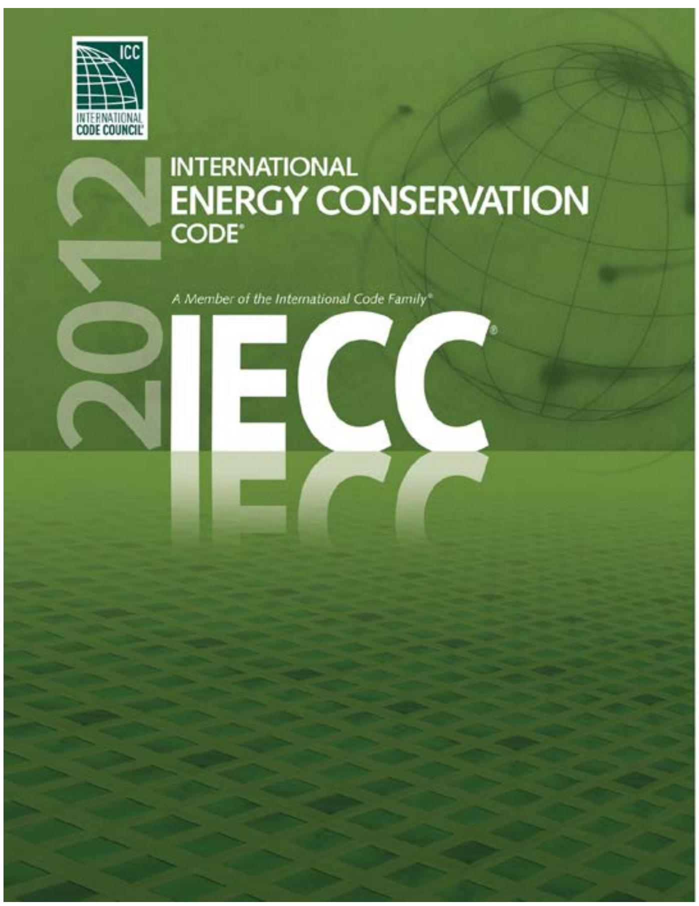
National Association of Home Builders

2012

IECC - Energy Code Action Kit



The NAHB-developed amendments provided below offer more cost-effective and affordable energy conservation code provisions than shown in the 2012 IECC.

Included in these amendments are performance criteria that provide flexibility and choices that a designer or engineer can use in lieu of using only the strict prescriptive requirements, or the limited performance requirements. These amendments allow for versatility of design to advance energy savings such reinstating the equipment trade-offs. These trade-offs were included in the 2006 IECC, but were deleted from the 2009 and 2012 IECC without credible substantiation.

Each amendment, is shown in legislative text (underline and ~~strikethrough~~), also includes a supporting reason for its adoption. The white paper titled, *Energy Code Percent Savings Calculation Methodology*, and its supporting materials are provided on the main Action page, under “Methodology and Costing Data” section, which provides substantiation on how these amendments, achieve energy savings.

From the following pages read the brief introduction and choose the proposed code change that you are interested in. The underlined portion is a hotlink to the proposed change. You can copy and or change any portion of the “Word” document to fit you precise needs. If you have questions or would like additional information, please contact:

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Amendment List

(1) Comprehensive Amendment
This is a comprehensive amendment to provide flexibility for meeting energy code requirements while maintaining energy performance. It will provide a "true" unrestricted performance path to allow for cost-optimized construction of an energy-equivalent house. ***(If you use this amendment you do not have to adopt these amendments: E6,15,16, they are part of #1)***
(2) Remove Mandatory Requirements for Above Code Program
This proposal eliminates the need to meet all "Mandatory" requirements identified by the IRC/IECC as long as the program exceeds the energy-efficiency levels required.
(3) Overhang Credit for SHGC (Climate Zone 1-4)
This amendment allows for the use of overhangs to meet the solar heat gain coefficient requirements within the IECC.
(4) MULTI-FAMILY AIR-LEAKAGE TESTING ALTERNATIVE
This amendment adds an exception to allow compliance to the air barrier requirements and allow builders to test the entire building as a whole, as is permitted for commercial buildings.
(5) AIR LEAKAGE RATE CORRECTION CLIMATE ZONES 3-8
Building Tightness Leakage Rate Correction. The 2012 IECC requires homes to have a leakage rate of no more than three air changes per hour (3 ACH) in climate zones 3-8. The ASHRAE Handbook of Fundamentals shows that less than 10% of homes achieve 3 ACH or less. This proposal modifies the requirement from 3 ACH to 4 ACH, an aggressive tightness level that will provide a tight, comfortable, energy-efficient home for the consumer.
(6) BUILDING TIGHTNESS TRADE-OFF
This proposal allows builders to trade improvements in other building energy components for less stringent building envelope pressure test results. This performance option provides flexibility in meeting the air tightness requirements and provides options for recovering from an unexpected air tightness test failure. ***(Part of Amendment #1)***
(7) DUCT LEAKAGE TRADEOFF
This proposal allows an energy neutral duct-tightness trade-off. The proposal keeps the mandatory testing; however, it permits duct leakage to exceed the prescriptive requirement provided the performance of the building still meets the target efficiency in the performance path.
(8) HOT WATER PIPING INSULATION
Research has been performed by a two different sources that indicate insulating hot water piping in a residential home is not cost effective; a simple payback for insulating hot water piping was in the 60 to 183 year range based on the piping material.
(9) BASEMENT WALL INSULATION IN CLIMATE ZONE 5
Basement Wall Insulation correction for Climate Zone 5 This amendment allows the requirement to be cost effective. These are the same values as proposed by the Department of Energy in the 2009 code cycle. Those values were overturned and increased by special interest groups. Energy savings totaled $7/year in Chicago (Climate zone 5). The additional cost for this is conservatively estimated at $590. This makes the simple payback in excess of 58 years. Creating a negative cash flow for the homebuyer.
(10) CEILING INSULATION CLIMATE ZONES 2-5
Ceilings Climate Zones 2, 3, 4 & 5. This proposal reinstates the appropriate minimum ceiling R-Values in climate zones 2, 3, 4 and 5, those published in the 2009 IECC. The 2012 IECC values increase construction costs an average of $1,342 per home yet save only $14 per year in

energy costs – or a payback of 99 years.

(11) WALL VALUES FOR CLIMATE ZONE 3

Walls R Value/U Factor Correction Climate Zone 3. This proposal reinstates the appropriate minimum wall assembly R-Values/U-Factors in Climate Zone 3 published in the 2009 IECC. The 2012 IECC values increased the upfront construction costs an average of $1,199 per home yet only save $50 year in energy costs, or an average payback of 24 years.

(12) WALL VALUES FOR CLIMATE ZONES 6-8

Walls R Value/U Factor Corrections, Climate Zones 6, 7 & 8. This proposal reinstates the appropriate minimum wall assembly R-Values/U-Factors in climate zones 6, 7 & 8 published in the 2009 IECC. The 2012 IECC values increased the upfront construction costs an average of $1,819 per home yet only save $48 year in energy costs – or an average payback of 41 years.

(13) U-FACTOR TABLE CORRECTION

Adjustment of U-Factor Calculations. This corrects the conversion from R-Value to U-Factor without changing stringency. It is important that the U-Factors and R-Values match when small alterations are being made to the wall assemblies selected in the R-Value table. This was added to the 2015 IECC.

(14) Trade-Off for 2X6 Wall

This amendment provides an option for a thermally equivalent tradeoff for 2x6 wall assemblies, which have reduced framing factors and R-18 insulation.

(15) MECHANICAL EQUIPMENT TRADE-OFF CREDIT

Mechanical Equipment Credit. This proposal reinstates the performance option in the International Energy Conservation Code (IECC) to reduce prescriptive requirements by installing HVAC equipment with higher energy-efficiency performance ratings than required by the code. ***(Part of Amendment #1)***

(16) WINDOW AREA TRADE-OFF CREDIT

Window Area Credit. Currently the 2012 IECC provides no incentive in the performance path to optimize the window area in order to save energy and provide day lighting, egress and views that makes for a safe and comfortable house. This code change proposal will provide the building designer the ability to reduce window area and get credit for the energy saved. ***(Part of Amendment #1)***

(17) Exhaust Hood Makeup Air

This amendment reduces the amount of makeup air required for kitchen draft hoods in excess of 400 cfm and includes an exception which increases the threshold for requiring makeup air to draft hoods larger than 600 cfm

(18) Joints, Seams, and Connections

This amendment eliminates the need to seal longitudinal seams in residential ductwork that operate at pressures below a 2 inch water column.

(1) Comprehensive Amendment

This is a comprehensive amendment that provides flexibility for meeting the energy code requirements while maintaining energy performance. It provides a "true" unrestricted performance path that will allow for cost-optimized construction of an energy-equivalent house. (Includes Amendments E6, E7, 14, 15)

Revise as follows:

R402.4 Air leakage ~~(Mandatory)~~. The building thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections N1102.4.1 through N1102.4.4.

R402.4.1 Building thermal envelope. The *building thermal envelope* shall comply with Sections N1102.4.1.1 and N1102.4.1.2. The sealing methods between dissimilar materials shall allow for differential expansion and contraction.

R402.4.1.1 Installation (Mandatory). The components of the *building thermal envelope* as listed in Table R402.4.1.1 shall be installed in accordance with the manufacturer's instructions and the criteria listed in Table R402.4.1.1, as applicable to the method of construction. Where required by the *code official*, an *approved* third party shall inspect all components and verify compliance.

R402.4.1.2 Testing (Mandatory). The building or dwelling unit shall be tested ~~and verified as having an air leakage rate of not exceeding 5 air changes per hour in Climate Zones 1 and 2, and 3 air changes per hour in Climate Zones 3 through 8~~ for air leakage. Testing shall be conducted with a blower door at a pressure of 0.2 inches w.g. (50 Pascals). Where required by the *code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope*. During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures;
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures;
3. Interior doors, if installed at the time of the test, shall be open;
4. Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;
5. Heating and cooling systems, if installed at the time of the test, shall be turned off; and
6. Supply and return registers, if installed at the time of the test, shall be fully open.

R402.4.1.3 Leakage rate (Prescriptive). The building or dwelling unit shall have an air leakage rate not exceeding 5 air changes per hour in Climate Zones 1 and 2, and 3 air changes per hour in Climate Zones 3 through 8, when tested in accordance with Section N1102.4.1.2.

TABLE R405.5.2(1)

SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Footnotes remain unchanged

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Vertical fenestration other than opaque doors	Total area[b] = ~~(a) The proposed glazing area; where proposed glazing area is less than 15% of the conditioned floor area.~~ ~~(b)~~ 15% of the conditioned floor area~~; where the proposed glazing area is 15% or more of the conditioned floor area.~~ Orientation: equally distributed to four cardinal compass orientations (N, E, S, & W) U-factor: from Table R402.1.3 SHGC: From Table R402.1.1 except that for climates with no requirement (NR) SHGC = 0.40 shall be used. Interior shade fraction: 0.92-(0.21 × SHGC for the standard reference design) External shading: none	~~As proposed~~ As proposed As proposed As proposed 0.92-(0.21 × SHGC as proposed) As proposed
Heating Systems [d, e]	~~As proposed for other than electric heating without a heat pump, Where the proposed design utilizes electric heating without a heat pump the standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the IECC-Commercial Provisions.~~ Fuel type: same as proposed design Efficiencies: Electric: air-source heat pump with prevailing federal minimum standards Nonelectric furnaces: natural gas furnace with prevailing federal minimum standards Nonelectric boilers: natural gas boiler with prevailing federal minimum standards Capacity: sized in accordance with Section N1103.7	~~As proposed~~ As proposed As proposed As proposed As proposed As proposed
Cooling Systems [d, f]	~~As proposed~~ Fuel type: Electric Efficiency: in accordance with prevailing federal minimum standards Capacity: sized in accordance with Section N1103.7	As proposed As proposed
Service Water Heating [d, e, f]	~~As proposed~~ Fuel type: same as proposed design Efficiency: in accordance with prevailing federal minimum standards Use: gal/day = 30 + 10 × *Nbr* Tank temperature: 120°F ~~Use: same as proposed design~~	~~As proposed~~ As proposed Same as standard reference Same as standard reference ~~gal/day = 30 + (10 × *Nbr*)~~

Reason:

This is a comprehensive amendment that provides flexibility for meeting the energy code requirements while maintaining energy performance. It provides a “true” unrestricted performance path that will allow for cost-optimized construction of an energy-equivalent house. The proposed changes provide alternatives that encourage innovation and the use of materials and equipment to result in a home which is at least equivalent to that prescribed in the energy code.

The modifications will reinstate many of the changes made since the 2006 IRC Chapter 11 that restricted the flexibility of the builder/designer to construct an energy efficient code compliant home while still meeting the energy performance levels of the current code.

Items included in this amendment:
Energy-neutral building tightness tradeoffs
Credit for more energy-efficient buildings which incorporate reduced window area
Energy-neutral heating, cooling and water heating equipment efficiency tradeoffs

Currently all homes have a "mandatory" requirement to be equal to or tighter than 3ACH50 or 5ACH50, depending on climate zone. Proposed changes will allow for homes to be less tight provided other efficiency changes are made to the house to offset energy lost due to the change in air infiltration.

Currently, when conducting a performance analysis, a building glazing area greater than 15% of the conditioned floor area (CFA) is penalized for using more energy. However, a building with less than 15% window to CFA does not get credit for saving energy. This amendment allows the builder/designer to optimize window area that is both energy efficient and pleasing to the consumer.

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(2) Remove Mandatory Requirements for Above Code Program

This proposal eliminates the need to meet all “Mandatory” requirements identified by the IRC/IECC as long as the program exceeds the energy-efficiency levels required.

Revise as follows:

R102.1.1 Above code programs.
The *code official* or other authority having jurisdiction shall be permitted to deem a national, state or local energy efficiency program to exceed the energy efficiency required by this code. Buildings *approved* in writing by such an energy efficiency program shall be considered in compliance with this code. ~~The requirements identified as “mandatory” in Chapter 4 shall be met.~~

Reason:

The key element of an above-code program is that it must meet or exceed the energy-efficiency requirements of the IECC. Requiring such a program to also meet the detailed prescriptive requirements labeled as “mandatory” in the IECC defeats the purpose of performance based above code program. This code change proposal will allow flexibility in the methodology used for any above-code program to meet or exceed IECC minimums.

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(3) Overhang Credit for SHGC (Climate Zone 1-4)

This amendment allows for the use of overhangs to meet the solar heat gain coefficient requirements within the IECC.

Add new text as follows:

PROJECTION FACTOR. The ratio of the horizontal depth of an overhang, eave, or permanently attached shading device, divided by the distance measured vertically from the bottom of the fenestration glazing to the underside of the overhang, eave, or permanently attached shading device.

R402.3.2.1 Glazed fenestration SHGC exception. In Climate Zones 1 through 4, permanently shaded vertical fenestration shall be permitted to satisfy the SHGC requirements. The projection factor of an overhang, eave, or permanently attached shading device shall be greater than or equal to the value listed in table 402.3.3 for the appropriate orientation. The minimum projection shall extend beyond each side of the glazing a minimum of 12 inches (0.3 m). Each orientation shall be rounded to the nearest cardinal orientation (+/-45 degrees or 0.79 rad) for purposes of calculations and demonstrating compliance.

TABLE R402.3.2.1
MINIMUM PROJECTION FACTOR REQUIRED BY ORIENTATION FOR SHGC EXCEPTION

ORIENTATION	PROJECTION FACTOR
North	>=0.40[a]
South	>=0.20
East	>=0.50
West	>=0.50

a. *For the north orientation, a vertical projection located on the west-edge of the fenestration with equivalent PF >= 0.15 shall also satisfy the minimum projection factor requirement.*

Reason:

The concept of using shading to reduce heat gain is integral to the architecture of some of the oldest cultures. Shading in modern construction offers many possibilities. This proposed code change allows for the use of overhangs to meet the solar heat gain coefficient requirements within the IECC. Permanent exterior shading features such as overhangs are allowed to be used in IECC Chapter 5 as a prescriptive tradeoff to meeting SHGC requirements. The calculation for determining the projection factor for overhangs has been in the 2000, 2003, 2006, and 2009 IECC for commercial buildings and has been proven to be very simple to calculate, fitting well into a prescriptive approach. The use of shading devices was allowed under the 2003 IECC and is currently allowed as a tradeoff under the commercial provisions of the IECC. Allowing flexibility in meeting the solar heat gain coefficient through the use of proven shading alternatives will increase the usability of the code for the building and design community while ensuring that the new fenestration is energy efficient. When credit for shading is permitted in the building code, it encourages an integrated approach to building designs, energy use, construction materials and renewable resources particularly as part of urban infrastructure, site and town planning and building design to be considered holistically. It also creates the opportunity for aesthetically pleasing and ingenious designs that might not otherwise be permitted.

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(4) MULTI-FAMILY AIR-LEAKAGE TESTING ALTERNATIVE

This amendment adds an exception to allow compliance to the air barrier requirements as and allow builders to test the entire building as a whole, as is permitted for commercial buildings.

Revise as follows:

R402.4 Air leakage (Mandatory). The building thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Section R402.4.1 through R402.4.4.

<u>**Exception:** Dwelling units of R-2 Occupancies and attached multiple single family dwellings shall be permitted to comply with IECC Section C402.4</u>

Reason:

Air tightness testing for single-family detached homes is very straightforward; however, it is much more difficult to accurately test attached dwelling units, including multi-family buildings and townhomes. Currently the IECC treats low-rise multifamily buildings of three stories or less like single-family homes and multifamily buildings of four stories or more like commercial buildings. Regardless of height, all multifamily buildings have the same air-tightness testing complications, such as: Does the entire building need to be tested at one time? What about multifamily buildings with open corridors? Does every dwelling need to be tested? Can the leakages be averaged between units? Is the leakage tested only to the “outside” or should it include leakage to adjacent units?

By approving this change, low-rise multifamily buildings and attached single-family dwellings will avoid these complications, but still held to the same level of performance as high-rise (R-2) residential as well as all commercial buildings.

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(5) AIR LEAKAGE RATE CORRECTION CLIMATE ZONE 3-8

Building Tightness Leakage Rate Correction. The 2012 IECC requires homes to have a leakage rate of no more than three air changes per hour (3 ACH) in climate zones 3-8. The ASHRAE Handbook of Fundamentals shows that less than 10% of homes achieve 3 ACH or less. This proposal modifies the requirement from 3 ACH to 4 ACH, an aggressive tightness level that will provide a tight, comfortable, energy-efficient home for the consumer

Revise as follows:

R402.4.1.2 Testing. The building or dwelling unit shall be tested and verified as having an air leakage rate of not exceeding 5 air changes per hour in Climate Zones 1 and 2, and ~~3~~ 4 air changes per hour in Climate Zones 3 through 8. Testing shall be conducted with a blower door at a pressure of 0.2 inches w.g. (50 Pascals). Where required by the *code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope*.

Table R405.5.2(1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Air exchange rate	Air leakage rate of 5 air changes per hour in Climate Zones 1 and 2, and ~~3~~ 4 air changes per hour in Climate Zones 3 through 8 at a pressure of 0.2 inches w.g (50 Pa). The mechanical ventilation rate shall be in addition to the air leakage rate and the same as in the proposed design, but no greater than 0.01 × CFA + 7.5 × (N_{br} + 1) where: CFA = conditioned floor area Nbr = number of bedrooms Energy recovery shall not be assumed for mechanical ventilation.	For residences that are not tested, the same air leakage rate as the standard reference design. For tested residences, the measured air exchange rate[c]. The mechanical ventilation rated shall be in addition to the air leakage rate and shall be as proposed.

Reason:

Building tightness is an important part of an energy efficient and comfortable house; however, 3 air changes per hour at 50 Pascals is an extremely low target tightness especially for smaller homes. The ASHRAE Handbook of Fundamentals shows that less than 10% of new homes achieve 3 ACH or less. Four ACH is still an aggressive tightness level, which will provide a tight, comfortable, energy efficient home for the consumer.

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(6) BUILDING TIGHTNESS TRADE-OFF

Building Tightness Trade-off. This proposal allows builders to trade improvements in other building energy components for less stringent building envelope pressure test results. This performance option provides flexibility in meeting the air tightness requirements and provides options for recovering from an unexpected air tightness test failure at C/O with the resident waiting to move in. Without this option what can be done? ***(Part of Amendment #1)***

Revise as follows:

R402.4 Air leakage ~~(Mandatory)~~. The building thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.4.

R402.4.1 Building thermal envelope. The *building thermal envelope* shall comply with Sections R402.4.1.1 and R402.4.1.2. The sealing methods between dissimilar materials shall allow for differential expansion and contraction.

R402.4.1.1 Installation (Mandatory). The components of the *building thermal envelope* as listed in Table R402.4.1.1 shall be installed in accordance with the manufacturer's instructions and the criteria listed in Table R402.4.1.1, as applicable to the method of construction. Where required by the *code official*, an *approved* third party shall inspect all components and verify compliance.

R402.4.1.2 Testing (Mandatory). The building or dwelling unit shall be tested ~~and verified as having an air leakage rate of not exceeding 5 air changes per hour in Climate Zones 1 and 2, and 3 air changes per hour in Climate Zones 3 through 8~~ for air leakage. Testing shall be conducted with a blower door at a pressure of 0.2 inches w.g. (50 Pascals). Where required by the *code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope*. During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures;
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures;
3. Interior doors, if installed at the time of the test, shall be open;
4. Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;
5. Heating and cooling systems, if installed at the time of the test, shall be turned off; and
6. Supply and return registers, if installed at the time of the test, shall be fully open.

R402.4.1.3 Leakage rate (Prescriptive). The building or dwelling unit shall have an air leakage rate not exceeding 5 air changes per hour in Climate Zones 1 and 2, and 3 air changes per hour in Climate Zones 3 through 8, when tested in accordance with Section R402.4.1.2.

Reason:

These modifications remove the mandatory maximum air tightness requirement and provide designers and builders the flexibility to trade-off building tightness with other performance path measures when using the performance path. Currently the building tightness requirement is mandatory and the 3 and 5 ACH tightness levels even under ideal circumstances are very difficult to achieve. This will provide energy neutral trade-offs for expensive and sometimes unattainable requirements with other building improvements. This proposal does not change the stringency of the code it only increases the flexibility while not lowering efficiency.

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(7) DUCT LEAKAGE TRADEOFF

Duct Leakage Tradeoff. This proposal allows an energy neutral duct-tightness trade-off. The proposal keeps the mandatory testing; however, it permits duct leakage to exceed the prescriptive requirement provided the performance of the building still meets the target efficiency in the performance path.

Revise as follows:

R403.3.2 Sealing ~~**(Mandatory).**~~ ~~Ducts, air handlers, and filter boxes shall be sealed. Joints and seams shall comply with either the International Mechanical Code or International Residential Code, as applicable.~~

~~**Exceptions:**~~

~~1.Air-impermeable spray foam products shall be permitted to be applied without additional joint seals.~~
~~2.Where a duct connection is made that is partially inaccessible, three screws or rivets shall be equally spaced on the exposed portion of the joint so as to prevent a hinge effect.~~
~~3.Continuously welded and locking-type longitudinal joints and seams in ducts operating at static pressures less than 2 inches of water column (500 Pa) pressure classification shall not require additional closure systems.~~

~~Duct tightness shall be verified by either of the following:~~

~~1.Postconstruction test: Total leakage shall be less than or equal to 4 cfm (113.3 L/min) per 100 square feet (9.29 m2) of conditioned floor area when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. All register boots shall be taped or otherwise sealed during the test.~~

~~2.Rough-in test: Total leakage shall be less than or equal to 4 cfm (113.3 L/min) per 100 square feet (9.29 m2) of conditioned floor area when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the system, including the manufacturer's air handler enclosure. All registers shall be taped or otherwise sealed during the test. If the air handler is not installed at the time of the test, total leakage shall be less than or equal to 3 cfm (85 L/min) per 100 square feet (9.29 m2) of conditioned floor area.~~

~~**Exception**: The total leakage test is not required for ducts and air handlers located entirely within the building thermal envelope.~~

R403.2.2.1 Construction (Mandatory). Ducts, air handlers, and filter boxes shall be sealed. Joints and seams shall comply with either the International Mechanical Code or International Residential Code, as applicable.

Exceptions:

1.Air-impermeable spray foam products shall be permitted to be applied without additional joint seals.
2.Where a duct connection is made that is partially inaccessible, three screws or rivets shall be equally spaced on the exposed portion of the joint so as to prevent a hinge effect.
3.Continuously welded and locking-type longitudinal joints and seams in ducts operating at static pressures less than 2 inches of water column (500 Pa) pressure classification shall not require additional closure systems.

R403.2.2.2 Duct testing (Mandatory). Ducts shall be pressure tested for air leakage by either of the following methods:

1.Postconstruction test: Total leakage shall be measured when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. All register boots shall be taped or otherwise sealed during the test.
2.Rough-in test: Total leakage shall be measured when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the system, including the manufacturer's air handler enclosure if present at the time of the test. All registers shall be taped or otherwise sealed during the test.

Exception: The total leakage test is not required for ducts and air handlers located entirely within the building thermal envelope.

A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*.

R403.2.2.3 Duct leakage (Prescriptive). Total leakage of the ducts, when measured in accordance with Section R403.2.2.2, shall be as follows:

1. Postconstruction test: Total leakage shall be less than or equal to 4 cfm (113.3 L/min) per 100 square feet (9.29 m2) of conditioned floor area.
2. Rough-in test: Total leakage shall be less than or equal to 4 cfm (113.3 L/min) per 100 square feet (9.29 m2) of conditioned floor area if the air handler is present at the time of the test, or 3 cfm (85 L/min) per 100 square feet (9.29 m2) of conditioned floor area if the air handler is not present at the time of the test.

Exception: No maximum duct leakage rate is required when ducts and air handlers are located entirely within the building thermal envelope.

Reason:

These modifications remove the mandatory maximum duct leakage requirement and provide designers and builders the flexibility to trade-off duct tightness with other performance path measures when using the performance path. Currently the duct tightness requirements are mandatory and even under ideal circumstances, difficult to achieve. This will provide energy neutral trade-offs for expensive and sometimes unattainable requirements with other building improvements. This proposal does not change the stringency of the code it only increases the flexibility.

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(8) HOT WATER PIPING INSULATION

Research has been performed by a two different sources that indicate insulating hot water piping in a residential home is not cost effective, a simple payback for insulating hot water piping was in excess of 60 years based on the piping material.

Revise as follows:

R403.4.2 Hot water pipe insulation (Prescriptive). Insulation for hot water pipe with a minimum thermal resistance (*R*-value) of R-3 shall be applied to the following:
1. Piping larger than 3/4 inch nominal diameter.
2. Piping serving more than one dwelling unit.
~~3.Piping from the water heater to kitchen outlets.~~
~~4~~3. Piping located outside the conditioned space.
~~5~~4. Piping from the water heater to a distribution manifold.
~~6~~5. Piping located under a floor slab.
~~7~~6. Buried piping.
~~8~~7. Supply and return piping in recirculation systems other than demand recirculation systems.
~~9. Piping with run lengths greater than the maximum run lengths for the nominal pipe diameter given in Table R403.4.2.~~

~~All remaining piping shall be insulated to at least R-3 or meet the run length requirements of Table R403.4.2.~~

Delete Table R403.4.2

Reason:

Research has been performed by a two different sources that indicate insulating hot water piping in a residential home is not cost effective. The NAHB Research Center performed a study in 2010 that concluded, based on a low cost estimate that the simple payback for insulating hot water piping was in the 60 to 100 year range based on the piping material. Additionally, a 2009 study presented by the National Renewable Energy Lab at the ASME 3rd International Conference of Energy Sustainability estimated paybacks between 72 and 183 years for various insulation configurations.

First cost, as determined in the NAHB Research Center report varied between $500 and $1,200. The NREL report had a slightly smaller house with an estimated installation cost of $366.

The simulations demonstrate that the benefit of insulation is greatest when all of the hot water uses are spaced apart from 10 to 30 minutes; however, this is not typically how hot water is consumed in a home. The benefit of insulation is diminished with shorter and longer time between uses.

It was shown in the study that pipes located in colder locations such as an unconditioned crawl space, benefit more from pipe insulation than pipes located in more conditioned spaces. This is why the insulation requirement was not changed for hot water pipes outside conditioned space.
Plastic pipe was shown to have less loss than copper pipe and commensurately insulation is more beneficial on metal pipe than on plastic pipe. However, copper pipe is losing market share and currently is only being installed in 14% of new homes.

Sources:

NAHB Research Center (2010), *Domestic Hot Water System Piping Insulation: Analysis of Benefits and Cost*
Hendron, R. Burch, J. Hoeschele, M. Rainer, L. (2009), *Potential for Energy Savings Through Residential Hot Water Distribution System Improvements*, Proceedings of the 3rd International Conference on Energy Sustainability

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(9) BASEMENT WALL INSULATION IN CLIMATE ZONE 5

Basement Wall Insulation correction for Climate Zone 5. Energy savings totaled $7/yr in Chicago (Climate zone 5). The additional cost for this is conservatively estimated at $590. This makes the simple payback in excess of 84 years. This creates a negative cash flow for the homebuyer.

Revise as follows:

TABLE R402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENES-TRATION *U*-FACTOR[b]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENES-TRATION SHGC[b,e]	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE	MASS WALL *R*-VALUE[i]	FLOOR *R*-VALUE	BASEMENT[c] WALL *R*-VALUE	SLAB[d] *R*-VALUE AND DEPTH	CRAWL SPACE[c] WALL *R*-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13+5[h,i]	8/13	19	5/13[f]	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5[h,i]	8/13	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5[h,i]	13/17	30[g]	10/13 ~~15/19~~	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10[h,i]	15/20	30[g]	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10[h,i]	19/21	38[g]	15/19	10, 4 ft	15/19

TABLE R402.1.3 EQUIVALENT U-FACTORS[a]

Climate Zone	Fenestration U-Factor	Skylight U-Factor	Ceiling U- Factor	Frame Wall U-Factor	Mass Wall U-Factor[b]	Floor U-Factor	Basement Wall U-Factor	Crawl Space Wall U-Factor
1	0.50	0.75	0.035	0.082	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	0.082	0.165	0.064	0.360	0.477
3	0.35	0.55	0.030	0.057	0.098	0.047	0.091[c]	0.136
4 except Marine	0.35	0.55	0.026	0.057	0.098	0.047	0.059	0.065
5 and Marine 4	0.32	0.55	0.026	0.057	0.082	0.033	~~0.050~~ 0.059	0.055
6	0.32	0.55	0.026	0.048	0.060	0.033	0.050	0.055
7 and 8	0.32	0.55	0.026	0.048	0.057	0.028	0.050	0.055

All Footnotes remain unchanged

Reason:

The prescriptive basement wall requirement increased from R-10 to R-15 in the 2012 IECC. Calculations used to justify the change were based on energy models, which had less sophisticated algorithms than Energy Plus which is now the preferred modeling software of the Department of Energy. When using Energy Plus, the energy savings in a 700 square foot basement totaled $7/yr in Chicago (Climate zone 5). The additional cost for this is conservatively estimated at $590. This makes the simple payback in excess of 84 years. This also will create a negative cash flow for the consumer.

Climate Zone	Representative City	Basement Wall R-Value Change	Energy Savings	Incremental Cost	Simple Payback
5	Chicago, IL	R-10->R-15	$7/yr	$590 ($0.82/ft2)	84 years

The energy modeling was done using the Energy Plus simulation engine and BEopt version 1.4, Cost figures came from ASHRAE RP-1481

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(10) CEILING INSULATION CLIMATE ZONES 2-5

Ceilings Climate Zones 2, 3, 4 & 5. This proposal reinstates the appropriate minimum ceiling R-Values in climate zones 2, 3, 4 and 5, those published in the 2009 IECC. The 2012 IECC values increase construction costs an average of $1,342 per home yet save only $14 per year in energy costs – or a payback of 99 years.

Revise as follow:

TABLE R402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENES-TRATION *U*-FACTOR[b]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENES-TRATION SHGC[b,e]	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE	MASS WALL *R*-VALUE[i]	FLOOR *R*-VALUE	BASEMENT[c] WALL *R*-VALUE	SLAB[d] R-VALUE AND DEPTH	CRAWL SPACE[c] WALL *R*-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	~~38~~ 30	13	4/6	13	0	0	0
3	0.35	0.55	0.25	~~38~~ 30	20 or 13+5[h,i]	8/13	19	5/13[f]	0	5/13
4 except Marine	0.35	0.55	0.40	~~49~~ 38	20 or 13+5[h,i]	8/13	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	~~49~~ 38	20 or 13+5[h,i]	13/17	30[g]	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10[h,i]	15/20	30[g]	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10[h,i]	19/21	38[g]	15/19	10, 4 ft	15/19

TABLE R402.1.3
EQUIVALENT U-FACTORS[a]

Climate Zone	Fenestration U-Factor	Skylight U-Factor	Ceiling U-Factor	Frame Wall U-Factor	Mass Wall U-Factor[b]	Floor U-Factor	Basement Wall U-Factor	Crawl Space Wall U-Factor
1	0.50	0.75	0.035	0.082	0.197	0.064	0.360	0.477
2	0.40	0.65	~~0.030~~ 0.035	0.082	0.165	0.064	0.360	0.477
3	0.35	0.55	~~0.030~~ 0.035	0.057	0.098	0.047	0.091[c]	0.136
4 except Marine	0.35	0.55	~~0.026~~ 0.030	0.057	0.098	0.047	0.059	0.065
5 and Marine 4	0.32	0.55	~~0.026~~ 0.030	0.057	0.082	0.033	0.059	0.055
6	0.32	0.55	0.026	0.048	0.060	0.033	0.050	0.055
7 and 8	0.32	0.55	0.026	0.048	0.057	0.028	0.050	0.055

All Footnotes remain unchanged

Reason:

There were four changes in the residential Ceiling R-value requirements in the 2012 IECC, none of which are cost-effective. An energy and cost analysis was performed to show that the simple paybacks are in the 80-130 year range. NAHB surveys show that consumers expect a simple payback of 7 years or less.

Climate Zone	Representative City	Change	Energy Savings	Incremental Cost	Simple Payback
2	Orlando, FL	R-38->R-30	$10/yr	$1,305	130 years
3	Atlanta, GA	R-38->R-30	$16/yr	$1,305	82 years
4	Richmond, VA	R-49->R-38	$15/yr	$1,379	92 years
5	Indianapolis, IN	R-49->R-38	$15/yr	$1,379	92 years

The energy modeling was done using the Energy Plus simulation engine and BEopt version 1.4, Cost figures came from ASHRAE RP-1481. Vaulted or cathedralized ceiling are very problematic when trying to achieve R- 49, which is about 16 inches thick. This would require a rafter at least 17” tall (which does not exist) or an insulated panel, which represents a very small portion of the market.

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(11) WALL VALUES FOR CLIMATE ZONE 3

Walls R Value/U Factor Correction Climate Zone 3. This proposal reinstates the appropriate minimum wall assembly R-Values/U-Factors in Climate Zone 3 published in the 2009 IECC. The 2012 IECC values increased the upfront construction costs an average of $1,199 per home yet only save $50 year in energy costs, or an average payback of 24 years.

Revise as follows:

TABLE R402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENES-TRATION *U*-FACTOR[b]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENES-TRATION SHGC[b,e]	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE	MASS WALL *R*-VALUE[i]	FLOOR *R*-VALUE	BASEMENT[c] WALL *R*-VALUE	SLAB[d] *R*-VALUE AND DEPTH	CRAWL SPACE[c] WALL *R*-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	13 ~~20 or 13+5[h,i]~~	8/13	19	5/13[f]	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5[h,i]	8/13	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5[h,i]	13/17	30[g]	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10[h,i]	15/20	30[g]	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10[h,i]	19/21	38[g]	15/19	10, 4 ft	15/19

TABLE R402.1.3
EQUIVALENT U-FACTORS[a]

Climate Zone	Fenestration U-Factor	Skylight U-Factor	Ceiling U-Factor	Frame Wall U-Factor	Mass Wall U-Factor[b]	Floor U-Factor	Basement Wall U-Factor	Crawl Space Wall U-Factor
1	0.	0.75	0.035	0.082	0.197	0.064	0.360	0.477
2	0.	0.65	0.030	0.082	0.165	0.064	0.360	0.477
3	0.	0.55	0.030	~~0.057~~ 0.082	0.098	0.047	0.091[c]	0.136
4 except Marine	0.35	0.55	0.026	0.057	0.098	0.047	0.059	0.065
5 and Marine 4	0.32	0.55	0.026	0.057	0.082	0.033	0.059	0.055
6	0.32	0.55	0.026	0.048	0.060	0.033	0.050	0.055
7 and 8	0.32	0.55	0.026	0.048	0.057	0.028	0.050	0.055

All Footnotes remain unchanged

Reason:

Frame wall requirements in climate zone 3 changed from R-13 to R-20, which was, is not cost effective for the consumer.

Climate Zone	Representative City	Wall R-Value Change	Energy Savings	Incremental Cost	Simple Payback
3	Atlanta, GA	R-13->R-20	$50/yr	$1,199	24 years

The energy modeling was done using the Energy Plus simulation engine and BEopt version 1.4, Cost figures came from ASHRAE RP-1481. Not only is the payback 24 years, but for a consumer, there would be a negative cash flow based on the incremental cost and energy savings. The increase in the monthly mortgage would be $6.43 (@ 5%) and the average monthly energy savings would be $4.17.

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(12) WALL VALUES FOR CLIMATE ZONES 6-8

Walls R Value/U Factor Corrections, Climate Zones 6, 7 & 8. This proposal reinstates the appropriate minimum wall assembly R-Values/U-Factors in climate zones 6, 7 & 8 published in the 2009 IECC. The 2012 IECC values increased the upfront construction costs an average of $1,819 per home yet only save $48 year in energy costs – or an average payback of 41 years.

Revise as follows:

TABLE R402.1.1

INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENES-TRATION *U*-FACTOR[b]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENES-TRATION SHGC[b,e]	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE	MASS WALL *R*-VALUE[i]	FLOOR *R*-VALUE	BASEMENT[c] WALL *R*-VALUE	SLAB[d] *SR*-VALUE AND DEPTH	CRAWL SPACE[c] WALL *R*-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13+5[h,i]	8/13	19	5/13[f]	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5[h,i]	8/13	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5[h,i]	13/17	30[g]	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20 or 13+5[h,i] ~~20+5 or 13+10[h,i]~~	15/20	30[g]	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20 or 13+5[h,i] ~~20+5 or 13+10[h,i]~~	19/21	38[g]	15/19	10, 4 ft	15/19

TABLE R402.1.3
EQUIVALENT U-FACTORS[a]

Climate Zone	Fenestration U-Factor	Skylight U-Factor	Ceiling U-Factor	Frame Wall U-Factor	Mass Wall U-Factor[b]	Floor U-Factor	Basement Wall U-Factor	Crawl Space Wall U-Factor
1	0.50	0.75	0.035	0.082	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	0.082	0.165	0.064	0.360	0.477
3	0.35	0.55	0.030	0.057	0.098	0.047	0.091[c]	0.136
4 except Marine	0.35	0.55	0.026	0.057	0.098	0.047	0.059	0.065
5 and Marine 4	0.32	0.55	0.026	0.057	0.082	0.033	0.050	0.055
6	0.32	0.55	0.026	~~0.048~~ 0.057	0.060	0.033	0.050	0.055
7 and 8	0.32	0.55	0.026	~~0.048~~ 0.057	0.057	0.028	0.050	0.055

All Footnotes remain unchanged

Reason:

The prescriptive wall requirement increased to R-20+R5 in Climate zones 6, 7 and 8 of the 2012 IECC. The additional cost for this is estimated at $1,819 for 1,016 square feet of wall. This makes the simple payback between 26 and 55 years depending on the climate zone. This also will create a negative cash flow for the consumer in all cases.

Climate Zone	Representative City	Basement Wall R-Value Change	Energy Savings	Incremental Cost	Simple Payback
6	Minneapolis, MN	R-20->R-20+5	$33/yr	$1,819 ($1.79/ft2)	55 years
7	Bemidgi, MN	R-20->R-20+5	$41/yr	$1,819 ($1.79/ft2)	44 years
8	Fairbanks, AK	R-20->R-20+5	$71/yr	$1,819 ($1.79/ft2)	26 years

The energy modeling was done using the Energy Plus simulation engine and BEopt version 1.4, Cost figures came from ASHRAE RP-1481.

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(13) U-FACTOR TABLE CORRECTION

Adjustment of U-Factor Calculations. This proposal corrects the conversion from R-Value to U-Factor without changing stringency. It is important that the U-Factors and R-Values match when small alterations are being made to the wall assemblies selected in the R-Value table. These corrections were made to the 2015 IECC

Revise as follows:

TABLE R402.1.3
EQUIVALENT U-FACTORS[a]

Climate Zone	Fenestration U-Factor	Skylight U-Factor	Ceiling U-Factor	Frame Wall U-Factor	Mass Wall U-Factor[b]	Floor U-Factor	Basement Wall U-Factor	Crawl Space Wall U-Factor
1	0.50	0.75	0.035	~~0.082~~ 0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	~~0.082~~ 0.084	0.165	0.064	0.360	0.477
3	0.35	0.55	0.030	~~0.057~~ 0.060	0.098	0.047	0.091[c]	0.136
4 except Marine	0.35	0.55	0.026	~~0.057~~ 0.060	0.098	0.047	0.059	0.065
5 and Marine 4	0.32	0.55	0.026	~~0.057~~ 0.060	0.082	0.033	0.059	0.055
6	0.32	0.55	0.026	~~0.048~~ 0.045	0.060	0.033	0.050	0.055
7 and 8	0.32	0.55	0.026	~~0.048~~ 0.045	0.057	0.028	0.050	0.055

All Footnotes remain unchanged

Reason:

The intent of these changes is not to alter the stringency of the code, but rectify the conversion from R- Value to U-Factor. Currently the R-Values and equivalent U-Factors do not match when applying a consistent calculation method.

It is important that the U-Factors and R-Values do match when small alterations are being made to the wall assemblies selected in the R-Value table. For example, a builder does not want to install R-20 as suggested in the R-Value table. Instead, the builder’s preferred wall is R-15+R3.8c.i. Although the R- 15+R3.8c.i. wall is thermally better than the R-20 wall, it does not meet the requirements of the Equivalent U-Factor table.

Following are a series of calculations which justify the proposed changes to the Frame Wall U-Factor values:

Climate Zone 1 and 2 Wall U-Factor Calculation Spreadsheet

Wall Thermal Resistance by Component	2x4 Wall R-13 Batt		
	R-Value Studs	R-Value Cavity	Assembly Value
Wall - Outside Winter Air Film[A]	0.17		
Siding - Vinyl[A]	0.62		
Continuous Insulation	0		
OSB - 7/16"[A]	0.62		
SPF Stud/Cavity Insulation	4.375	13	
1/2" Drywall [A]	0.45		
Inside Air Film[A]	0.68		
Studs at 16" o.c. [A]	25%	75%	
Total Wall R-Values	6.92	15.54	**11.85**
Total Wall U-Values	0.145	0.064	**0.084**
[A]2009 ASHRAE Handbook of Fundamentals			

Climate Zones 3-5 Wall U-Factor Calculation Spreadsheet

Wall Thermal Resistance by Component	2x4 Wall R-13+R5			2x6 Wall R-20		
	R-Value Studs	R-Value Cavity	Assembly U-Factor	R-Value Studs	R-Value Cavity	Assembly U-Factor
Wall - Outside Winter Air Film[A]	0.17			0.17		
Siding - Vinyl[A]	0.62			0.62		
Continuous Insulation	5			0		
OSB - 7/16"[A]	0.62			0.62		
SPF Stud/Cavity Insulation	4.375	13		6.875	20	
1/2" Drywall [A]	0.45			0.45		
Inside Air Film[A]	0.68			0.68		
Studs at 16" o.c. [A]	25%	75%		25%	75%	
Total Wall R-Values	11.92	20.54	**17.39**	9.42	22.54	**16.71**
Total Wall U-Factor	0.084	0.049	**0.057**	0.106	0.044	**0.060**
[A]2009 ASHRAE Handbook of Fundamentals						

Climate Zones 6-8 Wall U-Factor Calculation Spreadsheet

Wall Thermal Resistance by Component	2x4 Wall R-13+R-10 c.i.			2x6 Wall R-20+R-5 c.i.		
	R-Value Studs	R-Value Cavity	Assembly Value	R-Value Studs	R-Value Cavity	Assembly Value
Wall - Outside Winter Air Film[A]	0.17			0.17		
Siding - Vinyl[A]	0.62			0.62		
Continuous Insulation	10			5		
OSB - 7/16"[A]	0.62			0.62		
SPF Stud/Cavity Insulation	4.375	13		6.875	20	
1/2" Drywall [A]	0.45			0.45		
Inside Air Film[A]	0.68			0.68		
Studs at 16" o.c. [A]	25%	75%		25%	75%	
Total Wall R-Values	16.92	25.54	**22.65**	14.42	27.54	**22.43**
Total Wall U-Values	0.059	0.039	**0.044**	0.069	0.036	**0.045**
[A]2009 ASHRAE Handbook of Fundamentals						

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14. Trade-Off for 2X6 Wall

This amendment provides an option for a thermally equivalent tradeoff for 2x6 wall assemblies, which have reduced framing factors and R-18 insulation.

Revise as follows:

SECTION R202 GENERAL DEFINITIONS (new)

Framing Factor. The fraction of the total building component area that is structural framing.

TABLE N1102.1.2 (R402.1.2)
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION U-FACTOR[b]	SKYLIGHT[b] U-FACTOR	GLAZED FENESTRATION SHGC[b,e]	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE[i]	FLOOR R -VALUE	BASEMENT[c] WALL R -VALUE	SLAB[d] R-VALUE AND DEPTH	CRAWL SPACE[c] WALL R - VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13+5[h,i]	8/13	19	5/13f	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5[h,i]	8/13	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5[h,i]	13/17	30g	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10[h,i]	15/20	30g	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10[h,i]	19/21	38[g]	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

a. *R*-values are minimums. *U*-factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R*-value of the insulation shall not be less than the *R*-value specified in the table.

b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration. Exception: Skylights may be excluded from glazed fenestration SHGC requirements in Climate Zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

c. "15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.

d. R-5 shall be added to the required slab edge *R*-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.

e. There are no SHGC requirements in the Marine Zone.

f. Basement wall insulation is not required in warm-humid locations as defined by Figure R301.1 and Table R301.1.

g. Or insulation sufficient to fill the framing cavity, R-19 minimum.

h. First value is cavity insulation, second is continuous insulation or insulated siding, so "13+5" means R-13 cavity insulation plus R-5 continuous insulation or insulated siding. If structural sheathing covers 40 percent or less of the exterior, continuous insulation *R*-value shall be permitted to be reduced by no more than R-3 in the locations where structural sheathing is used – to maintain a consistent total sheathing thickness.

i. The second *R*-value applies when more than half the insulation is on the interior of the mass wall.

j. R-18 insulation shall be permitted in place of the R-20 requirement provided the wall *framing factor* is 20% or less or exterior walls with 24" o.c. nominal vertical stud spacing.

Reason:

The ASHRAE Handbook of Fundamentals and ASHRAE Transaction 1995 Volume 101, Part 2 assumes that wood framed walls have a framing factor of 25%. This means that 25% of the wall area consists of structural framing members and the remainder is a cavity suitable for installing insulation. When calculating the U-factor for a wall assembly, a high framing factor increases the overall assembly U-Factor. Reducing the framing factor also provides an increase in the thermal performance of the wall.

This amendment provides an option for a thermally equivalent tradeoff for 2x6 wall assemblies which have reduced framing factors and R-18 insulation. Here are the calculations showing equal U-Factors for both assemblies (0.060).

Wall Thermal Resistance by Component	2x6 Wall R-20 25%FF (16" o.c.)			2x6 Wall R-18 20% FF		
	R-Value Studs	R-Value Cavity	Assembly U-Factor	R-Value Studs	R-Value Cavity	Assembly U-Factor
Wall - Outside Winter Air Film[A]	0.17			0.17		
Siding - Vinyl[A]	0.62			0.62		
Continuous Insulation	0			0		
OSB - 7/16"[A]	0.62			0.62		
SPF Stud/Cavity Insulation	6.875	20		6.875	18	
1/2" Drywall [A]	0.45			0.45		
Inside Air Film[A]	0.68			0.68		
Studs at 16" o.c. [A]	25%	75%		20%	80%	
Total Wall R-Values	9.42	22.54		9.42	20.54	
Total Wall U-Factor	0.106	0.044	**0.060**	0.106	0.049	**0.060**
[A]2009 ASHRAE Handbook of Fundamentals						

Enermodal, 2001. Characterization of Framing Factors for Low-Rise Residential Building Envelopes (904-RP). Final Report prepared for ASHRAE.

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(15) MECHANICAL EQUIPMENT TRADE-OFF CREDIT

Mechanical Equipment Credit. This proposal reinstates the performance option in the International Energy Conservation Code (IECC) to reduce prescriptive requirements by installing HVAC equipment with higher energy-efficiency performance ratings than required by the code. ***(Part of Amendment #1)***

Revise as follows:

TABLE R405.5.2(1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Heating systems [f, g]	~~As proposed for other than electric heating without a heat pump, Where the proposed design utilizes electric heating without a heat pump the standard reference design shall be an air source heat pump meeting the requirements of Section R403 of the IECC-Commercial Provisions.~~ Fuel type: same as proposed design Efficiencies: Electric: air-source heat pump with prevailing federal minimum standards Nonelectric furnaces: natural gas furnace with prevailing federal minimum standards Nonelectric boilers: natural gas boiler with prevailing federal minimum standards Capacity: sized in accordance with Section R403.6	~~As proposed~~ As proposed As proposed As proposed As proposed
Cooling systems [f,h]	~~As proposed~~ Fuel type: Electric Efficiency: in accordance with prevailing federal minimum standards Capacity: sized in accordance with Section R403,6	~~As proposed~~ As proposed As proposed
Service Water Heating [f,g,h,i]	~~As proposed~~ Fuel type: same as proposed design Efficiency: in accordance with prevailing federal minimum standards Use: gal/day = 30 + 10 × *Nbr* Tank temperature: 120°F ~~Use: same as proposed design~~	~~As proposed~~ As proposed Same as standard reference Same as standard reference ~~gal/day = 30 + (10 × *Nbr*)~~

Reason:

This amendment serves to retain energy neutral equipment trade-off provisions from the 2006 International Energy Conservation Code (IECC) for the heating systems, cooling systems, and service water heating. By retaining these, builders have an opportunity to optimize a code-compliant house design by using energy efficient equipment. Quite often, the use of this high efficiency equipment provides a more cost effective solution to achieve code compliance. Eliminating this ability discourages the concept of the "house as a system" approach which is a cornerstone of building science.

Rejecting this amendment will create a negative impact on the installation of state-of-the-art, energy efficient equipment. It will increase the cost of construction by driving builders to often use less efficient equipment while increasing the cost of construction.

Significant improvements in the efficiency of HVAC and water heating equipment have been made in the last 20 years. With the increased emphasis on new and improved technologies, this trend is expected to continue and will result in even higher energy savings in future years. If builders are forced to comply with the energy code by installing requirements which are not cost-effective, there will be a resistance to install higher efficiency equipment. This could end up hurting energy efficiency in the long term, consumers which have non-condensing furnaces will be less likely to install a higher efficiency condensing replacement furnace because of the additional cost to run an exhaust vent.

Industries such as log home manufacturers may no longer be able to construct to projected higher envelope requirements. The combination of increases in envelope thermal requirements, building tightness and duct tightness combined with the elimination of energy neutral trade-offs pose a serious threat to the viability of the log home industry. There are practical limitations to the thickness of log home walls, increases in the log diameter has a exponential increase in the cost of the logs making log walls with a U- factor of 0.082 or lower prohibitively expensive

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(16) WINDOW AREA TRADE-OFF CREDIT

Window Area Credit. Currently the 2012 IECC provides no incentive in the performance path to optimize the window area in order to save energy and provide day lighting, egress and views that makes for a safe and comfortable house. This code change proposal will provide the building designer the ability to reduce window area and get credit for the energy saved. ***(Part of Amendment #1)***

Revise as follows:

TABLE R405.5.2(1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Glazing[a]	Total area[b] =	As proposed
	~~(a) The proposed glazing area; where proposed glazing area is less than 15% of the conditioned floor area.~~	~~As proposed~~
	~~(b)~~ 15% of the conditioned floor area~~; where the proposed glazing area is 15% or more of the conditioned floor area.~~	~~As proposed~~
	Orientation: equally distributed to four cardinal compass orientations (N, E, S, & W)	As Proposed
	U-factor: from Table R402.1.3	As proposed
	SHGC: From Table R402.1.1 except that for climates with no requirement (NR) SHGC = 0.40 shall be used.	As proposed
	Interior shade fraction: 0.92-(0.21 × SHGC for the standard reference design)	0.92-(0.21 × SHGC as proposed)
	External shading: none	As proposed

Reason:

Walls generally perform better thermally than windows. Currently in the code there is no incentive in the performance path for the building designer to optimize the window area in order to save energy and provide daylighting, egress and views that makes for a safe and comfortable house. These modifications will provide the building designer the ability to reduce window area and get credit for the energy saved. As this section is currently written, the house is penalized for having more than 15% window area yet receives no credit toward code compliance when the window area is reduced below 15%. This change rectifies this disparity and makes the performance path a more representative of actual energy use.

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17. Exhaust Hood Makeup Air

This amendment reduces the amount of makeup air required for kitchen draft hoods in excess of 400 cfm and includes an exception that increases the threshold for requiring makeup air to draft hoods larger than 600 cfm.

Revise as follows:

M1503.4 Makeup air required. Exhaust hood systems capable of exhausting ~~in excess of~~ more than 400 cubic feet per minute (0.19 m^3/s) shall be mechanically or naturally provided with makeup air at a rate approximately equal to the exhaust air rate in excess of 400 cubic feet per minute. Such makeup air systems shall be equipped with not less than one damper. Each damper shall be a gravity damper or an electrically operated damper that automatically opens when the exhaust system operates. Dampers shall be accessible for inspection, service, repair and replacement without removing permanent construction or any other ducts not connected to the damper being inspected, serviced, repaired or replaced.

Exception: Makeup air openings are not required for kitchen exhaust systems capable of exhausting not greater than 600 cubic feet per minute (0.28 m^3/s) provided that one of the following conditions is met:

1. Where the floor area within the air barrier of a dwelling unit is at least 1500 square feet, and where natural draft or mechanical draft space- or water-heating appliances are not located within the air barrier.
2. Where the floor area within the air barrier of a dwelling unit is at least 3000 square feet, and where natural draft space- or water-heating appliances are not located within the air barrier.
3. Where all appliances in the house are sealed combustion, power-vent, unvented, or electric.

Reason:

As originally written, this section allows range hoods up to 400 cfm to be installed without makeup air. This amendment aims for consistency by requiring makeup air equaling the amount above and beyond 400 cfm for larger fans. Essentially there would be no difference between the effect a 400 cfm fan has on a house and a 600 cfm fan with 200 cfm of makeup air. This would also improve the feasibility and acceptance of this code section as well as cut down on the amount of wasted energy and potential occupant discomfort caused by needlessly introducing excessive amounts of unconditioned air.

The exception takes into consideration that in many homes there is no danger of backdrafting due to the natural infiltration of outdoor air (which is relative to the size of the home) or the lack of natural draft appliances. The 400 cfm threshold can be raised to 600 cfm in these cases with no added danger.

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18. Joints, Seams, and Connections

This amendment eliminates the need to seal longitudinal seams in residential ductwork that operate at pressures below a 2 inch water column.

Revise as follows:

M1601.4.1 Joints, seams and connections. Longitudinal and transverse joints, seams and connections in metallic and nonmetallic ducts shall be constructed as specified in SMACNA HVAC *Duct Construction Standards—Metal and Flexible* and NAIMA *Fibrous Glass Duct Construction Standards*. Joints, longitudinal and transverse seams, and connections in ductwork shall be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic- plus-embedded-fabric systems, liquid sealants or tapes. Tapes and mastics used to seal fibrous glass ductwork shall be *listed* and *labeled* in accordance with UL 181A and shall be marked "181A-P" for pressure-sensitive tape, "181 A-M" for mastic or "181 A-H" for heat-sensitive tape.

Tapes and mastics used to seal metallic and flexible air ducts and flexible air connectors shall comply with UL 181B and shall be marked "181 B-FX" for pressure-sensitive tape or "181 BM" for mastic. Duct connections to flanges of air distribution system equipment shall be sealed and mechanically fastened. Mechanical fasteners for use with flexible nonmetallic air ducts shall comply with UL 181B and shall be marked 181B-C. Crimp joints for round metallic ducts shall have a contact lap of not less than 1 inch (25 mm) and shall be mechanically fastened by means of not less than three sheet-metal screws or rivets equally spaced around the joint.

Closure systems used to seal all ductwork shall be installed in accordance with the manufacturers' instructions.

Exceptions:

1. Spray polyurethane foam shall be permitted to be applied without additional joint seals.
2. Where a duct connection is made that is partially inaccessible, three screws or rivets shall be equally spaced on the exposed portion of the joint so as to prevent a hinge effect.
3. ~~For ducts having a static pressure classification of less than 2 inches of water column (500Pa), additional closure systems shall not be required for continuously welded joints and seams and locking-type joints and seams of other than the snap-lock and button-lock types~~. Continuously welded and locking type longitudinal joints and seams in ducts operating at static pressures less than 2 inches of water column (500 Pa) pressure classification shall not require additional closure systems.

Reason:

The requirement to seal longitudinal duct joints and seams is fitting for commercial applications with static pressures of 2 inches water column and greater. However, this should not apply to residential applications which operate at a much lower pressure, closer to 0.2 inches water column.

One argument to seal all seams and joints is so the duct system functions efficiently. However, whether the longitudinal joints and seams are sealed or not on a low-pressure system has very little effect on system efficiency. To a much greater degree, system efficiency is affected by factors outside of the installer's influence. For example, the duct system can be perfectly balanced at the time of the inspection, but the occupants set furniture in front of registers, change the settings on the registers, open and close doors, etc.

Sealing the longitudinal joints and seams will not make a noticeable difference in either the efficiency or the energy saved, making the added time and cost unnecessary.

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