

DuPont™ Tyvek® ThermaWrap™ Managing Radiant Heat Flow

BUILDING SCIENCE BULLETIN

DuPont™ Tyvek® ThermaWrap™ helps increase the R-value of a wall system by helping reduce radiant heat flow and shrinking thermal bridges, thereby minimizing both summer heat gain and winter heat loss. Like other DuPont™ Tyvek® products, such as Tyvek® HomeWrap®, this innovative membrane resists air and water penetration while still allowing moisture vapor to pass through it.



A well-wrapped house provides many layers of thermal and moisture protection to a home.

DuPont™ Tyvek® ThermaWrap™:

1 manages radiant heat flow by reflecting solar radiation away from the house, and by reducing the emissivity of the exterior surface that helps prevent radiant heat losses

2 breathes to help indoor water vapor diffuse out of wall systems

3 provides an effective air barrier to help reduce infiltration and exfiltration

4 provides a barrier to bulk water that helps keep the wall dry at all times

Nearly two thirds of the total heat lost or gained through the building envelope occurs through radiant heat flow. This is not surprising to building professionals in warm climates where radiant heat gains through the roof are apparent, and radiant barriers are commonly installed to reduce cooling loads. But the effects of radiant heat flow through wall systems in heating climates is not well understood and often ignored.

DuPont™ Tyvek® ThermaWrap™ is designed to manage radiant heat flow through walls. Originally developed to improve the thermal performance of wall systems in some of the coldest climates of northern Europe, Tyvek® ThermaWrap™ provides a vapor-permeable air barrier to help reduce air flow through walls, like other

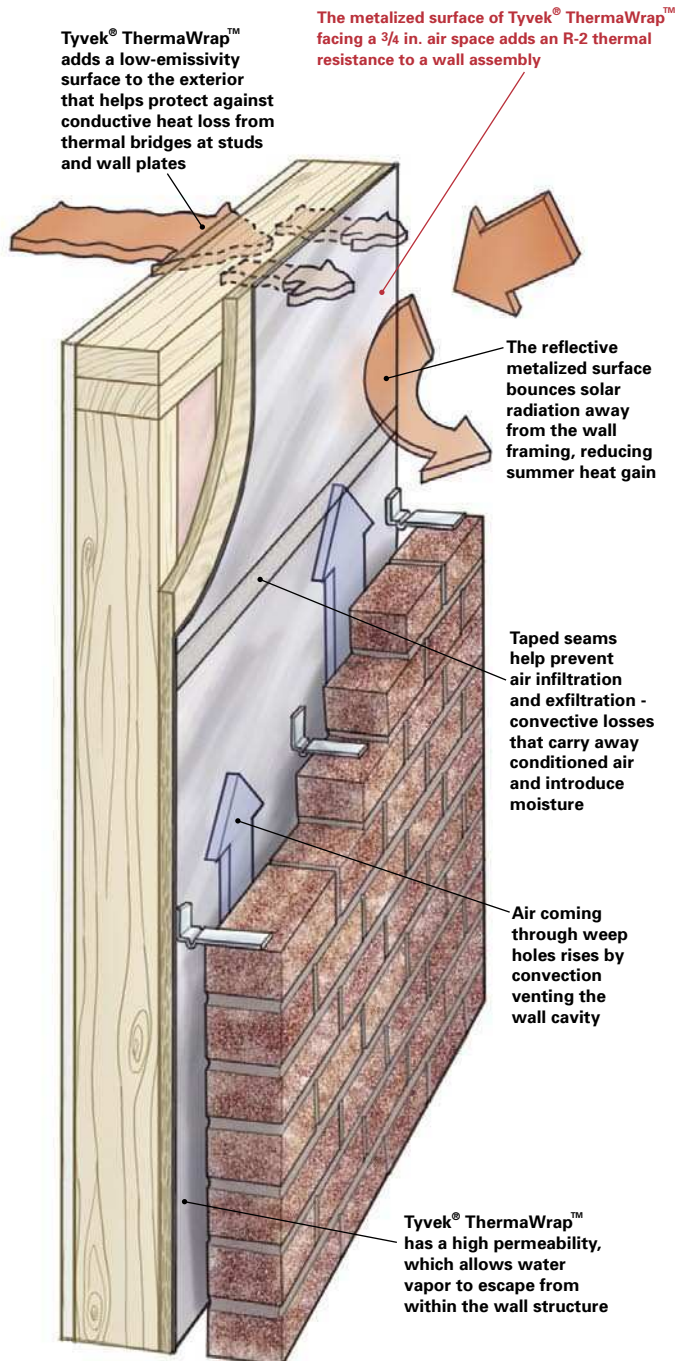
DuPont™ Tyvek® products, such as, Tyvek® HomeWrap®. However, Tyvek® ThermaWrap™ adds a low-emissivity ("low-e") surface that changes the dynamics of heat flow across the entire wall system, and dramatically helps improve the insulating value of the wall system.

Tyvek® ThermaWrap™ does more than help improve the thermal performance of homes in cold climates. By regulating the vapor drive through walls, and allowing walls to breathe, Tyvek® ThermaWrap™ helps to prevent moisture problems. This is important for homes in all climates, but is particularly important in hot, humid climates where builders often mistakenly wrap walls with foil-faced sheathings or foil building wraps, creating exterior vapor barriers that can lead to extreme mold and mildew problems.



The miracles of science™

DUPONT™ TYVEK® THERMAWRAP™
ADDS R-VALUE TO WALL ASSEMBLIES



To understand how Tyvek® ThermaWrap™ works, it's important to first understand the three scientific principles – conduction, convection and radiation – that describe the way heat moves through a wall.

Sorting Out Heat Transfer In any wall system in any climate, heat always moves from warmer areas to colder areas, and the greater the temperature difference between inside and outside (often referred to as a temperature gradient), the faster the heat flows. This heat flows through a wall in three ways – by conduction, by convection and by radiation. All three of these heat transfer mechanisms are active in every wall system.

Conduction In a typical cavity wall, insulation is installed to reduce heat flow by **conduction** – the transfer of energy directly through a material from molecule to molecule. However, not all of the heat is stopped. Depending on the amount of insulation, more or less heat will conduct through the insulation itself, and an even greater amount of heat will conduct through the studs and wall plates where there is little or no insulation.

Convection Heat also flows by **convection** – the transfer of heat on air. Stopping air flow through the wall is one of the principle reasons why we wrap houses with DuPont™ Tyvek®. By stopping air flow, we stop the leakage of heated air (and moisture in the form of vapor that is carried by warm air) and the infiltration of cold air.

Radiation Heat also moves through the wall by **radiation**, but this mechanism is often the least well understood method of heat transfer, and it is typically ignored when building a wall. But there's nothing mysterious about it. Radiant heat flow is transferred from a warmer body to a cooler body on electromagnetic waves. These waves do not need to flow through air, and do not need direct

Tyvek® ThermaWrap™ breathes, allowing walls to dry without creating an exterior vapor barrier. Having a wall that can dry out is essential for every home, but particularly critical in extreme climates such as the hot, humid Gulf coast, where walls covered with foil-faced products are prone to rot.



contact between objects. Radiant heat crosses empty space from a glowing, hot object to a cooler object at a distance. We know the effects of radiant heat flow all too well: It is precisely how the sun warms the earth. The sun is a glowing, radiant object, which emits energy to our bodies across space. The sun can warm us even if there is wind; it is not affected by air, or by the millions of miles of cold empty space between the sun and the earth where no air exists at all.

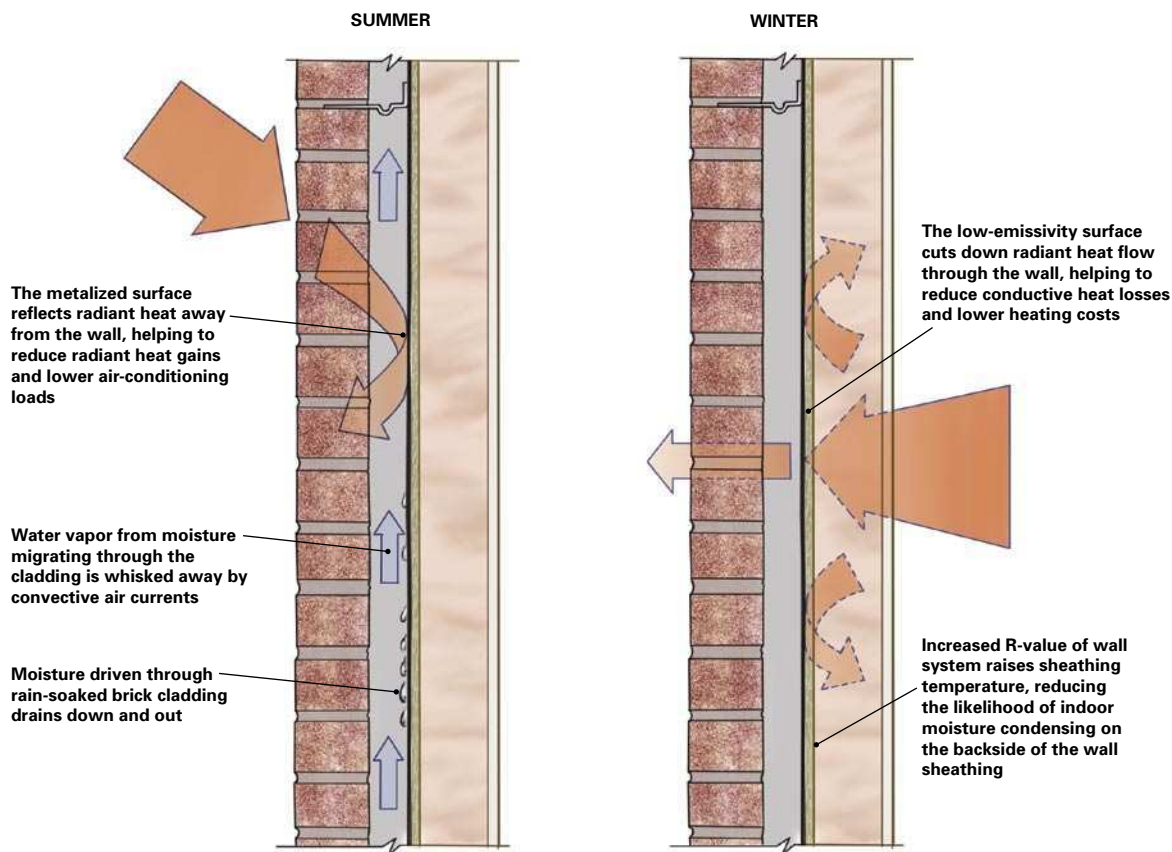
The concept of a glowing body radiating energy is important to keep in mind when we evaluate heat flow through a wall. In a wall, the “glowing object” – or radiant body – we want to focus on is the wall assembly, and particularly the outer surface at the exterior sheathing.

Three mechanisms at work In a cold climate, heat conducts through the wall from inside to outside, flowing faster at the studs and wall plates and slower, but still moving, through the cavity insulation. This

heat warms the exterior sheathing. If housewrap and siding are installed directly over the sheathing, this heat continues to conduct through these materials, as well. In essence, the exterior of the wall becomes a radiant body that releases energy into the space around the home. In most cases, however, the heat is whisked off the exterior by convection, as wind currents blow across the face of the wall.

In any wall system with a gap between the wall structure and the siding, as with brick veneer or any type of rain-screen siding, the exterior sheathing and the house wrap become the radiant object that releases energy across the gap. Typically there is a convective current flowing through this gap (from air entering the weep holes in brick, for example, and flowing upwards to the eaves) that whisks away the radiant energy emitted by the wall. Most building wraps are highly emissive and release this energy easily. Black paper is the most emissive of all, as it absorbs radiant heat more readily than other building wraps.

AN INSULATING HOUSEWRAP FOR ALL SEASONS



Reducing Radiation This is where Tyvek® ThermaWrap™ comes into play. By replacing this building wrap with Tyvek® ThermaWrap™ – a low-emissivity membrane – in any wall system with a gap of at least 3/4-inch between the framing and the siding, we create an effective thermal resistance (R-value) equal to R-2. The R-value created by Tyvek® ThermaWrap™ helps to reflect the radiant energy that has accumulated in the wall sheathing back into the wall system so it is not released to the exterior. This reduction in radiant heat flow is particularly important at the studs, plate lines, rim joists and headers, where conductive heat flow through the wall is greatest. Not only does this save energy, but by maintaining a higher sheathing temperature, Tyvek® ThermaWrap™ changes the dew point in the wall, and helps reduce the risk of condensation in wall cavities.

Preventing Moisture Problems

Tyvek® ThermaWrap™ has a very high vapor permeability (36 perms), which makes it the only high-perm reflective membrane available today. Due to its high vapor permeability and thermal resistance, it provides the best possible control of condensation in a wall structure, helping to minimize the risk of mold, mildew and wood rot. This is especially important to keep in mind in hot, humid climates, where foil-faced sheathing and other radiant barriers are often installed on the exterior to reflect heat away from homes. Aluminum foil is a perfect vapor barrier, so whenever the vapor drive moves from inside to the outside – a common occurrence whenever the outside temperature drops below the indoor temperature – humid air will become trapped behind the foil. This is a leading cause of mold and rot in Gulf coast homes.



On the wall, courses of Tyvek® ThermaWrap™ are lapped shingle-style from bottom to top to shed water, while taping seams ensures an effective air barrier (above left). Best practice is to seal the joints of Tyvek® ThermaWrap™ with DuPont™ Tyvek® Metalized Tape (above right).

This is not likely to happen with Tyvek® ThermaWrap™. While the face of Tyvek® ThermaWrap™ is metalized, and can reflect heat away from wall surfaces, it retains its vapor permeability. The walls continue to breathe, and can dry out under any climate conditions. **A high-perm membrane and a low-e surface: The best of both worlds.**

Our Specialist Network A national group of over 160 highly-trained field representatives is available to assist customers with their installations. From the latest updates on building codes to on-site consulting and training, your local DuPont™ Tyvek® Specialist will help make sure each installation is done right.

For more information:
1-800-44-TYVEK
www.tyvek.com

Product Replacement: DuPont will replace any Tyvek® product damaged during installation by weather or normal handling if it is installed according to procedures published by DuPont. If you have any questions, call DuPont™ Tyvek® at 1-800-44-TYVEK.

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