Chimney Flashing Systems

Flashing is a particularly important aspect of water exclusion for the home. There are two types of chimney that may penetrate the roof, metal or factory built chimney and field built masonry chimney.

Factory Built Chimney

For factory built chimneys the chimney manufacturer makes a specific flashing to be used. Some install in a self evident manner, others have very specific instructions. These flashing are designed to help define the clearance to combustible roof materials.

Field Built Masonry

Masonry chimneys may be built of brick, solid cinder block, or stone. In some cases the masonry is stucco applied to a framed structure. In that case the actual chimney is a factory built chimney and the structure surrounding it is called the chase. Sometimes the chase is clad with siding. In all cases the structure needs to have flashing.

Chimney flashing is very vaguely approached by chimney code and standards. The IRC abdicates to the shingle manufacturer's instructions. The NFPA211 only says that the chimney must be flashed. There is no real consensus among manufacturers. Further, manufacturer instructions rarely cover counter flashing. This document attempts to pull together best practices from manufacturer instructions and incorporate some ideas about clearances and fire safety.

All flashing is composed of two elements, base flashing, and counter flashing. The base flashing is installed on the roof and is interleaved with the shingles as they are laid up. The counter flashing is installed on the chimney. The two elements are independent of each other because each surface moves in a different fashion with expansion and contraction. If the two elements were connected they would tear each other apart. Because of this we have both base flashing and counter flashing.

Base Flashing

The base flashing is comprised of metal. It is bent along its long axis at 90 degrees. In our research, the most explicit instruction was that the height should be at least equal to the shingle reveal, or the part of the shingle that is exposed, commonly about 6” . The leg that is against the chimney should be tall enough to prevent wind driven rain from being blown up over it. Some instructions allow for as little as three inches. The most common height is 4 inches. Flashing manufacturers typically make a range of heights from 2” to 8”. The shorter ones are intended for sidewall flashing such as shed dormers. Some roofers make base flashing on site. We recommend at least 6”. Flashing that is 6 x 6 x10 is commonly available at roofing supply companies.

The leg that is against the roof should also be a minimum of 6”. The most common instruction is for 4”. However, all illustrations are based on sidewall installations. With chimneys, a 2” clearance to combustibles is needed.

The base flashing needs to bridge that gap and extend under the shingle to prevent wind driven water from rolling back under the flashing. Therefor, that 4” minimum should be extended to 6”.

The final dimension is the length. The length should be 1.5 times the shingle reveal. That allows for the single nail that will secure the base flashing to be driven into the deck above the shingle. That leaves that nail covered instead of letting it be a path for water entry. No other nails should penetrate the base flashing. To secure the shingles in that last 6 inches an approved roofing adhesive should be used.

Two other base flashing components are the apron and saddle. The apron should extend to the reveal of the last full course of shingles below the 2 inch clearance between roof framing (and deck) and the chimney. For decoration, pieces of shingle may be glued to the apron with an approved mastic, but should be spaced at least 2 inches from the chimney.

Counter Flashing

There are many ways that counter flashing is installed on chimneys. Some are based on convenience to the roofer, some are based on the longevity of a water tight system. Most fall into two categories, gutter flashing and tuck flashing. An exception is with stucco. When installed with a stop bead, stucco performs as the counter flashing.

Gutter Style

Gutter flashing, sometimes called K flashing, is fast and easy. It requires frequent maintenance. Because the masonry is a friable surface, over time any sealant applied loses adhesion. Water seeps into the pores of the masonry, freezes and breaks the seal. Gutter flashing is connected to the chimney using nails or screws. Because of the greatly disparate expansion coefficients (Brick: 5, Aluminum: 21, Steel: 12, Copper: 16),long stretches of gutter flashing are prone to flexing and buckling, also breaking the seal. Flexing may also cause the metal to fail due to fatigue. Gutter style flashing should be inspected bi-annually to ensure an intact seal. As sealant applications pile up they can look ugly and begin to be impossible to evaluate. After 3 applications it is best to replace the counter flashing.

Step Style

Step flashing is a style that is only legitimately installed as the chimney is built. It should extend through a joint rising up on the inside of the chimney wall and down outside over the base flashing. Sometimes look alike is installed in a reglet channel cut into the masonry joint. In that respect it is similar to tuck flashing (below). Differently, though each step needs to be sealed to the next step or water may be blown through the laps. Sealants may be flexible like silicone sealants. They may be rigid such as is the case with soldered laps. Soldered laps can introduce buckling and tearing because of expansion and contraction flexing.

Tuck Style

Tuck Style is a superior style of counter flashing. It consists of a continuous piece of metal for each side. A reglet channel is cut into the masonry. That is filled with a sealant such as silicone. The counter flashing is tucked into the channel. Since the sealant is captured in the channel freezing water can not work on the sealant such as with the gutter flashing. Since tucked flashing floats int the channel it is not subject to flexing and buckling. Corners remain a place where sealant must be maintained.

Potential Points of Entry

There are a few paths for water to take in the vicinity of the chimney. The basic path is gaps in the materials. Nails, unless gasketed are penetrations where water may weep. Flexion in the decking from wind forces may loosen nails. In general the underlayment provides a gasket for nails. Where shingles abut the chimney tightly, expansion of material may cause buckling. Of course shingles should not abut the chimney due to clearance requirements, but many roofers install them tightly anyway. Wind driven water can overcome short flashing materials.

Materials

All chimney flashing must be non-combustible. That means metal. The main metals used are lead, copper, galvanized steel and tin plate, and aluminum. The metal chosen should be resistant to corrosion.

Lead

Lead is metal used for the longest time. It is quite malleable and lends its self to forming for tile and slate. While it is very durable it has certain drawbacks in our modern world. First the cost is higher than most materials. As a naturally occurring material, there is a finite amount of lead in the world, and like any situation where there is an increase in demand and a decrease in supply, the price of lead flashing has increased quite significantly over the years. Now, there is an argument to be made that because of the flashing's longevity it will eventually pay for itself. However, this is entirely dependent on the scope and budget of your project.

Not only this, but as lead holds on to it’s value flashing produced from it can be a far more tempting target for thieves. While this occurs more commonly on larger and older buildings, such as churches, the possibility can be enough to deter potential buyers.

It is no secret that lead can be poisonous. As such, proper precautions always need to be taken to protect both the occupants and builders. This includes wearing gloves and washing your hands, face and other exposed areas with soap and water after working. You should also make sure that the lead is covered with Patination oil. This treatment helps prevent lead carbonate from forming. It is a white powder that can form on the flashing when it is exposed to rainwater. Lead carbonate is toxic and, when washed down onto adjoining roofing, leaves unsightly stains. If it should flow onto the ground it spreads the contamination potentially entering the living space via footwear or on the wind. Inspectors should be on the look out for this powder! Bi-annual inspection is recommended for lead flashing.

Copper

Copper is the second longest running flashing material. It may be more expensive than lead. It is less malleable but about as durable. It can be soldered as needed. It will naturally develop a patina of green or blue. The patina is called verdigris and usually consists of varying mixtures of copper chlorides, sulfides, sulfates and carbonates, depending upon environmental conditions such as sulfur-containing acid rain. The patina some times runs onto adjacent surfaces, staining them. Acids, such as evolved from oil and gas combustion can accelerate the formation and running of verdigris .

Galvanized Steel and Tin Plate

Galvanized steel is very durable. It not as malleable as other flashing metals. It's corrosion resistance comes from the zinc plating that is electro-chemically deposited on the surface. It is recognizable as spangling. The spangling can be tiny or large. The thickness of the galvanization affects it's corrosion resistance. The thicker the more resistant. However, thicker deposits are more apt to crack and break away when the sheet is bent.

Tin plated iron and steel is similar to galvanized steel. Tin plating is easily damaged by scratching. Both tin plate and galvanized steel have largely gone out of fashion.

Aluminum

Aluminum is the metal used in most all base flashing. It should be noted that in contact with the alkalai materials in masonry it can corrode rapidly. That said, aluminum can be had with an anodized coating that protects the metal from corrosives. It is the second most malleable metal next to gold, but is usually in an alloy that gives it more hardness. Dead soft aluminum (aka DSA) is super malleable while most trim coil is more rigid. Anodized aluminum is an affordable, durable material.

A Superior Method of Flashing

This method is designed for a masonry chimney or chase which has the correct clearance to combustibles. It will work admirably for chimneys with inadequate clearance which have been upgraded to zero-clearance by re-lining with sufficient insulation. If you are unsure of your chimney's clearance to combustible, please hire a certified[1] chimney sweep to perform a level 2 inspection[2.] In some cases a level 3 inspection may be needed as well.

While this method is designed specifically for asphalt shingles it is also appropriate for cedar, slate, terra cotta tile, and cement tile. It can be adapted for metal roofing.

Laminate (Asphalt) Shingling Components

Roofing components consist of several different type a material such as wood, metal, rubber, and asphalt (also called Bitumen). With the exception of the flashing, the components are all combustible. For an interior chimney, they should be kept 2 inches away. That 2 inches should be air space. From the inside out at the flashing the layers are:

- Rafter
- Decking (also called sheeting, sheathing, or sarking)
- Underlayment
- Base Flashing
- Shingle
- Counter Flashing

Base Flashing

Apron

The first component of this method is the apron. It should be composed of a corrosion resistant metal. It is installed on the down side of the chimney. The apron is essentially L shaped with the vertex angle matching the pitch of the roof. The apron should extend at least 8 inches beyond each side of the chimney that abuts the shingles. The vertex is cut allowing the vertical leg to wrap the corner(s). The end of the horizontal leg should have a flat hem formed. The flat hem creates a capillary channel that will contain and conduct water to a lower roofing layer. The vertical leg should be no less than 6 inches. The horizontal leg must be long enough to extend to the seal strip of the last course of shingles below the chimney. Gasketed nails may be used on the last 2 inches of the apron.

Bridging Strip

Next will be a bridging strip. It should be composed of a corrosion resistant metal. The strip is L shaped. The roofward leg has a flat hem (capillary channel) formed. Any water that might penetrate to this strip is thus contained and conducted to the apron.

The roofward leg should be at least 3" but shorter than the horizontal leg of the base flashing.

The vertical leg should be at least 3" but less than the vertical leg of the base flashing. It should ride on top of the apron corners extend onto the apron by 4" and along the entire sidewall of the chimney extending an additional 4". The vertex of the upper extension is then cut to allow the corner to be wrapped.

Saddle Strip

Following the bridging strip is the saddle strip. It is formed in the same manner at the bridging strip with side extensions wrapping on top of the bridging strip. If there is a cricket (required for chimneys 30 inches or more on the up side), 2 saddle strips will be used.

The bridging and saddle strips may be glued to the decking or nailed. If nailed, a gasketed nail should be used. If glued, a silicone sealant should be used.

Aluminum flashing corners can now be installed. After forming to the corners it can be glued in place using silicone sealant. Ensure a plenteous bead along all 4 edges. Place one on each roof bearing corner.

Roofing underlayment, whether rubberized, type I (15#) felt or type II (30#) felt, can then be installed to overlap the bridging strip. It should terminate 2 inches away from the chimney. If the underlayment is not self adhesive it should be glued down with an approved mastic. Nails should not penetrate the apron, bridging strip, or saddle strip from here on.

Base Flashing

Shingles can now be laid up along with base flashing. Each piece of base flashing should be formed in corrosion resisted metal. Base flashing is L shaped. Each leg should be at least 6". The base flashing should extend from the reveal of the shingle below plus at least 2 inches above the top of the shingle. For most shingles an 8 inch length will be sufficient. A single gasketed nail should be used in the roofward top corner. This ensures that it does not penetrate the bridging strip. The nail will be wholly concealed by the following shingle. The bottom most piece of base flashing will have its vertex cut and be wrapped onto the down side face of the chimney. A second aluminum corner flashing should be installed on top of the first piece of base flashing. Shingles shall terminate at least 2 inches away from the chimney. Since additional nails must not penetrate the base flashing, the edge of the shingles will need to be glued down with an approved mastic.

Saddle

The top most piece of base flashing should be cut at the vertex to be able to wrap onto the up side face of the chimney. The saddle can now be installed. The vertical leg of the saddle should be no less than 6 inches. The horizontal leg of the saddle should extend 6 inches beyond the roof bearing corner(s). It should rise up the roof to extend to the seal strip of the first full course of shingle above the chimney. Gasketed nails may be used to secure the saddle to the roof. The vertex of the extending should be cut and the vertical extension wrapped over the base flashing and onto the face of of the chimney sidewall. A second aluminum corner flashing should be installed on each roof bearing corner.

Underlayment should overlap onto the saddle terminating 2 inches away from the chimney. Shingles must terminate 2 inches away from the chimney. Since additional nails must not penetrate the saddle, an approved mastic should be used to secure the shingles covering the saddle. This completes the base flashing installation.

Counter Flashing

Counter flashing is installed to overlap the base flashing. Any water flowing down the face of the chimney should flow onto the base flashing. Counter flashing should never be attached to the base flashing. They must be able to move independently.

Reglet Channel

A reglet channel must be cut into each roof bearing face of the chimney. The reglet channel should be at least ¾ inch deep. The channel should be cut at least 2 inches above the base flashing.

Counter Flashing

Each face of the chimney will need a continuous piece of counter flashing. All counter flashing pieces should extend at least 2 inches beyond the roof bearing corner(s). The counter flashing is L shaped. The horizontal leg will be at least ¾ inch long. It may have a hemmed barb formed. The vertical leg of the counter flashing should terminate at least ½ inch but no more than 2 inches from the base flashing. This reveal allows for inspection of the base flashing and prevents rubbing of the two components.

All pieces should be dry fit before proceeding. Fill the reglet channel with silicone sealant. Starting on the down side face of the chimney, insert the counter flashing wrapping the extension onto the adjacent face. The sidewall counter flashing is installed next, wrapping the extension(s) onto the adjacent face(s). If mechanical fasteners are needed to bond the pieces together, brazier or flat head hammer rivets may be used. Finish with the up side counter flashing, overlapping extension(s) onto the adjacent sidewall(s). Each overlap should sandwich a bead of silicone caulk. Ensure the caulk extrudes through the top corner.

Conclusion

This is a fairly involved flashing process. While it may be tedious, it gives a very reliable resistance to water entry. All parts are able to move independently, reducing wear and tear. Where expansion coefficients might impinge on each other either a flexible interface or total disconnect is afforded. This “superior method” is planned for submission to standards committees and for public review.

[1] Certifying agencies include
Chimney Safety Institute of America – CSIA.org
National Fireplace Institute – NFIcertified.org
National Chimney Sweep Guild – NCSG.org
F.I.R.E.Service – f-i-r-e-service.com

[2] A standard of care cf. *NFPA 211: Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances* § 15.4

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