

Have Asphalt Shingles Improved?

Asphalt shingles have been a familiar standby for more than 100 years. Over time, they've come to dominate the steep-slope roofing market, accounting for 80% to 90% of all residential roofs.

by Ted Cushman

After problems in the late '80s, many fiberglass-mat shingle manufacturers have adopted tougher standards

Throughout most of this century, shingles didn't change much: 1965's basic product wasn't a whole lot different from 1925's. Since the mid-1970s, however, shingle makers have introduced quite a few innovations, including fiberglass reinforcing mats, self-sealing tabs, laminated construction, and modified asphalt formulas. Today, there are many types of shingles to choose from.

But in the 1980s and 1990s, some of the latest "improvements" turned out to have drawbacks. In particular, homeowners and home inspectors started to report a widespread splitting and cracking problem in fiberglass shingles. Often, shingles warranted for 20 or 30 years would fail in just three to seven years (see the photographs on page 3), and warranty service frequently left owners dissatisfied. Eight years after *The Journal of Light Construction* first reported on the cracking and splitting problem ("Choosing an Asphalt Shingle: Organic vs. Fiberglass," 5/93), controversy still simmers over the problem's extent, its causes, and the solutions.

When we took a second look at shingle quality this spring, we found that the roofing industry has made strides toward answering complaints and improving its products. Successful lawsuits have spurred shingle makers to pull many low-end shingle brands, and a tightening of codes and standards seems to have improved quality throughout the industry. Home inspectors report seeing the familiar splitting and cracking problem only rarely, and roofer groups acknowledge that the phenomenon has declined.

Picking a shingle still involves some guesswork, and it can still be a

gamble. But if you take reasonable care in both selecting and installing shingles, the odds of getting a roof that lasts have improved.

What's in a Shingle

Roofing shingles are a composite product that's tricky to manufacture. Every shingle contains an inner reinforcing mat, a coating of hard asphalt modified with mineral fillers, a top surfacing of mineral granules, and a back-surface dusting of finely ground mineral dust. Each shingle also has a stripe of adhesive sealant across its center to hold shingle edges down when the wind blows.

Each of these components must have the right qualities to do its special job. The strength of the reinforcing mat, the flexibility and durability of the asphalt, the thickness and coverage of the granule layer, and the holding power of the sealant all affect the way the shingles function. Shingle brands can differ in all sorts of ways, but the most critical factors seem to be the strength of the mat and the quality of the asphalt.

Reinforcing mats. Two different types of mats are used in the shingle industry: non-woven fiberglass mats and organic felt mats made of wood fibers and recycled paper. The organic mats are thicker, heavier (more than 20 lb./100 sq. ft.), and a good bit stronger than the fiberglass mats, and are saturated with a soft, pliable asphalt that binds the fibers together and protects them from water. Fiberglass mats, on the other hand, weigh very little (around 2 lb./100 sq. ft.), and are bound together with a phenolic adhesive. Since they are not affected by water, fiberglass mats don't have to be saturated with asphalt.

The asphalt. Organic shingles use two kinds of asphalt: a soft saturating asphalt in the mat and a harder, filler-modified coating asphalt for the top and bottom surfaces. Fiberglass shingles have just the coating asphalt, and so use less asphalt overall. This has made fiberglass shingles less vulnerable to oil price hikes, since asphalt's price reflects the price of the crude oil it's made from. (However, even fiberglass shingle brands have been squeezed by recent high oil prices.)

Asphalt formulas are complex, and the quality of both the soft and hard kinds is challenging for manufacturers to control. The coating asphalt needs finely ground mineral fillers to stabilize it, but the amount and type of filler have to be carefully monitored in order for the asphalt to have the right combination of flexibility, scuff resistance, and durability over time.

Fiberglass vs. Organic

Fiberglass shingles have come to dominate the market, for several reasons: They are lighter and easier to handle, they are more resistant to moisture, and they carry a higher fire rating than organic shingles.

But organic shingles remain popular in the northern United States and in Canada. Many roofers say that organic shingles are easier to handle in cold weather, and while the hot sun in the southern U.S. can degrade their soft asphalt, they hold up well in colder climates.

Splits and Cracks

While both kinds of shingles can suffer performance problems, the widespread cracking and splitting problems of the 1980s and 1990s involved only fiberglass shingles, particularly the lighter-weight brands. Organic shingles suffer occasional defects that can make the shingles cup, curl, or lose granules, but they don't generally split: If the coating asphalt stiffens with age and cracks, the softer asphalt underneath tends to stay intact, and the very strong organic mat restrains the crack and stops it from progressing.

In fiberglass shingles, by contrast, a split in the brittle coating asphalt can go right through the shingle, sometimes overwhelming the limited strength of the mat. Thermal shrinkage puts tension on the shingles when temperatures fall, and once a crack gets started, it tends to propagate itself as the stress concentration moves along the split. In fact, in shingles that are vulnerable to the problem, splits and cracks that start in one shingle are often seen to run from shingle to shingle over large areas of the roof.

Preventing the cracking problem requires the manufacturer to pay attention to both the fiberglass mat and the asphalt. The asphalt blend has to be flexible, but not too soft, with just the right amount of filler. The mat, for its part, has to have adequate strength and be positioned near the center of the shingle so that it isn't overstressed if the shingle bends up or down.

Unfortunately, it is very hard for the buyer to know anything about the asphalt or the mat in a shingle. Appearances can be deceiving: A thick, heavy shingle might have poor quality asphalt with too much filler, or it could have a very lightweight fiberglass mat; and a thin shingle that feels flimsy may in fact have good toughness and flexibility, with a well-made asphalt mix that will stand up to years of exposure. Labels and product literature do not include information about the shingle ingredients, and manufacturers typically will not disclose the details.

Objective standards elusive. Since the eye is no judge, the industry has looked for objective measures. Roofer organizations have pressured the manufacturers for years to develop industry standards to ensure the quality of shingles on the market. There has been a lot of argument about the properties, types of test, and test minimums that should be required; a manufacturers task force that formed in 1993, for instance,

recommended tests for tensile strength and elongation, but was never able to develop any. The same task force proposed a grading system for shingles, with labels to distinguish Grade A, Grade B, and Grade C; but companies could not agree on the terms of any such system.

However, there has been progress on one industry standard, ASTM D 3462, which sets minimum weights for shingles and for their reinforcing mats, and which also includes several physical test protocols that shingles must pass to comply. D 3462 has been amended seven times since 1993 — and it seems to be having some effect.

Testing Standards Debated

The American Society for Testing and Materials (ASTM) writes voluntary standards for just about every material produced in America. Committees include representatives from all parts of the industry involved — most or all of the manufacturing companies participate, along with “general interest” members such as architects, engineers, or literally anyone who is motivated to join and attend meetings. Standards are set by consensus, not by majority vote — any member’s objection to a proposed change sets off a new round of deliberations.

Fiberglass-asphalt shingles fall under ASTM Standard D 3462; organic shingles are covered by ASTM Standard D 225. Before the cracking problem appeared in the late 1980s, the committee that writes

and amends ASTM D 3462 was little noticed, and the standard itself was widely ignored. But when roofer groups began to voice vigorous complaints about shingle defects, the D 3462 committee became a focus of hot disputes.

Different “stakeholders” — companies or other groups with an interest in the standard — have pushed different points of view in these discussions. Manufacturers who target the low-cost do-it-yourself market with “commodity-grade” shingles have argued against upgrading or enforcing it, while companies who mainly sell through big wholesalers to professional roofers have wanted the standard toughened.

As a result, the standard still represents something of a compromise: Some roofers and even some manufacturers believe the minimum requirements are too low. But in recent years, new requirements have been introduced that test shingle qualities in new ways.

Tear test. The standard has long included a tear-strength provision based on the Elmendorf tear tester, a pendulum device that measures the force needed to tear a shingle. To comply, shingles need an average strength of at least 1700 grams. While some companies maintain that tear testing does not identify the qualities a shingle really needs in service, other companies have joined roofers in supporting the requirement, and it remains in force.

Nail pull-through. One new requirement in ASTM D 3462 is a fastener pull-through test that measures the force needed to pull a nail head through the



Many fiberglass shingles installed in the late 1980s and early 1990s developed cracking problems. The shingles on the left, installed in 1988, showed typical vertical cracking when inspected 11 years later, in 1999. The shingles on the right, installed in 1992, showed noticeable cracking in 1997, when they were only 5 years old.

shingle at two temperatures (around 73°F and around 32°F). CertainTeed's technical director Mike Noone, who pushed for the nail-pull requirement, is chairman of ASTM's committee for asphalt shingles. He says CertainTeed's research shows that the nail-pull test is a good measure of a shingle's overall toughness. However, Noone believes the pull-through minimums should be set higher: "At 32°F, the value is 23 pounds [of force required to pull the nail through the shingle]. I think if you aren't closer to 30 you aren't going to do very well on the roof."

Pliability. Another new requirement is a pliability test that requires the shingles to handle a right-angle 1-inch radius bend without cracking. This helps to ensure that efforts to increase shingle thickness or strength don't make the products too stiff or brittle.

Future enhancements. One change that has been talked about, but not yet adopted, is a test method that would put shingles through an accelerated heat-conditioning process in a "dark oven" to simulate the effects of heat aging in the field, before subjecting the shingles to the nail-pull, tear, and pliability tests. CertainTeed's Noone says his company's research shows that this process would predict how well shingles would retain their toughness and flexibility after enduring years of sunlight. But the technology to withstand this kind of abuse involves the complex chemistry of asphalt, and not all manufacturers are eager to take the problem on.

Tests vs. Reality

In fact, companies still argue over whether the tests in the existing standard relate to the actual causes of performance failures.

In the early 1990s, the Asphalt Roofing Manufacturers Association (ARMA) argued that ASTM D 3462, especially the tear-test part, didn't bear on the cracking and splitting problem. Asserting that other shingle qualities such as pliability and tensile elongation were more the issue, ARMA argued against raising or enforcing the tear-test requirement.

Roofer organizations like the National Roofing Contractors Association (NRCA), the Midwest Roofing Contractors Association (MRCA), and the Western States Roofing Contractors Association (WSRCA) took the opposite side. "NRCA's opinion is that compliance with D 3462 is the principal indicator," says Tom Bollnow of the NRCA technical services staff. "It's not the only causal effect, but it is an indicator that the shingle is more likely to perform than one that doesn't comply."

On the other hand, notes Bollnow, "You have to be careful. There are certain things a manufacturer can do to a shingle to increase the tear strength that might have adverse effects on the rest of the shingle.

And there are some shingles that don't meet the ASTM 1700-gram tear-strength minimum that are performing fine."

"But in eight years," Bollnow says, "they haven't been able to come up with another test. This is the one we have."

Engineer Kent Blanchard is a TAMKO executive who serves on the ASTM task force for the D 3462 standard. He questions relying on the standard as a guide: "D 3462 has become a proxy for quality, and that is not right. If you really want to know how the shingle is made, you've got to know about the filler, the asphalt, the granules.... [A shingle] could meet D 3462 and still have a problem with the asphalt or the filler. Even 2000 grams of tear strength does not guarantee that you are not going to have problems with the shingle."

Blanchard argues in favor of market forces. "The people that have to determine whether the product is good enough are the ones who install it. They buy a shingle and if they don't have problems with it, they will stick with that shingle. When they start having problems they bail out of the shingle. I know of roofing manufacturers who knew they were putting out a bad shingle, but if you are in it for the long haul, you can't do it that way."

"There is a lot more to the buying process than an ASTM standard," insists Blanchard. "That's not to say, 'let's don't have any standard,' but don't put your trust in a standard. You have to put your trust in the company, that they know how to make a good shingle."

Mike Noone counters Blanchard this way: "Whatever he may say, his company's shingles still pass D 3462." CertainTeed, like most manufacturers, routinely runs its competitors' brands through ASTM testing, and Noone says, "I don't think I've ever seen one of theirs [TAMKO's] that doesn't pass D 3462. Most of them are well above it." And in fact, a check of TAMKO's web site shows that their product literature for one brand, the Stormfighter, claims test results of more than double the ASTM minimums.

ASTM and the Building Code

A decade ago, with the cracking problem hurting their businesses, roofers started pushing to include the D 3462 shingle standard in building codes. In 1997, the roofers got their way. The most recent versions of ICBO, BOCA, and SBCCI codes require D 3462 compliance, as does the new *International Residential Code* created jointly by all three bodies. Only in states or municipalities where pre-1997 versions of the codes still apply are non-ASTM-compliant shingles allowed.

Tim Ryan, a building official in Overland Park, Kan., is on the International Code Council board of directors. Overland Park has adopted the new

International Code, and Ryan says his office is enforcing ASTM D 3462 for asphalt shingle roofs.

"Different localities handle it differently," says Ryan. "Some require separate permits for roofing, some incorporate it into the general building permit. Some want to be out at the site when they deliver the roofing material, because the product's not labeled — just the wrapper is. Our guys will pick up the wrappers off the ground to see if the shingles are properly labeled. If we found a non-compliant shingle on the roof, we'd make them take it off, or else get an evaluation report from the manufacturer that says it does comply."

Verifying Compliance

ASTM doesn't perform any testing itself, relying on manufacturers to monitor their own compliance with standards. In 1997, *Consumer Reports* magazine ran a selection of shingle brands through the ASTM tear test and printed their findings. They discovered that some shingles whose bundle wrappers claimed compliance with ASTM D 3462 actually failed the tear-test minimum. (Not surprisingly, shingles that weren't labeled as ASTM-compliant flunked also).

With shingle buyers questioning the manufacturers' self-certification, companies began turning to

independent certifiers. Underwriters Laboratories (UL) has long had an independent testing program to certify that fiberglass-asphalt shingles meet the ASTM test for Class A fire resistance. Now companies can enroll in a similar UL program that certifies compliance with ASTM Standard D 3462. A shingle that tests out okay, and continues to pass tests monitored by UL in random factory visits, gets the right to use the familiar "UL" mark on its bundles. CertainTeed was the first to get the UL stamp; after buying out shingle makers Bird, Celotex, and GS, CertainTeed brought those brands into compliance and now has them UL-certified also. Other companies have since followed suit, and the majority of brands now have UL certification.

However, many companies still make ASTM-compliant and substandard versions of the same brand, selling one where compliance is enforced and another where it isn't. Also, it's important when you check for the UL sign to make sure that it relates specifically to ASTM D 3462 and not some other standard: All fiberglass shingles have been marked as meeting the UL Class A fire resistance standard for many years, but that has no bearing on the strength or durability of the shingle.



ASTM Standard D 3462 for fiberglass asphalt shingles includes a nail pull-through test using a special apparatus (left) and a tear test using the Elmendorf tear-test machine (right). Experts say that shingles meeting the test minimums at the time of manufacture don't experience splitting and cracking on roofs. Many companies now have their testing results verified by Underwriters Laboratories.

Some Satisfaction from Shingle Suits

Tougher standard enforcement has evidently improved today's shingles, but that doesn't solve the problem of customers who have older, defective shingles on the roof. But court action has begun to provide a remedy.

Every manufacturer reportedly experienced some cracking and splitting of shingles installed in the late 1980s and early 1990s. Complaints were widespread, but individual homeowners had little luck in court. Now, however, several companies have been held accountable in class action lawsuits. GAF Corporation settled with lawyers for homeowners in 1999, and Bird Corporation reached a final settlement in February of this year. A suit against Elk in Connecticut's Federal District Court is being hotly contested.

Agreements in the two settled cases are similar. Lawyers for the homeowners have insisted on four main elements:

- **Warranty defenses dropped:** GAF agreed to abandon its usual warranty defense that improper installation had caused the failures. Regardless of how the shingles were installed, the company agreed to provide compensation for failed shingles. Bird still holds to some installation defenses, but they are restricted.
- **Money for tear-off and labor:** Typically, warranties have covered the product, and that's it. Most warranties have never paid to remove existing shingles when replacing a bad roof, or even for the labor to install the new shingles. Contractors or homeowners have been left holding the bag for what is usually the bulk of a reroof's cost. In the two settled cases, however, manufacturers agreed to provide money toward tear-off and reroof expenses.

- **Transferability:** Most warranties have never been transferable — they cover only the original buyer. But since the average homebuyer only keeps a home for seven years, shingle failures have often occurred (or been noticed) only after a new owner has moved in. Under the terms of the settlements, companies must compensate second and third owners if shingles fail prematurely.
- **Independent review:** The manufacturers remain responsible for evaluating claims and deciding whether or not the settlement covers any given complaint. However, a claimant who disagrees with the company's decision has the right to an automatic appeal to a designated independent third party. The company pays for the review, whatever the outcome.

The bad news for roofers and builders is that the class-action settlements cover homeowners, not contractors. If you've replaced a bad roof at your own expense, don't look to be compensated out of these lawsuits. On the other hand, if you have trouble right now with a GAF or Bird roof you put on in the late 1980s or early 1990s, your customer is probably entitled to collect from the manufacturer to pay for a replacement.

Information on the lawsuits is available on the World Wide Web. For Bird shingles, go to www.birdshingleclaims.com or call 800/247-3047; for GAF shingles, go to www.gaf.com/settlement or call the GAFMC Warranty Claims Department at 800/458-1860. Attorneys for the plaintiffs in both cases, as well as the ongoing suit against Elk, are Gilman & Pastor, Stonehill Corporate Center, 999 Broadway, Suite 500, Saugus, MA 01906; 781/231-7850.

—T.C.

Aging concerns. There is some concern about whether shingles that pass the standard when they are manufactured will keep their good qualities over time. Tear-test values, in particular, have been reported to drop quickly: UL's Ken Rhodes reports that some shingle brands that pass factory testing may flunk after a few months of storage in the package. Rhodes says nail-withdrawal and pliability results don't show the same decline.

CertainTeed's Mike Noone says that this drop in test values has only been seen in a few cases, but he says it has prompted some manufacturers to argue that the D 3462 standard should only apply on the day the shingles are made, not months later. Noone disagrees: "You should be able to test the shingles three or six months later and find that they pass."

In the field after years of service, it is clear that test results drop. Carl Cash, an engineer with consulting firm Simpson, Gumpertz, and Heger, has investigated large numbers of failed roofs, and says shingle samples from roofs with splitting and cracking show very low tear test values — 400, 800, or 1000 grams on the tear-test, rather than the standard minimum of 1700 grams.

These low values after years of exposure aren't in themselves considered a violation of ASTM D 3462, which is primarily a manufacturing standard; but they may be a good argument in favor of choosing shingles that far exceed the minimums, rather than barely passing them. Even so, Cash admits, "There are shingles out there that have a lower tear strength than 1700 grams that are performing adequately."

Installation Smoke Screen

Companies that make shingles, or any other product, typically make it a practice to look at installation when the product's performance is called into question. In the case of the well-known cracking problem, says Carl Cash, that is a smoke screen.

Cash chairs ASTM's overall roofing committee, with responsibility for commercial "flat" roofing products as well as steep-slope materials. He has served as an expert witness for the plaintiffs in lawsuits over defective shingles.

Cash states flatly, "There is nothing a roofing contractor can do to cause a roofing shingle to split, and there is nothing a contractor can do to prevent a shingle from splitting if it wants to."

"One of the things manufacturers focus on is the lack of ventilation in the attic," notes Cash. "That is a load of [baloney]. I have seen vented and unvented roofs side by side with the same orientation, same contractor, both split to the same degree. Ventilation is important for survival of the roof deck, but not for preventing shingle splitting."

About Warranties

Most experts agree that with shingles, you get what you pay for — usually. The cheaper shingles are more likely to suffer early deterioration, while the higher-priced shingles will probably last longer. Most often, a company also offers longer warranties on the pricier shingles. And although "20-year" shingles have become scarcer, some companies still produce a "20-year" shingle at bargain prices as well as a middle-of-the-market "25-year" line, and perhaps a premium line of shingle with a warranty term of 30 or 40 years, or even a "lifetime" warranty.

Technical people throughout the industry, however, generally agree that the warranties are little more than a marketing device, and can't be considered an accurate predictor of shingle life.

Read the fine print. As for the protection warranties offer the buyer, other factors are more important than the length of the term. Most warranties are prorated, losing a portion of their value every year; but some have an introductory term of five, seven, or ten years in which the full value is covered. Most warranties only cover the original buyer, but some will cover a second or third homeowner, at least in part. And the restrictions on installation details also vary slightly, although virtually all warranties can be voided if the installer doesn't follow the instructions on the label.

The big difference in warranties relates to this last point — whether the company will honor it or use some installation issue to avoid paying. Very few roofs, if any, are perfectly installed, and if a company is determined to avoid paying out, they can usually come up with an excuse to do so. So it really comes down to whether the manufacturer is motivated to stand behind its product, and has the means to do so. In this regard, TAMKO's Kent Blanchard's point may hold: It's the installer who ultimately has to judge the manufacturer's trustworthiness.

"I was 30 years in the contracting industry," says the NRCA's Tom Bollnow. "As a contractor you try to associate with one or two manufacturers that are going to provide service. Out of thirteen manufacturers, there might be one or two that have a problem, but seven or eight are going to be pretty much the same."

On the other hand, notes Bollnow, "Companies can change hands, policies can change. That's the value of belonging to a contractor association — you get to talk to other contractors, and if you hear of problems with a company that you have been dealing with, you watch out."



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