INSULATION CONTRACTORS ASSOCIATION OF AMERICA

# Technical Bulletin

1321 Duke Street, Suite 303 • Alexandria, VA 22314 • (703) 739-0356 • FAX (703) 739-0412

## No. 6 Use of Vapor Retarders (Revised 7/04)



*In all cases, consult with the project architect, engineer, or building code official prior to the use of vapor retarders. ICAA Technical Bulletins are provided for informational purposes only. ICAA and/or its members are not responsible for loss or damage caused by errors or omissions or any other cause.*

### I. SCOPE:

This bulletin provides an overview of the use, types, and placement of vapor retarders, commonly known as vapor barriers, that represents a small portion of the current information available on this very complicated and controversial subject.

### II. 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 diffusion of water vapor through a material. Vapor diffusion accounts for only a small amount of the total moisture in a building. Therefore, other means should be utilized to reduce water vapor migration due to air infiltration.

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. Typical exterior housewraps are not vapor retarders.

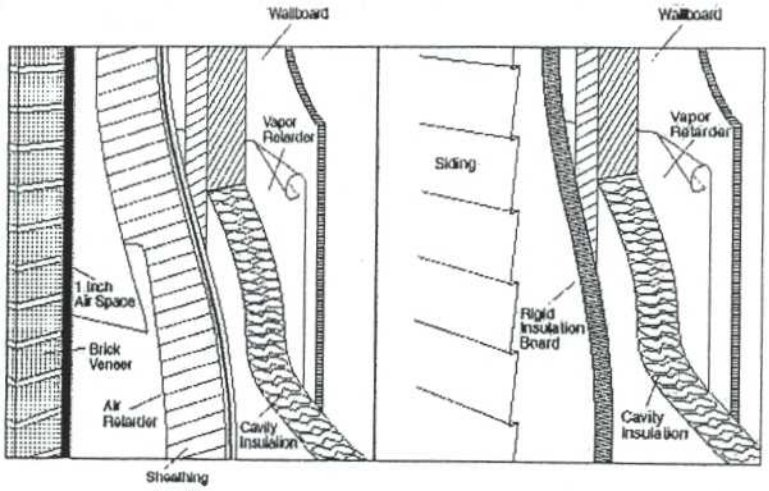
## III. WHAT IS THE PURPOSE OF A VAPOR RETARDER?

A vapor retarder slows the rate of water vapor diffusion but does not totally prevent its movement. Building occupants, certain appliances, and plumbing equipment generate moisture that 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 can damage the building. It is for this reason vapor retarders are installed in buildings.

## IV. PLACEMENT OF VAPOR RETARDERS

The International Residential Code (IRC Section R322, N1102.5) states that frame walls, floors, and ceilings not ventilated to allow moisture to escape shall be provided with an approved vapor retarder. The IRC specifies that the vapor retarder shall be installed on the warm-in-winter side of the thermal insulation (see illustration) with the following exceptions:

Exception 1: In construction where moisture or its freezing will not damage the materials.
Exception 2: Frame walls, floors, and ceilings in jurisdictions in Zones 1 through 4.
Exception 3: Where other approved means to avoid condensation are provided.




Check local practices and code regulations for details.

## V. MATERIALS THAT ARE VAPOR RETARDERS

Many insulation products are faced with an asphalt-impregnated kraft paper or a foil laminate. Each of these facings is a vapor retarder. Other materials such as polyethylene sheet or aluminum 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. See ICAA Technical Bulletin No. 27 and No. 28 for details.

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

| Vapor Retarders | Perm Rating |
|---|---|
| Insulation Facing, Kraft | 1.0 |
| 1/4 inch Plywood (douglas fir, exterior glue) | 0.7 |
| Insulation Facing, Foil Kraft Laminate | 0.5 |
| Vapor Retarder Latex Paint, 0.0031 inch thick | 0.45 |
| 0.002 inch Polyethylene Sheet | 0.16 |
| 0.004 inch Polyethylene Sheet | 0.08 |
| 0.006 inch Polyethylene Sheet | 0.06 |
| Aluminum Foil 0.00035 inch thick | 0.05 |
| Aluminum Foil 0.001 inch thick | 0.01 |

| Not Vapor Retarders | Perm Rating |
|---|---|
| 3/8 inch Gypsum Wall Board (plain) | 50 |
| 4 inch Unfaced Mineral Wool | 30 |
| Typical Latex Paint, ~ 0.002 inch thickness | 5.5 to 8.6 |
| 4.4 lb./100 ft.$^2$ Asphalt Saturated Sheathing Paper | 3.3 |
| 1/4 inch Plywood (douglas fir, interior glue) | 1.9 |

## VI. VAPOR RETARDERS AND INSULATED WALLS

In general, the colder the climate, the greater the need for a vapor retarder. Heating climates are defined as climates with 4000 heating degree-days (HDD) or greater. Since the majority of moisture in the assembly is the result of water intrusion and air infiltration, the assembly should be designed so that excessive moisture can escape the assembly. In addition, the moisture storage capacity of the assembly is important. A wall consisting of wood studs, kraft-faced insulation, and wood sheathing is more forgiving than a steel assembly with foil-faced insulating sheathing and continuous 4 mil polyethylene sheet over unfaced insulation, since the former assembly can store more moisture when needed and release it later as conditions permit.

In climates requiring a vapor retarder on the interior surface, a kraft-faced insulation is usually sufficient. When a loose-fill product such as fiberglass or cellulose is installed, a 4 mil continuous polyethylene sheet or a vapor retarder paint on the interior drywall should be used.

The poly is acceptable for heating climates and a vapor retarder paint for milder climates. In most cases, the use of a vapor retarder is not influenced by the type of cavity insulation used.

Most manufacturers of sprayed cellulose advise contractors that a vapor retarder is not necessary or desired in a wall system. If the insulation is applied with water, manufacturers generally recommend waiting between 24 to 48 hours before installing drywall. Consult manufacturer's recommendations for details.

If you are reinsulating a home with blown insulation, installing a vapor retarder on 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.

## VII. 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 fiberglass or cellulose, vapor retarders are required unless proper ventilation is provided. As with fiberglass 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 is 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; 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/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.

## VIII. VAPOR RETARDERS AND CATHEDRAL (SLOPED) CEILINGS

Since commonly used asphalt roof shingles have very low vapor permeance, cathedral ceilings perform like 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. Otherwise the shingle warranty is often reduced to ten years. An airspace of approximately 1 inch should be provided between the insulation and the roof deck. This airspace, when coupled with eave and ridge vents, allows

for the successful movement of moisture 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 move into the vented airspace. Check codes for up-to-date regulations.

Airspaces 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 can move by diffusion through many materials, including fibrous insulation. 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 lots 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 moisture accumulation exceeds 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 used, air/vapor tight fixtures. A kraft-faced batt is sufficient in those areas requiring a vapor retarder. If blown insulation is used, a continuous 4 mil vapor retarder can be used in heating climates and a vapor retarder paint in mild climates.

## IX. 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 hollow cores, 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 that wall may use a vapor retarder, if the climate dictates a vapor retarder in above-grade walls.

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 thermal bridging.

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.

## X. 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 and posing a fire hazard. The opportunity for air to infiltrate between the floor and facing and bypass the insulation is reduced. 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. Please refer to the IRC exceptions as noted in Section IV of this bulletin.

When insulating perimeter walls, proceed the same as with a below grade masonry wall and 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 4 mil polyethylene sheet (ground cover) to minimize the movement of underground moisture up into the structure.

The latest thinking is that it is best to have non-vented crawlspaces and insulated walls, treating the crawlspace as conditioned space.

## XI. INSULATION PRODUCTS

### A. Kraft Faced Insulation

Three accepted methods of installing faced insulation are inset stapling, face stapling, and pressure fit-no stapling. The vapor permeance of a wall is not affected by any one of these methods.

### B. Polyethylene Sheet or Foil Vapor Retarders

Separate vapor retarders are used in some applications. When required, a separate vapor retarder should be installed at the warm-in-winter side of the framing. In hot, humid climates, vapor retarders are sometimes omitted or installed outside the insulation.

### C. Ground Covers

Where the floor of a crawl space is soil or gravel, a ground cover should be used to limit the movement of water from damp soil into the crawl space. It is recommended that a ground cover be 4 mil or thicker polyethylene sheet or 55 pound or heavier asphalt roll roofing, lay on the floor and approximately 6 inches up the walls.

**D. Encapsulated Batts**

Polyethylene facings that are "nonperforated" are vapor retarders and should be considered interchangeable with other faced batts. A perforated poly "backer" film on one or both sides of the batt should be considered interchangeable with unfaced batts; i.e., a non-vapor retarder.

**E. Spray Foam Insulation**

Check with manufacturers for recommendations regarding the installation of a vapor retarder with spray foam applications. The perm ratings of closed-cell polyurethane and spray foam products vary from 0.8 to 2.5. Therefore, some do qualify as a vapor retarder in general construction situations. Open-cell spray foam perm ratings vary from 16 to 25 perms or more and do not qualify as a vapor retarder. For those spray foam products not qualifying as a vapor retarder, the use of foil-backed gypsum board or a vapor retarder paint applied to the interior wall surface is generally recommended.

*In all cases, consult with the project architect, engineer, or building code official prior to the use of vapor retarders. ICAA Technical Bulletins are provided for informational purposes only. ICAA and/or its members are not responsible for loss or damage caused by errors or omissions or any other cause.*