BRESSLER INSULATION
3530 South Park Drive ~ P.O. Box 1129 ~ Wilson, Wyoming 83014
307-733-5312 ~ Fax 307-739-0767 ~ www.BresslerInsulation.com

REFLECTIVE BARRIER INSULATION IN COLD WEATHER CLIMATES AND UNDER SLAB APPLICATIONS

Heat loss or heat gain flows from a warm side to a cold side in three ways.

- Conduction: This is the physical heat movement through a material.
- Convection: This is the transfer of heat caused by air movement.
- Radiation: This is the transfer of heat from infrared energy.

Infrared light is a portion of light that is between the microwave length and visible light wave length spectrum. Infrared light is measured in wavelengths, which run between .7 and 300 microns. All light waves and microwave waves will heat surfaces. Most heat transfer is the result of conduction or convection; radiation heat gain is different in that it can travel through a vacuum.

Reflective barriers work by deflecting light waves. The most common and strongest source of light waves that produce infrared energy comes from sunlight. Most reflective barriers are designed to reflect infrared energy with wavelengths of 3-15 micrometers. Reflective barriers are rated by the emittance or reflectivity of its surface. All materials have emissivities ranging from zero to one. The lower the emissivity, the better it reflects the infrared light wavelength.

Radiant energy travels easily through the air, but cannot easily travel through solid materials. Most materials will block radiant energy. The myth that radiant energy is like an X-ray and will pass through surfaces is not true. When you stand under a tree in the shade on a hot summer day, it is cooler because the leaves block the sunlight, or radiant energy, from passing through as the radiant energy is unable to readily penetrate the foliage. Just as sunlight (radiant energy) hitting the ground warms the very top of the soil, radiant energy does not penetrate into the ground. Any heat gain into the ground is a result of conductive heat gain, not radiation gain.

For the radiant energy to pass into a building, it must first be able to pass through the roofing, siding, or sheetrock and then through the insulation into the building; all these building materials block radiant energy from passing through. From a construction practicality point, radiant energy mainly heats the surface of the material it is striking, and only in extremely hot climates does it penetrate the roofing or siding materials. Just as in the winter, having the back of your head to the sun will not heat the skin on your face as the radiant energy cannot pass through your head, the sun must strike your skin on the front of your face to warm your skin.

R-Values

Some reflective barrier manufacturers claim ***equivalent*** R-values as high as R15. This is where the confusion comes in: R-values for all insulations, <u>except for reflective products,</u> are tested by a hot box test that records the amount of heat lost through the product. (ASTM C518). Reflective insulations would have a low R value of about R1 or R2 if tested this way. Therefore, reflective insulations use "*equivalent* R-values" which are calculated by the emissitivy of the product, and then are converted into a equivalent R-value via mathematical calculations. No true R-value test, as is required on all other insulations, is performed on reflective insulations.

Typically, the equivalent R-value for radiant barriers is measured for heat traveling downward into a building with airspace located over the radiant barrier. This R-value can be reduced by up to 85% if the heat flow direction changes (i.e., if the heat is traveling any other direction than down), if the airspace is less than 3.5", if the airspace is not thoroughly sealed, or if the facing is degraded by dust. According to the Reflective Insulation Manufacturer's Association, "Due to variations in building construction, location and climate, one cannot assign a unique R-value to this application."

Radiant barriers must have airspace to function correctly. The Department of Energy / Building Science Report recommends a 3.5" air space above the reflective barrier in ceilings. On walls, the Reflective Insulation Manufacturer's Association recommends installing furring strips over the reflective side (the warm side of the wall) to provide the necessary airspace. It is important to remember that reflective barriers are vapor barriers and thought should be given to their location to ensure that there will be no problems with condensation.

Performance

The vast majority of heat transfer is through conduction and convection. Reflective barriers have little or no conductive or convective values. Listed are statements from the Reflective Insulation Manufacturer's Association, the Oak Ridge National Laboratory (United States Department of Energy) and Building Science - High R-Value Enclosures Report -

- Oak Ridge National Laboratory (United States Department of Energy): In Zone 7, (Jackson Hole) based on a 1,542 sq. ft. attic, with no duct work located in the attic and where the attic is insulated to code, there is a $0 (zero) dollar savings from installing a radiant barrier. In Miami, Zone 1, in a similar attic, there is an annual savings of $180 by adding the radiant barrier.

- Reflective Insulation Manufacturer's Association: In a metal building with no insulation, where a radiant barrier with a .05 emissivity is installed to the face of the ceiling purlins, in the summer, the R-value is 7.8. In the winter, the R-value is 3.7. There is a disclaimer that that states, "The thermal resistance values for reflective insulation systems installed in metal buildings depend on heat flow direction and the design of the reflective insulation material."

- Oak Ridge National Laboratory (United States Department of Energy) and Building Science - High R-Value Enclosures: "Reflective barrier systems are complex in that their performance varies with temperature, air gap, and direction of flow. A reflective barrier system with a 3.5" gap has a performance that varies significantly between operating at a temperature of 140 degrees (i.e., solar heated roof sheathing) with an R-value of about 10 and (compared to) a temperature of 0 degrees (a cold winter night) with an R-value of only 2.5. Add additional variables such as dirt accumulation on the barrier and a wide range of performance values can be quoted. In most cases, the annual benefit of a reflective barrier system relative to an inch of insulation is small or non-existent."

- Minnesota Office of Energy Security states: "In Minnesota's climate zone, however, potential energy savings from the installation of a radiant barrier are negligible in nearly every situation.

HVAC Applications

Reflective barriers are sometimes used to insulate HVAC ducts. For the reflective barrier to properly function, there needs to be an airspace between the ducting and the reflective barrier. According to the Reflective Insulation Manufacturer's Association, "Reflective insulation systems used on the exterior of air-handling ducts usually include spacers to provide a reflective air space between the ducts and the insulation."

Under Slab Applications

As a radiant barrier must have an air space to function, under slab radiant barriers are ineffective for providing under slab R-values. Without an airspace, the reflective barrier has little R-value. Under slab heat loss is caused by conduction, where heat from the slab or in-slab heating system is directly conducted into the ground as that heat is easily transferred from the slab into the soil. Using insulations that have an R-values based on conductive values will reduce the heat loss in under slab applications.

- According to the Reflective Insulation Manufacturer's Association, the actual in place R-value of an under slab reflective barrier is R1.2.

- A different radiant group, the Radiant Panel Association, states, "Reflective foil under a slab, with no airspace, is totally ineffective as an insulator."

- Some states will not allow an under slab reflective barrier to be credited towards under the under slab insulation requirements.

Radiant reflective barriers have a proven track record in hot weather where their main application is for reducing the heat from solar gain getting into attic spaces. The physics that allow these products to work in hot weather do not correspond to cold weather climate performance, or to applications without appropriate airspaces.