

Housewrap vs. Felt

Nearly 20 years ago, plastic housewrap burst onto the building scene with the introduction of Dupont's Tyvek. Since that time, Tyvek and a host of imitators have become standard materials, and are displacing tar paper in much the same way that plywood displaced

by Paul Fiset

board sheathing. Housewraps were originally marketed chiefly as air infiltration barriers, but since these materials are commonly used instead of felt

paper, they are also relied upon as weather barriers. This means that in addition to preventing outside air from leaking through, the housewrap also has to keep out any rainwater or snowmelt that finds its way behind the siding.

The plastic wraps are touted for another reason: Not only do they keep out the wind and water, but they are also permeable to any water vapor that migrates from inside the house into the exterior wall cavities. In effect, claim the makers, housewrap keeps the walls dry and airtight while still letting the house "breathe" — like an expensive Goretex jacket.

Nagging Questions

The reasons builders give for using housewrap or felt range from "to keep the wind out" to "the inspector says I have to." Somewhere in the middle, many practical-minded builders use wraps out of habit, "to protect the shell until the siding goes up." But so far, there's no clear consensus that housewrap should be considered "standard practice" — despite the advertising hype.

If the amount of mail and the number of questions coming to *JLC* and to our

Either product
will work —
the devil is in
the installation
details





Under most codes (the most recent BOCA supplement is an exception), this assembly is legal because rated OSB is counted as a water-repellant material. Code or no, the shell should be covered with paper or housewrap to protect it against the water that will inevitably blow behind the vinyl siding.

online building materials forum here at the University of Massachusetts are any indication, builders are skeptical of the claims and confused about the best course of action (see *Letters*, 10/98). Some question whether housewrap works as advertised, and whether abandoning felt — a time-honored material — may be creating problems in new construction that will surface later. Confusion lingers as to whether either housewrap or felt constitutes a “wrong-side vapor barrier.” Some wonder whether housewrap or felt are even necessary.

What the Codes Say

Don't look to the code for clear-cut answers. While the model codes generally agree on the need for a weather-resistant barrier paper (usually specified as #15 felt or Grade D Kraft paper) behind stucco, brick, stone, and other porous veneers, the paper requirement is typically omitted for other types of siding when they're installed over rated structural sheathing. Alone among the codes, BOCA, in its 1998 supplement, requires a layer of #15 felt over the sheathing regardless of the siding type. BOCA has also beefed up its flashing requirements, spelling out nine areas needing flashing, and getting rid of an

earlier exception for “leakproof” caulking (apparently in recognition that no caulking is leakproof for long.)

Though 15-lb. felt is usually cited, all the codes allow for the substitution of “equivalent” materials — opening the door for plastic housewraps. To qualify as an equal, the housewrap must pass performance tests conducted by an independent lab and paid for by the manufacturer. The manufacturer submits the test data to the evaluation services of the various code bodies, which issue reports describing the material's properties and stating which code performance requirements it meets. Assuming it meets the right criteria, the housewrap can then be used instead of the felt or building paper specified in the code.

Be careful, though: As in most code matters, it's up to your local inspector to approve an equivalent material. Chances are, given the wide use and acceptance of housewrap, you won't have a problem. But if it's an unfamiliar brand, the inspector may ask you to provide the evaluation service report for the product.

So far, we've just been talking about the structural codes, all of which reference the *Model Energy Code*. Under *MEC*, you either have to use caulk, tape, and gaskets to seal up seams and penetrations

BOCA on Flashing

1405.3.6 Water-resistive barrier: A minimum of one layer of No. 15 asphalt felt complying with ASTM D226 as listed in Chapter 35, for Type I felt, shall be attached to the sheathing with flashing as described in Section 1405.3.10, in such a manner as to provide a continuous water-resistive barrier behind the exterior wall veneer.

1405.3.10 Flashings: Approved corrosion-resistant flashings shall be provided in the exterior wall envelope in such a manner as to prevent entry of water into the wall cavity or penetration of water to the building structural framing components. Approved corrosion-resistant flashings shall be installed at all of the following locations:

1. At all exterior window and door openings to protect the underlying wall materials and structure from moisture, regardless of the classification of wall construction; whether barriers or constructions configured with inner drainage planes. For face-sealed barrier walls, flashings shall provide closure by containing incidental moisture and redirecting it to the exterior, thereby protecting underlying material layers within the wall. For wall constructions that incorporate inner planes of moisture-protective material such as cavity-type assemblies, the installed flashings shall prevent water from bypassing the innermost moisture-protective plane.
2. At the intersection where dissimilar exterior wall finishes abut, such as chimneys or masonry walls.
3. Fully under all copings and sills.
4. Continuously above all projecting wood trim.
5. At the intersection of exterior walls and porches and decks.
6. At wall and roof intersections.
7. At built-in gutters.
8. At the base of the exterior wall finish above finished ground level.
9. At intermediate supports of the exterior wall finish such as structural floors, shelf angles, plates or lintels.

Flashings at sills and copings, and over wall openings such as doors and windows, shall be sloped toward the exterior, with an upturned leg on the interior side and at the ends of the flashing to prevent water from flowing off the flashing into the wall interior, into the building interior, or to the structural system of the building. The flashing shall extend beyond the surface of the exterior wall finish and shall be installed to prevent water from reentering the exterior wall envelope.

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in the building shell against air infiltration, or — the easier route — you can install a “vapor-permeable housewrap.” If you live in a state or locale that has adopted and enforces *MEC*, this may be the reason you use a housewrap. Felt will also meet the criteria, since its perm rating is typically around 5 in its dry state.

To Wrap or Not to Wrap?

Given that your local code may not require you to use felt or housewrap, should you use one of them anyway? In a word, yes.

Many carpenters make the mistake of thinking that siding — wood, vinyl, stucco — is an impenetrable barrier against the elements. The truth is, whether water is propelled by wind, capillary attraction, gravity, or some combination of these forces, sooner or later it finds its way behind, around, or through the siding. Unless you build in an extremely arid climate, you need to protect the building shell against this moisture intrusion.

During a rain storm, a thin film of water is deposited on all windward surfaces. As the wind's speed and direction shift, the water moves up, down, and sideways from areas of high pressure to areas of low pressure. Since the area

directly behind wind-blown siding is at a lower pressure than the exterior face, the water is sucked inward. I've stripped perfectly sound siding from walls immediately after a heavy rain to monitor rain intrusion and establish moisture profiles, and it's obvious that butt joints, seams, holes, and overlaps are siphon points for capillary suction. If there's no building paper, this water will get wicked up into the wood sheathing,

where it often causes problems.

Typically, building paper goes up as soon as the sheathing is installed. But to be effective, it must be integrated with the flashing that follows in later stages of the job. This means, for example, having to slit the housewrap above windows to tuck under the upper leg of a metal cap flashing, then taping the wrap to the flashing. And the wrap itself must be properly layered, overlapped, and taped

where necessary to provide a clear drainage path (see "Making Walls Watertight," 12/95, for flashing details).

Does It Matter Which Housewrap You Use?

Plastic housewraps are engineered materials: They're designed to prevent air infiltration and keep out liquid water, while allowing water vapor to escape from inside the house. That's a tall order.

Making Sense of Housewrap Specs

ASTM (the American Society of Testing & Materials) has recently convened a task force on weather-resistive barriers — asphalt-treated kraft paper, asphalt-saturated organic felt, and housewrap — in an effort to bring some consistency to the performance criteria by which these products are measured. A recent memo from the chairman of the group states that the three materials, any of which may meet the code criteria for "building paper" or "weather-resistive barrier," are "described by different...standards" and that "there is no way to compare materials by a common set of criteria." The memo goes on to list no less than 24 test standards that manufacturers may pick and choose from to gain code approval for their products.

Apples to Oranges

Even if two manufacturers use the same test, the results can't be compared because the tests are often set up differently. For example, ASTM E 283, commonly used to test resistance to air infiltration, requires that the weather barrier be stretched over an 8x8-foot wall frame. However, the manufacturer can instruct the testing lab to put the wrap over anything from an open-stud wall to a fully-sheathed, sided, insulated, and drywalled frame. To make a comparison, you would have to buy a copy of the code report for each product. Unless the test assemblies were exactly the same, a comparison of the specs would be meaningless.

There are many test procedures that can be used to qualify wall wraps as water resistant, but ASTM D 779, commonly called the "boat test," is recognized as the industry standard. In this test, a small sample of wall wrap is folded like a piece of origami and floated on water in a petri dish. A powdered substance, called an "indicator," is sprinkled on top of the wrap in a fine-layered, 1-inch circle. As water soaks up through the wrap, the indicator begins to change color. When an observer determines that the indicator is changing color at the fastest rate — a sign that water is passing through the wrap at the most rapid rate — the test is over and the elapsed time is noted. To qualify as a Grade D wrap, it must take at least 10 minutes for the color to change at its fastest rate. If a wall wrap claims a rating of 60, that means it took 60 minutes.

A problem with the boat test is that water vapor can also trigger the indicator's change of color — meaning that a highly vapor-permeable wrap like Tyvek fails. As an alternative, DuPont put Tyvek through AATCC 127, the "hydro-head" test, to prove its water resistance. In this test, the material is subjected to a 22-inch column of water — approximately the force exerted by a 200-mph wind — and must not leak a drop for 5 hours. This is a far more demanding test for water resistance than the boat test, yet as far as I know, among the plastic wraps, only Tyvek and R-Wrap have passed. Some

researchers claim that felt has also passed, though inconsistently.

How Much Is Enough?

Here again, product literature can be misleading. Some manufacturers may list hydro-head test values like "186 cm." This is the height that the water column reached before the material began to leak.

One tested value that actually can be compared between brands of housewrap is vapor permeance, which is usually tested according to ASTM E 96, with the results expressed in perms. The higher the value, the more permeable the material. (A material with a perm rating of 1 or less is considered a vapor barrier.) Unfortunately, the wide spread in perm ratings among brands — from 5 perms to over 200 perms — makes it a little difficult to assess the importance of this number. The codes require wall wraps to match or exceed Grade D building paper, which has a minimum perm value of 5.

To complicate things, the permeance of felt paper is a moving target. Felt paper absorbs water and ranges from a low of around 5 perms when it's dry to over 60 perms when it's exposed to relative humidity above 95%. The perm values of engineered wall wraps, however, are moisture-stable. Although high permeance is generally desirable in a wrap, excessively high ratings are not as important as resistance to air and water.

— P.F.



To test for water repellancy, the author's students subjected housewraps to a column of water for two hours. All of the perforated wraps leaked 100% of the water, some very quickly. The non-perforated wraps, Tyvek and R-Wrap, held back all the water, while felt lost 30%.

Felt paper and all of the plastic wraps display these properties to one degree or another. The difficulty comes in distinguishing between them.

The question is, how well do these materials work? And if you choose to use a housewrap, does it matter which brand?

With all of the code test data available, you'd think it would be easy to evaluate performance and compare one

product to another. Unfortunately, there's no consistency in the testing procedures or in how the results are reported, so comparisons are difficult or meaningless (see "Making Sense of Housewrap Specs").

As an alternative, my students and I recently decided to do some testing of our own in the lab at U. Mass. We wanted to explore how various wall wraps performed when exposed to clean and soapy water, and to water mixed with cedar chips. We used a test similar to the hydro-head test used for code testing, in which the housewrap is subjected to the pressure of a 22-inch water column. In our test, we subjected each wrap to a 3 1/2-inch water column, which delivers a force roughly equivalent to a 70-mph wind (see Figure 1). Wind pressure and hydro-head conditions are certainly two different things, but we felt this was a reasonable level of stress to apply since wind commonly exerts a similar force on rain-covered walls.

We recorded the loss of water over a two-hour period for each test we performed. Our results showed that clean water never leaked through Tyvek or R-Wrap, and that 15-lb. felt lost 30% of its water on average; all the other products drained completely. The performance of felt paper and Tyvar was highly variable — both often held water for 30 minutes or more before leaking. Amowrap,

Pinkwrap, and Barricade (all perforated wraps) lost more than 80% of the water in the first 15 minutes.

We conducted a second series of tests using soapy water, and a third set, using a "tea" made by soaking cedar chips in water, to see if the water-soluble extractions in cedar acted as surfactants, making wall wraps more water permeable. Surfactants, which break down the surface tension of water, making it flow more easily, are present in soaps and oils that can be found on the surface of construction materials and on the hands of installers. Paint, stucco, and detergents used in powerwashing also contain surfactants.

We ran these additional hydro-head tests only on Tyvek, R-Wrap, and felt paper, the materials that had performed best with clean water. Tyvek and R-Wrap lost about 10% of the soapy water column in two hours, and about 3% of the cedar tea. Felt was unaffected by the surfactants, still losing 30% of its water.

In future lab tests, I plan to explore how wall wraps perform while in constant contact with saturated siding. I'm also curious about how perforations from siding nails affect housewrap performance.

Housewrap or Felt?

Based on our testing, if I were buying a housewrap today, I would choose



Backpriming wood siding, as was done here, helps to prevent the wood from storing water that may later be driven through the housewrap as vapor. Treating the cut ends would have improved the job. Unfortunately, the incomplete housewrap job and the reverse laps make it possible for wind-driven rain to soak the sheathing.



It's a good idea to tape housewrap to window flanges and flashing, but you've got to use the proper tape. Duct tape won't do the job.



Horizontal projections like these window heads should be flashed, and the housewrap above should overlay the upper leg of the flashing and be taped to it.

either Tyvek or R-Wrap, because they display the best water resistance. But so far, I've avoided the million dollar question — housewrap or felt? The truth is, there's no million dollar answer. In general — I don't think it matters a whole lot. If you get the flashing details right, and are careful installing the building paper, you will prevent 99% of moisture problems caused by wind-driven rain and snow. Either product — housewrap or felt — will provide an adequate secondary drainage plane. And either product is permeable enough to allow interior moisture to escape.

As it happens, I have felt paper on my own home, and if I could choose between felt and housewrap and do it over again, I'd still choose felt. That's because I believe that under certain circumstances, felt outperforms housewrap. For example, an ice dam or roof leak may allow water to get behind the felt or housewrap. It's also possible for the sun's heat to drive water vapor through the housewrap from the outside, where it can condense on the



sheathing. In either of these cases, you now have liquid water on the wrong side of the wrap. Under these conditions, the liquid water would be trapped by the housewrap, which is permeable only to water vapor. Felt, on the other hand will absorb the water, and more quickly dry to the outside.

Recommendations

Despite your best efforts, some water will make it through the siding, so you ought to plan for it. Here are my suggestions for avoiding problems.

Use proper flashing materials and techniques. BOCA's section 1405.3.10 of the 1998 Supplement spells this out thoroughly (see box, page 50).

Always use a weather-resistant barrier paper, whether felt or housewrap. Felt resists water penetration reasonably well, and because it is more vapor permeable the wetter it gets, it may promote drying better than plastic wall wraps. If you prefer housewrap, I would avoid the perforated ones, because they don't appear to have much water resistance. From what I've seen so far, Tyvek and R-Wrap are the best of the bunch, with Typar a respectable but distant third. If the wrap is going to be in place for a while before the siding goes up, housewrap might be a better bet. Felt paper's UV resistance is not good, and it tends to wrinkle and rip in the wind over time.

Tape or caulk the building paper where it overlaps the upper leg of a flashing. The wall wrap should drain completely, with no imperfections. That means overlapping successive courses 4 to 6 inches, and preferably taping all seams, always making sure the wrap over-

lays any flashing. In extreme climates or in areas of extreme exposure, consider using a self-adhering membrane around openings, and also on the walls above decks and other areas where splashback could create unusually wet conditions.

Always backprime wood siding. As explained above, the sun's heat can drive water vapor through a wall wrap, where it can condense on the sheathing. You can minimize this by priming all sides of the wood, or better yet, pretreating with a coating of clear water repellant preservative. Water repellants block liquid water much better than paint primers, and they allow vapor to pass out of the wood if any water happens to get in. Backpriming also prevents the siding from bleeding surfactants onto the wall wrap. After the water repellant has dried, install the siding, prime it, and apply two topcoats of a high-quality paint.

Avoid use of caulking as a first line of defense against water intrusion. Look closely at caulked joints that have been in service for a while and you will see hairline cracks where the caulk once bonded securely to wood, masonry, or vinyl components. A hairline crack is large enough to admit pressurized water, but not large enough to encourage drying. In the short term, caulking can help block water penetration, but in the long run it actually traps moisture behind the siding. Concentrate instead on flashing details that allow water to drain away from the building.



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