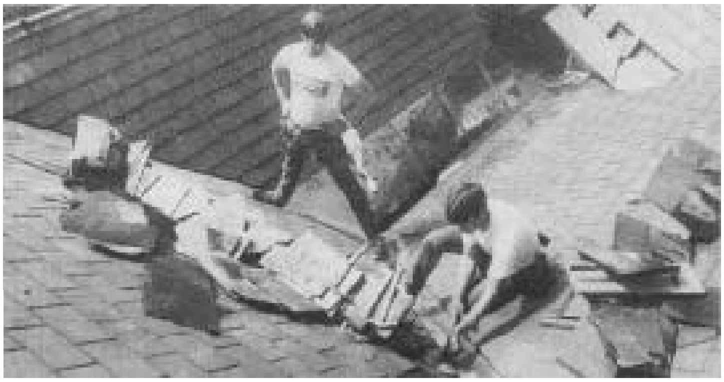
FLASHING PRIMER



The copper valleys and other flashings, installed when the slate roof was completed in 1899, began to develop pinhole leaks around 1975, and was replaced 10 years later by the author of this article.

Paul Boisvert

Details for leak-free flashing with slate, wood, asphalt, and clay

by Les Gove

The primary purpose of any roof is to protect the interior of a building from rain and snow. In addition, the roof should add to the character of the building. A proper flashing job is essential for both. In fact, how long a roof will serve you maintenance-free depends largely on the durability of the flashing materials, and how they are applied.

In this article, we'll discuss basic flashing principles and techniques that apply to all shingle-type roofing materials, including slate, clay tile, asphalt, and wood shingles and shakes. The materials most commonly used for roof flashing now are copper, lead-coated copper, galvanized steel, aluminum, and lead. Several others, such as zinc, stainless steel, and terne-coated stainless steel, are less common but seem to be the fancy of some architects and contractors.

Valleys

There are two techniques for forming a valley. First, we will consider an open valley (see Figure 1). In colder climates, such as northern New England, this seems to be the best choice. An open valley is formed simply by laying strips of sheet metal that are already pre-bent to conform to the roof. The strips are normally 8 feet long. If they are longer than 10 feet, you'll run into problems with excessive expansion and contraction.

For jobs that use long-lasting roofing materials such as slate or clay tiles, you may want to use the cleat method to fasten the valley strips. This technique makes a lip up each edge of the valley, which not only prevents water from penetrating beyond the valley, but also raises the edge of the rigid roofing mate-

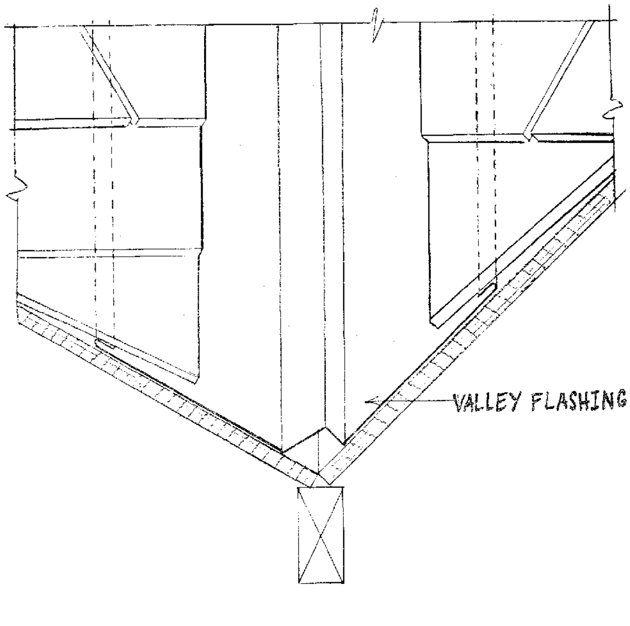


Figure 1. *Open valley: Usually the best choice in cold climates.*

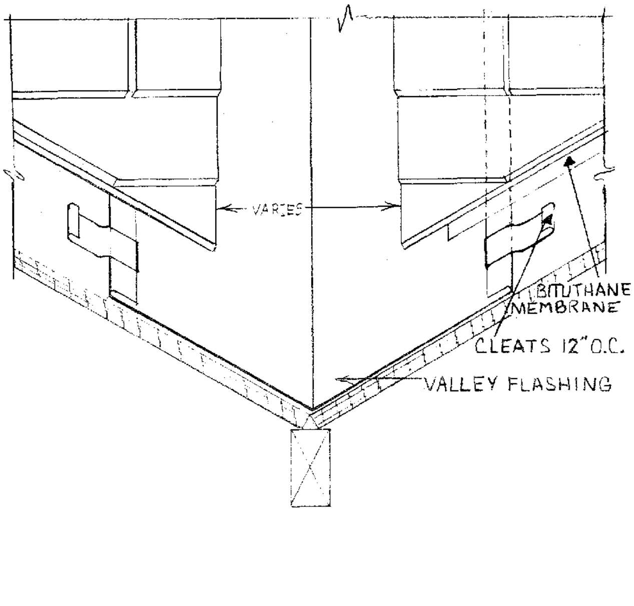


Figure 2. *Valley with unequal slopes: This should have a standing seam in the center to slow the flow off the steep roof.*

rial slightly above the flashing. This prevents a line of corrosion from forming where the edge of the roofing rests on the flashing. The corrosion is due to water being conducted along the edge of the roofing, rather than flowing down the middle of the valley.

The typical width of the exposed valley flashing varies in different parts of the country. One rule of thumb that is widely accepted is that the farther you get from the top of the valley, the farther away the roofing material should be from the center of the valley. This allows for the heavier flow of water lower down in the valley.

At the top, the distance from the center of the valley to the edge of the roofing usually ranges from 2 to 4 inches. As you work your way down the valley, the distance increases by 1/2 inch for every 8 linear feet. All of this has to be established before the valleys are installed, since the metal flashing should extend under the roofing materials at least 4 inches, preferably more. And at no time should the valley be pierced by roofing nails—even when asphalt shingles are used.

Where intersecting roofs are on different slopes (Figure 2) the valley should be formed with a standing seam in the center of the valley. The standing seam will soften the force of the water from the steep roof and keep it from being forced under the opposite side.

Any valley flashing can be enhanced by using a bitumen waterproofing membrane, such as W.R. Grace's Ice & Water Shield. It can be used underneath the valley or, better yet, running up each side of the valley and lapped over the valley flashing, as shown in Figure 1.

A closed valley (Figure 3) is installed by laying the roofing materials tight to the valley line using the step-flashing method. This is not the usual procedure for asphalt shingles, since they can be woven several different ways without using metal flashing. A closed valley has a very clean and appealing look. However, it tends to hold more snow and ice than an open valley does, so it's not as practical in areas that get much snow.

Lines of corrosion will form unless the edges of the valley flashing are formed with lips.

There are two general ways to flash the ridge of the roof. First, you can use the same materials that were used for the roof. (Each manufacturer has details for its specific product.) Second, you can use a metal ridge cap—typically seen on slate roofs (Figure 4). A metal cap may not be as appealing to the eye, but may give you better service in the long run, as the ridge gets a lot of abuse from ladder hooks and traffic for repairs or chimney cleaning.

The side flanges of the ridge cap should have a minimum width of 4 inches. Each 8- or 10-foot length of ridge cap should be overlapped at least 3 inches and sealed to prevent rain from being driven in sideways.

The method and material used for fastening the ridge cap should correspond to the metal being used. The older method of using a galvanized strap and galvanized nails did a good job of securing the ridge cap, but the straps eventually rusted and stained the roof. When used with zinc ridge caps, the galvanized straps often corroded the cap itself. A better method is to use brass screws (which do not react with any metal) with either neoprene or lead washers, approximately 24 inches o.c. The same procedure can be applied to hips.

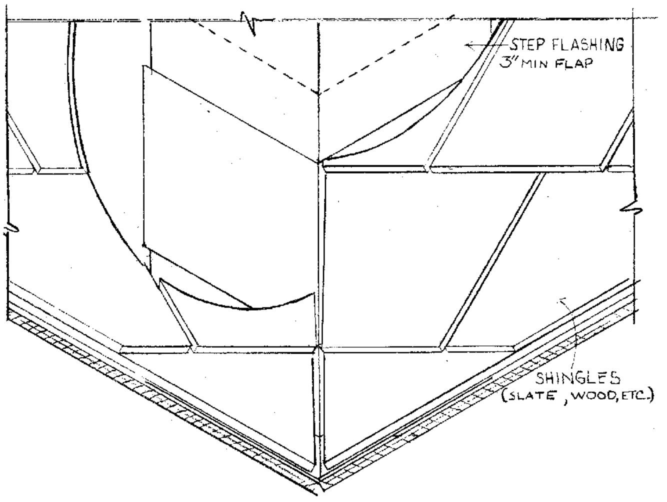


Figure 3. *Closed valley: This detail uses hidden step flashing. It's attractive, but tends to hold ice and snow.*

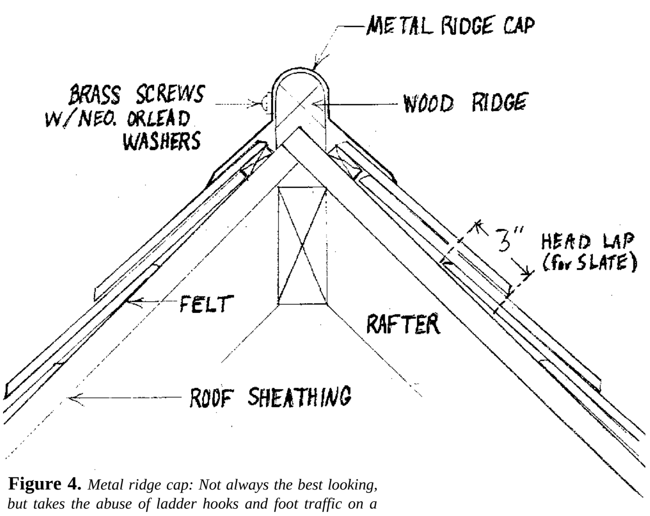


Figure 4. *Metal ridge cap: Not always the best looking, but takes the abuse of ladder hooks and foot traffic on a slate ridge.*

Base Flashing and Step Flashing

Step flashing, as the name implies, is used on a sidewall with a piece of flashing woven into each course of roofing material (Figure 5). The step flashing should be installed so that the next course of roofing material will completely cover it. Extend the lower leg of the step flashing out onto the roof at least 4 inches—many prefer up to 8 inches.

The vertical leg of the step flashing should extend up the wall so that it is covered by at least 3 inches of siding or cap flashing. For instance, if your cap flashing or siding stops 2 inches above the roof, the total length of the vertical leg should be at least 5 inches.

Where a roof runs directly into a vertical wall (parallel with the eave) base flashing is required (Figure 5). The same principles can be applied again. The most important item to note is that the flange sloping down the roof should have at least a 3-inch "head lap" with the roofing material directly below it. This means the flashing should cover 3 inches of the roofing material two courses down. (If this confuses you, see Figure 4, where "head lap" is illustrated.) Whether you cover the base flashing with a final row of roofing material depends on personal preference. However, sometimes it does more harm than good, because you have to puncture the flashing material.

Cap Flashing

Where base or step flashings are not covered by a vertical material (clapboards, wood shingles, slate) a cap flashing should be used (Figure 6). The most obvious place is on a chimney. The cap flashing should lap over the roof flashing at least 3 inches. Turning the lower edge back under itself by 1/2 inch gives the cap flashing some rigidity. Also, with most metals (except lead or soft copper) it's good practice to make a horizontal crease about halfway up the cap flashing. This will create a spring action in the flashing, keeping it tight at the bottom.

In new masonry work, the cap flashing should be laid into the joints at least 2 inches, with a 1/2-inch bend on the inner edge. On restoration work the joints can be raked out, with the metal fabricated to fit. Again, the inner edge should have a 1/2-inch bend to create a fishhook effect. These joints can be secured with a lead wedge and repointed with mortar or a compatible sealant, which many prefer.

Saddles or Crickets

Where any vertical surface breaks through the roof—typically at a chimney—it's best to build a saddle or cricket (Figure 7) to divert water away from the vertical wall. For smaller crickets, light construction such as two pieces of plywood is adequate. In this case, the entire cricket is covered with sheet metal. Two small valleys are formed on the roof sides. The valleys work on the principles previously discussed. The vertical leg of the cricket should lap at least 4 inches underneath the cap flashing since this is a likely place for snow and ice to build up.

If the cricket is a very large area and can be seen from the ground, it is acceptable to cover the cricket with the same roofing material as the rest of the house. Valleys will be formed at the roof, and step flashing used along the sidewalls. It is important that the cricket be large enough to handle the flow of water.

Change in Roof Slope

When a roof changes in slope from a steep to a shallow pitch or vice versa (Figure 8) a flashing is usually required to connect the two (except with asphalt shingles, since they can be molded to the slope of the roof).

Many of the principles outlined earlier can be applied here for the length of the flanges. Pay particular attention where a steep roof dumps onto a low-pitched roof. A 6-inch flange on the bottom and an 8- to 10-inch flange on top are usually adequate here. But a bitumen membrane is also recommended—particularly on the upper slope.

Flashing Materials

The flashing materials should match the type of roofing being used. For instance, for a slate roof that may last well over a hundred years, lightweight aluminum would not be appropriate. Rather, you would want a durable material like copper. Over the past several years, copper has become more affordable and come into the budgets of many builders. It's an ideal metal for flashing as it is easily worked and joined, and is extremely durable.

Presently there are three types of copper being used: cold-rolled, soft, and lead-coated copper. The cold-rolled has captured most of the market. It is less workable than soft copper, but it is far stronger. Soft copper is invaluable where intricate work is involved, since it is easily worked.

Lead-coated copper has a coating of lead on each side, ranging from 2 to 5 ounces per square foot, depending on the grade. The properties of lead-coated copper are the same as those of cold-rolled copper.

Lead flashing at one time was used extensively for cap, base, and step flashing. It's used less often now with the introduction of other materials. But lead is still the most commonly used cap flashing, as it is very malleable.

Aluminum and galvanized steel are widely used today. Both are much cheaper than copper and lead but have

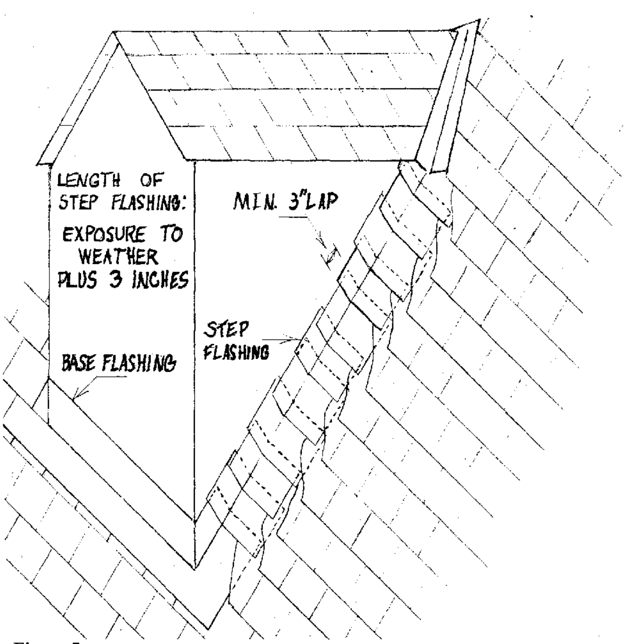


Figure 5. *Step flashing: Each course should be covered completely by the next course of shingles.*

much shorter life expectancies. If you use them, select a sufficiently heavy gauge. Also, since these materials are relatively short-lived, they should be used only with short-lived roofing materials such as asphalt and wood.

When choosing flashing materials, take care not to have dissimilar metals in contact with each other. If dissimilar metals meet in the presence of an electrolyte (which may be moisture from the air, or rainwater) galvanic action occurs. Galvanic action will cause one of the metals to deteriorate. Check the galvanic scale: the metal with the lower galvanic number will corrode. Since copper has the highest galvanic number, the other metals cannot harm it.

Painting the surfaces with a primer or using a gasketing material is recommended if two dissimilar metals are used together. Many architects and builders believe that a reaction occurs between copper and red cedar. I personally have never seen it, but there seems to be enough evidence to discourage this combination.

Sealants

Typically, where watertight seams are needed in metal roofing or flashing, soldering is preferred. A properly soldered seam provides extreme strength and durability. Over the past two decades, however, the use of sealants has grown very rapidly. In some instances, sealants have successfully replaced solder. This is true, though, only in places where the sealant does not have to provide any strength to the joint.

Care should be taken in choosing a sealant. Just because one brand works on one type of metal does not mean it will function on others. Many sealants are known to actively corrode copper. They may seem to perform well at first, but the adhesion breaks down over time. Of course, to guarantee good adhesion, the surfaces involved should be free of dust, dirt, oil, and grease. Use the recommended solvents to remove oil and grease from metal surfaces.

Many sealant failures are due to unrealistic expectations of the material—or the philosophy that the more sealant you heap on a joint, the better the seal. Too much sealant can actually weaken a joint. Also, the sealant is going to have to move with the rest of the building without cracking. Therefore, choose a sealant that is flexible enough for the job and *stays* flexible. Any sealant that is worth using should state its federal specifications (ASTM number) and its hardness when dry. Hardness is often rated by percentage—100 percent being the least flexible.

Galvanic Scale

1 ALUMINUM
2 ZINC
3 STEEL
4 IRON
5 TIN
6 LEAD
7 COPPER

Tips and Cautions

Using common sense is perhaps the best way to assure a tight roof. Ask yourself this: What's the water going to do, where's it going to flow, and what's the easiest course for it to follow? This will help you to flash any area. One of the biggest mistakes made is allowing water to settle in a flat space, such as behind a chimney. Any mason, while constructing a chimney, should be able to flash for a cricket.

Another common mistake is that the flange on a ridge cap, end wall, or base flashing just isn't large enough. The flashing may cover the top of the course of shingles that it rests on, but doesn't lap over the second course down. If this is true, you'll have a small leak that can do a lot of damage to the structure before it appears as a stain on the ceiling. Since many times the flange is a fixed size, the roofing contractor must add enough courses of shingles up under the flange to allow for adequate head lap.

By following these basic formulas, using a metal that complements the roofing material, and using skilled workers, you should have a roof that is maintenance-free for years to come. ■

Les Gove, of Middlebury Slate Co. in Middlebury, Vt., specializes in the repair and restoration of slate roofs.

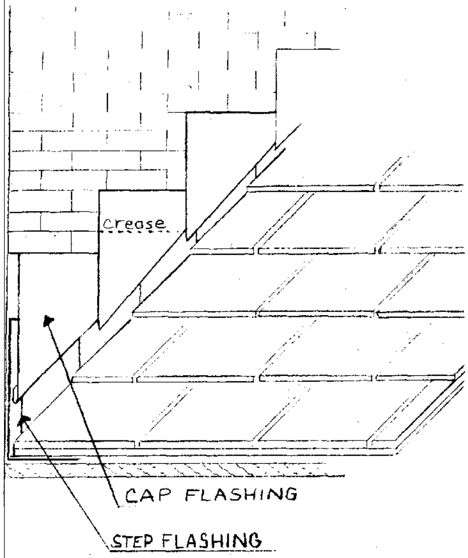


Figure 6. *Cup flashing: Should lap over the base flashing by at least 3 inches. A lip at the bottom and crease in the middle will keep it rigid and tight.*

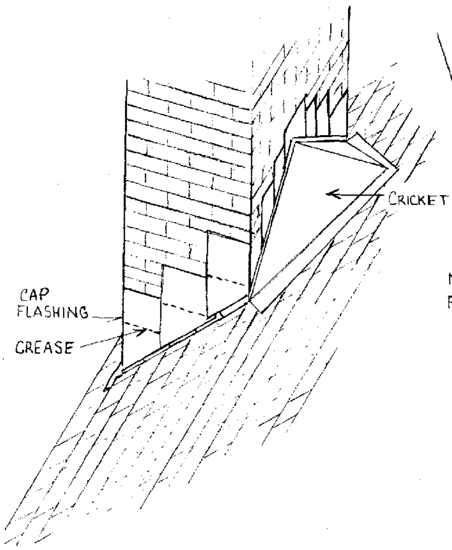


Figure 7. *Saddle (or cricket): Can be covered entirely by sheet metal—or treated as a small roof with two small valleys.*

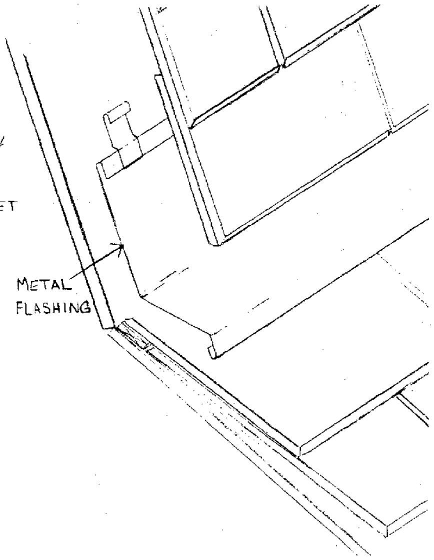


Figure 8. *Change in roof slope: Use large enough flanges, plus a bitumen membrane on the upper slope.*

WEAVING UP THE VALLEY

My oldest son, Bill, is 20 and an accomplished carpenter. He's been building since he was big enough to handle a hammer and saw—about 10 years old. Bill finished high school with a degree in the building trades and went to work the next Monday. When he decided to build a house without a piece of land, the house had to be mobile.

His house on wheels is 12x40 feet, but has little relation to a typical mobile home. It is a product of love, care, and craftsmanship, and is extremely energy-efficient. Bill did a real piece of framer's art with a combination hip and gable roof that gives the inside a wonderfully spacious feeling. Sitting in his living room, you see a sequence of paneled ceiling planes that is at once slightly strange, somewhat grand, and very homey.

The roof is the point of interest this month. It is one of the slight imperfections in an otherwise remarkable structure. The hipped roof hits the gabled roof in a valley, and the shingles from the hip are woven into the shingles on the gable pitch where they meet. I had never seen this woven-valley detail before coming to New England, but around here in coastal Maine it is pretty common. It is an effective detail. The roofing goes on easily, and the valleys are completely waterproof without any flashing or patching.

But the hip on Bill's trailer had a pitch of 4 in 12, and the gable had a pitch of 5 in 12. We're still not sure why, but there must have been a good reason—something relating to the maximum road-clearance height. The framing was tedious, but went together well and turned out beautifully. The pitches were nice flat planes and looked good, so it didn't really matter that they were at different angles. It was a fine job—until the time came for shingling.

The shingles just wouldn't make it up the valley. The weave line kept wandering off the valley line until it was necessary to skip a shingle to make the weave come out right. Bill is a perfectionist and he didn't like this at all, so he ripped up the valley area and redid it, being very, very careful. Same result. A third try produced a weave line that started out a little on the hip pitch, crossed the valley line, and wound up slightly into the gable pitch. He didn't like this, either, but his sense of practicality overrode his need for perfection. He accepted the result and shingled the other three valleys this way.

It took a little while to figure out what had happened. The shingles on both pitches were nailed up with 5 inches to the weather. On the 5-in-12 pitch, this exposure produced a rise of 1-15/16 inches in each course of shingles; on the 4-in-12 pitch, the 5-inch exposure produced a rise of only 1-9/16 inches. This left each course with a mismatch of 3/8 inch in rise, so after five courses the 4-in-12 side was a course behind and needed to skip a weave. The roof had only 14 courses, so it looked more like a bit of sloppy craftsmanship than a fundamental problem. On a larger roof, it would have been much more apparent.

After that, I started looking for other examples, and found that it is actually a common problem. The "funny" woven valley looks particularly bad on a house where the dormers have a double pitch and flare out at the bottom to match a similar flare on the main roof. The roof gives the house a slightly oriental flavor, but the valleys should never have been woven. The whole roof looks sloppy, and it isn't for lack of craftsmanship. As the saying goes, you just can't get there from here.

I know of two solutions. The first is obvious: Don't weave the valleys; use conventional metal flashing instead. The second is a little more subtle: Vary the exposure, with more on the shallower pitch and less on the steeper pitch, so that the rise of each course is the same. On the mobile house, an exposure of 4-1/8 inches for the 5-in 12 pitch would have produced a perfect match to the 5-inch exposure on the 4-in-12 pitch. With this, the weave would have run up the valley perfectly.

I calculated these numbers with a little trig on my ever-handy briefcase calculator, but high tech isn't really necessary. Appropriate matching exposures can be found by messing around with a level and a tape on the actual valleys of the roof to be shingled.

Mismatched exposure is a strange solution, and it runs counter to the basic rule for waterproofing. The rule (and common sense) says that reduced exposure should be applied to a lower pitch to tighten it up and keep rain out. But to match a woven valley, the shallower pitches need *more* exposure.

A solution like this feels strange, but it works. It should be used judiciously, and probably only on small expanses of roof. ■

—Harris Hyman