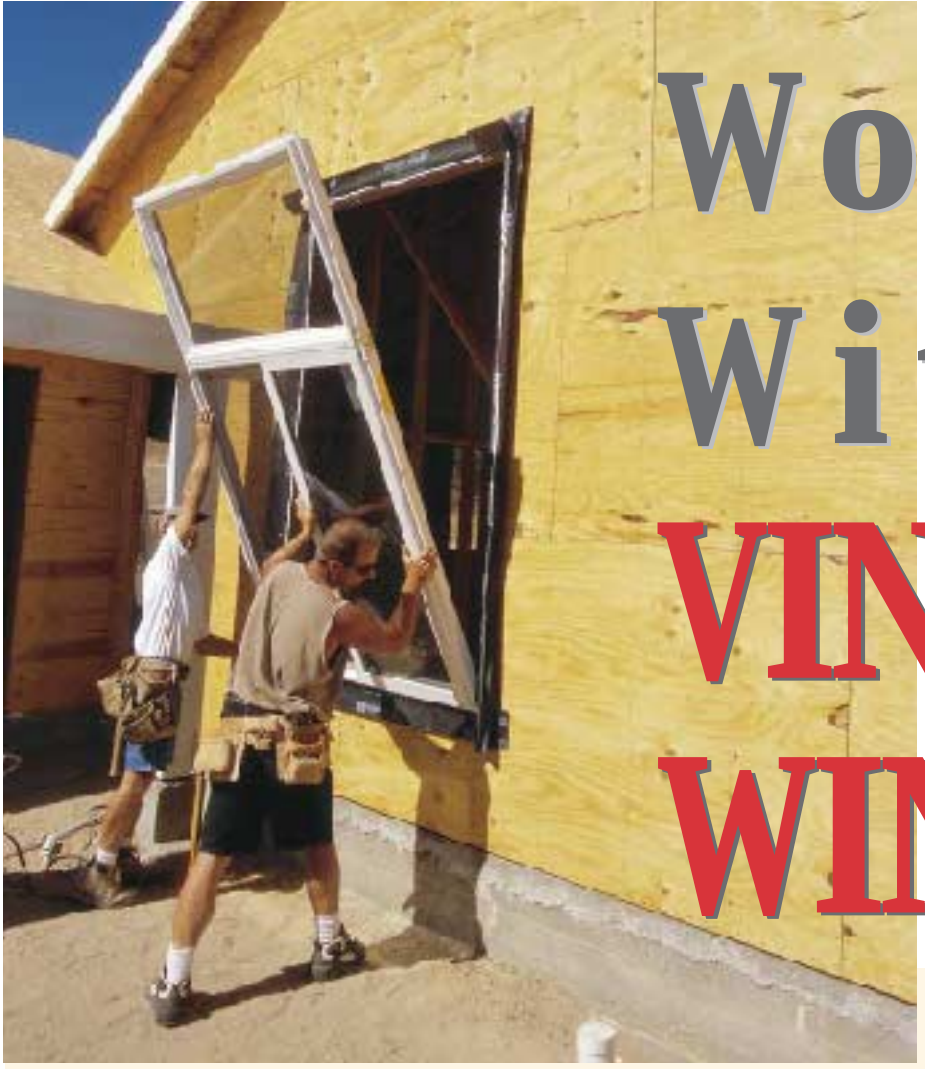


Working With VINYL WINDOWS

by Martin Holladay

In the past five years, the number of residential vinyl windows sold in the U.S. has doubled. Once confined to the replacement window market, today about a third of all windows used in new homes are vinyl. In fact, most observers predict that vinyl windows will overtake wood windows in new residential construction sometime in the next few years.

To explain this steady growth, vinyl window makers point to advantages vinyl windows have over their aluminum and clad wood counterparts. None of the three window types require painting, but most vinyl windows have better thermal performance than aluminum windows and don't swell with changes in humidity like wood windows.

The biggest advantage, however, is lower price, especially when compared with wood windows. Some vinyl window critics charge, however, that the strong price competition between vinyl window manufacturers has led to lower quality. Skeptics point to several shortcomings, including:

- vinyl's high rate of thermal expansion and contraction, which is especially troublesome with wide windows
- the tendency in the past for some vinyl sash and frames to become brittle after being exposed to strong sunlight
- the fact that vinyl windows are available in a limited number of colors

In this article, we'll give you the information you need to make a sound decision when purchasing vinyl windows. We'll also look at installation procedures that will ensure trouble-free performance.

Allowing for thermal expansion is the biggest concern when installing vinyl windows

Quality Issues for Vinyl Windows

Vinyl window production follows three steps: resin production, vinyl extrusion, and window fabrication. At all three steps of the process, decisions are made that can affect the quality of the window.

Chemistry vs. cost. Resin producers make

polyvinyl chloride (PVC) in the form of pellets or powder. The vinyl formulations used for window parts usually include heat stabilizers, as well as pigments like titanium dioxide, which protects vinyl from ultraviolet light. Manufacturers vary the percentage of these expensive ingredients in an effort to strike a balance between durability and price.

When asked whether a builder should worry about the quality of the vinyl used to manufacture windows, Kevin Jones, vice president of Dallas Laboratory, which reviews test reports as part of the AAMA window certification program, answered, "Some compounds are better than others. Some plants might produce inconsistent vinyl. In the weathering tests, we have seen some white vinyl that has gone brown, and some light browns that have gone chalky." Jones explained that such color changes can indicate embrittlement, which weakens the structure of the vinyl. "Embrittlement is more of an issue in hot climates," says Jones. "It is caused by UV degradation. The sunlight actually breaks down the polymers."

According to Jones, manufacturers understand the chemistry behind making weather-resistant vinyl. "The problem is really based on cost," says Jones. "If you use the best of the materials, it will be high-priced, and it will be hard to compete selling windows."

Since the quality of vinyl cannot be determined by appearance, the window buyer's main assurance of quality is the reputation of the window manufacturer. One way to ensure that a window meets industry standards is to look for AAMA-certified windows (see "AAMA Certification").

Structural characteristics. In the second step of vinyl window production, manufacturers called extruders use the vinyl resin to produce "profiles," or "lineals" — extrusions made up of webs and voids for structural rigidity and stability (see Figure 1). To improve the rigidity of extrusions used in wider windows (or in windows sold in high-wind regions), some manufacturers insert steel or aluminum reinforcement into the hollow vinyl profiles. In general, this results in a window that is stronger but somewhat less thermally efficient.

Some manufacturers will fill the voids in vinyl profiles with foam insulation. Although this improves thermal performance, the benefits from the foam may be so slight that the added cost is not justified. Metal-reinforced profiles, which are already more expensive, are generally not foam-filled.

Sturdier windows can be built, but in the U.S., price competition is at the heart of the

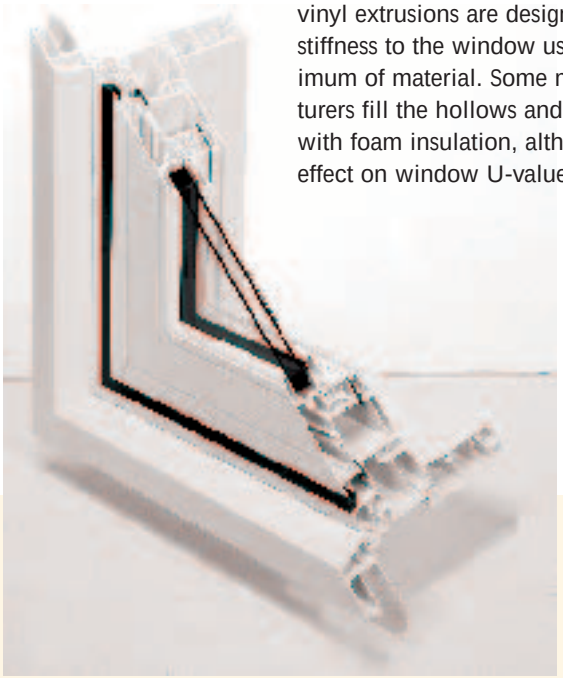


Figure 1. The webs and voids in vinyl extrusions are designed to give stiffness to the window using a minimum of material. Some manufacturers fill the hollows and voids with foam insulation, although the effect on window U-value is slight.

AAMA Certification

Vinyl extruders and window manufacturers have responded to quality concerns by participating in the certification program developed by the American Architectural Manufacturers Association (AAMA). In 1985, the AAMA standard for steel and aluminum windows was expanded to include vinyl windows. The most recent version of the standard, AAMA/NWWDA 101/I.S.2-97, was approved in 1997, and has separate requirements for aluminum, wood, and vinyl windows.

The section for vinyl windows, Section 303, stipulates that vinyl profiles must meet certain requirements for impact resistance, dimensional stability, heat resistance, weight tolerance, color fastness, and weathering. The weathering tests are performed at three U.S. locations chosen to represent extremes of climate (Florida and Arizona) and air pollution levels (Kentucky). For the weathering tests, vinyl profiles (not whole windows) are exposed at a 45-degree angle, facing south, for up to two years.

When purchasing vinyl windows, it is worth looking for the AAMA certification label, since certified windows are more likely to be of consistent quality than uncertified windows. Most, but not all, vinyl extruders and window manufacturers participate in the AAMA certification program. Of the top 15 U.S. manufacturers of vinyl windows, 14 are AAMA-certified. The exception is Croft Metals in Mississippi.

The new International Residential Code, which may eventually be adopted by various states and local jurisdictions, requires that all windows comply with the AAMA standard.

issue. "European windows are built stronger than American windows," says Bill Gorman, an engineer at Milgard Windows. "The problem is cost. Americans won't pay the price necessary to build a European-quality window. In Europe, you see 1/8-inch wall thickness [for vinyl extrusions], which is .125 inch. Here in the U.S., the wall thickness varies from .060 inch to .090 inch."

Window fabrication. The actual assembly of vinyl windows, using vinyl profiles, glass, and hardware, is performed by a window fabricator (Figure 2). Some larger manufacturers produce their own profiles and run their own fabrication plants; others purchase extrusions on the open market and subcontract fabrication to small, local companies.

Figure 2. Vinyl window assembly is often performed by subcontractors, called fabricators. To avoid warranty complications, ask the manufacturer how claims related to fabrication will be handled.

Coefficients of Thermal Expansion

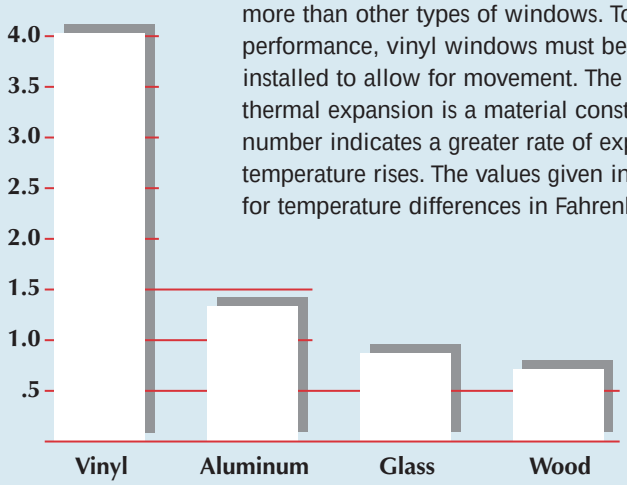


Figure 3. Vinyl windows expand and contract much more than other types of windows. To ensure proper performance, vinyl windows must be carefully installed to allow for movement. The coefficient of thermal expansion is a material constant. A higher number indicates a greater rate of expansion as the temperature rises. The values given in this chart are for temperature differences in Fahrenheit degrees.

Buying Vinyl Windows

Given the variety in product quality, what should you look for when you buy a vinyl window? Vinyl window manufacturers, especially small local fabricators, tend to come and go, so there is an advantage to choosing an established manufacturer (see "Vinyl Window Manufacturers", page 7). You may want to ask, however, whether the "manufacturer" actually fabricates the window, or subcontracts the fabrication to another company. The more fabricators there are for a single brand of window, the more complicated it can be to make claims against the warranty, even when that warranty is backed by a major manufacturer.

When shopping for a vinyl window, consider the following features:

- ***Heavy, thick-walled extrusions.*** If the window is a double-hung, examine the edge of the extrusions at the side jambs, where the sash slide up and down. If possible, examine a wide window rather than just a narrow sample window in a showroom. With a wider window, it will be easier to test the frame at the window head for flex.
- ***Metal-reinforced profiles.*** Since you can't see this feature by looking at the window, check the spec sheet or ask the manufacturer.
- ***Welded corners.*** Mechanically-fastened corners are more likely to separate as the window expands and contracts.
- ***Streamlined design.*** Avoid windows with small plastic parts that might easily get snapped off.
- ***Substantial, solid-feeling sash locks and balance hardware.*** As with wood windows, good hardware will operate longer without problems.

Allow for Expansion

When installing vinyl windows, keep in mind that vinyl has a higher thermal coefficient of expansion than wood or aluminum (Figure 3). "A vinyl window is always moving," says Karl Kardel, a window consultant in Piedmont, Calif. "An 8-foot-wide window can expand 7/16 inch." That's why it's essential to leave a 1/4-inch gap between the window frame and the siding. In hot weather, a vinyl window can expand with enough force to crack stucco.

That's also why most vinyl windows are white: When exposed to the sun, white windows generally don't get as hot as dark-colored windows, so the vinyl is less likely to soften or expand excessively. Window

manufacturers have, however, developed a limited number of dark colors, which are carefully formulated to minimize problems from overheating.

Thermal bowing. In cold weather, gaps can open up between a vinyl window frame and the sash. This occurs when the sash shrinks, while the frame is held fast by the nailing fins.

Cold temperatures can also cause "thermal bowing." "When the outside of a vinyl window is trying to contract, and the inside is trying to expand, it bows," says Charles Deer, owner of Alaska Window, a manufacturer in Fairbanks. "Thermal bowing starts when you have a 40-degree temperature differential between the two sides of the window." In cold climates where thermal bowing is a problem, it's best to choose a vinyl window with metal-reinforced profiles.

Experts disagree, however, on the best way to accommodate the thermal expansion of vinyl, beginning with the size of the rough opening. On one hand are those like Rich Walker, eastern regional director of AAMA, who feels a small rough opening prevents expansion problems. "The window is confined by the rough opening," says Walker. "It's better to have a tight rough opening than a sloppy rough opening." Jeff Ward, marketing manager for Jeld-Wen Windows, disagrees. "If the opening is too tight and the window expands, it can bind. You need enough room for expansion." Allen Hinkle, head of sales at Kasson and Keller Windows, also likes a generous rough opening. "Sometimes, when a window expands, it bows. If there is bowing, it's because the rough opening is too small."

Installation Contradictions

These kinds of inconsistencies carry over into the installation instructions provided by various manufacturers. Here, for example, are some of the most striking contradictions we encountered when asking about basic installation guidelines:

Should the sill be shimmed? Several manufacturers' instructions recommend shimming between the rough sill and the window frame in two or three locations, just as with wood windows. Others recommend that their windows be installed on a continuous, level rough sill. "There is no guarantee that [a vinyl window] won't sag in the center if you shim it in two spots," says Doug McDougall, a window certification manager at CertainTeed. "You're better off providing full support under the sill."

One manufacturer, Simonton, introduces a third option. It instructs the installer to use shims as with a wood window, then to remove the shims after nailing fins are fastened — leaving the window hanging by the nailing fins.

Should the fasteners be driven home or left proud? The instructions from Willmar Windows recommend leaving the fasteners proud: "Do not over-tighten screws or set nails too tight. This will restrict the window from expanding and contracting." Installers of Jeld-Wen Windows, on the other hand, are instructed to use roofing nails driven all the way in. When we posed this question to other manufacturers' technical experts, four recommended driving the fasteners home, while four others recommended leaving the fasteners a little loose.

Should the nailing fin at the head of the window be left unfastened? Some manufacturers recommend fastening the nailing fin at the head of the window, while others warn against the practice (Figure 4). Some installers avoid the problem by driving a nail above the fin, then bending it down to pinch the fin. This procedure is also part of some companies' installation instructions. Superior's instructions, for example, say, "Do not nail through the nail fin at the head — put the nails 1/2 inch above the fin and bend them over the fin." But the nail head in this case can tear the building paper and interfere with other flashing and siding.

Among the variety of reasons given for not fastening the head fin is one that might be called "the myth of the settling header." For example, CertainTeed's McDougall says, "You don't want the rough header to settle down and distort the window." A variation of this myth comes from Scott Clauss, product development engineer at Insulate Windows, who says, "If the house settles, it will pull the sill down, but the head will stay."

Figure 4. Comparing installation instructions from different vinyl window manufacturers reveals a jumble of contradictions. For example, some recommend attaching the fin at the top of the window, while others warn against it. The conflicting advice causes many installers — including the one who installed this window — to risk voiding the warranty by ignoring the manufacturer's instructions.

Given a properly sized and installed header, this concern seems misplaced. While headers may shrink a little, this movement is far less than that of the vinyl window itself due to thermal expansion.

Should a vinyl window be fastened at the corners? This question, too, produces no consensus. In some instructions, including those from Vinylcrest, the installer is told to fasten the nailing fins at the corners. Other manufacturers warn against nailing near the corners. "When the corners are fastened tight," explains Jeld-Wen's Jeff Ward, "that's where the window can crack, because it won't have room to expand."

Installing a Vinyl Window

All of this conflicting advice from window experts is confusing for installers. It can also be costly, since the warranty will be void if you fail to follow the manufacturer's written instructions. This is a particular problem for installers who work with several brands of windows, since it is easier for them to confuse instructions or fail to notice subtle differences in recommended procedures.

Finally, some of the recommended procedures may run counter to reliable methods that you have developed over the years. If the manufacturer's written instructions seem ill-conceived, your best recourse may be to buy windows from a manufacturer whose instructions you can live with.

The installation procedures listed below are consistent with those of many, but not all, vinyl window manufacturers. These procedures also incorporate best practices for avoiding leaks when installing flanged windows of any kind (see "Flashing a Vinyl Window," next page).

Avoid cold-weather installation, when a hammer can shatter the brittle vinyl nailing fins. If you must install a window when the temperature is below 20°F, use flat-head screws instead of nails.

Size the rough opening according to the manufacturer's instructions. Most manufacturers specify an opening 1/2 inch larger than the window frame. The window should then be centered, left to right, leaving a 1/4-inch gap on either side. Be careful: If the rough opening is even a little bit larger, the nailing fins might not catch the framing.

Don't shim the sill — instead, install the window on a continuous, level base. Some installers prefer to double up the rough sill, using stacked 2x4s or 2x6s. This permits easy shimming between the two sills, and also gives wide blocking for stucco installers to fasten their wire lath without puncturing the window's nailing fins.

Install flexible flashing around the perimeter of the window opening. Flexible flashing, which generally comes in 9-inch wide rolls, is made from a variety of materials, including polyethylene and rubberized asphalt (Figure 5). Flashing suppliers are listed at the end of the article.

Lap the flashing in the proper sequence to ensure that the flashing conveys moisture away from the sheathing.

Fasten the nailing fins according to the manufacturer's instructions. Fasteners should be installed tight, unless the manufacturer directs you to leave them proud (Figure 6).

Figure 5. Flexible flashing at the side of the rough opening should extend over the flashing at the bottom. Here, the side flashing was cut too short, and the installer incorrectly failed to lap the filler piece over the bottom flashing. When housewrap or felt paper is later installed, it should be tucked under the horizontal flashing at the bottom of the window.

Figure 6. The use of nail guns is discouraged by some manufacturers, who prefer to see the fasteners left proud to allow for window movement. Also be careful to avoid driving additional nails into the nailing fins when installing trim and siding.

Don't puncture the nailing fin with extra holes when installing housewrap, exterior trim, wire lath, or siding. In all cases, fasteners should be held back from the nailing fin.

Leave a 1/4-inch gap between the siding and the window to allow for expansion. Otherwise, wood or fiber-cement siding may restrict window expansion, causing the window to deform; in the case of stucco, window expansion may cause cracking.

You may need to adjust the gap depending on the temperature at the time the siding is installed. In cold weather, for example, the window will be at its smallest dimension, so the gap between the window and the siding may need to be larger. The reverse is true during very hot weather.

Don't use spray foam to fill the gap between a vinyl window and the rough opening. Vinyl windows frames, being less rigid than wood or aluminum frames, are particularly susceptible to being deformed by expanding foam.

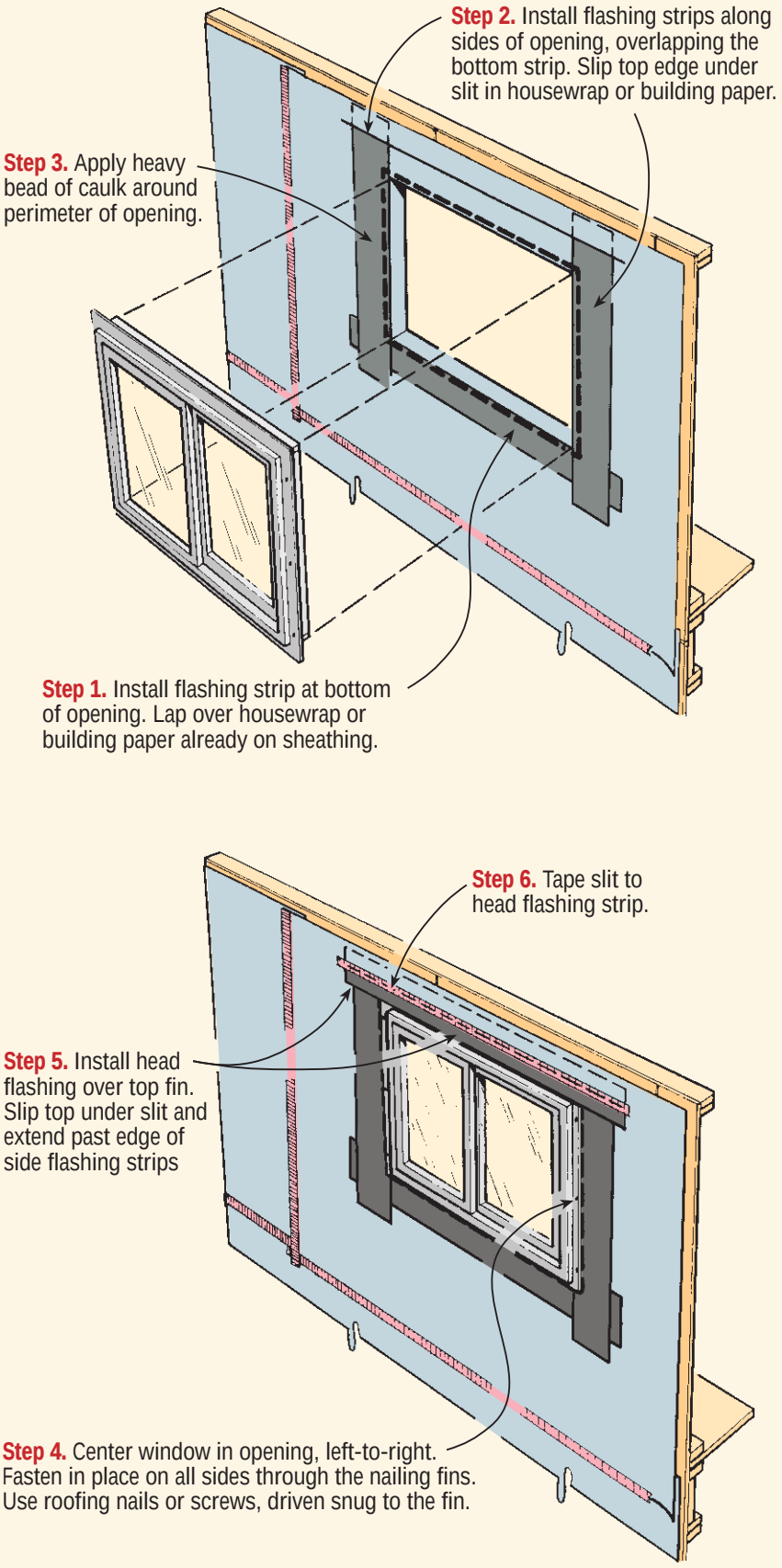
Repair and Maintenance

Vinyl is a relatively soft material that scratches easily. Fortunately, shallow scratches can be rubbed out with light steel wool, fine emery cloth, or Soft Scrub cleaner (an abrasive cleaner available in grocery stores). Scratches can also be removed with acetone, a solvent — but be careful, because too much acetone can dissolve the vinyl. For deeper gouges, some manufacturers recommend a liquid vinyl product called Stelmax Gap Filler (available for about $22 from G-U Hardware; 800/927-1097). Before repairing a window, contact the manufacturer so as not to void the warranty.

How long will vinyl windows last? Eventually, any window will need to be replaced, and vinyl windows are no exception. "Some vinyl window manufacturers are now replacing the first vinyl windows from 20 years ago," says Jon Hills, sales manager for Dayton Technologies, a vinyl extruder. "But the formulation of vinyl has evolved since then. Will today's vinyl windows last longer than 20 years? To know that, we'll have to wait and see."

Martin Holladay *is an assistant editor at the* Journal of Light Construction.

Flashing a Vinyl Window



Vinyl Window Manufacturers
(by Distribution Area)

Nationwide
◊Alside
800/922-6009
www.alside.com

Care Free Windows
Reliant Building Products
800/824-3246

◊CertainTeed Corp.
800/274-8530
www.certainteed.com

Crestline Windows
SNE Enterprises
800/552-4111
www.crestlinewindows.com

◊Croft Metals
800/222-3195

Gorell Windows and Doors
800/946-7355
www.gorell.com

Great Lakes Window
800/666-0000
www.greatlakeswindow.com

Hurd Millwork Co.
800/433-4873
www.hurd.com

Jeld-Wen
800/877-9482
www.doors-windows.com
Manufacturer of Summit, Wenco, and Willmar brands.

◊MI Home Products
717/365-3300
www.mihomeproducts.com

Owens-Corning
800/438-7465
www.owenscorning.com

Simonton Windows
800/542-9118
www.simonton.com

Summit Windows
800/987-7674
(owned by Jeld-Wen)

Vetter Windows & Doors
800/838-8372
www.vetterwindows.com
(owned by SNE Enterprises)

◊Weather Shield Windows
800/222-2995
www.weathershield.com

Wenco Windows
800/458-9128
(owned by Jeld-Wen)

Windsor Windows & Doors
800/283-3399

Northwest
LBL Windows
503/667-8979

Window Products Inc.
800/442-8544
www.windowproducts.com

West Coast
EuroLine Windows
800/337-8604

International Window Corp.
562/928-6411
www.intlwindow.com

West Coast, Alaska, Hawaii
◊Insulate Windows
800/562-4649

West of the Rockies
◊Milgard Windows
800/645-4273 for dealer near you
www.milgard.com

◊Superior Window Products
800/800-3306
www.superior-windows.com

Viking Industries
503/667-6030

West of the Mississippi
Amerimax Building Products
800/827-4369
www.amerimaxwindows.com

Southeast and Midwest
◊Ellison Windows and Doors
336/764-6400

Midwest
Gerkin Windows and Doors
800/475-5061

Willmar
800/265-0070
www.willmar.ca
(owned by Jeld-Wen)

Southeast
Binnings Building Products
336/249-9193

National Windows
800/888-3609

East of the Rockies
◊Silver Line Building Products
800/234-4228
www.silverlinewindow.com

East of the Mississippi
◊Accu-Weld Windows
800/782-6347

American Weather-Seal
800/358-2954

Kaskel Windows
Kasson and Keller
800/452-7535

Survivor Door & Window Systems
800/926-8133
www.survivorwindows.com

Traco Windows
800/837-7003
www.tracowindows.com

Northeast
Harvey Industries
800/942-7839
www.harveyindustries.com

Mid-Atlantic
Vinyl-lite Windows
888/779-4636
www.vinyl-lite.com

◊ - Companies that manufacture their own extrusions

Flashing Suppliers

Carlisle Coating and Waterproofing
800/338-8701
www.carlisle-ccw.com
Window and Door Flashing

Fortifiber Co.
800/773-4777
www.fortifiber.com
Moistop EZ-Seal Window and Door Flashing

Grace Construction Products
Vycor
800/354-5414
www.gcp-grace.com
Vycor

Hyload Inc.
800/457-4056
www.hyload-inc.com
Hyload flashing membrane; Hyload surface-adhered membrane

MFM Building Products
800/882-7663
www.coshocton.com
Future Flash

Nervastral Inc.
203/622-6030
Nervastral Seal-Pruf HD; Biturap

Polytite Construction Products
800/776-0930
www.polytite.com
PolyBarrier

Protecto Wrap
800/759-9727
www.protectowrap.com
Rubberized asphalt peel-and-stick flashing for windows

Sandell Manufacturing Co.
800/283-3888
www.sandellmfg.com