

Manufactured Deck Railings

These durable systems are much easier to install than site-built rails

by David Frane

After decades of cobbling together deck railings from various pieces of pressure-treated lumber — often to ill effect — carpenters now have new options. Following on the development of composite and plastic decking, manufacturers are offering kits that can speed installation and provide a clean, professional-looking railing that doesn't need painting or staining. For this article, I looked at wood-plastic composite and vinyl railings, as well as a few aluminum systems.

The railing kits include top and bottom rails, balusters, and installation hardware. Screws and hardware are usually made from stainless steel and, if exposed, are powder-coated to match the rails. Post sleeves, caps, and post trims are typically purchased separately. Special hardware — usually hinged brackets that you pivot to the proper angle — is available for angled layouts and stair rails.

Manufacturers offer a variety of styles and colors to match or complement most types of decking. Products can be customized by using different types of balusters or mixing colors.

Planning Ahead

While manufactured rails promise easy installation — the post sleeves require no assembly, the balusters are precut, and all the connections have been worked out in advance — there are a couple of key points to keep in mind.

First, baluster spacing is fixed, because the top and bottom rails come with predrilled holes for fastening balusters. This is a great time-saver, but it means there's no good way to fudge the spacing when balusters crowd the posts. The instructions typically say to lay out rail cuts from the



Manufactured Deck Railings

middle — usually the center of a space — in order to create equal end spaces. Check before you cut; you might be able to gain space by shifting the layout and using one less baluster. You'll get the best results if you can lay out your posts to match the railing, but this isn't always possible.

Second, while many manufacturers offer rugged post mounts

for attaching to stone or concrete slabs, most railing kits installed in residential settings rely on 4x4 posts for their structural integrity. This means that the builder assumes responsibility for giving the customer a safe, code-compliant railing. Fortunately, researchers and manufacturers have addressed this issue and there are now several hardware options available that provide a straightforward solution (more on that to come).

Wood-Plastic Composite Railings

Composite railings are made from the same kinds of formulations used in composite decking. First-generation railing products were made from a single layer of composite. More recently, manufacturers have begun using co-extruded material.

Single-layer railing products have the look and feel of composite decking; typically heavier and more flexible than wood, they're often waxy and mottled in appearance (see Figure 1). Composites contain a mix of wood flour (finely ground sawdust) and a polymer such as polyethylene or polypropylene. The polymer binds the material together; the wood fiber is an inexpensive filler that increases strength and thermal stability.

Parts are produced by extrusion. Manufacturers take pains to ensure that the fiber is fully encapsulated within the polymer so that the composite is resistant to insects, rot, and mold. Inevitably, though, some of the fiber remains at or near the surface, where sun and rain can get to it. Past failures of composite decking were often the result of fiber getting wet. In extreme cases, the material cracked, swelled, or deteriorated; more typically, the partially exposed fibers became stained or supported the growth of mold. Most composites now contain biocides to suppress the growth of rot and mold.

Discoloration from the sun is also a problem. Manufacturers add pigment and UV stabilizers to the mix, but fading is usually excluded from warranty coverage.

Co-extruded composites. Some newer composite railings are co-extruded, meaning that a thin cap layer of vinyl (or acrylic) is bonded to the composite core. Co-extruded composites are more resistant to mold and fading because there's no wood fiber in the cap. The cores are typically a wood-vinyl mix, which bonds well to the vinyl cap and is also lighter and stiffer than a conventional composite. The cap layers are fairly tough: In researching this article, I scraped co-extruded parts from several manufacturers with the tip of a screwdriver. It was hard getting through to the core — much harder



Figure 1. The most basic type of composite railing is made from a single layer (above) of the same material used to make composite decking. Pieces are heavy and waxy and look slightly grainy (right) — the plastic equivalent of MDF or particle board.

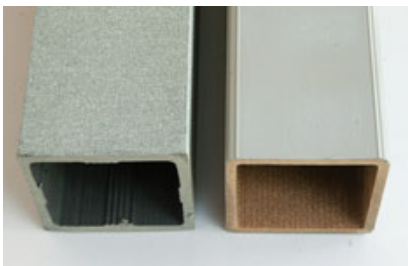
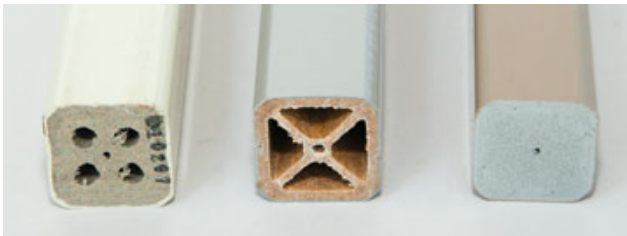


Figure 2. Co-extruded material has a wood-vinyl composite capped by a thin layer of vinyl (top). The mottled appearance of the single-layer composite at far left (in above-left photo) is due to the presence of partially exposed wood fiber; the cap layer of the co-extruded material to its right contains no fiber. The cap layer on the GAF RailWays product (above-right photo) has the texture of wood that's been painted and back-rolled.



Figure 3. Like many composite products, the Azek Premier Rail system is installed by sliding a post sleeve over a wood support post (far left), screwing balusters to a subrail (left), covering the subrail with a top rail (below left), and then securing the rails to posts (below).

than scraping through paint on wood. The resulting scratches looked bad but posed no danger to the composite below.

Co-extruded railings are available in standard colors like white, tan, brown, and gray, as well as in black, which is currently quite popular. The cap layer can be textured to look like painted wood, though the finish is typically glossier (Figure 2, page 2). Azek's Premier Rail and GAF's RailWays are among the more convincing lookalikes, resembling wood that's been sprayed and then back-rolled. Radiance Rail (TimberTech) and Horizon Plus (Fibron) are also fairly convincing, though their balusters are a bit too smooth. At the other end of the spectrum are products such as CertainTeed's Panorama, which is far too smooth to be mistaken for wood.

Installation of composites. Composite rails are easy to install. The carpenter slides the post covers over the 4x4 support posts (Figure 3), cuts the rails to length, then assembles the balustrade. In most cases, the balusters attach with screws driven through predrilled holes in the subrails. Once assembled, the balustrade is positioned between the posts, fastened in place, and covered with a top rail. While screwing in balusters is not the fastest method of assembly, it's certainly the most bullet-proof, providing little opportunity for joints to open or balusters to rattle. Some manufacturers have devised methods to speed the installation of balusters by omitting the screws (Figure 4).

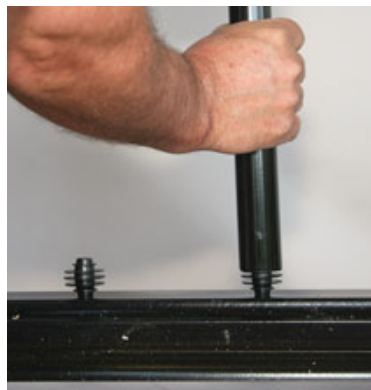


Figure 4. The hollow balusters in GAF's RailWays system fit over ribbed plastic fittings screwed to the rail before assembly (above left). Fibron's Horizon Plus Railing (above) relies on press-fit plastic inserts — one end fits in the baluster and the other in a slot in the rail. The balusters in Trex's Artisan Series (left) drop into routed openings in a vinyl spacer strip; it snaps into the rail.

Manufactured Deck Railings

Rails are typically joined to posts with stainless-steel fasteners and L-shaped metal brackets that butt to the post and the bottom of the rail. While color-matched powder-coated brackets are fairly inconspicuous, a cleaner look is achieved with a



Figure 5. While the powder-coated hardware on this Azek rail is fairly unobtrusive (above left), the bracket on the TimberTech Radiance rail (above right) is completely concealed by the top rail (right).

two-piece rail that completely conceals the hardware, as with CertainTeed's Panorama, TimberTech's Radiance, and Trex's Artisan series (**Figure 5**).

Vinyl Rails

Vinyl rails consist of hollow vinyl sleeves over structural metal channels. The metal, usually an aluminum extrusion, supports the sleeve, which by itself is not stiff enough for long spans. Because balusters are subject to less stress than rails, they can be made from vinyl alone. Dark vinyl tends to fade, so only light colors are available — white, tan, brown, and gray.

Though vinyl railings are intended to resemble painted wood, the effect is not convincing. The smooth, shiny surface is a giveaway, as are the plastic brackets that vinyl systems typically rely on to conceal the connections between posts and rails (**Figure 6**).

Most companies buy vinyl extrusions from large manufacturers like Veka or Kroy, then combine the parts in various ways to produce individualized products. It's not unusual to see the same parts across several brands.

Installing vinyl rails. Vinyl systems are very easy to install because the balusters drop into holes in the rails. (The drawback is that because they're not screwed into place, the balusters could rattle in the wind or squeak when someone leans on the rail.) The railing cuts aren't critical because the connection is hidden by the plastic bracket



(**Figure 7**, page 5).

Noteworthy products. CertainTeed makes a couple of vinyl products that — when viewed from a distance — might almost pass for wood. The company's Edgewood series rails are colored and textured to resemble wood brushed with paint or stain. If it weren't for the plastic brackets, they'd be fairly convincing. And its Colonial vinyl baluster, which is supposed to look like a turned wood spindle, is thicker-walled than most and crisp enough to be believable.

Veka's VI Pro Handrail System comes with the usual square balusters or can be routed to accept round 3/4-inch steel pickets in a variety of patterns and finishes. Curved railings are available in stock and custom radii. The beefy aluminum connectors for the VI Pro rail are more substantial and contain more screws than the plastic connectors normally used with vinyl rail.



Figure 6. Vinyl rail extrusions are reinforced with aluminum channel (above). In most vinyl kits, an obvious plastic bracket covers the joint between post and rail (right).

Manufactured Deck Railings



Figure 7. With the lower rail of the Veka VI Pro system in place and the balusters in their holes (far left), all that's left to do is fit the upper ends of the balusters into the top rail. The VI Pro uses heavy aluminum hardware (above left); plastic hardware — as on the CertainTeed Panorama rail (left) — is more typical for vinyl railings.

When a Guardrail Contains Glass

Though permitted by the IRC and IBC, tempered-glass infill poses problems for vinyl and composite railing systems. If the guard contains glass, the glass and the rails require a four-times safety factor, so the rail must be tested to 800 pounds (200 pounds x 4) and the glass to 200 pounds (50 pounds x 4). Tempered glass can pass this kind of testing, but many railings cannot — at least not without being thicker, shorter, and more expensive than they currently are.

What's more, code compliance reports cannot be issued for systems with glass infill, because the test standard contains no acceptance criteria for glass. The lack of a compliance report makes it difficult — though not impossible — to convince the inspector that the system complies with code.

When asked about the code status of their rails with glass infill, most manufacturers will say the glass complies with ANSI Z97.1 (a standard test for impact resistance) or that the infill is merely “decorative.” Trex took the added step of having an Artisan rail with glass infill tested by an outside lab and can provide a report of how it fared during structural testing. There's no guarantee that the inspector will accept this report — but there's no guarantee he'll accept a code compliance report, either.

If glass infill is a problem in your jurisdiction, you



It's not possible to issue code compliance reports for composite and vinyl rails with glass infill, so it can be difficult to get approval from the building department for rails with tempered-glass panels (above) or balusters (right).



might consider Fiberon's composite Clear Vision System or Fairway's Grandview Vinyl Railing System, both of which contain clear acrylic panels. Since the panels aren't glass, the code treats them like any other baluster material.

Manufactured Deck Railings



Figure 8. The Durarail system is made from heavy powder-coated aluminum; here it's shown with a combination of pickets and tempered glass (above). The balusters in CertainTeed's Durham system (right) are held in the rails by spring-loaded pins; the compressible rubber end piece prevents rattling.



Aluminum Rails

Aluminum rails are a good option for customers who want the sleek unobtrusive look of metal without the corrosion associated with steel. Most aluminum rails receive a factory-applied powder-coat finish that is tougher than conventional paint.

Frequently used on commercial and multifamily projects, aluminum systems are usually tested to both the IRC and IBC standards. Aluminum is considered a conventional building material in the code, so aluminum rails do not require special approval and are often available with tempered glass infill (see

"When a Guardrail Contains Glass," previous page).

Installation. Some products, such as CertainTeed's Durham, are assembled entirely on site. The Durham balusters fit into pre-cut holes in the rails and are held in place by spring-loaded pins. Once assembled, the rail sections are installed between aluminum posts that are bolted to the deck (**Figure 8**).

The Durarail system is ordered to size and arrives partially assembled, with pickets

How Railing Kits Are Tested

The loads published in the code are design loads. For a manufacturer to meet code, however, the railing system must be tested at a much higher load — at a safety factor of 2.5. This means the top rail is tested to a load of 500 pounds (200 pounds x 2.5) and the baluster infill to 125 pounds (50 pounds x 2.5).

The upper rail is tested in the two locations where it is most likely to fail — at the center of the span and at the post connection (see photos). Testing is performed by installing a railing system between wood posts on a test rack, connecting a cable to the upper rail, and observing what happens as the cable is tensioned to 500 pounds. Infill is tested by pressing or pulling on a one-foot-square piece of material placed against the balusters.

A rail system passes if no part of it breaks or deflects excessively during testing. Maximum allowable deflection is calculated using formulas referenced in AC174. As an example, a rail 36 inches high and spanning 72 inches between posts would be allowed to deflect a maximum of 2¼ inches.



A 500-pound point load is being applied to this rail to test for compliance with the IBC (above). Balusters are tested with a 125-pound load (50 pounds x 2.5 safety factor) applied over one square foot of area (left).

Photos: Architectural Testing Inc.

Post Attachment Details*

Plan View

Posts located at outside joist.
2x8 (min.) blocking with two
hold-down anchors. Attach
blocking with 10d common nails
top and bottom, each side.

Corner posts. Two hold-down
anchors, offsetting — one located
at top and other at bottom

Post through-bolted
to rim joist

Section View

4x4 post

(2) 1/2" galvanized
through-bolts
with washers

2 x 8 (min.)
deck joists

Metal connector
(Simpson HD2AHDG
hold-down or equivalent)

2x8 (min.) band joist

2" min.

2 1/2" min.
to 5" max.

2" min.

(2) 1/2" galvanized
through-bolts with washers

At deck joists.
One hold-down anchor,
see detail below

Between joists.
Two hold-down anchors
located at adjacent
deck joist/band joist

*Deck support structure omitted for clarity

Figure 9. Though the IRC contains few specific details for attaching rail posts to deck framing, there are several sources now available to provide guidance to builders and inspectors. This drawing is based on research done at Virginia Tech and published in *JLC* (2/05) and the American Wood Council's new deck construction guide, DCA6. Approved hardware is available from Simpson Strong-Tie, USP, and DeckLok.

welded between rails that have already been cut to length. The posts and rail cap are exceptionally stout. Durarail is also available with tempered glass panels.

Do Manufactured Railings Meet Code?

Under the IRC, vinyl and composite railings are considered to be an "alternative" material, which means their use is subject to approval by the local building department. Inspectors may ask for proof that the product complies with code, such as stamped drawings from an engineer. In most cases, however, they will be satisfied if you can show them a code compliance report from the ICC Evaluation Service (ICC-ES) or an accredited lab such as Architectural Testing Inc. (ATI). The report affirms that the product has been tested in accordance with ICC-ES AC174 — the

Acceptance Criteria for Deck Board Span Ratings and Guardrail Systems. This protocol requires specific tests for durability — resistance to termites, decay, freeze/thaw, ultraviolet, and the like. More significantly, it requires testing of the guardrail system to prove that it complies with the structural requirements of the building code.

Structural requirement. Table R301.5 of the IRC states that the upper rail of the guard must be designed to withstand a 200-pound point load from any direction and that the infill — the balusters — must withstand a 50-pound horizontal force over one square foot of area. The bottom rail is not considered except insofar as it supports the infill. (Site-built wood rails must be designed for the same loads, but because wood is considered a conventional material by code, wood rails aren't usually tested.

Manufactured Deck Railings

It's up to the inspector to decide if a particular wood railing is strong enough.)

Most vinyl and composite railings rely on 4x4 wood posts for support — posts for which the railing manufacturer takes absolutely no responsibility. When a manufacturer addresses these posts at all, it's to give a blanket statement that they must comply with the local building code. Under the IRC, the post must be designed to withstand the same 200-pound load as the rail. The problem is, the code doesn't explain how to achieve this, which places liability for safe performance of the manufactured railing squarely on the builder.

Lacking guidance, some carpenters use questionable methods to install posts — for example, notching and bolting them to a rim that is merely nailed into place. Notching severely weakens the post, and the lever action of the post can pull the rim free from the joists.

Prescriptive guide. Last year, the American Wood Council took the guesswork out of code-compliant wooden decks by publishing the "Prescriptive Residential Wood Deck Construction Guide" (DCA6). Available for free at awc.org, it contains specific construction details for all aspects of deck construction, including post attachments. According to DCA6, the posts supporting deck rails should be 4x4 or larger, unnotched, and through-bolted to the outside joist using a metal connector detail like the one developed by Frank Woeste and Joe Loferski in tests at Virginia Tech and published in *JLC* in 2005 ("Strong Rail-Post Connections for Wooden Decks," 2/05). Note that since 2005, at least three manufacturers have released hardware specifically designed for attaching 4x4 pressure-treated wood posts to deck framing: DeckLok's bracket system (866/617-3325, deck-lok.com), Simpson's DTT2Z and HD2AHDG deck post connector (800/999-5099, strongtie.com), and USP's DTB-TZ deck tie bracket (800/328-5934, uspconnectors.com). The upshot is that builders can now easily provide strong, tested connections for critical guardrail attachment (**Figure 9, page 7**).

Of course, not all railings are installed on decks: For posts installed on stone patios or concrete slabs, manufacturers offer flanged metal post mounts that attach with masonry anchors (**Figure 10**).

Graspable rail. Though the requirement for graspable handrails on stairs is rarely enforced on residential decks, the top rails of most manufactured railings are too wide to comply. If the inspector is strict, however, many products are available with ADA- and code-compliant secondary rails, usually a cylindrical aluminum core with a vinyl cover (**Figure 11**).

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Figure 10. For instances when it's not possible to support rails with wooden posts, most manufacturers sell metal post mounts similar to this one from Azek.



Figure 11. Most manufacturers can supply secondary graspable rails for use on stairs. The model shown here is from Fairway Vinyl Systems.

	JLC Extra	
For a list of companies that make deck-rail kits and links to their products, go to jlconline.com and click on the JLC Extra tab.		