INSULATION FACTS #71

Use of Vapor Retarders

This fact sheet provides an overview of the use, types, and placement of vapor retarders commonly known as vapor barriers. It covers only a small portion of the current information available on this very complicated and controversial subject. In all cases, consult with the project architect, engineer, or building code official prior to the use of vapor retarders.

What is a Vapor Retarder?

A vapor retarder is defined by ASTM Standard C 755 as a material or system that adequately retards the transmission of *water vapor* under specified conditions. The permeance of an adequate retarder for residential construction will not exceed 1 perm. A perm rating is a measure of the flow of water vapor through a material. Vapor diffusion accounts for only a small amount of the total moisture in a building. Therefore, other mechanisms should be utilized to retard moisture migration.

An air retarder is different from a vapor retarder in that it blocks only air and liquid water, not water vapor. Air retarders block drafts of hot or cold air caused by winds and pressure differences between the inside and outside of the house. A housewrap is one form of an air retarder but typical exterior housewraps are not vapor retarders.

What Does a Vapor Retarder Do?

A vapor retarder slows the rate of water vapor diffusion but does not totally prevent its movement. Building occupants, plants, unvented gas appliances, and plumbing equipment are a few examples of things that generate moisture, which is carried in the air as vapor. As water vapor moves from a warm interior through construction materials to a cooler surface, the water vapor may condense as liquid water that could damage the building. It is for this reason vapor retarders are needed.

Materials That Are Vapor Retarders

Any material that has a perm rating of 1 or less is considered a vapor retarder. Table 1 shows the perm rating of some common building materials whose values are consistent with ASHRAE Handbook of Fundamentals and other industry sources.

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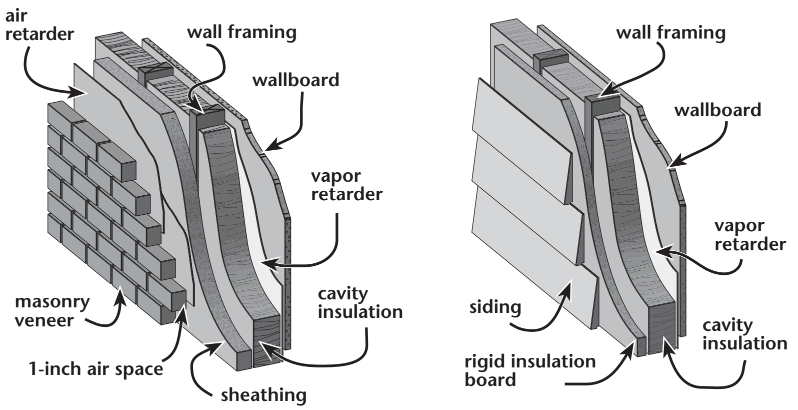
Figure 1: Vapor Retarder Installation Details



Many insulation products are faced with an asphalt-impregnated kraft paper or a foil laminate, which qualify as vapor retarders. Other materials such as polyethylene sheet or foil backed gypsum board are also vapor retarders that are typically used with unfaced insulation.

Important

Many standard insulation facings will burn and must not be left exposed in an occupied building. Standard facings must be covered with gypsum board or another code-approved interior finish. Use only flame-resistant facings for exposed applications.

Placement of Vapor Retarders

The International Residential Code (IRC Section R322) specifies that a vapor retarder must be installed on the warm-in-winter side of the insulation (See Figure 1) with the following exceptions:

Exception 1

In construction where the accumulation of moisture or freezing of moisture will not damage the materials.

Very few situations occur in residential construction that would permit the builder to select Exception 1.

Exception 2

Where the framed cavity or space is ventilated to allow moisture to escape.

Ventilated cavities and spaces include ventilated attics, properly designed and vented cathedral ceilings, and vented crawl spaces.

Exception 3

In counties identified by footnote (a) in Table N1101.2 of the IRC standard where the local environmental conditions do not support a recommendation for vapor retarders. These locations, in general, have high outside temperature and humidity levels during a significant portion of the year. These locations may be found along the Southern Coast (SC, GA, FL, AL, MS, LA, TX), Puerto Rico, and Hawaii. See Figure 2 for the locations specified for Exception 3.

Check local practices and code regulations for the specific area.

Vapor Retarders and Insulated Walls

In general, the colder the climate, the greater the need for a vapor retarder. In climates requiring a vapor retarder on the interior surface, a kraft-faced insulation is usually sufficient. When a loose-fill product such as fiber glass or cellulose is installed, a 4 mil continuous polyethylene sheet or a vapor retarder paint on the interior drywall should be used. The polyethylene sheet is acceptable

Table 1: Permeability Values for Common Building Materials

Vapor Retarders	Perm Rating
Insulation Facing, Kraft	1
¼″ Plywood (Douglas Fir, Exterior Glue)	0.7
Insulation Facing, Foil Kraft Laminate	0.5
Vapor Retarder Latex Paint, 0.0031″ Thick	0.45
0.002″ Polyethylene Sheet	0.16
0.004″ Polyethylene Sheet	0.08
0.006″ Polyethylene Sheet	0.06
Aluminum Foil 0.00035″ Thick	0.05
Not Vapor Retarders	**Perm Rating**
⅜″ Gypsum Wall Board (Plain)	50
4″ Unfaced Mineral Wool	30
Typical Latex Paint, ~ 0.002″ Thick	5.5 to 8.6
4.4 lb./100 ft.2 Asphalt Saturated Sheathing Paper	3.3
¼″ Plywood (Douglas Fir, Interior Glue)	1.9

Source: *2001 ASHRAE Handbook of Fundamentals*, Section 25.16 and manufacturers' literature.

for heating climates (defined universally as climates with 4000 heating degree days or higher), and a vapor retarder paint is acceptable for milder climates. In most cases, the use of a vapor retarder is not influenced by the type of cavity insulation used.

If you are reinsulating a home with blown-in insulation, installing a vapor retarder onto the sidewalls, if one has not been previously installed, can be quite difficult. It may be necessary to paint the interior surfaces of exterior walls and ceilings with a vapor retarder paint instead.

Vapor Retarders and Attic Insulation

Insulation of any form should not be relied upon to prevent moisture movement within an insulated cavity. Whether batts or blown-in fiber glass, vapor retarders are required unless proper ventilation is provided. As with fiber glass batt insulation, materials used for vapor retarders for blown-in insulations must have a perm rating of less than 1 perm. In a ceiling where the space above is adequately ventilated, a vapor retarder may not be required. The exception would be in cases where the cold side cannot be ventilated.

Attic vapor retarders are commonly omitted when blown-in insulation is used. If sufficient attic ventilation exists, condensation problems do not occur in most U.S. climates. Sufficient attic ventilation is usually defined as having a net free ventilating area equal to 1/150 of the attic floor area. When an attic vapor retarder is used, ventilation requirements are halved; net free vent area can be 1/300 of the attic floor area.

Even when not required to prevent condensation problems, attic vapor retarders may be worthwhile, because their presence may help maintain more comfortable humidity levels. When a vapor retarder is desired and blown-in ceiling insulation is used, a combination of faced batts and blown-in insulation or a vapor retarder ceiling paint can be used.

It should be noted that all kitchen and bathroom exhaust fans must be vented to the outside of the building and not into a ventilated attic or crawl space.

Vapor Retarders and Cathedral (Sloped) Ceilings

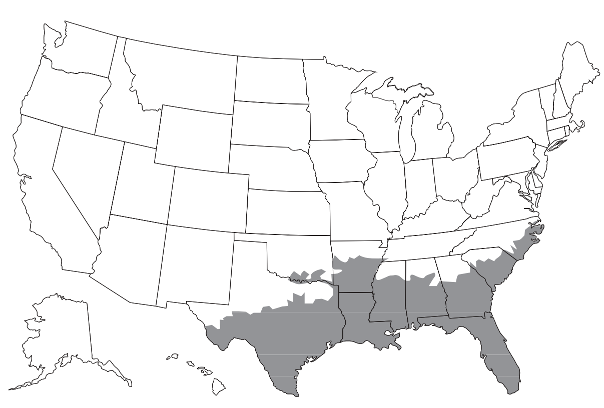
Since commonly used asphalt roof shingles have very low vapor permeance, cathedral ceilings can be likened to walls with very low permeance exterior skins.

If there is no vented airspace between the insulation and the wood roof deck, moisture problems may occur in the wood deck, and ice dams may occur in cold climates. Most asphalt shingle manufacturers require a ventilated ceiling below their shingles. Without ventilation, the shingle warranty is often reduced to ten years. An airspace of 1 inch or more should be provided between the insulation and the roof deck. This airspace, when coupled with eave and ridge vents, allows moisture to be vented from the ceiling cavity. This airspace is usually maintained with a formed attic vent chute or baffle that is installed from eave to ridge. Since these baffles are sometimes made of a vapor retarder material, it is common to maintain an approximate 2 inch gap between the ends of adjacent baffles so that moisture may migrate into the vented airspace.

Roofs without both eave and ridge vents will not add protection against moisture condensation in sloped ceilings; air won't move through a space unless it has a place to exit as well as a place to enter.

Water vapor moves through many materials, including fibrous insulation, by diffusion. Therefore, limited amounts of water vapor that get around or through a vapor retarder can exit a cathedral ceiling rafter bay through a vent opening even when an airspace does not exist. Moving air can carry a large amount of moisture, but air movement is not necessary for moisture to escape from buildings. However, without a vented airspace, one needs to be concerned if the mois-

Figure 2: Vapor Retarder Exception



ture accumulation will exceed the ability of the ceiling to dissipate the moisture through diffusion alone.

The best strategy for cathedral ceilings in cold and mild climates is to use a vapor retarder below the insulation and, if recessed lights are present, to use air/vapor tight fixtures as well. A kraft-faced batt is sufficient in those areas requiring a vapor retarder. If blown-in insulation is used, a continuous 4 mil polyethylene sheet can be used in heating climates and a vapor retarder paint in mild climates.

Vapor Retarders and Insulated Basements

Below-grade basement walls differ from above-grade walls in that they are vulnerable to ground moisture wicking into the wall or basement floor. Because of this, it is important to maintain the drying potential of the wall since one never knows if the long-term moisture drive will be from the outside or the inside. A masonry wall is capable of absorbing large quantities of water due to the capillary action of concrete. If the masonry wall unit has a hollow core, air movements within the wall also increase the thermal and moisture movement. For this reason, it is recommended that a vapor retarder not be used in a wall that is partially or fully below grade. If a wall is above grade, such as in a walk-out basement, then a vapor retarder may be used, if the climate dictates.

If no stud wall is available, the insulation can be applied in blanket form with a perforated flame-resistant facing. Applied directly onto the wall, this is often used on the top half of the wall only, which may take it to the depth of the local frost line. If hollow core masonry units are used because of the air convection that takes place within the wall, the insulation should be applied on the entire wall.

While it is sometimes suggested that an airspace should be maintained between the masonry wall and the stud wall insulation in order to keep the wall dry, in actuality this may make matters worse. This vertical airspace can lead to a convective air loop, thereby increasing not only the thermal but also the moisture transfer within the wall. If a full height stud wall is used in addition to the masonry wall, this stud wall is often inset an inch or so, increasing the depth of the cavity to be insulated. The entire depth of this wall cavity should be insulated. This also insulates the back of the studs, reducing the thermal bridging of the wall.

If a stud wall is placed on a partially below-grade masonry wall, the stud wall should be insulated the same way as other above-grade walls in the house. When a vapor retarder is not desired, slashing a faced product's sheathing is not recommended, because narrow cuts are unlikely to significantly increase vapor transmission.

Vapor Retarders and Crawl Spaces

When the undersides of frame floors above crawl spaces are insulated with faced insulation, the vapor retarder facing, generally kraft facing, should be placed on the top side, and in substantial contact with the floor above. This prevents the kraft facing from being exposed in a concealed configuration and posing a fire hazard, and reduces the opportunity for air to infiltrate between the floor and facing, and bypass the insulation. In many localities it is standard practice to use unfaced insulation under floors, with the assumption that the flooring materials provide adequate vapor resistance to inside moisture.

When insulating the perimeter walls, they can be treated the same as a below-grade masonry wall, and can use a perforated flame-resistant blanket that is attached to the top plate, extended down the wall, and preferably extended two feet along the floor. Where the crawl space floor is bare earth, it is highly recommended that the entire area be covered with a polyethylene sheet ground cover to minimize the migration of underground moisture up into the structure.

About NAIMA

NAIMA is the association for North American manufacturers of fiber glass, rock wool, and slag wool insulation products. Its role is to promote energy efficiency and environmental preservation through the use of fiber glass, rock wool, and slag wool insulation, and to encourage the safe production and use of these materials.

For additional information contact:

NAIMA
44 Canal Center Plaza, Suite 310
Alexandria, VA 22314
Tel: 703/684-0084
Fax: 703/684-0427
E-mail: insulation@naima.org
Website: http://www.naima.org

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