# Achieve Energy Star (Part 2)



# Step 1 - Achieve Energy Star Outline of Process...

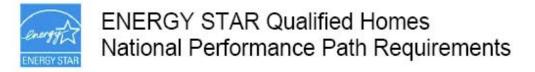
- 1. Learn about Energy Star
- 2. Find a rater
- 3. Become a partner
- 4. Preliminary Evaluation (by rater)
  - Critical Changes (Combustion Safety, Durability, Call Backs)
  - HERS Index
  - Prescriptive Requirements
  - Thermal Bypass Inspection
  - Infiltration Test
  - Duct Leakage Test
- 5. Review Raters Recommendations and Select an "Improvement Package"
- 6. Build an Energy Star House
  - 1. Preconstruction: Design, Specs, Prelim HERS Index
  - 2. Construction: Quality Assurance, **Thermal Bypass Inspection**
  - 3. Post Construction: Testing, Final HERS Index, Paper work
- 7. Rater Registers your Energy Star house, gives you a certificate when you reach Energy Star write a press release!
- What next? Decide what to implement in production, add details to plans and specs, training



# Step 1 - Achieve Energy Star Outline of Process...

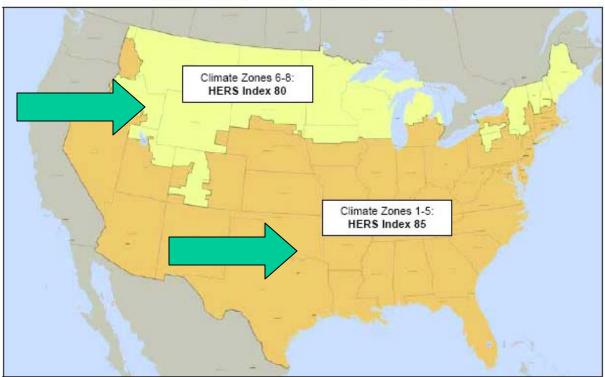
- 1. Learn about Energy Star
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#### **ENERGY STAR Performance Requirements:**

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#### Maximum HERS Index Required to Earn the ENERGY STAR<sup>1</sup>

Note: Due to the unique nature of some state codes and/or climates, EPA has agreed to allow regionally-developed definitions of ENERGY STAR in California, Hawaii, and the Pacific Northwest to continue to define program requirements. The States of Montana and Idaho may use either the requirements of the national program or the regionally-developed program in the Pacific Northwest.

Envelope 2,3,4	Completed Thermal Bypass Inspection Checklist
Ductwork 5,6	Leakage ≤ 6 cfm to outdoors / 100 sq. ft.
ENERGY STAR Products <sup>13,14</sup>	Include at least one ENERGY STAR qualified product category: <ul> <li>Heating or cooling equipment <sup>7</sup>; <u>OR</u></li> <li>Windows <sup>8</sup>; <u>OR</u></li> </ul> <li>Five or more ENERGY STAR qualified light fixtures <sup>9,10</sup>, appliances <sup>11</sup>, ceiling fans equipped with lighting fixtures, and/or ventilation fans <sup>12</sup></li>
ENERGY STAR Scoring Exceptions	<ul> <li>On-site power generation may not be used to decrease the HERS Index to qualify for ENERGY STAR.</li> <li>A maximum of 20% of all screw-in light bulb sockets in the home may use compact fluorescent lamps (CFLs) to decrease the HERS Index for ENERGY STAR compliance. CFLs used for this purpose must be ENERGY STAR qualified.</li> </ul>

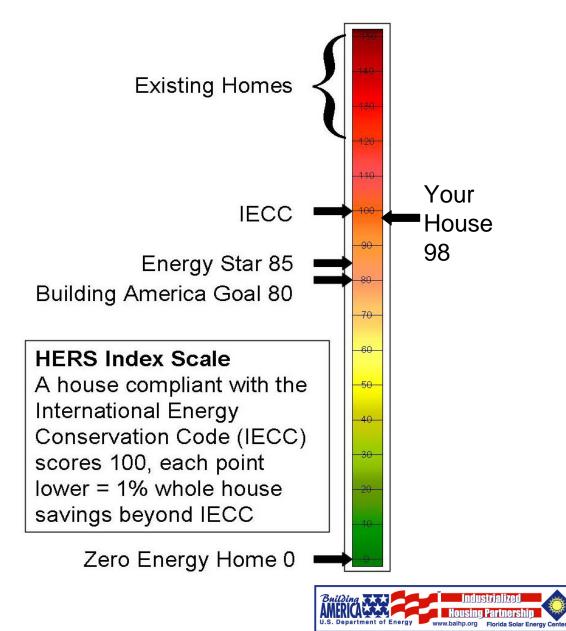
Page 1 of 2



- The HERS Index
- HERS=Home Energy Rating System
- Compares a "designed" or "as built" home
- To the HERS "Reference Home"
  - same size, wall areas, structural system, fuel
  - Minimum efficiency equipment
  - Insulation etc to comply with 2004
     International Energy Conservation
     Code (IECC)
  - Reference house has a HERS Index of 100

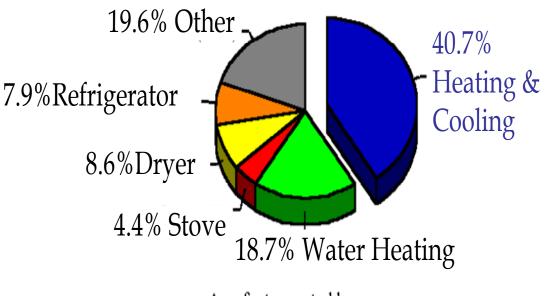


• Comparison of projected energy use of your house to the 2004 International Energy Code



- Projected energy use of your house for..
  - Heating, Cooling, Water Heating, Appliances, Lighting, and "Other"
- Compared to 2004 IECC

Average Annual Energy Use Measured in 10 Florida Habitat Homes

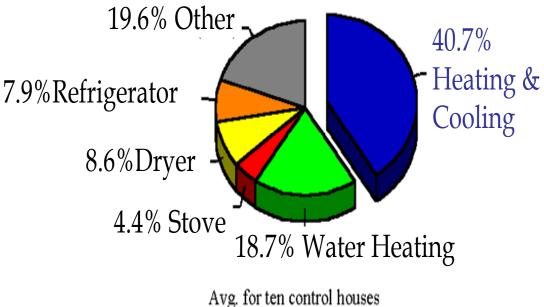


Avg. for ten control houses Total=43 kWh/day



- Rater Needs equipment characteristics
  - Fuel gas/elec
  - Size capacity
  - Location cond/uncond
  - Efficiency

Average Annual Energy Use Measured in 10 Florida Habitat Homes

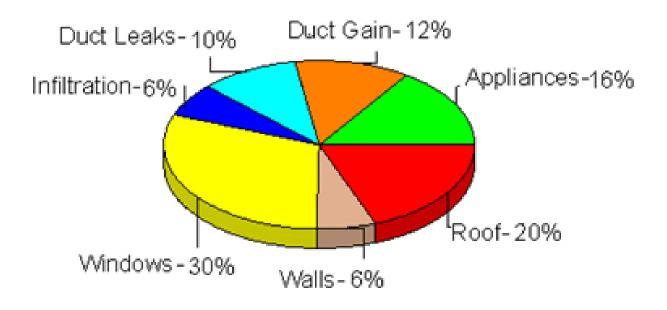


Total=43 kWh/day



- Heating and Cooling Energy Use
- Driven by heat gain/loss

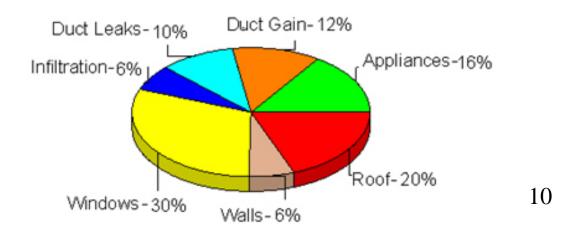
# Annual Cooling Load Components Tampa FL, 2000 sqft Residence

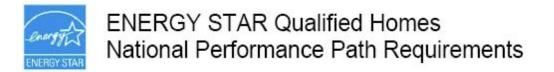




- Rater needs "enclosure" characteristics
- Location
- Dimensional characteristics
- Materials/assemblies
- Window characteristics
- Also test results
  - Duct leakage mandatory
  - Infiltration optional

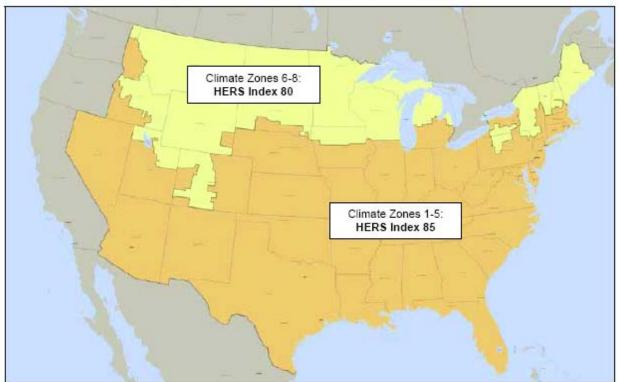
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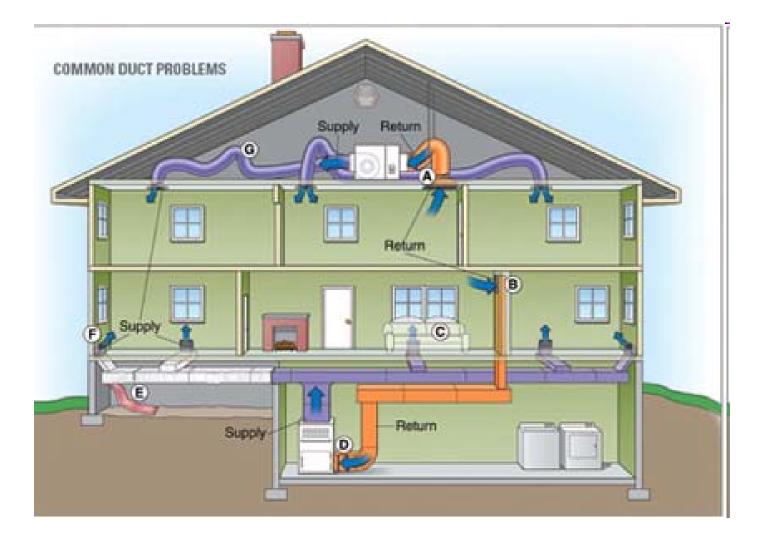
- Limit 6 cfm of air leakage
- to the outside
- per 100 sq ft of conditioned space
- at the test pressure of 25 pascals





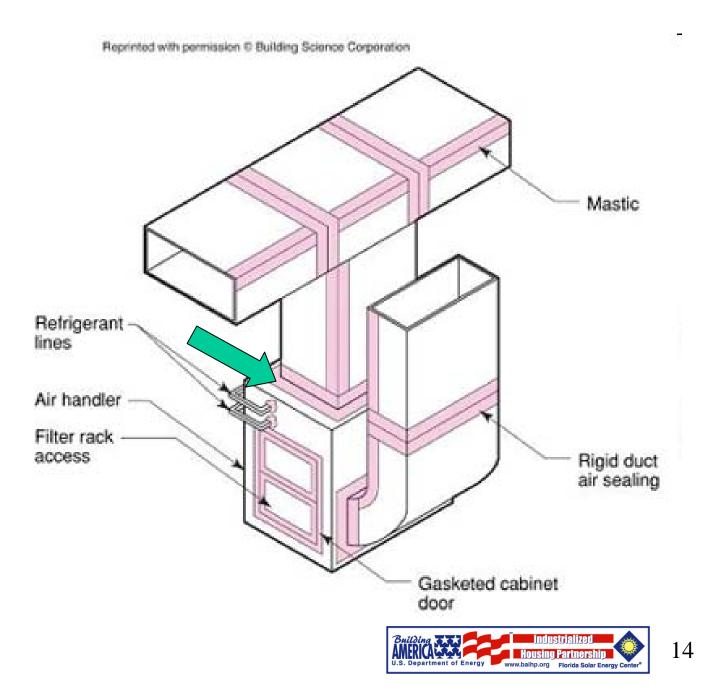


• Typical leakage sites...





Typical leakage sites...
– Plenum to Air Handler Connection



• Typical leakage sites...



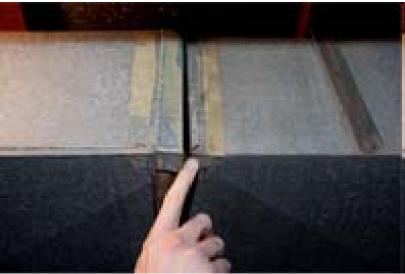


# **Building Cavities** As Ducts



• Typical leakage sites...







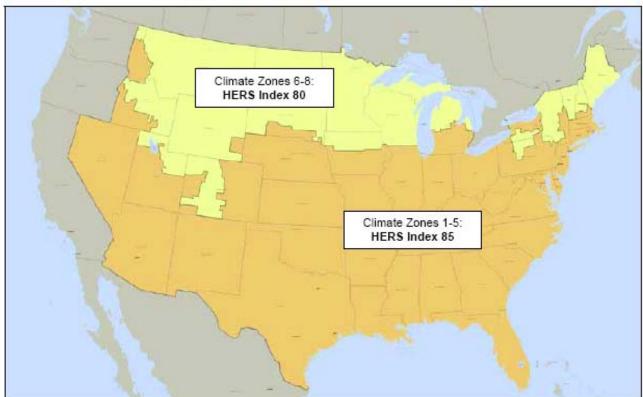




## ENERGY STAR Qualified Homes National Performance Path Requirements

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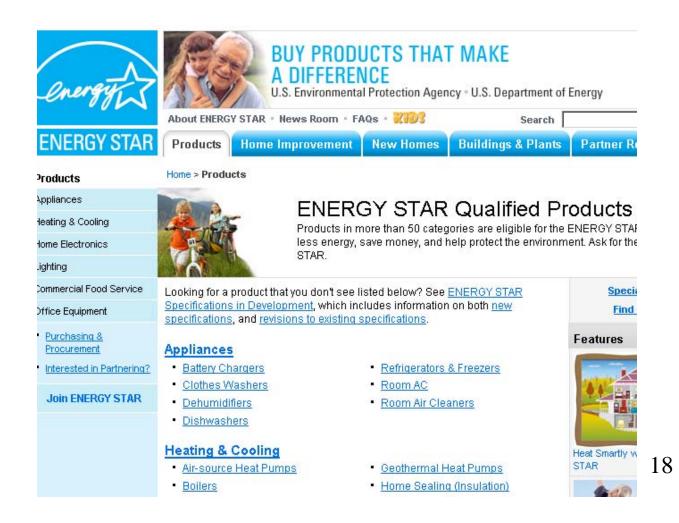
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# Energy Star Qualified Products

- www.energystar.gov
- Select "Products"
  - Windows, Heating/cooling, Appliances, Lighting

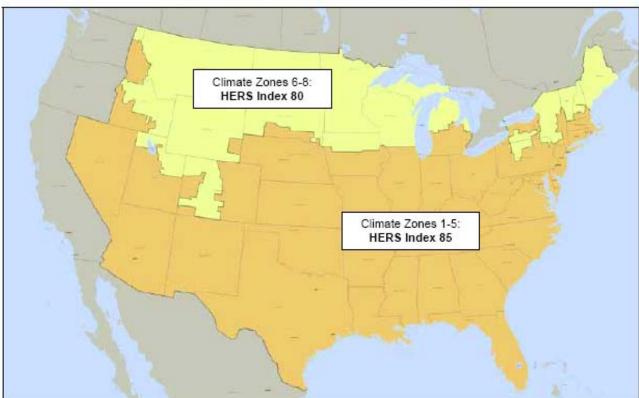




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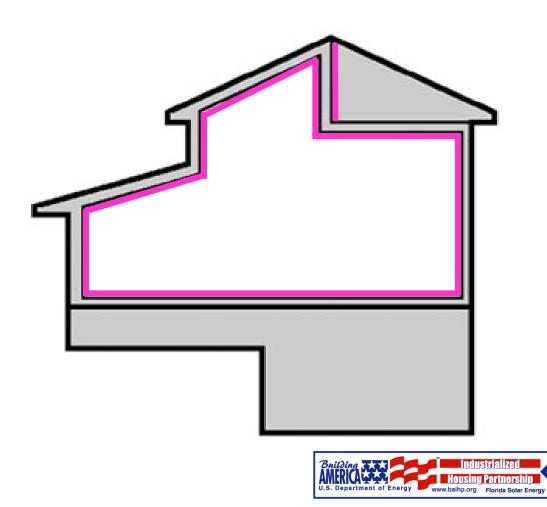
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# Thermal Bypass Inspection

Rater inspects integrity of...

- Air Barrier
- Thermal Barrier
- Alignment of the two



# Thermal Bypass Inspection

- Quality of the "enclosure"
- Eliminating
  - common "holes" in air barrier
  - common bypasses around insulation







## ENERGY STAR Qualified Homes Thermal Bypass Inspection Checklist

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

#### Guidance on Completing the Thermal Bypass Inspection Checklist:

- Accredited HERS Providers and certified home energy raters shall use their experience and discretion in verifying that each Inspection Checklist item is installed per the inspection guidelines (e.g., identifying minor defects that the Provider or rater deems acceptable versus identifying major defects that undermine the intent of the Checklist item).
- Alternative methods of meeting the Checklist requirements may be used in completing the Checklist, if the Provider deems them to be equivalent, or more stringent, than the Inspection Checklist guidelines.
- 3. In the event an item on the Checklist cannot be verified by the rater, the home cannot be qualified as ENERGY STAR, unless the builder assumes responsibility for verifying that the item has met the requirements of the Checklist. This option is available at the discretion of the Provider or rater but may not be used to verify more than six (6) items on the Inspection Checklist. This responsibility will be formally acknowledged by the builder signing-off on the Checklist for the item(s) that they verified. The column titled "N/A" should be used when the checklist item is not present in the home or when local code requirements take precedent.
- The Checklist may be completed for a batch of homes using a RESNET-approved sampling protocol when qualifying homes as ENERGY STAR. For example, if the approved sampling protocol requires rating one in seven homes, then the Checklist will be completed for the one home which was rated.
- In the event that a Provider or rater finds an item that is inconsistent with the Checklist Inspection guidelines, the home cannot be qualified as ENERGY STAR until the item is corrected in a manner that meets the ENERGY STAR requirements. If correction of the item is not possible, the home cannot earn the ENERGY STAR label.
- The Provider or rater is required to keep a hard copy record of the completed and signed Checklist. The signature of a builder employee is also required if the builder verified compliance with any item on the Checklist.
- 7. For purposes of this Checklist, an air barrier is defined as any solid material that blocks air flow between a conditioned space and an unconditioned space, including necessary sealing to block excessive air flow at edges and seams. Additional information on proper air sealing of thermal bypasses can be found on the Building America Web site (www.eere.energy.gov/buildings/building\_america) and in the EEBA Builder's Guides (www.eeba.org). These references include guidance on identifying and sealing air barriers, as well as details on many of the items included in the Checklist.





# ENERGY STAR Qualified Homes Thermal Bypass Inspection Checklist

Thermal Bypass         Inspection Guidelines         Corrections Needed         Builder Patient Werified           1.         Overall Air Barrier and Thermal Barrier Alignment         Requirements: Insulation shall be installed in full contact with sealed interior and extentor air barrier except for atternate to interior air under them.o. 2 (Walk Adjouring Extended Walks or Unconditioned Spaces)         II         III         III         IIII         IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII		City:			State.	
and Thermal Barrier Alignment       Insulation shall be installed in full contact with sealed interior and exterior ar barrier except for alternate to interior air under them o. 2 (Wails Adjoining Exterior Waits or Uticonditioned Spaces)         All Climate Zonesa       Internation of the state adjoining conditioned spaces)         All Climate Zonesa       Internation of the state adjoining conditioned spaces)         International Climate Zones 4 and Higher:       Internation (A maximum of 25% of the stab edge may be uninsulated in Climate Zones 4 and Higher)         International Climate Zones 4 and Higher       Internation (A maximum of 25% of the stab edge may be uninsulated in Climate Zones 4 and Higher)         Is All barder Kill Adjoining Exterior Waits or Unconditioned Spaces       Internation (A maximum of 25% of the stab edge may be uninsulated in Climate Zones 4 and Higher)         Is All barder Kill Adjoining Exterior Waits or Unconditioned Spaces       Requirements:         Waits Adjoining Exterior Waits or Unconditioned Spaces       Requirements:         Is All barder Kill Bard Jones (Thub a) spaced exterior of the exterior Spaces       Insulation fully support exterior Barder Adjoining Porch Roof         Is A Hoarine Is installed at any exposed fibrous insulation edges       Insulation fully support exterior Spaces         Pioors between Conditioned and Exterior Spaces       Requirements:         A Hoarine Is installed at any exposed fibrous insulation edges         Is Insulated Fibror Anove Garage       Insulation is installed at any exposed fibrous ins	Thermal Bypass		Contraction of the Contraction o		Rater	N/A
1.2 Garage Band Jolst All Bartler (at Days adjoining conditioned space)	and Thermal	Insulation shall be installed in full contact with sealed interior and exterior a under item no. 2 (Walls Adjoining Exterior Walls or Unconditioned Spaces)	ir barrier except fo	or alternate to	o interior air t	barrier
1.3 Attic Eave Baffles Where Vents/Leakage Exist   Only at Climate Zones 4 and Higher:   1.4 Stible-deg insulation (A maximum of 25% of the slab edge may be uninsulated in Climate Zones 4 and 5.)   Beet Practices Encouraged. Not Regd(1:   1.5 Air Barrier At All Band Joists (Climate Zones 4 and higher)   1.6 Minimize Thermal Bridging (e.g., OVE framing, SIPs, ICFs)   2. Walls Adjoining Extend Visits or Climate Zones 1 thru 3, sealed exterior arb barner aligned with RESNET Grade 1 insulation fully supp Continuous top and bottom plates or sealed blocking   2. Walls Adjoining Extend Visits or Climate Zones 4 and Signed with arb barrier at both Interior and exterior, OR   4. Memate for Climate Zones 4 and Signed With air barrier at both Interior and exterior, OR   9. Atternate for Climate Zones 1 thru 3, sealed exterior arb barner aligned with RESNET Grade 1 insulation fully supp Continuous top and bottom plates or sealed blocking   2.1 Wall Behind Shower/Tub   2.2 Wall Behind Fineplace   2.3 Insulated Attic Stopes/Walls   2.4 Mol Knee Walls   2.5 Skytight Shart Walls   2.6 Wall Adjoining Porch Roof   2.7 Statrasee Walls   2.8 Aution Is verified to have proper density with firm packing   3. Floors between Conditioned and Exterior Spaces   4. Shafts   4. Shafts   4. Shafts   9. Aution Is verified to have proper density with firm packing   3.1 Insulated Floor Above Garage   3.2 Cantilevered Floor   4. Shafts   9. Autior family for Book for a base no gape, volds or compression.   9. Shafts   9. Shafts <t< td=""><td>&lt;</td><td>1.1 Overali Alignment Throughout Home</td><td></td><td></td><td></td><td></td></t<>	<	1.1 Overali Alignment Throughout Home				
Only al Climate Zones 4 and Higher:           1.4 Slab-edge Insulation (A maximum of 25% of the slab edge may be uninsulated in Climate Zones 4 and S).           Beel Practicese Encouraged, Not Reg'd::           15 Air Barrier AI all Band Joists (Climate Zones 4 and higher)           16 Minimize Thermal Bridging (e.g., OVE framing, SIPs, IOPs)           2. Walls Adjoining Extensive Valls or Unconditioned Spaces           2. Walls Adjoining           2. Walls Bendind Shower/Tub           2.1 Wall Bendind Freptace           2.1 Wall Bendind Freptace           2.3 Insulated Attic Stopes/Walls           2.4 Attic Knee Walls           2.5 Skylight Shart Walls           2.6 Wall Adjoining Porch Roof           2.7 Statrasee Walls           2.8 Double Walls           2.8 Double Walls           2.9 Double Walls           2.1 Insulation Is Installed at any exposed fibrous insulation edges           • Insulation Is installed at any exposed fibrous insulation edges           • Insulation Is installed at any exposed fibrous insulation edges           • Insulation Is verified to have morag		1.2 Garage Band Joist Air Barner (at bays adjoining conditioned space)				
Only at Climate Zones 4 and Higher:           1.4 Stab-edge Insulation (A maximum of 25% of the stab edge may be uninsulated in Climate Zones 4 and S).           Beel Practicese Encouraged, Not Reg'd::           15 Arl Bartier At All Band Joists (Climate Zones 4 and higher)           16 Minimize Thermal Bridging (e.g., OVE framing, SIPs, ICPs)           2. Walls Adjoining Exterior Walls of Unconditioned Spaces           2. Walls Adjoining Exterior Walls of Unconditioned Spaces           3. Floors between Continuous top and bottom plates or sealed blocking           2.1 Wall Benind Shower/Tub           2.2 Wall Benind Shower/Tub           2.3 Insulated Attic Stopes/Walls           2.4 Walls Adjoining Proch Roof           2.5 Skylight Shaft Walls           2.6 Walls Adjoining Proch Roof           2.7 Statraces Walls           2.8 Double Walls           2.9 Double Walls           2.1 Maulated at any exposed fibrous insulation edges           • Insulation Is installed at any exposed fibrous insulation edges           • Insulation Is verified to have no gaps, voids or compression.           • Banket Insulation Is verified to have no gaps, voids or compression.           • Banket Insulation Is verified to have no gaps, voids or compression.           • Insulation Is verified to have no gaps, voids or compression.           • Sharts         Openings to unconditioned space are fully sealed with solid		1.3 Attic Eave Baffles Where Vents/Leakage Exist				
1.5 Air Banter At All Band Joists (Climate Zones 4 and higher)		Only at Climate Zones 4 and Higher: 1.4 Slab-edge Insulation (A maximum of 25% of the slab edge may be uninsulated in Climate Zones 4 and 5.)				
1.6 Minimize Thermal Bridging (e.g., OVE framing, SIPs, ICPs)						
2. Walls Adjoining Exterior Walls of Unconditioned Spaces       Requirements: + Fully insulated wall aligned with all barrier at both interior and exterior, OR - Alternate for Climate Zones 1 thru 3, sealed exterior and exterior, OR - Alternate for Climate Zones 1 thru 3, sealed exterior arb amer aligned with RESNET Grade 1 insulation fully supp - Continuous top and bottom plates or sealed blocking         2.1 Wall Behind Shower/Tub			1			
2.2 Wall Behind Fireptace	Exterior Walls or Unconditioned	Requirements: • Fully insulated wall aligned with air barrier at both interior and exterior, O • Alternate for Climate Zones 1 thru 3, sealed exterior air barrier aligned v	R	de 1 Insulatio	an fully suppl	orted
2.3 Insulated Attic Stopes/Walls     2.4 Attic Knee Walls     2.4 Attic Knee Walls     2.4 Attic Knee Walls     2.5 Skylight Shaft Walls     2.5 Skylight Shaft Walls     2.6 Wall Adjoining Porch Roof     2.7 Staircase Walls     2.8 Double Walls     4.1 barrier is installed at any exposed fibrous insulation edges     4. Insulation is installed to maintain permanent contact with sub-floor above including necessary supports (e.g., staver blankets, netting for blown-in)     4. Shafts     Requirementa:     Openings to unconditioned space are fully sealed with solid blocking or flashing and any remaining gaps are sealed v     caulk or foam (provide fire-rated collars and cauking where required)     4.1 Duct Shaft     Attic/ Celling     Interface     Requirements:     Attic/ Celling     Interface     Requirements:     Attic Access Panel (fully gasketed and insulated)     Insulation with any gaps fully		2.1 Wall Behind Shower/Tub				
2.4 Attic Knee Walls		2.2 Wall Behind Fireplace				
Exterior Spaces     Conditioned and     Exterior Spaces     Condition is installed to maintain permanent contact with sub-floor above including necessary supports (e.g., staves     bianket insulation is verified to have no gaps, volds or compression.     Biown-in insulation is verified to have proper density with firm packing     Conditioned Floor Above Garage     Conditioned Floor Above Garage     Conditioned space are fully sealed with solid blocking or flashing and any remaining gaps are sealed v     caulk or foam (provide fire-rated collars and caulking where required)     Conditioned space are fully sealed with solid blocking or flashing and any remaining gaps are sealed v     caulk or foam (provide fire-rated collars and caulking where required)     Conditioned space are fully sealed with solid blocking or flashing and any remaining gaps are sealed v     caulk or foam (provide fire-rated collars and caulking where required)     Conditioned space are fully sealed with solid blocking or flashing and any remaining gaps are sealed v     caulk or foam (provide fire-rated collars and caulking where required)     Conditioned space are fully sealed with solid blocking or flashing and any remaining gaps are sealed v     caulk or foam (provide fire-rated collars and caulking where required)     Conditioned space are fully sealed with solid blocking or flashing and any remaining gaps are sealed v     caulk or foam (provide fire-rated collars and caulking where required)     Conditioned space are fully gaps fully     with caulk, foam or flap		2.3 Insulated Attic Slopes/Walls				
2.6 Wall Adjoining Porch Roof     2.7 Staircase Walls     2.7 Staircase Walls     2.8 Double Walls     2.8 Double Walls     Air barrier is installed at any exposed fibrous insulation edges     Air barrier is installed to maintain permanent contact with sub-floor above including necessary supports (e.g., staver biankets, netting for blown-in)     Bianket insulation is verified to have no gaps, volds or compression.     Biown-in insulation is verified to have no gaps, volds or compression.     Biown-in insulation is verified to have no gaps, volds or compression.     Biown-in insulation is verified to have proper density with firm packing     3.1 insulated Floor Above Garage     3.2 Cantilevered Floor     Gepenings to unconditioned space are fully sealed with solid blocking or flashing and any remaining gaps are sealed v caulk or foam (provide fire-rated collars and caulking where required)     4.1 Duct Shaft     Attic/ Ceiling interface     Attic/ Ceiling interface     Attic/ Ceiling interface     Attic penetrations and dropped ceilings include a full interior air barrier aligned with insulation with any gaps fully with cault, foam or tape     Movable insulation fits snugly in opening and air barrier is fully gasketed     5.1 Attic Access Panel (fully gasketed and insulated)		2.4 Attic Knee Walls				
2.7 Stalrcase Walls		2.5 Skylight Shaft Walls				
2.7 Staircase Walls				Ē	Ē	Ē
2.6 Double Walls				Ē	Ē	
Floors between Conditioned and Exterior Spaces       Requirements: • Air barrier is installed at any exposed fibrous insulation edges • insulation is installed to maintain permanent contact with sub-floor above including necessary supports (e.g., staver blankets, netting for blown-in) • Blanket insulation is verified to have no gaps, volds or compression. • Blown-in insulation is verified to have no gaps, volds or compression. • Blown-in insulation is verified to have no gaps, volds or compression. • Blown-in insulation is verified to have no gaps, volds or compression. • Blown-in insulation is verified to have no gaps, volds or compression. • Blown-in insulation is verified to have no gaps, volds or compression. • Blown-in insulation is verified to have no gaps, volds or compression. • Blown-in insulation is verified to have no gaps, volds or compression. • Blown-in insulation is verified to have no gaps, volds or compression. • Blown-in insulation is verified to have no gaps, volds or compression. • Blown-in insulation is verified to have no gaps, volds or compression. • Blown-in insulation is verified to have no gaps, volds or compression. • Blown-in insulation is verified to have no gaps, volds or compression. • Blown-in insulation is verified to have no gaps, volds or compression. • Compression unconditioned space are fully sealed with solid blocking or flashing and any remaining gaps are sealed v caulk or foam (provide fire-rated collars and caulking where required) • 4.1 Duct Shaft • All bloc Shaft • All attic penetrations • All attic penetrations and dropped ceilings include a full interior air barrier aligned with insulation with any gaps fully with caulk, foam or tape • Movable insulation fits snugly in opening and air barrier is fully gasketed 5.1 Attic Access Panel (fully gasketed and insulated)				Ē	Ē	H
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4.2 Piping Shaft/Penetrations	Exterior Spaces	Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)     Blanket insulation is verified to have no gaps, volds or compression.     Blown-in insulation is verified to have proper density with firm packing     3.1 insulated Floor Above Garage     3.2 Cantilevered Floor				
4.3 Flue Shaft     4.3 Flue Shaft     Attic/ Celling Interface     All attic penetrations and dropped cellings include a full interior air barrier aligned with insulation with any gaps fully     with caulk, foam or tape     Movable insulation fits snugly in opening and air barrier is fully gasketed     5.1 Attic Access Panel (fully gasketed and insulated)	Exterior Spaces	Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)     Blanket insulation is verified to have no gaps, volds or compression.     Blown-in insulation is verified to have proper density with firm packing     3.1 insulated Floor Above Garage     3.2 Cantilevered Floor     Requirements:     Openings to unconditioned space are fully sealed with solid blocking or flas     caulk or foam (provide fire-rated collars and caulking where required)				
Attic/ Ceiling     Interface     Attic/ penetrations and dropped ceilings include a full interior air barrier aligned with insulation with any gaps fully     with caulk, foam or tape     Movable insulation fits snugly in opening and air barrier is fully gasketed     5.1 Attic Access Panel (fully gasketed and insulated)	Exterior Spaces	Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)     Blanket insulation is verified to have no gaps, volds or compression.     Blown-in insulation is verified to have proper density with firm packing     3.1 Insulated Floor Above Garage     3.2 Cantilevered Floor     Requirements:     Openings to unconditioned space are fully sealed with solid blocking or flas     caulk or foam (provide fire-rated collars and caulking where required)     4.1 Duct Shaft	hing and any rem	alning gaps a	are sealed w	
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	Exterior Spaces	Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)     Blanket insulation is verified to have no gaps, volds or compression.     Blown-in insulation is verified to have proper density with firm packing     3.1 Insulated Floor Above Garage     3.2 Cantilevered Floor     Requirements:     Openings to unconditioned space are fully sealed with solid blocking or flas     caulk or foam (provide fire-rated collars and caulking where required)     4.1 Duct Shaft     4.2 Plping Shaft/Penetrations     4.3 Flue Shaft	hing and any rem	alning gaps a	are sealed w	
5.2 Amc Drop-down Stair (fully gasketed and insulated)	Exterior Spaces	Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)     Blanket insulation is verified to have no gaps, volds or compression.     Blown-in insulation is verified to have proper density with firm packing     3.1 insulated Floor Above Garage     3.2 Cantilevered Floor     Requirements:     Openings to unconditioned space are fully sealed with solid blocking or flas     caulk or foam (provide fire-rated collars and caulking where required)     4.1 Duct Shaft     4.2 Piping Shaft/Penetrations     4.3 Flue Shaft     Requirements:     All attic penetrations and dropped ceilings include a full interior air barrier     with caulk, foam or tape     Movable insulation fits snugly in opening and air barrier is fully gasketed	hing and any rem	aining gaps a	are sealed w	th
	Exterior Spaces	Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)     Blanket insulation is verified to have no gaps, volds or compression.     Blown-in insulation is verified to have proper density with firm packing     3.1 Insulated Floor Above Garage     3.2 Cantilevered Floor     Requirements:     Openings to unconditioned space are fully sealed with solid blocking or flas     caulk or foam (provide fire-rated collars and caulking where required)     4.1 Duct Shaft     4.2 Piping Shaft/Penetrations     4.3 Flue Shaft     Requirements:     • All attic penetrations and dropped ceilings include a full interior air barrier     with caulk, foam or tape     • Movable insulation fits snugly in opening and air barrier is fully gasketed     5.1 Attic Access Panel (fully gasketed and insulated)	hing and any rem	alning gaps a	are sealed w	
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	Exterior Spaces	<ul> <li>Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)</li> <li>Blanket insulation is verified to have no gaps, volds or compression.</li> <li>Blown-in insulation is verified to have proper density with firm packing</li> <li>3.1 Insulated Floor Above Garage</li> <li>3.2 Cantilevered Floor</li> <li>Requirements:</li> <li>Openings to unconditioned space are fully sealed with solid blocking or flas caulk or foam (provide fire-rated collars and caulking where required)</li> <li>4.1 Duct Shaft</li> <li>4.2 Piping Shaft/Penetrations</li> <li>4.3 Flue Shaft</li> <li>Requirements:</li> <li>All attic penetrations and dropped cellings include a full interior air barrier with caulk, foam or tape</li> <li>Movable insulation fits snugly in opening and air barrier is fully gasketed</li> <li>5.1 Attic Access Panel (fully gasketed and insulated)</li> <li>5.2 Attic Drop-down Stair (fully gasketed and insulated)</li> <li>5.3 Dropped Celling/Sofft (full air barrier aligned with insulation)</li> </ul>	hing and any rem	alning gaps a	are sealed w	
	Exterior Spaces	<ul> <li>Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)</li> <li>Blanket insulation is verified to have no gaps, volds or compression.</li> <li>Blown-in insulation is verified to have proper density with firm packing</li> <li>3.1 Insulated Floor Above Garage</li> <li>3.2 Cantilevered Floor</li> <li>Requirements:</li> <li>Openings to unconditioned space are fully sealed with solid blocking or flas caulk or foam (provide fire-rated collars and caulking where required)</li> <li>4.1 Duct Shaft</li> <li>4.2 Piping Shaft/Penetrations</li> <li>4.3 Flue Shaft</li> <li>Requirements:</li> <li>All attic penetrations and dropped ceilings include a full interior air barrier with caulk, foam or tape</li> <li>Movable insulation fits snugly in opening and air barrier is fully gasketed</li> <li>5.1 Attic Access Panel (fully gasketed and insulated)</li> <li>5.2 Attic Drop-down Stair (full gasketed and insulated)</li> <li>5.4 Recessed Lighting Fixtures (ICAT labeled and sealed to drywall)</li> </ul>	hing and any rem	alning gaps a	are sealed w	
Common Walls Between Dweiling Units Common Walls Gap between drywall shaft wall (i.e., common wall) and the structural framing between units is fully sealed at all exter boundary conditions	Exterior Spaces Shafts Attic/ Celling Interface	<ul> <li>Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)</li> <li>Blanket insulation is verified to have no gaps, volds or compression.</li> <li>Blown-in insulation is verified to have proper density with firm packing</li> <li>3.1 Insulated Floor Above Garage</li> <li>3.2 Cantilevered Floor</li> <li>Requirements:</li> <li>Openings to unconditioned space are fully sealed with solid blocking or flas caulk or foam (provide fire-rated collars and caulking where required)</li> <li>4.1 Duct Shaft</li> <li>4.2 Piping Shaft/Penetrations</li> <li>4.3 Flue Shaft</li> <li>Requirements:</li> <li>All attic penetrations and dropped ceilings include a full interior air barrier with caulk, foam or tape</li> <li>Movable insulation fits snugly in opening and air barrier is fully gasketed</li> <li>5.1 Attic Access Panel (fully gasketed and insulated)</li> <li>5.2 Attic Drop-down Stair (full air barrier aligned with insulation)</li> <li>5.4 Recessed Lighting Fixtures (ICAT labeled and sealed to drywall)</li> <li>5.5 Whole-house Fan (insulated cover gasketed to the opening)</li> </ul>	hing and any rem	alning gaps a	are sealed w	
6.1 Common Wall Between Dwelling Units	Exterior Spaces  Shafts  Attic/ Celling Interface  Common Walls Between Dwelling	<ul> <li>Insulation Is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)</li> <li>Blanket Insulation Is verified to have no gaps, volds or compression.</li> <li>Blown-in insulation is verified to have proper density with firm packing</li> <li>3.1 Insulated Floor Above Garage</li> <li>3.2 Cantilevered Floor</li> <li>Requirements:</li> <li>Openings to unconditioned space are fully sealed with solid blocking or flas caulk or foam (provide fire-rated collars and caulking where required)</li> <li>4.1 Duct Shaft</li> <li>4.2 Piping Shaft/Penetrations</li> <li>4.3 Flue Shaft</li> <li>Requirements:</li> <li>All attic penetrations and dropped cellings include a full interior air barrier with caulk, foam or tape</li> <li>Movable insulation fits snugly in opening and air barrier is fully gasketed</li> <li>5.1 Attic Access Panel (fully gasketed and insulated)</li> <li>5.2 Attic Drop-down Stair (fully gasketed and insulated)</li> <li>5.3 Dropped Celling/Soffit (full air barrier aligned with insulation)</li> <li>5.4 Recessed Lighting Fixtures (ICAT labeled and sealed to drywall)</li> <li>5.5 Whole-house Fan (insulated cover gasketed to the opening)</li> <li>Requirements:</li> <li>Gap between drywall shaft wall (i.e., common wall) and the structural framili</li> </ul>	hing and any rem	alning gaps a	are sealed w	

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#### 1.1 AIR BARRIER AND THERMAL ALIGNMENT

Generally, the Thermal Bypass Inspection Checklist requires a sealed air-barrier on all six sides of insulation (top, bottom, back, front, left, and right), however, there are a few exceptions as noted throughout the checklist. In Climate Zones 1 thru 3, there is a general exemption for the internal air barrier closest to conditioned space because the predominant direction of air-flow in hot climates is from the outside to the inside of the house. In Climate Zones 4 thru 6, the most critical air-flow is from inside the home to the outside during cold weather, therefore the internal air barrier is required.

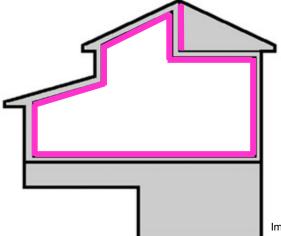


Image courtesy of Southface Energy Institute

## Figure 1.1.3 - The air barrier should be contiguous and continuous over the entire building envelope. Insulation should be perfectly aligned with the air barrier.

In order for insulation to be an effective thermal barrier, it should be installed without any gaps, voids, compression, or wind intrusion. Gaps and voids allow air to flow through the insulation, decreasing its effectiveness (Figure 1.1.4). Compression reduces the effective R-value of the insulation.

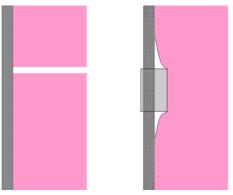


Figure 1.1.4 - Gaps (left) and voids (right) allow air to flow through insulation.

The following images depict misalignment between the air barrier and insulation that undermine the performance of the thermal enclosure.



## 1.1 AIR BARRIER AND THERMAL ALIGNMENT

## **KEY POINTS**

### Installation Criteria:

- Insulation shall be installed in full contact with the air barrier on all six sides to provide continuous alignment with the air barrier. For example, batt insulation shall be cut to fit around any wiring, pipes, or blocking and shall be correctly sized for wall width and height.
- Climate Zones 1 thru 3 are not required to have an inside air barrier at exterior wall assemblies since the predominant driving force in hot climates is from outside to inside.
- Two general exceptions to the requirement for a six-sided air barrier with insulation are at band joist insulation and at the top of ceiling insulation. Although a significant performance advantage is realized where a six-sided assembly is provided (e.g. SIPs), band joist insulation is only required to be in contact with the exterior framing and any exposed edges, and ceiling insulation is only required to be in contact with the airbarrier below (e.g. the ceiling sheetrock) and at any exposed edges. This is due to current cost effectiveness concerns with traditional construction practices. As a best practice, air barriers at band joists are discussed further in Section 1.5.

### Tips and Best Practices:

- When choosing insulation, consider options that most readily achieve the proper installation requirements.
- Verify that insulation subcontractor installers are trained and/or certified in proper installation practices.



# **Bad Insulation Installation**





# **Good Insulation Installation**









RUNUMU D

## ENERGY STAR Qualified Homes Thermal Bypass Inspection Checklist

ть		City:	10	D. 21	State:	
. IT	nermal Bypass	Inspection Guidelines	Corrections Needed	Builder Verified	Rater Verified	N/A
I.	Overall Air Barrier and Thermai Barrier Allgnment	Requirements: Insulation shall be installed in full contact with sealed interior and exterior a under item no. 2 (Walls Adjoining Exterior Walls or Unconditioned Spaces)		or alternate to	o interior air i	barrie
		All Climate Zones: 1.1 Overall Alignment Throughout Home				
			<u> </u>	H		
		1.2 Garage Band Joist Air Barrier (at bays adjoining conditioned space)			<u> </u>	
	•	1.3 Attic Eave Baffies Where Vents/Leakage Exist				
		Only at Climate Zones 4 and Higher: 1.4 Slab-edge insulation (A maximum of 25% of the slab edge may be uninsulated in Climate Zones 4 and 5.) Best Practices Encouraged, Not Reg'd.:				
		1.5 Air Barrier At All Band Joists (Climate Zones 4 and higher)				
		1.6 Minimize Thermal Bridging (e.g., OVE framing, SIPs, ICFs)	Ē	Ē	Ē	
2	Walls Adjoining Exterior Walls or Unconditioned Spaces	Requirements: • Fully insulated wall aligned with air barrier at both interior and exterior, O • Alternate for Climate Zones 1 thru 3, sealed exterior air barrier aligned • Continuous top and bottom plates or sealed blocking		de 1 Insulatio	on fully supp	orted
		2.1 Wall Behind Shower/Tub				
		2.2 Wall Behind Fireplace				
		2.3 Insulated Attic Slopes/Walls				
		2.4 Attic Knee Walls				
		2.5 Skylight Shaft Walls				
		2.6 Wall Adjoining Porch Roof				
		2.7 Staircase Walls				
		2.8 Double Walls			П	
J.	Floors between Conditioned and Exterior Spaces	Requirements: • Air barrier is installed at any exposed fibrous insulation edges • Insulation is installed to maintain permanent contact with sub-fibor above blocking activities for blocking link	e including necess	ary supports	(e.g., staves	for
3.	Conditioned and	<ul> <li>Air barrier is installed at any exposed fibrous insulation edges</li> <li>Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)</li> <li>Blanket insulation is verified to have no gaps, volds or compression.</li> <li>Blown-in insulation is verified to have proper density with firm packing</li> </ul>	e including necess	ary supports	(e.g., staves	for
3.	Conditioned and	<ul> <li>Air barrier is installed at any exposed fibrous insulation edges</li> <li>Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)</li> <li>Blanket insulation is verified to have no gaps, volds or compression.</li> <li>Blown-in insulation is verified to have proper density with firm packing</li> <li>3.1 insulated Floor Above Garage</li> </ul>	e Including necess	ary supports	(e.g., staves	for
3.	Conditioned and	<ul> <li>Air barrier is installed at any exposed fibrous insulation edges</li> <li>Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)</li> <li>Blanket insulation is verified to have no gaps, volds or compression.</li> <li>Blown-in insulation is verified to have proper density with firm packing</li> <li>3.1 Insulated Floor Above Garage</li> <li>3.2 Cantilevered Floor</li> </ul>	e Including necess	ary supports	(e.g., staves	for
	Conditioned and	<ul> <li>Air barrier is installed at any exposed fibrous insulation edges</li> <li>Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)</li> <li>Blanket insulation is verified to have no gaps, volds or compression.</li> <li>Blown-in insulation is verified to have proper density with firm packing</li> <li>3.1 insulated Floor Above Garage</li> </ul>				
	Conditioned and Exterior Spaces	Air barrier is installed at any exposed fibrous insulation edges     Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)     Blanket insulation is verified to have no gaps, volds or compression.     Blown-in insulation is verified to have proper density with firm packing     3.1 insulated Floor Above Garage     3.2 Cantilevered Floor     Requirements:     Openings to unconditioned space are fully sealed with solid blocking or flait				
	Conditioned and Exterior Spaces	Air barrier is installed at any exposed fibrous insulation edges     Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)     Blanket insulation is verified to have no gaps, volds or compression.     Blown-in insulation is verified to have proper density with firm packing     3.1 insulated Floor Above Garage     3.2 Cantilevered Floor     Requirements:     Openings to unconditioned space are fully sealed with solid blocking or flar     caulk or foam (provide fire-rated collars and caulking where required)			are sealed w	
	Conditioned and Exterior Spaces	Air barrier is installed at any exposed fibrous insulation edges     Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)     Blanket insulation is verified to have no gaps, volds or compression.     Blown-in insulation is verified to have proper density with firm packing     3.1 Insulated Floor Above Garage     3.2 Cantilevered Floor     Requirements:     Openings to unconditioned space are fully sealed with solid blocking or flas     caulk or foam (provide fire-rated collars and caulking where required)     4.1 Duct Shaft			are sealed w	
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4.	Conditioned and Exterior Spaces Shafts Attic/ Celling	Air barrier is installed at any exposed fibrous insulation edges     Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)     Blanket insulation is verified to have no gaps, volds or compression.     Blown-in insulation is verified to have proper density with firm packing     3.1 Insulated Floor Above Garage     3.2 Cantilevered Floor     Requirements:     Openings to unconditioned space are fully sealed with solid blocking or flat     caulk or foam (provide fire-rated collars and caulking where required)     4.1 Duct Shaft     4.2 Piping Shaft/Penetrations     4.3 Flue Shaft     Requirements:     • All attic penetrations and dropped ceilings include a full interior air barrie	shing and any ren	iaining gaps :	are sealed w	th seale
4.	Conditioned and Exterior Spaces Shafts Attic/ Celling	<ul> <li>Air barrier is installed at any exposed fibrous insulation edges</li> <li>Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)</li> <li>Blanket insulation is verified to have no gaps, volds or compression.</li> <li>Blown-in insulation is verified to have proper density with firm packing</li> <li>3.1 Insulated Floor Above Garage</li> <li>3.2 Cantilevered Floor</li> <li>Requirements:</li> <li>Openings to unconditioned space are fully sealed with solid blocking or flat caulk or foam (provide fire-rated collars and caulking where required)</li> <li>4.1 Duct Shaft</li> <li>Requirements:</li> <li>All attic penetrations and dropped ceilings include a full interior air barrie with caulk, foam or tape</li> <li>Movable insulation fits snugly in opening and air barrier is fully gasketed</li> </ul>	shing and any rem	aining gaps a	are sealed w	Ith Seale
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4.	Conditioned and Exterior Spaces Shafts Attic/ Celling	<ul> <li>Air barrier is installed at any exposed fibrous insulation edges</li> <li>Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)</li> <li>Blanket insulation is verified to have no gaps, volds or compression.</li> <li>Blown-in insulation is verified to have proper density with firm packing</li> <li>3.1 Insulated Floor Above Garage</li> <li>3.2 Cantilevered Floor</li> <li>Requirements:</li> <li>Openings to unconditioned space are fully sealed with solid blocking or flat caulk or foam (provide fire-rated collars and caulking where required)</li> <li>4.1 Duct Shaft</li> <li>4.2 Piping Shaft/Penetrations</li> <li>4.3 Flue Shaft</li> <li>Requirements:</li> <li>All attic penetrations and dropped ceilings include a full interior air barrie with caulk, foam or tape</li> <li>Movable insulation fits snugly in opening and air barrier is fully gasketed</li> <li>5.1 Attic Drop-down Stair (fully gasketed and insulated)</li> </ul>	shing and any rem	alning gaps a	are sealed w	
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4. 5.	Conditioned and Exterior Spaces Shafts Attic/ Celling Interface Common Walls Between Dweiling Units	<ul> <li>Air barrier is installed at any exposed fibrous insulation edges</li> <li>Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)</li> <li>Blanket insulation is verified to have no gaps, volds or compression.</li> <li>Blown-In insulation is verified to have proper density with firm packing</li> <li>3.1 Insulated Floor Above Garage</li> <li>3.2 Cantilevered Floor</li> <li>Requirements:</li> <li>Openings to unconditioned space are fully sealed with solid blocking or flat caulk or foam (provide fire-rated collars and caulking where required)</li> <li>4.1 Duct Shaft</li> <li>4.2 Piping Shaft/Penetrations</li> <li>4.3 Flue Shaft</li> <li>Requirements:</li> <li>All attic penetrations and dropped cellings include a full interior air barrie with caulk, foam or tape</li> <li>Movable insulation fits snugly in opening and air barrier is fully gasketed</li> <li>5.1 Attic Access Panel (fully gasketed and insulated)</li> <li>5.2 Attic Drop-down Stair (fully gasketed and insulated)</li> <li>5.3 Dropped Celling/Sofft (full air barrier aligned with insulation)</li> <li>5.4 Recessed Lighting Fixtures (ICAT labeled and sealed to drywall)</li> <li>5.5 Whole-house Fan (insulated cover gasketed to the opening)</li> <li>Requirements:</li> <li>Gap between drywall shaft wall (i.e., common wall) and the structural framiboundary conditions</li> </ul>	shing and any rem	alning gaps a	are sealed w	
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# **1.3 ATTIC EAVE BAFFLES**

# **KEY POINTS**

#### Installation Criteria:

• Solid baffles shall be provided at all framing bays with soffit vents to prevent wind washing at attic insulation.

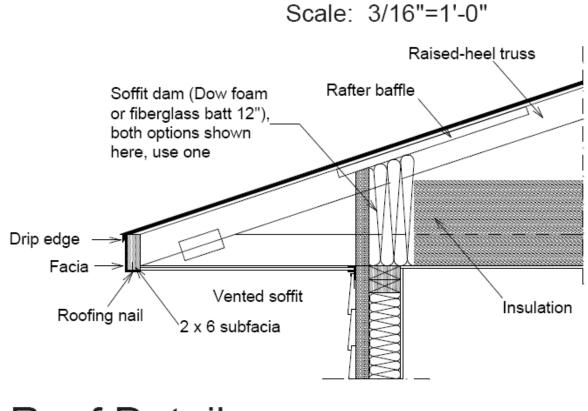
#### **Tips and Best Practices:**

• Even if soffit vents are not continuous, wind baffles are strongly recommended at all framing bays since air gaps commonly occur between roof sheathing and the fascia board. This can allow wind intrusion along the entire roof edge.





# "Dam" for blown-in foam, cellulose, and fiberglass



# Roof Detail





## ENERGY STAR Qualified Homes Thermal Bypass Inspection Checklist

-		City:		L D	State:	
	hermal Bypass	Inspection Guidelines	Corrections Needed	Builder	Rater Verified	N/A
1.	Overall Air Barrier and Thermal Barrier Alignment	Requirements: Insulation shall be installed in full contact with sealed interior and exterior a under item no. 2 (Walls Adjoining Exterior Walls or Unconditioned Spaces)	ir barrier except f			barrier
		All Climate Zones:	_		_	-
		1.1 Overali Alignment Throughout Home			<u> </u>	
		<ol> <li>1.2 Garage Band Joist Air Barrier (at bays adjoining conditioned space)</li> </ol>				
		1.3 Attic Eave Baffies Where Vents/Leakage Exist				
		Only at Climate Zones 4 and Higher: 1.4 Slab-edge insulation (A maximum of 25% of the slab edge may be uninsulated in Climate Zones 4 and 5.) Best Practices Encouraged, Not Reg'd.:				
		1.5 Air Barrier At All Band Joists (Climate Zones 4 and higher)				
		1.6 Minimize Thermal Bridging (e.g., OVE framing, SIPs, ICFs)	<u> </u>	Ē	Ē	Ē
2	Walls Adjoining Exterior Walls or Unconditioned Spaces	Requirements: • Fully insulated wall aligned with air barrier at both interior and exterior, O • Alternate for Climate Zones 1 thru 3, sealed exterior air barrier aligned v • Continuous top and bottom plates or sealed blocking		ade 1 Insulatio	on fully supp	orted
		2.1 Wali Behind Shower/Tub				
		22 Weil Behind Fireplace				
		2.3 Insulated Attic Slopes/Walls				
		2.4 Attic Knee Walls				
		2.5 Skylight Shaft Walls				
		2.6 Wali Adjoining Porch Roof				
		2.7 Staircase Walls				
		2.8 Double Walls				1
3.	Floors between Conditioned and Exterior Spaces	Requirements: • Air barrier is installed at any exposed fibrous insulation edges • Insulation is installed to maintain permanent contact with sub-floor above blackets patting for blown in	including necess	ary supports	(e.g., staves	for
3.	Conditioned and	<ul> <li>Air barrier is installed at any exposed fibrous insulation edges</li> <li>Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)</li> <li>Blanket insulation is verified to have no gaps, voids or compression.</li> <li>Blown-in insulation is verified to have proper density with firm packing</li> </ul>				for
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4. 5.	Conditioned and Exterior Spaces Shafts Attic/ Celling Interface Common Walls Between Dwelling Units	<ul> <li>Air barrier is installed at any exposed fibrous insulation edges</li> <li>Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)</li> <li>Blanket insulation is verified to have no gaps, volds or compression.</li> <li>Blown-in insulation is verified to have proper density with firm packing</li> <li>3.1 insulated Floor Above Garage</li> <li>3.2 Cantilevered Floor</li> <li>Requirements:</li> <li>Openings to unconditioned space are fully sealed with solid blocking or flas caulk or foam (provide fire-rated collars and caulking where required)</li> <li>4.1 Duct Shaft</li> <li>4.2 Piping Shaft/Penetrations</li> <li>4.3 Flue Shaft</li> <li>Requirements:</li> <li>All attic penetrations and dropped cellings include a full interior air barrier with caulk, foam or tape</li> <li>Movable insulation fits snugly in opening and air barrier is fully gasketed</li> <li>5.1 Attic Access Panel (fully gasketed and insulated)</li> <li>5.2 Attic Drop-down Stair (full gasketed and insulated)</li> <li>5.3 Dropped Celling/Soffit (full air barrier aligned with insulation)</li> <li>5.4 Recessed Lighting Fixtures (ICAT labeled and sealed to drywall)</li> <li>5.5 Whole-house Fan (insulated cover gasketed to the opening)</li> <li>Requirements:</li> <li>Gap between drywall shaft wall (i.e., common wall) and the structural framit boundary conditions</li> </ul>	aligned with Insu	alining gaps a	are sealed w	



## 2.1 WALL BEHIND SHOWER/TUB

# **KEY POINTS**

#### **Installation Criteria:**

• Exterior walls shall be enclosed on all six sides, including a complete and continuous air barrier behind the tub. An exception is provided for Climate Zones 1 thru 3 where as an alternative to the inside air barrier, the builder can install a fully sealed and continuous exterior along with RESNET Grade 1 insulation fully supported.

#### Tips and Best Practices:

- Use a material that is readily available to ensure the air barrier is installed prior to setting the tub. Plywood, oriented strand board (OSB), sheathing boards, and drywall are good choices.
- Using spray foam at framing behind tubs is also an option to avoid labor installing both air barrier and insulation. However, it will need to be installed prior to setting the tub or shower.
- Insulation material and air barrier sheathing should be made available on site for installation by the framing subcontractor prior to plumbing rough-ins, or the framing subcontractor could install an air barrier behind the tub with the wall cavity left accessible for installation of loose fill or blown-in insulation by the insulation subcontractor.





## ENERGY STAR Qualified Homes Thermal Bypass Inspection Checklist

Home Address:	City:			State:	
Thermal Bypass	Inspection Guidelines	Corrections Needed	Builder Verified	Rater Verified	N//
<ol> <li>Overall Air Barrier and Thermal Barrier Alignment</li> </ol>	Requirements: Insulation shall be installed in full contact with sealed interior and exterior a under item no. 2 (Walls Adjoining Exterior Walls or Unconditioned Spaces) All Climate Zones:		or alternate t	o interior air t	oarrie
	1.1 Overali Alignment Throughout Home				
	1.2 Garage Band Joist Air Barrier (at bays adjoining conditioned space)				
	1.3 Attic Eave Baffles Where Vents/Leakage Exist				
	Only at Climate Zones 4 and Higher:				_
	<ol> <li>4 Slab-edge Insulation (A maximum of 25% of the slab edge may be uninsulated in Climate Zones 4 and 5.)</li> </ol>				
	Best Practices Encouraged, Not Req'd.:			-	-
	1.5 Air Barrier At All Band Joists (Climate Zones 4 and higher)			<u> </u>	
2. Walls Adjoining	1.6 Minimize Thermal Bridging (e.g., OVE framing, SIPs, ICFs) Regultrements:				
Exterior Walls or Unconditioned Spaces	Fully insulated wall aligned with air barrier at both interior and exterior, O     Alternate for Climate Zones 1 thru 3, sealed exterior air barrier aligned     Continuous top and bottom plates or sealed blocking     2.1 Wall Behind Shower/Tub		ide 1 Insulatio	on fully suppl	orted
	2.2 Wall Behind Fireplace				Ē
	2.3 Insulated Attic Slopes/Walls	Ē	1 n	Ē	Ē
	2.4 Attic Knee Walls	- H	H	H	
	2.5 Skylight Shaft Walls		- T	H H	
	2.6 Wali Adioining Porch Roof		H	H	F
			H	H	
	2.7 Staircase Walls				_
<ol> <li>Floors between Conditioned and Exterior Spaces</li> </ol>	2.8 Double Walls     Requirements:     Air barrier is installed at any exposed fibrous insulation edges     Insulation is installed to maintain permanent contact with sub-floor above	Including necess	ary supports	(e.g., staves	
Conditioned and	Requirements: • Air barrier is installed at any exposed fibrous insulation edges • Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in) • Blanket insulation is verified to have no gaps, volds or compression.				for
Conditioned and	Requirements: • Air barrier is installed at any exposed fibrous insulation edges • insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)				
Conditioned and	Requirements:         Air barrier is installed at any exposed fibrous insulation edges           Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)         Blanket insulation is verified to have no gaps, volds or compression.           Blown-in insulation is verified to have proper density with firm packing				
Conditioned and	Requirements:         Air barrier is installed at any exposed fibrous insulation edges           Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)         Blanket insulation is verified to have no gaps, volds or compression.           Blown-in insulation is verified to have proper density with firm packing         3.1 insulated Floor Above Garage	Including necess	ary supports	(e.g., staves	for
Conditioned and Exterior Spaces	Requirements:           • Air barrier is installed at any exposed fibrous insulation edges           • Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)           • Blanket insulation is verified to have no gaps, volds or compression.           • Blown-in insulation is verified to have proper density with firm packing           3.1 Insulated Floor Above Garage           3.2 Cantilevered Floor           Requirements:           Openings to unconditioned space are fully sealed with solid blocking or flat	Including necess	ary supports	(e.g., staves	for C
Conditioned and Exterior Spaces	Requirements:         • Air barrier is installed at any exposed fibrous insulation edges         • Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)         • Blanket insulation is verified to have no gaps, volds or compression.         • Blown-in insulation is verified to have proper density with firm packing         3.1 Insulated Floor Above Garage         3.2 Cantilevered Floor         Requirements:         Openings to unconditioned space are fully sealed with solid blocking or flat caulk or from (provide fire rated collars and caulking where required)         4.1 Duct Shaft	including necess	ary supports	(e.g., staves	for
Conditioned and Exterior Spaces	Requirements:           • Air barrier is installed at any exposed fibrous insulation edges           • Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)           • Blanket insulation is verified to have no gaps, volds or compression.           • Blown-in insulation is verified to have proper density with firm packing           3.1 Insulated Floor Above Garage           3.2 Cantilevered Floor           Requirements:           Openings to unconditioned space are fully sealed with solid blocking or flat caulk or from (provide fire rated collars and caulking where required)	including necess	ary supports	(e.g., staves	for
Conditioned and Exterior Spaces	Requirementa:         • Air barrier is installed at any exposed fibrous insulation edges         • Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)         • Blanket insulation is verified to have no gaps, volds or compression.         • Blanket insulation is verified to have proper density with firm packing         3.1 Insulated Floor Above Garage         3.2 Cantilevered Floor         Requirementa:         Openings to unconditioned space are fully sealed with solid blocking or flat caulk or foam (provide fire rated collars and caulking where required)         4.1 Duct Shaft         •.2 Ripleg Shaft/Denetrations         4.3 Flue Shaft         Requirements:         • All attic penetrations and dropped cellings include a full interior air barrier with caulk, foam or tape	e including necess	ary supports	(e.g., staves	
Conditioned and Exterior Spaces	Requirements:         • Air barrier is installed at any exposed fibrous insulation edges         • Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)         • Blanket insulation is verified to have no gaps, volds or compression.         • Blanket insulation is verified to have proper density with firm packing         3.1 Insulated Floor Above Garage         3.2 Cantilevered Floor         Requirements:         Openings to unconditioned space are fully sealed with solid blocking or flat caulk or fbart (provide fire rated collars and caulking where required)         4.1 Duct Shaft         •.2 Plying Shaft/Penetrations         4.3 Flue Shaft         Requirements:         • All attic penetrations and dropped ceilings include a full interior air barrier	e including necess	ary supports	(e.g., staves	for
Conditioned and Exterior Spaces	Requirements:         • Air barrier is installed at any exposed fibrous insulation edges         • Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)         • Blanket insulation is verified to have no gaps, volds or compression.         • Blanket insulation is verified to have proper density with firm packing         3.1 Insulated Floor Above Garage         3.2 Cantilevered Floor         Requirements:         Openings to unconditioned space are fully sealed with solid blocking or flat caulk or foam (provide fire cated collars and caulking where required)         4.1 Duct Shaft         •.2 Sping Shaft/Benetrations         4.3 Flue Shaft         Requirements:         • All attic penetrations and dropped ceilings include a full interior air barrie with caulk, foam or tape         • Movable insulation fits snugly in opening and air barrier is fully gasketed         5.1 Attic Access Panel (fully gasketed and insulated)	e including necess	any supports	(e.g., staves	for the the seale
Conditioned and Exterior Spaces	Requirements:         • Air barrier is installed at any exposed fibrous insulation edges         • Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)         • Blanket insulation is verified to have no gaps, volds or compression.         • Blanket insulation is verified to have proper density with firm packing         3.1 Insulated Floor Above Garage         3.2 Cantilevered Floor         Requirements:         Openings to unconditioned space are fully sealed with solid blocking or flat caulk or foam (provide fire rated collars and caulking where required)         4.1 Duct Shaft <b>4.2 Requirements:</b> • All attic penetrations and dropped cellings include a full interior air barrie with caulk, foam or tape         • Movable Insulation fits snugly in opening and air barrier is fully gasketed         5.1 Attic Access Panel (fully gasketed and insulated)         5.2 Attic Drop-down Stair (fully gasketed and insulated)	e including necess	any supports	(e.g., staves	for th seale
Conditioned and Exterior Spaces	Requirements:         • Air barrier is installed at any exposed fibrous insulation edges         • Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)         • Blanket insulation is verified to have no gaps, volds or compression.         • Blanket insulation is verified to have proper density with firm packing         3.1 Insulated Floor Above Garage         3.2 Cantilevered Floor         Requirements:         Openings to unconditioned space are fully sealed with solid blocking or flat caulk or foam (provide fire rated collars and caulking where required)         4.1 Duct Shaft         4.2 Flying Shaft/Penetrations         4.3 Flue Shaft         Requirements:         • All attic penetrations and dropped cellings include a full interior air barrier with caulk, foam or tape         • Movable Insulation fits snugly in opening and air barrier is fully gasketed         5.1 Attic Access Panel (fully gasketed and insulated)         5.2 Attic Drop-down Stair (fully gasketed and insulated)         5.3 Dropped Celling/Sofft (full air barrier aligned with insulation)	e including necess	any supports	(e.g., staves	
Conditioned and Exterior Spaces	Requirements:         • Air barrier is installed at any exposed fibrous insulation edges         • Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)         • Blanket insulation is verified to have no gaps, volds or compression.         • Blown-in insulation is verified to have proper density with firm packing         3.1 Insulated Floor Above Garage         3.2 Cantilevered Floor         Requirements:         Openings to unconditioned space are fully sealed with solid blocking or flat caulk or fnam (provide fire rated collars and caulking where required)         4.1 Duct Shaft         4.3 Flue Shaft         Requirements:         • All attic penetrations and dropped cellings include a full interior air barrier with caulk, foam or tape         • Movable insulation fits snugly in opening and air barrier is fully gasketed         5.1 Attic Access Panel (fully gasketed and insulated)         5.2 Attic Drop-down Stair (full gasketed and insulated)         5.3 Dropped Celling/Soffit (full alr barrier aligned with insulation)         5.4 Recessed Lighting Fixtures (ICAT labeled and sealed to drywall)	e including necess	any supports	(e.g., staves	
Conditioned and Exterior Spaces	Requirements:         • Air barrier is installed at any exposed fibrous insulation edges         • Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)         • Blanket insulation is verified to have no gaps, volds or compression.         • Blanket insulation is verified to have proper density with firm packing         3.1 Insulated Floor Above Garage         3.2 Cantilevered Floor         Requirements:         Openings to unconditioned space are fully sealed with solid blocking or flat caulk or foam (provide fire rated collars and caulking where required)         4.1 Duct Shaft         Requirements:         • All attic penetrations and dropped cellings include a full interior air barrie with caulk, foam or tape         • Movable Insulation fits snugly in opening and air barrier is fully gasketed         5.1 Attic Access Panel (fully gasketed and insulated)         5.2 Attic Drop-down Stair (fully gasketed and insulated)         5.3 Dropped Celling/Soffit (full air barrier aligned with insulation)         5.4 Recessed Lighting Fixtures (ICAT labeled and sealed to drywall)         5.5 Whole-house Fan (insulated cover gasketed to the opening)         Requirements:	e including necess	any supports	(e.g., staves	
Conditioned and Exterior Spaces 4. Shafts 5. Attic/ Celling Interface 6. Common Walls Between Dweiling	Requirements:         • Air barrier is installed at any exposed fibrous insulation edges         • Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)         • Bianket insulation is verified to have no gaps, volds or compression.         • Biown-in insulation is verified to have proper density with firm packing         3.1 Insulated Floor Above Garage         3.2 Cantilevered Floor         Requirements:         Openings to unconditioned space are fully sealed with solid blocking or flat caulk or foam increate free reled collars and caulking where required)         4.1 Duct Shaft         *: 2 Piping Shaft/Denetrations         4.3 Flue Shaft         Requirements:         • All attic penetrations and dropped cellings include a full interior air barrie with caulk, foam or tape         • Movable insulation fits snugly in opening and air barrier is fully gasketed         5.1 Attic Access Panel (fully gasketed and insulated)         5.2 Attic Drop-down Stair (fully gasketed and insulated)         5.3 Dropped Celling/Soffit (full air barrier aligned with insulation)         5.4 Recessed Lighting Fixtures (ICAT labeled and sealed to drywall)         5.5 Whole-house Fan (insulated cover gasketed to the opening)         Requirements:         Gap between drywall shaft wall (i.e., common wall) and the structural fram	e including necess	any supports	(e.g., staves	
Conditioned and Exterior Spaces 4. Shafts 5. Attic/ Celling Interface 5. Common Walls Between Dwelling Units	Requirements:         • Air barrier is installed at any exposed fibrous insulation edges         • Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)         • Biawn-in insulation is verified to have no gaps, volds or compression.         • Biown-in insulation is verified to have proper density with firm packing         3.1 Insulated Floor Above Garage         3.2 Cantilevered Floor         Requirements:         Openings to unconditioned space are fully sealed with solid blocking or flat caulk or foam (provide fice-rated collars and caulking where required)         4.1 Duct Shaft         •: Pipleg Shaft/Denetrations         4.3 Flue Shaft         Requirements:         • All attic penetrations and dropped cellings include a full interior air barrie with caulk, foam or tape         • Movable insulation filts snugly in opening and air barrier is fully gasketed         5.1 Attic Access Panel (fully gasketed and insulated)         5.2 Attic Drop-down Stair (full gasketed and insulated)         5.3 Dropped Celling/Soffit (full air barrier aligned with insulation)         5.4 Recessed Lighting Fixtures (ICAT labeled and sealed to drywall)         5.5 Whole-house Fan (insulated cover gasketed to the opening)         Requirements:         Gap between drywall shaft wall (i.e., common wall) and the structural fram boundary conditions	e including necess	ary supports ary supports anining gaps anini	(e.g., slaves	





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# 4.1 DUCT SHAFT

## **KEY POINTS**

#### **Installation Criteria:**

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

### **Tips and Best Practices:**

- Since the flashing or framed caps at shafts and penetrations are typically installed by the framing subcontractors before the HVAC trades do their work, make sure subcontractors understand the importance of complete air barrier assemblies.
- Use mastic to seal cracks and gaps.



Well Sealed



Not sealed





## ENERGY STAR Qualified Homes Thermal Bypass Inspection Checklist

Th	ome Address:	City:			_State:	
	hermal Bypass	Inspection Guidelines	Corrections Needed	Builder Verified	Rater Verified	N//
	Overall Air Barrier and Thermal Barrier Alignment	Requirements: Insulation shall be installed in full contact with sealed interior and exterior a under Item no. 2 (Waits Adjoining Exterior Waits or Unconditioned Spaces) All Climate Zones:		or alternate to	o interior air t	barrie
		1.1 Overall Alignment Throughout Home				
		1.2 Garage Band Joist Air Barrier (at bays adjoining conditioned space)				
		1.3 Attic Eave Baffles Where Vents/Leakage Exist				
		Only at Climate Zones 4 and Higher: 1.4 Slab-edge insulation (A maximum of 25% of the slab edge may be uninsulated in Climate Zones 4 and 5.)				
		Best Practices Encouraged, Not Req'd.:				-
		1.5 Air Barrier At Ali Band Joists (Climate Zones 4 and higher)		<u> </u>		
	Walls Adjoining	1.6 Minimize Thermal Bridging (e.g., OVE framing, SIPs, ICFs)				
	Exterior Walls or Unconditioned Spaces	Fully insulated wall aligned with air barrier at both interior and exterior, O     Alternate for Climate Zones 1 thru 3, sealed exterior air barrier aligned v     Continuous top and bottom plates or sealed blocking     2.1 Wall Behind Shower/Tub		de 1 Insulatio	on fully suppo	orted
		2.2 Wall Behind Fireplace				
		2.3 Insulated Attic Slopes/Walls			Ē	
		2.4 Attic Knee Walls		Ē	Ē	Ē
		2.5 Skylight Shaft Walls	ā		Ē	Ē
		2.6 Wall Adjoining Porch Roof	- F	Ē	- T	Ē
		2.7 Staircase Walls	Ē	Ē	H	
		2.8 Double Walls		H	H	
		blankets, netting for blown-in) • Blanket insulation is verified to have no gaps, volds or compression. • Blown-in insulation is verified to have proper density with firm packing				
		3.1 Insulated Floor Above Garage	<u> </u>	<u> </u>	<u> </u>	
		3.2 Cantilevered Floor				
4.	Shafts	Requirements: Openings to unconditioned space are fully sealed with solid blocking or flas	bing and any rem			
		caulk or foam (provide fire-rated collars and caulking where required)		aining gaps :	are sealed w	ith
		caulk of foam (provide fire-rated collars and caulking where required) 4.1 Duct Shaft		aining gaps :	are sealed w	th
		caulk of foam (provide fire-rated collars and caulking where required) 4.1 Duct Shaft 4.2 Piping Shaft/Penetrations		aining gaps :	are sealed w	
		caulk of foam (provide fire-rated collars and caulking where required) 4.1 Duct Shaft 4.2 Piping Shaft/Penetrations 4.3 Flue Shaft		aining gaps :	are sealed w	
	Attic/ Celling Interface	caulk of foam (provide fire-rated collars and caulking where required) 4.1 Duct Shart 4.2 Piping Shaft/Penetrations 4.3 Flue Shaft Requirements: • All attic penetrations and dropped ceilings include a full interior air barrier with caulk, foam or tape				
		caulk of foam (provide fire-rated collars and caulking where required) 4.1 Duct Shaft 4.2 Piping Shaft/Penetrations 4.3 Flue Shaft Requirements: • All attic penetrations and dropped ceilings include a full interior air barrier	aligned with Insu			seale
		caulk of foam (provide fire-rated collars and caulking where required) 4.1 Duct Shaft 4.2 Piping Shaft/Penetrations 4.3 Flue Shaft Requirements: • All attic penetrations and dropped ceilings include a full interior air barrier with caulk, foam or tape • Movable insulation fits snugly in opening and air barrier is fully gasketed	aligned with Insu	lation with an	y gaps fully :	
		caulk of foam (provide fire-rated collars and caulking where required) 4.1 Duct Shaft 4.2 Piping Shaft/Penetrations 4.3 Flue Shaft Requirements: • All attic penetrations and dropped ceilings include a full interior air barrier with caulk, foam or tape • Movable insulation fits snugly in opening and air barrier is fully gasketed 5.1 Attic Access Panel (fully gasketed and insulated) 5.2 Attic Drop-down Stair (fully gasketed and insulated)	aligned with Insu	lation with an	I gaps fully :	
		caulk of foam (provide fire-rated collars and caulking where required) 4.1 Duct Shaft 4.2 Piping Shaft/Penetrations 4.3 Flue Shaft Requirements: • All attic penetrations and dropped ceilings include a full interior air barrier with caulk, foam or tape • Movable insulation fits snugly in opening and air barrier is fully gasketed 5.1 Attic Access Panel (fully gasketed and insulated)	aligned with insu	lation with ar	I gaps fully :	
		<ul> <li>caulk of foam (provide fire-rated collars and caulking where required)</li> <li>4.1 Duct Shaft</li> <li>4.2 Piping Shaft/Penetrations</li> <li>4.3 Flue Shaft</li> <li>Requirements: <ul> <li>All attic penetrations and dropped cellings include a full interior air barrier with caulk, foam or tape</li> <li>Movable insulation fits snugly in opening and air barrier is fully gasketed</li> <li>5.1 Attic Access Panel (fully gasketed and insulated)</li> <li>5.2 Attic Drop-down Stair (fully gasketed and insulated)</li> <li>5.3 Dropped Celling/Soffit (full air barrier aligned with insulation)</li> <li>5.4 Recessed Lighting Fixtures (ICAT labeled and sealed to drywali)</li> </ul> </li> </ul>	aligned with Insu	Lation with ar	y gaps fully :	
6.	Interface Common Walls Between Dwelling	caulk of foam (provide fire-rated collars and caulking where required) 4.1 Duct Shaft 4.2 Piping Shaft/Penetrations 4.3 Flue Shaft Requirements: • All attic penetrations and dropped ceilings include a full interior air barrier with caulk, foam or tape • Movable insulation fils snugly in opening and air barrier is fully gasketed 5.1 Attic Access Panel (fully gasketed and insulated) 5.2 Attic Drop-down Stair (fully gasketed and insulated) 5.3 Dropped Ceiling/Soffit (full air barrier aligned with insulation)	aligned with Insu		y gaps fully :	
5.	Interface Common Walls	caulk of foam (provide fire-rated collars and caulking where required) 4.1 Duct Shaft 4.2 Piping Shaft/Penetrations 4.3 Flue Shaft Requirements: • All attic penetrations and dropped ceilings include a full interior air barrier with caulk, foam or tape • Movable insulation fits snugly in opening and air barrier is fully gasketed 5.1 Attic Access Panel (fully gasketed and insulated) 5.2 Attic Drop-down Stair (fully gasketed and insulated) 5.3 Dropped Ceiling/Soffit (full air barrier aligned with insulation) 5.4 Recessed Lighting Fixtures (ICAT labeled and sealed to drywall) 5.5 Whole-house Fan (insulated cover gasketed to the opening) Requirements: Gap between drywall shaft wall (i.e., common wall) and the structural frami	aligned with Insu		y gaps fully :	
5.	Common Walls Between Dwelling Units	caulk of foam (provide fire-rated collars and caulking where required) 4.1 Duct Shaft 4.2 Piping Shaft/Penetrations 4.3 Flue Shaft Requirements: • All attic penetrations and dropped ceilings include a full interior air barrier with caulk, foam or tape • Movable insulation fits snugly in opening and air barrier is fully gasketed 5.1 Attic Access Panel (fully gasketed and insulated) 5.2 Attic Drop-down Stair (fully gasketed and insulated) 5.3 Dropped Ceiling/Soffit (full air barrier aligned with insulation) 5.4 Recessed Lighting Fixtures (ICAT labeled and sealed to drywall) 5.5 Whole-house Fan (insulated cover gasketed to the opening) Requirements: Gap between drywall shaft wall (i.e., common wall) and the structural frami boundary conditions	aligned with Insu	lation with ar	I gaps fully :	
i.	Common Walls Between Dwelling Units	caulk of foam (provide fire-rated collars and caulking where required) 4.1 Duct Shaft 4.2 Piping ShafuPenetrations 4.3 Flue Shaft Requirements: • All attic penetrations and dropped ceilings include a full interior air barrier with caulk, foam or tape • Movable insulation fits snugly in opening and air barrier is fully gasketed 5.1 Attic Access Panel (fully gasketed and insulated) 5.2 Attic Drop-down Stair (fully gasketed and insulated) 5.3 Dropped Ceiling/Soffit (full air barrier aligned with insulation) 5.4 Recessed Lighting Fixtures (ICAT labeled and sealed to drywall) 5.5 Whole-house Fan (insulated cover gasketed to the opening) Requirements: Gap between drywall shaft wall (i.e., common wall) and the structural frami boundary conditions 6.1 Common Wall Between Dweiling Units	aligned with Insu	lation with an	I gaps fully :	

Posted 06/02/08:

# 4.2 PIPING SHAFT/PENETRATIONS

# **KEY POINTS**

#### **Installation Criteria:**

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

### **Tips and Best Practices:**

- Work with plumbing and electrical subcontractors to make the smallest openings needed for penetrations.
- Since the flashing or framed caps at shafts and penetrations are typically installed by framers before the plumbing and electrical trades do their work, make sure subcontractors understand the importance of complete air barrier assemblies.



Unsealed



Sealed





## ENERGY STAR Qualified Homes Thermal Bypass Inspection Checklist

	Address:	City:			State:	_
Therm	nal Bypass	Inspection Guidelines	Corrections Needed	Builder Verified	Rater Verified	N//
and	rall Air Barrier Thermai rier Allgnment	Requirements: Insulation shall be installed in full contact with sealed interior and exterior a under item no. 2 (Wails Adjoining Exterior Wails or Unconditioned Spaces) All Climate Zones:		or alternate to	o interior air t	barrie
		1.1 Overall Alignment Throughout Home				
		1.2 Garage Band Joist Air Barrier (at bays adjoining conditioned space)				
		1.3 Attic Eave Baffles Where Vents/Leakage Exist				
		Only at Climate Zones 4 and Higher:		1		10
		1.4 Slab-edge insulation (A maximum of 25% of the slab edge may be uninsulated in Climate Zones 4 and 5.) Best Practices Encouraged, Not Reg'd.:				
		1.5 Air Barrier At All Band Joists (Climate Zones 4 and higher)				
		1.6 Minimize Thermal Bridging (e.g., OVE framing, SIPs, ICFs)		H	H	H
Exter	is Adjoining erlor Wails or onditioned ces	Requirements: • Fully insulated wall aligned with air barrier at both interior and exterior, O • Alternate for Climate Zones 1 thru 3, sealed exterior air barrier aligned • Continuous top and bottom plates or sealed blocking	R			
		2.1 Wall Behind Shower/Tub				
		2.2 Wall Behind Fireplace	ā	Ē		
		2.3 Insulated Attic Slopes/Walls	Ē	<u> </u>	Ē	
		2.4 Attic Knee Walls	ā	H	H	F
		2.5 Skylight Shaft Walls	ā	Ē		Ē
		2.6 Wall Adjoining Porch Roof	Ē	Ē		Ē
		2.7 Staircase Walls	ä		H	
		2.7 Standase Walls		H	H	늗
Cond	ors between Iditioned and erior Spaces	Requirements: • Air barrier is installed at any exposed fibrous insulation edges • insulation is installed to maintain permanent contact with sub-floor above bioaction and for the sub-floor above	e including necess	ary supports	(e.g., staves	for
Cond	ditioned and	<ul> <li>Air barrier is installed at any exposed fibrous insulation edges</li> </ul>	Including necess	ary supports	(e.g., staves	for
Cond	ditioned and	<ul> <li>Air barrier is installed at any exposed fibrous insulation edges</li> <li>insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)</li> <li>Blanket insulation is verified to have no gaps, volds or compression.</li> </ul>		ary supports	(e.g., staves	for
Cond	ditioned and	<ul> <li>Air barrier is installed at any exposed fibrous insulation edges</li> <li>insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)</li> <li>Blanket insulation is verified to have no gaps, volds or compression.</li> <li>Blown-in insulation is verified to have proper density with firm packing</li> </ul>		ary supports	(e.g., staves	
Conc Exte	ditioned and erior Spaces	Air barrier is installed at any exposed fibrous insulation edges     insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)     Blanket insulation is verified to have no gaps, volds or compression.     Blown-in insulation is verified to have proper density with firm packing     3.1 insulated Floor Above Garage     3.2 Cantilevered Floor     Requirements:     Openings to unconditioned space are fully sealed with solid blocking or flaat caulk or foam (provide fire-rated collars and caulking where required)	shing and any rem			
Conc Exte	ditioned and erior Spaces	Air barrier is installed at any exposed fibrous insulation edges     insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)     Blanket insulation is verified to have no gaps, volds or compression.     Blown-in insulation is verified to have proper density with firm packing     3.1 insulated Floor Above Garage     3.2 Cantilevered Floor     Requirements:     Openings to unconditioned space are fully sealed with solid blocking or flat     caulk or foam (provide fire-rated collars and caulking where required)     4.1 Duct Shaft				
Conc Exte	ditioned and erior Spaces	Air barrier is installed at any exposed fibrous insulation edges     insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)     Blanket insulation is verified to have no gaps, volds or compression.     Blown-in insulation is verified to have proper density with firm packing     3.1 insulated Floor Above Garage     3.2 Cantilevered Floor     Requirements:     Openings to unconditioned space are fully sealed with solid blocking or flaat caulk or foam (provide fire-rated collars and caulking where required)	shing and any rem		are sealed w	
Conc Exte	ditioned and erior Spaces	Air barrier is installed at any exposed fibrous insulation edges     insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)     Blanket insulation is verified to have no gaps, volds or compression.     Blown-in insulation is verified to have proper density with firm packing     3.1 insulated Floor Above Garage     3.2 Cantilevered Floor     Requirements:     Openings to unconditioned space are fully sealed with solid blocking or flax     caulk or foam (provide fire-rated collars and caulking where required)     4.1 Duct Shaft     4.2 Piping Shaft/Penetrations     4.3 Flue Shaft	shing and any rem			
Conc Exte 4. Shar 5. Attic	ditioned and erior Spaces	<ul> <li>Air barrier is installed at any exposed fibrous insulation edges</li> <li>insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)</li> <li>Blanket insulation is verified to have no gaps, volds or compression.</li> <li>Blown-In insulation is verified to have proper density with firm packing</li> <li>3.1 insulated Floor Above Garage</li> <li>3.2 Cantilevered Floor</li> <li>Requirementa:</li> <li>Openings to unconditioned space are fully sealed with solid blocking or flat caulk or foam (provide fire-rated collars and caulking where required)</li> <li>4.1 Duct Shaft</li> <li>4.2 Piping Shaft/Penetrations</li> <li>4.3 Flue Shaft</li> <li>Requirements:</li> <li>All attic penetrations and dropped ceilings include a full interior air barrie with caulk, foam or tape</li> </ul>	shing and any rem	aining gaps :	are sealed w	
Conc Exte 4. Shar 5. Attic	ditioned and erior Spaces fts 2/ Celling	Air barrier is installed at any exposed fibrous insulation edges     insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)     Blanket insulation is verified to have no gaps, volds or compression.     Biown-in insulation is verified to have proper density with firm packing     3.1 insulated Floor Above Garage     3.2 Cantilevered Floor     Requirements:     Openings to unconditioned space are fully sealed with solid blocking or flat     caulk or foam (provide fire-rated collars and caulking where required)     4.1 Duct Shaft     4.2 Piping Shaft/Penetrations     4.3 Flue Shaft     Requirements:     Ail attic penetrations and dropped ceilings include a full interior air barrier     with caulk, foam or tape     Movable insulation fits sought in opening and air barrier is fully gasketed	shing and any rem	aining gaps :	are sealed w	ith seale
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Posted 06/02/08

## 5.1 ATTIC ACCESS PANEL

## **KEY POINTS**

#### **Installation Criteria:**

- Attic access panel shall be fully gasketed for a snug fit.
- Attic access panel shall be fitted with insulation (minimum of R-5) that fits snugly in the framed opening.

#### Tips and Best Practices:

 To increase durability, consider using a pre-insulated door panel or SIP panel for the attic access panel.

## **5.2 ATTIC DROP-DOWN STAIR**

## **KEY POINTS**

#### Installation Criteria:

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

#### **Tips and Best Practices:**

• Factory made attic drop-down stair assemblies that are fully gasketed and include a rigid insulation panel much like an exterior insulated door are a great simple solution (see Figure 5.2.5 below).





## ENERGY STAR Qualified Homes Thermal Bypass Inspection Checklist

H	ome Address:	City:			State:	_
Т	hermal Bypass	Inspection Guidelines	Corrections Needed	Builder Verified	Rater Verified	N/A
1.	Overall Air Barrier and Thermal Barrier Alignment	Requirements: Insulation shall be installed in full contact with sealed interior and exterior air barrier except for alternate to interior air barrier under item no. 2 (Walls Adjoining Exterior Walls or Unconditioned Spaces) All Climate Zones:				
		1.1 Overall Alignment Throughout Home				
		1.2 Garage Band Joist Air Barrier (at bays adjoining conditioned space)				
		1.3 Attic Eave Baffles Where Vents/Leakage Exist				
		Only at Climate Zones 4 and Higher:		1		1
		1.4 Slab-edge insulation (A maximum of 25% of the slab edge may be uninsulated in Cilmate Zones 4 and 5.)				
		Best Practices Encouraged, Not Reg'd.:				
		1.5 Air Barrier At Ali Band Joists (Climate Zones 4 and higher)	<u> </u>	<u> </u>	<u> </u>	1
2.	Walls Adjoining	1.6 Minimize Thermal Bridging (e.g., OVE framing, SIPs, ICFs)				
	Exterior Walls or Unconditioned Spaces	Fully insulated wall aligned with air barrier at both interior and exterior, OR     Alternate for Climate Zones 1 thru 3, sealed exterior air barrier aligned with RESNET Grade 1 Insulation fully supported     Continuous top and bottom plates or sealed blocking     2.1 Wall Behind Shower/Tub				
		2.2 Wall Behind Fireplace	ā	Ē		
		2.3 Insulated Attic Slopes/Walls	ū	П	Ē	Ē
		2.4 Attic Knee Walls		H	H	H
		2.5 Skylight Shaft Walls		H	-	H
				H	<u> </u>	H
		2.6 Wall Adjoining Porch Roof		<u> </u>	<u> </u>	-
		O T Obstances Minite				
3.	Floors between Conditioned and Exterior Spaces	2.7 Staircase Walls 2.8 Double Walls 2.8 Double Walls Requirements: • Air barrier is installed at any exposed fibrous insulation edges • insulation is installed to maintain permanent contact with sub-floor above bised to be be be been been been been been been	including necess	ary supports	(e.g., staves	
3.	Conditioned and	2.8 Double Walls     Requirements:     Air barrier is installed at any exposed fibrous insulation edges     insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)     Blanket insulation is verified to have no gaps, volds or compression.		ā		
3.	Conditioned and	2.8 Double Walls     Requirements:     Air barrier is installed at any exposed fibrous insulation edges     insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)		ā		
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~	Conditioned and Exterior Spaces	2.8 Double Walls     Requirements:     Air barrier is installed at any exposed fibrous insulation edges     insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)     Blanket insulation is verified to have no gaps, volds or compression.     Blown-in insulation is verified to have proper density with firm packing     3.1 Insulated Floor Above Garage     3.2 Cantilevered Floor     Requirements:     Openings to unconditioned space are fully sealed with solid blocking or flag	Including necess	ary supports	(e.g., staves	for
~	Conditioned and Exterior Spaces	2.8 Double Walls     Requirements:     Air barrier is installed at any exposed fibrous insulation edges     insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)     Blanket insulation is verified to have no gaps, volds or compression.     Blown-in insulation is verified to have proper density with firm packing     3.1 insulated Floor Above Garage     3.2 Cantilevered Floor     Requirements:     Openings to unconditioned space are fully sealed with solid blocking or flaa caulk or foam (provide fire-rated collars and caulking where required)	Including necess	ary supports	(e.g., staves	for
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3. 4. 5.	Conditioned and Exterior Spaces Shafts Attic/ Celling Interface	2.8 Double Walls     Requirements:     Air barrier is installed at any exposed fibrous insulation edges     Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)     Blanket insulation is verified to have no gaps, volds or compression.     Blown-in insulation is verified to have proper density with firm packing     3.1 insulated Floor Above Garage     3.2 Cantilevered Floor     Requirements:     Openings to unconditioned space are fully sealed with solid blocking or flaa caulk or foam (provide fire-rated collars and caulking where required)     4.1 Duct Shaft     4.2 Piping Shaft/Penetrations     4.3 Flue Shaft     Requirements:     • All attic penetrations and dropped ceilings include a full interior air barrie with caulk, foam or tape     • Movable insulation fits snugly in opening and air barrier is fully gasketed     5.1 Attic Access Panel (fully gasketed and insulated)     5.2 Attic Drop-down Stair (fully gasketed and insulated)     5.3 Dropped Ceiling/Sofft (full air barrier aligned with insulation)	Including necess	ary supports	(e.g., staves	
4.	Conditioned and Exterior Spaces Shafts Attic/ Celling Interface	2.8 Double Walls     Requirements: <ul> <li>Air barrier is installed at any exposed fibrous insulation edges</li> <li>Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)</li> <li>Blanket insulation is verified to have no gaps, volds or compression.</li> <li>Blown-in insulation is verified to have proper density with firm packing</li> <li>3.1 Insulated Floor Above Garage</li> <li>3.2 Cantilevered Floor</li> <li>Requirements:</li> <li>Openings to unconditioned space are fully sealed with solid blocking or flaa caulk or foam (provide fire-rated collars and caulking where required)</li> <li>4.1 Duct Shaft</li> <li>4.2 Piping Shaft/Penetrations</li> <li>4.3 Flue Shaft</li> <li>Requirements:</li> <li>All attic penetrations and dropped ceilings include a full interior air barrie with caulk, foam or tape</li> <li>Movable insulation fits snugly in opening and air barrier is fully gasketed</li> <li>5.1 Attic Access Panel (fully gasketed and insulated)</li> <li>5.2 Attic Drop-down Stair (fully gasketed and insulated)</li> <li>5.3 Drooped Ceiling/Soft (full air barrier aligned with insulation)</li> <li>5.4 Recessed Lighting Fixtures (ICAT labeled and sealed to driviall)</li> <li>5.5 Whole-house Fan (insulated cover gasketed to the opening)</li> <li>Requirements:</li> <li>Gap between drywall shaft wall (i.e., common wall) and the structural framily</li> </ul>	Including necess	ary supports	(e.g., staves	
4. 5.	Conditioned and Exterior Spaces Shafts Attic/ Celling Interface Common Walls Between Dwelling Units	2.8 Double Walls     Requirements: <ul> <li>Air barrier is installed at any exposed fibrous insulation edges</li> <li>Insulation is installed to maintain permanent contact with sub-floor above blankets, netting for blown-in)</li> <li>Blanket insulation is verified to have no gaps, volds or compression.</li> <li>Blown-in insulation is verified to have proper density with firm packing</li> <li>3.1 Insulated Floor Above Garage</li> <li>3.2 Cantilevered Floor</li> <li>Requirements:</li> <li>Openings to unconditioned space are fully sealed with solid blocking or flaa caulk or foam (provide fire-rated collars and caulking where required)</li> <li>4.1 Duct Shaft</li> <li>4.2 Piping Shaft/Penetrations</li> <li>4.3 Flue Shaft</li> <li>Requirements:</li> <li>All attic penetrations and dropped ceilings include a full interior air barrie with caulk, foam or tape</li> <li>Movable insulation fits snugly in opening and air barrier is fully gasketed</li> <li>5.1 Attic Access Panel (fully gasketed and insulated)</li> <li>5.2 Attic Drop-down Stair (fully gasketed and insulated)</li> <li>5.3 Drooped Ceiling/Soft (full air barder aligned with insulation)</li> <li>5.4 Recessed Lighting Fixtures (ICAT labeled and sealed to drywall)</li> <li>5.5 Whole-house Fan (insulated cover gasketed to the opening)</li> <li>Requirements:</li> <li>Gap between drywall shaft wall (i.e., common wall) and the structural framiboundary conditions</li> <li>All conditions</li> <li>All conditions</li> <li>All conditions</li> <li>5.5 Whole-house Fan (insulated cover gasketed to the opening)</li> <li>Requirements:</li> <li>Gap between drywall shaft wall (i.e., common wall) and the structural framiboundary conditions</li> <li>All conditions</li> <li>All conditions</li> <li>All conditions</li> <li>All condit</li></ul>	Including necess Including necess Including and any rem Including any rem Includi	ary supports ary supports and s	(e.g., staves	

Posted 06/02/08

# 5.4 RECESSED LIGHTING FIXTURES

# **KEY POINTS**

#### Installation Criteria:

• All recessed lighting fixtures to unconditioned attics shall be "insulation contact, airtight rated" (ICAT), and shall be sealed to drywall with gasket, caulk, or foam.

#### Tips and Best Practices:

- Consider using non-recessed lighting fixtures at all attic/ceiling interface locations where appropriate to design preferences.
- Install recessed lighting fixtures in dropped ceilings with a complete air barrier assembly above.
- Use ICAT fixtures that do not have air gaps in the housing assembly and with built-in gaskets.
- Where ICAT fixtures are selected that come with air gaps in the housing assembly, manually seal the gaps on the job site. However, manufacturer recommendations must be followed since lighting fixtures get very hot.
- Recognize that ICAT recessed lighting fixtures are only needed at ceilings adjoining unconditioned space.
- If gaskets are not built-in, develop a system for storing trim seal gaskets provided by the manufacturer after initial installation of the recessed cans so they are available at the end of the job.



# Energy Star Performance Path Summary

Thermal Bypass Checklist:

http://www.energystar.gov/ia/partners/bldrs\_lenders\_raters/dow nloads/Thermal\_Bypass\_Inspection\_Checklist.pdf

Guide to the Thermal Bypass Checklist: http://www.energystar.gov/ia/partners/bldrs\_lenders\_raters/dow nloads/TBC\_Guide\_062507.pdf

Remember that many of the items on this checklist do not pertain to Habitat construction because of the simplicity of the floor plans. Concentrate on items 1.1, 1.3, 2.1, & 5.1 (or 5.2 if attic stair) + 5.4 for can lights. Upon closer inspection, we may find another item or two that applies to your design, but it's not likely.

Review this material explaining the Performance Path for reaching Energy Star:

http://www.energystar.gov/ia/partners/bldrs\_lenders\_raters/dow nloads/**PerfPathTRK\_060206.pdf** 

Note that in addition to the TBC Inspection, there are several other prescriptive requirements included in the Performance Path:

•Sizing the HVAC system using Manual J (footnote 7 of perf. path)

•Duct leakage 6cfm/100 sq ft of conditioned space or less •Energy Star certified HVAC or windows or 5 appliances:

http://www.energystar.gov/index.cfm?fuseaction=find\_a\_prod uct.)



# Going forward...

- Building America High Performance Affordable Demonstration Houses: <u>www.baihp.org/gulfcoast</u>
- Building America Habitat Partnership
  - www.baihp.org/habitat
- Energy Star New Homes Program
  - <u>www.energystar.gov</u> click on "New Homes"
- Local Home Energy Raters
  - <u>http://www.natresnet.org/directory/raters.aspx</u>
  - Look for the "Volunteer Rater" emblem
- Building America Best Practices Documents
  - <u>www.buildingamerica.gov</u> (right hand margin)
- Janet McIlvaine and David Beal
  - janet@fsec.ucf.edu and david@fsec.ucf.edu
  - please include "Habitat" in your subject line
  - 321-638-1434 and 321-638-1433

