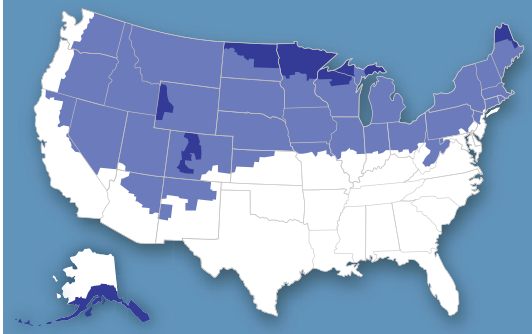
ENERGY | Energy Efficient Energy

BUILDING TECHNOLOGIES PROGRAM

VOLUME 12.

BUILDING AMERICA BEST PRACTICES SERIES



COLD & VERY COLD CLIMATES

BUILDERS CHALLENGE GUIDE TO

40% Whole-House Energy Savings in the Cold and Very Cold Climates

PREPARED BY

Pacific Northwest National Laboratory
& Oak Ridge National Laboratory

February 2011

Building AMERICA

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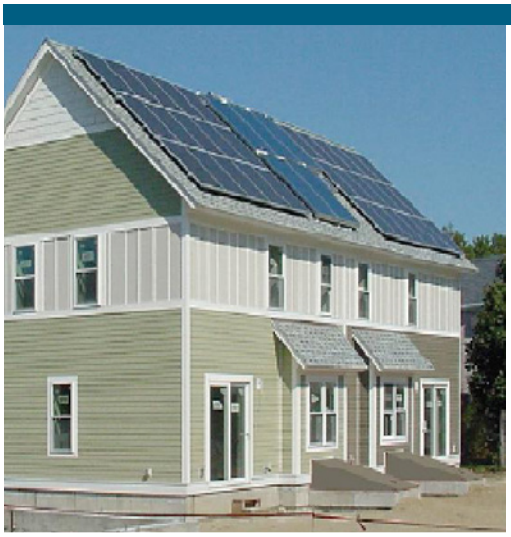
MEASURE	Building America Recommendations	Builder #1	Builder #2	Builder #3
INSULATION (take a look at a house under construction before sheetrock is installed)				
Insulation installed behind tubs, landings, and other hard to reach places	Yes			
Insulation fills entire cavities—no voids or compressed batts— Attic insulation level without gaps and covers entire attic floor	Yes			
Where fiberglass batt insulation is used it is high-density	Yes			
Rim joists are insulated	Yes			
Rigid foam insulation applied under exterior siding or stucco	Yes			
WINDOWS (take a look at a house under construction before exterior siding is installed)				
ENERGY STAR qualified windows, doors, and skylights	Yes			
Windows flashed to help repel water	Yes			
Windows rated to U-factor of 0.40 or less and SHGC of 0.40 or less	Yes			
MOISTURE MANAGEMENT (take a look at a house under construction before exterior siding is installed)				
Ground slopes away from house	Yes			
Housewrap, building paper, or rigid foam exterior insulation, taped at seams and caulked at edges, covers OSB walls in wood-framed houses	Yes			
Roof flashing in valleys, where walls and roofs intersect, and at other places where water may enter the house—the more complex the roof, the more flashing you should see	Yes			
Air gap between stucco, brick, or masonry cladding and housewrap	Yes			
Overhangs for shade and to direct water away from walls	Yes			
Trees planted ten feet from house, no overhanging branches	Yes			
Plantings 18 to 36 inches away from the foundation	Yes			
No wood or siding in direct contact with ground	Yes			
AIR BARRIERS				
Follow ENERGY STAR Thermal Bypass Checklist	Yes			
All penetrations through exterior walls sealed	Yes			
Careful sealing of sheetrock or exterior sheathing	Yes			
Canned lights rated as airtight and for insulated ceiling (ICAT)	Yes			
Electrical boxes on exterior walls caulked or gasketed	Yes			
Holes into attic sealed	Yes			
Attic hatch weather-stripped and insulated	Yes			
Air leakage determined with house depressurization test	Yes			
Wall-roof intersection carefully sealed to avoid ice dams	Yes			
Draft stops installed behind tubs, showers, stairs, and fireplaces	Yes			
Garage completely sealed from conditioned areas of house	Yes			
Careful sealing around bathtubs, landings, fireplaces, kneewalls, cantilevered floors, etc.	Yes			
Sill plates gasketed or sealed	Yes			



(top) RDI used a basic roof shape on its homes in Greenfield, Massachusetts, which minimizes the need for complicated flashing and provides the added benefit of more space for photovoltaics and solar water heating panels *(Photo Source: RDI).*

(bottom) Kick-out flashing should be installed to divert water runoff into gutters rather than flowing down the wall.

- Use pressure-treated lumber to frame out sub-jambs and spacers within window and door rough openings.
- As with other walls, penetrations to the exterior or through top and bottom plates should be foam sealed or caulked. Also air seal penetrations to garages and porches.
- Mud, tape, and caulk seams and corners of gypsum board to control air leakage through the walls.
- When pouring the slab, take care to create a seat in the concrete to accept the block and seats in the concrete to act as drain pans where exterior doors and sliding doors will be located.

Roof Assemblies

Controlling Liquid Water in Roof Assemblies

Roof and wall assemblies must contain surfaces that will drain water in a continuous manner down and off the building. Water must have a path that will take it from its point of impact, around any elements, such as chimneys, windows, doors, and seams, all the way to the exterior ground, and away from the house. Consider implementing the following recommendations:

- Properly flash valleys and roof edges.
- Size gutters and downspouts to accommodate anticipated storms. Show gutter sizes on elevations and specify sizes in construction documents.
- Provide downspout drainage to carry water at least 3 feet beyond the building.
- In areas with potentially high winds and heavy rains, install 4-inch to 6-inch “peel and seal” self-adhering water-proofing strips over joints in roof decking before installing the roof underlayment and cover.
- Keep roof geometry simple. The more complex the roof—the more dormers, ridges, and valleys—the more likely the roof will leak.

Ice Dam Protection

Ice dams can form when the air temperature is below freezing, but the roof deck temperature is above freezing, causing snow on the roof to melt. The melted snow flows to the edge of the roof where it refreezes, forming an ice dam that collects more water. The dam may not be

Indoor airPLUS Verification Checklist

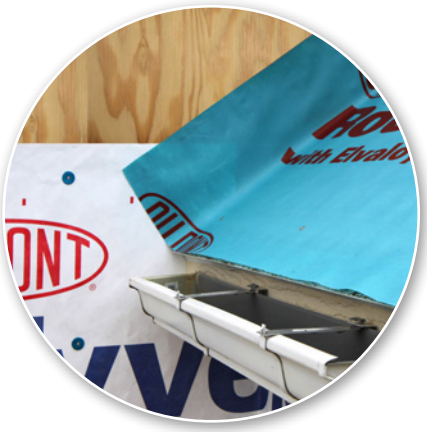
Address or Div/Lot#:					
City/State/Zip:		Date:		Verified by	
Section		Requirements (see Indoor airPLUS Construction Specifications for details)	N/A	Builder	Rater
Moisture Control		**Water-Managed Site and Foundation**			
	1.1	Site & foundation drainage: sloped grade, protected drain tile, & foundation floor drains		☐	☐
	1.2	Capillary break below concrete slabs & in crawlspaces (Exception - see specification)	☐	☐	☐
	1.3	Foundation wall damp-proofed or water-proofed (Except for homes without below-grade walls)	☐	☐	☐
	1.4	Basements/crawlspaces insulated & conditioned (Exceptions - see specification)	☐	☐	☐
		Water-Managed Wall Assemblies			
	1.5	Continuous drainage plane behind exterior cladding, properly flashed to foundation		☐	☐
	1.6	Window & door openings fully flashed		☐	☐
		Water-Managed Roof Assemblies			
	1.7	Gutters/downspouts direct water a minimum of 5' from foundation (Except in dry climates)	☐	☐	☐
	1.8	Fully flashed roof/wall intersections (step & kick-out flashing) & roof penetrations		☐	☐
	1.9	Bituminous membrane installed at valleys & penetrations (Except in dry climates)	☐	☐	☐
	1.10	Ice flashing installed at eaves (Except in Climate Zones 1 - 4)	☐	☐	☐
		Interior Water Management			
	1.11	Moisture-resistant materials/protective systems installed (i.e., flooring, tub/shower backing, & piping)			☐
	1.12	No vapor barriers installed on interior side of exterior walls with high condensation potential		☐	☐
	1.13	No wet or water-damaged materials enclosed in building assemblies		☐	☐
Radon	2.1	Approved radon-resistant features installed (Exception - see specification)	☐	☐	☐
	2.2	Two radon test kits & instructions/guidance for follow-up actions provided for buyer (Advisory-see specification)	☐	☐	☐
Pests	3.1	Foundation joints & penetrations sealed, including air-tight sump covers			☐
	3.2	Corrosion-proof rodent/bird screens installed at all openings that cannot be fully sealed (e.g., attic vents)		☐	☐
HVAC	4.1	HVAC room loads calculated, documented; system design documented; coils matched			☐
	4.2	Duct system design documented & properly installed OR duct system tested (check box if tested) ☐	☐		☐
	4.3	No air handling equipment or ductwork installed in garage; continuous air barrier required in adjacent assemblies			☐
	4.4	Rooms pressure balanced (using transfer grills or jump ducts) as required OR tested (check box if tested) ☐	☐		☐
	4.5	Whole house ventilation system installed to meet ASHRAE 62.2 requirements			☐
	4.6	Local exhaust ventilation to outdoors installed for baths, kitchen, clothes dryers, central vacuum system, etc.			☐
	4.7	Central forced-air HVAC system(s) have minimum MERV 8 filter, no filter bypass, & no ozone generators			☐
	4.8	Additional dehumidification system(s) or central HVAC dehumidification controls installed (In warm-humid climates only)	☐		☐
Combustion Pollutants		**Combustion Source Controls**			
	5.1	Gas heat direct vented; oil heat & water heaters power vented or direct vented (Exceptions - see specifications)	☐		☐
	5.2	Fireplaces/heating stoves vented outdoors & meet emissions/efficiency standards/restrictions	☐		☐
	5.3	Certified CO alarms installed in each sleeping zone (e.g., common hallway) according to NFPA 720			☐
	5.4	Smoking prohibited in common areas; outside smoking at least 25' from building openings (Multi-family homes only)	☐	☐	☐
		Attached Garage Isolation			
	5.5	Common walls/ceilings (house & garage) air-sealed before insulation installed; house doors gasketed & closer installed	☐		☐
	5.6	Exhaust fan (minimum 70 cfm, rated for continuous use) installed in garage & vented to outdoors (controls optional)	☐		☐
Materials	6.1	Certified low-formaldehyde pressed wood materials used (i.e., plywood, OSB, MDF, cabinetry)		☐	☐
	6.2	Certified low-VOC or no-VOC interior paints & finishes used		☐	☐
	6.3	Carpet, adhesives, & cushion qualify for CRI Green Label Plus or Green Label testing program	☐	☐	☐
Final	7.1	HVAC system & ductwork verified dry, clean, & properly installed			☐
	7.2	Home ventilated before occupancy OR initial ventilation instructions provided for buyer		☐	☐
	7.3	Completed checklist & other required documentation provided for buyer		☐	☐

Rater/Provider:	Builder:
Company:	Company:
Signature:	Signature:

Wall-to-Roof Flashing

Kick-Out Diverter Flashing Details

Water runoff from roof-wall intersections can flow down the exterior wall and eventually find its way into the wall where it can cause serious damage. Anywhere roof sections adjoin wall sections, kick-out flashing should be used to divert water away from the walls and preferably into rain gutters where it can be carried down and away from the structure.



STEP 1 Apply drip edge and roof underlayment over roof deck. Continue lapping up the sidewall and over the water-resistive barrier (in this case housewrap) a minimum of 6 inches.

STEP 2 Install shingle starter strip at roof eave in accordance with roofing manufacturer's instructions.

- Place seamless one-piece of non-corrosive kick-out diverter flashing as the first piece of step flashing.
- Slide kick-out diverter up roof plane until the starter trough stops at the shingle starter strip.
- The diverter must be flat on the roof and flush to the sidewall.
- Fasten and seal diverter to the roof deck and starter strip. (Do not fasten to the sidewall.)

STEP 3 Place first shingle and next section of sidewall flashing over the up-slope edge of diverter, lapping a minimum of 4 inches over diverter. (Sidewall flashing height requirement should be determined by design professional and local building codes.)

STEP 4 Install remaining sidewall flashing, appropriate counter flashing, and shingles in accordance with manufacturer's instructions.

STEP 5 Apply self-adhesive flashing over top of wall flashing, diverter, and housewrap.

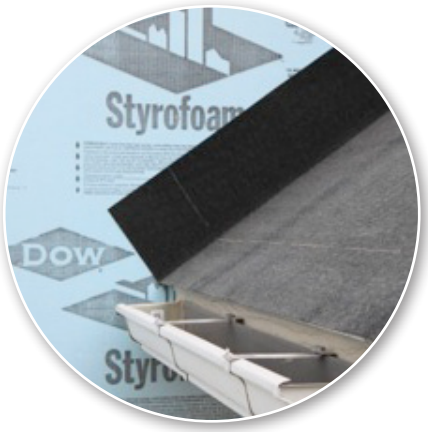
STEP 6 Install house wrap; cut the house wrap to fit over the self-adhesive flashing and sidewall flashing.

STEP 7 Apply siding over housewrap.

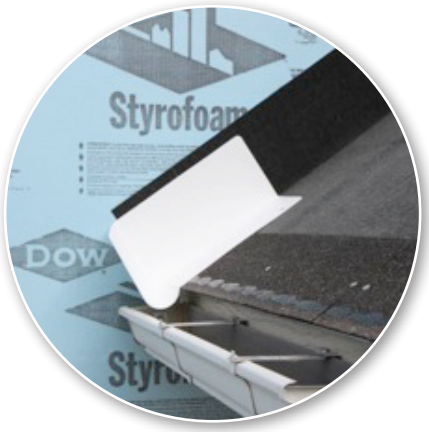
Wall-to-Roof Flashing

Kick-Out Diverter Flashing Details - Rigid Foam Insulation Installed as a Water-Resistive Barrier

Water runoff from roof-wall intersections can flow down the exterior wall and eventually find its way into the wall where it can cause serious damage. Anywhere roof sections adjoin wall sections; kick-out flashing should be used to divert water away from the walls and preferably into rain gutters where it can be carried away from the structure.

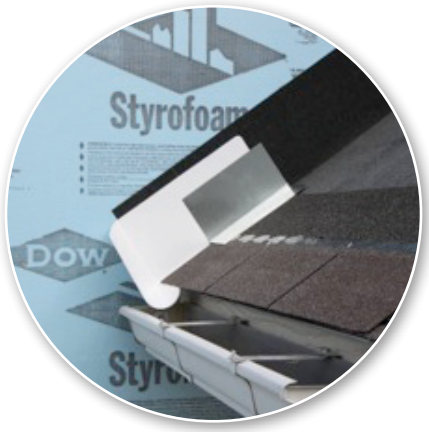


STEP 1 Apply drip edge and roof underlayment over roof deck and continue lapping up the sidewall and over the water-resistive barrier (in this case rigid foam insulation) a minimum of 7 inches.



STEP 2 Install shingle starter strip at roof eave in accordance with roofing manufacturer's instructions.

- Place seamless, one-piece, non-corrosive kick-out diverter flashing as the first piece of step flashing.
- Slide kick-out diverter up roof plane until the starter trough stops at the shingle starter strip.
- Diverter must be flat on the roof and flush to the sidewall.
- Fasten and seal diverter to the roof deck and starter strip. (Do not fasten to the sidewall.)



STEP 3 Place first shingle and next section of sidewall flashing over up-slope edge of diverter, lapping a minimum of 4" over diverter.

(Sidewall flashing height requirement should be determined by design professional and local building codes.)

STEP 4 Install remaining sidewall flashing, appropriate counter flashing and shingles in accordance with manufacturer's instructions.

STEP 5 Apply self adhesive flashing over top of wall flashing, diverter and rigid foam insulation.

STEP 6 Apply construction tape over the self-adhered flashing.

STEP 7 Apply siding over rigid foam insulation.