



**New Code Compliance Briefs Assist in
Resolving Codes and Standards
Concerns in Energy Innovations**

**Pam Cole
Pacific Northwest National
Laboratory
February 24, 2016**

The Building America Program is designed to compliment and support the work done by other Building Technologies Office (BTO) programs. It supports codes and standards by identifying and filling gaps in building science and system knowledge that may limit effective implementation of new and existing standards.



Building America in the BTO Ecosystem



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BUILDING TECHNOLOGIES OFFICE



Release of Final Multi-Year Program Plan

The Plan outlines BTO's strategies and goals, for FY 2016 - FY 2020, for significantly reducing building energy use intensity across the U.S.

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We lead a vast network of research and industry partners to develop innovative, cost-effective, energy-saving solutions for our homes and buildings. [Learn more](#)

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- Continually develop innovative cost-effective energy saving solutions
- Better products
- Better new homes
- Better ways to improve older homes

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Visitors Tour Solar Decathlon Homes Featuring the Latest in Energy Efficient Building Technology.

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The Building Technologies Office (BTO) collaborates with the residential building industry to improve the energy efficiency of both new and existing homes. By developing, demonstrating, and deploying cost-effective solutions, BTO strives to reduce energy consumption across the residential building sector by at least 50%.

RESEARCH AND DEVELOPMENT

- Conduct research that focuses on engineering solutions to design, test, and build or upgrade homes through [Building America](#).

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[BTO FY17-FY19 National Laboratory Call & Merit Review](#)

DECEMBER 18, 2015

[Updated Funding Opportunity: Emerging Technologies](#)

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NEWS

FEBRUARY 12, 2016

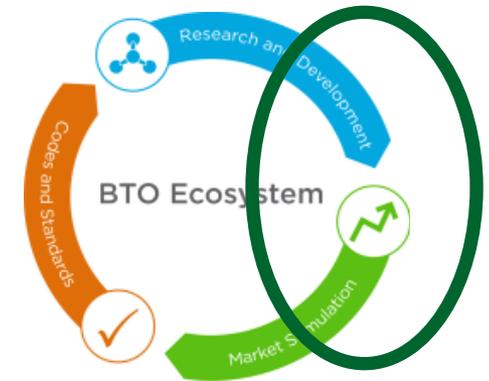
[Saving American Families and Businesses Money through Lighting Efficiency](#)

FEBRUARY 11, 2016

[Energy Department Announces New Asset Score Partnership Program](#)

Low-E Storm Windows

- Developed in Emerging Technologies
- Tested and promoted through Building America
- [DOE Success Story](#), Published Sept. 30th



2018 Residential Energy Code Proposals

- All proposals proven through Building America (Advanced wall framing, improved glazing U-factor, prescriptive option packages, etc.)
- See references to Building America and ZERH Program on [BECP website](#)



BUILDING AMERICA: BRINGING BUILDING INNOVATIONS TO MARKET

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[Better Buildings Neighborhood Program](#)

[Zero Energy Ready Home](#)

[Guidelines for Home Energy Professionals](#)

[Commercial Buildings](#)

[Appliance & Equipment](#)

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[Solution Center Home](#)

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The Building America Solution Center provides access to expert information on hundreds of performance construction topics, including air sealing and insulation, HVAC component indoor air quality, and much more. Click on the links below to explore the Solution Center.

Program Checklists

Access guides directly from checklists for Zero Energy Ready Home, ENERGY STAR Certified Home, and Indoor airPLUS



Building Components

Access guides for new and existing homes based on building components of interest.



Register for the Feb. 24 Webinar

Attend the February Building America webinar to learn about how the new Code Compliance Brief content on the Building America Solution Center assists in resolving codes and standards concerns in energy innovations.

[READ MORE](#)

Learn about how this [world-class research](#) program can help the U.S. building industry promote and construct homes that are better for business, homeowners, and the nation.



NEW PUBLICATIONS FROM BUILDING AMERICA

The [Building America Publications Library](#) offers an extensive collection of technical reports, measure guidelines, case studies, and other resources to help you boost energy efficiency in new and existing homes. Here are samples of our most recent publications:

- [Compact Buried Ducts in a Hot-Humid Climate House](#)
- [Community-Wide Zero Energy Ready Home Standard](#)

WEBINARS

[New Code Compliance Briefs Assist in Resolving Codes and Standards Concerns in Energy Innovations](#)

February 24, 2016

[View past webinars](#)

FUNDING OPPORTUNITIES

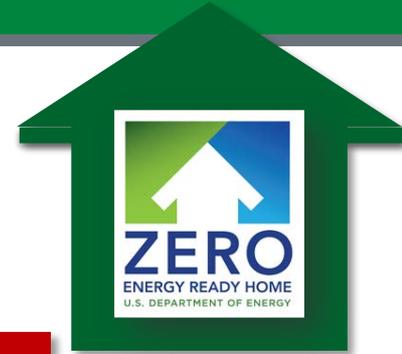
[BUILDING AMERICA INDUSTRY PARTNERSHIPS FOR HIGH PERFORMANCE HOUSING INNOVATION](#)

The Building Technologies Office has issued a funding

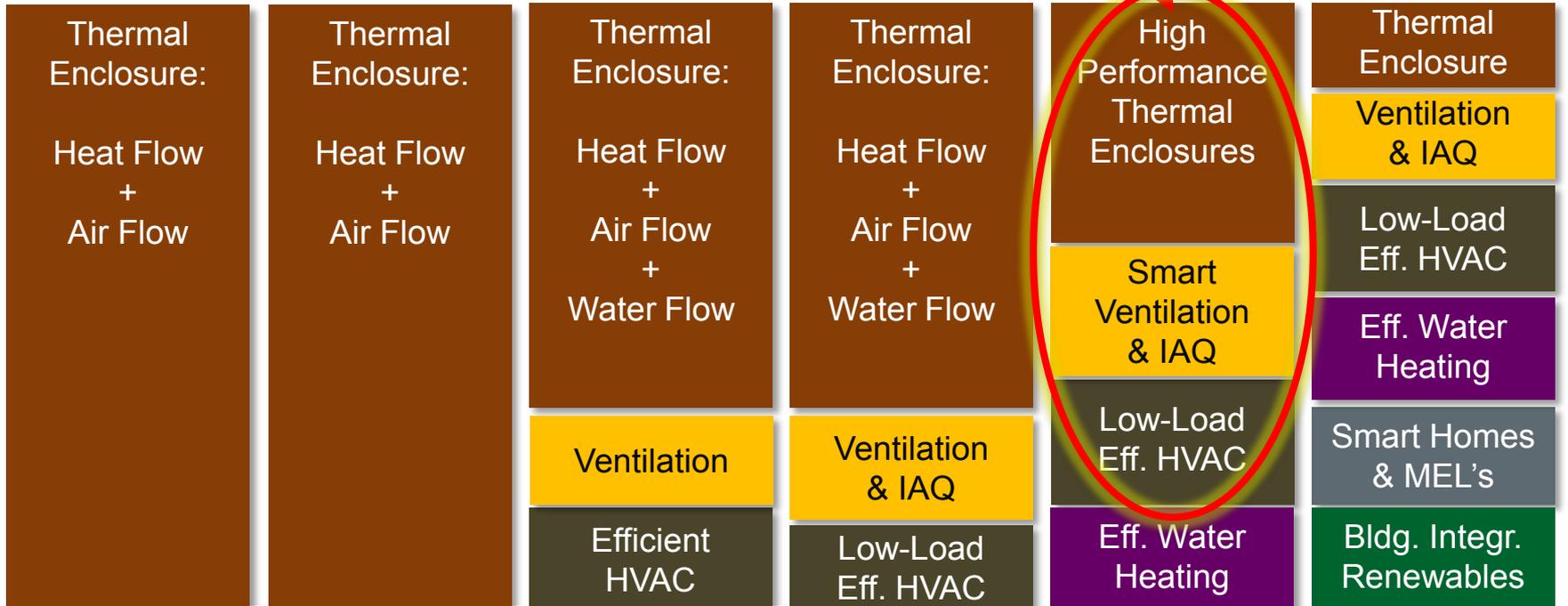
Thermal Load



**TARGET THESE 3
INTER-RELATED
CHALLENGES**



Resulting Research Priorities





What's New Now

- **Restructured ENERGY STAR checklists for Revision 08**
- **New Sales Tool to relate high-performance home features to consumer experience and provide customized sales worksheets**
- **Updated Building Components feature to better emphasize existing homes**
- **EPA Indoor airPLUS checklist**
- **Code Compliance Briefs to explain innovations with references for code officials**
- **Now updating Mobile Apps**

**Best Practices
at Your Fingertips**

World Class Guidance for High-Performance Homes...

U.S. DEPARTMENT OF
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... at Your Finger Tips





As part of the Codes and Standards Innovation (CSI) efforts, a need was identified to develop additional guidance on codes and standards barriers to builders, remodelers, and code officials and add it to certain BASC guides.

- ▶ Research findings readily available in an organized format to help builders, remodelers, and code officials better understand innovative measures with potential barriers and how the measure can be deemed acceptance with the code and/or standard.
- ▶ Technical validation (TV) is critical and the audience must know that TV has been performed and is VALID without having to read extensive technical information (Building America technical publications).
- ▶ Identify needs of other BTO residential programs and how to leverage each others activities to meet the needs.

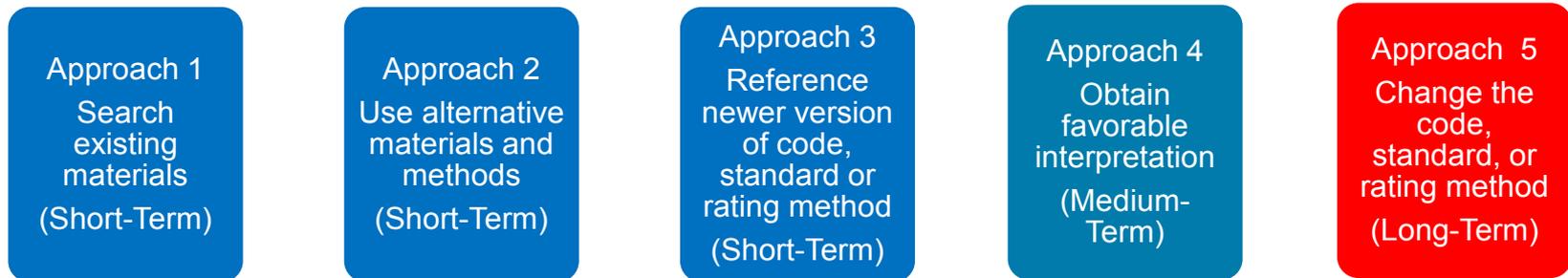
The first step is identifying the barrier and tracing it to the relevant codes, standards, and/or rating methods.

Building America defines barriers as any requirement in a code, standard, or rating method that:

- requires construction practices that may be ineffective in specific climate zones,
- prohibits a Building America innovation,
- discourages a Building America innovation, or
- does not encourage a Building America innovation that would lead to better, more efficient homes.

2015 IECC, R102.1/2015 IRC, R104.11 Alternative materials, design and methods of construction and equipment

The code is not intended to prevent the installation of any material or prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been approved.

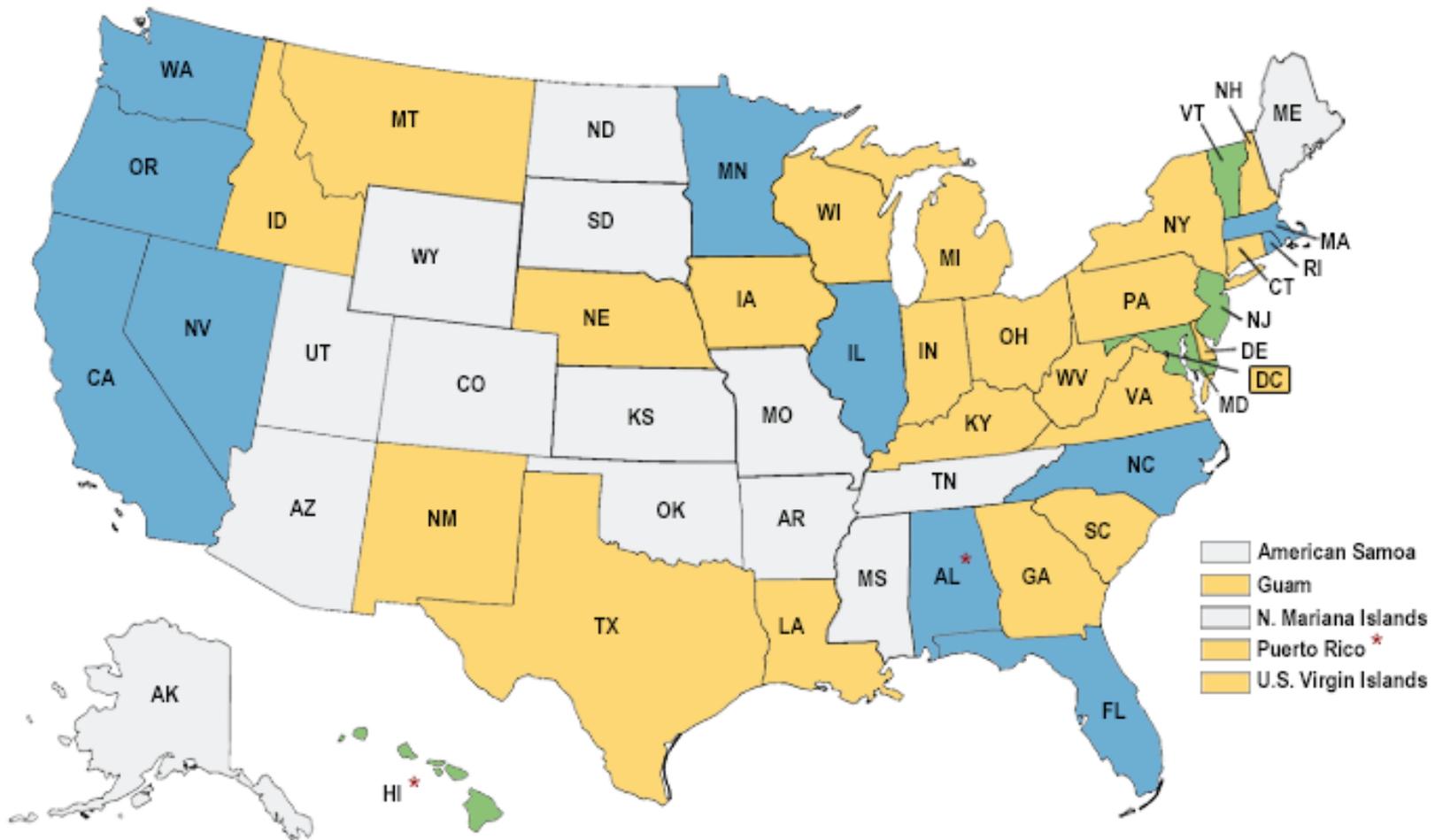


The code official (CO) is permitted to approve an alternative material, design or method of construction where the CO finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and the material, method or work offered is for the purpose intended, at least the equivalent of that prescribed in the code.

Solution for Various Types of Barriers

Barrier Type	Short Term Solution	Long Term Solution
C/S construction practices that may be ineffective in specific climate zones	Establish technical argument for why code/standard is inappropriate AND argue based on common sense	Develop code/standard change that does not require the wrong thing (and hopefully requires the “right thing”)
C/S prohibits the innovation	Establish equivalent or better performance of innovation AND argue blanket prohibition is against alternate materials and methods clause	Develop code/standard change that removes prohibition
C/S discourages the innovation	Establish equivalent or better performance of innovation	Develop code/standard change that removes discouragement of innovation
C/S to encourage innovation does not exist	Establish technical argument for why it should be encouraged and equivalent or better performance of innovation	Develop code/standard change that encourages innovation

Status of State Residential Energy Code Adoption



* Adopted new Code to be effective at a later date

Describes content required to accelerate the review, installation and final acceptance of the measure for compliance.

- Overview
 - Summary of technology
 - Explanation of barrier(s) (if any)
- Plan Review
 - Code sections to be confirmed on construction documents
- Field Inspection
 - Items to be verified during inspection
- Technical Validation/Resources
 - White papers (Building America Research Partners)
 - Manufacturer Data and Installation Specifications
 - Code Notes (Building Energy Codes Program)

- ▶ Air Sealing and Insulating Attic Knee Walls
- ▶ Air Sealing and Insulating Garage Walls
- ▶ Bathroom Fan Ratings
- ▶ Continuous Insulation – Cladding/Furring Attachments
- ▶ Double Wall Framing
- ▶ Ductless Mini-Split Heat Pumps
- ▶ Dynamic Glazing
- ▶ Evaporative Cooling
- ▶ Fireplaces, Proper Ventilation for New Wood-Burning Fireplaces
- ▶ Floors: Above Unconditioned Basements, Vented Crawlspace, Cantilevered Floors, and Floors above Garages
- ▶ Gas Fired Boilers
- ▶ Heat Pump Water Heaters
- ▶ Insulated Interior Exterior Wall Intersections
- ▶ Insulating and Sealing Structural Headers
- ▶ Oil-Fired Boilers
- ▶ Recessed Lighting
- ▶ Rooms Containing Fuel-Burning Appliances
- ▶ Slab-on-Grade Insulation
- ▶ Window and Frame Replacement

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Program Checklists

Access guides directly from checklists for Zero Energy Ready Home, ENERGY STAR Certified Home, and Indoor airPLUS



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Access guides for new and existing homes based on building components of interest.



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Translate building science technical terms into a new language of value.



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The intent of Building America's Code Compliance Briefs are to provide code-related information about Building America's research, best practices, and new innovations to help ensure that the measures will be accepted as being in compliance with the code. Providing notes for code officials on how to plan review and conduct field inspections can help builders or remodelers with proposed designs and provide jurisdictional officials with information for acceptance. Providing the same information to all interested parties (e.g., code officials, builders, designers, etc.) is expected to result in increased compliance and fewer innovations being questioned at the time of plan review and/or field inspection.

[Air Sealing and Insulating Attic Knee Walls - Code Compliance Brief](#)

Air sealing and insulating attic knee walls to code.

[Air Sealing and Insulating Garage Walls - Code Compliance Brief](#)

This brief provides an overview of the 2009 through 2015 IRC/IECC code requirements related to air sealing and insulating attached garage walls.

[Bathroom Fan Ratings - Code Compliance Brief](#)

If the bathroom fan is part of the whole-house mechanical ventilation system (WHMV), there are code provisions that should be verified during plan review and field inspection depending upon codes enforced in your jurisdiction.

[Continuous Insulation – Cladding/Furring Attachment - Code Compliance Brief](#)

Guidance is needed for code-compliant installations of various cladding materials when installed over thicker foam sheathing also known as insulated sheathing or continuous insulation (c.i.).

FILTER BY TAXONOMY

[Air Barriers Aligned with Insulation \(2\)](#)

[Bathroom Exhaust \(1\)](#)

[Bathroom Fan Ratings \(1\)](#)

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[Evaporative Cooling \(1\)](#)

[Exhaust-Only Ventilation \(1\)](#)

[Fireplaces/Stoves with Proper Ventilation \(1\)](#)

[Floor Above Garage \(1\)](#)

[Floor Above Unconditioned Basement or Vented Crawlspace \(1\)](#)

[Fully Flashed Window and Door Openings \(1\)](#)

[Heat Pump Water Heaters \(1\)](#)

[Heating, Ventilation and Air Conditioning \(HVAC\) Quality Installation \(1\)](#)

[Kitchen Exhaust \(1\)](#)

[Lighting and Appliances \(1\)](#)

[Radiant \(1\)](#)

[Recessed Light Fixtures Below Unconditioned Space \(1\)](#)

[Reduced Thermal Bridging \(1\)](#)

[Slab Edge Insulation \(1\)](#)

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Double Wall Framing - Code Compliance Brief

Double stud wall wood framing is not specifically addressed in the International Residential Code (IRC) or International Energy Conservation Code (IECC); it is neither encouraged nor discouraged.

Recommendations of where the vapor retarder and air barrier should be placed, based on research and testing are further defined in this Code Compliance Brief.

Ductless Mini-Split Heat Pumps - Code Compliance Brief

The intent of this brief is to provide code-related information about ductless mini-split heat pumps to help ensure that the measure will be accepted as being in compliance with the code.

Dynamic Glazing - Code Compliance Brief

Code compliance brief describing glazing requirements added to the residential portion of the IECC and the IRC in 2015.

Evaporative Cooling - Code Compliance Brief

This brief discusses the provisions in the 2015 International Energy Conservation Code (IECC) and International Residential Code (IRC) related to evaporative cooling.

Fireplaces, Proper Ventilation for New Wood-Burning Fireplaces - Code Compliance Brief

The intent of this brief is to cover the new requirements for new wood-burning fireplaces regarding doors, dampers, and combustion air and proper ventilation.

Floors: Above Unconditioned Basement, Vented Crawlspace, Cantilevered Floors, and Floors above Garage, Code Compliance Brief

New language in the 2015 IECC allows different installation of insulation in floors over unconditioned spaces.

FILTER BY CLIMATE ZONE

[All Climate Zones \(18\)](#)

[Zone 3 \(1\)](#)

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[Zone 6 \(1\)](#)

[Zone 7 \(1\)](#)

[Zone 8 \(1\)](#)

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[Insulation \(4\)](#)

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[Mechanical \(3\)](#)

[Walls \(3\)](#)

[Flashing \(2\)](#)

[Heat Pumps \(2\)](#)

[Openings \(2\)](#)

[Sheathing \(2\)](#)

[Windows \(2\)](#)

[Appliances \(1\)](#)

[Attics \(1\)](#)

[Cantilever \(1\)](#)

[Climate \(1\)](#)

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[HVAC Commissioning Checklist Refrigerant Charge](#)

Last Updated: January 27, 2016

[HVAC Commissioning Indoor HVAC Fan Airflow](#)

Last Updated: January 27, 2016

[HVAC Commissioning Air Balancing of Supply Registers & Return Grilles \(recommended but not required\)](#)

Last Updated: January 27, 2016

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RECENTLY ADDED CONTENT

[Slab edge insulation](#)

Image Posted: January, 2016

[Solar on Sips](#)

Reference Posted: December, 2015

[First row and quality assurance](#)

Image Posted: December, 2015



As a community driven tool, we welcome your [comments](#) on how to continuously improve the Solution Center. If you are interested in submitting content, please become a [registered user](#) and see the [criteria for submissions](#).

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[2009 IECC Code Level Insulation – ENERGY STAR Requirements](#)

This guide describes IECC 2009 and ENERGY STAR Certified Homes insulation requirements.

[2012 IECC Code Level Insulation – DOE Zero Energy Ready Home Requirements](#)

This guide describes IECC 2012 and DOE Zero Energy Ready Home insulation requirements.

[70 Amp Dual-Pole Circuit Breaker for PV Systems](#)

This measure guide describes the need to install a dedicated dual-pole circuit breaker for a future solar photovoltaic installation.

[Above Deck Rigid Foam Insulation for Existing Roofs](#)

This guide provides information about installing Insulating sheathing above the roof deck on existing homes. This retrofit assembly is appropriate for homes with conditioned attics or where the retrofit is intended to create a conditioned attic.

[Air Seal HVAC Cabinet Seams](#)

Guide describing air sealing of the seams and holes in HVAC air handler and furnace cabinets.

[Air Sealing Attached Garage](#)

Guide describing ways to air seal an attached garage.

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209 Guides

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[Existing Homes \(183\)](#)

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[New and Existing Homes \(155\)](#)

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The Building Components tool will help you find new and existing homes guides. Click the images below for a list of subcategories corresponding to each of the primary categories. Select

The screenshot shows a dropdown menu titled "Walls & Openings" with a close button in the top right corner. The menu lists the following subcategories: Air Sealing/Insulation, Doors, Wall Structure (circled in red), Water Management, and Windows/Skylights. Below the menu is a circular navigation hub with five icons: "Walls & Openings" (circled in red), "Foundations & Floors", "HVAC", "Water Heaters, Appliances, & Lighting", and "Roofs, Attics & Ceilings". A red arrow points from the "Walls & Openings" icon in the hub to the "Wall Structure" option in the dropdown menu.

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Walls & Openings - Wall Structure

The guides on this page present information about wall structures, such as advanced framing techniques, double walls, ICFs, and SIPs. Guides are presented in alphabetical order. Use the filters to the right of the page to further focus your search based on construction type or keywords.



Solution Center Guides

[Continuous Rigid Insulation Sheathing/Siding](#)

This guide describes installation procedures for continuous rigid insulation to help provide thermal protection, reduce thermal bridging and provide a moisture barrier.

[Double Walls](#)

This guide describes air barrier and insulation installation, along with air sealing for double walls - half or full walls included in a home design as an architectural feature that provides a more dimensional appearance.

[Double-Stud Wall Framing](#)

Guide describing construction and insulation techniques for double wall framing.

[Framing Members and Insulation Products Having High Moisture Content Not Enclosed](#)

Guide describing how to avoid using wet materials and reduce moisture exposure in construction.

[Insulated Concrete Forms \(ICFs\)](#)

Guide describing how to install insulated concrete forms to block excessive heat loss and gain through structural framing.

[Insulated Corners](#)

Guide describing how to frame and insulate corners to reduce the heat loss and gain through structural framing.

[Insulated Headers](#)

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[Existing Homes \(5\)](#)

[New and Existing Homes \(2\)](#)

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[Walls \(13\)](#)

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[Insulation \(8\)](#)

[Thermal Bridging \(8\)](#)

[Framing \(7\)](#)

[Installation \(3\)](#)

[Air Barriers \(2\)](#)

[Doors \(2\)](#)

[Sheathing \(2\)](#)

[Windows \(2\)](#)

[Air Sealing \(1\)](#)

[ICFs \(1\)](#)

[Materials \(1\)](#)

[SIPs \(1\)](#)

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Continuous Rigid Insulation Sheathing/Siding

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Scope

Reduced Thermal Bridging

Continuous rigid insulation, insulated siding, or combination of the two; $\geq R-3$ in [Climate Zones 1 to 4](#), $\geq R-5$ in [Climate Zones 5 to 8](#)

- If utilizing insulated siding that is not water-resistant barrier, install a water-resistant barrier before installing siding.
- If using steel studs, install continuous rigid insulation of $\geq R-3$ in Climate Zones 1 to 4 or $\geq R-5$ in Climate Zones 5 to 8.
- Tape and seal all seams of continuous rigid insulation if it is being utilized as a water-resistant barrier.



ENERGY STAR Certified Homes Notes:

[Note: Guidance for ENERGY STAR Certified Homes Version 3.0, Revision 08 is coming soon.]

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[Note: Guidance for ENERGY STAR Certified Homes Version 3.0, Revision 08 is coming soon.] ENERGY STAR Certified Homes (Version 3.0, Revision 07), Thermal Enclosure Checklist, Reduced Thermal Bridging. Mass walls utilized as the thermal mass component of a passive solar design (e.g., a Trombe wall) are exempt from this Item. To be eligible for this exemption, the passive solar design shall be comprised of the following five components: an aperture or collector, an absorber, thermal mass, a distribution system, and a control system. [See DOE's guidance for passive solar home design](#) . Mass walls that are not part of a passive solar design (e.g., CMU block or log home enclosure) shall either utilize the strategies outlined in Item 4.4 (of the ENERGY STAR Thermal Enclosure System Rater Checklist). Or, the pathway in the assembly with the least thermal resistance, as determined using a method consistent with the 2009 ASHRAE Handbook of Fundamentals, shall provide $\geq 50\%$ of the applicable assembly resistance, defined as the reciprocal of the mass wall equivalent U-factor in the 2009 IECC – Table 402.1.3. Documentation identifying the pathway with the least thermal resistance and its resistance value shall be collected by the rater and any Builder Verified or Rater Verified box under Item 4.4 (of the ENERGY STAR Thermal Enclosure System Rater Checklist) shall be checked.

- **Overview:**
 - Older versions of code limited the thickness of continuous insulation (c.i.) applications
 - Newer versions of code require c.i. > 1.5” in certain climate zones
- **Plan Review:**
 - Verify materials and R-values meet code
 - Verify cladding attachment materials and specifications
 - Verify air barrier materials and specifications
- **Field Inspection:**
 - Confirm materials and R-values installed per approved construction documents
 - Confirm cladding attachments installed properly
 - Confirm air barrier installed properly
- **Technical Validation/Resources:** see CCB

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Continuous Insulation - Cladding/Furring Attachment - Code Compliance Brief

Overview:

The intent of this brief is to provide code-related information to help ensure that the measure will be accepted as being in compliance with the code. Providing notes for code officials on how to plan review and conduct field inspections can help builders or remodelers with proposed designs and provide jurisdictional officials with information for acceptance. Providing the same information to all interested parties (e.g., code officials, builders, designers, etc.) is expected to result in increased compliance and fewer innovations being questioned at the time of plan review and/or field inspection.

Guidance is needed for code-compliant installations of various cladding materials when installed over thicker foam sheathing also known as insulated sheathing or continuous insulation (c.i.). The code has generally provided generic prescriptive attachment requirements without consideration of c.i. thickness or deferred to the manufacturers to provide guidance on fastener selection. But, many manufacturers' installation instructions have limited the thickness of c.i. applications to 0.5 inch to 1.5 inches of thickness, or not addressed it at all. Therefore, warranty, liability, and potential code conflicts exist when using thicker (>1.5") levels of c.i. due to the limitations cited in manufacturer installation instructions for exterior finishes and code provisions that prescriptively require c.i. > 1.5" in certain climate zones. In such cases, a designed alternative solution may be required to address these concerns. However, newer codes have now begun to provide engineered prescriptive solutions for use by builders, designers, code officials, and siding manufacturers.

As the energy codes continue to become more stringent, the thickness of c.i. has increased prescriptively. Only recently have codes begun to question whether all applicable loads were being addressed. Loads include seismic, wind, and dead load. Seismic and wind loads can be identified by

Continuous Insulation - Cladding/Furring Attachment - Plan Review Example

2012 and 2015 IECC Prescriptive Above-Grade Wall Insulation R-values

(R-values are the same for both versions)

Climate Zone	1	2	3	4	5	6	7 - 8
Wood Frame Wall	13	13	R-20 OR R-13+5	R-20 OR R-13+5	R-20 OR R-13+5	R-20+5 OR R-13+10	R-20+5 OR R-13+10
Steel Frame Wall 16" o.c.	Wood frame R-value equivalent R-13	Wood frame R-value equivalent R-13+3	Wood frame R-value equivalent R-20	Wood frame R-value equivalent R-20+5	Wood frame R-value equivalent R-20+5	Wood frame R-value equivalent R-20+5	Wood frame R-value equivalent R-21
	R-13+4.2 OR R-19+2.1 OR R-21+2.8 OR R-0+9.3 OR R-15+3.8 OR R-21+3.1	R-0+11.2 OR R-13+6.1 OR R-15+5.7 OR R-19+5.0 OR R-21+4.7	R-0+14.0 OR R-13+8.9 OR R-15+8.5 OR R-19+7.8 OR R-19+6.2 OR R-21+7.5	R-13+12.7 OR R-15+12.3 OR R-19+11.6 OR R-21+11.3 OR R-25+10.9	R-13+12.7 OR R-15+12.3 OR R-19+11.6 OR R-21+11.3 OR R-25+10.9	R-13+12.7 OR R-15+12.3 OR R-19+11.6 OR R-21+11.3 OR R-25+10.9	R-0+14.6 OR R-13+9.5 OR R-15+9.1 OR R-19+8.4 OR R-21+8.1 OR R-25+7.7
Steel Frame Wall 24" o.c.	Wood frame R-value equivalent R-13	Wood frame R-value equivalent R-13+3	Wood frame R-value equivalent R-20	Wood frame R-value equivalent R-20+5	Wood frame R-value equivalent R-20+5	Wood frame R-value equivalent R-20+5	Wood frame R-value equivalent R-21
	R-0+9.3 OR R-13+3.0 OR R-15+2.4	R-0+11.2 OR R-13+4.9 OR R-15+4.3 OR R-19+3.5 OR R-21+3.1	R-0+14.0 OR R-13+7.7 OR R-15+7.1 OR R-19+6.3 OR R-21+5.9	R-13+11.5 OR R-15+10.9 OR R-19+10.1 OR R-21+9.7 OR R-25+9.1	R-13+11.5 OR R-15+10.9 OR R-19+10.1 OR R-21+9.7 OR R-25+9.1	R-13+11.5 OR R-15+10.9 OR R-19+10.1 OR R-21+9.7 OR R-25+9.1	R-0+14.6 OR R-13+8.3 OR R-15+7.7 OR R-19+6.9 OR R-21+6.5 OR R-25+5.9

Continuous Insulation - Cladding/Furring Attachment - Field Inspection Example

Field Inspection:

Per the **2015 IECC, Section R104 Inspections**. Construction or work for which a permit is required is subject to inspection. Construction or work is to remain accessible and exposed for inspection purposes until approved. Required inspections include footing and foundation, framing and rough-in work, plumbing rough-in, mechanical rough-in, and final inspection.

Per the **2015 IRC, Section R109 Inspections**. The wording is somewhat different in that for onsite construction, from time to time the building official, upon notification from the permit holder or his agent, can make or cause to be made any necessary inspections. Further details are provided for inspections regarding foundation, plumbing, mechanical, gas and electrical, floodplain, frame and masonry, and final inspection. Any additional inspections are at the discretion of the building official.

This section provides details for inspecting to the specific provisions for continuous insulation and cladding attachments where one or more specific type of inspection per the IECC or IRC may be necessary to confirm compliance. Verifying code compliance would typically be at the framing and rough-in work inspection.

Inspections should provide verification in the following areas:

- Cavity insulation completely fills the cavity with no compression or gaps, the manufacturer's R-value mark is readily available, and meets the approved R-value per plans.
- Continuous insulation is installed in accordance with manufacturer's installation instructions, the manufacturer's R-value mark is readily available, and meets the approved R-value per plans.
- Cladding or furring attachments are installed in accordance with manufacturer's installation instructions and fastening requirements included in the locally applicable code, designed, or otherwise approved by the code official and specified on construction documents.
- Joints, seams, and penetrations in the c.i. are caulked, gasketed, weatherstripped, or otherwise sealed.
- Vapor retarder (if applicable) is properly installed on the interior (warm-in-winter) side of the exterior wall and in compliance with the locally applicable building code (e.g., only required in mixed or colder climate zones).
- Air barrier is properly installed on the interior or exterior (or both sides) of the exterior wall, or in the cavity if using an air-impermeable insulation product. All seams, gaps, and holes are sealed properly. Confirm corners and headers are insulated and the junction of the foundation and sill plate is sealed. The junction of the top plate and top of exterior walls are sealed. Confirm the exterior thermal

Technical Validation(s):

This section provides additional information and helpful resources.

Building America Top Innovation Hall of Fame Profile

[Exterior Rigid Insulation Best Practices](#) 

[Cladding Attachment Over Thick Exterior Insulating Sheathing](#) , P. Baker, P. Eng, and R. Lepage, Building Science Corporation, January 2014.

[Initial and Long-Term Movement of Cladding Installed Over Exterior Rigid Insulation](#) , P. Baker, Building Science Corporation, September 2014

[Attachment of Exterior Wall Coverings Through Foam Plastic Insulating Sheathing \(FPIS\) to Wood or Steel Framing](#), Applied Building Technology Group, LLC, March 27, 2015

Manufacturer Literature and Technical Code Compliance Data:

[Applying James Hardie Siding over Continuous Insulation and Non-Nailable Substrates](#) , #19, September 2014.

[DRJ Technical Evaluation Report, Use of FastenMaster HeadLOK™ Fasteners to Attach Cladding and/or Furring to Wood Framing through Foam Sheathing](#), April 2015.

[Engineering Evaluation Report TRU11910-21, Guide to Attaching Sheathing, Furring and/or Cladding through Continuous Foam Insulation to Wood Framing, Steel Framing, Concrete and CMU Substrates with TRUFAST SIP, TP, SIP LD and Tru-Grip Fasteners](#) 

Related BASC Guides

[Continuous Rigid Insulation Sheathing/Siding](#)

- Overview:
 - Original barrier in commercial code (not addressed)
 - Proposal submitted and approved for 2015 IECC residential
- Plan Review:
 - Verify U-factor and SHGC, tested, rated, and labeled
 - Verify area-weighted calculations
 - Verify flashing design or method
 - Verify air sealing specifications
- Field Inspection:
 - Confirm ratings match approved construction documents
 - Confirm windows have been flashed and sealed properly
- Technical Validation/Resources:
 - Advanced Glazing and Window Technologies (NIBS)
 - ENERGY STAR Windows

Dynamic Glazing - Code Compliance Brief

Overview:

The intent of this brief is to provide additional information to help assure the measure will be deemed in acceptance with the code. Providing notes for codes officials on how to plan review and field inspect can help the builder or remodeler with the proposed designs and provide the jurisdiction with information for acceptance. Providing the same information to all interested parties (i.e., code officials, builders, designers) is expected to result in increased compliance and fewer innovations being questioned at the time of plan review and/or field inspection.

Dynamic glazing requirements were added to the residential portion of the International Energy Conservation Code (IECC) and International Residential Code (IRC) in the 2015 version. Dynamic glazing is defined as “any fenestration¹ product that has the fully reversible ability to change its performance properties, including U-factor², solar heat gain coefficient (SHGC), or visible transmittance (VT).”³ This variation in performance properties can be useful in addressing conflicts between, for example, the desire for views of the outdoors and desire for reduction in solar gain. There are two main types of dynamic glazing:

- switchable glazing products⁴
- internal shading systems.⁵

Commercially available dynamic glazing products typically focus on U-factor or SHGC, providing a range of thermal insulation or solar shading.⁶ Switchable glazing products typically provide SHGC variability, while internal shading systems may provide both U-factor and SHGC variability. The range of solar shading may be provided by window films that automatically respond to sunlight or temperature or by integrated blinds or shades that are automatically controlled.

Because dynamic glazing products have multiple U-factor or SHGC values, the question immediately arises as to which value should be compared to the fenestration requirements in the 2015 IECC/IRC. The code requirements in the 2015 IECC/IRC state that, “... if the ratio of the higher to the lower value is greater than or equal to 2.4 and the product is automatically controlled to modulate the amount of solar gain into the space in multiple steps, the product may be permitted to comply with the requirements of the Insulation and Fenestration Requirements by Component Table R402.1.2.”

For SHGC, the “upper SHGC” value for dynamic glazing is typically close to that of a “clear” window, while the “lower SHGC” for dynamic glazing is typically closer to that of a heavily tinted window. This means that for dynamic glazing products, the SHGC-0.25 requirement in climate zones 1-3 and the SHGC-0.40 requirement in climate zone 4 are not applicable. Instead, the ratio of the upper and lower SHGC values and the presence of an appropriate automated control system are substituted for the prescriptive SHGC values. A special note should be made of what are called

Dynamic Glazing – Plan Review Example

- **2015 IECC/IRC, Section R402.3.1/N1102.3.1 U-factor.** An area-weighted average of fenestration products is permitted to satisfy the U-factor requirements prescriptively.
- **2015 IECC/IRC, Section R402.3.2/N1102.3.2 Glazed fenestration SHGC.** An area-weighted average of fenestration products more than 50% glazed is permitted to satisfy the SHGC requirements prescriptively.
- **Dynamic glazing** shall be permitted to satisfy the SHGC requirements of Table R402.1.2/N1102.1.2 provided the ratio of the higher to lower labeled SHGC is greater than or equal to 2.4, and the *dynamic glazing* is automatically controlled to modulate the amount of solar gain into the space in multiple steps. *Dynamic glazing* shall be considered separately from other fenestration, and area-weighted averaging with other fenestration that is not dynamic glazing is not be permitted.
 - Exception: *Dynamic glazing* is not required to comply with this section of the code when both the lower and higher labeled SHGC already comply with the requirements of Table R402.1.1/R1102.1.2. (Note that there is no Table R402.1.1/R1102.1.2 in the 2015 IECC/IRC and this is an obvious typo that should refer to Table R402.1.2/N1102.1.2.)

2015 IECC/IRC (Table R402.1.2/N1102.1.2)

Climate Zone	1	2	3	4 except Marine	5 and Marine 4	6	7, 8
U-factor	NR	0.40	0.35	0.35	0.32	0.32	0.32
SHGC	0.25	0.25	0.25	0.40	NR	NR	NR

– **2015 IECC/IRC Section R402.5/N1102.5 Maximum fenestration U-factor and SHGC.** The area-weighted average maximum fenestration U-factor and SHGC permitted using the following tradeoffs:

- Climate zones 4 and 5 – U-factor 0.48
- Climate zones 6-8 – U-factor 0.40
- Climate zones 1-3 – SHGC 0.50

Dynamic Glazing – Field Inspection and Technical Validation Example

Field Inspection:

Per the **2015 IECC, Section R104, Inspections**, construction or work for which a permit is required is subject to inspection. Construction or work is to remain accessible and exposed for inspection purposes until approved. Required inspections include: footing and foundation, framing and rough-in, plumbing rough-in, mechanical rough-in, and final inspection.

Per the **IRC, Section R109, Inspections**, the wording is somewhat different in that for on-site construction, from time to time the building official, upon notification from the permit holder or his agent, can make or cause to be made any necessary inspections. Further details are provided for inspections regarding foundation, plumbing, mechanical, gas and electrical, floodplain, frame and masonry, and final inspection. Any additional inspections are at the discretion of the building official.

This section provides details for inspecting to the specific provisions for "dynamic glazing" where one or more specific type of inspection per the IECC or IRC may be necessary to confirm compliance.

- *Confirm windows meet the ratings approved on the construction documents.* If the labels have been removed from the products, ask the contractor or homeowner if they saved a label to confirm the ratings meet compliance.
- *Confirm the windows have been flashed and sealed properly.* An inspection during installation to make sure the windows have been flashed properly before the siding and trim goes up is recommended. The following websites provide information on flashing/sealing windows.
 - [Guide with pictures on how to properly flash the window.](#)
 - [Guide with pictures on how to properly seal the window.](#)

Technical Validation(s):

[Advanced Glazing and Window Technologies, National Institute of Building Sciences](#) 

Related BASC Guides

[ENERGY STAR Windows](#)

- Overview:
 - Installing natural-draft gas appliances in tight homes and possible back-drafting
 - Testing to verify venting of byproducts of combustion
- Plan Review:
 - Verify materials and R-values for thermally isolated room
 - Verify combustion air ducts materials and specifications
- Field Inspection:
 - Confirm materials and R-values installed per approved construction documents
 - Confirm air barrier installed properly
 - Confirm combustion air openings meet approved construction documents
- Technical Validation/FAQ's:
 - Guide on Combustion Appliance Zone (CAZ) testing

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Rooms Containing Fuel-Burning Appliances - Code Compliance Brief

Overview:

The intent of this brief is to provide code-related information about rooms containing fuel-burning appliances to help ensure that the measure will be accepted as being in compliance with the code. Providing notes for codes officials on how to plan review and conduct field inspections can help builders or remodelers with proposed designs and provide jurisdictional officials with information for acceptance. Providing the same information to all interested parties (e.g., code officials, builders, designers, etc.) is expected to result in increased compliance and fewer innovations being questioned at the time of plan review and/or field inspection.

As houses are being built "tighter" to meet stricter air leakage requirements (e.g., climate zones 1-3 at 5 ACH/50 [air changes per hour at 50 Pa] and climate zones 3-8 at 3 ACH/50 in the 2015 International Energy Conservation Code (IECC) and International Residential Code (IRC), concern has risen for installing natural-draft gas *appliances*¹ (*vented*² or *direct-vented appliances*³) in these tighter homes without dealing with issues related to back-drafting due to possible increased negative pressure near the *combustion*⁴ *appliance* and drawing carbon monoxide into the building. For example, this scenario could potentially occur in a somewhat tight home tested at 900 cfm (cubic feet per minute) (e.g., a 2000-square foot home with 9-foot ceiling heights = 18,000 cubic feet/volume) by turning on one exhaust fan (e.g., 300 cfm), which could depressurize the home to the point that no natural-draft gas *appliance* could safely draft under these conditions⁵.

In an attempt to deal with these combustion issues, an entirely new section in the 2015 IECC/IRC regarding fuel-burning *appliances* basically requires the *appliance* to be isolated from the *building thermal envelope*,⁶ located either outside or within a separate room if the fuel-burning appliance is supplied by open combustion air ducts. The room must be insulated and sealed off from the rest of the conditioned space. Furthermore, a NEW Appendix 'RA' has been added providing for a Code Official's option to require a Combustion Appliance Zone (CAZ) test to verify "manufacturer's operational parameters" for venting byproducts of combustion in a "tight" <5 ACH/50 (air changes per hour) home.

This brief provides an overview of the requirements and further details of approving the actual "room," based on equipment choices and location of installed equipment, approving the "open combustion air ducts" as to the installation, insulation and sealing of the ducts, and any other ducts or water lines in the "room."

Rooms Containing Fuel-Burning Appliances – Plan Review Example

2015 IECC/IRC, Insulation and Fenestration Requirements by Component Table R402.1.2/N1102.1.2

Climate Zone	3	4 except Marine	5 and Marine 4	6	7, 8
Ceiling R-Value	38	49	49	49	49
Wood Frame Wall R-Value	20 or 13+5	20 or 13+5	20 or 13+5	20 or 13+5	20+5 or 13+10
Floor R-Value	19	19	30	30	38
Basement Wall R-Value³	5/13	5/13	15/19	15/19	15/19

³ The basement wall R-values are the minimum insulation requirements for the "room." The first R-value is continuous insulation with no thermal breaks; the second R-value is cavity insulation between studs or framing members.

Code Compliant Minimum Insulation Levels for the "Room"

Note: The actual code provision does not explicitly address requirements for any windows, skylights, slab-on-grade, or the door leading into the "room." If the "room" has any windows or skylights or is located as part of the building thermal envelope where one or more of the walls are exterior walls on a slab-on-grade foundation, then those components should meet the minimum insulation and fenestration values per Table R402.1.2/N1102.1.2. Also, because the "room" is to be isolated from the rest of the home, it should have an exterior type door (i.e., insulated door), not an interior door (i.e., hollow core) and should not have any grills or openings in it.

Climate Zone	3	4 except Marine	5 and Marine 4	6	7, 8
Ceiling, Wood Frame Walls, Floor R-Value³	5/13	5/13	15/19	15/19	15/19

³ The first R-value is continuous insulation with no thermal breaks; the second R-value is cavity insulation between studs or framing members. Either one will meet the minimum insulation requirements for the "room."

Rooms Containing Fuel-Burning Appliances – Field Inspection Example

Field Inspection:

Per the **2015 IECC, Section R104, Inspections**, construction or work for which a permit is required is subject to inspection. Construction or work is to remain accessible and exposed for inspection purposes until approved. Required inspections include footing and foundation, framing and rough-in work, plumbing rough-in, mechanical rough-in, and final inspection.

Per the **2015 IRC, Section R109, Inspections**, the wording is somewhat different in that for onsite construction, from time to time the building official, upon notification from the permit holder or his agent, can make or cause to be made any necessary inspections. Further details are provided for inspections regarding foundation, plumbing, mechanical, gas and electrical, floodplain, frame and masonry, and final inspection. Any additional inspections are at the discretion of the building official. This section provides details for inspecting to the specific provisions for "rooms containing fuel-burning appliances" where one or more specific type of inspection per the IECC or IRC may be necessary to confirm compliance. The framing and rough-in inspection would be most likely the inspection to confirm code compliance for the "room."

- Cavity insulation completely fills the cavity with no compression or gaps, the manufacturer's R-value mark is readily available, and meets the approved R-value per construction documents.
- Continuous insulation is installed in accordance with manufacturer's installation instructions, the manufacturer's R-value mark is readily available, and meets the approved R-value per construction documents.
- Batt insulation is cut neatly around any wiring and plumbing, or insulation readily conforms to available space and extends behind piping and wiring.
- Joints, seams, holes, and penetrations are caulked, gasketed, weather-stripped, or otherwise sealed.
- Continuous air barrier is properly installed. Confirm the "room's" thermal envelope insulation for framed ceiling, walls, and floor is installed in substantial contact and continuous alignment with the air barrier.
- Corners and headers are insulated and the junction of the foundation and sill plate is sealed. The junction of the top plate and top of exterior walls are sealed.
- Any recessed lighting is sealed with a gasket or caulk between the housing and the interior walls or ceiling covering. Confirm the luminaires are IC-rated and labeled.
- Door leading into the "room" is an insulated door, is weather-stripped with a threshold, and remains closed. The door remaining closed, is not so much a code requirement, but the essence of the isolated "room" is to keep it isolated from the rest of the home.
- Combustion air opening(s) size and placement meet the approved construction documents.
- Combustion air duct(s), other ducts, and piping are insulated properly and meet the approved R-values per the construction documents.

Rooms Containing Fuel-Burning Appliances – Technical Validation/FAQ's Example

Technical Validation(s):

This section provides additional information and helpful resources.

Guide on Combustion Appliance Zone (CAZ) Testing, <https://basc.pnnl.gov/resource-guides/combustion-appliance-zone-caz-testing>

Measure Guideline: Combustion Safety for Natural Draft Appliances Through Appliance Zone Isolation, Fitzgerald, Bohac, May 2014, <https://basc.pnnl.gov/resource-guides/combustion-appliance-zone-caz-testing>

Measure Guideline: Combustion Safety for Natural Draft Appliances Using Indoor Air, L. Brand, Partnership for Advanced Residential Retrofit, April 2014, <http://www.gastechnology.org/Solutions/Documents/BAPARR-Reports/Measure-guidelines-combustion-safety-for-natural-draft-appliances-using-indoor-air.pdf> 

Natural Fuel Gas Code, 2015 Edition, http://www.nfpa.org/codes-and-standards/document-information-pages?mode=code&code=54&DocNum=54&cookie_test=1

FAQ'S:

What are **"open combustion air ducts?"** "Combustion air" is regulated in the IRC. "Ducts" are defined in the IECC and regulated in the IRC. "Open" presumably refers to a duct that simply empties into a room, as opposed to a closed combustion system with direct vent appliance.

What are **"open combustion fuel-burning appliances?"** Open combustion fuel-burning appliances indicate any device that burns fuel and pulls air from the room surrounding the device. This would include gas kitchen stoves and presumably gas driers, but if a room in which these devices are used does not have "open combustion air ducts," there is no regulation.

What is **"outside the building thermal envelope?"** "Building thermal envelope" is defined in the 2015 IECC. To be "outside" the thermal envelope essentially requires tracing the thermal envelope (which is also regulated elsewhere in the 2015 IECC) and ensuring that the room is "outside" of that envelope. This might be in an unheated garage, an unheated basement, an unheated crawlspace, or even an unheated attic.

What is **"isolated from inside the thermal envelope?"** This phrase applies to a "room with the furnace" that is located inside the house. *The room must be insulated and sealed off from the rest of the "conditioned space."* The definition of conditioned space plays into this requirement because the combustion air is dumped into the room, the room is essentially unconditioned and the room must be sealed off from the conditioned space.

- ▶ Common Walls/Multi-family Walls
- ▶ Compact Ducts
- ▶ Insulating and sealing existing crawlspaces
- ▶ Insulating and air sealing existing vented attics
- ▶ Insulating and air sealing existing exterior walls
- ▶ Insulating and air sealing existing floors

- ▶ New Topics???

Thank you!

Questions??

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