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Installation, Care, and Maintenance of Wood Shake and Shingle Siding

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Abstract

This article gives general guidelines for selection, installation, finishing, and maintenance of wood shakes and shingles. The authors gathered information from a variety of sources: research publications on wood finishing, technical data sheets from paint manufacturers, installation instructions for shake and shingle siding, and interviews with experts having experience constructing and inspecting shake and shingle siding. If research reports could not be found, the recommendations are based on opinions of experts and practices that have been shown to give good service life for shakes and shingles. More detailed information is available from shake and shingle suppliers, paint manufacturers, and the Cedar Shake and Shingle Bureau (CSSB).

Keywords: Shakes, shingles, ultraviolet radiation, UV degradation, water-repellent preservatives, semitransparent stains, solid-color stains, paints

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Authors are members of the Joint Coatings Forest Product Committee. The American Coatings Association and the Forest Products Laboratory co-sponsor the committee and it is comprised of representatives from the wood and coatings industries. The committee functions through task groups organized to write articles on wood/paint interaction. Jack Dwyer chaired the Shake and Shingle task group until he retired; Tony Bonura chaired the task group after Jack retired.

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The Cedar Shake and Shingle Bureau (CSSB) is a nonprofit organization that oversees the inspection of western redcedar (*Thuja plicata*), Alaska yellow-cedar (*Chamaecyparis nootkatensis*), and redwood (*Sequoia sempervirens*) shakes and shingles. The CSSB publishes quality standards (grade rules) and ensures that the member mills producing shakes and shingles meet these standards through periodical third-party inspection. Shakes and shingles having their “Certigrade®,” “Certi-Split®,” or “Certi-Sawn®” designations have been inspected to meet grade standards. A grade stamp/label (with color code for the grade) is placed on each bundle or carton of shakes or shingles and clearly shows the grade. The label contains other information such as wood species, certifying agency, building code standards, and manufacturer (Fig. 1). This “Certi” label assures the consumer that the shake and shingle manufacturer is adhering to grading rules as prescribed by building codes.

Introduction

Wood shakes and shingles have been used for centuries as a siding material. Western redcedar, Alaska yellow-cedar (also called yellow cedar), and redwood are the wood species most commonly used to manufacture shakes and shingles. Shakes and shingles from these species are included in the building codes for the United States and Canada, and to meet these building code requirements, shakes and shingles must meet specific wood quality standards (Table 1).

Eastern white-cedar (also known as northern white-cedar, *Thuja occidentalis*) is also currently used for shingles, and grade rules are established for this species (Table 2). Shingles from this species are not covered under CSSB standards and their quality is not certified through third-party inspection; therefore, their use on roofs is not authorized under United States and Canadian building codes. However, they are approved for use on sidewalls. Check with local code officials for details. Other species have historically been used for shakes and shingles: white oak (*Quercus alba*) and southern pine (also called southern yellow pine, *Pinus* spp.). The quality of white oak and southern pine shakes and shingles is not assured through CSSB inspection; therefore, check with code officials in your area for acceptance of these products.

Wood shakes or shingles, if properly installed, finished, and maintained, will age gracefully providing a long service life (Fig. 2).

Selection

The first requirement for long service life is selection of the shake or shingle. Western redcedar, Alaska yellow-cedar, and redwood are available in a range of grades (Table 1). They are listed in decreasing quality along with a brief description of the grade. This is where “money talks!” The higher the grade (and price), the longer the siding can be expected to last. Vertical-grain (or edge-grain) shakes and shingles will probably perform better than flat-grain grades; vertical-grain wood is more dimensionally stable and therefore less likely to warp and split.

Some areas of the United States and Canada have code requirements for fire-treated shakes and shingles for roofs and siding. Chromated copper arsenate (CCA) preservative treated shakes and shingles are also available. This is probably not required for shakes and shingles used in siding applications, but it is prudent to check. Even if not required, CCA pressure-impregnation of shakes and shingles can dramatically extend their service life, especially in areas where warm temperatures and humid conditions are present for substantial parts of the year. Non-pressure treatments such as with copper 8-quinolate and copper naphthenate are also available, but these are not as leach resistant as pressure-applied preservatives.

Shakes

Shakes come in a variety of sizes, shapes, and surfaces and are graded on the split side. Shakes are most commonly available in 18-in. (457-mm)¹ and 24-in. (610-mm) lengths, but longer lengths can be special ordered. Shakes can be split on the face and have sawn backs (handsplit), split on both sides (straight split and tapersplit), or sawn on both sides (tapersawn). Handsplit shakes are graded on the split side. Tapersawn shakes are commonly available having butt-end thickness of 5/8, 3/4, and 7/8 in. (16, 19, and 22 mm), may be special ordered up to 2 in. (51 mm) butt-end thickness, and are graded on the best face. All shakes

¹The variability in manufacturing results in large variance in measured values of shakes and shingles, which are not necessarily reflected in the precision of the reported conversions to SI units.



Figure 1. Information on a Certi-Label™: 1) “Certi” brand name; 2) Product grade; 3) Product type; 4) Independent third party quality control agency; 5) Compliance with total quality processes; 6) Manufacturer; 7) Industry product description; 8) Product dimensions; 9) Cedar Shake and Shingle Bureau label number; 10) Building code compliance numbers; 11) Product performance tests passed; 12) Label identification number; 13) UPC code; 14) Coverage showing the number of bundles/100 square-feet and recommended exposure; 15) Application instruction on reverse side. Used with permission from Cedar Shake and Shingle Bureau *Exterior and Interior Wall Manual*.

are graded to one face according to the grain angle, flaws, and heartwood/sapwood content (available in two grades, Premium and No. 1). A brief description of each grade is contained in Table 1 and Figure 3.

Additional information on grades and grade rules is contained in “CSSB-97 Grading and Packing Rules for Western redcedar, Alaska yellow-cedar (also called yellow cedar) and Redwood Shakes and Shingles. These grade and packing rules are available on the Cedar Shake & Shingle Bureau’s website: www.cedarbureau.org.

Shingles

Shingles are sawn on both faces and have a butt-end thickness of about 3/8 to 1/2 in. (9.52 to 13 mm). Western

redcedar, Alaska yellow-cedar, and redwood shingles are graded according to the grain angle, flaws, and the amount of heartwood/sapwood and are available in four grades (Fig. 4).

No. 1 grade shingles must be 100% clear, 100% heartwood, and 100% vertical grain. Shingles that contain only heartwood are more resistant to decay than are shingles that contain sapwood. Lower grades may contain sapwood, flat grain, and knots. Vertical-grained shingles are less likely to warp and split than are flat-grained shingles. Narrow shingles are less likely than wide shingles, and thicker less likely than thinner shingles to warp and split. Thickness of shingles is described as the number of shingles per the total of butt-end thickness of a specific length of shingle.

For example, a 24-in. by 4/2-in. (610-mm by 4/51-mm) “Royal” shingle measures approximately 1/2 in. at the butt. That is, the total butt-end thickness of 4 shingles must be at least 2 in. (51 mm). An 18-in. by 5/2¼-in. (457-mm by

Table 1. Grade and description of shakes and shingles from western redcedar, Alaska yellow-cedar, and redwood

Grade ^a	Description
Shakes^b	
Premium	Handsplit, tapersawn, tapersplit, or straight-split shakes from 100% clear vertical-grained heartwood. Tapersplit shakes have a natural taper that is similar to the taper of a shingle. Straight-split shakes are of the same thickness throughout the length of the shake.
No. 1	Handsplit and tapersawn shakes of clear heartwood with no more than 20% flat-grained pieces in each bundle.
Shingles^c	
No. 1	The top grade of shingles. This grade of shingle can be used for sidewalls and roofs. This grade of shingle must be 100% clear, 100% heartwood, and 100% vertical grain. These shingles are available in three lengths (16, 18, and 24 inches). ^d
No. 2	No. 2 grade can be used in various applications. This grade of shingle must have at least 10 inches of clear wood (butt-end) on a 16-inch shingle, 11 inches on an 18-inch shingle, and 16 inches on a 24-inch shingle. This grade allows no limitation on flat grain. Limited sapwood is also allowed in this grade.
No. 3	No. 3 grade is a utility grade intended to be used on economy applications as well as on secondary buildings. This grade must have at least 6 inches of clear wood (butt end) on 16-inch and 18-inch shingles and 10 inches on a 24-inch shingle.
No. 4	No. 4 grade is to be used for the under course of double-coursed sidewalls only. This shingle is never to be used for roof application or as a starter course on roofs

^a Refer to CSSB 97 for more information on grade rules for cedars and redwood.

^b Graded on the split side.

^c Sawn on both sides and graded on one face.

^d 1 inch = 25.4 mm.

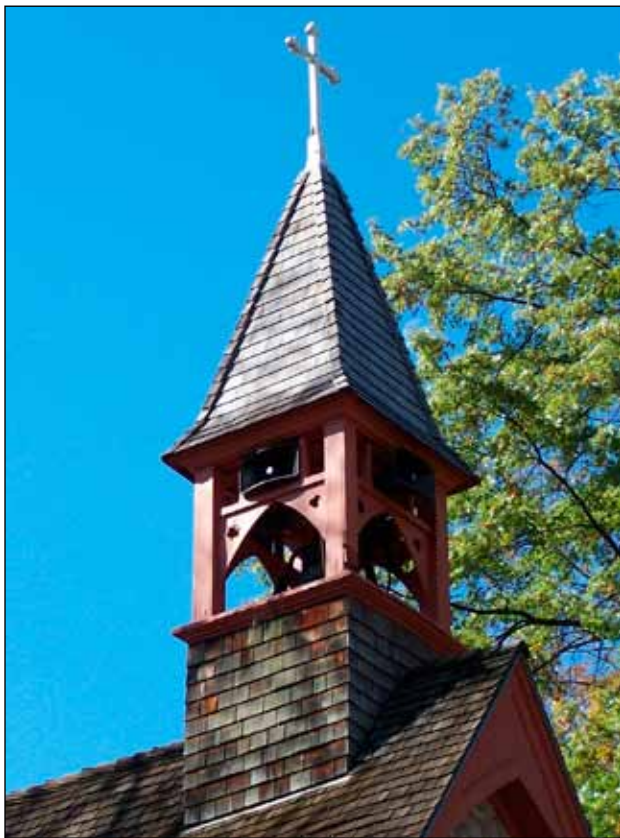


Figure 2. Example of shingle siding after many years of service.

5/57-mm) “Perfection” measures approximately 7/16 in. at the butt. That is, the total butt-end thickness of 5 shingles must be at least 2¼ in. Lengths may be 16, 18, or 24 in. (406, 457, or 610 mm). A 16-in. (406-mm) shingle is referred to as a “5X” because they are installed with a 5-in. exposure. Shingles are available in specified widths or random widths. Figure 5 shows a typical modern structure having random-width shingle siding.

Specialty Sidewall Products

Rebuted and Rejoined Shingles

Rebuted and rejoined shingles (commonly known as R&R shingles) are kiln-dried and may be specified as having a “sanded” or “un-sanded” face (Fig. 6). The length of the sanded face is greater than the maximum exposure. These shingles are identical to No. 1 and No. 2 grades and must be specified as No. 1 or No. 2, but are machined to have parallel edges and smooth butt-ends. They are used for sidewall application. This product is available in 16-, 18-, and 24-in. (406-, 457-, and 610-mm) lengths.

Machine-Grooved Shingles

Machine-grooved shingles are identical to rebuted and rejoined shingles but have grooves machined on the face of the shingle (Fig. 6). Machine grooved products are for sidewall applications only. This product is available in 16-, 18-, and 24-in. (406-, 457-, and 610-mm) lengths.

Table 2. Grade and description of shingles from northern white-cedar (*Thuja occidentalis*)

Grade ^a	Description ^b
Extra	No defects are allowed in this grade.
Clears	No limitations on flat grain. Knots are allowed no closer than 7 inches from the butt-end. ^c Holes of 1 inch in diameter allowed not closer than 8 inches from the butt. Rot is not allowed. Sapwood can be ¾ inch wide not closer than 10 inches from the butt-end. Wane can be ¾ inch wide not closer than 10 inches from the butt-end.
Second Clears	No limitations on flat grain. Knots must be sound with no restriction. Coarse or black knots may be a maximum of 1 inch in diameter not closer than 6 inches from the butt-end. Holes of 1 inch in diameter allowed not closer than 6½ inches from the butt-end. Rot streaks not closer than 6 inches from the butt-end. Sapwood can be 1½ inches wide not closer than 6 inches from the butt-end. Wane can be ¾ inch wide not closer than 6½ inches from the butt-end.
Clear Walls	No limitations on flat grain. Knots must be sound with no restriction. Coarse or black knots may be a maximum of 1/3 the width of the shingle but not closer than 6 inches from the butt-end. Holes of 1 inch in diameter allowed not closer than 6 inches from the butt-end. Rot streaks not closer than 6 inches from the butt-end. Sapwood, no restriction. Wane is allowed not closer than 6 inches from the butt-end.
Utility	No limitations on flat grain. All defects found in wood shall be permitted provided that the extent of the defects, singular or in combination, do not impair the use of the shingle.

^a Refer to Quebec Lumber Manufacturer's Association (QLMA) for complete information on grades of eastern white-cedar.

^b All eastern white cedar grades contain flat grain.

^c One inch = 25.4 mm.

CERTI-LABEL WESTERN CEDAR SHAKES

Certi-Split® Handsplit Shakes



Certi-Sawn® Tapersawn Shakes



Certi-Split® Tapersplit Shakes



Certi-Split® Straight-Split Shakes

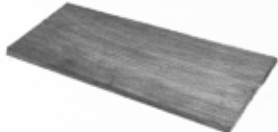


Figure 3. Certi-label western redcedar shakes. Used with permission from Cedar Shake and Shingle Bureau *Exterior and Interior Wall Manual*.

CERTIGRADE® WESTERN CEDAR SHINGLES

Number 1 Blue Label®



Number 2 Red Label



Number 3 Black Label



Number 4 Undercoursing



Figure 4. Certigrade western redcedar shingles. Used with permission from Cedar Shake and Shingle Bureau *Exterior and Interior Wall Manual*.



Figure 5. Newly installed shingle siding with transparent water-repellent preservative finish.

Specialty-Cut Shingles

Specialty-cut specialty shingles are cut 5 in. (127 mm) wide and come in 16- and 24-in. (406- and 610-mm) lengths with a variety of different butt-end designs (Fig. 6). Some examples are square, diamond, half-cove, octagonal, round, arrow, hexagonal, diagonal, and fish-scale butt-end designs.

Installation

The spacing between shakes and shingles depends on the grain angle, width of the shake or shingle, and moisture content at the time of installation. Flat-grained shakes and shingles shrink and swell almost twice as much as vertical-grained ones and require more space between them to avoid

buckling (Fig. 7). Wide shingles require more space than narrow shingles. If the moisture content is low (5%–6%), leave a little extra space; if it is high (above 20%), decrease the spacing slightly. As a general rule for shingles equilibrated to ambient conditions (about 12% moisture content), shingles should be installed about 1/8 to 1/4 in. (3 to 6 mm) apart whereas shakes should be spaced about 3/8 in. (9.52 mm) apart and not more than 1/2 in. (13 mm) apart. Adjacent courses should be offset at least 1 1/2 in. (38 mm). Shakes and shingles siding may be attached to exterior walls in a variety of ways.

Rain-Screen Method

The rain-screen method of building construction gives a secondary barrier and drainage plane for water (Fig. 8). Sheathing is placed over the studs and a water-resistant barrier (usually Type 30 felt) is applied. Although the shakes and shingles are not nailed directly to the sheathing in rain-screen applications, most codes still require plywood sheathing. Plywood sheathing transmits moisture better than OSB; therefore, if it gets wet, it dries more quickly. A variance to use OSB in a rain-screen application needs to be requested before installing the sheathing. Furring strips (nominal 1 by 2 in. dimension lumber (19 mm by 38 mm)) or nominal 2 by 2 in. dimensional lumber (38 mm by 38 mm) are placed over the building paper directly over each wall stud. The thickness of the furring strips or (2 by 2s) must be sufficient to avoid having the siding nails penetrate the felt or house wrap. Horizontal boards (usually nominal 1 by 4 in. dimensional lumber (19 mm by 89 mm)), spaced to coincide with the exposed shake or shingle length,

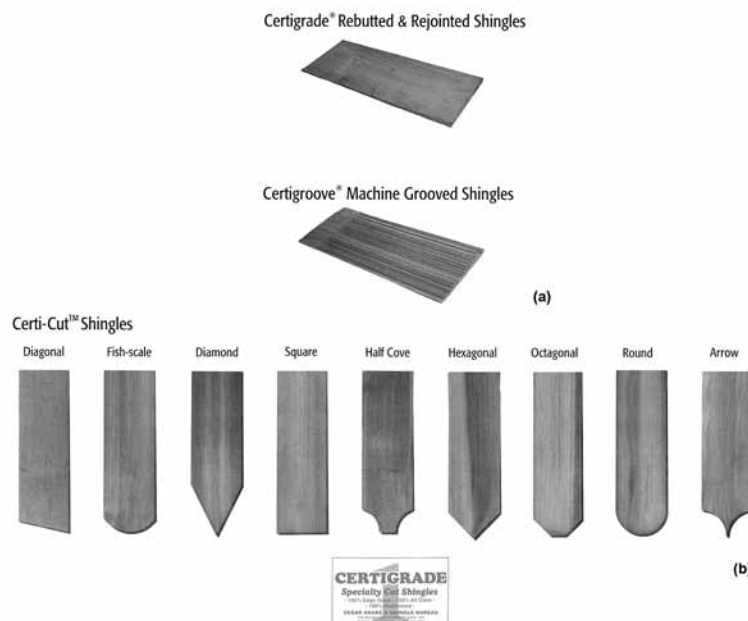


Figure 6. Specialty cut shingles: a, rebutted and rejoined shingles, machine grooved shingles; b, butt-end design. Used with permission from Cedar Shake and Shingle Bureau *Exterior and Interior Wall Manual*.



Figure 7. Buckling of shingles installed with insufficient gap.



Figure 8. Rain screen technique.

are placed across the furring strips to give an open space between the backside of the shakes or shingle and the sheathing. The space is vented at the top and bottom and must be screened to keep out insects. The top may be vented directly into the soffit to connect the air-flow with the attic ventilation. Flashing must be installed around doors and windows just as with any siding system.

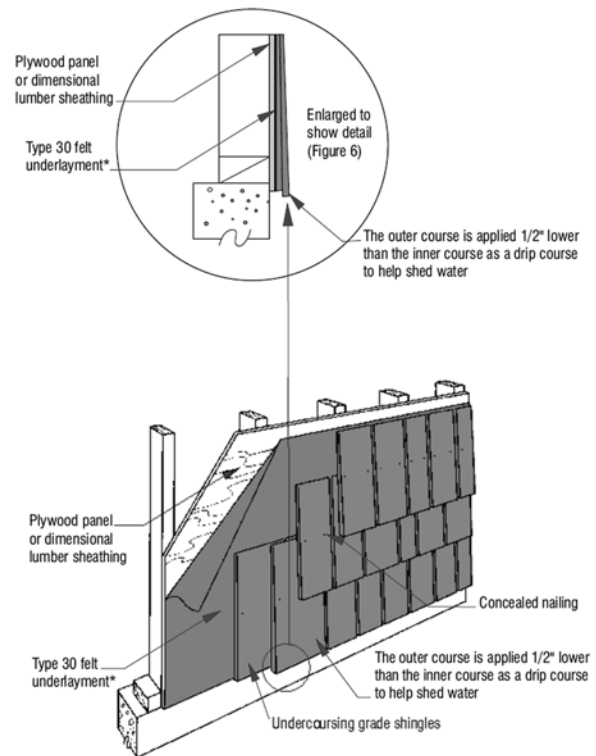


Figure 9. Single-coursed application of shingles. Used with permission from Cedar Shake and Shingle Bureau *Exterior and Interior Wall Manual*.

Note: There are two current ASTM designations for Type 30 felt depending on the area of the country. Where Type IV felt is required, it must meet ASTM D4869 standard; Type II felt must meet ASTM D226 (Check with local code officials.).

Direct Application

For direct application, shakes or shingles are applied directly over properly installed and flashed Type 30 felt (or house wrap as approved by local codes). Shakes and shingles may be single-coursed (Fig. 9), stagger-coursed (Fig. 10), or double-coursed (Fig. 11). The double-course application permits the use of a lower grade for the first layer and a greater exposure of the higher quality second layer of shake or shingle. Pressure-impregnated preservative-treated products can be used in these applications.

Application Over Existing Siding

Shakes and shingles may be used to cover existing wood beveled siding, masonry, or stucco. The shakes or shingles can be applied directly over the existing siding; however, rain screen application is necessary over brick, stucco, and

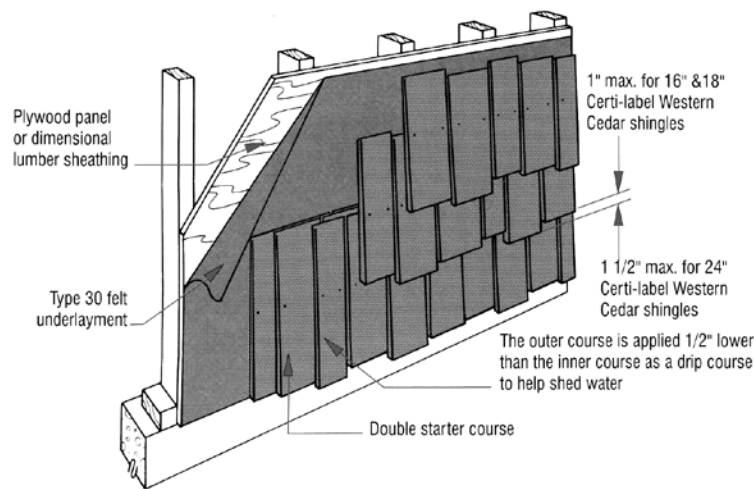


Figure 10. Stagger-course application. Used with permission from Cedar Shake and Shingle Bureau *Exterior and Interior Wall Manual*.

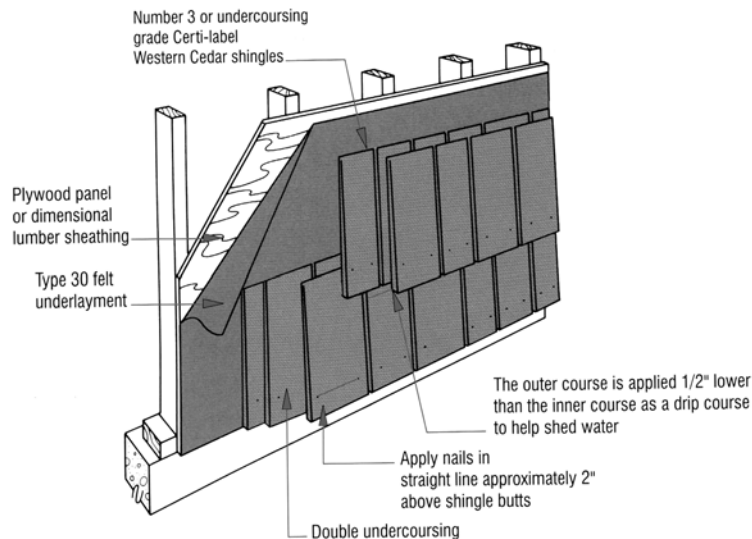


Figure 11. Double-course application. Used with permission from Cedar Shake and Shingle Bureau *Exterior and Interior Wall Manual*.

foam sheathing (Fig. 12). If applied directly over composite wood siding products such as hardboard siding, use longer fasteners and nail through the siding to the underlying sheathing. The brick molding around windows and doors will have to be extended, so it may be better to increase the wall thickness even more and use the rain-screen application. Fasten vertical furring strips to the underlying wall-studs, fasten horizontal boards to the vertical strips, and nail the shakes or shingles to the horizontal nailing strips.

Note: Always check with the manufacturer of the product as well as with your local code official for approved application methods in your local area. Keep in mind that local codes often specify minimal requirements.

Fasteners

Nail placement for cedar shingles up to 10 in. (254 mm) wide requires two corrosion-resistant nails driven $\frac{3}{4}$ in. (19 mm) from each edge and 1 in. (25 mm) above the exposure line. For shingles wider than 10 in. (254 mm), drive two additional nails approximately 1 in. (25 mm) apart near the center. To decrease the chance of splitting the shake/shingle, fasteners should be blunted siding nails and should be ring-or twist-shank to improve holding. A ring-shank nail will have adequate holding power if it penetrates $\frac{3}{4}$ in. (19 mm) into the wood. Corrosion-resistant nails are needed to avoid iron stains caused by extractives in the wood and corrosion by acid rain, salt air, etc. Certain

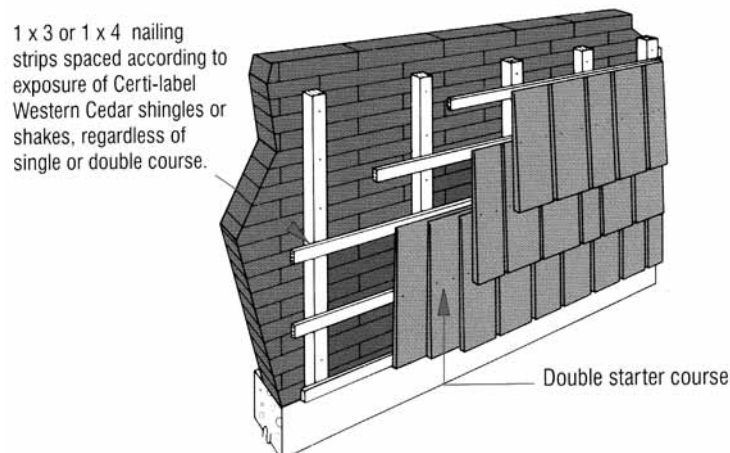


Figure 12. Rain screen technique over brick. Used with permission from Cedar Shake and Shingle Bureau Exterior and Interior Wall Manual.



Figure 13. Shingles treated with tinted water-repellent preservative.

preservative- and fire-retardant treatments also may be corrosive. Check with the product supplier for recommendations on proper fasteners for their products. Non-corrosive siding-nails are available in hot-dipped galvanized (as per ASTM A 153/D) and type 304 or 316 stainless steel. Additional information may be available from supplier websites, and some suppliers may have additional requirements.

Finishes

Finish Selection

Wide selections of oil- and latex-based finishes are available for shakes and shingles. Oil-based finishes are solvent-borne, and latex-based are water-borne; however, in recent years the solvent-borne finishes often have co-solvents in them to make them water soluble. As with any other wood product, shakes and shingles can be finished with water-repellent preservatives (clear and lightly pigmented), semitransparent stains, solid-color stains, or paints.

Water-Repellent Preservatives

Water-repellant preservative (WRP) is a generic term that describes a clear penetrating finish that traditionally was formulated with about 10% to 20% oil or alkyd binder, 1% to 3% wax or similar water repellent, a preservative, and an organic solvent such as mineral spirits or turpentine. The finish does not contain a pigment and gives a natural wood appearance (Fig. 5). The low wax content in some of the traditional WRP formulations made it possible to use them for pretreatment of wood prior to painting. They were also an excellent pretreatment for shakes and shingles prior to installation. Bundles of shingles could be dipped. Most of the finish was absorbed into the end grain at the butt end of the shake or shingle and gave years of protection by minimizing end-grain water penetration.

To meet stringent air quality requirements, these solvent-borne types of WRPs are no longer available. They have been largely replaced by waterborne formulations and formulations having low organic solvents content. Many of these formulations are intended for use on wood decks, but they can also be used on siding. These finishes often are tinted with a small amount of pigments, UV stabilizers, and other additives to improve their service life (Fig. 13). They give some water repellency and inhibit mold and algae growth on the lateral surface. If used on single-story structures having wide roof overhang, they give about 2 to 3 years of service, depending on exposure.

Semitransparent Stains

Semitransparent penetrating oil-based stains are similar to WRPs, but have considerably more pigments than WRPs (Fig. 14). As with WRPs, new semitransparent finishes are low in organic solvents and may not penetrate wood as well as traditional semitransparent stains. Semitransparent stain provides a color without entirely concealing the color, grain, and texture of the wood. Stains with the highest



Figure 14. Semitransparent stain application to shingles that were let weather for about two years. NOTE: The stain application was not done correctly. The painter allowed stain to partially coat the bottom of the course of shingles directly above the stained portion. When the shingles above are stained, there will be a lap mark.

pigment concentration will provide the longest service life and provide the most protection from weathering. Some companies formulate stains especially for use on wood shakes and shingles. (Check the internet for “wood shingles and paint” to find leads on paint manufacturers having products for wood shakes and shingles.) Stains that contain a water repellent and wood preservative will provide additional protection and further extend the service life of your siding. Oil-based stains penetrate the wood and generally give longer service life than latex semitransparent stains do. Oil-based formulations degrade by slow erosion of the pigment from the surface and it is seldom necessary to do extensive surface preparation prior to refinishing. Latex semitransparent stains do not penetrate the wood but form a thin film on the surface. They tend to fail by flaking and may require extensive surface preparation prior to refinishing. Paint manufacturers and resin suppliers are making progress to overcome these limitations.

Solid-Color Stains

Solid-color stains (also called solid-body stains or opaque stains) are available in oil- and latex-based formulations. They give more protection against UV radiation than semitransparent stains. However, solid-color stains do not penetrate wood; they form a film just as paints do. To get good service life, they need to have sufficient film thickness to avoid failing by flaking and peeling. Prior to application, it is best to prime shakes or shingles with a stain-blocking primer prior to applying a solid-color stain to avoid extractives bleed (Fig. 15). These stains perform best on textured or rough surfaces, but should not be used on a weathered surface (see Refinishing section).

Paint

Paint is a film-forming opaque finish and provides the best surface protection against water and weathering. Good

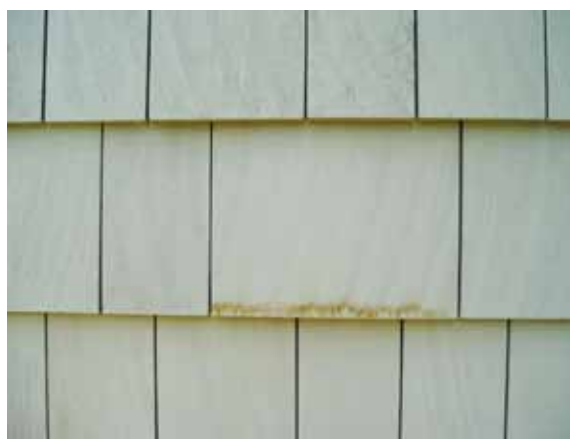


Figure 15. Single coat of solid-color stain. Note the extractives bleed.

quality stain-blocking primers applied to all surfaces prior to installation offer the best protection against discoloration by water-soluble extractives. (See discussion of back priming in Factory Finishing section.) Top coat with good quality acrylic latex-based paint. As with solid-color stains, paints will not adhere to weathered surfaces.

Caution: The use of transparent film-forming finishes such as urethane varnish, lacquer, conventional varnish, and shellac are not recommended for exterior use. Ultraviolet (UV) radiation can penetrate these types of finishes and degrade the wood. The finish will become brittle, then develop cracks and peel from the surface. Paint manufacturers continue to improve the UV radiation resistance of these products. It may be possible to get 2 to 3 years of good performance with finishes formulated with some of these new products, particularly on structures having moderate protection from sunlight (single-story structures having wide roof overhangs and/or shaded by trees).

Finish Application

Factory Finishing

Factory-finished shakes and shingles are available and in recent years have become the preferred product in many areas of the country. Factory finishing offers several advantages over on-site finishing. Factory finishing eliminates weather limitations and avoids damage by UV radiation to the unpainted wood. Back priming (the application of finish to the back side of the shake) of shakes and shingles is easily done during factory application. Back priming decreases water absorption and extractives bleed. The primer should extend about half to two thirds up the back side of the shingle. If pre-finished shakes or shingles need to be trimmed during application, the cut surfaces should be touched up with finish.

Onsite Finishing

It is possible to finish shakes and shingles prior to installation. It is a rather labor-intensive process, but will improve

the performance of finishes on shake and shingle siding, particularly on structures having minimal roof overhang and on the sides of structures exposed to strong wind-blown rain. Finishing shakes or shingles prior to installation makes it possible to back-prime with a stain-blocking primer or penetrating stain.

As mentioned above, traditional WRPs could be dip-applied to shakes and shingles prior to application. Modern tinted WRPs and semitransparent stains contain pigments and should not be used to dip-treat shakes and shingles in bundles. The finish may not flow among the shakes or shingles, thus giving a blotchy appearance. If they are dipped, it should be done piece-by-piece, followed by brushing to work the finish into the wood. If shakes and shingles are unseasoned (green), WRPs and stains will not penetrate very well.

Whether applying the finish prior to or following installation, select a top-quality finish recommended for use on cedar or redwood and follow the manufacturer's recommendations for application (recommendations for proper wood moisture content and ambient temperature at the time of application). In general, finishes should not be applied to wood having a moisture content above 20%. The temperature during application and for 24 h following application should be above 40° to 50°F (depending on the manufacturer). Application instructions are usually stated on the label and additional information is available from the company help desk. The telephone number is usually listed on the label.

Note: For all types of finish, always follow the coating manufacturer's application recommendations for their particular product.

The most effective means for applying finishes to wood is by brush. Brushes are an investment and it is wise to purchase top quality brushes, as they will last for a long time if properly cared for. For latex-based finish, use a synthetic bristle brush; for oil-based finishes, use a natural-bristle brush. For best results, purchase long-bristle brushes. If you choose to apply the finish by spraying or with a roller, brush the surface (back brush) immediately after application. Back brushing is essential to ensure that the finish is spread evenly and worked into the wood surface. Ensure that the butt-end gets a liberal application of finish; this is the most important surface. This is especially important for semitransparent stains and tinted WRPs. If using a roller, use natural roller covers for oil-based finishes and synthetic rollers for latex-based finishes.

For tinted WRPs and semitransparent stain application to installed shakes and shingles, it is necessary to take care to prevent lap marks (an area with two coats rather than one). Apply the finish in a single direction, usually across the structure, from a corner to a door, window, or other corner, keeping a wet edge throughout the application of this



Figure 16. An example of a lap mark from improper application of a semitransparent stain.

section. The lateral edges of the advancing strip of finish must coincide with the top and bottom edge of the course (s) of shake or shingle. When applying finish adjacent to the course that is already finished (the next strip), take care not to apply additional finish to the area that is already finished, as this causes a lap mark. For penetrating finishes such as WRPs, semitransparent stains, and to some extent solid-color stains, lap marks give an unsightly blotchy appearance (Fig. 16). The stain application shown in Figure 14 was not done correctly. The painter allowed the stain to partially coat the bottom of the course of shingles directly above the stained portion, creating a lap mark.

Maintenance

Removal of Algae, Mold, and Iron Stains

Wood Surfaces

As wood ages, mildew (mold) and algae begin to grow on the surface. This is a normal process and these organisms do not degrade the wood; they cannot break down the structural components of wood. Although they can metabolize extractives in wood, they primarily feed off airborne contaminants. Because they do not attack the wood, removing them is a cosmetic issue: ignoring them will not damage the wood. Algae and molds can be cleaned quite easily and effectively with bleaching agents such as sodium

hypochlorite (liquid household bleach) or sodium percarbonate (the active ingredient in some commercial cleaners). Bleaching agents quickly kill mold and algae, but they also can degrade wood. Therefore, dilute cleaners as much as possible. The object is to remove the fungi without excessive wood damage.

We recommend using commercial cleaners containing sodium percarbonate or other oxygen bleaches because they are more gentle oxidizers than chlorine-containing bleaches such as household bleach. Chlorine bleaches may cause excessive pulping of the wood to give a fuzzy surface. Some commercial cleaners contain strong alkali (sodium hydroxide or potassium hydroxide). These ingredients help to remove residual finishes on the wood surface, but can cause even more surface damage than chlorine bleach.

When using a cleaner, you might mix the solution weaker than the recommended strength and try it on a small area. If the weaker solution doesn't work, increase the concentration until you find a concentration that cleans the wood. A fuzzy surface appearance or excessive removal of surface fibers indicates that the solution concentration is too strong. Apply cleaning solutions with a garden-type sprayer, sponge mop, or soft bristle brush and keep the surface wet with the cleaning solution for 12 to 15 min. It is best to work on a cool, cloudy day or even during a gentle rain so the solution doesn't evaporate. Aggressive scrubbing shouldn't be necessary; let the cleaner do the work. Rinse with a garden hose keeping the water-stream pointed down to avoid forcing water behind the courses of shakes or singles. High pressure shouldn't be necessary. Allow the surface to dry for several days before refinishing.

We recommend using commercial cleaners, but if you prefer to use liquid household bleach, start with a cleaning solution having about five parts warm water, one part bleach, and a small amount of powdered detergent. **Do not use detergent that contains ammonia.** Ammonia reacts with bleach to form toxic fumes. If the surface mildew is difficult to remove, try using a stronger solution of three or four parts water added to one part bleach and detergent. It should not be necessary to use a concentration stronger than three to one.

If the dilute cleaning solutions described above are not effective, it is probably because the mildew has inter-grown with residual finish on the surface. The residual finish is keeping the cleaning solution away from the mildew. In this situation, it may be necessary to use aggressive cleaning methods, such as the cleaners containing strong alkali. In extreme cases, it may be necessary to use a paint stripper to remove the residual finish prior to cleaning.

As with unfinished wood, wood finished with WRPs and semitransparent stains degrades as these finishes degrade. Ultraviolet radiation in sunlight degrades lignin at the surface. Lignin is the natural glue in wood that holds the

cellulose fibers in place. Degradation of lignin weakens the surface fibers, and strong cleaning solutions and aggressive methods will remove excessive amounts of fiber from the surface. Removing these fibers is detrimental to the performance of subsequent application of WRPs or semitransparent stains. These finishes perform best by penetrating the wood surface; as a wood surface degrades, it becomes more porous. If excessive amounts of fiber are removed during cleaning, the surface will not accept these finishes as well as the porous weathered surface. Again, when cleaning wood, the gentler the better.

Iron reacts with some of the extractives in cedar and redwood to give a dark blue-black stain. This often occurs when the zinc on galvanized fasteners weathers away. Use only hot-dipped galvanized fasteners that meet ASTM A153/D or type 304 or 316 stainless steel that meet ASTM A276. Shakes and shingles can also be contaminated with rust washed from other sources such as window screens, failed flashing, or metal ornaments. A 5% solution of oxalic acid (usually available at drugstores) neutralizes this blue-black stain.

Note: Oxalic acid is toxic. Many commercial wood cleaners contain oxalic acid, which neutralizes iron stains and removes extractive stains. Oxalic acid generally brightens wood surfaces, but is not very effective for removing algae or mold, nor will it keep iron stain from reoccurring if the source of the iron is not removed.

Finished Surfaces

Finished surfaces (paints, semitransparent stains, and solid-color stains) often develop mold and algae. As with wood surfaces, these microorganisms feed off airborne contaminants, but can also metabolize oils in some finishes. Surfaces of paint and solid-color stain can easily be cleaned with commercial cleaners or a dilute solution of household bleach and as with wood, the gentler the better. Abrasive methods will damage the finish surface. It is more difficult to remove these microorganisms from saw-textured wood; the microorganisms may be inter-grown through and under the finish.

Refinishing

WRPs and Semitransparent Stains

Other than mold removal and gentle washing, WRP and semitransparent stains should not require additional surface preparation. They can be reapplied as soon as shakes or shingles are dry following cleaning. The reapplication of semitransparent stains and tinted WRPs requires special care. Usually residual finish is left in some areas, whereas the finish may be completely weathered away in other areas. The weathered and unweathered surfaces accept penetrating stains differently; the weathered areas absorb stain easily, whereas stain forms a second coat on areas having residual stain. During application, feather the stain into areas having old finish to avoid forming this second coat. If a second coat



Figure 17. Severely weathered wood surface.

is formed, it will give a shiny appearance and will fail by flaking. When refinishing a structure, it is often necessary to have the north, east, west, and south sides on different cycles. Semitransparent stains usually last 4 to 5 years on the south side and more than 10 years on the north side. These estimates can vary considerably depending on the design of the structure, exposure conditions, and the quality of the shake or shingle. As with the application for new construction, take care to avoid lap marks. Changing colors or switching to a paint or solid-color stain is not an option with semitransparent stains unless the old finish and weathered surface is removed. The surface must be scuff-sanded, primed, and finished (at least two coats may be required to hide residual stain).

Solid-Color Stains

When reapplying solid-color stain, wash the surface to remove dirt and mold. If areas have peeled exposing the wood surface, the weathered surface must be removed prior to re-priming the peeled area (Fig. 17). Figure 17 shows an extreme case of surface degradation following the failure of the coating. Solid-color stains form films, and like all other film-forming finishes, do not bond properly to weathered wood. It has been well established through several studies that cedar exposed to sunlight for as little as 2 to 3 weeks will not hold film-forming finishes as well as an unweathered surface. It may be possible to remove the damaged wood from small areas by scuff sanding, but this is difficult with shakes and shingles because the surfaces are saw-textured or split. The sanded surface won't match the unsanded surface. If the previous finish contained lead, do not sand. (See section on lead paint.)

The situation shown in Figure 17 is an extremely difficult problem to reconcile. A penetrating finish, such as an oil-based semitransparent stain, cannot be used over the existing finish, and a film-forming finish will not adhere to the weathered surface. It is probably necessary to remove

all the finish and the weathered surface by power washing prior to application of the primer and solid-color stain. (See section on lead paint.) This may be one of the few instances where careful power washing by a skilled operator is necessary. As with using a garden hose to wash siding, keep the nozzle pointed down to avoid forcing water behind the siding.

Paints

Refinish in the same way as solid-color stains. Lap marks should not be a problem with paint systems.

Lead Paint—Prior to about 1985, many paints used on wood structures contained lead. **Do not sand these surfaces.** Dust containing lead can contaminate the interior of the structure causing severe health problems and can even be fatal. Dust from lead-containing paint is extremely toxic. All lead paint removed from a structure must be treated as hazardous waste and be disposed of in accordance with federal, state, and local regulations. Some areas may require a certified specialist to remove paint containing lead pigments.

Safety Precautions

It is best to apply cleaners on a cloudy day. This slows evaporation and allows the cleaner to work more effectively. Wear eye protection, rubber gloves, an apron, boots, and other protective gear when using and preparing cleaning solutions. Avoid getting cleaning solutions on yourself, other parts of the structure, and vegetation. If the cleaning solution comes in contact with you or these other areas, rinse promptly and thoroughly with water. Follow all additional instructions on labels and technical data sheets supplied by manufacturers of cleaning products and finishes.

In the rare case that pressure washing of shakes and shingles is necessary, it should be done only by contractors having experience cleaning cedar. In the wrong hands, high-pressure water can easily remove an excessive amount of wood fiber, which could drastically decrease the life expectancy of your shakes and shingles.

Other Sources of Information

Cedar Shake and Shingle Bureau
P.O. Box 1178
Sumas, WA 98295-1178
604-820-7700
www.cedarbureau.org

USDA Forest Service
Forest products Laboratory
One Gifford Pinchot Drive
Madison, WI 53726-2398
608-231-9200
www.fpl.fs.fed.us

Copper Development Association

P.O. Box 144

Pocopson, PA 19366-0144

800-232-3282

www.copper.org

American Society for Testing and Materials (ASTM)

100 Barr Harbor Drive

West Conshohocken, PA 19428-2959

610-832-9585

www.astm.org

Maze Nails

100 Church Street

Peru IL 61354

800-435-5949

www.mazenails.com

Swan Secure Products, Inc.

7525 Perryman Court

Baltimore, MD 21226

800-966-2801

www.swansecure.com