# Chapter 5: Air Leakage and Moisture Control

[502.1.6] **Vapor Retarders.** A vapor retarder is a material placed to minimize vapor movement through the diffusion process. Types of vapor retarders include:

- Kraft paper or foil facings on insulation.
- 4-mil or thicker polyethylene.
- Vapor retarder rated paint.

To meet the *Washington State Energy Code* (WSEC), vapor retarders need to be rated at 1 perm dry cup or less. This is a rating of how permeable to vapor movement a given material is (see Table 5-1 for perm ratings).

*Table 5-1*

### Permeance Values for Common Building Materials*

| Materials | Permeance |
|---|---|
| Polyethylene (4 mil) | 0.08 |
| Latex Primer/Sealer | 6.28 |
| Vapor Retarder Paint | 0.45 |
| Polyvinyl Acetate Latex (PVA) | 5.5 |
| Kraft Paper (Asphalt Impregnated) | 0.03 |
| 15 lb. Asphalt Felt Paper | 1.0 |
| Gypsum Wall Board (3/8 inch) | 50 |
| Plywood (1/4 inch with exterior glue) | 0.7 |

*2005 ASHRAE Handbook of Fundamentals

*Materials must be applied in accordance with the manufacturer's instructions to achieve specified permeance ratings.*

Components of the house requiring a vapor retarder are:

- Floors between heated and unheated spaces.
- Walls – on the inside (warm side in winter).
- Ceilings averaging less than 12 inches of ventilated area above the insulation.

[502.1.6.1, Exception] Vapor retarders must be installed either on the warm side (in winter) of insulation or with not more than 1/3 of the nominal R-value between it and the conditioned space.

[502.1.6.2.] **Floors.** Floors that separate a heated space from an unheated space are required to have a vapor retarder. Usually the floor decking itself meets the perm rating and qualifies as a vapor retarder. Three-quarters (3/4) inch tongue-and-groove exterior plywood and exterior grade OSB both meet the vapor retarder requirements. Floors with obvious gaps and holes call for a vapor retarder such as polyethylene or 15 lb. felt paper.

[502.1.6.6] **Walls.** All walls separating heated from unheated spaces must have a vapor retarder. Vapor retarders need to be installed on the inside of the wall, or the warm side in the winter.

[502.1.6.6, Exception] Wood framed walls with insulated sheathing installed outside of the framing and structural sheathing do not need a vapor barrier. R-5 insulated sheathing must be used in Climate Zone 1 and R-7.5 must be used in Climate Zone 2. The interior cavity insulation for this exception must be a maximum of R-21.

[502.1.6.3] **Ceilings.** All roof/ceiling assemblies must have an installed vapor retarder when the ventilation space between the top of the insulation and underside of the roof deck averages less than 12 inches.

[502.1.6.3, Exception] Unvented attic spaces are allowed under certain conditions. See Chapter 3 for details.

Air leakage control is an important but commonly misunderstood component of the energy efficient house. Tightening the structure with caulking and sealants has several positive impacts. A tight house will:

- Have lower heating bills due to less heat loss.
- Have fewer drafts and be more comfortable.
- Reduce the chance of mold and rot because moisture can not enter and become trapped in cavities.
- Have a better performing ventilation system.

[502.4.1] WSEC states specific locations in buildings requiring sealing. Air leakage must be controlled where outdoor ambient conditions are separated from interior spaces that are heated or mechanically cooled.

The type of sealing material used varies with the size of the gap. For example:

- Caulk and low expansion foam should be used for small holes and cracks (less than 1/8 inch).
- A combination of caulking and backer rod (foam rope) should be used for wider gaps (greater than 1/8 inch ).
- Polyethylene, rubber or neoprene material should be used for large openings (greater than 1 inch).

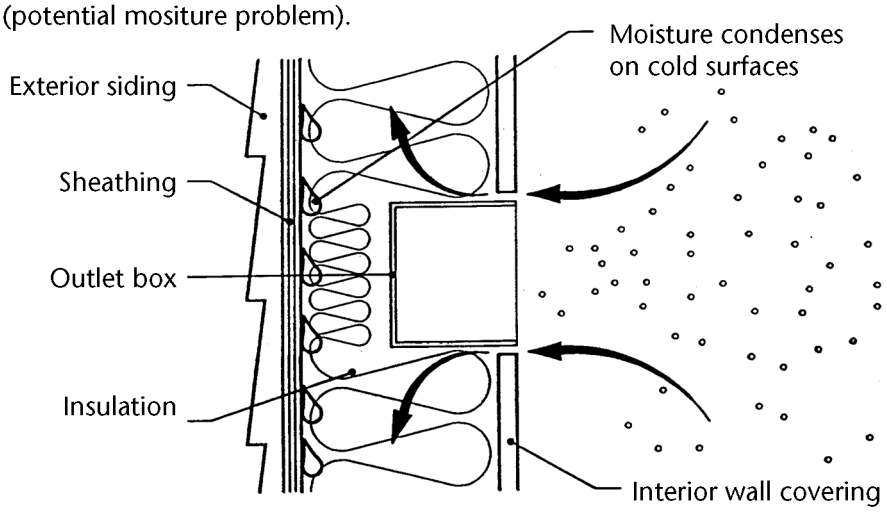
Fiberglass, loose cellulose and rockwool insulation are not suitable air sealing materials; they do not stop air movement.

[502.4.2] **Windows and Doors.** All windows and doors in exterior walls must be sealed between the frame and the rough opening framing material (see Figure 5-2).

*Figure 5-1*

## Critical Areas for Air leakage Control

**Positive Pressure:**
Moist indoor air leaks into cavities (potential mositure problem).




**Negative Pressure (Exhaust Ventilation):**
Dry outdoor air leaking in prevents moist indoor air from leaking out (prevents moisture problems).

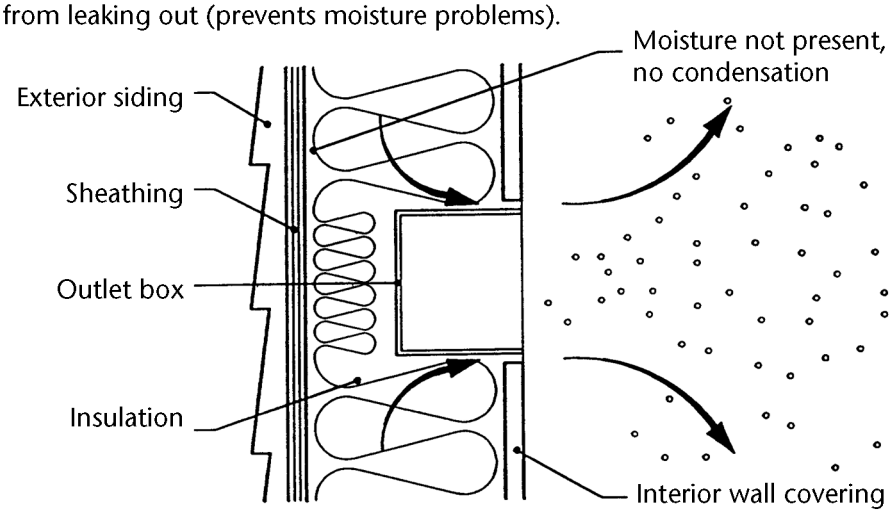
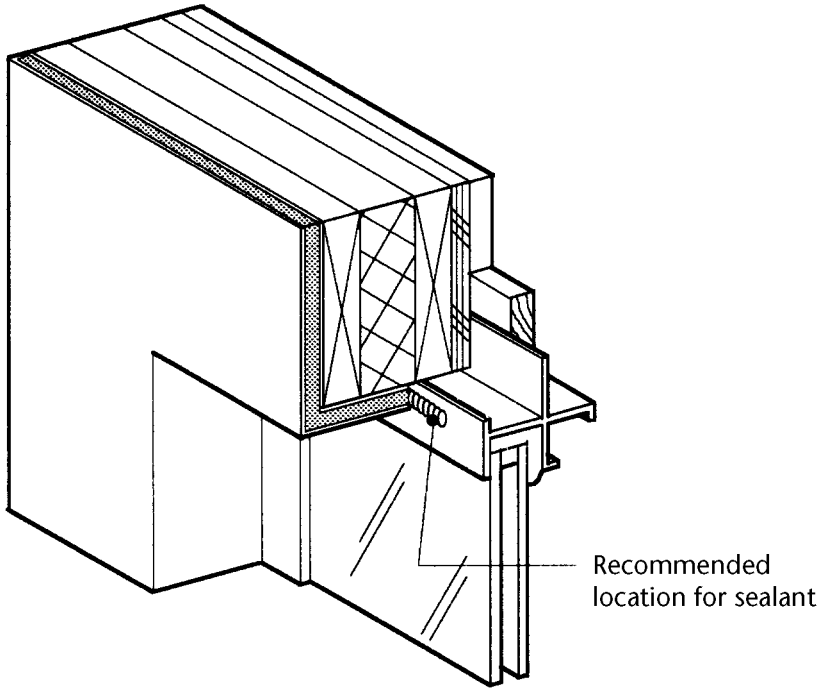


*Figure 5-2*

## Window Sealing




[502.4.3] **Wiring and Plumbing Penetrations.** Holes drilled in top and bottom plates (between heated and unheated spaces) need to be sealed. Plumbing penetrations often leave large holes requiring sealing (see Figure 5-3).

[502.4.3] Drain traps penetrating floors over unconditioned spaces are often overlooked, but must be sealed (see Figure 5-5).

Holes drilled where interior and exterior walls intersect also need to be sealed.

Electrical boxes are considered holes in the envelope and call for sealing. A typical sealing technique is to caulk where the wire enters the box. Make sure a latex or non-petroleum based caulk is used. A silicone type caulk may corrode the insulation on the wiring and expose the wire.

*Figure 5-3*

## Plumbing Bypass

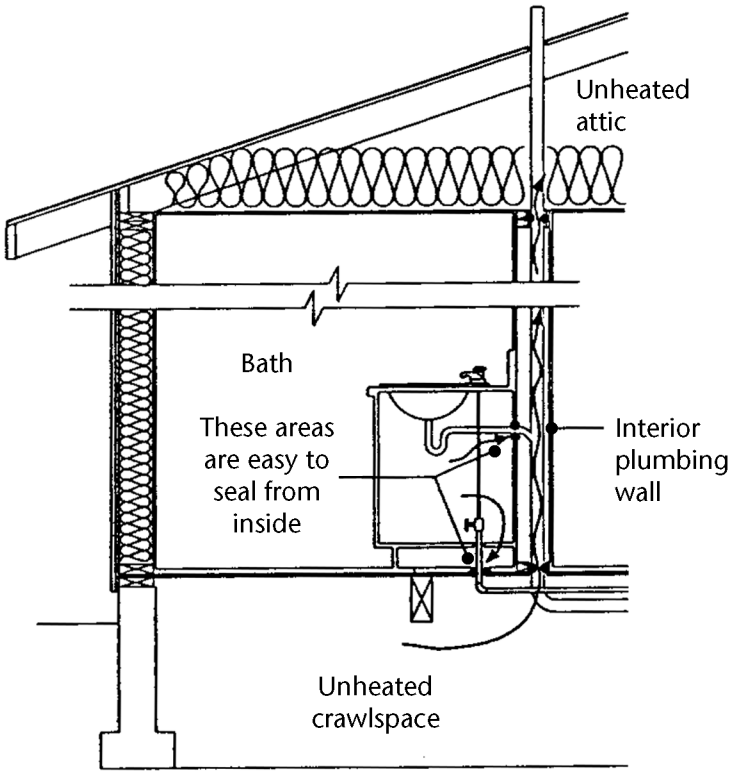
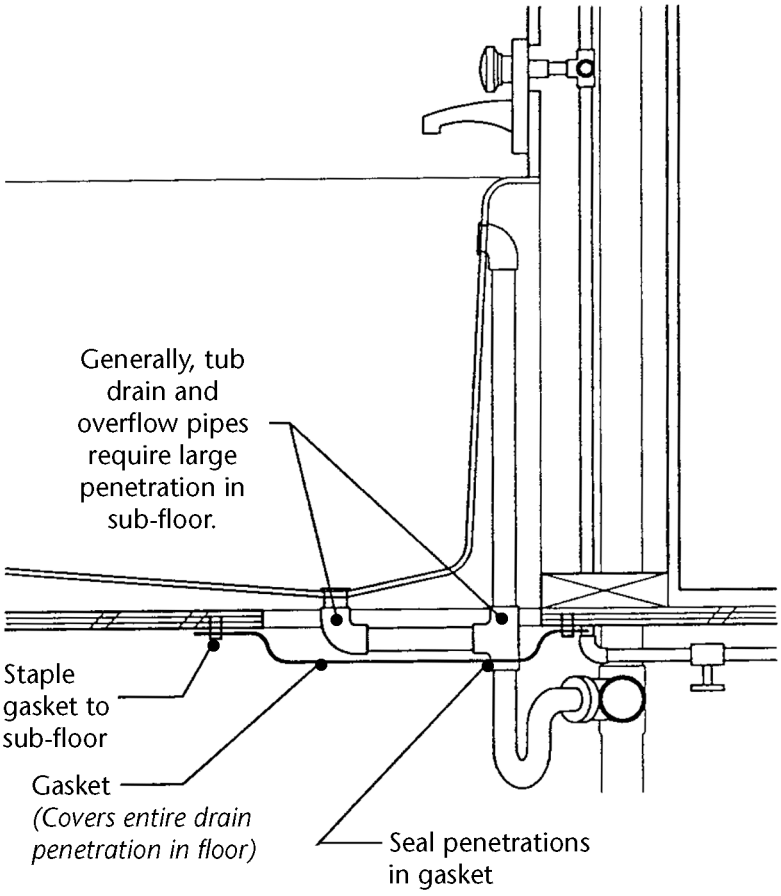


*Figure 5-4*

## Gasket at Tub Penetration



Outlet and switchplate gaskets are recommended, but should always be installed if gaps exist between the box and wallboard.

**Recessed Lighting Fixtures.** Leaky recessed lighting fixtures, when installed in the building envelope, can be a major source of heat loss and moisture movement. WSEC does not limit the number of recessed lights that can be installed, but does give specific installation specifications.

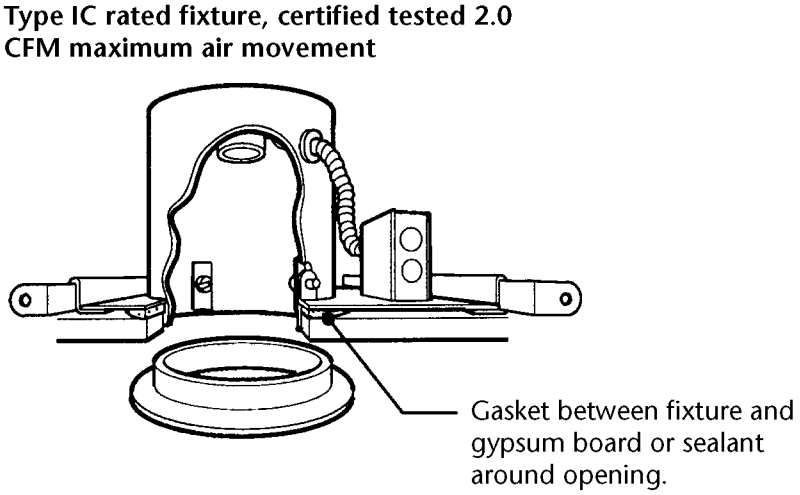
[502.4.4] To meet Code, a recessed fixture must be IC-rated (insulation cover) and installed in a way that limits air leakage (see Figure 5-6):

- Type IC-rated, tested using ASTM E283 method and was certified and labeled to meet the WSEC air leakage requirements.

> **Note:** Many recessed lighting fixtures only meet the air sealing requirement when a specific trim kit is used. Check with your supplier for details.

*Figure 5-5*

## Recessed Lighting Fixtures



[502.4.3a] **Other Building Penetrations.** Additional areas of potential air leakage requiring sealing are:

- **Sole Plates.** Sealing sole plates to subfloors is commonly done after the house is framed and dried in. The caulking is applied at the point where the sole plate meets the subflooring. This method works well because the caulk can be applied to a clean, dry surface for a better bond and the building inspector can easily see it has been done.

  Alternative methods are to seal the sole plate on the bottom when erected or by using a plate gasket product (see Chapter 3, Figures 3-2 and 3-3).

- **Rim Joists.** Rim joists between floors can be sealed either on the interior side with caulking or on the exterior side. The exterior sealing approach requires sealing the house wrap at the rim joist to create an air barrier.

- **Mud Sills.** These are treated the same as sole plates. Mud sills are usually placed on a sill sealer that stops both air leakage and moisture wicking.

- **Flues.** Chimney penetrations are typically sealed where the support or collar meets the ceiling. Observe all fire rating restrictions.

[502.4.5] **Building Air Leakage Testing.** All new construction and additions over 750 sq.ft. need to have a blower door test done and the resulting air leakage should be less than 0.00030 Specific Leakage Area (SLA) when tested at 50 Pascals (0.2 inch w.g.) of depressurization. Testing can be done any time after rough in and after installation of penetrations of the building envelope, including penetrations for utilities, plumbing, electrical, ventilation and combustion appliances (and sealing of these penetrations) have been completed. Building officials can request that the test be conducted while building department staff is present.

The blower door test results need to be recorded on the certificate that is required in Section 105.4 (see Figure 5-7

for an example).

*Figure 5-7*

**tures**

**2009 WSEC Residential Energy Compliance Certificate**

**Property Address:** _____

**Conditioned Floor Area** _____ Date ___/___/___

**Builder or registered design professional :**

_____

***Signature:*** _____

***R-Values***

| | | | | | |
|---|---|---|---|---|---|
| **Ceiling:** | Vaulted | R-____ | **Floors** | Over unconditioned space | R-____ |
| | Attic | R-____ | | Slab on grade floor | R-____ |
| **Walls:** | Above grade | R-____ | **Doors** | _____ | R-____ |
| | Below, int. | R-____ | | _____ | R-____ |
| | Below, ext. | R-____ | | _____ | R-____ |

***U-Factors and SHGC***

| | | |
|---|---|---|
| NFRC rating (or) | Windows U-____ | SHGC-____ |
| Default rating (Chapter 10 WSEC 2009) | Skylights U-____ | SHGC-____ |

***Chapter 9 Option(s)*** _____ ***Total Chpt. 9 Credits*** _____

***Heating, Cooling & Domestic Hot Water***

| System | Type | Efficiency |
|---|---|---|
| Heating | | |
| Cooling | | |
| DHW | | |

***Duct & Building Air Leakage***

All ducts & HVAC in conditioned space ( yes / no ) Insulation R-____

**Test Method:** __Total leakage __Leakage to exterior __Air handler present

Test Target _____ CFM@25Pa Test Result _____ CFM@25Pa

Building air leakage target: SLA<0.00030 - Tested leakage: SLA= _____

***Onsite Renewable Energy Electric Power System***

System type: _____ Rated annual generation _____ **Kwh**

*Record building air leakage results here*