

Consumer Report:

**5 Things
You Must Know
Before Buying
Radiant Barrier**

INDEX

I:	How Do Radiant Barriers Really Work	pg 3
	A: Understanding Heat Transfer	pg 3
	B: How Radiant Barriers Stop the Heat	pg 4
II:	What Type of Savings Can I Expect	pg 5
III:	How, When and Where to Install Radiant Barrier	pg 7
	A: Perforated or Non-Perforated	pg 7
	B: Required Installation Tools	pg 8
	C: Where to Install Radiant Barrier	pg 9
IV:	Radiant Barrier Myths... Busted	pg 10
	A: Radiant Barrier Paint vs. Rolls	pg 10
	B: Radiant Barrier & Roof Shingles	pg 10
V:	Not All Radiant Barriers Are Made the Same	pg 11

I: How Do Radiant Barriers Really Work?

To help you to understand how a radiant barrier works, let me first start by explaining a little about heat transfer. When talking about radiant barriers, insulation, HVAC systems and energy efficiency, it is important that we recognize that all of these things are about controlling heat.

A: Understanding Heat Transfer

Heat transfer happens in homes and building in three distinct ways.

- * *Conductive heat transfer (conduction)*
- * *Convective heat transfer (convection)*
- * *Radiant heat transfer (thermal radiation)*

Conduction is the least efficient method of transferring heat, and in a kitchen analogy, that would be an equivalent of boiling water in a pot over a stove. The fire heats the pot and the pot transfers its heat to the water and the water eventually comes to a boil. The key point here is that conduction is the transfer of heat through direct physical contact.

Convection is more efficient than conduction, and in our kitchen analogy, convection would be the use of an oven to heat food. Convection heat transfer is the process by which heat is circulated in an area through the air and/or fluid. The key point here is that heat is transferred through air circulation.

Radiant heat otherwise known as thermal radiation is the most efficient type of heat transfer and the best example in our kitchen analogy would be the use of a microwave. Radiant heat is generated when heat from the movement of charged particles within atoms is converted to electromagnetic radiation. In a home or building, radiant heat refers to heat radiated from objects and materials, such as incandescent lights, concrete flooring and the sun. It is also important to note that radiant heat moves through the air without heating the air, instead it will heat the first surface that it touches, and this surface will then re-radiate that heat in the space making it feel warmer when you are in that space.

In general, heat transfer between the interior and exterior of a home or building is bad and decreases the efficiency of the heating and cooling system. There are some special conditions where heat transfer is used to increase the efficiency, such as traum walls, thermal masses, and other natural heating and cooling techniques. But for the most part, in a typical home or building which relies on mechanical means of heating and cooling, heat transfer is the enemy.

So, it makes sense to stop as much heat transfer as possible. This is why insulation is used in all structures. Insulation is great at reducing convective heat transfer, while also reducing some radiant and conductive heat transfer as well. However, the typical amount of insulation in a home or building (anything below R39) is simply not enough to stop the majority of radiant heat from infiltrating the structure.

B: How Radiant Barriers Stop the Heat

A radiant barrier is a material with a very low emissivity and high reflectivity giving it the ability to virtually stop the transfer of radiant heat or thermal conductivity. This allows the radiant barrier to reduce heat gain in the summer and heat loss in the winter, thus reducing the net heating and cooling needs of the structure.

There are two key values that determine the effectiveness of a radiant barrier, and those are its reflectivity (higher is better) and emissivity (lower is better) values.

The reflectivity value of a radiant barrier is pretty easy to understand, the higher the reflectivity value, the more light energy (heat) the radiant barrier is able to reflect. Reflectivity values are expressed as a percentage number (%), which basically describes how much light energy the surface will reflect.

The emissivity value is basically the ratio of heat energy radiated by a material to the heat energy radiated by a true black body at the same temperature. This may sound a bit confusing, so let's talk in layman's terms. Basically, if we were to take a pure black object (theoretical) which reflects no light energy and absorbs all light energy that touches it, it would have an emissivity value of one ($\epsilon = 1$). Any real object, whether it is black or not would have an emissivity value of less than 1.

So, what this definition is really saying is that the darker an object is, the more light energy it will absorb and re-radiate. And subsequently, the lighter and more reflective a material is, the less light energy it will absorb and re-radiate.

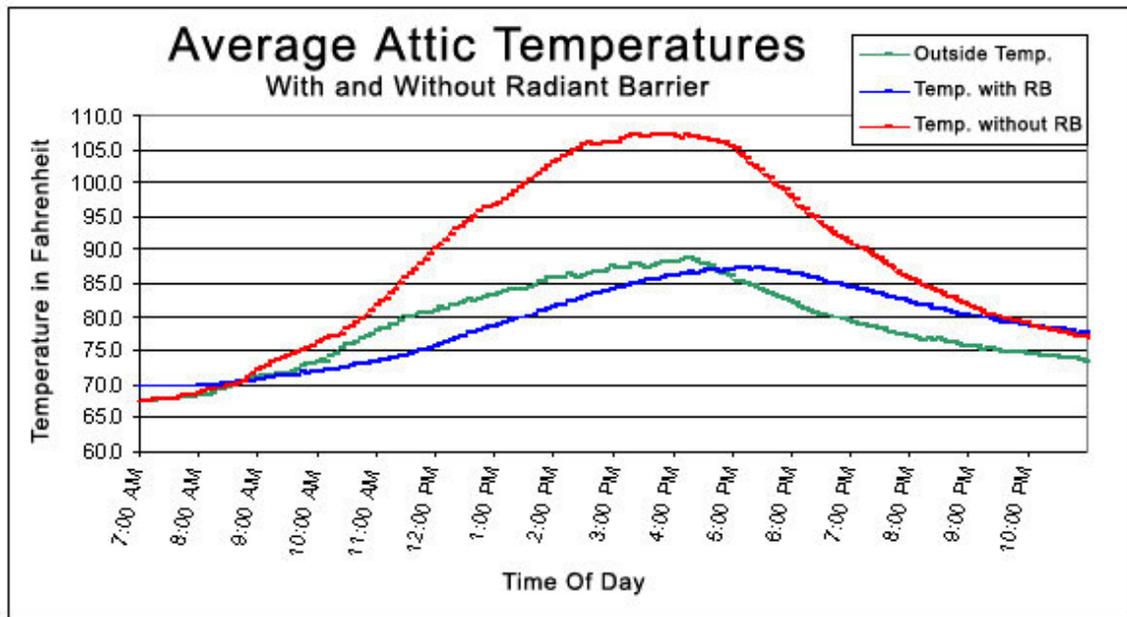
Radiant barriers, even though they have little or no "insulation" properties can effectively block most of the heat coming in or leaving a structure. This is because radiant heat is the most efficient type of heat transfer, and stopping radiant heat transfer is the most effective way to decreasing your heating and cooling needs. In the summer, less radiant heat entering your attic makes your AC system run more efficiently, and in the winter, less heat energy being lost through the roof makes your heater more efficient.

II: What Type of Savings Can I Expect

Many individuals want a hard number or percentage of estimated savings from a radiant barrier, it really is impossible to predict, because there are so many different factors which contribute to its effectiveness or ineffectiveness. However, according to studies done by the U.S. Department Of Energy, it is generally accepted that installing radiant barrier in the attic will reduce heat gain through the ceiling by 40% typically leading up to a 17% reduction on heating and cooling utility bills.

While this 17% figure may hold true for many climates and a typical installation, it will vary from place to place. Many independent studies and radiant barrier users have tested their results and reported energy savings varying from as low as 12% up to as high as 39%.

The graph below shows the attic temperature difference between two similar attics spaces, one with a radiant barrier installed and the other without. As you can see, the attic with the radiant barrier(blue) stayed much cooler throughout the day.



This report is not meant to give hard figures, rather it is meant to give the potential radiant barrier user/installer the proper information to make the most informed decision possible. With that being said, the section below will list and describe some of the main factors which will affect the performance of a radiant barrier installation.

Main Factors Determining Radiant Barrier Effectiveness:

- **Attic Ductwork** – If ductwork or air handlers are located in the attic, the temperature of the attic area will affect the efficiency of the HVAC system. Using a Radiant Barrier to control attic temperatures will increase HVAC system efficiency, thus reducing energy costs.
- **Existing Insulation** – If existing attic insulation is less than a R39, a Radiant Barrier installation will help to stop excess radiant heat. Homes with a R39 or higher ceiling-insulation, and have no ductwork in the attic will not achieve much energy savings from a Radiant Barrier installation.
- **Cold Climates** – In climates where the majority of annual energy usage goes towards heating the structure, a radiant barrier on the floor of the attic, above the insulation and ductwork will provide substantial energy savings.
- **Hot Climates** – In climates where the majority of annual energy usage goes towards cooling the structure, a radiant barrier stapled to the bottom of the roof rafters will provide maximum energy savings.
- **Mild Climates** – In more mild climates where neither heating nor cooling is used much, a radiant barrier installation will not create massive energy savings. However, the Radiant Barrier can increase the overall comfort of the structure while providing small to moderate energy savings.

III: How, When and Where to Install Radiant Barrier

A Radiant Barrier installation can be a very daunting task. But with a little know how and the proper tools, any handy man (or woman) can definitely do the job. A radiant barrier installation is best done when the outside temperature is mild so as to minimize installer discomfort. Spring or fall are the best seasons to install radiant barrier, however if you must install radiant barrier during summer or winter months, early mornings and evenings are the best times to work, as the attic is cooler.

There are a variety of different installation procedures and locations, which depend on a number of different factors. Below, we will address all of the most common factors and their subsequent installation applications.

A: Perforated or Non-perforated

The type of radiant barrier you choose will depend on your local climate and humidity. You will find that radiant barriers come in two main flavors, Perforated or Non-Perforated (aka: Vapor Barrier). It is very important to understand when, where and if a non-perforated (Vapor Barrier) radiant barrier is needed.

A vapor barrier or vapor retardant is a material which does not allow water vapor to pass through it. A non-perforated radiant barrier is a vapor retardant (vapor barrier) and if used, it will not allow water vapor to pass through. While this may seem like a desirable feature, if used incorrectly the radiant barrier may actually cause condensation.

In certain conditions, one side of the radiant barrier may be warm, while the other side may be cold which could cause water to condense on the cold side of the radiant barrier. Once the water condenses, it will naturally flow downward due to gravity, then drip and pool at the bottom of the radiant barrier sheet. This dripping and pooling could cause a variety of different problems, from mold and rot to rust and deterioration. These are all undesirable and will end up costing thousands to fix, so please choose your material wisely.

The most obvious solution is to use a perforated radiant barrier! A perforated radiant barrier will allow water vapor to pass through it, eliminating the risk of condensation issues. If you are not sure weather a perforated or non-perforated radiant barrier is needed, you're better off playing it safe and going with a perforated radiant barrier.

If you still want to use a Non-Perforated Radiant Barrier (Vapor Barrier), the graphic below will show you where it should be installed. In Northern States, a vapor barrier will want to be installed on the interior (warm side) of the insulation. In southern

states, the vapor barrier if installed (We **do NOT** recommend it) will want to be installed on the exterior (warm side) of the insulation. The small band, north of the southern states is simply too humid to use a vapor barrier and you are asking for trouble if you insist on installing one.



B: Required Installation Tools:

Regardless of the installation location, one common factor is the required tools for the job. Below we have listed the most common tools that any individual will need for a typical radiant barrier installation job.



Required Tools	Safety Tools	Optional Tools
Staple Gun	Safety Glasses	Ladder
Utility Knife/Box Cutter	Dust Mask	Shop Light
Measuring Tape	Gloves	Dowel w/ Nail Point

C: Where to Install Radiant Barrier

Radiant barriers can be installed and used in a variety of ways. This report is not meant to be an installation guide, and will only cover the two most common, tried and true installation scenarios. These two installation methods have been tested over time and have ample data to support the 17% average energy savings.

Attic – Bottom of Roof Rafters

As mentioned above, maximum energy savings can be achieved in hot climates when the radiant barrier sheets are stapled to the bottom of the roof rafters as shown in the images below.



This installation is considered to be the best method in hot climates where cooling is far more important than heating. This type of installation will keep the entire attic space much cooler compared to a non radiant barrier insulated attic, and will effectively block radiant heat from striking air handlers and ductwork in the attic. Also, any attic air which happens to leak into the return side of the ductwork will be cooler, causing less stress on the cooling equipment, increasing its efficiency and lengthening its life.

Although this installation method is the most efficient, it is also the most challenging and requires the most work and time to install. However, once complete, this is a virtually maintenance free installation method, requiring no cleaning because it is not generally affected by dust.

Attic – Over Insulation & Ductwork

In cooler climates radiant barrier can simply be draped over the attic floor covering the existing insulation and ductwork. This method is the most common and easiest way of installing Radiant Barrier in an existing attic. The location of the radiant barrier in this installation primarily reduced heat loss through the ceiling in colder climates, although it will also reduce radiant heat gain through the ceiling in the summer.



IV: Radiant Barrier Myths... Busted

A: Radiant Barrier Paint vs. Roll Radiant Barriers

Many radiant barrier paint manufacturers will have you believe that radiant barrier paint is an equal or superior product to roll type radiant barriers. This could not be further from the truth. In fact, radiant barrier paint is technically not even a radiant barrier, because its reflectance is only 75%.

According to the Department of Energy (DOE), a product classified as a “radiant barrier” must have a high reflectance of at least 90% and a low emittance of 10% or less. Not only that, but the EPA won't even classify a radiant barrier paint as an insulation. On the other hand, roll type radiant barriers, meeting certain criteria can in fact be classified as insulation under the EPA, qualifying them as ENERGY STAR products.

B: Radiant Barrier & Shingle Roofs

A common myth about radiant barriers is that they will reflect radiant heat into the back of the existing roof shingles and degrade the life of the shingles. While radiant heat from the sun will be reflected back into the opposite direction and cause heat exchange from the underside of the roof, its affect on the shingles is negligible.

According to countless studies from as early as 1989, sponsored by the U.S. Department of Energy and the Reflective Insulation Manufactures Association, a common conclusion has been met:

“When properly installed, the use of radiant barriers with proper venting should not cause any damage to the roofing materials and will not void the warranty, since shingle warranties cover defects in manufacturing, not installation.”

The fact is shingles are designed for hot temperatures that range from 160 to 190 degrees. The only measurable increase in temperature on shingles from a radiant barrier installation was between 2 and 5 degrees Fahrenheit on a hot summer day. This small rise is negligible and will not void any roofing warranties.

IV: Not All Radiant Barriers Are Made the Same

As with most products, Radiant barriers come in a variety of different shapes, sizes, styles and qualities. And while most manufacturers will carry similar sizes and styles, the quality of the radiant will drastically vary between them. The following is a list of some of the qualities to compare when shopping for a radiant barrier:

1. *Double Sided*
2. *Emittance*
3. *Reflectance*
4. *Thickness/weight of 5mills*
5. *Tensile Strength (both directions)*
6. *Mullen Burst Strength*
7. *Woven polyethylene material*

We highly recommend against purchasing a single sided radiant barrier. These single sided radiant barriers are inferior products when compared to a good double sided radiant barrier. This is because a double sided radiant barrier will provide radiant heat reflection in both directions making it helpful in both winter and summer months. A single sided radiant barrier will only be useful as an energy saver for one season out of the year, while a double sided radiant barrier is useful all year round.

As mentioned earlier in this report, reflectance and emittance are crucial values when comparing radiant barriers. The ideal reflectance is as close to 100% as possible, however most roll type radiant barriers will have a reflectance value of 97%. The ideal emittance value is as close to zero as possible, however most roll radiant barriers will have an emittance of about 3% (.03).

Thickness, weight, tensile strength and mullion burst strength are the qualities that really set one radiant barrier apart from another. When looking at all of these values, the higher the number is, the better the product is. These are the qualities that you will appreciate as you fumble around in the attic getting it installed. If you go with a cheap, flimsy and weak material, you will pay the price during installation and will be cursed with continuous and frequent maintenance. Weak radiant barrier is notorious for not holding a staple, ripping and tearing, which are all undesirable properties when installing a radiant Barrier.

The better radiant barrier manufacturers such as Ra-flect™ (<http://www.rafflect.com>) use a woven polyethylene mesh, sandwiched between two layers of high quality heavyweight aluminum foil to create a thick tear-proof radiant barrier. These mesh-infused radiant barriers provide for an easier and more permanent installation, due to the fact that less staples are required and the radiant barrier will never rip at the point of contacts (the staples).