SELF-SEALING ASPHALT SHINGLES – TECHNICAL BULLETIN 2.0

WIND RESISTANCE BASICS

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Key Factors that Control Asphalt Shingle Wind Resistance:

1. Things you (as the manufacturer or the consumer) have control over:
    a. Shingle weight
    b. Shingle rigidity (ASTM D7158 - 08d & ASTM D3161 - 08b)
    c. Nail pullout resistance (ASTM D3462 – 07)
    d. Asphalt sealant - specifically its formulation and amount/location of application
    e. Requirements for installation
2. Things you may have control over:
    a. How old the shingles are when they are purchased (warehousing)
    b. How professionally the installer does his job – specifically proper nailing or hand sealing if required
3. Things you don't have control over:
    a. Age-related deterioration (wear & tear)
    b. Seal strip adhesion following shingle installation (ASTM D6381 - 03b)
    c. Roof exposure/design – we don't design roofs specifically for certain shingles, but design certain shingles for certain roofs
    d. Wind – frequency, speed, duration, etc.

Note: As a manufacturer or a consumer, there are countless more variables that you do not have control over versus what you do have control over. Extreme variation is therefore observed in the field during and after a significant wind event, where some roofs perform very well whereas others nearby sustain perhaps large amounts of damage. Likewise, as they apply to wind resistance the warranties offered by shingle manufacturers generally only apply to those things that can be controlled, and even then only for a limited amount of time that is a fraction of the anticipated lifetime of the roof.

Comparing Asphalt Shingle Warranties for Wind Resistance

Shingle Design	Manufacturer	Warranty Duration	Wind Speed Criteria	Wind Warranty Duration
Conventional 3-Tab	Owens Corning	20 or 25 years	60 mph	5 years
	GAF/ELK	20, 25 or 30 years	60 or 80 mph	3 or 5 years
	CertainTeed	20, 25 or 30 years	60 mph	3 or 5 years
	Tamko	20 or 25 years	60 mph	5 years
Imitation Dimensional	Owens Corning	30 years	80 mph	5 years
	GAF/ELK	-	-	-
	CertainTeed	30 years	70 mph	5 years
	Tamko	-	-	-
Conventional Dimensional	Owens Corning	30 years	70 mph	5 years
	GAF/ELK	30 years	100 - 110 mph	5 years
	CertainTeed	30 years	70 mph	5 years
	Tamko	30 years	80 mph	5 years
Heavyweight	Owens Corning	30 years	110 mph	5 years
	GAF/ELK	40 years	110 mph	5 years
	CertainTeed	40 years	80 - 110 mph	5 years
	Tamko	40 years	80 - 110 mph	5 years
Lifetime	Owens Corning	50 years	90 - 130 mph	10 years
	GAF/ELK	50 years	130 mph	10 years
	CertainTeed	50 years	110 mph	10 years or 5 years
	Tamko	50 years	90 - 130 mph	10 years

Important Considerations:

1. The industry is competitive; therefore warranties contain the same basic components from one manufacturer to another, regardless of shingle design.
2. Regardless of the shingle manufacturer and shingle design (cost), the duration of the wind warranty is only a small fraction of the time that the shingles are expected to last, and generally 10 – 20 percent of the overall warranty's duration.
3. Because any roof's resistance to wind is determined by so many factors that the manufacturer has no control over, basic shingle wind warranties are written to cover only manufacturing defects.
4. Regardless of nature of the problem(s) with a roof – shingle warranties are designed to guarantee qualities that the manufacturer has control over – they are not a performance guarantee.

Proper Asphalt Shingle Fastening (Nailing)

Note: This discussion is limited to shingles fastened with conventional roofing nails. Staples are not a recommended fastener by most shingle manufacturers and industry organizations, nor are staples approved by many building codes to fasten asphalt shingles.

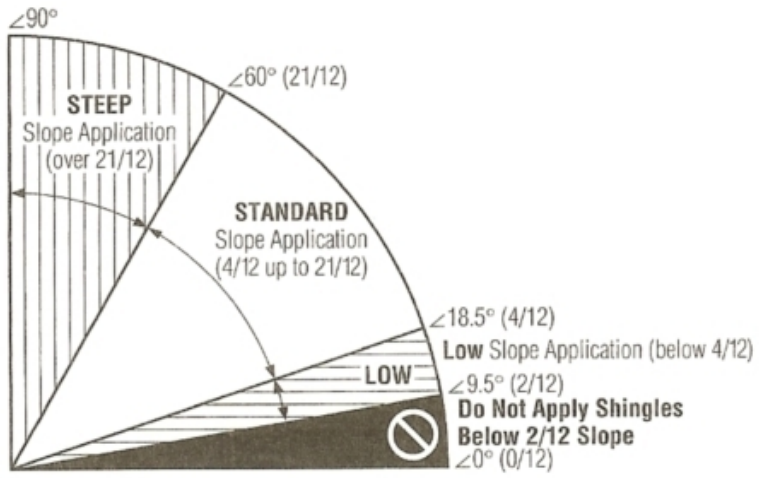
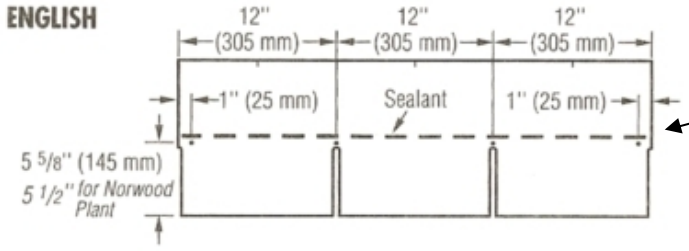


Figure 15-1: Slope definitions.

Rule #1: Proper fastening is contingent on the slope of the roof. Generally, regardless of shingle manufacturer or shingle type, more aggressive fastening is required on steep roof slopes. Other more demanding fastening requirements are made for areas where high winds are likely.

Conventional Three-Tab Shingles – Standard Roof Slopes



The dark dashed line in this drawing of a conventional three-tab shingle is the asphalt sealant strip.

When properly installed, the bottom ("butt") edge of each shingle overlies the sealant strip on the top center of the underlying shingle course, as shown in this illustration.

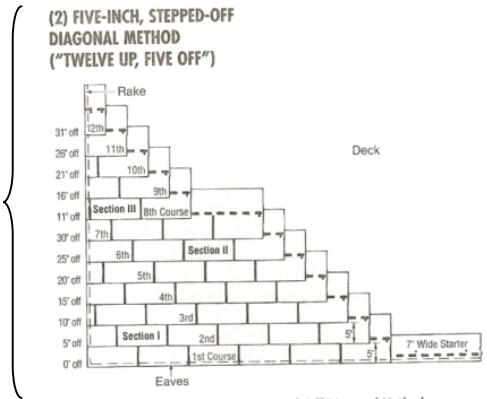
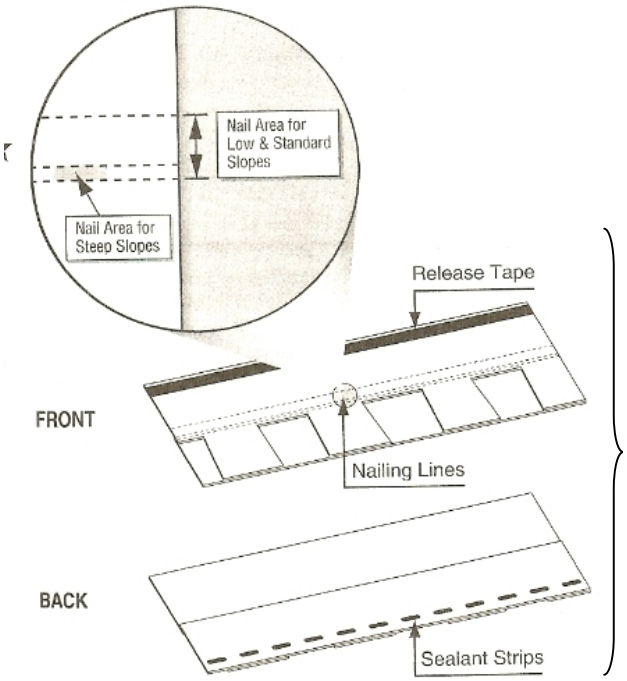


Figure 12-9: Five-Inch, Stepped-Off Diagonal Method.

Note: Four nails per shingle, where the nails are installed above the keyway (joint between each tab) and below the sealant strip. Nails installed in the sealant strip or above the sealant strip are improperly located and will have a negative effect on how well the shingle resists wind.

Conventional Dimensional Shingles – Standard Roof Slopes



The asphalt sealant strip on many dimensional shingles is located on the backside of the shingle, near the bottom, so that when the shingles are assembled on the roof, the bottom of each overlying shingle seals to the top center of the underlying shingle.

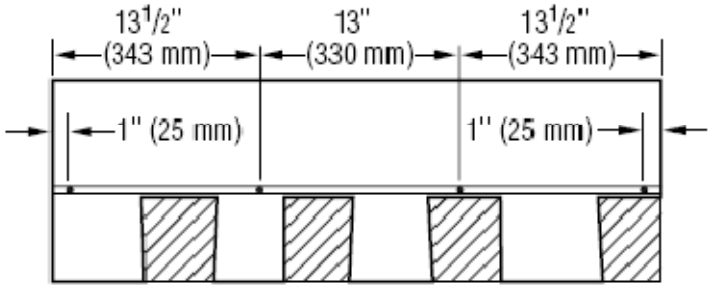


Figure 13-4: Use four nails for every full shingle.

Note: Four nails per shingle, where the nails are installed above the sawteeth (cutouts between the overlying and underlying layers of the shingle), usually on or within an area on the shingle that is defined by white lines placed there by the manufacturer. Nails installed outside of this area will have a negative effect on how well the shingle resists wind.

Conventional Three-Tab Shingles – Steep Roof Slopes

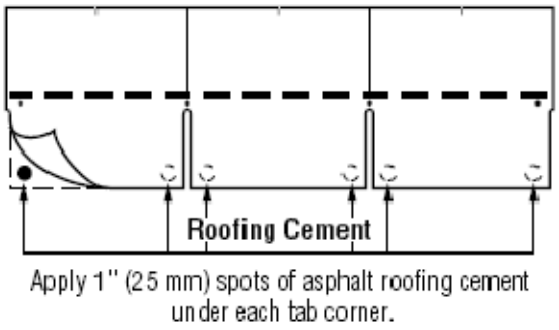


*Figure 11-4: Use **four** nails and six spots of asphalt cement on steep slopes.*

Note: Shingles must be hand-sealed under each corner of each shingle tab at the time they are being installed. The sealant is required since the force of gravity holding each course of shingles against one another becomes less as a roof becomes steeper.

Conventional Dimensional Shingles – Steep Roof Slopes

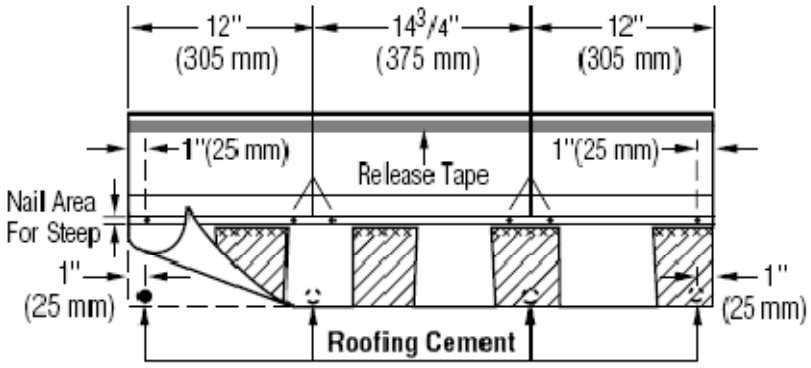


Figure 13-5: Use six nails and four spots of asphalt roofing cement on steep slopes.

Note: Shingles must be hand-sealed and installed with six versus four nails per shingle. Specifically, the nails must be placed in a much narrower area compared to the allowable area for standard slope installation. The sealant is required since the force of gravity holding each course of shingles against one another becomes less as a roof becomes steeper. The extra nails are required to more aggressively fasten the top and bottom portions of the dimensional shingle together to prevent them from separating under the more planar (on the same plane as the shingle) force of gravity which is trying to pull them apart.

Hand Sealing

Hand sealing is understandably unappealing. Compared to conventional shingle installation it is slow and labor-intensive, which is synonymous with greater expense. *However, manufacturers not only recommend hand sealing if shingles are installed in unseasonal weather, they require hand sealing if shingles are installed on "steep" roof slopes, where the roof slope is greater than 60 degrees (21:12).* Why? Because on steep roofs the force of gravity no longer keeps enough compression (pressure) on successive shingle courses, which is a key factor in proper shingle adhesion when the sealant strips become warm and attempt to bond to the overlying or underlying layer of shingles.

The following hand sealing procedure is based on Asphalt Roofing Manufacturers' Association (ARMA) recommendations:

1. Choose a sunny day because warm shingles are more easily raised enough to apply the cement without damaging the shingles. In cool weather, the cement should be stored in a heated area so it can easily be applied. The cement may be applied with a caulking gun if tubes are used, or with a small trowel or putty knife if used from a pail.
2. The amount and position of the cement are typically the most important features for a good seal. Seal the tabs by carefully lifting the tab just high enough to apply two spots of cement, each about the six of a quarter (twenty-five cent piece), near the corner of each tab. The spots should be located so that when the tab is pressed into place, the cement reaches the tab edge but is not exposed.

   CAUTION: Avoid excessive use of cement so as to prevent the formation of blisters or a lumpy appearance on the roof.
3. To make certain that all tabs are sealed, decide upon a predetermined pattern of sealing before starting the job. A recommended pattern to follow in sealing three-tab shingles is to start at one rake or hip of the roof, and beginning at the eaves, seal three tabs. Then seal the three tabs of the course above it, and continue in this manner until the ridge or hip is reached. Repeat this procedure starting at the eaves with three tabs adjacent to the ones just sealed. Continue until all tabs are sealed.

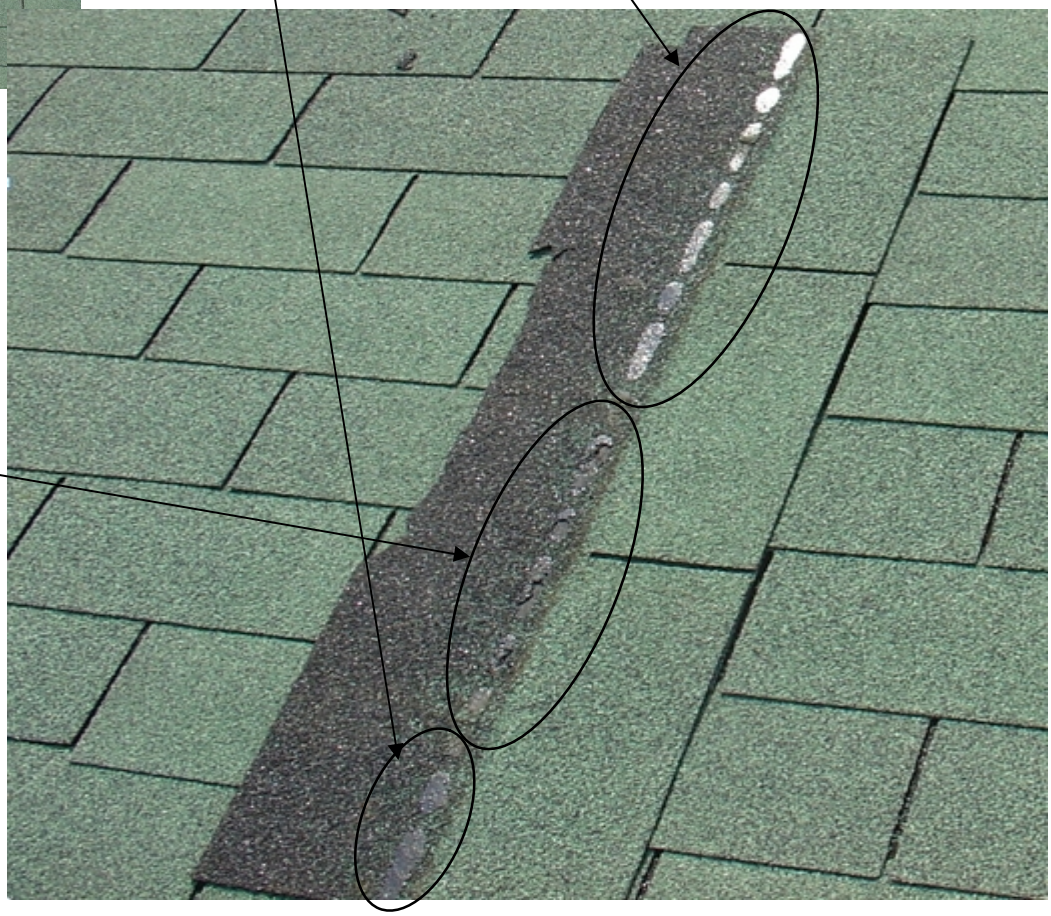
Proper Asphalt Shingle Seal Strip Adhesion

How do you know if the sealant strips are or were properly sealed (performing as designed)?

Here's a basic test… If the shingle's sealant strip has adhered as it was designed, you'll have a hard time pulling the shingles apart with your fingers. In order to separate the shingles you'll need a pry tool such as a putty knife to wedge between the shingle layers and physically break the asphalt sealant strip. However, do not do this unless you're prepared to hand seal the shingles when you're finished. Assuming that they'll reseal is not wise – and it may be totally false. Even if they partially reseal, they'll never reach the amount of adhesion they had before the seal strip was broken.

When the sealant strip has reached design adhesion, the bond between the underlying and overlying shingles is so strong that forcefully pulling shingles apart, as may be expected in severe wind, will actually cause the shingles to physically delaminate. The following photographs illustrate both insufficient and sufficient adhesion of the asphalt sealant strip on a relatively new wind-damaged roof.

In these areas, the smooth and slick texture and reflective appearance indicates that the sealant strip failed to adhere as designed.



In this area, the shingle physically delaminated when it was torn from the roof by wind. This delamination indicates that, at least in this area, the shingle's sealant strip reached a design level of adhesion.

Another way to illustrate the amount of adhesion an asphalt seal strip is designed to achieve is to intentionally pull apart the top and bottom pieces of a dimensional shingle. As these two pieces are sealed together in the factory, the adhesion between them is a carefully controlled design quality. Pulling them apart delaminates the shingle as shown in the following photograph, where the delamination indicates that the material was suitably glued together by the asphalt adhesive.

Conclusions:

The wind resistance of conventional asphalt shingle roofs is only partially controllable by the manufacturer or consumer in his directives and decisions. The warranties that major manufacturers offer for wind resistance are temporary, and generally protect against material defect versus a performance failure.

The wind resistance of any asphalt shingle roof is predominately controlled by two factors:

1. How well the product was installed with respect to its installation instructions and requirements, and
2. How well the shingles seal after they are installed.

For additional information on asphalt shingle roofs with respect to wind other technical bullitens are available at www.donan.com under the “Roofing Investigations” heading.

Acknowledgements

We wish to thank the following organizations for the material they make available which has been incorporated into this document:

- CertainTeed Corporation
    - CertainTeed's Shingle Applicator's Manual – Seventh Edition
    - CertainTeed's Shingle Technology Manual – Seventh Edition
- GAF Materials Corporation
- Owens Corning
- Tamko
- The National Roofing Contractors Association
- The Asphalt Roofing Manufacturers Association

About Donan Engineering

Donan Engineering Co., Inc. is a forensic engineering and fire investigation company headquartered in Louisville, Kentucky with offices throughout the central United States. The firm conducts forensic investigations on several thousand commercial and residential roofs per year, and is routinely called upon by insurance companies, attorneys, manufacturers, contractors, and property owners for training and investigations on all types of roofs and structures.

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