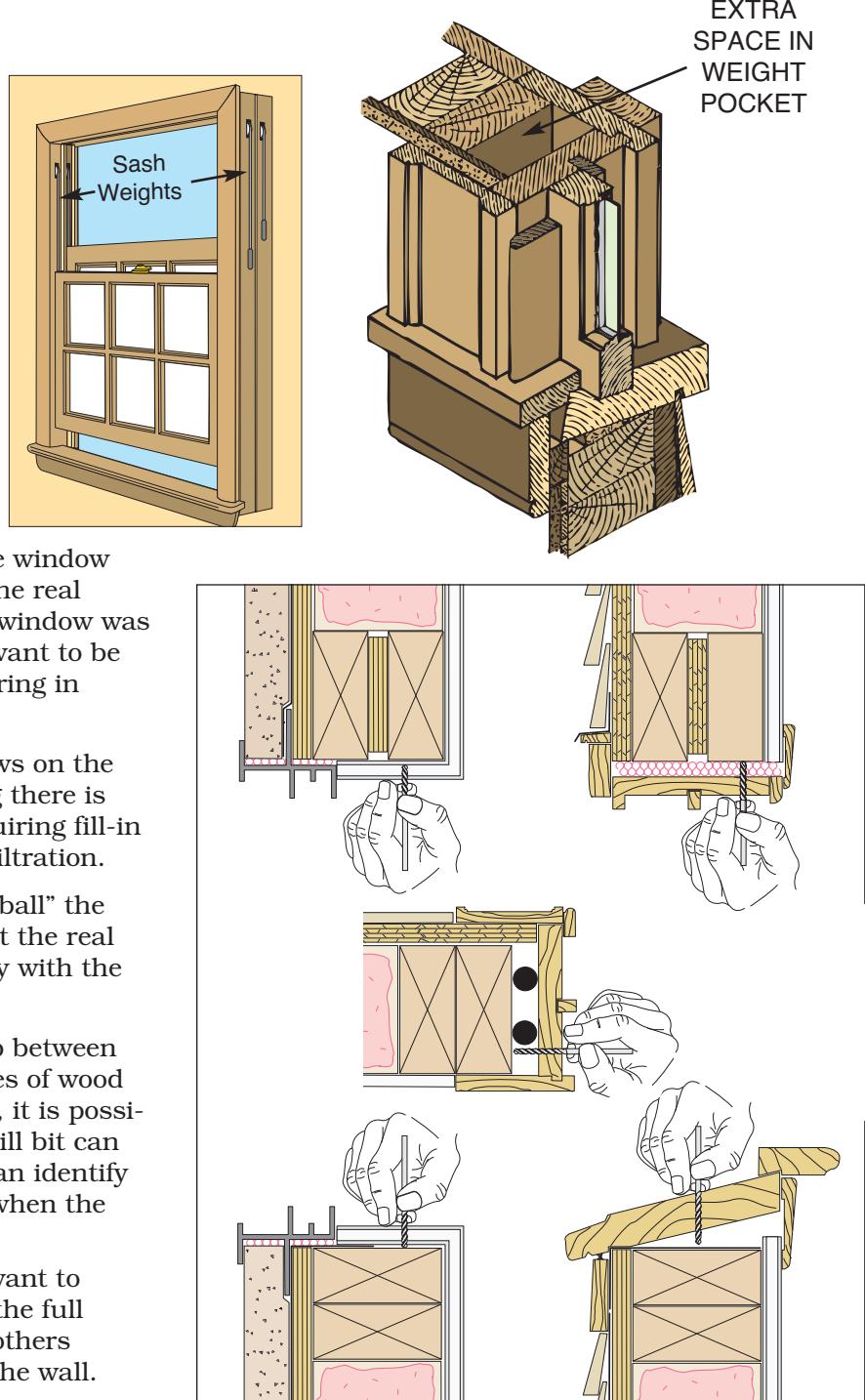
Perhaps worse is receiving the new windows on the job, removing the old windows and finding there is a mis-measure (really a mis-estimate) requiring fill-in or larger gaps that invite water and air infiltration.

Experienced installers may be able to "eyeball" the real dimension, but the safest way is to get the real dimensions and supply them to the factory with the order.

The drawings show the actual relationship between the rough opening and the interior surfaces of wood and finned window. Using a small drill bit, it is possible to make a small hole into which the drill bit can be inserted, and using your fingers, you can identify the additional space that will be exposed when the old window is totally removed.

These techniques can be used when you want to determine the space that will be left after the full frame is removed for Metal Windows and others where mounting parts are "buried" inside the wall.

Professional measurement sheets have extensive dimension call-outs. Too much information back at the factory is better than too little. Use your best judgement.



Using a small drill bit, create a hole in the frame or wall board to insert. Using your fingers, as shown, push the drill bit until it rests on the rough opening framing. Remove the drill bit and measure from the tip of your fingers to the drill bit tip and add that to the measurement between the inside surfaces of the old window.

Variance in Measurements

Measure instructions request that the width and the height be measured in three places – end the ends and in the middle – and the smallest be used in providing the “rough opening” dimension to a window manufacturer to produce the properly sized replacement window. While it is desirable to have a window that fits – especially with any irregularities in plumb and square - making the glass area smaller by shrinking the new window, or restricting the egress of the replaced window are not desirable so the largest window that fits is the goal.

The most common replacement is “blind-stop or “pocket” install where the old operating sash, weights and parting stops are removed to make a space for the new replacement window to fit. Alternatively, windows with plastic or aluminum tracks have the old sash and the track assemblies removed leaving the same opening for the new window.

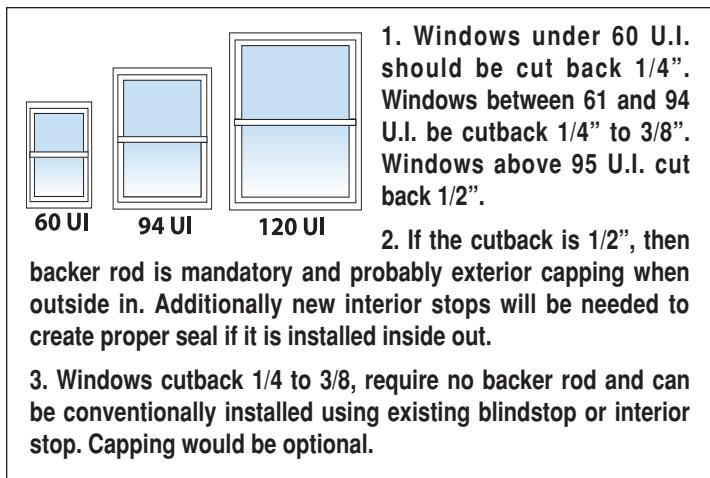
Common industry traditional cut-back has been $\frac{1}{4}$ ” on the width and $\frac{3}{4}$ ” on the height when a head expander is used and when the new window is to be fit against the exterior stop.

Cut-back for an “outside-in” install, where the interior stops are left intact but the exterior blindstop is cut or fractured off to allow the new window to be inserted into the opening without a head expander, has traditionally been $\frac{1}{4}$ to $\frac{3}{8}$ ”.

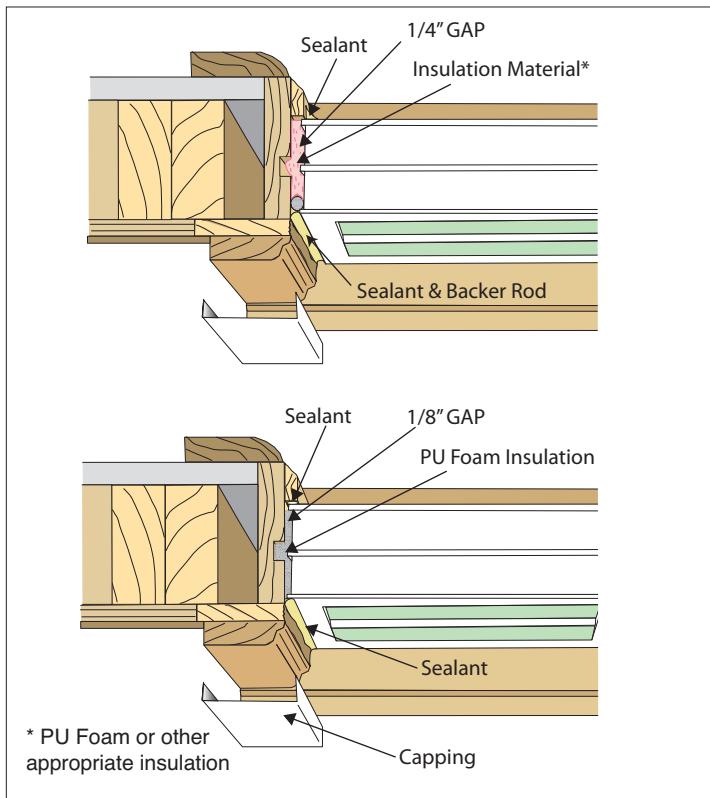
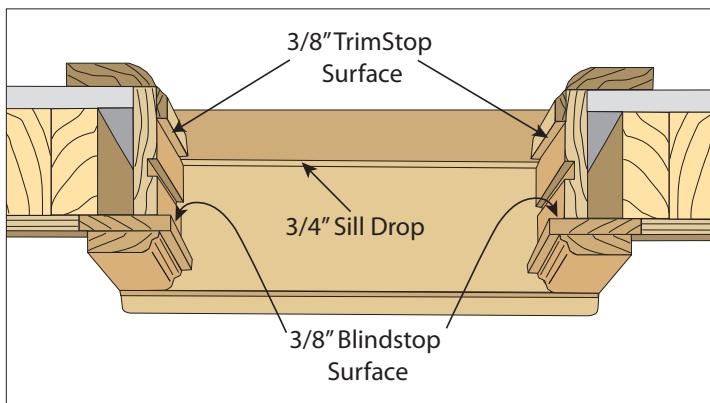
These cut back dimensions have been the most common because stop surfaces (interior stop or blind stop) are $\frac{3}{8}$ ”. Cutting back any more than $\frac{1}{4}$ ” (which leaves $2/8$ ” on each side) risks having too little contact surface for the new window impeding proper sealing and mounting and risking air and water intrusion.

However, many openings are not square and when the three measures are taken, while they may even be equal, they are not square and the new window would need to be racked out of square to fit with these minimum tolerances. This has led many replacement cut backs to become larger – to nominal $\frac{1}{2}$ ” cutback on width and $\frac{3}{4}$ ” on height when using a head expander, and $\frac{1}{2}$ ” on height when not.

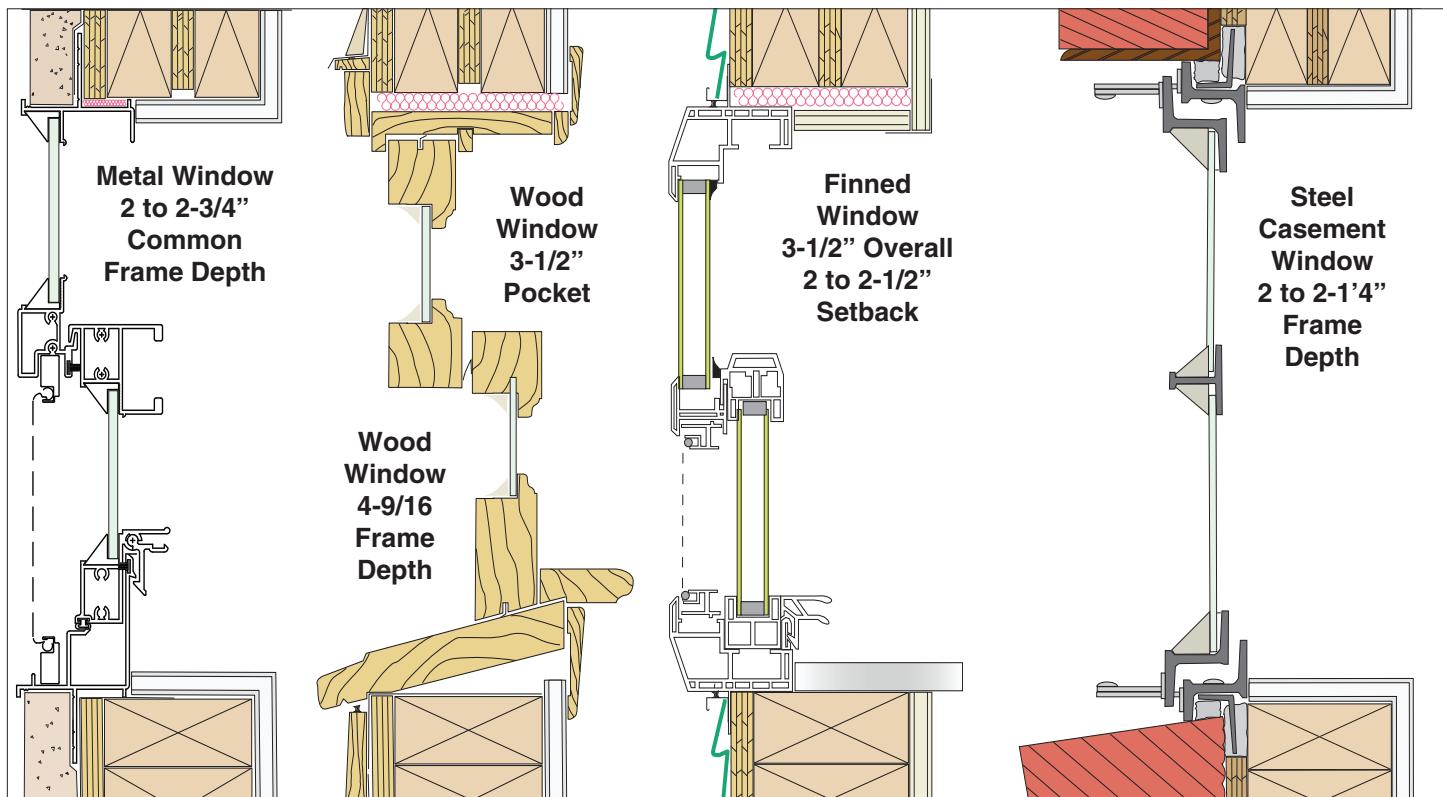
AWDI recommends three circumstances to determine the appropriate cutback, because as a window becomes taller (and wider), the out-of-square condition of the opening becomes a more progressive problem. For example, a $1/16$ ” deviance over 2 feet tall will become $1/8$ ” out at 4 feet tall. An un-level sill (more common) might require shimming the new window off the old sill, and that distance will lessen the room at the top of the new window.



Different procedures are also being recommended depending on the space between the new window ordered and sized by the factory, and the rough opening created by the removal of the old window.



Frame Depth



The importance of proper measurement must also take into account depth, because the depth of the opening after removing the old window, will determine the order size of the window and the method of installation and requirements for finish trim inside and out.

Standard 2 x 4 construction, with sheathing on the exterior and wall board or sheetrock on the interior has, for the most part, standardized measurements. From the outside surface of the sheathing to interior surface of the wall, the default dimension will be 4 and 9/16 inches.

The residential window universe consists of three basic window frame materials – pretty much distributed evenly when it comes to existing windows needing replacement: Wood frame, Metal frame (steel and aluminum), and Vinyl frame (similar with composites).

Window size is influenced by whether the old window and its trim is removed down to the rough opening; or if the window is removed and the old trim remains; or if the old frame of the window remains and only the operating and glass panels are removed.

If the old window and trim is removed down to the rough opening, the replacement window will be as big as possible to fill the opening. This can be important because the bulkier frame material for modern replacement windows tend to reduce the glass area that is not always desirable to the consumer – especially for smaller windows.

If the trim remains, then the replacement window will need to fit to it, altering and probably increasing the needed work to install the new window.

If the old frame is left intact the new window needs to butt to it, fit inside it, or sit on top of the frame; again influencing the cost and complexity of the installation of the new window.

The illustrations show common existing conditions for old windows to be replaced. The next illustrations show the various openings after either partial or full removal of the old window.

Whatever method is chosen, proper installation is possible remembering to accommodate the water, moisture, air, thermal and vapor barriers. Best practices for all are covered in detail throughout this manual.

Various Openings Can be Created When Old Windows are Removed

Old Wood Window – Removing the old sash and parting stops or aluminum track leaves a perfect opening for a “pocket Install” from inside or out.

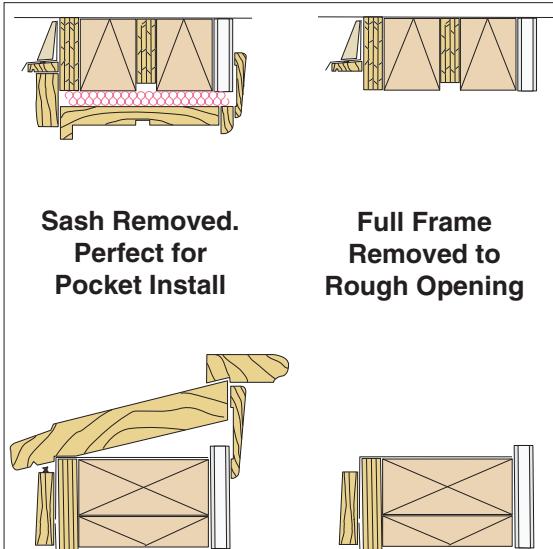
Finned Window – Common mount for residential windows of wood or pvc. When removed, and the interior wall board and sill remain, then the new window will need to fit to the old trim or mount on top of the sill and beneath the header and filled accordingly.

Old Aluminum Window – New windows can be mounted on top of the old frame if left intact, or butted to the interior finish if removed. Removing the interior trim will allow all options for install.

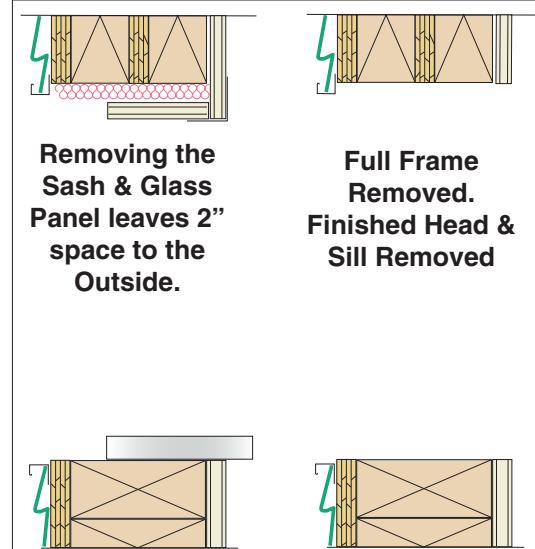
Old Steel Window – Most common in brick veneer buildings or other masonry applications. Leaving the old frame in, the new window needs to mount butting the frame or on top.

Totally removing the frame requires some work to patch, but allows most any type of new window to be installed.

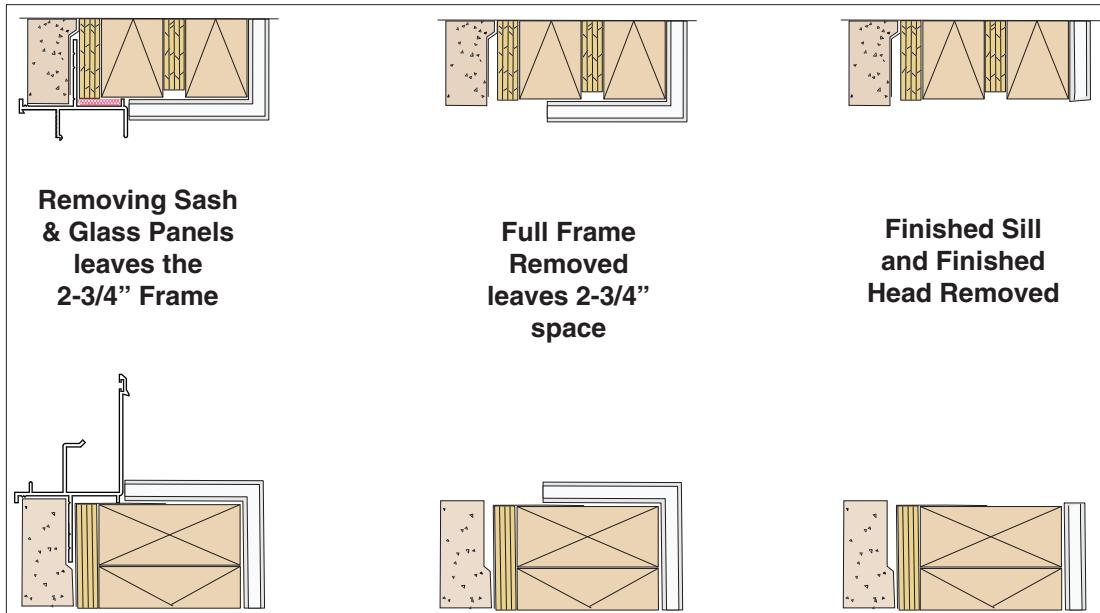
Old Wood Window



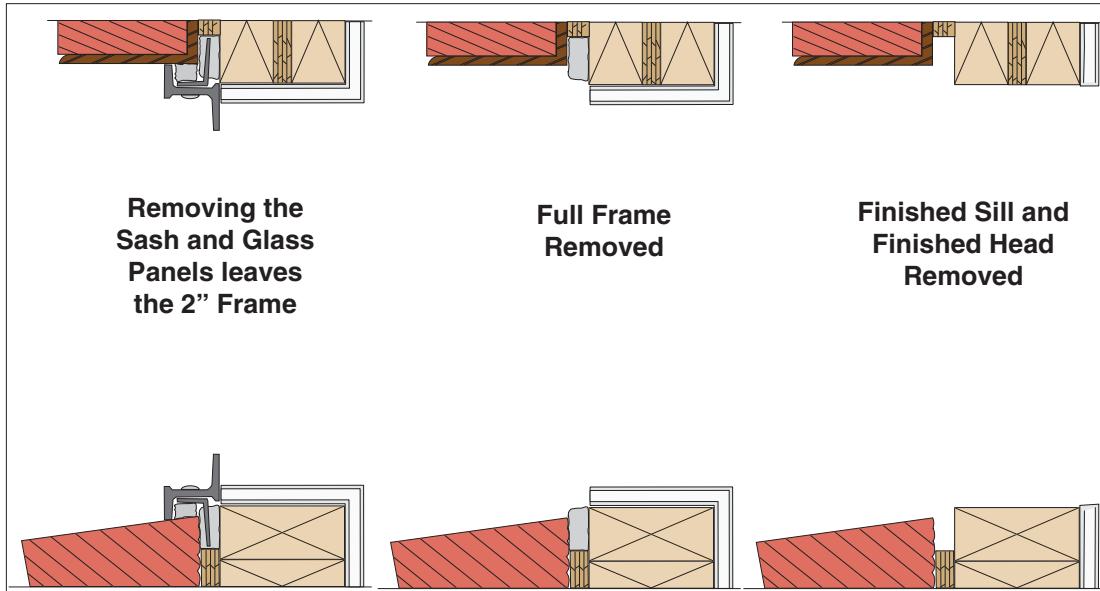
Old Finned Window



Old Aluminum Window



Old Steel Window



Other Important Measurements

Most installers plumb the jambs, and attempt to level the header, but are often unsuccessful because the sill is out-of-level (even in new construction) and they don't compensate for this with shimming.

Construction Standards accept out-of-level sills up to 1/240th of the span. Translated into small dimensions, this allows each 32" span to be out of level up to 1/8". An average 6 foot picture window or garden window can be out-of level over 1/4" in a new home. In older homes, the situation can be worse due to settling and softer building codes. Construction debris, nail heads, knots and splits in the subsill can create irregularities in the level of the sill on which the new window rests.

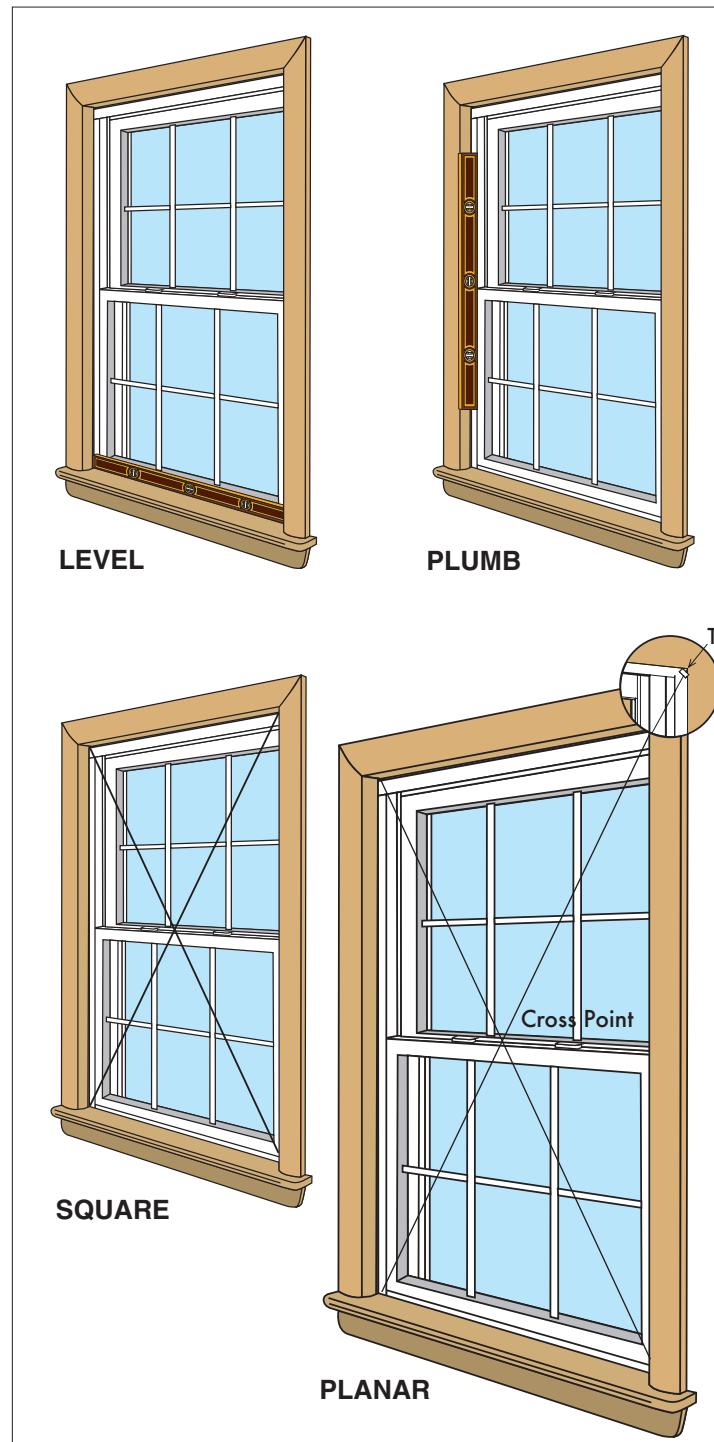
The first solution is to shim the bottom of the window unit to level, as long as shimming doesn't raise the sill to a point where water can leak under the sill to rot the subsill or leak into the house. Because a shimming a sill can cause part of the window bottom to be unsupported, it is possible that the new window's sill can bend under the weight. And, in cases where there is a crown in the sill, shimming becomes complicated considering the size and weight of the master frame. The only stable and long-lasting solution is to establish level across the entire sill prior to installation. Use some kind of shimming, hardening filler, or a rigid "sub-sill".

Plumb – Plumb is measured with a "Bulb Level" placed on each jamb. Record how much one end needs to be moved away from the jamb to create a plumb condition – on each side.

Plumb is often defined as vertical level. The sides of the opening must be vertical so as not to distort or skew the window or door frame.

Out of plumb can render locks inoperable at worst, and difficult to operate at best. As with level, construction often accepts out-of-plumb, so while measurements of width and height may be relatively equal in the 3 recommended locations, it doesn't mean the sill is level or the jambs plumb. Record the condition of the plumb of the jambs on a specification sheet.

Planar – Planar is measured by temporarily anchoring a string diagonally from upper corner to opposite lower corner. The strings will touch in the center where they cross, or they will not. If they touch, reverse which string is on the outside. If they cease touching, the distance between the strings where they cross will be the planar condition measurement.



Careful Measuring and Checking is the difference between successful installation and problems.

This condition is significant because it will indicate that the upper corner of the window is not flat in plane to the opposite lower corner. This will render the new window contorted in installation.

If it is a finned window, the fin will not rest flat on the frame of the opening without pushing the window out of shape. This can impede operation. Worse might be leaving the out-of-plane condition opening up one or more corners to leaks.

If possible, you can use the "Bulb Level" on the face of the wall to determine if one side or both sides are out of plane and by how much. Record all these dimensions on the specification sheet.

Crown – This condition will appear in the sill where the center between the jambs is higher than at the edges of the opening. Placing a window or door on a crowned sill can cause the interlocks to not meet properly; the panels to not slide properly on a sliding window or door, or will impede the proper operation of a hinged door or window.

Use a "Bulb Level" to determine crown, and record location of the crown, and measure how much the edge of the level needs to be raised on either side of the high point to create a level condition. Record these measurements to help in sizing and shimming needs.

Bow – The opposite of Crown, a Bow will be a low spot between the jambs. As with a crown, a depression can cause the sill of the window or door to deflect, and impede proper operation and sealing/locking. As with Crown, record location and height differences on either side of the depression. Record these dimensions on a specification sheet.



Trapezoid – While most openings have equal widths and equal heights down and across the opening, occasional an opening can be wider at the top, or wider at the bottom.

This condition might become evident when measuring the plumb and square, but a trapezoidal effect can require a change in the width and/or height of the specified window, and therefore needs to be recorded on its own on the specification sheet.

The specifier should consider the conditions of the opening to properly order the appropriate size of the new window.

Then the installer should consider all 8 conditions to properly prepare to install the new window in a plumb, square and planar condition – necessary for proper operation, locking, and sealing.

