

Underlayment, Ice and Water Shield, Drip Edging, Rakers, and Cant Strips

After you strip and repair the roof, prepare the surface to receive the roofing by installing any required cant strips, underlayment, ice and water shield, drip edging, and raker shingles. You must accomplish this work in the proper order so that the roof functions properly. Do not add anything to improve the function of the roof that will be visible on the edges of the roof; it will change the appearance of the cabin and won't be appropriate to the building.

Cant strips (figure 237) are triangular boards used to ease the transition between a vertical element, such as a dormer, and the drainage pitch of the roof. Cant strips help guide water away from vertical surfaces, such as dormer walls, and also provide support for felt or ice and water shield that bends up the vertical surface under the flashing or for roofing that bends up the vertical surface. If the builders originally used cant strips, install the replacement cant strips before installing the underlayment.

Next, lay the underlayment, if you need it. The builders of most historic log cabins constructed before the mid-1800s attached roofing directly to the purlins or sheathing. In contrast, most builders who constructed cabins after 1900 included a layer of asphalt felt roofing paper between the sheathing and roofing. Do not install underlayment if the sheathing isn't continuous, except in the case of interwoven underlayment with shake roofs on skip sheathing, as explained in the [Reroofing With Wood Shakes](#) section of this guide.

Some roofing manufacturers recommend ice and water shield in areas with harsh winters. Always install ice and water shield on roofs with continuous sheathing where you know there's a history of ice damming. Some manufacturers recommend breathable underlayment, particularly in humid climates. To provide the best protection, follow the manufacturer's recommendations for coverage and overlaps.



Figure 237—The builders placed a cant strip under the shingles that bend up the side of the cupola on this cabin in Grand Teton National Park in Wyoming.

Generally, replicating the original construction is the best practice, but you must sometimes upgrade to protect the cabin. Because underlayment isn't visible after you apply the roofing, it is one area where you often can use modern materials. Upgrading to ice and water shield can prevent leaks caused by ice damming and provide extra insurance against leaks in screw-down metal roofs. It also can provide a barrier that prevents bats from colonizing attics and depositing guano (figure 238). 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 to determine if you must consult with or seek approval from the SHPO for the change.

For ice-dam protection, ensure that the ice and water shield extends from the eave edge completely across the overhang and at least 2 feet up the roof from the outside edge of the cabin walls. Also, apply ice and water shield at all valleys, extending the full length of the valley for about 2 feet from each side of the valley bottom.

Some metal roofing manufacturers recommend installing a synthetic underlayment before installing any metal components. Sometimes, the building code requires additional layers of underlayment on certain parts of the roof. In some cases when water and ice shield or synthetic underlayment cover the entire roof, you don't need to apply asphalt roofing felt underlayment to the roof. Following the manufacturer's instructions, especially with metal roofing, is extremely important. Consult an engineer with experience in designing roofs to ensure that the underlayment won't create condensation or other problems for the cabin, and to also ensure that you receive the right solution to the problem you are trying to solve. For a leak-free roof, read and carefully follow the manufacturer's directions and the engineer's design.

Most roofing extends beyond the edges of the roof sheathing to allow water to drain off the roofing without soaking the sheathing and fascia (if any). Many 20th-century cabin roofs also had drip edging to help protect the sheathing and fascia. Companies manufactured historic drip edging using galvanized steel. When you're replacing historic drip edging,

Keeping the Rain Out

Figure 238—Preservation crewmembers covered the entire roof surface of the Office/Cookhouse building at the Moose Creek Wilderness Station (Nez Perce National Forest, Northern Region) with ice and water shield before reshingling it. The crew completed the reroofing between September and May while the maternal colony of more than 500 Yuma Myotis bats that inhabited the cabin's attic was at its winter location in another part of the State. The ice and water shield not only protects the cabin from roof leaks, it also keeps the bats out. Bat guano presented a significant hazard in the attic for many years. The district provided a large bat box nearby for the colony's use.



do not use the standard preformed white drip edging commonly available today. Replace the drip edging in kind, but be sure to use at least 20-ounce (copper) or 26 gauge (galvanized steel) flashing for durability. Lighter flashing may deteriorate faster than the shingles. If you use drip edging, install the eave drip edging before the underlayment, but install the gable (sloping edge of the roof) drip edging after placing the underlayment.

If you need to install asphalt roofing felt underlayment, do so after cant strips, water and ice shield, and eave drip edging are in place. Follow the accepted practice of laying 15- or 30-pound roofing felt over the entire roof. Apply the roofing felt in rows, starting at the eaves and lapping each row at least 4 inches over the row below it. Attach the underlayment using roofing nails or staples no more than 6 inches apart in a line about 1 inch below the top of each row.

If the builders used skip sheathing on your cabin, they may have interwoven roofing felt with each layer of wood shakes,

as explained in the [Reroofing Using Wood Shakes](#) section of this guide. It may be appropriate for you to duplicate this historic technique using shakes, but do not use the interwoven roofing felt technique with shingles or if the building has continuous sheathing; the interwoven felt will trap water against the wood and lead to moisture damage.

Some shingle or shake roofs have raker shingles along the gable edges and along dormer walls. Raker shingles raise the finished roof elevation enough to guide water back over the main part of the roof instead of allowing it to run off the gable edge or down the joint where the dormer wall meets the roof. Lay raker shingles perpendicular to normal shingles, with the butts along the gable edge (figure 239) or adjacent to the dormer wall. Lay the raker shingles on top of the roofing felt or ice and water shield (if any) before installing the rest of the roofing. As you install each course of roofing, overlay the raker shingles with the finish roofing.



Figure 239—The roofer at the top of the photo is laying raker shingles. The other roofer is laying the starter course. Before laying any shingles, the crew covered the entire roof with ice and water shield underlayment.

Flashing

If you replace roofing on a building that has a flue, chimney, vent pipe, dormer, or valley, you probably will need to add or replace flashing during the reroofing process. Flashing protects the building against leaks around roof penetrations, at the joints between different materials, or where different slopes meet.

The most important thing to consider when installing flashing is the path that water will take as it runs down the roof. Remember that water flows into any nooks and crannies and that sealant materials eventually fail, but overlaps last nearly forever. Likewise, the amount of overlap is important because wind can drive rain uphill into small gaps.

Use many overlapping pieces to construct flashing that protects gaps around large roof penetrations, such as chimneys and the joints between dormer walls and roofs. You must use many pieces of the flashing because materials such as brick, metal, and wood expand and contract at different rates when the temperature changes and because wind or snow loads tend to move different parts of any structure somewhat independently. The multiple flashing pieces slide past each other ever so slightly to accommodate the different movements without opening gaps that would allow water to penetrate. If you use shortcuts instead of installing flashing properly, you will pay the price in leaks.

Flashing can be made of sheet lead (figure 240), galvanized or Galvalume steel (figure 241), copper, lead-coated copper, or aluminum. Aluminum is a modern material that usually is inappropriate for use on historic cabins. In most cases, use the same material as the original flashing.

Sheet lead used for flashing is approximately 1/16- to 1/8-inch thick. It is easy to shape into odd angles or curves because it is such a soft metal. Unfortunately, you can absorb lead through your skin and it can cause serious health problems. Information about working safely with lead is available in the Forest Service Facilities Toolbox section on [lead roofing and flashing](http://www.fs.fed.us/eng/toolbox/haz/haz22.htm) <<http://www.fs.fed.us/eng/toolbox/haz/haz22.htm>>. Always use these safe-handling methods when you work with lead and lead-coated copper.



Figure 240—The lead on the left is lead wool. You can use it to pack the joints behind the mortar in a chimney and hold the flashing in place. The lead on the right is used lead sheet flashing.

When purchasing copper or lead-coated copper flashing, buy 20-gauge for a good balance of strength, durability, and workability. For galvanized steel, 32-gauge is typical for sheet or rolled flashing material and 26- or 28-gauge is typical for preformed shapes. Steel and copper are both more rigid than lead, but copper is easier to form than steel. Lead-coated copper is stiffer than lead sheet, but easier to shape than plain copper because the lead coating acts as a lubricant. Steel is quite rigid and you generally can only use it in flat or folded sheets. Unlike lead and copper, steel flashing may corrode when it contacts mortar, copper, lead, uncured wood, or pressure-treated lumber. On the other hand, copper may corrode when in contact with wet cedar shingles or shakes. Lead-coated copper combines copper's durability with lead's acid rain resistance and nonstaining properties.

Figure 241—This roofer is installing galvanized steel step flashing and valley flashing during the reroofing of this complex roof at the historic Ninemile Ranger Station (Lolo National Forest, Northern Region).



Install flashing using nails of the same or compatible material to prevent galvanic corrosion. Do not use aluminum and steel, aluminum and copper, or copper and steel together. Stainless steel isn't compatible with either galvanized or zinc-coated steel, so do not mix them. You can use hot-dipped galvanized, copper, or stainless steel fasteners with lead flashing. When installing flashing, use short nails with a broad head that will hold the flashing in place without going completely through the sheathing.

Chimney Flashing

The first step for flashing a brick, stone, or cement block chimney is to rake out all of the brick joints immediately above an imaginary line 5 inches above the roof line (figure 242). Raking out the joints means removing the mortar to about a ¾-inch depth from the face of the bricks. Use a hammer and stone chisel, rock hammer, double jack, or similar tools (figure 243). Be very careful. If you break any of the masonry, you will have to rebuild the chimney. Consider also making any other needed repairs to the chimney while you're at it. See the [Fireplaces, Wood Stoves, Chimneys, and Flues](#) section of this guide.



Figure 242—In preparation for reflashing, a preservation crewmember raked out the mortar from the joints on the chimney of the house at the Main Boulder Station (Gallatin National Forest, Northern Region) built in 1905.

Chimneys that extend through shake or shingle roofs need four types of flashing (figures 244 and 245): base (sometimes called apron flashing), step, counter (sometimes called cap flashing, figure 246), and saddle (sometimes called cricket flashing). You can shorten the chimney-flashing task by measuring the chimney and cutting all the pieces of flashing before beginning installation.



Figure 243—This preservation crewmember is using a hammer and plugging chisel to rake the joints on the chimney of a house built in 1905 at the Main Boulder Station (Gallatin National Forest, Northern Region).

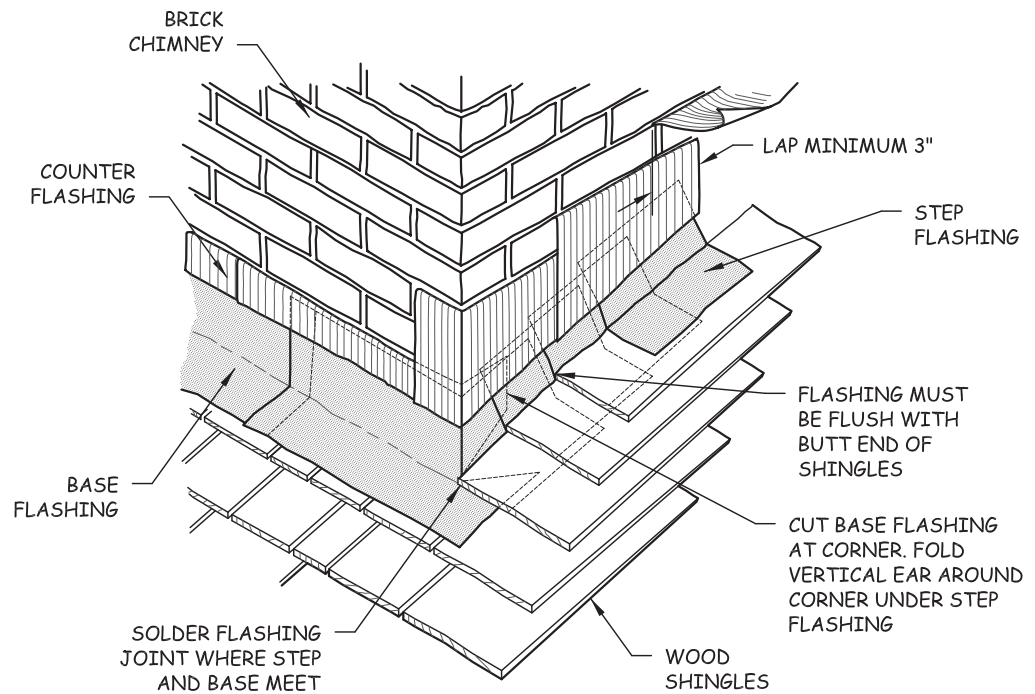


Figure 244—This drawing shows the base flashing, step flashing, and counter flashing around the lower corner of a masonry chimney. Use the same flashing methods at the lower corners of dormers.

Figure 245—This drawing shows the saddle flashing, step flashing, and counter flashing at the upper side of a masonry chimney.

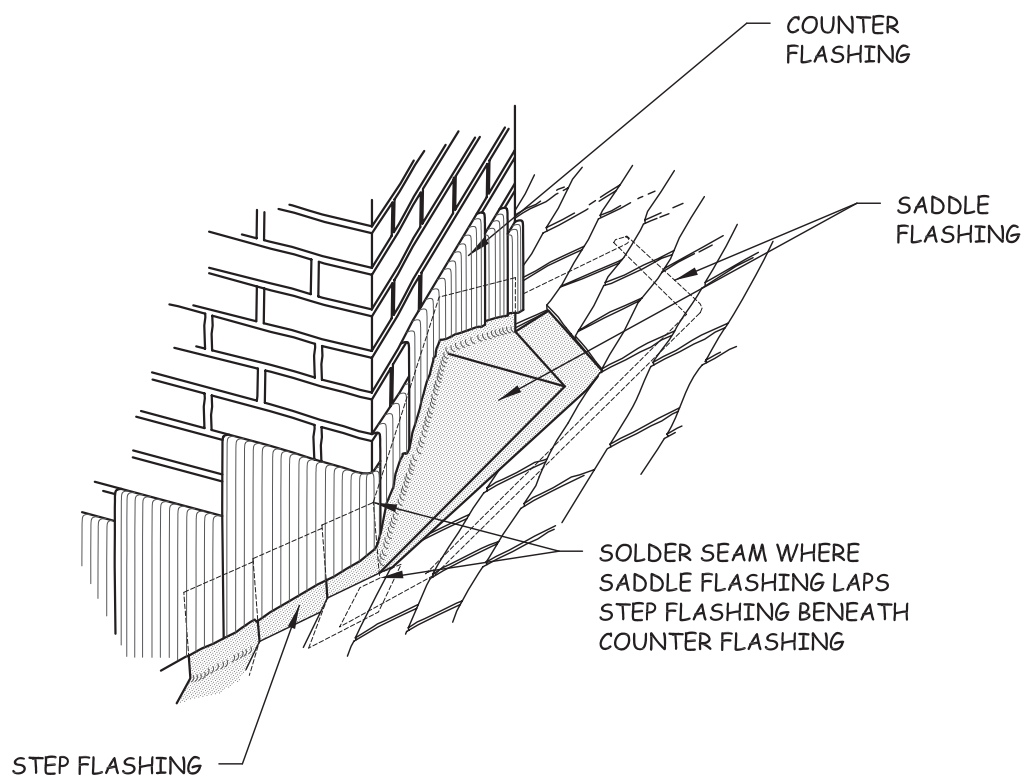


Figure 246—This closeup view of the chimney constructed in 1905 at the Zortman Guard Station within the Bureau of Land Management's HiLine District in Montana shows how the builder used lead sheets to counter flash the chimney. The builder stuffed lead wool into the masonry joints to match the original method of holding the counter flashing in place. The step flashing under the counter flashing is just barely visible.

To flash the chimney, first, cut the roofing below the chimney flush against the base of the chimney. Then, place base flashing across the width of the downhill side of the chimney. Extend it a short distance up the chimney and down over the top of the roofing that you cut to butt into the chimney. Fold it around the bottom corners of the chimney and tuck it up along the sides.

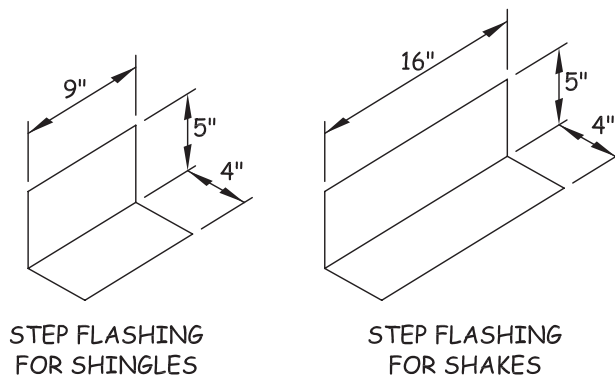
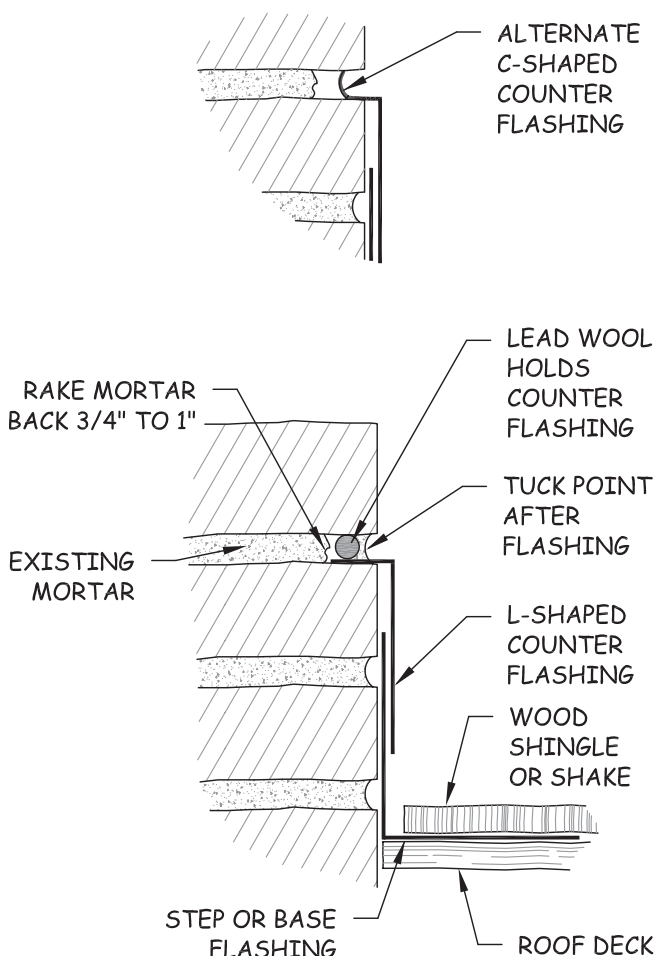
Next, with each course of roofing, lay step flashing up along the sides of the chimney. Lay the lowest course of step flashing over the base flashing at the lower side of the chimney. When laying the roofing courses with the step flashing, don't nail closer than 3 inches from the chimney. If you're roofing with wood shingles or shakes, you may end up with nails in the middle—instead of within 1 inch—of the edge of the shingles or shakes in your efforts to keep nails away from the chimney. This deviation is acceptable when you're nailing into flashing.

When your roofing course work reaches the upper side of the chimney, lay saddle flashing across the uphill side of the chimney so that it extends up the chimney and overlays the step flashing at the sides. Form saddle flashing into a peak at the middle to encourage drainage. Cut the roofing in the courses crossing the saddle flashing to fit, as shown in figure 245.

If the uphill side of the chimney has a framed cricket, you don't need saddle flashing. If necessary, rebuild the cricket to match the historic shape. Flash the joint between the chimney and the roofing on the cricket using step and counter flashing, just like on the sides of the chimney. Flash the valley between the main roof and cricket, as explained in the [Valley Flashing](#) section of this guide.

Finally, place counter flashing (figure 247) in the mortar joints and fold it down to overlay the apron, step, and saddle flashing. To keep galvanized steel or copper counter flashing in the raked mortar joint while you work, crimp the end of the horizontal leg of the flashing into a "C" shape the same size as the mortar joint or use lead wool or mortar to keep L-shaped flashing in place. Lead flashing is flexible enough that L-shaped flashing will stay in the joint if you press it

tightly to the masonry. Solder all the corners, being careful to seal the pinhole opening at each corner where the base or saddle, step, and counter flashing all come together. Be careful while soldering—you don't want solder dripping onto the shingles, nor do you want to start a fire.



STEP FLASHING SIZES

Figure 247—This detail drawing shows how to size and install step flashing and counter flashing on a masonry chimney.

After you place all the counter flashing, repoint the joints that you raked out. If the builders originally filled the joints with mortar, match the original color and type of mortar using the same method used for matching masonry daubing explained in the [Chinking and Daubing](#) section of this guide. If the builders originally packed the joints with lead wool, repack them with matching lead wool. Remember to pack the wool in tightly to keep out water.

When you finish installing the flashing, the metal will surround the chimney (figure 248). The flashing will guide water away from the chimney and onto the surface of the roof so that water, snow, and ice won't penetrate the roof.

Construct chimney flashing for a metal, rolled asphalt, or sod roof in a similar fashion. However, instead of step flashing, use one long piece of flashing that runs up the slope of the roof for the entire length of the side of the chimney. Counter flash in the same manner as you would with shingles or shakes—in steps running up the courses of masonry to approximately match the angle of the roof.



Vent Flashing

Buying a premade combination vent boot or vent sleeve and flashing unit to slide over each vent stack and flue is much easier than hand-shaping and soldering a separate boot or sleeve and flashing sheet. Premade vent flashing is great for newly installed vents or to replace older premade flashing, but is not appropriate for replacing historic, individually crafted boots and flashing. If you use a premade flashing unit, install it so that the flat sheet runs over the lower course of roofing and under the upper and side courses. Be sure to buy a unit with a large flashing sheet so that the flashing extends beyond the vent boot at least 4 inches on all sides.

Figures 249 and 250 show historic flashing methods for vents. The advantage of the historic sleeve and flashing method shown in figure 249 is that it doesn't require sealant or exposed fasteners, and the pipe and cap can move separately from the roof and flashing. Leaks commonly develop over time at sealant joints and fastener penetrations, so the older, more difficult methods tend to be more durable. Figures 249 and 250 also show how the flashing sheet extends under the top and side shingles but lies over the shingles below the vent, which is the same way you should install modern, premade combination units. The folds in the flashing guide any water that penetrates the overlapping shingles down the flashing and out onto the roof surface so that the roof sheathing doesn't get wet.

Figure 248—Preservation crewmembers replaced the flashing all around the chimney at the Lost Horse cabin (Bitterroot National Forest, Northern Region).

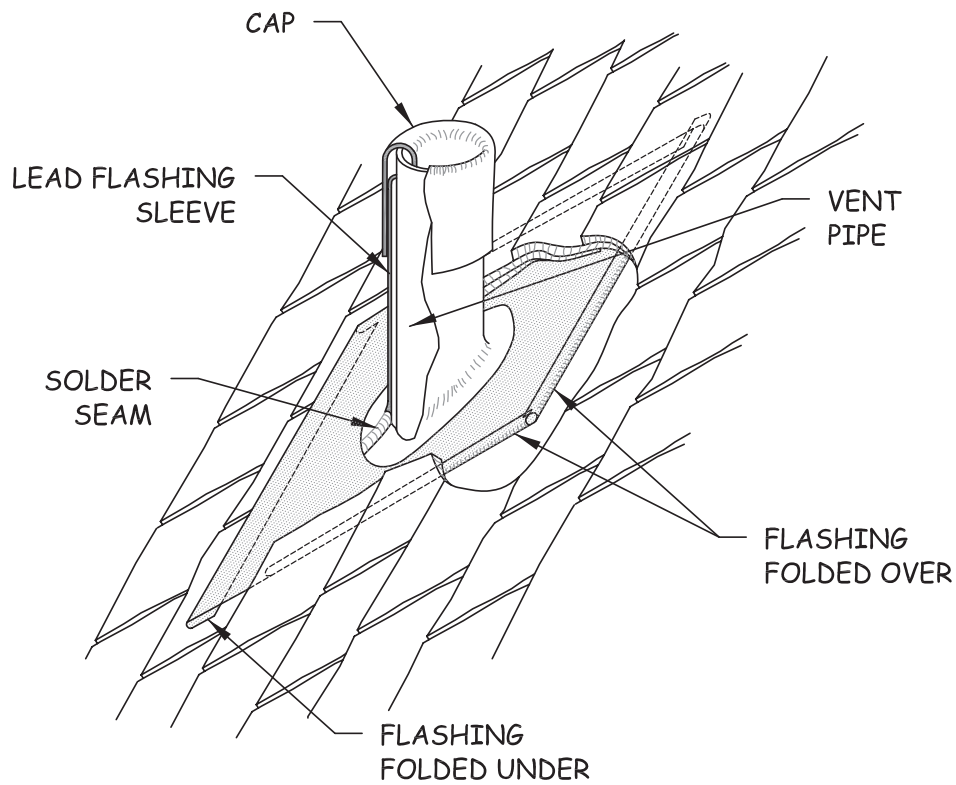


Figure 249—This drawing shows a historic method for using lead flashing, a sleeve, and a cap around a roof vent.

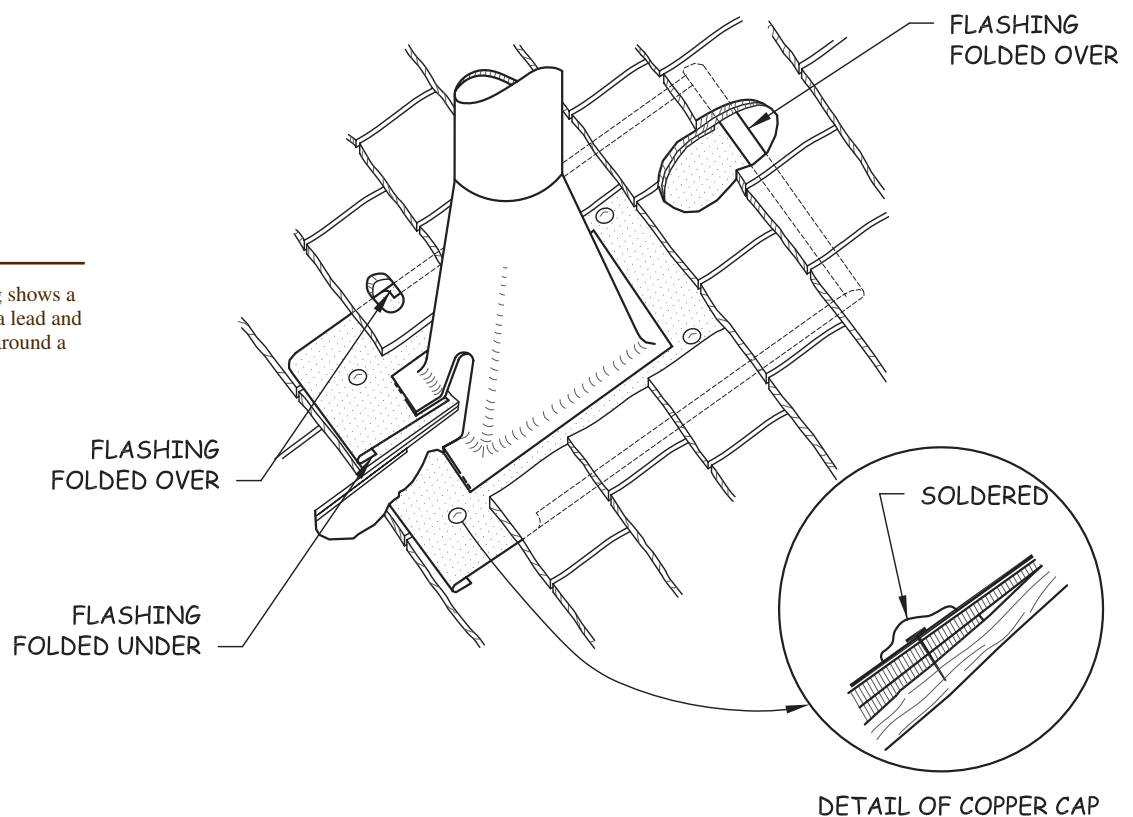


Figure 250—This drawing shows a historic method for using a lead and copper boot and flashing around a roof vent.

Cut shingles around larger vents and flues to fit around the boot (figure 251). You won't need to trim many shingles as you lay them around smaller vent pipe sleeves (figure 252).



Figure 251—A preservation crewmember trimmed the shingles around this booted flue on the Moose Creek Wash House (Nez Perce National Forest, Northern Region).



Figure 252—The shakes around this small vent in the Moose Creek Ranger's House (Nez Perce National Forest, Northern Region) required little trimming.

Valley Flashing

Install valley flashing after installing the asphalt felt roofing paper and before installing the roofing. On buildings with continuous sheathing, consider carefully installing a continuous layer of ice and water shield along the full length of the valley before laying the asphalt roofing paper. This provides an extra measure of leak protection. Before laying the flashing, extend felt asphalt roofing paper from each side completely across and at least a foot beyond the center of the valley (figure 253).

You can make valley flashing from flat metal sheets or rolls. You also can buy it preformed in a "V" shape (figure 254) or a "W" shape (figure 255) with or without hems (metal folded back on itself) or crimps at the edges. The ridge in the middle of W-shaped valleys is called a splash rib. You can find metal flashing at most building supply stores in 10- or 20-foot lengths and either 16- or 24-inch widths, which means it will extend 8 to 12 inches beyond the centerline of the valley.

Valley flashing is easy to install, as long as you make sure to align the middle of the flashing along the low point of the roof valley. Just lay the flashing in place and nail it down along the edges. Begin laying valley flashing at the roof eave and work up the roof. If the valley requires more than one length of flashing, overlap each section by at least 4 inches. Then, install the roofing shingles, lapping the shingles at least 6 inches over the flashing and trimming the shingles to match the angle of the valley (see figure 254).

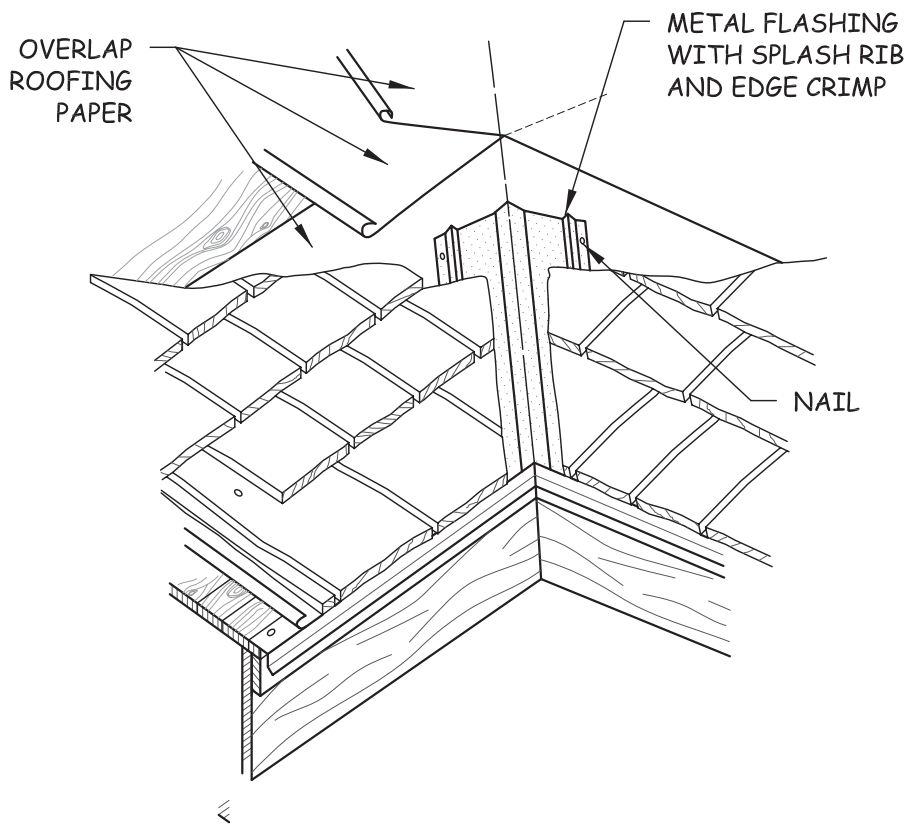


Figure 253—This drawing shows how to place roofing paper, valley flashing, and shingles over continuous sheathing. If you use ice and water shield, install it under the roofing paper directly onto the sheathing.

Keeping the Rain Out

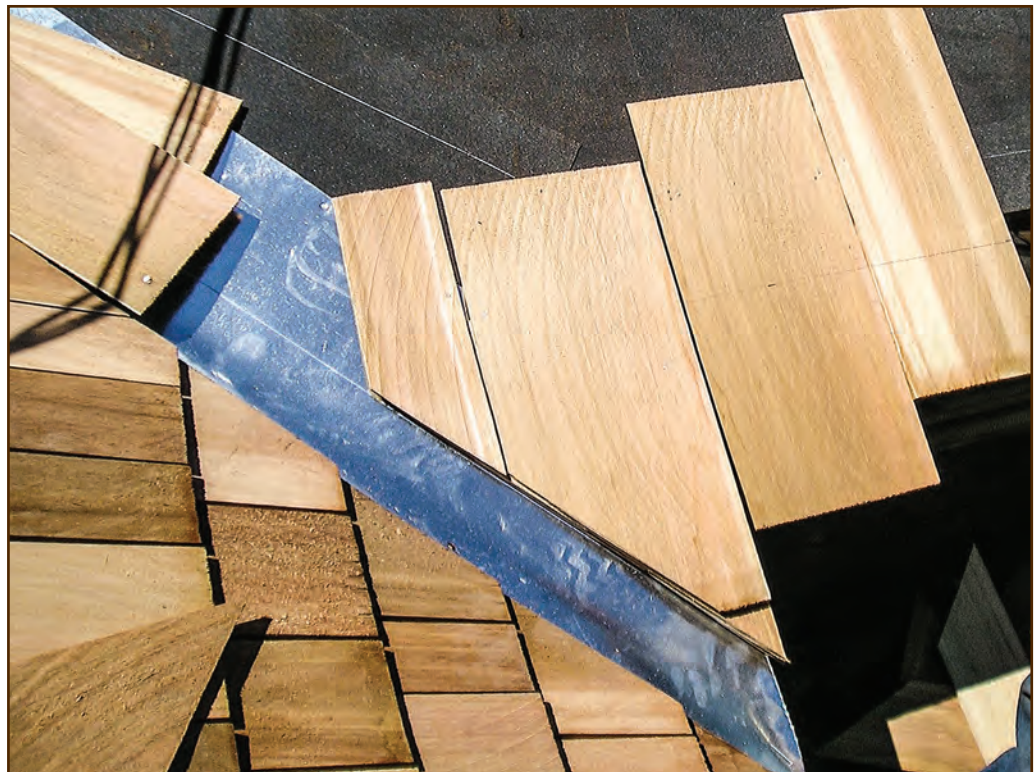


Figure 254—Preservation crewmembers used V-shaped valley flashing while replacing the roof at the Phillipsburg Ranger Station (Beaverhead-Deerlodge National Forest, Northern Region). Note how the crew cut the shingles that overlap the flashing on a diagonal to match the chalkline.

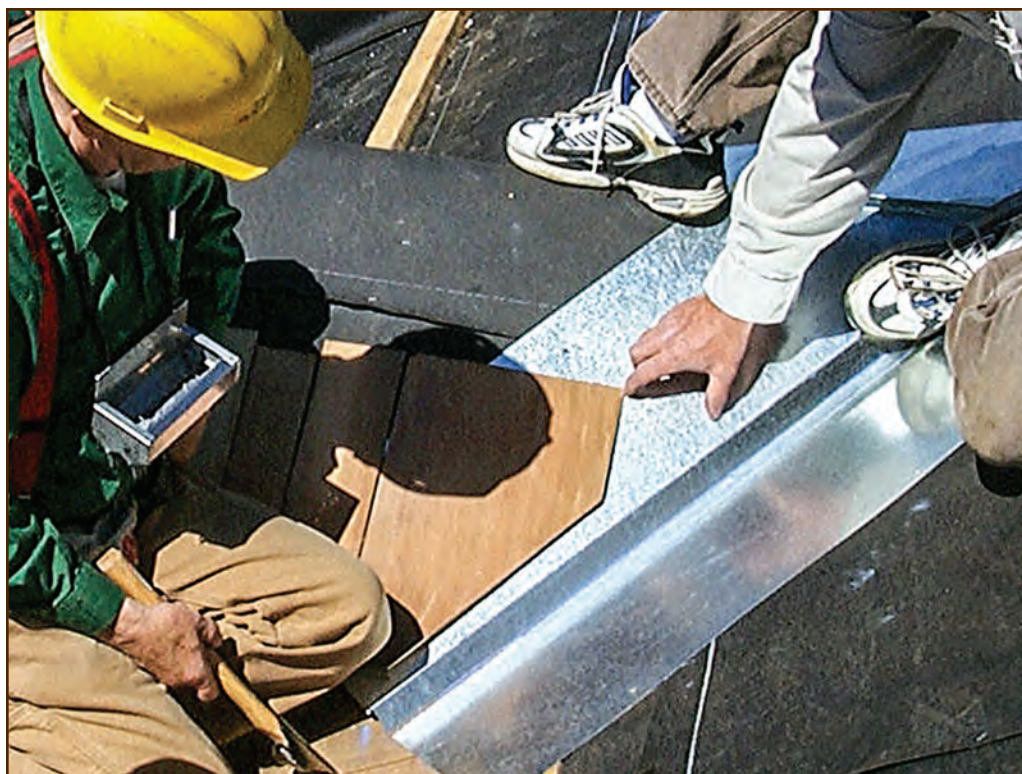


Figure 255— Preservation crewmembers used W-shaped valley flashing when they replaced the roof on this building at the Ninemile Ranger Station (Lolo National Forest, Northern Region).

Roof valleys on cabins in locations that frequently receive heavy rainstorms often have a tapered run that is wider at the bottom than at the top to accommodate the larger flow of water that accumulates near the bottom of the valley. To lay out a typical tapered run, install the valley flashing as usual, using 24-inch-wide flashing. Measure and mark 3 inches from each side of the center at the top of the valley. Next, measure and mark 4 inches from each side of the center at the bottom of the valley. Then, snap a chalkline from the marks at the top of the valley to the marks at the bottom. This gives you a tapered line. Lay the roofing as you normally would and trim the roof material to match the chalkline.

Rolled asphalt roofing valley flashing and woven asphalt shingle valleys tend to not be as durable as metal valleys. Over time, asphalt roofing tends to pull away from the roof sheathing and to crack where it bends, especially in climates

with hot summers and cold winters. Don't give in to the temptation to shortcut your roofing project by using either of these two methods, unless you must do so to retain the historic character of the building. If you must use one of these methods, lay ice and water shield the full length of the valley before placing the asphalt felt roofing paper and roofing.

The best valleys have 4 to 8 inches of exposed metal in the middle (called an "open valley"), a central splash rib, and either a hem or a crimp near each side edge. You may need to install a different valley flashing from the one the cabin originally had. The SHPO probably will need to review or approve noticeable changes in appearance 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.

Dormer Flashing

Install dormer flashing (figure 256, and also see figure 228) on the lower edge and sides of the dormer in much the same way you install chimney flashing. Where the roof of peaked dormers meets the main roof, install valley flashing as explained previously. Handle flashing at the top of shed roof dormers the same way you would handle any other roof pitch transition. Generally, use base and step flashing on the lower edge and sides of a dormer, exactly as you would a chimney. If the dormer is sided with shingles, shakes, or siding boards, install the upper portion of each piece of step flashing under the siding and don't use counter flashing; the siding functions as counter flashing. Where the valley flashing for a peaked dormer meets on the ridge, fold the two pieces together and solder them along the joint.

Roof Pitch Transition Flashing

Where a porch or shed dormer roof with a shallow slope meets a steeper slope on the main roof (see figure 228), or where the pitches meet on a gambrel roof, you probably need to install flashing to help deflect water. In these cases, install the flashing after you lay the roofing on the lower section but before you lay the roofing on the upper section. Lay the flashing over the roofing on the lower section of roof. Lay the flashing over the asphalt felt roofing paper but under the roofing of the upper section.

Builders also frequently use flashing under the ridge shingles of a Boston ridge on wood shake and shingle roofs. See the [Ridge Caps for Wood Shake and Shingle Roofs](#) section of this guide to learn this method.

Keeping the Rain Out



Figure 256—The shed roof dormer on the back of the Big Prairie Ranger Station (Flat-head National Forest, Northern Region) has flashing at the base, sides, and top. The roofers installed base flashing where the lower side of the dormer meets the roof. The board and batten siding on the sides of the dormer covers most of the step flashing. The roofers also installed flashing at the transition between the top of the dormer roof and the main roof (not visible in the photo).

Roofing Fasteners and Tools

We all love labor-saving building tools, but using a shingle hatchet (figures 257 and 258) or a lightweight smooth-faced hammer to drive nails flush with the shingle or shake surface still is the best way to attach wood or asphalt shingles to historic roofs. Do not use a wafflehead hammer for roofing on a historic building; it will leave a waffle mark around the nail heads. The marks are unsightly, don't conform to the historic appearance of the building, and hold water, leading to rot.

Do not use nail guns to attach roofing. The common practice of using pneumatic nail guns can crack the roofing or shoot fasteners completely through it, leading to its premature failure. Using nail guns is the normal roofing practice these days, but the author has spent too much time repairing relatively new roofs that someone nailed using a nail gun to

recommend this practice under any circumstances. If you plan to contract out the roofing work, contact the [Northern Region Historic Preservation Team](http://fsweb.r1.fs.fed.us/e/FacilitiesAndEnvironmental/HistoricPreservation/include_home.htm#team) at <http://fsweb.r1.fs.fed.us/e/FacilitiesAndEnvironmental/HistoricPreservation/include_home.htm#team> or 406-329-3478 for copies of shingle roofing specifications that have successfully required roofers to use hand nailing techniques.

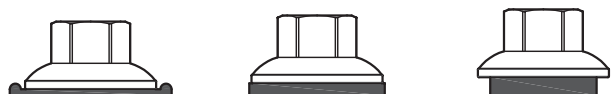
Use caution when you install metal roofing using power screwdrivers. Overdriving screws results in gasket or clip damage and a leaky roof. Underdriving screws leaves tiny gaps through which water can penetrate. Figure 259 shows the difference between properly driven, underdriven, and overdriven gasketed screws. If you use power screwdrivers, check and adjust the torque settings several times during the day as the temperature changes.



Figure 257—This older shingling hatchet serves the same function as newer models—use the hammer end to drive nails, the hatchet end to trim shingles, and the notch in the hatchet to pry out nails.



Figure 258—These newer shingling hatchets work exactly the same way as the older hatchet shown in figure 257. Their steel handles are less likely to break, but the basic design hasn't changed much in more than 100 years.



TOO TIGHT

JUST RIGHT

TOO LOOSE

Figure 259—The drawing on the left shows an overdriven roofing screw with a deformed gasket. The drawing in the center shows a roofing screw that is driven correctly, with the gasket just barely visible around the edges of the flange. The drawing on the right shows an underdriven roofing screw. The gasket is not visible around the edge of the flange and is not compressed enough for the gasket to seal properly.

Use the correct type of fastener. Do not use staples to attach shingles or rolled roofing. Staples are more likely than nails to cause rips or cracks in the roofing, even if you set them perfectly. Instead, use box nails (for wood shingles or shakes) or broad head roofing nails (for asphalt rolls or shingles) with shanks long enough to extend through the roofing and about three-fourths of the roof sheathing. For shingles and shakes, use corrosion-resistant roofing nails (stainless steel type 304 or 316, hot-dipped zinc coated, or aluminum). Do not use copper nails with cedar roofing because a chemical reaction between the wood and the copper will corrode the nails and reduce the life of the roof. Do not use nails that penetrate the sheathing; they will provide a pathway for leaks.

For metal roofs, follow the manufacturer's recommendations for fasteners. If the manufacturer has not provided recommendations, use self-tapping metal-to-wood roofing screws with gasketed flanges. Builders historically attached metal roofs using lead-headed nails, but nails are far more prone to leaking and popping than gasketed roofing screws; they no longer are recommended for use.

Roofing professionals disagree on the best location to place fasteners to attach corrugated and ribbed metal roofs. Manufacturer's instructions usually say to drive screws in the valleys of corrugated roofing and on the flats of ribbed roofing. Because neoprene gaskets don't last as long as the metal of the roof and water is more likely to leak around a wornout gasket in the valley than in the peak, many long-time roofers suggest fastening through predrilled holes in the tops of the ribs or peaks of corrugations. The author doesn't recommend this practice because you easily can damage ribs and unsupported corrugation peaks while fastening them. Replacing wornout gaskets simply is part of normal maintenance for metal roofing. If you disregard the author's advice and decide to fasten through the tops of ribs or peaks of corrugations, remember that you must use longer screws. Use screws that are long enough to extend at least halfway and no more than three-fourths of the way into the sheathing. You can buy roofing screws for metal panels in carbon steel, stainless steel, and with a salt spray coating. Buy screws that provide the longest service for your climate and the type of panel you use.

Reroofing With Wood Shingles

For shingles, “exposure” refers to the surface of the shingle that is exposed to the weather and not covered by the shingle above it. Usually, roofers lay 16-inch wood shingles with a 5-inch exposure, 18-inch shingles with a 5½-inch exposure, and 24-inch shingles with a 7½-inch exposure. This provides a triple layer of protection to the entire roof (figure 260).

If the builders laid historic shingles differently but still provided a triple layer of protection—such as with a 4½-inch exposure—use the historic pattern. If the historic shingles don’t provide a triple layer of protection, consider changing from the historic shingling pattern to a pattern that provides proper overlap. This will make the roof last longer. Because this pattern changes the appearance of the roof, 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 to determine if you must consult with or seek approval from the SHPO for the change.

Lay wood shingles with a ¼- to ⅜-inch gap between horizontally adjacent shingles. This gap is called a joint. Each horizontal row of shingles is called a course. Stagger the joints for each successive course at least 1½ inches horizontally from the joints in the course immediately below and 1½ inches from the joints in the second course below so that precipitation cannot flow through stacked joints and soak the sheathing or leak into the building. You must stagger joints for the triple layer of protection (figure 261) to work properly and to provide a leak-free wood shingle roof.

When laying shingles, ensure that each shingle or shake covers the nails from the course below. Use two nails per shingle and set the nails between 1¼ and 2 inches above the exposure line and ¾ to 1 inch in from the edges (figure 262). Exposed nail heads, called shiners, not only are unsightly, they also provide a water path to the sheathing and building interior. Nails set too high on the shingle are likely to split the shingle over time, leading to leaks.

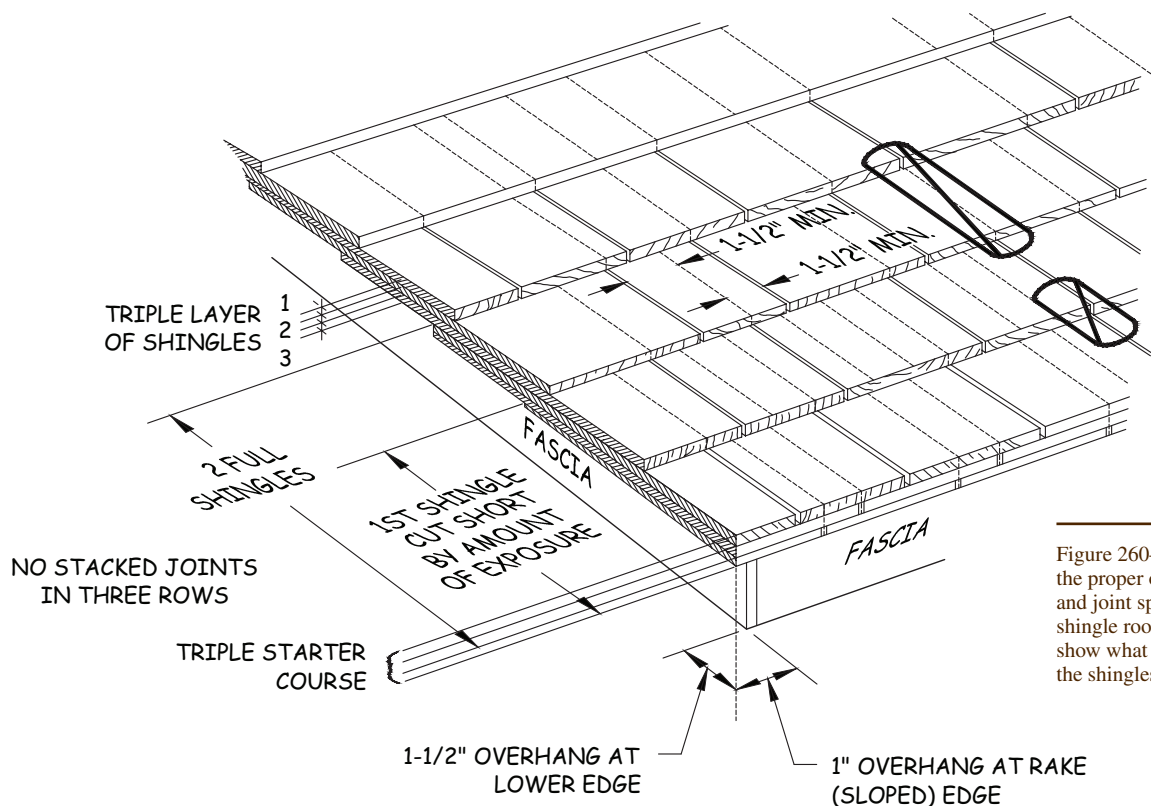
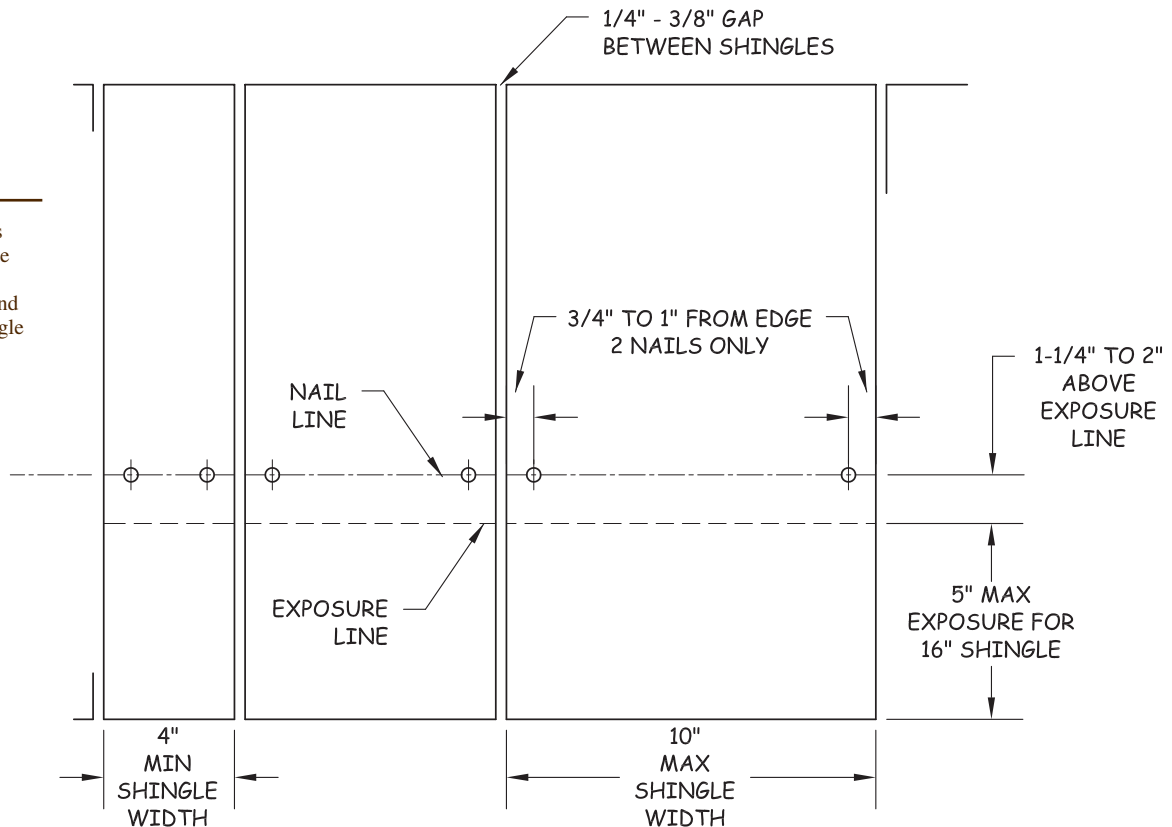


Figure 260—This drawing shows the proper overlaps, overhangs, and joint spacing for a wood shingle roof. The “X” symbols show what **not** to do: don’t lay the shingles with stacked joints.



Figure 261—This edge view of the stud barn roof at the Nine Mile Ranger Station (Lolo National Forest, Northern Region) shows rakers and three layers of shingles. The shingles immediately above the fascia are rakers. You can tell which shingles are rakers because their end grain is exposed, rather than the edge grain exposed on the sides of other shingles.

Figure 262—This drawing shows the proper exposure, nailing patterns and spacing, and shingle width for a wood shingle roof.



Only use shingles that are between 4 and 10 inches wide. Split wider shingles into narrower shingles. Discard any shingles narrower than 4 inches or use them elsewhere as shims or for kindling. Hand drive the nails and set them flush with the surface of the shingle. Do not drive the nails below the surface of the shingle; the wood fibers will break, causing early deterioration and rot. Do not overdrive the nails to achieve the required penetration of one-half to three-fourths of the sheathing depth; buy longer nails.

Generally, lay the shingles so that the starter courses project $1\frac{1}{2}$ inches beyond the eave or fascia and lay the gable edge shingles so that they extend 1 inch beyond the gable fascia or sheathing. If the builders laid the historic shingles so that they projected out farther, lay the new shingles the same way.

To easily get an even spacing for the 1-inch overhang on the gable ends, snap a chalkline from the peak to the eave, 4 inches in from the rake edge. When you pick the shingles for the gable ends, choose shingles that are more than 5 inches wide and make a pencil mark 5 inches from the outside edge of each gable end shingle. Line up the mark with the chalkline for a perfect 1-inch overhang (figure 263). If you must use a shingle narrower than 5 inches, use a tape measure to position the shingle.

Figure 263—You can use a chalkline to produce even spacing for rake edge overhangs on both shingle and shake roofs. Roofers are installing this shake roof on the Office/Cookhouse building at the Moose Creek Wilderness Station (Nez Perce National Forest, Northern Region).

Lay shingles with a triple starter course. Unless the sheathing is uncommonly thick, the nails for the first layer will go through the sheathing because box nails less than $1\frac{1}{4}$ -inches long aren't commercially available. This protrusion won't lead to leaks inside the building because of the coverage from the second and third layers of the starter course, so don't worry about it.

The first starter course layer is the shortest. To easily cut shingles to the correct length for the first starter course, lay the shingles so that the butts extend over the eave line by a distance that is equal to the length of the normal shingle exposure plus $1\frac{1}{2}$ inches. Snap a blue chalkline $1\frac{1}{2}$ inches beyond the eave or fascia and cut the shingles off at the line using a small circular saw (if you have one), or a hand saw. Trimming the first layer is extra work, but it provides a triple starter course without the pagoda look. Use the same technique at the pitch transition on gambrel roofs (figures 264 and 265).





Figure 264—This roofer is using a small circular saw to cut off the first course of shingles on the gambrel of the stud barn at the Nine Mile Ranger Station (Lolo National Forest, Northern Region).



Figure 265—The overhang at the gambrel pitch change on the stud barn at the Ninemile Ranger Station (Lolo National Forest, Northern Region) creates the deep shadow line visible in the middle of this photo.

Next, lay the second starter course of shingles, aligning the butts with the butts of the shorter first starter course shingles. After you place the second starter course layer, you may find it helpful to mark the asphalt felt roofing paper or the shingles with pencil lines that indicate the location of the vertical joints of the starter course layers. Marking the joints allows you to easily space subsequent layers to avoid stacking the joints without bending over to look at the edge of the eave. Lay the third starter course directly on top of the two previous courses.

After you finish the triple starter course but before you start to nail succeeding courses, measure from the eave to the peak on both sides of the roof. If the roof isn't square, slightly adjust the exposure measurement on one side of the roof for several courses until the measurements come out even. Do not adjust more than $\frac{1}{2}$ inch on any course, or the adjustment will be visible from the ground.

Although it takes more time, measure up from the eave—not from the course below—to mark the stringline for each

successive course of shingles. Each course will be evenly spaced if you measure from the eave, because you're measuring from the same point. To mark the bottom edge of each shingle course, stretch a chalkline all the way across the roof, from side to side between measured marks, and snap it. Lay the shingles along that line (figure 266). You also can snap a second chalkline to guide nail placement $1\frac{1}{4}$ to 2 inches above the exposure line for each course, if you wish.

Pause for a reality check when you have covered the lower half of the roof with shingles. If the highest half dozen courses of shingles or shakes aren't parallel with the ridge cap, you will have an ugly roof. To check whether the courses you've laid so far are parallel with the roof ridge, measure from the course line to the ridge at each edge of the roof and in the middle. If you find that the courses aren't parallel to the ridge despite the adjustment you made after laying the triple starter course, stop measuring from the eave for each course and measure from the ridge as you shingle the rest of the roof. Adjust the course line spacing over several courses as described earlier.

Keeping the Rain Out



Figure 266—This roofer is laying shingles in courses on the west house at the historic Ninemile Ranger Station (Lolo National Forest, Northern Region). The shingle courses are evenly spaced due to careful measuring and the use of chalklines. The chalkline for the current course is visible in the photo. The horizontal spaces between the shingles are reasonably even.

To roof across a concave roof pitch transition, such as from a porch roof to the main roof, your shingles must be flexible enough to bend a little without cracking. Soak bundles of shingles in water overnight to make them flexible. Lay the soaked shingles tight, with no more than a 1/8-inch joint between adjacent shingles. The shingles will dry out and shrink, producing normal joint spacing but retaining their slight curve. You may have to stand on the shingles as you nail them to get them to flex across the transition. Use flashing where the pitch changes sharply; shingles flex only so far, even after soaking.

Cut off the tails of the shingles in the courses near the peak of the roof to make them even with the peak. You can cut the

tails on the ground before installing them or cut them after you nail them to the roof (figure 267). If you choose to cut the shingle tails after installation, lay a shingle course on one side of the roof and use a saw to cut the tails, then switch to the other side and repeat the process. Switch back to the other side and use the same process until you reach the ridge. This method of switching from one side to the other interweaves the shingles at the peak, adding extra weather protection. Do not lay a course so close to the ridge line that you have to cut the shingles shorter than the weather exposure or shorter than the width of the ridge cap. Install the ridge cap as described in the [Ridge Caps for Wood Shake and Shingle Roofs](#) section of this guide.



Figure 267—This roofer is using a small circular saw to cut the tails off shingles near the ridge of a roof.

Reroofing With Wood Shakes

Install shake roofs in much the same way as shingle roofs, but with some differences. For instance, lay double starter courses for shake roofs rather than the triple starter courses you would lay for shingle roofs.

For most roofs, lay 18-inch shakes with a 5½-inch exposure, 24-inch shakes with a 7½-inch exposure, and 36-inch shakes with an 11-inch exposure. This method provides a triple layer of protection for the entire roof. If the original builders laid the historic shakes with a different exposure that provides a triple layer of protection, install the new roofing with the same exposure.

If the historic roofing doesn't provide a triple layer of protection, consider using longer shakes or a shorter exposure length when reroofing, even if it changes the appearance of the roof. A roof that leaks hastens the deterioration of the cabin, so the longer life of the building may be well worth

the change of appearance. 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 to learn if you must consult with or obtain approval from the SHPO for the change.

Lay shakes with ⅜- to ⅝-inch spaces, called joints, between adjacent shakes on each horizontal course. As with shingle joints, stagger the shake joints at least 1½ inches to prevent joint stacking and leaks.

For shake roofs on solid sheathing (figure 268), handle the nailing, measuring and marking of courses, roof jacks, overhangs, pitch transitions, and shakes near the peak of the roof the same as you would with shingle roofing. Roofing methods are a little different if you lay the shakes directly on purlins or on skip sheathing.



Figure 268—Roofers are installing a new shake roof on the Wash House at the Moose Creek Wilderness Station (Nez Perce National Forest, Northern Region). This 1937 log building has solid roof sheathing.

Builders sometimes interwove 30-pound asphalt roofing felt between shakes laid on skip sheathing (figure 269). To interweave roofing felt, lay the bottom edge of each row of felt two times farther from the butt end of the shakes as the distance of the weather exposure. For example, if the shakes are 24 inches long, the weather exposure is 7½ inches, so position the bottom edge of the felt 15 inches beyond the butt end of the shake so that it covers only the upper 9 inches of the shake. The skip sheathing for the courses above supports the upper part of the felt.

If you lay shakes directly on widely spaced purlins with no sheathing, you may need to double course the shakes. Double coursing simply means that you lay two layers of shakes in each course (figure 270), with little overlap between courses. Shake exposure varies according to the length of the shakes and the spacing of the purlins. If you lay double courses, don't forget to stagger the joints on the two layers of shakes in each course and to stagger the joints from the succeeding and previous courses.

The original builders didn't always match the shake length to the purlin spacing. Even if the original builders used shakes long enough to properly span the purlin spacing, subsequent roofers replacing roofing may have used shorter shakes.

Unless photographic or other evidence shows that the original shakes didn't span the purlins properly, use extra-long shakes that match the purlin spacing (figure 271) to provide a more durable, water-resistant roof. If you must use short shakes to replicate the historic appearance, set the nails into the purlins. The nails will be visible on the finished roof, but that's less important than securely attaching the shakes to the roof structure.

People who spend time in cabins with shake on purlin roofs during dry summer weather sometimes are disconcerted to discover that they can see a few stars through the roof at night or a glow of sunlight during the day. Although the stars or sunlight are visible, a sound, properly constructed shake on purlin roof won't leak, except during some wind driven rain events. The shakes are positioned to shed water. Also, when the shakes get wet, they swell and make a tighter roof.

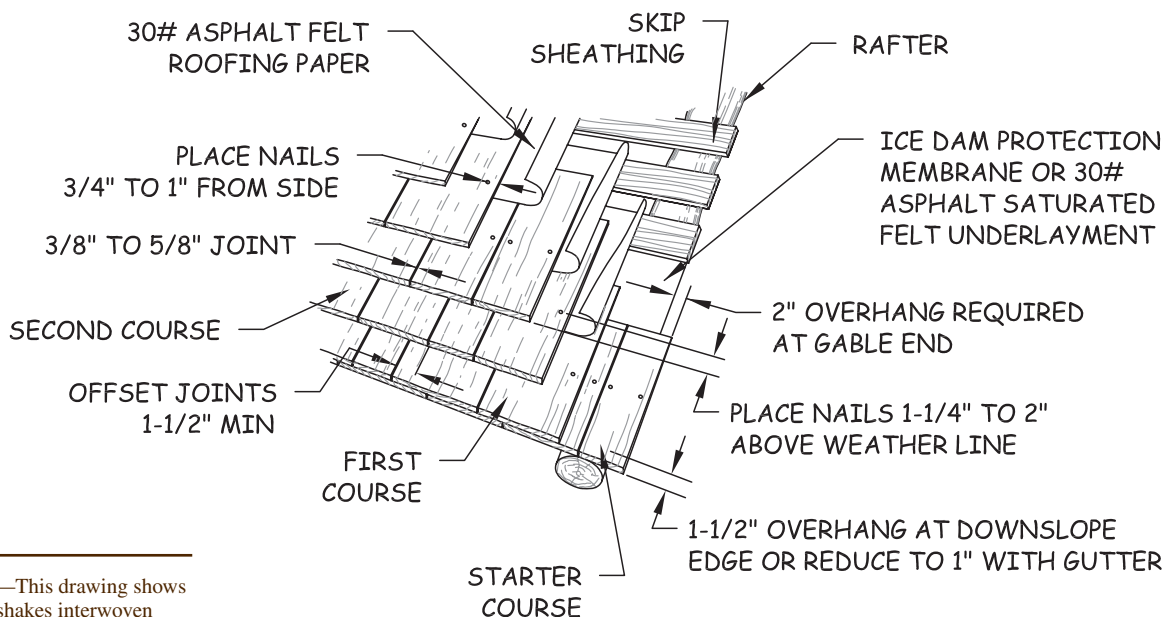


Figure 269—This drawing shows how to lay shakes interwoven with roofing felt on skip sheathing.

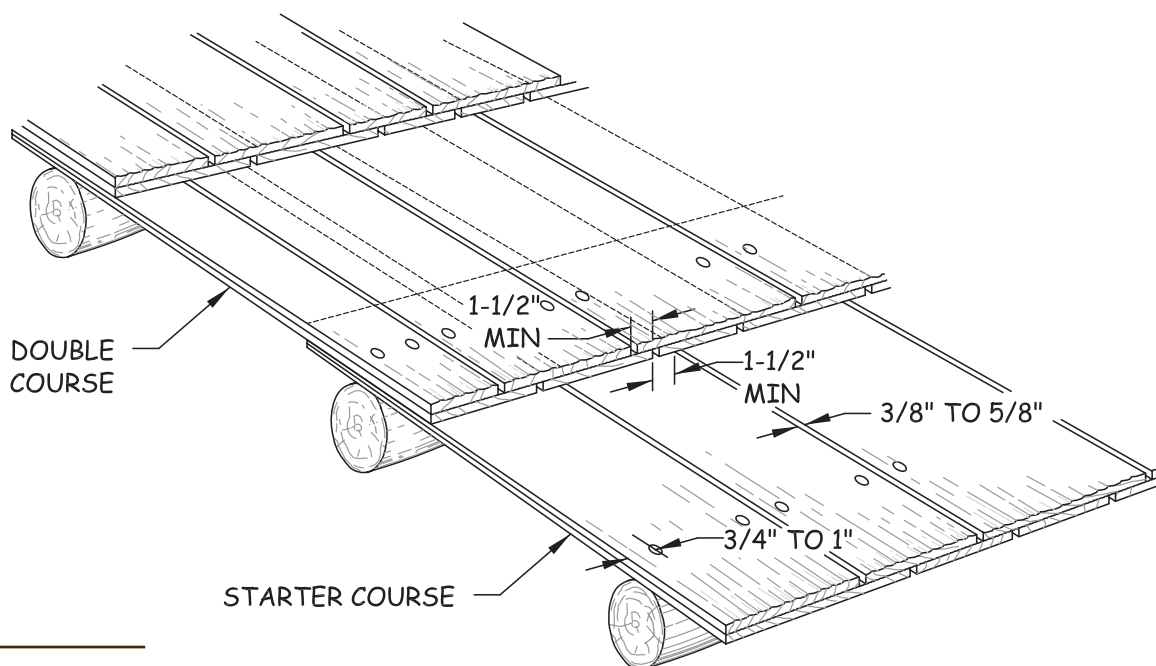


Figure 270—This drawing shows how roofers commonly lay double coursed shakes directly on purlins.



Figure 271—This crew laid 32-inch-long shakes on the purlin roof of the fire cache at the Moose Creek Wilderness Station (Nez Perce National Forest, Northern Region) during the 1990s. If they were laying the shakes today, they all would wear hard hats and would wear fall protection harnesses while working on the upper courses.

Ridge Caps for Wood Shake and Shingle Roofs

Finish each shingle or shake roof with a ridge cap that matches the original or is an appropriate substitute, as identified in the condition and historic assessment or by your heritage specialist or archaeologist. No matter what the ridge cap style, always use nails long enough to reach the sheathing or ridge purlin. Before installing any type of ridge cap, provide extra insurance against leaks by laying a strip of self-adhering ice and water shield (slightly narrower than the ridge cap) over the roofing shakes or shingles where they meet at the peak of the roof.

Metal ridge caps (figure 272) and board ridge caps (figure 273) are relatively easy to install. Just nail the cap in place over the top rows of shingles. Make sure to tightly butt together the two boards that make the board ridge cap. Miter the overlapping edges of the boards to match the pitch of the

roof for a tight, attractive joint. Ensure that the joint between the two boards is on the lee side of the roof (facing away from the prevailing wind).

Form cock's comb ridge caps by leaving log shingle tails on the windward side that extend above the ridge of the roof. Simply extend the shingles or shakes of the top course about 6 inches above the ridge of the building. Either precut the cock's comb shingles or shakes to the correct length before installing them or use a small saw to trim them along a chalkline after you place them (figure 274).

The upper ends of the shingles or shakes in the top course on the lee side must fit tightly to the extended cock's comb shingles or shakes on the windward side. Cut the top course lee side shingles or shakes to the correct length before installation.

Keeping the Rain Out



Figure 272—Preservation crewmembers carefully removed and reinstalled the original metal ridge cap after replacing the shingles on the Moose Creek Garage (Helena National Forest, Northern Region).

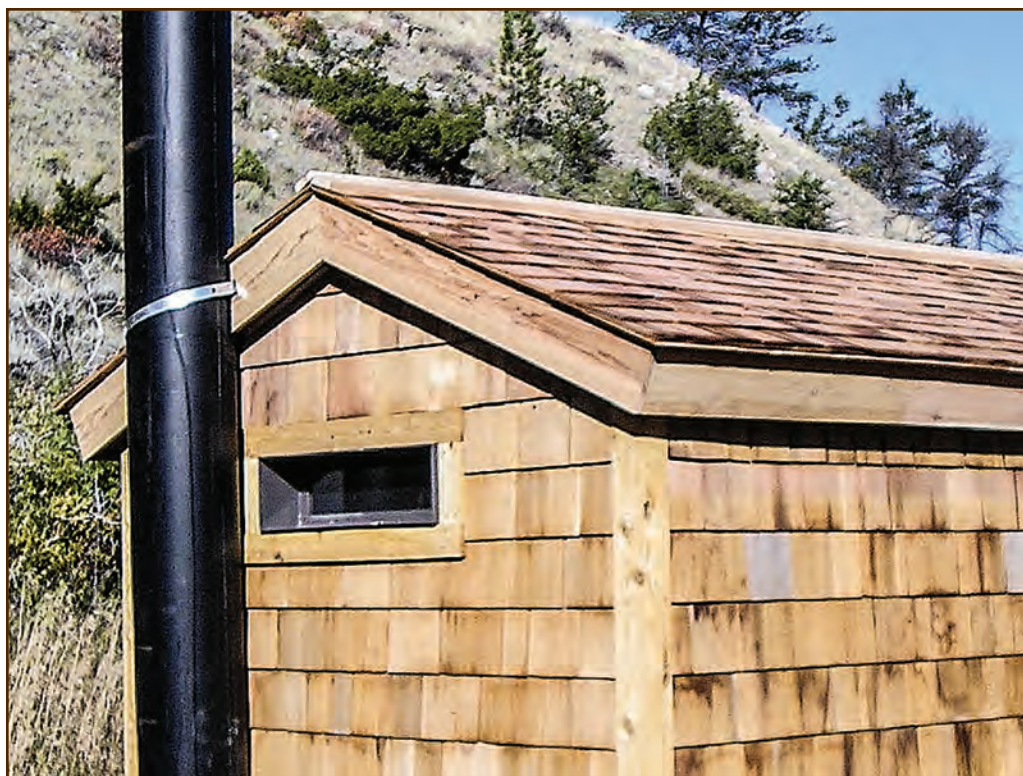


Figure 273—Although the Sage Creek vault toilet building isn't a log cabin, it does have a shingle roof with a board ridge cap. The outhouse serves the historic log cabin at Sage Creek (Custer National Forest, Northern Region).

Keeping the Rain Out



Figure 274—This roofer is using a small hand saw to trim the ends of the cock's comb ridge for the replacement roofing on the Moose Creek Wilderness Station Office/Cookhouse building (Nez Perce National Forest, Northern Region). Although the roof that the preservation crew replaced had a shingle ridge cap, historic photos showed that the original ridge cap was a cock's comb. The crew took the opportunity presented by the need for new roofing to restore the original configuration.

You can make the most common ridge or hip cap for log cabins roofed with shingles or shakes from the same shingles or shakes you use for the roof (figure 275). This ridge cap consists of an overlapping series of L-shaped, uniform width, two-shingle units joined together along one edge to create an angle that matches the angle where the two sides of the roof meet at the ridge. Lay them individually along the length of the ridge with the same exposure as the roofing shingles.

You can purchase manufactured ridge cap units, construct them on the ridge, or fabricate them on the ground. You can special order manufactured ridge cap units to match any roof pitch, but they normally are only available in a few shingle and shake styles and wood species. If you purchase manufactured ridge cap units, ensure that half have a right-hand overlap and half have a left-hand overlap so that you can alternate overlaps when you install them. You may not be able to find manufactured ridge cap units that match your cabin's shingles. In this case, you must make your own.



Figure 275—Preservation crewmembers constructed this shingle ridge cap when they replaced the roofing at the Ninemile Ranger Station (Lolo National Forest, Northern Region).

If you make your own ridge caps, choose the width of the shingles or shakes carefully to cover an area that is about 1 inch wider than the length of exposure used on the roof. Because overlapping pairs of shingles or shakes make up the ridge units, half of the shingles or shakes must be wider than the other half by the same amount as the thickness of the shingles or shakes. For example, if you lay 16-inch-long shingles, the standard exposure is 5 inches and the shingles are just shy of ½-inch thick. In this situation, half of the shingles for your ridge cap must be about 6 inches wide and the other half must be about 6½ inches wide to provide proper and equal coverage on both sides of the ridge. You need to fasten one wider and one narrower shingle together to create each ridge cap unit. Build half the ridge cap units to lap to the right and half to lap to the left.

To construct a good, tight overlap joint, set a table saw to the angle of the roof pitch and cut the overlapping edge of the wider shingles to that angle. Then, set the table saw to the angle perpendicular to the roof pitch and cut the underlapping edge of the narrower shingles to that angle. Assemble the cut shingles on the ground or take them up on the roof to assemble them.

To speed the actual on-roof installation, you can build a simple jig that matches the roof peak and you can assemble the shingle cap units on the ground ahead of time. Use an air stapler to fasten the two halves of each ridge cap unit together. Use three staples evenly placed from the butt to the middle of each pair of shingles. Make sure that you set the stapler pressure to drive the staples flush with the surface of the shingle, neither protruding nor indented. This application is the only acceptable use of staples on a shingle.

The following steps explain how to construct a shingle ridge without using manufactured or prebuilt ridge cap units. This example is for a roof covered with 16-inch-long, ½-inch-thick shingles using a 5-inch exposure. Adjust the measurements proportionally to match the length and thickness of your roofing. You will be working on the highest part of the cabin roof, so be sure to follow proper safety precautions to prevent falls.

1. Starting at the lee end of the roof, lay one 6-inch-wide shingle horizontally on your side of the roof with the shingle butt end on the roof's gable end and the top edge of the shingle even with the roof peak. Nail the shingle with two nails, 6 inches from the butt (1 inch plus the exposure).
2. Reach over the other side of the roof and lay a 6½-inch-wide shingle horizontally with the shingle butt on the roof's gable end and the top edge tight against and overlapping (but not overhanging) the top edge of the first shingle, so that the joint faces you. Nail it in place using two nails, 6 inches from the butt.
3. Install the third and fourth shingles the same way, but put the 6-inch-wide shingle on the side of the roof away from you and the 6½-inch-wide shingle on your side of the roof, so that the overlap is reversed and the joint faces away from you. Place the butts of the third and fourth shingles 5 inches closer to the middle of the roof ridge than the butts of the first two shingles.
4. Repeat the process, alternating the direction of the overlap with each ridge cap unit, all the way across the peak of the roof.

A variation of this type of ridge cap reverses the direction of the ridge shingle butts at the middle of the roof peak. To lay this type of ridge cap, mark the middle of the roof peak and then lay the ridge cap shingles as described above from both ends until they meet in the middle. At the middle, interlay

four shingles and cap them with a ridge cap unit, spanning the point where they meet. The middle cap shingles will have exposed nails (figure 276). Another variation of this type of ridge cap includes using metal flashing under the ridge cap (figure 277).



Figure 276—Preservation crewmembers constructed this complex shingle ridge cap while replacing roofing on the Zortman Guard Station within the Bureau of Land Management's HiLine District in Montana. The shingle butts switch direction in the middle of the roof peak, and a cross gable also intersects the main ridge line at that point. Because of the cross gable, the crew cut a notch into one side of the ridge cap unit at the middle of the roof.

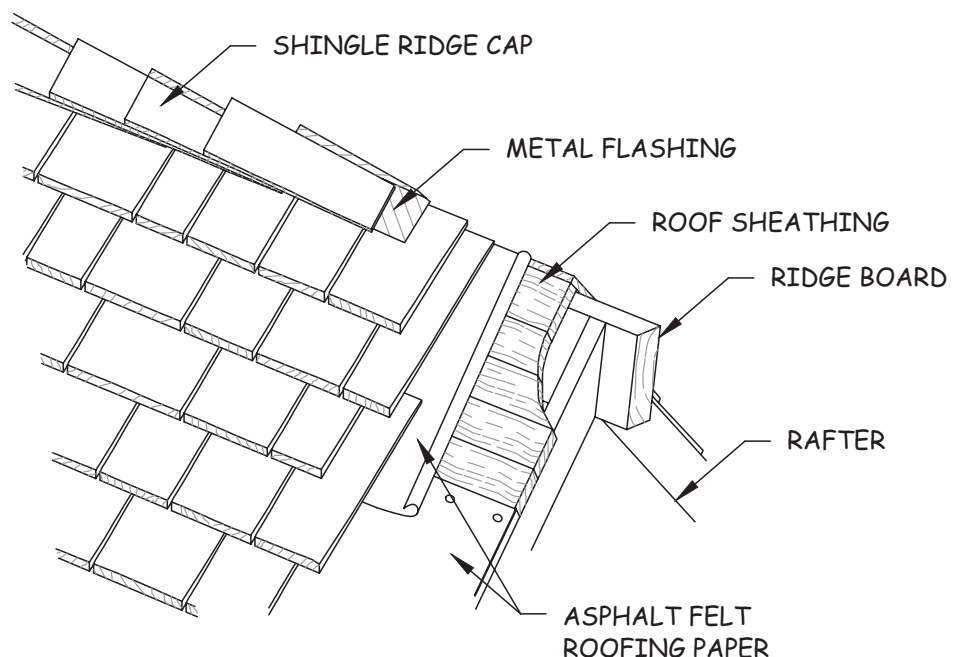


Figure 277—This drawing shows how to add metal flashing under a shingle ridge cap for extra leak protection. The same method works for adding self-adhering ice and water shield leak protection.

Reroofing With Metal

Unless you are replacing generic, corrugated metal roofing, metal roof installation isn't a project for the do-it-yourselfer. Specialized tools and techniques vary with manufacturers and generally require an experienced installer to obtain good results.

The most important thing to understand about metal roofing is that metal expands and contracts with temperature changes far more than other roofing. Fastening systems for metal roofs must accommodate this expansion and contraction or leaks develop as the metal rubs against and expands the holes around the fasteners.

Some metal roofs, such as a standing-seam style, have clip fasteners that handle expansion and contraction by allowing the panels to "float" over the roof structure. Other metal panels have ridges that allow accordion-effect movement between fasteners. Screw-down systems generally rely on elongated fastener holes and gasketed screws to accommodate longitudinal panel expansion and contraction. Other

systems rely on combinations of these methods to provide a leak-free roof.

Because of these differences, it is very important to follow the manufacturer's instructions to install metal roofing. For any metal roofing other than corrugated, the best advice is to hire an experienced contractor who understands historic buildings and who the manufacturer has trained to install the roofing you chose. Some contractors will allow you to assist with the work, which helps to reduce the cost. The rest of this section applies only to the installation of corrugated metal roofing.

You are most likely to achieve a leak-free metal roof installation by laying ice and water shield over the entire roof before you install the metal roofing (figure 278) and by using gasketed screws to attach the roofing. Ice and water shield for metal roofs is different from ice and water shield used for other roofs. Look for a label specifying the shield's suitability for use with metal roofs or for use under sustained high temperatures.



Figure 278—Preservation crewmembers are laying a new corrugated metal roof over ice and water shield on the Sav-enac Tree Nursery Bunkhouse (Lolo National Forest, Northern Region), built in 1930. The roof is the same kind you would find on log cabins of a similar vintage that have metal roofs.

Only lay ice and water shield over continuous sheathing. If the builders originally laid your historic metal roof over purlins or skip sheathing, you may be able to add continuous sheathing so you can install ice and water shield. Doing so will produce a more durable roof, but could lead to condensation or other problems for the cabin if the sheathing is not designed properly.

Before adding sheathing, be sure to consult with an engineer experienced in designing roofs. Without a proper design, adding sheathing could overload the rafters, purlins, or trusses. The engineer must design fastener spacing properly for the type of sheathing on the cabin and for the typical wind uplift at the site. 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 to determine if you must consult or seek approval from the SHPO for the change.

Eyeballing a sheet of metal roofing and laying it so that the seams and ridges appear to be perpendicular to the logs of the cabin is very difficult. Use chalklines to simplify aligning the panels. Measure from either the ridge or eave line, whichever is straighter and more nearly level, to mark your chalk lines.

To create guidelines perpendicular to the ridge or eave, use the geometry of right triangles. An easy-to-remember right angle triangle has one leg that is 3 feet long, one leg that is 4 feet long, and a connecting side (hypotenuse) that is 5 feet long. This arrangement is referred to as a 3-4-5 triangle. Larger triangles with the same proportions would be 6-8-10, 9-12-15, 12-16-20, and so on. If you create this sort of right triangle and position the “3” side parallel to the ridge or eave, you can use the “4” side of the triangle to align the long edge of the roofing because it will be reliably perpendicular to the “3” side.

How To Create Perpendicular Guidelines Using a 6-8-10 Triangle

1. Measure 1 foot up from the eave or 1 foot down from the ridge, whichever is straighter, at each end of the roof. Snap a chalkline the full width of the roof.
2. Mark a point on the chalkline near whichever end you plan to start placing the panels.
3. Measure 6 feet along the chalkline and mark a second point.
4. Next, have three people with two tape measures create the other leg and hypotenuse of the triangle.
 - a. Have a person hold the zero end of one tape measure at the first marked point.
 - b. Have another person hold the zero end of the second tape at the second marked point.
 - c. Have the third person hold the other end of the first person’s tape at the 8-foot mark and the other end of the second person’s tape at the 10-foot mark so that they cross to create a perfect right triangle.
5. Snap a line from the point marked in step 2 (shown as “starting point” in figure 279) to the point where the third person holds the junction of the two tapes. This line is your first perpendicular guideline.
6. Use the same triangular procedure to mark a perpendicular guideline at the other end of the roof. Snap a chalkline from the junction points of the two triangles to create a second horizontal chalkline that is parallel with the line that is 1 foot up from the eave or 1 foot down from the ridge of the roof.
7. As you lay panels across the roof, they will cover your first perpendicular guideline, so mark several perpendicular guidelines. To do this, measure matching distances from your first perpendicular guideline on the upper and lower parallel horizontal chalklines, mark those points, and snap perpendicular chalk guidelines between the matching distance points.