

HOW TO BUY Vinyl Replacement Windows

The Ultimate A to Z Guide



The Things You Need To Know
BEFORE Buying New Windows

by Joe Mills

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About the Author



Joe Mills is the Director of Marketing for Sunrise Windows and has been in Sales, Marketing and Management for over 30 years. He has **personally sold and installed 1000's of windows**, and has taught others **how to evaluate and choose windows for their homes**. This eBook represents his personal opinions on the best processes for homeowners to use when researching the purchase of new windows.

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About The 2016 Update

Just like anything else, times change and so do products, methods and political circumstances. Several things have changed in the seven years since this was originally written.

Here's just a few of the differences:

- **No more generous tax breaks**—When this book was originally written, you could take as much as \$1500 off of your tax bill for buying new replacement windows. Even though industry groups continue to fight for new incentives, in the current economic and political climate, Washington probably doesn't have the stomach for it.
- **Stringent new efficiency requirements**—Energy Star's 2016 requirements take into account the climate that you live in when certifying replacement windows. Many value line manufacturers had to scamper around trying to beef up their product lines to meet the new requirements.
- **Installation becomes even more important**—Over the past few years, as more and more windows are being replaced, the initial installation techniques have come into question. We've added an entire chapter on installation to this edition.



Introduction

A Quick History of Vinyl Replacement Windows

Vinyl windows were popular overseas prior to their widespread acceptance in the states somewhere around the late **1970's**. While suffering initially from a somewhat negative view as compared to their aluminum, wood or clad counterparts, vinyl replacement windows have continued to grow in popularity, and now represent the [largest anticipated growth in the replacement window market into the foreseeable future](#). Consumers, whether driven by a social conscience, or rather by financial necessity, have recognized the significant effect that vinyl products have on energy efficiency.



There are over 10, 000 companies in North America that have some level of involvement in the manufacturing of vinyl windows, including approximately 1000 actual window manufacturers in the United States. While brand name recognition will always have some level of importance, many of the smaller manufacturers have taken advantage of the growth of the overall market to make significant market share inroads as compared to the more established names by offering products that not only equal, but

often exceed, the quality and efficiency of many of the nationally known brands at a lower cost.

Cost

The **cost of replacing your existing windows with vinyl windows varies based upon a number of issues, including geography and manufacturer.** We will deal with a number of issues that can affect cost in this e-book. Consumers today have so much more available information to make value decisions on product performance rather than a “used car” advertising pitch.

There are also industry sources to use to compare average costs by project. The most useful of these comes from the [Remodeling Magazine Cost vs. Value Report](#), which is produced yearly. Although a part of this report certainly rates the potential increase in value of your home based on the project, because of the uncertainty in the housing market, the most useful numbers in this report are those that allow you to see the average cost of each potential project. Most consultants have access to this report and will be happy to share the results from your particular geographical area. Use this report as a guide to verify under and over charging for your particular project

What You Don't See Is What You Get

Survey

A recent [national survey by the Shelton Group](#) notes an interesting return to **aesthetics as being more important than energy efficiency in the consumer's decision making process**. I believe there are two reasons for the shift. First, the main thing that the government's stimulus tax credit from 2009-2010 did was to have created some level of expectation that most products provide enhanced levels of energy efficiency. The other reason for the change is that the higher end consumer, who previously considered vinyl a lesser quality product and would only look at high cost wood and clad windows, now, because of the economic realities, are ready to look at vinyl as a lower cost, more energy efficient, alternative. Aesthetics have always been a driving force in that customer's decision-making process.

Glass Viewing Area

As we mentioned earlier, vinyl windows have been around for over thirty years, realizing more and more acceptance from consumers for a number of reasons. Many focus group studies have been undertaken by various manufacturers and one of the most interesting things that has been learned is that the one main thing

that consumers that have otherwise loved their vinyl windows didn't like was the fact that they had to give up **glass viewing area**. Unfortunately, most manufacturers don't talk about that issue with the customer because of structural decisions that have required their vinyl extrusions to be big and boxy, leaving the customer to notice it only **AFTER** their windows are installed and too late to make a change. One of the reasons that so many products have big, bulky extrusions has to do with the **increased necessity of energy efficient mainframes to meet Energy Star guidelines**. As we will discuss shortly, some manufacturers have made the investment in products that, in essence, allow you to have your cake and eat it too.



Structure

One of the interesting things about vinyl is that it shares a couple of properties of steel. One of the properties is that **every 90° bend in vinyl** increases its structural integrity. Many salespeople equate the bulky, boxy mainframes they offer with increased structural integrity, but this increased bulk is a result of another reason we'll deal with in a bit and does little more than reduces the customer's glass viewing area. The aesthetics conscious consumer is looking for a product that combines looks, structure and energy efficiency.

Color

One rarely discussed difference in products is variations in the “white” color. Most customers that have white trim have **“painter’s white”**. Many manufacturers, including some that have some of the lowest advertised prices, still use the original “white” vinyl color, which has a blue or black tint to it. Again, this typically is not discussed at the time of purchase and is only discovered after the products are installed, too late to make a change. Make sure the home improvement consultant matches their “white” to your “white”.

The Corner Connection

Vinyl Window Frame Construction

There are several ways to piece together the vinyl extrusions of a mainframe and window sashes. Obviously, this is an extraordinarily important decision that a window manufacturer makes, because it truly affects how airtight a window is, as well as its ability to deal with moisture.

The first, and typically the least expensive, way for a manufacturer to attach the frames and sashes is what is called **mechanically fastening**. After the frame and sash pieces are cut, they are screwed together at the corners. Some dealers can actually show you a piece of mechanically fastened sash that they pour water into. Guess what happens to the water when it gets down to the corner? Let's just hope that the sales rep holds the mechanically fastened sash over your sink, instead of your carpet! The easiest way to think about this is to realize

that every double hung window in your home has 12 corners that could be mechanically fastened together. Multiply that number by the number of windows in your home and you can begin to see the problem with mechanically fastened pieces.

The second way is some sort of a **chemical or glue-like material** being used to fasten the pieces of extrusion together. This is sort of an in-between process that often saves a manufacturer money, while giving the consumer the **“illusion”** that all those corners are sealed. The issue that sometimes arises with this method of fastening is that there have been instances of some of these connecting materials breaking down because of environmental issues, such as high humidity climates. This is a **similar concept to using caulk** to fill gaps in pieces of wood connecting together.

The third way to connect is called fusion welding. This option requires the most significant manufacturer investment. As we discussed earlier, vinyl shares two traits with steel; the first being the use of 90° bends for structural integrity, and the second shared characteristic is that all points at which pieces of steel are welded together are stronger than the individual pieces. **Fusion welding** is accomplished by placing a metal plate, heated to over 200°, between the two



pieces of extrusion, and then pulling the plate out and allowing the two pieces of vinyl to fuse together, thus creating a stronger, more secure seal at the point of the weld.

Who Welds and Who Doesn't

As you can see, from the standpoint of getting the strongest structural frame, and achieving the goal of the home being more airtight, a fusion welded frame is a must. The unfortunate thing is that some of the most popular types of windows over the years don't have a lot of options when it comes to the fastening process. Let's take a look at the three methods, and the type of windows you will find in each category.

In the mechanically fastened category you will most often find **aluminum window frames**. Interestingly, however, many of the lowest cost (advertised) vinyl products have both mechanically fastened sashes and mainframes or welded mainframes and mechanically fastened sashes. This is the only way they can truly afford to sell a product for those low, low rates that are advertised. Check out the contract and look for phrases like **“mechanical frame and sash”** or the **abbreviation “mech.”**

There are more and more **fiberglass or composite** framed replacement windows coming on the market, and while there are many things that these products can do, being fusion welded is one thing they can't. Many fiberglass and composite windows are mechanically fastened, although some newer products are **using a combination of mechanical fastening and a chemical/glue-like material**. These window manufacturers don't fasten in this manner from a cost standpoint, as fiberglass and composite replacement windows are almost always more expensive than their vinyl counterparts, but rather because their products can't be fusion welded.

Chemical or glue-like welds are more prevalent in the **wood frame market**. If you have ever gone into a home under construction, right after the trim carpenters have gone in, you would notice the first thing the painter has to do before he can paint is to caulk all of the joints where two pieces of wood come together. You probably could look at some of the mitered joints in the door casings, baseboards or crown mold in your own home and see that caulking is only a temporary fix.

Far and away, if you are looking for the best combination of strength and best air/moisture performance in your new replacement windows, vinyl windows are your best bet. Be sure to do your homework however, and make sure that you are getting a fully welded (**mainframe and sash**) product.

There's No Crying In Replacement Windows

Weep Holes: The Good, The Bad And the Ugly

When looking at a double hung vinyl replacement window frame, there are three basic parts: a **header** (the top rail), the **side rails** (2), and the

sill. Each of these pieces performs a specific, important function on a window.

One of the ways that a vinyl window manufacturer can save money in the manufacturing process is to use the same piece of vinyl extrusion to create three sides of the frame. In other words, a machine operator only has to feed one piece of vinyl extrusion into a saw that then cuts it into 3 pieces, rather than keep up with feeding three different pieces in, making sure they go in the proper order.

If the pieces aren't "**dedicated**" to the purpose they fill, the manufacturer must add parts to insure that part of the mainframe performs its proper function. This is especially true with the window sill. This piece is especially important because it serves to move exterior sources of water away from the home. Very often this is referred to as a "snap in" or "pocket" sill. This piece is added after the rest of the frame has been fusion welded together, leaving small gaps where water can get into the mainframe.

For this reason, most double hung windows have what are referred to as "**weep holes**" on the exterior part of the mainframe. These are most often placed at the bottom of the mainframe, as this picture illustrates.

When you see "weep holes" on the outside of the mainframe, you can be



assured that moisture is getting into the mainframe. This becomes a real problem because of where the holes are actually located.

As you can see in the picture above, the holes aren't at the corners, but placed away from the corners. (The actual distance is determined by the overall size of the double hung window.) A close examination of the picture above will reveal one of the potential drawbacks to a "weeped" double hung window, that is moisture tends to pool on the inside of the mainframe, most often in the corners. Freezing and thawing can cause expansion and contraction, potentially leading to compromising the fusion weld and allowing the moisture to seep out of the window. In this picture, another issue emerges. Standing water is a breeding ground for mold and insects. These are obviously the "bad weep holes."

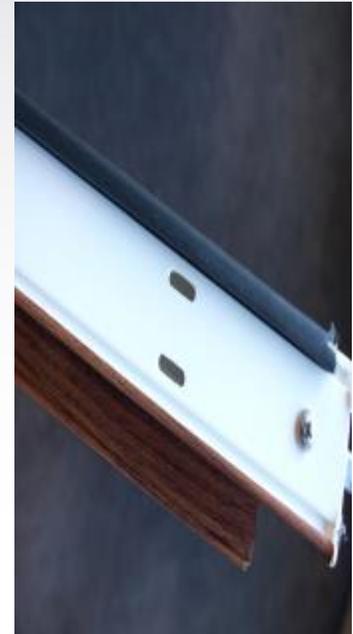


Where every double hung window should have a weep hole is in the bottom of each sash, and it's realistically more of a drainage hole than the strict definition of a weep hole.

Any dealer representative that says his window keeps all moisture out of the sash is not being truthful. A quality product is going to have a small piece of rubber material, called

a durometer that sort of outlines the glass in each sash, and limits the amount of moisture that can possibly get into the sash.

Remembering the expansion and contraction conversation from freezing/thawing above leads to the understanding that water remaining inside of the sash can be a major issue. As a matter of fact, this is one of the leading causes of catastrophic seal failure, which diminishes the window's performance and can lead to condensation between the panes of glass.



The bad part of the otherwise “good weep hole” (illustrated here) is the shape of the hole. Round (the “ugly”) drainage holes are as bad as no drainage holes in the sash at all, as they develop an air pocket which keeps the water from coming out of the hole and down onto the sill, where the water can be moved away from the home.

Make sure the contractor shows you how the water gets to the drainage hole; the best products are going to have some sort of internal system similar to a gutter built into the sash extrusion.

To Fill or Not To Fill; **That Is the Question**

... Whether 'tis nobler in the mind to suffer the slings and arrows of outrageous power bills, or, by insulating thy mainframes, mitigate

them...My apologies to “The Bard”, but the question is one that many of you might be asking. After all, the vast majority of manufacturers of vinyl replacement windows do not insulate their mainframes, and some manufacturers and dealers will tell you that putting **insulation into your windows mainframe** is overkill. Is that true?

Prior to 1950, exterior walls in our homes were insulated by dead air space, i.e. nothing. As we have since learned that is not the most energy efficient way to insulate an exterior wall. As a matter of fact, most building codes for exterior walls require, depending upon area of country, an R value of anywhere from a 9 to a 20. (R value is a measurement of thermal resistance used in the building construction industry; the higher the number the better.) These numbers are only achieved in an exterior wall by insulating with a highly thermally resistant material, typically fiberglass.

The easiest way to think about this is to imagine putting an addition on your home. As an example, let’s say you are going to add a room with two exterior walls; one that extends from one existing exterior wall 10 feet wide and then a longer exterior wall that extends 20 feet and ends at another existing exterior wall in your home. Imagine now that all most exterior work has been completed and it is considered “dried in.”

After the electrician completes most of his interior work, it’s time to add the sheet rock, before painting. But before the sheet rock man can do his work, the inspector has to give his OK, and will only do so after verifying that the proper amount of insulation has been added to the wall. So the insulation man comes in and installs the insulation all the way down the first 10 feet of wall space, then starts down the 20 foot wall but, unfortunately runs out of insulation with 6 feet remaining.

Are you, or the inspector, going to allow the sheet rock to be installed? Even if you could hide it from the inspector, you are probably not going to move forward because you recognize that that last 48 square feet (assuming a 8 foot ceiling) will be a very drafty part of that brand new addition. **Based on a jamb depth of 3 1/4" (the proper jamb depth for a replacement window)**, a standard window size of 36" X 60", and 12 windows in a home (the median number of windows in a home across the US), if you took apart the mainframe pieces you would come up with 48 square feet of material. How many windows are in your home? Are you willing to leave that much square footage un-insulated?

Another way to look at this is to **imagine that today your refrigerator/freezer goes out**. You and your spouse head out to your local appliance store to find a new one. You find two, side by side, same size and color, the only difference is the price. One is \$299 and the other is \$899. Based on everything you know right now, you would probably be like most of us and buy the \$299 fridge. But what if we introduced different information, namely that the \$299 refrigerator has no insulation in the door. Would that change your purchasing decision?

So, if it is indeed important to insulate a vinyl replacement window frame, the question then becomes what is the best way to insulate? There are two main ways to insulate, **polystyrene and polyurethane**. All of us make use of polystyrene, a lot of us every day for our coffee, as polystyrene is better known as **Styrofoam**. Its insulating capabilities are evident, and its manufacturing costs are manageable. The other way to fill a mainframe is to use polyurethane. **Polyurethane** is enjoying more

and more use in residential insulation applications, after many years of acceptance in commercial uses.

Let's take a look and how each product is used in applications other than in vinyl replacement windows to judge the potential efficiency in providing the desired level of insulation for our purposes.

- **Polystyrene (Styrofoam®)**—As we have already discussed, the most familiar use that most of us have for Styrofoam is in “to-go” coffee cups. Other applications that you might be familiar with are its use as filler when we mail items in a box (“popcorn”), or also you may have used it in a canoe to provide extra buoyancy. In most cases, polystyrene comes in some sort of **pre-formed shape** (i.e. cup, “popcorn”, square, etc.) Comparatively speaking, polystyrene is significantly less expensive, manufacturing-wise, than polyurethane.
- **Polyurethane**—The most common use for polyurethane is in something that you use every day, and may not even know that the polyurethane is there. If you could peel back **your freezer door**, you would find 1 ½” of polyurethane insulation. Typically, polyurethane comes in a liquid form and is applied/injected and allowed to dry. Manufacturers often pay more for polyurethane than they would for polystyrene.



- **Replacement window application**—Since **polystyrene** most often comes in a pre-shaped form; most of the relatively few window manufacturers that use polystyrene as a frame insulator use it in pre-formed, pre-cut pieces. Often this means that **the frame is not totally filled**, either length-wise or width-wise. **Polyurethane**, again most often in a liquid form, is **injected** into the space, allowing for virtually a total space fill. Another question to ask yourself is if the freezer door manufacturer thought that polystyrene was a better insulator, and cost them less, wouldn't it make sense that they would put it in their doors? Finally, one other interesting point of note is that the polyurethane seems to be the more environmentally friendly product, as **no CFC's** are used in the manufacturing process.
- Insulated vinyl replacement windows are **5 to 10 times** more thermally efficient than their non-insulated counterparts.
- **Polyurethane insulates about twice as well as polystyrene**, achieving R values from 13 to 20.
- To get the same insulating ability from a wood window as from a polyurethane filled window, you have to have a **wood thickness of between 10" and 16"**.

All In All You Lost Another Brick in Your Wall

You might be wondering “What do bricks and vinyl replacement windows have to do with each other?” The easiest way to begin to answer that question is with another question. “If you have a tire with



three holes in it and you plug two, what have you got?” Of course the answer to that is, “A flat tire.”

Because of the proliferation of vinyl replacement window suppliers, and a salespersons desire to paint their particular product in the best possible light, it is

sometimes hard for the consumer to determine who has the best frame or the best glass. However, there is **one performance number that almost no manufacturer/dealer talks about that may be one of the most important things you should know BEFORE buying any replacement window at any cost.**

With all those products out there, it is important to provide consumers a way to independently verify the information available. The **NFRC** ([National Fenestration Rating Council](#)) is a non-profit organization that administers the only uniform, independent rating and labeling system for the energy performance of windows, doors, skylights, and attachment products. Their stated goal is to provide fair, accurate, and reliable energy performance ratings so that:

Architects, builders, code officials, contractors, homeowners, and others can compare different products and make informed product choices.

Building officials, state government employees, and others involved in code development and enforcement can determine if products meet local codes.

Government- and utility-run energy efficiency programs can establish performance requirements and standards.

Manufacturers have a fair and level playing field to compare products and an accurate method of showing the energy benefits of new designs or technology.

After receiving the testing results for products voluntarily submitted by participating manufacturers, the NFRC approves a sticker similar to what you'll see [here](#). This sticker is required to be affixed to each window upon delivery to the dealer. You might equate this to the EPA mileage sticker on a car, or the Energy Star sticker on appliances.



We will discuss the other numbers later, but, for now, let's spend some time on the 4th number "**Air Leakage.**" Quoting from this NFRC publication, "Air Leakage (AL) is indicated by an air leakage rating expressed as the equivalent cubic feet of air passing through a square foot of window area (cfm/sq ft). *Heat loss and gain occur by infiltration through cracks in the window assembly. The lower the AL, the less air will pass through cracks in the window assembly.*" (Italics added)

This is probably not a foreign concept as one of the reasons that you may be considering replacing your windows could be drafts that you feel coming through your existing windows.

See the picture here. According to the EPA, windows offer the most significant opportunity for air to leak into your home.

So, if you bought any brand new replacement window couldn't you presuppose that these new windows would stop this airflow? Therein lies one of the biggest "**dirty little secrets**" of replacement windows. No matter what you pay, a lot or a little, there are very few vinyl replacement windows that do an acceptable job of keeping air out of your home.

As our **“tire” analogy** illustrates, the best frame and glass system does absolutely no good if the window is allowing in cold air in the winter and hot air in the summer. It’s a lot like trying to blow up a balloon with several holes in it; you’re losing as much as you put in!

So, how do you know and how can you **protect yourself** to make sure that the product that you purchase will provide the performance that you need?

- First, **understand what Air Leakage is** and how it’s measured (discussed earlier).
- Second, understand that the American Architectural Manufacturers Association has set a [maximum allowable Air Leakage rate at .30](#). This is a measurement of cubic feet/minute of air passing through 1 square foot of window assembly. The key, as you’ll see in a minute, is to remember the .30 number and use it for comparison purposes.
- Third, understand that as far as this particular performance number goes, **the sticker won’t tell you much**. See a copy of the testing sticker here. Under a recent ruling, the NFRC changed the reporting structure for Air Leakage so that all stickers report the same number...less than or equal to .30.
- Fourth, think through what this sticker change actually means... less than or equal to basically tells you two things:
 - **Not every brand new window is airtight.**
 - **All new windows don’t perform the same when it comes to Air Leakage.**

- Finally, **ask you home improvement professional for proof** of their actual tested Air Leakage number. Most contractors will say that the .30 is fine because that is what everyone else has. **Going with the right replacement window manufacturer can get you numbers more than 10 times better** than that! If they can't prove whatever number their literature might say they get, beware!

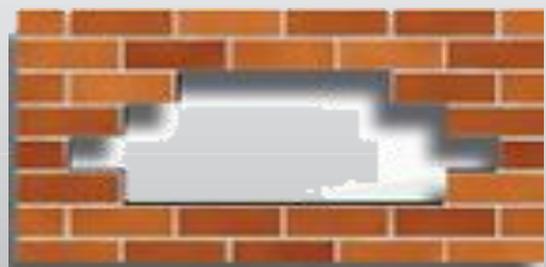
What if you can't get the proof, or you are at a home show and there are many window products to look at?

One of the best ways that you can do a quick test on any replacement window and get an idea of how it will handle air is what the industry calls the "sash slop" test.

With the window locked, grab the lift rail on the bottom sash and try to move the sash; then do the same with the top sash. If a window has much play ("sash slop") you can be pretty sure that it does a poor job of handling air.

By the way, sales representatives that sell windows with excess "sash slop" have been trained to answer the question as to why there is so much movement by saying that the window, being made of vinyl, has to allow for some movement for expansion and contraction. While this seems to make some sense, remember that the frame is made of vinyl as well, and there is no movement in the mainframe.

This is where the bricks come in...According to industry experts every



1/16” gap between a sash and the frame of your window allows the same amount of air in as if you removed a brick from the side of your home.

Again, how many windows do you have in your home? Can you imagine how many pollutants, allergens and just hot or cold air all those missing bricks will allow into your home?

Driving Miss Window

Did you know that **windows have engines**? These are the mechanisms that control the up and down movement of your windows. The technology, called a “**balance system**,” has evolved from an iron weight and kite string to three basic systems in use today. Most dealer representatives will carry a couple of these to demonstrate to you.

- **Spiral balance**—Chances are if you have never replaced your windows and they are more than five years old, this is the system you have. It looks like a silver tube, with a piece at one end that pulls out and looks like a “**spiral**.” A lot of vinyl replacement windows in the “low end” cost category use these systems as well. If you unlock your windows, and they start up by themselves, or they

make a springing noise as you raise them, it's a good bet that you have spiral balances that are reaching the end of their useful life.

- **Constant force balances**—These are by far the most used balances in vinyl replacement windows. They look like the inside of a tape measure, complete with the hook at the end that, like on a **tape measure**, is used to hook the tape to the end of whatever is being measured. They all come in the same size, so, from a manufacturers inventory standpoint, are very cost effective.
- **Self-tensioning “block and tackle” system**—These are the modern day versions of the original sash movement idea. They typically have some sort of sleeve, a fairly large spring, and some sort of pulley mechanism similar to a **“chain fall”** which is used to manually pull engines out of automobiles, and a string, which actually handles most of the lifting duties. Because of the relatively complex structure, this balance system is the most expensive from a manufacturing standpoint, and is normally only found in the highest quality products. (Be careful and feel the string yourself, as there are some “knockoff” products out there that do use something similar to kite string)

As with any piece of an overall product, each of these parts has positive and negative traits. Interestingly, a manufacturer can buy any one of these systems from the same company, so the manufacturers decision on which one to put in their window should be illustrative of the overall quality of the product. Another judge of quality would be **“cycle testing”** results, which measure how many “cycles” (a “cycle” is the

equivalent of raising and lowering a window one time) the balance system is designed to last.

- **Spiral balance** —Being the oldest technology of the three, it's pretty safe to say the cons probably outweigh the pro's here. There is a way to tighten the spring and re-oil the inner workings, but at the cost of \$25-45 per window to get this done, it becomes a question of whether or not an upgrade in technology is a better allocation of resources. These are engineered to last about **5000 cycles**.
- **Constant force** —Far and away, the industry standard. This product is engineered to last about **12,000 cycles**, more than twice as long as the spiral balance. It does share a couple of characteristics of its look alike, a tape measure. Typically, a tape measure, when it fails, is going to fail on either end, especially the tip. Also, one of the things that makes it inexpensive to the manufacturer (all being the same size) can be a draw back in taller windows, as they have to be "stacked" on top of each other to fully move the window. This can cause the window to stop before it fully opens. Some users report a **rougher "ride"** (sash movement up and down) as compared to either the spiral balance or the self-tensioning system.
- **Self-tensioning block and tackle** —As discussed, the complexity of this system, as compared to the other two is reflected in the higher cost. Also, be careful, as there is a "knockoff" version of the real thing that uses kite string, which will eventually dry rot. Make sure the product that goes into your window uses parachute cord. Is the higher cost justified? You'll have to decide that, but one thing is for

sure about this product. The **40, 000 cycle** tested life will ensure trouble free operation for many, many years to come.

You CAN Always Get What
You Want

As you can imagine, the home improvement industry has undertaken many focus group studies over the years to address all the different parts of their business processes. One of the most telling is the question about why a customer didn't purchase. If you ask a group of home improvement dealer sales representatives you'll get answers

ranging from “the price was too high,” to “they were just looking,” to even things like “they just didn’t like me.”

While those things may have been a contributing factor, the main reason repeated over and over again by potential home improvement



customers is that you perceived that the sales representative was trying to sell you what they decided you wanted, rather than taking the time to truly **find out what you wanted** and creating an opportunity for you to make a decision to purchase. What we are referring to here is, of course, options; those things that you would

really like to have, or at least be told about, so that you could choose to have exactly what you want based on your investment.

Why wouldn’t a salesperson at least make an attempt to let you know what was available? In most cases, it is because his product has very **few, if any, available options.**

Many of the options we’ll discuss shortly require pretty significant investments by the manufacturers, and, so, most dealers offer no options or maybe throw a couple in so they can say they have options available.

If you remember earlier discussing the recent survey about the desire for pleasing aesthetics now being the driving force (over energy efficiency) in the purchase decision, it is now becoming obvious that savvy homeowners have realized they can truly have their cake (options) and eat it too (energy efficiency)!

A sales rep that has a vinyl replacement window with limited or no options will probably be scared to even discuss an option with you because you may look elsewhere for your entire project.

Let's talk about some of the available options in the marketplace, and some of the things to look for.

- **Colors**—Probably the first option that any homeowner considers is color. Do I match the existing trim or do I make a change in the living room? What about the exterior of the home? What about a **wood grain**? Colors can be applied to a vinyl replacement window in several ways, including a laminate type of coloring, where the color is, in essence, laid on top of the vinyl, co-extruded into the vinyl itself, or painted on.

Because of the proven durability of mixing the color into the vinyl, a **co-extruded** product with many color combination options, and a warranty against fading is probably your best option.

Almost all wood grain finishes on vinyl replacement windows are done with some sort of **lamine**. To get a high quality appearance, and true longevity, make sure the laminate is an exterior grade, with a mil thickness of at least 8, and preferably 10.

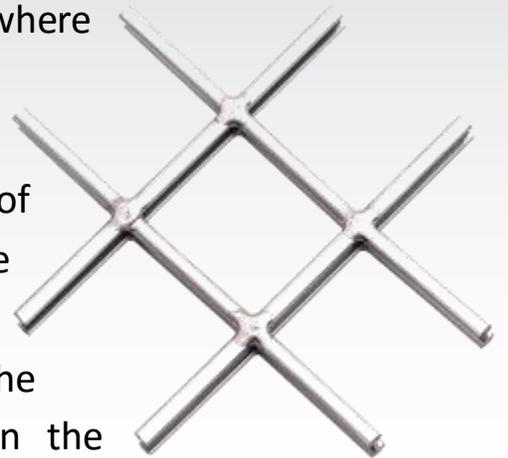
Also, don't forget our earlier conversation about the differences in the "white" color. Make sure your dealer puts his white against your white before making that decision. Once the windows are installed, it's too late.

One of the most exciting options that have been added over the last few years is the option to **have the exterior colors painted to match any color you'd like**. This is an option you absolutely won't find on most low end products. The key here is the warranty which isn't going to provide coverage for the same period of time as a warranty for a color that is co-extruded.

Most often you'll see a 10 year chip and peel warranty, and a five year no fade warranty. However, if you shop around, there are manufacturers that double these warranties and give you 20/10 for basically the same price as the lesser warranties.

- **Grids**—One of the reasons many people replace old windows is they hate cleaning those old single pane windows where each pane is separated by those wooden or plastic grids. Virtually all manufacturers offer at least one or two versions of a "between the glass" type of grid. The higher end manufacturers will offer other options, including sculpted grids, two-tone grids, brass pencil grids, and even special patterns like diamond grids.

If you live in an area that would allow you to install vinyl windows, but require that you maintain the original grid on the outside look, or, if you just love the way that looks, a very few manufacturers offer what is called “**simulated divided lights**”, where they actually place grids on the outside of the glass. When correctly done, these are absolutely beautiful and add to the illusion of having a wood window with vinyl’s absolute superiority in energy efficiency. The best of these will actually carry the illusion to the extreme by putting a spacer bar between the panes of glass to give that separate pane look.



- One of the most popular options recently because of our lack of time is what is sometimes called “**self-cleaning**” glass.

Although they certainly don’t send out someone with a ladder, some paper towels and some ammonia to clean your windows, cleaning the exterior of your windows can become as easy as spraying them occasionally with a water hose.

As with anything else however, there are two different ways to accomplish the task. The lowest cost way for a manufacturer to offer this is to use a product similar to what we might know as “Rain X®”. Many of us have used this exceptional product on automobile windshields. Because of the extreme exterior conditions in driving, however, its usefulness is limited and a reapplication must occur to retain its benefits.

The proper way to do this with replacement windows is an application that actually becomes part of the glass. If you have ever looked at glass under a microscope it has a similar look as a mountainous area with its separating valleys. The best products in this category are going to use a chemical agent, titanium dioxide, to actually fill in the valleys and smooth out the surface so that most dust and other foreign materials don't have anything to adhere to.

This product is activated by UV light from the sun, and is characterized by a sheeting action. The only cleaning you may have to do here is to occasionally wipe the bottom sash.

One of the ways to know that you are getting a less expensive, and maybe less effective product, is if you are told NOT to use an ammonia based product to clean the windows.

Most homeowners that like the idea will probably have all windows treated, but you may want to at least consider doing second story windows that don't tilt-in, like picture windows or specialty shaped windows. Also, very tall double hungs that could be heavy to tilt in, may be candidates for this treatment.

- Another popular, and hard to find, option is having **blinds between the glass**. These require meticulous handling in the manufacturing process, and most manufacturers have determined that the investment is not worth it. However, more manufacturers are realizing that there are customers that are considering them so they do offer them. Be careful of those manufacturers that **severely limit the warranty period (5-10 years)**, and tell you that you may have to

wait up to three months for the product. Again, very few customers put the blinds in every window in the home, but you'll find them in sliders and casements. They enjoy their greatest popularity in sliding glass doors, replacing those long, loud, plastic scalloped blinds.

- Although probably not really considered an option, one of the best “little things” you can look at to determine the quality of a vinyl replacement window is the **screen**.

Most of us have dealt with cheaply made screens that bend and break with seemingly no effort whatsoever. Make sure the salesperson pulls the screen out and you test the flexibility. The right screen is heavy duty and has very little flex.

Several manufacturers have recently introduced another option that not only enhances the aesthetics of a vinyl replacement window, but also provides other benefits as well. These so-called “**invisible**” screens reduce the dark look most replacement window screens have, offering smaller holes for better insect repelling, and an increased air flow for those who like to raise their windows in the spring and the fall. Ask your manufacturer if they offer that type of screen.

- **Others**—Obscure types of glass, designer art glass, v-grooves (cut into the glass) and specialty grid patterns are also other options you can ask your dealer if they carry.

Now We're Cooking With Gas

Have you ever heard of **seal failure**? Thermal pane windows have been on the marketplace long enough that chances are you have either experienced it, or know someone who has.



Seal failure is characterized by the appearance of a milky white substance between the panes of glass, most often near the edges, and substantially diminished thermal performance.

A thermal pane window has a spacer that separates the pieces of glass. This spacer is “sealed” to each piece of glass. Seal failure occurs when the material in the seal (typically polyisobutyl), begins to deteriorate, allowing the inert gas between the panes to escape and allowing outside substances in that cause that “milky” look.

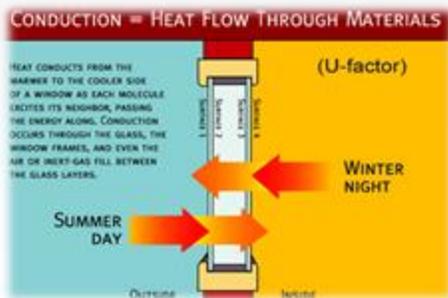
What causes seal failure? Several factors are involved here including one we have previously discussed (See Good Weep Holes). One of the main reasons for seal failure is **excess movement** of the panes of glass. Glass, like many other materials “moves” based on changes in temperature. As a matter of fact, the more change in temperature over the course of a day, the more “movement” in the glass. This is a similar concept to water expanding when it freezes, and contracting when it thaws.

How do you reduce the occurrences of seal failure? There are three main things a manufacturer can do to prevent seal failure.

- Use a **structurally sound, low conductivity spacer system**. Since the spacer is the part actually sealed to the glass, its importance can't be overrated. Let's deal with each issue specifically...
 - Not only is the material that the spacer is made of important here, but the **structure of the spacer is vital**. It's probably no surprise that a metallic type of spacer will always be structurally better than its foam or vinyl counterpart.
 - The key is the corners. Almost all spacer systems have some sort of break in the corners, whether they have some means of connecting the corners, or, as is common with some of the newer systems, mitered corners. The miters allow for more bend in the corners, which means that the four corners of the glass could be all moving in different directions at the same

time, thus putting a lot of stress on the polyisobutyl seal. **Structure is extremely critical in climates that have fluctuating temperatures.**

- Without some long drawn out technical explanation, **conductive heat transfer occurs** as heat is drawn towards the cool side of the glass. The way a spacer system affects this is what you may have heard called “warm edge.” A spacer’s “warm edge” rating reflects its ability to slow the transfer of heat and cold. The



cool side of the glass. The way a spacer system affects this is what you may have heard called “warm edge.” A spacer’s “warm edge” rating reflects its ability to slow the transfer of heat and cold. The

easiest way to talk about this is to think about those aluminum window frames we mentioned earlier.

If you, or a neighbor, have aluminum framed windows, touch the frame, on the inside of the home, on a cold night and you will notice that the frame will be pretty close to the same temperature as the outside. This reflects aluminum’s higher conductivity rating, in other words, it moves heat and cold very well, not a good thing for a spacer system.

As a matter of fact, the spacer system that has the most reported issues of seal failure is the boxed aluminum spacer. If you have dual pane windows in your home, that have never been replaced, there is a good chance that this is the spacer system that your windows have. The spacer system with the best “warm edge” rating is are foam spacers, typically outperforming a stainless steel spacer by a few degrees.

- The best overall choice may be the **stainless steel spacer system**. As discussed, stainless steel has obvious structural benefits, and while the foam spacer has somewhat better warm edge numbers, the difference is negligible.



- The proof of this may already be in your kitchen. Most people own stainless steel pots and pans. If you look at the bottom, you notice a coating, typically brass or copper. This coating provides the mechanism for spreading and transferring the heat, otherwise it would take much longer to cook. Bad for cooking, great for a spacer system.

Unless you live in a climate that is always warm, or always cold, the **movement of the window is of paramount importance in maintaining seal integrity**, and structurally the stainless steel gets the nod here. A stainless steel spacer with continuous (no breaks) corners is the best choice.

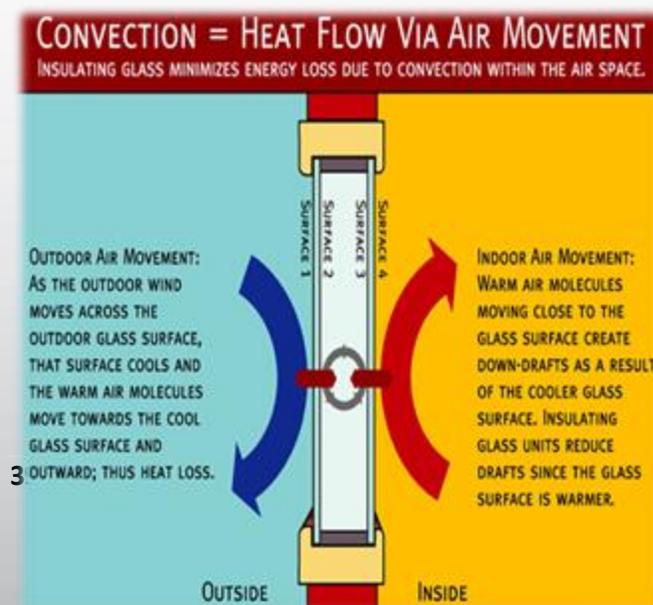
- Ask about **how many seals** the spacer system has?
 - Almost all spacer systems are sealed to the glass with one polyisobutyl seal. You'll hedge your bet against seal failure even more by **demanding a product with a dual seal system**, especially if the secondary seal is a silicone, as this will provide more cushion for any extra movement of the glass. The old conversation about **two being better than one** definitely applies here.

- Ask about “**edge deletion**”

- As glass coating systems have evolved, there has been some concern that one of the things that might contribute to seal deterioration and, ultimately, catastrophic failure, is the interaction of the materials in the best performing glass products and the polyisobutyl.

Virtually all of your highest performing glass products use silver and silver oxides in their glass coatings. Silver is adversely affected and can break down in hot, humid climates. A very small number of manufacturers have addressed this by adding a step to the manufacturing process that literally grinds the low e coating off of the edge of the glass that comes into direct contact with the seal.

This process is called “**edge deletion**” or “**edge delineation.**” This does not affect the thermal performance of the glass, but, again, reduces the occurrence of seal failure via the interaction of the coatings and the seal. Make sure to **ask the dealer’s representative how they address this issue and listen to their answer.**



One of the consistent questions asked about thermal pane windows is **whether or not gas is a necessity.** Gas is used in between the panes of glass as a means to control **convective**

heat transfer, which refers to the movement of molecules between the panes of glass because of the effects of heat rising and cold air falling.

Without the use of a dense, inert gas, these molecules get more “excited” and allow for more transfer of heat and cold. Argon, Krypton and more recently Xenon, are the most widely used gases. Argon is the most widely used of the three from a value standpoint.

Another thing that the government’s stimulus tax credit taught us was that **Argon gas was an absolute must** have. The reason most offered as to why gas is a waste of money is that, “It’s just going to leak out anyway.” As we have discussed there are ways for a consumer to reduce the possibility of catastrophic seal failure, but let’s be clear...The very best spacer system will lose 1/3 of 1 percent per year of its gas through a process called **dissipation**.

Dissipation is similar to evaporation for moisture. So the initial gas fill is critical. According to some reports, the industry standard starting gas fill is somewhere around 78%. This has to do with the filling process, which, in some instances, means that a smaller glass unit will have more gas (as a percentage) than a larger product.

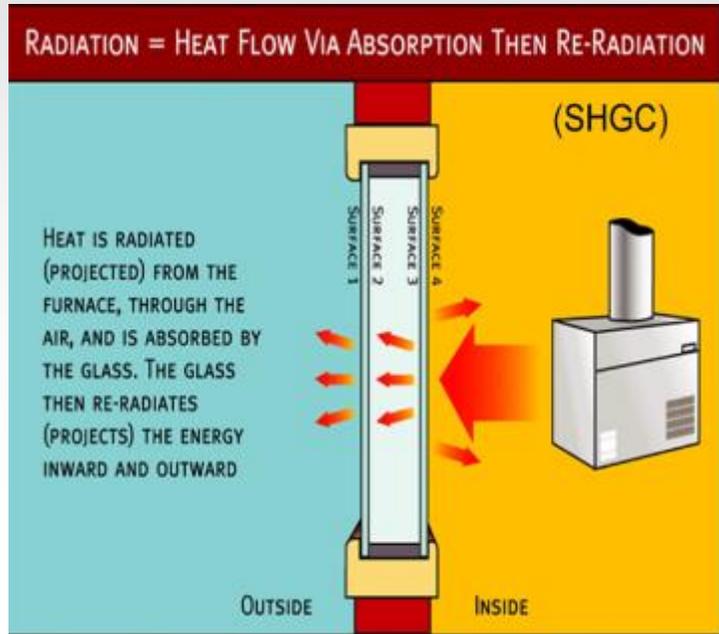
Again, questioning the representative on the filling process is important. Any process that is similar to **immersion is the optimal method**, and will usually give the unit a 90+ % fill, while the insertion of a probe, or other object to fill a pre-sealed glass unit will typically result in a lower percentage fill. You do the math...If you start at over 90%, and lose 1/3 of 1% per year, how long will it take to get to the industry standard?

Put Your Coating On

As **85% of your window is glass** no material on how to purchase windows would be complete without an extensive discussion about the evolution of glass, its importance in determining the overall efficiency of your windows, and how to evaluate and choose the glass product that, in combination with everything that we have discussed previously, will give you the best overall value, all things considered.

As we have previously dealt with the two other kinds of heat transfer, conduction and convection earlier when discussing the spacer and gas fill, it is appropriate, at this point, to discuss the final type.

Radiant heat comes from some exterior source (i.e. your furnace or the sun) and “radiates” out. The easiest way to understand radiant heating is to remember going to the beach in the summertime and feeling the sun’s heat warm your arm. That is radiant heating.



This is also the reason so many people get burned on a cloudy day. They can’t feel the radiant heat so they assume they aren’t getting the sun’s rays and stay out too long. The most effective way to deal with the radiant heat is to reflect it back at its source. We will discuss shortly the method that windows use to accomplish that.

First, let’s talk about the evolution of glass itself. In windows, it really all started with a single pane of glass, and, because it was felt that glass was solid, there was no real concern about heat or cold travelling through the glass.

As science discovered the concepts of convective, conductive and radiant heating, glass manufacturers figured out what many of us would have thought; more has to be better. Hence the development of **double pane, or the original “thermal pane,” glass**. One of the most famous of these double pane products was **storm windows**, which many of us still have on our homes today.

The best dealer’s sales reps will carry a heat lamp to demonstrate their glass package. If you have old single pane, standard double pane, or even storm windows ask the sales representative to shine the heat lamp towards your windows and see for yourself how glass alone has little or no effect on how much heat moves through your glass.

The industry thought, “Let’s take it one more step.” Hence the birth of **triple pane windows**. Unfortunately, you probably can guess what happened; it still wasn’t enough.

Someone finally put two and two together and figured out that the heat had to be reflected back at its source. This led to the development of what today is called **“low e (low emissivity)” coating**.

It is a microscopic coating that is intended to inhibit absorption of heat by the glass by reflecting it back at its original source. Cost and technological advances have helped to improve the effectiveness of low e products.

Unfortunately, as with so much other technology, some have determined to use the lack of familiarity that so much of the public has about low e to “**commoditize**” the concept, by fostering the impression that “low e is low e.” In this way, the consumer is guided into purchasing an inferior product because “it has low e too.”

Basically, there are three main areas of differentiation in low e products...

- **The method of application**

- **Hard Coat**-- This is the original way that low e coating was applied to glass. Also called “**pyrolytic**”, the low e coatings are applied while the glass is in its molten state, allowing the product to harden along with the glass, hence the name. This “hard coat” was suitable for handling and could be placed on the exposed side of the glass, and was the first low e applied to a single pane of glass.

Cost-wise this was, and still is, a less expensive form of low e coating. The thing that most negatively affected the performance of a hard coat was the way it was applied. Because the glass was still in a semi-liquid state, there tended to be some shifting in the coating causing inconsistent coverage all over the glass.

- **Soft Coat**-- This is the newest technology, also referred to as “**sputter coat.**” The process of coating the glass in this manner can be best compared to thinking of the glass as a magnet attracting a piece of metal.

Because of this, soft coat is widely believed to provide superior performance because of its more consistent coverage. As a matter of fact, virtually all manufacturers that had to scramble to produce a glass package that qualified for the governments stimulus tax credit found that soft coat was a must.

As the name implies, the soft coat is much more prone to be damaged during handling and exposure to the elements, so you will always see this product in a protected environment, typically in between panes of glass. Soft coat definitely costs a window manufacturer more to include on his product as compared to hard coat.

- **The materials used in each** not only contribute to the durability of the soft coat/hard coat, but also the “tint” of the glass and the performance of the product.
 - The hard coat products, as you would imagine, use “harder” materials such as tin and iron. These materials can create a “greenish” tint. Softer materials such as zinc and silver or silver oxide are most often used in the soft coating process, and will tend to have a lighter, more conventional, tint.

- The only way to get a product with no tint, is to sacrifice energy efficiency and go for clear glass. The “softer” materials usually offer the best low e performance, remembering that we are trying to reflect the heat back at its source. Silver oxide is one of the main materials in the most reflective pieces of glass currently in your home; a mirror.
- **The number of coats** being better is applicable here, as
 - More layers of coating equate to better performance.

Today’s **best performing products** are soft coated low e products with multiple layers (8-12) of a silver or silver oxide. These are materials that are used in mirrors; the most reflective pieces of glass in a home, and, as you may remember from our earlier discussions about low e, represent the best way to **“reflect” radiant heat back at its source.**

Given all of this information, how does the consumer sift through all of not only the manufacturer’s information, but what each individual home improvement dealer is telling them?

Again the NFRC rides to the rescue. Earlier we discussed the ratings sticker that, by law, must be affixed to each window upon delivery to your home.

There are two important numbers that you can use for comparison purposes.

- **U Factor** is a number, typically between .20 and 1.20, simply put, that rates how well the product keeps heat inside your home. The closer the number is to .20, the better the product performs in keeping your heat inside your home.
- **Solar Heat Gain Coefficient (SHGC)**, rates the products performance in keeping the sun's radiant heat out of the home. This is expressed as a number between 0 and 1, again, the lower the number or better. The preferred choice may be a combination of the above, with a U factor of less than .30, and a SHGC number based more on where you live.

As of January 1, 2016, Energy Star has tied its certification to the climate zone that you live in(see [Energy Star Map](#)). For example, if you live in a colder Northern climate, and Energy Star certified window will give you a lower U value and a higher SHGC, whereas the same certified product in a Southern climate would offer a bit higher U factor and much lower SHGC. For more information on Energy Star certification of windows and doors go [here](#).

They Give and They Take Away

Warranties are, appropriately, one of the biggest concerns when buying any home improvement product, and, maybe especially, vinyl replacement windows. With the proliferation of products, suppliers and features, a manufacturer's warranty, if understood, can serve to clarify your thought process and help you make a truly informed decision. Let's look at how warranties are constructed.

- **Length**—This refers to the physical “length” of the warranty itself. Typically, the more words in a warranty, the more “**outs**” the manufacturer is giving itself.
- **The fine print**—The saying in the industry is “**The bold print giveth and the fine print taketh away.**” Make sure you have your glasses on when you read most manufacturers warranties, as over half may be “the fine print,” which also outlines all of the **exclusions** the manufacturer gets.
- **Pro-rating**—This is a way to **limit a manufacturer's exposure** by paying “X” amount for a certain number of years, less for the next few years, and so on. Interestingly, some of the **most expensive windows** in the marketplace have prorated warranties.
- **Words**—Words do mean things. Let's take a look at some of the words you need to look for.

- **Limited**—This is a scary word, because we typically don't know what the "limit" is until we need the warranty, then we often find out that "limit" is exactly what we need to fix our problem.

- **Non-transferrable** (the word "transferrable" is left out)—Certainly, the burst of the housing bubble has affected this number, but it is common knowledge that people typically stay in their homes from 5-7 years. If a manufacturer is not willing to allow a transfer of warranty are they saying they don't believe their product is going to last more than 7 years?

- **Other words**—Even if a warranty says "Lifetime, Transferrable, Non-Prorated" warranty you may not be out of the woods yet. There are at least two more areas to check for wording:
 - One is **hardware**. Most hardware warranties use wording about warranting against "**manufacturer defects.**" The question to ask yourself is," What happens after five years, when your lock has worked perfectly for 5 years then all of a sudden stops?" How are you going to prove manufacturers defect after it working so well for five years? The answer is you are probably not going to prove defect, rather it will be chalked up to wear and tear. The best wording here will leave out manufacturer defect, and deal with breakage or other failure.

- The other is how the manufacturer **handles the co-extruded color on the vinyl**. As we already know, most manufacturers that are offering the painted extrusions are only giving 5-10 years on the paint. One word that may be an indicator of the quality of the colorizing process is the word “**fade**.” If a warranty covers fading of colors, it’s a pretty sure bet they use some sort of co-extrusion process, insuring far and away the longest lasting color.

Square Pegs, Round Holes

Over the course of my years in the replacement window business, I have come to find out that the least discussed, and therefore, least understood, piece of the replacement window puzzle, is installation.

At the end of the day, **the best product on the market can perform just like the worst if it's not installed properly.** But even beyond proper installation there is often a misunderstanding on the part of customers and, sometimes even home improvement company owners, regarding the different ways a replacement window can be installed.

The main way the replacement industry installs today is called a “pocket” install. The easiest way to describe it is to think about a wood window. When it was originally installed, the wood window consisted of a frame, tracks for the window sashes to slide along, and the sashes themselves (we are specifically talking about the most popular window type, a double hung). This window was installed into a rough opening, part of the home's original framing process.



In a **pocket replacement**, the installer takes out the sashes, removes the sliding tracks and leaves the original wood frame in place. The new

replacement window slides into the original frame. Think of it as putting a box inside of another box. Most window installers will then wrap any exterior mold (typically called brick mold) in an aluminum based coil stock.

The advantages to this type of installation method is relative ease, (as compared to a complete removal/reinstall) lower cost to the consumer, and speed. However, if you are putting one box into another, you will sacrifice more glass area. Also, leaving the wood frame naturally means at some time in the future you may have to redo this process because it's not a question of if wood will go bad, it's a question of when.



The other opportunity missed here is the ability to determine if there is any other damage or insect infestation in the original rough opening itself. You also won't know if the original window was ever properly insulated, nor will you have the opportunity to do anything about it.



In some parts of the country virtually every vinyl window replacement is done as a pocket replacement. But in other areas of the country especially a different type of install is being performed. Most often this type of installation is

called a **full frame installation, or full tear out**. As the name implies, the entire window, including the frame is torn out all the way down to the original rough opening. Often this type of installation technique has mainly been recommended when there is visible rotted wood.

When replacing a wood window with a vinyl replacement window in this manner, you'll also need to understand that **you'll probably have to replace the interior trim** as well. This has to do with the difference in the slope of a sill of a wood double hung window, as opposed to its vinyl counterpart.

Wood double hung window sills can have as much as a 15 degree slope, whereas most vinyl windows have around a 5 degree sloped sill. This variation means that the vinyl window will actually sit lower in the rough opening than the original wood window. More on the interior trim momentarily.



You can probably guess that the pros and cons for this method are basically the opposite of the pocket install and you'd be correct. First, **you add glass area** instead of take it away. Not only do you get about an inch on each side since you've removed the whole frame, but you also get as much as two additional inches on the bottom because of the difference in the slopes of the sill.

You are also getting rid of all the wood and replacing it with vinyl making it maintenance free, as well as being able to deal with any moisture and/or insect infestation issues that you can now see.



Additionally, this type of installation will include **removing the old wood brick mold** as well, and including vinyl brick mold as part of the new installation. Issues have arisen with improperly wrapped brick mold where moisture was allowed to get in and hasten wood rot.

Because we are removing and replacing the interior trim, the other thing we'll be able to see is whether or not the area surrounding the window frame was ever insulated properly, something you can only do if you remove the interior trim. During the rapid housing build up, **many window openings were not properly insulated when the house was originally built.** Most window companies will use a spray in, expanding, open cell foam to reinsulate here, helping block any air infiltration from around the window.



The **challenges** here are basically two-fold; cost and time. A full frame installation in and of itself doesn't take any more time. In this scenario, often a vinyl brick mold has already been attached to the new replacement window. There is opportunity to create an additional air

and moisture seal on the exterior of the home before the brick mold is attached to the house. This time and effort replaces the cost and time involved in the wrapping of the exterior brick mold in aluminum coil stock that we mentioned was part of the pocket replacement process. As installers that were used to pocket installs will attest, the full frame install process, given time and experience, can actually be quicker overall.

Most of the additional time and cost comes in because of the necessity to replace the interior trim. A trim carpenter has to get the correct trim type, cut and build and add finish. Think about a stained piece of interior trim. First, stain grade, matching millwork has to be purchased, then the measuring, cutting and installing and then the stain. A good stain job has a minimum of five components with drying time in between each. As you can imagine along with this time component, comes a premium from a cost standpoint as well.

Although, this method of install offers the best overall value from a “one and done” standpoint, consumers often times opt out of this because they don’t want the additional two to three days of hassle that doing this by hand typically adds, along with the premium expense.



Interestingly, there has been some movement to take care of the time and cost issue of interior trim by companies that are offering pre-made interior trim boxes that match the size and color of the window unit they go with. This literally allows the installer to complete this part while installing the window. This dramatic reduction in time, also reduces the cost as

well. Once such example of this is [here](#).

It is definitely worth the time for a homeowner to discuss these options with a home improvement dealer that you are considering to complete your project. An inability to have at least a rudimentary discussion of installation techniques could be an indication of a lack of professionalism.

Remember, the best vinyl replacement window, improperly installed is no better than the worse one properly installed.

Conclusion

Getting new replacement windows can make your home more comfortable and add to your personal, unique look. It's just the process that can be a daunting one.

After all, with over 1000 window manufacturers, and 1000's more installers, contractors and home improvement dealers, information overload and confusion can easily overwhelm with you.

A few final **pointers**...

- **The internet should never make your decision for you.** Do you really think that any window manufacturer is going to talk about their own issues? Do find out what others that have used the product that you are considering think, but talk to a professional

BEFORE you make your final decision and use this book as your guide.

- **Understand the right questions to ask and ASK THEM**—Over the next few weeks you'll get some follow ups with brief snippets from this book to remind you of the most important things. Remember the moments during your reading that you said to yourself, "That is crucial."
- **A brochure is NOT proof.** Make your home improvement professional show you third party proof, especially from some of the organizations that we mention here (NFRC, AAMA, Energy Star, Remodeling Magazine, etc.)

I hope you enjoyed the book, and, more importantly, learned some things that can help you make a more informed decision. If you have other questions or need clarification, feel free to [email me](#).