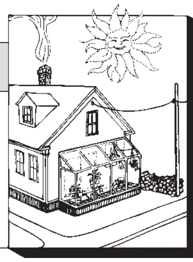
FOCUS ON ENERGY



Attic Insulation — the Secrets to Success

by J.D. Ned Nisson

There is more to attic insulation than just picking the cheapest material to achieve a given R-value. Almost every common attic insulation has some peculiarity that must be considered. Also we are still learning new things about insulation performance in different climates.

This column is an update of important attic insulation issues that are commonly overlooked or misunderstood.

Heat Doesn't Rise

The most common misconception about attic insulation is that attics need higher R-value than walls because heat rises. This is not true.

Heat does not rise; it travels equally in all directions — up, down, and sideways. Warm air does tend to rise. However in rooms with high solar gain, the air temperature near the ceiling of a well-insulated house is typically only a few degrees higher than near the walls — not enough to justify added insulation. (If a room has enormous temperature stratification, a ceiling fan would probably be more cost effective than increased attic insulation.)

Then why does every energy guideline call for higher R-value for attics than for walls? Mainly because attic insulation is less costly to install. To increase attic insulation from R-19 to R-38 in a 1,000-square-foot house costs less than $100 in materials plus a few hours labor. The cost for a similar jump in wall R-value is huge in comparison.

No matter what computer program or economic analysis I use, the most sensible R-value for attics in most U.S. climatic regions (under 7,000 heating degree days) is about R-30. To achieve that overall R-value, the insulation should be R-38 to R-40 to allow for losses through framing and installation defects.

Fiberglass Batts

Buy full-width only. Every major manufacturer makes fiberglass batts in two widths. Narrow batts, which are 23 inches, are designed for walls and cathedral ceilings. Narrow batts should never be used in attics because they leave a gap above joists or truss chords. Full-width, 24-inch batts are specifically designed for attic use and should fully close over the tops of framing members (Figure 1).

Narrow-width batts are still commonly used in attics — sometimes out of ignorance but sometimes as a way to cheat customers. In fact, last year the Insulation Contractors Association of America (ICAA) asked the major batt manufacturers to discontinue the narrow batts to eliminate this problem.

Cover your butt ends. Two research studies have found that cold outdoor air from eaves vents can penetrate into or under the butt ends of fiberglass batts. Aside from increasing heat loss, the penetrating air also cools the ceiling drywall, sometimes causing condensation and mold growth at the corners where walls meet ceilings.

The solution to this problem is to protect the batt ends with standard cardboard or plastic insulation baffles along the eaves (Figure 2).

Loose-Fill Fiberglass

Understanding bag labels. The most controversial issue with loose-fill fiberglass is the relationship between thickness and R-value. Thickness alone does *not* determine R-value; density must also be considered. Blowing in loose fill at low density, called "fluffing," can produce a very thick layer of insulation. But the fluffed blanket will settle and end up thinner with a lower R-value.

Intentional fluffing has been a problem in certain regions of the country. The ICAA has been leaning

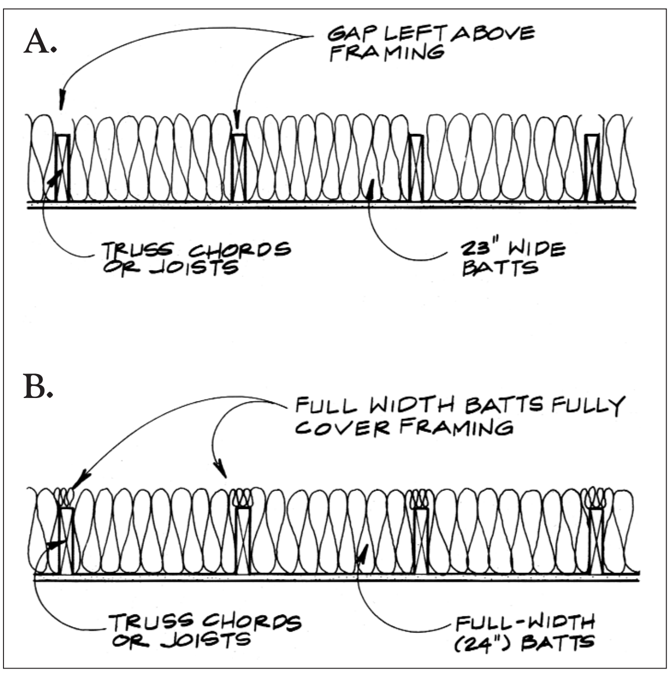


Figure 1. *Standard 23-inch batts (A) should not be used in attics because they leave gaps above the framing. Instead, use full 24-inch batts (B), which are made to fully cover the tops of floor joists or truss bottom chords.*

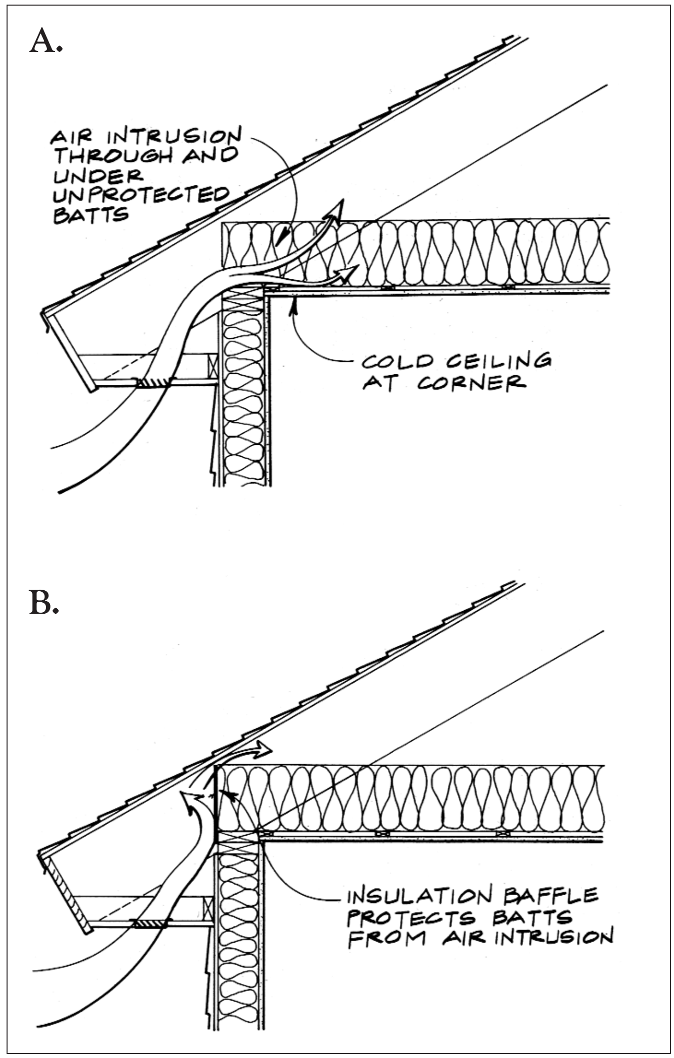


Figure 2. *Air intrusion into or under batts at the eaves (A) can cut insulation performance and cause condensation and mold at ceiling corners. Insulation baffles installed at batt edges (B) prevent the problem*

R-Value	Bags per 1,000 Sq. Ft.	Maximum Sq. Ft. Per Bag	Minimum Weight Pounds Per Sq. Ft.	Minimum Thickness
To obtain a thermal resistance of:	Bags per 1,000 sq. ft. of net area:	Contents of bag should not cover more than:	Weight per sq. ft. of installed insulation should not be less than:	Should not be less than:
R-38	26.6	38 sq. ft.	.665 lbs.	15 1/2"
R-30	20.8	48 sq. ft.	.521 lbs.	12 1/2"
R-19	13.2	76 sq. ft.	.330 lbs.	8 1/4"

Figure 3. *In the example shown, to guarantee an R-38 ceiling, you must use 26.6 bags of fiberglass per 1,000 square feet, installed at a minimum thickness of 15 1/2 inches. The thickness can be greater (fluffed), but you must use the minimum number of bags. The chart is adapted from the bag label for Insul-Safe III loose-fill fiberglass.*

on manufacturers for years to produce a material that cannot be fluffed, but the manufacturers insist that it can't be done.

A solution to the problem is clearly indicated on bag labels. Figure 3 shows part of the bag label for Insul-Safe III loose-fill fiberglass manufactured by Certainteed Corp. Notice the two left-hand columns — **R-Value and Bags per 1,000 Sq. Ft.** To obtain a specific R-value (column 1 in the chart), the most important factor is how many bags are installed (column 2). With the bag count satisfied, you must next make sure the minimum thickness, shown in the last column, is achieved.

It is okay to fluff the material to greater than minimum thickness, but *only* if the bag count is also met. The initial R-value will be higher than the one shown, but will drop over time as the insulation settles.

Cold-climate convection. A series of experiments performed last year at Oak Ridge National Laboratory showed that at very cold outdoor temperatures (20°F or below), the performance of some types of loose-fill fiberglass degrades due to air circulation within the insulation.

The same phenomenon was observed through infrared thermography at the University of Saskatoon in Canada. In both experiments, the material was cubed fiberglass.

Insulation manufacturers claim that the Oak Ridge tests are not conclusive. But until more research either confirms or refutes the results, it is probably prudent to avoid cubed fiberglass in climatic regions where the outdoor temperature is below 20°F for significant portions of the winter.

Researchers have found that cold outdoor air from eaves vents can penetrate the ends of fiberglass batts, sometimes causing condensation and mold growth at ceiling corners

Although air circulation can theoretically occur in any type of insulation material, I haven't seen any test data showing problems in any other loose-fill or batt materials.

Cellulose

Label confusion. Through several field and laboratory studies, researchers at Oak Ridge have conclusively determined that cellulose attic insulation always settles between 15% and 20% after installation, regardless of installed density. This is not a problem as long as cellulose contractors install 15% to 20% extra thickness to account for settling.

The problem is that most cellulose bag labels can be somewhat deceptive because they ignore settling. For example, one label I saw said that to obtain R-38, the installed thickness should be at least 10.3 inches. But that is *settled* thickness. The label didn't mention that at least 12 inches of insulation must be installed to assure the right thickness after settling.

The cellulose industry is well aware of this problem and may fix it. (I've seen one bag label that includes columns for both installed and settled thickness.) But until then, the best recommendation is to add 15% to 20% onto the bag label thickness to achieve any specified R-value.

You should also make sure you install *at least* the recommended bag count for the desired R-value.

The Cadillac Attic System

A somewhat unusual attic insulation system I came across recently consists of 2 inches of spray urethane covered by 8 inches of loose-fill cellulose (Figure 4).

The most attractive feature of this system is that the urethane forms an extremely tight air barrier across the entire ceiling, eliminating the need for any other air sealing. It also provides about R-12 thermal resistance over the entire surface, including joists and truss bottom chords.

In theory, the spray urethane should also serve as an adequate vapor retarder. But to play it safe I would add a polyethylene or paint vapor retarder in the ceiling. (One Wisconsin contractor told me that the 2-inch skim coat of urethane over drywall is strong enough to walk on after it dries, but I didn't try it.)

The cellulose provides an additional R-30. The result is a completely airtight R-42 attic insulation system which is only 10 inches thick. Of course, fiberglass could be substituted for cellulose or the thickness could be increased for higher R-value.

This is an expensive system because of the cost of foam installation. Typical installed costs average around $1.25 per foot. ■

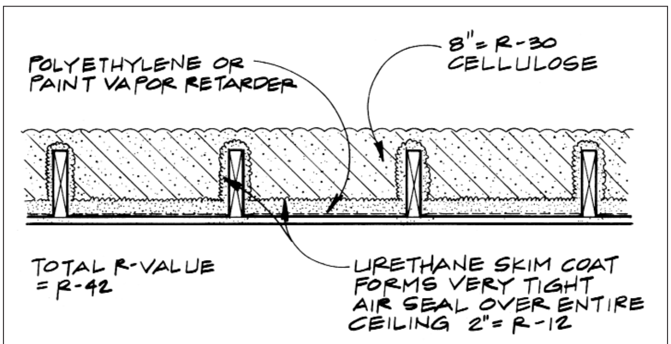


Figure 4. *A spray-urethane skim coat with cellulose (or fiberglass) over it forms a completely airtight, high R-value attic insulation system in relatively little space.*

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