MECHANICS FOR PROPERLY SEALING FIBERGLASS REINFORCED ASPHALT ROOFING SHINGLES

By Raymond L. Corbin

The goal of properly installed fiberglass reinforced asphalt shingles is to protect the roof and the contents of the structure from the various elements of nature. To accomplish this, shingles must resist tearing while being handled during the application stage. Following installation, they must seal properly to prevent blow-off.

I. Prior to Sealing (or Bonding)

Manufacturing Process

The design and manufacture of the shingle should include the right type and amount of asphalt coating and mineral stabilizer (filler) and a fiberglass mat designed to resist normal stresses from handling during manufacture and installation. In addition, the installed shingle should be capable of resisting exposure to the various elements—wind, rain, and snow.

The shingle's sealing adhesive must be capable of attaching to the shingle in the adjourning course, either above or below as the case may be and be capable of doing this at as low a temperature as possible. (See Climatic Conditions, below, for approximate sealing time.) Recent technology has enabled modifiers to be incorporated into the adhesive resin, allowing for lower sealing temperatures and imparting a degree of elasticity to the adhesive. Sealing adhesives are temperature activated. Generally, the hotter the ambient temperature, the quicker the bond. In addition, since the covering granules of a shingle are anchored in a socket of black asphalt, direct radiant energy from the sun can easily heat the shingle up to 40° F warmer than ambient conditions, resulting in a quicker sealing bond.

The amount, thickness, and type of the adhesive strip and its location relative to the tab in the adjourning course is also key to proper sealing. Too little adhesive or locating the strip so that it will align too high on the tab in the adjourning course will have a negative effect on its ability to bond properly. (See Application, below.)

The type and location of the release film are also critical. The release action must be sufficient to overcome the tackiness of the adhesive. Inadequate release or improper alignment of the release film to the adhesive stripe will cause shingles to stick together in the package, inhibit shingle separation, and reduce the shingles' ability to properly seal once they are installed. If shingles are packaged with sealant facing the wrapper, a release agent must be applied to that area of the wrapper. A point of note is that the release film is attached to the coating asphalt of each shingle during its manufacture. The area beneath the release film is not an adhesive but is the shingle itself; therefore, removing the release film from the back of the shingle will not assist in the sealing function.

Storage

Manufacturers suggest that shingle bundles be stored not to exceed a maximum number of bundles in height and in a location designed to protect them from moisture and heat, either of which can damage the shingle's ability to separate from the bundle during application. Refer to each manufacturer's recommendations as to number of bundles allowable.

The conditions under which shingle bundles are stacked can have a negative effect on the ability of the shingles to seal properly. Being stacked too high under elevated temperatures could flatten the sealing strip and limit its effectiveness.

Application

When installing the shingle, the applicator should align the shingle using the specified tab exposure. Raising the tab more than 1/8" above the specified area cuts down on the double coverage area required for proper waterproofing. This practice also reduces the nailing area and promotes "high nailing," which puts

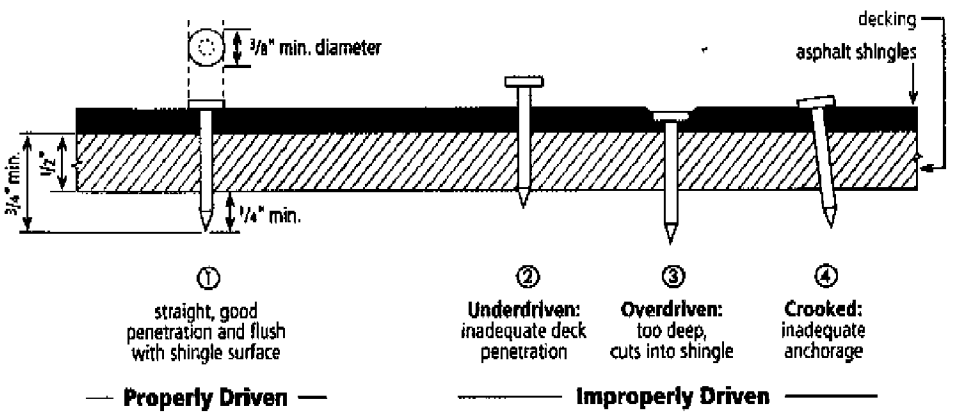
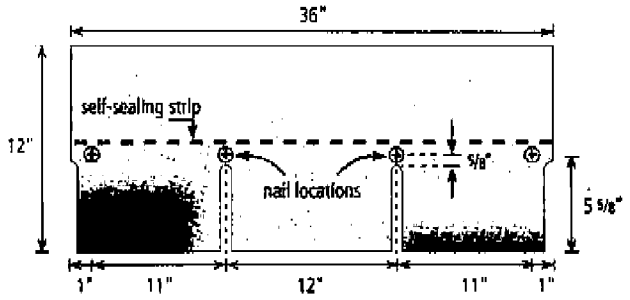


Figure 1: Proper and improper application of roofing nails. (ARMA)

more stress on the shingle. Surprisingly, the occasionally used practice of reducing the exposure to provide increased headlap dimension is also a problem, particularly on three-tab shingles. This practice increases the tab area beyond the designed contact point of the sealant, allowing for increased uplift pressure on the tab.

Fastener type and location are critical to achieving a properly-applied shingled roof, and if done improperly, will have a negative effect upon the shingle's ability to seal and even perform properly. If hurried, the applicator has a tendency to place the fasteners higher than desired. Also, by reaching across the body, the applicator tends to place those fasteners higher as well. Hand-driven or pneumatically-applied nails offer superior holding power versus a wire staple. The rounded head of the nail offers better holding power than the narrow crown of a staple. Fasteners must be flush with the shingle's surface since raised heads or crowns inhibit or prevent sealing, and overdriven fasteners can cut the shingle's reinforcement, weakening its blow-off resistance. All fasteners must be applied according to manufacturer's instructions.

It is always best to avoid nailing directly into the sealant. Occasionally, this may be unavoidable. If so, assure that the nail head is not raised but is seated below the sealant thickness and on the shingle's surface. Fasteners applied in the strip during cooler weather may dislodge adhesive resin, thus reducing the sealant's effectiveness.



Above: Figure 2: Nail locations for three-tab strip shingles. (ARMA)

Fasteners that are located above the sealing strip create greater wind force on the shingle tab, stressing the shingle as well as increasing the chance of blow-off. Finally, fasteners applied "high" may miss the underlying shingle entirely, greatly reducing the fasteners' holding power to secure the shingle to the deck. Properly located fasteners not only secure each shingle, they also engage the shingle beneath it. This means that applying four fasteners per shingle actually results in eight points of securement per shingle.

In areas with a history of high prevailing winds or on steep slopes such as mansards (21:12), some manufacturers require six fasteners per shingle rather than the conventional four. The increased frequency results in greater holding power, and when properly located, gives twelve holding points per shingle. In addition, it is usually recommended to hand seal each shingle at installation with one or two quarter-size spots of adhesive (referred to as "tab cement") per tab, four spaced out evenly on no-cutout shingles.

For high wind areas, this procedure reduces chances for blow-off during the sealing process. For steep slopes facing east or north, hand sealing is very important for shingles applied during the cooler months.

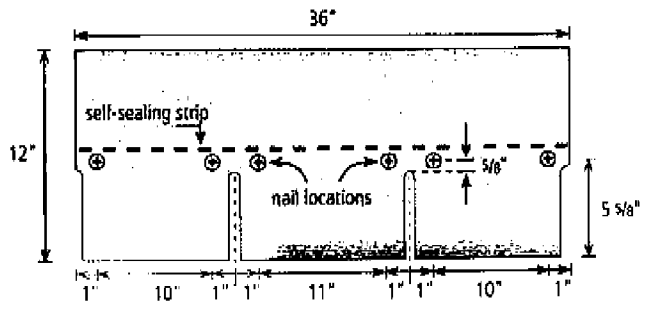
Shingles installed on steep slopes have less force (weight) bearing on the sealant, thereby slowing the sealing process. These slopes will not directly receive the sun's radiant energy and, therefore, will not seal properly until warmer weather.

Hand sealing is also a good idea on new construction sites where wind-blown debris can contaminate the sealing strip prior to its activation.

Generally in re-roofing, care must be taken when applying shingles over an existing roof. Three-tab shingles should not be installed over other types of shingles, and when re-roofing over existing three-tab shingles, the roof must be flat or made to be flat. An existing shingled roof that is raised or curled will give the newly-applied shingles an irregular appearance and, in most cases, prevent proper sealing of the new roof.

Sealing in Different Climatic Conditions

Sealing in some areas of the country, fall to spring, might take 20 to 30 warm, sunny days to activate the seal strip enough to adequately bond the shingles. Orientation of the roof to the sun, steepness of slope, and geographical area have a major impact on the bonding action. Also, when exposed to the sun's radiant energy, darker-colored shingles will heat up faster than lighter, more



Left: Figure 3: Nail locations for three-tab strip shingles, 6-nail method. (ARMA)

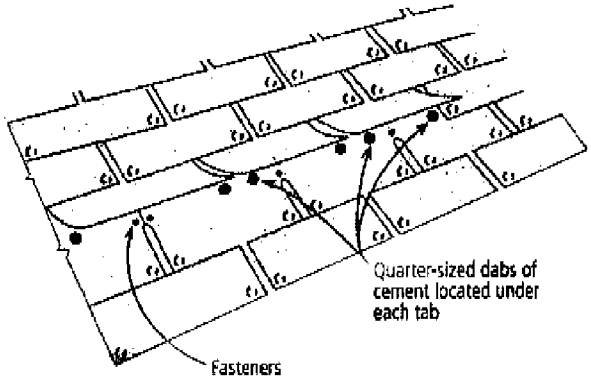


Figure 4: Application of cement under three-tab shingles. (ARMA)

reflective colors, thus effecting a quicker seal.

During the cooler months, the sun is at its lowest angle; therefore, only south and some west-facing slopes receive enough of the sun's radiant energy to bond properly. It may take until the following spring for north- and some east-facing slopes to bond. Another problem during cooler weather application is the danger of fracturing or stressing the shingle. This damage may not become apparent until after a year or two of weathering. A good rule of thumb is to never apply shingles stored outside until they have had sufficient time to reach 40° Fahrenheit or higher.

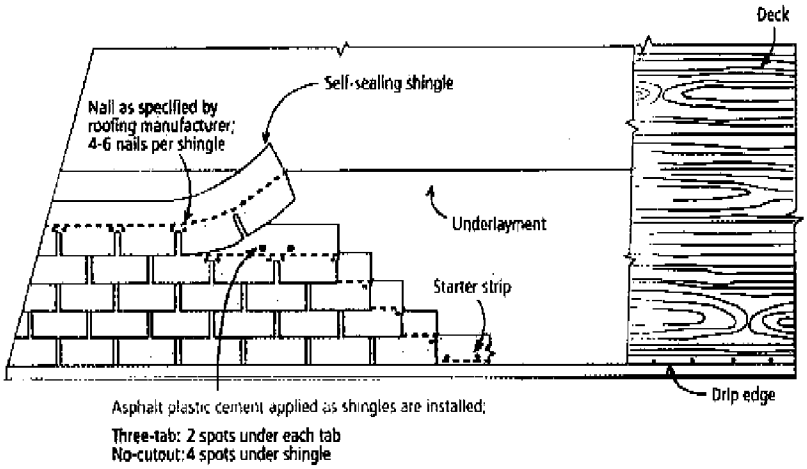


Figure 5: Application of shingles on steep slopes. (ARMA)

II. After Sealing (or Bonding)

After consideration of the variables discussed, it should be apparent that not all shingles will bond at the same rate or to the same degree. Conditions such as time of year, roof slope, roof orientation, and shadows from dormers, upper stories, adjacent buildings, and even large trees can all have an effect on how the shingles seal. Shingles with broken bonds may reseal when warmer weather occurs. Those shingles with aged or oxidized adhesive will have difficulty in resealing. Contamination of the adhesive will also reduce its ability to reseal. In these cases, hand resealing is an option. In addition, the following can also affect the shingles' sealant performance.

Thermal Disbonding

Thermal shock caused by a rapid drop in temperature creates forces that can break the bond of an adequately-sealed shingle.

Some shingles' tendency to curl (lift at the edges) in cooler weather can sometimes break the seal on a marginally-bonded shingle.

High Wind Conditions

Localized peak wind speed are caused by turbulence generated by various wind angles and roof shapes. "Hot spots" are formed where the resulting vortices and gusts have a much higher wind speed than the average approach wind speed (Refer to "New Method for Measuring the Wind Resistance of Asphalt Roofing Shingles," *Interface*, January 2000.)

Areas of high gusts or moderate sustained winds can have a direct impact on marginally-bonded shingles. This can result in

bond failure and blow-off that may not have been experienced under normal wind conditions.

Dormers and valleys produce turbulence and wind speeds in excess of the approach wind speed. These elevated wind conditions can be very damaging to otherwise adequately-bonded shingles.

Summary

The sealing strip on most shingles is designed to activate at rooftop temperatures of approximately 105° F, usually after a day of exposure to full sun. Depending upon roof slope, shingle application technique, shingle construction, climatic conditions, and time of year, it could take days or even months to achieve a proper bond. Hotter climates and direct exposure to the sun's radiant energy could achieve a bond in a matter of hours. Darker colored shingles will seal more quickly than lighter, more reflective shades.

Recent technology derived from asphalt modification allows for activation of the seal strip at lower rooftop temperatures. These adhesives offer a degree of elasticity and will stay bonded longer over an adverse range of conditions, resisting bond failure during very cold temperatures.

When over-roofing, make certain that the existing roof is flat prior to installing the new roof. Of course, even the best designed and manufactured shingles will not perform if the shingles are not properly installed in accordance with the guidelines set forth by the shingle manufacturer, the National Roofing Contractor Association (NRCA) and the Asphalt Roofing Manufacturer's Association (ARMA). ■

About the Author

Raymond L. Corbin is Director of the Better Understanding of Roofing Systems Institute (BURSI), sponsored by Johns Manville. He holds several U.S. roofing shingle design and application patents. Ray is a faculty member of the Roofing Industry Educational Institute (RIEI), an Industry member of RCI, and has served as Chairman of the Code Committee for the Asphalt Roofing Manufacturers Association (ARMA). This article was written on behalf of ARMA.

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