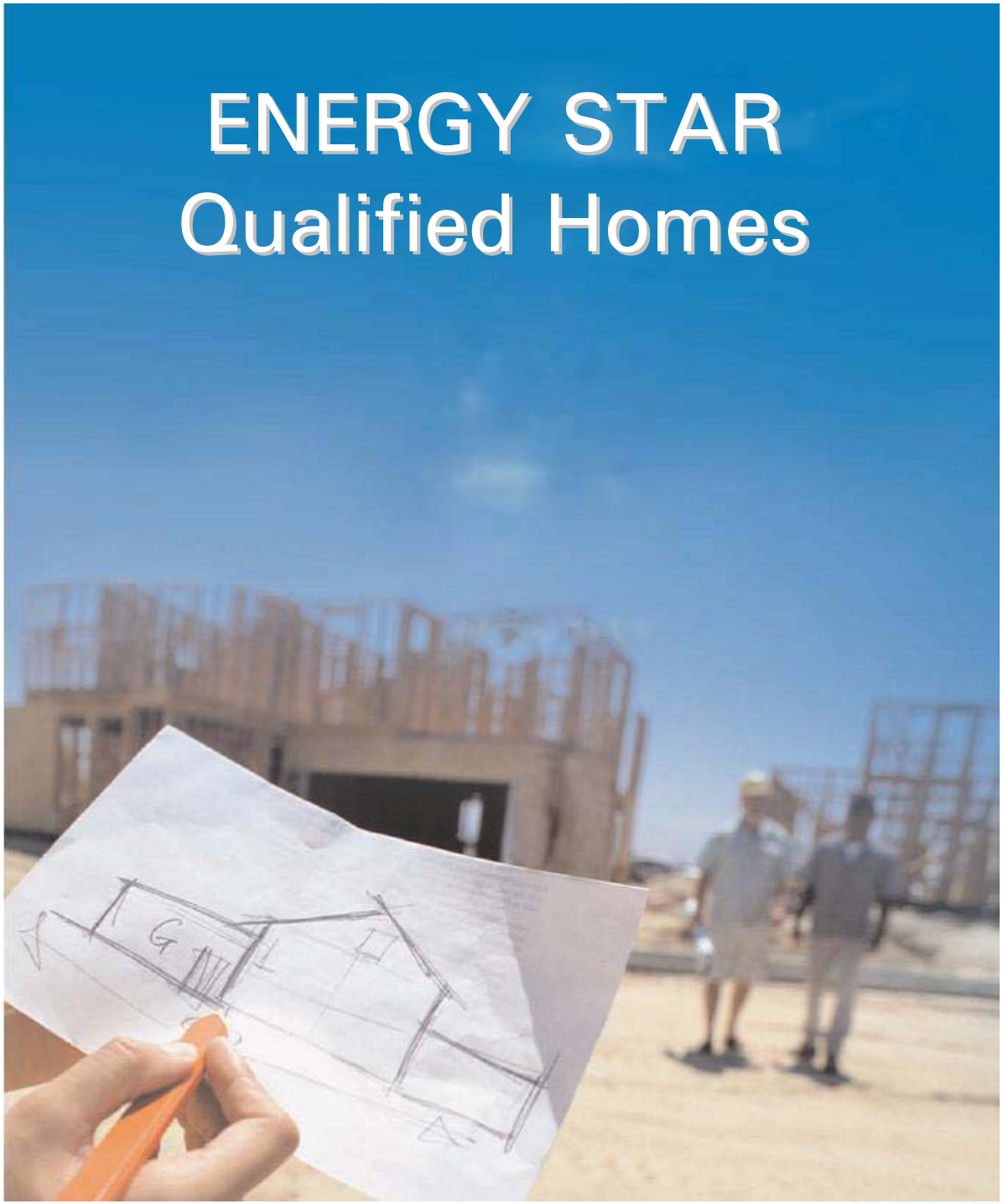
ENERGY STAR Qualified Homes



THERMAL BYPASS CHECKLIST GUIDE

Version 1.1

ENERGY STAR

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THERMAL BYPASS CHECKLIST

INTRODUCTION

In response to significant changes in residential energy codes and standards, the United States Environmental Protection Agency (EPA) released a new set of guidelines for ENERGY STAR qualified homes, to be implemented in 2006. A major new requirement is the Thermal Bypass Checklist.

The Thermal Bypass Checklist is a 16-point list of building details where thermal bypass, or movement of heat around or through insulation, frequently occurs due to missing air barriers or gaps between the air barrier and insulation. Reducing thermal bypasses are important as they can lead to comfort and warranty issues as well as higher utility bills.

The Thermal Bypass Checklist must be completed by a certified home energy rater in order for a home to be qualified as ENERGY STAR. However, up to four items may be verified by the builder to minimize required field trips by the rater.

Key points regarding the implementation of the Thermal Bypass Checklist are:

Key Points

1. If a state, local, or regional energy code contradicts the ENERGY STAR Thermal Bypass Checklist, precedence must be given to the state, local, or regional energy code. Precedence should also be given to guidelines set by *regional* ENERGY STAR programs.
2. Not every specific detail and field condition can be covered in these guidelines. EPA and the Residential Services Network (RESNET) rely on Home Energy Rating System (HERS) Providers and raters to employ their judgment when determining compliance with the general intent of the Thermal Bypass Checklist.
3. Subject to the Providers approval, builders may self-verify up to four items on the list; the remaining items, however, must be verified by a certified home energy rater.
4. Not all details will apply to every home (e.g., some homes may have no room above the garage or cantilever). These items should be checked as “NA” for not applicable by the HERS rater.
5. Both the builder and the certified rater shall sign the Checklist, ensuring accountability on both sides.
6. Any items found to be non-compliant with the Thermal Bypass Checklist must be corrected.

A copy of the Thermal Bypass Checklist is provided at the end of this guide.

THERMAL BYPASS CHECKLIST

GENERIC TIPS AND BEST PRACTICES

Infrared Images in Guide:

- Infrared images help reveal thermal bypass conditions by exposing hot and cold surface temperatures resulting from unintended thermal air flow. In infrared images, darker colors indicate cool temperatures, while lighter colors indicate warmer temperatures.

Builder:

- This guidance has been created to help facilitate both contractor bidding and quality installation.
- The architect or designer should add wall sections to the construction drawings that outline the thermal barrier to clearly define the transition between conditioned and unconditioned space throughout the home. Complete air barrier details should also be provided.
- The architect or designer should provide drawings in multiple languages to accommodate likely field crews (e.g., English and Spanish).
- The builder should facilitate coordination between the framing, insulation and air sealing contractors to ensure air and thermal barrier measures are properly and continuously installed.
- The builder should instruct other trades to limit penetrations being cut into blocking during rough-in stage.
- The builder should consult with local building code officials regarding acceptable air barrier materials exposed to air spaces in attics, shafts, soffits, and dropped ceilings.

Contractor:

- The contractor should use photos in this guide for technical assistance.
- The contractor should follow scope of work for all thermal bypass details.
- The contractor should share new ideas for more effectively and economically providing the required air barriers.

Field Superintendent:

- The field superintendent should review contractor performance by verifying installation meets the objectives of the Thermal Bypass Checklist and scope of work.
- The field superintendent should develop in-house procedures for inspection to ensure the air and thermal barriers are not compromised by other trade contractors.

HERS Rater:

- The HERS rater should use field observations as an opportunity to help the builder be more successful, including reporting details close to failing that should be improved and opportunities to simplify construction or reduce cost.
- The purpose of the thermal bypass inspection is to constructively work with builders to provide more effective thermal envelopes. Thus the HERS rater should use their judgment before failing an item that generally meets the intent of an air barrier requirement, but is not perfect.

1. AIR BARRIER AND THERMAL BARRIER ALIGNMENT

"Insulation is installed in full contact with the air barrier to provide continuous alignment of the insulation with the air barrier."

A *thermal barrier* restricts or slows the flow of heat using materials such as fiberglass batts, rock wool, blown cellulose, vermiculite, spray foam and rigid board insulation. This resistance to heat flow is measured by the R-value of the material. Insulation is not fully effective unless it is installed without gaps, voids, and compression, and is aligned with a continuous air barrier. However, most insulation products (with the exception of closed cell foam insulation) do a poor job at stopping air flow (Figure 1.1).

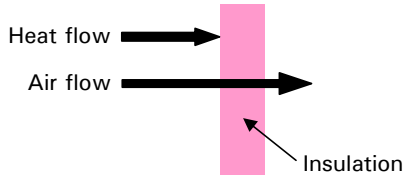

Figure 1.1 - Insulation does not stop the flow of air.

Thus, for insulation to be effective, a separate air barrier or skin is needed on all six sides to stop the flow of air (Figure 1.2). An *air barrier* is any material that restricts air flow. In wall assemblies, the exterior air barrier is typically a combination of sheathing and either building paper, house wrap, or board insulation. The interior air barrier is often an interior finish, like gypsum board.

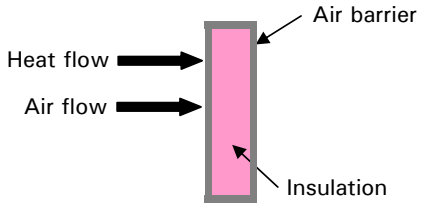

Figure 1.2 - Air barrier prevents the flow of air through insulation.

For the air barrier itself to be effective, it must be contiguous and continuous across the entire building envelope, with all holes and cracks fully sealed, and it must be in full contact with the insulation (Figure 1.3) which is also referred to as fully aligned. The results will be a more comfortable home with less risk of moisture problems.

1. AIR BARRIER AND THERMAL BARRIER ALIGNMENT

EXAMPLES

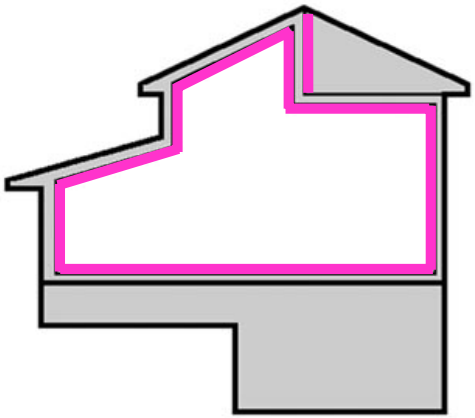

Image courtesy of Southface Energy Institute

Figure 1.3 - The air barrier should be contiguous and continuous over the entire building envelope. Insulation should be in full contact with the air barrier.

When checking for alignment, it is important to verify that insulation is not compressed and is free of gaps and voids. Compression reduces the effective R-value of insulation by reducing the air pockets that drive thermal resistance. In addition, convective heat losses can occur in the air gap that is created when insulation is compressed, further reducing the effective R-value. Gaps and voids also reduce thermal resistance by allowing air to flow through the insulation (Figure 1.4). They are addressed with a separate insulation inspection where rated R-value is downgraded based on the degree they are present.

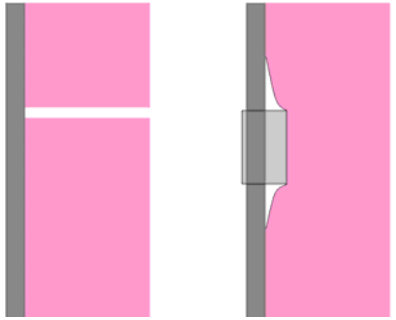

Figure 1.4 - Gaps (left) and voids (right) allow air to flow through insulation.

The following images depict examples of misalignment between the air barrier and the home's insulation.

1. AIR BARRIER AND THERMAL BARRIER ALIGNMENT

EXAMPLES

Figure 1.5 - Insulation installed with voids and compressions

Figure 1.5 shows a common practice for installing insulation by stapling the paper facing along the inside edges of the wall framing. However, this technique called inset stapling results in a large gap between the insulation and interior finish. This can allow air flow around the insulation and facilitate air leakage at any gaps or holes in the framing. Note how the insulation is also compressed around piping and wiring, which further reduces R-value. In contrast, stapling the insulation to the face of the studs would have allowed the batts to fill the framing space and be aligned with the interior finish (see Figure 1.7).

Figure 1.6 - Insulation installed with gaps and voids

Figure 1.6 also shows a large gap between the insulation and where the interior ceiling finish will be installed that will allow air flow to bypass the insulation.

1. AIR BARRIER AND THERMAL BARRIER ALIGNMENT

EXAMPLES

Images courtesy of Environments for Living

1.7 - Alignment of insulation and air barrier

Figure 1.7 shows proper insulation installation with both faced and unfaced fiberglass batt insulation. Note that the batts are not compressed, there are no gaps, voids or compression, and the insulation is fully aligned with the interior surface. Note also that insulation is carefully fit around piping and electrical wiring as shown in Figure 1.8 rather than being compressed in these areas.

Image courtesy of Environments for Living

Figure 1.8 - Insulation is fit around piping and wiring

1. AIR BARRIER AND THERMAL BARRIER ALIGNMENT

EXAMPLES

Figure 1.9 - Blown cellulose insulation

Figure 1.9 shows wet-spray cellulose insulation, which is blown into wall assemblies with a mixture of water and glue that allows it to stay in place without falling out or settling. Since it goes in wet, it needs time to dry. But, the value of blown-in insulation is that it inherently fills the entire wall cavity without any gaps, voids or compression.

Figure 1.10 - Spray-in foam insulation

Figure 1.10 shows a wall being insulated with spray-in foam. Closed-cell spray-in foams act as both an air barrier and a thermal barrier, so it is not critical that the foam be aligned with the interior finish. Properly installed, the foam application will fill holes and cracks creating both a well-insulated and air-tight wall assembly.

1. AIR BARRIER AND THERMAL BARRIER ALIGNMENT

EXAMPLES

Figure 1.11 - Structural Insulated Panels

In addition to batts and blown-in insulation, there are factory-built insulated wall assemblies available today that ensure full alignment of insulation with the integrated air barriers including no gaps, voids or compression by virtue of how they are manufactured and assembled in the field. Structural Insulated Panels (SIPs) shown in Figure 1.11 are whole wall panels composed of insulated foam board glued to both an internal and external layer of wood sheathing, typically OSB or plywood. This assembly will often be manufactured with precut window openings and chases.

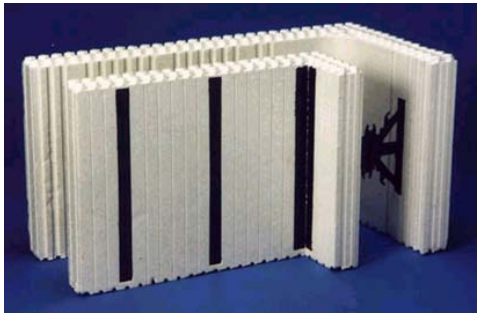

Figure 1.12 - Insulated Concrete Form

Insulated Concrete Forms, or ICFs, as shown in Figure 1.12 is another factory-built wall system. ICFs are blocks made from extruded polystyrene insulation designed to be assembled like “Lego” blocks into a compete wall assembly. Steel reinforcing rods are added and concrete is poured into the voids, resulting in a very air-tight, well-insulated, and sturdy wall. The insulation is inherently aligned with the exterior and interior air barriers with no gaps, voids or compression.

EXAMPLES

While the alignment of air and thermal barriers is important throughout the home, one specific detail merits further mention. Cold concrete slabs are a common source of discomfort in a home, and properly insulating the slab can dramatically reduce heat loss and decrease energy bills. Therefore, slab edge insulation is required in IECC Climate Zones 4 and higher.

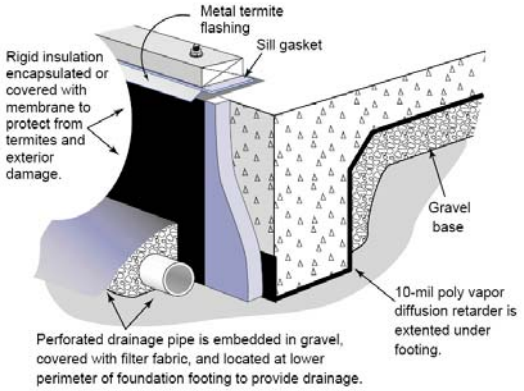

Diagram courtesy of the US Department of Energy

Figure 1.13 - Exterior slab edge insulation

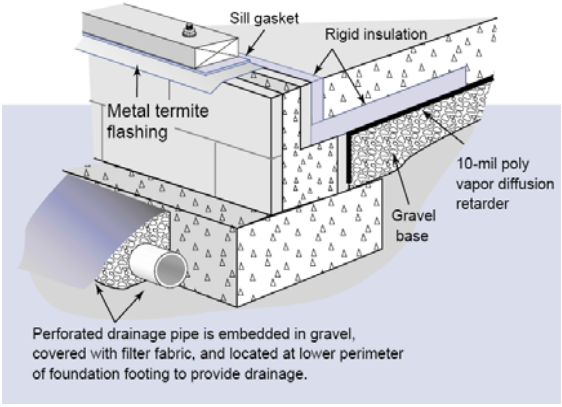

Diagram courtesy of the US Department of Energy

Figure 1.14 - Interior slab edge insulation

There are two basic ways to insulate a slab. First, rigid insulation can be installed directly against the exterior of the slab, as shown in Figure 1.13. Note that in areas with high termite populations, builders should be careful to avoid installing foam insulation in contact with the ground because it enables termites to burrow through to the home undetected in the insulation. A second option is a “floating slab,” which can be constructed using insulation on the interior as shown in Figure 1.14. In this detail, it is important to plan for installation of a floor covering such as carpeting (tack strips) and sheet flooring. For example, adhesives used for sheet flooring eat foam and can result in curled edges. Therefore, provisions must be made to isolate the adhesive from the foam insulation.

EXCEPTION

An exception to this first requirement for continuous alignment of insulation and air barrier is at band joists **not** located at cantilevered floors or garage/conditioned space interfaces. While EPA highly encourages builders to include air barriers at band joists, it is not required except in homes with open web truss-joist floors and leaky duct systems (4 cfm/100 square feet total leakage).

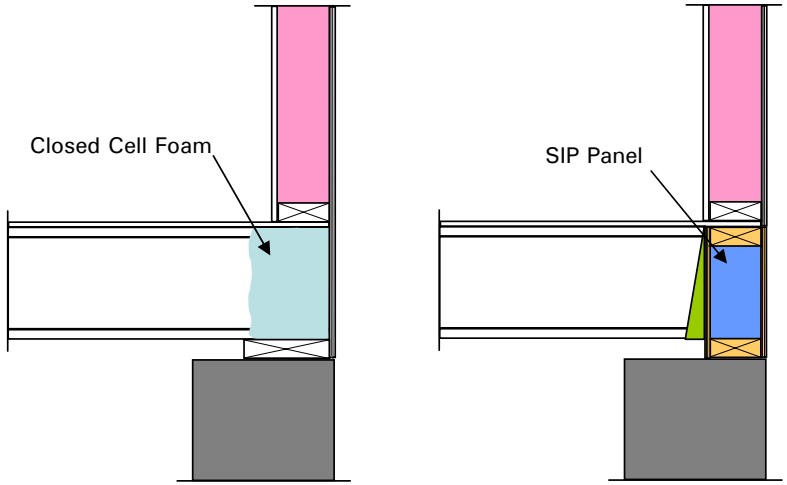

Figure 1.14 - Options for insulation/air barrier alignment at band joists

Figure 1.14 depicts two options for ensuring the alignment of an air barrier and thermal barrier at band joists. In the detail at left, closed cell foam is used to fill the entire joist area and acts as both a thermal and air barrier. At right, a small structural insulated panel (SIP), much like that used for window headers, provides both a thermal and air barrier.

1. AIR BARRIER AND THERMAL BARRIER ALIGNMENT

SCOPE OF WORK

Installation Criteria:

- Insulation shall be installed in full contact with the air barrier on all six sides to provide continuous alignment with the air barrier. For example, batt insulation shall be cut to fit around any wiring, pipes, or blocking and shall be correctly sized for wall width and height.
- As an exception for locations other than cantilevered floors and garages, an air barrier at band joist insulation is only required if ducts are located between a finished ceiling and a sub-floor and the total duct leakage exceeds 4 cfm per 100 square feet of conditioned floor space.
- Insulation installed on the underside of sloped attic roof assemblies shall have an air barrier on the attic side (in the conditioned space) or be devalued, per RESNET's guidelines for insulation installation without an air barrier on all six sides.
- In Climate Zones 4 and higher, complete slab edge insulation shall be provided per IECC requirements to avoid thermal bypass at exposed concrete slabs.
- Doors to unconditioned spaces such as attics and basements shall meet IECC insulation requirements for exterior doors and shall include full weather-stripping.

Tips and Best Practices:

- When choosing insulation, consider options most conducive to proper installation requirements.
- Verify that insulation subcontractor installers are properly trained and/or certified in proper installation practices.
- Include an air barrier at band joists. To avoid the labor-intensive process of cutting, installing and caulking board products at each floor framing bay, consider using closed cell foam or SIP "header" panels. As a least desirable option, paper-faced batts can work if carefully installed and taped at all edges, seams and tears to avoid air leakage.
- Frame corners and wall intersections with drywall clips or 1"x nailing strips so that insulation can be installed in corners and behind the partition walls.
- Use value-engineered framing that allows more wall insulation and reduces framing material costs.
- When using interior slab edge insulation, plan for details needed to install floor coverings.

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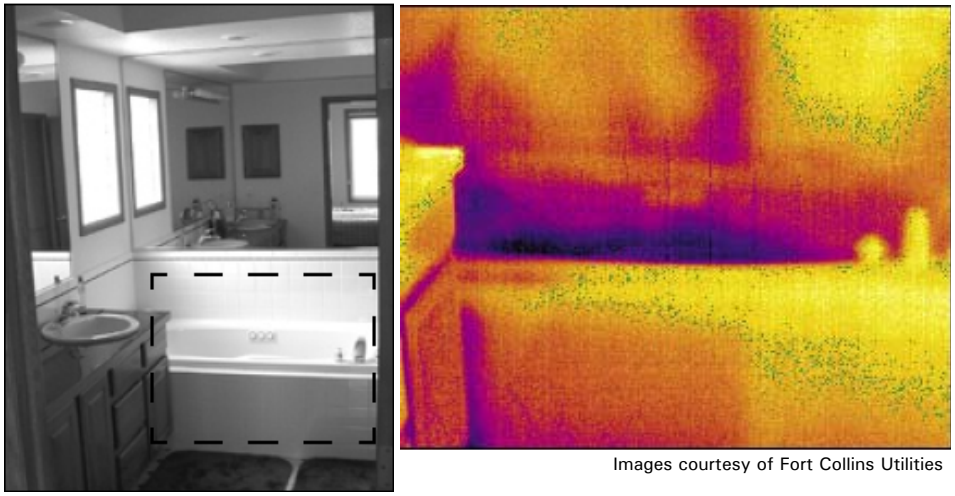
2. SHOWER/TUB AT EXTERIOR WALL

“Exterior walls have been enclosed on all six sides.”
“Exterior walls have been fully insulated.”

Tubs and showers are often installed immediately after rough framing is complete and before insulation is installed (Figure 2.1). As a result, it is almost impossible to properly install insulation and complete air barriers at exterior walls adjoining tubs and showers. This can lead to air flow that circumvents insulation.

Image courtesy of Building Science Corp.

Figure 2.1 - Tub installed against exterior wall without air barrier or insulation



Images courtesy of Fort Collins Utilities

Figure 2.2 - Infrared image showing thermal bypass at tub with incomplete insulation and air barrier

The infrared image in Figure 2.2 shows a common problem where homeowners have tubs and showers that get cold in the winter. In this case, cool air from outside the home is decreasing the temperature of the tub inside the home. As shown in Figure 2.3, if an air barrier and insulation were properly installed behind the tub against the exterior wall, the tub would be protected by an effectively insulated wall assembly, making the bathroom more comfortable.

2. SHOWER/TUB AT EXTERIOR WALL

EXAMPLES

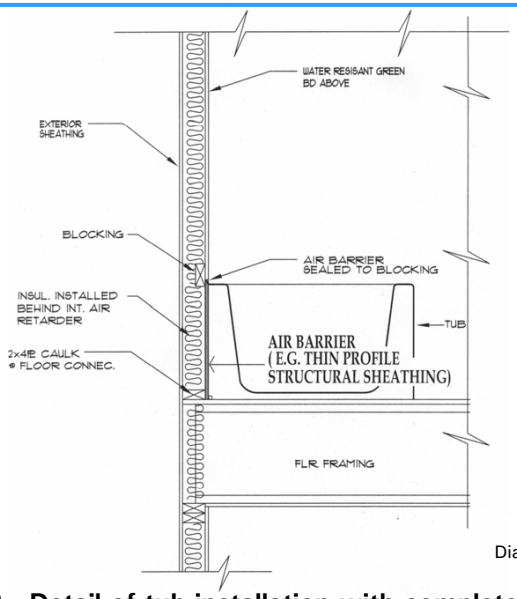


Diagram courtesy of MaGrann Associates

Figure 2.3 - Detail of tub installation with complete air and thermal barriers

Image courtesy of Energy Services Group

Image courtesy of Building Science Corp.

Figure 2.4 - Two options for air barriers where tubs adjoin exterior walls

The installation of air barriers and insulation behind tubs and showers at exterior walls can be achieved with proper planning (Figure 2.4). In the image at left, the builder left insulation batts and drywall for his framers and held them accountable for installing the materials where the tub was to be installed. In the home at right, the builder left a thin-board sheathing product to be installed by the framer. Another option (not shown) would be to fill the cavity around the tub with closed-cell foam, which acts as both a thermal and air barrier.

2. SHOWER/TUB AT EXTERIOR WALL

SCOPE OF WORK

Installation Criteria:

- Exterior walls shall be enclosed on all six sides, including a complete and continuous air barrier behind the tub.
- Any gaps or cracks in this air barrier shall be appropriately air sealed with a compressible sealant, caulk, foam, tape, or mastic.
- Exterior walls shall be fully insulated with no gaps, voids, or compression.

Tips and Best Practices:

- Use a material that is readily available to ensure the air barrier is installed prior to setting the tub. Plywood, oriented strand board (OSB), sheathing boards, and drywall are good choices, but thin-board products may best accommodate a smooth transition between the tub and finish wall above.
- Consider using spray foam at framing behind tubs to avoid labor installing both air barrier and insulation. However, it will need to be installed prior to setting the tub or shower.
- Insulation material and air barrier sheathing should be made available on site for installation prior to plumbing rough-ins, or the wall cavity behind the tub could be left accessible for installation of loose fill or blown in insulation by the insulation subcontractor.

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3. INSULATED FLOOR ABOVE GARAGE

"Air barrier is installed at any exposed edges of insulation."
"Insulation is installed to maintain permanent contact with the underside of the sub-floor decking."

Conditioned rooms above garages can pose both comfort and health and safety issues if the space between the garage ceiling and the sub-floor of the conditioned rooms are not properly sealed and insulated. In Figure 3.1, insulation has been installed in contact with the garage ceiling, but with a large gap between the insulation and the sub-floor above. In this detail, air can move underneath the sub-floor, greatly undermining the effectiveness of the floor insulation.

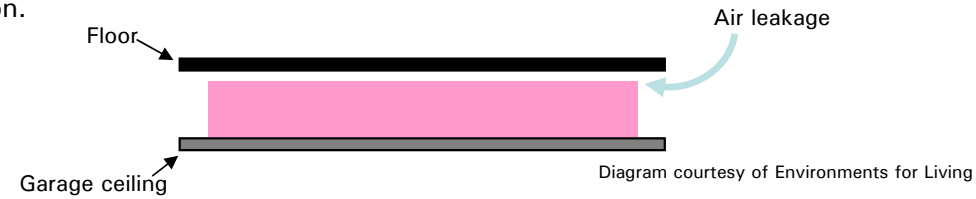

Figure 3.1 - Air leakage at garage ceiling

One solution for this problem is to completely fill the floor framing space with insulation so it is snug against the sub-floor and then provide an air barrier such as thin sheathing or rigid insulation where edges of the floor insulation are exposed between floor framing to stop air flow through the insulation.

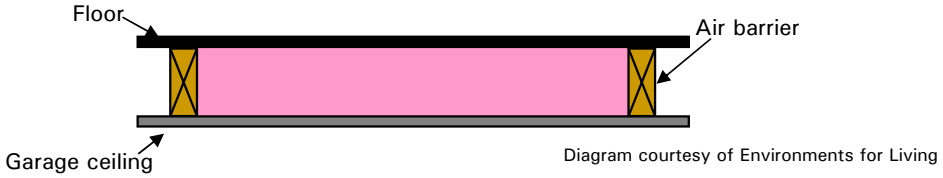

Figure 3.2 - Alignment of insulation and air barrier at garage ceiling

Another solution is to spray foam insulation against the sub-floor to desired thickness / R-value. Faced batts may be used with the facing towards the garage but is more difficult as all seams, edges, and tears must taped and sealed. If faced batts are used, an air barrier must also be installed at the edges of the floor insulation to stop air flow through the insulation. The air barrier can be blocking, thin sheathing or rigid insulation.

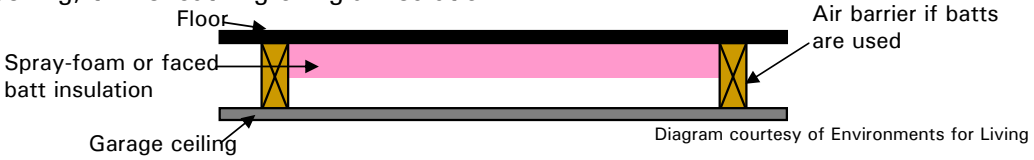

Figure 3.3 - Alignment of insulation and air barrier at garage ceiling with spray foam or faced batt insulation

3. INSULATED FLOOR ABOVE GARAGE

EXAMPLES

Air barrier blocking is much more difficult with floor framing constructed with engineered lumber than dimensional lumber because its I-shape requires additional cutting of the blocking material. Figure 3.4 illustrates blocking material locations.

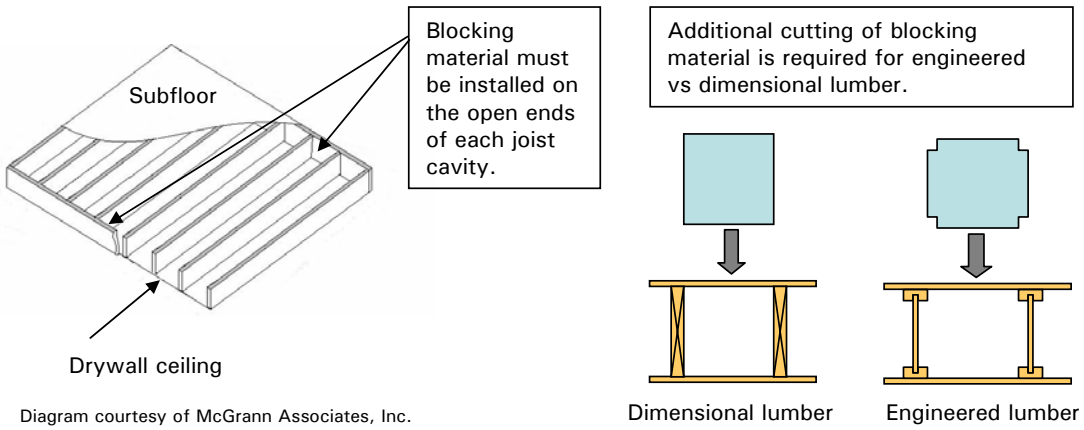

Diagram courtesy of McGrann Associates, Inc.

Figure 3.4 - Blocking for floor over garage

Floor assemblies constructed with open web trusses or truss joists can be difficult to effectively air seal. They are labor-intensive to fill with batt or rigid insulation but can easily be filled with blown or spray insulation. All four edges of an open web truss or truss joist floor assemblies require the installation of specially shaped sheathing material to enclose the entire floor cavity. In addition, all joints and penetrations need to be air sealed. Figure 3.5 illustrates how to enclose the floor assembly on all four sides.

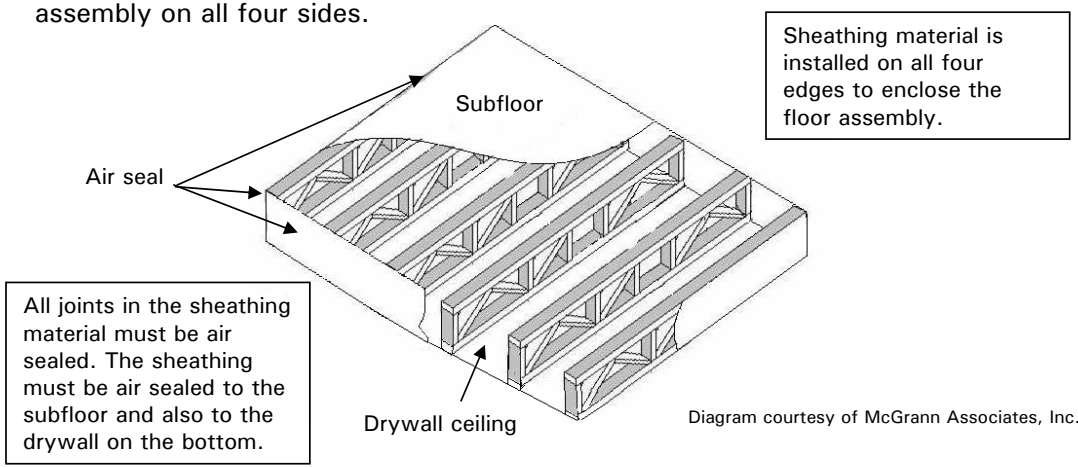

Diagram courtesy of McGrann Associates, Inc.

Figure 3.5 - Enclosing four edges of open web truss floor

3. INSULATED FLOOR ABOVE GARAGE

SCOPE OF WORK

Installation Criteria:

- Insulation shall be installed to maintain permanent contact with the underside of the sub-floor decking.
- Except where spray foam insulation is used, air barriers shall be provided at any exposed edges of insulation and on the bottom face of insulation not in contact with the garage ceiling.
- Blocking material shall be installed on open ends of framed cavities.

Tips and Best Practices:

- Before choosing to completely fill the floor cavity (as in Figure 3.2), make sure that the weight of the insulation will not be excessive for the drywall ceiling, due to the depth of the floor framing. Check with the drywall manufacturer to determine whether netting installed for blown-in insulation effectively removes the extra weight from bearing on the drywall ceiling.
- If weight is not an issue, blown-in insulation completely filling the floor space may be the simplest and most cost-effective solution for assuring alignment with both sub-floor and ceiling.
- Consider using spray foam insulation to avoid completely filling thick framing space between garage and sub-floor with insulation and installing edge air barriers.
- Although less desirable, paper faced insulation batts can work if open-web trusses are not used and paper is carefully installed and taped at edges and seams to avoid air leakage.
- Where batts are used, they may be installed with metal staves holding the insulation against the sub-floor above the garage. Any pipes in the floor system should have adequate insulation installed below them.
- Where open web trusses or truss joists are used to frame garage ceilings, consider supporting framing on partitions separating conditioned space and garage rather than running continuous to interior spaces. This will allow framing to be more easily sealed with an end cap rather than blocking at each bay.

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4. WALLS ADJOINING UNCONDITIONED SPACES

"Continuous top and bottom plates are installed with an air barrier on the unconditioned side of insulated walls, including exposed edges of insulation at joists and rafters."
"Insulation is in complete alignment with interior wall finish and the air barrier on unconditioned side."

There are a number of common places where insulated walls adjoin unconditioned spaces. These include attic knee walls, double walls used for architectural interest, and skylight shafts. Where air barriers are not installed on the unconditioned side of these walls, very hot or very cold air in the unconditioned space can easily flow through and around the wall insulation. Figure 4.1. depicts cold surface temperatures at an attic knee wall in winter as a result of no attic-side air barrier and poorly installed insulation.

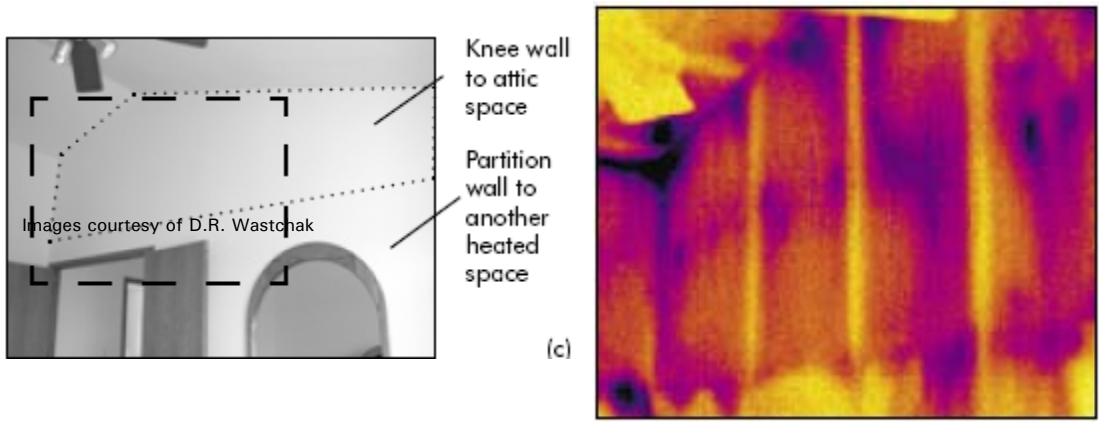


Figure 4.1 - Infrared image of attic knee wall detail

The darker colors in the infrared image in Figure 4.1 indicate excessive heat loss to the cold attic through the knee wall insulation. The wood studs appear as much brighter vertical lines, indicating they are much warmer than the insulated spaces between them. Therefore, the wood studs are providing more effective thermal protection than the insulation itself. The improperly installed insulation will not provide the rated R-value, and the resulting increase in energy bills can be significant.

The solution to this problem is providing an air barrier at the knee walls with sheathing or rigid insulation on the attic side. Figure 4.2 shows a knee wall constructed as a "six-sided wall," with air barriers on all sides of the insulation, including top and bottom plates and blocking at floor framing.

EXAMPLES

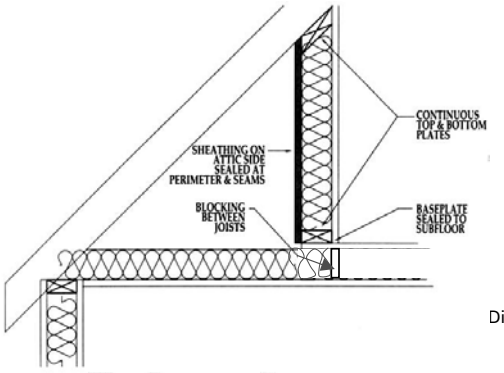


Diagram courtesy of MaGrann Associates

Figure 4.2 - Diagram of knee wall detail

Images courtesy of Energy Services Group

Figure 4.3 - Examples of properly blocked and air sealed attic knee walls

The images in Figure 4.3 above show examples of attic knee walls that have been fully blocked and air sealed. Once these walls are properly insulated, the rooms will be more comfortable and less likely to suffer from moisture problems.

EXAMPLES

The drawing in Figure 4.4 shows a skylight shaft where an air barrier is required on the attic side of all insulated walls.

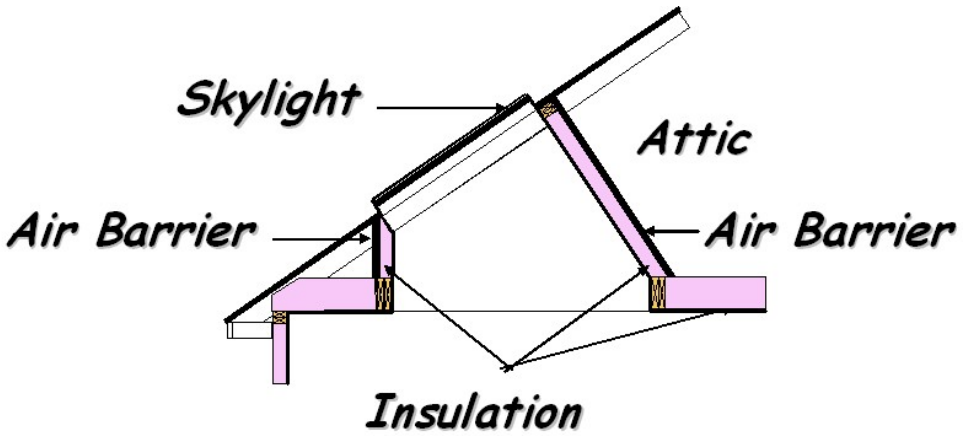


Figure 4.4 – Skylight shaft detail

4. WALLS ADJOINING UNCONDITIONED SPACES

SCOPE OF WORK

Installation Criteria:

- Continuous top and bottom plates shall be installed with an air barrier on the unconditioned side of insulated walls, including exposed edges of insulation at joists and rafters.
- Where truss framing is used, blocking is required at the top and bottom of each wall/roof section.
- In Climate Zones 1 through 5, air gaps between insulation and outside sheathing at pop-out or double-wall exterior wall assemblies shall have air barriers installed that align with the exposed exterior face of the insulation.

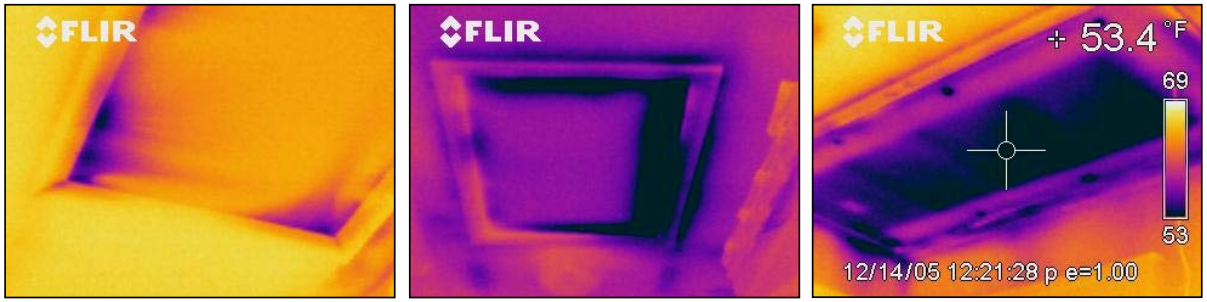
Tips and Best Practices

- Recognize that air barriers are only needed when walls adjoin an unconditioned space.
- Acceptable materials for air barriers exposed to unconditioned spaces vary significantly around the country. Be sure to confirm that the air barrier material is acceptable to the local code official. For example, FSK (Foil / Scrim / Kraft) radiant barrier facing material typically meets code requirements for flame spreadability on attic-side materials. If FSK is intended to be used as an air barrier material, verify that it is acceptable to the local code official.

5. ATTIC ACCESS PANEL / DROP DOWN STAIR

"Attic access panel or drop down stair is fully gasketed for a snug fit."
"Attic access panel or drop down stair includes insulation that fits snugly in the framed opening."

Attic access panels or drop-down stairs without insulation and gaskets are essentially large thermal holes that allow heat loss or gain and air leakage between the conditioned home and the unconditioned attic space.



Images courtesy of Energy Services Group

Figure 5.1 - Infrared images of thermal bypass at attic access panel

Dark colors in the infrared images in Figure 5.1 above reveal thermal bypass at attic access panels and drop down stairs exposed to cold attic air in winter. The image at far left shows an insulated attic hatch with no gasket that allows air to leak in through the edges of the access panel. At center, the attic hatch is insulated, but the black area inside the frame indicates that the fiberglass batt used was too small to cover the entire panel. The resulting void allows cold air to come in contact with the attic hatch. The image at far right shows a drop-down stair installed with no insulation or gasket. The temperature of the stair is approximately ten degrees cooler than the rest of the room.

Tip: Insulation should not block the stairs themselves, as is shown in Figure 5.2.

Figure 5.2 - Improperly installed insulation impedes use of drop-down attic access stair

5. ATTIC ACCESS PANEL / DROP DOWN STAIR

EXAMPLES

Images courtesy of Energy Services Group

Figure 5.3 - Example of properly insulated attic hatch

There are several solutions for stopping thermal bypass at attic hatches or drop-down stairs. In Figure 5.3 above, the image at left depicts an attic hatch insulated with a fiberglass batt that extends all the way to the edge of the hatch. At right, the frame around the hatch has been fitted with a gasket for effective air sealing.

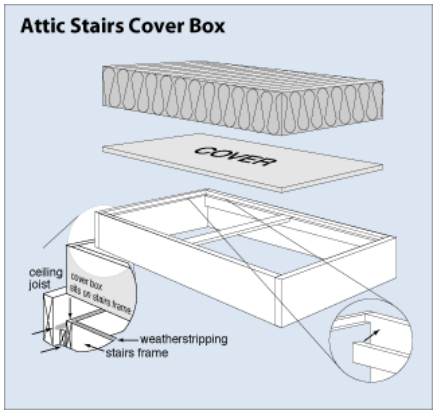


Diagram courtesy of the US Department of Energy

Figure 5.4 - Option for insulation of drop-down stair

One way to properly insulate attic drop-down stairs is to construct a cover box and cover it with insulation (Figure 5.4). Insulated boxes made specifically for this purpose are available from several manufacturers as shown in Figure 5.5.

5. ATTIC ACCESS PANEL / DROP DOWN STAIR

EXAMPLES

Figure 5.5 – Drop down stair panel with factory-made insulated cover

An excellent solution for drop down stairs is to select a product with integral insulation and gasket built into the attic panel as shown in Figure 5.6 below.

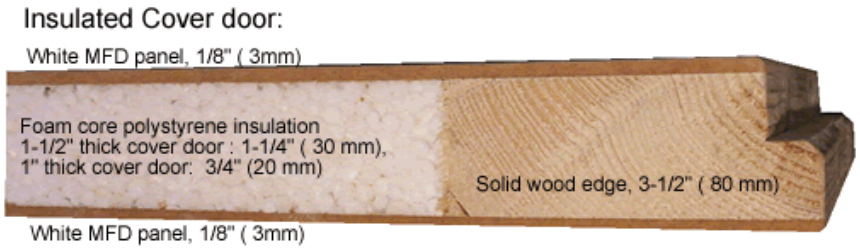


Figure 5.6 – Drop down stair panel with built-in rigid insulation

5. ATTIC ACCESS PANEL / DROP DOWN STAIR

SCOPE OF WORK

Installation Criteria:

- Attic access panel or drop down stair shall be fully gasketed for a snug fit. However, gaps in weather-stripping to accommodate hinge hardware at drop down stairs shall be acceptable.
- Attic access panel or drop down stair shall be fitted with minimum R-5 insulation that fits snugly in the framed opening.

Tips and Best Practices:

- For drop-down stairs, rigid insulation can be installed in the space between the steps and solid panel. However, this may cause potential builder liability if the insulation limits use of the steps or covers manufacturer instructions on the hatch.
- The simplest and possibly most effective solution for drop down stairs is to purchase a model with integral insulation and gasket.

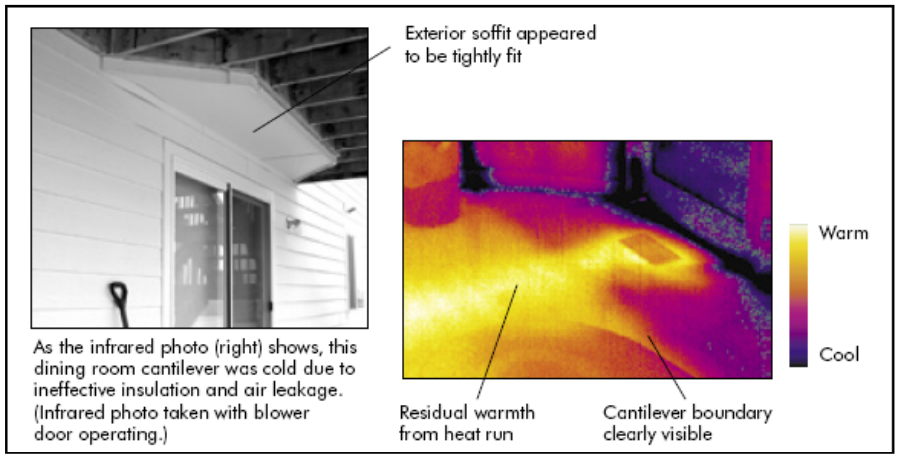
6. CANTILEVERED FLOOR

"Air barrier spans cantilever and any exposed edges of insulation."
"Floor framing is completely filled with insulation or insulation is installed to maintain permanent contact with the sub-floor decking."

There are three areas in cantilevered floors that can cause comfort, indoor air quality and durability problems if not properly addressed. The first area is the intersection where the soffit material on the bottom of exterior cantilevered floor joists and the exterior wall sheathing meet (Figure 6.1). If this intersection is not sealed air can flow through the floor insulation, reducing its effective R-value. The second area is the installation of the floor insulation. Builders typically lay insulation on top of the cantilevered soffit. This often results in an air gap between the top of the insulation and the sub-floor above. Convective currents can occur in this gap, reducing the insulation's effective R-value. The third area is ensuring there is a continuous air barrier separating the cantilevered sub-floor from the conditioned space inside the home. If this air barrier does not exist then warm air will be able to migrate out in the winter and in during the summer.

Image courtesy of Energy Services Group

Figure 6.1 - Visible daylight indicates that there is an incomplete air barrier separating the cantilevered floor from the outside



Images courtesy of Fort Collins Utilities

Figure 6.2 - Infrared image of a cantilevered floor with misaligned insulation

In Figure 6.2, the temperature differential on the cantilevered floor is clearly visible, as the floor over the cantilever is much cooler (darker colored) than the floor over conditioned space due to air gap between insulation and subfloor.

6. CANTILEVERED FLOOR

EXAMPLES

To eliminate thermal bypass at cantilevered floors, the framing space should be completely filled with insulation so that the insulation is in full contact with the sub-floor above and soffit below. Also, an air barrier of thin sheathing, blocking, or rigid insulation should be added to the edge of the insulation, so that air flow is blocked between the exterior and interior of the home (Figure 6.3). Proper air sealing of the exterior sheathing on the bottom of the cantilevered floor is extremely important to stop air infiltration into the floor system. Not only will these proper insulation and air sealing details improve the energy efficiency, they will the improve comfort, air quality, and durability of the home.

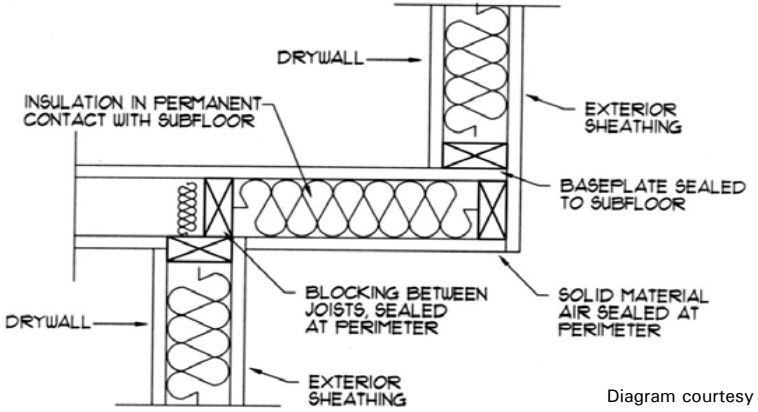


Diagram courtesy of MaGrann Associates

Figure 6.3 - Air barrier detail using blocking at cantilevered floor

Images courtesy of MaGrann Associates

Figure 6.4 - Proper installation of insulation under a cantilevered floor

The image at left in Figure 6.4 above shows insulation installed to fill the space underneath the sub-floor. In the image at right, the assembly has been blocked and air sealed below the conditioned floor above.

6. CANTILEVERED FLOOR

SCOPE OF WORK

Installation Criteria:

- Floor framing shall be completely filled with insulation or insulation is installed to maintain permanent contact with the sub-floor decking.
- An air barrier with fully sealed blocking shall be provided on the inside edge of the wall top plate across the cantilever at all insulated framing bays. Blocking is not needed If spray foam insulation is used.
- If any holes cut are cut into the blocking area to install insulation, they shall be fully closed with air barrier material and sealed.
- Exterior bottom sheathing shall be installed to provide a complete and continuous air barrier at the underside of the cantilever. Any intersections between sheathing, gaps, or cracks in the air barrier shall be fully air sealed with a compressible sealant, caulk, foam, or mastic.

Tips and Best Practices:

- If the cantilever is completely framed at HERS inspection, builder verification may be needed for this item since the insulation will not be exposed.
- Consider spray foam insulation installed to desired thickness because it can serve as both insulation and an air barrier.

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7. DUCT SHAFT/PIPING SHAFT AND PENETRATIONS

"Openings to unconditioned space are sealed with solid blocking and any remaining gaps are sealed with caulk or foam."

Penetrations in framing are often cut by plumbers, electricians, or HVAC contractors who may not be careful nor responsible for sealing them. Unfortunately, these holes can allow excessive air leakage. Duct and plumbing penetrations should be fully sealed with caulking or foam including flashing where needed for very large openings.

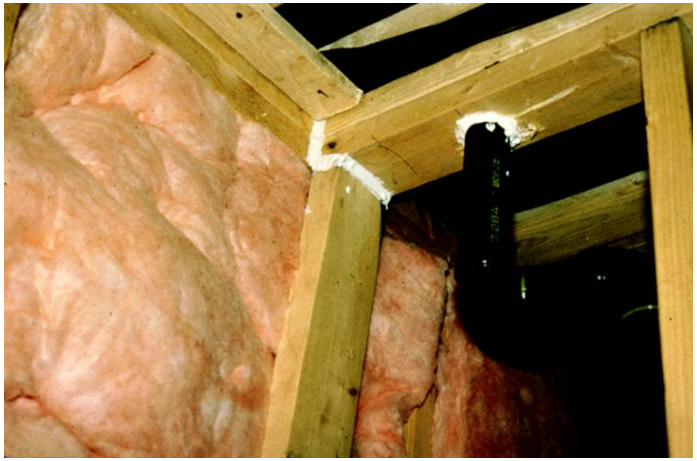

Image courtesy of Building Science Corp.

Figure 7.1 – Correct caulking around piping penetration

In Figure 7.1 above, only caulking was needed because the plumber neatly cut the hole for the plastic pipe. In Figure 7.2 below, there was a very large opening for ducts, a vent and wiring. These required both blocking and foam to seal penetrations in the chase.

Image courtesy of Energy Services Group

Figure 7.2 – Correct blocking and foam air sealing in a chase

7. DUCT SHAFT/PIPING SHAFT AND PENETRATIONS

SCOPE OF WORK

Installation Criteria:

- Openings to unconditioned spaces shall be sealed with solid blocking as required, and any remaining gaps shall be sealed with caulk or foam.

Tips and Best Practices:

- Since the flashing or framed caps at shafts and penetrations are typically installed by framers before the plumbing and HVAC trades do their work, make sure subcontractors understand their responsibilities to assure the integrity of the air barrier.
- Make sure the air sealing crew has been trained to identify transitions between conditioned and unconditioned spaces, since workers not fully trained have been observed to unnecessarily seal blocking and framing between conditioned spaces.

8. FLUE SHAFT

"Opening around flue is fully sealed with flashing and any remaining gaps are sealed with fire-rated caulk or sealant."
"Combustion clearance between flue and combustible materials (e.g., OSB) are properly closed with UL-approved metal collars."

Effectively air-sealing flue shafts can be difficult due to large sizes and odd shapes. However, it is important because significant air infiltration can occur at unsealed openings. For example, the flue shaft shown in Figure 8.1 below has a very large air gap that must be sealed.

Image courtesy of Building Science Corp.

Figure 8.1 - Lack of air sealing around flue shaft

In Figure 8.2 below, insulation has been used to fill the space between the flue and the studs. However, this is a poor detail because insulation is not an effective air barrier.

Image courtesy of EnergyLogic

Figure 8.2 - Insulation improperly used for air sealing

EXAMPLES

Image courtesy of Building Science Corp.

Figure 8.3 - UL-rated metal collar installed around a flue shaft

Figure 8.3 above shows how a flue can be fully sealed in a large opening. In this case, an OSB panel was cut to fill the air space around the flue with necessary combustion safety clearance. The flue was then fitted with a metal collar, sealing the combustion safety clearance gap between the OSB panel and flue. In Figure 8.4 below, fire-rated caulk, typically red in color, has been used to seal any gaps between the flue and metal collar.

Note that caution should always be used when installing insulation against potentially hot surfaces, for both combustible and non-combustible insulation may present a fire hazard if caused to overheat. Refer to local building codes for more information.

Image courtesy of EnergyLogic

Figure 8.4 - Fire-rated caulk around a flue shaft

8. FLUE SHAFT

SCOPE OF WORK

Installation Criteria:

- Flue openings shall be fully sealed with flashing as required and any remaining gaps sealed with fire-rated caulk or sealant.
- Combustion clearance between flue openings and combustible materials (e.g., OSB) shall be properly closed with UL-approved metal collars.

Tips and Best Practices:

- Trades should be informed to prevent degradation of the fire-rating during rough-in stage if blocking is installed by the framing contractor.
- Specially colored fire-rated foam is now available for sealing difficult air gaps at flue openings.

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9. ATTIC EAVES

"Solid baffles are provided at framing bays to avoid wind washing of attic insulation."

Wind intrusion can occur at roof eaves with soffit vents or from air gaps between roof sheathing and fascia boards. If the attic insulation is left exposed, wind can blow through the soffit vent and through the insulation, and in some cases blow it away from the edge. As a result, wind intrusion can undermine the effectiveness of the insulation and create opportunities for moisture problems.

Figure 9.1 - Wind intrusion around a soffit vent

In Figure 9.1 above, air flow coming through the soffit vent has completely pushed back the blown-in insulation that was originally installed over the entire attic floor.

EXAMPLES

One solution is to install a baffle between each rafter or truss to serve as an air barrier and prevent wind-washing. The baffles can be made of any number of materials specifically designed for this purpose including cardboard and foam sheathing.

Image courtesy of MaGrann Associates

Figure 9.2 - Cardboard baffles installed to protect insulation

In Figure 9.2 above, cardboard baffles have been installed to direct the flow of air over and above the insulation below.

9. ATTIC EAVES

SCOPE OF WORK

Installation Criteria:

- Wind baffles shall be provided at all framing bays with soffit vents to prevent wind-wash.

Tips and Best Practices:

- Even if soffit vents are not continuous, consider providing wind baffles at all framing bays since air gaps that commonly occur between roof sheathing and fascia boards can allow wind intrusion along the entire roof edge.

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10. DROPPED CEILING/SOFFIT

"Air barrier is fully aligned with insulated framing and any gaps are fully sealed with caulk, foam, or tape."

Framing crews typically build dropped ceilings and soffits early in the construction process. This leaves very difficult conditions for the proper installation of insulation with a complete air barrier. As a result, heat can flow from the home through the dropped ceiling in the winter and potentially reach cold surfaces where it can condense and cause moisture and dry rot problems. In the summer, heat from the attic can easily migrate to the dropped ceiling and soffit, thus heating the conditioned space. In addition, where insulation sags or has gaps in the framing, cold or hot attic air can migrate to the framed-out spaces.

Image courtesy of Maryland Energy Administration

Figure 10.1 - Improperly installed insulation over a dropped ceiling

Figure 10.2 – Infrared image of poorly insulated dropped ceiling

The framed dropped ceiling in Figure 10.1 shows insulation that has been installed without an air barrier. It also shows voids and compressions that decrease its effectiveness. Figure 10.2 shows an example of how this installation practice allows cold air in the winter to easily migrate to the dropped ceiling, resulting in high energy bills and reduced comfort.

10. DROPPED CEILING/SOFFIT

EXAMPLES

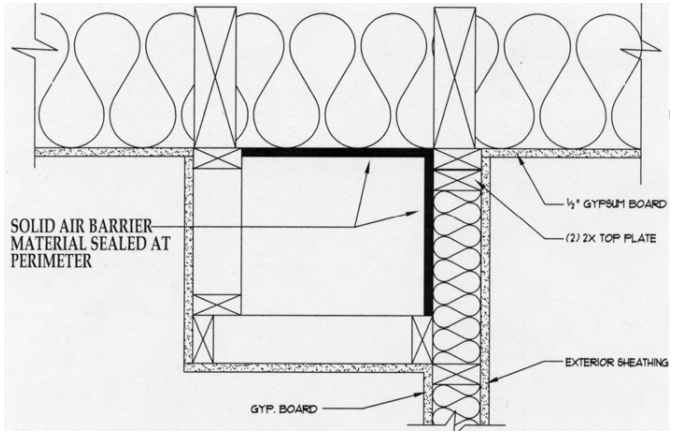

Diagram courtesy of MaGrann Associates

Figure 10.3 - Diagram of a soffit capped by an air barrier

The simplest option for a complete air barrier at dropped ceilings and soffits is to cap the soffit with an air barrier as shown in Figure 10.3. This makes proper installation of insulation much easier for the insulation subcontractor. Note, as also shown in Figure 10.3, an air barrier must also be included where dropped ceilings or soffits adjoin exterior walls at exposed insulation.

Images courtesy of Energy Services Group

Figure 10.4 – Examples of correctly air sealed soffits

The homes shown in Figure 10.4 are good examples of a complete air barrier. At left, a soffit for ducts has been sealed with sheathing and foam. Likewise, on the right, a kitchen soffit has been similarly air sealed.

10. DROPPED CEILING/SOFFIT

SCOPE OF WORK

Installation Criteria:

- A complete sealed air barrier fully aligned with attic insulation shall be provided at all attic framing above soffits and dropped ceilings.
- Where drop ceilings or soffits occur at exterior walls, air barriers shall be included at the wall as well as at the attic floor.

TIPS AND BEST PRACTICES

- Use of plywood, OSB, thin-board sheathing, or sheetrock as a rigid air barrier between the soffit and unconditioned space; seal any gaps with caulk, foam, or mastic.

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11. FIREPLACE WALL

"Air barrier is fully aligned with insulated framing in framed shaft behind fireplace and any gaps are fully sealed with caulk, foam, or tape."

It is very difficult to properly install insulation and a complete air barrier at wall chases such as furred out fireplaces once they are framed in. Therefore, proper insulation needs to be carefully coordinated with the relevant trades.

Air barrier missing at framed exterior wall

Image courtesy of EnergyLogic

Figure 11.1 - Fireplace installed without air barrier

In Figure 11.1 above, the fireplace has been framed and installed without an air barrier. This makes it difficult to later install an air barrier and insulation properly. The diagram in Figure 11.2 below shows a detail of how the air barrier and insulation at fireplaces should be installed.

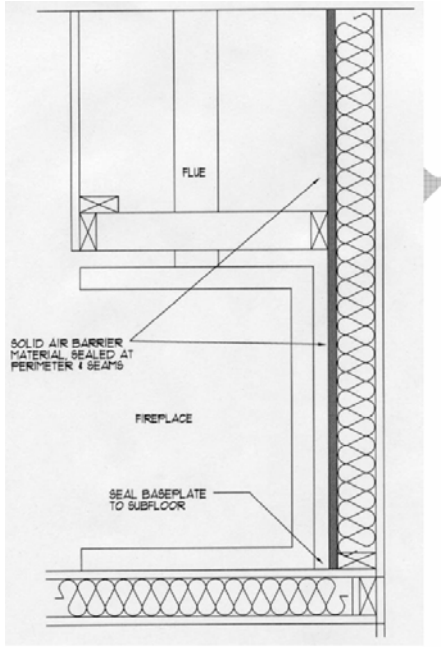

Diagram courtesy of MaGrann Associates

Figure 11.2 - Detail of fireplace air barrier installation

EXAMPLES

One solution to this problem is for the builder to hold the framer responsible for installing the insulation and drywall at the fireplace shaft during the framing process when it is easily accessible.

Image courtesy of EnergyLogic

Image courtesy of Building Science Corp

Figure 11.3 - Fireplaces installed with air barrier

At left in Figure 11.3, the builder has used a thin-board sheathing product to create an air barrier around the fireplace, bringing the furred out space into the conditioned space. At right, the builder has used drywall for the same purpose.

11. FIREPLACE WALL

SCOPE OF WORK

Installation Criteria:

- Insulation must be installed without voids, gaps, or compressions prior to installation of the interior air barrier. Insulation shall be cut to fit around any wiring, pipes, or blocking and correctly sized for wall cavities width and height.
- Provide an air barrier that is fully aligned with insulated framing in framed shaft behind fireplace, and any gaps shall be fully sealed with caulk, foam, or tape.
- Fire-rated caulking along with flashing or UL-rated collars shall be installed continuous around fireplace flue.
- Drywall, thin board sheathing, or other air barrier materials shall be used to create an interior air barrier on the exterior wall behind the fireplace.

Tips and Best Practices:

- Since insulation must be installed prior to the installation of the air barrier and will therefore often not be visible for inspection by the HERS rater, this is a good item to rely on the builder to verify for the Thermal Bypass Checklist.

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12. STAIRCASE FRAMING AT EXTERIOR WALL/ATTIC

"Air barrier is fully aligned with insulated framing and any gaps are fully sealed with caulk or foam."

Staircases adjoining exterior walls, garages, or attics need complete air barriers to avoid thermal bypass between conditioned and unconditioned space (Figure 12.1). A common area missing an air barrier on the interior wall is where staircases have small areas under enclosed landings or bottom stairs. It is difficult to properly install an air barrier and insulation in these spaces once the staircase has been framed. Therefore, install a rigid sheathing or air barrier material prior to installing the staircase, so that the sheathing overlaps the stringer above and below, to provide a continuous and complete air barrier.

Image courtesy of Energy Services Group

Figure 12.1 - Staircase left open to attic

12. STAIRCASE FRAMING AT EXTERIOR WALL/ATTIC

EXAMPLES

An air barrier is needed at staircases where the stairs come in contact with the exterior wall or attic above and below the stairs. This involves sealing any gaps with caulk or foam, and insulating the air barrier properly. This detail is depicted below in Figure 12.2.

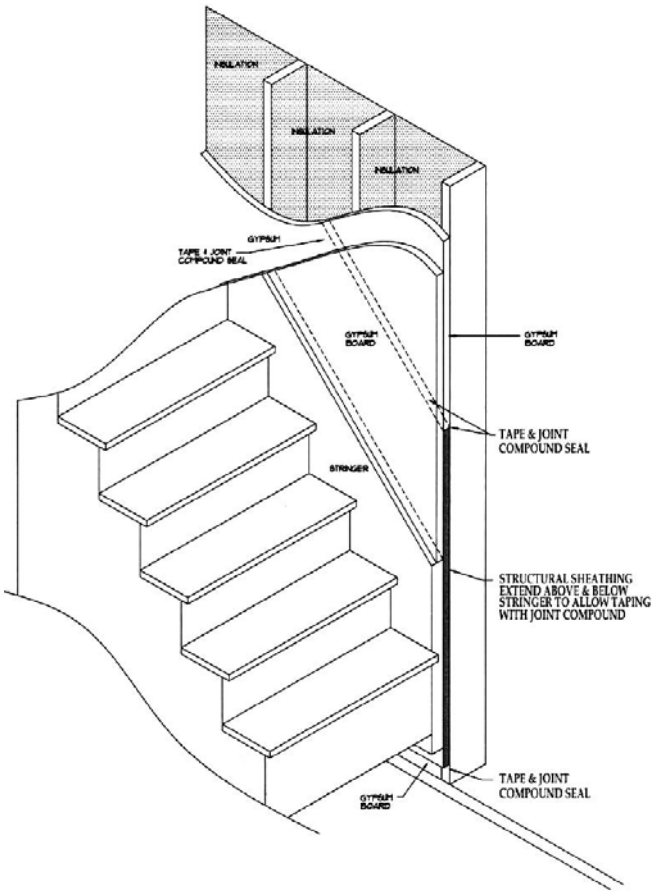

Diagram courtesy of MaGrann Associates

Figure 12.2 - Staircase air barrier detail

12. STAIRCASE FRAMING AT EXTERIOR WALL/ATTIC

SCOPE OF WORK

Installation Criteria:

- Air barrier shall be fully aligned with insulated framing and any gaps are fully sealed with caulk or foam.

Tips and Best Practices:

- Structural sheathing can be used to extend above and below stringers to allow for taping with joint compound.
- If the stair air barrier is completely framed at inspection, builder verification may be needed for this item.

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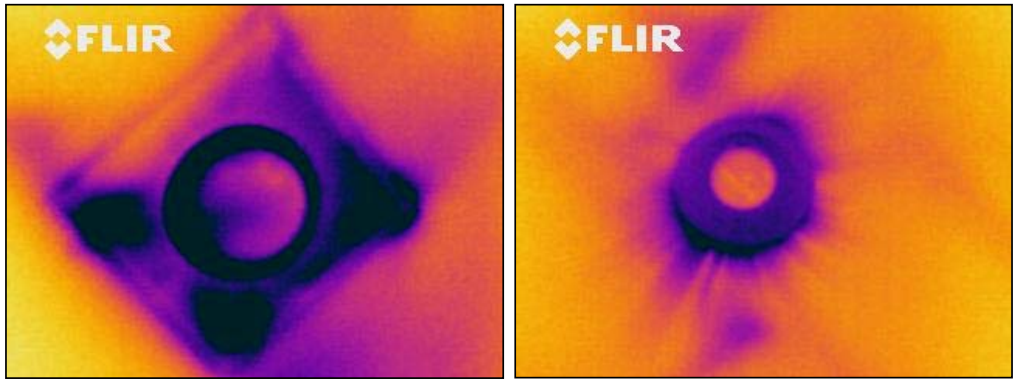
13. RECESSED LIGHTING

"Recessed lighting fixtures to unconditioned attics shall be airtight IC-rated (ICAT) and sealed to drywall with gasket, caulk, or foam."

Recessed lighting into unconditioned attics can cause excessive air leakage and thermal bypass resulting in high utility bills and moisture problems. Each recessed light that is not insulated creates almost a two square foot thermal hole to the attic. Additionally, since these lights get very hot, they create a natural draft, pulling air through them. Some recessed light fixtures are rated IC for "insulation contact," meaning insulation can be placed over the top of the fixture. However, insulation stops thermal flow but not air flow. With the intense heat inside the fixture, there is a large driving force pushing air through the fixture and insulation above for large energy losses, even with IC fixtures.



Images courtesy of Energy Services Group

Figure 13.1 - Infrared images of thermal bypass at recessed lighting

The infrared images in Figure 13.1 show large thermal bypass at recessed light fixtures below an attic. In the left image, the can light has traditional large clearance with insulation for non-IC-rated fixtures resulting in a large thermal hole that allows cold air to enter the home from the attic. In the right image, air is leaking excessively through the air gaps between the can light and the drywall and within the fixture.

13. RECESSED LIGHTING

EXAMPLES

The best solution for reducing thermal bypass at recessed lighting fixtures is to include the lights in the conditioned space of the home. This can be done directly below attics by using non-recessed light fixtures or locating recessed light fixtures in a dropped ceiling with an air barrier to the attic (Figure 13.2). However, where having a fixture below an unconditioned attic cannot be avoided, there are "insulation contact, air-tight" (ICAT) rated fixtures that seal tightly and can be covered with insulation. Note that some of these fixtures have sealed gaskets built-in (Figure 13.3), while others have to be carefully installed with a separate gasket.

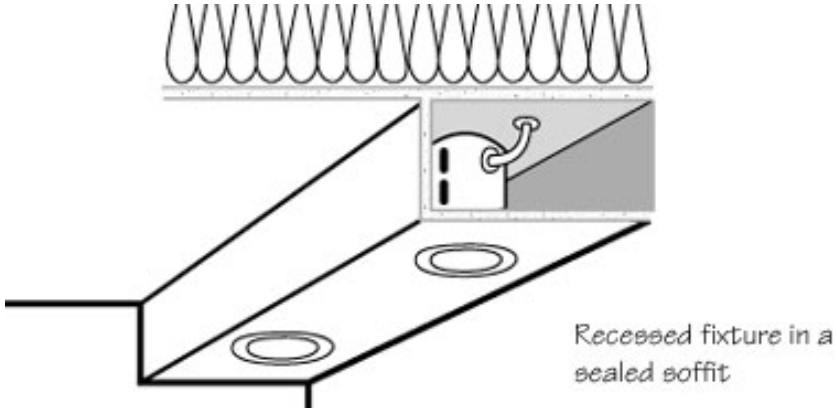


Figure 13.2 - Recessed light fixture in a sealed soffit

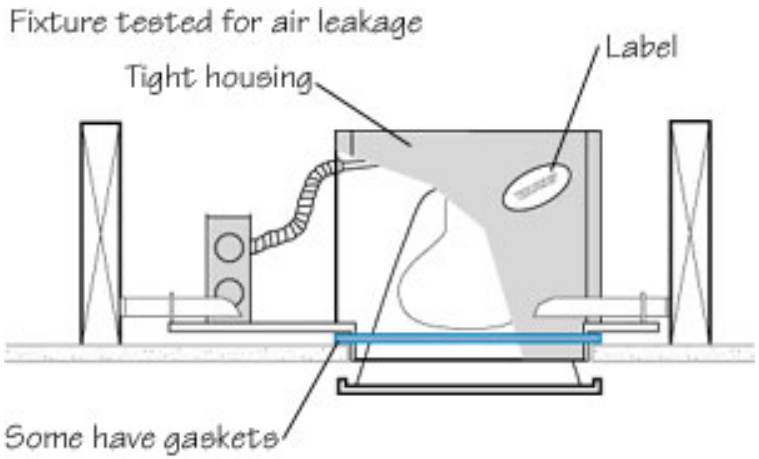


Figure 13.3 - ICAT-rated fixture installed with gasket

13. RECESSED LIGHTING

SCOPE OF WORK

Installation Criteria:

- All recessed lighting fixtures to unconditioned attics shall be airtight IC-rated (ICAT), and they shall be sealed to drywall with gasket, caulk, or foam.

Tips and Best Practices:

- Recognize that insulation contact, air-tight (ICAT) rated recessed light fixtures are only needed at ceilings adjoining unconditioned space.
- Use ICAT recessed light fixtures with built-in gasket seals.
- Develop a system for storing trim seal gaskets provided by manufacturer after initial installation of the recessed cans so they are available at the end of the job.
- Follow manufacturer recommendations for sealing since light fixtures get very hot.

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14. PORCH ROOF

"Air barrier is installed at the intersection of the porch roof and exterior wall."

Where blocking and air sealing are missing at the intersection between a home's interior and porch roof (as shown below in Figure 14.1), air can easily pass through the insulation, between the exterior and interior of the home, causing high utility bills along with potential comfort and moisture problems. An example of this problem is shown in the infrared image in Figure 14.2 where cold exterior walls occur at walls adjoining a porch roof without an air barrier.

Image courtesy of Energy Services Group

Figure 14.1 - Interior of the home is exposed to exterior air infiltration via the porch roof

Image courtesy of Energy Services Group

Figure 14.2 - Cold air infiltration into home via porch roof

14. PORCH ROOF

EXAMPLES

One solution to this problem is to install blocking or another solid air barrier between the porch roof and the conditioned space of the home, as shown Figures 14.3 and 14.4 below. Once the blocking is installed, the area can be easily insulated.

Image courtesy of Energy Services Group

Figure 14.3 - Conditioned space separated from exterior by blue colored blocking at intersection of porch roof and wall

Image courtesy of Environments for Living

Figure 14.4 - Exterior view of blocking between porch roof and wall

14. PORCH ROOF

SCOPE OF WORK

Installation Criteria:

- Air barrier shall be installed at the intersection of the porch roof and exterior wall.

Tips and Best Practices:

- Acceptable materials for attic-side air barrier vary significantly around the country. Be sure to confirm that the preferred material is acceptable to the local code official.
- FSK (Foil / Scrim / Kraft) radiant barrier facing material typically meets code requirements for flame spreadability on attic-side materials.

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15. WHOLE-HOUSE FAN PENETRATION AT ATTIC

"An insulated cover is provided that is gasketed or sealed to the opening from either the attic side or ceiling side of the fan."

While whole-house fans are not frequently found in new construction in many parts of the country, they can provide quick night-time cooling in hot-dry climates with cool evenings. However, they represent almost a 10 square foot thermal hole to the attic because the large opening is not insulated and the metal louvers effectively transfer and leak heat between the home and unconditioned attic. This can cause comfort and moisture problems. This problem can be easily fixed with an insulated cover that can be constructed and gasketed to the fan to prevent the flow of heat from the attic into the conditioned space (Figure 15.1). However, this cover must lift automatically when the fan is switched on, or be able to be lifted without the homeowner climbing into the attic. Units that do require climbing into the attic are not allowed because they are highly unlikely to be used. Some whole-house fans feature built-in insulated covers that operate automatically and are fully sealed (Figure 15.2).

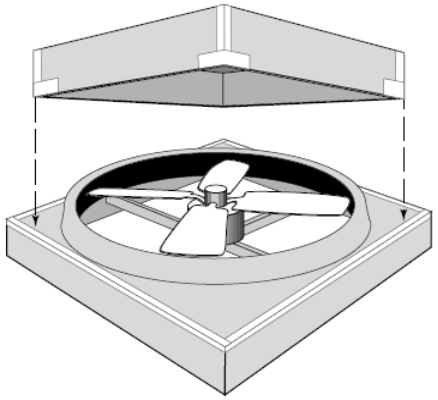


Figure 15.1 - Whole-house fan cover

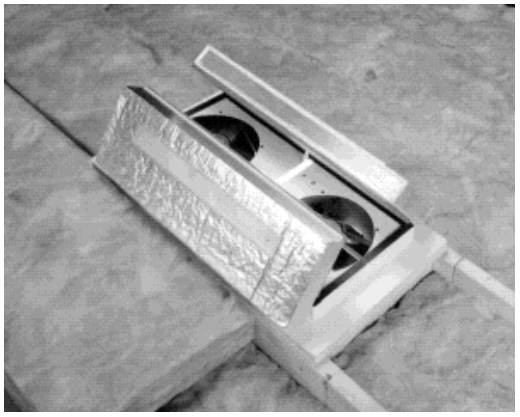


Figure 15.2 - Whole-house fan with built-in cover

15. WHOLE-HOUSE FAN PENETRATION AT ATTIC

SCOPE OF WORK

Installation Criteria:

- Whole-house fan shall include a minimum R-5 insulated cover that is fully gasketed to the framing assembly and opens either automatically or with a mechanism that does not require the homeowner to climb into the attic.

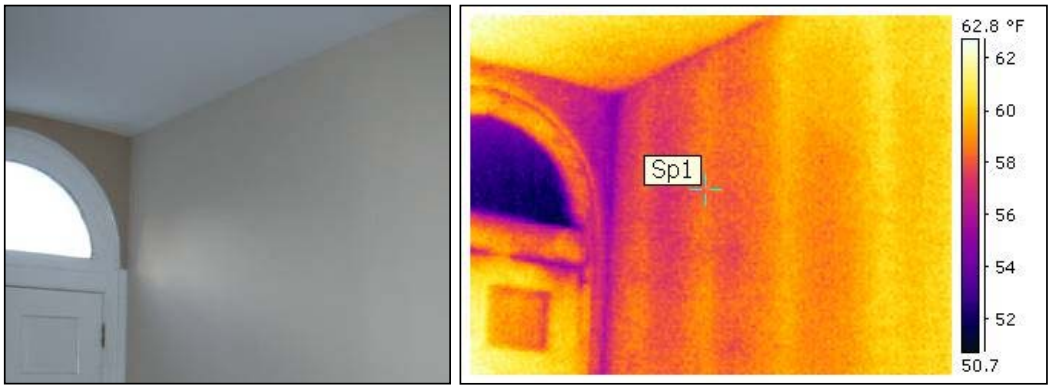
Tips and Best Practices:

- Whole-house fans are available with insulated covers that are fully gasketed and automatically lift when turned on.
- Make sure any modifications for an insulated cover to a whole-house fan do not conflict with manufacturer requirements.
- Make sure the homeowner understands how this product works and operates with an insulated cover.

16. COMMON WALLS BETWEEN DWELLING UNITS

"Fully seal all gaps between a gypsum shaft wall (i.e., common wall) and the structural framing between units in duplex and townhouse construction."

Common, or party, walls between units in attached housing can be significant sources of thermal bypass. For example, the infrared image in Figure 16.1 reveals a gap between the common wall and the structural framing has not been sealed, resulting in cool air leaking into the home.



Images courtesy of Energy Services Group

Figure 16.1 - Infrared image of cool air infiltration at a common wall

Images courtesy of Energy Services Group

Figure 16.2 - Poorly sealed common wall

In Figure 16.2, an exterior view of a common wall/structural framing interface is shown on the left. While this corner will be covered by "J" channel siding, the corner will still leak. The large size of this leakage area can clearly be seen from the inside (at right), as daylight streams into the home.

EXAMPLES

A solution to this problem is to air seal the gaps between the drywall and framed wall using expanding foam (if allowed by code) or fire rated blocking or caulk (Figures 16.3 and 16.4).

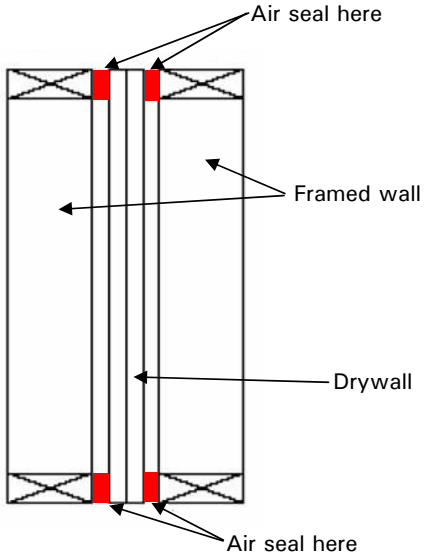


Diagram courtesy of EnergyLogic

Figure 16.3 - Diagram of common wall air sealing

Image courtesy of MaGrann Associates

Figure 16.4 - Example of properly air sealed common wall with fire-rated caulking (in red)

16. COMMON WALLS BETWEEN DWELLING UNITS

SCOPE OF WORK

Installation Criteria:

- All gaps between a gypsum shaft wall (i.e., common wall) and the structural framing between units in duplex and townhouse construction shall be fully sealed.

Tips and Best Practices:

- Acceptable materials for air-sealing gypsum shaft walls can vary significantly around the country. Be sure to confirm that the preferred material is acceptable to the local code official.
- Fireproof spray foam designated with a special color is now available as a possible solution for easily sealing large gaps between adjoining units.

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ENERGY STAR Qualified Homes
Thermal Bypass Inspection Checklist

The Thermal Bypass Inspection Checklist must be completed for homes to earn the ENERGY STAR label. The Checklist requires visual inspection of framing areas where air barriers are commonly missed and inspection of insulation to ensure proper alignment with air barriers, thus serving as an extra check that the air and thermal barriers are continuous and complete. State, local, and regional codes, as well as product manufacturers' warranty and regional ENERGY STAR program requirements, supersede the items specified in this Checklist.

Guidance on Completing the Thermal Bypass Inspection Checklist:

1. Accredited HERS Providers and certified home energy raters shall use their experience and discretion in verifying that each Inspection Checklist item is installed per the inspection guidelines (e.g., identifying minor defects that the Provider or rater deems acceptable versus identifying major defects that undermine the intent of the Checklist item).

2. Alternative methods of meeting the Checklist requirements may be used in completing the Checklist, if the Provider deems them to be equivalent, or more stringent, than the Inspection Checklist guidelines.

3. In the event an item on the Checklist cannot be verified by the rater, the home cannot be qualified as ENERGY STAR, unless the builder assumes responsibility for verifying, under the direction and oversight of the Provider, that the item has met the requirements of the Checklist. This option is available at the discretion of the Provider or rater but may not be used to verify more than four (4) items on the Inspection Checklist. This responsibility will be formally acknowledged by the builder signing-off on the Checklist for the item(s) that they verified. The column titled "N/A" should be used when the checklist item is not present in the home or when local code requirements take precedent.

4. The Checklist may be completed for a batch of homes using a RESNET-approved sampling protocol when qualifying homes as ENERGY STAR. For example, if the approved sampling protocol requires rating one in seven homes, then the Checklist will be completed for the one home which was rated.

5. In the event that a Provider or rater finds an item that is inconsistent with the Checklist Inspection guidelines, the home cannot be qualified as ENERGY STAR until the item is corrected in a manner that meets the ENERGY STAR requirements. If correction of the item is not possible, the home cannot earn the ENERGY STAR label.

6. The Provider or rater is required to keep a hard copy record of the completed and signed Checklist. The signature of a builder employee is also required if the builder verified compliance with any item on the Checklist.

7. For purposes of this Checklist, an air barrier is defined as any solid material that blocks air flow between a conditioned space and an unconditioned space, including necessary sealing to block excessive air flow at edges and seams. Additional information on proper air sealing of thermal bypasses can be found on the Building America Web site (www.eere.energy.gov/buildings/building_america) and in the EEBA Builder's Guides (www.eeba.org). These references include guidance on identifying and sealing air barriers, as well as details on many of the items included in the Checklist.

8. As an exception for locations other than cantilevered floors and garages, an air barrier at band joist insulation is encouraged but only required if ducts are located between a finished ceiling and a sub-floor and the total duct leakage exceeds 4 cfm per 100 square feet of conditioned floor space.

ENERGY STAR Qualified Homes
Thermal Bypass Inspection Checklist

Home Address:_____ City:_____ State:_____

Thermal Bypass	Inspection Guidelines	Corrections Needed	Builder Verified	Rater Verified	N/A
1. Air Barrier and Thermal Barrier Alignment	Insulation is installed in full contact with the air barrier to provide continuous alignment of the insulation with the air barrier	☐	☐	☐	☐
2. Shower / Tub at Exterior Wall	Exterior walls have been enclosed on all six sides	☐	☐	☐	☐
	Exterior walls have been fully insulated	☐	☐	☐	☐
3. Insulated Floor Above Garage	Air barrier is installed at any exposed edges of insulation	☐	☐	☐	☐
	Insulation is installed to maintain permanent contact with the underside of the sub-floor decking	☐	☐	☐	☐
4. Walls Adjoining Unconditioned Spaces	Continuous top and bottom plates are installed with an air barrier on the unconditioned side of insulated walls, including exposed edges of insulation at joists and rafters	☐	☐	☐	☐
	Insulation is completely aligned with interior wall finish and the air barrier on the unconditioned side	☐	☐	☐	☐
5. Attic Access Panel / Drop-Down Stair	Attic access panel or stair is fully gasketed for an air-tight fit	☐	☐	☐	☐
	Attic access panel or stair is covered with insulation that is attached and fits snugly in the framed opening	☐	☐	☐	☐
6. Cantilevered Floor	Air barrier spans cantilever and any exposed edges of insulation	☐	☐	☐	☐
	Floor framing is completely filled with insulation or insulation is installed to maintain permanent contact with the sub-floor decking	☐	☐	☐	☐
7. Duct Shaft / Piping Shaft and Penetrations	Openings to unconditioned space are sealed with solid blocking and any remaining gaps are sealed with caulk or foam	☐	☐	☐	☐
8. Flue Shaft	Opening around flue is fully sealed with flashing and any remaining gaps are sealed with fire-rated caulk or sealant	☐	☐	☐	☐
	Combustion clearance between flue and combustible materials (e.g., OSB) are properly closed with UL- approved metal collars	☐	☐	☐	☐
9. Attic Eaves	Solid baffles are provided at framing bays to avoid wind washing of attic insulation	☐	☐	☐	☐
10. Dropped Ceiling / Soffit	Air barrier is fully aligned with insulated framing and any gaps are fully sealed with caulk, foam, or tape	☐	☐	☐	☐
11. Fireplace Wall	Air barrier is fully aligned with insulated framing in framed shaft behind fireplace and any gaps are fully sealed with caulk, foam, or tape	☐	☐	☐	☐
12. Staircase Framing at Exterior Wall / Attic	Air barrier is fully aligned with insulated framing and any gaps are fully sealed with caulk or foam	☐	☐	☐	☐
13. Recessed Lighting	Recessed lighting fixtures to unconditioned attics shall be airtight IC-rated (ICAT) and sealed to drywall with gasket, caulk, or foam	☐	☐	☐	☐
14. Porch Roof	Air barrier is installed at the intersection of the porch roof and exterior wall	☐	☐	☐	☐
15. Whole-House Fan Penetration at Attic	An insulated cover is provided that is gasketed or sealed to the opening from either the attic side or ceiling side of the fan	☐	☐	☐	☐
16. Common Walls Between Dwelling Units	Air barrier is installed to seal the gap between a gypsum shaft wall (i.e., common wall) and the structural framing between units in duplex and townhouse construction	☐	☐	☐	☐

Home Energy Rating Provider:_____ Builder Company:_____

Home Energy Rater Company:_____ Builder Employee Signature:_____

Home Energy Rater Signature:_____ Inspection Date:_____

Inspection Date:_____ Re-Inspection Date:_____