

## RADIANT BARRIERS: A SOLUTION IN SEARCH OF A PROBLEM

# Musings of an Energy Nerd

Contemplating residential energy use

## RADIANT BARRIERS: A SOLUTION IN SEARCH OF A PROBLEM

A well-insulated home doesn't need a radiant barrier

POSTED ON SEP 24 BY **MARTIN HOLLADAY, GBA ADVISOR**

A radiant barrier is a shiny panel or flexible membrane used in construction. Although radiant barriers have no R-value, they can be used as part of a building assembly — for example, an assembly made up of a radiant barrier and an air space — to slow heat transfer.

The sale and distribution of radiant barriers has always attracted a disproportionate share of scam artists, many of whom promise impossible energy savings. The explanations made by these hucksters usually include multiple references to space vehicles and NASA. Having been swayed by this type of misinformation, a few builders have adopted an almost religious belief in the magical powers of radiant barriers.

So, what's the real scoop on these products?

### **Low-e surfaces don't emit much radiant heat**

A radiant barrier is a thin sheet of reflective material, often aluminum, applied to a substrate such as kraft paper, plastic film, cardboard, or plywood. By definition, a radiant barrier has a low emissivity (0.1 or less). Radiant barriers reduce radiant heat transfer across the space which they face. The lower a material's emissivity, the more effective it is at reducing radiant heat transfer.

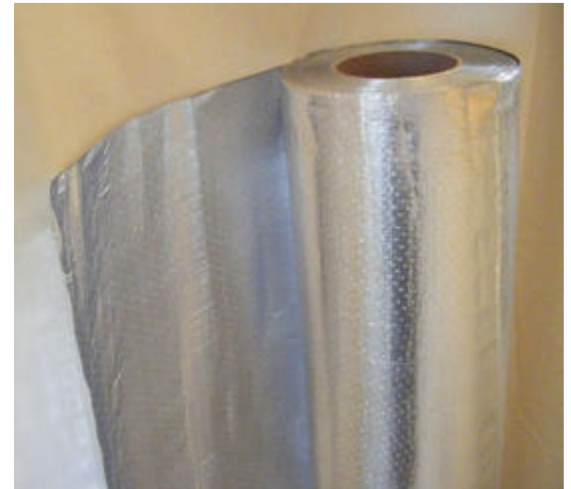
Although radiant barriers can be made from a variety of materials, there is no such thing as radiant barrier paint. No one has yet invented a paint that achieves an emissivity of 0.1 or below. (For more information on low-e paints, see '[Insulating' Paint Merchants Dupe Gullible Homeowners.](#))

Radiant barriers that aren't facing an air space don't work. If it's sandwiched between a layer of sand and a concrete slab, it's a conductor, not an insulator.

Although a radiant barrier has no R-value, it can help boost the R-value of an adjacent air space. According to *ASHRAE Fundamentals*, a vertical 3/4-inch air space has an R-value of about R-1 — assuming that the heat-emitting surface adjacent to the air space has an emissivity of 0.82. If the same air space is faced with a radiant barrier with a emissivity of 0.05, the R-value of the air space is boosted from R-1 to about R-3.

### **Radiant barriers make sense for uninsulated barns**

The effect of a radiant barrier on a building assembly's R-value may be significant or insignificant, depending on whether the assembly is well insulated or poorly insulated. Radiant barriers do not significantly benefit well-insulated assemblies.



**Image 1 of 2**

**Where do radiant barriers make sense?**

For example, consider drywall installed on a SIP wall. If the SIP has an R-value of R-30, the emissivity of the drywall hardly matters. Since the drywall is at room temperature, it isn't emitting any radiant heat. (Radiant heat transfer only becomes significant when a radiating surface is at a significantly higher temperature than surfaces in the room or air space which it faces.)

A poorly insulated assembly, however, will benefit from a radiant barrier. For example, consider an uninsulated barn with galvanized steel panels for roofing and siding. On a hot sunny day, the steel panels are warmer than the interior of the barn, so they radiate a lot of heat. If a radiant barrier is installed on the interior of the wall, it cuts down on the transfer of radiant heat from the steel panels to the interior surfaces.

Because building codes require the walls and ceilings of new homes to be insulated, there isn't any need to install a radiant barrier in a well-designed home.

### **Building a stack of 1-inch air spaces**

A few "religious believers" in radiant barriers have experimented with building wall or ceiling assemblies consisting of multiple 1-inch air spaces separated by aluminum foil. While these assemblies work — after all, if you put together a thick enough pile of R-3 pancakes, you can eventually achieve a reasonable R-value — they cost far more to build than ordinary walls with conventional insulation.

Radiant barrier fanatics have also experimented with horizontal radiant barriers on the top side of attic floor insulation. There are two problems with such radiant barriers:

Once the radiant barrier gets dusty, it's no longer a low-e surface. Radiant barriers have to stay shiny to work.

Unless the radiant barrier is perforated, it acts as a vapor barrier. During the winter, condensation will form on the underside of the radiant barrier.

Don't be tempted to install foil-faced bubble pack under a concrete slab. The R-value of foil-faced bubble pack — generally between R-1 and R-2 — is far too low for such an application.

### **Radiant-barrier roof sheathing**

The most common type of radiant barrier used in new-home construction is radiant-barrier roof sheathing — that is, plywood or OSB with a radiant barrier on one side of the panel. These panels are installed over unconditioned attics, with the shiny side facing down. Radiant-barrier roof sheathing only makes sense in hot-climate homes that have HVAC equipment or ductwork installed in an unconditioned attic.

Here's the logic: the builder knows that the HVAC equipment and ductwork will get very hot in the summer. The builder doesn't want to move the HVAC equipment and ductwork where they belong — inside the home's conditioned space — because it's cheaper to install everything in the hot attic. So the builder installs radiant-barrier sheathing to keep the attic a little cooler. At best, it's a halfway solution to a basic design problem.

That said, radiant-barrier roof sheathing is effective at lowering attic temperatures. Since it doesn't cost much more than ordinary roof sheathing, it makes sense to install it on new hot-climate homes.

New homes in a cold climate, on the other hand, shouldn't use radiant-barrier roof sheathing. Up north, a sun-warmed attic helps lower heating bills.

### **What about energy savings?**

Installers of attic radiant barriers often make exaggerated energy-savings claims. What do the experts say?

According to a [research report](#) published by Oak Ridge National Laboratory, “The tests to date have shown that in attics with R-19 insulation, radiant barriers can reduce summer ceiling heat gains by about 16 to 42 percent compared to an attic with the same insulation level and no radiant barrier. These figures are for the average reduction in heat flow through the insulation path. They do not include effects of heat flow through the framing members. ... THIS DOES NOT MEAN THAT A 16 TO 42 PERCENT SAVINGS IN UTILITY BILLS CAN BE EXPECTED. Since the ceiling heat gains represent about 15 to 25 percent of the total cooling load on the house, a radiant barrier would be expected to reduce the space cooling portion of summer utility bills by less than 15 to 25 percent. Multiplying this percentage (15 to 25 percent) by the percentage reduction in ceiling heat flow (16 to 42 percent) would result in a 2 to 10 percent reduction in the cooling portion of summer utility bills.”

That’s the bottom line — a 2% to 10% reduction in the *cooling portion* of your summer electric bill. (Obviously, that’s less than a 2% to 10% reduction in your summer electric bill.) However, notice that these figures were calculated for a very poorly insulated attic — one with R-19 fiberglass batts. Even in Florida, it’s now illegal to build a house with such a poorly insulated attic. If you have a code-compliant home in Florida, you should have R-30 attic insulation.

If you have properly installed R-30 or R-38 attic insulation, don't expect a radiant barrier to lower your cooling bills — unless, of course, your builder installed ductwork in your attic.

### **Meanwhile, up in Minnesota ...**

If you live in a cold climate, radiant barriers make even less sense than they do in Florida. According to the U.S. Department of Energy’s Energy Efficiency and Renewable Energy Clearinghouse, “Two field tests, one in Minnesota and one in Canada, both found that a radiant barrier placed over R-19 attic floor insulation (which is less than half the DOE minimum recommendation for those climates), found that the radiant barrier contributed to less than a 1% reduction in energy consumption for heating and cooling.”

As with the Florida example, it should be pointed out that even these meager savings are associated with attics that are poorly insulated. If the attic has code-minimum insulation, the savings disappear.

### **A retrofit study in Nevada**

In 2001, researchers from the National Association of Home Builders (NAHB) Research Center evaluated several energy-retrofit measures in a 1,270-square-foot ranch house in Henderson, Nevada. The researchers focused on measures appropriate for hot climates.

At a cost of \$650, the researchers installed a radiant barrier on the underside of the attic rafters. The energy savings attributable to the radiant barrier were calculated at \$11 per year, meaning that the simple payback period for the radiant barrier was 59 years.

After I wrote a report on the research for *Energy Design Update*, several radiant-barrier dealers wrote letters complaining that the numbers couldn’t be right. However, Danny Parker, a senior researcher at the Florida Solar Energy Center, came to my defense. Comparing the NAHB researchers’ findings with the results of his own Florida research, Parker wrote, “I looked over the NAHB report and think it’s pretty good. ... In the section on economics in our detailed comparison with ceiling insulation, we show a radiant barrier system to be more expensive than added ceiling insulation. And our retrofit experience with radiant barriers shows them to be very expensive to put in (high labor costs).”

**Less effective — and more costly**

Even radiant barrier products that provide some benefit — for example, foil-faced bubble wrap or “**radiant barrier chips**” — have an Achilles’ heel: they cost more than conventional insulation. When I wrote a report on foil-faced bubble wrap in 2003, I found that the product was selling for between \$.38 and \$.50 per square foot. In other words, the R-1 bubble-wrap costs more than R-5 extruded polystyrene.

In 2004, I looked into the cost of radiant barrier chips — a product designed for horizontal application on attic floors. At that time, the developer of the product claimed that radiant barrier chips could be installed for \$1.50 per square foot. In other words, it cost more to install a thin layer of radiant barrier chips than 12 inches of cellulose.

*Last week’s blog:* **“Easy Ways to Avoid Condensation in Your Walls.”**



TAGS: **EMISSIVITY, EMITTANCE, LOW-E, RADIANT BARRIER, RADIANT HEAT, RADIANT TRANSFER, REFLECTIVITY**

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