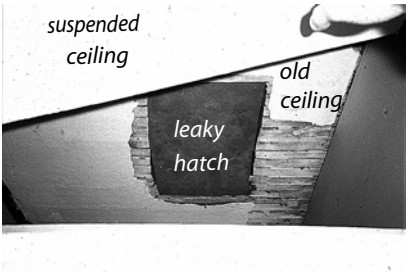
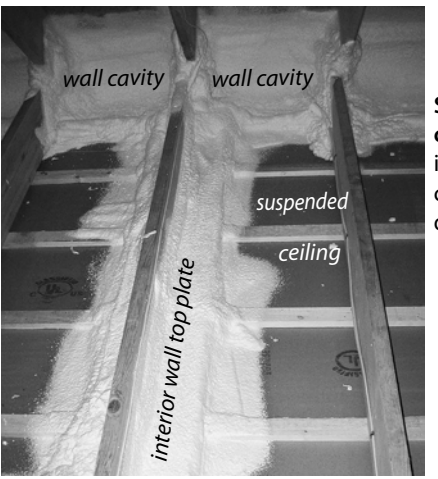


Sealing existing upper ceilings: With a non-structural suspended ceiling and a damaged plaster ceiling above, seal the plaster ceiling above if it's impractical to air seal the suspended ceiling.



Sealing structural suspended ceilings: Two-part foam air seals an interior wall top plate and the wall cavity between the ceiling and roof deck.

Sealing the roof deck: Seal the roof wall junction with spray foam. Insulate the walls above the suspended ceiling. Insulate the roof deck if there's no insulation on top of the roof deck.

4.2 Insulating Attics and Roofs

SWS Detail: 4.0101 Exterior Roof Insulation; 4.0102 Interior Roof Insulation; 4.0103 Attic Floors - Unconditioned Attics; 4.0188.2 Unconditioned Attic Ventilation

Attic and roof insulation are two of the most cost-effective energy-conservation measures.

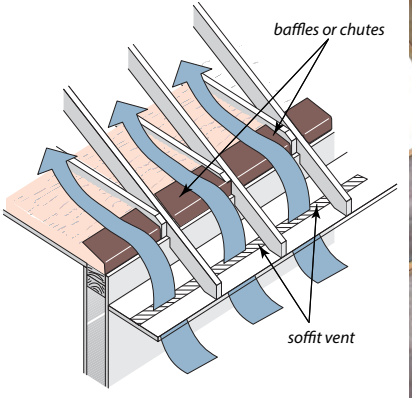
An attic is a space under a roof where a person can walk or crawl. Buildings with flat ceilings and sloping roofs are usually insulated above the ceiling and this is attic insulation.

Buildings with sloping ceilings and flat roofs are usually insulated inside the roof cavity. Roof cavities may not be accessible for walking or crawling.

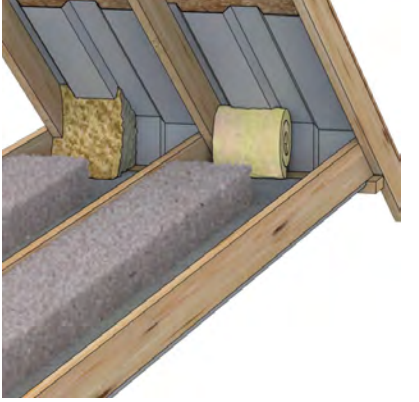
A majority of buildings have fibrous insulation in their attics or roof cavities. Fibrous insulation is the most economical insulation for attics and roof cavities. Attics and roof cavities need ventilation for drying, cooling, and to prevent ice dams. *See "Fibrous Insulation Materials" on page 105.*

General Insulation Specifications: **Important**

- ✓ Select fibrous insulation with a flame-spread/smoke developed of 25/450.
- ✓ Select foam insulation with a flame-spread/smoke-developed of 75/450.
- ✓ Separate all fibrous and foam insulation from living spaces or storage spaces with a thermal barrier or an ignition barrier as specified by applicable building code and the authority having jurisdiction (AHJ).
- ✓ Post an insulation certificate, with insulation type and number of bags installed, installed thickness, coverage area, and insulation R-value at the attic entrance. *See "Insulation Receipt or Certificate" on page 104.*



Ventilation pathways: Install baffles or chutes in every roof bay where soffit or eave venting exists.



Insulation at the eaves: Stuff fibrous insulation into the eave area to maximize R-value. Use mechanical fasteners to attach the baffles to the framing.

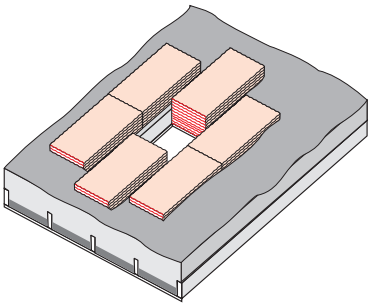
4.2.1 Preparing for Attic Insulation

SWS Detail: 4.0103 Attic Floors - Unconditioned Attics; 3.0103.1 Access Doors and Hatches

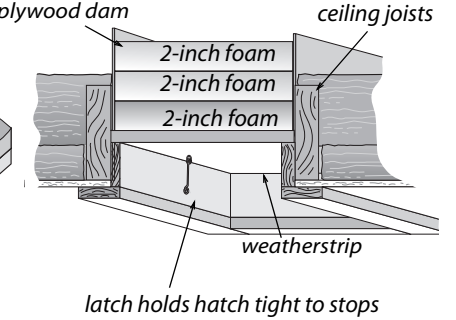
Take these preparatory steps before insulating the attic.

- ✓ Repair roof leaks, remove other moisture sources, and repair other attic-related moisture problems before insulating attic.
- ✓ Remove hazardous materials, contaminated insulation, and debris from the attic, employing hazmat professionals if necessary.
- ✓ Shield or replace unshielded high-temperature devices — non-IC rated recessed lights, chimneys, flues, vents, for example — unless they are zero clearance devices. *See "Safety Preparations for Attic Insulation" on page 139.*

- ✓ Vent all kitchen and bath fans outdoors through appropriate roof fittings or side wall fittings. *See "Fan and Duct Specifications" on page 418.*
- ✓ Seal the perimeter of the eave area, install baffles or chutes using mechanical fasteners such as staples or screws, and install insulation against the baffle to maximize the R-value at the attic's perimeter.
- ✓ Evaluate the existing attic ventilation, and make improvements if necessary.
- ✓ Evaluate attic ventilation and make necessary improvements. *See "Attic Ventilation Requirements" on page 440.*
- ✓ Before insulating the attic, seal air leaks and bypasses as described in *"Air-Sealing Attics and Roofs" on page 121*
- ✓ Verify attic air-tightness as described in *"Simple Zone Pressure Testing" on page 561*.
- ✓ Install an attic access hatch if none is present, preferably at a large gable vent on the home's exterior. An interior attic hatch should be at least 22 inches square if possible. Insulate the hatch with rigid foam board to the maximum practical R-value. The roof's height above the hatch may limit the thickness of insulation that you can attach to the back of the hatch door.
- ✓ Build an insulation dam around the attic access hatch two inches above the height of the insulation. Build the dam with rigid materials like plywood or oriented-strand board so that the dam supports the weight of a person entering or leaving the attic.
- ✓ If head space is very limited at an interior hatch, use fiberglass batts to dam loose fill insulation.



Batts form attic-insulation dam: Where head space is limited, fiberglass batts are a good choice for a low-profile insulation dam.



Insulated attic hatch: Building a dam prevents loose-fill insulation from falling down the hatchway. Foam insulation prevents the access hatch from being a thermal weakness. Install foam to achieve attic-insulation R-value of R-38. Foam can be glued together in layers.

Video: Attic Insulation Preparation— All of the steps necessary to inspect and prepare an attic for insulation.

4.2.2 Safety Preparations for Attic Insulation

SWS Detail: Section 4 Insulation; 4.0103 Attic Floors - Unconditioned Attics; 2.0301.1 Junctions/Splices Enclosed; 2.0301.2 Knob and Tube Wiring - Isolation

Before insulating the attic, remove electrical hazards and protect heat-producing fixtures, such as recessed light fixtures and chimneys, by installing shields. Without shields, the light fixture or chimney might ignite the insulation. Or, the insulation might cause a light fixture or chimney to become hot enough to ignite something else.

The shielding enclosure must often serve as the air seal for the chimney or light fixture.

Protecting Electrical Wires and Enclosures

Verify that all wire splices are enclosed in UL-listed electrical enclosures with UL listed covers. All enclosures must have UL-listed covers.

See *"Electrical Safety" on page 53* and *"Constructing Shielding for Knob-and-Tube Wiring" on page 56*.

Protecting Recessed Light Fixtures

There are three different types of recessed light fixtures and light-fan fixtures. (IC = insulation contact)

1. Non-IC-rated fixtures that must not touch insulation.
2. Type IC-rated fixtures that may be covered with fibrous insulation.
3. Type IC-AT, which are reasonably airtight (AT) and safe for contact by fibrous insulation.

Consider these options when preparing recessed light fixtures for attic insulation.

- Remove the recessed light fixture and replace it with a surface-mount fixture.
- Replace non-IC-rated fixtures with airtight IC-rated fixtures (IC-AT). You can cover these IC-AT fixtures with fibrous insulation after sealing the gap between the fixture and the surrounding materials.
- If the existing fixture is rated IC, you can seal the fixture's enclosure to the ceiling with caulk and cover the fixture with fibrous insulation. Or you can shield the fixture with an enclosure, seal the enclosure to the ceiling with foam, and then cover the enclosure with insulation.
- Shield all existing non-IC-rated fixtures with airtight enclosures that provide 3-inch clearance above the level of the retrofitted insulation. Seal the enclosure to the ceiling with

foam, and then surround the enclosure with insulation, but don't insulate over its top.

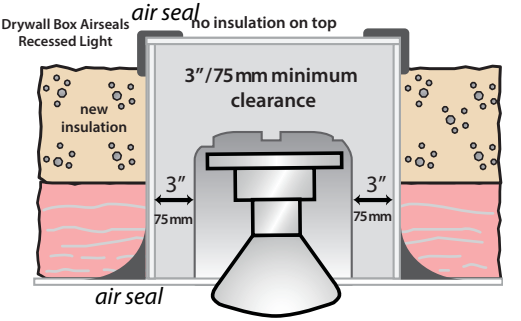
- In cavities that are sheeted on both sides, either shield non-IC recessed lights or replace them before dense-packing the cavities.

Caution: Spray foam must not cover or surround recessed light fixtures or any other heat-producing devices.

Enclosing the Non-IC Fixture that Remains

If an existing older recessed fixture that isn't labeled IC must remain in place, do these steps.

Recessed light fixtures: Cover recessed light fixtures with fire-resistant drywall or sheet-metal enclosures to reduce air leakage to allow installers to safely insulate around the box.



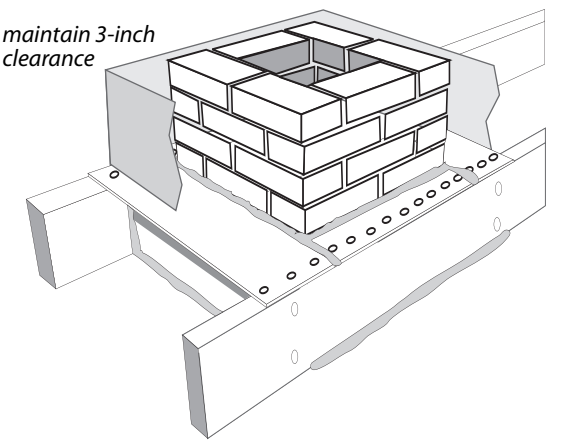
- ✓ Build a Class I fire-resistant enclosure over the non-IC-rated fixture leaving at least 3 inches clearance from insulation on all sides and to the lid of the enclosure. The top of this fire-resistant enclosure must have an R-value of 0.5 or less and extend 4 inches above the level of the new insulation.
- ✓ Notch the shields around wires.
- ✓ Seal the enclosure to the ceiling with foam or caulk.
- ✓ Don't cover the top of the enclosure with insulation.

Protecting Chimneys

The requirements for protecting chimneys from contact with insulation vary widely from one building department to

another. We know of three common approaches to insulating around chimneys, which are listed here beginning with the most restrictive.

1. air seal around the chimney using non-combustible material like 26 gauge galvanized steel. Seal the steel to the chimney with a high-temperature sealant.
2. After air sealing gaps, install non-combustible insulation shields around masonry chimneys and manufactured metal chimneys to keep insulation at least 3 inches away from these chimneys.
3. A clearance smaller than 3 inches may be allowed if the attic insulation is non-combustible or if the specifications of the vent material allow a clearance less than 3 inches. For example: type B gas vent has a typical minimum clearance of 1 inch and all-fuel chimneys have a typical minimum clearance of 2 inches.
4. If the insulation is non-combustible, such as blown fiberglass or rock wool, no clearance between insulation and manufactured or masonry chimneys is necessary if this option is permitted by local building officials.



Air-sealed chimney with metal shield: Metal flashing bridges the gap between the chimney and the framing. A metal shield keeps the insulation 3 inches away from the chimney.

Electrical Junction Boxes

Observe these specifications during attic-insulation preparation.

1. Install covers on all electrical junction boxes that lack covers.
2. Use caulk or two-part foam to air seal electrical boxes that penetrate the ceiling (for light fixtures and fans), before blowing fibrous insulation over the boxes.
3. Flag the electrical boxes so that an electrician can find the boxes for future electrical work.

Knob-and-Tube Wiring

If knob-and-tube wiring is present in the attic, consider decommissioning knob-and-tube wiring prior to installing insulation or shielding it. See *"Decommissioning Knob-and-Tube Wiring" on page 55* or *"Constructing Shielding for Knob-and-Tube Wiring" on page 56*

Isolating Fibrous Insulation from Occupants

If you install fibrous insulation in open cavities within living spaces, cover the insulation to protect occupants from breathing fibers. A thermal barrier, like drywall, may be necessary to establish or maintain an acceptable fire rating of the assembly.

4.2.3 Blowing Attic Insulation

SWS Detail: 4.0103.2 Accessible Attic - Loose Fill Installation; 4.0103.4 Accessible Attic - Loose Fill Over Existing Insulation; 4.0103.6 Accessible Attic - Dense Pack Insulation; 4.0103.8 Loose Fill to Capacity; 4.0188.2 Unconditioned Attic Ventilation

Install attic insulation to a cost-effective R-value, depending upon existing insulation level and climatic region. Air seal attics before installing attic insulation. Air sealing may require remov-

ing existing insulation and debris that obstruct air sealing. *See "Removing Insulation for Attic Air Sealing" on page 129.*

Blown insulation is usually better than batt insulation because blown insulation forms a seamless blanket. Blown fibrous attic insulation settles: cellulose settles 10% to 20% and fiberglass settles 3% to 10%. Blowing attic insulation at the highest achievable density helps minimize both settling and air circulation within the blown insulation.

Observe these specifications when blowing loose-fill attic insulation.

- ✓ Calculate how many bags of insulation are needed to achieve the R-value specified on the work order from the table on the bag's label.
- ✓ Install insulation depth rulers: one for every 300 square feet.
- ✓ Maintain a high density by moving as much insulation as possible through the hose with the available air pressure. The more the insulation is packed together in the blowing hose, the greater is the insulation's installed density.
- ✓ Fill the edges of the attic first, near the eaves or gable end, then fill the center.
- ✓ When filling a tight eaves space, push the hose out to the edge of the ceiling. Allow the insulation to fill and pack against the chute or baffle.
- ✓ Install insulation to a consistent depth. Level the insulation with a stick if necessary.
- ✓ *See "Insulation Receipt or Certificate" on page 104.*

Blown-in attic insulation: Blown insulation is more continuous than batts and produces better coverage. Insulation should be blown at a high density to minimize settling and air convection.

4.2.4 Closed-Cavity Attic Floors

SWS Detail: 4.0103.6 Accessible Attic - Dense Pack Insulation

The ceiling joists in the attic are often covered by a wood floor for storage. You may have to remove some floor boards or drill the floor sheathing to install dense-packed insulation.

Finished attic floor: Find the large air leaks underneath the flooring and seal them before insulating the space between the joists.

- ✓ Check for live knob-and-tube wiring in the cavity, and act to decommission it or protect it from burial in insulation. *See "Knob-and-Tube Wiring" on page 143.*
- ✓ Protect recessed light fixtures and other heat-producing devices in the floor cavity. *See "Protecting Recessed Light Fixtures" on page 140.*
- ✓ Thoroughly seal the floor cavity's air leaks before blowing insulation.

✓ Then dense-pack fiberglass or cellulose insulation into the spaces between the ceiling joists.

✓ Spray foam isn't approved for use as insulation in NYS weatherization.

✓ *See "Insulation Receipt or Certificate" on page 104.*

4.2.5 Insulating Closed Roof Cavities

SWS Detail: 4.0103.7 Accessible Pitched/Vaulted/Cathedralized Ceilings - Loose Fill Over; 4.0103.6 Accessible Attic - Dense Pack Insulation; 4.0102.3 Inaccessible Ceilings - Dense Pack

Many existing homes have cathedral ceilings or flat roofs that are partially filled with fibrous insulation. These roofs are often unventilated or ineffectively ventilated. The insulation job may include repair of the roof deck and installation of foam insulation over the roof deck. The IRC building code requires one of these two approaches to insulate a roof cavity.

1. Verify or provide a ventilated space of at least one inch between the roof insulation and the roof sheathing by providing soffit and ridge ventilation.
2. If no roof ventilation, then install foam roof insulation in addition to filling the cavity with insulation. Foam R-value of between R-5 and R-35 depending on climate as specified by the IRC.

Ventilated Closed Roof Cavities

To prepare for roof-cavity insulation, without existing baffles and with a ventilated space above the insulation, use this procedure.

✓ Remove either the roofing and sheathing or the interior ceiling to gain full access to the cavity.

- ✓ Remove recessed light fixtures and replace them with surface-mounted light fixtures. Carefully patch and air seal the openings.
- ✓ Install fiberglass or foam insulation to meet the IECC regional minimum roof-assembly R-value requirements.
- ✓ Install openings into the ventilation channel above the insulation totaling $^{1}/_{150}$ of the roof area. If the ceiling has a Class I or II vapor retarder, the requirement is reduced to $^{1}/_{300}$ of the roof area.
- ✓ In cold climates, install a Class I or II vapor retarder at the ceiling. One option is to paint an oil-based primer over the interior drywall or plaster.
- ✓ Repair roof leaks or install a new water-tight roof. Replace moisture-damaged sheathing as part of the roof replacement.
- ✓ Install an air-barrier ceiling (drywall) if the existing ceiling isn't an adequate air barrier, for example tongue-and-groove paneling.
- ✓ Seal other air leaks with great care, especially at the perimeter and around ridge beams.

Un-Ventilated Closed Roof Cavities: Decisions

Many homes have cathedral ceilings, vaulted ceilings, or flat roofs that are partially or completely filled with insulation and would require major building surgery to install code-compliant roof ventilation or rooftop foam board during retrofit cavity insulation.

Dense-packing the cavities prevent most convection and moist-air infiltration, which are leading causes of moisture problems in roof cavities.

Insulators have dense-packed many cathedral roof cavities with fiberglass insulation without ventilation or foam rooftop insulation. Some experts believe that this method is acceptable. How-

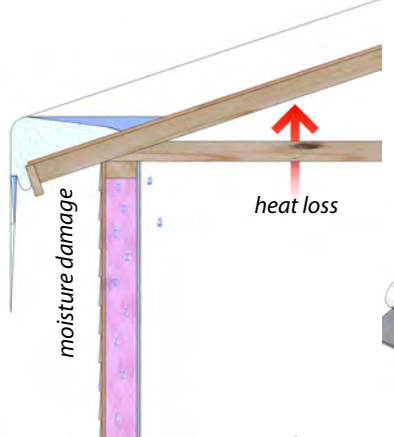
ever, this method isn't a code-compliant one and it usually requires special approval by the building department when and if the department issues a building permit.

Important Note: Dense-packing roof cavities with fiberglass insulation and without ventilation is controversial. The colder the climate, the higher the risk of problems, such as ice damming. However, dense-packing the cavities prevents most convection and moist-air infiltration, which are leading causes of moisture problems in roof cavities. Consult a knowledgeable local engineer before deciding to dense-pack a roof cavity with fiberglass. Don't dense-pack roof cavities with cellulose because of its moisture absorption and its susceptibility to moisture damage.

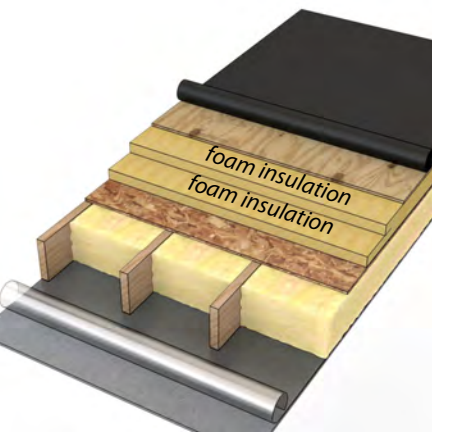
Closed Roof Cavities: Preparation

To prepare for dense-packing the roof-cavity, consider the following steps.

- ✓ Reduce or eliminate sources of moisture in the home. *See "Solutions for Moisture Problems" on page 35.*
- ✓ Verify that the ceiling has a Class I or II vapor retarder and air barrier on the interior. If not, install a vapor retarder and air barrier.
- ✓ Remove recessed light fixtures and replace them with IC-AT fixtures or surface-mounted fixtures. Carefully patch and air seal the openings if you replace the recessed fixtures with surface-mounted ones.
- ✓ Seal other ceiling air leaks, large and small, with great care.
- ✓ When replacing the roof during roof-cavity insulation, install 1-to-8 inches of rigid high-density foam insulation on top of the roof deck, as required by the IRC. If you replace the roof, dense-pack the existing roof cavity as part of the process.



Ice damming: When a roof is unventilated, the home's heat loss warms the roof deck melting snow. The water re-freezes at the eaves and causes moisture damage.



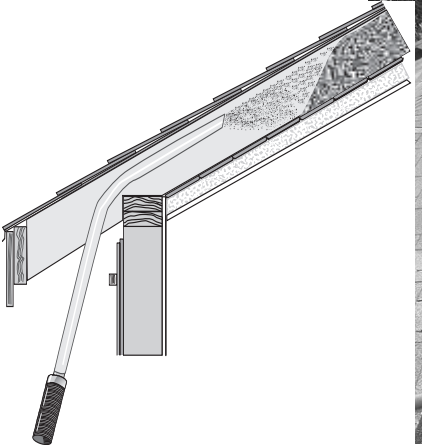
Rooftop foam insulation: The IRC code requires foam insulation over the structural sheathing when the roof is unventilated.

Blowing Insulation into the Closed Roof Cavity

Always use a fill tube when blowing closed roof cavities. Insert the tube into the cavity to within a foot of the end of the cavity. Access the cavity through the eaves, the roof ridge, the roof deck, or the ceiling. Consider one of these procedures.

- Drill holes in the roof deck after removing shingles or ridge roofing.
- Remove the soffit and blow insulation from the eaves. Drill and blow through a drywall ceiling.
- Carefully remove a tongue-and-groove ceiling plank and blow insulation into cavities through this slot.

See also "Insulating Mobile-Home Roof Cavities" on page 517.



Blowing from the eaves: Some vaulted ceilings can be blown from the eaves and/or the ridge.

Blowing from the roof deck: Technicians remove a row of shingles, drill, and blow fiberglass into this vaulted roof cavity.

4.2.6 Exterior Rooftop Foam Insulation

Only install rooftop foam insulation over dense-packed roof cavities. A ventilation space between existing insulation and the new rooftop insulation reduces the roof assembly's R-value. Roofers install exterior foam roof insulation when re-roofing low-sloping roofs after filling the cavities with fibrous insulation.

- ✓ Use high density foam board: 2 pcf for polystyrene or 3 pcf for polyisocyanurate if the roof is flat or low sloping.
- ✓ Flash all external penetrations according to the roofing manufacturer's specifications.
- ✓ Use a cool roofing material such as white rubber or white metal to limit the foam's temperature during intense summer sun and to minimize cooling costs.
- ✓ Contact a design professional to ensure that the roof drains properly after you install foam installation.

- ✓ Provide an insulation certificate, with insulation type and number of bags installed, installed thickness, coverage area, and insulation R-value at the attic entrance. *See "Insulation Receipt or Certificate" on page 104.*

Many foam manufacturers can taper expanded polystyrene foam, providing wedge-shaped pieces to create slope for drainage. *See "Expanded Polystyrene (EPS) Foam Board" on page 114.* *See "Polyisocyanurate (PIC) Foam Board" on page 115.*

4.2.7 Installing Fiberglass Batts in Attics

SWS Detail: 4.0103.3 Accessible Attic - Batt Insulation Over Existing Insulation; 4.0103.1 Accessible Attic - Batt Installation

Follow these specifications when installing fiberglass batts in an attic. Fiberglass batts aren't the best insulation for attics because of all their seams.

- ✓ When layering batts, install new layers at right angles to underlying layers if the top of the existing batts are level with or above the ceiling joist or truss bottom chord.
- ✓ Install un-faced fiberglass insulation whenever possible.
- ✓ If you must install faced batts, install them with the facing toward the heated space. Never install faced insulation over existing insulation.
- ✓ Cut batts carefully to ensure a tight fit against the ceiling joists and other framing.

4.2.8 Roof Deck Underside /Cathedralized Attics

SWS Details: 4.0103.6 Accessible Attic - Dense Pack Insulation

A cathedralized attic has insulation attached to the bottom of the roof deck and is also called a hot roof if it isn't ventilated. Choose to insulate the bottom of the roof deck instead of insulating the ceiling when the building owner wants to use the attic

or to enclose an attic air handler and leaky ducts within the building's thermal boundary.

Avoiding Moisture Problems

Insulating the underside of the roof deck presents a risk of moisture problems in the structural sheathing from roof leaks or condensation.

To avoid moisture condensation within the insulation or within the structural sheathing during cold weather.

- For protection against moisture, install a low-high roof-vent chute to provide ventilating air directly to the roof deck above the insulation.
- If the insulation job requires a permit, see the IRC and the AHJ for guidance on roof insulation, to prevent condensation and optimize the assembly's thermal resistance.

Provide the client an insulation certificate, with insulation type and number of bags installed, installed thickness, coverage area, and insulation R-value. *See "Insulation Receipt or Certificate" on page 104.*

Fiberglass Roof-Deck Insulation

Insulating the rafter space with an air-permeable insulation requires an air barrier, vapor retarder, and Class I (or A) fire-rated material at the roof cavity's lower boundary. Consider these two alternatives.

1. Install the rafter's depth of fiberglass batts and then a material or combination of materials that constitutes an air barrier, vapor retarder, and Class I fire barrier.
2. Blow dense-packed fiberglass insulation between the roof deck using a rigid or flexible insulation restraint.

4.2.9 Vaulted Attics

SWS Detail: 4.0102.3 Inaccessible Ceilings - Dense Pack; 4.0103.1 Accessible Attic - Batt Installation; 4.0103.2 Accessible Attic - Loose Fill Installation; 4.0103.3 Accessible Attic - Batt Insulation Over Existing Insulation; 4.0103.8 Loose Fill to Capacity

A vaulted attic is framed with a special truss that creates a sloping roof and a sloping ceiling. Access to the cavity varies from difficult to impossible.

Install insulation from either the top of the roof deck or through the ceiling. Insulation, installed at the ceiling, must have some stability to prevent gravity from pulling it downhill or wind from piling it, leaving some areas under-insulated. Damp spray fibrous insulation may serve this purpose.

Consider the following options to insulating uninsulated or partially insulated vaulted attics.

1. Insulate the ceiling with fiberglass batts. Install the batts parallel to the framing if the top of existing insulation is below the framing. Install the batts perpendicular to the framing if the top of the existing insulation is above the framing.
2. Insulate the bottom of the roof deck, as described previously for a cathedralized attic, if you remove the ceiling.
3. Insulate the ceiling with sprayed foam, damp-spray fibrous insulation, or batts from the roof with the roof sheathing removed.
4. Fill the cavity to approximately 100% with loosely blown fiberglass from indoors or through the roof. Maintain the existing vents and hope that settling or under-filling provides room for ventilation.
5. Preserve or install openings into the ventilation space above the insulation totaling $^{1}/_{150}$ of the roof area. If the

ceiling has a vapor retarder the requirement is $^{1}/_{300}$ of the roof area.

6. Post a dated receipt as described in *"Insulation Receipt or Certificate" on page 104*.

4.2.10 Finished Knee-Wall Attics

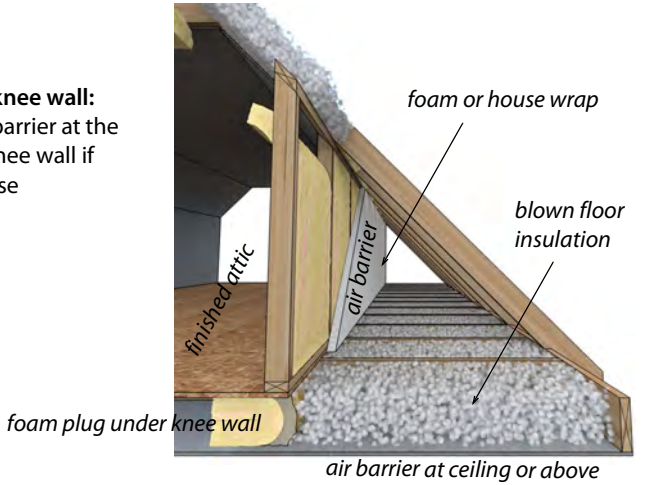
SWS Detail: 4.0104 Attic Knee Walls; 4.0104.1 Knee Wall - Dense Packing; 4.0104.2 Knee Wall - Batt Insulation; 4.0104.3 Knee Wall - Existing Batt Insulation Repair; 4.0104.4 Knee Wall - Rigid Insulation

The finished attics of story-and-a-half homes or Cape-Cod homes require special procedures when installing insulation. They often include five separate sections that require different air-sealing and insulating methods. Seal air leaks in all these assemblies before insulating them. If necessary, remove the planking and insulation from the side-attic floor to expose the air leaks.

Use these specifications to prepare for insulating finished attics.

- ✓ Seal large air leaks between conditioned and non-conditioned spaces.
- ✓ Inspect the structure to confirm that it has the strength to support the weight of the insulation.
- ✓ Insulate access hatches to the approximate R-value of the assembly through which it is located.
- ✓ Select fibrous insulation with a flame-spread/smoke developed or 25/450. Select foam insulation with a flame-spread/smoke developed or 75/450.

Attic floor and knee wall: Establish an air barrier at the attic floor and knee wall if you insulate these assemblies.



Attic Floor

There are a number of options for insulating the attic floor of a finished attic with knee walls. By attic floor, we mean the ceiling of the living space below with its ceiling joists and any floor sheeting installed over the joists for a storage platform.

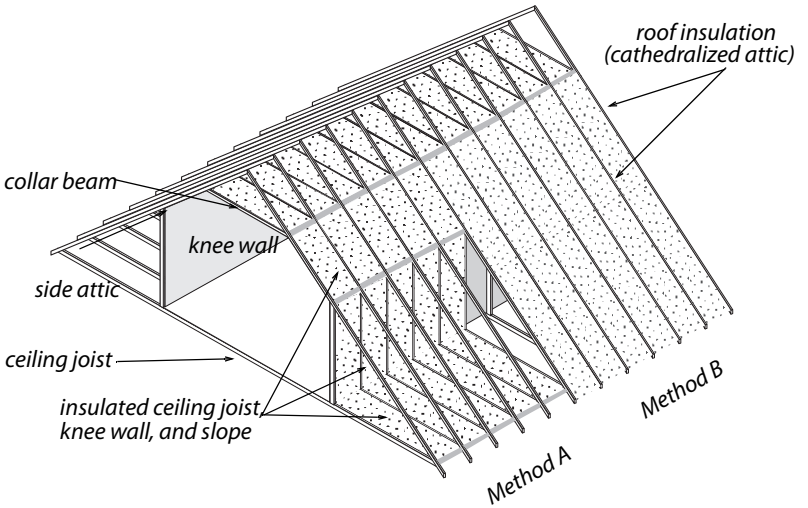
Choose among these options.

- Install blown fibrous insulation over the ceiling, which should be an air barrier.
- Install blown fibrous insulation over existing insulation.
- Install fiberglass batts over the ceiling, which should be an air barrier.
- Install fiberglass batts over the existing insulation.

Whichever of these options that you choose, do the necessary air sealing to the attic floor before installing insulation. Also observe the preparations and safety precautions discussed in *"Preparing for Attic Insulation" on page 137* and *"Safety Preparations for Attic Insulation" on page 139*.

Collar-Beam Attic

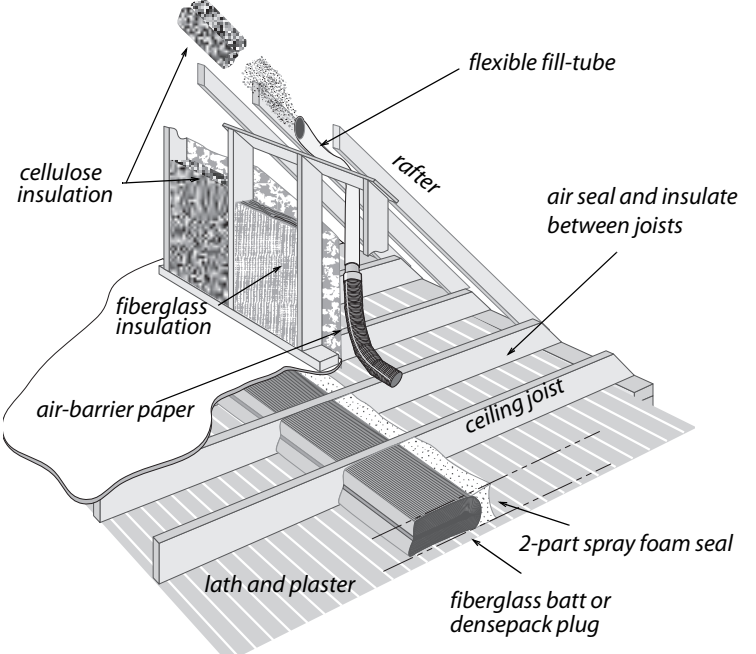
Insulate this type of half-story attic as described in *"Blowing Attic Insulation" on page 143*.



Finished attic: This illustration depicts two approaches to insulating a finished attic. Either A) insulate the knee wall and side attic floor, or B) insulate the roof deck.

Sloped Roof

Insulate sloped roof with densepack fiberglass insulation. Install plugs of fiberglass batt, or other vapor permeable material, at the ends of this cavity to contain the blown insulation while allowing it to breathe.



Finished attic best practices: Air sealing and insulation combine to dramatically reduce heat transmission and air leakage in homes with finished attics.

4.2.11 Knee-Wall Insulation

SWS Detail: 4.0104 Attic Knee Walls; 4.0104.1 Knee Wall - Dense Packing; 4.0104.2 Knee Wall - Batt Insulation; 4.0104.3 Knee Wall - Existing Batt Insulation Repair; 4.0104.4 Knee Wall - Rigid Insulation

Insulate knee walls using any of these methods.

- Install un-faced fiberglass batts and cover the insulation with house wrap or rigid foam on the attic side. Prefer R-13 or R-15, 3.5-inch fiberglass batts.
- Install the house wrap, rigid foam, or another insulation restrainer first and reinforce it with wood lath. Then blow dense-packed fibrous insulation into the cavity through the

insulation restrainer and patch the insulation restrainer with an airtight patch. (Cellulose: 3.5 pcf; fiberglass 2.2 pcf)

- For knee walls without framing, mechanically fasten rigid insulation to the wall's surface and seal the seams.
- Post a dated receipt as described in *"Insulation Receipt or Certificate" on page 104*.

Preparation for Knee-Wall Insulation

Make whatever repairs and seal air leaks before installing the knee-wall insulation.

- ✓ Seal all large air leaks with structural materials.
- ✓ Seal all joints, penetrations, and other potential air leaks in the cavities with caulk or foam.
- ✓ Before installing caulk or spray-foam sealant, clean dust and any other material that might interfere with the spray foam's adhesion.

Air Sealing and Insulating under the Knee Wall

To seal and insulate under the knee wall, create an airtight and structurally strong seal in the joist spaces under the knee wall. Consider these options.

- Install sealed wood blocking between the floor joists covered with spray-foam sealant.
- Insert 2-inch-thick foam sheets, and foam their perimeters with one-part or two-part spray-foam sealant.
- Insert a fiberglass batt into the cavity and foam its face with an inch of two-part closed-cell spray-foam sealant.

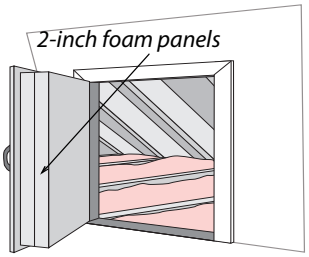
4.2.12 Access Doors in Vertical Walls

SWS Detail: 3.0103.1 Access Doors and Hatches

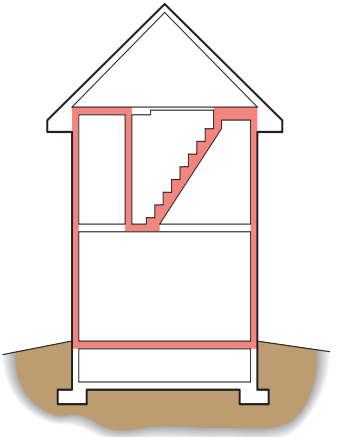
For knee-wall access doors, observe the following.

√ Insulate knee-wall access hatches and collar-beam access hatch to the approximate R-value of the assembly that surrounds them.

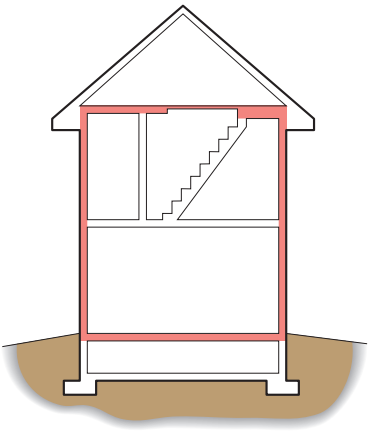
√ Weatherstrip the hatch and install a latch or other method to hold the access door closed against the weatherstrip.



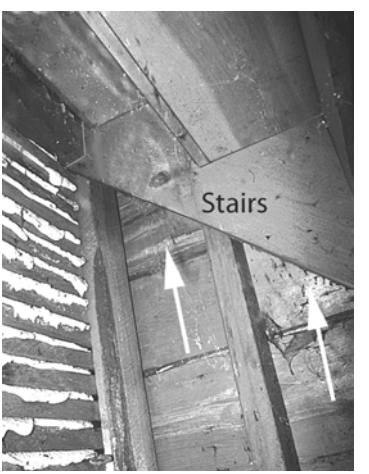
Insulated access door in knee wall: Achieve an R-value as close to the wall as practical. Weatherstrip the door and install some type of latch.



Insulating and sealing attic stair walls, doors, and stairs: Insulating and air sealing these is one way of establishing the thermal boundary.



Insulating and weatherstripping the attic hatch: Air sealing around the hatch and insulating the hatch is an alternative method.



4.2.13 Walk-Up Stairways and Doors

SWS Detail: 3.0103.1 Access Doors and Hatches; 4.0201 Accessible Walls; 3.0202.1 Door Air Sealing

Think carefully about how to install a continuous insulation blanket and air barrier around or over the top of an attic stair-

way. If you enter the attic by a stairwell and standard vertical door, use these instructions.

- ✓ Blow dense-pack fibrous insulation into walls of the stairwell.
- ✓ Install a threshold or door sweep, and weatherstrip the door.
- ✓ Insulate or replace the door with an insulated door if cost effective.
- ✓ Blow dense-packed insulation into the sloping cavity beneath the stair treads and risers.

You can also establish the thermal boundary at the ceiling level, but this requires a horizontal hatch at the top of the stairs.

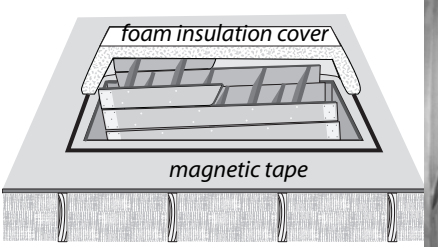
When planning to insulate stairwells, investigate barriers such as fire blocking that might prevent insulation from filling cavities you want to fill. Also consider what passageways may lead to areas you don't want to fill, such as closets.

4.2.14 Insulating & Sealing Pull-Down Attic Stairways

SWS Detail: 3.0103.1 Access Doors and Hatches

Pull-down attic stairways are sometimes installed above the access hatch. Building a foam-insulated box or buying a manufactured stair-and-hatchway cover are good solutions to insulating and sealing this weak point in the ceiling insulation. Install weatherstripping around the insulated box.

Educate the client on the purpose and operation of stair-and-hatchway cover, and ask them to carefully replace it when they access the attic.



Manufactured pull-down-stair covers: Manufacturers provide insulated stair covers for use with walkable attic floors or with dams to be surrounded by fibrous insulation.

4.2.15 Parapet Walls

Parapet walls are a continuation of exterior walls that rise above the roof. Parapet walls are often an air-leakage and thermal bridging problem because the insulation and air barrier aren't continuous between the exterior wall and roof.

Inspect the parapet area from both indoors and outdoors and decide how to connect the wall insulation and air barrier with the roof insulation and air barrier. Consider these two alternatives.

1. Install an air barrier and dense-pack the wall cavity of the parapet.
2. Install spray-foam sealant to the parapet to connect the air barrier of the exterior wall with attic or roof air barrier.

4.2.16 Skylights

Skylights are places where the insulation and air barrier may not be continuous. Inspect the insulation and air barrier of the skylight shaft. Install insulation and air seals as necessary to make a continuous insulated and air-sealed assembly as shown in the illustration.