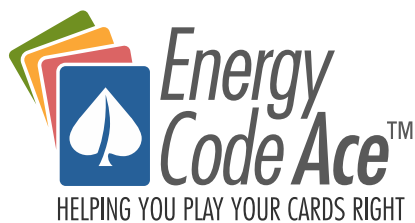




Residential





This stamp shows which installation practices are required by code. The code reference is included for more detail.



This stamp shows which installation practices are Best Practices, above and beyond code requirements.



This stamp shows items that are purely informational. These are intended to help broaden your understanding of the topic.

!! SUBMIT PICTURES !!

Thank you for using the Installation Ace, and providing feedback to keep this tool up to date, and as useful as possible.

If you have pictures of correct installations you've taken in the field that you think would be useful to include in this tool, please send them to installation.feedback@energycodeace.com

Please include a short description of what's shown in the photo. We will give your department, organization or firm photo credit.

Thanks!

The California Statewide Codes & Standards Program offers free training, tools and resources designed to improve compliance with the state's energy code. The program aims to advance the adoption and effective implementation of energy efficiency measures and building practices to lock in long-term energy savings.

The program is funded by California utility customers under the auspices of the California Public Utilities Commission and implemented by Pacific Gas and Electric Company, San Diego Gas and Electric, Southern California Edison and Southern California Gas Company in support of the California Energy Commission.

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Instructions for Use

The Installation Ace is intended to be used as a field guide, that can be updated, added to and replaced easily. For best use, print pages double-sided, slip into plastic sheet protectors and add to a 3-ring binder.

Each section of the guide is color-coded for easy identification, and a separate file of printable matching tab inserts is also available. A printable binder spine label is also provided in a separate file.

To find or suggest updates or to print additional field guides, please visit www.energycodeace.com or email us at installation.feedback@energycodeace.com

EQUIPMENT



Equipment Efficiencies

Space-conditioning equipment may be installed only if the manufacturer has certified to the Commission that the equipment complies with all the applicable requirements, including efficiencies. Check the CF-1R for the minimum efficiencies for each project. Check the CF-2R for certification of efficiencies. Use AHRI information, not the yellow EnergyGuide label.

Code Reference: 2013 Title 24, Part 6 Standards §110.2(a)



Equipment Sizing – Load Calculations

Building heating and cooling loads shall be determined using a method based on: The ASHRAE Handbook, the SMACNA Residential Comfort System Installation Standards Manual, or ACCA Manual J.

NOTE: Under-sizing of heating system is not allowed by the CBC. Over-sizing of the heating system and under- or over-sizing of the cooling system should be documented and explained by the designer.

Code Reference: 2013 Title 24, Part 6 Standards §150.0(h)1]



Fireplaces

REQUIRED FEATURES

If a masonry or factory-built fireplace is installed, it shall have the following:

- Closeable metal or glass doors covering the entire opening
- A outside air intake at least 6 square inches in area and equipped with a readily accessible, operable, and tight-fitting damper or combustion-air control device, unless the fireplace will be installed over concrete slab flooring and not on an exterior wall.
- A flue damper with a readily accessible control.



PROHIBITED FEATURES

Masonry or factory-built fireplaces:

- Continuous burning pilot lights are prohibited.
- The use of indoor air for cooling a firebox jacket, when that indoor air is vented to the outside of the building is prohibited.

Code Reference: 2013 Title 24, Part 6 Standards §150.0(e)

R-H-E1: ©Sierra Building Science, Inc.

R-H-E2: ©Sierra Building Science, Inc.

R-H-E3: © Architectural Energy Corporation

R-H-E4: PLACEHOLDER, Need replacement image

EQUIPMENT



Thermostats

Heating systems shall be equipped with thermostats that have a clock mechanism with set points for at least four periods within 24 hours.

EXCEPTIONS: Gravity gas wall heaters, room heaters, non-central electric heaters, fireplaces or decorative gas appliances, wood stoves, room air conditioners, etc.

Code Reference: 2013 Title 24, Part 6 Standards §150.0(i), 110.2(c)

Heat pumps with supplementary electric resistance heaters shall have controls:

1. That prevent supplementary heater operation when the heating load can be met by the heat pump alone; and
2. In which the cut-on temperature for compression heating is higher than the cut-on temperature for supplementary heating, and the cut-off temperature for compression heating is higher than the cut-off temperature for supplementary heating.

Code Reference: 2013 Title 24, Part 6 Standards §150.0(i), 110.2(c)



Condenser vs. Dryer Vent Location

Installed air conditioner and heat pump outdoor condensing units shall have a clearance of at least five (5) feet (1.5 meters) from the outlet of any dryer vent.

Code Reference: 2013 Title 24, Part 6 Standards §150.0(h)3



Central Furnace – Temperature Split

Central forced-air heating furnace installations shall be configured to operate in conformance with the furnace manufacturer's maximum inlet-to-outlet temperature rise specifications. See CF-2R for verification.

Code Reference: 2013 Title 24, Part 6 Standards §150.0(h)4

R-H-E5: © Architectural Energy Corporation

R-H-E6: © California Energy Commission

R-H-E7: ©Sierra Building Science, Inc.

DUCTS - CONSTRUCTION



Duct Construction Standards

All air-distribution system ducts and plenums shall be installed, sealed and insulated to meet the requirements of the CMC Sections 601.0, 602.0, 603.0, 604.0, 605.0 and ANSI/SMACNA-006-2006 HVAC Duct Construction Standards Metal and Flexible 3rd Edition.

Code Reference: 2013 Title 24, Part 6 Standards §150.0(m)1



UL Ratings

Flexible ducts for field-fabricated duct systems shall comply with UL 181.

All pressure-sensitive tapes, mastics, aerosol sealants, or other closure systems used for installing field fabricated duct systems shall meet the applicable requirements of UL 181, UL 181A, and UL 181B.

Code Reference: 2013 Title 24, Part 6 Standards §150.0(m)3A



“Old Fashioned Duct Tape” Prohibited

Joints and seams of duct systems and their components shall not be sealed with cloth back rubber adhesive duct tapes (“old fashioned duct tape”) unless such tape is used in combination with mastic and drawbands .

Code Reference: 2013 Title 24, Part 6 Standards §150.0(m)3D

R-H-DC1: PLACEHOLDER, Need replacement image

R-H-DC2: PLACEHOLDER, Need replacement image

R-H-DC3: © Sierra Building Science, Inc.

DUCTS - CONSTRUCTION



Mechanically Fasten Duct

Connections of metal ducts and the inner core of flexible ducts shall be mechanically fastened. Use sheet metal screws for rigid duct seams and compression straps for flex duct.

Code Reference: 2013 Title 24, Part 6 Standards §150.0(m)1



Seal with Mastic

Apply mastic to all connections and joints to air seal duct work. Mastic is the consistency of peanut butter and can be applied with a paintbrush or with a putty knife. It should be layered about the thickness of a nickel, and should be applied over mesh. Avoid using tape beneath mastic.



Seal Duct Boot to Subfloor with Mastic

Duct boots can be completely sealed with mesh and mastic. Sealing is required around register boots if air could escape to unconditioned space. Foil tapes, butyl backed tapes or caulks can also be used.



Reinforce Gaps and Seams with Mesh

Joints and seams shall be sealed with mastic, tape, or other duct-closure system that meets the applicable requirements of UL 181, UL 181A or UL 181B. If mastic or tape is used to seal openings greater than 1/4 inch, the combination of mastic and either mesh or tape shall be used.

Code Reference: 2013 Title 24, Part 6 Standards §150.0(m)1

DUCTS - CONSTRUCTION



Un-ducted Building Cavities Not Allowed

Building cavities, support platforms for air handlers, and plenums constructed with materials other than sealed sheet metal, duct board or flexible duct shall not be used for conveying conditioned air.

Code Reference: 2013 Title 24, Part 6 Standards §150.0(m)1



Duct Testing

When space conditioning systems utilize forced air duct systems to supply conditioned air to an occupiable space, the ducts shall be sealed, as confirmed through field verification and diagnostic testing (by HERS Rater).

Code Reference: 2013 Title 24, Part 6 Standards §150.0(m)11

NOTE: This mandatory requirement is new for the 2013 code.

Previously, duct testing was a prescriptive requirement and could be traded off by using the performance approach.



Backdraft Dampers

All fan systems, regardless of volumetric capacity, that exchange air between the building conditioned space and the outside of the building shall be provided with backdraft or automatic dampers to prevent unintended air leakage through the fan system when the fan system is not operating. This includes bathroom exhaust fans, kitchen hoods, and dryer vents.

Code Reference: 2013 Title 24, Part 6 Standards §150.0(m)7

DUCTS – CONSTRUCTION

Notes:

DUCTS - INSULATION



Unconditioned Spaces

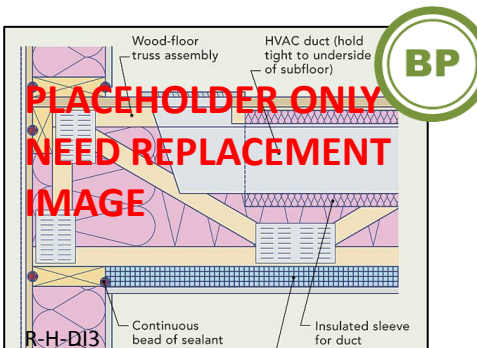
Portions of supply-air and return-air ducts and plenums of a space heating or cooling system shall either be insulated to a minimum installed level of R-6.0 (or any higher level required by CF-1R) or be enclosed entirely in directly conditioned space as confirmed through field verification and diagnostic testing (by a HERS Rater).

Code Reference: 2013 Title 24, Part 6 Standards §150.0(m)1



Details

First seal and then insulate the entire duct boot. Make sure that connections at takeoffs from main supply or return trunk lines are sealed, then insulated.



Exterior Walls, Floor Above Garage, Cantilevers

In these building cavities, locate the duct as close as possible to conditioned space. Insulate the duct and fill space between duct and exterior air barrier with insulation.



R-value Labeled on Flex Duct

Insulated flexible duct products installed in homes shall include labels, in maximum intervals of 3 feet, showing the thermal performance R-value for the duct insulation itself.

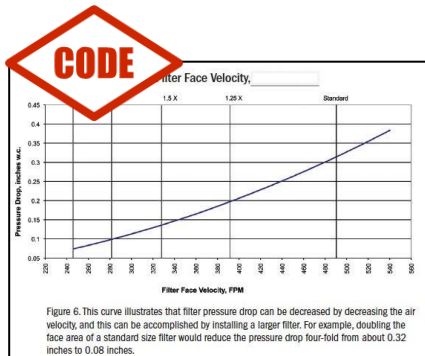
Code Reference: 2013 Title 24, Part 6 Standards §150.0(m)6

HVAC

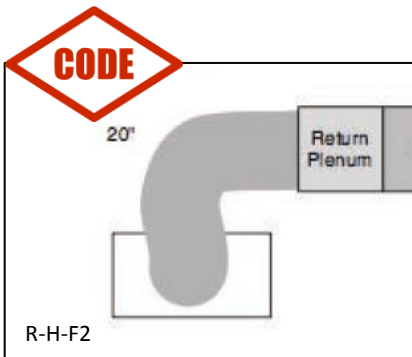
DUCTS – INSULATION

Notes:

FILTRATION



R-H-F1



R-H-F2



R-H-F3

Design Ducts to Proper Filter Specifications

Mechanical systems that supply air to an occupiable space through ductwork exceeding 10 ft in length and through a thermal conditioning component shall:

- be designed to ensure that all recirculated air and all outdoor air is filtered before passing through the system's thermal conditioning components.
- be designed to accommodate the appropriate clean-filter pressure drop
- have air filter devices located and installed in such a manner as to allow access and regular service by the system owner.
- have air filter device locations labeled to disclose the applicable design airflow rate and the maximum allowable clean-filter pressure drop.

Code Reference: 2013 Title 24, Part 6 Standards §150.0(m)12Ai

Install Proper Filter

Mechanical systems that supply air to an occupiable space through ductwork exceeding 10 ft (3m) in length and through a thermal conditioning component, except evaporative coolers, shall be provided with air filter media :

- having a designated efficiency equal to or greater than MERV 6.
- that conforms to the maximum allowable clean-filter pressure drop used in the system design.
- that has been labeled by the manufacturer to disclose the efficiency and pressure drop ratings that demonstrate conformance with these requirements.

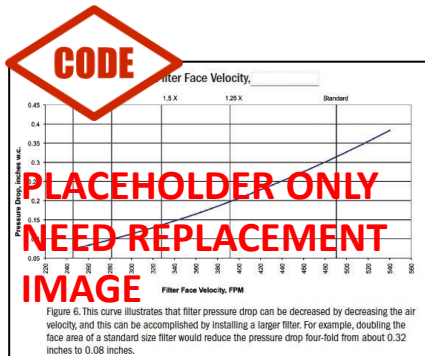
Code Reference: 2013 Title 24, Part 6 Standards §150.0(m)12B, C, D

HVAC

FILTRATION

Notes:

AIR FLOW



R-H-AF1



R-H-AF2



R-H-AF3

Hole to Measure Static Pressure

Space conditioning systems that utilize forced air ducts to supply cooling to an occupiable space shall have a hole for the placement of a static pressure probe (HSPP) in the supply plenum downstream of the air conditioning evaporator coil.

Code Reference: 2013 Title 24, Part 6 Standards §150.0(m)13A

Minimum CFM per Ton at Max Watts per CFM

Space conditioning systems that utilize forced air ducts to supply cooling to an occupiable space shall demonstrate, in every control mode, airflow greater than 350 CFM per ton of nominal cooling capacity through the return grilles, and an air-handling unit fan efficacy less than or equal to 0.58 W/CFM as confirmed by field verification and diagnostic testing. (See alternative, below.)

Code Reference: 2013 Title 24, Part 6 Standards §150.0(m)13B

Alternative to Air Flow and Fan Watt Test

Standard ducted systems (systems without zoning dampers) may comply by default return duct and grill sizing that meets the applicable requirements in TABLE 150.0-C or TABLE 150.0-D as confirmed by field verification and diagnostic. The design clean-filter pressure drop requirements for the system air filter device(s) shall conform to the requirements given in TABLE 150.0-C and 150.0-D.

Code Reference: 2013 Title 24, Part 6 Standards §150.0(m)13B

R-H-AF1: PLACEHOLDER, Need replacement image

R-H-AF2: © Sierra Building Science, Inc.

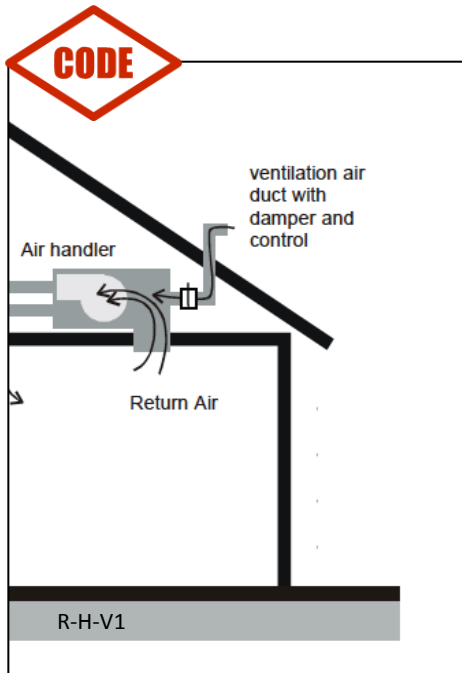
R-H-AF3: © Architectural Energy Corporation

HVAC

AIR FLOW

Notes:

VENTILATION



Whole Building Ventilation

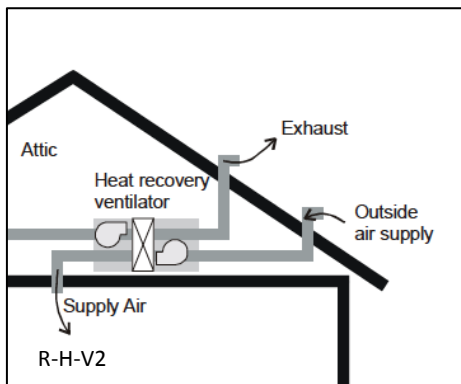
All dwelling units shall meet the requirements of ASHRAE Standard 62.2, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings.

Window operation is not a permissible method of providing the Whole-Building Ventilation airflow.

Continuous operation of central forced air system air handlers used in central fan integrated ventilation systems is not a permissible method of providing the whole-building ventilation airflow.

The Whole-Building Ventilation airflow shall be confirmed through field verification and diagnostic testing (by a HERS Rater).

Code Reference: 2013 Title 24, Part 6 Standards §150.0(o)



HVAC

VENTILATION

Notes:

Envelope

GENERAL



Mandatory Sealing

All joints, penetrations and other openings in the building envelope that are potential sources of air leakage shall be caulked, gasketed, weather stripped, or otherwise sealed to limit air infiltration and exfiltration.

This includes gaps between register boots and surrounding material (drywall, subfloor, etc.), around plumbing penetrations and electrical penetrations, between the floor (slab) and bottom plate and between the sheetrock and the top plate.

Code Reference: 2013 Title 24, Part 6 Standards §110.7



Quality Installation of Insulation (QII)

There is a special compliance credit available for installing insulation to a much higher than standard level of quality. This will be indicated on the CF-1R. When taken, many of the best practices described in this document become mandatory. These will all be independently verified by a HERS rater and documented on CF-3R forms.



Recessed Can Lights

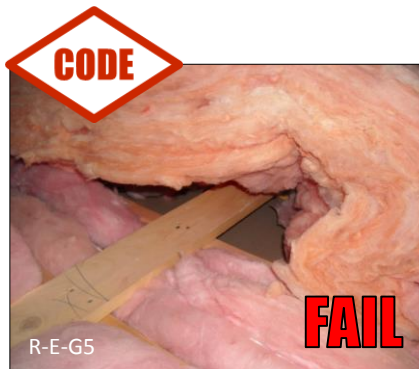
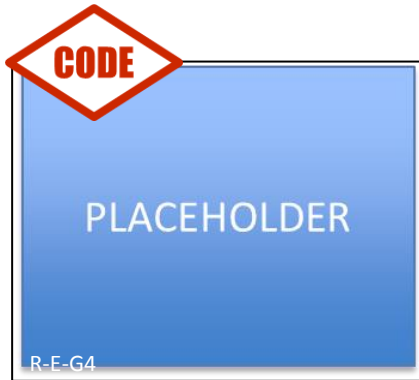
Luminaires recessed into ceilings ("can lights") shall meet all of the following requirements:

- Be listed for zero clearance insulation contact (IC) by Underwriters Laboratories or other nationally recognized testing/rating laboratory; and
- Have a label that certifies that the luminaire is airtight (AT). (Exhaust fan-light housings shall not be required to be certified airtight.)
- Be sealed with a gasket or caulk between the luminaire housing and ceiling.

Code Reference: 2013 Title 24, Part 6 Standards §150.0(k)8

Envelope

GENERAL



Insulation Products - Certification

Any thermal insulation product shall be certified by Department of Consumer Affairs, Bureau of Home Furnishing and Thermal Insulation that the insulation's conductive thermal performance is approved. Refer to the CF-2R-ENV-XXX for product name and certification by the installer.

Code Reference: 2013 Title 24, Part 6 Standards §110.8(a)

Ceiling Insulation in Contact with Air Barrier

Insulation installed to limit heat loss and gain through the top of conditioned spaces shall be installed in direct contact with a continuous roof or ceiling air barrier. (Insulation shall not be placed on top of a suspended ceiling with removable ceiling panels (T-bar ceilings) .

Code Reference: 2013 Title 24, Part 6 Standards §110.8(e)

Wall Insulation in Contact with Air Barrier

Insulation installed to limit heat loss and gain through walls should be in direct contact with an air barrier on both sides of the insulation and all around the edges. This prevent thermal loops within the wall cavity.

Roofing Products Are Part of the Envelope

A roofing product's thermal emittance and aged solar reflectance shall be certified and labeled or shall use default value:

A. For asphalt shingles: 0.08/0.75

B. For all other roofing products: 0.10/0.75. Check the CF-1R for required values to be installed.

Code Reference: 2013 Title 24, Part 6 Standards §110.8(i)

R-E-G4: PLACEHOLDER, Need replacement image

R-E-G5: © Sierra Building Science, Inc.

R-E-G6: PLACEHOLDER, Need replacement image

R-E-G7: PLACEHOLDER, Need replacement image

Envelope

INSULATION – BATT

FYI



Pressure or Friction Fit

Insulation should be cut to fit snugly against studs on all sides, and should completely fill the cavity with no air gaps. Cut lengths of insulation should be butted together with no gaps. Friction fit batts are slightly wider than the stud cavity and so held in place by friction, not stapling. Friction fit batts should not be used in walls over 8 feet tall.

BP



Face & Inset Stapling

Push batt into stud cavity so that it makes contact with framing, especially at corners and sides. Then pull batt forward to full loft so that it fills the whole cavity.

(1) Face Stapling: Paper flanges are stapled to stud face. This method of installation is best practice and avoids loss of performance from air gap channels created with inset stapling.



(2) Inset Stapling: Insulation should be compressed only as far as is required to staple the flange to the inside of the stud. Extra compression will result in loss of performance therefore **this method is NOT RECOMMENDED.**

BP



Obstructions

Junction boxes that back to outside walls should have insulation cut to fit snugly around them, and behind them, to fill the cavity. Similarly, insulation should be cut to fit around ceiling exhaust fans. All holes in junction boxes whether there are wires entering the boxes there or not should be air sealed.

Envelope

INSULATION – BATT



Split , Don't Stuff

Take the time to split insulation to fit snugly around electrical wires and plumbing. Do not stuff the batt in front of or behind the wire; this compresses the insulation and leaves an air gap.



Proper Support

Wire struts or laced wire can be used to support fiberglass to keep it in touch with the floor above. Wire should not compress the insulation but also should not let it sag. Netting or mesh can also be used.

Notes:

Envelope

INSULATION – BLOWN

FYI



Fill the Crevices

Blown attic insulation fills in spaces between framing and covers bottom chords for an even and full installation. In walls, the blown insulation surrounds wires and piping. Always seal all penetrations to unconditioned space including attic, bottom plate, and exterior, before insulating. Be sure to install eave vent baffles if eave vents are present to prevent wind washing.

FYI



Dry Blown

Dry blown cellulose can be blown into walls through holes in netting fixed to the studs. The insulation should be packed firmly but not bulging. Rolling the packed insulation helps evenly distribute the cellulose in the stud cavity and leaves it flat ready for drywall installation.

FYI



Damp Blown

Damp blown cellulose is typically used in new construction or major renovations and sticks to the framing to fill the cavity. It is trimmed so that it aligns with the face of the studs.

The wall should not be covered until the insulation is totally dry (follow manufacturer instructions for approximate dry times).

FYI



Spray

Open-cell foam sprayed into walls fully fills the stud cavity with no voids. Properly installed foam will not shrink away from framing members. Pay attention to the rim joist area, where blocking and other obstructions, in addition to nozzles used to spray the foam, make it hard to cover the lower edge of that space. Closed cell foam has a higher R value per inch and adds shear strength to the building. Thickness of more than 1.5 inches of closed-cell foam can act as an air and moisture barrier.

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R-E-IBL2: © Baechler, Gilbride, Hefty, Cole, Love

R-E-IBL3: © Architectural Energy Corporation

R-E-IBL4: © Baechler, Gilbride, Hefty, Cole, Love

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INSULATION – BLOWN

Notes:

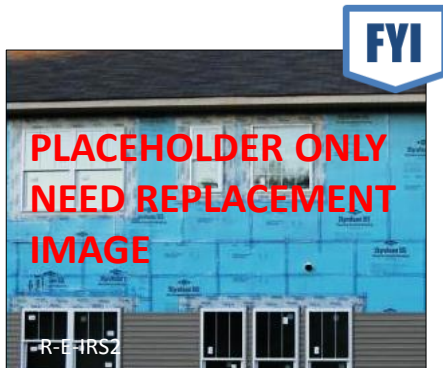
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INSULATION – RIGID/ SIPs



Rigid

Install rigid foam on the exterior of the home to cover the studs and provide continuous insulation. This approach requires greater attention to finish details for the windows, trim, electrical boxes and gas meters. Extend insulating sheathing up the eave to meet the ventilation air space.



SIPs

Structural Insulated Panels sandwich rigid foam insulation between layers of sheathing. Air seal electrical wiring channels in exterior walls. Seal connections between panels, sill and top plates when assembling to reduce water vapor and air transmission. Where appropriate, use SIPs with splines, allowing insulation to remain as continuous as possible. Some panels are produced with rough sawn plywood to speed up installation for board and batt siding.

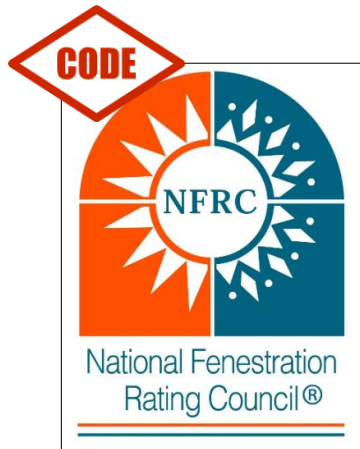
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INSULATION – RIGID/ SIPs

Notes:

Envelope

FENESTRATION



R-E-FE1

Manufactured Products - Certification

Manufactured fenestration products and exterior doors may be installed only if the manufacturer has certified to the Commission that the product complies with all of the applicable requirements. Look for the NRFC label on all fenestration products, unless they are site built.

Code Reference: 2013 Title 24, Part 6 Standards §110.6(a)



R-E-FE2

Manufactured Products - Labeling

Manufactured fenestration products shall have a temporary label listing the certified U-factor, SHGC and VT. It shall not be removed before inspection by the enforcement agency. Compare the U-factor and SHGC on the labels to the maximum values shown on the CF-1R.

Code Reference: 2013 Title 24, Part 6 Standards §110.6(a)5



R-E-FE3

Field Fabricated Fenestration Products

Field-fabricated fenestration and field-fabricated exterior doors may be installed only if the compliance documentation has demonstrated compliance for the installation using default U-factors from TABLE 110.6-A and SHGC values from TABLE 110.6-B.

Field-fabricated fenestration and field-fabricated exterior doors shall be caulked and weather-stripped.

Code Reference: 2013 Title 24, Part 6 Standards §110.6(b)

R-E-FE1: PLACEHOLDER, Need replacement image

R-E-FE2: © Environmental Protection Agency

R-E-FE3 © Architectural Energy Corporation

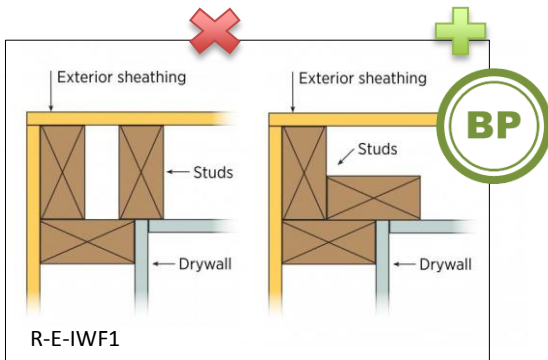
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FENESTRATION

Notes:

Envelope

INSULATION – WALLS/ FOUNDATION



Advanced Framing- Corners

Install wall components to allow for as much insulation coverage as possible while meeting structural requirements. Use two or three stud corners that allow insulation to reach these cavities.



Advanced Framing- Ladder Blocking

Frame exterior with advanced framing techniques such as ladder blocking so that insulation can continue along the exterior wall where interior walls meet exterior ones.



Slab Insulation

Insulation should extend all the way to the top of the slab. The best type for this application is extruded polystyrene (typically blue or pink boards).

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R-E-IWF2: © Baechler, Gilbride, Hefty, Cole, Love

R-E-IWF3: © Environmental Protection Agency

INSULATION – WALLS/ FOUNDATION

CODE

PLACEHOLDER

R-E-IWF5

Minimum R-Values

2x4 Walls shall be insulated between framing members with insulation having an installed thermal resistance of not less than R-13, or the weighted average U-factor shall not exceed U-0.102 (the U-factor that results from installing R-13 in a 2x4 inch wood framed assembly).

Code Reference: 2013 Title 24, Part 6 Standards §150.0(c)

2x6 Walls shall be insulated between framing members with insulation having an installed thermal resistance of not less than R-19 in framing of 2x6 inch or greater, or the U-factor shall not exceed the U-0.074 (the U-factor that results from installing R-19 in a 2x6 inch or greater wood framed assembly)

Code Reference: 2013 Title 24, Part 6 Standards §150.0(c)

NOTE: These are absolute minimums. The prescriptive or performance compliance approaches may result in higher minimum levels of insulation. See CF-1R for specific project requirements.

Notes:

Envelope

INSULATION – ATTIC

CODE



Minimum R-values

Ceilings and rafter roofs shall be insulated between wood-framing members with insulation resulting in:

1. An installed thermal resistance of R-30 or greater for the insulation alone. ~OR~
2. The weighted average U-factor shall not exceed 0.031 (the same U-factor that would result from installing R-30 insulation between wood-framing members).

NOTE: These are absolute minimums. The prescriptive or performance compliance approaches may result in higher minimum levels of insulation. See CF-1R for specific project requirements.

Code Reference: 2013 Title 24, Part 6 Standards §150.0(a)

CODE



Attic Access Doors Insulated and Gasketed

Attic access doors shall have permanently attached insulation using adhesive or mechanical fasteners. The attic access shall be gasketed to prevent air leakage.

Code Reference: 2013 Title 24, Part 6 Standards §150.0(a)

CODE



Loose-fill Insulation to be Proper Weight/sf

When loose-fill (blown-in) insulation is installed, the minimum installed weight per square foot shall conform with the insulation manufacturer's installed design weight per square foot at the manufacturer's labeled R-value. This ensures that the insulation has not been "fluffed" and will not settle over time. Refer to the CF-2R-ENV-XXX for installer certification that this was done.

Code Reference: 2013 Title 24, Part 6 Standards §150.0(b)

Envelope

INSULATION – ATTIC

BP



Attic Baffles

Baffles should be installed in every bay of eaves with vents. These allow insulation to reach full depth over the exterior wall and at the same time they maintain air flow below the roof and prevent wind washing of loose fill insulation. Make sure there is at least a 1" air gap between the baffle and roof. Baffles are often made of cardboard or plastic. Do not locate water supply pipes in vented bay. Remember to install a baffle at the edge of attic insulation above a kneewall as well.

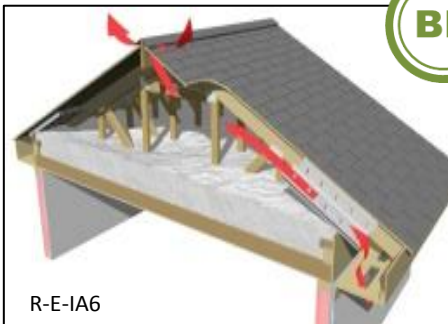
BP



Measure the Depth

When using blown insulation, rulers should be installed throughout the attic to clearly show proper depth and evenness of insulation. Markers should face attic hatch opening. Add an extra inch of insulation to allow for settling of loose fill material.

BP



Cover the joists

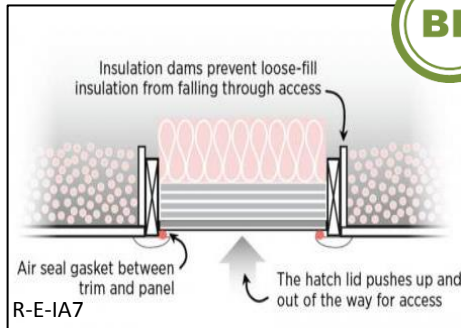
Insulation should cover joist/bottom chord of the attic truss to slow heat loss. This is easy to achieve with blown insulation. Although loose fill is recommended for this application, one way to accomplish this with fiberglass is to lay a second layer crosswise to the first layer. Always make sure batt layers are continuous with no air gaps.

Envelope

INSULATION – ATTIC

BP

Build A Dam



Achieve full attic R value immediately surrounding an attic hatch, whole house fan or pull down stairs, by building a dam to the height of the insulation. The dam can be constructed of plywood, or fiberglass batts can be placed around the hatch opening the full depth of the loose fill insulation to prevent the loose fill from falling into the hatch when opened.

BP

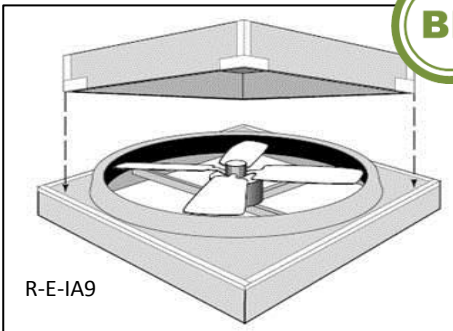
Raise the Roof



Raised heel trusses allow for full attic insulation R value over exterior walls by increasing the available space. Attic baffles are an integral part of this strategy to maintain venting space under the roof deck. Raised heel trusses are also a good idea if the attic will be sealed, thus allowing for full depth of spray foam insulation around the entire building envelope.

BP

Whole House Fan



When not in use during winter months, a whole house fan should be air sealed and insulated.

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Integral Insulation on Fans



Build a box made of rigid insulation that fits over the fan from the attic side and cover the box with batt insulation. Air seal the box to the drywall on the attic side. New fans are available with rigid foam insulation built in to louvered doors that close when not in use.

R-E-IA7: © Baechler, Gilbride, Hefty, Cole, Williamson, Love

R-E-IA8: © Environmental Protection Agency

R-E-IA9: © DOE's Office of Energy Efficiency and Renewable Energy

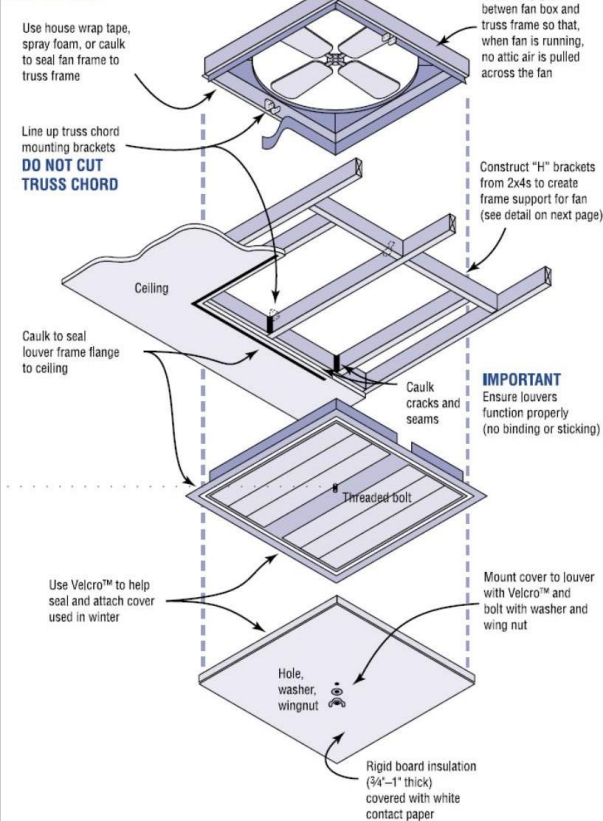
R-E-IA10: © Pacific Northwest National Laboratory

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INSULATION – ATTIC

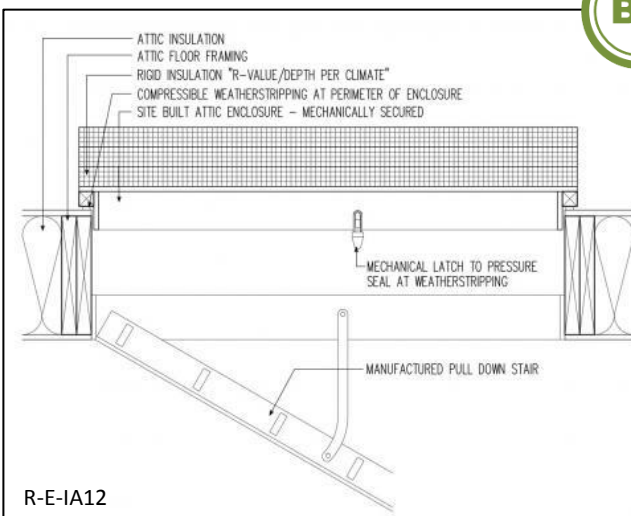
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INSTALLING A WHOLE HOUSE FAN



R-E-IA11

BP



R-E-IA12

Sealing Details

Seal 1) fan frame to truss frame with caulk or UL listed house wrap tape and 2) louver frame flange to ceiling with caulk.

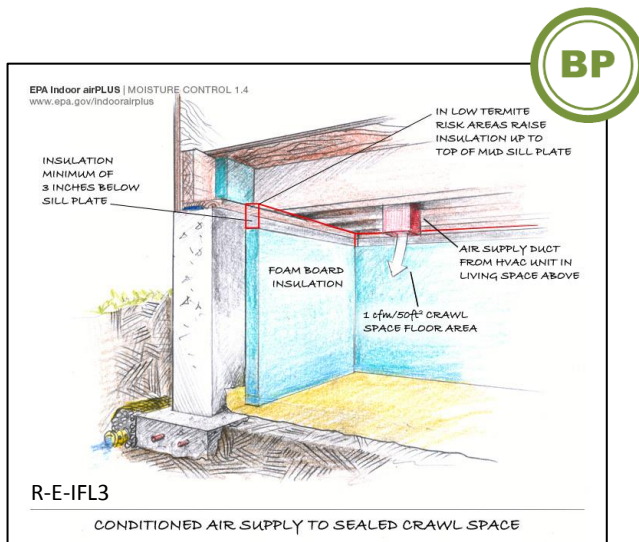
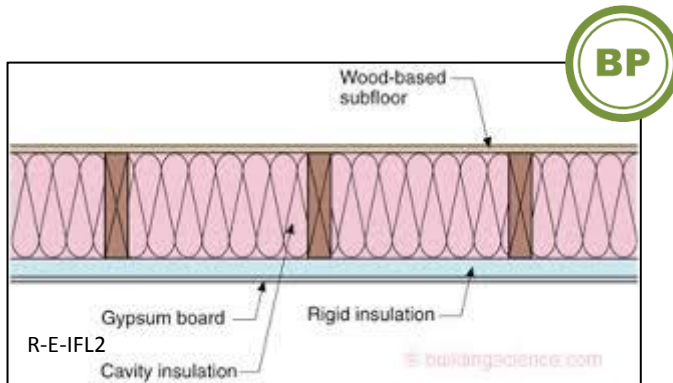
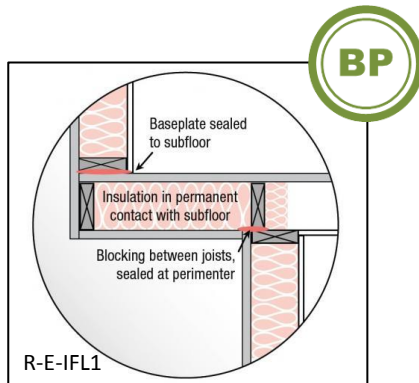
Flexible material can be used to air seal from below with UL listed magnetic tape.

Air Seal & Insulate Attic Stairs

Create an air tight lid from the attic side by building a box made of rigid insulation that fits over the stairs. Other products zip up suitcase style. Cover with batt insulation to full R-value (or additional layers of rigid foam) and attach to the rigid foam box.

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INSULATION - FLOORS



Cantilevers

Insulate cantilevers with blown insulation that fills the cavity. Dense Pack cellulose will get the most R-value and air tightness from the assembly. Block and air seal the cantilever from the floor joist space.

Garage

After air sealing any penetrations that lead to the home, insulate floor above the garage. Either fully fill the floor joist cavity or install the insulation aligned with the underside of the floor above. Duct work and plumbing in this cavity should be insulated and located close to the conditioned space. Consider adding rigid insulation across the bottom of the joists to reduce thermal bridging.

Crawlspace

Treat your crawlspace like a short basement. Condition it and insulate the walls and rim joist area. Seal out moisture with a vapor barrier covering the ground and attached to the walls. Be sure to air seal all penetrations through the floor and exterior walls. Conditioning the Crawlspace is only appropriate if radon has been addressed and moisture controlled. The rigid insulation gap for termite inspection can be placed near the bottom of the exterior walls, below grade, thereby reducing energy loss.

R-E-IFL1: © Baechler, Gilbride, Hefty, Cole, Love

R-E-IFL2: **Permission Pending**

R-E-IFL3: **Permission Pending**

INSULATION – FLOORS



Minimum R-Value

Raised floors separating conditioned space from unconditioned space shall be insulated between wood-framing members with insulation having an installed thermal resistance of R-19 or greater,

or the weighted average U-factor of floor assemblies shall not exceed 0.037 (the U-factor that would result from installing R-19 insulation between wood-framing members and accounting for the effects of framing members).

NOTE: These are absolute minimums. The prescriptive or performance compliance approaches may result in higher minimum levels of insulation. See CF-1R for specific project requirements.

Code Reference: 2013 Title 24, Part 6 Standards § 150.0(d)

Notes:

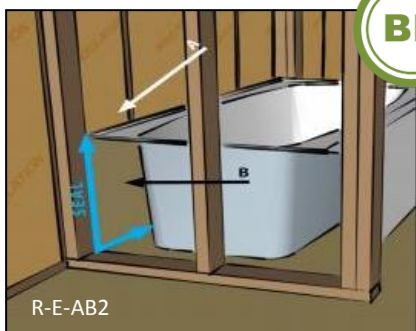
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AIR BARRIERS



Insulation Enclosed On All Sides aka “insulation sandwich”

Wall Insulation should be enclosed on all sides including top, bottom and side framing as well as front and back sheathing or drywall. If the wall backs up to an attic space, the back side of the insulation needs an air barrier.



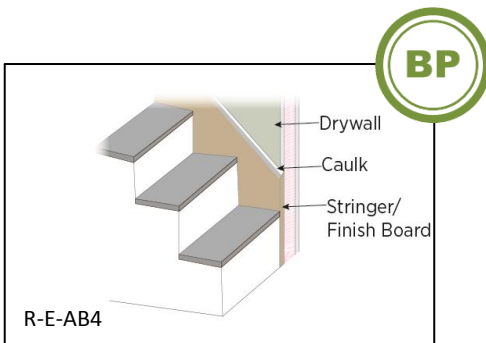
Hard to Reach Areas

Some areas require early coordination with other trades, such as framers. Otherwise it may be difficult to install an air barrier or the area may become inaccessible. The area below a tub, or other areas that will not have interior finishes but that separate conditioned & unconditioned space, need special attention. Other examples are fireplaces, soffits and double walls.



Lids and Floors

Vertical and horizontal chases need air barriers where they meet the attic and unconditioned space below. Make sure these spaces have air tight lids and floors. Another example that needs an air barrier include where a cantilever meets the rim joist.



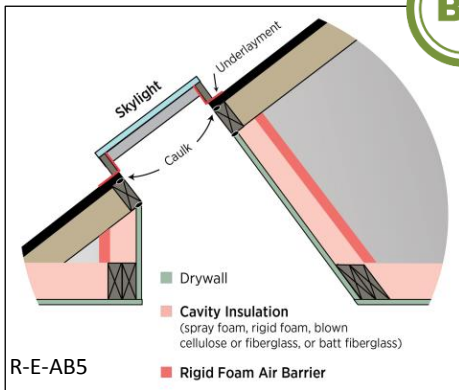
Stair Walls

Install an air barrier on the conditioned side of walls under stairs that are adjacent to the exterior wall. These areas are sometimes used for storage and still need the air barrier enclosing the wall Insulation.

R-E-AB1: © Architectural Energy Corporation
R-E-AB2: © Environmental Protection Agency
R-E-AB3: © Architectural Energy Corporation
R-E-AB4: © Environmental Protection Agency

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AIR BARRIERS



Insulate Skylight Walls

Provide an air barrier on the attic side of skylight walls all the way from the ceiling to the roof so that the insulation is fully enclosed on all sides. Although in most climates an air seal on the conditioned side of the skylight well is acceptable, it may not perform as well thermally when the well is sealed on the attic side when using fiberglass batts. Air seal and insulate these walls to the same R value as exterior walls.



Porches

Exterior sheathing should be continuous at porches and other architectural features to complete the building enclosure.



Garage Connections

There should be a well sealed air barrier between the floor system, walls and rim joists between the home and garage. It is especially important to minimize air leakage from the garage to preserve indoor air quality and for fire safety.

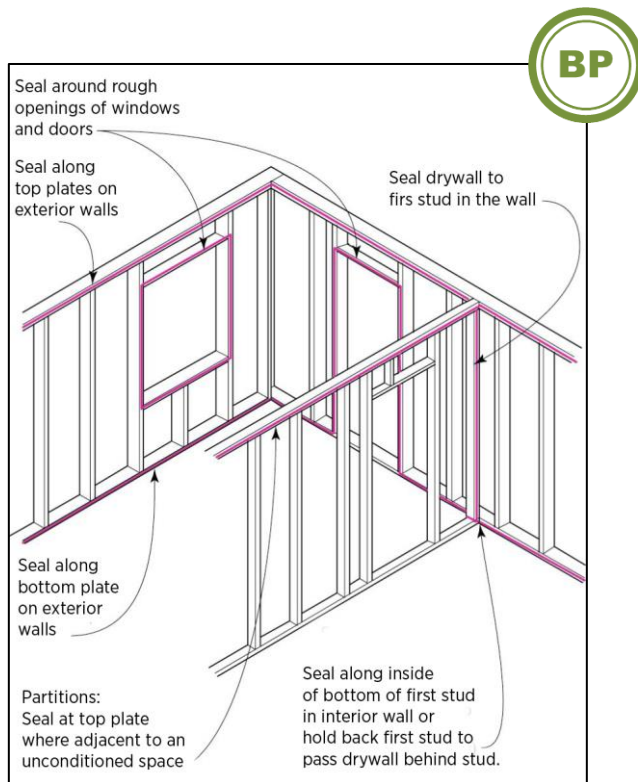
R-E-AB5: © Lstiburek

R-E-AB6: © Environmental Protection Agency

R-E-AB7: © Environmental Protection Agency

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AIR BARRIERS



R-E-AB8

Drywall As An Air Barrier

Seal drywall to framing to create an air barrier. Drywall can be sealed with adhesive at top and bottom plates and where interior walls meet the exterior wall, and at all drywall penetrations such as plumbing and wiring. This is known as the Airtight Drywall Approach.

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AIR BARRIERS

Notes:

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AIR SEALING

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Electrical, Duct & Pipe Penetrations

Seal all electrical, duct and pipe penetrations through exterior walls, ceilings, rim joists, top/bottom plates; anywhere air might leak between conditioned and unconditioned space. Use UL rated sealing material.

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Outlet Boxes

Seal electrical outlet box with UL listed fire rated putty. These boxes inevitably leak. Baby proofing outlet covers used for safety also help stop the air leaks!

BP



Exterior Wall Penetrations

Air seal everything that passes through the exterior wall such as plumbing and refrigerant lines with caulk.

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Crawlspace Penetrations

Seal below tubs and other penetrations to the crawlspace or any unheated area with a durable, rodent and other pest proof barrier.

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AIR SEALING

BP



Rim Joists

Seal the rim joist of crawlspaces, basements and areas between stories in a home. Install insulation with an air barrier and air seal any gaps. Or use closed cell foam which seals and insulates.

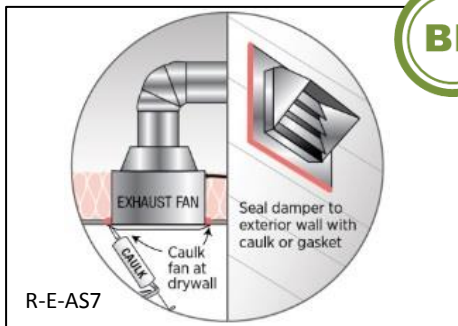
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Window & Door Gaps

Caulk or foam window and door gaps in framing with low expansive foam.

BP



Exhaust Fans

Fully seal all gaps, penetrations and holes to the attic before insulating. Caulk the drywall to bathroom and kitchen exhaust fan housing.

BP



Recessed Lighting

Install only IC/AT rated recessed lighting. Insulation Contact Air Tight light fixtures help reduce air leakage and allow attic insulation to cover the fixture, leaving no gaps in the attic insulation. Recessed light fixtures can even leak when installed in the first story of a 2 story home.

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MOISTURE MANAGEMENT



BP

Windows

Flash windows in proper sequence. Coordinate with building wrap to maintain continuous air barrier and proper drainage plane. Install pan flashing at the rough sill opening of the window to help protect the sill and direct water to the exterior.



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Roof Valleys

Install self sealing material at all roof valleys and roof penetrations.



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Flashing

Step flashing at roof/wall intersections should extend at least 4" up the wall. Building wrap overlaps the flashing. Kick flashing meets step flashing at the roof edge diverting water to the gutter.



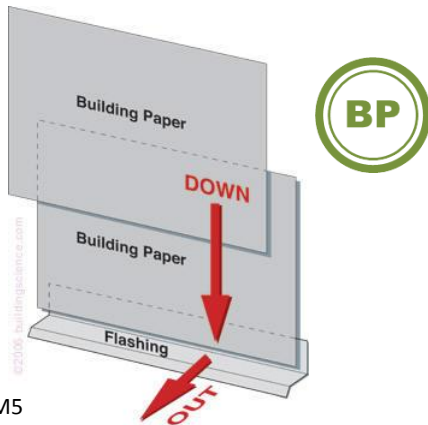
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Exhaust Direction

Route all kitchen, bathroom and dryer exhausts directly to the outside the building to remove moisture from the home. Take care to use properly sized ducts and fittings.

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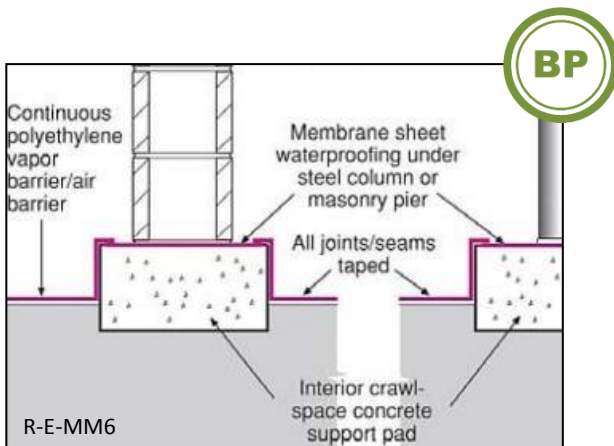
MOISTURE MANAGEMENT



Wrap

House wrap is often installed as the drainage plane and should be installed in shingle lap fashion. Unroll house wrap around the home from the bottom up. Install cladding as soon as possible after house wrap to protect it from tears. Seal any tears with tape.

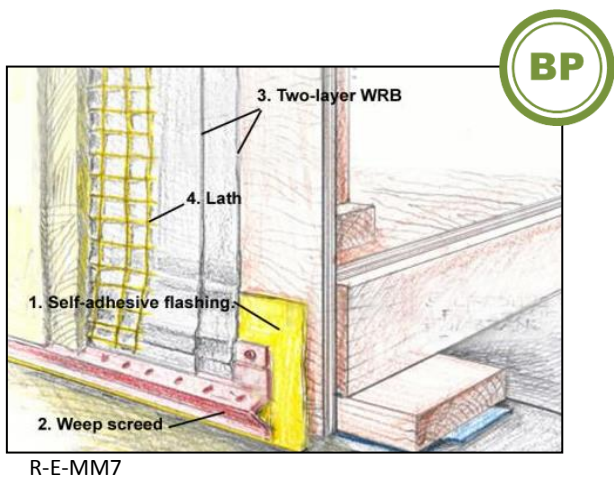
* Vapor retarders are required in climate zones 14 & 16.



Crawlspace Floors

Seal dirt crawlspace floors with minimum 6 mil polyethylene sheeting. Overlap seams at least 6" and tape. Lap sheeting up walls and piers and fasten.

*Required when crawlspace is unvented, otherwise this is a Best Practice



Manage the Moisture

Moisture is managed through a planned system from the roof to the foundation. It is "managed" because it is impossible to keep out all moisture. The weather resistive barrier allows liquid moisture to drain and vapor to diffuse. Stop air movement through the building envelope and you automatically stop moisture movement.