

Keeping the Rain Out

Figure 279—This drawing shows how to establish and use a right triangle to create vertical guidelines for placing metal roofing panels.

Lay each roofing panel so that it aligns with the perpendicular guidelines. Be sure that the overlapping lip of each panel sits properly in its receiving channel (figure 280). Attach the metal roofing to the sheathing using roofing screws that have a flexible rubber or synthetic gasket under the flange. Use the screw spacing recommended by the manufacturer or designed by the engineer. See the [Roofing Fasteners and Tools](#) section of this guide for information about using impact drivers and screw placement. Drive each screw tight to the roofing, but not so tight that the rubber washer deforms (see figure 259).

Finish the roofing using a ridge cap that is recommended by the roofing manufacturer and that matches the original or is an appropriate replacement (figure 281). Use precut closure strips that match the roofing corrugation or ribbing at the ridge and eaves to prevent insects and other pests from inhabiting the spaces under the roofing. Use butyl tape to seal side laps and end laps between panels.



Figure 280—For metal roofing, it is very important for the overlapping lip of each panel to sit properly in the receiving channel of the adjacent panel, as shown on this vertical joint.



Figure 281—The ridge cap is the final element that you install on a metal roof. In this photo, the roof is complete, but the preservation crew has not yet replaced the siding on the dormer.

### Reroofing With Asphalt Rolls

Rolled asphalt roofing (figure 282) is the easiest type of roofing to install. Rolls typically are 36 inches wide by 33 feet long and weigh about a hundred pounds. Constructing a leak-free roof isn't quite as simple as rolling it out and nailing it down, though. When you order the rolled roofing, get the manufacturer's installation guidelines and follow the directions. If no instructions are available, install the roofing as explained below.

Because asphalt roofing cracks easily in cold weather and is easily disfigured and scuffed in hot weather, install it only when the temperature is between 40 and 85 °F. Store your rolls in the shade if the temperature is more than 70 °F. Because rolled roofing isn't tough material, sweep the roof (or use a leaf blower) before beginning installation to remove debris from the sheathing so the roofing can lay absolutely flat. Stray nails, debris, or protruding splinters from the sheathing will result in holes and leaks.

Next, install underlayment as explained in the [Underlayment, Ice and Water Shield, Drip Edging, Rakers, and Cant Strips](#) section of this guide. Consider installing ice and water shield if the cabin has a history of ice damming or leak damage.

Some original asphalt rolled roofs had drip edging. Sometimes builders used T- or L-shaped drip edge, and sometimes they used drip edging with a C-shaped channel for the asphalt roofing to slip into. Using the C-shaped channel drip edge results in a more durable roof because it protects the edges of the asphalt roofing from fraying. If the cabin builders didn't originally install C-channel drip edge, adding it will change the cabin's appearance. A change of appearance may trigger a requirement for review or approval by the SHPO if a Federal or State government agency owns the cabin, or if Federal or State sources provided some or all of the funding for the cabin preservation work. Check with your heritage resource specialist or archaeologist for the requirements. If you use drip edging, install it as explained in the [Underlayment, Ice and Water Shield, Drip Edging, Rakers, and Cant Strips](#) section of this guide.

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Figure 282—These roofers are replacing the old asphalt rolled roofing at Hogback Cabin (Lolo National Forest, Northern Region). The roofing had deteriorated along the unusual vertical seams. Roofers usually lay asphalt rolled roofing with horizontal seams.

If the rolled roofing is the standard 36 inches wide, saw a roll or a partial roll in half to make 18-inch-wide starter strips on a cool morning or evening (under 60 °F). Even when it is cool, the asphalt will gum up the saw blade and the granules will dull it, so don't use your good circular saw blade for this work. If you can't saw a roll to make starter strips, cut them with a roofing knife. This will take a while, so plan accordingly. You'll need enough length to go completely around the perimeter of the roof, plus the full length of any valleys.

Apply a 2-inch-wide stripe of roofing cement along all edges of the roof and lay the starter strips on top of the cement. If the roof has no metal drip edge, apply the starter strips so that they overhang the sheathing by about ½ inch. Run a roller over the strips to ensure that there aren't any air bubbles under the strips and that the strips fully contact the roofing cement. Nail down the strips about 1 inch from both edges (1½ inches from edges that overhang the sheathing) using the fastener spacing recommended by the manufacturer. Use roofing nails specifically designed for use with asphalt roofing—the ones with broad heads, not the box nails used on wood shingle roofs. Overlap any vertical joints by 6 inches and use roofing cement between the layers. At the corners, fully lap the gable end starter strips over the eave starter strips and use roofing cement to adhere the layers.

Next, apply 17- to 18-inch-wide rolled roofing strips bedded in roofing cement for the full length of any valleys on the roof. Roll the valley strips to remove any air bubbles and nail them down with roofing nails using the same procedure you used for the starter strips.

Where a vent protrudes through the roof, cut a hole for the vent in the middle of a 24-inch-square roll of asphalt roofing. Apply roofing cement to a 24-inch-square area around the vent. Slip the roofing over the vent, roll it to remove bubbles, and nail it in place. Space the roofing nails about 3 inches apart around the edges. Follow the normal flashing procedures explained in the [Flashing](#) section of this guide as you lay the main field of the roofing.

Duplicate the pattern of the original roofing for the main field of the roofing, unless it is obviously deficient. Because the original builders laid most rolls horizontally, that process is explained here. Some builders originally laid asphalt rolled roofing vertically. Modify the process if your cabin has vertical roofing strips.

Starting at the eave, snap a chalkline the width of the roll above the eave, minus the overhang width. This line serves as a reference for aligning the top edge of the first course of rolled roofing. Apply a 2-inch-wide strip of roofing cement to the eave edge of the starter strip and then roll the first row of roofing out over the entire width of the roof. Allow the ends to hang over the gable end about 1 inch, unless you are using "C" channel.

If you are using "C" channel, tuck the gable end edges into the "C" slot. Make sure that the entire length of the roll lays flat on the roof and then nail it in place, spacing the roofing nails about 4 inches apart and about 1 inch in from both the top and bottom edges. If the roll isn't long enough to extend the full width of the roof, apply roofing cement in a 2-inch strip over the short end. Overlap the next roll 6 inches and nail it in place as you would the edges of each roll. Seal these vertical overlap seams with roofing cement.

On each gable end, measure up from the top edge of the first roll of roofing the width of the roofing roll minus 6 inches. Snap a chalkline between the two points. Apply roofing cement to the top 6 inches of the first row of roofing. Using the new chalkline as a guide, roll the second row of roofing out over the entire width of the roof, overlapping the first row 6 inches (the width of the roofing cement). Make sure that the entire length of the roll lays flat. Nail it in place, as you did with the first row. Continue this process all the way to the peak of the roof, then use the same process on the other side of the roof.

If you use a premanufactured ridge cap, install it according to the manufacturer's instructions. If not, make a double overlap

ridge cap by lapping the final row of asphalt roofing at least 6 inches over the peak of the roof and down the opposite side. Apply a 2-inch-wide layer of cement under the far edge before securing the material in place. Repeat the same process on the other side of the roof (figure 283).

To finish the gable end edges of roofs without "C" channel edging, measure  $\frac{1}{2}$  inch beyond the gable end edges of the sheathing at the eave and ridge on both sides of the roof, then snap a chalkline. Use a sharp knife to trim the edges of the roofing along the chalkline.



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Figure 283—The ridge cap for the asphalt rolled roofing at Hogback Cabin consists of two 12-inch-long overlaps at the peak of the roof. Matching the original pattern, the preservation crew overlapped each roofing roll from the back of the cabin 12 inches past the ridge onto the front roof. They then overlapped each roll from the front of the cabin 12 inches past the ridge and secured it on top of the roofing on the back of the cabin.

### Reroofing Using Asphalt Shingles

Installing asphalt shingles on the simple gable roof of a one-story cabin is pretty straightforward. It can be pleasant work if the weather is mild, but problematic when the weather is either too hot or too cold. As with asphalt rolled roofing, asphalt shingles crack easily in cold weather. The seal tab adhesive (tack strips) won't adhere properly in cold weather. Asphalt shingles are easily disfigured and scuffed in hot weather. Despite the plastic separation strips, the seal tabs tend to bind together in the bundles if the weather is excessively hot, making it hard to separate the shingles.

Although organic base asphalt shingles are a little more flexible than fiberglass base asphalt shingles, install either type only when the temperature is between 40 and 85 °F. Install asphalt shingles early enough in the season to expose them to several days of hot weather before winter sets in so the self-sealing adhesive spots will adhere properly before the first winter storm hits.

As with asphalt rolled roofing, sweep the roof (or use a leaf blower) to remove debris before you install the shingles. Visually check for and remove protruding splinters or nails that could poke holes in the roofing and cause the roof to leak.

Standard asphalt shingles seldom include detailed manufacturer's installation instructions because these shingles are so common. Manufacturers usually do include installation instructions for specialty asphalt shingles, such as interlocking shingles. Installing specialty shingles is a little tricky, but proper installation is essential for the roof to perform satisfactorily. If you have manufacturer's installation instructions, follow them. If not, use the following installation procedure.

Install asphalt shingles starting at the eaves and work up to the ridge in horizontal rows, as with all shingles. Install the shingles by starting either at the middle or on one gable end of the roof.

After you install the underlayment and drip edge (if any), lay a starter course across the eave edge of one side of the roof.

Use precut starter shingles or cut the tabs off regular shingles to create your own starter shingles. Be sure to orient the starter shingles so that the adhesive spots face up along the eave edge (figure 284). Do not flip full-size shingles and nail them down as a starter course; the adhesive spots won't be in the correct position to secure the first full course of shingles against windy conditions. Because of wind patterns around a building, the first course of shingles is the most susceptible to wind lift and ripping if you don't secure the shingles properly.

When you use standard 12-inch-wide shingles, your starter course shingles will be 7 inches wide and 36 inches long after you cut off the tabs. Mark a spot 6½ inches up from the eave on each gable end of the roof and snap a chalkline across the roof between these two points. This line marks the top edge of the starter course.

Next, if you're shingling from the middle, mark the exact middle of the roof with a vertical chalkline that extends from the eave to the ridge. Center the first starter shingle on the chalkline. Lay the rest of the starter shingles in a line that extends in both directions to each gable end and cut off the end shingles so that they extend ½ inch beyond the gable ends.

If you are shingling from the gable end, begin with a 6-inch-long piece cut from a starter shingle and lay it so that the edge extends ½ inch beyond the gable end of the roof. Lay full-length starter shingles in a line down the length of the eave, cutting off the edge of the last starter shingle so that it extends ½ inch beyond the gable end.

Align the top of each starter shingle with the horizontal chalkline so that the bottom of each shingle extends about ½ inch beyond the eave edge. Attach each full-length starter course shingle with four roofing nails in a line directly above the adhesive spots.

Install the first full row of shingles over the starter course. Assuming that your shingles are the standard 12 inches wide, mark a spot on each gable end of the roof that is 11½ inches from the eave edge and snap a horizontal chalkline between



Figure 284—As shown in the lower right of this photo, roofers created an asphalt shingle starter course for the roof of this historic log cabin by cutting the tabs off regular shingles. Note the position of the adhesive spots near the eave edge of the shingles. The original builders constructed the log part of the cabin, known as “the Homestead,” in the early 1800s on what is now the Bradford District (Allegheny National Forest, Eastern Region). The owner added frame wings in the early 1900s.

the points. Use the chalkline to position the top of each shingle. This will assure that the bottom edge of the starter course and first full row of shingles are aligned.

If you are shingling from the middle, lay one full shingle on either side of the vertical chalkline so that the joint between them aligns with the vertical chalkline. Lay the rest of the row in both directions to the gable ends.

If you start at a gable end, start with a full shingle and lay the row straight across to the other gable end.

Attach each shingle with four roofing nails. If your shingles have three tabs, place a nail about  $\frac{1}{2}$  inch beyond the top of each shingle slot, including each end slot. Drive the nails above the end slots about  $\frac{1}{2}$  to 1 inch from the edge of the shingle. If the shingles aren't slotted, drive the nails about 6 inches above the bottom of the shingles if they have the standard 5-inch exposure.

Whether the shingles are tabbed or not, ensure that the row of nails is directly below the sealer spots. Do not nail even with

or above the sealer spots or you will deprive the underlying layer of shingles of its second row of fasteners and reduce the intended fastening strength of the roof by one-half. Drive the nails flush, but do not dent the shingle. Improperly set nails will cause premature roof failure when the shingles tear around the nails or crack above them.

If you last installed asphalt shingles a number of years ago, you may be surprised to notice that the plastic separator strips stick to the underside (rather than the top) of each shingle as you remove the shingles from the bundle. You don't need to remove separator strips that stick to the undersides of the shingles. If the separator strips stick to the adhesive spots on the tops of the shingles, remove the strips before you place the next course of shingles over the spots or the shingles won't adhere properly.

If the roof is extremely steep, more than  $1\frac{1}{2}$  times as much rise as run to the roof slope (18/12), the adhesive spots may not set up properly. On these very steep roofs, apply additional adhesive by hand under each corner of each tab overlap.

Next, if the shingles have a standard 5-inch exposure, mark both gable ends at 5-inch intervals all the way to the ridge, starting from the top of the first row of shingles. Snap chalklines between the marks. Use the chalklines to position the top of each row of shingles. If the roof isn't square, slightly adjust the measurement on one side of the roof for several courses until the measurements are even. Do not adjust more than ½ inch on any course, or it will be visible from the ground.

You can finish the shingling after you mark the rows. Use the same process used on the first row, but offset the shingles in each row 6 inches horizontally from the layer below so that the slots don't line up and expose the nails of the row below. If you are shingling from the center of the roof, simply move the edge of the middle shingle 6 inches to the left on each succeeding row. If you are starting from the gable end, cut 6 inches off the gable end of the first shingle on the second row, 12 inches off the first shingle on the third row, and 18 inches off the first shingle of the fourth row. If you cut each shingle carefully, you can use the 12 inches cut off the first shingle for the third row to start the fifth row and the 6 inches you cut off the first shingle for the second row to start the sixth row.

You can either complete each full course of shingles before installing the next course, or you can install the shingles in a stair step pattern (figure 285). Start at a gable end to install shingles in a stair step pattern. Lay the end shingles (trimmed to length) of the first six rows. Next, lay a full-size shingle in each of the first six rows, starting at the bottom, and add a full-size shingle to start the seventh row. Lay the next full-size shingle in each of the seven rows, starting at the bottom, and begin the eighth row by adding a shingle with 6 inches cut off the gable end. Work up and diagonally until you cover the roof from eave to peak.

Extend the top row of shingles a couple of inches above the peak of the roof. Do not add another row if the shingles will extend more than 5 inches above the peak. Fold the extra shingle length over the ridge and nail it down using four roofing nails per shingle. This provides extra protection against leaks at the roof ridge. Then, repeat the process on the other side of the roof.

Do not install shingles in vertical rows, sometimes referred to as vertical racking. If you install shingles in vertical rows, it will be nearly impossible to nail under the edges without



Figure 285—When the roofers replaced the roof on this 1936 residence, they applied asphalt shingles in a stair step pattern. Roofing nails are visible near the right edge of each tier of shingles. The building, located just north of Lincoln City, OR, is part of the Pacific Northwest Research Station's Cascade Head Experimental Forest.

damaging the shingles. You are almost certain to damage the shingles as you bend back alternating course edges to install adjacent shingles. Vertical racking leads to premature roof failure. It also often produces unattractive vertical stripes on the roof because of variations in color between shingle bundles.

After shingling both sides of the roof, install the ridge shingles. Do not use the premanufactured ridge vents that people commonly use on modern asphalt shingle roofs. Ridge vents have been around since about 1980; they aren't appropriate for cabins built before that time. Builders who constructed cabins between about 1930 and 1970 and used asphalt shingles on the roof nearly always vented the attic through the gable ends. Maintain this venting method. If the attic shows signs of moisture or condensation problems, consider using larger gable vents that appear similar to the existing gable vents.

Follow the manufacturer's directions if you use precut ridge shingles. To make your own ridge shingles, cut regular three-tab roofing shingles apart at each slot to make three 12-inch-wide ridge shingles from each roofing shingle. Taper the sides of the top half of each shingle slightly to produce a neat profile and to keep the lap portion of each shingle hidden from view on the finished ridge cap.

You may install ridge caps from both gable ends toward the center, or orient them all in the same direction with the overlap facing away from the prevailing winter wind (if any). Install the ridge cap shingles by bending them into place over the ridge and fastening them with one roofing nail on each side of the ridge. Use slightly longer nails on the ridge shingles to penetrate the extra shingle layers and the sheathing. Install ridge shingles with the same exposure as regular shingles and nail them directly below the adhesive spots, exactly as you would with regular shingles. Cover the exposed nails in the last ridge shingle with roofing cement to prevent leaks.

Install hip ridge shingles using the same method as the main ridge shingles, but install them before you install the main ridge shingles. The main ridge shingles must cover the top of the hip. Slit the final hip shingle at the top where it meets the ridge, fold it over the ridge in both directions, and nail it in place using one nail on each folded piece in addition to the nails below the adhesive spots. You may need to trim the top hip shingle so that the main ridge shingle installed over it hides the folded-over ears (figure 286).

Application procedures for asphalt shingles are critical. It is true that nearly everyone who has worked in residential construction is familiar with asphalt shingle roofing procedures. It also is true that nearly anyone can successfully apply an asphalt shingle roof. However, the roof's performance will be disappointing if you don't carefully install it, so don't get sloppy or cut corners.

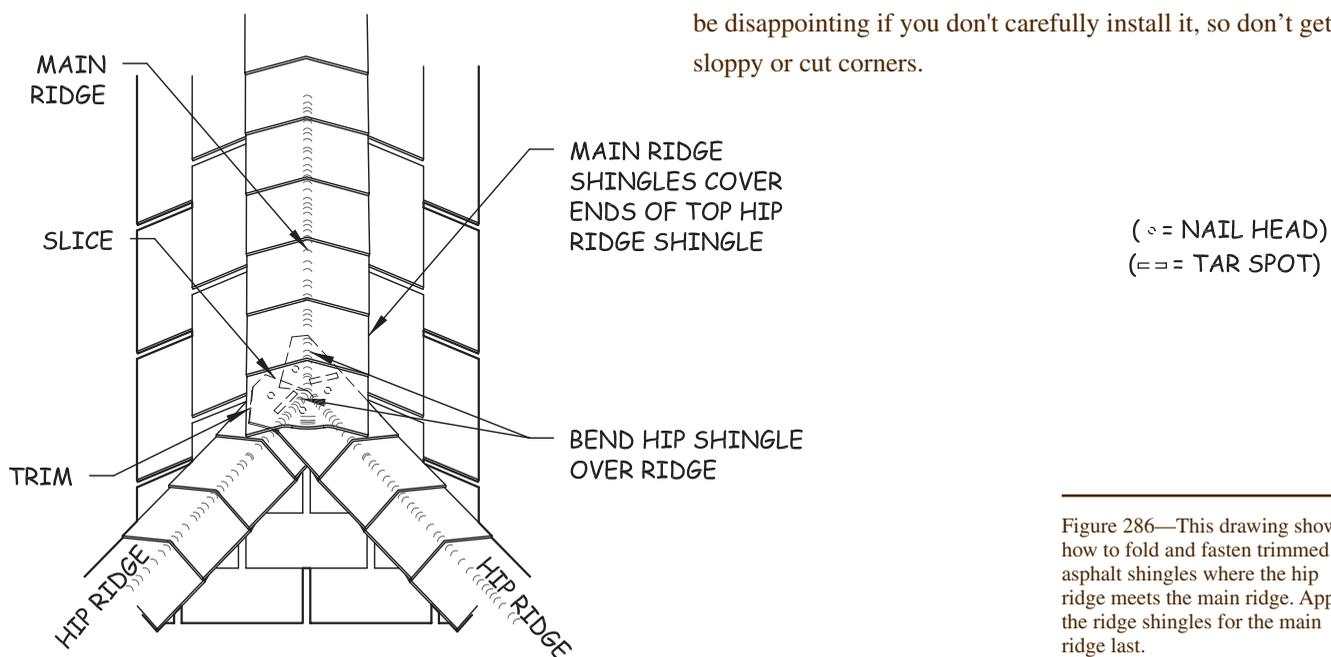


Figure 286—This drawing shows how to fold and fasten trimmed asphalt shingles where the hip ridge meets the main ridge. Apply the ridge shingles for the main ridge last.

### Reroofing Using Sod

Sod roofs are surprisingly durable. The sod and drainage layers of historic sod roofs (figure 287) required replacement every few years, but engineered vegetated roofs can last for 20 years or more before requiring significant repair. Unless you have the resources to continually replace the sod and drainage layers, you probably want to replace your historic sod roof with an engineered vegetated roof, or at least use modern waterproof and drainage layers. Use vegetation similar to or the same as that on the historic roof, if possible.

An engineered vegetated roof consists, from the bottom to the top, of:

1. **Roof structure**—Ensure that the historic roof structure is sturdy enough to hold the sod, which can weigh from 15 to 50 pounds per square foot when fully saturated, depending on soil depth and absorbency.
2. **Waterproof layer**—Prevents water from leaking through the roof and prevents root penetration into the roof structure. Products available range from heavy duty single-ply sheet roofing to roll- or spray-on waterproofing.
3. **Drainage layer**—Enables water not absorbed by the soil and plant roots to drain from under the soil and be channelled away from the roof. Products range from open-graded gravel or lightweight aggregates, to geotextiles, to drainage materials that are specially designed for vegetated roofs. These drainage materials allow the roof to store some water and drain the rest.
4. **Soil layer**—In contrast to the historic practice of cutting sod from the prairie and placing it on the roof, modern growth media is lightweight and designed to retain moisture, drain excess water, provide and absorb nutrients, and anchor plant roots. The media usually contains perlite, vermiculite, or light expanded clay granules, as well as native soil and organic additives.
5. **Vegetation**—Depending on the thickness of the soil layer and the local climate, plants that do well on green roofs include stone crop (*Sedum*), ice plant (*Delosperma*), hens and chicks (*Sempervivums*), pinks (*Dianthus*), thyme, alyssum, sedge, and native grasses and shallow-rooted forbs. Be sure to choose hardy, drought-resistant species acclimated to your area.



Figure 287—The large sod-roofed Cunningham cabin in Grand Teton National Park, constructed in 1888, is one of the earliest homesteads in Jackson Hole. The cabin is listed on the National Register of Historic Places and is maintained as part of a large homestead used to interpret the area history.

Constructing an engineered vegetated roof that will last a long time and won't leak isn't particularly difficult if you engage knowledgeable professionals to design it, but you must execute the details properly. Hire a structural engineer (if needed) and a green roofing expert, such as a landscape architect, to design the roof. You may need prior input to or approval of the design by the SHPO if a Federal or State government agency owns the cabin, or if Federal or State sources provide some or all of the funding for the cabin preservation work. Check with your heritage resource specialist or archaeologist for the requirements. In some cases, engineered soil layers may be acceptable. Historic considerations may necessitate using sod cut from adjacent soils in other instances.

Consider hiring an experienced contractor to install or help you if you are installing an engineered vegetated roof. Many modern systems have specialized installation requirements; you must complete the work exactly as detailed on the plans to avoid premature roof failure and leaks.

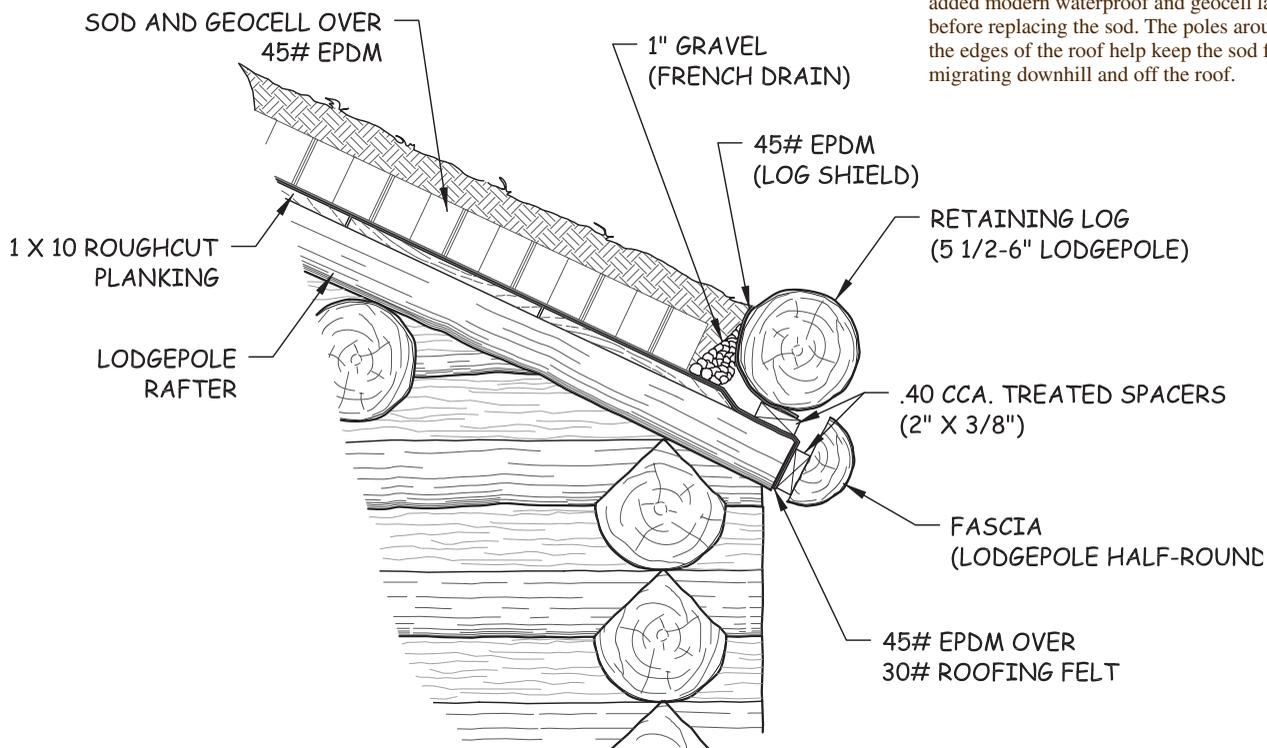
The process for installing a sod roof that includes modern waterproof and drainage layers but closely resembles a historic roof is fairly straightforward. Following the manufacturer's instructions and the engineer or landscape architect's design, lay ice and water shield and then geotextile drainage fabric over the sheathing. If you will use native sod, cut squares or strips of good, solid, healthy sod to roughly

the same thickness as the historic sod, but never less than 4 inches thick. Lay the sod on the roof, butting the individual pieces tightly together and using small scraps to fill any voids between pieces. Form and install a ridge cap of sod or boards to match the original. Replace any log or board borders around the roof (see figure 1). Next, water the sod sufficiently to thoroughly soak the soil. Unless precipitation provides plenty of moisture, water the sod regularly for the first year after installation to ensure its survival.

Of course, this guide provides only a general description of the process. Many variations are possible and may be reasonable, depending on the building and climate. For instance, when roofers replaced the sod roof on the Alta Ranger Station, they installed a layer of ethylene propylene diene monomer (EPDM) over the plank sheathing, then a layer of geocell fabric to hold the soil in place. EPDM is an inert synthetic rubber with excellent heat, ozone, and weather resistance. It commonly is used for many products, including sheet roofing and pond liner. The native soil the roofers cut from the prairie to use as sod was so porous that it didn't require a drainage layer, but the roofers installed a drain between the sod and the retaining log (figure 288). Unfortunately, 2 inches of soil over the geocell did not insulate it well enough. The geocell overheated, warped, and emerged from the soil (figure 289). Be sure that your vegetated roof design will function properly in your climate area.



Figure 288—This sketch shows the materials the roofers used to replace the sod roof on the Alta Ranger Station (Bitterroot National Forest, Northern Region), constructed in 1899. They added modern waterproof and geocell layers before replacing the sod. The poles around the edges of the roof help keep the sod from migrating downhill and off the roof.



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Figure 289—When preservation crewmembers replaced the sod roof of the Alta Ranger Station, they put down a layer of ethylene propylene diene terpolymer (EPDM) over the puncheon sheathing, then laid geocell to hold the soil in place. Unfortunately, the crew had to remove the geocell fabric after it warped and emerged from the soil.

### Preserving Logs

A log cabin is pretty durable (figure 290), especially if its logs are rot resistant. It takes a long time for a log cabin, even an abandoned one, to completely melt into the landscape. Unfortunately, though, once decay sets in, a cabin will be uninhabitable in just a few years unless someone replaces the decayed logs or halts the decay in the very early stages. Take steps to ensure that insects and fungi don't destroy the work you put so much effort into, especially in humid climates.

Treating logs with wood preservatives isn't an appropriate substitute for ensuring that the ground slopes away from your cabin for drainage and that the cabin foundation holds the logs above the ground. Restore the cabin properly and use preservatives only as supplemental protection.

The publication, “[Preservative-Treated Wood and Alternative Products in the Forest Service](http://www.fs.fed.us/t-d/php/library_card.php?p_num=0677_2809P)” <[http://www.fs.fed.us/t-d/php/library\\_card.php?p\\_num=0677\\_2809P](http://www.fs.fed.us/t-d/php/library_card.php?p_num=0677_2809P)> explains the types of commercially available preservatives and the conditions under which their use is effective. The publication, “[Guide for Use of Wood Preservatives in Historic Structures](#)”

<[http://www.fpl.fs.fed.us/documnts/fplgtr/fpl\\_gtr217.pdf](http://www.fpl.fs.fed.us/documnts/fplgtr/fpl_gtr217.pdf)> addresses concerns about the preservation requirements and physical properties of historic log cabins when using wood preservatives. Most wood preservatives are unsuitable for use on cabin logs because the preservatives are toxic and change the color of the wood. Toxicity is a problem because most cabin interiors have log surfaces. People touch the logs and breathe vapors given off by the preservatives.

Manufacturers recently developed less toxic preservatives. In particular, some preservationists favor the use of borate preservatives. Borate is a water-soluble preservative that penetrates wood through osmosis. This characteristic is valuable because borate migrates readily into areas where high moisture content can lead to decay and insect infestations. It provides relatively nontoxic protection against wood-destroying beetles, fungus, and termites (upwards of 20 to 50 years), and it helps increase the fire resistance of the wood. Borate protects logs near ground level from wood-destroying beetles, termites, and fungal decay related to high humidity conditions. Because borate is water soluble, its protection will be lost if water flushes it from the wood.



Figure 290—The Nothnagle Log House in Gibbstown, NJ, built around 1638, may be the oldest surviving log cabin in the United States. The original hewn-log cabin is 16 by 22 feet, with full dovetail notching, local clay daubing, and a brick fireplace in one corner. The owner constructed the two-story frame addition in the early 1700s. The building still serves as a home.

You can apply borate to the log surface, inject it, or insert dry borate rods into holes drilled into the wood. To use borate rods, drill holes into the logs inside the building using the borate rod manufacturer's recommended spacing. Borate swells when wet, so make the holes larger than the rods. After inserting the borate rod, fit a wood plug into the hole, plane the plug flush with the log, and finish the surface to match the rest of the log if necessary. Borate rods remain inert until they get wet, and then they disperse through the wood to protect it from fungus. Borate rods may not protect logs from insects in dry climates, because they may not become wet and disperse into the wood.

You can mix liquid borate preservative with some water-repellent concentrates. Check the manufacturer's information before mixing preservatives and water repellants. Forest Products Laboratory (FPL) research suggests that you should apply water repellent every 2 to 3 years to any wood protected by borate that is exposed to the weather. As with all preservatives, read and follow the manufacturer's application instructions and suggestions for personal protection.

## Using Paint, Stain, and Oil

Color is one of the strongest influences on people's perception and is an important part of log cabin preservation. Restoring the original color(s) can greatly enhance the historic character of the cabin, inside and out (figure 291).

Do not apply paint or clear coatings to surfaces that didn't originally have paint or coating. Paints and clear coatings cover and change the appearance of logs or roofing, damaging the historic integrity of the structure.

You may use FPL log oil to treat logs and wood roofing that didn't historically have treatment because color changes are temporary. As wood ages, it dries out, cracks, and becomes less water resistant and more susceptible to rot and damage. Treating the logs and wood roofing from time to time with FPL log oil extends the life of the wood and causes only a temporary change in color. See more detailed information about the FPL log oil formula later in this section.

Using Paint, Stain, and Oil



Figure 291—The Deadwood storage building (Boise National Forest, Intermountain Region) shows the original brown-stained logs, green-stained roof, and light brown-painted trim.

The Forest Service used standard paint colors at different times within most of its regions. Check your region's historical facilities files to see whether your region used standard colors at the time your cabin was built. If so, information in the files may help you to better match the original paint. If not, it probably used colors that could be described using the Federal color specifications in place at the time of construction. You can order Federal Standard 595C color fan decks and other [paint color matching products and specifications](#) from FedSpecs.com <<http://www.fed-std-595.com/>>.

Unfortunately, lead-based paint covers many historic surfaces. Lead-based paint may be the surface layer or may be buried under post-1978 paint that doesn't contain lead. Even if you remove the lead-based paint, some of the lead may have soaked into and remained in the wood. Fortunately, lead-based paint in good condition usually is not a hazard, and you can seal old lead-based paint or lead remaining in wood away from normal human contact by properly preparing the surface, then applying new primer and latex paint over it.

Exposure to lead results in human health problems. Don't treat maintenance work on lead-based paint surfaces casually. You must take special precautions any time you cut, sand, drill, strip, or do anything else to disturb lead-based paint or lead that has soaked into the wood. More information about determining the presence of lead-based paint, working with materials coated with lead-based paint, and properly disposing of lead-based paint debris, such as paint chips, dust, or sludge is available in the [lead-based paint](#) section of the Forest Service's Facilities Toolbox <<http://www.fs.fed.us/eng/toolbox/haz/haz03.htm>> and in the U.S. Environmental Protection Agency (EPA) web page "[Lead in Renovation, Repair, and Painting](#)" <<http://www2.epa.gov/lead/renovation-repair-and-painting-program>>.

Stricter rules apply when children regularly use buildings with lead-based paint. See the Forest Service Facilities Toolbox section on [required lead-based paint removal](#) <<http://www.fs.fed.us/eng/toolbox/haz/haz34.htm>> for guidance on when you should remove lead-based paint from buildings that may be occupied by children. You must use certified

renovation firms or renovators with accredited training who follow the work practice requirements found on the EPA web page "[Lead: Lead Renovation, Repair and Painting Program Rules](#)" <<http://www2.epa.gov/lead/lead-renovation-repair-and-painting-program-rules>> when you conduct renovations that disturb lead-based paint in these buildings.

Remove deteriorated paint, whether lead based or not, before you begin repairs or repaint. Before stripping any paint, take the time to determine the historic paint (figure 292), stain, or sealer color and type so that you know which finish to use. You may be able to find the original finish by gently and carefully sanding through the paint to expose all the layers down to the wood. Sand a shallow circle several inches in diameter. Sand progressively deeper toward the center to expose all the layers of paint in concentric circles. This process is explained on the "[Historic Media: Finding the Original Colors of My House](#)" web page <<http://www.oldhousecolors.com/2007/01/18/finding-the-original-colors-of-my-house/>>.

If sanding doesn't clearly reveal the original finish or you need a more precise determination, have a heritage consultant take samples and inspect them under a microscope. Remember that the old paint may contain lead; take proper precautions.

You can remove paint in a number of different ways. Mechanical methods include machines that have little blades or bits that spin to remove the paint (figures 293 and 294), sanders, and wheels or abrasive pads. Heat methods include heat guns and infrared units. Steam methods include portable garment steamers and steam ovens. You can find chemical strippers in a variety of strengths and formulas, and hand scrapers in many different sizes and shapes.

Each paint removal method has its pros and cons. Sanding, scraping, and mechanical strippers create dust. You can attach a vacuum to some machines and sanders to minimize the dust. Heat methods can char fragile wood. Steam creates no dust, but it is a slower method. Chemicals can be caustic—read and follow the label directions carefully.



Figure 292—Preservation crewmembers repainted the original seafoam green color on the fiberboard bathroom walls they repaired at the 1933 Adams Ranger’s House (Nez Perce National Forest, Northern Region).



Figure 293—A power paint stripper, such as this Metabo model, can really speed up the process of removing deteriorated paint.

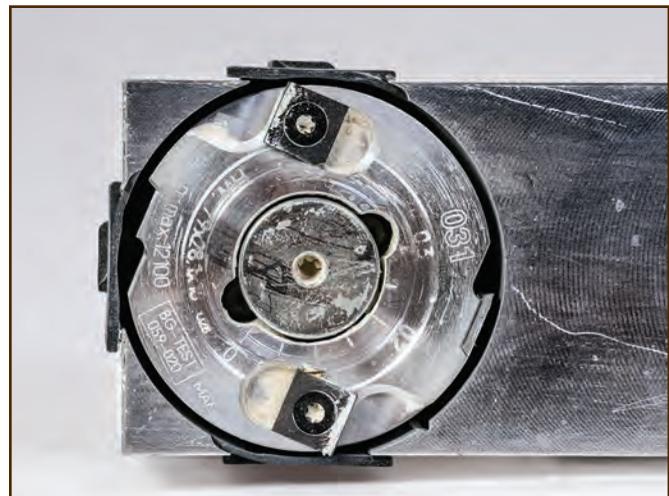


Figure 294—The rotating head of this Metabo paint stripper has tiny blades that peel very thin layers off the painted surface.

A combination of techniques, such as first using steam to remove most of the paint, then scraping and sanding to remove the rest, usually is the most effective. The most effective method depends on the type of paint, the condition of the paint, and the condition of the substrate. For example, the paint on the north side of a building may be difficult

to remove, but the paint on the south side may be easy to remove because of weathering. You may need to perform some experiments to find the most effective method for removing paint from your siding, window, door, etc. Information on the [steam removal process](http://www.historichomeworks.com/hhw/reports/reports.htm#steam) is available on the John Leeke’s Historic Homeworks website <<http://www.historichomeworks.com/hhw/reports/reports.htm#steam>> and

the Olde Window Restorers [Portable Steam Paint and Putty Stripper web page](http://www.oldwindowrestorer.com/steamstripper.html) <<http://www.oldwindowrestorer.com/steamstripper.html>>.

Even if the paint contains no lead, wear a mask while you're removing paint so that you don't get the dust or chemicals into your lungs. If the paint contains lead, you need to take more extensive precautions.

Forest Service direction prohibits Forest Service employees from purchasing or using oil-based paints for most purposes. The resins, solvents, pigments, and additives in the liquid paint or stain can be toxic when breathed or touched. The EPA requires that you dispose of any leftover paint as a hazardous material. More information about [using oil-based paint](http://www.fs.fed.us/eng/toolbox/haz/haz40.htm) for Forest Service buildings is available at <<http://www.fs.fed.us/eng/toolbox/haz/haz40.htm>>.

Newer oil-based formulas tend to be thicker and less durable than oil-based paints manufactured many years ago because the formulas have changed in response to regulations limiting the off-gassing of volatile organic compounds. You can still find high-solvent paint; it usually is labeled as "quick-dry enamel," "industrial maintenance coating," or "marine paint." These formulas are appropriate for some uses. In addition, you may need to use oil-based primer coats under some circumstances, such as when you repaint over old oil-based paint.

You can find high-quality latex paints that perform as well as or better than oil-based paints for most uses nearly everywhere. Keep in mind that the more expensive, all-acrylic latex generally performs better than less expensive latex with vinyl acrylics. The FPL recommends latex paint for nearly all applications except exterior use over some old oil-based paint. When you paint doors, windows, or cabinets, keep in mind that modern latex paint doesn't produce as hard a finish as older oil-based paint formulas. When you use latex paint on door, window, or cabinetry components, allow it to dry and cure thoroughly before reassembling items or closing doors or windows so that adjacent surfaces don't stick together.

Preparing surfaces properly and ensuring the compatibility between the paint primer and topcoats are both critical to a durable paint job. If a solvent in the topcoat is incompatible with the primer coat, the primer may dissolve or wrinkle or the two layers may fail to adhere to each other. If the primer and topcoat don't adhere well, the top layers will crack, peel, and fall off prematurely. For more information about properly preparing surfaces to receive paint, see the FPL publication "[Why House Paint Fails](http://www.fpl.fs.fed.us/products/publications/specific_pub.php?posting_id=1024&header_id=p)" <[http://www.fpl.fs.fed.us/products/publications/specific\\_pub.php?posting\\_id=1024&header\\_id=p](http://www.fpl.fs.fed.us/products/publications/specific_pub.php?posting_id=1024&header_id=p)>.

You can find stain with either an oil- or latex-base and in semitransparent and semisolid/opaque formulas. Semitransparent stains allow the wood grain to stand out while coloring and protecting the wood. Semisolid/opaque stains completely cover the wood grain. Both types of stain penetrate the wood better than paints do.

Opaque stain seldom is appropriate for historic cabins, because it wasn't available historically. If someone used stain on a historic cabin, the stain most likely was oil-based, semitransparent. If the stain on the surface is visible but faded, restain the surface using an oil-based semitransparent stain that matches the original as closely as possible. Latex stain won't penetrate properly if the old, oil-based stain remains on the logs. If the stain is deteriorated to the point that most of the wood is bare or if you strip the stain from the surface, use a latex semitransparent stain that closely matches the original color.

Some owners whitewashed their buildings (figure 295). To maintain the historic appearance, reapply whitewash to these buildings every few years. The Internet has a number of recipes for whitewash, but the Northern Region Historic Preservation Team prefers the recipe in the box on the next page. This recipe covers about 4,000 square feet with one coat.



Figure 295—Whitewash covers these log buildings at Bill Menor's ferry and homestead in Grand Teton National Park, as it has since the late 1800s. A replica ferry still operates, and the current owner outfitted the log buildings as a country store, similar to the store the original owner operated.

Using Paint, Stain, and Oil

### Northern Region Whitewash Recipe

After you develop your job hazard analysis, assemble your ingredients and personal protective equipment. Applying whitewash is messy, so wear disposable clothing, gloves, and safety glasses.

1. Mix 50 pounds of hydrated Type S lime with 6 gallons of water. Let the mix sit overnight.
2. Mix 5 pounds of calcium chloride (CaCl) with 5 gallons of water. CaCl is used to absorb oil spills from concrete floors and is available at automotive supply stores.
3. Mix the two solutions together.
4. Apply whitewash using brushes.

People sometimes used tung oil or linseed oil to produce a natural protective finish for historic interior woodwork. Tung oil and linseed oil penetrate into the wood and then harden. Many commercially available tung oil products aren't pure

tung oil, but contain resins and solvents in addition to the tung oil. Polymerized tung oil goes through a heating process; it is preferable for most uses because it dries faster. Linseed oil is available in raw and boiled types. Raw linseed oil takes many weeks to cure, so boiled or heat-treated linseed oil is a better choice for most uses.

People commonly used varnish or shellac as a transparent protective surface coating for historic interior woodwork. You still can find these products. Polyurethanes are the modern equivalent of varnishes and shellacs. You can purchase polyurethanes in water-based formulas, but they won't produce an identical appearance. Varnishes and shellacs yellow over time, while polyurethanes remain clear.

Modern wood preservatives and water-repellent coatings aren't appropriate for treating the wood in a historic log cabin. People sometimes treated the logs or wood roofing of historic cabins with a combination of paraffin wax, plant-based oil, and solvent to help protect the wood. The oil protects the wood and the paraffin wax repels water. The FPL developed an effective formula of this historic log treatment

during the 1970s that you may use to recoat cabin logs. Although this formula is the most effective treatment for logs that aren't painted or stained, it has a strong smell and is sticky and extremely flammable. Table 3 shows the formula for the FPL log oil.

Table 3—Formula for Making FPL Water-Repellent Log Oil Mix.

Ingredients	For 1 gallon	For 5 gallons
Boiled linseed oil	½ gallon	2½ gallons
Paraffin wax	1 ounce	4–5 ounces
Solvent (mineral spirits or turpentine)	Add to make 1 gallon	Add to make 5 gallons

To make the mix, start by grating the paraffin with a cheese grater. Ensure that the solvent is at room temperature. Slowly stir the grated paraffin into the solvent, mixing vigorously to dissolve the wax. Add the linseed oil, again stirring until the consistency is uniform. Then, add the solvent and stir to mix thoroughly. Some log buildings had a shiny, clear finish you can duplicate by using spar varnish instead of the solvent in the FPL log oil formula.

If possible, mix only as much FPL log oil as you can use in a day to avoid having to store this very flammable mixture. If you must store the FPL log oil at low or freezing temperatures, the ingredients may separate. You can reheat the formula to room temperature and stir it to a uniform mixture once again.

When you apply FPL log oil, wear appropriate PPE that prevents skin and eye contact; the solvents are toxic.

Start by applying a light coat of FPL log oil with a pump sprayer or brush. Apply the FPL log oil the full length of each log in a continuous application. If you stop in the middle of a log and come back later, you will create a visible line where the two applications meet, as occurs with most paints and stains. Unlike with paints and stains, the FPL log oil line fades as the log returns to its normal color. If the FPL log oil doesn't absorb evenly right away, use a brush to spread the coating evenly over the surface to prevent a splotchy appearance. Recoat until the log no longer absorbs the formula, but don't apply so much that oil icicles form on the undersides of the logs or eaves.

Avoid applying FPL log oil to daubing; it eventually will turn the daubing yellow. Don't panic if you accidentally get a little on the daubing, though; the daubing will absorb a single light coat or overspray of the formula, and the formula usually won't change the daubing's appearance. Also, avoid applying the formula to metal objects, such as vehicles, or glass, especially windows and windshields. Removing FPL log oil from those surfaces is difficult. Use sprayers only on a calm day, because any breeze will transport the formula to unintended surfaces.

If you use a pump sprayer to apply FPL log oil, use a disposable one; the sprayer will gum up within a day and you will have to discard it. If you use brushes to apply FPL log oil, use inexpensive ones and discard them whenever they get too sticky.

Properly discard all brushes, containers, pumps, and rags that you use to apply or clean up FPL log oil mix. Rags soaked with FPL log oil mix can spontaneously combust because the oil releases heat as it oxidizes. Either lay the rags flat in a single layer until they cure (become dry and hard) and then throw them in the trash, or store them in an airtight metal container until you can remove them from the site and dispose of them or have them commercially cleaned.

Do not apply paint or other commercially available decorative or protective coatings to roof materials that historically were unpainted and uncoated. Untreated wood shakes or shingles age to a silver-grey or soft brown, depending on the wood species.

Aside from damaging the historic integrity of the cabin, top-coatings on wood shingles or shakes may also lead to shortened roofing life. This occurs because the uncoated underside of the shake or shingle expands when wet and contracts when it dries, while the coated side of the shake or shingle doesn't. This differential movement eventually warps the shake or shingle, preventing it from lying flat and allowing water to leak through the roof.

You can apply FPL log oil to wood shingles and shakes on historic cabins. The FPL log oil darkens the wood for a while, but it eventually fades back to the original color. You also can apply protective coatings to wood shingles or shakes when building codes require fire-resistive treatments.

On the other hand, if someone treated, coated, or colored the original materials, make sure to treat, coat, or color the replacement roofing to visually match. Commonly used paint and stain colors changed over time because popular tastes changed and because the available pigments, carriers, binders, fillers, and additives also changed over time. Common 18th-century coatings for wood shingles or shakes included a pine pitch coating similar to turpentine and a colored, boiled linseed oil or fish oil mixture. Coloring agents for the oil mixture included oxides, red lead, brick dust, and other minerals. The coloring agents produced tints such as yellow, red, brown, and grey. In the 19th century, people applied red, chocolate brown, or brown-green stains or paints to some roofs to complement the building colors. The Forest Service stained the roofs on many compounds green during the 20th century. See [Appendix F—Acquiring Tools and Materials](#), for a source of “Forest Service green” shingle stain.

If someone originally stained (figure 296) or coated a cabin roof, you can produce a similar look on the new shingles using semitransparent latex stain in a matching color. For best results, stain all four surfaces of well-cured, dry shingles or shakes. The full stain coverage helps prevent warping or cupping of the shingles or shakes because of differential drying and wetting. You can stain the shingles or shakes more quickly by dipping them instead of using a brush or rag, but try the process on a couple of the shingles or shakes first to ensure that it produces the desired appearance. Let the stain dry completely before installing the shingles or shakes on the roof.

Although the results won't be as good, you can apply the stain after you put the shingles or shakes on the roof if you don't have time to pre-stain the shingles or shakes. Use a sprayer to apply the stain and finish with a paintbrush. The price you pay for saving time is the service life of the roof. Applying stain after installing the shingles results in warping and cupping, so the shingles won't last as long as they would if you stained them on all four sides. Shakes are thicker, so they will warp and cup, but not as much as shingles. This price rarely is worth the time savings.



Figure 296—The roof of the 1934 Stump Creek Guard Station fly shed (Caribou-Targhee National Forest, Intermountain Region) still shows the original green roof stain and white trim. A Forest Service crew used logs salvaged from the 1909 Stump Creek Ranger Station buildings to build the shed.

## Repairing Openings

The openings that penetrate a building's walls and roof are as important as the walls and roof themselves. Without the openings, a building would be as dark and stuffy as a rabbit hole. Doors admit people and windows bring light and air into the interior. Chimneys and flues allow smoke from a heating or cooking fire to escape the building. If not properly constructed and maintained, these openings can admit moisture that leads to the deterioration of the building. Flues and chimneys that don't function properly can lead to fires that destroy the building. Ensuring that these openings operate as intended is as important as replacing rotten logs or a roof that leaks.

### Windows

The original windows in most historic log cabins are true divided lite windows (figure 297). Divided lite windows are comprised of several small panes of glass (also called lites or glazing) held by tiny wedges (also called points) and window putty (also called glazing compound) in mullions and

muntins within the window frame. Individual panes of glass were historically small, because large sheets of glass were expensive before the mid-1900s and were difficult to transport to remote locations without breaking. Builders usually arranged glass panes in simple patterns of equally sized lites, but sometimes arranged them in decorative patterns, such as many small lites surrounding a larger central lite.

Nearly all original cabin windows are wood framed. In most cases, at least one-half of each window slides open either horizontally or vertically. Windows that open horizontally are simply called sliding windows. Windows that open vertically are called single hung if only one half of the window opens and double hung if each half opens. Single- and double-hung windows normally operate with the aid of pulleys, cords, and weights. Sliding windows operate on tracks within the window frame. A few log cabins have casement windows that swing open on side hinges or awning windows that swing open on hinges at the top of the window.

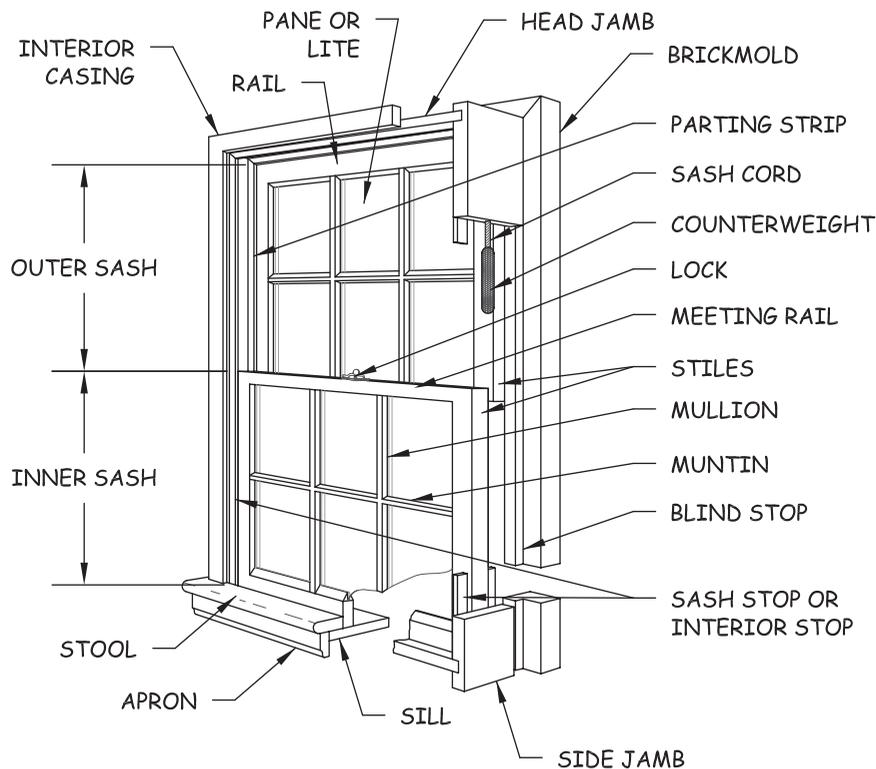


Figure 297—This drawing shows the terminology for a typical historic divided-lite, double-hung window. Although the terms “mullion” and “muntin” are sometimes used interchangeably, mullions are vertical dividers that provide structural support. Muntins are strips of wood or metal separating and holding panes of glass in a window.

Most people assume that they cannot repair wood windows (figure 298), but if you can repair a log building, you can repair a window, especially if the window was built before about 1940. The Anderson Lumber Company manufactured the first mass-produced windows in 1915, but manufactured windows were not commonly used for homes or other small buildings until after World War II. Before that time, builders usually constructed wood windows from individual parts, each of which you can repair or replace. The wood itself is likely to be denser and more rot- and warp-resistant than wood used in newer windows, so it's worth saving as much of the original window material as you can. You can patch and repair windows in much the same way as logs, only on a smaller scale.

If some of the windows in your cabin are deteriorated beyond repair, you usually should build new windows to match the size and configuration of the original windows, rather than purchasing and installing modern windows. If you can't copy

the original windows because they're completely missing from the cabin, search for historic photos of the building and other buildings nearby. Replicate these styles in sizes that fit the original openings in your cabin. Do not replace historic windows with windows made from modern materials, such as fiberglass or aluminum. If the cabin windows aren't original, you sometimes can replace them with modern wood windows without adversely impacting the building.

Do not change the size of the windows unless the accessibility and fire escape requirements of applicable building codes and accessibility standards require it. Refer to the [Decisions, Decisions: Deciding What To Do to the Cabin](#) section of this guide for more information on reconciling seemingly conflicting requirements. Modifying a window affects the visual integrity of a building, so limit modifications required by code to windows that aren't on the main façade of the cabin, if possible.

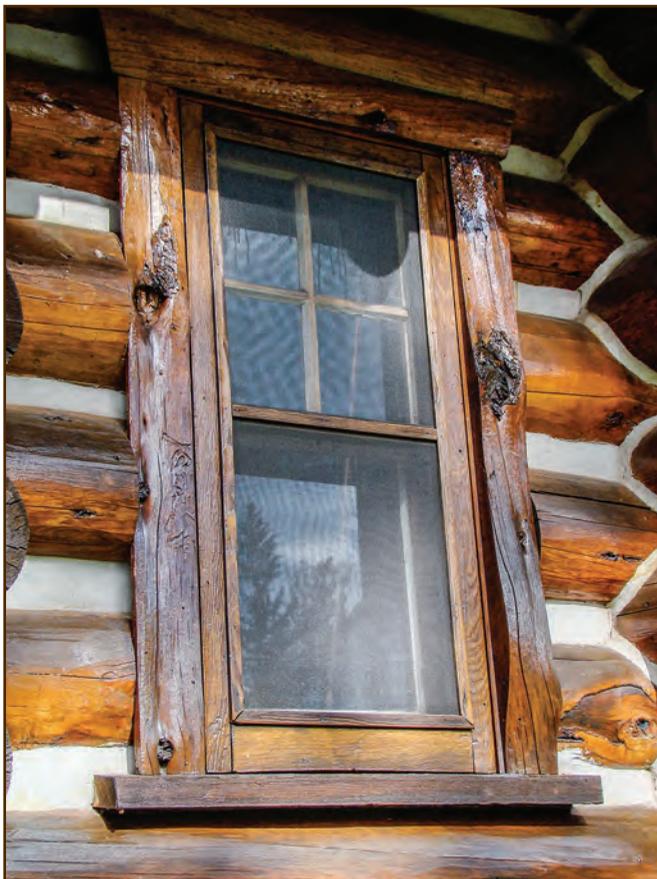


Figure 298—This screened, double-hung window is on a Wyoming Game and Fish cabin at the Sunlight Basin work center. The Sunlight Basin Ranch, established in 1896, included a dude ranch component beginning in 1913. The State of Wyoming acquired the ranch in the mid-1900s.

The SHPO probably will have to approve any window changes if a Federal or State government agency owns the cabin, or if Federal or State sources provide some or all of the funding for the cabin preservation work. Check with your heritage resource specialist or archaeologist for the requirements.

Common window problems include windows that stick or don't open. Structural problems may cause windows to warp or go out of square, preventing them from operating properly. Be sure to fix any structural problems before you fix the windows, or you may have to fix the windows twice. If the window sticks, try waxing the window sash (see figure 297 for labeled window parts). If waxing doesn't work, try slightly adjusting the position of the sash stop. Tighten loose hardware and reattach loose weather stripping. You can plane down any part of the window, but keep in mind that once you plane off wood you cannot put it back.

Sash cords, counterweights, or pulleys that don't work also may prevent windows from opening. Some window frames have an access panel. Look carefully; the panel may be hidden under grime and layers of paint. If the window doesn't have an access panel, you will need to remove all the inside trim to access the moving parts. After you expose the sash cords, counterweights, and pulleys, clean everything and then make repairs. Most hardware stores sell sash cord—it may be labeled as such or as cotton clothesline.

If the window has a broken pane, remove the putty or glazing compound with scrapers, steam, or heat and replace the glass. Some older glazing compounds contain asbestos or lead, so take the necessary precautions explained in the [Safety First](#) section of this guide.

Unless the window repair is small, such as resetting a single pane of glass, you probably will need to carefully remove the window from the cabin to repair or rebuild it. Use small flat

bars, pry bars, and cat's paws (figure 299). The frame and trim pieces of the windows may be sealed together with many built-up layers of paint, making them difficult to remove. Cut through the paint layers where the pieces meet using a window zipper (figure 300) or razor blade utility knife before attempting to pry the pieces apart.

If the paint on the window is deteriorated, you should remove it down to the wood before beginning repairs. Repaint it after you complete the repairs, using a color that matches the



Repairing Openings

Figure 299—These tools are handy for window work. They are, from left to right, a Woodcraft beech wood mallet and handmade window frame wedges, a smooth-head hammer, two putty knives, three small pry bars, a cat's paw, an awl, a retractable razor blade utility knife, a pocket knife and, at top right, a battery-powered drill with a long bit.



Figure 300—Use window zippers such as these to cut through layers of paint that have sealed a window frame and trim together.

original paint (figure 301). Use the methods described in the [Using Paint, Stain, and Oil](#) section of this guide to determine original paint colors and to strip paint from woodwork. This section also contains information about lead-based paint and the properties and appropriate uses of latex and oil-based paint.

Make repairs after you strip and sand the window. Repairs must match the profile (the shape, size, and joining types)

of the original window components. A shaper, tenoning machine, and band saw are useful tools for matching any window profile. You can make many, but not all, profiles using multiple passes on a router, band saw, and table saw.

Carefully observing and replicating the original construction methods can help you to accomplish wood window repair. Knowing the tricks of the trade listed in the tips box on the next page makes the process easier and more effective.

Repairing Openings



Figure 301—As part of the restoration work at the Adams Camp Ranger’s House on the Salmon River Ranger District (Nez Perce National Forest, Northern Region), preservation crewmembers rebuilt this kitchen window and painted it a deep green to match the original paint. This particular green was a standard color in the Northern Region when the builders originally constructed the cabin in 1933.

### Tips for Effective Window Repair

- Use a linseed oil-based glazing putty that will move with the wood, such as Crawford’s Natural Blend Painters Putty.
  - Do not use soya oil-based or paraffinic process oil-based putties, such as DAP 33, to glaze historic windows; these putties dry too hard and eventually will break the window.
  - Linseed oil-based putties take a few weeks to harden, so plan your work accordingly.
- Use diamond or triangular window points to hold the glass in, not modern points with “ears”—you cannot hide the ears using historic putty profiles.
- You can replace broken single-strength glass with double-strength glass or tempered glass in locations such as lookouts, where glass breakage is likely and where safety codes may require stronger glass. The change in appearance is minimal.
- You can install rubber bulb or brush weather-stripping (figure 302) to help make the windows weather tight because these are historically appropriate improvements.
- Paint carefully. Do not leave excess paint buildup or drips.
- Achieve a clean paint line at the edge of the window glass by using one of the following three methods:
  - Paint over the glazing putty and about one-sixteenth of an inch onto the glass with both the primer and paint. Although this approach sounds difficult, it is easier to accomplish if you rest your arm on the sash for stability and use a sharp-cut paintbrush. Sweep your hand down the pane in one continual motion. With a steady hand and a little practice, this method is the fastest way to get a clean paint edge.
  - Paint a little farther onto the glass, and don’t worry about getting the edge straight. After the paint fully cures, use a utility knife and straight edge to cut through the paint at the edge of the putty and peel the excess paint from the glass. A safety blade scraper may be helpful to get the peel started.
  - Lay a strip of painter’s tape on the glass and seal it tightly to the pane to prevent paint from leaking under the tape onto the glass. Because tape rarely seals perfectly, you probably will need to use a scraper to remove the “fuzzies” after the paint dries.



Figure 302—This mock-up of a small double-hung window shows bulb-type weather stripping on the top and brush-type weather stripping on the side. Notice how the flanges on the weather stripping fit into routed slots in the frame and hold the weather stripping in place without fasteners.

The City of San Antonio’s Office of Historic Preservation website <<http://www.sanantonio.gov/historic/Docs/Brochures/WindowRestorationWorkshop.pdf>> has excellent information about restoring historic windows. Photos on the site show how to get an old window apart without damaging it. The site also includes reprints of documents about restoring historic windows from the National Trust for Historic Preservation, the National Park Service, and other preservation agencies.

You can use the Internet to access several historic publications intended for use by the construction trades. For instance, “Audels Carpenters and Builder’s Guide, Volume 4” (1923) includes a lot of door and window information and construction techniques of the times. Source and contact information are available in [Appendix G—Support Organizations and Publications](#). Several sources for historically appropriate window hardware are listed in [Appendix F—Acquiring Tools and Materials](#).

Storm windows are easy to build and can give your historic windows the performance of modern thermal pane windows. Look carefully for evidence that the building once had storm windows, such as clips or screws used to fasten them in place. When storm windows were present historically, matching or similar replacements are always appropriate. Interior or exterior storm windows usually are an acceptable addition where they weren’t present historically if you can remove them (when not in use) without damaging the window frames. Interior storm windows should have air-tight gaskets and ventilating holes to avoid condensation damage to historic windows. More information on [retrofitting historic windows to achieve energy savings](#) is available from the National Trust for Historic Preservation <<http://www.preservationnation.org/information-center/sustainable-communities/green-lab/saving-windows-saving-money/>>.